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# CDM Smith

## Northeast Water Purification System Improvements Project
## City of Houston WBS No.: 5-000066-0012-3

# Stress Analysis
# High Service Pump Station and UV Buildings Piping Systems

**Worley Parsons Project No. 408004-01751**

STATE OF TEXAS
DONALD R. CLARK
46532
LICENSED
PROFESSIONAL ENGINEER

WP FIRM # F-1480 3/8/14

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Client: CDM Smith
Project: **City of Houston Northeast Water Purification Plant (NEWPP) Piping Stress Analysis**

Date: Mar. 12, 2014
Rev: 1
By: DClark

## 1.0 Executive Summary

Worley Parsons (WP) has been contracted by CDM Smith to perform a stress analysis on the High Service Pump Station piping system and the two UV Building piping systems for the water purification system for the City of Houston at the NEWPP Plant. There is one system for the High Service Pump Station system and two systems at the buildings for the UV Disinfection systems, including the following:

- Finished water piping inside and outside the High Service Pump Station, including 30-inch pump discharge branch piping, 84-inch discharge header(s), and finished water piping at the Finished Water Flow Meter Station.
- Treated water piping inside and outside the UV Buildings, including 30-inch treated water piping upstream and downstream of UV reactors, 48-inch treated water header, and 30-inch backwash piping (Phase I and Phase II).
- 48-inch treated water piping in Post –UV chemical additional area (Phase I and Phase II).

**Appendix A** provides exhibits to show all piping systems that were evaluated in this report. Field photos are included in **Appendix B.**

## 2.0 Report Objectives

The analysis has been performed to assure that the piping is within code allowable stresses and to evaluate the three systems which includes multiple "Depend-O-Lok" couplings. The concern is the stability of the piping systems with these couplings and the supports. The analysis will provide an answer to whether these couplings are required or can be removed from the systems. WP will report the resultant loads for the supports and the High Service Pumps discharge nozzles. WP will provide CDM Smith with recommendations regarding supports and the couplings.

## 3.0 Reference Documents

NEWPP mechanical drawings
ASME B31.3
AWWA M-11
NEWPP Pipe xtics.xlsx – description of materials used, provided in **Appendix C**

## 4.0 Stress Analysis Report

The three piping systems has been input into and analyzed, utilizing Caesar II, version 6.1 stress analysis program. The piping models include an internal mortar liner as described in the piping specifications. The spring rates for the Depend-O-Lok couplings are not available and assumed values were input. The systems were analyzed based on the plant drawings from which many of the dimensions were provided from field measurements. The systems were evaluated for deadweight and internal pressure only as the systems operate at ambient temperature and have continuous flow.

## 5.0 Conclusions

### 5.1 High Service Pump Station System –

This piping system was analyzed two ways in regard to the Depend-O-Lok couplings. One analysis simulates the couplings, unrestrained and the other as they have been removed from the system. The couplings were modeled as unrestrained because there is no way to visually determine if the couplings have moved to a position where it is restrained by internal hardware. This is the conservative approach of modeling the couplings. There is one area within the High Service Pump system that exceeds the allowable stresses with and without the couplings. The two branches between pumps 03 and 04 exceed the allowable stress range. When the couplings are input as unrestrained, there are multiple branches overstressed. As the system operates at ambient temperature, the couplings do not displace, thermally, to a point to where they are restrained. The pressure thrust on the pump anchoring system is quite high.

### 5.2 UV Building-1 -

This piping system was analyzed two ways in regard to the Depend-O-Lok couplings. One analysis simulates the couplings, unrestrained and the other as they have been removed from the system. The couplings were modeled as unrestrained because there is no way to visually determine if the couplings have moved to a position where it is restrained by internal hardware. This is the conservative approach of modeling the couplings. When the couplings are input as unrestrained, there are multiple branches overstressed. As the system operates at ambient temperature, the couplings do not displace, thermally, to a point to where they are restrained. When the couplings are removed from the system, there is no overstress in the piping system.

### 5.3 UV Building-2 –

This piping system was analyzed two ways in regard to the Depend-O-Lok couplings. One analysis simulates the couplings, unrestrained and the other as they have been removed from the system. The couplings were modeled as unrestrained because there is no way to visually determine if the couplings have moved to a position where it is restrained by internal hardware. This is the conservative approach of modeling the couplings. When the couplings are input as unrestrained, there are multiple branches overstressed. As the system operates at ambient temperature, the couplings do not displace, thermally, to a point to where they are restrained. When the couplings are removed from the system, there is no overstress in the piping system.

### 5.4 General –

The piping systems that have been stress reviewed have many branches. None of these branches have reinforcement at the connections. ASME B31.3, paragraph 304.3, Branch Connections, requires that any pipe with a d/t ratio higher than 100, will require branch reinforcement. AWWA M-11, Chapter 13 defines the PDV (pressure diameter value) and the d/D ratio. The 84 inch main header with 30-inch branches from the High Service Pumps has a PDV of 2143 and a d/D ratio of 0.36, based on the assumed pipe wall thickness of 0.375 inch thick. It is unclear if this chapter is requiring branch reinforcement, but by these values a collar plate for reinforcement is defined.

Northwest Pipe Company (Brent Keil) was contacted for advice of an interpretation about branch reinforcement requirements per AWWA M-11. With the design parameters and assuming the steel has the same yield strength, it is recommended additional reinforcement be provided on the 84-inch x 30-inch branches.

A Finite Element Analysis (FEA) analysis has been run on the maximum loads at the 30-inch branches off the 84-inch header to the pumps. The FEA analysis indicates each branch connection is overstressed as does the Caesar II analysis. These loads are the loads based on the flex couplings in the lines. Another FEA analysis has been run on the maximum loads based on the flex couplings removed. This analysis indicates an approximate 30 percent overstress in the branch evaluated. This analysis would indicate the branches would require reinforcing pads. Further, there are numerous line size branches, 48-inch into 48-inch, 42-inch into 42-inch, etc. These line size branches would also need branch reinforcement.

## 6 Recommendations

### 6.1 High Service Pump Station System –

It is recommended that the Depend-O-Lok couplings be removed from the system. It is also recommended that a support be added under the 84-inch header as shown on the stress sketch in **Appendix D**. It is recommended that the saddle type support be designed based on the existing supports on the 84-inch header. Further, it is recommended that the supports that have displaced from under the 84-inch pump header, on the West end, be replaced and the soil below the support be stabilized to be able to properly withstand the load from the pipe. As this concrete appears to not be a part of the original mat that supports the 84-inch header, it should have pilings or footings poured to prevent the failing of the supports.

### 6.2 UV Building-1 -

It is recommended that these couplings be removed from the system.

### 6.3 UV Building-2 -

It is recommended that these couplings be removed from the system.

### 6.4 Branch reinforcement -

In **paragraph 5.4** above, based on the FEA analysis, it is recommended that reinforcing pads be added to the branches off the 84-inch header. The reinforcement pad would

need to be at least 3 inches wide and the thickness and material of the 84-inch pipe. This would include the underground lateral where the 84-inch stubs into the 84-inch header and the line size branches mentioned in **paragraph 5.4** above. Reinforcement is also recommended for the 84-inch x 30-inch branches.

## 7 Attachments

a. Appendix A – Pipe Stress Analysis Limit and Field Conditions
b. Appendix B – Field Photos
c. Appendix C – Piping Material and Technical Data
d. Appendix D – Stress Sketches for each system and graphics printout of models
e. Appendix E – Stress analysis input data; load summary; stress summary for each system
f. Appendix F – FEA Analysis input/output of 84-inch header branch

## Clark, Don (Houston)

**From:** Keil, Brent <BKEIL@nwpipe.com>
**Sent:** Friday, February 21, 2014 11:07 AM
**To:** Clark, Don (Houston)
**Subject:** RE: CDM Project - City Of Houston - AWWA M-11 Branches

Don,

After reviewing what you have, the 84"x30" is what I would call borderline, but would technically need additional reinforcement with the parameters we are discussing and assuming the steel all is the same yield strength. With the assumptions, if the 84" is even 0.01" thicker it meets the requirement of not needing any further reinforcement. To put it in perspective, if I reduce the design pressure to 98psig, it also works without added reinforcement. So it appears to be on the edge, but not way out of line, and could go either way.

If I was dealing with this fitting and I was certain about all the parameters, thickness, material used, etc, I wouldn't have any issue with leaving added reinforcement off the fitting.

Hopefully this is helpful for you.

If you need more info, feel free to email or give me a call.

Brent Keil, P.E.
Northwest Pipe Company

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**From:** Clark, Don (Houston) [mailto:Don.Clark@WorleyParsons.com]
**Sent:** Friday, February 21, 2014 6:19 AM
**To:** Keil, Brent
**Subject:** RE: CDM Project - City Of Houston - AWWA M-11 Branches

Brent,

Assumption is that 84" pipe wall is 0.375", as well as 30".
30" branch is at 90 deg angle to 84" header
Pressure is 100 psig.

We also have a lateral at 45 deg in the 84" header. So, it is 84" into the 84".

**Don Clark, BSME, PE**
**Senior Supervising Engineer | WorleyParsons**
Tel: +17134077455

---

**From:** Keil, Brent [mailto:BKEIL@nwpipe.com]
**Sent:** Thursday, February 20, 2014 5:28 PM
**To:** Clark, Don (Houston)
**Subject:** RE: CDM Project - City Of Houston - AWWA M-11 Branches

Thanks Clark, just to verify a couple of things:

84” main pipe 0.375” wall thickness
30” outlet pipe, is this also 0.375” wall?
30” is at a 45 degree angle to the main pipe axis?
Working pressure is 100 psig

Brent Keil, P.E.
Northwest Pipe Company

---

**From:** Clark, Don (Houston) [mailto:Don.Clark@WorleyParsons.com]
**Sent:** Thursday, February 20, 2014 3:27 PM
**To:** Keil, Brent
**Subject:** RE: CDM Project - City Of Houston - AWWA M-11 Branches

Sorry for not attaching file……

**Don Clark, BSME, PE**
**Senior Supervising Engineer | WorleyParsons**
Tel: +17134077455

---

**From:** Clark, Don (Houston)
**Sent:** Thursday, February 20, 2014 4:15 PM
**To:** 'bkeil@nwpipe.com'
**Subject:** CDM Project - City Of Houston - AWWA M-11 Branches

Brent,

I appreciate your time yesterday regarding the interpretation of AWWA M-11, Chapt 13. See the attached list of piping materials. The pressure for this system is 100 psig.

I need to know if branch reinforcement is required for the 30” branches off the 84” headers per AWWA M-11.

Best Regards,

**Don Clark, BSME, PE**
**Senior Supervising Engineer | WorleyParsons**
Tel: +17134077455
13501 Bay Area Blvd. | Bayport | TX | 77507 | United States of America
Don.Clark@WorleyParsons.com | www.worleyparsons.com

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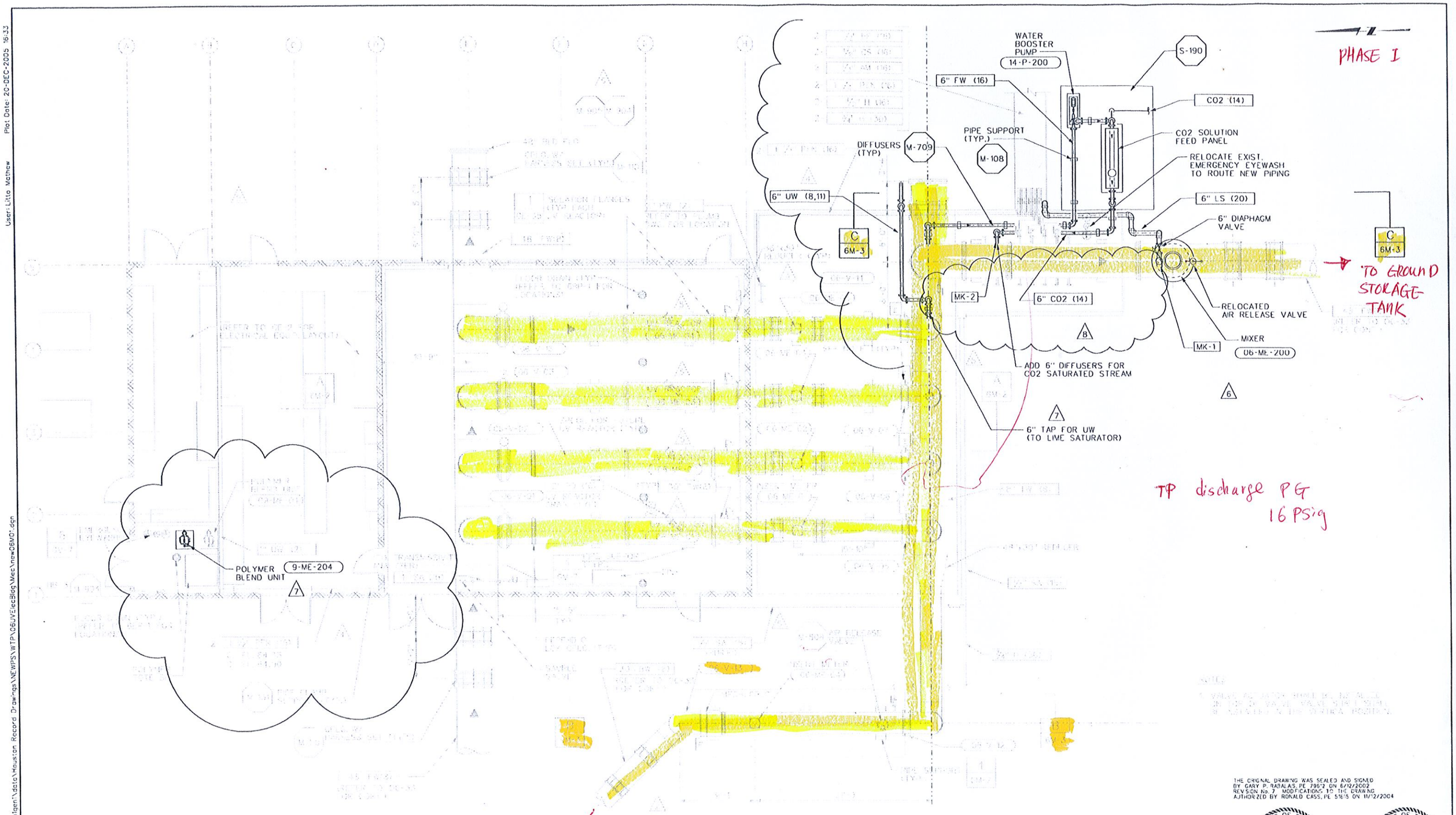


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REVISION No. 7 MODIFICATIONS TO THE DRAWING AUTHORIZED BY RONALD CASS, PE 51815 ON 11/12/2004

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STATE OF TEXAS — GARY P. RABALAIS — 79612 — REGISTERED PROFESSIONAL ENGINEER

| REV | DATE | BY | DESCRIPTION |
|---|---|---|---|
| 8 | 8-9-05 | DYN | RECORD DRAWING |
| 7 | 11-12-04 | RC | Adderdum No.1 |
| 6 | 9-3-04 | RC | HAWC and Permit Agency Approval |
| 5 | 11-14-03 | DYN | RECORD DRAWINGS |
| 4 | 9-10-2003 | TRL | Piping Modifications |
| 3 | 2-25-2003 | TRL | RFIResponse 269 UV Units |
| 2 | 11-4-2002 | TRL | BLDG. LAYOUT CHANGE |
| 1 | 6-7-2002 | TRL | REACTOR LAYOUT CHANGE |

SCALE 3/16" = 1'-0"

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DRAWN I. THORNE/B. LAMAY
CHECKED T. LARSON

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LICENSE NO. DATE

MWH MONTGOMERY WATSON HARZA
5100 Westheimer, Suite 580
Houston, TX 77056

**Houston Area Water Corporation**

NORTHEAST WATER PURIFICATION SYSTEM
PHASE I
UV BUILDING PLAN

SHEET 6M-1

Job No: 1650228

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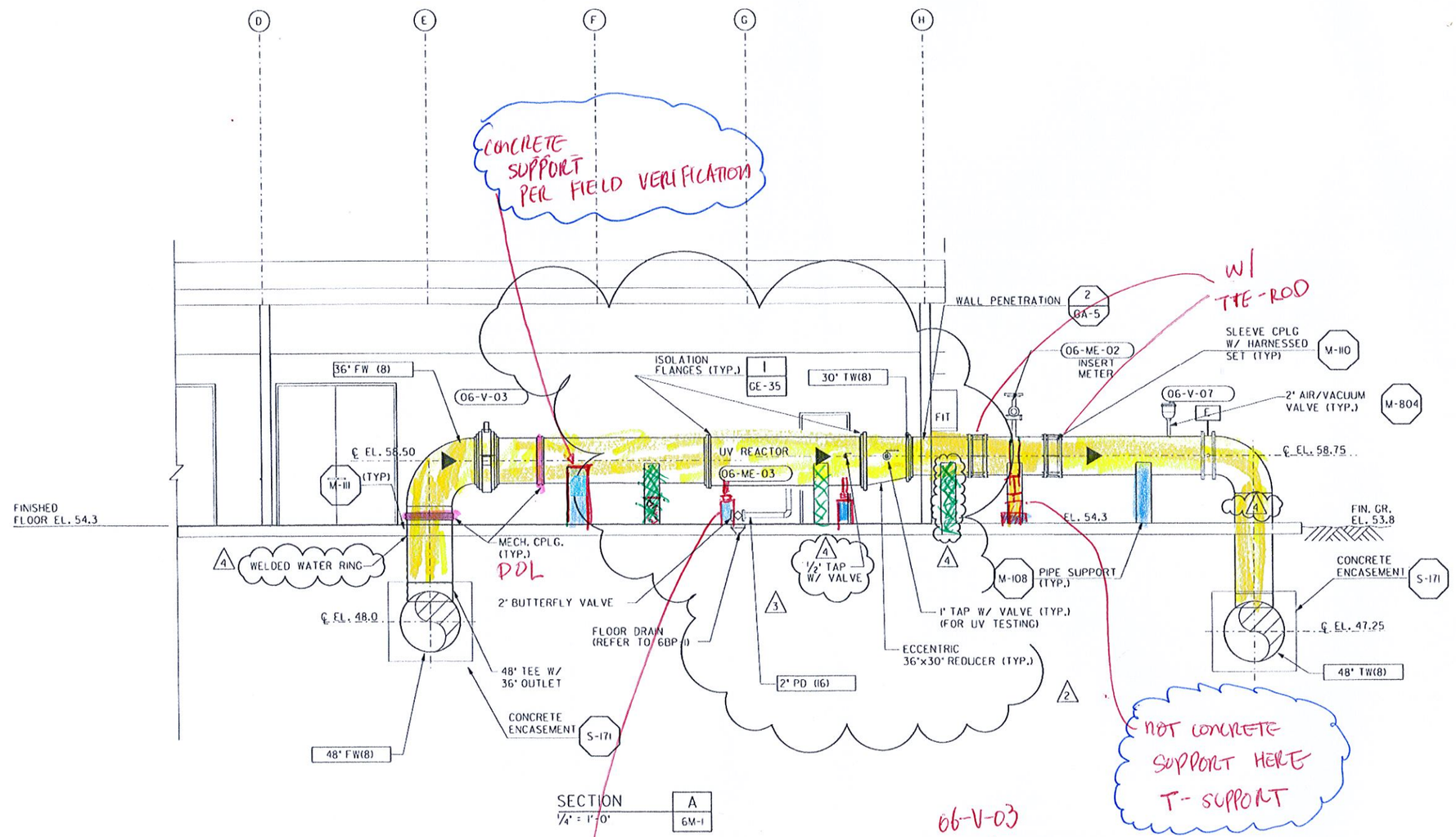
PHASE I




SECTION A
1/4" = 1'-0" 6M-1

DEPEND-O-LOK COUPLING

NOT INSTALLED IN THE FIELD

06-V-03
• val-matic
SO. M798130
model 2036/1600

• UV REACTOR SUPPORT RS 283-1812 SUNNEX

The Seal appearing on this document was authorized by Gary P. Rabalais, P.E. 79612, on Date indicated for Revision 1

STATE OF TEXAS
GARY P. RABALAIS
79612
REGISTERED PROFESSIONAL ENGINEER

| REV | DATE | BY | DESCRIPTION |
|---|---|---|---|
| 4 | 2-06-2004 | DYN | RECORD DRAWING |
| 3 | 2-26-2003 | TRL | RFI RESPONSE 269 UV Units |
| 2 | 10-23-2002 | TRL | RFI RESPONSE |
| 1 | 6-7-2002 | TRL | REACTOR LAYOUT CHANGE |

SCALE 1/4" = 1'-0"

WARNING 0 1/2 1 IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

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UV BUILDING SECTION

SHEET 6M-2

JOB No: 1650228

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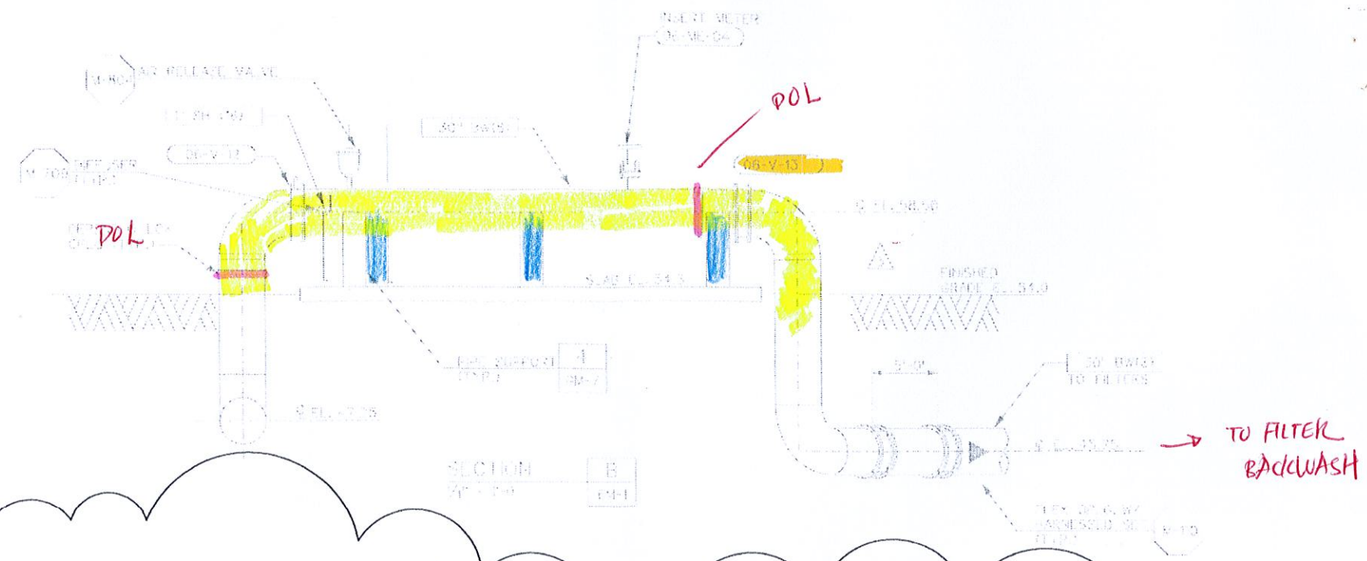
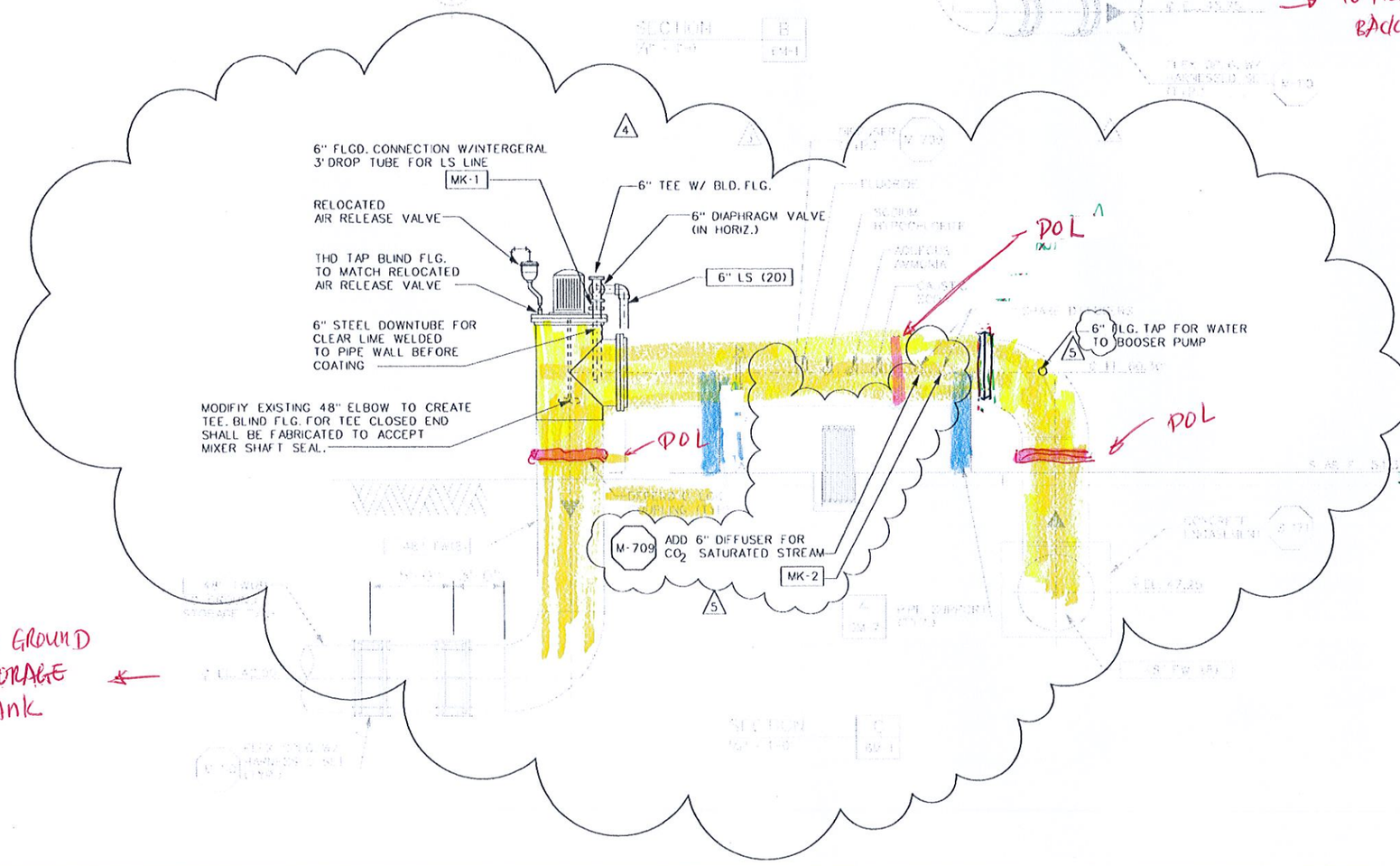
PHASE I




DEPEND-O-LOK COUPLING (DOL)

CONCRETE PIPE SUPPORT

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|---|---|---|---|
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| 4 | 9-3-04 | RC | HAWC and Permit Agency Approval |
| 3 | 11-14-03 | DYN | RECORD DRAWINGS |
| 2 | 11-4-2002 | TRL | PIPELINE LAYOUT CHANGE |
| 1 | 6-7-02 | TRL | REACTOR LAYOUT CHANGE |

SCALE: 1/4" = 1'-0"

WARNING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

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CHECKED T. LARSON

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**Houston Area Water Corporation**

NORTHEAST WATER PURIFICATION SYSTEM
PHASE - 1
UV BUILDING SECTIONS

SHEET 6M-3

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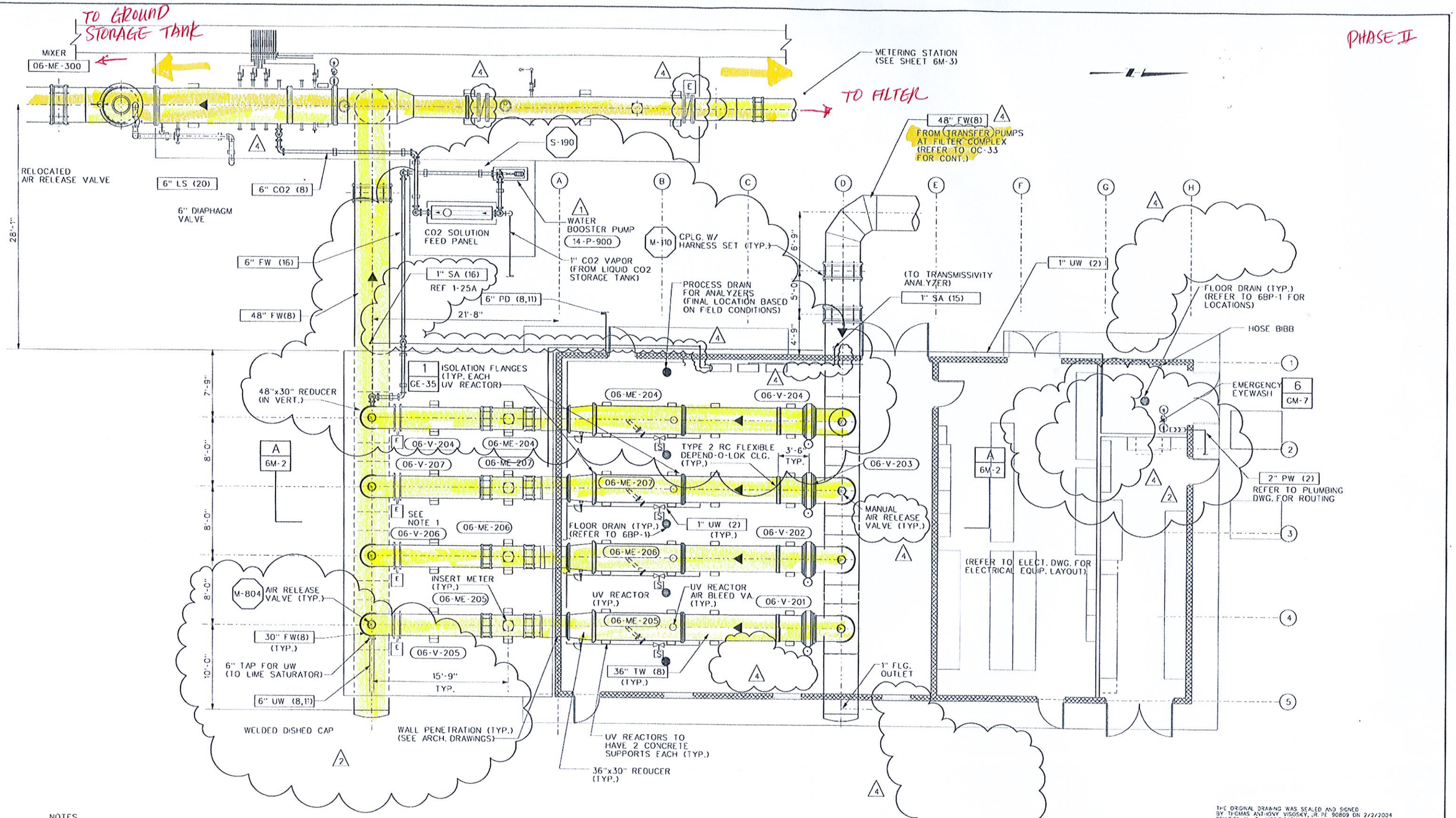


NOTES

1. VALVE ACTUATOR SHALL BE INSTALLED ON TOP OF VALVE. VALVE SHAFT SHALL BE INSTALLED IN THE VERTICAL POSITION.

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CDC 5 12/22 04

CDC 77 6/13 05

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| REV | DATE | BY | DESCRIPTION |
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| 4 | 1-10-06 | RVS | RECORD DRAWING |
| 3 | 12-8-04 | SJ | HOT LIST MEETING : 12/6/04 |
| 2 | 11-12-04 | RMC | Addendum No1 |
| 1 | 10-18-04 | RMC | HAWC and Permit Agency Approva |
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| B | 3-23-04 | TAV | CLIENT REVIEW |
| A | 3-2-04 | TAV | INTERNAL QA/QC REVIEW |

SCALE: 3/16" = 1'-0"

WARNING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED S. MENDOZA
DRAWN J. THORNE
CHECKED J. VISOSKY

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**Houston Area Water Corporation**

NORTH-EAST WATER PURIFICATION SYSTEM
PHASE 2 EXPANSION

UV BUILDING PLAN

SHEET 6M-1

Job No: 1650285

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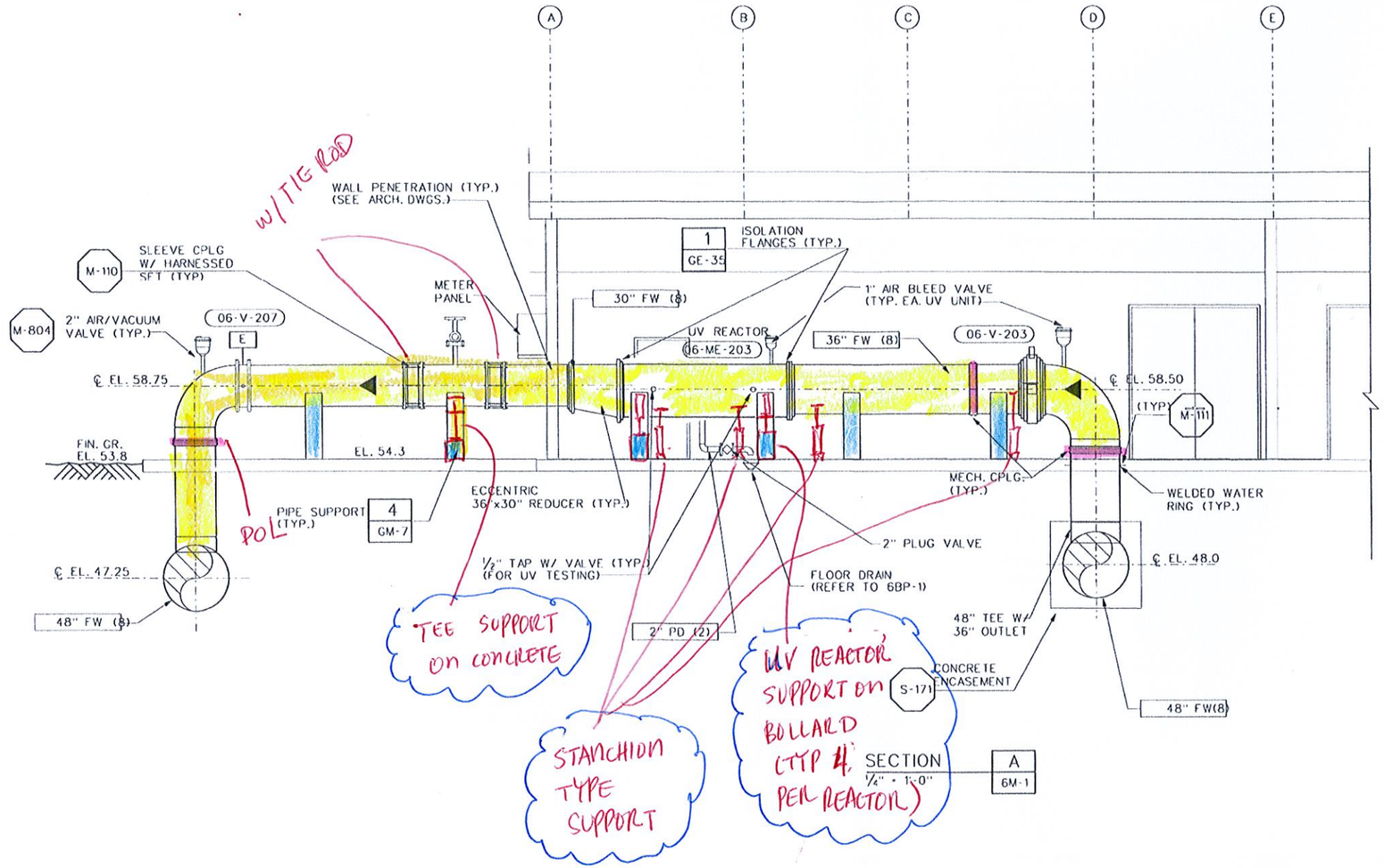
PHASE II




DEPEND-O-LOK
COUPLING
(DOL)

STATE OF TEXAS
THOMAS ANTHONY VISOSKY
92829
REGISTERED
PROFESSIONAL ENGINEER

| REV | DATE | BY | DESCRIPTION |
|---|---|---|---|
| 1 | 2-6-06 | YBN | RECORD DRAWING |
| 0 | 4-13-04 | TAV | IFC AND PERMITTING |
| B | 3-23-04 | TAV | CLIENT REVIEW |
| A | 3-2-04 | TAV | INTERNAL QA/QC REVIEW |

SCALE ¼" = 1'-0"

WARNING 0 ½ 1 IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

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CHECKED T. VISOSKY

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Houston, TX 77056

**Houston Area Water Corporation**

NORTHEAST WATER PURIFICATION SYSTEM
PHASE 2 EXPANSION
UV BUILDING SECTION

SHEET 6M-2

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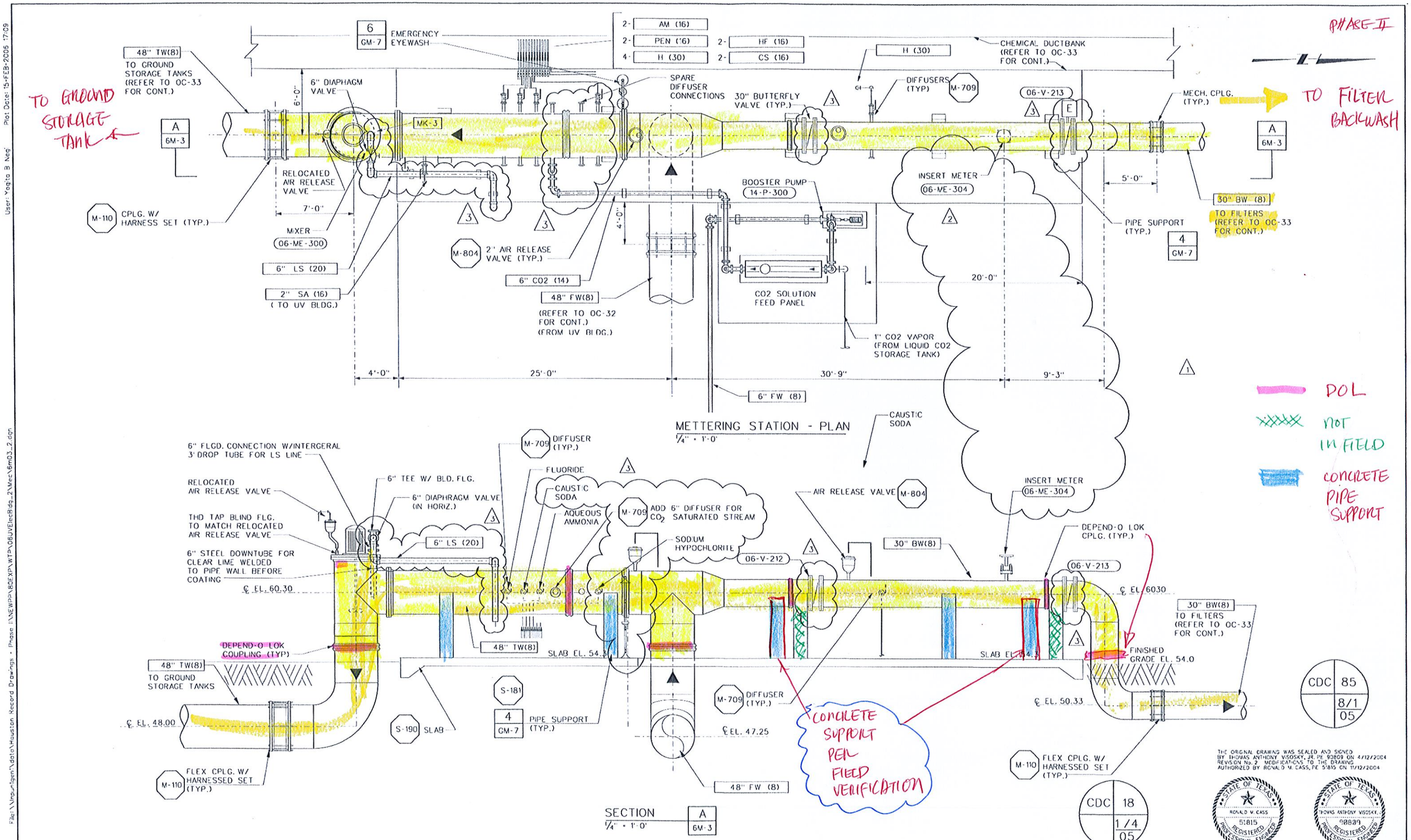


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| 1 | 10-18-04 | RMC | HAWC and Permit Agency Approval |
| 0 | 4-13-04 | TAV | IFC AND PERMITTING |
| B | 3-23-04 | TAV | CLIENT REVIEW |
| A | 3-2-04 | TAV | INTERNAL QA/QC REVIEW |

SCALE: 1/4" = 1'-0"

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DESIGNED S. MENDOZA
DRAWN L. THORNE
CHECKED T. VISOSKY

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LICENSE NO. DATE

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Houston, TX 77056

**Houston Area Water Corporation**

NORTH-EAST WATER PURIFICATION SYSTEM
PHASE 2 EXPANSION

UV BUILDING METERING STATION PLAN AND SECTIONS

SHEET 6M-3

Job No: 1850285
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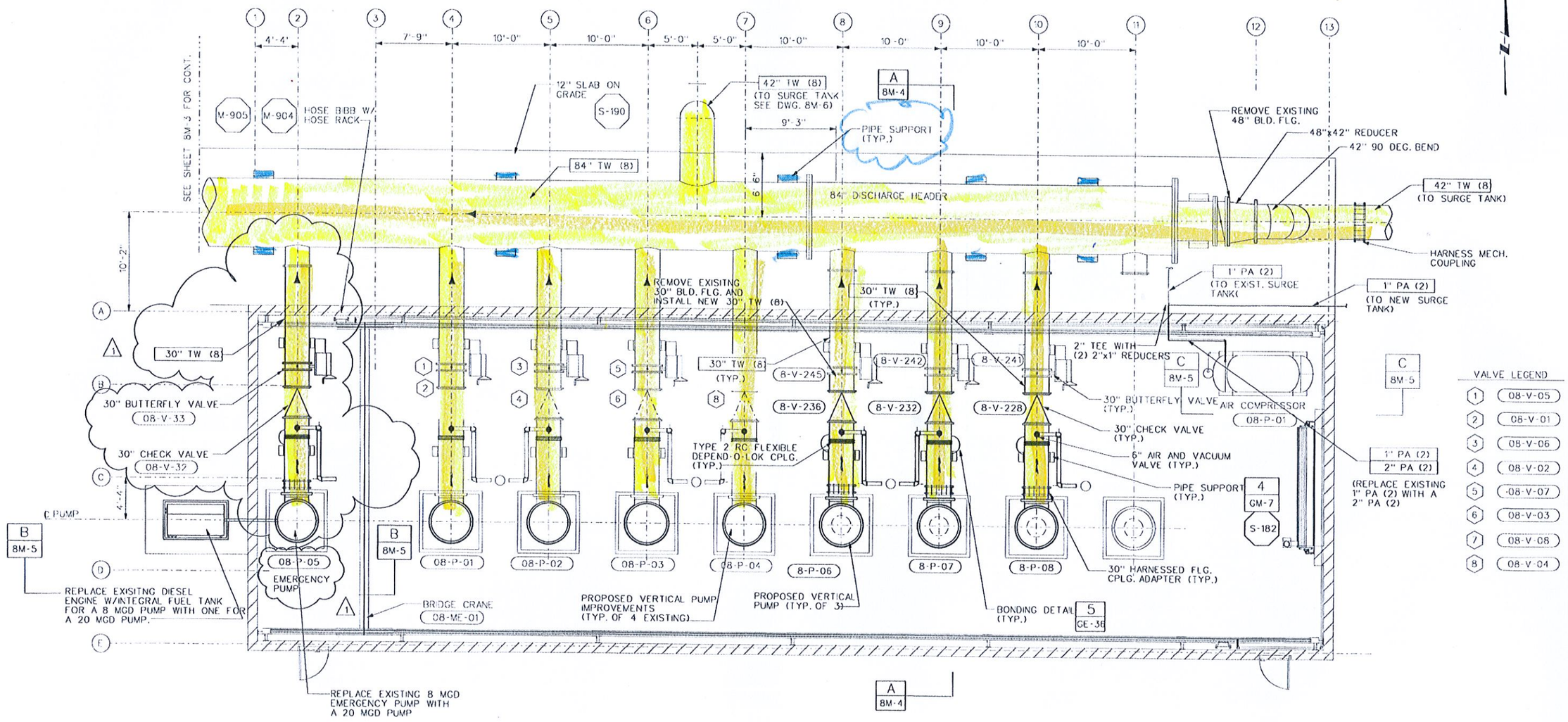


CDC 75 5/31 05

STATE OF TEXAS — THOMAS ANTHONY VISOSKY, 98829, REGISTERED PROFESSIONAL ENGINEER

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| 1 | 1-10-06 | RVS | RECORD DRAWINGS |
| 0 | 4-13-04 | TAV | IFC AND PERMITTING |
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| A | 3-2-04 | TAV | INTERNAL QA/QC REVIEW |

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5100 Westheimer, Suite 580
Houston, TX 77056

**Houston Area Water Corporation**

NORTH-EAST WATER PURIFICATION SYSTEM
PHASE 2 EXPANSION

EXISTING HIGH SERVICE PUMP STATION MODIFICAIONS - UPPER PIPING PLAN

SHEET 8M-2

Job No. 1650285 File:\\Houston\data\Houston Record Drawings - Phase 1\NEWP\WOEXP\WTP\08HiServicePump_2\Wet\8M-2_2.dgn User: Yogita B Negi Plot Date: 15-FEB-2006 16:59

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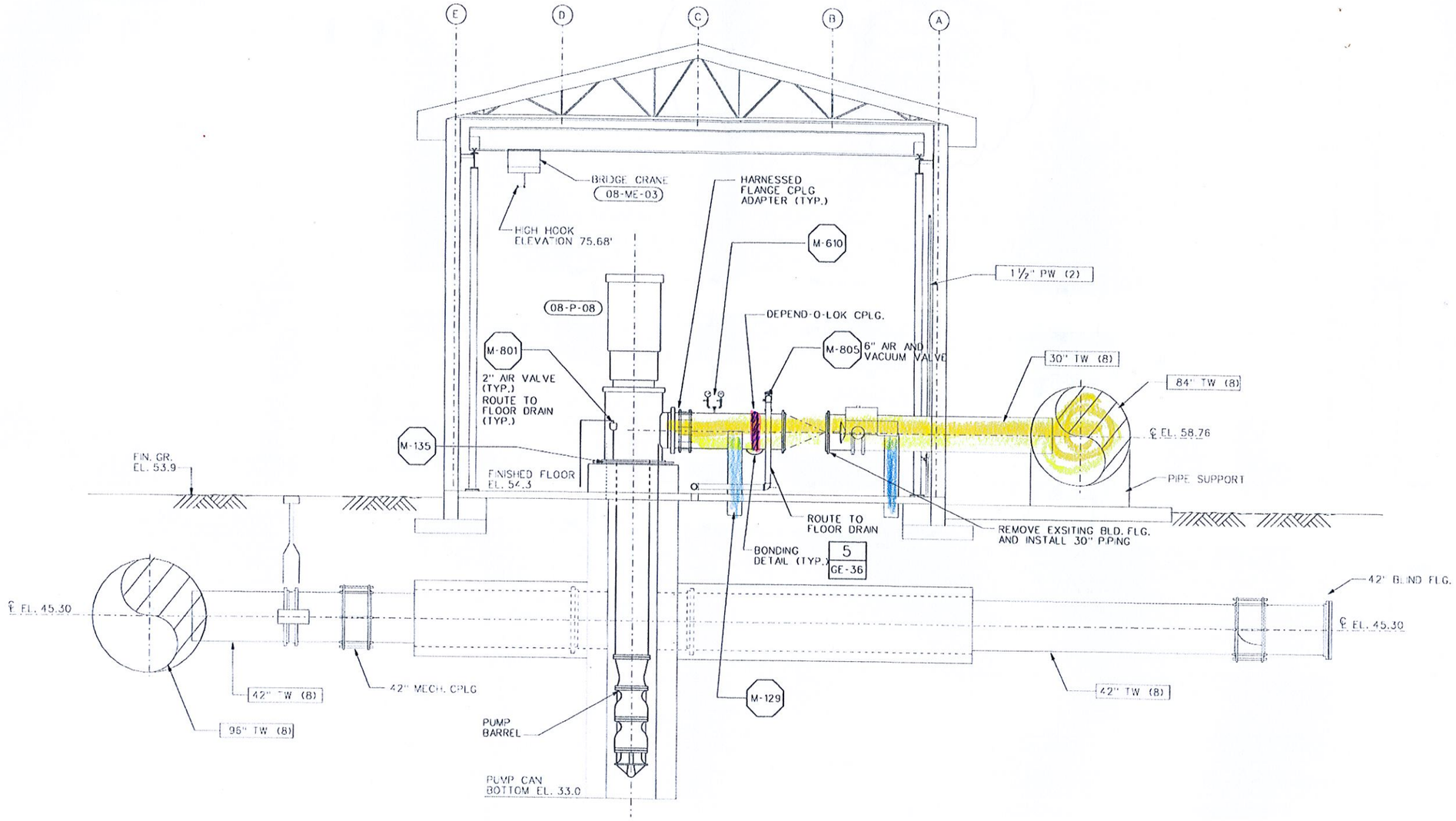


NOTES:
1. • INDICATES DIMENSION TO BE DETERMINED BY EQUIPMENT PROVIDED.

SECTION A
1/4" = 1'-0" 8M-2

STATE OF TEXAS
THOMAS ANTHONY VISOSKY
92869
REGISTERED PROFESSIONAL ENGINEER

| REV | DATE | BY | DESCRIPTION |
|---|---|---|---|
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| 0 | 4-13-04 | TAV | IFC AND PERMITTING |
| B | 3-23-04 | TAV | CLIENT REVIEW |
| A | 3-2-04 | TAV | INTERNAL QA/QC REVIEW |

SCALE 1/4" = 1'-0"

WARNING 0 1/2 1 IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED S. MENDOZA
DRAWN J. THORNE
CHECKED T. VISOSKY

SUBMITTED BY
(RECOMMENDED) LICENSE NO. DATE
LICENSE NO. DATE

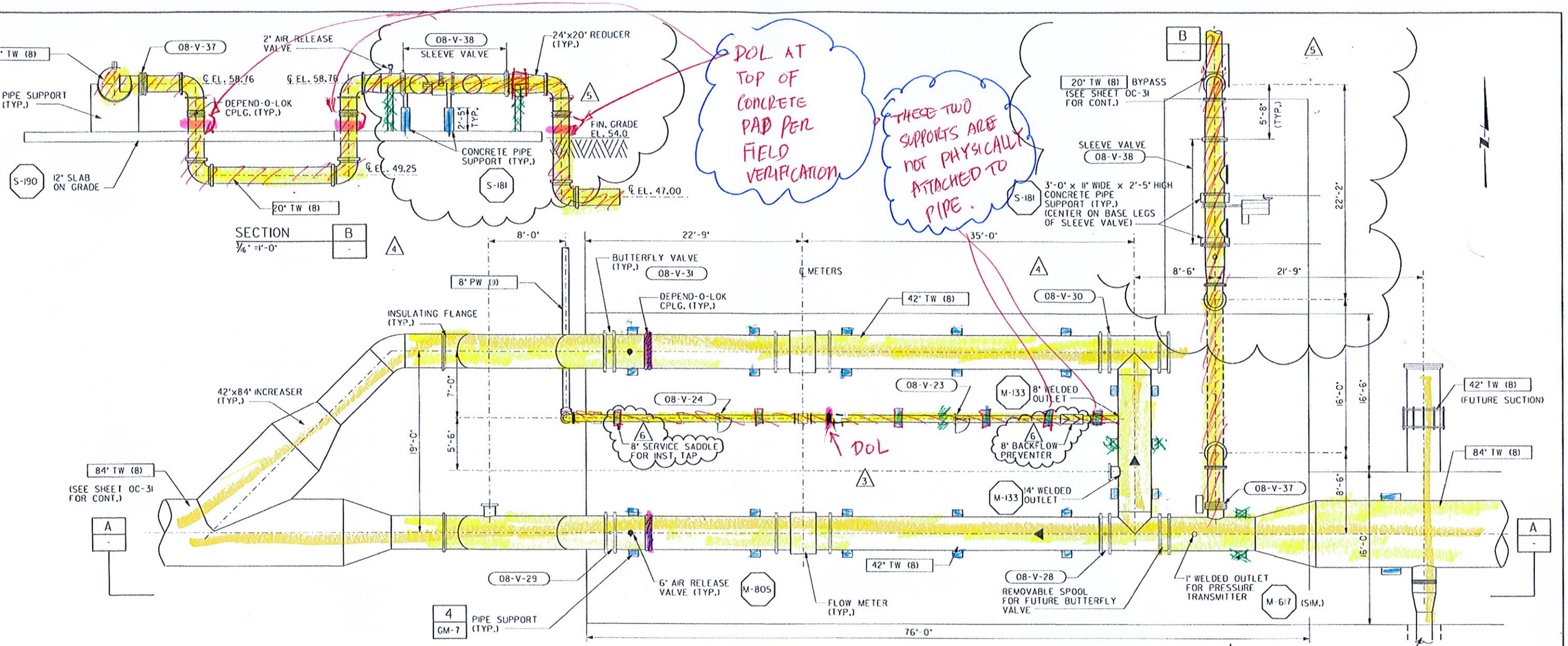
MWH
MONTGOMERY WATSON HARZA
5100 Westheimer, Suite 580
Houston, TX 77056

**Houston Area Water Corporation**

NORTHEAST WATER PURIFICATION SYSTEM
PHASE 2 EXPANSION

HIGH SERVICE PUMP STATION
SECTION

SHEET 8M-4




The Seal appearing on this document was authorized by Wayne K. Hunter, P.E. 65325 on Date Indicated for Revision 1

The Seal appearing on this document was authorized by Todd Randal Larson, P.E. 70899, on Date Indicated for Revision 1

STATE OF TEXAS — TODD RANDAL LARSON — 70899 — REGISTERED PROFESSIONAL ENGINEER

| REV | DATE | BY | DESCRIPTION |
|---|---|---|---|
| 6 | 1-5-04 | LMK | RECORD DRAWING |
| 5 | 5-9-03 | TRL | SLEEVE VALVE SUPPORT |
| 4 | 0-12-2002 | TRL | SUBMITTAL RESPONSE |
| 3 | 10-11-2002 | TRL | PIPING MODIFICATIONS RFI160 |
| 2 | 9-5-2002 | TRL | PIPING MODIFICATIONS |
| 1 | 7-9-2002 | TRL | ISSUED FOR CONSTRUCTION |

0 2-15-2002 COH Building Permit Department

SCALE: 3/16" = 1'-0"

WARNING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED T. LARSON
DRAWN L. THORNE
CHECKED G. RABALAIS

SUBMITTED BY
(RECOMMENDED) LICENSE NO. DATE
LICENSE NO. DATE

MWH — MONTGOMERY WATSON HARZA
5100 Westheimer, Suite 580
Houston, TX 77056

**Houston Area Water Corporation**

HIGH SERVICE PUMP STATION
FLOW METER STATION PLAN AND SECTIONS

SHEET 8M-3

JOB No: 650228

File:\\inpunis02\projects\NEWPS\WTP\08HiServicePumps\Mech\new08W03.dgn

User:rtto mcthew Plot Date:07-JUN-2004 16:58

| Reference Project | Referene Sheet | Pipe | Pipe Material | Per NEWPP Specs | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Pipe OD (in) | Net Pipe ID (in) | Nominal Wall thickness (in) | | Interior Liner thickness (in) | Exterior Coating (in) |
| | | | | | | Flexible Coating | Mortar Coating | | |
| Phase 1 | Sheet 6M-1, 2, 3 | 30" FW (8) | AWWA C200 Welded steel | | 30 | 0.149 | 0.136 | 0.375 (Cement Mortar) | 9.5-12.5 mils DFT Epoxy |
| Phase 1 | Sheet 6M-1, 2, 3 | 36" FW (8) | AWWA C200 Welded steel | | 36 | 0.178 | 0.163 | 0.375 (Cement Mortar) | 9.5-12.5 mils DFT Epoxy |
| Phase 1 | Sheet 6M-1, 2, 3 | 48" FW (8) | AWWA C200 Welded steel | | 48 | 0.235 | 0.215 | 0.5(Cement Mortar) | 9.5-12.5 mils DFT Epoxy |
| | | | | | | | | | |
| Phase 2 | Sheet 6M-1, 2, 3 | 30" FW (8) | AWWA C200 Welded steel | | 30 | 0.149 | 0.136 | 0.375 (Cement Mortar) | 9.5-12.5 mils DFT Epoxy |
| Phase 2 | Sheet 6M-1, 2, 3 | 36" FW (8) | AWWA C200 Welded steel | | 36 | 0.178 | 0.163 | 0.375 (Cement Mortar) | 9.5-12.5 mils DFT Epoxy |
| Phase 2 | Sheet 6M-1, 2, 3 | 48" FW (8) | AWWA C200 Welded steel | | 48 | 0.235 | 0.215 | 0.5 (Cement Mortar) | 9.5-12.5 mils DFT Epoxy |
| | | | | | | | | | |
| Phase 2 | Sheet 8M-2, 4 | 84" TW (8) | AWWA C200 Welded steel | | 84 | 0.423 | 0.395 | 0.5 (Cement Mortar) | 9.5-12.5 mils DFT Epoxy |
| Phase 2 | Sheet 8M-2, 4 | 30" TW (8) | AWWA C200 Welded steel | | 30 | 0.149 | 0.136 | 0.375 (Cement Mortar) | 9.5-12.5 mils DFT Epoxy |
| Phase 2 | Sheet 8M-2 | 42" TW (8) | AWWA C200 Welded steel | | 42 | 0.207 | 0.189 | 0.5 (Cement Mortar) | 9.5-12.5 mils DFT Epoxy |
| Phase 2 | Sheet 8M-3 | 42" TW (8) | AWWA C200 Welded steel | | 42 | 0.207 | 0.189 | 0.5 (Cement Mortar) | 9.5-12.5 mils DFT Epoxy |
| Phase 2 | Sheet 8M-3 | 20" TW (8) | AWWA C200 Welded steel | 20 | | 0.375 | | 12-18 mils DFT Epoxy | 9.5-12.5 mils DFT Epoxy |

*Photo 1* *HSPS Pump 8-P-08*

*Photo 2* *HSPS Pump 8-P-08_First Structural Support from Pump and Pump Flange*

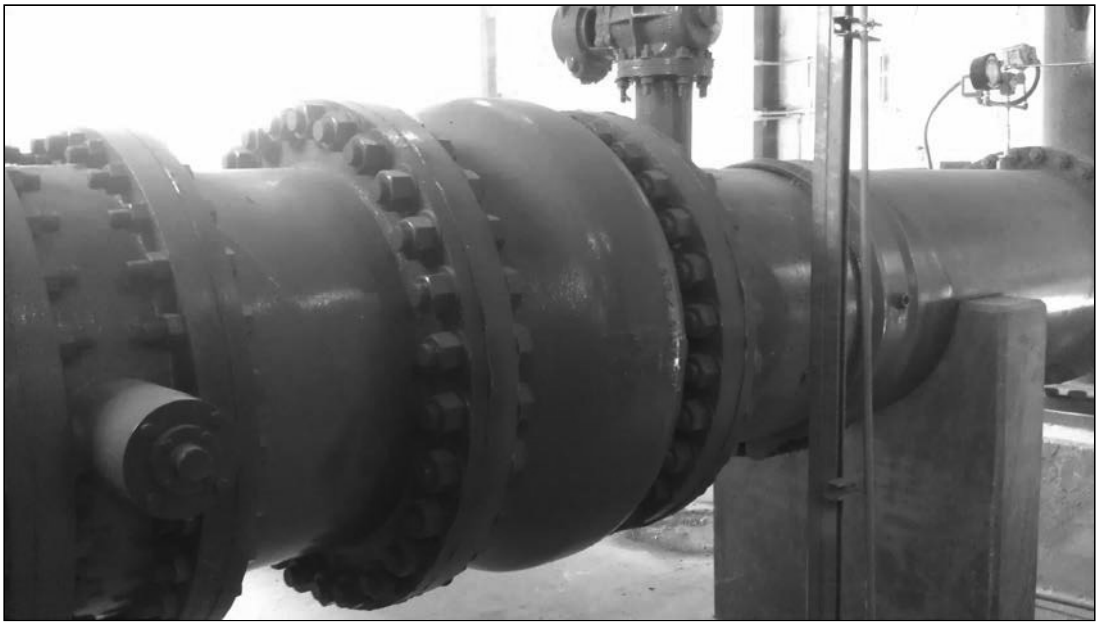


*Photo 3 HSPS Pump 8-P-08_Butterfly Valve, Check Valve and First Structural Support from Pump*

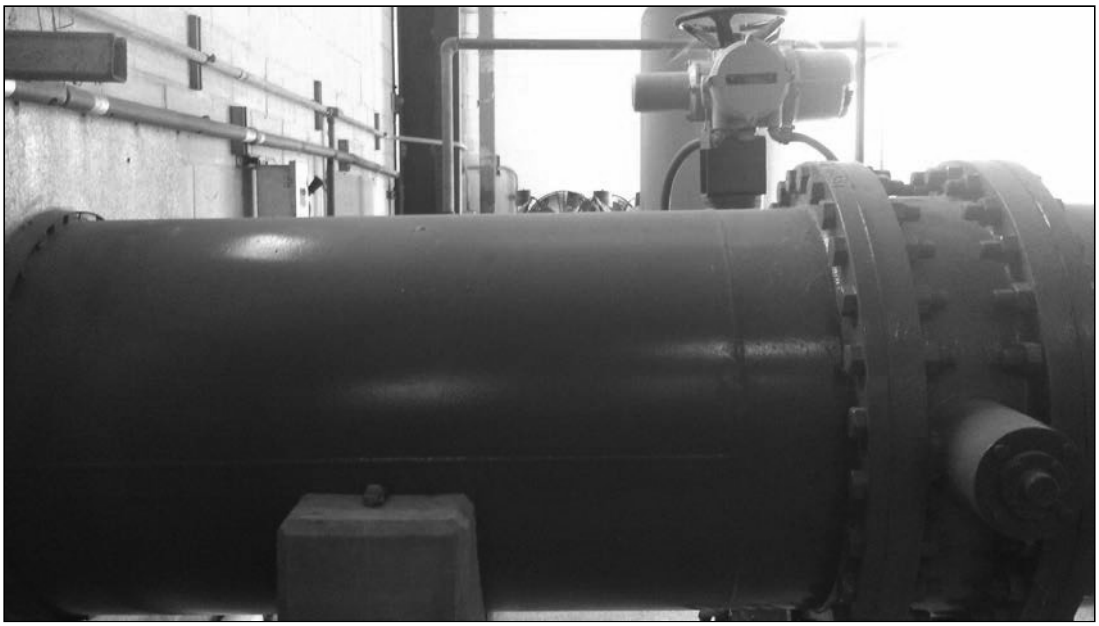


*Photo 4 HSPS Pump 8-P-08_Butterfly Valve and Second Structural Support from Pump*

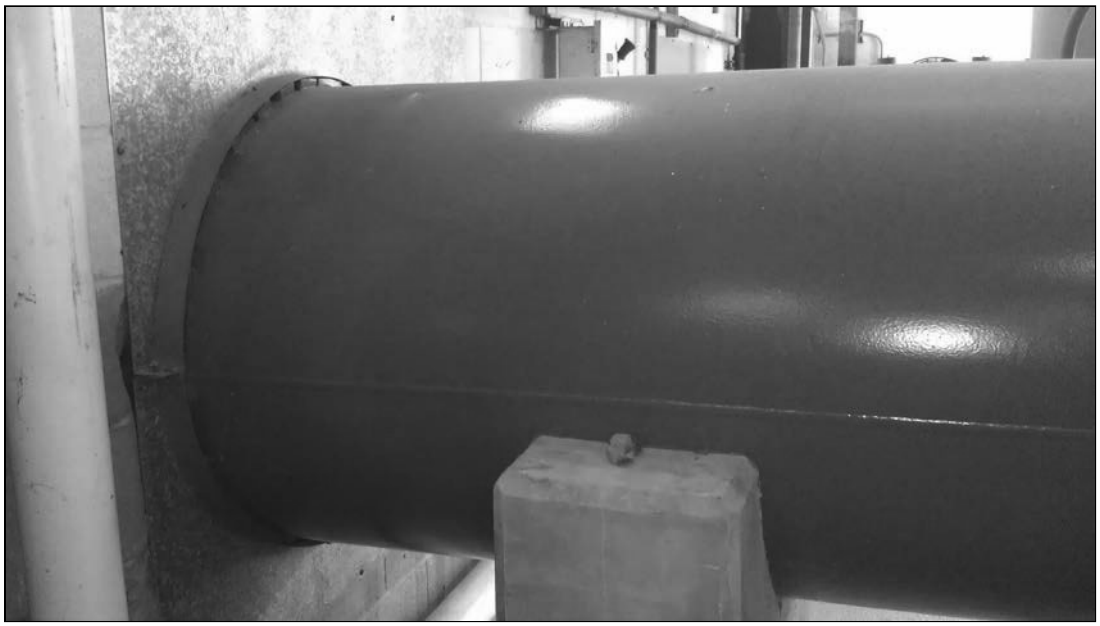


*Photo 5 HSPS Pump 8-P-08_Second Structural Support from Pump and Wall Penetration*

*Photo 6* *HSPS Pump 8-P-08_Victaulic Depend-O-Lok Nameplate*

*Photo 7* *HSPS Pressure Gauges and Air & Vacuum Valves*

*Photo 8* *HSPS_20" Treated Water Bypass Line and Sleeve Valve*

*Photo 9* *HSPS _84" Treated Water Line Split to 2 (42") lines*

*Photo 10* *HSPS_84" Treated Water Line showing 42" lines to Surge Tank*

*Photo 11* *HSPS_20" Treated Water Bypass Line and Northern 42" Treated Water Line*

*Photo 12* *HSPS_ Northern 42" Treated Water Line continued*

*Photo 13* *HSPS_View of 42" Treated Water Lines from the East*

*Photo 14* *HSPS_View of 42" Treated Water Lines from the South*

*Photo 15* *HSPS_View of Southern 42" Treated Water Lines from the South With Surge tank in Background*

*Photo 16* *HSPS_View of Northern 42" Treated Water Lines from the East at Ground Penetration – Temporary wood support underneath the pipe and existing concrete*

*Photo 17* *HSPS_20" Treated Water Bypass Line and Northern 42" Treated Water Line*

*Photo 18* *HSPS_42" Treated Water Line to Surge Tank and 84" Treated Water Line*

*Photo 19 HSPS_30" Treated Water Line from Pump 8-P-08 connecting to 84" Treated Water Line*

*Photo 20* *HSPS_8" Backflow Preventer*

*Photo 21* *HSPS_Service Tap and 8" Backflow Preventer*

*Photo 22* *HSPS_ 8" Process Water and Northern 42" Treated Water Lines*

*Photo 23* *HSPS_ 8" Process Water and Northern 42" Treated Water Lines continued*

*Photo 24 HSPS_ 8" Process Water and Northern 42" Treated Water Lines continued*

*Photo 25 HSPS_ 8" Process Water and Northern 42" Treated Water Lines with Flow Meters*

*Photo 26* *HSPS_ 8" Process Water and Northern 42" Treated Water Lines continued with temporary wood support underneath the pipe*

*Photo 27* *HSPS_ 8" Process Water Line and Southern 42" Treated Water Line Flow Meters*

*Photo 28* *HSPS_8" Process Water Line Flow Meter Nameplate*

*Photo 29* *Phase 1 UV System_ 48" Treated Water Line to Ground Storage Tank*

*Photo 30* *Phase 1 UV System_View of 4 (30") Treated Water Lines leaving UV Building from the South with Depend-O-Lok coupling on elbow*

*Photo 31* *Phase 1 UV System_View of 30" Backwash Water Line to Filters from the East with Depend-O-Lok coupling on elbow*

*Photo 32* *Phase 1 UV System_View of 4 (30") Treated Water Lines leaving UV Building from the West with Depend-O-Lok coupling on elbow*

*Photo 33 Phase 1 UV System_View of 30" Backwash Water Line to Filters from the West*

*Photo 34 Phase 1 UV System_View of First Structural Pipe Support from the UV Building Wall*

*Photo 35* *Phase 1 UV System_Butterfly Valve on 30" Backwash Water Line to Filters with Depend-O-Lok coupling on elbow*

*Photo 36* *Phase 1 UV System_Butterfly Valve on 30" Backwash Water Line to Filters Close-up*

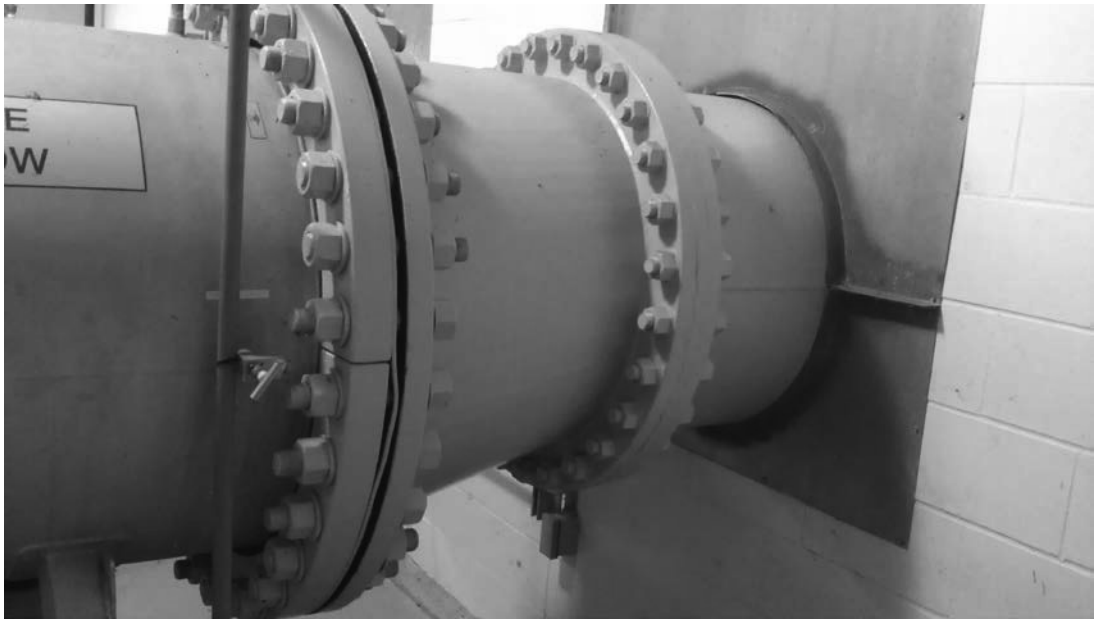


*Photo 37* *Phase 1 UV System_36" X 30" Reducer from UV Reactor to Wall Penetration*

*Photo 38* *Phase 1 UV System_UV Reactor 06-ME-01*

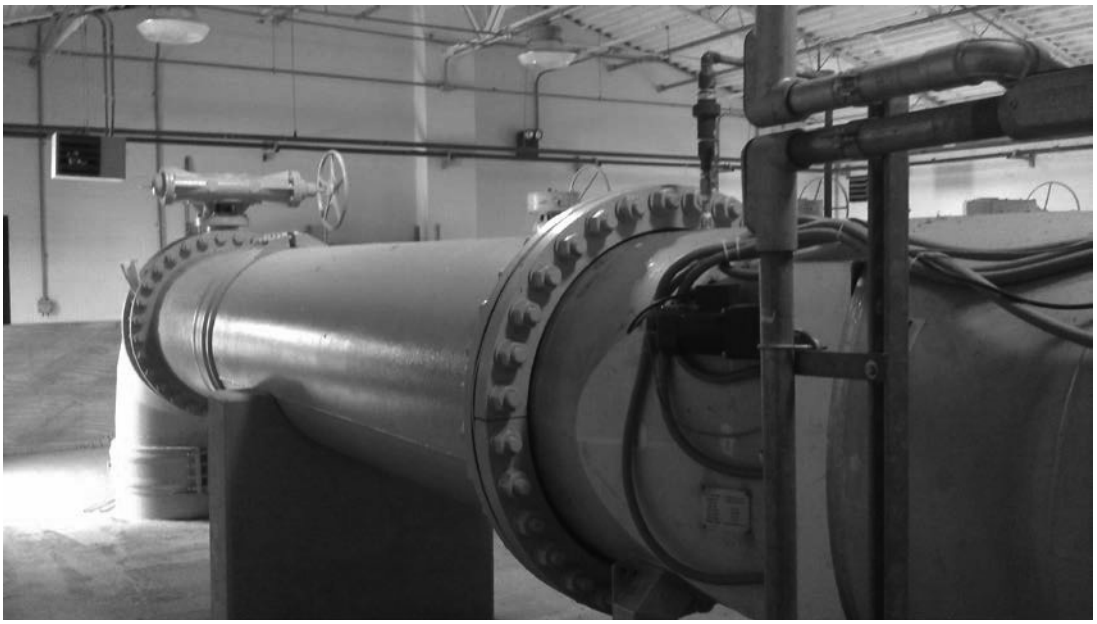


*Photo 39* *Phase 1 UV System_36" Filtered Water Line feeding the UV Reactor 06-ME-01 with Depend-O-Lok coupling on elbow in the background*

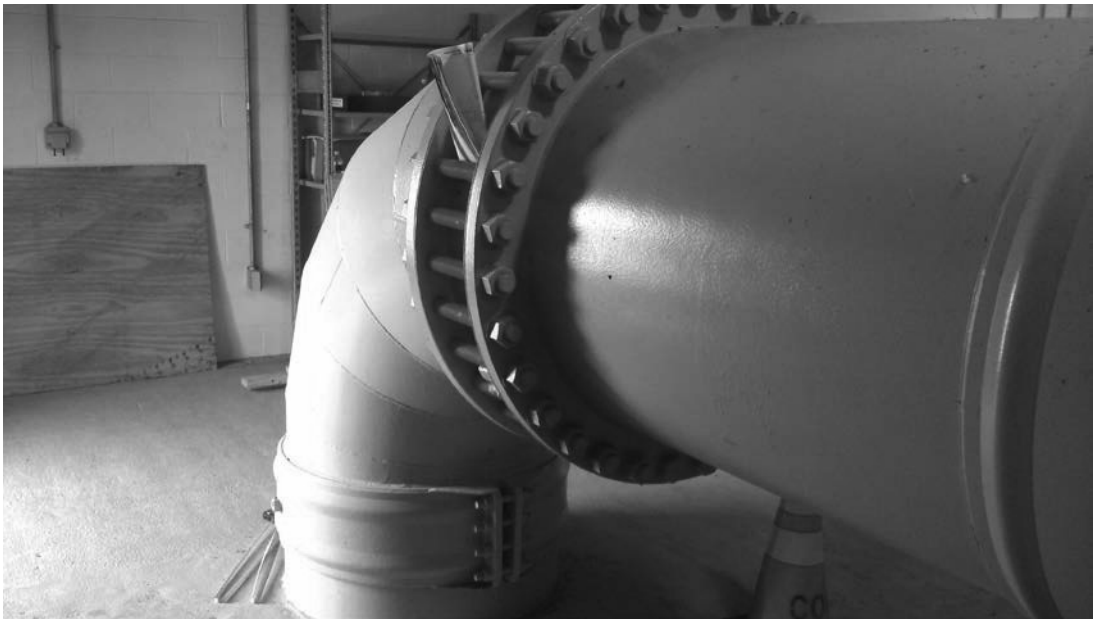


*Photo 40* *Phase 1 UV System_36" Filtered Water Line feeding the UV Reactor 06-ME-01 continued with Depend-O-Lok coupling on elbow*

*Photo 41* *Phase 2 UV System_View of 4 (30") Treated Water Lines leaving UV Building from the West with Depend-O-Lok coupling on elbow*

*Photo 42* *Phase 2 UV System_View of 4 (30") Treated Water Lines leaving UV Building from the West Continued*

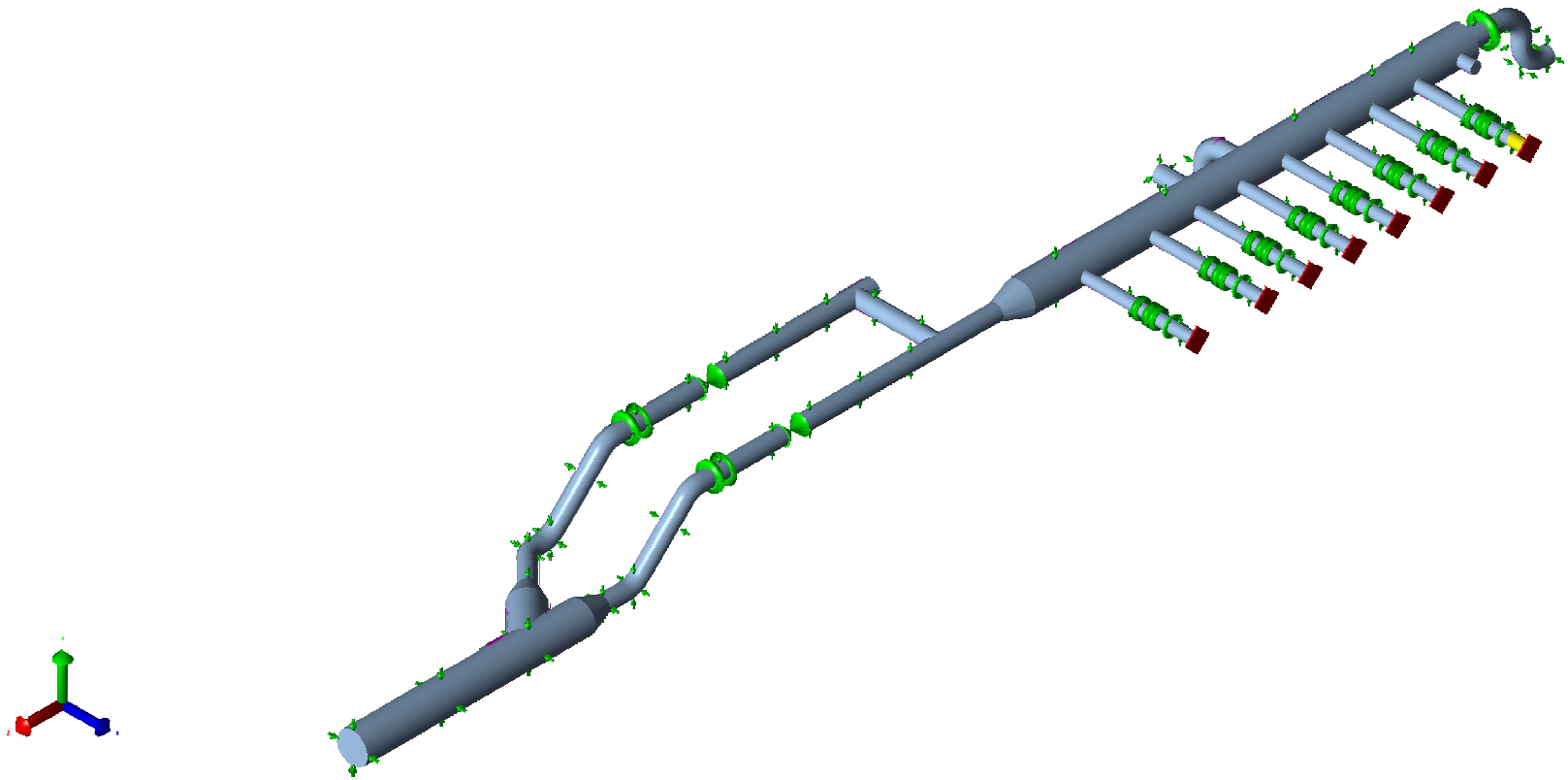
*Photo 43 Phase 2 UV System_View of 30" Backwash Water Line to Filters from the East with Depend-O-Lok coupling on elbow*

*Photo 44 Phase 2 UV System_View of 30" Backwash Water Line to Filters from the East Continued*

*Photo 45* *Phase 2 UV System_View of Treated Water Line Split to Filters and Ground Storage Tanks from the East with Depend-O-Lok coupling on vertical pipe*

*Photo 46* *Phase 2 UV System_View of 48" Treated Water Line to Ground Storage Tanks from the East with Depend-O-Lok coupling on vertical pipe*

*Photo 47* *Phase 2 UV System Butterfly Valve on Filtered Water Line prior to UV Reactor with Depend-O-Lok Coupling on the elbow*



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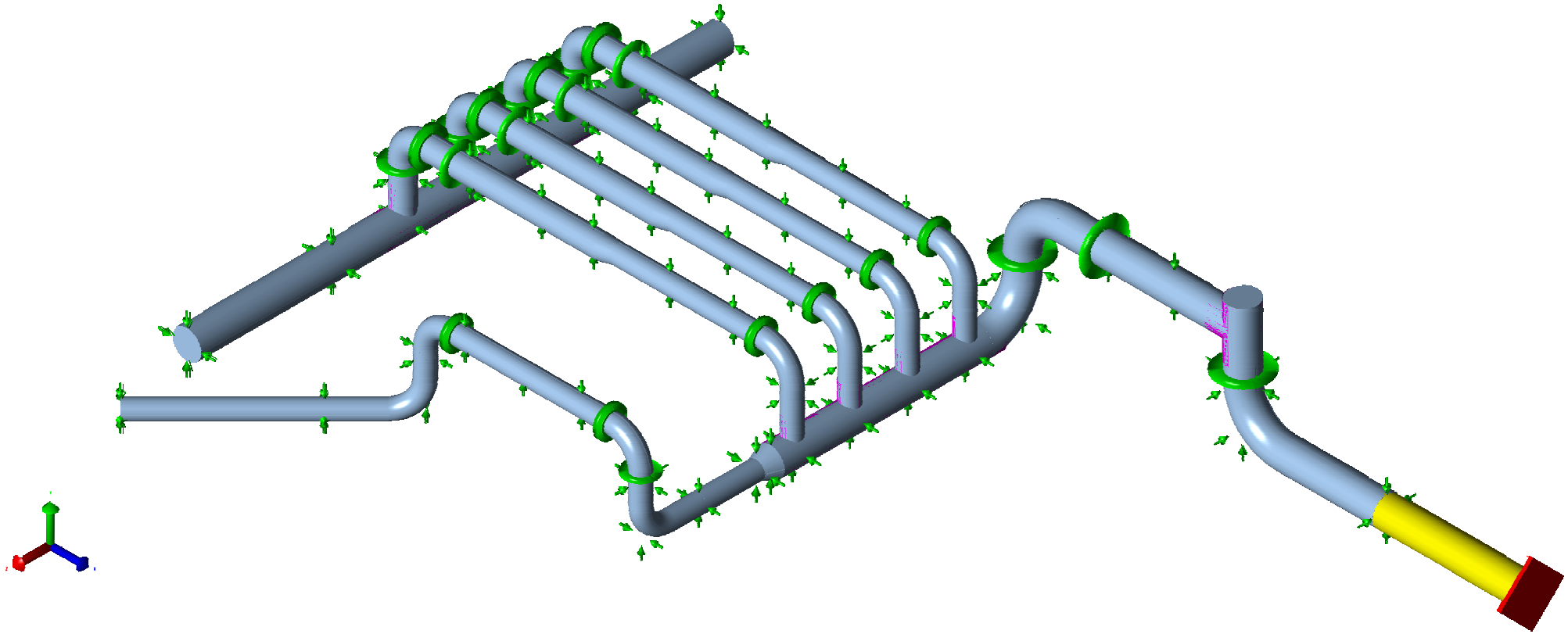

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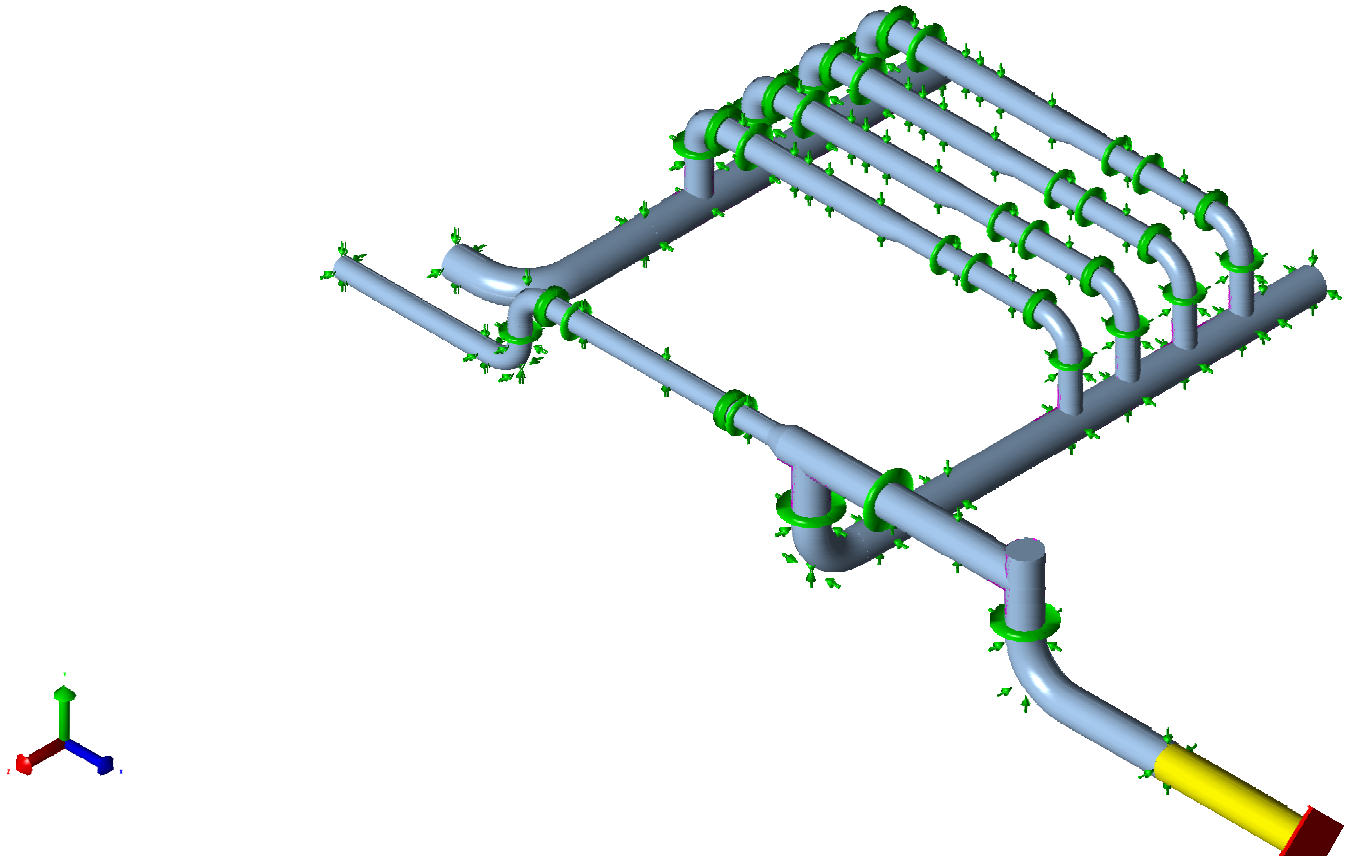
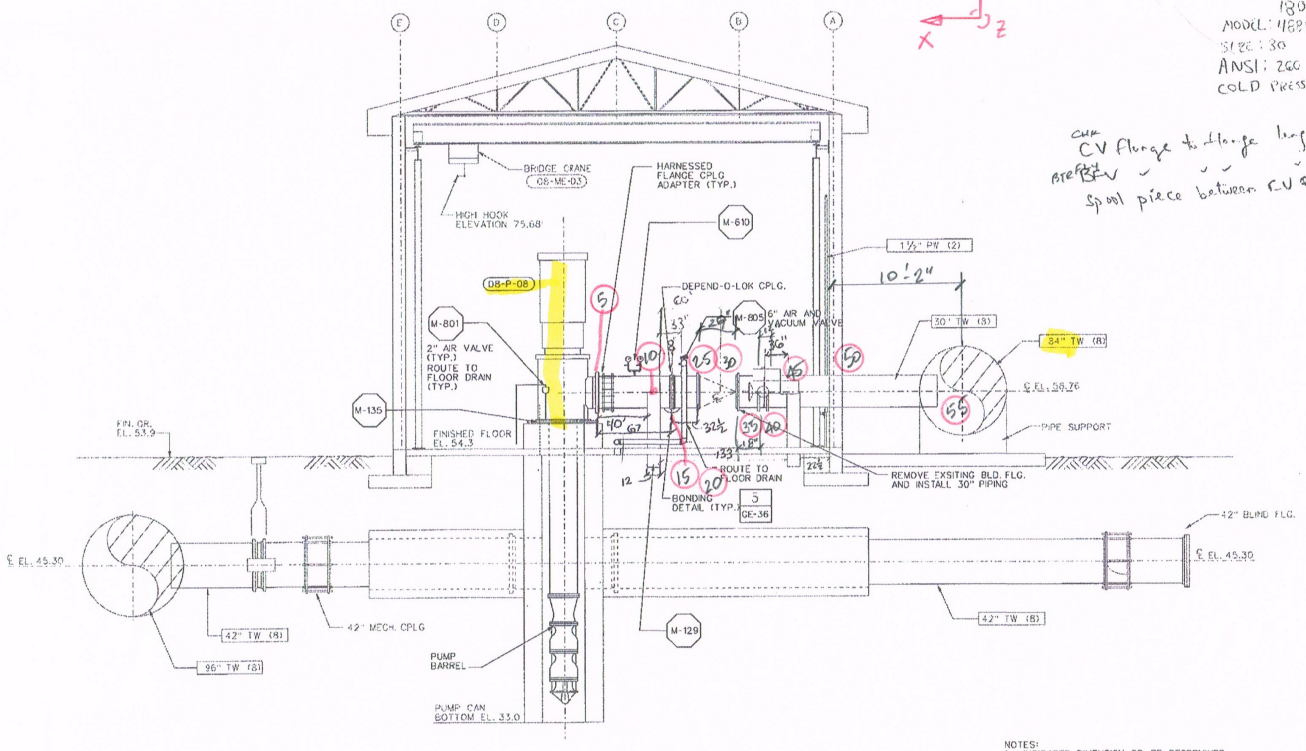


printed: 11/05/13 16:15:42  model:

GLOBE STYLE CHECK VALVE
VACMATIC 4-316
1800 SERIES
MODEL: 4880 BNXDO3
SIZE: 30 BODY: D1
ANSI: 200 TRIM: BRZ/BN
COLD PRESSURE: 300 PSI

CHK CV flange to flange length = 20.9"
BRFFLY BFV ✓ ✓ ✓ = 12" 736#
spool piece between FV and BFV = 18"




NOTES:
1. • INDICATES DIMENSION TO BE DETERMINED BY EQUIPMENT PROVIDED.

SECTION A / 8M-2
¼" = 1'-0"

| REV | DATE | BY | DESCRIPTION |
|---|---|---|---|
| 1 | 2-6-06 | YBN | RECORD DRAWING |
| D | 4-13-04 | TAV | IFC AND PERMITTING |
| B | 3-23-04 | TAV | CLIENT REVIEW |
| A | 3-2-04 | TAV | INTERNAL QA/CC REVIEW |

SCALE ¼" = 1'-0"
WARNING 0 ½ 1 IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED S. MENDOZA
DRAWN J. THORNE
CHECKED T. VISOSKY

SUBMITTED BY
(RECOMMENDED) LICENSE NO. DATE
LICENSE NO. DATE

MWH MONTGOMERY WATSON HARZA
5100 Westheimer, Suite 580
Houston, TX 77056

Houston Area Water Corporation

404004-01751

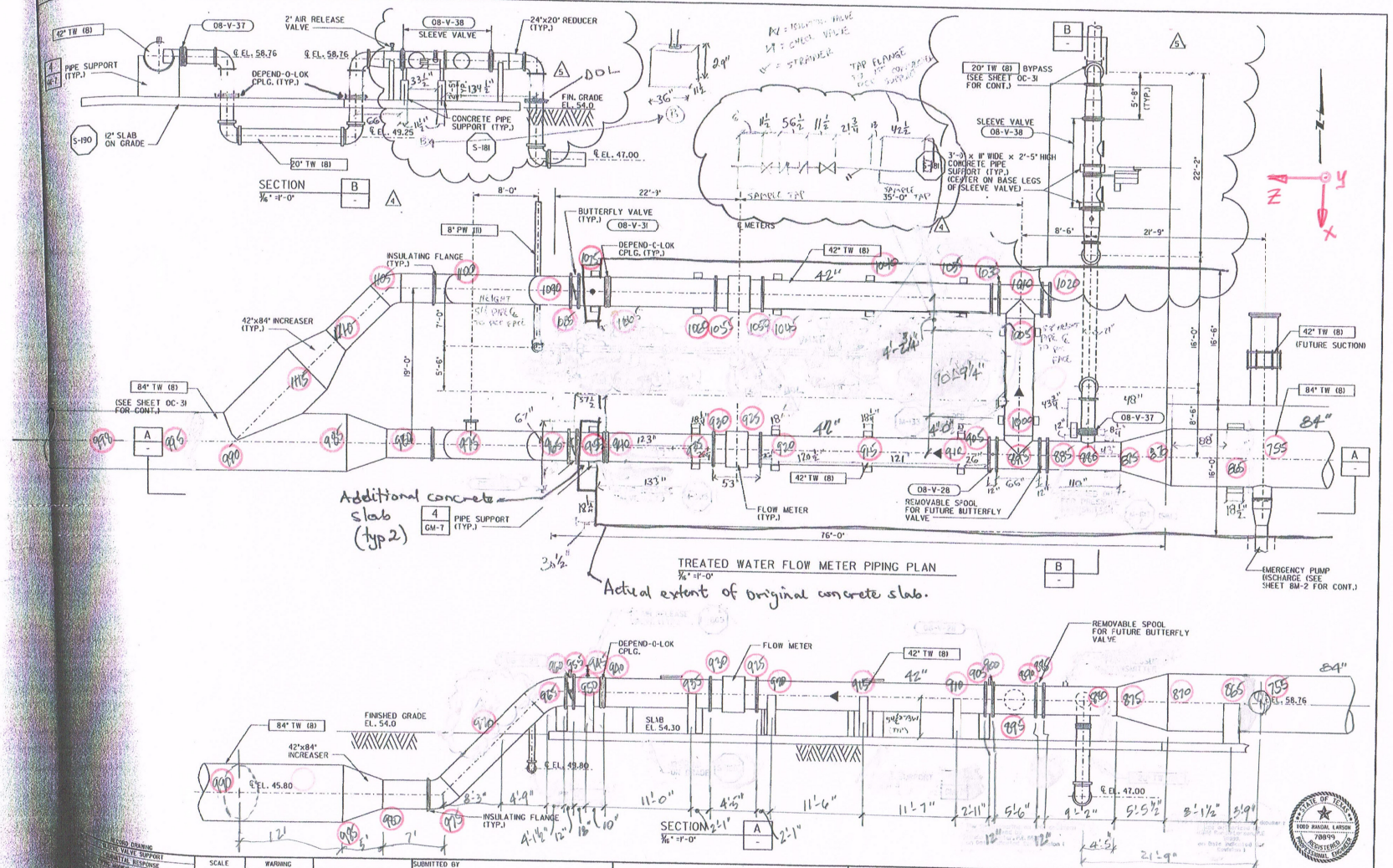
NORTHEAST WATER PURIFICATION SYSTEM PHASE 2 EXPANSION
HIGH SERVICE PUMP STATION SECTION

1

SHEET 8M-4

STATE OF TEXAS
MICHAEL ANTHONY VISOSKY
98893
REGISTERED PROFESSIONAL ENGINEER

Job No: 1650265
File: \\mpwhgen1\data\houston record drawings - phase 2\Mech\8Dwg\Hrg\08HServicePumps_2Mech8M-4_2.dgn
User: Teresa B Hrg Plot Date: 06-FEB-2008 14:31

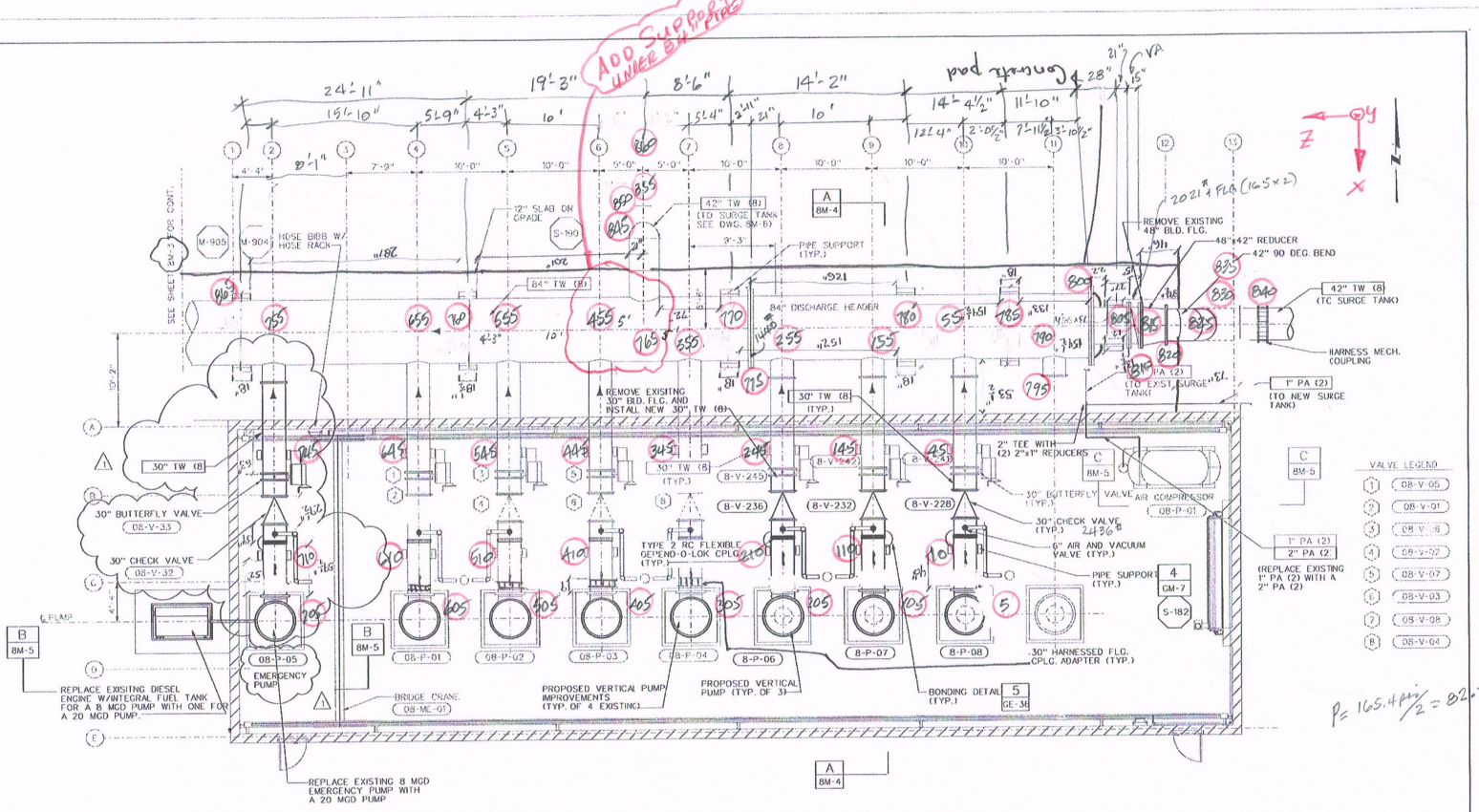



| | | | | | |
|---|---|---|---|---|---|
| SCALE 1/16" = 1'-0" | WARNING 0 1/2 1 IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE | DESIGNED T. LARSON<br>DRAWN L. THORNE<br>CHECKED G. RABALAIS | SUBMITTED BY<br>(RECOMMENDED) LICENSE NO. DATE<br>LICENSE NO. DATE | MWH MONTGOMERY WATSON HARZA<br>5100 Westheimer, Suite 580 Houston, TX 77056 | Houston Area Water Corporation |

HIGH SERVICE PUMP STATION
FLOW METER STATION PLAN AND SECTIONS

3

SHEET 8M-3




08-P-01 THRU 08-P-04 HAVE 30" HARNESS FLANGE COUPLING ADAPTER

08-P-05 THRU 08-P-08 DO NOT HAVE 30" HARNESS FLANGE COUPLING ADAPTER

$P = \frac{165.4 \text{ psi}}{2} = 82.7$ psig @ 13,888 gpm

$\pi(48^2 - 42^2) \times 1.5 = 2543.4 \text{ IN}^2$

CDC 75 5/31 05

| REV | DATE | BY | DESCRIPTION |
|---|---|---|---|
| 1 | 1-10-06 | RVS | RECORD DRAWINGS |
| 0 | 4-13-05 | TAV | IFC AND PERMITTING |
| B | 3-23-04 | TAV | CLIENT REVIEW |
| A | 3-2-04 | TAV | INTERNAL QA/QC REVIEW |

SCALE 3/8" = 1'-0"

WARNING 0 ½ 1 IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED S. MENDOZA
DRAWN L. THORNE
CHECKED J. VISOSKY

SUBMITTED BY (RECOMMENDED) LICENSE NO. DATE
LICENSE NO. DATE

MWH MONTGOMERY WATSON HARZA
5100 Westheimer, Suite 580 Houston, TX 77056

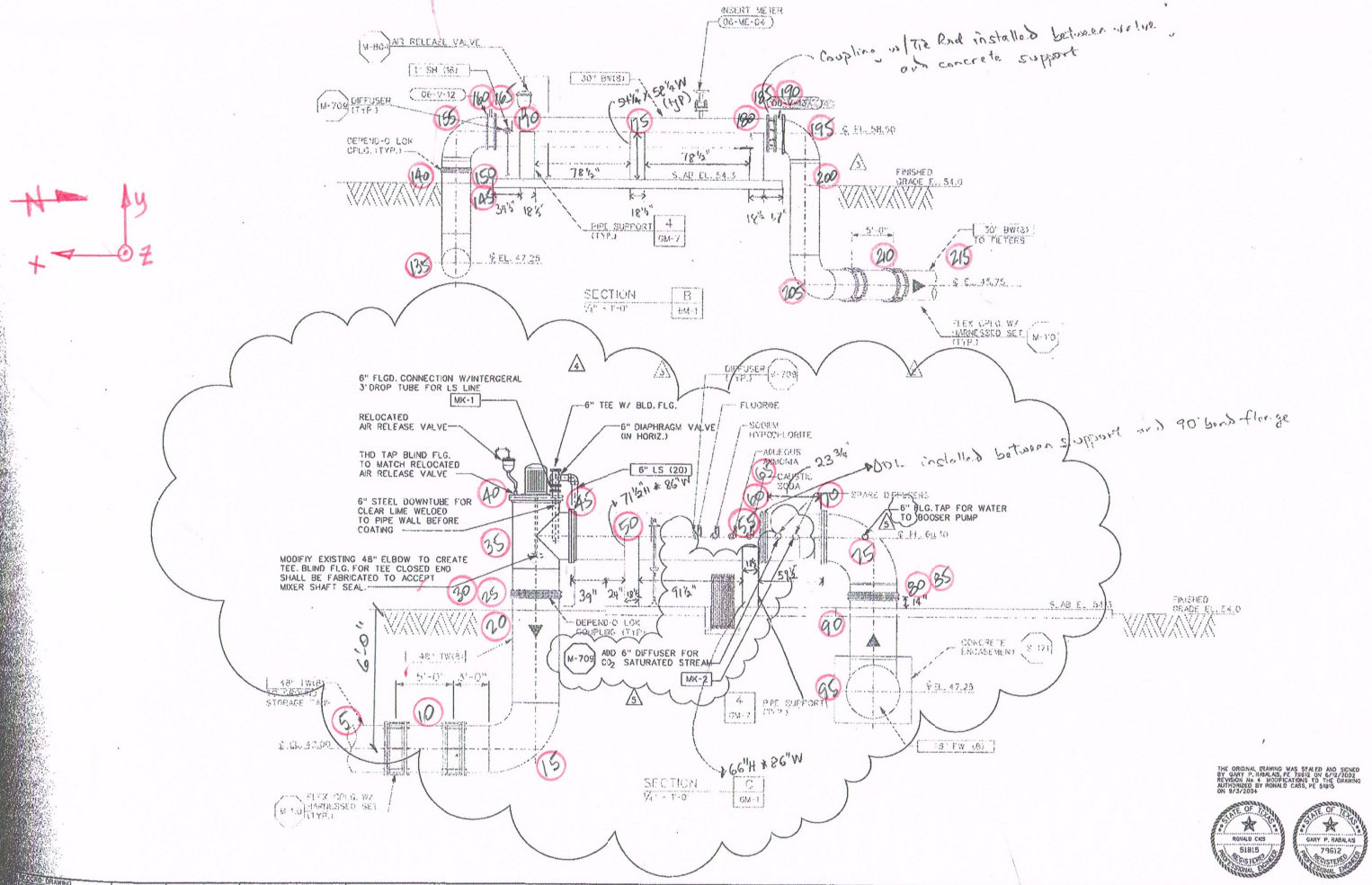
Houston Area Water Corporation

NORTHEAST WATER PURIFICATION SYSTEM PHASE 2 EXPANSION

EXISTING HIGH SERVICE PUMP STATION MODIFICAIONS - UPPER PIPING PLAN

SHEET 8M-2

Job No: 1650285 File: \\houwfgsrh\data\Houston Record Drawings - Phase II\NE\WPP\08\CP\WTP-U08HServicePumps_2\Vrs\8M-2.2.dgn User: Tagle B Wang Plot Date: 15-FEB-2006 16:59



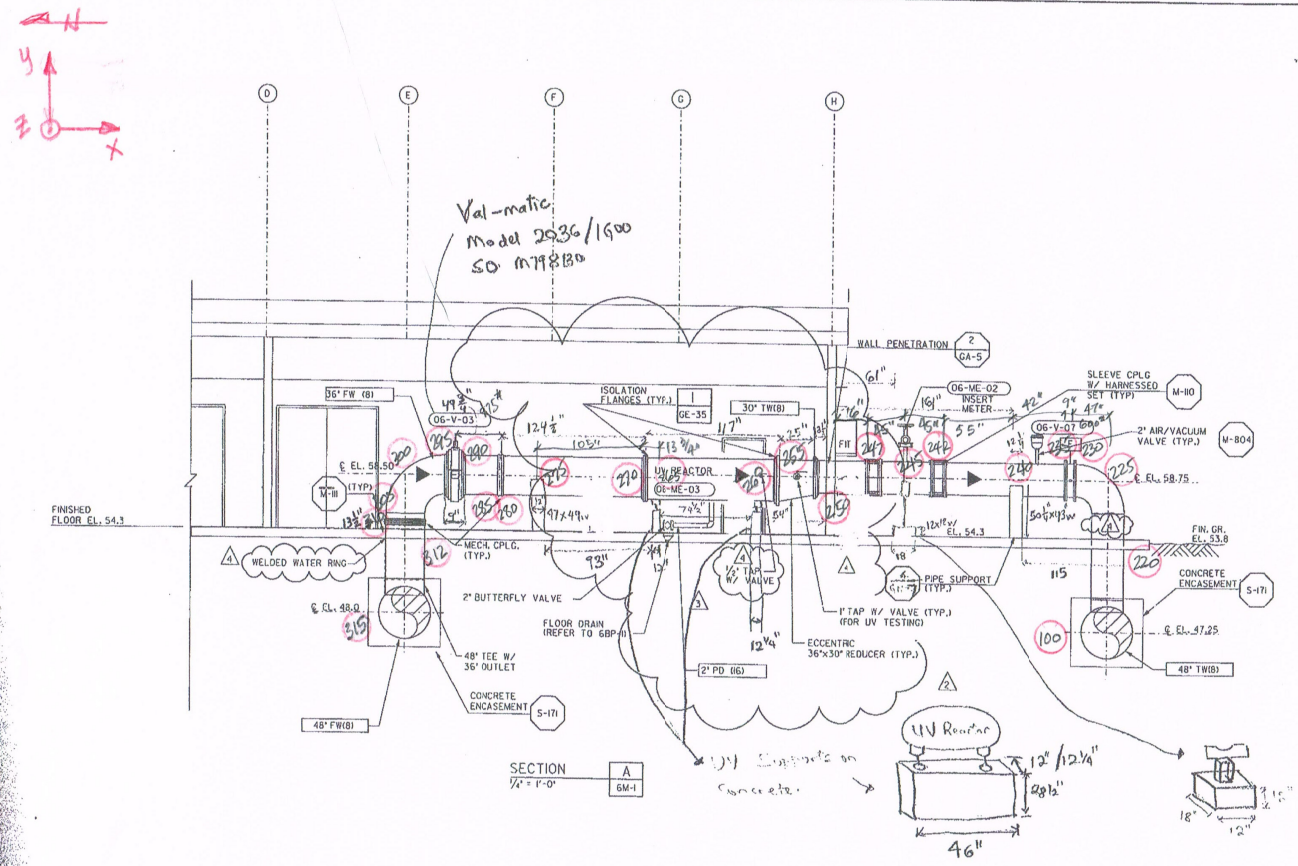

THE ORIGINAL DRAWING WAS SEALED AND SIGNED BY GARY P. RABALAIS, PE 79812 ON 8/8/2002 REVISION No 4 MODIFICATIONS TO THE DRAWING AUTHORIZED BY RONALD CASE, PE 51815 ON 9/3/2004

STATE OF TEXAS — RONALD CASE — 51815 — REGISTERED PROFESSIONAL ENGINEER

STATE OF TEXAS — GARY P. RABALAIS — 79812 — REGISTERED PROFESSIONAL ENGINEER

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CHANGE DRAWING / Agency Approval / CHANGE / COST CHANGE / TIME CHANGE / DESCRIPTION | SCALE ¼" = 1'-0" | WARNING 0 ½ 1 IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE | DESIGNED G. RABALAIS / DRAWN L. THORNE/B. LAMAY / CHECKED T. LARSON | SUBMITTED BY (RECOMMENDED) LICENSE NO. DATE / LICENSE NO. DATE | MWH MONTGOMERY WATSON HARZA 5100 Westheimer, Suite 580 Houston, TX 77056 | Houston Area Water Corporation | NORTHEAST WATER PURIFICATION SYSTEM PHASE - 1 / UV BUILDING SECTIONS | SHEET 6M-3 |

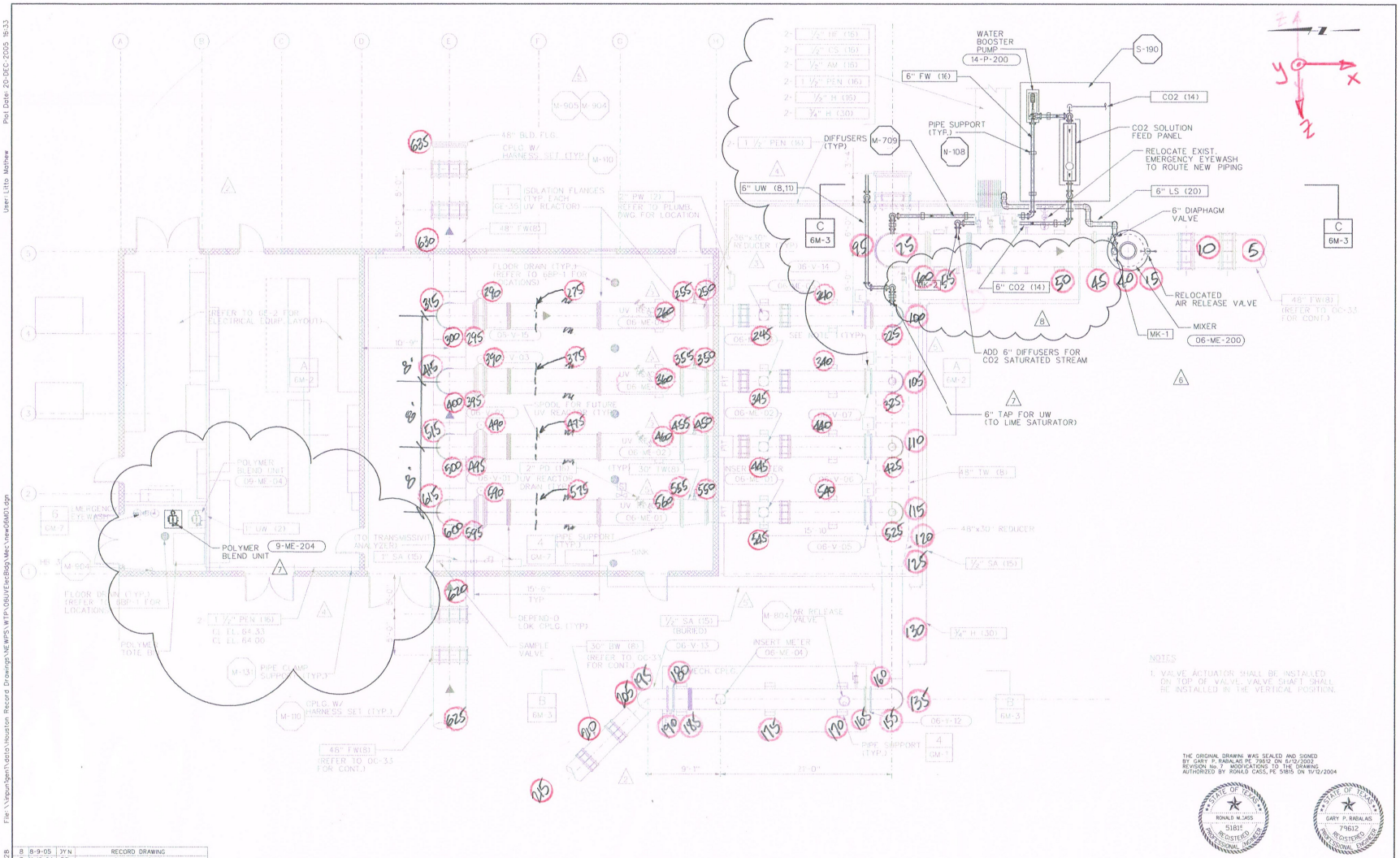
1




The Seal appearing on this document was authorized by Gary P. Rabalais, P.E. 79812, on Date indicated for Revision 1

STATE OF TEXAS
GARY P. RABALAIS
79812
REGISTERED PROFESSIONAL ENGINEER

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| RECORD DRAWING<br>AS BUILT UV Units<br>REVISIONS<br>REVISION CHANGE<br>DESCRIPTION | SCALE<br>1/4" = 1'-0" | WARNING<br>0 1/2 1<br>IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE | DESIGNED L. THORNE<br>DRAWN G. RABALAIS<br>CHECKED T. LARSON | SUBMITTED BY<br>(RECOMMENDED)<br>LICENSE NO. DATE<br>LICENSE NO. DATE | MWH<br>MONTGOMERY WATSON HARZA<br>5100 Westheimer, Suite 580<br>Houston, TX 77056 | Houston Area Water Corporation | PHASE 1<br>UV BUILDING SECTION | SHEET<br>6M-2 |




| REV | DATE | BY | DESCRIPTION |
|---|---|---|---|
| 8 | 8-9-05 | JYN | RECORD DRAWING |
| 7 | 11-12-04 | RC | Addendum No.1 |
| 6 | 9-3-04 | RC | HAWC and Permit Agency Approval |
| 5 | 11-14-03 | JYN | RECORD DRAWINGS |
| 4 | 9-10-2003 | TRL | Piping Modifications |
| 3 | 2-25-2003 | TRL | RFI Response 269 UV Units |
| 2 | 11-4-2002 | TRL | BLDG. LAYOUT CHANGE |
| 1 | 8-7-2002 | TRL | REACTOR LAYOUT CHANGE |

SCALE: 3/16" = 1'-0"

WARNING: 0 ½ 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED G. RABALAIS
DRAWN L THORNE/B. LAMA
CHECKED T. LARSON

SUBMITTED BY
(RECOMMENDED) LICENSE NO. DATE
LICENSE NO. DATE

MWH MONTGOMERY WATSON HARZA
5100 Westheimer, Suite 580
Houston, TX 77056

**Houston Area Water Corporation**

NORTHEAST WATER PURIFICATION SYSTEM
PHASE 1

UV BUILDING PLAN

SHEET 6M-1

Job No 1502228

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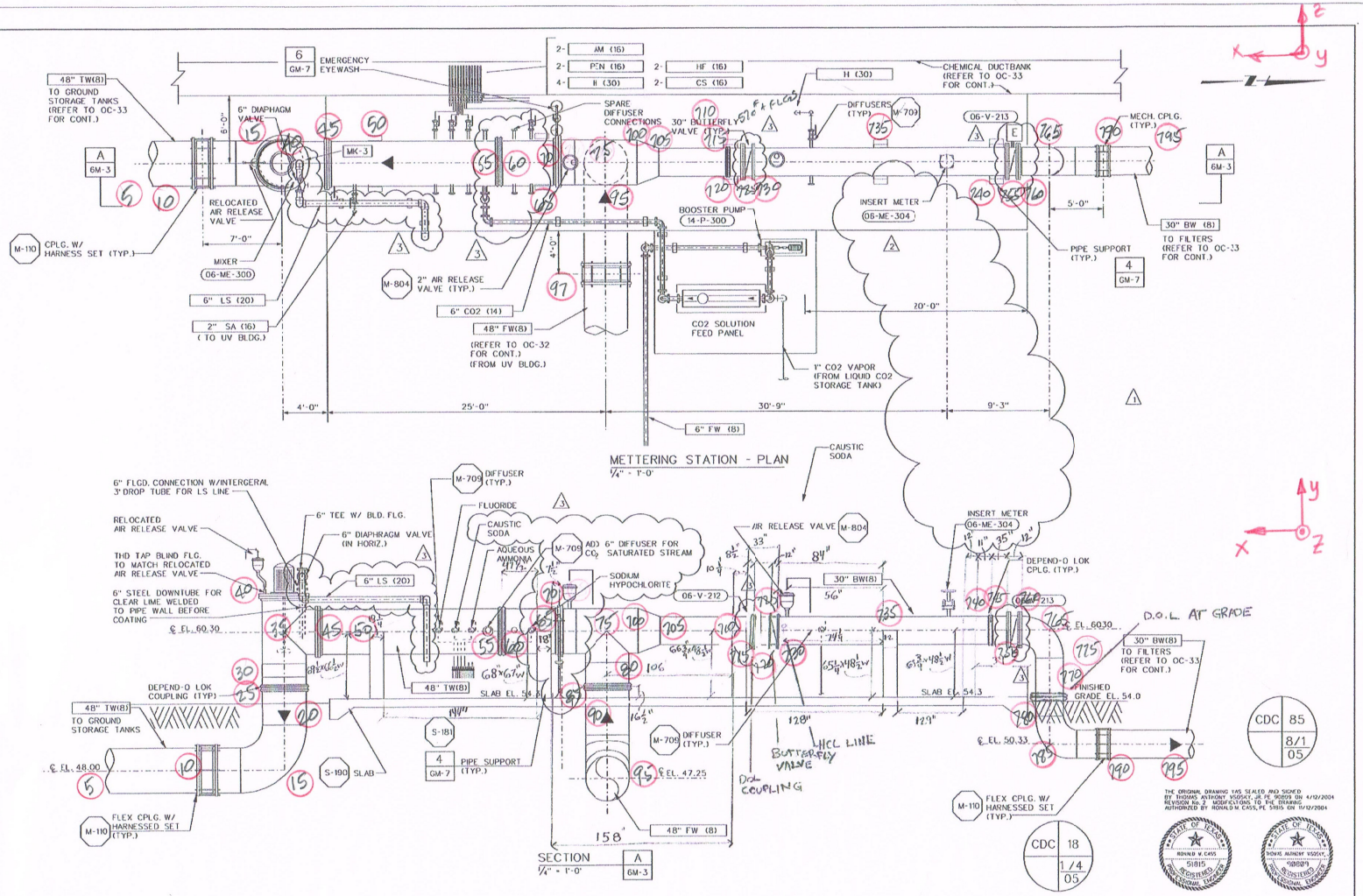
User: Little Mathew Plot Date: 20-DEC-2005 16:33




| REV | DATE | BY | DESCRIPTION |
|---|---|---|---|
| 3 | 1-10-06 | RVS | RECORD DRAWING |
| 2 | 11-12-04 | RMC | Addendum No.1 |
| 1 | 10-18-04 | RMC | HAWC and Permit Agency Approval |
| 0 | 4-13-04 | TAV | IFC AND PERMITTING |
| B | 3-23-04 | TAV | CLENT REVIEW |
| A | 3-2-04 | TAV | INTERNAL QA/QC REVIEW |

SCALE: 1/4" = 1'-0"

WARNING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED S. MENDOZA
DRAWN I. THORNE
CHECKED J. VISOSKY

SUBMITTED BY
RECOMMENDED
LICENSE NO. DATE
LICENSE NO. DATE

MWH MONTGOMERY WATSON HARZA
5100 Westheimer, Suite 580
Houston, TX 77056

**Houston Area Water Corporation**

NORTHEAST WATER PURIFICATION SYSTEM PHASE 2 EXPANSION

UV BUILDING METERING STATION PLAN AND SECTIONS

SHEET 6M-3

Job No. 1650265

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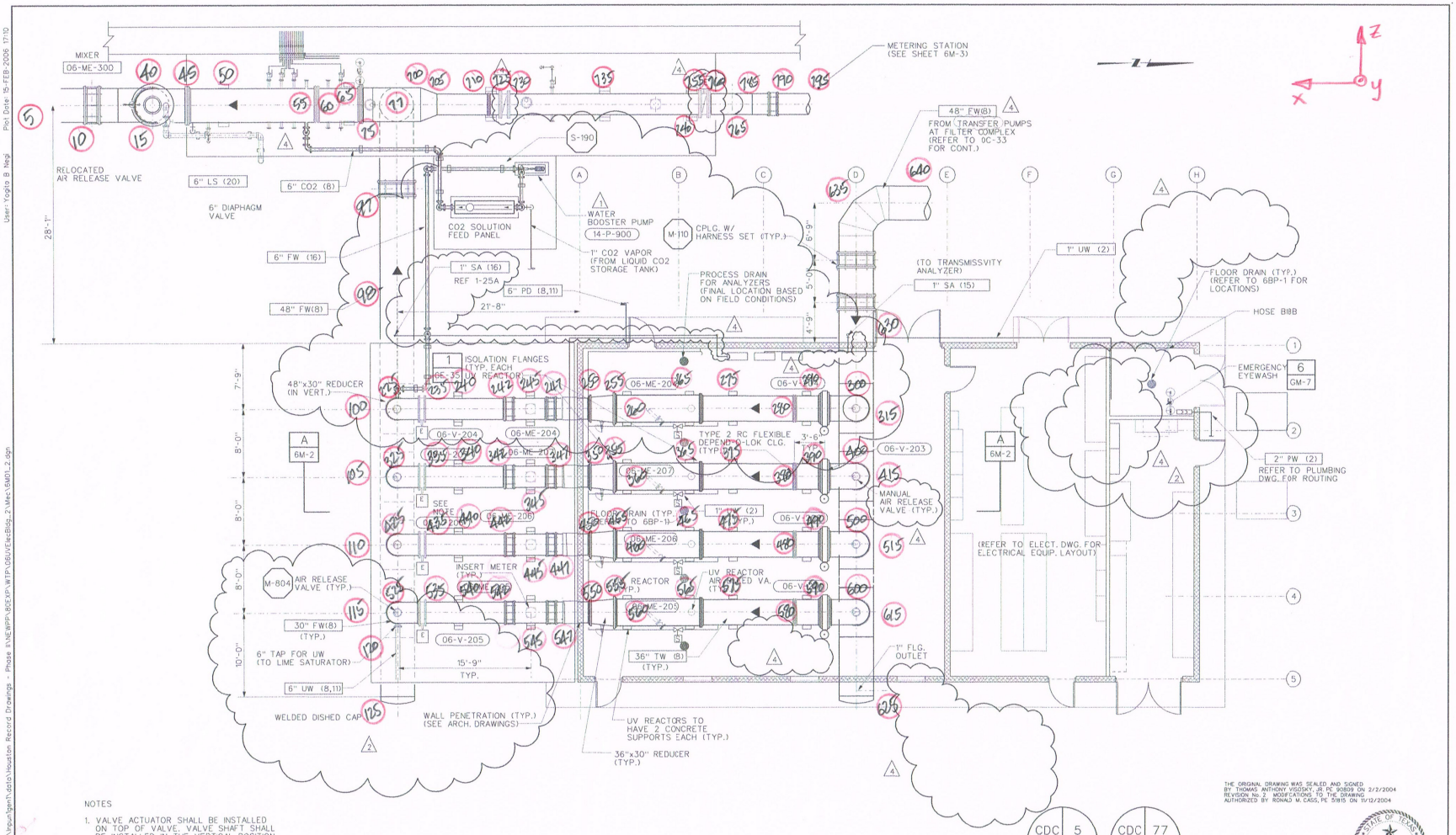



NOTES

1. VALVE ACTUATOR SHALL BE INSTALLED ON TOP OF VALVE. VALVE SHAFT SHALL BE INSTALLED IN THE VERTICAL POSITION.

| CDC | 5 | 12/22 04 |
|---|---|---|
| CDC | 77 | 6/13 05 |

THE ORIGINAL DRAWING WAS SEALED AND SIGNED BY THOMAS ANTHONY VISOSKY, JR. PE 90809 ON 2/2/2004
REVISION No. 2: MODIFICATIONS TO THE DRAWING AUTHORIZED BY RONALD M. CASS, PE 51815 ON 11/12/2004

STATE OF TEXAS — RONALD M. CASS — 51815 — REGISTERED PROFESSIONAL ENGINEER

| REV | DATE | BY | DESCRIPTION |
|---|---|---|---|
| 4 | 1-10-06 | RVS | RECORD DRAWING |
| 3 | 12-8-04 | SJ | HOT LIST MEETING - 12/6/04 |
| 2 | 11-12-04 | RMC | Addendum No1 |
| 1 | 10-18-04 | RMC | HAWC and Permit Agency Approval |
| 0 | 4-13-04 | TAV | IFC AND PERMITTING |
| B | 3-23-04 | TAV | CLIENT REVIEW |
| A | 3-2-04 | TAV | INTERNAL QA/QC REVIEW |

SCALE: 3/4" = 1'-0"

WARNING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED S. MENDOZA
DRAWN I. THORNE
CHECKED J. VISOSKY

SUBMITTED BY
(RECOMMENDED) LICENSE NO. DATE
LICENSE NO. DATE

MWH MONTGOMERY WATSON HARZA
5100 Westheimer, Suite 580
Houston, TX 77056

**Houston Area Water Corporation**

NORTHEAST WATER PURIFICATION SYSTEM
PHASE 2 EXPANSION

UV BUILDING PLAN

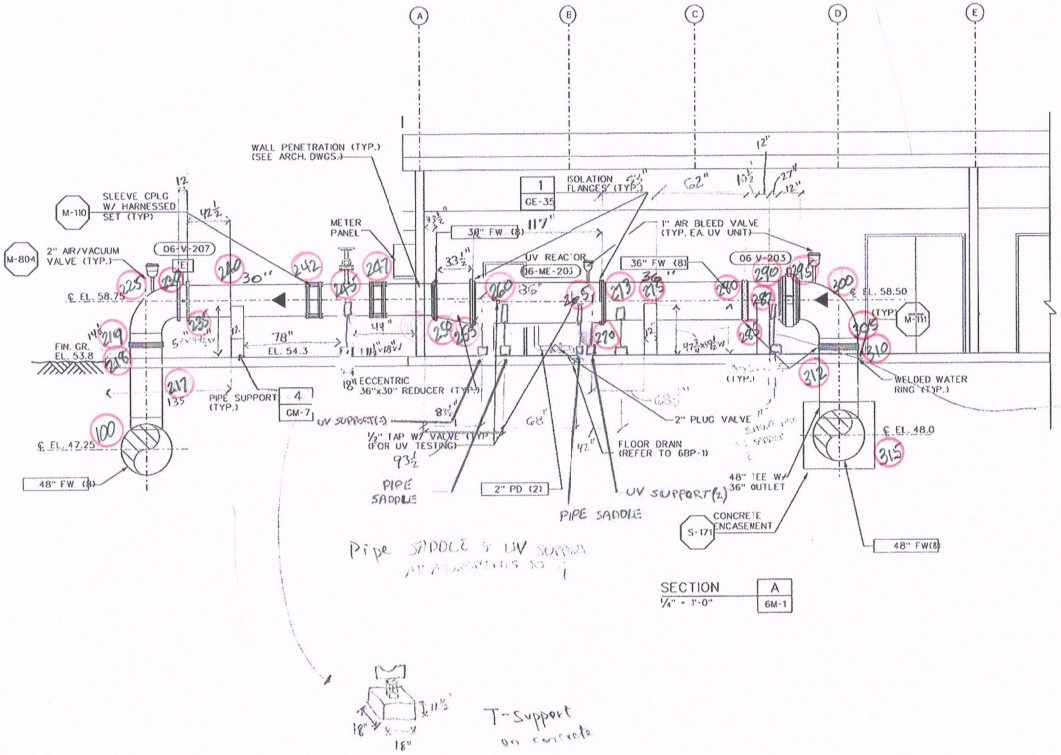
SHEET 6M-1

Job No. 1550285

File: \\Houston\Houston\Record Drawings - Phase II\NEWPP-BOS\PWP\06UVDecBldg_2.dgn

User: Yogita B Negi  Plot Date: 15-FEB-2006 17:10

3




| REV | DATE | BY | DESCRIPTION |
|---|---|---|---|
| 1 | 2-6-06 | YBN | RECORD DRAWING |
| 0 | 4-13-04 | TAV | IFC AND PERMITTING |
| B | 3-23-04 | TAV | CLIENT REVIEW |
| A | 3-2-04 | TAV | INTERNAL QA/QC REVIEW |

SCALE: 1/4" = 1'-0"

WARNING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED S. MENDOZA
DRAWN L. THORNE
CHECKED T. VISOSKY

SUBMITTED BY
(RECOMMENDED) LICENSE NO. DATE
LICENSE NO. DATE

MWH MONTGOMERY WATSON HARZA
5100 Westheimer, Suite 580
Houston, TX 77056

**Houston Area Water Corporation**

NORTHEAST WATER PURIFICATION SYSTEM
PHASE 2 EXPANSION

UV BUILDING SECTION

SHEET 6M-2

STATE OF TEXAS — THOMAS ANTHONY VISOSKY — 78580 — REGISTERED PROFESSIONAL ENGINEER

Job No: 1650285 File:\\houfiler\data\Houston record drawings - phase II\mwpo\8bwp\wtp\08UVEnclBldg_2\Wsc\8M02_2.dgn User: Vagita B. Nagi Plot Date: 06-FEB-2006 14:40

②

Job Description:

PROJECT: NEWPP Water Purifiaction Plant, Houston

CLIENT : CDM Smith

ANALYST: DClark

CHECKER: RSinghal

NOTES : High Service Pumps & Header

Existing Configuration without Flex Joints
Conditions: AMB at 82.7 psig (pump disch)

PIPE DATA
---
---
From 5 To 10 DX= -3.833 ft.
B31.3 (2010) Cycle Max Switch = --- App.P Sy/St Switch = ON
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.
Dia= 30.000 in. Wall= .375 in. Cor= .0000 in.
GENERAL
T1= 70 F P1= 82.7000 lb./sq.in. Mat= (102)A53 B
E= 29,500,000 lb./sq.in. EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in. EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in. EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in. EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in. EH9= 29,500,000 lb./sq.in. v = .292
Pipe Den= .2830000 lb./cu.in. Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .375 in. Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 5 ANC
Node 10 Y
ALLOWABLE STRESSES
---
From 10 To 15 DX= -1.667 ft.
---
From 15 To 20 DX= -.167 ft.
---
From 20 To 25 DX= -2.625 ft.
---
From 25 To 30 DX= -2.417 ft.
RIGID Weight= 4,000.00 lb.
---
From 30 To 35 DX= -1.500 ft.
---
From 35 To 40 DX= -1.000 ft.
RIGID Weight= 1,556.00 lb.
---
From 40 To 45 DX= -2.000 ft.
RESTRAINTS
Node 45 Y
---

From  45  To  50  DX= -3.208 ft.
---
From  50  To  55  DX= -10.167 ft.
SIF's & TEE's
  Node  55  Unreinforced Tee
---
From  105  To  110  DX= -3.833 ft.
  B31.3 (2010)  Cycle Max Switch = ---  App.P Sy/St Switch = ON
  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.
  Dia= 30.000 in.  Wall= .375 in.  Cor= .0000 in.
GENERAL
  T1= 70 F  P1= 165.0000 lb./sq.in.  Mat= (102)A53 B
  E= 29,500,000 lb./sq.in.  EH1= 29,500,000 lb./sq.in.
  EH2= 29,500,000 lb./sq.in.  EH3= 29,500,000 lb./sq.in.
  EH4= 29,500,000 lb./sq.in.  EH5= 29,500,000 lb./sq.in.
  EH6= 29,500,000 lb./sq.in.  EH7= 29,500,000 lb./sq.in.
  EH8= 29,500,000 lb./sq.in.  EH9= 29,500,000 lb./sq.in.  v = .292
  Pipe Den= .2830000 lb./cu.in.  Fluid Den= .0361111 lb./cu.in.
  Refract. Thk= .375 in.  Refract. Den= .0643300 lb./cu.in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  105  ANC
  Node  110  Y
ALLOWABLE STRESSES
---
From  110  To  115  DX= -1.667 ft.
---
From  115  To  120  DX= -.167 ft.
---
From  120  To  125  DX= -2.625 ft.
---
From  125  To  130  DX= -2.417 ft.
RIGID  Weight= 4,000.00 lb.
---
From  130  To  135  DX= -1.500 ft.
---
From  135  To  140  DX= -1.000 ft.
RIGID  Weight= 1,556.00 lb.
---
From  140  To  145  DX= -2.000 ft.
RESTRAINTS
  Node  145  Y
---
From  145  To  150  DX= -3.208 ft.
---
From  150  To  155  DX= -10.167 ft.
SIF's & TEE's
  Node  155  Unreinforced Tee
---
From  150  To  155  DX= -10.167 ft.
SIF's & TEE's
  Node  155  Unreinforced Tee
---
From  205  To  210  DX= -3.833 ft.
  B31.3 (2010)  Cycle Max Switch = ---  App.P Sy/St Switch = ON

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.
Dia= 30.000 in.  Wall= .375 in.  Cor= .0000 in.
GENERAL
T1= 70 F  P1= 165.0000 lb./sq.in.  Mat= (102)A53 B
E= 29,500,000 lb./sq.in.  EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in.  EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in.  EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in.  EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in.  EH9= 29,500,000 lb./sq.in.  v = .292
Pipe Den= .2830000 lb./cu.in.  Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .375 in.  Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 205 ANC
Node 210 Y
ALLOWABLE STRESSES
---
From 210 To 215 DX= -1.667 ft.
---
From 215 To 220 DX= -.167 ft.
---
From 220 To 225 DX= -2.625 ft.
---
From 225 To 230 DX= -2.417 ft.
RIGID Weight= 4,000.00 lb.
---
From 230 To 235 DX= -1.500 ft.
---
From 235 To 240 DX= -1.000 ft.
RIGID Weight= 1,556.00 lb.
---
From 240 To 245 DX= -2.000 ft.
RESTRAINTS
Node 245 Y
---
From 245 To 250 DX= -3.208 ft.
---
From 250 To 255 DX= -10.167 ft.
SIF's & TEE's
Node 255 Unreinforced Tee
---
From 250 To 255 DX= -10.167 ft.
SIF's & TEE's
Node 255 Unreinforced Tee
---
From 305 To 310 DX= -3.833 ft.
B31.3 (2010)  Cycle Max Switch = ---  App.P Sy/St Switch = ON
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.
Dia= 30.000 in.  Wall= .375 in.  Cor= .0000 in.
GENERAL
T1= 70 F  P1= 165.0000 lb./sq.in.  Mat= (102)A53 B
E= 29,500,000 lb./sq.in.  EH1= 29,500,000 lb./sq.in.

EH2= 29,500,000 lb./sq.in.  EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in.  EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in.  EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in.  EH9= 29,500,000 lb./sq.in.  v = .292
Pipe Den= .2830000 lb./cu.in.  Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .375 in.  Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 305 ANC
Node 310 Y
ALLOWABLE STRESSES
---
From 310 To 315 DX= -1.667 ft.
---
From 315 To 320 DX= -.167 ft.
---
From 320 To 325 DX= -2.625 ft.
---
From 325 To 330 DX= -2.417 ft.
RIGID Weight= 4,000.00 lb.
---
From 330 To 335 DX= -1.500 ft.
---
From 335 To 340 DX= -1.000 ft.
RIGID Weight= 1,556.00 lb.
---
From 340 To 345 DX= -2.000 ft.
RESTRAINTS
Node 345 Y
---
From 345 To 350 DX= -3.208 ft.
---
From 350 To 355 DX= -10.167 ft.
SIF's & TEE's
Node 355 Unreinforced Tee
---
From 350 To 355 DX= -10.167 ft.
SIF's & TEE's
Node 355 Unreinforced Tee
---
From 405 To 410 DX= -3.833 ft.
B31.3 (2010)  Cycle Max Switch = ---  App.P Sy/St Switch = ON
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.
Dia= 30.000 in.  Wall= .375 in.  Cor= .0000 in.
GENERAL
T1= 70 F  P1= 165.0000 lb./sq.in.  Mat= (102)A53 B
E= 29,500,000 lb./sq.in.  EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in.  EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in.  EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in.  EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in.  EH9= 29,500,000 lb./sq.in.  v = .292
Pipe Den= .2830000 lb./cu.in.  Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .375 in.  Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS

Node 405 ANC
Node 410 Y
ALLOWABLE STRESSES
---
From 410 To 415 DX= -1.667 ft.
---
From 415 To 420 DX= -.167 ft.
---
From 420 To 425 DX= -2.625 ft.
---
From 425 To 430 DX= -2.417 ft.
RIGID Weight= 4,000.00 lb.
---
From 430 To 435 DX= -1.500 ft.
---
From 435 To 440 DX= -1.000 ft.
RIGID Weight= 1,556.00 lb.
---
From 440 To 445 DX= -2.000 ft.
RESTRAINTS
Node 445 Y
---
From 445 To 450 DX= -3.208 ft.
---
From 450 To 455 DX= -10.167 ft.
SIF's & TEE's
Node 455 Unreinforced Tee
---
From 505 To 510 DX= -3.833 ft.
B31.3 (2010) Cycle Max Switch = --- App.P Sy/St Switch = ON
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.
Dia= 30.000 in. Wall= .375 in. Cor= .0000 in.
GENERAL
T1= 70 F P1= 165.0000 lb./sq.in. Mat= (102)A53 B
E= 29,500,000 lb./sq.in. EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in. EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in. EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in. EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in. EH9= 29,500,000 lb./sq.in. v = .292
Pipe Den= .2830000 lb./cu.in. Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .375 in. Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 505 ANC
Node 510 Y
ALLOWABLE STRESSES
---
From 510 To 515 DX= -1.667 ft.
---
From 515 To 520 DX= -.167 ft.
---
From 520 To 525 DX= -2.625 ft.
---
From 525 To 530 DX= -2.417 ft.
RIGID Weight= 4,000.00 lb.

---
From 530 To 535 DX= -1.500 ft.
---
From 535 To 540 DX= -1.000 ft.
RIGID Weight= 1,556.00 lb.
---
From 540 To 545 DX= -2.000 ft.
RESTRAINTS
  Node 545 Y
---
From 545 To 550 DX= -3.208 ft.
---
From 550 To 555 DX= -10.167 ft.
SIF's & TEE's
  Node 555 Unreinforced Tee
---
From 605 To 610 DX= -3.833 ft.
  B31.3 (2010) Cycle Max Switch = --- App.P Sy/St Switch = ON
  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.
  Dia= 30.000 in. Wall= .375 in. Cor= .0000 in.
GENERAL
  T1= 70 F P1= 165.0000 lb./sq.in. Mat= (102)A53 B
  E= 29,500,000 lb./sq.in. EH1= 29,500,000 lb./sq.in.
  EH2= 29,500,000 lb./sq.in. EH3= 29,500,000 lb./sq.in.
  EH4= 29,500,000 lb./sq.in. EH5= 29,500,000 lb./sq.in.
  EH6= 29,500,000 lb./sq.in. EH7= 29,500,000 lb./sq.in.
  EH8= 29,500,000 lb./sq.in. EH9= 29,500,000 lb./sq.in. v = .292
  Pipe Den= .2830000 lb./cu.in. Fluid Den= .0361111 lb./cu.in.
  Refract. Thk= .375 in. Refract. Den= .0643300 lb./cu.in.
  Insul Thk= .000 in.
RESTRAINTS
  Node 605 ANC
  Node 610 Y
ALLOWABLE STRESSES
---
From 610 To 615 DX= -1.667 ft.
---
From 615 To 620 DX= -.167 ft.
---
From 620 To 625 DX= -2.625 ft.
---
From 625 To 630 DX= -2.417 ft.
RIGID Weight= 4,000.00 lb.
---
From 630 To 635 DX= -1.500 ft.
---
From 635 To 640 DX= -1.000 ft.
RIGID Weight= 1,556.00 lb.
---
From 640 To 645 DX= -2.000 ft.
RESTRAINTS
  Node 645 Y
---
From 645 To 650 DX= -3.208 ft.
---

From 650 To 655 DX= -10.167 ft.
SIF's & TEE's
Node 655 Unreinforced Tee
---
From 705 To 710 DX= -3.833 ft.
B31.3 (2010) Cycle Max Switch = --- App.P Sy/St Switch = ON
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.
Dia= 30.000 in. Wall= .375 in. Cor= .0000 in.
GENERAL
T1= 70 F P1= 165.0000 lb./sq.in. Mat= (102)A53 B
E= 29,500,000 lb./sq.in. EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in. EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in. EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in. EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in. EH9= 29,500,000 lb./sq.in. v = .292
Pipe Den= .2830000 lb./cu.in. Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .375 in. Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 705 ANC
Node 710 Y
ALLOWABLE STRESSES
---
From 710 To 715 DX= -1.667 ft.
---
From 715 To 720 DX= -.167 ft.
---
From 720 To 725 DX= -2.625 ft.
---
From 725 To 730 DX= -2.417 ft.
RIGID Weight= 4,000.00 lb.
---
From 730 To 735 DX= -1.500 ft.
---
From 735 To 740 DX= -1.000 ft.
RIGID Weight= 1,556.00 lb.
---
From 740 To 745 DX= -2.000 ft.
RESTRAINTS
Node 745 Y
---
From 745 To 750 DX= -3.208 ft.
---
From 750 To 755 DX= -10.167 ft.
SIF's & TEE's
Node 755 Unreinforced Tee
---
From 755 To 655 DZ= -15.833 ft.
Dia= 84.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .500 in. Insul Thk= .000 in.
---
From 655 To 760 DZ= -5.750 ft.
RESTRAINTS
Node 760 Y

---
From 760 To 555 DZ= -4.250 ft.
---
From 555 To 455 DZ= -10.000 ft.
RESTRAINTS
  Node 455 +Y
---
From 455 To 765 DZ= -5.000 ft.
SIF's & TEE's
  Node 765 Unreinforced Tee
---
From 765 To 355 DZ= -5.000 ft.
---
From 355 To 770 DZ= -5.333 ft.
RESTRAINTS
  Node 770 Y
---
From 770 To 775 DZ= -2.917 ft.
FORCES & MOMENTS
  Node 775 FY1= -1,440.00 lb.
---
From 775 To 255 DZ= -1.750 ft.
---
From 255 To 155 DZ= -10.000 ft.
---
From 155 To 780 DZ= -3.000 ft.
RESTRAINTS
  Node 780 Y
---
From 780 To 55 DZ= -7.000 ft.
---
From 55 To 785 DZ= -2.042 ft.
RESTRAINTS
  Node 785 Y
---
From 785 To 790 DZ= -7.958 ft.
SIF's & TEE's
  Node 790 Unreinforced Tee
---
From 790 To 795 DX= 6.500 ft.
  Dia= 30.000 in. Wall= .375 in.
GENERAL
  Refract. Thk= .375 in. Insul Thk= .000 in.
FORCES & MOMENTS
  Node 795 FY1= -660.00 lb.
---
From 790 To 800 DZ= -3.875 ft.
  Dia= 84.000 in. Wall= .375 in.
GENERAL
  Refract. Thk= .500 in. Insul Thk= .000 in.
---
From 800 To 805 DZ= -2.333 ft.
  Dia= 48.000 in. Wall= .375 in.
  Insul Thk= .000 in.
RESTRAINTS
  Node 805 Y
---
From 805 To 810 DZ= -1.500 ft.

```
------------------------------------------------------------------------------
From  810  To  815 DZ= -1.250 ft.
RIGID  Weight= 2,185.00 lb.
------------------------------------------------------------------------------
From  815  To  820 DZ= -2.500 ft.
------------------------------------------------------------------------------
From  820  To  825 DZ= -5.333 ft.
   Dia= 42.000 in.   Wall= .375 in.
   Insul Thk= .000 in.
BEND at "TO" end
   Radius= 63.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 824
   Miters= 4   Ftg Thk= .375 in.
------------------------------------------------------------------------------
From  825  To  830 DY= -5.860 ft.
RESTRAINTS
   Node  830  Guide   Gap= .250 in.
------------------------------------------------------------------------------
From  830  To  835 DY= -6.000 ft.
BEND at "TO" end
   Radius= 63.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 834
   Angle/Node @2= .00 833   Miters= 4   Ftg Thk= .375 in.
RESTRAINTS
   Node  834  Y
   Node  834  X
------------------------------------------------------------------------------
From  835  To  840 DZ= -6.000 ft.
RESTRAINTS
   Node  840  Y
   Node  840  X
------------------------------------------------------------------------------
From  765  To  845  DX= -10.500 ft.
BEND at "TO" end
   Radius= 63.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 844
   Angle/Node @2= .00 843   Miters= 4   Ftg Thk= .375 in.
------------------------------------------------------------------------------
From  845  To  850 DY= -5.860 ft.
RESTRAINTS
   Node  850  Guide   Gap= .250 in.
------------------------------------------------------------------------------
From  850  To  855 DY= -6.000 ft.
BEND at "TO" end
   Radius= 63.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 854
   Angle/Node @2= .00 853
RESTRAINTS
   Node  854  Y
   Node  854  Z
------------------------------------------------------------------------------
From  855  To  860  DX= -10.000 ft.
RESTRAINTS
   Node  860  Y
   Node  860  Z
------------------------------------------------------------------------------
From  755  To  865 DZ= 3.583 ft.
   Dia= 85.000 in.   Wall= .375 in.
   Insul Thk= .000 in.
RESTRAINTS
   Node  865  Y
------------------------------------------------------------------------------
```

From  865  To  870 DZ= 8.125 ft.
---
From  870  To  875 DZ= 5.458 ft.
---
From  875  To  880 DZ= 4.417 ft.
  Dia= 42.000 in.  Wall= .375 in.
  Insul Thk= .000 in.
SIF's & TEE's
  Node  880  Unreinforced Tee
---
From  880  To  885 DZ= 4.750 ft.
FORCES & MOMENTS
  Node  885  FY1= -330.00 lb.
---
From  885  To  890 DZ= 1.000 ft.
FORCES & MOMENTS
  Node  890  FY1= -330.00 lb.
---
From  890  To  895 DZ= 2.750 ft.
SIF's & TEE's
  Node  895  Unreinforced Tee
---
From  895  To  900 DZ= 2.750 ft.
FORCES & MOMENTS
  Node  900  FY1= -330.00 lb.
---
From  900  To  905 DZ= 1.000 ft.
FORCES & MOMENTS
  Node  905  FY1= -330.00 lb.
---
From  905  To  910 DZ= 2.917 ft.
RESTRAINTS
  Node  910  Y
---
From  910  To  915 DZ= 11.583 ft.
RESTRAINTS
  Node  915  Y
---
From  915  To  920 DZ= 11.500 ft.
RESTRAINTS
  Node  920  Y
---
From  920  To  925 DZ= 2.083 ft.
---
From  925  To  930 DZ= 4.417 ft.
RIGID  Weight= 955.00 lb.
---
From  930  To  935 DZ= 2.083 ft.
RESTRAINTS
  Node  935  Y
---
From  935  To  940 DZ= 11.000 ft.
---
From  940  To  945 DZ= .167 ft.
---
From  945  To  950 DZ= .833 ft.
RESTRAINTS
  Node  950  Y

---
From  950  To  955 DZ= 1.500 ft.
---
From  955  To  960 DZ= 1.000 ft.
RIGID  Weight= 2,085.00 lb.
---
From  960  To  965 DZ= 4.125 ft.
BEND at "TO" end
  Radius= 63.000 in. (LONG)  Bend Angle= 45.000  Angle/Node @1= 22.50 964
  Miters= 4  Ftg Thk= .375 in.
---
From  965  To  970 DY= -4.750 ft.  DZ= 4.750 ft.
RESTRAINTS
  Node  970  Guide  Gap= .250 in.
---
From  970  To  975 DY= -8.250 ft.  DZ= 8.250 ft.
BEND at "TO" end
  Radius= 63.000 in. (LONG)  Bend Angle= 45.000  Angle/Node @1= 22.50 974
  Angle/Node @2= .00 973  Miters= 4  Ftg Thk= .375 in.
RESTRAINTS
  Node  974  Y
  Node  974  X
---
From  975  To  980 DZ= 7.000 ft.
RESTRAINTS
  Node  980  Y
  Node  980  X
---
From  980  To  985 DZ= 5.000 ft.
---
From  985  To  990 DZ= 12.000 ft.
  Dia= 84.000 in.  Wall= .375 in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  990  Y
  Node  990  X
SIF's & TEE's
  Node  990  Unreinforced Tee
---
From  990  To  995 DZ= 20.000 ft.
RESTRAINTS
  Node  995  Y
  Node  995  X
---
From  995  To  998 DZ= 20.000 ft.
RESTRAINTS
  Node  998  Y
  Node  998  X
---
From  895  To  1000  DX= -4.000 ft.
  Dia= 42.000 in.  Wall= .375 in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  1000  Y
---
From  1000  To  1005  DX= -10.771 ft.
RESTRAINTS
  Node  1005  Y

---
From 1005 To 1010 DX= -4.229 ft.
SIF's & TEE's
Node 1010 Unreinforced Tee
---
From 1010 To 1015 DZ= -2.750 ft.
FORCES & MOMENTS
Node 1015 FY1= -330.00 lb.
---
From 1015 To 1020 DZ= -1.000 ft.
FORCES & MOMENTS
Node 1020 FY1= -445.00 lb.
---
From 1010 To 1025 DZ= 2.750 ft.
FORCES & MOMENTS
Node 1025 FY1= -330.00 lb.
---
From 1025 To 1030 DZ= 1.000 ft.
FORCES & MOMENTS
Node 1030 FY1= -330.00 lb.
---
From 1030 To 1035 DZ= 2.917 ft.
RESTRAINTS
Node 1035 Y
---
From 1035 To 1040 DZ= 11.583 ft.
RESTRAINTS
Node 1040 Y
---
From 1040 To 1045 DZ= 11.500 ft.
RESTRAINTS
Node 1045 Y
---
From 1045 To 1050 DZ= 2.083 ft.
---
From 1050 To 1055 DZ= 4.417 ft.
RIGID Weight= 955.00 lb.
---
From 1055 To 1060 DZ= 2.083 ft.
RESTRAINTS
Node 1060 Y
---
From 1060 To 1065 DZ= 11.000 ft.
---
From 1065 To 1070 DZ= .167 ft.
---
From 1070 To 1075 DZ= .833 ft.
RESTRAINTS
Node 1075 Y
---
From 1075 To 1080 DZ= 1.500 ft.
---
From 1080 To 1085 DZ= 1.000 ft.
RIGID Weight= 2,085.00 lb.
---
From 1085 To 1090 DZ= 4.125 ft.
BEND at "TO" end
Radius= 63.000 in. (LONG) Bend Angle= 45.000 Angle/Node @1= 22.50 1089

Miters= 4  Ftg Thk= .375 in.
---
From  1090  To  1095 DY= -4.750 ft.  DZ= 4.750 ft.
RESTRAINTS
Node  1095  Guide  Gap= .250 in.
---
From  1095  To  1100 DY= -8.250 ft.  DZ= 8.250 ft.
BEND at "TO" end
Radius= 63.000 in. (LONG)  Bend Angle= 45.000  Angle/Node @1= 22.50 1099
Angle/Node @2= .00 1098  Miters= 4  Ftg Thk= .375 in.
RESTRAINTS
Node  1099  Y
Node  1099  X
---
From  1100  To  1105 DZ= 5.000 ft.
BEND at "TO" end
Radius= 63.000 in. (LONG)  Bend Angle= 45.000  Angle/Node @1= 22.50 1104
Miters= 3  Ftg Thk= .375 in.
RESTRAINTS
Node  1104  Y
Node  1104  X
---
From  1105  To  1110  DX= 7.071 ft.  DZ= 7.071 ft.
RESTRAINTS
Node  1110  Y
---
From  1110  To  1115  DX= 3.536 ft.  DZ= 3.536 ft.
---
From  1115  To  990  DX= 8.393 ft.  DY= .000 ft.  DZ= 8.393 ft.
Dia= 84.000 in.  Wall= .375 in.
Insul Thk= .000 in.

# Summary of Support Loads

CASE 1 (SUS) W+P1+F1

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| 5 | | Rigid ANC | | | | | |
| | 1(SUS) | 367 | 250 | 7 | -20.0 | 35.9 | 1336.5 |
| | | | | | | | |
| | | | | | | | |
| 10 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -6020 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 45 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -9432 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 105 | | Rigid ANC | | | | | |
| | 1(SUS) | -56 | 133 | -1 | 455.5 | -41.3 | 1246.0 |
| | | | | | | | |
| | | | | | | | |
| 110 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -5570 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 145 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -11580 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 205 | | Rigid ANC | | | | | |
| | 1(SUS) | -85 | 115 | -6 | -272.4 | -84.2 | 1232.0 |
| | | | | | | | |
| | | | | | | | |
| 210 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -5500 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 245 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -11620 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 305 | | Rigid ANC | | | | | |
| | 1(SUS) | -36 | 149 | -7 | 88.1 | -90.6 | 1258.1 |
| | | | | | | | |
| | | | | | | | |
| 310 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -5630 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 345 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -11168 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 405 | | Rigid ANC | | | | | |
| | 1(SUS) | -12 | 307 | -5 | -119.0 | -76.1 | 1381.4 |
| | | | | | | | |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 410 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -6243 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 445 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -8742 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 455 | | Rigid +Y | | | | | |
| | 1(SUS) | 0 | -45685 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 505 | | Rigid ANC | | | | | |
| | 1(SUS) | -2 | 264 | -5 | 140.9 | -75.8 | 1347.3 |
| | | | | | | | |
| | | | | | | | |
| 510 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -6074 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 545 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -9116 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 605 | | Rigid ANC | | | | | |
| | 1(SUS) | 2 | 122 | -5 | 652.2 | -74.7 | 1237.7 |
| | | | | | | | |
| | | | | | | | |
| 610 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -5528 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 645 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -10244 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 705 | | Rigid ANC | | | | | |
| | 1(SUS) | -17 | 193 | -5 | -242.0 | -70.3 | 1292.7 |
| | | | | | | | |
| | | | | | | | |
| 710 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -5802 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 745 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -9735 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 760 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -55988 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 770 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -58436 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 780 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -42352 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 785 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -33721 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 805 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -26577 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 830 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 834 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -346 | -11314 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 840 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 179 | 19 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 850 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 854 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -12391 | 40 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 860 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -2302 | -13 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 865 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -74802 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 910 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -11289 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 915 | | Rigid Y | | | | | |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | 1(SUS) | 0 | -7210 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 920 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -8770 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 935 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -2973 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 950 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -21240 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 970 | | Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 974 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -208 | -11217 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 980 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 249 | -16549 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 990 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -93 | -75251 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 995 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 5 | -60677 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 998 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -0 | -22288 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1000 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -16419 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1005 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -11447 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1035 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -10479 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 1040 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7578 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1045 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -8715 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1060 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -2969 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1075 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -21285 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1095 | | Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1099 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 93 | -12288 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1104 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -39 | -1798 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1110 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -24604 | 0 | 0.0 | 0.0 | 0.0 |

```
 Piping Code: B31.3      = B31.3 -2010, March 31, 2011


 CODE STRESS CHECK PASSED      : LOADCASE 1 (SUS) W+P1+F1

Highest Stresses: (lb./sq.in.)
Ratio (%):                     84.4       @Node    990
Code Stress:                16878.2       Allowable Stress:      20000.0
Axial Stress:                9226.4       @Node    865
Bending Stress:             12765.2       @Node    790
Torsion Stress:                74.7       @Node    875
Hoop Stress:                18535.0       @Node    865
Max Stress Intensity:       19538.1       @Node    990
```

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 62.8 | -0.5 | 1.000 | 1.000 | 1644.6 | 20000.0 | 8.2 | B31.3 | |
| 10 | 253.3 | 0.5 | 1.000 | 1.000 | 1835.0 | 20000.0 | 9.2 | B31.3 | |
| | | | | | | | | | |
| 10 | 253.3 | -0.5 | 1.000 | 1.000 | 1835.0 | 20000.0 | 9.2 | B31.3 | |
| 15 | 44.8 | 0.5 | 1.000 | 1.000 | 1626.5 | 20000.0 | 8.1 | B31.3 | |
| | | | | | | | | | |
| 15 | 44.8 | -0.5 | 1.000 | 1.000 | 1626.5 | 20000.0 | 8.1 | B31.3 | |
| 20 | 71.6 | 0.5 | 1.000 | 1.000 | 1653.3 | 20000.0 | 8.3 | B31.3 | |
| | | | | | | | | | |
| 20 | 71.6 | -0.5 | 1.000 | 1.000 | 1653.3 | 20000.0 | 8.3 | B31.3 | |
| 25 | 420.8 | 0.5 | 1.000 | 1.000 | 2002.5 | 20000.0 | 10.0 | B31.3 | |
| | | | | | | | | | |
| 25 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 30 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 30 | 410.8 | -0.5 | 1.000 | 1.000 | 1992.5 | 20000.0 | 10.0 | B31.3 | |
| 35 | 215.5 | 0.5 | 1.000 | 1.000 | 1797.2 | 20000.0 | 9.0 | B31.3 | |
| | | | | | | | | | |
| 35 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 40 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 40 | 26.9 | -0.5 | 1.000 | 1.000 | 1608.6 | 20000.0 | 8.0 | B31.3 | |
| 45 | 477.7 | 0.5 | 1.000 | 1.000 | 2059.4 | 20000.0 | 10.3 | B31.3 | |
| | | | | | | | | | |
| 45 | 477.7 | -0.5 | 1.000 | 1.000 | 2059.4 | 20000.0 | 10.3 | B31.3 | |
| 50 | 30.3 | 0.5 | 1.000 | 1.000 | 1612.0 | 20000.0 | 8.1 | B31.3 | |
| | | | | | | | | | |
| 50 | 30.3 | -0.5 | 1.000 | 1.000 | 1612.0 | 20000.0 | 8.1 | B31.3 | |
| 55 | 889.0 | 0.5 | 15.887 | 20.849 | 2248.4 | 20000.0 | 11.2 | B31.3 | |
| | | | | | | | | | |
| 105 | 58.6 | 10.7 | 1.000 | 1.000 | 3237.1 | 20000.0 | 16.2 | B31.3 | |
| 110 | 228.0 | -10.7 | 1.000 | 1.000 | 3406.5 | 20000.0 | 17.0 | B31.3 | |
| | | | | | | | | | |
| 110 | 228.0 | 10.7 | 1.000 | 1.000 | 3406.5 | 20000.0 | 17.0 | B31.3 | |
| 115 | 43.9 | -10.7 | 1.000 | 1.000 | 3222.4 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 115 | 43.9 | 10.7 | 1.000 | 1.000 | 3222.4 | 20000.0 | 16.1 | B31.3 | |
| 120 | 68.1 | -10.7 | 1.000 | 1.000 | 3246.5 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 120 | 68.1 | 10.7 | 1.000 | 1.000 | 3246.5 | 20000.0 | 16.2 | B31.3 | |
| 125 | 376.1 | -10.7 | 1.000 | 1.000 | 3554.5 | 20000.0 | 17.8 | B31.3 | |
| | | | | | | | | | |
| 125 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 130 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 130 | 328.2 | 10.7 | 1.000 | 1.000 | 3506.6 | 20000.0 | 17.5 | B31.3 | |
| 135 | 109.3 | -10.7 | 1.000 | 1.000 | 3287.8 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 135 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 140 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 140 | 95.1 | 10.7 | 1.000 | 1.000 | 3273.6 | 20000.0 | 16.4 | B31.3 | |
| 145 | 630.9 | -10.7 | 1.000 | 1.000 | 3809.3 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 145 | 630.9 | 10.7 | 1.000 | 1.000 | 3809.3 | 20000.0 | 19.0 | B31.3 | |
| 150 | 90.5 | -10.7 | 1.000 | 1.000 | 3268.9 | 20000.0 | 16.3 | B31.3 | |
| | | | | | | | | | |
| 150 | 45.2 | 5.4 | 1.000 | 1.000 | 3222.8 | 20000.0 | 16.1 | B31.3 | |
| 155 | 3.5 | -5.4 | 1.000 | 1.000 | 3181.1 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 150 | 45.2 | 5.4 | 1.000 | 1.000 | 3222.8 | 20000.0 | 16.1 | B31.3 | |
| 155 | 3.5 | -5.4 | 1.000 | 1.000 | 3181.1 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 205 | 58.0 | -6.4 | 1.000 | 1.000 | 3237.3 | 20000.0 | 16.2 | B31.3 | |
| 210 | 224.1 | 6.4 | 1.000 | 1.000 | 3403.4 | 20000.0 | 17.0 | B31.3 | |
| | | | | | | | | | |
| 210 | 224.1 | -6.4 | 1.000 | 1.000 | 3403.4 | 20000.0 | 17.0 | B31.3 | |
| 215 | 43.8 | 6.4 | 1.000 | 1.000 | 3223.0 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 215 | 43.8 | -6.4 | 1.000 | 1.000 | 3223.0 | 20000.0 | 16.1 | B31.3 | |
| 220 | 67.5 | 6.4 | 1.000 | 1.000 | 3246.8 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |
| 220 | 67.5 | -6.4 | 1.000 | 1.000 | 3246.8 | 20000.0 | 16.2 | B31.3 | |
| 225 | 369.2 | 6.4 | 1.000 | 1.000 | 3548.4 | 20000.0 | 17.7 | B31.3 | |
| | | | | | | | | | |
| 225 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 230 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 230 | 315.3 | -6.4 | 1.000 | 1.000 | 3494.6 | 20000.0 | 17.5 | B31.3 | |
| 235 | 92.9 | 6.4 | 1.000 | 1.000 | 3272.1 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 235 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 240 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 240 | 114.0 | -6.4 | 1.000 | 1.000 | 3293.2 | 20000.0 | 16.5 | B31.3 | |
| 245 | 654.7 | 6.4 | 1.000 | 1.000 | 3833.9 | 20000.0 | 19.2 | B31.3 | |
| | | | | | | | | | |
| 245 | 654.7 | -6.4 | 1.000 | 1.000 | 3833.9 | 20000.0 | 19.2 | B31.3 | |
| 250 | 65.0 | 6.4 | 1.000 | 1.000 | 3244.2 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |
| 250 | 32.5 | -3.2 | 1.000 | 1.000 | 3210.5 | 20000.0 | 16.1 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 255 | 12.2 | 3.2 | 1.000 | 1.000 | 3190.2 | 20000.0 | 16.0 | B31.3 | |
| | | | | | | | | | |
| 250 | 32.5 | -3.2 | 1.000 | 1.000 | 3210.5 | 20000.0 | 16.1 | B31.3 | |
| 255 | 12.2 | 3.2 | 1.000 | 1.000 | 3190.2 | 20000.0 | 16.0 | B31.3 | |
| | | | | | | | | | |
| 305 | 59.3 | 2.1 | 1.000 | 1.000 | 3237.1 | 20000.0 | 16.2 | B31.3 | |
| 310 | 231.4 | -2.1 | 1.000 | 1.000 | 3409.2 | 20000.0 | 17.0 | B31.3 | |
| | | | | | | | | | |
| 310 | 231.4 | 2.1 | 1.000 | 1.000 | 3409.2 | 20000.0 | 17.0 | B31.3 | |
| 315 | 44.1 | -2.1 | 1.000 | 1.000 | 3221.9 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 315 | 44.1 | 2.1 | 1.000 | 1.000 | 3221.9 | 20000.0 | 16.1 | B31.3 | |
| 320 | 68.5 | -2.1 | 1.000 | 1.000 | 3246.3 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |
| 320 | 68.5 | 2.1 | 1.000 | 1.000 | 3246.3 | 20000.0 | 16.2 | B31.3 | |
| 325 | 382.1 | -2.1 | 1.000 | 1.000 | 3559.9 | 20000.0 | 17.8 | B31.3 | |
| | | | | | | | | | |
| 325 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 330 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 330 | 339.2 | 2.1 | 1.000 | 1.000 | 3517.0 | 20000.0 | 17.6 | B31.3 | |
| 335 | 123.5 | -2.1 | 1.000 | 1.000 | 3301.3 | 20000.0 | 16.5 | B31.3 | |
| | | | | | | | | | |
| 335 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 340 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 340 | 78.8 | 2.1 | 1.000 | 1.000 | 3256.6 | 20000.0 | 16.3 | B31.3 | |
| 345 | 610.4 | -2.1 | 1.000 | 1.000 | 3788.2 | 20000.0 | 18.9 | B31.3 | |
| | | | | | | | | | |
| 345 | 610.4 | 2.1 | 1.000 | 1.000 | 3788.2 | 20000.0 | 18.9 | B31.3 | |
| 350 | 55.6 | -2.1 | 1.000 | 1.000 | 3233.4 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |
| 350 | 27.8 | 1.0 | 1.000 | 1.000 | 3205.1 | 20000.0 | 16.0 | B31.3 | |
| 355 | 101.8 | -1.0 | 1.000 | 1.000 | 3279.0 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 350 | 27.8 | 1.0 | 1.000 | 1.000 | 3205.1 | 20000.0 | 16.0 | B31.3 | |
| 355 | 101.8 | -1.0 | 1.000 | 1.000 | 3279.0 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 405 | 65.0 | -2.8 | 1.000 | 1.000 | 3242.1 | 20000.0 | 16.2 | B31.3 | |
| 410 | 265.8 | 2.8 | 1.000 | 1.000 | 3442.9 | 20000.0 | 17.2 | B31.3 | |
| | | | | | | | | | |
| 410 | 265.8 | -2.8 | 1.000 | 1.000 | 3442.9 | 20000.0 | 17.2 | B31.3 | |
| 415 | 45.3 | 2.8 | 1.000 | 1.000 | 3222.4 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 415 | 45.3 | -2.8 | 1.000 | 1.000 | 3222.4 | 20000.0 | 16.1 | B31.3 | |
| 420 | 73.3 | 2.8 | 1.000 | 1.000 | 3250.4 | 20000.0 | 16.3 | B31.3 | |
| | | | | | | | | | |
| 420 | 73.3 | -2.8 | 1.000 | 1.000 | 3250.4 | 20000.0 | 16.3 | B31.3 | |
| 425 | 443.0 | 2.8 | 1.000 | 1.000 | 3620.1 | 20000.0 | 18.1 | B31.3 | |
| | | | | | | | | | |
| 425 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 430 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 430 | 451.8 | -2.8 | 1.000 | 1.000 | 3628.9 | 20000.0 | 18.1 | B31.3 | |
| 435 | 268.1 | 2.8 | 1.000 | 1.000 | 3445.2 | 20000.0 | 17.2 | B31.3 | |
| | | | | | | | | | |
| 435 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 440 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 440 | 87.2 | -2.8 | 1.000 | 1.000 | 3264.3 | 20000.0 | 16.3 | B31.3 | |
| 445 | 401.7 | 2.8 | 1.000 | 1.000 | 3578.8 | 20000.0 | 17.9 | B31.3 | |
| | | | | | | | | | |
| 445 | 401.7 | -2.8 | 1.000 | 1.000 | 3578.8 | 20000.0 | 17.9 | B31.3 | |
| 450 | 32.9 | 2.8 | 1.000 | 1.000 | 3210.1 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 450 | 32.9 | -2.8 | 1.000 | 1.000 | 3210.1 | 20000.0 | 16.1 | B31.3 | |
| 455 | 4336.8 | 2.8 | 15.887 | 20.849 | 6429.7 | 20000.0 | 32.1 | B31.3 | |
| | | | | | | | | | |
| 505 | 63.4 | 3.3 | 1.000 | 1.000 | 3240.3 | 20000.0 | 16.2 | B31.3 | |
| 510 | 256.3 | -3.3 | 1.000 | 1.000 | 3433.1 | 20000.0 | 17.2 | B31.3 | |
| | | | | | | | | | |
| 510 | 256.3 | 3.3 | 1.000 | 1.000 | 3433.1 | 20000.0 | 17.2 | B31.3 | |
| 515 | 44.9 | -3.3 | 1.000 | 1.000 | 3221.8 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 515 | 44.9 | 3.3 | 1.000 | 1.000 | 3221.8 | 20000.0 | 16.1 | B31.3 | |
| 520 | 72.0 | -3.3 | 1.000 | 1.000 | 3248.8 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |
| 520 | 72.0 | 3.3 | 1.000 | 1.000 | 3248.8 | 20000.0 | 16.2 | B31.3 | |
| 525 | 426.1 | -3.3 | 1.000 | 1.000 | 3603.0 | 20000.0 | 18.0 | B31.3 | |
| | | | | | | | | | |
| 525 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 530 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 530 | 420.6 | 3.3 | 1.000 | 1.000 | 3597.5 | 20000.0 | 18.0 | B31.3 | |
| 535 | 228.2 | -3.3 | 1.000 | 1.000 | 3405.0 | 20000.0 | 17.0 | B31.3 | |
| | | | | | | | | | |
| 535 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 540 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 540 | 41.3 | 3.3 | 1.000 | 1.000 | 3218.1 | 20000.0 | 16.1 | B31.3 | |
| 545 | 459.4 | -3.3 | 1.000 | 1.000 | 3636.2 | 20000.0 | 18.2 | B31.3 | |
| | | | | | | | | | |
| 545 | 459.4 | 3.3 | 1.000 | 1.000 | 3636.2 | 20000.0 | 18.2 | B31.3 | |
| 550 | 53.2 | -3.3 | 1.000 | 1.000 | 3230.1 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |
| 550 | 53.2 | 3.3 | 1.000 | 1.000 | 3230.1 | 20000.0 | 16.2 | B31.3 | |
| 555 | 2315.7 | -3.3 | 15.887 | 20.849 | 4913.6 | 20000.0 | 24.6 | B31.3 | |
| | | | | | | | | | |
| 605 | 58.3 | 15.3 | 1.000 | 1.000 | 3235.1 | 20000.0 | 16.2 | B31.3 | |
| 610 | 225.7 | -15.3 | 1.000 | 1.000 | 3402.6 | 20000.0 | 17.0 | B31.3 | |
| | | | | | | | | | |
| 610 | 225.7 | 15.3 | 1.000 | 1.000 | 3402.6 | 20000.0 | 17.0 | B31.3 | |
| 615 | 43.8 | -15.3 | 1.000 | 1.000 | 3220.7 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 615 | 43.8 | 15.3 | 1.000 | 1.000 | 3220.7 | 20000.0 | 16.1 | B31.3 | |
| 620 | 67.7 | -15.3 | 1.000 | 1.000 | 3244.6 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |
| 620 | 67.7 | 15.3 | 1.000 | 1.000 | 3244.6 | 20000.0 | 16.2 | B31.3 | |
| 625 | 372.0 | -15.3 | 1.000 | 1.000 | 3548.8 | 20000.0 | 17.7 | B31.3 | |
| | | | | | | | | | |
| 625 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 630 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 630 | 320.5 | 15.3 | 1.000 | 1.000 | 3497.4 | 20000.0 | 17.5 | B31.3 | |
| 635 | 99.5 | -15.3 | 1.000 | 1.000 | 3276.4 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 635 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 640 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 640 | 106.4 | 15.3 | 1.000 | 1.000 | 3283.2 | 20000.0 | 16.4 | B31.3 | |
| 645 | 645.1 | -15.3 | 1.000 | 1.000 | 3821.9 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 645 | 645.1 | 15.3 | 1.000 | 1.000 | 3821.9 | 20000.0 | 19.1 | B31.3 | |
| 650 | 129.8 | -15.3 | 1.000 | 1.000 | 3306.7 | 20000.0 | 16.5 | B31.3 | |
| | | | | | | | | | |
| 650 | 129.8 | 15.3 | 1.000 | 1.000 | 3306.7 | 20000.0 | 16.5 | B31.3 | |
| 655 | 3230.0 | -15.1 | 15.887 | 20.849 | 5599.3 | 20000.0 | 28.0 | B31.3 | |
| | | | | | | | | | |
| 705 | 60.9 | -5.7 | 1.000 | 1.000 | 3238.1 | 20000.0 | 16.2 | B31.3 | |
| 710 | 241.1 | 5.7 | 1.000 | 1.000 | 3418.3 | 20000.0 | 17.1 | B31.3 | |
| | | | | | | | | | |
| 710 | 241.1 | -5.7 | 1.000 | 1.000 | 3418.3 | 20000.0 | 17.1 | B31.3 | |
| 715 | 44.4 | 5.7 | 1.000 | 1.000 | 3221.7 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 715 | 44.4 | -5.7 | 1.000 | 1.000 | 3221.7 | 20000.0 | 16.1 | B31.3 | |
| 720 | 69.9 | 5.7 | 1.000 | 1.000 | 3247.2 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |
| 720 | 69.9 | -5.7 | 1.000 | 1.000 | 3247.2 | 20000.0 | 16.2 | B31.3 | |
| 725 | 399.2 | 5.7 | 1.000 | 1.000 | 3576.4 | 20000.0 | 17.9 | B31.3 | |
| | | | | | | | | | |
| 725 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 730 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 730 | 370.8 | -5.7 | 1.000 | 1.000 | 3548.1 | 20000.0 | 17.7 | B31.3 | |
| 735 | 164.1 | 5.7 | 1.000 | 1.000 | 3341.4 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 735 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 740 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 740 | 32.2 | -5.7 | 1.000 | 1.000 | 3209.5 | 20000.0 | 16.0 | B31.3 | |
| 745 | 551.8 | 5.7 | 1.000 | 1.000 | 3729.1 | 20000.0 | 18.6 | B31.3 | |
| | | | | | | | | | |
| 745 | 551.8 | -5.7 | 1.000 | 1.000 | 3729.1 | 20000.0 | 18.6 | B31.3 | |
| 750 | 82.7 | 5.7 | 1.000 | 1.000 | 3260.0 | 20000.0 | 16.3 | B31.3 | |
| | | | | | | | | | |
| 750 | 82.7 | -5.7 | 1.000 | 1.000 | 3260.0 | 20000.0 | 16.3 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 755 | 1195.4 | 5.6 | 16.011 | 21.015 | 4073.8 | 20000.0 | 20.4 | B31.3 | |
| | | | | | | | | | |
| 755 | 8552.3 | 14.8 | 16.011 | 21.015 | 15530.8 | 20000.0 | 77.7 | B31.3 | |
| 655 | 4706.1 | -14.8 | 15.887 | 20.849 | 12646.1 | 20000.0 | 63.2 | B31.3 | |
| | | | | | | | | | |
| 655 | 4785.7 | 5.1 | 15.887 | 20.849 | 12705.8 | 20000.0 | 63.5 | B31.3 | |
| 760 | 586.6 | -5.1 | 1.000 | 1.000 | 9703.2 | 20000.0 | 48.5 | B31.3 | |
| | | | | | | | | | |
| 760 | 586.6 | 5.1 | 1.000 | 1.000 | 9703.2 | 20000.0 | 48.5 | B31.3 | |
| 555 | 2871.8 | -5.1 | 15.887 | 20.849 | 11270.4 | 20000.0 | 56.4 | B31.3 | |
| | | | | | | | | | |
| 555 | 2854.6 | 12.1 | 15.887 | 20.849 | 11257.5 | 20000.0 | 56.3 | B31.3 | |
| 455 | 7395.0 | -12.1 | 15.887 | 20.849 | 14662.8 | 20000.0 | 73.3 | B31.3 | |
| | | | | | | | | | |
| 455 | 7409.5 | 25.2 | 15.887 | 20.849 | 14673.8 | 20000.0 | 73.4 | B31.3 | |
| 765 | 4133.9 | -25.2 | 15.887 | 20.849 | 12217.2 | 20000.0 | 61.1 | B31.3 | |
| | | | | | | | | | |
| 765 | 4101.6 | -45.4 | 15.887 | 20.849 | 12192.9 | 20000.0 | 61.0 | B31.3 | |
| 355 | 154.5 | 45.4 | 1.000 | 1.000 | 9271.3 | 20000.0 | 46.4 | B31.3 | |
| | | | | | | | | | |
| 355 | 155.0 | -32.7 | 1.000 | 1.000 | 9271.6 | 20000.0 | 46.4 | B31.3 | |
| 770 | 482.1 | 32.7 | 1.000 | 1.000 | 9598.8 | 20000.0 | 48.0 | B31.3 | |
| | | | | | | | | | |
| 770 | 482.1 | -32.7 | 1.000 | 1.000 | 9598.8 | 20000.0 | 48.0 | B31.3 | |
| 775 | 25.9 | 32.7 | 1.000 | 1.000 | 9142.5 | 20000.0 | 45.7 | B31.3 | |
| | | | | | | | | | |
| 775 | 25.9 | -32.7 | 1.000 | 1.000 | 9142.5 | 20000.0 | 45.7 | B31.3 | |
| 255 | 167.8 | 32.7 | 1.000 | 1.000 | 9284.5 | 20000.0 | 46.4 | B31.3 | |
| | | | | | | | | | |
| 255 | 166.2 | -31.2 | 1.000 | 1.000 | 9282.9 | 20000.0 | 46.4 | B31.3 | |
| 155 | 70.8 | 31.2 | 1.000 | 1.000 | 9187.5 | 20000.0 | 45.9 | B31.3 | |
| | | | | | | | | | |
| 155 | 73.4 | -31.7 | 1.000 | 1.000 | 9190.1 | 20000.0 | 46.0 | B31.3 | |
| 780 | 347.1 | 31.7 | 1.000 | 1.000 | 9463.8 | 20000.0 | 47.3 | B31.3 | |
| | | | | | | | | | |
| 780 | 347.1 | -31.7 | 1.000 | 1.000 | 9463.8 | 20000.0 | 47.3 | B31.3 | |
| 55 | 3176.0 | 31.7 | 15.887 | 20.849 | 11498.7 | 20000.0 | 57.5 | B31.3 | |
| | | | | | | | | | |
| 55 | 3180.2 | -34.3 | 15.887 | 20.849 | 11501.8 | 20000.0 | 57.5 | B31.3 | |
| 785 | 267.0 | 34.3 | 1.000 | 1.000 | 9383.7 | 20000.0 | 46.9 | B31.3 | |
| | | | | | | | | | |
| 785 | 267.0 | -34.3 | 1.000 | 1.000 | 9383.7 | 20000.0 | 46.9 | B31.3 | |
| 790 | 4595.6 | 34.3 | 15.887 | 20.849 | 12563.3 | 20000.0 | 62.8 | B31.3 | |
| | | | | | | | | | |
| 790 | 12765.2 | 0.0 | 15.887 | 20.849 | 12750.7 | 20000.0 | 63.8 | B31.3 | |
| 795 | 0.0 | 0.0 | 1.000 | 1.000 | 3176.8 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 790 | 4595.6 | 4.3 | 15.887 | 20.849 | 12563.2 | 20000.0 | 62.8 | B31.3 | |
| 800 | 15.8 | -4.3 | 1.000 | 1.000 | 9132.3 | 20000.0 | 45.7 | B31.3 | |
| | | | | | | | | | |
| 800 | 49.0 | 13.2 | 1.000 | 1.000 | 5205.6 | 20000.0 | 26.0 | B31.3 | |
| 805 | 620.0 | -13.2 | 1.000 | 1.000 | 5776.6 | 20000.0 | 28.9 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 805 | 620.0 | 13.2 | 1.000 | 1.000 | 5776.6 | 20000.0 | 28.9 | B31.3 | |
| 810 | 372.5 | -13.2 | 1.000 | 1.000 | 5529.1 | 20000.0 | 27.6 | B31.3 | |
| | | | | | | | | | |
| 810 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 815 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 815 | 218.6 | 13.2 | 1.000 | 1.000 | 5375.3 | 20000.0 | 26.9 | B31.3 | |
| 820 | 44.6 | -17.3 | 1.000 | 1.000 | 4541.3 | 20000.0 | 22.7 | B31.3 | |
| | | | | | | | | | |
| 820 | 44.6 | 17.3 | 1.000 | 1.000 | 4541.3 | 20000.0 | 22.7 | B31.3 | |
| 824 | 316.0 | -12.4 | 3.356 | 3.356 | 4731.0 | 20000.0 | 23.7 | B31.3 | |
| | | | | | | | | | |
| 824 | 316.0 | 12.4 | 3.356 | 3.356 | 4731.0 | 20000.0 | 23.7 | B31.3 | |
| 825 | 163.9 | -6.4 | 3.356 | 3.356 | 4551.3 | 20000.0 | 22.8 | B31.3 | |
| | | | | | | | | | |
| 825 | 48.8 | 6.4 | 1.000 | 1.000 | 4477.2 | 20000.0 | 22.4 | B31.3 | |
| 830 | 48.2 | -6.4 | 1.000 | 1.000 | 4467.0 | 20000.0 | 22.3 | B31.3 | |
| | | | | | | | | | |
| 830 | 48.2 | 6.4 | 1.000 | 1.000 | 4467.0 | 20000.0 | 22.3 | B31.3 | |
| 833 | 47.6 | -6.4 | 1.000 | 1.000 | 4454.7 | 20000.0 | 22.3 | B31.3 | |
| | | | | | | | | | |
| 833 | 159.8 | 6.4 | 3.356 | 3.356 | 4526.9 | 20000.0 | 22.6 | B31.3 | |
| 834 | 638.7 | -4.4 | 3.356 | 3.356 | 4866.7 | 20000.0 | 24.3 | B31.3 | |
| | | | | | | | | | |
| 834 | 638.7 | 4.4 | 3.356 | 3.356 | 5029.8 | 20000.0 | 25.1 | B31.3 | |
| 835 | 21.2 | 0.0 | 3.356 | 3.356 | 4512.5 | 20000.0 | 22.6 | B31.3 | |
| | | | | | | | | | |
| 835 | 6.3 | 0.0 | 1.000 | 1.000 | 4502.9 | 20000.0 | 22.5 | B31.3 | |
| 840 | 0.0 | 0.0 | 1.000 | 1.000 | 4496.6 | 20000.0 | 22.5 | B31.3 | |
| | | | | | | | | | |
| 765 | 11826.2 | 3.1 | 15.887 | 20.849 | 13366.3 | 20000.0 | 66.8 | B31.3 | |
| 843 | 9.0 | -3.1 | 1.000 | 1.000 | 4505.6 | 20000.0 | 22.5 | B31.3 | |
| | | | | | | | | | |
| 843 | 30.1 | 3.1 | 3.356 | 3.356 | 4519.2 | 20000.0 | 22.6 | B31.3 | |
| 844 | 371.0 | -2.0 | 3.356 | 3.356 | 4767.4 | 20000.0 | 23.8 | B31.3 | |
| | | | | | | | | | |
| 844 | 371.0 | 2.0 | 3.356 | 3.356 | 4767.4 | 20000.0 | 23.8 | B31.3 | |
| 845 | 176.4 | -0.8 | 3.356 | 3.356 | 4553.9 | 20000.0 | 22.8 | B31.3 | |
| | | | | | | | | | |
| 845 | 52.6 | 0.8 | 1.000 | 1.000 | 4474.2 | 20000.0 | 22.4 | B31.3 | |
| 850 | 52.5 | -0.8 | 1.000 | 1.000 | 4464.6 | 20000.0 | 22.3 | B31.3 | |
| | | | | | | | | | |
| 850 | 52.5 | 0.8 | 1.000 | 1.000 | 4464.6 | 20000.0 | 22.3 | B31.3 | |
| 853 | 52.5 | -0.8 | 1.000 | 1.000 | 4452.9 | 20000.0 | 22.3 | B31.3 | |
| | | | | | | | | | |
| 853 | 175.4 | 0.8 | 3.341 | 2.784 | 4531.9 | 20000.0 | 22.7 | B31.3 | |
| 854 | 654.6 | -0.7 | 3.341 | 2.784 | 4873.9 | 20000.0 | 24.4 | B31.3 | |
| | | | | | | | | | |
| 854 | 654.6 | 0.7 | 3.341 | 2.784 | 5052.5 | 20000.0 | 25.3 | B31.3 | |
| 855 | 180.7 | -0.0 | 3.341 | 2.784 | 4632.1 | 20000.0 | 23.2 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 855 | 54.1 | 0.0 | 1.000 | 1.000 | 4550.7 | 20000.0 | 22.8 | B31.3 | |
| 860 | 0.0 | -0.0 | 1.000 | 1.000 | 4496.6 | 20000.0 | 22.5 | B31.3 | |
| | | | | | | | | | |
| 755 | 8321.9 | 18.0 | 16.011 | 21.015 | 15467.9 | 20000.0 | 77.3 | B31.3 | |
| 865 | 1120.1 | -18.0 | 1.000 | 1.000 | 10346.6 | 20000.0 | 51.7 | B31.3 | |
| | | | | | | | | | |
| 865 | 1120.1 | 18.0 | 1.000 | 1.000 | 10346.6 | 20000.0 | 51.7 | B31.3 | |
| 870 | 49.6 | -18.0 | 1.000 | 1.000 | 9276.1 | 20000.0 | 46.4 | B31.3 | |
| | | | | | | | | | |
| 870 | 49.6 | 18.0 | 1.000 | 1.000 | 9276.1 | 20000.0 | 46.4 | B31.3 | |
| 875 | 578.5 | -74.7 | 1.000 | 1.000 | 5077.3 | 20000.0 | 25.4 | B31.3 | |
| | | | | | | | | | |
| 875 | 578.5 | 74.7 | 1.000 | 1.000 | 5077.3 | 20000.0 | 25.4 | B31.3 | |
| 880 | 8628.3 | -74.7 | 13.095 | 13.095 | 10968.9 | 20000.0 | 54.8 | B31.3 | |
| | | | | | | | | | |
| 880 | 8628.3 | 74.7 | 13.095 | 13.095 | 10968.9 | 20000.0 | 54.8 | B31.3 | |
| 885 | 349.0 | -74.7 | 1.000 | 1.000 | 4847.9 | 20000.0 | 24.2 | B31.3 | |
| | | | | | | | | | |
| 885 | 349.0 | 74.7 | 1.000 | 1.000 | 4847.9 | 20000.0 | 24.2 | B31.3 | |
| 890 | 223.6 | -74.7 | 1.000 | 1.000 | 4722.6 | 20000.0 | 23.6 | B31.3 | |
| | | | | | | | | | |
| 890 | 223.6 | 74.7 | 1.000 | 1.000 | 4722.6 | 20000.0 | 23.6 | B31.3 | |
| 895 | 3099.0 | -74.7 | 10.071 | 13.095 | 6822.5 | 20000.0 | 34.1 | B31.3 | |
| | | | | | | | | | |
| 895 | 2784.4 | -28.9 | 10.071 | 13.095 | 6584.4 | 20000.0 | 32.9 | B31.3 | |
| 900 | 247.7 | 28.9 | 1.000 | 1.000 | 4744.0 | 20000.0 | 23.7 | B31.3 | |
| | | | | | | | | | |
| 900 | 247.7 | -28.9 | 1.000 | 1.000 | 4744.0 | 20000.0 | 23.7 | B31.3 | |
| 905 | 302.4 | 28.9 | 1.000 | 1.000 | 4798.7 | 20000.0 | 24.0 | B31.3 | |
| | | | | | | | | | |
| 905 | 302.4 | -28.9 | 1.000 | 1.000 | 4798.7 | 20000.0 | 24.0 | B31.3 | |
| 910 | 588.8 | 28.9 | 1.000 | 1.000 | 5085.1 | 20000.0 | 25.4 | B31.3 | |
| | | | | | | | | | |
| 910 | 588.8 | -28.9 | 1.000 | 1.000 | 5085.1 | 20000.0 | 25.4 | B31.3 | |
| 915 | 152.8 | 28.9 | 1.000 | 1.000 | 4649.1 | 20000.0 | 23.2 | B31.3 | |
| | | | | | | | | | |
| 915 | 152.8 | -28.9 | 1.000 | 1.000 | 4649.1 | 20000.0 | 23.2 | B31.3 | |
| 920 | 169.1 | 28.9 | 1.000 | 1.000 | 4665.4 | 20000.0 | 23.3 | B31.3 | |
| | | | | | | | | | |
| 920 | 169.1 | -28.9 | 1.000 | 1.000 | 4665.4 | 20000.0 | 23.3 | B31.3 | |
| 925 | 8.2 | 28.9 | 1.000 | 1.000 | 4504.4 | 20000.0 | 22.5 | B31.3 | |
| | | | | | | | | | |
| 925 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 930 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 930 | 98.1 | -28.9 | 1.000 | 1.000 | 4594.4 | 20000.0 | 23.0 | B31.3 | |
| 935 | 15.8 | 28.9 | 1.000 | 1.000 | 4512.0 | 20000.0 | 22.6 | B31.3 | |
| | | | | | | | | | |
| 935 | 15.8 | -28.9 | 1.000 | 1.000 | 4512.0 | 20000.0 | 22.6 | B31.3 | |
| 940 | 966.4 | 28.9 | 1.000 | 1.000 | 5462.6 | 20000.0 | 27.3 | B31.3 | |
| | | | | | | | | | |
| 940 | 966.4 | -28.9 | 1.000 | 1.000 | 5462.6 | 20000.0 | 27.3 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 945 | 998.2 | 28.9 | 1.000 | 1.000 | 5494.4 | 20000.0 | 27.5 | B31.3 | |
| | | | | | | | | | |
| 945 | 998.2 | -28.9 | 1.000 | 1.000 | 5494.4 | 20000.0 | 27.5 | B31.3 | |
| 950 | 1164.7 | 28.9 | 1.000 | 1.000 | 5660.9 | 20000.0 | 28.3 | B31.3 | |
| | | | | | | | | | |
| 950 | 1164.7 | -28.9 | 1.000 | 1.000 | 5660.9 | 20000.0 | 28.3 | B31.3 | |
| 955 | 740.4 | 28.9 | 1.000 | 1.000 | 5236.7 | 20000.0 | 26.2 | B31.3 | |
| | | | | | | | | | |
| 955 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 960 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 960 | 503.1 | -28.9 | 1.000 | 1.000 | 4999.4 | 20000.0 | 25.0 | B31.3 | |
| 964 | 562.0 | 29.0 | 3.341 | 3.341 | 4961.3 | 20000.0 | 24.8 | B31.3 | |
| | | | | | | | | | |
| 964 | 562.0 | -29.0 | 3.341 | 3.341 | 4961.3 | 20000.0 | 24.8 | B31.3 | |
| 965 | 1220.4 | 24.6 | 3.341 | 3.341 | 5469.3 | 20000.0 | 27.3 | B31.3 | |
| | | | | | | | | | |
| 965 | 365.2 | -24.6 | 1.000 | 1.000 | 4919.3 | 20000.0 | 24.6 | B31.3 | |
| 970 | 539.5 | 24.6 | 1.000 | 1.000 | 5043.3 | 20000.0 | 25.2 | B31.3 | |
| | | | | | | | | | |
| 970 | 539.5 | -24.6 | 1.000 | 1.000 | 5043.3 | 20000.0 | 25.2 | B31.3 | |
| 973 | 55.0 | 24.6 | 1.000 | 1.000 | 4453.8 | 20000.0 | 22.3 | B31.3 | |
| | | | | | | | | | |
| 973 | 183.8 | -24.6 | 3.341 | 3.341 | 4536.6 | 20000.0 | 22.7 | B31.3 | |
| 974 | 867.7 | 28.4 | 3.341 | 3.341 | 5081.9 | 20000.0 | 25.4 | B31.3 | |
| | | | | | | | | | |
| 974 | 867.7 | -28.4 | 3.341 | 3.341 | 5169.4 | 20000.0 | 25.8 | B31.3 | |
| 975 | 537.5 | 28.7 | 3.341 | 3.341 | 4899.4 | 20000.0 | 24.5 | B31.3 | |
| | | | | | | | | | |
| 975 | 160.9 | -28.7 | 1.000 | 1.000 | 4657.1 | 20000.0 | 23.3 | B31.3 | |
| 980 | 226.5 | 28.7 | 1.000 | 1.000 | 4722.7 | 20000.0 | 23.6 | B31.3 | |
| | | | | | | | | | |
| 980 | 226.5 | -28.7 | 1.000 | 1.000 | 4722.7 | 20000.0 | 23.6 | B31.3 | |
| 985 | 262.5 | 7.1 | 1.000 | 1.000 | 9378.6 | 20000.0 | 46.9 | B31.3 | |
| | | | | | | | | | |
| 985 | 262.5 | -7.1 | 1.000 | 1.000 | 9378.6 | 20000.0 | 46.9 | B31.3 | |
| 990 | 10063.1 | 7.1 | 15.887 | 20.849 | 16663.4 | 20000.0 | 83.3 | B31.3 | |
| | | | | | | | | | |
| 990 | 10349.1 | 0.0 | 15.887 | 20.849 | 16878.2 | 20000.0 | 84.4 | B31.3 | |
| 995 | 595.2 | -0.0 | 1.000 | 1.000 | 9711.7 | 20000.0 | 48.6 | B31.3 | |
| | | | | | | | | | |
| 995 | 595.2 | 0.0 | 1.000 | 1.000 | 9711.7 | 20000.0 | 48.6 | B31.3 | |
| 998 | 0.0 | 0.0 | 1.000 | 1.000 | 9116.4 | 20000.0 | 45.6 | B31.3 | |
| | | | | | | | | | |
| 895 | 2714.0 | 12.0 | 10.071 | 13.095 | 6532.5 | 20000.0 | 32.7 | B31.3 | |
| 1000 | 757.1 | -12.0 | 1.000 | 1.000 | 5254.1 | 20000.0 | 26.3 | B31.3 | |
| | | | | | | | | | |
| 1000 | 757.1 | 12.0 | 1.000 | 1.000 | 5254.1 | 20000.0 | 26.3 | B31.3 | |
| 1005 | 606.4 | -12.0 | 1.000 | 1.000 | 5103.4 | 20000.0 | 25.5 | B31.3 | |
| | | | | | | | | | |
| 1005 | 606.4 | 12.0 | 1.000 | 1.000 | 5103.4 | 20000.0 | 25.5 | B31.3 | |
| 1010 | 341.6 | -12.0 | 10.071 | 13.095 | 4753.2 | 20000.0 | 23.8 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 1010 | 2476.6 | -0.0 | 10.071 | 13.095 | 6354.1 | 20000.0 | 31.8 | B31.3 | |
| 1015 | 19.7 | 0.0 | 1.000 | 1.000 | 4516.3 | 20000.0 | 22.6 | B31.3 | |
| | | | | | | | | | |
| 1015 | 19.7 | 0.0 | 1.000 | 1.000 | 4516.3 | 20000.0 | 22.6 | B31.3 | |
| 1020 | 0.0 | 0.0 | 1.000 | 1.000 | 4496.6 | 20000.0 | 22.5 | B31.3 | |
| | | | | | | | | | |
| 1010 | 2794.4 | 12.0 | 10.071 | 13.095 | 6593.2 | 20000.0 | 33.0 | B31.3 | |
| 1025 | 216.6 | -12.0 | 1.000 | 1.000 | 4714.0 | 20000.0 | 23.6 | B31.3 | |
| | | | | | | | | | |
| 1025 | 216.6 | 12.0 | 1.000 | 1.000 | 4714.0 | 20000.0 | 23.6 | B31.3 | |
| 1030 | 259.6 | -12.0 | 1.000 | 1.000 | 4757.0 | 20000.0 | 23.8 | B31.3 | |
| | | | | | | | | | |
| 1030 | 259.6 | 12.0 | 1.000 | 1.000 | 4757.0 | 20000.0 | 23.8 | B31.3 | |
| 1035 | 512.0 | -12.0 | 1.000 | 1.000 | 5009.4 | 20000.0 | 25.0 | B31.3 | |
| | | | | | | | | | |
| 1035 | 512.0 | 12.0 | 1.000 | 1.000 | 5009.4 | 20000.0 | 25.0 | B31.3 | |
| 1040 | 163.9 | -12.0 | 1.000 | 1.000 | 4661.3 | 20000.0 | 23.3 | B31.3 | |
| | | | | | | | | | |
| 1040 | 163.9 | 12.0 | 1.000 | 1.000 | 4661.3 | 20000.0 | 23.3 | B31.3 | |
| 1045 | 167.0 | -12.0 | 1.000 | 1.000 | 4664.4 | 20000.0 | 23.3 | B31.3 | |
| | | | | | | | | | |
| 1045 | 167.0 | 12.0 | 1.000 | 1.000 | 4664.4 | 20000.0 | 23.3 | B31.3 | |
| 1050 | 6.2 | -12.0 | 1.000 | 1.000 | 4503.6 | 20000.0 | 22.5 | B31.3 | |
| | | | | | | | | | |
| 1050 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 1055 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 1055 | 98.7 | 12.0 | 1.000 | 1.000 | 4596.1 | 20000.0 | 23.0 | B31.3 | |
| 1060 | 13.9 | -12.0 | 1.000 | 1.000 | 4511.3 | 20000.0 | 22.6 | B31.3 | |
| | | | | | | | | | |
| 1060 | 13.9 | 12.0 | 1.000 | 1.000 | 4511.3 | 20000.0 | 22.6 | B31.3 | |
| 1065 | 968.9 | -12.0 | 1.000 | 1.000 | 5466.3 | 20000.0 | 27.3 | B31.3 | |
| | | | | | | | | | |
| 1065 | 968.9 | 12.0 | 1.000 | 1.000 | 5466.3 | 20000.0 | 27.3 | B31.3 | |
| 1070 | 1000.8 | -12.0 | 1.000 | 1.000 | 5498.2 | 20000.0 | 27.5 | B31.3 | |
| | | | | | | | | | |
| 1070 | 1000.8 | 12.0 | 1.000 | 1.000 | 5498.2 | 20000.0 | 27.5 | B31.3 | |
| 1075 | 1167.5 | -12.0 | 1.000 | 1.000 | 5664.9 | 20000.0 | 28.3 | B31.3 | |
| | | | | | | | | | |
| 1075 | 1167.5 | 12.0 | 1.000 | 1.000 | 5664.9 | 20000.0 | 28.3 | B31.3 | |
| 1080 | 742.1 | -12.0 | 1.000 | 1.000 | 5239.5 | 20000.0 | 26.2 | B31.3 | |
| | | | | | | | | | |
| 1080 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 1085 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 1085 | 503.9 | 12.0 | 1.000 | 1.000 | 5001.4 | 20000.0 | 25.0 | B31.3 | |
| 1089 | 565.8 | -12.2 | 3.341 | 3.341 | 4965.5 | 20000.0 | 24.8 | B31.3 | |
| | | | | | | | | | |
| 1089 | 565.8 | 12.2 | 3.341 | 3.341 | 4965.5 | 20000.0 | 24.8 | B31.3 | |
| 1090 | 1219.2 | -10.6 | 3.341 | 3.341 | 5469.7 | 20000.0 | 27.3 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 1090 | 364.9 | 10.6 | 1.000 | 1.000 | 4920.2 | 20000.0 | 24.6 | B31.3 | |
| 1095 | 536.7 | -10.6 | 1.000 | 1.000 | 5041.7 | 20000.0 | 25.2 | B31.3 | |
| | | | | | | | | | |
| 1095 | 536.7 | 10.6 | 1.000 | 1.000 | 5041.7 | 20000.0 | 25.2 | B31.3 | |
| 1098 | 38.8 | -10.6 | 1.000 | 1.000 | 4438.9 | 20000.0 | 22.2 | B31.3 | |
| | | | | | | | | | |
| 1098 | 129.8 | 10.6 | 3.341 | 3.341 | 4497.4 | 20000.0 | 22.5 | B31.3 | |
| 1099 | 896.8 | -11.1 | 3.341 | 3.341 | 5105.0 | 20000.0 | 25.5 | B31.3 | |
| | | | | | | | | | |
| 1099 | 896.8 | 11.1 | 3.341 | 3.341 | 5200.9 | 20000.0 | 26.0 | B31.3 | |
| 1100 | 393.9 | -10.3 | 3.341 | 3.341 | 4792.8 | 20000.0 | 24.0 | B31.3 | |
| | | | | | | | | | |
| 1100 | 117.9 | 10.3 | 1.000 | 1.000 | 4615.3 | 20000.0 | 23.1 | B31.3 | |
| 1104 | 114.9 | 0.3 | 3.341 | 3.341 | 4584.1 | 20000.0 | 22.9 | B31.3 | |
| | | | | | | | | | |
| 1104 | 114.9 | -0.3 | 3.341 | 3.341 | 4583.8 | 20000.0 | 22.9 | B31.3 | |
| 1105 | 102.4 | -0.7 | 3.341 | 3.341 | 4574.5 | 20000.0 | 22.9 | B31.3 | |
| | | | | | | | | | |
| 1105 | 30.6 | 0.7 | 1.000 | 1.000 | 4528.3 | 20000.0 | 22.6 | B31.3 | |
| 1110 | 429.8 | -0.7 | 1.000 | 1.000 | 4927.5 | 20000.0 | 24.6 | B31.3 | |
| | | | | | | | | | |
| 1110 | 429.8 | 0.7 | 1.000 | 1.000 | 4927.5 | 20000.0 | 24.6 | B31.3 | |
| 1115 | 358.3 | -0.2 | 1.000 | 1.000 | 9475.2 | 20000.0 | 47.4 | B31.3 | |
| | | | | | | | | | |
| 1115 | 358.3 | 0.2 | 1.000 | 1.000 | 9475.2 | 20000.0 | 47.4 | B31.3 | |
| 990 | 411.2 | -0.2 | 15.887 | 20.849 | 9425.3 | 20000.0 | 47.1 | B31.3 | |

Job Description:

PROJECT: NEWPP Water Purifiaction Plant, Houston

CLIENT : CDM Smith

ANALYST: DClark

CHECKER: RSinghal

NOTES : UV Building Phase 1

Existing Configuration with Flex Joints

PIPE DATA
---
---
From 5 To 10 DX= -20.000 ft.
B31.3 (2010) Cycle Max Switch = --- App.P Sy/St Switch = ON
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.
Dia= 48.000 in. Wall= .375 in. Cor= .0000 in.
GENERAL
T1= 70 F P1= 165.0000 lb./sq.in. Mat= (102)A53 B
E= 29,500,000 lb./sq.in. EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in. EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in. EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in. EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in. EH9= 29,500,000 lb./sq.in. v = .292
Pipe Den= .2830000 lb./cu.in. Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .500 in. Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 5 ANC
Node 10 Y
Node 10 Z
ALLOWABLE STRESSES
---
From 10 To 15 DX= -20.000 ft.
BEND at "TO" end
Radius= 72.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 14
Angle/Node @2= .00 13
RESTRAINTS
Node 14 Y
Node 14 Z
---
From 15 To 20 DY= 6.000 ft.
RESTRAINTS
Node 20 Guide Gap= .250 in.
---
From 20 To 25 DY= 1.083 ft.
---
From 25 To 30 DY= .167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 47.250 in.

---
From 30 To 35 DY= 5.042 ft.
SIF's & TEE's
Node 35 Welding Tee
---
From 35 To 40 DY= 3.500 ft.
FORCES & MOMENTS
Node 40 FY1= -1,200.00 lb.
---
From 35 To 45 DX= -3.500 ft.
FORCES & MOMENTS
Node 45 FY1= -800.00 lb.
---
From 45 To 50 DX= -6.000 ft.
RESTRAINTS
Node 50 Y
---
From 50 To 55 DX= -9.187 ft.
RESTRAINTS
Node 55 +Y
---
From 55 To 60 DX= -.500 ft.
---
From 60 To 65 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 47.250 in.
---
From 65 To 70 DX= -5.062 ft.
FORCES & MOMENTS
Node 70 FY1= -800.00 lb.
---
From 70 To 75 DX= -6.167 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 72.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 74
Angle/Node @2= .00 73
---
From 75 To 80 DY= -6.167 ft.
---
From 80 To 85 DY= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 47.250 in.
---
From 85 To 90 DY= -1.000 ft.
RESTRAINTS
Node 90 Guide Gap= .250 in.
---
From 90 To 95 DY= -6.750 ft.
BEND at "TO" end
Radius= 72.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 94
Angle/Node @2= .00 93
RESTRAINTS
Node 94 Y
Node 94 X
---
From 95 To 100 DZ= 8.000 ft.
RESTRAINTS

Node 100 Y
Node 100 X
SIF's & TEE's
Node 100 Unreinforced Tee
---
From 100 To 105 DZ= 8.000 ft.
RESTRAINTS
Node 105 Y
Node 105 X
SIF's & TEE's
Node 105 Unreinforced Tee
---
From 105 To 110 DZ= 8.000 ft.
RESTRAINTS
Node 110 Y
Node 110 X
SIF's & TEE's
Node 110 Unreinforced Tee
---
From 110 To 115 DZ= 8.000 ft.
RESTRAINTS
Node 115 Y
Node 115 X
SIF's & TEE's
Node 115 Unreinforced Tee
---
From 115 To 120 DZ= 3.000 ft.
RESTRAINTS
Node 120 Y
---
From 120 To 125 DZ= 2.000 ft.
RESTRAINTS
Node 125 Y
Node 125 X
---
From 125 To 130 DZ= 8.000 ft.
Dia= 30.000 in. Wall= .375 in.
Insul Thk= .000 in.
RESTRAINTS
Node 130 Y
Node 130 X
---
From 130 To 135 DZ= 8.000 ft.
BEND at "TO" end
Radius= 45.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 134
Angle/Node @2= .00 133
RESTRAINTS
Node 134 Y
Node 134 X
---
From 135 To 140 DY= 6.750 ft.
RESTRAINTS
Node 140 Guide Gap= .250 in.
---
From 140 To 145 DY= 1.000 ft.
---
From 145 To 150 DY= .167 ft.
EXPANSION JOINT

Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg  Eff Dia= 29.250 in.
---
From 150 To 155 DY= 3.750 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 45.000 in. (LONG)  Bend Angle= 90.000  Angle/Node @1= 45.00 154
---
From 155 To 160 DX= -3.917 ft.
FORCES & MOMENTS
Node 160  FY1= -330.00 lb.
---
From 160 To 165 DX= -.750 ft.
RIGID Weight= 475.00 lb.
FORCES & MOMENTS
Node 165  FY1= -330.00 lb.
---
From 165 To 170 DX= -3.646 ft.
RESTRAINTS
Node 170 Y
---
From 170 To 175 DX= -8.083 ft.
RESTRAINTS
Node 175 +Y
---
From 175 To 180 DX= -8.083 ft.
RESTRAINTS
Node 180 Y
---
From 180 To 185 DX= -.750 ft.
FORCES & MOMENTS
Node 185  FY1= -330.00 lb.
---
From 185 To 190 DX= -.750 ft.
RIGID Weight= 475.00 lb.
FORCES & MOMENTS
Node 190  FY1= -330.00 lb.
---
From 190 To 195 DX= -3.917 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 45.000 in. (LONG)  Bend Angle= 90.000  Angle/Node @1= 45.00 194
Angle/Node @2= .00 193
---
From 195 To 200 DY= -4.500 ft.
RESTRAINTS
Node 200 Guide  Gap= .250 in.
---
From 200 To 205 DY= -6.750 ft.
BEND at "TO" end
Radius= 45.000 in. (LONG)  Bend Angle= 90.000  Angle/Node @1= 45.00 204
Angle/Node @2= .00 203
RESTRAINTS
Node 204 Y
---
From 205 To 210 DX= -7.071 ft. DZ= 7.071 ft.
RESTRAINTS
Node 210 Y
Node 210 Guide
---

From 210 To 215 DX= -14.142 ft. DZ= 14.142 ft.
RESTRAINTS
Node 215 Y
Node 215 Guide
---
From 100 To 220 DY= 6.750 ft.
GENERAL
Refract. Thk= .375 in. Refract. Den= .0643000 lb./cu.in.
RESTRAINTS
Node 220 Guide Gap= .250 in.
---
From 220 To 225 DY= 4.750 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 45.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 224
Angle/Node @2= .00 223
---
From 225 To 230 DX= -3.917 ft.
FORCES & MOMENTS
Node 230 FY1= -365.00 lb.
---
From 230 To 235 DX= -.750 ft.
RIGID Weight= 600.00 lb.
FORCES & MOMENTS
Node 235 FY1= -365.00 lb.
---
From 235 To 240 DX= -3.500 ft.
RESTRAINTS
Node 240 Y
---
From 240 To 245 DX= -8.844 ft.
RESTRAINTS
Node 245 Y
---
From 245 To 250 DX= -7.125 ft.
FORCES & MOMENTS
Node 250 FY1= -730.00 lb.
---
From 250 To 255 DX= -2.083 ft. DY= -.250 ft.
FORCES & MOMENTS
Node 255 FY1= -1,730.00 lb.
---
From 255 To 260 DX= -1.385 ft.
Dia= 36.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Insul Thk= .000 in.
RESTRAINTS
Node 260 Y
---
From 260 To 265 DX= -7.219 ft.
Dia= 36.000 in. Wall= .375 in.
Insul Thk= .000 in.
RESTRAINTS
Node 265 Y
---
From 265 To 270 DX= -1.146 ft.
FORCES & MOMENTS
Node 270 FY1= -1,730.00 lb.
---

From 270 To 275 DX= -8.750 ft.
RESTRAINTS
Node 275 Y
---
From 275 To 280 DX= -1.542 ft.
---
From 280 To 285 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 35.250 in.
---
From 285 To 290 DX= -3.687 ft.
FORCES & MOMENTS
Node 290 FY1= -590.00 lb.
---
From 290 To 295 DX= -.750 ft.
RIGID Weight= 975.00 lb.
FORCES & MOMENTS
Node 295 FY1= -590.00 lb.
---
From 295 To 300 DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 36.000 in. (SHORT Bend Angle= 90.000 Angle/Node @1= 45.00 299
Angle/Node @2= .00 298
---
From 300 To 305 DY= -3.458 ft.
---
From 305 To 310 DY= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 35.250 in.
---
From 310 To 312 DY= -1.042 ft.
RESTRAINTS
Node 312 Guide Gap= .250 in.
---
From 312 To 315 DY= -6.000 ft.
RESTRAINTS
Node 315 Y
Node 315 X
SIF's & TEE's
Node 315 Unreinforced Tee
---
From 105 To 320 DY= 6.750 ft.
Dia= 30.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Refract. Den= .0643000 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 320 Guide Gap= .250 in.
---
From 320 To 325 DY= 4.750 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 45.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 324
Angle/Node @2= .00 323
---
From 325 To 330 DX= -3.917 ft.
FORCES & MOMENTS

Node 330 FY1= -365.00 lb.
---
From 330 To 335 DX= -.750 ft.
RIGID Weight= 600.00 lb.
FORCES & MOMENTS
Node 335 FY1= -365.00 lb.
---
From 335 To 340 DX= -3.500 ft.
RESTRAINTS
Node 340 Y
---
From 340 To 345 DX= -8.844 ft.
RESTRAINTS
Node 345 Y
---
From 345 To 350 DX= -7.125 ft.
FORCES & MOMENTS
Node 350 FY1= -730.00 lb.
---
From 350 To 355 DX= -2.083 ft. DY= -.250 ft.
FORCES & MOMENTS
Node 355 FY1= -1,730.00 lb.
---
From 355 To 360 DX= -1.385 ft.
Dia= 36.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Insul Thk= .000 in.
RESTRAINTS
Node 360 Y
---
From 360 To 365 DX= -7.219 ft.
Dia= 36.000 in. Wall= .375 in.
Insul Thk= .000 in.
RESTRAINTS
Node 365 Y
---
From 365 To 370 DX= -1.146 ft.
FORCES & MOMENTS
Node 370 FY1= -1,730.00 lb.
---
From 370 To 375 DX= -8.750 ft.
RESTRAINTS
Node 375 Y
---
From 375 To 380 DX= -1.542 ft.
---
From 380 To 385 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 35.250 in.
---
From 385 To 390 DX= -3.687 ft.
FORCES & MOMENTS
Node 390 FY1= -590.00 lb.
---
From 390 To 395 DX= -.750 ft.
RIGID Weight= 975.00 lb.
FORCES & MOMENTS

Node 395 FY1= -590.00 lb.
---
From 395 To 400 DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 36.000 in. (SHORT Bend Angle= 90.000 Angle/Node @1= 45.00 399
Angle/Node @2= .00 398
---
From 400 To 405 DY= -3.458 ft.
---
From 405 To 410 DY= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 35.250 in.
---
From 410 To 412 DY= -1.042 ft.
RESTRAINTS
Node 412 Guide Gap= .250 in.
---
From 412 To 415 DY= -6.000 ft.
RESTRAINTS
Node 415 Y
Node 415 X
SIF's & TEE's
Node 415 Unreinforced Tee
---
From 110 To 420 DY= 6.750 ft.
Dia= 30.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Refract. Den= .0643000 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 420 Guide Gap= .250 in.
---
From 420 To 425 DY= 4.750 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 45.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 424
Angle/Node @2= .00 423
---
From 425 To 430 DX= -3.917 ft.
FORCES & MOMENTS
Node 430 FY1= -365.00 lb.
---
From 430 To 435 DX= -.750 ft.
RIGID Weight= 600.00 lb.
FORCES & MOMENTS
Node 435 FY1= -365.00 lb.
---
From 435 To 440 DX= -3.500 ft.
RESTRAINTS
Node 440 Y
---
From 440 To 445 DX= -8.844 ft.
RESTRAINTS
Node 445 Y
---
From 445 To 450 DX= -7.125 ft.
FORCES & MOMENTS
Node 450 FY1= -730.00 lb.

---
From 450 To 455 DX= -2.083 ft. DY= -.250 ft.
FORCES & MOMENTS
Node 455 FY1= -1,730.00 lb.
---
From 455 To 460 DX= -1.385 ft.
Dia= 36.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Insul Thk= .000 in.
RESTRAINTS
Node 460 Y
---
From 460 To 465 DX= -7.219 ft.
Dia= 36.000 in. Wall= .375 in.
Insul Thk= .000 in.
RESTRAINTS
Node 465 Y
---
From 465 To 470 DX= -1.146 ft.
FORCES & MOMENTS
Node 470 FY1= -1,730.00 lb.
---
From 470 To 475 DX= -8.750 ft.
RESTRAINTS
Node 475 Y
---
From 475 To 480 DX= -1.542 ft.
---
From 480 To 485 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 35.250 in.
---
From 485 To 490 DX= -3.687 ft.
FORCES & MOMENTS
Node 490 FY1= -590.00 lb.
---
From 490 To 495 DX= -.750 ft.
RIGID Weight= 975.00 lb.
FORCES & MOMENTS
Node 495 FY1= -590.00 lb.
---
From 495 To 500 DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 36.000 in. (SHORT Bend Angle= 90.000 Angle/Node @1= 45.00 499
Angle/Node @2= .00 498
---
From 500 To 505 DY= -3.458 ft.
---
From 505 To 510 DY= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 35.250 in.
---
From 510 To 512 DY= -1.042 ft.
RESTRAINTS
Node 512 Guide Gap= .250 in.
---

From  512  To  515 DY= -6.000 ft.
RESTRAINTS
  Node  515  Y
  Node  515  X
SIF's & TEE's
  Node  515   Unreinforced Tee
---
From  115  To  520 DY= 6.750 ft.
  Dia= 30.000 in.   Wall= .375 in.
GENERAL
  Refract. Thk= .375 in.   Refract. Den= .0643000 lb./cu.in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  520  Guide   Gap= .250 in.
---
From  520  To  525 DY= 4.750 ft.
SINGLE FLANGED BEND at "TO" end
  Radius= 45.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 524
  Angle/Node @2= .00 523
---
From  525  To  530  DX= -3.917 ft.
FORCES & MOMENTS
  Node  530   FY1= -365.00 lb.
---
From  530  To  535  DX= -.750 ft.
RIGID  Weight= 600.00 lb.
FORCES & MOMENTS
  Node  535   FY1= -365.00 lb.
---
From  535  To  540  DX= -3.500 ft.
RESTRAINTS
  Node  540  Y
---
From  540  To  545  DX= -8.844 ft.
RESTRAINTS
  Node  545  Y
---
From  545  To  550  DX= -7.125 ft.
FORCES & MOMENTS
  Node  550   FY1= -730.00 lb.
---
From  550  To  555  DX= -2.083 ft.  DY= -.250 ft.
FORCES & MOMENTS
  Node  555   FY1= -1,730.00 lb.
---
From  555  To  560  DX= -1.385 ft.
  Dia= 36.000 in.   Wall= .375 in.
GENERAL
  Refract. Thk= .375 in.   Insul Thk= .000 in.
RESTRAINTS
  Node  560  Y
---
From  560  To  565  DX= -7.219 ft.
  Dia= 36.000 in.   Wall= .375 in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  565  Y
---

From 565 To 570 DX= -1.146 ft.
FORCES & MOMENTS
Node 570 FY1= -1,730.00 lb.
---
From 570 To 575 DX= -8.750 ft.
RESTRAINTS
Node 575 Y
---
From 575 To 580 DX= -1.542 ft.
---
From 580 To 585 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 35.250 in.
---
From 585 To 590 DX= -3.687 ft.
FORCES & MOMENTS
Node 590 FY1= -590.00 lb.
---
From 590 To 595 DX= -.750 ft.
RIGID Weight= 975.00 lb.
FORCES & MOMENTS
Node 595 FY1= -590.00 lb.
---
From 595 To 600 DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 36.000 in. (SHORT Bend Angle= 90.000 Angle/Node @1= 45.00 599
Angle/Node @2= .00 598
---
From 600 To 605 DY= -3.458 ft.
---
From 605 To 610 DY= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 35.250 in.
---
From 610 To 612 DY= -1.042 ft.
RESTRAINTS
Node 612 Guide Gap= .250 in.
---
From 612 To 615 DY= -6.000 ft.
RESTRAINTS
Node 615 Y
Node 615 X
SIF's & TEE's
Node 615 Unreinforced Tee
---
From 615 To 620 DZ= 10.000 ft.
Dia= 48.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .500 in. Insul Thk= .000 in.
RESTRAINTS
Node 620 Y
Node 620 X
---
From 620 To 625 DZ= 20.000 ft.
RESTRAINTS
Node 625 Y

Node 625 X

---

From 615 To 515 DX= .000 ft. DY= .000 ft. DZ= -8.000 ft.

---

From 515 To 415 DX= .000 ft. DY= .000 ft. DZ= -8.000 ft.

---

From 415 To 315 DX= .000 ft. DY= .000 ft. DZ= -8.000 ft.

---

From 315 To 630 DZ= -8.000 ft.

RESTRAINTS

Node 630 Y

Node 630 X

---

From 630 To 635 DZ= -12.000 ft.

RESTRAINTS

Node 635 Y

Node 635 X

# Summary of Support Loads

CASE 1 (SUS) W+P1+F1

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| 5 | | Rigid ANC | | | | | |
| | 1(SUS) | 83153 | -2827 | -1 | -1.9 | -4.3 | -6611.9 |
| | | | | | | | |
| | | | | | | | |
| 10 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -40084 | 2 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 14 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -289882 | -2 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 20 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 40479 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 50 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 475491 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 55 | | Rigid +Y | | | | | |
| | 1(SUS) | 0 | -152341 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 90 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | -94533 | 0 | -4529 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 94 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -45505 | -119726 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 100 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 16981 | -26268 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 105 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -25374 | -80091 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 110 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -23974 | -68863 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 115 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -26468 | -65365 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 120 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -23 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 125 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 7308 | -17968 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 130 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -11916 | 34055 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 134 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 5929 | -140445 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 140 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 4521 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 170 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 229506 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 175 | | Rigid +Y | | | | | |
| | 1(SUS) | 0 | -144831 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 180 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 11794 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 200 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | -47 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 204 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -6430 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 210 | | Rigid Y; | | | | | |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | Rigid GUI | | | | | |
| | 1(SUS) | 23 | -7518 | 23 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 215 | | Rigid Y; Rigid GUI | | | | | |
| | 1(SUS) | -14 | -3651 | -14 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 220 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 102244 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 240 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 74346 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 245 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -29208 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 260 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -2071 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 265 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -18809 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 275 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 46983 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 312 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | -113842 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 315 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 17483 | -61148 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 320 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 115224 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 340 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 73990 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 345 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -29074 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 360 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -2093 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 365 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -18803 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 375 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 46983 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 412 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | -113842 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 415 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 17483 | -61804 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 420 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 120236 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 440 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 73852 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 445 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -29023 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 460 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -2101 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 465 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -18801 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 475 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 46982 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 512 | | Rigid GUI | | | | | |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | -113842 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 515 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 17483 | -61836 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 520 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 121691 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 540 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 73812 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 545 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -29008 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 560 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -2103 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 565 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -18801 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 575 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 46982 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 612 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | -113842 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 615 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 17483 | -60083 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 620 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 0 | -18855 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 625 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -0 | -8180 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 630 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -0 | -11258 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 635 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -0 | -4991 | 0 | 0.0 | 0.0 | 0.0 |

```
Piping Code: B31.3      = B31.3 -2010, March 31, 2011


 CODE STRESS CHECK FAILED      : LOADCASE 1 (SUS) W+P1+F1

Highest Stresses: (lb./sq.in.)
Ratio (%):                    373.5       @Node    100
Code Stress:                74698.2       Allowable Stress:      20000.0
Axial Stress:                5539.7       @Node     94
Bending Stress:             97715.0       @Node    100
Torsion Stress:              2220.3       @Node     95
Hoop Stress:                10395.0       @Node     10
Max Stress Intensity:      100378.7       @Node    100
```

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 119.7 | -0.0 | 1.000 | 1.000 | 3794.2 | 20000.0 | 19.0 | B31.3 | |
| 10 | 2387.7 | 0.0 | 1.000 | 1.000 | 6062.2 | 20000.0 | 30.3 | B31.3 | |
| | | | | | | | | | |
| 10 | 2387.7 | -0.0 | 1.000 | 1.000 | 6062.2 | 20000.0 | 30.3 | B31.3 | |
| 13 | 1814.6 | 0.0 | 1.000 | 1.000 | 5489.2 | 20000.0 | 27.4 | B31.3 | |
| | | | | | | | | | |
| 13 | 5596.5 | -0.0 | 3.084 | 2.570 | 7871.9 | 20000.0 | 39.4 | B31.3 | |
| 14 | 766.6 | -0.1 | 3.084 | 2.570 | 4618.5 | 20000.0 | 23.1 | B31.3 | |
| | | | | | | | | | |
| 14 | 766.6 | 0.1 | 3.084 | 2.570 | 965.2 | 20000.0 | 4.8 | B31.3 | |
| 15 | 8331.6 | -0.1 | 3.084 | 2.570 | 6268.8 | 20000.0 | 31.3 | B31.3 | |
| | | | | | | | | | |
| 15 | 2701.5 | 0.1 | 1.000 | 1.000 | 2721.5 | 20000.0 | 13.6 | B31.3 | |
| 20 | 2611.2 | -0.1 | 1.000 | 1.000 | 2630.2 | 20000.0 | 13.2 | B31.3 | |
| | | | | | | | | | |
| 20 | 2611.2 | 0.1 | 1.000 | 1.000 | 2630.2 | 20000.0 | 13.2 | B31.3 | |
| 25 | 186.4 | -0.1 | 1.000 | 1.000 | 186.6 | 20000.0 | 0.9 | B31.3 | |
| | | | | | | | | | |
| 25 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 30 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 30 | 186.6 | 0.1 | 1.000 | 1.000 | 188.7 | 20000.0 | 0.9 | B31.3 | |
| 35 | 60834.3 | -0.1 | 5.303 | 6.738 | 45715.4 | 20000.0 | 228.6 | B31.3 | * |
| | | | | | | | | | |
| 35 | 0.0 | 0.0 | 5.303 | 6.738 | 5074.4 | 20000.0 | 25.4 | B31.3 | |
| 40 | 0.0 | 0.0 | 1.000 | 1.000 | 5135.2 | 20000.0 | 25.7 | B31.3 | |
| | | | | | | | | | |
| 35 | 60834.3 | 0.0 | 5.303 | 6.738 | 48578.8 | 20000.0 | 242.9 | B31.3 | * |
| 45 | 6141.8 | -0.0 | 1.000 | 1.000 | 9094.9 | 20000.0 | 45.5 | B31.3 | |
| | | | | | | | | | |
| 45 | 6141.8 | 0.0 | 1.000 | 1.000 | 9094.9 | 20000.0 | 45.5 | B31.3 | |
| 50 | 35745.1 | -0.0 | 1.000 | 1.000 | 38698.2 | 20000.0 | 193.5 | B31.3 | * |
| | | | | | | | | | |
| 50 | 35745.1 | 0.0 | 1.000 | 1.000 | 38698.2 | 20000.0 | 193.5 | B31.3 | * |
| 55 | 755.6 | -0.0 | 1.000 | 1.000 | 3708.6 | 20000.0 | 18.5 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 55 | 755.6 | 0.0 | 1.000 | 1.000 | 3708.6 | 20000.0 | 18.5 | B31.3 | |
| 60 | 187.6 | -0.0 | 1.000 | 1.000 | 3140.7 | 20000.0 | 15.7 | B31.3 | |
| | | | | | | | | | |
| 60 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 65 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 65 | 2.7 | 0.0 | 1.000 | 1.000 | 2955.7 | 20000.0 | 14.8 | B31.3 | |
| 70 | 6013.7 | -0.0 | 1.000 | 1.000 | 8966.7 | 20000.0 | 44.8 | B31.3 | |
| | | | | | | | | | |
| 70 | 6013.7 | 0.0 | 1.000 | 1.000 | 8966.7 | 20000.0 | 44.8 | B31.3 | |
| 73 | 6221.7 | -0.0 | 1.000 | 1.000 | 9174.7 | 20000.0 | 45.9 | B31.3 | |
| | | | | | | | | | |
| 73 | 11552.1 | 0.0 | 1.857 | 1.547 | 11617.1 | 20000.0 | 58.1 | B31.3 | |
| 74 | 14401.3 | -0.1 | 1.857 | 1.547 | 13471.7 | 20000.0 | 67.4 | B31.3 | |
| | | | | | | | | | |
| 74 | 14401.3 | 0.1 | 1.857 | 1.547 | 13471.7 | 20000.0 | 67.4 | B31.3 | |
| 75 | 1210.6 | -0.1 | 1.857 | 1.547 | 4670.6 | 20000.0 | 23.4 | B31.3 | |
| | | | | | | | | | |
| 75 | 652.0 | 0.1 | 1.000 | 1.000 | 4414.7 | 20000.0 | 22.1 | B31.3 | |
| 80 | 279.0 | -0.1 | 1.000 | 1.000 | 4038.7 | 20000.0 | 20.2 | B31.3 | |
| | | | | | | | | | |
| 80 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 85 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 85 | 94.1 | 0.1 | 1.000 | 1.000 | 3851.6 | 20000.0 | 19.3 | B31.3 | |
| 90 | 2332.3 | -0.1 | 1.000 | 1.000 | 6072.4 | 20000.0 | 30.4 | B31.3 | |
| | | | | | | | | | |
| 90 | 2332.3 | 0.1 | 1.000 | 1.000 | 6072.4 | 20000.0 | 30.4 | B31.3 | |
| 93 | 2728.1 | -0.1 | 1.000 | 1.000 | 6455.2 | 20000.0 | 32.3 | B31.3 | |
| | | | | | | | | | |
| 93 | 7012.2 | 0.1 | 3.084 | 2.570 | 8986.2 | 20000.0 | 44.9 | B31.3 | |
| 94 | 12734.6 | -1427.2 | 3.084 | 2.570 | 13878.4 | 20000.0 | 69.4 | B31.3 | |
| | | | | | | | | | |
| 94 | 12734.6 | 1427.2 | 3.084 | 2.570 | 15358.2 | 20000.0 | 76.8 | B31.3 | |
| 95 | 1508.4 | -2220.3 | 3.084 | 2.570 | 7632.0 | 20000.0 | 38.2 | B31.3 | |
| | | | | | | | | | |
| 95 | 522.9 | 2220.3 | 1.000 | 1.000 | 7145.9 | 20000.0 | 35.7 | B31.3 | |
| 100 | 20886.1 | -2220.3 | 10.994 | 14.325 | 21210.5 | 20000.0 | 106.1 | B31.3 | * |
| | | | | | | | | | |
| 100 | 20885.5 | 890.2 | 10.994 | 14.325 | 20816.2 | 20000.0 | 104.1 | B31.3 | * |
| 105 | 1173.4 | -890.2 | 10.994 | 14.325 | 6216.3 | 20000.0 | 31.1 | B31.3 | |
| | | | | | | | | | |
| 105 | 1173.4 | 343.7 | 10.994 | 14.325 | 5995.4 | 20000.0 | 30.0 | B31.3 | |
| 110 | 1032.7 | -343.7 | 10.994 | 14.325 | 5890.6 | 20000.0 | 29.5 | B31.3 | |
| | | | | | | | | | |
| 110 | 1032.7 | 99.8 | 10.994 | 14.325 | 5853.8 | 20000.0 | 29.3 | B31.3 | |
| 115 | 1255.9 | -99.8 | 10.994 | 14.325 | 6021.1 | 20000.0 | 30.1 | B31.3 | |
| | | | | | | | | | |
| 115 | 1256.1 | -56.4 | 10.994 | 14.325 | 6018.9 | 20000.0 | 30.1 | B31.3 | |
| 120 | 205.5 | 56.4 | 1.000 | 1.000 | 5282.5 | 20000.0 | 26.4 | B31.3 | |
| | | | | | | | | | |
| 120 | 205.5 | -56.4 | 1.000 | 1.000 | 5282.5 | 20000.0 | 26.4 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 125 | 889.4 | 146.3 | 1.000 | 1.000 | 3947.2 | 20000.0 | 19.7 | B31.3 | |
| | | | | | | | | | |
| 125 | 889.4 | -146.3 | 1.000 | 1.000 | 3947.2 | 20000.0 | 19.7 | B31.3 | |
| 130 | 4197.4 | 146.3 | 1.000 | 1.000 | 7250.3 | 20000.0 | 36.3 | B31.3 | |
| | | | | | | | | | |
| 130 | 4197.4 | -146.3 | 1.000 | 1.000 | 7250.3 | 20000.0 | 36.3 | B31.3 | |
| 133 | 1376.9 | 146.3 | 1.000 | 1.000 | 4433.6 | 20000.0 | 22.2 | B31.3 | |
| | | | | | | | | | |
| 133 | 4767.0 | -146.3 | 3.622 | 3.018 | 6628.7 | 20000.0 | 33.1 | B31.3 | |
| 134 | 16828.8 | -3.3 | 3.622 | 3.018 | 16247.7 | 20000.0 | 81.2 | B31.3 | |
| | | | | | | | | | |
| 134 | 16828.8 | 3.3 | 3.622 | 3.018 | 13402.2 | 20000.0 | 67.0 | B31.3 | |
| 135 | 2315.9 | 0.1 | 3.622 | 3.018 | 1783.2 | 20000.0 | 8.9 | B31.3 | |
| | | | | | | | | | |
| 135 | 639.4 | -0.1 | 1.000 | 1.000 | 685.7 | 20000.0 | 3.4 | B31.3 | |
| 140 | 1.6 | 0.1 | 1.000 | 1.000 | 11.3 | 20000.0 | 0.1 | B31.3 | |
| | | | | | | | | | |
| 140 | 1.6 | -0.1 | 1.000 | 1.000 | 11.3 | 20000.0 | 0.1 | B31.3 | |
| 145 | 0.4 | 0.1 | 1.000 | 1.000 | 2.8 | 20000.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 145 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 150 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 150 | 1.5 | -0.1 | 2.362 | 1.968 | 4.9 | 20000.0 | 0.0 | B31.3 | |
| 154 | 13391.1 | -0.1 | 2.362 | 1.968 | 11001.0 | 20000.0 | 55.0 | B31.3 | |
| | | | | | | | | | |
| 154 | 13391.1 | 0.1 | 2.362 | 1.968 | 11001.0 | 20000.0 | 55.0 | B31.3 | |
| 155 | 45426.0 | -0.7 | 2.362 | 1.968 | 37245.2 | 20000.0 | 186.2 | B31.3 | * |
| | | | | | | | | | |
| 155 | 19231.5 | 0.7 | 1.000 | 1.000 | 22407.1 | 20000.0 | 112.0 | B31.3 | * |
| 160 | 20079.1 | -0.7 | 1.000 | 1.000 | 23254.8 | 20000.0 | 116.3 | B31.3 | * |
| | | | | | | | | | |
| 160 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 165 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 165 | 23868.2 | 0.7 | 1.000 | 1.000 | 27043.9 | 20000.0 | 135.2 | B31.3 | * |
| 170 | 42037.9 | -0.7 | 1.000 | 1.000 | 45213.6 | 20000.0 | 226.1 | B31.3 | * |
| | | | | | | | | | |
| 170 | 42037.9 | 0.7 | 1.000 | 1.000 | 45213.6 | 20000.0 | 226.1 | B31.3 | * |
| 175 | 5825.3 | -0.7 | 1.000 | 1.000 | 9001.0 | 20000.0 | 45.0 | B31.3 | |
| | | | | | | | | | |
| 175 | 5825.3 | 0.7 | 1.000 | 1.000 | 9001.0 | 20000.0 | 45.0 | B31.3 | |
| 180 | 36.6 | -0.7 | 1.000 | 1.000 | 3212.3 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 180 | 36.6 | 0.7 | 1.000 | 1.000 | 3212.3 | 20000.0 | 16.1 | B31.3 | |
| 185 | 97.5 | -0.7 | 1.000 | 1.000 | 3273.1 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 185 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 190 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 190 | 129.5 | 0.7 | 1.000 | 1.000 | 3305.2 | 20000.0 | 16.5 | B31.3 | |
| 193 | 131.0 | -0.7 | 1.000 | 1.000 | 3306.7 | 20000.0 | 16.5 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 193 | 309.1 | 0.7 | 2.362 | 1.968 | 3407.5 | 20000.0 | 17.0 | B31.3 | |
| 194 | 186.0 | -4.7 | 2.362 | 1.968 | 3293.4 | 20000.0 | 16.5 | B31.3 | |
| | | | | | | | | | |
| 194 | 186.0 | 4.7 | 2.362 | 1.968 | 3293.4 | 20000.0 | 16.5 | B31.3 | |
| 195 | 11.2 | -6.4 | 2.362 | 1.968 | 3118.0 | 20000.0 | 15.6 | B31.3 | |
| | | | | | | | | | |
| 195 | 4.7 | 6.4 | 1.000 | 1.000 | 3114.3 | 20000.0 | 15.6 | B31.3 | |
| 200 | 6.1 | -6.4 | 1.000 | 1.000 | 3106.6 | 20000.0 | 15.5 | B31.3 | |
| | | | | | | | | | |
| 200 | 6.1 | 6.4 | 1.000 | 1.000 | 3106.6 | 20000.0 | 15.5 | B31.3 | |
| 203 | 5.1 | -6.4 | 1.000 | 1.000 | 3069.0 | 20000.0 | 15.3 | B31.3 | |
| | | | | | | | | | |
| 203 | 17.9 | 6.4 | 3.622 | 3.018 | 3077.3 | 20000.0 | 15.4 | B31.3 | |
| 204 | 874.8 | -5.0 | 3.622 | 3.018 | 3727.8 | 20000.0 | 18.6 | B31.3 | |
| | | | | | | | | | |
| 204 | 874.8 | 5.0 | 3.622 | 3.018 | 3858.0 | 20000.0 | 19.3 | B31.3 | |
| 205 | 614.7 | 0.0 | 3.622 | 3.018 | 3637.8 | 20000.0 | 18.2 | B31.3 | |
| | | | | | | | | | |
| 205 | 169.9 | -0.0 | 1.000 | 1.000 | 3346.7 | 20000.0 | 16.7 | B31.3 | |
| 210 | 563.5 | 0.0 | 1.000 | 1.000 | 3740.2 | 20000.0 | 18.7 | B31.3 | |
| | | | | | | | | | |
| 210 | 563.5 | 0.0 | 1.000 | 1.000 | 3740.2 | 20000.0 | 18.7 | B31.3 | |
| 215 | 0.0 | -0.0 | 1.000 | 1.000 | 3176.8 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 100 | 97715.0 | -0.1 | 10.994 | 14.325 | 74698.2 | 20000.0 | 373.5 | B31.3 | * |
| 220 | 8773.7 | 0.1 | 1.000 | 1.000 | 10267.1 | 20000.0 | 51.3 | B31.3 | |
| | | | | | | | | | |
| 220 | 8773.7 | -0.1 | 1.000 | 1.000 | 10267.1 | 20000.0 | 51.3 | B31.3 | |
| 223 | 4244.4 | 0.1 | 1.000 | 1.000 | 5749.9 | 20000.0 | 28.7 | B31.3 | |
| | | | | | | | | | |
| 223 | 10025.6 | -0.1 | 2.362 | 1.968 | 9024.7 | 20000.0 | 45.1 | B31.3 | |
| 224 | 11329.7 | 0.1 | 2.362 | 1.968 | 8565.1 | 20000.0 | 42.8 | B31.3 | |
| | | | | | | | | | |
| 224 | 11329.7 | -0.1 | 2.362 | 1.968 | 8565.1 | 20000.0 | 42.8 | B31.3 | |
| 225 | 6465.5 | 0.0 | 2.362 | 1.968 | 5264.9 | 20000.0 | 26.3 | B31.3 | |
| | | | | | | | | | |
| 225 | 2737.2 | -0.0 | 1.000 | 1.000 | 3153.0 | 20000.0 | 15.8 | B31.3 | |
| 230 | 2300.0 | 0.0 | 1.000 | 1.000 | 2715.8 | 20000.0 | 13.6 | B31.3 | |
| | | | | | | | | | |
| 230 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 235 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 235 | 361.0 | -0.0 | 1.000 | 1.000 | 776.9 | 20000.0 | 3.9 | B31.3 | |
| 240 | 8438.1 | 0.0 | 1.000 | 1.000 | 8853.9 | 20000.0 | 44.3 | B31.3 | |
| | | | | | | | | | |
| 240 | 8438.1 | -0.0 | 1.000 | 1.000 | 8853.9 | 20000.0 | 44.3 | B31.3 | |
| 245 | 1314.6 | 0.0 | 1.000 | 1.000 | 1730.4 | 20000.0 | 8.7 | B31.3 | |
| | | | | | | | | | |
| 245 | 1314.6 | -0.0 | 1.000 | 1.000 | 1730.4 | 20000.0 | 8.7 | B31.3 | |
| 250 | 516.3 | 0.0 | 1.000 | 1.000 | 932.1 | 20000.0 | 4.7 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 250 | 516.3 | -0.0 | 1.000 | 1.000 | 952.3 | 20000.0 | 4.8 | B31.3 | |
| 255 | 402.2 | 0.0 | 1.000 | 1.000 | 1956.8 | 20000.0 | 9.8 | B31.3 | |
| | | | | | | | | | |
| 255 | 402.2 | -0.0 | 1.000 | 1.000 | 1942.9 | 20000.0 | 9.7 | B31.3 | |
| 260 | 266.3 | 0.0 | 1.000 | 1.000 | 1807.0 | 20000.0 | 9.0 | B31.3 | |
| | | | | | | | | | |
| 260 | 266.3 | -0.0 | 1.000 | 1.000 | 1807.0 | 20000.0 | 9.0 | B31.3 | |
| 265 | 540.4 | 0.0 | 1.000 | 1.000 | 2081.2 | 20000.0 | 10.4 | B31.3 | |
| | | | | | | | | | |
| 265 | 540.4 | -0.0 | 1.000 | 1.000 | 2081.2 | 20000.0 | 10.4 | B31.3 | |
| 270 | 59.4 | 0.0 | 1.000 | 1.000 | 1600.2 | 20000.0 | 8.0 | B31.3 | |
| | | | | | | | | | |
| 270 | 59.4 | -0.0 | 1.000 | 1.000 | 1600.2 | 20000.0 | 8.0 | B31.3 | |
| 275 | 2309.0 | 0.0 | 1.000 | 1.000 | 3849.7 | 20000.0 | 19.2 | B31.3 | |
| | | | | | | | | | |
| 275 | 2309.0 | -0.0 | 1.000 | 1.000 | 3849.7 | 20000.0 | 19.2 | B31.3 | |
| 280 | 227.7 | 0.0 | 1.000 | 1.000 | 1768.4 | 20000.0 | 8.8 | B31.3 | |
| | | | | | | | | | |
| 280 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 285 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 285 | 0.1 | -0.0 | 1.000 | 1.000 | 1540.8 | 20000.0 | 7.7 | B31.3 | |
| 290 | 5167.8 | 0.0 | 1.000 | 1.000 | 6708.5 | 20000.0 | 33.5 | B31.3 | |
| | | | | | | | | | |
| 290 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 295 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 295 | 6275.1 | -0.0 | 1.000 | 1.000 | 7815.8 | 20000.0 | 39.1 | B31.3 | |
| 298 | 6528.1 | 0.0 | 1.000 | 1.000 | 8068.9 | 20000.0 | 40.3 | B31.3 | |
| | | | | | | | | | |
| 298 | 19618.4 | -0.0 | 3.005 | 2.504 | 16254.6 | 20000.0 | 81.3 | B31.3 | |
| 299 | 21186.6 | 0.0 | 3.005 | 2.504 | 17290.8 | 20000.0 | 86.5 | B31.3 | |
| | | | | | | | | | |
| 299 | 21186.6 | -0.0 | 3.005 | 2.504 | 17290.8 | 20000.0 | 86.5 | B31.3 | |
| 300 | 5430.1 | 0.0 | 3.005 | 2.504 | 6727.9 | 20000.0 | 33.6 | B31.3 | |
| | | | | | | | | | |
| 300 | 1806.9 | -0.0 | 1.000 | 1.000 | 4462.2 | 20000.0 | 22.3 | B31.3 | |
| 305 | 374.3 | 0.0 | 1.000 | 1.000 | 3023.3 | 20000.0 | 15.1 | B31.3 | |
| | | | | | | | | | |
| 305 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 310 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 310 | 146.7 | -0.0 | 1.000 | 1.000 | 2794.0 | 20000.0 | 14.0 | B31.3 | |
| 312 | 3402.6 | 0.0 | 1.000 | 1.000 | 6035.5 | 20000.0 | 30.2 | B31.3 | |
| | | | | | | | | | |
| 312 | 3402.6 | -0.0 | 1.000 | 1.000 | 6035.5 | 20000.0 | 30.2 | B31.3 | |
| 315 | 0.2 | 0.0 | 10.994 | 14.325 | 2550.3 | 20000.0 | 12.8 | B31.3 | |
| | | | | | | | | | |
| 105 | 40149.1 | 0.0 | 10.994 | 14.325 | 31530.7 | 20000.0 | 157.7 | B31.3 | * |
| 320 | 8823.1 | -0.0 | 1.000 | 1.000 | 10323.4 | 20000.0 | 51.6 | B31.3 | |
| | | | | | | | | | |
| 320 | 8823.1 | 0.0 | 1.000 | 1.000 | 10323.4 | 20000.0 | 51.6 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 323 | 4293.8 | -0.0 | 1.000 | 1.000 | 5806.1 | 20000.0 | 29.0 | B31.3 | |
| | | | | | | | | | |
| 323 | 10142.3 | 0.0 | 2.362 | 1.968 | 9119.0 | 20000.0 | 45.6 | B31.3 | |
| 324 | 11242.2 | -0.0 | 2.362 | 1.968 | 8504.4 | 20000.0 | 42.5 | B31.3 | |
| | | | | | | | | | |
| 324 | 11242.2 | 0.0 | 2.362 | 1.968 | 8504.4 | 20000.0 | 42.5 | B31.3 | |
| 325 | 6448.4 | -0.0 | 2.362 | 1.968 | 5252.2 | 20000.0 | 26.3 | B31.3 | |
| | | | | | | | | | |
| 325 | 2730.0 | 0.0 | 1.000 | 1.000 | 3145.8 | 20000.0 | 15.7 | B31.3 | |
| 330 | 2294.6 | -0.0 | 1.000 | 1.000 | 2710.5 | 20000.0 | 13.6 | B31.3 | |
| | | | | | | | | | |
| 330 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 335 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 335 | 364.1 | 0.0 | 1.000 | 1.000 | 780.0 | 20000.0 | 3.9 | B31.3 | |
| 340 | 8395.6 | -0.0 | 1.000 | 1.000 | 8811.4 | 20000.0 | 44.1 | B31.3 | |
| | | | | | | | | | |
| 340 | 8395.6 | 0.0 | 1.000 | 1.000 | 8811.4 | 20000.0 | 44.1 | B31.3 | |
| 345 | 1308.2 | -0.0 | 1.000 | 1.000 | 1724.1 | 20000.0 | 8.6 | B31.3 | |
| | | | | | | | | | |
| 345 | 1308.2 | 0.0 | 1.000 | 1.000 | 1724.1 | 20000.0 | 8.6 | B31.3 | |
| 350 | 515.3 | -0.0 | 1.000 | 1.000 | 931.2 | 20000.0 | 4.7 | B31.3 | |
| | | | | | | | | | |
| 350 | 515.3 | 0.0 | 1.000 | 1.000 | 951.3 | 20000.0 | 4.8 | B31.3 | |
| 355 | 401.8 | -0.0 | 1.000 | 1.000 | 1956.3 | 20000.0 | 9.8 | B31.3 | |
| | | | | | | | | | |
| 355 | 401.8 | 0.0 | 1.000 | 1.000 | 1942.5 | 20000.0 | 9.7 | B31.3 | |
| 360 | 265.1 | -0.0 | 1.000 | 1.000 | 1805.9 | 20000.0 | 9.0 | B31.3 | |
| | | | | | | | | | |
| 360 | 265.1 | 0.0 | 1.000 | 1.000 | 1805.9 | 20000.0 | 9.0 | B31.3 | |
| 365 | 540.3 | -0.0 | 1.000 | 1.000 | 2081.1 | 20000.0 | 10.4 | B31.3 | |
| | | | | | | | | | |
| 365 | 540.3 | 0.0 | 1.000 | 1.000 | 2081.1 | 20000.0 | 10.4 | B31.3 | |
| 370 | 59.3 | -0.0 | 1.000 | 1.000 | 1600.1 | 20000.0 | 8.0 | B31.3 | |
| | | | | | | | | | |
| 370 | 59.3 | 0.0 | 1.000 | 1.000 | 1600.1 | 20000.0 | 8.0 | B31.3 | |
| 375 | 2309.0 | -0.0 | 1.000 | 1.000 | 3849.7 | 20000.0 | 19.2 | B31.3 | |
| | | | | | | | | | |
| 375 | 2309.0 | 0.0 | 1.000 | 1.000 | 3849.7 | 20000.0 | 19.2 | B31.3 | |
| 380 | 227.7 | -0.0 | 1.000 | 1.000 | 1768.4 | 20000.0 | 8.8 | B31.3 | |
| | | | | | | | | | |
| 380 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 385 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 385 | 0.1 | 0.0 | 1.000 | 1.000 | 1540.8 | 20000.0 | 7.7 | B31.3 | |
| 390 | 5167.8 | -0.0 | 1.000 | 1.000 | 6708.5 | 20000.0 | 33.5 | B31.3 | |
| | | | | | | | | | |
| 390 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 395 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 395 | 6275.1 | 0.0 | 1.000 | 1.000 | 7815.8 | 20000.0 | 39.1 | B31.3 | |
| 398 | 6528.1 | -0.0 | 1.000 | 1.000 | 8068.9 | 20000.0 | 40.3 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 398 | 19618.5 | 0.0 | 3.005 | 2.504 | 16254.6 | 20000.0 | 81.3 | B31.3 | |
| 399 | 21186.6 | -0.0 | 3.005 | 2.504 | 17290.8 | 20000.0 | 86.5 | B31.3 | |
| | | | | | | | | | |
| 399 | 21186.6 | 0.0 | 3.005 | 2.504 | 17290.8 | 20000.0 | 86.5 | B31.3 | |
| 400 | 5430.1 | -0.0 | 3.005 | 2.504 | 6727.9 | 20000.0 | 33.6 | B31.3 | |
| | | | | | | | | | |
| 400 | 1806.9 | 0.0 | 1.000 | 1.000 | 4462.2 | 20000.0 | 22.3 | B31.3 | |
| 405 | 374.3 | -0.0 | 1.000 | 1.000 | 3023.3 | 20000.0 | 15.1 | B31.3 | |
| | | | | | | | | | |
| 405 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 410 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 410 | 146.7 | 0.0 | 1.000 | 1.000 | 2794.0 | 20000.0 | 14.0 | B31.3 | |
| 412 | 3402.6 | -0.0 | 1.000 | 1.000 | 6035.5 | 20000.0 | 30.2 | B31.3 | |
| | | | | | | | | | |
| 412 | 3402.6 | 0.0 | 1.000 | 1.000 | 6035.5 | 20000.0 | 30.2 | B31.3 | |
| 415 | 0.1 | -0.0 | 10.994 | 14.325 | 2550.2 | 20000.0 | 12.8 | B31.3 | |
| | | | | | | | | | |
| 110 | 17922.3 | 0.0 | 10.994 | 14.325 | 14863.1 | 20000.0 | 74.3 | B31.3 | |
| 420 | 8842.2 | -0.0 | 1.000 | 1.000 | 10345.1 | 20000.0 | 51.7 | B31.3 | |
| | | | | | | | | | |
| 420 | 8842.2 | 0.0 | 1.000 | 1.000 | 10345.1 | 20000.0 | 51.7 | B31.3 | |
| 423 | 4312.9 | -0.0 | 1.000 | 1.000 | 5827.9 | 20000.0 | 29.1 | B31.3 | |
| | | | | | | | | | |
| 423 | 10187.3 | 0.0 | 2.362 | 1.968 | 9155.5 | 20000.0 | 45.8 | B31.3 | |
| 424 | 11208.4 | -0.0 | 2.362 | 1.968 | 8480.9 | 20000.0 | 42.4 | B31.3 | |
| | | | | | | | | | |
| 424 | 11208.4 | 0.0 | 2.362 | 1.968 | 8480.9 | 20000.0 | 42.4 | B31.3 | |
| 425 | 6441.9 | -0.0 | 2.362 | 1.968 | 5247.2 | 20000.0 | 26.2 | B31.3 | |
| | | | | | | | | | |
| 425 | 2727.2 | 0.0 | 1.000 | 1.000 | 3143.1 | 20000.0 | 15.7 | B31.3 | |
| 430 | 2292.6 | -0.0 | 1.000 | 1.000 | 2708.4 | 20000.0 | 13.5 | B31.3 | |
| | | | | | | | | | |
| 430 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 435 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 435 | 365.3 | 0.0 | 1.000 | 1.000 | 781.1 | 20000.0 | 3.9 | B31.3 | |
| 440 | 8379.2 | -0.0 | 1.000 | 1.000 | 8795.0 | 20000.0 | 44.0 | B31.3 | |
| | | | | | | | | | |
| 440 | 8379.2 | 0.0 | 1.000 | 1.000 | 8795.0 | 20000.0 | 44.0 | B31.3 | |
| 445 | 1305.8 | -0.0 | 1.000 | 1.000 | 1721.6 | 20000.0 | 8.6 | B31.3 | |
| | | | | | | | | | |
| 445 | 1305.8 | 0.0 | 1.000 | 1.000 | 1721.6 | 20000.0 | 8.6 | B31.3 | |
| 450 | 515.0 | -0.0 | 1.000 | 1.000 | 930.8 | 20000.0 | 4.7 | B31.3 | |
| | | | | | | | | | |
| 450 | 515.0 | 0.0 | 1.000 | 1.000 | 950.9 | 20000.0 | 4.8 | B31.3 | |
| 455 | 401.6 | -0.0 | 1.000 | 1.000 | 1956.1 | 20000.0 | 9.8 | B31.3 | |
| | | | | | | | | | |
| 455 | 401.6 | 0.0 | 1.000 | 1.000 | 1942.3 | 20000.0 | 9.7 | B31.3 | |
| 460 | 264.7 | -0.0 | 1.000 | 1.000 | 1805.4 | 20000.0 | 9.0 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 460 | 264.7 | 0.0 | 1.000 | 1.000 | 1805.4 | 20000.0 | 9.0 | B31.3 | |
| 465 | 540.3 | -0.0 | 1.000 | 1.000 | 2081.1 | 20000.0 | 10.4 | B31.3 | |
| | | | | | | | | | |
| 465 | 540.3 | 0.0 | 1.000 | 1.000 | 2081.1 | 20000.0 | 10.4 | B31.3 | |
| 470 | 59.3 | -0.0 | 1.000 | 1.000 | 1600.1 | 20000.0 | 8.0 | B31.3 | |
| | | | | | | | | | |
| 470 | 59.3 | 0.0 | 1.000 | 1.000 | 1600.1 | 20000.0 | 8.0 | B31.3 | |
| 475 | 2309.0 | -0.0 | 1.000 | 1.000 | 3849.7 | 20000.0 | 19.2 | B31.3 | |
| | | | | | | | | | |
| 475 | 2309.0 | 0.0 | 1.000 | 1.000 | 3849.7 | 20000.0 | 19.2 | B31.3 | |
| 480 | 227.7 | -0.0 | 1.000 | 1.000 | 1768.4 | 20000.0 | 8.8 | B31.3 | |
| | | | | | | | | | |
| 480 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 485 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 485 | 0.1 | 0.0 | 1.000 | 1.000 | 1540.8 | 20000.0 | 7.7 | B31.3 | |
| 490 | 5167.8 | -0.0 | 1.000 | 1.000 | 6708.5 | 20000.0 | 33.5 | B31.3 | |
| | | | | | | | | | |
| 490 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 495 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 495 | 6275.1 | 0.0 | 1.000 | 1.000 | 7815.8 | 20000.0 | 39.1 | B31.3 | |
| 498 | 6528.1 | -0.0 | 1.000 | 1.000 | 8068.9 | 20000.0 | 40.3 | B31.3 | |
| | | | | | | | | | |
| 498 | 19618.5 | 0.0 | 3.005 | 2.504 | 16254.6 | 20000.0 | 81.3 | B31.3 | |
| 499 | 21186.6 | -0.0 | 3.005 | 2.504 | 17290.8 | 20000.0 | 86.5 | B31.3 | |
| | | | | | | | | | |
| 499 | 21186.6 | 0.0 | 3.005 | 2.504 | 17290.8 | 20000.0 | 86.5 | B31.3 | |
| 500 | 5430.1 | -0.0 | 3.005 | 2.504 | 6727.9 | 20000.0 | 33.6 | B31.3 | |
| | | | | | | | | | |
| 500 | 1806.9 | 0.0 | 1.000 | 1.000 | 4462.2 | 20000.0 | 22.3 | B31.3 | |
| 505 | 374.3 | -0.0 | 1.000 | 1.000 | 3023.3 | 20000.0 | 15.1 | B31.3 | |
| | | | | | | | | | |
| 505 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 510 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 510 | 146.7 | 0.0 | 1.000 | 1.000 | 2794.0 | 20000.0 | 14.0 | B31.3 | |
| 512 | 3402.6 | -0.0 | 1.000 | 1.000 | 6035.5 | 20000.0 | 30.2 | B31.3 | |
| | | | | | | | | | |
| 512 | 3402.6 | 0.0 | 1.000 | 1.000 | 6035.5 | 20000.0 | 30.2 | B31.3 | |
| 515 | 0.1 | -0.0 | 10.994 | 14.325 | 2550.2 | 20000.0 | 12.8 | B31.3 | |
| | | | | | | | | | |
| 115 | 11470.4 | 0.0 | 10.994 | 14.325 | 10025.0 | 20000.0 | 50.1 | B31.3 | |
| 520 | 8847.7 | -0.0 | 1.000 | 1.000 | 10351.4 | 20000.0 | 51.8 | B31.3 | |
| | | | | | | | | | |
| 520 | 8847.7 | 0.0 | 1.000 | 1.000 | 10351.4 | 20000.0 | 51.8 | B31.3 | |
| 523 | 4318.4 | -0.0 | 1.000 | 1.000 | 5834.2 | 20000.0 | 29.2 | B31.3 | |
| | | | | | | | | | |
| 523 | 10200.4 | 0.0 | 2.362 | 1.968 | 9166.0 | 20000.0 | 45.8 | B31.3 | |
| 524 | 11198.6 | -0.0 | 2.362 | 1.968 | 8474.1 | 20000.0 | 42.4 | B31.3 | |
| | | | | | | | | | |
| 524 | 11198.6 | 0.0 | 2.362 | 1.968 | 8474.1 | 20000.0 | 42.4 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 525 | 6439.9 | -0.0 | 2.362 | 1.968 | 5245.8 | 20000.0 | 26.2 | B31.3 | |
| | | | | | | | | | |
| 525 | 2726.4 | 0.0 | 1.000 | 1.000 | 3142.2 | 20000.0 | 15.7 | B31.3 | |
| 530 | 2292.0 | -0.0 | 1.000 | 1.000 | 2707.8 | 20000.0 | 13.5 | B31.3 | |
| | | | | | | | | | |
| 530 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 535 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 535 | 365.7 | 0.0 | 1.000 | 1.000 | 781.5 | 20000.0 | 3.9 | B31.3 | |
| 540 | 8374.4 | -0.0 | 1.000 | 1.000 | 8790.3 | 20000.0 | 44.0 | B31.3 | |
| | | | | | | | | | |
| 540 | 8374.4 | 0.0 | 1.000 | 1.000 | 8790.3 | 20000.0 | 44.0 | B31.3 | |
| 545 | 1305.1 | -0.0 | 1.000 | 1.000 | 1720.9 | 20000.0 | 8.6 | B31.3 | |
| | | | | | | | | | |
| 545 | 1305.1 | 0.0 | 1.000 | 1.000 | 1720.9 | 20000.0 | 8.6 | B31.3 | |
| 550 | 514.9 | -0.0 | 1.000 | 1.000 | 930.7 | 20000.0 | 4.7 | B31.3 | |
| | | | | | | | | | |
| 550 | 514.9 | 0.0 | 1.000 | 1.000 | 950.8 | 20000.0 | 4.8 | B31.3 | |
| 555 | 401.5 | -0.0 | 1.000 | 1.000 | 1956.0 | 20000.0 | 9.8 | B31.3 | |
| | | | | | | | | | |
| 555 | 401.5 | 0.0 | 1.000 | 1.000 | 1942.3 | 20000.0 | 9.7 | B31.3 | |
| 560 | 264.6 | -0.0 | 1.000 | 1.000 | 1805.3 | 20000.0 | 9.0 | B31.3 | |
| | | | | | | | | | |
| 560 | 264.6 | 0.0 | 1.000 | 1.000 | 1805.3 | 20000.0 | 9.0 | B31.3 | |
| 565 | 540.3 | -0.0 | 1.000 | 1.000 | 2081.0 | 20000.0 | 10.4 | B31.3 | |
| | | | | | | | | | |
| 565 | 540.3 | 0.0 | 1.000 | 1.000 | 2081.0 | 20000.0 | 10.4 | B31.3 | |
| 570 | 59.3 | -0.0 | 1.000 | 1.000 | 1600.1 | 20000.0 | 8.0 | B31.3 | |
| | | | | | | | | | |
| 570 | 59.3 | 0.0 | 1.000 | 1.000 | 1600.1 | 20000.0 | 8.0 | B31.3 | |
| 575 | 2309.0 | -0.0 | 1.000 | 1.000 | 3849.7 | 20000.0 | 19.2 | B31.3 | |
| | | | | | | | | | |
| 575 | 2309.0 | 0.0 | 1.000 | 1.000 | 3849.7 | 20000.0 | 19.2 | B31.3 | |
| 580 | 227.7 | -0.0 | 1.000 | 1.000 | 1768.4 | 20000.0 | 8.8 | B31.3 | |
| | | | | | | | | | |
| 580 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 585 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 585 | 0.1 | 0.0 | 1.000 | 1.000 | 1540.8 | 20000.0 | 7.7 | B31.3 | |
| 590 | 5167.8 | -0.0 | 1.000 | 1.000 | 6708.5 | 20000.0 | 33.5 | B31.3 | |
| | | | | | | | | | |
| 590 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 595 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 595 | 6275.1 | 0.0 | 1.000 | 1.000 | 7815.8 | 20000.0 | 39.1 | B31.3 | |
| 598 | 6528.1 | -0.0 | 1.000 | 1.000 | 8068.9 | 20000.0 | 40.3 | B31.3 | |
| | | | | | | | | | |
| 598 | 19618.5 | 0.0 | 3.005 | 2.504 | 16254.6 | 20000.0 | 81.3 | B31.3 | |
| 599 | 21186.6 | -0.0 | 3.005 | 2.504 | 17290.8 | 20000.0 | 86.5 | B31.3 | |
| | | | | | | | | | |
| 599 | 21186.6 | 0.0 | 3.005 | 2.504 | 17290.8 | 20000.0 | 86.5 | B31.3 | |
| 600 | 5430.1 | -0.0 | 3.005 | 2.504 | 6727.9 | 20000.0 | 33.6 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 600 | 1806.9 | 0.0 | 1.000 | 1.000 | 4462.2 | 20000.0 | 22.3 | B31.3 | |
| 605 | 374.3 | -0.0 | 1.000 | 1.000 | 3023.3 | 20000.0 | 15.1 | B31.3 | |
| | | | | | | | | | |
| 605 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 610 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 610 | 146.7 | 0.0 | 1.000 | 1.000 | 2794.0 | 20000.0 | 14.0 | B31.3 | |
| 612 | 3402.6 | -0.0 | 1.000 | 1.000 | 6035.5 | 20000.0 | 30.2 | B31.3 | |
| | | | | | | | | | |
| 612 | 3402.6 | 0.0 | 1.000 | 1.000 | 6035.5 | 20000.0 | 30.2 | B31.3 | |
| 615 | 0.1 | -0.0 | 10.994 | 14.325 | 2550.2 | 20000.0 | 12.8 | B31.3 | |
| | | | | | | | | | |
| 615 | 977.2 | 0.0 | 10.994 | 14.325 | 5889.5 | 20000.0 | 29.4 | B31.3 | |
| 620 | 569.4 | -0.0 | 1.000 | 1.000 | 5726.0 | 20000.0 | 28.6 | B31.3 | |
| | | | | | | | | | |
| 620 | 569.4 | -0.0 | 1.000 | 1.000 | 5726.0 | 20000.0 | 28.6 | B31.3 | |
| 625 | 0.0 | 0.0 | 1.000 | 1.000 | 5156.6 | 20000.0 | 25.8 | B31.3 | |
| | | | | | | | | | |
| 615 | 977.3 | 0.0 | 10.994 | 14.325 | 5889.5 | 20000.0 | 29.4 | B31.3 | |
| 515 | 1035.6 | -0.0 | 10.994 | 14.325 | 5933.3 | 20000.0 | 29.7 | B31.3 | |
| | | | | | | | | | |
| 515 | 1035.6 | 0.0 | 10.994 | 14.325 | 5933.3 | 20000.0 | 29.7 | B31.3 | |
| 415 | 1035.2 | -0.0 | 10.994 | 14.325 | 5933.0 | 20000.0 | 29.7 | B31.3 | |
| | | | | | | | | | |
| 415 | 1035.2 | 0.0 | 10.994 | 14.325 | 5933.0 | 20000.0 | 29.7 | B31.3 | |
| 315 | 1027.2 | -0.0 | 10.994 | 14.325 | 5927.0 | 20000.0 | 29.6 | B31.3 | |
| | | | | | | | | | |
| 315 | 1027.1 | -0.0 | 10.994 | 14.325 | 5926.9 | 20000.0 | 29.6 | B31.3 | |
| 630 | 186.9 | 0.0 | 1.000 | 1.000 | 5343.5 | 20000.0 | 26.7 | B31.3 | |
| | | | | | | | | | |
| 630 | 186.9 | 0.0 | 1.000 | 1.000 | 5343.5 | 20000.0 | 26.7 | B31.3 | |
| 635 | 0.0 | 0.0 | 1.000 | 1.000 | 5156.6 | 20000.0 | 25.8 | B31.3 | |

Job Description:

PROJECT: NEWPP Water Purifiaction Plant, Houston

CLIENT : CDM Smith

ANALYST: DClark

CHECKER: RSinghal

NOTES : UV Building Phase 1

Existing Configuration without Flex Joints

PIPE DATA
---
---
From 5 To 10 DX= -20.000 ft.
B31.3 (2010) Cycle Max Switch = --- App.P Sy/St Switch = ON
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.
Dia= 48.000 in. Wall= .375 in. Cor= .0000 in.
GENERAL
T1= 70 F P1= 165.0000 lb./sq.in. Mat= (102)A53 B
E= 29,500,000 lb./sq.in. EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in. EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in. EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in. EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in. EH9= 29,500,000 lb./sq.in. v = .292
Pipe Den= .2830000 lb./cu.in. Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .500 in. Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 5 ANC
Node 10 Y
Node 10 Z
ALLOWABLE STRESSES
---
From 10 To 15 DX= -20.000 ft.
BEND at "TO" end
Radius= 72.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 14
Angle/Node @2= .00 13
RESTRAINTS
Node 14 Y
Node 14 Z
---
From 15 To 20 DY= 6.000 ft.
RESTRAINTS
Node 20 Guide Gap= .250 in.
---
From 20 To 25 DY= 1.083 ft.
---
From 25 To 30 DY= .167 ft.
---
From 30 To 35 DY= 5.042 ft.
SIF's & TEE's

Node 35 Welding Tee
---
From 35 To 40 DY= 3.500 ft.
FORCES & MOMENTS
Node 40 FY1= -1,200.00 lb.
---
From 35 To 45 DX= -3.500 ft.
FORCES & MOMENTS
Node 45 FY1= -800.00 lb.
---
From 45 To 50 DX= -6.000 ft.
RESTRAINTS
Node 50 Y
---
From 50 To 55 DX= -9.187 ft.
RESTRAINTS
Node 55 +Y
---
From 55 To 60 DX= -.500 ft.
---
From 60 To 65 DX= -.167 ft.
---
From 65 To 70 DX= -5.062 ft.
FORCES & MOMENTS
Node 70 FY1= -800.00 lb.
---
From 70 To 75 DX= -6.167 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 72.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 74
Angle/Node @2= .00 73
---
From 75 To 80 DY= -6.167 ft.
---
From 80 To 85 DY= -.167 ft.
---
From 85 To 90 DY= -1.000 ft.
RESTRAINTS
Node 90 Guide Gap= .250 in.
---
From 90 To 95 DY= -6.750 ft.
BEND at "TO" end
Radius= 72.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 94
Angle/Node @2= .00 93
RESTRAINTS
Node 94 Y
Node 94 X
---
From 95 To 100 DZ= 8.000 ft.
RESTRAINTS
Node 100 Y
Node 100 X
SIF's & TEE's
Node 100 Unreinforced Tee
---
From 100 To 105 DZ= 8.000 ft.
RESTRAINTS
Node 105 Y
Node 105 X

SIF's & TEE's
  Node  105   Unreinforced Tee
---
From  105  To  110 DZ= 8.000 ft.
RESTRAINTS
  Node  110  Y
  Node  110  X
SIF's & TEE's
  Node  110   Unreinforced Tee
---
From  110  To  115 DZ= 8.000 ft.
RESTRAINTS
  Node  115  Y
  Node  115  X
SIF's & TEE's
  Node  115   Unreinforced Tee
---
From  115  To  120 DZ= 3.000 ft.
RESTRAINTS
  Node  120  Y
---
From  120  To  125 DZ= 2.000 ft.
RESTRAINTS
  Node  125  Y
  Node  125  X
---
From  125  To  130 DZ= 8.000 ft.
  Dia= 30.000 in.   Wall= .375 in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  130  Y
  Node  130  X
---
From  130  To  135 DZ= 8.000 ft.
BEND at "TO" end
  Radius= 45.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 134
  Angle/Node @2= .00 133
RESTRAINTS
  Node  134  Y
  Node  134  X
---
From  135  To  140 DY= 6.750 ft.
RESTRAINTS
  Node  140  Guide   Gap= .250 in.
---
From  140  To  145 DY= 1.000 ft.
---
From  145  To  150 DY= .167 ft.
---
From  150  To  155 DY= 3.750 ft.
SINGLE FLANGED BEND at "TO" end
  Radius= 45.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 154
---
From  155  To  160  DX= -3.917 ft.
FORCES & MOMENTS
  Node  160   FY1= -330.00 lb.
---
From  160  To  165  DX= -.750 ft.

RIGID  Weight= 475.00 lb.
FORCES & MOMENTS
  Node  165   FY1= -330.00 lb.
---
From  165  To  170  DX= -3.646 ft.
RESTRAINTS
  Node  170  Y
---
From  170  To  175  DX= -8.083 ft.
RESTRAINTS
  Node  175  +Y
---
From  175  To  180  DX= -8.083 ft.
RESTRAINTS
  Node  180  Y
---
From  180  To  185  DX= -.750 ft.
FORCES & MOMENTS
  Node  185   FY1= -330.00 lb.
---
From  185  To  190  DX= -.750 ft.
RIGID  Weight= 475.00 lb.
FORCES & MOMENTS
  Node  190   FY1= -330.00 lb.
---
From  190  To  195  DX= -3.917 ft.
SINGLE FLANGED BEND at "TO" end
  Radius= 45.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 194
  Angle/Node @2= .00 193
---
From  195  To  200 DY= -4.500 ft.
RESTRAINTS
  Node  200  Guide   Gap= .250 in.
---
From  200  To  205 DY= -6.750 ft.
BEND at "TO" end
  Radius= 45.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 204
  Angle/Node @2= .00 203
RESTRAINTS
  Node  204  Y
---
From  205  To  210  DX= -7.071 ft.  DZ= 7.071 ft.
RESTRAINTS
  Node  210  Y
  Node  210  Guide
---
From  210  To  215  DX= -14.142 ft.  DZ= 14.142 ft.
RESTRAINTS
  Node  215  Y
  Node  215  Guide
---
From  100  To  220 DY= 6.750 ft.
GENERAL
  Refract. Thk= .375 in.   Refract. Den= .0643000 lb./cu.in.
RESTRAINTS
  Node  220  Guide   Gap= .250 in.
---
From  220  To  225 DY= 4.750 ft.

SINGLE FLANGED BEND at "TO" end
Radius= 45.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 224
Angle/Node @2= .00 223
---
From 225 To 230 DX= -3.917 ft.
FORCES & MOMENTS
Node 230 FY1= -365.00 lb.
---
From 230 To 235 DX= -.750 ft.
RIGID Weight= 600.00 lb.
FORCES & MOMENTS
Node 235 FY1= -365.00 lb.
---
From 235 To 240 DX= -3.500 ft.
RESTRAINTS
Node 240 Y
---
From 240 To 245 DX= -8.844 ft.
RESTRAINTS
Node 245 Y
---
From 245 To 250 DX= -7.125 ft.
FORCES & MOMENTS
Node 250 FY1= -730.00 lb.
---
From 250 To 255 DX= -2.083 ft. DY= -.250 ft.
FORCES & MOMENTS
Node 255 FY1= -1,730.00 lb.
---
From 255 To 260 DX= -1.385 ft.
Dia= 36.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Insul Thk= .000 in.
RESTRAINTS
Node 260 Y
---
From 260 To 265 DX= -7.219 ft.
Dia= 36.000 in. Wall= .375 in.
Insul Thk= .000 in.
RESTRAINTS
Node 265 Y
---
From 265 To 270 DX= -1.146 ft.
FORCES & MOMENTS
Node 270 FY1= -1,730.00 lb.
---
From 270 To 275 DX= -8.750 ft.
RESTRAINTS
Node 275 Y
---
From 275 To 280 DX= -1.542 ft.
---
From 280 To 285 DX= -.167 ft.
---
From 285 To 290 DX= -3.687 ft.
FORCES & MOMENTS
Node 290 FY1= -590.00 lb.
---

From  290  To  295  DX= -.750 ft.
RIGID  Weight= 975.00 lb.
FORCES & MOMENTS
  Node  295   FY1= -590.00 lb.
---
From  295  To  300  DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
  Radius= 36.000 in. (SHORT   Bend Angle= 90.000   Angle/Node @1= 45.00 299
  Angle/Node @2= .00 298
---
From  300  To  305 DY= -3.458 ft.
---
From  305  To  310 DY= -.167 ft.
---
From  310  To  312 DY= -1.042 ft.
RESTRAINTS
  Node  312  Guide   Gap= .250 in.
---
From  312  To  315 DY= -6.000 ft.
RESTRAINTS
  Node  315  Y
  Node  315  X
SIF's & TEE's
  Node  315   Unreinforced Tee
---
From  105  To  320 DY= 6.750 ft.
  Dia= 30.000 in.   Wall= .375 in.
GENERAL
  Refract. Thk= .375 in.   Refract. Den= .0643000 lb./cu.in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  320  Guide   Gap= .250 in.
---
From  320  To  325 DY= 4.750 ft.
SINGLE FLANGED BEND at "TO" end
  Radius= 45.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 324
  Angle/Node @2= .00 323
---
From  325  To  330  DX= -3.917 ft.
FORCES & MOMENTS
  Node  330   FY1= -365.00 lb.
---
From  330  To  335  DX= -.750 ft.
RIGID  Weight= 600.00 lb.
FORCES & MOMENTS
  Node  335   FY1= -365.00 lb.
---
From  335  To  340  DX= -3.500 ft.
RESTRAINTS
  Node  340  Y
---
From  340  To  345  DX= -8.844 ft.
RESTRAINTS
  Node  345  Y
---
From  345  To  350  DX= -7.125 ft.
FORCES & MOMENTS
  Node  350   FY1= -730.00 lb.

---
From 350 To 355 DX= -2.083 ft. DY= -.250 ft.
FORCES & MOMENTS
Node 355 FY1= -1,730.00 lb.
---
From 355 To 360 DX= -1.385 ft.
Dia= 36.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Insul Thk= .000 in.
RESTRAINTS
Node 360 Y
---
From 360 To 365 DX= -7.219 ft.
Dia= 36.000 in. Wall= .375 in.
Insul Thk= .000 in.
RESTRAINTS
Node 365 Y
---
From 365 To 370 DX= -1.146 ft.
FORCES & MOMENTS
Node 370 FY1= -1,730.00 lb.
---
From 370 To 375 DX= -8.750 ft.
RESTRAINTS
Node 375 Y
---
From 375 To 380 DX= -1.542 ft.
---
From 380 To 385 DX= -.167 ft.
---
From 385 To 390 DX= -3.687 ft.
FORCES & MOMENTS
Node 390 FY1= -590.00 lb.
---
From 390 To 395 DX= -.750 ft.
RIGID Weight= 975.00 lb.
FORCES & MOMENTS
Node 395 FY1= -590.00 lb.
---
From 395 To 400 DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 36.000 in. (SHORT Bend Angle= 90.000 Angle/Node @1= 45.00 399
Angle/Node @2= .00 398
---
From 400 To 405 DY= -3.458 ft.
---
From 405 To 410 DY= -.167 ft.
---
From 410 To 412 DY= -1.042 ft.
RESTRAINTS
Node 412 Guide Gap= .250 in.
---
From 412 To 415 DY= -6.000 ft.
RESTRAINTS
Node 415 Y
Node 415 X
SIF's & TEE's
Node 415 Unreinforced Tee

---
From 110 To 420 DY= 6.750 ft.
Dia= 30.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Refract. Den= .0643000 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 420 Guide Gap= .250 in.
---
From 420 To 425 DY= 4.750 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 45.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 424
Angle/Node @2= .00 423
---
From 425 To 430 DX= -3.917 ft.
FORCES & MOMENTS
Node 430 FY1= -365.00 lb.
---
From 430 To 435 DX= -.750 ft.
RIGID Weight= 600.00 lb.
FORCES & MOMENTS
Node 435 FY1= -365.00 lb.
---
From 435 To 440 DX= -3.500 ft.
RESTRAINTS
Node 440 Y
---
From 440 To 445 DX= -8.844 ft.
RESTRAINTS
Node 445 Y
---
From 445 To 450 DX= -7.125 ft.
FORCES & MOMENTS
Node 450 FY1= -730.00 lb.
---
From 450 To 455 DX= -2.083 ft. DY= -.250 ft.
FORCES & MOMENTS
Node 455 FY1= -1,730.00 lb.
---
From 455 To 460 DX= -1.385 ft.
Dia= 36.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Insul Thk= .000 in.
RESTRAINTS
Node 460 Y
---
From 460 To 465 DX= -7.219 ft.
Dia= 36.000 in. Wall= .375 in.
Insul Thk= .000 in.
RESTRAINTS
Node 465 Y
---
From 465 To 470 DX= -1.146 ft.
FORCES & MOMENTS
Node 470 FY1= -1,730.00 lb.
---
From 470 To 475 DX= -8.750 ft.
RESTRAINTS

Node 475 Y
---
From 475 To 480 DX= -1.542 ft.
---
From 480 To 485 DX= -.167 ft.
---
From 485 To 490 DX= -3.687 ft.
FORCES & MOMENTS
Node 490 FY1= -590.00 lb.
---
From 490 To 495 DX= -.750 ft.
RIGID Weight= 975.00 lb.
FORCES & MOMENTS
Node 495 FY1= -590.00 lb.
---
From 495 To 500 DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 36.000 in. (SHORT Bend Angle= 90.000 Angle/Node @1= 45.00 499
Angle/Node @2= .00 498
---
From 500 To 505 DY= -3.458 ft.
---
From 505 To 510 DY= -.167 ft.
---
From 510 To 512 DY= -1.042 ft.
RESTRAINTS
Node 512 Guide Gap= .250 in.
---
From 512 To 515 DY= -6.000 ft.
RESTRAINTS
Node 515 Y
Node 515 X
SIF's & TEE's
Node 515 Unreinforced Tee
---
From 115 To 520 DY= 6.750 ft.
Dia= 30.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Refract. Den= .0643000 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 520 Guide Gap= .250 in.
---
From 520 To 525 DY= 4.750 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 45.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 524
Angle/Node @2= .00 523
---
From 525 To 530 DX= -3.917 ft.
FORCES & MOMENTS
Node 530 FY1= -365.00 lb.
---
From 530 To 535 DX= -.750 ft.
RIGID Weight= 600.00 lb.
FORCES & MOMENTS
Node 535 FY1= -365.00 lb.
---
From 535 To 540 DX= -3.500 ft.

RESTRAINTS
  Node 540 Y
---
From 540 To 545 DX= -8.844 ft.
RESTRAINTS
  Node 545 Y
---
From 545 To 550 DX= -7.125 ft.
FORCES & MOMENTS
  Node 550 FY1= -730.00 lb.
---
From 550 To 555 DX= -2.083 ft. DY= -.250 ft.
FORCES & MOMENTS
  Node 555 FY1= -1,730.00 lb.
---
From 555 To 560 DX= -1.385 ft.
  Dia= 36.000 in. Wall= .375 in.
GENERAL
  Refract. Thk= .375 in. Insul Thk= .000 in.
RESTRAINTS
  Node 560 Y
---
From 560 To 565 DX= -7.219 ft.
  Dia= 36.000 in. Wall= .375 in.
  Insul Thk= .000 in.
RESTRAINTS
  Node 565 Y
---
From 565 To 570 DX= -1.146 ft.
FORCES & MOMENTS
  Node 570 FY1= -1,730.00 lb.
---
From 570 To 575 DX= -8.750 ft.
RESTRAINTS
  Node 575 Y
---
From 575 To 580 DX= -1.542 ft.
---
From 580 To 585 DX= -.167 ft.
---
From 585 To 590 DX= -3.687 ft.
FORCES & MOMENTS
  Node 590 FY1= -590.00 lb.
---
From 590 To 595 DX= -.750 ft.
RIGID Weight= 975.00 lb.
FORCES & MOMENTS
  Node 595 FY1= -590.00 lb.
---
From 595 To 600 DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
  Radius= 36.000 in. (SHORT Bend Angle= 90.000 Angle/Node @1= 45.00 599
  Angle/Node @2= .00 598
---
From 600 To 605 DY= -3.458 ft.
---
From 605 To 610 DY= -.167 ft.
---

From 610 To 612 DY= -1.042 ft.
RESTRAINTS
  Node 612 Guide  Gap= .250 in.
---
From 612 To 615 DY= -6.000 ft.
RESTRAINTS
  Node 615 Y
  Node 615 X
SIF's & TEE's
  Node 615  Unreinforced Tee
---
From 615 To 620 DZ= 10.000 ft.
  Dia= 48.000 in.  Wall= .375 in.
GENERAL
  Refract. Thk= .500 in.  Insul Thk= .000 in.
RESTRAINTS
  Node 620 Y
  Node 620 X
---
From 620 To 625 DZ= 20.000 ft.
RESTRAINTS
  Node 625 Y
  Node 625 X
---
From 615 To 515 DX= .000 ft. DY= .000 ft. DZ= -8.000 ft.
---
From 515 To 415 DX= .000 ft. DY= .000 ft. DZ= -8.000 ft.
---
From 415 To 315 DX= .000 ft. DY= .000 ft. DZ= -8.000 ft.
---
From 315 To 630 DZ= -8.000 ft.
RESTRAINTS
  Node 630 Y
  Node 630 X
---
From 630 To 635 DZ= -12.000 ft.
RESTRAINTS
  Node 635 Y
  Node 635 X

# Summary of Support Loads

CASE 1 (SUS) W+P1+F1

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| 5 | | Rigid ANC | | | | | |
| | 1(SUS) | 733 | -9650 | -94 | -3539.4 | -530.8 | 31926.4 |
| | | | | | | | |
| | | | | | | | |
| 10 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -19810 | 134 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 14 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -26351 | -54 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 20 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 50 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -10448 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 55 | | Rigid +Y | | | | | |
| | 1(SUS) | 0 | -14494 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 90 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 94 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -850 | -21019 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 100 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 509 | -7975 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 105 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 229 | -15304 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 110 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 279 | -14144 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 115 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 284 | -11646 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 120 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -1771 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 125 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -24 | -2628 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 130 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 68 | -2356 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 134 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -61 | -7277 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 140 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 170 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -6062 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 175 | | Rigid +Y | | | | | |
| | 1(SUS) | 0 | -1785 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 180 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -5874 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 200 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 204 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -4274 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 210 | | Rigid Y; | | | | | |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | Rigid GUI | | | | | |
| | 1(SUS) | 29 | -8197 | 29 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 215 | | Rigid Y; Rigid GUI | | | | | |
| | 1(SUS) | -15 | -3558 | -15 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 220 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 240 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -4740 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 245 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -4227 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 260 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7225 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 265 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -5540 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 275 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7858 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 312 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 315 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -330 | -15838 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 320 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 340 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -4751 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 345 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -4225 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 360 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7227 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 365 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -5530 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 375 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7885 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 412 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 415 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -293 | -16481 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 420 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 440 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -4752 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 445 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -4225 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 460 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7227 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 465 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -5525 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 475 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7897 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 512 | | Rigid GUI | | | | | |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 515 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -279 | -16500 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 520 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 540 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -4749 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 545 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -4226 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 560 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7227 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 565 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -5525 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 575 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7898 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 612 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 615 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -280 | -14746 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 620 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 0 | -18854 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 625 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -0 | -8180 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 630 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 1 | -11252 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 635 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -0 | -4991 | 0 | 0.0 | 0.0 | 0.0 |

```
Piping Code: B31.3      = B31.3 -2010, March 31, 2011


 CODE STRESS CHECK PASSED      : LOADCASE 1 (SUS) W+P1+F1

Highest Stresses: (lb./sq.in.)
Ratio (%):                      30.1       @Node    100
Code Stress:                  6029.3       Allowable Stress:      20000.0
Axial Stress:                 5251.9       @Node     14
Bending Stress:               1163.7       @Node    100
Torsion Stress:                 32.0       @Node     10
Hoop Stress:                 10395.0       @Node     10
Max Stress Intensity:        10643.4       @Node     10
```

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 578.1 | -32.0 | 1.000 | 1.000 | 5721.9 | 20000.0 | 28.6 | B31.3 | |
| 10 | 615.6 | 32.0 | 1.000 | 1.000 | 5759.5 | 20000.0 | 28.8 | B31.3 | |
| | | | | | | | | | |
| 10 | 615.6 | -32.0 | 1.000 | 1.000 | 5759.5 | 20000.0 | 28.8 | B31.3 | |
| 13 | 178.3 | 32.0 | 1.000 | 1.000 | 5322.2 | 20000.0 | 26.6 | B31.3 | |
| | | | | | | | | | |
| 13 | 549.3 | -32.0 | 3.084 | 2.570 | 5555.9 | 20000.0 | 27.8 | B31.3 | |
| 14 | 919.8 | 27.1 | 3.084 | 2.570 | 5941.9 | 20000.0 | 29.7 | B31.3 | |
| | | | | | | | | | |
| 14 | 919.8 | -27.1 | 3.084 | 2.570 | 5609.9 | 20000.0 | 28.0 | B31.3 | |
| 15 | 555.2 | 5.8 | 3.084 | 2.570 | 5333.1 | 20000.0 | 26.7 | B31.3 | |
| | | | | | | | | | |
| 15 | 183.5 | -5.8 | 1.000 | 1.000 | 5100.2 | 20000.0 | 25.5 | B31.3 | |
| 20 | 182.7 | 5.8 | 1.000 | 1.000 | 5100.5 | 20000.0 | 25.5 | B31.3 | |
| | | | | | | | | | |
| 20 | 182.7 | -5.8 | 1.000 | 1.000 | 5100.5 | 20000.0 | 25.5 | B31.3 | |
| 25 | 169.2 | 5.8 | 1.000 | 1.000 | 5105.8 | 20000.0 | 25.5 | B31.3 | |
| | | | | | | | | | |
| 25 | 169.2 | -5.8 | 1.000 | 1.000 | 5105.8 | 20000.0 | 25.5 | B31.3 | |
| 30 | 167.2 | 5.8 | 1.000 | 1.000 | 5106.6 | 20000.0 | 25.5 | B31.3 | |
| | | | | | | | | | |
| 30 | 167.2 | -5.8 | 1.000 | 1.000 | 5106.6 | 20000.0 | 25.5 | B31.3 | |
| 35 | 627.8 | 5.8 | 5.303 | 6.738 | 5497.9 | 20000.0 | 27.5 | B31.3 | |
| | | | | | | | | | |
| 35 | 0.0 | 0.0 | 5.303 | 6.738 | 5074.4 | 20000.0 | 25.4 | B31.3 | |
| 40 | 0.0 | 0.0 | 1.000 | 1.000 | 5135.2 | 20000.0 | 25.7 | B31.3 | |
| | | | | | | | | | |
| 35 | 470.7 | -31.4 | 5.303 | 6.738 | 5496.9 | 20000.0 | 27.5 | B31.3 | |
| 45 | 148.0 | 31.4 | 1.000 | 1.000 | 5291.9 | 20000.0 | 26.5 | B31.3 | |
| | | | | | | | | | |
| 45 | 148.0 | -31.4 | 1.000 | 1.000 | 5291.9 | 20000.0 | 26.5 | B31.3 | |
| 50 | 340.1 | 31.4 | 1.000 | 1.000 | 5483.9 | 20000.0 | 27.4 | B31.3 | |
| | | | | | | | | | |
| 50 | 340.1 | -31.4 | 1.000 | 1.000 | 5483.9 | 20000.0 | 27.4 | B31.3 | |
| 55 | 580.0 | 31.4 | 1.000 | 1.000 | 5723.9 | 20000.0 | 28.6 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 55 | 580.0 | -31.4 | 1.000 | 1.000 | 5723.9 | 20000.0 | 28.6 | B31.3 | |
| 60 | 504.7 | 31.4 | 1.000 | 1.000 | 5648.5 | 20000.0 | 28.2 | B31.3 | |
| | | | | | | | | | |
| 60 | 504.7 | -31.4 | 1.000 | 1.000 | 5648.5 | 20000.0 | 28.2 | B31.3 | |
| 65 | 480.5 | 31.4 | 1.000 | 1.000 | 5624.4 | 20000.0 | 28.1 | B31.3 | |
| | | | | | | | | | |
| 65 | 480.5 | -31.4 | 1.000 | 1.000 | 5624.4 | 20000.0 | 28.1 | B31.3 | |
| 70 | 26.2 | 31.4 | 1.000 | 1.000 | 5170.1 | 20000.0 | 25.9 | B31.3 | |
| | | | | | | | | | |
| 70 | 26.2 | -31.4 | 1.000 | 1.000 | 5170.1 | 20000.0 | 25.9 | B31.3 | |
| 73 | 31.2 | 31.4 | 1.000 | 1.000 | 5175.1 | 20000.0 | 25.9 | B31.3 | |
| | | | | | | | | | |
| 73 | 55.1 | -31.4 | 1.857 | 1.547 | 5185.2 | 20000.0 | 25.9 | B31.3 | |
| 74 | 113.4 | 15.7 | 1.857 | 1.547 | 5200.1 | 20000.0 | 26.0 | B31.3 | |
| | | | | | | | | | |
| 74 | 113.4 | -15.7 | 1.857 | 1.547 | 5200.1 | 20000.0 | 26.0 | B31.3 | |
| 75 | 121.7 | -9.6 | 1.857 | 1.547 | 5120.1 | 20000.0 | 25.6 | B31.3 | |
| | | | | | | | | | |
| 75 | 74.6 | 9.6 | 1.000 | 1.000 | 5103.4 | 20000.0 | 25.5 | B31.3 | |
| 80 | 73.5 | -9.6 | 1.000 | 1.000 | 5099.4 | 20000.0 | 25.5 | B31.3 | |
| | | | | | | | | | |
| 80 | 73.5 | 9.6 | 1.000 | 1.000 | 5099.4 | 20000.0 | 25.5 | B31.3 | |
| 85 | 72.5 | -9.6 | 1.000 | 1.000 | 5095.5 | 20000.0 | 25.5 | B31.3 | |
| | | | | | | | | | |
| 85 | 72.5 | 9.6 | 1.000 | 1.000 | 5095.5 | 20000.0 | 25.5 | B31.3 | |
| 90 | 67.6 | -9.6 | 1.000 | 1.000 | 5073.3 | 20000.0 | 25.4 | B31.3 | |
| | | | | | | | | | |
| 90 | 67.6 | 9.6 | 1.000 | 1.000 | 5073.3 | 20000.0 | 25.4 | B31.3 | |
| 93 | 65.5 | -9.6 | 1.000 | 1.000 | 5058.1 | 20000.0 | 25.3 | B31.3 | |
| | | | | | | | | | |
| 93 | 201.4 | 9.6 | 3.084 | 2.570 | 5143.6 | 20000.0 | 25.7 | B31.3 | |
| 94 | 1001.7 | -14.8 | 3.084 | 2.570 | 5733.9 | 20000.0 | 28.7 | B31.3 | |
| | | | | | | | | | |
| 94 | 1001.7 | 14.8 | 3.084 | 2.570 | 5998.8 | 20000.0 | 30.0 | B31.3 | |
| 95 | 140.7 | -21.2 | 3.084 | 2.570 | 5262.0 | 20000.0 | 26.3 | B31.3 | |
| | | | | | | | | | |
| 95 | 45.7 | 21.2 | 1.000 | 1.000 | 5202.2 | 20000.0 | 26.0 | B31.3 | |
| 100 | 1163.7 | -21.2 | 10.994 | 14.325 | 6029.3 | 20000.0 | 30.1 | B31.3 | |
| | | | | | | | | | |
| 100 | 1146.3 | 11.5 | 10.994 | 14.325 | 6016.1 | 20000.0 | 30.1 | B31.3 | |
| 105 | 1052.2 | -11.5 | 10.994 | 14.325 | 5945.5 | 20000.0 | 29.7 | B31.3 | |
| | | | | | | | | | |
| 105 | 1052.0 | 5.4 | 10.994 | 14.325 | 5945.4 | 20000.0 | 29.7 | B31.3 | |
| 110 | 1038.0 | -5.4 | 10.994 | 14.325 | 5934.8 | 20000.0 | 29.7 | B31.3 | |
| | | | | | | | | | |
| 110 | 1037.9 | 0.6 | 10.994 | 14.325 | 5934.8 | 20000.0 | 29.7 | B31.3 | |
| 115 | 663.8 | -0.6 | 10.994 | 14.325 | 5654.2 | 20000.0 | 28.3 | B31.3 | |
| | | | | | | | | | |
| 115 | 661.2 | -4.3 | 10.994 | 14.325 | 5652.2 | 20000.0 | 28.3 | B31.3 | |
| 120 | 38.5 | 4.3 | 1.000 | 1.000 | 5194.8 | 20000.0 | 26.0 | B31.3 | |
| | | | | | | | | | |
| 120 | 38.5 | -4.3 | 1.000 | 1.000 | 5194.8 | 20000.0 | 26.0 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 125 | 107.1 | 11.2 | 1.000 | 1.000 | 3283.6 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 125 | 107.1 | -11.2 | 1.000 | 1.000 | 3283.6 | 20000.0 | 16.4 | B31.3 | |
| 130 | 9.1 | 11.2 | 1.000 | 1.000 | 3185.6 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 130 | 9.1 | -11.2 | 1.000 | 1.000 | 3185.6 | 20000.0 | 15.9 | B31.3 | |
| 133 | 3.8 | 11.2 | 1.000 | 1.000 | 3180.3 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 133 | 12.3 | -11.2 | 3.622 | 3.018 | 3185.7 | 20000.0 | 15.9 | B31.3 | |
| 134 | 680.0 | 5.6 | 3.622 | 3.018 | 3729.7 | 20000.0 | 18.6 | B31.3 | |
| | | | | | | | | | |
| 134 | 680.0 | -5.6 | 3.622 | 3.018 | 3582.3 | 20000.0 | 17.9 | B31.3 | |
| 135 | 211.7 | -4.1 | 3.622 | 3.018 | 3224.1 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 135 | 59.8 | 4.1 | 1.000 | 1.000 | 3125.1 | 20000.0 | 15.6 | B31.3 | |
| 140 | 57.3 | -4.1 | 1.000 | 1.000 | 3159.1 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 140 | 57.3 | 4.1 | 1.000 | 1.000 | 3159.1 | 20000.0 | 15.8 | B31.3 | |
| 145 | 56.5 | -4.1 | 1.000 | 1.000 | 3170.5 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 145 | 56.5 | 4.1 | 1.000 | 1.000 | 3170.5 | 20000.0 | 15.9 | B31.3 | |
| 150 | 56.4 | -4.1 | 1.000 | 1.000 | 3172.4 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 150 | 114.1 | 4.1 | 2.362 | 1.968 | 3201.6 | 20000.0 | 16.0 | B31.3 | |
| 154 | 139.5 | 15.3 | 2.362 | 1.968 | 3264.2 | 20000.0 | 16.3 | B31.3 | |
| | | | | | | | | | |
| 154 | 139.5 | -15.3 | 2.362 | 1.968 | 3264.2 | 20000.0 | 16.3 | B31.3 | |
| 155 | 176.9 | 25.0 | 2.362 | 1.968 | 3310.2 | 20000.0 | 16.6 | B31.3 | |
| | | | | | | | | | |
| 155 | 75.0 | -25.0 | 1.000 | 1.000 | 3252.5 | 20000.0 | 16.3 | B31.3 | |
| 160 | 71.7 | 25.0 | 1.000 | 1.000 | 3249.2 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |
| 160 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 165 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 165 | 31.8 | -25.0 | 1.000 | 1.000 | 3209.4 | 20000.0 | 16.0 | B31.3 | |
| 170 | 413.0 | 25.0 | 1.000 | 1.000 | 3590.5 | 20000.0 | 18.0 | B31.3 | |
| | | | | | | | | | |
| 170 | 413.0 | -25.0 | 1.000 | 1.000 | 3590.5 | 20000.0 | 18.0 | B31.3 | |
| 175 | 42.1 | 25.0 | 1.000 | 1.000 | 3219.7 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 175 | 42.1 | -25.0 | 1.000 | 1.000 | 3219.7 | 20000.0 | 16.1 | B31.3 | |
| 180 | 298.3 | 25.0 | 1.000 | 1.000 | 3475.8 | 20000.0 | 17.4 | B31.3 | |
| | | | | | | | | | |
| 180 | 298.3 | -25.0 | 1.000 | 1.000 | 3475.8 | 20000.0 | 17.4 | B31.3 | |
| 185 | 181.2 | 25.0 | 1.000 | 1.000 | 3358.8 | 20000.0 | 16.8 | B31.3 | |
| | | | | | | | | | |
| 185 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 190 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 190 | 93.9 | -25.0 | 1.000 | 1.000 | 3271.5 | 20000.0 | 16.4 | B31.3 | |
| 193 | 80.2 | 25.0 | 1.000 | 1.000 | 3257.8 | 20000.0 | 16.3 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 193 | 189.1 | -25.0 | 2.362 | 1.968 | 3319.4 | 20000.0 | 16.6 | B31.3 | |
| 194 | 167.6 | 14.4 | 2.362 | 1.968 | 3312.5 | 20000.0 | 16.6 | B31.3 | |
| | | | | | | | | | |
| 194 | 167.6 | -14.4 | 2.362 | 1.968 | 3312.5 | 20000.0 | 16.6 | B31.3 | |
| 195 | 179.4 | -5.4 | 2.362 | 1.968 | 3289.1 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 195 | 81.3 | 5.4 | 1.000 | 1.000 | 3235.9 | 20000.0 | 16.2 | B31.3 | |
| 200 | 81.3 | -5.4 | 1.000 | 1.000 | 3226.7 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 200 | 81.3 | 5.4 | 1.000 | 1.000 | 3226.7 | 20000.0 | 16.1 | B31.3 | |
| 203 | 81.1 | -5.4 | 1.000 | 1.000 | 3190.0 | 20000.0 | 16.0 | B31.3 | |
| | | | | | | | | | |
| 203 | 293.7 | 5.4 | 3.622 | 3.018 | 3329.2 | 20000.0 | 16.6 | B31.3 | |
| 204 | 304.8 | -4.6 | 3.622 | 3.018 | 3332.1 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 204 | 304.8 | 4.6 | 3.622 | 3.018 | 3418.6 | 20000.0 | 17.1 | B31.3 | |
| 205 | 310.0 | -0.0 | 3.622 | 3.018 | 3409.3 | 20000.0 | 17.0 | B31.3 | |
| | | | | | | | | | |
| 205 | 85.9 | -0.0 | 1.000 | 1.000 | 3262.7 | 20000.0 | 16.3 | B31.3 | |
| 210 | 651.0 | 0.0 | 1.000 | 1.000 | 3827.8 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 210 | 651.0 | 0.0 | 1.000 | 1.000 | 3827.8 | 20000.0 | 19.1 | B31.3 | |
| 215 | 0.0 | 0.0 | 1.000 | 1.000 | 3176.8 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 100 | 712.4 | -0.0 | 10.994 | 14.325 | 3535.5 | 20000.0 | 17.7 | B31.3 | |
| 220 | 54.5 | 0.0 | 1.000 | 1.000 | 3137.3 | 20000.0 | 15.7 | B31.3 | |
| | | | | | | | | | |
| 220 | 54.5 | -0.0 | 1.000 | 1.000 | 3137.3 | 20000.0 | 15.7 | B31.3 | |
| 223 | 70.0 | 0.0 | 1.000 | 1.000 | 3164.8 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 223 | 165.3 | -0.0 | 2.362 | 1.968 | 3218.7 | 20000.0 | 16.1 | B31.3 | |
| 224 | 14.2 | 1.4 | 2.362 | 1.968 | 3147.9 | 20000.0 | 15.7 | B31.3 | |
| | | | | | | | | | |
| 224 | 14.2 | -1.4 | 2.362 | 1.968 | 3147.9 | 20000.0 | 15.7 | B31.3 | |
| 225 | 231.1 | 2.0 | 2.362 | 1.968 | 3340.7 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 225 | 97.9 | -2.0 | 1.000 | 1.000 | 3265.2 | 20000.0 | 16.3 | B31.3 | |
| 230 | 100.6 | 2.0 | 1.000 | 1.000 | 3267.9 | 20000.0 | 16.3 | B31.3 | |
| | | | | | | | | | |
| 230 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 235 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 235 | 84.0 | -2.0 | 1.000 | 1.000 | 3251.4 | 20000.0 | 16.3 | B31.3 | |
| 240 | 242.5 | 2.0 | 1.000 | 1.000 | 3409.8 | 20000.0 | 17.0 | B31.3 | |
| | | | | | | | | | |
| 240 | 242.5 | -2.0 | 1.000 | 1.000 | 3409.8 | 20000.0 | 17.0 | B31.3 | |
| 245 | 177.6 | 2.0 | 1.000 | 1.000 | 3344.9 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 245 | 177.6 | -2.0 | 1.000 | 1.000 | 3344.9 | 20000.0 | 16.7 | B31.3 | |
| 250 | 164.1 | 2.0 | 1.000 | 1.000 | 3331.4 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 250 | 164.1 | -1.9 | 1.000 | 1.000 | 3327.3 | 20000.0 | 16.6 | B31.3 | |
| 255 | 1.0 | 1.3 | 1.000 | 1.000 | 3823.5 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 255 | 0.9 | -1.4 | 1.000 | 1.000 | 3829.7 | 20000.0 | 19.1 | B31.3 | |
| 260 | 196.4 | 1.4 | 1.000 | 1.000 | 4025.2 | 20000.0 | 20.1 | B31.3 | |
| | | | | | | | | | |
| 260 | 196.4 | -1.4 | 1.000 | 1.000 | 4025.2 | 20000.0 | 20.1 | B31.3 | |
| 265 | 115.6 | 1.4 | 1.000 | 1.000 | 3944.4 | 20000.0 | 19.7 | B31.3 | |
| | | | | | | | | | |
| 265 | 115.6 | -1.4 | 1.000 | 1.000 | 3944.4 | 20000.0 | 19.7 | B31.3 | |
| 270 | 13.1 | 1.4 | 1.000 | 1.000 | 3841.9 | 20000.0 | 19.2 | B31.3 | |
| | | | | | | | | | |
| 270 | 13.1 | -1.4 | 1.000 | 1.000 | 3841.9 | 20000.0 | 19.2 | B31.3 | |
| 275 | 308.7 | 1.4 | 1.000 | 1.000 | 4137.5 | 20000.0 | 20.7 | B31.3 | |
| | | | | | | | | | |
| 275 | 308.7 | -1.4 | 1.000 | 1.000 | 4137.5 | 20000.0 | 20.7 | B31.3 | |
| 280 | 121.5 | 1.4 | 1.000 | 1.000 | 3950.3 | 20000.0 | 19.8 | B31.3 | |
| | | | | | | | | | |
| 280 | 121.5 | -1.4 | 1.000 | 1.000 | 3950.3 | 20000.0 | 19.8 | B31.3 | |
| 285 | 104.0 | 1.4 | 1.000 | 1.000 | 3932.8 | 20000.0 | 19.7 | B31.3 | |
| | | | | | | | | | |
| 285 | 104.0 | -1.4 | 1.000 | 1.000 | 3932.8 | 20000.0 | 19.7 | B31.3 | |
| 290 | 151.1 | 1.4 | 1.000 | 1.000 | 3979.9 | 20000.0 | 19.9 | B31.3 | |
| | | | | | | | | | |
| 290 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 295 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 295 | 146.8 | -1.4 | 1.000 | 1.000 | 3975.6 | 20000.0 | 19.9 | B31.3 | |
| 298 | 138.8 | 1.4 | 1.000 | 1.000 | 3967.7 | 20000.0 | 19.8 | B31.3 | |
| | | | | | | | | | |
| 298 | 417.2 | -1.4 | 3.005 | 2.504 | 4141.7 | 20000.0 | 20.7 | B31.3 | |
| 299 | 6.0 | 0.8 | 3.005 | 2.504 | 3787.1 | 20000.0 | 18.9 | B31.3 | |
| | | | | | | | | | |
| 299 | 6.0 | -0.8 | 3.005 | 2.504 | 3787.1 | 20000.0 | 18.9 | B31.3 | |
| 300 | 219.7 | -0.3 | 3.005 | 2.504 | 3900.3 | 20000.0 | 19.5 | B31.3 | |
| | | | | | | | | | |
| 300 | 73.1 | 0.3 | 1.000 | 1.000 | 3808.7 | 20000.0 | 19.0 | B31.3 | |
| 305 | 68.2 | -0.3 | 1.000 | 1.000 | 3797.4 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 305 | 68.2 | 0.3 | 1.000 | 1.000 | 3797.4 | 20000.0 | 19.0 | B31.3 | |
| 310 | 66.4 | -0.3 | 1.000 | 1.000 | 3793.4 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 310 | 66.4 | 0.3 | 1.000 | 1.000 | 3793.4 | 20000.0 | 19.0 | B31.3 | |
| 312 | 55.3 | -0.3 | 1.000 | 1.000 | 3767.8 | 20000.0 | 18.8 | B31.3 | |
| | | | | | | | | | |
| 312 | 55.3 | 0.3 | 1.000 | 1.000 | 3767.8 | 20000.0 | 18.8 | B31.3 | |
| 315 | 130.5 | -0.3 | 10.994 | 14.325 | 3727.6 | 20000.0 | 18.6 | B31.3 | |
| | | | | | | | | | |
| 105 | 450.3 | -0.0 | 10.994 | 14.325 | 3339.2 | 20000.0 | 16.7 | B31.3 | |
| 320 | 60.8 | 0.0 | 1.000 | 1.000 | 3143.7 | 20000.0 | 15.7 | B31.3 | |
| | | | | | | | | | |
| 320 | 60.8 | -0.0 | 1.000 | 1.000 | 3143.7 | 20000.0 | 15.7 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 323 | 74.5 | 0.0 | 1.000 | 1.000 | 3169.5 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 323 | 175.9 | -0.0 | 2.362 | 1.968 | 3227.0 | 20000.0 | 16.1 | B31.3 | |
| 324 | 13.7 | 0.0 | 2.362 | 1.968 | 3148.5 | 20000.0 | 15.7 | B31.3 | |
| | | | | | | | | | |
| 324 | 13.7 | -0.0 | 2.362 | 1.968 | 3148.5 | 20000.0 | 15.7 | B31.3 | |
| 325 | 232.8 | -0.0 | 2.362 | 1.968 | 3343.0 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 325 | 98.6 | 0.0 | 1.000 | 1.000 | 3267.0 | 20000.0 | 16.3 | B31.3 | |
| 330 | 101.2 | -0.0 | 1.000 | 1.000 | 3269.6 | 20000.0 | 16.3 | B31.3 | |
| | | | | | | | | | |
| 330 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 335 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 335 | 84.4 | 0.0 | 1.000 | 1.000 | 3252.8 | 20000.0 | 16.3 | B31.3 | |
| 340 | 243.4 | -0.0 | 1.000 | 1.000 | 3411.8 | 20000.0 | 17.1 | B31.3 | |
| | | | | | | | | | |
| 340 | 243.4 | 0.0 | 1.000 | 1.000 | 3411.8 | 20000.0 | 17.1 | B31.3 | |
| 345 | 177.5 | -0.0 | 1.000 | 1.000 | 3345.9 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 345 | 177.5 | 0.0 | 1.000 | 1.000 | 3345.9 | 20000.0 | 16.7 | B31.3 | |
| 350 | 164.3 | -0.0 | 1.000 | 1.000 | 3332.7 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 350 | 164.3 | 0.0 | 1.000 | 1.000 | 3328.6 | 20000.0 | 16.6 | B31.3 | |
| 355 | 0.7 | -0.0 | 1.000 | 1.000 | 3824.0 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 355 | 0.7 | 0.0 | 1.000 | 1.000 | 3830.4 | 20000.0 | 19.2 | B31.3 | |
| 360 | 196.5 | -0.0 | 1.000 | 1.000 | 4026.2 | 20000.0 | 20.1 | B31.3 | |
| | | | | | | | | | |
| 360 | 196.5 | 0.0 | 1.000 | 1.000 | 4026.2 | 20000.0 | 20.1 | B31.3 | |
| 365 | 115.2 | -0.0 | 1.000 | 1.000 | 3945.0 | 20000.0 | 19.7 | B31.3 | |
| | | | | | | | | | |
| 365 | 115.2 | 0.0 | 1.000 | 1.000 | 3945.0 | 20000.0 | 19.7 | B31.3 | |
| 370 | 13.2 | -0.0 | 1.000 | 1.000 | 3842.9 | 20000.0 | 19.2 | B31.3 | |
| | | | | | | | | | |
| 370 | 13.2 | 0.0 | 1.000 | 1.000 | 3842.9 | 20000.0 | 19.2 | B31.3 | |
| 375 | 311.0 | -0.0 | 1.000 | 1.000 | 4140.8 | 20000.0 | 20.7 | B31.3 | |
| | | | | | | | | | |
| 375 | 311.0 | 0.0 | 1.000 | 1.000 | 4140.8 | 20000.0 | 20.7 | B31.3 | |
| 380 | 122.9 | -0.0 | 1.000 | 1.000 | 3952.7 | 20000.0 | 19.8 | B31.3 | |
| | | | | | | | | | |
| 380 | 122.9 | 0.0 | 1.000 | 1.000 | 3952.7 | 20000.0 | 19.8 | B31.3 | |
| 385 | 105.3 | -0.0 | 1.000 | 1.000 | 3935.0 | 20000.0 | 19.7 | B31.3 | |
| | | | | | | | | | |
| 385 | 105.3 | 0.0 | 1.000 | 1.000 | 3935.0 | 20000.0 | 19.7 | B31.3 | |
| 390 | 151.9 | -0.0 | 1.000 | 1.000 | 3981.6 | 20000.0 | 19.9 | B31.3 | |
| | | | | | | | | | |
| 390 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 395 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 395 | 148.0 | 0.0 | 1.000 | 1.000 | 3977.8 | 20000.0 | 19.9 | B31.3 | |
| 398 | 140.2 | -0.0 | 1.000 | 1.000 | 3969.9 | 20000.0 | 19.8 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 398 | 421.3 | 0.0 | 3.005 | 2.504 | 4145.7 | 20000.0 | 20.7 | B31.3 | |
| 399 | 3.3 | 0.0 | 3.005 | 2.504 | 3786.0 | 20000.0 | 18.9 | B31.3 | |
| | | | | | | | | | |
| 399 | 3.3 | -0.0 | 3.005 | 2.504 | 3786.0 | 20000.0 | 18.9 | B31.3 | |
| 400 | 221.3 | 0.0 | 3.005 | 2.504 | 3902.0 | 20000.0 | 19.5 | B31.3 | |
| | | | | | | | | | |
| 400 | 73.6 | -0.0 | 1.000 | 1.000 | 3809.6 | 20000.0 | 19.0 | B31.3 | |
| 405 | 69.3 | 0.0 | 1.000 | 1.000 | 3798.9 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 405 | 69.3 | -0.0 | 1.000 | 1.000 | 3798.9 | 20000.0 | 19.0 | B31.3 | |
| 410 | 67.7 | 0.0 | 1.000 | 1.000 | 3795.1 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 410 | 67.7 | -0.0 | 1.000 | 1.000 | 3795.1 | 20000.0 | 19.0 | B31.3 | |
| 412 | 57.9 | 0.0 | 1.000 | 1.000 | 3770.8 | 20000.0 | 18.9 | B31.3 | |
| | | | | | | | | | |
| 412 | 57.9 | -0.0 | 1.000 | 1.000 | 3770.8 | 20000.0 | 18.9 | B31.3 | |
| 415 | 15.1 | 0.0 | 10.994 | 14.325 | 3641.5 | 20000.0 | 18.2 | B31.3 | |
| | | | | | | | | | |
| 110 | 353.1 | -0.0 | 10.994 | 14.325 | 3266.3 | 20000.0 | 16.3 | B31.3 | |
| 420 | 63.4 | 0.0 | 1.000 | 1.000 | 3146.4 | 20000.0 | 15.7 | B31.3 | |
| | | | | | | | | | |
| 420 | 63.4 | -0.0 | 1.000 | 1.000 | 3146.4 | 20000.0 | 15.7 | B31.3 | |
| 423 | 76.5 | 0.0 | 1.000 | 1.000 | 3171.5 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 423 | 180.6 | -0.0 | 2.362 | 1.968 | 3230.5 | 20000.0 | 16.2 | B31.3 | |
| 424 | 14.6 | 0.0 | 2.362 | 1.968 | 3149.4 | 20000.0 | 15.7 | B31.3 | |
| | | | | | | | | | |
| 424 | 14.6 | -0.0 | 2.362 | 1.968 | 3149.4 | 20000.0 | 15.7 | B31.3 | |
| 425 | 233.3 | 0.0 | 2.362 | 1.968 | 3343.7 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 425 | 98.7 | -0.0 | 1.000 | 1.000 | 3267.5 | 20000.0 | 16.3 | B31.3 | |
| 430 | 101.4 | 0.0 | 1.000 | 1.000 | 3270.2 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 430 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 435 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 435 | 84.5 | -0.0 | 1.000 | 1.000 | 3253.3 | 20000.0 | 16.3 | B31.3 | |
| 440 | 243.4 | 0.0 | 1.000 | 1.000 | 3412.2 | 20000.0 | 17.1 | B31.3 | |
| | | | | | | | | | |
| 440 | 243.4 | -0.0 | 1.000 | 1.000 | 3412.2 | 20000.0 | 17.1 | B31.3 | |
| 445 | 177.5 | 0.0 | 1.000 | 1.000 | 3346.3 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 445 | 177.5 | -0.0 | 1.000 | 1.000 | 3346.3 | 20000.0 | 16.7 | B31.3 | |
| 450 | 164.3 | 0.0 | 1.000 | 1.000 | 3333.1 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 450 | 164.3 | -0.0 | 1.000 | 1.000 | 3329.1 | 20000.0 | 16.6 | B31.3 | |
| 455 | 0.6 | 0.0 | 1.000 | 1.000 | 3824.3 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 455 | 0.6 | -0.0 | 1.000 | 1.000 | 3830.7 | 20000.0 | 19.2 | B31.3 | |
| 460 | 196.5 | 0.0 | 1.000 | 1.000 | 4026.6 | 20000.0 | 20.1 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 460 | 196.5 | -0.0 | 1.000 | 1.000 | 4026.6 | 20000.0 | 20.1 | B31.3 | |
| 465 | 115.1 | 0.0 | 1.000 | 1.000 | 3945.1 | 20000.0 | 19.7 | B31.3 | |
| | | | | | | | | | |
| 465 | 115.1 | -0.0 | 1.000 | 1.000 | 3945.1 | 20000.0 | 19.7 | B31.3 | |
| 470 | 13.2 | 0.0 | 1.000 | 1.000 | 3843.2 | 20000.0 | 19.2 | B31.3 | |
| | | | | | | | | | |
| 470 | 13.2 | -0.0 | 1.000 | 1.000 | 3843.2 | 20000.0 | 19.2 | B31.3 | |
| 475 | 312.1 | 0.0 | 1.000 | 1.000 | 4142.2 | 20000.0 | 20.7 | B31.3 | |
| | | | | | | | | | |
| 475 | 312.1 | -0.0 | 1.000 | 1.000 | 4142.2 | 20000.0 | 20.7 | B31.3 | |
| 480 | 123.6 | 0.0 | 1.000 | 1.000 | 3953.7 | 20000.0 | 19.8 | B31.3 | |
| | | | | | | | | | |
| 480 | 123.6 | -0.0 | 1.000 | 1.000 | 3953.7 | 20000.0 | 19.8 | B31.3 | |
| 485 | 105.9 | 0.0 | 1.000 | 1.000 | 3935.9 | 20000.0 | 19.7 | B31.3 | |
| | | | | | | | | | |
| 485 | 105.9 | -0.0 | 1.000 | 1.000 | 3935.9 | 20000.0 | 19.7 | B31.3 | |
| 490 | 152.3 | 0.0 | 1.000 | 1.000 | 3982.3 | 20000.0 | 19.9 | B31.3 | |
| | | | | | | | | | |
| 490 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 495 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 495 | 148.6 | -0.0 | 1.000 | 1.000 | 3978.6 | 20000.0 | 19.9 | B31.3 | |
| 498 | 140.8 | 0.0 | 1.000 | 1.000 | 3970.9 | 20000.0 | 19.9 | B31.3 | |
| | | | | | | | | | |
| 498 | 423.1 | -0.0 | 3.005 | 2.504 | 4147.4 | 20000.0 | 20.7 | B31.3 | |
| 499 | 5.7 | 0.0 | 3.005 | 2.504 | 3788.2 | 20000.0 | 18.9 | B31.3 | |
| | | | | | | | | | |
| 499 | 5.7 | -0.0 | 3.005 | 2.504 | 3788.2 | 20000.0 | 18.9 | B31.3 | |
| 500 | 221.0 | 0.0 | 3.005 | 2.504 | 3901.9 | 20000.0 | 19.5 | B31.3 | |
| | | | | | | | | | |
| 500 | 73.5 | -0.0 | 1.000 | 1.000 | 3809.7 | 20000.0 | 19.0 | B31.3 | |
| 505 | 69.4 | 0.0 | 1.000 | 1.000 | 3799.2 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 505 | 69.4 | -0.0 | 1.000 | 1.000 | 3799.2 | 20000.0 | 19.0 | B31.3 | |
| 510 | 67.9 | 0.0 | 1.000 | 1.000 | 3795.4 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 510 | 67.9 | -0.0 | 1.000 | 1.000 | 3795.4 | 20000.0 | 19.0 | B31.3 | |
| 512 | 58.5 | 0.0 | 1.000 | 1.000 | 3771.6 | 20000.0 | 18.9 | B31.3 | |
| | | | | | | | | | |
| 512 | 58.5 | -0.0 | 1.000 | 1.000 | 3771.6 | 20000.0 | 18.9 | B31.3 | |
| 515 | 60.9 | 0.0 | 10.994 | 14.325 | 3676.0 | 20000.0 | 18.4 | B31.3 | |
| | | | | | | | | | |
| 115 | 360.7 | -0.1 | 10.994 | 14.325 | 3272.0 | 20000.0 | 16.4 | B31.3 | |
| 520 | 63.4 | 0.1 | 1.000 | 1.000 | 3146.3 | 20000.0 | 15.7 | B31.3 | |
| | | | | | | | | | |
| 520 | 63.4 | -0.1 | 1.000 | 1.000 | 3146.3 | 20000.0 | 15.7 | B31.3 | |
| 523 | 76.6 | 0.1 | 1.000 | 1.000 | 3171.6 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 523 | 180.8 | -0.1 | 2.362 | 1.968 | 3230.6 | 20000.0 | 16.2 | B31.3 | |
| 524 | 15.1 | -0.1 | 2.362 | 1.968 | 3149.7 | 20000.0 | 15.7 | B31.3 | |
| | | | | | | | | | |
| 524 | 15.1 | 0.1 | 2.362 | 1.968 | 3149.7 | 20000.0 | 15.7 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 525 | 233.1 | -0.3 | 2.362 | 1.968 | 3343.6 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 525 | 98.7 | 0.3 | 1.000 | 1.000 | 3267.4 | 20000.0 | 16.3 | B31.3 | |
| 530 | 101.3 | -0.3 | 1.000 | 1.000 | 3270.1 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 530 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 535 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 535 | 84.5 | 0.3 | 1.000 | 1.000 | 3253.3 | 20000.0 | 16.3 | B31.3 | |
| 540 | 243.1 | -0.3 | 1.000 | 1.000 | 3411.9 | 20000.0 | 17.1 | B31.3 | |
| | | | | | | | | | |
| 540 | 243.1 | 0.3 | 1.000 | 1.000 | 3411.9 | 20000.0 | 17.1 | B31.3 | |
| 545 | 177.5 | -0.3 | 1.000 | 1.000 | 3346.3 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 545 | 177.5 | 0.3 | 1.000 | 1.000 | 3346.3 | 20000.0 | 16.7 | B31.3 | |
| 550 | 164.3 | -0.3 | 1.000 | 1.000 | 3333.1 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 550 | 164.3 | 0.3 | 1.000 | 1.000 | 3329.0 | 20000.0 | 16.6 | B31.3 | |
| 555 | 0.6 | -0.2 | 1.000 | 1.000 | 3824.3 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 555 | 0.6 | 0.2 | 1.000 | 1.000 | 3830.6 | 20000.0 | 19.2 | B31.3 | |
| 560 | 196.5 | -0.2 | 1.000 | 1.000 | 4026.5 | 20000.0 | 20.1 | B31.3 | |
| | | | | | | | | | |
| 560 | 196.5 | 0.2 | 1.000 | 1.000 | 4026.5 | 20000.0 | 20.1 | B31.3 | |
| 565 | 115.0 | -0.2 | 1.000 | 1.000 | 3945.1 | 20000.0 | 19.7 | B31.3 | |
| | | | | | | | | | |
| 565 | 115.0 | 0.2 | 1.000 | 1.000 | 3945.1 | 20000.0 | 19.7 | B31.3 | |
| 570 | 13.2 | -0.2 | 1.000 | 1.000 | 3843.2 | 20000.0 | 19.2 | B31.3 | |
| | | | | | | | | | |
| 570 | 13.2 | 0.2 | 1.000 | 1.000 | 3843.2 | 20000.0 | 19.2 | B31.3 | |
| 575 | 312.2 | -0.2 | 1.000 | 1.000 | 4142.2 | 20000.0 | 20.7 | B31.3 | |
| | | | | | | | | | |
| 575 | 312.2 | 0.2 | 1.000 | 1.000 | 4142.2 | 20000.0 | 20.7 | B31.3 | |
| 580 | 123.7 | -0.2 | 1.000 | 1.000 | 3953.7 | 20000.0 | 19.8 | B31.3 | |
| | | | | | | | | | |
| 580 | 123.7 | 0.2 | 1.000 | 1.000 | 3953.7 | 20000.0 | 19.8 | B31.3 | |
| 585 | 106.0 | -0.2 | 1.000 | 1.000 | 3936.0 | 20000.0 | 19.7 | B31.3 | |
| | | | | | | | | | |
| 585 | 106.0 | 0.2 | 1.000 | 1.000 | 3936.0 | 20000.0 | 19.7 | B31.3 | |
| 590 | 152.3 | -0.2 | 1.000 | 1.000 | 3982.3 | 20000.0 | 19.9 | B31.3 | |
| | | | | | | | | | |
| 590 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 595 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 595 | 148.6 | 0.2 | 1.000 | 1.000 | 3978.6 | 20000.0 | 19.9 | B31.3 | |
| 598 | 140.8 | -0.2 | 1.000 | 1.000 | 3970.9 | 20000.0 | 19.9 | B31.3 | |
| | | | | | | | | | |
| 598 | 423.3 | 0.2 | 3.005 | 2.504 | 4147.5 | 20000.0 | 20.7 | B31.3 | |
| 599 | 6.2 | -0.1 | 3.005 | 2.504 | 3788.5 | 20000.0 | 18.9 | B31.3 | |
| | | | | | | | | | |
| 599 | 6.2 | 0.1 | 3.005 | 2.504 | 3788.5 | 20000.0 | 18.9 | B31.3 | |
| 600 | 220.1 | 0.1 | 3.005 | 2.504 | 3901.3 | 20000.0 | 19.5 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 600 | 73.2 | -0.1 | 1.000 | 1.000 | 3809.4 | 20000.0 | 19.0 | B31.3 | |
| 605 | 69.1 | 0.1 | 1.000 | 1.000 | 3798.9 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 605 | 69.1 | -0.1 | 1.000 | 1.000 | 3798.9 | 20000.0 | 19.0 | B31.3 | |
| 610 | 67.6 | 0.1 | 1.000 | 1.000 | 3795.1 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 610 | 67.6 | -0.1 | 1.000 | 1.000 | 3795.1 | 20000.0 | 19.0 | B31.3 | |
| 612 | 58.1 | 0.1 | 1.000 | 1.000 | 3771.3 | 20000.0 | 18.9 | B31.3 | |
| | | | | | | | | | |
| 612 | 58.1 | -0.1 | 1.000 | 1.000 | 3771.3 | 20000.0 | 18.9 | B31.3 | |
| 615 | 51.0 | 0.1 | 10.994 | 14.325 | 3668.6 | 20000.0 | 18.3 | B31.3 | |
| | | | | | | | | | |
| 615 | 978.5 | -0.0 | 10.994 | 14.325 | 5890.4 | 20000.0 | 29.5 | B31.3 | |
| 620 | 569.4 | 0.0 | 1.000 | 1.000 | 5726.0 | 20000.0 | 28.6 | B31.3 | |
| | | | | | | | | | |
| 620 | 569.4 | -0.0 | 1.000 | 1.000 | 5726.0 | 20000.0 | 28.6 | B31.3 | |
| 625 | 0.0 | 0.0 | 1.000 | 1.000 | 5156.6 | 20000.0 | 25.8 | B31.3 | |
| | | | | | | | | | |
| 615 | 975.9 | 1.0 | 10.994 | 14.325 | 5888.5 | 20000.0 | 29.4 | B31.3 | |
| 515 | 1035.6 | -1.0 | 10.994 | 14.325 | 5933.3 | 20000.0 | 29.7 | B31.3 | |
| | | | | | | | | | |
| 515 | 1035.6 | 2.2 | 10.994 | 14.325 | 5933.3 | 20000.0 | 29.7 | B31.3 | |
| 415 | 1035.4 | -2.2 | 10.994 | 14.325 | 5933.1 | 20000.0 | 29.7 | B31.3 | |
| | | | | | | | | | |
| 415 | 1035.2 | 2.5 | 10.994 | 14.325 | 5933.0 | 20000.0 | 29.7 | B31.3 | |
| 315 | 1018.5 | -2.5 | 10.994 | 14.325 | 5920.5 | 20000.0 | 29.6 | B31.3 | |
| | | | | | | | | | |
| 315 | 1035.9 | 0.0 | 10.994 | 14.325 | 5933.5 | 20000.0 | 29.7 | B31.3 | |
| 630 | 186.9 | -0.0 | 1.000 | 1.000 | 5343.5 | 20000.0 | 26.7 | B31.3 | |
| | | | | | | | | | |
| 630 | 186.9 | 0.0 | 1.000 | 1.000 | 5343.5 | 20000.0 | 26.7 | B31.3 | |
| 635 | 0.0 | 0.0 | 1.000 | 1.000 | 5156.6 | 20000.0 | 25.8 | B31.3 | |

Job Description:

PROJECT: NEWPP Water Purifiaction Plant, Houston

CLIENT : CDM Smith

ANALYST: DClark

CHECKER: RSinghal

NOTES : UV Building Phase 2

Existing Configuration with Flex Joints

PIPE DATA
---
---
From 5 To 10 DX= -20.000 ft.
B31.3 (2010) Cycle Max Switch = --- App.P Sy/St Switch = ON
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.
Dia= 48.000 in. Wall= .375 in. Cor= .0000 in.
GENERAL
T1= 70 F P1= 165.0000 lb./sq.in. Mat= (102)A53 B
E= 29,500,000 lb./sq.in. EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in. EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in. EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in. EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in. EH9= 29,500,000 lb./sq.in. v = .292
Pipe Den= .2830000 lb./cu.in. Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .500 in. Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 5 ANC
Node 10 Y
Node 10 Z
ALLOWABLE STRESSES
---
From 10 To 15 DX= -20.000 ft.
BEND at "TO" end
Radius= 72.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 14
Angle/Node @2= .00 13
RESTRAINTS
Node 14 Y
Node 14 Z
---
From 15 To 20 DY= 6.000 ft.
RESTRAINTS
Node 20 Guide Gap= .250 in.
---
From 20 To 25 DY= 1.083 ft.
---
From 25 To 30 DY= .167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 47.250 in.

---
From 30 To 35 DY= 5.042 ft.
SIF's & TEE's
Node 35 Welding Tee
---
From 35 To 40 DY= 3.500 ft.
FORCES & MOMENTS
Node 40 FY1= -1,200.00 lb.
---
From 35 To 45 DX= -3.500 ft.
FORCES & MOMENTS
Node 45 FY1= -800.00 lb.
---
From 45 To 50 DX= -6.000 ft.
RESTRAINTS
Node 50 Y
---
From 50 To 55 DX= -9.187 ft.
RESTRAINTS
Node 55 +Y
---
From 55 To 60 DX= -.500 ft.
---
From 60 To 65 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 47.250 in.
---
From 65 To 70 DX= -5.062 ft.
FORCES & MOMENTS
Node 70 FY1= -800.00 lb.
---
From 70 To 75 DX= -5.583 ft.
SIF's & TEE's
Node 75 Welding Tee
---
From 75 To 80 DY= -6.167 ft.
---
From 80 To 85 DY= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 47.250 in.
---
From 85 To 90 DY= -1.000 ft.
RESTRAINTS
Node 90 Guide Gap= .250 in.
---
From 90 To 95 DY= -6.750 ft.
BEND at "TO" end
Radius= 72.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 94
Angle/Node @2= .00 93
RESTRAINTS
Node 94 Y
Node 94 X
---
From 95 To 97 DZ= -9.531 ft.
RESTRAINTS
Node 97 Y

```
   Node  97  X
------------------------------------------------------------------------------
From  97  To  98 DZ= -9.531 ft.
RESTRAINTS
   Node  98  Y
   Node  98  X
------------------------------------------------------------------------------
From  98  To  100 DZ= -17.281 ft.
RESTRAINTS
   Node  100  Y
   Node  100  X
SIF's & TEE's
   Node  100   Unreinforced Tee
------------------------------------------------------------------------------
From  100  To  105 DZ= -8.000 ft.
RESTRAINTS
   Node  105  Y
   Node  105  X
SIF's & TEE's
   Node  105   Unreinforced Tee
------------------------------------------------------------------------------
From  105  To  110 DZ= -8.000 ft.
RESTRAINTS
   Node  110  Y
   Node  110  X
SIF's & TEE's
   Node  110   Unreinforced Tee
------------------------------------------------------------------------------
From  110  To  115 DZ= -8.000 ft.
RESTRAINTS
   Node  115  Y
   Node  115  X
SIF's & TEE's
   Node  115   Unreinforced Tee
------------------------------------------------------------------------------
From  115  To  120 DZ= -3.000 ft.
RESTRAINTS
   Node  120  Y
   Node  120  X
------------------------------------------------------------------------------
From  120  To  125 DZ= -7.000 ft.
RESTRAINTS
   Node  125  Y
   Node  125  X
------------------------------------------------------------------------------
From  100  To  217 DY= 6.750 ft.
   Dia= 30.000 in.   Wall= .375 in.
GENERAL
   Refract. Thk= .375 in.   Refract. Den= .0643000 lb./cu.in.
   Insul Thk= .000 in.
RESTRAINTS
   Node  217  Guide   Gap= .250 in.
------------------------------------------------------------------------------
From  217  To  218 DY= 1.000 ft.
------------------------------------------------------------------------------
From  218  To  219 DY= .167 ft.
EXPANSION JOINT
   Axial K= 100 lb./in.   Trans K= 100 lb./in.   Bend K= 100 in.lb./deg
```

Tors K= 1,000 in.lb./deg
---
From 219 To 225 DY= 3.750 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 45.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 224
---
From 225 To 230 DX= -3.917 ft.
FORCES & MOMENTS
Node 230 FY1= -365.00 lb.
---
From 230 To 235 DX= -.750 ft.
RIGID Weight= 600.00 lb.
FORCES & MOMENTS
Node 235 FY1= -365.00 lb.
---
From 235 To 240 DX= -3.500 ft.
RESTRAINTS
Node 240 Y
---
From 240 To 242 DX= -5.000 ft.
---
From 242 To 243 DX= -.083 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg
---
From 243 To 245 DX= -2.760 ft.
RESTRAINTS
Node 245 Y
---
From 245 To 247 DX= -1.500 ft.
---
From 247 To 248 DX= -.083 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg
---
From 248 To 250 DX= -5.542 ft.
FORCES & MOMENTS
Node 250 FY1= -730.00 lb.
---
From 250 To 255 DX= -2.083 ft. DY= -.250 ft.
FORCES & MOMENTS
Node 255 FY1= -1,730.00 lb.
---
From 255 To 260 DX= -1.385 ft.
Dia= 36.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Insul Thk= .000 in.
RESTRAINTS
Node 260 Y
---
From 260 To 265 DX= -7.219 ft.
Dia= 36.000 in. Wall= .375 in.
Insul Thk= .000 in.
RESTRAINTS
Node 265 Y
---

From 265 To 270 DX= -1.146 ft.
FORCES & MOMENTS
Node 270 FY1= -1,730.00 lb.
---
From 270 To 273 DX= -1.750 ft.
RESTRAINTS
Node 273 Y
---
From 273 To 275 DX= -2.000 ft.
RESTRAINTS
Node 275 Y
---
From 275 To 280 DX= -5.542 ft.
---
From 280 To 285 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 35.250 in.
---
From 285 To 287 DX= -1.500 ft.
RESTRAINTS
Node 287 Y
---
From 287 To 290 DX= -2.188 ft.
FORCES & MOMENTS
Node 290 FY1= -590.00 lb.
---
From 290 To 295 DX= -.750 ft.
RIGID Weight= 975.00 lb.
FORCES & MOMENTS
Node 295 FY1= -590.00 lb.
---
From 295 To 300 DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 36.000 in. (SHORT Bend Angle= 90.000 Angle/Node @1= 45.00 299
Angle/Node @2= .00 298
---
From 300 To 305 DY= -3.458 ft.
---
From 305 To 310 DY= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 35.250 in.
---
From 310 To 312 DY= -1.042 ft.
RESTRAINTS
Node 312 Guide Gap= .250 in.
---
From 312 To 315 DY= -6.000 ft.
RESTRAINTS
Node 315 Y
Node 315 X
SIF's & TEE's
Node 315 Unreinforced Tee
---
From 105 To 317 DY= 6.750 ft.
Dia= 30.000 in. Wall= .375 in.
GENERAL

Refract. Thk= .375 in.  Refract. Den= .0643000 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 317 Guide  Gap= .250 in.
---
From 317 To 318 DY= 1.000 ft.
---
From 318 To 319 DY= .167 ft.
EXPANSION JOINT
Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg
---
From 319 To 325 DY= 3.750 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 45.000 in. (LONG)  Bend Angle= 90.000  Angle/Node @1= 45.00 324
---
From 325 To 330 DX= -3.917 ft.
FORCES & MOMENTS
Node 330  FY1= -365.00 lb.
---
From 330 To 335 DX= -.750 ft.
RIGID Weight= 600.00 lb.
FORCES & MOMENTS
Node 335  FY1= -365.00 lb.
---
From 335 To 340 DX= -3.500 ft.
RESTRAINTS
Node 340 Y
---
From 340 To 342 DX= -5.000 ft.
---
From 342 To 343 DX= -.083 ft.
EXPANSION JOINT
Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg
---
From 343 To 345 DX= -2.760 ft.
RESTRAINTS
Node 345 Y
---
From 345 To 347 DX= -1.500 ft.
---
From 347 To 348 DX= -.083 ft.
EXPANSION JOINT
Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg
---
From 348 To 350 DX= -5.542 ft.
FORCES & MOMENTS
Node 350  FY1= -730.00 lb.
---
From 350 To 355 DX= -2.083 ft.  DY= -.250 ft.
FORCES & MOMENTS
Node 355  FY1= -1,730.00 lb.
---
From 355 To 360 DX= -1.385 ft.
Dia= 36.000 in.  Wall= .375 in.
GENERAL

Refract. Thk= .375 in.  Insul Thk= .000 in.
RESTRAINTS
Node 360 Y
---
From 360 To 365 DX= -7.219 ft.
Dia= 36.000 in.  Wall= .375 in.
Insul Thk= .000 in.
RESTRAINTS
Node 365 Y
---
From 365 To 370 DX= -1.146 ft.
FORCES & MOMENTS
Node 370 FY1= -1,730.00 lb.
---
From 370 To 373 DX= -1.750 ft.
RESTRAINTS
Node 373 Y
---
From 373 To 375 DX= -2.000 ft.
RESTRAINTS
Node 375 Y
---
From 375 To 380 DX= -5.542 ft.
---
From 380 To 385 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg  Eff Dia= 35.250 in.
---
From 385 To 387 DX= -1.500 ft.
RESTRAINTS
Node 387 Y
---
From 387 To 390 DX= -2.188 ft.
FORCES & MOMENTS
Node 390 FY1= -590.00 lb.
---
From 390 To 395 DX= -.750 ft.
RIGID Weight= 975.00 lb.
FORCES & MOMENTS
Node 395 FY1= -590.00 lb.
---
From 395 To 400 DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 36.000 in. (SHORT  Bend Angle= 90.000  Angle/Node @1= 45.00 399
Angle/Node @2= .00 398
---
From 400 To 405 DY= -3.458 ft.
---
From 405 To 410 DY= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg  Eff Dia= 35.250 in.
---
From 410 To 412 DY= -1.042 ft.
RESTRAINTS
Node 412 Guide  Gap= .250 in.
---

From  412  To  415 DY= -6.000 ft.
RESTRAINTS
  Node  415  Y
  Node  415  X
SIF's & TEE's
  Node  415   Unreinforced Tee
---
From  110  To  417 DY= 6.750 ft.
  Dia= 30.000 in.   Wall= .375 in.
GENERAL
  Refract. Thk= .375 in.   Refract. Den= .0643000 lb./cu.in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  417  Guide   Gap= .250 in.
---
From  417  To  418 DY= 1.000 ft.
---
From  418  To  419 DY= .167 ft.
EXPANSION JOINT
  Axial K= 100 lb./in.   Trans K= 100 lb./in.   Bend K= 100 in.lb./deg
  Tors K= 1,000 in.lb./deg
---
From  419  To  425 DY= 3.750 ft.
SINGLE FLANGED BEND at "TO" end
  Radius= 45.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 424
---
From  425  To  430  DX= -3.917 ft.
FORCES & MOMENTS
  Node  430   FY1= -365.00 lb.
---
From  430  To  435  DX= -.750 ft.
RIGID  Weight= 600.00 lb.
FORCES & MOMENTS
  Node  435   FY1= -365.00 lb.
---
From  435  To  440  DX= -3.500 ft.
RESTRAINTS
  Node  440  Y
---
From  440  To  442  DX= -5.000 ft.
---
From  442  To  443  DX= -.083 ft.
EXPANSION JOINT
  Axial K= 100 lb./in.   Trans K= 100 lb./in.   Bend K= 100 in.lb./deg
  Tors K= 1,000 in.lb./deg
---
From  443  To  445  DX= -2.760 ft.
RESTRAINTS
  Node  445  Y
---
From  445  To  447  DX= -1.500 ft.
---
From  447  To  448  DX= -.083 ft.
EXPANSION JOINT
  Axial K= 100 lb./in.   Trans K= 100 lb./in.   Bend K= 100 in.lb./deg
  Tors K= 1,000 in.lb./deg
---
From  448  To  450  DX= -5.542 ft.

FORCES & MOMENTS
  Node 450  FY1= -730.00 lb.
---
From 450 To 455 DX= -2.083 ft. DY= -.250 ft.
FORCES & MOMENTS
  Node 455  FY1= -1,730.00 lb.
---
From 455 To 460 DX= -1.385 ft.
  Dia= 36.000 in.  Wall= .375 in.
GENERAL
  Refract. Thk= .375 in.  Insul Thk= .000 in.
RESTRAINTS
  Node 460 Y
---
From 460 To 465 DX= -7.219 ft.
  Dia= 36.000 in.  Wall= .375 in.
  Insul Thk= .000 in.
RESTRAINTS
  Node 465 Y
---
From 465 To 470 DX= -1.146 ft.
FORCES & MOMENTS
  Node 470  FY1= -1,730.00 lb.
---
From 470 To 473 DX= -1.750 ft.
RESTRAINTS
  Node 473 Y
---
From 473 To 475 DX= -2.000 ft.
RESTRAINTS
  Node 475 Y
---
From 475 To 480 DX= -5.542 ft.
---
From 480 To 485 DX= -.167 ft.
EXPANSION JOINT
  Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
  Tors K= 1,000 in.lb./deg  Eff Dia= 35.250 in.
---
From 485 To 487 DX= -1.500 ft.
RESTRAINTS
  Node 487 Y
---
From 487 To 490 DX= -2.188 ft.
FORCES & MOMENTS
  Node 490  FY1= -590.00 lb.
---
From 490 To 495 DX= -.750 ft.
RIGID Weight= 975.00 lb.
FORCES & MOMENTS
  Node 495  FY1= -590.00 lb.
---
From 495 To 500 DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
  Radius= 36.000 in. (SHORT  Bend Angle= 90.000  Angle/Node @1= 45.00 499
  Angle/Node @2= .00 498
---
From 500 To 505 DY= -3.458 ft.

---
From  505  To  510 DY= -.167 ft.
EXPANSION JOINT
  Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
  Tors K= 1,000 in.lb./deg  Eff Dia= 35.250 in.
---
From  510  To  512 DY= -1.042 ft.
RESTRAINTS
  Node  512  Guide  Gap= .250 in.
---
From  512  To  515 DY= -6.000 ft.
RESTRAINTS
  Node  515  Y
  Node  515  X
SIF's & TEE's
  Node  515  Unreinforced Tee
---
From  115  To  517 DY= 6.750 ft.
  Dia= 30.000 in.  Wall= .375 in.
GENERAL
  Refract. Thk= .375 in.  Refract. Den= .0643000 lb./cu.in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  517  Guide  Gap= .250 in.
---
From  517  To  518 DY= 1.000 ft.
---
From  518  To  519 DY= .167 ft.
EXPANSION JOINT
  Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
  Tors K= 1,000 in.lb./deg
---
From  519  To  525 DY= 3.750 ft.
SINGLE FLANGED BEND at "TO" end
  Radius= 45.000 in. (LONG)  Bend Angle= 90.000  Angle/Node @1= 45.00 524
---
From  525  To  530  DX= -3.917 ft.
FORCES & MOMENTS
  Node  530  FY1= -365.00 lb.
---
From  530  To  535  DX= -.750 ft.
RIGID  Weight= 600.00 lb.
FORCES & MOMENTS
  Node  535  FY1= -365.00 lb.
---
From  535  To  540  DX= -3.500 ft.
RESTRAINTS
  Node  540  Y
---
From  540  To  542  DX= -5.000 ft.
---
From  542  To  543  DX= -.083 ft.
EXPANSION JOINT
  Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
  Tors K= 1,000 in.lb./deg
---
From  543  To  545  DX= -2.760 ft.
RESTRAINTS

Node 545 Y
---
From 545 To 547 DX= -1.500 ft.
---
From 547 To 548 DX= -.083 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg
---
From 548 To 550 DX= -5.542 ft.
FORCES & MOMENTS
Node 550 FY1= -730.00 lb.
---
From 550 To 555 DX= -2.083 ft. DY= -.250 ft.
FORCES & MOMENTS
Node 555 FY1= -1,730.00 lb.
---
From 555 To 560 DX= -1.385 ft.
Dia= 36.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Insul Thk= .000 in.
RESTRAINTS
Node 560 Y
---
From 560 To 565 DX= -7.219 ft.
Dia= 36.000 in. Wall= .375 in.
Insul Thk= .000 in.
RESTRAINTS
Node 565 Y
---
From 565 To 570 DX= -1.146 ft.
FORCES & MOMENTS
Node 570 FY1= -1,730.00 lb.
---
From 570 To 573 DX= -1.750 ft.
RESTRAINTS
Node 573 Y
---
From 573 To 575 DX= -2.000 ft.
RESTRAINTS
Node 575 Y
---
From 575 To 580 DX= -5.542 ft.
---
From 580 To 585 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 35.250 in.
---
From 585 To 587 DX= -1.500 ft.
RESTRAINTS
Node 587 Y
---
From 587 To 590 DX= -2.188 ft.
FORCES & MOMENTS
Node 590 FY1= -590.00 lb.
---
From 590 To 595 DX= -.750 ft.

RIGID  Weight= 975.00 lb.
FORCES & MOMENTS
  Node  595  FY1= -590.00 lb.
---
From  595  To  600  DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
  Radius= 36.000 in. (SHORT  Bend Angle= 90.000  Angle/Node @1= 45.00 599
  Angle/Node @2= .00 598
---
From  600  To  605 DY= -3.458 ft.
---
From  605  To  610 DY= -.167 ft.
EXPANSION JOINT
  Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
  Tors K= 1,000 in.lb./deg  Eff Dia= 35.250 in.
---
From  610  To  612 DY= -1.042 ft.
RESTRAINTS
  Node  612  Guide  Gap= .250 in.
---
From  612  To  615 DY= -6.000 ft.
RESTRAINTS
  Node  615  Y
  Node  615  X
SIF's & TEE's
  Node  615  Unreinforced Tee
---
From  615  To  625 DZ= -10.000 ft.
  Dia= 48.000 in.  Wall= .375 in.
GENERAL
  Refract. Thk= .500 in.  Refract. Den= .0643000 lb./cu.in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  625  Y
  Node  625  X
---
From  615  To  515  DX= .000 ft.  DY= .000 ft.  DZ= 8.000 ft.
---
From  515  To  415  DX= .000 ft.  DY= .000 ft.  DZ= 8.000 ft.
---
From  415  To  315  DX= .000 ft.  DY= .000 ft.  DZ= 8.000 ft.
---
From  315  To  630 DZ= 7.750 ft.
RESTRAINTS
  Node  630  Y
  Node  630  X
---
From  630  To  635 DZ= 16.500 ft.
BEND at "TO" end
  Radius= 72.000 in. (LONG)  Bend Angle= 90.000  Angle/Node @1= 45.00 634
  Angle/Node @2= .00 633  Miters= 4
RESTRAINTS
  Node  634  Y
  Node  634  X
---
From  635  To  640  DX= -10.000 ft.
RESTRAINTS
  Node  640  Y

Node 640 Z
---
From 75 To 700 DX= -3.000 ft.
---
From 700 To 705 DX= -2.000 ft.
---
From 705 To 710 DX= -3.917 ft.
Dia= 30.000 in. Wall= .375 in.
Insul Thk= .000 in.
RESTRAINTS
Node 710 Y
---
From 710 To 715 DX= -.708 ft.
---
From 715 To 720 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg
---
From 720 To 725 DX= -.875 ft.
---
From 725 To 730 DX= -1.000 ft.
RIGID Weight= 1,300.00 lb.
---
From 730 To 735 DX= -8.750 ft.
RESTRAINTS
Node 735 Y
---
From 735 To 740 DX= -11.667 ft.
RESTRAINTS
Node 740 Y
---
From 740 To 745 DX= -.833 ft.
---
From 745 To 750 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg
---
From 750 To 755 DX= -2.833 ft.
---
From 755 To 760 DX= -1.000 ft.
RIGID Weight= 1,300.00 lb.
---
From 760 To 765 DX= -3.917 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 45.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 764
Angle/Node @2= .00 763
---
From 765 To 770 DY= -5.125 ft.
---
From 770 To 775 DY= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg
---
From 775 To 780 DY= -.833 ft.
RESTRAINTS

Node 780 Guide Gap= .250 in.
---
From 780 To 785 DY= -3.750 ft.
BEND at "TO" end
Radius= 45.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 784
RESTRAINTS
Node 784 Y
Node 784 Z
---
From 785 To 790 DX= -5.000 ft.
RESTRAINTS
Node 790 Y
Node 790 Z
---
From 790 To 795 DX= -20.000 ft.
RESTRAINTS
Node 795 Y
Node 795 Z

# Summary of Support Loads

CASE 1 (SUS) W+P1+F1

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| 5 | | Rigid ANC | | | | | |
| | 1(SUS) | 90746 | -2371 | 1 | 2.6 | 4.2 | -9188.6 |
| | | | | | | | |
| | | | | | | | |
| 10 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -41463 | -2 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 14 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -288954 | 2 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 20 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 2265 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 50 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 490036 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 55 | | Rigid +Y | | | | | |
| | 1(SUS) | 0 | -114390 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 90 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | -39057 | 0 | 7220 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 94 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -46845 | -338144 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 97 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 30740 | 120738 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 98 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -11705 | -53137 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 100 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 8948 | -37219 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 105 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -1010 | -30253 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 110 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -4528 | -31537 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 115 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -5804 | -28913 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 120 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -0 | -4095 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 125 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -0 | -2643 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 217 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 35880 | 0 | -1652 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 240 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 8495 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 245 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 6962 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 260 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -18402 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 265 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 20842 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 273 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 30362 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 275 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -87433 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 287 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 63696 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 312 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | -35000 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 315 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -9304 | -53943 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 317 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 45164 | 0 | -1949 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 340 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 8495 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 345 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 6962 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 360 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -18402 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 365 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 20842 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 373 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 30362 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 375 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -87433 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 387 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 63696 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 412 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | -46123 | 0 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 415 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 1820 | -52065 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 417 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 48833 | 0 | -1856 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 440 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 8495 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 445 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 6962 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 460 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -18402 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 465 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 20842 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 473 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 30362 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 475 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -87433 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 487 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 63696 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 512 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | -49623 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 515 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 5319 | -51761 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 517 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | 1(SUS) | 50107 | 0 | -1764 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 540 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 8495 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 545 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 6962 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 560 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -18402 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 565 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 20842 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 573 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 30362 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 575 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -87433 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 587 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 63696 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 612 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | -50632 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 615 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 6328 | -54023 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 625 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -0 | -4139 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 630 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -0 | -9804 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 634 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 0 | 5111 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 640 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -20364 | -0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 710 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 102325 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 735 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -20931 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 740 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 20028 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 780 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | -26518 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 784 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -20166 | 1 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 790 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -8852 | -1 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 795 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -3716 | 0 | 0.0 | 0.0 | 0.0 |

```
Piping Code: B31.3      = B31.3 -2010, March 31, 2011


 CODE STRESS CHECK FAILED      : LOADCASE 1 (SUS) W+P1+F1

Highest Stresses: (lb./sq.in.)
Ratio (%):                    486.4       @Node     75
Code Stress:                97289.4       Allowable Stress:      20000.0
Axial Stress:                 6262.1       @Node     94
Bending Stress:             125054.1       @Node     75
Torsion Stress:               1604.0       @Node     95
Hoop Stress:                 10395.0       @Node     10
Max Stress Intensity:       131868.4       @Node     75
```

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 166.3 | 0.0 | 1.000 | 1.000 | 3705.6 | 20000.0 | 18.5 | B31.3 | |
| 10 | 2506.2 | -0.0 | 1.000 | 1.000 | 6045.4 | 20000.0 | 30.2 | B31.3 | |
| | | | | | | | | | |
| 10 | 2506.2 | 0.0 | 1.000 | 1.000 | 6045.4 | 20000.0 | 30.2 | B31.3 | |
| 13 | 1930.1 | -0.0 | 1.000 | 1.000 | 5469.3 | 20000.0 | 27.3 | B31.3 | |
| | | | | | | | | | |
| 13 | 5952.5 | 0.0 | 3.084 | 2.570 | 8003.6 | 20000.0 | 40.0 | B31.3 | |
| 14 | 936.9 | 0.0 | 3.084 | 2.570 | 4638.9 | 20000.0 | 23.2 | B31.3 | |
| | | | | | | | | | |
| 14 | 936.9 | -0.0 | 3.084 | 2.570 | 997.3 | 20000.0 | 5.0 | B31.3 | |
| 15 | 6362.4 | 0.1 | 3.084 | 2.570 | 4791.7 | 20000.0 | 24.0 | B31.3 | |
| | | | | | | | | | |
| 15 | 2063.0 | -0.1 | 1.000 | 1.000 | 2082.9 | 20000.0 | 10.4 | B31.3 | |
| 20 | 1964.4 | 0.1 | 1.000 | 1.000 | 1983.3 | 20000.0 | 9.9 | B31.3 | |
| | | | | | | | | | |
| 20 | 1964.4 | -0.1 | 1.000 | 1.000 | 1983.3 | 20000.0 | 9.9 | B31.3 | |
| 25 | 140.2 | 0.1 | 1.000 | 1.000 | 140.3 | 20000.0 | 0.7 | B31.3 | |
| | | | | | | | | | |
| 25 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 30 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 30 | 140.4 | -0.1 | 1.000 | 1.000 | 142.6 | 20000.0 | 0.7 | B31.3 | |
| 35 | 45766.7 | 0.1 | 5.303 | 6.738 | 34414.8 | 20000.0 | 172.1 | B31.3 | * |
| | | | | | | | | | |
| 35 | 0.0 | 0.0 | 5.303 | 6.738 | 5074.4 | 20000.0 | 25.4 | B31.3 | |
| 40 | 0.0 | 0.0 | 1.000 | 1.000 | 5135.2 | 20000.0 | 25.7 | B31.3 | |
| | | | | | | | | | |
| 35 | 45766.7 | -0.0 | 5.303 | 6.738 | 37823.8 | 20000.0 | 189.1 | B31.3 | * |
| 45 | 8982.7 | 0.0 | 1.000 | 1.000 | 12481.5 | 20000.0 | 62.4 | B31.3 | |
| | | | | | | | | | |
| 45 | 8982.7 | -0.0 | 1.000 | 1.000 | 12481.5 | 20000.0 | 62.4 | B31.3 | |
| 50 | 38585.4 | 0.0 | 1.000 | 1.000 | 42084.3 | 20000.0 | 210.4 | B31.3 | * |
| | | | | | | | | | |
| 50 | 38585.4 | -0.0 | 1.000 | 1.000 | 42084.3 | 20000.0 | 210.4 | B31.3 | * |
| 55 | 1175.9 | 0.0 | 1.000 | 1.000 | 4674.7 | 20000.0 | 23.4 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 55 | 1175.9 | -0.0 | 1.000 | 1.000 | 4674.7 | 20000.0 | 23.4 | B31.3 | |
| 60 | 132.7 | 0.0 | 1.000 | 1.000 | 3631.5 | 20000.0 | 18.2 | B31.3 | |
| | | | | | | | | | |
| 60 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 65 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 65 | 216.0 | -0.0 | 1.000 | 1.000 | 3714.8 | 20000.0 | 18.6 | B31.3 | |
| 70 | 11038.6 | 0.0 | 1.000 | 1.000 | 14537.4 | 20000.0 | 72.7 | B31.3 | |
| | | | | | | | | | |
| 70 | 11038.6 | -0.0 | 1.000 | 1.000 | 14537.4 | 20000.0 | 72.7 | B31.3 | |
| 75 | 125054.1 | 0.0 | 5.303 | 6.738 | 97289.4 | 20000.0 | 486.4 | B31.3 | * |
| | | | | | | | | | |
| 75 | 39679.4 | -0.1 | 5.303 | 6.738 | 30803.3 | 20000.0 | 154.0 | B31.3 | * |
| 80 | 58.7 | 0.1 | 1.000 | 1.000 | 995.3 | 20000.0 | 5.0 | B31.3 | |
| | | | | | | | | | |
| 80 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 85 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 85 | 141.9 | -0.1 | 1.000 | 1.000 | 1076.2 | 20000.0 | 5.4 | B31.3 | |
| 90 | 1345.7 | 0.1 | 1.000 | 1.000 | 2262.6 | 20000.0 | 11.3 | B31.3 | |
| | | | | | | | | | |
| 90 | 1345.7 | -0.1 | 1.000 | 1.000 | 2262.6 | 20000.0 | 11.3 | B31.3 | |
| 93 | 1721.0 | 0.1 | 1.000 | 1.000 | 2624.9 | 20000.0 | 13.1 | B31.3 | |
| | | | | | | | | | |
| 93 | 4426.3 | -0.1 | 3.084 | 2.570 | 4223.6 | 20000.0 | 21.1 | B31.3 | |
| 94 | 23315.9 | 1044.0 | 3.084 | 2.570 | 19599.0 | 20000.0 | 98.0 | B31.3 | |
| | | | | | | | | | |
| 94 | 23315.9 | -1044.0 | 3.084 | 2.570 | 23840.7 | 20000.0 | 119.2 | B31.3 | * |
| 95 | 1840.0 | 1604.0 | 3.084 | 2.570 | 7166.0 | 20000.0 | 35.8 | B31.3 | |
| | | | | | | | | | |
| 95 | 687.5 | -1604.0 | 1.000 | 1.000 | 6554.1 | 20000.0 | 32.8 | B31.3 | |
| 97 | 6249.7 | 1604.0 | 1.000 | 1.000 | 11725.0 | 20000.0 | 58.6 | B31.3 | |
| | | | | | | | | | |
| 97 | 6249.7 | -1604.0 | 1.000 | 1.000 | 11725.0 | 20000.0 | 58.6 | B31.3 | |
| 98 | 680.1 | 1604.0 | 1.000 | 1.000 | 6547.7 | 20000.0 | 32.7 | B31.3 | |
| | | | | | | | | | |
| 98 | 680.1 | -1604.0 | 1.000 | 1.000 | 6547.7 | 20000.0 | 32.7 | B31.3 | |
| 100 | 1986.8 | 1604.0 | 10.994 | 14.325 | 7264.6 | 20000.0 | 36.3 | B31.3 | |
| | | | | | | | | | |
| 100 | 4193.5 | -646.0 | 10.994 | 14.325 | 8303.6 | 20000.0 | 41.5 | B31.3 | |
| 105 | 289.1 | 646.0 | 10.994 | 14.325 | 5430.1 | 20000.0 | 27.2 | B31.3 | |
| | | | | | | | | | |
| 105 | 2329.9 | -255.3 | 10.994 | 14.325 | 6858.5 | 20000.0 | 34.3 | B31.3 | |
| 110 | 210.4 | 255.3 | 10.994 | 14.325 | 5274.6 | 20000.0 | 26.4 | B31.3 | |
| | | | | | | | | | |
| 110 | 2282.5 | -88.7 | 10.994 | 14.325 | 6839.3 | 20000.0 | 34.2 | B31.3 | |
| 115 | 370.4 | 88.7 | 10.994 | 14.325 | 5405.8 | 20000.0 | 27.0 | B31.3 | |
| | | | | | | | | | |
| 115 | 1999.1 | 0.0 | 10.994 | 14.325 | 6655.9 | 20000.0 | 33.3 | B31.3 | |
| 120 | 97.6 | -0.0 | 1.000 | 1.000 | 5254.2 | 20000.0 | 26.3 | B31.3 | |
| | | | | | | | | | |
| 120 | 97.6 | 0.0 | 1.000 | 1.000 | 5254.2 | 20000.0 | 26.3 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 125 | 0.0 | -0.0 | 1.000 | 1.000 | 5156.6 | 20000.0 | 25.8 | B31.3 | |
| | | | | | | | | | |
| 100 | 70610.7 | -0.0 | 10.994 | 14.325 | 55456.8 | 20000.0 | 277.3 | B31.3 | * |
| 217 | 2301.9 | 0.0 | 1.000 | 1.000 | 4882.1 | 20000.0 | 24.4 | B31.3 | |
| | | | | | | | | | |
| 217 | 2301.9 | -0.0 | 1.000 | 1.000 | 4882.1 | 20000.0 | 24.4 | B31.3 | |
| 218 | 219.4 | 0.0 | 1.000 | 1.000 | 2811.7 | 20000.0 | 14.1 | B31.3 | |
| | | | | | | | | | |
| 218 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 219 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 219 | 301.5 | -0.0 | 2.362 | 1.968 | 2819.8 | 20000.0 | 14.1 | B31.3 | |
| 224 | 10962.8 | 0.0 | 2.362 | 1.968 | 10114.1 | 20000.0 | 50.6 | B31.3 | |
| | | | | | | | | | |
| 224 | 10962.8 | -0.0 | 2.362 | 1.968 | 10114.1 | 20000.0 | 50.6 | B31.3 | |
| 225 | 10931.9 | 0.0 | 2.362 | 1.968 | 10106.3 | 20000.0 | 50.5 | B31.3 | |
| | | | | | | | | | |
| 225 | 4628.1 | -0.0 | 1.000 | 1.000 | 6535.5 | 20000.0 | 32.7 | B31.3 | |
| 230 | 4488.4 | 0.0 | 1.000 | 1.000 | 6395.7 | 20000.0 | 32.0 | B31.3 | |
| | | | | | | | | | |
| 230 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 235 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 235 | 3888.3 | -0.0 | 1.000 | 1.000 | 5795.7 | 20000.0 | 29.0 | B31.3 | |
| 240 | 1337.4 | 0.0 | 1.000 | 1.000 | 3244.8 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |
| 240 | 1337.4 | -0.0 | 1.000 | 1.000 | 3244.8 | 20000.0 | 16.2 | B31.3 | |
| 242 | 110.5 | 0.0 | 1.000 | 1.000 | 2017.8 | 20000.0 | 10.1 | B31.3 | |
| | | | | | | | | | |
| 242 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 243 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 243 | 94.2 | -0.0 | 1.000 | 1.000 | 2001.6 | 20000.0 | 10.0 | B31.3 | |
| 245 | 368.0 | 0.0 | 1.000 | 1.000 | 2275.3 | 20000.0 | 11.4 | B31.3 | |
| | | | | | | | | | |
| 245 | 368.0 | -0.0 | 1.000 | 1.000 | 2275.3 | 20000.0 | 11.4 | B31.3 | |
| 247 | 65.0 | 0.0 | 1.000 | 1.000 | 1972.3 | 20000.0 | 9.9 | B31.3 | |
| | | | | | | | | | |
| 247 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 248 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 248 | 46.8 | -0.0 | 1.000 | 1.000 | 1954.2 | 20000.0 | 9.8 | B31.3 | |
| 250 | 1465.2 | 0.0 | 1.000 | 1.000 | 3372.6 | 20000.0 | 16.9 | B31.3 | |
| | | | | | | | | | |
| 250 | 1465.2 | -0.0 | 1.000 | 1.000 | 3355.3 | 20000.0 | 16.8 | B31.3 | |
| 255 | 1205.6 | 0.0 | 1.000 | 1.000 | 3969.4 | 20000.0 | 19.8 | B31.3 | |
| | | | | | | | | | |
| 255 | 1205.6 | -0.0 | 1.000 | 1.000 | 3986.7 | 20000.0 | 19.9 | B31.3 | |
| 260 | 1694.5 | 0.0 | 1.000 | 1.000 | 4475.6 | 20000.0 | 22.4 | B31.3 | |
| | | | | | | | | | |
| 260 | 1694.5 | -0.0 | 1.000 | 1.000 | 4475.6 | 20000.0 | 22.4 | B31.3 | |
| 265 | 516.7 | 0.0 | 1.000 | 1.000 | 3297.8 | 20000.0 | 16.5 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 265 | 516.7 | -0.0 | 1.000 | 1.000 | 3297.8 | 20000.0 | 16.5 | B31.3 | |
| 270 | 1194.4 | 0.0 | 1.000 | 1.000 | 3975.5 | 20000.0 | 19.9 | B31.3 | |
| | | | | | | | | | |
| 270 | 1194.4 | -0.0 | 1.000 | 1.000 | 3975.5 | 20000.0 | 19.9 | B31.3 | |
| 273 | 2375.4 | 0.0 | 1.000 | 1.000 | 5156.4 | 20000.0 | 25.8 | B31.3 | |
| | | | | | | | | | |
| 273 | 2375.4 | -0.0 | 1.000 | 1.000 | 5156.4 | 20000.0 | 25.8 | B31.3 | |
| 275 | 5765.2 | 0.0 | 1.000 | 1.000 | 8546.3 | 20000.0 | 42.7 | B31.3 | |
| | | | | | | | | | |
| 275 | 5765.2 | -0.0 | 1.000 | 1.000 | 8546.3 | 20000.0 | 42.7 | B31.3 | |
| 280 | 166.4 | 0.0 | 1.000 | 1.000 | 2947.5 | 20000.0 | 14.7 | B31.3 | |
| | | | | | | | | | |
| 280 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 285 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 285 | 335.9 | -0.0 | 1.000 | 1.000 | 3117.0 | 20000.0 | 15.6 | B31.3 | |
| 287 | 1838.8 | 0.0 | 1.000 | 1.000 | 4619.9 | 20000.0 | 23.1 | B31.3 | |
| | | | | | | | | | |
| 287 | 1838.8 | -0.0 | 1.000 | 1.000 | 4619.9 | 20000.0 | 23.1 | B31.3 | |
| 290 | 565.0 | 0.0 | 1.000 | 1.000 | 3346.1 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 290 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 295 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 295 | 1434.8 | -0.0 | 1.000 | 1.000 | 4215.9 | 20000.0 | 21.1 | B31.3 | |
| 298 | 1635.1 | 0.0 | 1.000 | 1.000 | 4416.1 | 20000.0 | 22.1 | B31.3 | |
| | | | | | | | | | |
| 298 | 4913.8 | -0.0 | 3.005 | 2.504 | 6466.4 | 20000.0 | 32.3 | B31.3 | |
| 299 | 8922.2 | 0.0 | 3.005 | 2.504 | 9134.0 | 20000.0 | 45.7 | B31.3 | |
| | | | | | | | | | |
| 299 | 8922.2 | -0.0 | 3.005 | 2.504 | 9134.0 | 20000.0 | 45.7 | B31.3 | |
| 300 | 3094.2 | 0.0 | 3.005 | 2.504 | 5208.6 | 20000.0 | 26.0 | B31.3 | |
| | | | | | | | | | |
| 300 | 1029.6 | -0.0 | 1.000 | 1.000 | 3917.5 | 20000.0 | 19.6 | B31.3 | |
| 305 | 370.9 | 0.0 | 1.000 | 1.000 | 3252.5 | 20000.0 | 16.3 | B31.3 | |
| | | | | | | | | | |
| 305 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 310 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 310 | 131.4 | -0.0 | 1.000 | 1.000 | 3011.3 | 20000.0 | 15.1 | B31.3 | |
| 312 | 1365.6 | 0.0 | 1.000 | 1.000 | 4231.1 | 20000.0 | 21.2 | B31.3 | |
| | | | | | | | | | |
| 312 | 1365.6 | -0.0 | 1.000 | 1.000 | 4231.1 | 20000.0 | 21.2 | B31.3 | |
| 315 | 45031.2 | 0.0 | 10.994 | 14.325 | 36556.1 | 20000.0 | 182.8 | B31.3 | * |
| | | | | | | | | | |
| 105 | 29480.5 | -0.0 | 10.994 | 14.325 | 24609.1 | 20000.0 | 123.0 | B31.3 | * |
| 317 | 2301.9 | 0.0 | 1.000 | 1.000 | 4882.1 | 20000.0 | 24.4 | B31.3 | |
| | | | | | | | | | |
| 317 | 2301.9 | -0.0 | 1.000 | 1.000 | 4882.1 | 20000.0 | 24.4 | B31.3 | |
| 318 | 219.4 | 0.0 | 1.000 | 1.000 | 2811.7 | 20000.0 | 14.1 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 318 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 319 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 319 | 301.5 | -0.0 | 2.362 | 1.968 | 2819.8 | 20000.0 | 14.1 | B31.3 | |
| 324 | 10962.8 | 0.0 | 2.362 | 1.968 | 10114.1 | 20000.0 | 50.6 | B31.3 | |
| | | | | | | | | | |
| 324 | 10962.8 | -0.0 | 2.362 | 1.968 | 10114.1 | 20000.0 | 50.6 | B31.3 | |
| 325 | 10931.9 | 0.0 | 2.362 | 1.968 | 10106.3 | 20000.0 | 50.5 | B31.3 | |
| | | | | | | | | | |
| 325 | 4628.1 | -0.0 | 1.000 | 1.000 | 6535.5 | 20000.0 | 32.7 | B31.3 | |
| 330 | 4488.4 | 0.0 | 1.000 | 1.000 | 6395.7 | 20000.0 | 32.0 | B31.3 | |
| | | | | | | | | | |
| 330 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 335 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 335 | 3888.3 | -0.0 | 1.000 | 1.000 | 5795.7 | 20000.0 | 29.0 | B31.3 | |
| 340 | 1337.4 | 0.0 | 1.000 | 1.000 | 3244.8 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |
| 340 | 1337.4 | -0.0 | 1.000 | 1.000 | 3244.8 | 20000.0 | 16.2 | B31.3 | |
| 342 | 110.5 | 0.0 | 1.000 | 1.000 | 2017.8 | 20000.0 | 10.1 | B31.3 | |
| | | | | | | | | | |
| 342 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 343 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 343 | 94.2 | -0.0 | 1.000 | 1.000 | 2001.6 | 20000.0 | 10.0 | B31.3 | |
| 345 | 368.0 | 0.0 | 1.000 | 1.000 | 2275.3 | 20000.0 | 11.4 | B31.3 | |
| | | | | | | | | | |
| 345 | 368.0 | -0.0 | 1.000 | 1.000 | 2275.3 | 20000.0 | 11.4 | B31.3 | |
| 347 | 65.0 | 0.0 | 1.000 | 1.000 | 1972.3 | 20000.0 | 9.9 | B31.3 | |
| | | | | | | | | | |
| 347 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 348 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 348 | 46.8 | -0.0 | 1.000 | 1.000 | 1954.2 | 20000.0 | 9.8 | B31.3 | |
| 350 | 1465.2 | 0.0 | 1.000 | 1.000 | 3372.6 | 20000.0 | 16.9 | B31.3 | |
| | | | | | | | | | |
| 350 | 1465.2 | -0.0 | 1.000 | 1.000 | 3355.3 | 20000.0 | 16.8 | B31.3 | |
| 355 | 1205.6 | 0.0 | 1.000 | 1.000 | 3969.4 | 20000.0 | 19.8 | B31.3 | |
| | | | | | | | | | |
| 355 | 1205.6 | -0.0 | 1.000 | 1.000 | 3986.7 | 20000.0 | 19.9 | B31.3 | |
| 360 | 1694.5 | 0.0 | 1.000 | 1.000 | 4475.6 | 20000.0 | 22.4 | B31.3 | |
| | | | | | | | | | |
| 360 | 1694.5 | -0.0 | 1.000 | 1.000 | 4475.6 | 20000.0 | 22.4 | B31.3 | |
| 365 | 516.7 | 0.0 | 1.000 | 1.000 | 3297.8 | 20000.0 | 16.5 | B31.3 | |
| | | | | | | | | | |
| 365 | 516.7 | -0.0 | 1.000 | 1.000 | 3297.8 | 20000.0 | 16.5 | B31.3 | |
| 370 | 1194.4 | 0.0 | 1.000 | 1.000 | 3975.5 | 20000.0 | 19.9 | B31.3 | |
| | | | | | | | | | |
| 370 | 1194.4 | -0.0 | 1.000 | 1.000 | 3975.5 | 20000.0 | 19.9 | B31.3 | |
| 373 | 2375.4 | 0.0 | 1.000 | 1.000 | 5156.4 | 20000.0 | 25.8 | B31.3 | |
| | | | | | | | | | |
| 373 | 2375.4 | -0.0 | 1.000 | 1.000 | 5156.4 | 20000.0 | 25.8 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 375 | 5765.2 | 0.0 | 1.000 | 1.000 | 8546.3 | 20000.0 | 42.7 | B31.3 | |
| | | | | | | | | | |
| 375 | 5765.2 | -0.0 | 1.000 | 1.000 | 8546.3 | 20000.0 | 42.7 | B31.3 | |
| 380 | 166.4 | 0.0 | 1.000 | 1.000 | 2947.5 | 20000.0 | 14.7 | B31.3 | |
| | | | | | | | | | |
| 380 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 385 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 385 | 335.9 | -0.0 | 1.000 | 1.000 | 3117.0 | 20000.0 | 15.6 | B31.3 | |
| 387 | 1838.8 | 0.0 | 1.000 | 1.000 | 4619.9 | 20000.0 | 23.1 | B31.3 | |
| | | | | | | | | | |
| 387 | 1838.8 | -0.0 | 1.000 | 1.000 | 4619.9 | 20000.0 | 23.1 | B31.3 | |
| 390 | 565.0 | 0.0 | 1.000 | 1.000 | 3346.1 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 390 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 395 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 395 | 1434.8 | -0.0 | 1.000 | 1.000 | 4215.9 | 20000.0 | 21.1 | B31.3 | |
| 398 | 1635.1 | 0.0 | 1.000 | 1.000 | 4416.1 | 20000.0 | 22.1 | B31.3 | |
| | | | | | | | | | |
| 398 | 4913.8 | -0.0 | 3.005 | 2.504 | 6466.4 | 20000.0 | 32.3 | B31.3 | |
| 399 | 8922.2 | 0.0 | 3.005 | 2.504 | 9134.0 | 20000.0 | 45.7 | B31.3 | |
| | | | | | | | | | |
| 399 | 8922.2 | -0.0 | 3.005 | 2.504 | 9134.0 | 20000.0 | 45.7 | B31.3 | |
| 400 | 3094.2 | 0.0 | 3.005 | 2.504 | 5208.6 | 20000.0 | 26.0 | B31.3 | |
| | | | | | | | | | |
| 400 | 1029.6 | -0.0 | 1.000 | 1.000 | 3917.5 | 20000.0 | 19.6 | B31.3 | |
| 405 | 370.9 | 0.0 | 1.000 | 1.000 | 3252.5 | 20000.0 | 16.3 | B31.3 | |
| | | | | | | | | | |
| 405 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 410 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 410 | 131.4 | -0.0 | 1.000 | 1.000 | 3011.3 | 20000.0 | 15.1 | B31.3 | |
| 412 | 1365.6 | 0.0 | 1.000 | 1.000 | 4231.1 | 20000.0 | 21.2 | B31.3 | |
| | | | | | | | | | |
| 412 | 1365.6 | -0.0 | 1.000 | 1.000 | 4231.1 | 20000.0 | 21.2 | B31.3 | |
| 415 | 14338.8 | 0.0 | 10.994 | 14.325 | 13536.8 | 20000.0 | 67.7 | B31.3 | |
| | | | | | | | | | |
| 110 | 13806.4 | -0.0 | 10.994 | 14.325 | 12853.6 | 20000.0 | 64.3 | B31.3 | |
| 417 | 2301.9 | 0.0 | 1.000 | 1.000 | 4882.1 | 20000.0 | 24.4 | B31.3 | |
| | | | | | | | | | |
| 417 | 2301.9 | -0.0 | 1.000 | 1.000 | 4882.1 | 20000.0 | 24.4 | B31.3 | |
| 418 | 219.4 | 0.0 | 1.000 | 1.000 | 2811.7 | 20000.0 | 14.1 | B31.3 | |
| | | | | | | | | | |
| 418 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 419 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 419 | 301.5 | -0.0 | 2.362 | 1.968 | 2819.8 | 20000.0 | 14.1 | B31.3 | |
| 424 | 10962.8 | 0.0 | 2.362 | 1.968 | 10114.1 | 20000.0 | 50.6 | B31.3 | |
| | | | | | | | | | |
| 424 | 10962.8 | -0.0 | 2.362 | 1.968 | 10114.1 | 20000.0 | 50.6 | B31.3 | |
| 425 | 10931.9 | 0.0 | 2.362 | 1.968 | 10106.3 | 20000.0 | 50.5 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 425 | 4628.1 | -0.0 | 1.000 | 1.000 | 6535.5 | 20000.0 | 32.7 | B31.3 | |
| 430 | 4488.4 | 0.0 | 1.000 | 1.000 | 6395.7 | 20000.0 | 32.0 | B31.3 | |
| | | | | | | | | | |
| 430 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 435 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 435 | 3888.3 | -0.0 | 1.000 | 1.000 | 5795.7 | 20000.0 | 29.0 | B31.3 | |
| 440 | 1337.4 | 0.0 | 1.000 | 1.000 | 3244.8 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |
| 440 | 1337.4 | -0.0 | 1.000 | 1.000 | 3244.8 | 20000.0 | 16.2 | B31.3 | |
| 442 | 110.5 | 0.0 | 1.000 | 1.000 | 2017.8 | 20000.0 | 10.1 | B31.3 | |
| | | | | | | | | | |
| 442 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 443 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 443 | 94.2 | -0.0 | 1.000 | 1.000 | 2001.6 | 20000.0 | 10.0 | B31.3 | |
| 445 | 368.0 | 0.0 | 1.000 | 1.000 | 2275.3 | 20000.0 | 11.4 | B31.3 | |
| | | | | | | | | | |
| 445 | 368.0 | -0.0 | 1.000 | 1.000 | 2275.3 | 20000.0 | 11.4 | B31.3 | |
| 447 | 65.0 | 0.0 | 1.000 | 1.000 | 1972.3 | 20000.0 | 9.9 | B31.3 | |
| | | | | | | | | | |
| 447 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 448 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 448 | 46.8 | -0.0 | 1.000 | 1.000 | 1954.2 | 20000.0 | 9.8 | B31.3 | |
| 450 | 1465.2 | 0.0 | 1.000 | 1.000 | 3372.6 | 20000.0 | 16.9 | B31.3 | |
| | | | | | | | | | |
| 450 | 1465.2 | -0.0 | 1.000 | 1.000 | 3355.3 | 20000.0 | 16.8 | B31.3 | |
| 455 | 1205.6 | 0.0 | 1.000 | 1.000 | 3969.4 | 20000.0 | 19.8 | B31.3 | |
| | | | | | | | | | |
| 455 | 1205.6 | -0.0 | 1.000 | 1.000 | 3986.7 | 20000.0 | 19.9 | B31.3 | |
| 460 | 1694.5 | 0.0 | 1.000 | 1.000 | 4475.6 | 20000.0 | 22.4 | B31.3 | |
| | | | | | | | | | |
| 460 | 1694.5 | -0.0 | 1.000 | 1.000 | 4475.6 | 20000.0 | 22.4 | B31.3 | |
| 465 | 516.7 | 0.0 | 1.000 | 1.000 | 3297.8 | 20000.0 | 16.5 | B31.3 | |
| | | | | | | | | | |
| 465 | 516.7 | -0.0 | 1.000 | 1.000 | 3297.8 | 20000.0 | 16.5 | B31.3 | |
| 470 | 1194.4 | 0.0 | 1.000 | 1.000 | 3975.5 | 20000.0 | 19.9 | B31.3 | |
| | | | | | | | | | |
| 470 | 1194.4 | -0.0 | 1.000 | 1.000 | 3975.5 | 20000.0 | 19.9 | B31.3 | |
| 473 | 2375.4 | 0.0 | 1.000 | 1.000 | 5156.4 | 20000.0 | 25.8 | B31.3 | |
| | | | | | | | | | |
| 473 | 2375.4 | -0.0 | 1.000 | 1.000 | 5156.4 | 20000.0 | 25.8 | B31.3 | |
| 475 | 5765.2 | 0.0 | 1.000 | 1.000 | 8546.3 | 20000.0 | 42.7 | B31.3 | |
| | | | | | | | | | |
| 475 | 5765.2 | -0.0 | 1.000 | 1.000 | 8546.3 | 20000.0 | 42.7 | B31.3 | |
| 480 | 166.4 | 0.0 | 1.000 | 1.000 | 2947.5 | 20000.0 | 14.7 | B31.3 | |
| | | | | | | | | | |
| 480 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 485 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 485 | 335.9 | -0.0 | 1.000 | 1.000 | 3117.0 | 20000.0 | 15.6 | B31.3 | |
| 487 | 1838.8 | 0.0 | 1.000 | 1.000 | 4619.9 | 20000.0 | 23.1 | B31.3 | |
| | | | | | | | | | |
| 487 | 1838.8 | -0.0 | 1.000 | 1.000 | 4619.9 | 20000.0 | 23.1 | B31.3 | |
| 490 | 565.0 | 0.0 | 1.000 | 1.000 | 3346.1 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 490 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 495 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 495 | 1434.8 | -0.0 | 1.000 | 1.000 | 4215.9 | 20000.0 | 21.1 | B31.3 | |
| 498 | 1635.1 | 0.0 | 1.000 | 1.000 | 4416.1 | 20000.0 | 22.1 | B31.3 | |
| | | | | | | | | | |
| 498 | 4913.8 | -0.0 | 3.005 | 2.504 | 6466.4 | 20000.0 | 32.3 | B31.3 | |
| 499 | 8922.2 | 0.0 | 3.005 | 2.504 | 9134.0 | 20000.0 | 45.7 | B31.3 | |
| | | | | | | | | | |
| 499 | 8922.2 | -0.0 | 3.005 | 2.504 | 9134.0 | 20000.0 | 45.7 | B31.3 | |
| 500 | 3094.2 | 0.0 | 3.005 | 2.504 | 5208.6 | 20000.0 | 26.0 | B31.3 | |
| | | | | | | | | | |
| 500 | 1029.6 | -0.0 | 1.000 | 1.000 | 3917.5 | 20000.0 | 19.6 | B31.3 | |
| 505 | 370.9 | 0.0 | 1.000 | 1.000 | 3252.5 | 20000.0 | 16.3 | B31.3 | |
| | | | | | | | | | |
| 505 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 510 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 510 | 131.4 | -0.0 | 1.000 | 1.000 | 3011.3 | 20000.0 | 15.1 | B31.3 | |
| 512 | 1365.6 | 0.0 | 1.000 | 1.000 | 4231.1 | 20000.0 | 21.2 | B31.3 | |
| | | | | | | | | | |
| 512 | 1365.6 | -0.0 | 1.000 | 1.000 | 4231.1 | 20000.0 | 21.2 | B31.3 | |
| 515 | 4683.2 | 0.0 | 10.994 | 14.325 | 6295.1 | 20000.0 | 31.5 | B31.3 | |
| | | | | | | | | | |
| 115 | 8909.1 | -0.0 | 10.994 | 14.325 | 9180.6 | 20000.0 | 45.9 | B31.3 | |
| 517 | 2301.9 | 0.0 | 1.000 | 1.000 | 4882.1 | 20000.0 | 24.4 | B31.3 | |
| | | | | | | | | | |
| 517 | 2301.9 | -0.0 | 1.000 | 1.000 | 4882.1 | 20000.0 | 24.4 | B31.3 | |
| 518 | 219.4 | 0.0 | 1.000 | 1.000 | 2811.7 | 20000.0 | 14.1 | B31.3 | |
| | | | | | | | | | |
| 518 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 519 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 519 | 301.5 | -0.0 | 2.362 | 1.968 | 2819.8 | 20000.0 | 14.1 | B31.3 | |
| 524 | 10962.8 | 0.0 | 2.362 | 1.968 | 10114.1 | 20000.0 | 50.6 | B31.3 | |
| | | | | | | | | | |
| 524 | 10962.8 | -0.0 | 2.362 | 1.968 | 10114.1 | 20000.0 | 50.6 | B31.3 | |
| 525 | 10931.9 | 0.0 | 2.362 | 1.968 | 10106.3 | 20000.0 | 50.5 | B31.3 | |
| | | | | | | | | | |
| 525 | 4628.1 | -0.0 | 1.000 | 1.000 | 6535.5 | 20000.0 | 32.7 | B31.3 | |
| 530 | 4488.4 | 0.0 | 1.000 | 1.000 | 6395.7 | 20000.0 | 32.0 | B31.3 | |
| | | | | | | | | | |
| 530 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 535 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 535 | 3888.3 | -0.0 | 1.000 | 1.000 | 5795.7 | 20000.0 | 29.0 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 540 | 1337.4 | 0.0 | 1.000 | 1.000 | 3244.8 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |
| 540 | 1337.4 | -0.0 | 1.000 | 1.000 | 3244.8 | 20000.0 | 16.2 | B31.3 | |
| 542 | 110.5 | 0.0 | 1.000 | 1.000 | 2017.8 | 20000.0 | 10.1 | B31.3 | |
| | | | | | | | | | |
| 542 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 543 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 543 | 94.2 | -0.0 | 1.000 | 1.000 | 2001.6 | 20000.0 | 10.0 | B31.3 | |
| 545 | 368.0 | 0.0 | 1.000 | 1.000 | 2275.3 | 20000.0 | 11.4 | B31.3 | |
| | | | | | | | | | |
| 545 | 368.0 | -0.0 | 1.000 | 1.000 | 2275.3 | 20000.0 | 11.4 | B31.3 | |
| 547 | 65.0 | 0.0 | 1.000 | 1.000 | 1972.3 | 20000.0 | 9.9 | B31.3 | |
| | | | | | | | | | |
| 547 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 548 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 548 | 46.8 | -0.0 | 1.000 | 1.000 | 1954.2 | 20000.0 | 9.8 | B31.3 | |
| 550 | 1465.2 | 0.0 | 1.000 | 1.000 | 3372.6 | 20000.0 | 16.9 | B31.3 | |
| | | | | | | | | | |
| 550 | 1465.2 | -0.0 | 1.000 | 1.000 | 3355.3 | 20000.0 | 16.8 | B31.3 | |
| 555 | 1205.6 | 0.0 | 1.000 | 1.000 | 3969.4 | 20000.0 | 19.8 | B31.3 | |
| | | | | | | | | | |
| 555 | 1205.6 | -0.0 | 1.000 | 1.000 | 3986.7 | 20000.0 | 19.9 | B31.3 | |
| 560 | 1694.5 | 0.0 | 1.000 | 1.000 | 4475.6 | 20000.0 | 22.4 | B31.3 | |
| | | | | | | | | | |
| 560 | 1694.5 | -0.0 | 1.000 | 1.000 | 4475.6 | 20000.0 | 22.4 | B31.3 | |
| 565 | 516.7 | 0.0 | 1.000 | 1.000 | 3297.8 | 20000.0 | 16.5 | B31.3 | |
| | | | | | | | | | |
| 565 | 516.7 | -0.0 | 1.000 | 1.000 | 3297.8 | 20000.0 | 16.5 | B31.3 | |
| 570 | 1194.4 | 0.0 | 1.000 | 1.000 | 3975.5 | 20000.0 | 19.9 | B31.3 | |
| | | | | | | | | | |
| 570 | 1194.4 | -0.0 | 1.000 | 1.000 | 3975.5 | 20000.0 | 19.9 | B31.3 | |
| 573 | 2375.4 | 0.0 | 1.000 | 1.000 | 5156.4 | 20000.0 | 25.8 | B31.3 | |
| | | | | | | | | | |
| 573 | 2375.4 | -0.0 | 1.000 | 1.000 | 5156.4 | 20000.0 | 25.8 | B31.3 | |
| 575 | 5765.2 | 0.0 | 1.000 | 1.000 | 8546.3 | 20000.0 | 42.7 | B31.3 | |
| | | | | | | | | | |
| 575 | 5765.2 | -0.0 | 1.000 | 1.000 | 8546.3 | 20000.0 | 42.7 | B31.3 | |
| 580 | 166.4 | 0.0 | 1.000 | 1.000 | 2947.5 | 20000.0 | 14.7 | B31.3 | |
| | | | | | | | | | |
| 580 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 585 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 585 | 335.9 | -0.0 | 1.000 | 1.000 | 3117.0 | 20000.0 | 15.6 | B31.3 | |
| 587 | 1838.8 | 0.0 | 1.000 | 1.000 | 4619.9 | 20000.0 | 23.1 | B31.3 | |
| | | | | | | | | | |
| 587 | 1838.8 | -0.0 | 1.000 | 1.000 | 4619.9 | 20000.0 | 23.1 | B31.3 | |
| 590 | 565.0 | 0.0 | 1.000 | 1.000 | 3346.1 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 590 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 595 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 595 | 1434.8 | -0.0 | 1.000 | 1.000 | 4215.9 | 20000.0 | 21.1 | B31.3 | |
| 598 | 1635.1 | 0.0 | 1.000 | 1.000 | 4416.1 | 20000.0 | 22.1 | B31.3 | |
| | | | | | | | | | |
| 598 | 4913.8 | -0.0 | 3.005 | 2.504 | 6466.4 | 20000.0 | 32.3 | B31.3 | |
| 599 | 8922.2 | 0.0 | 3.005 | 2.504 | 9134.0 | 20000.0 | 45.7 | B31.3 | |
| | | | | | | | | | |
| 599 | 8922.2 | -0.0 | 3.005 | 2.504 | 9134.0 | 20000.0 | 45.7 | B31.3 | |
| 600 | 3094.2 | 0.0 | 3.005 | 2.504 | 5208.6 | 20000.0 | 26.0 | B31.3 | |
| | | | | | | | | | |
| 600 | 1029.6 | -0.0 | 1.000 | 1.000 | 3917.5 | 20000.0 | 19.6 | B31.3 | |
| 605 | 370.9 | 0.0 | 1.000 | 1.000 | 3252.5 | 20000.0 | 16.3 | B31.3 | |
| | | | | | | | | | |
| 605 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 610 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 610 | 131.4 | -0.0 | 1.000 | 1.000 | 3011.3 | 20000.0 | 15.1 | B31.3 | |
| 612 | 1365.6 | 0.0 | 1.000 | 1.000 | 4231.1 | 20000.0 | 21.2 | B31.3 | |
| | | | | | | | | | |
| 612 | 1365.6 | -0.0 | 1.000 | 1.000 | 4231.1 | 20000.0 | 21.2 | B31.3 | |
| 615 | 1898.2 | 0.0 | 10.994 | 14.325 | 4206.4 | 20000.0 | 21.0 | B31.3 | |
| | | | | | | | | | |
| 615 | 1467.4 | 0.0 | 10.994 | 14.325 | 6257.1 | 20000.0 | 31.3 | B31.3 | |
| 625 | 0.0 | 0.0 | 1.000 | 1.000 | 5156.6 | 20000.0 | 25.8 | B31.3 | |
| | | | | | | | | | |
| 615 | 1467.4 | 37.4 | 10.994 | 14.325 | 6257.6 | 20000.0 | 31.3 | B31.3 | |
| 515 | 1031.8 | -37.4 | 10.994 | 14.325 | 5930.9 | 20000.0 | 29.7 | B31.3 | |
| | | | | | | | | | |
| 515 | 1031.8 | 129.5 | 10.994 | 14.325 | 5936.1 | 20000.0 | 29.7 | B31.3 | |
| 415 | 1035.5 | -129.5 | 10.994 | 14.325 | 5938.9 | 20000.0 | 29.7 | B31.3 | |
| | | | | | | | | | |
| 415 | 1035.5 | 411.8 | 10.994 | 14.325 | 5990.1 | 20000.0 | 30.0 | B31.3 | |
| 315 | 994.9 | -411.8 | 10.994 | 14.325 | 5959.9 | 20000.0 | 29.8 | B31.3 | |
| | | | | | | | | | |
| 315 | 994.9 | 1298.1 | 10.994 | 14.325 | 6448.5 | 20000.0 | 32.2 | B31.3 | |
| 630 | 197.7 | -1298.1 | 1.000 | 1.000 | 5950.5 | 20000.0 | 29.8 | B31.3 | |
| | | | | | | | | | |
| 630 | 197.7 | 1298.1 | 1.000 | 1.000 | 5950.5 | 20000.0 | 29.8 | B31.3 | |
| 633 | 760.1 | -1298.1 | 1.000 | 1.000 | 6461.3 | 20000.0 | 32.3 | B31.3 | |
| | | | | | | | | | |
| 633 | 2352.3 | 1298.1 | 3.095 | 3.095 | 7391.8 | 20000.0 | 37.0 | B31.3 | |
| 634 | 6254.8 | -708.4 | 3.095 | 3.095 | 9949.1 | 20000.0 | 49.7 | B31.3 | |
| | | | | | | | | | |
| 634 | 6254.8 | 708.4 | 3.095 | 3.095 | 9949.1 | 20000.0 | 49.7 | B31.3 | |
| 635 | 4126.4 | 0.0 | 3.095 | 3.095 | 8251.4 | 20000.0 | 41.3 | B31.3 | |
| | | | | | | | | | |
| 635 | 1333.4 | -0.0 | 1.000 | 1.000 | 6490.0 | 20000.0 | 32.4 | B31.3 | |
| 640 | 0.0 | 0.0 | 1.000 | 1.000 | 5156.6 | 20000.0 | 25.8 | B31.3 | |
| | | | | | | | | | |
| 75 | 85374.7 | -0.0 | 5.303 | 6.738 | 68715.0 | 20000.0 | 343.6 | B31.3 | * |
| 700 | 10531.6 | 0.0 | 1.000 | 1.000 | 15215.6 | 20000.0 | 76.1 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 700 | 10531.6 | -0.0 | 1.000 | 1.000 | 15215.6 | 20000.0 | 76.1 | B31.3 | |
| 705 | 17919.8 | 0.0 | 1.000 | 1.000 | 20336.8 | 20000.0 | 101.7 | B31.3 | * |
| | | | | | | | | | |
| 705 | 17919.8 | -0.0 | 1.000 | 1.000 | 20336.8 | 20000.0 | 101.7 | B31.3 | * |
| 710 | 275.3 | 0.0 | 1.000 | 1.000 | 2692.3 | 20000.0 | 13.5 | B31.3 | |
| | | | | | | | | | |
| 710 | 275.3 | -0.0 | 1.000 | 1.000 | 2692.3 | 20000.0 | 13.5 | B31.3 | |
| 715 | 126.3 | 0.0 | 1.000 | 1.000 | 2543.3 | 20000.0 | 12.7 | B31.3 | |
| | | | | | | | | | |
| 715 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 720 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 720 | 89.9 | -0.0 | 1.000 | 1.000 | 2506.9 | 20000.0 | 12.5 | B31.3 | |
| 725 | 109.9 | 0.0 | 1.000 | 1.000 | 2526.9 | 20000.0 | 12.6 | B31.3 | |
| | | | | | | | | | |
| 725 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 730 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 730 | 384.8 | -0.0 | 1.000 | 1.000 | 2801.8 | 20000.0 | 14.0 | B31.3 | |
| 735 | 3885.3 | 0.0 | 1.000 | 1.000 | 6302.2 | 20000.0 | 31.5 | B31.3 | |
| | | | | | | | | | |
| 735 | 3885.3 | -0.0 | 1.000 | 1.000 | 6302.2 | 20000.0 | 31.5 | B31.3 | |
| 740 | 546.4 | 0.0 | 1.000 | 1.000 | 2963.4 | 20000.0 | 14.8 | B31.3 | |
| | | | | | | | | | |
| 740 | 546.4 | -0.0 | 1.000 | 1.000 | 2963.4 | 20000.0 | 14.8 | B31.3 | |
| 745 | 25.6 | 0.0 | 1.000 | 1.000 | 2442.6 | 20000.0 | 12.2 | B31.3 | |
| | | | | | | | | | |
| 745 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 750 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 750 | 141.6 | -0.0 | 1.000 | 1.000 | 2558.5 | 20000.0 | 12.8 | B31.3 | |
| 755 | 2196.5 | 0.0 | 1.000 | 1.000 | 4613.5 | 20000.0 | 23.1 | B31.3 | |
| | | | | | | | | | |
| 755 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 760 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 760 | 2987.9 | -0.0 | 1.000 | 1.000 | 5404.8 | 20000.0 | 27.0 | B31.3 | |
| 763 | 3126.3 | 0.0 | 1.000 | 1.000 | 5543.3 | 20000.0 | 27.7 | B31.3 | |
| | | | | | | | | | |
| 763 | 7384.6 | -0.0 | 2.362 | 1.968 | 7955.4 | 20000.0 | 39.8 | B31.3 | |
| 764 | 9538.8 | 0.0 | 2.362 | 1.968 | 9409.4 | 20000.0 | 47.0 | B31.3 | |
| | | | | | | | | | |
| 764 | 9538.8 | -0.0 | 2.362 | 1.968 | 9409.4 | 20000.0 | 47.0 | B31.3 | |
| 765 | 4096.0 | -0.0 | 2.362 | 1.968 | 5669.6 | 20000.0 | 28.3 | B31.3 | |
| | | | | | | | | | |
| 765 | 1734.1 | 0.0 | 1.000 | 1.000 | 4331.7 | 20000.0 | 21.7 | B31.3 | |
| 770 | 20.2 | -0.0 | 1.000 | 1.000 | 2601.1 | 20000.0 | 13.0 | B31.3 | |
| | | | | | | | | | |
| 770 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 775 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 775 | 187.5 | 0.0 | 1.000 | 1.000 | 2767.0 | 20000.0 | 13.8 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 780 | 1226.2 | -0.0 | 1.000 | 1.000 | 3795.6 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 780 | 4441.6 | 0.0 | 3.622 | 3.018 | 5900.5 | 20000.0 | 29.5 | B31.3 | |
| 784 | 322.8 | 0.0 | 3.622 | 3.018 | 2964.0 | 20000.0 | 14.8 | B31.3 | |
| | | | | | | | | | |
| 784 | 322.8 | -0.0 | 3.622 | 3.018 | 3372.6 | 20000.0 | 16.9 | B31.3 | |
| 785 | 1007.2 | -0.0 | 3.622 | 3.018 | 3932.2 | 20000.0 | 19.7 | B31.3 | |
| | | | | | | | | | |
| 785 | 278.1 | 0.0 | 1.000 | 1.000 | 3454.8 | 20000.0 | 17.3 | B31.3 | |
| 790 | 501.5 | -0.0 | 1.000 | 1.000 | 3678.3 | 20000.0 | 18.4 | B31.3 | |
| | | | | | | | | | |
| 790 | 501.5 | 0.0 | 1.000 | 1.000 | 3678.3 | 20000.0 | 18.4 | B31.3 | |
| 795 | 0.0 | 0.0 | 1.000 | 1.000 | 3176.8 | 20000.0 | 15.9 | B31.3 | |

Job Description:

PROJECT: NEWPP Water Purifiaction Plant, Houston

CLIENT : CDM Smith

ANALYST: DClark

CHECKER: RSinghal

NOTES : UV Building Phase 2

Existing Configuration with No Flex Joints

PIPE DATA
---
---
From 5 To 10 DX= -20.000 ft.
B31.3 (2010) Cycle Max Switch = --- App.P Sy/St Switch = ON
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.
Dia= 48.000 in. Wall= .375 in. Cor= .0000 in.
GENERAL
T1= 70 F P1= 165.0000 lb./sq.in. Mat= (102)A53 B
E= 29,500,000 lb./sq.in. EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in. EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in. EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in. EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in. EH9= 29,500,000 lb./sq.in. v = .292
Pipe Den= .2830000 lb./cu.in. Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .500 in. Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 5 ANC
Node 10 Y
Node 10 Z
ALLOWABLE STRESSES
---
From 10 To 15 DX= -20.000 ft.
BEND at "TO" end
Radius= 72.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 14
Angle/Node @2= .00 13
RESTRAINTS
Node 14 Y
Node 14 Z
---
From 15 To 20 DY= 6.000 ft.
RESTRAINTS
Node 20 Guide Gap= .250 in.
---
From 20 To 25 DY= 1.083 ft.
---
From 25 To 30 DY= .167 ft.
---
From 30 To 35 DY= 5.042 ft.
SIF's & TEE's

Node 35 Welding Tee
---
From 35 To 40 DY= 3.500 ft.
FORCES & MOMENTS
Node 40 FY1= -1,200.00 lb.
---
From 35 To 45 DX= -3.500 ft.
FORCES & MOMENTS
Node 45 FY1= -800.00 lb.
---
From 45 To 50 DX= -6.000 ft.
RESTRAINTS
Node 50 Y
---
From 50 To 55 DX= -9.187 ft.
RESTRAINTS
Node 55 +Y
---
From 55 To 60 DX= -.500 ft.
---
From 60 To 65 DX= -.167 ft.
---
From 65 To 70 DX= -5.062 ft.
FORCES & MOMENTS
Node 70 FY1= -800.00 lb.
---
From 70 To 75 DX= -5.583 ft.
SIF's & TEE's
Node 75 Welding Tee
---
From 75 To 80 DY= -6.167 ft.
---
From 80 To 85 DY= -.167 ft.
---
From 85 To 90 DY= -1.000 ft.
RESTRAINTS
Node 90 Guide Gap= .250 in.
---
From 90 To 95 DY= -6.750 ft.
BEND at "TO" end
Radius= 72.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 94
Angle/Node @2= .00 93
RESTRAINTS
Node 94 Y
Node 94 X
---
From 95 To 97 DZ= -9.531 ft.
RESTRAINTS
Node 97 Y
Node 97 X
---
From 97 To 98 DZ= -9.531 ft.
RESTRAINTS
Node 98 Y
Node 98 X
---
From 98 To 100 DZ= -17.281 ft.
RESTRAINTS

```
   Node  100  Y
   Node  100  X
SIF's & TEE's
   Node  100   Unreinforced Tee
-----------------------------------------------------------------------------
From  100  To  105 DZ= -8.000 ft.
RESTRAINTS
   Node  105  Y
   Node  105  X
SIF's & TEE's
   Node  105   Unreinforced Tee
-----------------------------------------------------------------------------
From  105  To  110 DZ= -8.000 ft.
RESTRAINTS
   Node  110  Y
   Node  110  X
SIF's & TEE's
   Node  110   Unreinforced Tee
-----------------------------------------------------------------------------
From  110  To  115 DZ= -8.000 ft.
RESTRAINTS
   Node  115  Y
   Node  115  X
SIF's & TEE's
   Node  115   Unreinforced Tee
-----------------------------------------------------------------------------
From  115  To  120 DZ= -3.000 ft.
RESTRAINTS
   Node  120  Y
   Node  120  X
-----------------------------------------------------------------------------
From  120  To  125 DZ= -7.000 ft.
RESTRAINTS
   Node  125  Y
   Node  125  X
-----------------------------------------------------------------------------
From  100  To  217 DY= 6.750 ft.
   Dia= 30.000 in.   Wall= .375 in.
GENERAL
   Refract. Thk= .375 in.   Refract. Den= .0643000 lb./cu.in.
   Insul Thk= .000 in.
RESTRAINTS
   Node  217  Guide   Gap= .250 in.
-----------------------------------------------------------------------------
From  217  To  218 DY= 1.000 ft.
-----------------------------------------------------------------------------
From  218  To  219 DY= .167 ft.
-----------------------------------------------------------------------------
From  219  To  225 DY= 3.750 ft.
SINGLE FLANGED BEND at "TO" end
   Radius= 45.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 224
-----------------------------------------------------------------------------
From  225  To  230  DX= -3.917 ft.
FORCES & MOMENTS
   Node  230   FY1= -365.00 lb.
-----------------------------------------------------------------------------
From  230  To  235  DX= -.750 ft.
RIGID  Weight= 600.00 lb.
```

FORCES & MOMENTS
  Node 235  FY1= -365.00 lb.
---
From 235 To 240 DX= -3.500 ft.
RESTRAINTS
  Node 240 Y
---
From 240 To 242 DX= -5.000 ft.
---
From 242 To 243 DX= -.083 ft.
---
From 243 To 245 DX= -2.760 ft.
RESTRAINTS
  Node 245 Y
---
From 245 To 247 DX= -1.500 ft.
---
From 247 To 248 DX= -.083 ft.
---
From 248 To 250 DX= -5.542 ft.
FORCES & MOMENTS
  Node 250  FY1= -730.00 lb.
---
From 250 To 255 DX= -2.083 ft. DY= -.250 ft.
FORCES & MOMENTS
  Node 255  FY1= -1,730.00 lb.
---
From 255 To 260 DX= -1.385 ft.
  Dia= 36.000 in.  Wall= .375 in.
GENERAL
  Refract. Thk= .375 in.  Insul Thk= .000 in.
RESTRAINTS
  Node 260 Y
---
From 260 To 265 DX= -7.219 ft.
  Dia= 36.000 in.  Wall= .375 in.
  Insul Thk= .000 in.
RESTRAINTS
  Node 265 Y
---
From 265 To 270 DX= -1.146 ft.
FORCES & MOMENTS
  Node 270  FY1= -1,730.00 lb.
---
From 270 To 273 DX= -1.750 ft.
RESTRAINTS
  Node 273 Y
---
From 273 To 275 DX= -2.000 ft.
RESTRAINTS
  Node 275 Y
---
From 275 To 280 DX= -5.542 ft.
---
From 280 To 285 DX= -.167 ft.
---
From 285 To 287 DX= -1.500 ft.
RESTRAINTS

Node 287 Y
---
From 287 To 290 DX= -2.188 ft.
FORCES & MOMENTS
Node 290 FY1= -590.00 lb.
---
From 290 To 295 DX= -.750 ft.
RIGID Weight= 975.00 lb.
FORCES & MOMENTS
Node 295 FY1= -590.00 lb.
---
From 295 To 300 DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 36.000 in. (SHORT Bend Angle= 90.000 Angle/Node @1= 45.00 299
Angle/Node @2= .00 298
---
From 300 To 305 DY= -3.458 ft.
---
From 305 To 310 DY= -.167 ft.
---
From 310 To 312 DY= -1.042 ft.
RESTRAINTS
Node 312 Guide Gap= .250 in.
---
From 312 To 315 DY= -6.000 ft.
RESTRAINTS
Node 315 Y
Node 315 X
SIF's & TEE's
Node 315 Unreinforced Tee
---
From 105 To 317 DY= 6.750 ft.
Dia= 30.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Refract. Den= .0643000 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 317 Guide Gap= .250 in.
---
From 317 To 318 DY= 1.000 ft.
---
From 318 To 319 DY= .167 ft.
---
From 319 To 325 DY= 3.750 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 45.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 324
---
From 325 To 330 DX= -3.917 ft.
FORCES & MOMENTS
Node 330 FY1= -365.00 lb.
---
From 330 To 335 DX= -.750 ft.
RIGID Weight= 600.00 lb.
FORCES & MOMENTS
Node 335 FY1= -365.00 lb.
---
From 335 To 340 DX= -3.500 ft.
RESTRAINTS

Node 340 Y
---
From 340 To 342 DX= -5.000 ft.
---
From 342 To 343 DX= -.083 ft.
---
From 343 To 345 DX= -2.760 ft.
RESTRAINTS
Node 345 Y
---
From 345 To 347 DX= -1.500 ft.
---
From 347 To 348 DX= -.083 ft.
---
From 348 To 350 DX= -5.542 ft.
FORCES & MOMENTS
Node 350 FY1= -730.00 lb.
---
From 350 To 355 DX= -2.083 ft. DY= -.250 ft.
FORCES & MOMENTS
Node 355 FY1= -1,730.00 lb.
---
From 355 To 360 DX= -1.385 ft.
Dia= 36.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Insul Thk= .000 in.
RESTRAINTS
Node 360 Y
---
From 360 To 365 DX= -7.219 ft.
Dia= 36.000 in. Wall= .375 in.
Insul Thk= .000 in.
RESTRAINTS
Node 365 Y
---
From 365 To 370 DX= -1.146 ft.
FORCES & MOMENTS
Node 370 FY1= -1,730.00 lb.
---
From 370 To 373 DX= -1.750 ft.
RESTRAINTS
Node 373 Y
---
From 373 To 375 DX= -2.000 ft.
RESTRAINTS
Node 375 Y
---
From 375 To 380 DX= -5.542 ft.
---
From 380 To 385 DX= -.167 ft.
---
From 385 To 387 DX= -1.500 ft.
RESTRAINTS
Node 387 Y
---
From 387 To 390 DX= -2.188 ft.
FORCES & MOMENTS
Node 390 FY1= -590.00 lb.

---
From 390 To 395 DX= -.750 ft.
RIGID Weight= 975.00 lb.
FORCES & MOMENTS
Node 395 FY1= -590.00 lb.
---
From 395 To 400 DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 36.000 in. (SHORT Bend Angle= 90.000 Angle/Node @1= 45.00 399
Angle/Node @2= .00 398
---
From 400 To 405 DY= -3.458 ft.
---
From 405 To 410 DY= -.167 ft.
---
From 410 To 412 DY= -1.042 ft.
RESTRAINTS
Node 412 Guide Gap= .250 in.
---
From 412 To 415 DY= -6.000 ft.
RESTRAINTS
Node 415 Y
Node 415 X
SIF's & TEE's
Node 415 Unreinforced Tee
---
From 110 To 417 DY= 6.750 ft.
Dia= 30.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .375 in. Refract. Den= .0643000 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 417 Guide Gap= .250 in.
---
From 417 To 418 DY= 1.000 ft.
---
From 418 To 419 DY= .167 ft.
---
From 419 To 425 DY= 3.750 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 45.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 424
---
From 425 To 430 DX= -3.917 ft.
FORCES & MOMENTS
Node 430 FY1= -365.00 lb.
---
From 430 To 435 DX= -.750 ft.
RIGID Weight= 600.00 lb.
FORCES & MOMENTS
Node 435 FY1= -365.00 lb.
---
From 435 To 440 DX= -3.500 ft.
RESTRAINTS
Node 440 Y
---
From 440 To 442 DX= -5.000 ft.
---
From 442 To 443 DX= -.083 ft.

---
From 443 To 445 DX= -2.760 ft.
RESTRAINTS
  Node 445 Y
---
From 445 To 447 DX= -1.500 ft.
---
From 447 To 448 DX= -.083 ft.
---
From 448 To 450 DX= -5.542 ft.
FORCES & MOMENTS
  Node 450 FY1= -730.00 lb.
---
From 450 To 455 DX= -2.083 ft. DY= -.250 ft.
FORCES & MOMENTS
  Node 455 FY1= -1,730.00 lb.
---
From 455 To 460 DX= -1.385 ft.
  Dia= 36.000 in. Wall= .375 in.
GENERAL
  Refract. Thk= .375 in. Insul Thk= .000 in.
RESTRAINTS
  Node 460 Y
---
From 460 To 465 DX= -7.219 ft.
  Dia= 36.000 in. Wall= .375 in.
  Insul Thk= .000 in.
RESTRAINTS
  Node 465 Y
---
From 465 To 470 DX= -1.146 ft.
FORCES & MOMENTS
  Node 470 FY1= -1,730.00 lb.
---
From 470 To 473 DX= -1.750 ft.
RESTRAINTS
  Node 473 Y
---
From 473 To 475 DX= -2.000 ft.
RESTRAINTS
  Node 475 Y
---
From 475 To 480 DX= -5.542 ft.
---
From 480 To 485 DX= -.167 ft.
---
From 485 To 487 DX= -1.500 ft.
RESTRAINTS
  Node 487 Y
---
From 487 To 490 DX= -2.188 ft.
FORCES & MOMENTS
  Node 490 FY1= -590.00 lb.
---
From 490 To 495 DX= -.750 ft.
RIGID Weight= 975.00 lb.
FORCES & MOMENTS
  Node 495 FY1= -590.00 lb.

---
From  495  To  500  DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
  Radius= 36.000 in. (SHORT  Bend Angle= 90.000  Angle/Node @1= 45.00 499
  Angle/Node @2= .00 498
---
From  500  To  505 DY= -3.458 ft.
---
From  505  To  510 DY= -.167 ft.
---
From  510  To  512 DY= -1.042 ft.
RESTRAINTS
  Node  512  Guide  Gap= .250 in.
---
From  512  To  515 DY= -6.000 ft.
RESTRAINTS
  Node  515  Y
  Node  515  X
SIF's & TEE's
  Node  515  Unreinforced Tee
---
From  115  To  517 DY= 6.750 ft.
  Dia= 30.000 in.  Wall= .375 in.
GENERAL
  Refract. Thk= .375 in.  Refract. Den= .0643000 lb./cu.in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  517  Guide  Gap= .250 in.
---
From  517  To  518 DY= 1.000 ft.
---
From  518  To  519 DY= .167 ft.
---
From  519  To  525 DY= 3.750 ft.
SINGLE FLANGED BEND at "TO" end
  Radius= 45.000 in. (LONG)  Bend Angle= 90.000  Angle/Node @1= 45.00 524
---
From  525  To  530  DX= -3.917 ft.
FORCES & MOMENTS
  Node  530  FY1= -365.00 lb.
---
From  530  To  535  DX= -.750 ft.
RIGID  Weight= 600.00 lb.
FORCES & MOMENTS
  Node  535  FY1= -365.00 lb.
---
From  535  To  540  DX= -3.500 ft.
RESTRAINTS
  Node  540  Y
---
From  540  To  542  DX= -5.000 ft.
---
From  542  To  543  DX= -.083 ft.
---
From  543  To  545  DX= -2.760 ft.
RESTRAINTS
  Node  545  Y
---

From  545  To  547  DX= -1.500 ft.
---
From  547  To  548  DX= -.083 ft.
---
From  548  To  550  DX= -5.542 ft.
FORCES & MOMENTS
  Node  550   FY1= -730.00 lb.
---
From  550  To  555  DX= -2.083 ft.  DY= -.250 ft.
FORCES & MOMENTS
  Node  555   FY1= -1,730.00 lb.
---
From  555  To  560  DX= -1.385 ft.
  Dia= 36.000 in.   Wall= .375 in.
GENERAL
  Refract. Thk= .375 in.   Insul Thk= .000 in.
RESTRAINTS
  Node  560  Y
---
From  560  To  565  DX= -7.219 ft.
  Dia= 36.000 in.   Wall= .375 in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  565  Y
---
From  565  To  570  DX= -1.146 ft.
FORCES & MOMENTS
  Node  570   FY1= -1,730.00 lb.
---
From  570  To  573  DX= -1.750 ft.
RESTRAINTS
  Node  573  Y
---
From  573  To  575  DX= -2.000 ft.
RESTRAINTS
  Node  575  Y
---
From  575  To  580  DX= -5.542 ft.
---
From  580  To  585  DX= -.167 ft.
---
From  585  To  587  DX= -1.500 ft.
RESTRAINTS
  Node  587  Y
---
From  587  To  590  DX= -2.188 ft.
FORCES & MOMENTS
  Node  590   FY1= -590.00 lb.
---
From  590  To  595  DX= -.750 ft.
RIGID  Weight= 975.00 lb.
FORCES & MOMENTS
  Node  595   FY1= -590.00 lb.
---
From  595  To  600  DX= -3.167 ft.
SINGLE FLANGED BEND at "TO" end
  Radius= 36.000 in. (SHORT   Bend Angle= 90.000   Angle/Node @1= 45.00 599
  Angle/Node @2= .00 598

---
From  600  To  605 DY= -3.458 ft.
---
From  605  To  610 DY= -.167 ft.
---
From  610  To  612 DY= -1.042 ft.
RESTRAINTS
  Node  612  Guide   Gap= .250 in.
---
From  612  To  615 DY= -6.000 ft.
RESTRAINTS
  Node  615  Y
  Node  615  X
SIF's & TEE's
  Node  615   Unreinforced Tee
---
From  615  To  625 DZ= -10.000 ft.
  Dia= 48.000 in.   Wall= .375 in.
GENERAL
  Refract. Thk= .500 in.   Refract. Den= .0643000 lb./cu.in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  625  Y
  Node  625  X
---
From  615  To  515  DX= .000 ft.  DY= .000 ft.  DZ= 8.000 ft.
---
From  515  To  415  DX= .000 ft.  DY= .000 ft.  DZ= 8.000 ft.
---
From  415  To  315  DX= .000 ft.  DY= .000 ft.  DZ= 8.000 ft.
---
From  315  To  630 DZ= 7.750 ft.
RESTRAINTS
  Node  630  Y
  Node  630  X
---
From  630  To  635 DZ= 16.500 ft.
BEND at "TO" end
  Radius= 72.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 634
  Angle/Node @2= .00 633   Miters= 4
RESTRAINTS
  Node  634  Y
  Node  634  X
---
From  635  To  640  DX= -10.000 ft.
RESTRAINTS
  Node  640  Y
  Node  640  Z
---
From  75  To  700  DX= -3.000 ft.
---
From  700  To  705  DX= -2.000 ft.
---
From  705  To  710  DX= -3.917 ft.
  Dia= 30.000 in.   Wall= .375 in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  710  Y

---
From 710 To 715 DX= -.708 ft.
---
From 715 To 720 DX= -.167 ft.
---
From 720 To 725 DX= -.875 ft.
---
From 725 To 730 DX= -1.000 ft.
RIGID Weight= 1,300.00 lb.
---
From 730 To 735 DX= -8.750 ft.
RESTRAINTS
Node 735 Y
---
From 735 To 740 DX= -11.667 ft.
RESTRAINTS
Node 740 Y
---
From 740 To 745 DX= -.833 ft.
---
From 745 To 750 DX= -.167 ft.
---
From 750 To 755 DX= -2.833 ft.
---
From 755 To 760 DX= -1.000 ft.
RIGID Weight= 1,300.00 lb.
---
From 760 To 765 DX= -3.917 ft.
SINGLE FLANGED BEND at "TO" end
Radius= 45.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 764
Angle/Node @2= .00 763
---
From 765 To 770 DY= -5.125 ft.
---
From 770 To 775 DY= -.167 ft.
---
From 775 To 780 DY= -.833 ft.
RESTRAINTS
Node 780 Guide Gap= .250 in.
---
From 780 To 785 DY= -3.750 ft.
BEND at "TO" end
Radius= 45.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 784
RESTRAINTS
Node 784 Y
Node 784 Z
---
From 785 To 790 DX= -5.000 ft.
RESTRAINTS
Node 790 Y
Node 790 Z
---
From 790 To 795 DX= -20.000 ft.
RESTRAINTS
Node 795 Y
Node 795 Z

CASE 1 (SUS) W+P1+F1

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| 5 | | Rigid ANC | | | | | |
| | 1(SUS) | 764 | -9646 | 69 | 3878.3 | 391.6 | 31905.7 |
| | | | | | | | |
| | | | | | | | |
| 10 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -19820 | -53 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 14 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -26358 | 13 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 20 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 50 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -10962 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 55 | | Rigid +Y | | | | | |
| | 1(SUS) | 0 | -15479 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 90 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 94 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -932 | -19514 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 97 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 297 | -3978 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 98 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -124 | -15396 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 100 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 315 | -20007 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 105 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 213 | -12275 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 110 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 194 | -14095 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 115 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 185 | -11435 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 120 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -30 | -5143 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 125 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -9 | -2964 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 217 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 240 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -4672 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 245 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -3902 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 260 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7560 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 265 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -3478 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 273 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -1825 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 275 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -2153 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 287 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -6443 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 312 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 315 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -192 | -13062 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 317 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 340 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -4712 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 345 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -3889 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 360 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7562 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 365 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -3477 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 373 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -1825 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 375 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -2149 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 387 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -6460 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 412 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 415 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -216 | -15109 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 417 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 440 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -4729 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 445 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -3884 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 460 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7562 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 465 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -3477 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 473 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -1825 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 475 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -2147 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 487 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -6466 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 512 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 515 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -194 | -14821 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 517 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 540 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -4736 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 545 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -3881 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 560 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7562 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 565 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -3477 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 573 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -1826 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 575 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -2147 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 587 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -6467 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 612 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 615 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -225 | -17082 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 625 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -22 | -4139 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 630 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -91 | -13818 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 634 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 69 | -12000 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 640 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -3208 | -62 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 710 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -11599 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 735 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -3282 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 740 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7254 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 780 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 784 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -3549 | 590 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 790 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -6992 | -643 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 795 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -3832 | 87 | 0.0 | 0.0 | 0.0 |

Piping Code: B31.3 = B31.3 -2010, March 31, 2011

CODE STRESS CHECK PASSED : LOADCASE 1 (SUS) W+P1+F1

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

| | | | |
|---|---|---|---|
| Ratio (%): | 39.3 | @Node | 100 |
| Code Stress: | 7857.1 | Allowable Stress: | 20000.0 |
| Axial Stress: | 5251.4 | @Node | 14 |
| Bending Stress: | 3602.1 | @Node | 100 |
| Torsion Stress: | 35.1 | @Node | 10 |
| Hoop Stress: | 10395.0 | @Node | 10 |
| Max Stress Intensity: | 10643.4 | @Node | 75 |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 577.7 | 35.1 | 1.000 | 1.000 | 5721.0 | 20000.0 | 28.6 | B31.3 | |
| 10 | 616.3 | -35.1 | 1.000 | 1.000 | 5759.7 | 20000.0 | 28.8 | B31.3 | |
| | | | | | | | | | |
| 10 | 616.3 | 35.1 | 1.000 | 1.000 | 5759.7 | 20000.0 | 28.8 | B31.3 | |
| 13 | 179.9 | -35.1 | 1.000 | 1.000 | 5323.3 | 20000.0 | 26.6 | B31.3 | |
| | | | | | | | | | |
| 13 | 553.6 | 35.1 | 3.084 | 2.570 | 5558.6 | 20000.0 | 27.8 | B31.3 | |
| 14 | 917.1 | -32.9 | 3.084 | 2.570 | 5939.6 | 20000.0 | 29.7 | B31.3 | |
| | | | | | | | | | |
| 14 | 917.1 | 32.9 | 3.084 | 2.570 | 5607.4 | 20000.0 | 28.0 | B31.3 | |
| 15 | 553.4 | -12.1 | 3.084 | 2.570 | 5331.5 | 20000.0 | 26.7 | B31.3 | |
| | | | | | | | | | |
| 15 | 183.3 | 12.1 | 1.000 | 1.000 | 5099.7 | 20000.0 | 25.5 | B31.3 | |
| 20 | 182.5 | -12.1 | 1.000 | 1.000 | 5100.0 | 20000.0 | 25.5 | B31.3 | |
| | | | | | | | | | |
| 20 | 182.5 | 12.1 | 1.000 | 1.000 | 5100.0 | 20000.0 | 25.5 | B31.3 | |
| 25 | 168.4 | -12.1 | 1.000 | 1.000 | 5104.8 | 20000.0 | 25.5 | B31.3 | |
| | | | | | | | | | |
| 25 | 168.4 | 12.1 | 1.000 | 1.000 | 5104.8 | 20000.0 | 25.5 | B31.3 | |
| 30 | 166.3 | -12.1 | 1.000 | 1.000 | 5105.5 | 20000.0 | 25.5 | B31.3 | |
| | | | | | | | | | |
| 30 | 166.3 | 12.1 | 1.000 | 1.000 | 5105.5 | 20000.0 | 25.5 | B31.3 | |
| 35 | 615.3 | -12.1 | 5.303 | 6.738 | 5488.3 | 20000.0 | 27.4 | B31.3 | |
| | | | | | | | | | |
| 35 | 0.0 | 0.0 | 5.303 | 6.738 | 5074.4 | 20000.0 | 25.4 | B31.3 | |
| 40 | 0.0 | 0.0 | 1.000 | 1.000 | 5135.2 | 20000.0 | 25.7 | B31.3 | |
| | | | | | | | | | |
| 35 | 467.1 | 32.1 | 5.303 | 6.738 | 5493.7 | 20000.0 | 27.5 | B31.3 | |
| 45 | 145.8 | -32.1 | 1.000 | 1.000 | 5289.1 | 20000.0 | 26.4 | B31.3 | |
| | | | | | | | | | |
| 45 | 145.8 | 32.1 | 1.000 | 1.000 | 5289.1 | 20000.0 | 26.4 | B31.3 | |
| 50 | 343.5 | -32.1 | 1.000 | 1.000 | 5486.8 | 20000.0 | 27.4 | B31.3 | |
| | | | | | | | | | |
| 50 | 343.5 | 32.1 | 1.000 | 1.000 | 5486.8 | 20000.0 | 27.4 | B31.3 | |
| 55 | 495.6 | -32.1 | 1.000 | 1.000 | 5638.9 | 20000.0 | 28.2 | B31.3 | |
| | | | | | | | | | |
| 55 | 495.6 | 32.1 | 1.000 | 1.000 | 5638.9 | 20000.0 | 28.2 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 60 | 406.8 | -32.1 | 1.000 | 1.000 | 5550.1 | 20000.0 | 27.8 | B31.3 | |
| | | | | | | | | | |
| 60 | 406.8 | 32.1 | 1.000 | 1.000 | 5550.1 | 20000.0 | 27.8 | B31.3 | |
| 65 | 378.2 | -32.1 | 1.000 | 1.000 | 5521.5 | 20000.0 | 27.6 | B31.3 | |
| | | | | | | | | | |
| 65 | 378.2 | 32.1 | 1.000 | 1.000 | 5521.5 | 20000.0 | 27.6 | B31.3 | |
| 70 | 264.3 | -32.1 | 1.000 | 1.000 | 5407.7 | 20000.0 | 27.0 | B31.3 | |
| | | | | | | | | | |
| 70 | 264.3 | 32.1 | 1.000 | 1.000 | 5407.7 | 20000.0 | 27.0 | B31.3 | |
| 75 | 1929.2 | -32.1 | 5.303 | 6.738 | 6590.2 | 20000.0 | 33.0 | B31.3 | |
| | | | | | | | | | |
| 75 | 886.8 | -11.2 | 5.303 | 6.738 | 5811.5 | 20000.0 | 29.1 | B31.3 | |
| 80 | 95.3 | 11.2 | 1.000 | 1.000 | 5134.5 | 20000.0 | 25.7 | B31.3 | |
| | | | | | | | | | |
| 80 | 95.3 | -11.2 | 1.000 | 1.000 | 5134.5 | 20000.0 | 25.7 | B31.3 | |
| 85 | 94.1 | 11.2 | 1.000 | 1.000 | 5130.4 | 20000.0 | 25.7 | B31.3 | |
| | | | | | | | | | |
| 85 | 94.1 | -11.2 | 1.000 | 1.000 | 5130.4 | 20000.0 | 25.7 | B31.3 | |
| 90 | 87.9 | 11.2 | 1.000 | 1.000 | 5106.8 | 20000.0 | 25.5 | B31.3 | |
| | | | | | | | | | |
| 90 | 87.9 | -11.2 | 1.000 | 1.000 | 5106.8 | 20000.0 | 25.5 | B31.3 | |
| 93 | 84.5 | 11.2 | 1.000 | 1.000 | 5090.3 | 20000.0 | 25.5 | B31.3 | |
| | | | | | | | | | |
| 93 | 255.5 | -11.2 | 3.084 | 2.570 | 5197.5 | 20000.0 | 26.0 | B31.3 | |
| 94 | 871.0 | 9.5 | 3.084 | 2.570 | 5644.5 | 20000.0 | 28.2 | B31.3 | |
| | | | | | | | | | |
| 94 | 871.0 | -9.5 | 3.084 | 2.570 | 5890.4 | 20000.0 | 29.5 | B31.3 | |
| 95 | 96.7 | 11.8 | 3.084 | 2.570 | 5228.1 | 20000.0 | 26.1 | B31.3 | |
| | | | | | | | | | |
| 95 | 31.9 | -11.8 | 1.000 | 1.000 | 5187.5 | 20000.0 | 25.9 | B31.3 | |
| 97 | 44.6 | 11.8 | 1.000 | 1.000 | 5200.1 | 20000.0 | 26.0 | B31.3 | |
| | | | | | | | | | |
| 97 | 44.6 | -11.8 | 1.000 | 1.000 | 5200.1 | 20000.0 | 26.0 | B31.3 | |
| 98 | 349.6 | 11.8 | 1.000 | 1.000 | 5505.1 | 20000.0 | 27.5 | B31.3 | |
| | | | | | | | | | |
| 98 | 349.6 | -11.8 | 1.000 | 1.000 | 5505.1 | 20000.0 | 27.5 | B31.3 | |
| 100 | 3602.1 | 11.8 | 10.994 | 14.325 | 7857.1 | 20000.0 | 39.3 | B31.3 | |
| | | | | | | | | | |
| 100 | 3591.0 | -4.4 | 10.994 | 14.325 | 7849.0 | 20000.0 | 39.2 | B31.3 | |
| 105 | 1011.3 | 4.4 | 10.994 | 14.325 | 5914.2 | 20000.0 | 29.6 | B31.3 | |
| | | | | | | | | | |
| 105 | 1021.3 | -1.5 | 10.994 | 14.325 | 5922.0 | 20000.0 | 29.6 | B31.3 | |
| 110 | 1033.7 | 1.5 | 10.994 | 14.325 | 5931.3 | 20000.0 | 29.7 | B31.3 | |
| | | | | | | | | | |
| 110 | 1043.6 | -0.4 | 10.994 | 14.325 | 5939.0 | 20000.0 | 29.7 | B31.3 | |
| 115 | 731.9 | 0.4 | 10.994 | 14.325 | 5705.2 | 20000.0 | 28.5 | B31.3 | |
| | | | | | | | | | |
| 115 | 736.1 | 0.0 | 10.994 | 14.325 | 5708.7 | 20000.0 | 28.5 | B31.3 | |
| 120 | 56.9 | -0.0 | 1.000 | 1.000 | 5213.5 | 20000.0 | 26.1 | B31.3 | |
| | | | | | | | | | |
| 120 | 56.9 | 0.0 | 1.000 | 1.000 | 5213.5 | 20000.0 | 26.1 | B31.3 | |
| 125 | 0.0 | -0.0 | 1.000 | 1.000 | 5156.6 | 20000.0 | 25.8 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 100 | 542.5 | -7.7 | 10.994 | 14.325 | 3408.1 | 20000.0 | 17.0 | B31.3 | |
| 217 | 48.4 | 7.8 | 1.000 | 1.000 | 3131.0 | 20000.0 | 15.7 | B31.3 | |
| | | | | | | | | | |
| 217 | 48.4 | -7.8 | 1.000 | 1.000 | 3131.0 | 20000.0 | 15.7 | B31.3 | |
| 218 | 61.1 | 7.8 | 1.000 | 1.000 | 3155.8 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 218 | 61.1 | -7.8 | 1.000 | 1.000 | 3155.8 | 20000.0 | 15.8 | B31.3 | |
| 219 | 63.2 | 7.8 | 1.000 | 1.000 | 3160.0 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 219 | 148.9 | -7.8 | 2.362 | 1.968 | 3208.5 | 20000.0 | 16.0 | B31.3 | |
| 224 | 14.6 | 8.8 | 2.362 | 1.968 | 3150.8 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 224 | 14.6 | -8.8 | 2.362 | 1.968 | 3150.8 | 20000.0 | 15.8 | B31.3 | |
| 225 | 245.9 | 5.4 | 2.362 | 1.968 | 3353.5 | 20000.0 | 16.8 | B31.3 | |
| | | | | | | | | | |
| 225 | 104.4 | -5.4 | 1.000 | 1.000 | 3273.4 | 20000.0 | 16.4 | B31.3 | |
| 230 | 106.5 | 5.4 | 1.000 | 1.000 | 3275.5 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 230 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 235 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 235 | 87.7 | -5.4 | 1.000 | 1.000 | 3256.7 | 20000.0 | 16.3 | B31.3 | |
| 240 | 250.9 | 5.4 | 1.000 | 1.000 | 3419.9 | 20000.0 | 17.1 | B31.3 | |
| | | | | | | | | | |
| 240 | 250.9 | -5.4 | 1.000 | 1.000 | 3419.9 | 20000.0 | 17.1 | B31.3 | |
| 242 | 55.9 | 5.4 | 1.000 | 1.000 | 3224.9 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 242 | 55.9 | -5.4 | 1.000 | 1.000 | 3224.9 | 20000.0 | 16.1 | B31.3 | |
| 243 | 56.8 | 5.4 | 1.000 | 1.000 | 3225.8 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 243 | 56.8 | -5.4 | 1.000 | 1.000 | 3225.8 | 20000.0 | 16.1 | B31.3 | |
| 245 | 165.4 | 5.4 | 1.000 | 1.000 | 3334.4 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 245 | 165.4 | -5.4 | 1.000 | 1.000 | 3334.4 | 20000.0 | 16.7 | B31.3 | |
| 247 | 13.1 | 5.4 | 1.000 | 1.000 | 3182.1 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 247 | 13.1 | -5.4 | 1.000 | 1.000 | 3182.1 | 20000.0 | 15.9 | B31.3 | |
| 248 | 6.4 | 5.4 | 1.000 | 1.000 | 3175.4 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 248 | 6.4 | -5.4 | 1.000 | 1.000 | 3175.4 | 20000.0 | 15.9 | B31.3 | |
| 250 | 163.2 | 5.4 | 1.000 | 1.000 | 3332.2 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 250 | 163.2 | -5.4 | 1.000 | 1.000 | 3328.0 | 20000.0 | 16.6 | B31.3 | |
| 255 | 3.0 | 3.7 | 1.000 | 1.000 | 3826.7 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 255 | 3.2 | -3.7 | 1.000 | 1.000 | 3833.5 | 20000.0 | 19.2 | B31.3 | |
| 260 | 201.9 | 3.7 | 1.000 | 1.000 | 4032.1 | 20000.0 | 20.2 | B31.3 | |
| | | | | | | | | | |
| 260 | 201.9 | -3.7 | 1.000 | 1.000 | 4032.1 | 20000.0 | 20.2 | B31.3 | |
| 265 | 52.0 | 3.7 | 1.000 | 1.000 | 3882.2 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 265 | 52.0 | -3.7 | 1.000 | 1.000 | 3882.2 | 20000.0 | 19.4 | B31.3 | |
| 270 | 12.9 | 3.7 | 1.000 | 1.000 | 3843.2 | 20000.0 | 19.2 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 270 | 12.9 | -3.7 | 1.000 | 1.000 | 3843.2 | 20000.0 | 19.2 | B31.3 | |
| 273 | 38.8 | 3.7 | 1.000 | 1.000 | 3869.0 | 20000.0 | 19.3 | B31.3 | |
| | | | | | | | | | |
| 273 | 38.8 | -3.7 | 1.000 | 1.000 | 3869.0 | 20000.0 | 19.3 | B31.3 | |
| 275 | 47.5 | 3.7 | 1.000 | 1.000 | 3877.7 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 275 | 47.5 | -3.7 | 1.000 | 1.000 | 3877.7 | 20000.0 | 19.4 | B31.3 | |
| 280 | 77.1 | 3.7 | 1.000 | 1.000 | 3907.4 | 20000.0 | 19.5 | B31.3 | |
| | | | | | | | | | |
| 280 | 77.1 | -3.7 | 1.000 | 1.000 | 3907.4 | 20000.0 | 19.5 | B31.3 | |
| 285 | 86.9 | 3.7 | 1.000 | 1.000 | 3917.1 | 20000.0 | 19.6 | B31.3 | |
| | | | | | | | | | |
| 285 | 86.9 | -3.7 | 1.000 | 1.000 | 3917.1 | 20000.0 | 19.6 | B31.3 | |
| 287 | 198.5 | 3.7 | 1.000 | 1.000 | 4028.7 | 20000.0 | 20.1 | B31.3 | |
| | | | | | | | | | |
| 287 | 198.5 | -3.7 | 1.000 | 1.000 | 4028.7 | 20000.0 | 20.1 | B31.3 | |
| 290 | 23.5 | 3.7 | 1.000 | 1.000 | 3853.7 | 20000.0 | 19.3 | B31.3 | |
| | | | | | | | | | |
| 290 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 295 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 295 | 50.7 | -3.7 | 1.000 | 1.000 | 3880.9 | 20000.0 | 19.4 | B31.3 | |
| 298 | 50.3 | 3.7 | 1.000 | 1.000 | 3880.5 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 298 | 149.5 | -3.7 | 3.005 | 2.504 | 3942.4 | 20000.0 | 19.7 | B31.3 | |
| 299 | 14.2 | 7.4 | 3.005 | 2.504 | 3817.5 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 299 | 14.2 | -7.4 | 3.005 | 2.504 | 3817.5 | 20000.0 | 19.1 | B31.3 | |
| 300 | 106.5 | 7.2 | 3.005 | 2.504 | 3848.2 | 20000.0 | 19.2 | B31.3 | |
| | | | | | | | | | |
| 300 | 35.6 | -7.2 | 1.000 | 1.000 | 3803.9 | 20000.0 | 19.0 | B31.3 | |
| 305 | 31.6 | 7.2 | 1.000 | 1.000 | 3793.6 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 305 | 31.6 | -7.2 | 1.000 | 1.000 | 3793.6 | 20000.0 | 19.0 | B31.3 | |
| 310 | 30.1 | 7.2 | 1.000 | 1.000 | 3789.8 | 20000.0 | 18.9 | B31.3 | |
| | | | | | | | | | |
| 310 | 30.1 | -7.2 | 1.000 | 1.000 | 3789.8 | 20000.0 | 18.9 | B31.3 | |
| 312 | 21.1 | 7.2 | 1.000 | 1.000 | 3766.4 | 20000.0 | 18.8 | B31.3 | |
| | | | | | | | | | |
| 312 | 21.1 | -7.2 | 1.000 | 1.000 | 3766.4 | 20000.0 | 18.8 | B31.3 | |
| 315 | 459.7 | 7.1 | 10.994 | 14.325 | 4007.3 | 20000.0 | 20.0 | B31.3 | |
| | | | | | | | | | |
| 105 | 216.8 | -8.1 | 10.994 | 14.325 | 3164.6 | 20000.0 | 15.8 | B31.3 | |
| 317 | 54.0 | 8.2 | 1.000 | 1.000 | 3137.5 | 20000.0 | 15.7 | B31.3 | |
| | | | | | | | | | |
| 317 | 54.0 | -8.2 | 1.000 | 1.000 | 3137.5 | 20000.0 | 15.7 | B31.3 | |
| 318 | 64.3 | 8.2 | 1.000 | 1.000 | 3159.8 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 318 | 64.3 | -8.2 | 1.000 | 1.000 | 3159.8 | 20000.0 | 15.8 | B31.3 | |
| 319 | 66.0 | 8.2 | 1.000 | 1.000 | 3163.5 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 319 | 155.8 | -8.2 | 2.362 | 1.968 | 3214.4 | 20000.0 | 16.1 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 324 | 22.6 | 7.4 | 2.362 | 1.968 | 3158.4 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 324 | 22.6 | -7.4 | 2.362 | 1.968 | 3158.4 | 20000.0 | 15.8 | B31.3 | |
| 325 | 249.3 | 3.1 | 2.362 | 1.968 | 3357.5 | 20000.0 | 16.8 | B31.3 | |
| | | | | | | | | | |
| 325 | 105.8 | -3.1 | 1.000 | 1.000 | 3276.4 | 20000.0 | 16.4 | B31.3 | |
| 330 | 107.8 | 3.1 | 1.000 | 1.000 | 3278.3 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 330 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 335 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 335 | 88.0 | -3.1 | 1.000 | 1.000 | 3258.5 | 20000.0 | 16.3 | B31.3 | |
| 340 | 255.1 | 3.1 | 1.000 | 1.000 | 3425.6 | 20000.0 | 17.1 | B31.3 | |
| | | | | | | | | | |
| 340 | 255.1 | -3.1 | 1.000 | 1.000 | 3425.6 | 20000.0 | 17.1 | B31.3 | |
| 342 | 57.2 | 3.1 | 1.000 | 1.000 | 3227.7 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 342 | 57.2 | -3.1 | 1.000 | 1.000 | 3227.7 | 20000.0 | 16.1 | B31.3 | |
| 343 | 58.0 | 3.1 | 1.000 | 1.000 | 3228.6 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 343 | 58.0 | -3.1 | 1.000 | 1.000 | 3228.6 | 20000.0 | 16.1 | B31.3 | |
| 345 | 165.0 | 3.1 | 1.000 | 1.000 | 3335.5 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 345 | 165.0 | -3.1 | 1.000 | 1.000 | 3335.5 | 20000.0 | 16.7 | B31.3 | |
| 347 | 12.7 | 3.1 | 1.000 | 1.000 | 3183.2 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 347 | 12.7 | -3.1 | 1.000 | 1.000 | 3183.2 | 20000.0 | 15.9 | B31.3 | |
| 348 | 6.1 | 3.1 | 1.000 | 1.000 | 3176.6 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 348 | 6.1 | -3.1 | 1.000 | 1.000 | 3176.6 | 20000.0 | 15.9 | B31.3 | |
| 350 | 163.5 | 3.1 | 1.000 | 1.000 | 3334.1 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 350 | 163.5 | -3.2 | 1.000 | 1.000 | 3329.8 | 20000.0 | 16.6 | B31.3 | |
| 355 | 3.3 | 2.2 | 1.000 | 1.000 | 3828.3 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 355 | 3.5 | -2.1 | 1.000 | 1.000 | 3835.0 | 20000.0 | 19.2 | B31.3 | |
| 360 | 202.1 | 2.1 | 1.000 | 1.000 | 4033.6 | 20000.0 | 20.2 | B31.3 | |
| | | | | | | | | | |
| 360 | 202.1 | -2.1 | 1.000 | 1.000 | 4033.6 | 20000.0 | 20.2 | B31.3 | |
| 365 | 52.0 | 2.1 | 1.000 | 1.000 | 3883.5 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 365 | 52.0 | -2.1 | 1.000 | 1.000 | 3883.5 | 20000.0 | 19.4 | B31.3 | |
| 370 | 13.2 | 2.1 | 1.000 | 1.000 | 3844.7 | 20000.0 | 19.2 | B31.3 | |
| | | | | | | | | | |
| 370 | 13.2 | -2.1 | 1.000 | 1.000 | 3844.7 | 20000.0 | 19.2 | B31.3 | |
| 373 | 38.8 | 2.1 | 1.000 | 1.000 | 3870.3 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 373 | 38.8 | -2.1 | 1.000 | 1.000 | 3870.3 | 20000.0 | 19.4 | B31.3 | |
| 375 | 47.5 | 2.1 | 1.000 | 1.000 | 3879.0 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 375 | 47.5 | -2.1 | 1.000 | 1.000 | 3879.0 | 20000.0 | 19.4 | B31.3 | |
| 380 | 77.9 | 2.1 | 1.000 | 1.000 | 3909.4 | 20000.0 | 19.5 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 380 | 77.9 | -2.1 | 1.000 | 1.000 | 3909.4 | 20000.0 | 19.5 | B31.3 | |
| 385 | 87.7 | 2.1 | 1.000 | 1.000 | 3919.2 | 20000.0 | 19.6 | B31.3 | |
| | | | | | | | | | |
| 385 | 87.7 | -2.1 | 1.000 | 1.000 | 3919.2 | 20000.0 | 19.6 | B31.3 | |
| 387 | 199.4 | 2.1 | 1.000 | 1.000 | 4030.9 | 20000.0 | 20.2 | B31.3 | |
| | | | | | | | | | |
| 387 | 199.4 | -2.1 | 1.000 | 1.000 | 4030.9 | 20000.0 | 20.2 | B31.3 | |
| 390 | 24.0 | 2.1 | 1.000 | 1.000 | 3855.5 | 20000.0 | 19.3 | B31.3 | |
| | | | | | | | | | |
| 390 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 395 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 395 | 51.3 | -2.1 | 1.000 | 1.000 | 3882.8 | 20000.0 | 19.4 | B31.3 | |
| 398 | 50.9 | 2.1 | 1.000 | 1.000 | 3882.4 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 398 | 151.4 | -2.1 | 3.005 | 2.504 | 3945.0 | 20000.0 | 19.7 | B31.3 | |
| 399 | 20.8 | 6.6 | 3.005 | 2.504 | 3823.5 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 399 | 20.8 | -6.6 | 3.005 | 2.504 | 3823.5 | 20000.0 | 19.1 | B31.3 | |
| 400 | 116.0 | 7.7 | 3.005 | 2.504 | 3855.7 | 20000.0 | 19.3 | B31.3 | |
| | | | | | | | | | |
| 400 | 38.6 | -7.7 | 1.000 | 1.000 | 3807.3 | 20000.0 | 19.0 | B31.3 | |
| 405 | 35.4 | 7.7 | 1.000 | 1.000 | 3797.7 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 405 | 35.4 | -7.7 | 1.000 | 1.000 | 3797.7 | 20000.0 | 19.0 | B31.3 | |
| 410 | 34.2 | 7.7 | 1.000 | 1.000 | 3794.2 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 410 | 34.2 | -7.7 | 1.000 | 1.000 | 3794.2 | 20000.0 | 19.0 | B31.3 | |
| 412 | 26.8 | 7.7 | 1.000 | 1.000 | 3772.5 | 20000.0 | 18.9 | B31.3 | |
| | | | | | | | | | |
| 412 | 26.8 | -7.7 | 1.000 | 1.000 | 3772.5 | 20000.0 | 18.9 | B31.3 | |
| 415 | 222.7 | 7.6 | 10.994 | 14.325 | 3829.9 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 110 | 82.3 | -8.1 | 10.994 | 14.325 | 3064.0 | 20000.0 | 15.3 | B31.3 | |
| 417 | 56.5 | 8.2 | 1.000 | 1.000 | 3140.3 | 20000.0 | 15.7 | B31.3 | |
| | | | | | | | | | |
| 417 | 56.5 | -8.2 | 1.000 | 1.000 | 3140.3 | 20000.0 | 15.7 | B31.3 | |
| 418 | 65.7 | 8.2 | 1.000 | 1.000 | 3161.6 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 418 | 65.7 | -8.2 | 1.000 | 1.000 | 3161.6 | 20000.0 | 15.8 | B31.3 | |
| 419 | 67.3 | 8.2 | 1.000 | 1.000 | 3165.1 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 419 | 158.8 | -8.2 | 2.362 | 1.968 | 3217.0 | 20000.0 | 16.1 | B31.3 | |
| 424 | 24.4 | 7.4 | 2.362 | 1.968 | 3160.5 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 424 | 24.4 | -7.4 | 2.362 | 1.968 | 3160.5 | 20000.0 | 15.8 | B31.3 | |
| 425 | 250.8 | 3.1 | 2.362 | 1.968 | 3359.3 | 20000.0 | 16.8 | B31.3 | |
| | | | | | | | | | |
| 425 | 106.4 | -3.1 | 1.000 | 1.000 | 3277.6 | 20000.0 | 16.4 | B31.3 | |
| 430 | 108.3 | 3.1 | 1.000 | 1.000 | 3279.5 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 430 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 435 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 435 | 88.1 | -3.1 | 1.000 | 1.000 | 3259.3 | 20000.0 | 16.3 | B31.3 | |
| 440 | 257.0 | 3.1 | 1.000 | 1.000 | 3428.2 | 20000.0 | 17.1 | B31.3 | |
| | | | | | | | | | |
| 440 | 257.0 | -3.1 | 1.000 | 1.000 | 3428.2 | 20000.0 | 17.1 | B31.3 | |
| 442 | 57.7 | 3.1 | 1.000 | 1.000 | 3228.9 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 442 | 57.7 | -3.1 | 1.000 | 1.000 | 3228.9 | 20000.0 | 16.1 | B31.3 | |
| 443 | 58.6 | 3.1 | 1.000 | 1.000 | 3229.8 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 443 | 58.6 | -3.1 | 1.000 | 1.000 | 3229.8 | 20000.0 | 16.1 | B31.3 | |
| 445 | 164.8 | 3.1 | 1.000 | 1.000 | 3336.0 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 445 | 164.8 | -3.1 | 1.000 | 1.000 | 3336.0 | 20000.0 | 16.7 | B31.3 | |
| 447 | 12.5 | 3.1 | 1.000 | 1.000 | 3183.7 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 447 | 12.5 | -3.1 | 1.000 | 1.000 | 3183.7 | 20000.0 | 15.9 | B31.3 | |
| 448 | 5.9 | 3.1 | 1.000 | 1.000 | 3177.1 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 448 | 5.9 | -3.1 | 1.000 | 1.000 | 3177.1 | 20000.0 | 15.9 | B31.3 | |
| 450 | 163.7 | 3.1 | 1.000 | 1.000 | 3334.9 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 450 | 163.7 | -3.2 | 1.000 | 1.000 | 3330.6 | 20000.0 | 16.7 | B31.3 | |
| 455 | 3.4 | 2.2 | 1.000 | 1.000 | 3828.9 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 455 | 3.6 | -2.1 | 1.000 | 1.000 | 3835.6 | 20000.0 | 19.2 | B31.3 | |
| 460 | 202.2 | 2.1 | 1.000 | 1.000 | 4034.2 | 20000.0 | 20.2 | B31.3 | |
| | | | | | | | | | |
| 460 | 202.2 | -2.1 | 1.000 | 1.000 | 4034.2 | 20000.0 | 20.2 | B31.3 | |
| 465 | 52.0 | 2.1 | 1.000 | 1.000 | 3884.0 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 465 | 52.0 | -2.1 | 1.000 | 1.000 | 3884.0 | 20000.0 | 19.4 | B31.3 | |
| 470 | 13.2 | 2.1 | 1.000 | 1.000 | 3845.2 | 20000.0 | 19.2 | B31.3 | |
| | | | | | | | | | |
| 470 | 13.2 | -2.1 | 1.000 | 1.000 | 3845.2 | 20000.0 | 19.2 | B31.3 | |
| 473 | 38.8 | 2.1 | 1.000 | 1.000 | 3870.9 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 473 | 38.8 | -2.1 | 1.000 | 1.000 | 3870.9 | 20000.0 | 19.4 | B31.3 | |
| 475 | 47.5 | 2.1 | 1.000 | 1.000 | 3879.5 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 475 | 47.5 | -2.1 | 1.000 | 1.000 | 3879.5 | 20000.0 | 19.4 | B31.3 | |
| 480 | 78.1 | 2.1 | 1.000 | 1.000 | 3910.1 | 20000.0 | 19.6 | B31.3 | |
| | | | | | | | | | |
| 480 | 78.1 | -2.1 | 1.000 | 1.000 | 3910.1 | 20000.0 | 19.6 | B31.3 | |
| 485 | 87.9 | 2.1 | 1.000 | 1.000 | 3919.9 | 20000.0 | 19.6 | B31.3 | |
| | | | | | | | | | |
| 485 | 87.9 | -2.1 | 1.000 | 1.000 | 3919.9 | 20000.0 | 19.6 | B31.3 | |
| 487 | 199.7 | 2.1 | 1.000 | 1.000 | 4031.7 | 20000.0 | 20.2 | B31.3 | |
| | | | | | | | | | |
| 487 | 199.7 | -2.1 | 1.000 | 1.000 | 4031.7 | 20000.0 | 20.2 | B31.3 | |
| 490 | 24.1 | 2.1 | 1.000 | 1.000 | 3856.1 | 20000.0 | 19.3 | B31.3 | |
| | | | | | | | | | |
| 490 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 495 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 495 | 51.5 | -2.1 | 1.000 | 1.000 | 3883.5 | 20000.0 | 19.4 | B31.3 | |
| 498 | 51.1 | 2.1 | 1.000 | 1.000 | 3883.2 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 498 | 151.9 | -2.1 | 3.005 | 2.504 | 3946.0 | 20000.0 | 19.7 | B31.3 | |
| 499 | 20.6 | 6.6 | 3.005 | 2.504 | 3823.9 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 499 | 20.6 | -6.6 | 3.005 | 2.504 | 3823.9 | 20000.0 | 19.1 | B31.3 | |
| 500 | 120.7 | 7.7 | 3.005 | 2.504 | 3859.3 | 20000.0 | 19.3 | B31.3 | |
| | | | | | | | | | |
| 500 | 40.2 | -7.7 | 1.000 | 1.000 | 3809.0 | 20000.0 | 19.0 | B31.3 | |
| 505 | 37.3 | 7.7 | 1.000 | 1.000 | 3799.7 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 505 | 37.3 | -7.7 | 1.000 | 1.000 | 3799.7 | 20000.0 | 19.0 | B31.3 | |
| 510 | 36.2 | 7.7 | 1.000 | 1.000 | 3796.4 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 510 | 36.2 | -7.7 | 1.000 | 1.000 | 3796.4 | 20000.0 | 19.0 | B31.3 | |
| 512 | 29.6 | 7.7 | 1.000 | 1.000 | 3775.4 | 20000.0 | 18.9 | B31.3 | |
| | | | | | | | | | |
| 512 | 29.6 | -7.7 | 1.000 | 1.000 | 3775.4 | 20000.0 | 18.9 | B31.3 | |
| 515 | 120.8 | 7.6 | 10.994 | 14.325 | 3753.6 | 20000.0 | 18.8 | B31.3 | |
| | | | | | | | | | |
| 115 | 30.1 | -8.0 | 10.994 | 14.325 | 3025.1 | 20000.0 | 15.1 | B31.3 | |
| 517 | 57.5 | 8.1 | 1.000 | 1.000 | 3141.4 | 20000.0 | 15.7 | B31.3 | |
| | | | | | | | | | |
| 517 | 57.5 | -8.1 | 1.000 | 1.000 | 3141.4 | 20000.0 | 15.7 | B31.3 | |
| 518 | 66.3 | 8.1 | 1.000 | 1.000 | 3162.3 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 518 | 66.3 | -8.1 | 1.000 | 1.000 | 3162.3 | 20000.0 | 15.8 | B31.3 | |
| 519 | 67.8 | 8.1 | 1.000 | 1.000 | 3165.8 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 519 | 159.9 | -8.1 | 2.362 | 1.968 | 3218.0 | 20000.0 | 16.1 | B31.3 | |
| 524 | 24.0 | 7.8 | 2.362 | 1.968 | 3160.5 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 524 | 24.0 | -7.8 | 2.362 | 1.968 | 3160.5 | 20000.0 | 15.8 | B31.3 | |
| 525 | 251.3 | 3.8 | 2.362 | 1.968 | 3359.9 | 20000.0 | 16.8 | B31.3 | |
| | | | | | | | | | |
| 525 | 106.6 | -3.8 | 1.000 | 1.000 | 3278.1 | 20000.0 | 16.4 | B31.3 | |
| 530 | 108.4 | 3.8 | 1.000 | 1.000 | 3279.9 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 530 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 535 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 535 | 88.1 | -3.8 | 1.000 | 1.000 | 3259.5 | 20000.0 | 16.3 | B31.3 | |
| 540 | 257.7 | 3.8 | 1.000 | 1.000 | 3429.1 | 20000.0 | 17.1 | B31.3 | |
| | | | | | | | | | |
| 540 | 257.7 | -3.8 | 1.000 | 1.000 | 3429.1 | 20000.0 | 17.1 | B31.3 | |
| 542 | 57.9 | 3.8 | 1.000 | 1.000 | 3229.4 | 20000.0 | 16.1 | B31.3 | |
| | | | | | | | | | |
| 542 | 57.9 | -3.8 | 1.000 | 1.000 | 3229.4 | 20000.0 | 16.1 | B31.3 | |
| 543 | 58.8 | 3.8 | 1.000 | 1.000 | 3230.2 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 543 | 58.8 | -3.8 | 1.000 | 1.000 | 3230.2 | 20000.0 | 16.2 | B31.3 | |
| 545 | 164.7 | 3.8 | 1.000 | 1.000 | 3336.1 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 545 | 164.7 | -3.8 | 1.000 | 1.000 | 3336.1 | 20000.0 | 16.7 | B31.3 | |
| 547 | 12.5 | 3.8 | 1.000 | 1.000 | 3183.9 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 547 | 12.5 | -3.8 | 1.000 | 1.000 | 3183.9 | 20000.0 | 15.9 | B31.3 | |
| 548 | 5.9 | 3.8 | 1.000 | 1.000 | 3177.3 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 548 | 5.9 | -3.8 | 1.000 | 1.000 | 3177.3 | 20000.0 | 15.9 | B31.3 | |
| 550 | 163.8 | 3.8 | 1.000 | 1.000 | 3335.2 | 20000.0 | 16.7 | B31.3 | |
| | | | | | | | | | |
| 550 | 163.7 | -3.8 | 1.000 | 1.000 | 3330.9 | 20000.0 | 16.7 | B31.3 | |
| 555 | 3.4 | 2.6 | 1.000 | 1.000 | 3829.1 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 555 | 3.6 | -2.6 | 1.000 | 1.000 | 3835.8 | 20000.0 | 19.2 | B31.3 | |
| 560 | 202.2 | 2.6 | 1.000 | 1.000 | 4034.4 | 20000.0 | 20.2 | B31.3 | |
| | | | | | | | | | |
| 560 | 202.2 | -2.6 | 1.000 | 1.000 | 4034.4 | 20000.0 | 20.2 | B31.3 | |
| 565 | 52.0 | 2.6 | 1.000 | 1.000 | 3884.2 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 565 | 52.0 | -2.6 | 1.000 | 1.000 | 3884.2 | 20000.0 | 19.4 | B31.3 | |
| 570 | 13.1 | 2.6 | 1.000 | 1.000 | 3845.4 | 20000.0 | 19.2 | B31.3 | |
| | | | | | | | | | |
| 570 | 13.1 | -2.6 | 1.000 | 1.000 | 3845.4 | 20000.0 | 19.2 | B31.3 | |
| 573 | 38.8 | 2.6 | 1.000 | 1.000 | 3871.0 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 573 | 38.8 | -2.6 | 1.000 | 1.000 | 3871.0 | 20000.0 | 19.4 | B31.3 | |
| 575 | 47.4 | 2.6 | 1.000 | 1.000 | 3879.7 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 575 | 47.4 | -2.6 | 1.000 | 1.000 | 3879.7 | 20000.0 | 19.4 | B31.3 | |
| 580 | 78.1 | 2.6 | 1.000 | 1.000 | 3910.3 | 20000.0 | 19.6 | B31.3 | |
| | | | | | | | | | |
| 580 | 78.1 | -2.6 | 1.000 | 1.000 | 3910.3 | 20000.0 | 19.6 | B31.3 | |
| 585 | 87.9 | 2.6 | 1.000 | 1.000 | 3920.1 | 20000.0 | 19.6 | B31.3 | |
| | | | | | | | | | |
| 585 | 87.9 | -2.6 | 1.000 | 1.000 | 3920.1 | 20000.0 | 19.6 | B31.3 | |
| 587 | 199.8 | 2.6 | 1.000 | 1.000 | 4032.0 | 20000.0 | 20.2 | B31.3 | |
| | | | | | | | | | |
| 587 | 199.8 | -2.6 | 1.000 | 1.000 | 4032.0 | 20000.0 | 20.2 | B31.3 | |
| 590 | 24.0 | 2.6 | 1.000 | 1.000 | 3856.2 | 20000.0 | 19.3 | B31.3 | |
| | | | | | | | | | |
| 590 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 595 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 595 | 51.5 | -2.6 | 1.000 | 1.000 | 3883.7 | 20000.0 | 19.4 | B31.3 | |
| 598 | 51.1 | 2.6 | 1.000 | 1.000 | 3883.4 | 20000.0 | 19.4 | B31.3 | |
| | | | | | | | | | |
| 598 | 152.0 | -2.6 | 3.005 | 2.504 | 3946.2 | 20000.0 | 19.7 | B31.3 | |
| 599 | 18.6 | 6.8 | 3.005 | 2.504 | 3822.5 | 20000.0 | 19.1 | B31.3 | |
| | | | | | | | | | |
| 599 | 18.6 | -6.8 | 3.005 | 2.504 | 3822.5 | 20000.0 | 19.1 | B31.3 | |
| 600 | 122.8 | 7.5 | 3.005 | 2.504 | 3860.9 | 20000.0 | 19.3 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 600 | 40.9 | -7.5 | 1.000 | 1.000 | 3809.7 | 20000.0 | 19.0 | B31.3 | |
| 605 | 38.1 | 7.5 | 1.000 | 1.000 | 3800.6 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 605 | 38.1 | -7.5 | 1.000 | 1.000 | 3800.6 | 20000.0 | 19.0 | B31.3 | |
| 610 | 37.1 | 7.5 | 1.000 | 1.000 | 3797.3 | 20000.0 | 19.0 | B31.3 | |
| | | | | | | | | | |
| 610 | 37.1 | -7.5 | 1.000 | 1.000 | 3797.3 | 20000.0 | 19.0 | B31.3 | |
| 612 | 30.8 | 7.5 | 1.000 | 1.000 | 3776.6 | 20000.0 | 18.9 | B31.3 | |
| | | | | | | | | | |
| 612 | 30.8 | -7.5 | 1.000 | 1.000 | 3776.6 | 20000.0 | 18.9 | B31.3 | |
| 615 | 82.0 | 7.5 | 10.994 | 14.325 | 3724.5 | 20000.0 | 18.6 | B31.3 | |
| | | | | | | | | | |
| 615 | 1467.8 | -0.0 | 10.994 | 14.325 | 6257.5 | 20000.0 | 31.3 | B31.3 | |
| 625 | 0.0 | 0.0 | 1.000 | 1.000 | 5156.6 | 20000.0 | 25.8 | B31.3 | |
| | | | | | | | | | |
| 615 | 1469.7 | 1.6 | 10.994 | 14.325 | 6259.1 | 20000.0 | 31.3 | B31.3 | |
| 515 | 1029.8 | -1.6 | 10.994 | 14.325 | 5929.2 | 20000.0 | 29.6 | B31.3 | |
| | | | | | | | | | |
| 515 | 1037.4 | 4.0 | 10.994 | 14.325 | 5935.2 | 20000.0 | 29.7 | B31.3 | |
| 415 | 1033.2 | -4.0 | 10.994 | 14.325 | 5932.1 | 20000.0 | 29.7 | B31.3 | |
| | | | | | | | | | |
| 415 | 1041.0 | 8.4 | 10.994 | 14.325 | 5938.2 | 20000.0 | 29.7 | B31.3 | |
| 315 | 1020.0 | -8.4 | 10.994 | 14.325 | 5922.4 | 20000.0 | 29.6 | B31.3 | |
| | | | | | | | | | |
| 315 | 1006.4 | 17.4 | 10.994 | 14.325 | 5912.6 | 20000.0 | 29.6 | B31.3 | |
| 630 | 360.2 | -17.4 | 1.000 | 1.000 | 5518.0 | 20000.0 | 27.6 | B31.3 | |
| | | | | | | | | | |
| 630 | 360.2 | 17.4 | 1.000 | 1.000 | 5518.0 | 20000.0 | 27.6 | B31.3 | |
| 633 | 210.9 | -17.4 | 1.000 | 1.000 | 5368.7 | 20000.0 | 26.8 | B31.3 | |
| | | | | | | | | | |
| 633 | 652.8 | 17.4 | 3.095 | 3.095 | 5647.4 | 20000.0 | 28.2 | B31.3 | |
| 634 | 542.3 | 3.7 | 3.095 | 3.095 | 5565.0 | 20000.0 | 27.8 | B31.3 | |
| | | | | | | | | | |
| 634 | 542.3 | -3.7 | 3.095 | 3.095 | 5564.1 | 20000.0 | 27.8 | B31.3 | |
| 635 | 282.1 | 0.0 | 3.095 | 3.095 | 5368.2 | 20000.0 | 26.8 | B31.3 | |
| | | | | | | | | | |
| 635 | 91.2 | -0.0 | 1.000 | 1.000 | 5247.7 | 20000.0 | 26.2 | B31.3 | |
| 640 | 0.0 | 0.0 | 1.000 | 1.000 | 5156.6 | 20000.0 | 25.8 | B31.3 | |
| | | | | | | | | | |
| 75 | 2664.2 | -2.9 | 5.303 | 6.738 | 7154.7 | 20000.0 | 35.8 | B31.3 | |
| 700 | 359.2 | 2.9 | 1.000 | 1.000 | 5515.8 | 20000.0 | 27.6 | B31.3 | |
| | | | | | | | | | |
| 700 | 359.2 | -2.9 | 1.000 | 1.000 | 5515.8 | 20000.0 | 27.6 | B31.3 | |
| 705 | 474.4 | 7.5 | 1.000 | 1.000 | 3651.2 | 20000.0 | 18.3 | B31.3 | |
| | | | | | | | | | |
| 705 | 474.4 | -7.5 | 1.000 | 1.000 | 3651.2 | 20000.0 | 18.3 | B31.3 | |
| 710 | 686.9 | 7.5 | 1.000 | 1.000 | 3863.7 | 20000.0 | 19.3 | B31.3 | |
| | | | | | | | | | |
| 710 | 686.9 | -7.5 | 1.000 | 1.000 | 3863.7 | 20000.0 | 19.3 | B31.3 | |
| 715 | 543.2 | 7.5 | 1.000 | 1.000 | 3720.0 | 20000.0 | 18.6 | B31.3 | |
| | | | | | | | | | |
| 715 | 543.2 | -7.5 | 1.000 | 1.000 | 3720.0 | 20000.0 | 18.6 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 720 | 510.8 | 7.5 | 1.000 | 1.000 | 3687.6 | 20000.0 | 18.4 | B31.3 | |
| | | | | | | | | | |
| 720 | 510.8 | -7.5 | 1.000 | 1.000 | 3687.6 | 20000.0 | 18.4 | B31.3 | |
| 725 | 350.2 | 7.5 | 1.000 | 1.000 | 3527.0 | 20000.0 | 17.6 | B31.3 | |
| | | | | | | | | | |
| 725 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 730 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 730 | 213.3 | -7.5 | 1.000 | 1.000 | 3390.1 | 20000.0 | 17.0 | B31.3 | |
| 735 | 105.0 | 7.5 | 1.000 | 1.000 | 3281.8 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 735 | 105.0 | -7.5 | 1.000 | 1.000 | 3281.8 | 20000.0 | 16.4 | B31.3 | |
| 740 | 540.2 | 7.5 | 1.000 | 1.000 | 3717.0 | 20000.0 | 18.6 | B31.3 | |
| | | | | | | | | | |
| 740 | 540.2 | -7.5 | 1.000 | 1.000 | 3717.0 | 20000.0 | 18.6 | B31.3 | |
| 745 | 391.3 | 7.5 | 1.000 | 1.000 | 3568.1 | 20000.0 | 17.8 | B31.3 | |
| | | | | | | | | | |
| 745 | 391.3 | -7.5 | 1.000 | 1.000 | 3568.1 | 20000.0 | 17.8 | B31.3 | |
| 750 | 363.1 | 7.5 | 1.000 | 1.000 | 3539.9 | 20000.0 | 17.7 | B31.3 | |
| | | | | | | | | | |
| 750 | 363.1 | -7.5 | 1.000 | 1.000 | 3539.9 | 20000.0 | 17.7 | B31.3 | |
| 755 | 32.1 | 7.5 | 1.000 | 1.000 | 3208.9 | 20000.0 | 16.0 | B31.3 | |
| | | | | | | | | | |
| 755 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 760 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 760 | 103.7 | -7.5 | 1.000 | 1.000 | 3280.5 | 20000.0 | 16.4 | B31.3 | |
| 763 | 109.2 | 7.5 | 1.000 | 1.000 | 3286.1 | 20000.0 | 16.4 | B31.3 | |
| | | | | | | | | | |
| 763 | 257.5 | -7.5 | 2.362 | 1.968 | 3370.0 | 20000.0 | 16.8 | B31.3 | |
| 764 | 284.4 | -0.0 | 2.362 | 1.968 | 3378.3 | 20000.0 | 16.9 | B31.3 | |
| | | | | | | | | | |
| 764 | 284.4 | 0.0 | 2.362 | 1.968 | 3378.3 | 20000.0 | 16.9 | B31.3 | |
| 765 | 163.4 | -9.2 | 2.362 | 1.968 | 3246.9 | 20000.0 | 16.2 | B31.3 | |
| | | | | | | | | | |
| 765 | 70.1 | 9.2 | 1.000 | 1.000 | 3194.5 | 20000.0 | 16.0 | B31.3 | |
| 770 | 70.8 | -9.2 | 1.000 | 1.000 | 3178.4 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 770 | 70.8 | 9.2 | 1.000 | 1.000 | 3178.4 | 20000.0 | 15.9 | B31.3 | |
| 775 | 70.9 | -9.2 | 1.000 | 1.000 | 3176.5 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 775 | 70.9 | 9.2 | 1.000 | 1.000 | 3176.5 | 20000.0 | 15.9 | B31.3 | |
| 780 | 71.3 | -9.2 | 1.000 | 1.000 | 3166.8 | 20000.0 | 15.8 | B31.3 | |
| | | | | | | | | | |
| 780 | 253.6 | 9.2 | 3.622 | 3.018 | 3285.7 | 20000.0 | 16.4 | B31.3 | |
| 784 | 454.9 | 3.0 | 3.622 | 3.018 | 3435.1 | 20000.0 | 17.2 | B31.3 | |
| | | | | | | | | | |
| 784 | 454.9 | -3.0 | 3.622 | 3.018 | 3507.0 | 20000.0 | 17.5 | B31.3 | |
| 785 | 996.5 | -0.0 | 3.622 | 3.018 | 3924.1 | 20000.0 | 19.6 | B31.3 | |
| | | | | | | | | | |
| 785 | 276.5 | 0.0 | 1.000 | 1.000 | 3453.2 | 20000.0 | 17.3 | B31.3 | |
| 790 | 401.5 | -0.0 | 1.000 | 1.000 | 3578.2 | 20000.0 | 17.9 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 790 | 401.5 | 0.0 | 1.000 | 1.000 | 3578.2 | 20000.0 | 17.9 | B31.3 | |
| 795 | 0.0 | 0.0 | 1.000 | 1.000 | 3176.8 | 20000.0 | 15.9 | B31.3 | |

Job Description:

PROJECT: NEWPP Water Purifiaction Plant, Houston

CLIENT : CDM Smith

ANALYST: DClark

CHECKER: RSinghal

NOTES : High Service Pumps & Header

Existing Configuration with Flex Joints
Conditions: AMB at 82.7 psig (pump disch)

PIPE DATA
---
---
From 5 To 10 DX= -3.833 ft.
B31.3 (2010) Cycle Max Switch = --- App.P Sy/St Switch = ON
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.
Dia= 30.000 in. Wall= .375 in. Cor= .0000 in.
GENERAL
T1= 70 F P1= 82.7000 lb./sq.in. Mat= (102)A53 B
E= 29,500,000 lb./sq.in. EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in. EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in. EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in. EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in. EH9= 29,500,000 lb./sq.in. v = .292
Pipe Den= .2830000 lb./cu.in. Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .375 in. Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 5 ANC
Node 10 Y
ALLOWABLE STRESSES
---
From 10 To 15 DX= -1.667 ft.
---
From 15 To 20 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 29.250 in.
---
From 20 To 25 DX= -2.625 ft.
---
From 25 To 30 DX= -2.417 ft.
RIGID Weight= 4,000.00 lb.
---
From 30 To 35 DX= -1.500 ft.
---
From 35 To 40 DX= -1.000 ft.
RIGID Weight= 1,556.00 lb.
---
From 40 To 45 DX= -2.000 ft.

RESTRAINTS
  Node  45  Y
---
From  45  To  50  DX= -3.208 ft.
---
From  50  To  55  DX= -10.167 ft.
SIF's & TEE's
  Node  55  Unreinforced Tee
---
From  105  To  110  DX= -3.833 ft.
  B31.3 (2010)  Cycle Max Switch = ---  App.P Sy/St Switch = ON
  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.
  Dia= 30.000 in.  Wall= .375 in.  Cor= .0000 in.
GENERAL
  T1= 70 F  P1= 165.0000 lb./sq.in.  Mat= (102)A53 B
  E= 29,500,000 lb./sq.in.  EH1= 29,500,000 lb./sq.in.
  EH2= 29,500,000 lb./sq.in.  EH3= 29,500,000 lb./sq.in.
  EH4= 29,500,000 lb./sq.in.  EH5= 29,500,000 lb./sq.in.
  EH6= 29,500,000 lb./sq.in.  EH7= 29,500,000 lb./sq.in.
  EH8= 29,500,000 lb./sq.in.  EH9= 29,500,000 lb./sq.in.  v = .292
  Pipe Den= .2830000 lb./cu.in.  Fluid Den= .0361111 lb./cu.in.
  Refract. Thk= .375 in.  Refract. Den= .0643300 lb./cu.in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  105  ANC
  Node  110  Y
ALLOWABLE STRESSES
---
From  110  To  115  DX= -1.667 ft.
---
From  115  To  120  DX= -.167 ft.
EXPANSION JOINT
  Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
  Tors K= 1,000 in.lb./deg  Eff Dia= 29.250 in.
---
From  120  To  125  DX= -2.625 ft.
---
From  125  To  130  DX= -2.417 ft.
RIGID  Weight= 4,000.00 lb.
---
From  130  To  135  DX= -1.500 ft.
---
From  135  To  140  DX= -1.000 ft.
RIGID  Weight= 1,556.00 lb.
---
From  140  To  145  DX= -2.000 ft.
RESTRAINTS
  Node  145  Y
---
From  145  To  150  DX= -3.208 ft.
---
From  150  To  155  DX= -10.167 ft.
SIF's & TEE's
  Node  155  Unreinforced Tee
---

From 150 To 155 DX= -10.167 ft.
SIF's & TEE's
Node 155 Unreinforced Tee
---
From 205 To 210 DX= -3.833 ft.
B31.3 (2010) Cycle Max Switch = --- App.P Sy/St Switch = ON
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.
Dia= 30.000 in. Wall= .375 in. Cor= .0000 in.
GENERAL
T1= 70 F P1= 165.0000 lb./sq.in. Mat= (102)A53 B
E= 29,500,000 lb./sq.in. EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in. EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in. EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in. EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in. EH9= 29,500,000 lb./sq.in. v = .292
Pipe Den= .2830000 lb./cu.in. Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .375 in. Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 205 ANC
Node 210 Y
ALLOWABLE STRESSES
---
From 210 To 215 DX= -1.667 ft.
---
From 215 To 220 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 29.250 in.
---
From 220 To 225 DX= -2.625 ft.
---
From 225 To 230 DX= -2.417 ft.
RIGID Weight= 4,000.00 lb.
---
From 230 To 235 DX= -1.500 ft.
---
From 235 To 240 DX= -1.000 ft.
RIGID Weight= 1,556.00 lb.
---
From 240 To 245 DX= -2.000 ft.
RESTRAINTS
Node 245 Y
---
From 245 To 250 DX= -3.208 ft.
---
From 250 To 255 DX= -10.167 ft.
SIF's & TEE's
Node 255 Unreinforced Tee
---
From 250 To 255 DX= -10.167 ft.
SIF's & TEE's
Node 255 Unreinforced Tee
---
From 305 To 310 DX= -3.833 ft.

B31.3 (2010)  Cycle Max Switch = ---  App.P Sy/St Switch = ON
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.
Dia= 30.000 in.  Wall= .375 in.  Cor= .0000 in.
GENERAL
T1= 70 F  P1= 165.0000 lb./sq.in.  Mat= (102)A53 B
E= 29,500,000 lb./sq.in.  EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in.  EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in.  EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in.  EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in.  EH9= 29,500,000 lb./sq.in.  v = .292
Pipe Den= .2830000 lb./cu.in.  Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .375 in.  Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 305 ANC
Node 310 Y
ALLOWABLE STRESSES
---
From 310 To 315 DX= -1.667 ft.
---
From 315 To 320 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg  Eff Dia= 29.250 in.
---
From 320 To 325 DX= -2.625 ft.
---
From 325 To 330 DX= -2.417 ft.
RIGID Weight= 4,000.00 lb.
---
From 330 To 335 DX= -1.500 ft.
---
From 335 To 340 DX= -1.000 ft.
RIGID Weight= 1,556.00 lb.
---
From 340 To 345 DX= -2.000 ft.
RESTRAINTS
Node 345 Y
---
From 345 To 350 DX= -3.208 ft.
---
From 350 To 355 DX= -10.167 ft.
SIF's & TEE's
Node 355 Unreinforced Tee
---
From 350 To 355 DX= -10.167 ft.
SIF's & TEE's
Node 355 Unreinforced Tee
---
From 405 To 410 DX= -3.833 ft.
B31.3 (2010)  Cycle Max Switch = ---  App.P Sy/St Switch = ON
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.

Dia= 30.000 in.  Wall= .375 in.  Cor= .0000 in.
GENERAL
T1= 70 F  P1= 165.0000 lb./sq.in.  Mat= (102)A53 B
E= 29,500,000 lb./sq.in.  EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in.  EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in.  EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in.  EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in.  EH9= 29,500,000 lb./sq.in.  v = .292
Pipe Den= .2830000 lb./cu.in.  Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .375 in.  Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node  405  ANC
Node  410  Y
ALLOWABLE STRESSES
---
From  410  To  415  DX= -1.667 ft.
---
From  415  To  420  DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg  Eff Dia= 29.250 in.
---
From  420  To  425  DX= -2.625 ft.
---
From  425  To  430  DX= -2.417 ft.
RIGID  Weight= 4,000.00 lb.
---
From  430  To  435  DX= -1.500 ft.
---
From  435  To  440  DX= -1.000 ft.
RIGID  Weight= 1,556.00 lb.
---
From  440  To  445  DX= -2.000 ft.
RESTRAINTS
Node  445  Y
---
From  445  To  450  DX= -3.208 ft.
---
From  450  To  455  DX= -10.167 ft.
SIF's & TEE's
Node  455  Unreinforced Tee
---
From  505  To  510  DX= -3.833 ft.
B31.3 (2010)  Cycle Max Switch = ---  App.P Sy/St Switch = ON
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.
Dia= 30.000 in.  Wall= .375 in.  Cor= .0000 in.
GENERAL
T1= 70 F  P1= 165.0000 lb./sq.in.  Mat= (102)A53 B
E= 29,500,000 lb./sq.in.  EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in.  EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in.  EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in.  EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in.  EH9= 29,500,000 lb./sq.in.  v = .292
Pipe Den= .2830000 lb./cu.in.  Fluid Den= .0361111 lb./cu.in.

Refract. Thk= .375 in.  Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 505 ANC
Node 510 Y
ALLOWABLE STRESSES
---
From 510 To 515 DX= -1.667 ft.
---
From 515 To 520 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in.  Trans K= 100 lb./in.  Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg  Eff Dia= 29.250 in.
---
From 520 To 525 DX= -2.625 ft.
---
From 525 To 530 DX= -2.417 ft.
RIGID Weight= 4,000.00 lb.
---
From 530 To 535 DX= -1.500 ft.
---
From 535 To 540 DX= -1.000 ft.
RIGID Weight= 1,556.00 lb.
---
From 540 To 545 DX= -2.000 ft.
RESTRAINTS
Node 545 Y
---
From 545 To 550 DX= -3.208 ft.
---
From 550 To 555 DX= -10.167 ft.
SIF's & TEE's
Node 555 Unreinforced Tee
---
From 605 To 610 DX= -3.833 ft.
B31.3 (2010)  Cycle Max Switch = ---  App.P Sy/St Switch = ON
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.
Dia= 30.000 in.  Wall= .375 in.  Cor= .0000 in.
GENERAL
T1= 70 F  P1= 165.0000 lb./sq.in.  Mat= (102)A53 B
E= 29,500,000 lb./sq.in.  EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in.  EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in.  EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in.  EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in.  EH9= 29,500,000 lb./sq.in.  v = .292
Pipe Den= .2830000 lb./cu.in.  Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .375 in.  Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 605 ANC
Node 610 Y
ALLOWABLE STRESSES
---
From 610 To 615 DX= -1.667 ft.
---

From 615 To 620 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 29.250 in.
---
From 620 To 625 DX= -2.625 ft.
---
From 625 To 630 DX= -2.417 ft.
RIGID Weight= 4,000.00 lb.
---
From 630 To 635 DX= -1.500 ft.
---
From 635 To 640 DX= -1.000 ft.
RIGID Weight= 1,556.00 lb.
---
From 640 To 645 DX= -2.000 ft.
RESTRAINTS
Node 645 Y
---
From 645 To 650 DX= -3.208 ft.
---
From 650 To 655 DX= -10.167 ft.
SIF's & TEE's
Node 655 Unreinforced Tee
---
From 705 To 710 DX= -3.833 ft.
B31.3 (2010) Cycle Max Switch = --- App.P Sy/St Switch = ON
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.
Dia= 30.000 in. Wall= .375 in. Cor= .0000 in.
GENERAL
T1= 70 F P1= 165.0000 lb./sq.in. Mat= (102)A53 B
E= 29,500,000 lb./sq.in. EH1= 29,500,000 lb./sq.in.
EH2= 29,500,000 lb./sq.in. EH3= 29,500,000 lb./sq.in.
EH4= 29,500,000 lb./sq.in. EH5= 29,500,000 lb./sq.in.
EH6= 29,500,000 lb./sq.in. EH7= 29,500,000 lb./sq.in.
EH8= 29,500,000 lb./sq.in. EH9= 29,500,000 lb./sq.in. v = .292
Pipe Den= .2830000 lb./cu.in. Fluid Den= .0361111 lb./cu.in.
Refract. Thk= .375 in. Refract. Den= .0643300 lb./cu.in.
Insul Thk= .000 in.
RESTRAINTS
Node 705 ANC
Node 710 Y
ALLOWABLE STRESSES
---
From 710 To 715 DX= -1.667 ft.
---
From 715 To 720 DX= -.167 ft.
EXPANSION JOINT
Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
Tors K= 1,000 in.lb./deg Eff Dia= 29.250 in.
---
From 720 To 725 DX= -2.625 ft.
---
From 725 To 730 DX= -2.417 ft.
RIGID Weight= 4,000.00 lb.

---
From 730 To 735 DX= -1.500 ft.
---
From 735 To 740 DX= -1.000 ft.
RIGID Weight= 1,556.00 lb.
---
From 740 To 745 DX= -2.000 ft.
RESTRAINTS
Node 745 Y
---
From 745 To 750 DX= -3.208 ft.
---
From 750 To 755 DX= -10.167 ft.
SIF's & TEE's
Node 755 Unreinforced Tee
---
From 755 To 655 DZ= -15.833 ft.
Dia= 84.000 in. Wall= .375 in.
GENERAL
Refract. Thk= .500 in. Insul Thk= .000 in.
---
From 655 To 760 DZ= -5.750 ft.
RESTRAINTS
Node 760 Y
---
From 760 To 555 DZ= -4.250 ft.
---
From 555 To 455 DZ= -10.000 ft.
---
From 455 To 765 DZ= -5.000 ft.
SIF's & TEE's
Node 765 Unreinforced Tee
---
From 765 To 355 DZ= -5.000 ft.
---
From 355 To 770 DZ= -5.333 ft.
RESTRAINTS
Node 770 Y
---
From 770 To 775 DZ= -2.917 ft.
FORCES & MOMENTS
Node 775 FY1= -1,440.00 lb.
---
From 775 To 255 DZ= -1.750 ft.
---
From 255 To 155 DZ= -10.000 ft.
---
From 155 To 780 DZ= -3.000 ft.
RESTRAINTS
Node 780 Y
---
From 780 To 55 DZ= -7.000 ft.
---
From 55 To 785 DZ= -2.042 ft.
RESTRAINTS
Node 785 Y
---
From 785 To 790 DZ= -7.958 ft.

SIF's & TEE's
  Node  790   Unreinforced Tee
---
From  790  To  795  DX= 6.500 ft.
  Dia= 30.000 in.   Wall= .375 in.
GENERAL
  Refract. Thk= .375 in.   Insul Thk= .000 in.
FORCES & MOMENTS
  Node  795   FY1= -660.00 lb.
---
From  790  To  800 DZ= -3.875 ft.
  Dia= 84.000 in.   Wall= .375 in.
GENERAL
  Refract. Thk= .500 in.   Insul Thk= .000 in.
---
From  800  To  805 DZ= -2.333 ft.
  Dia= 48.000 in.   Wall= .375 in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  805  Y
---
From  805  To  810 DZ= -1.500 ft.
---
From  810  To  815 DZ= -1.250 ft.
RIGID  Weight= 2,185.00 lb.
---
From  815  To  820 DZ= -2.500 ft.
---
From  820  To  825 DZ= -5.333 ft.
  Dia= 42.000 in.   Wall= .375 in.
  Insul Thk= .000 in.
BEND at "TO" end
  Radius= 63.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 824
  Miters= 4   Ftg Thk= .375 in.
---
From  825  To  830 DY= -5.860 ft.
RESTRAINTS
  Node  830  Guide   Gap= .250 in.
---
From  830  To  835 DY= -6.000 ft.
BEND at "TO" end
  Radius= 63.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 834
  Angle/Node @2= .00 833   Miters= 4   Ftg Thk= .375 in.
RESTRAINTS
  Node  834  Y
  Node  834  X
---
From  835  To  840 DZ= -6.000 ft.
RESTRAINTS
  Node  840  Y
  Node  840  X
---
From  765  To  845  DX= -10.500 ft.
BEND at "TO" end
  Radius= 63.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 844
  Angle/Node @2= .00 843   Miters= 4   Ftg Thk= .375 in.
---
From  845  To  850 DY= -5.860 ft.

RESTRAINTS
  Node  850  Guide   Gap= .250 in.
---
From  850  To  855 DY= -6.000 ft.
BEND at "TO" end
  Radius= 63.000 in. (LONG)   Bend Angle= 90.000   Angle/Node @1= 45.00 854
  Angle/Node @2= .00 853
RESTRAINTS
  Node  854  Y
  Node  854  Z
---
From  855  To  860  DX= -10.000 ft.
RESTRAINTS
  Node  860  Y
  Node  860  Z
---
From  755  To  865 DZ= 3.583 ft.
  Dia= 85.000 in.   Wall= .375 in.
  Insul Thk= .000 in.
RESTRAINTS
  Node  865  Y
---
From  865  To  870 DZ= 8.125 ft.
---
From  870  To  875 DZ= 5.458 ft.
---
From  875  To  880 DZ= 4.417 ft.
  Dia= 42.000 in.   Wall= .375 in.
  Insul Thk= .000 in.
SIF's & TEE's
  Node  880   Unreinforced Tee
---
From  880  To  885 DZ= 4.750 ft.
FORCES & MOMENTS
  Node  885   FY1= -330.00 lb.
---
From  885  To  890 DZ= 1.000 ft.
FORCES & MOMENTS
  Node  890   FY1= -330.00 lb.
---
From  890  To  895 DZ= 2.750 ft.
SIF's & TEE's
  Node  895   Unreinforced Tee
---
From  895  To  900 DZ= 2.750 ft.
FORCES & MOMENTS
  Node  900   FY1= -330.00 lb.
---
From  900  To  905 DZ= 1.000 ft.
FORCES & MOMENTS
  Node  905   FY1= -330.00 lb.
---
From  905  To  910 DZ= 2.917 ft.
RESTRAINTS
  Node  910  Y
---
From  910  To  915 DZ= 11.583 ft.
RESTRAINTS

```
   Node  915  Y
-----------------------------------------------------------------------------
From  915  To  920 DZ= 11.500 ft.
RESTRAINTS
   Node  920  Y
-----------------------------------------------------------------------------
From  920  To  925 DZ= 2.083 ft.
-----------------------------------------------------------------------------
From  925  To  930 DZ= 4.417 ft.
RIGID  Weight= 955.00 lb.
-----------------------------------------------------------------------------
From  930  To  935 DZ= 2.083 ft.
RESTRAINTS
   Node  935  Y
-----------------------------------------------------------------------------
From  935  To  940 DZ= 11.000 ft.
-----------------------------------------------------------------------------
From  940  To  945 DZ= .167 ft.
EXPANSION JOINT
   Axial K= 100 lb./in.   Trans K= 100 lb./in.   Bend K= 100 in.lb./deg
   Tors K= 1,000 in.lb./deg   Eff Dia= 41.250 in.
-----------------------------------------------------------------------------
From  945  To  950 DZ= .833 ft.
RESTRAINTS
   Node  950  Y
-----------------------------------------------------------------------------
From  950  To  955 DZ= 1.500 ft.
-----------------------------------------------------------------------------
From  955  To  960 DZ= 1.000 ft.
RIGID  Weight= 2,085.00 lb.
-----------------------------------------------------------------------------
From  960  To  965 DZ= 4.125 ft.
BEND at "TO" end
   Radius= 63.000 in. (LONG)   Bend Angle= 45.000   Angle/Node @1= 22.50 964
   Miters= 4   Ftg Thk= .375 in.
-----------------------------------------------------------------------------
From  965  To  970 DY= -4.750 ft.  DZ= 4.750 ft.
RESTRAINTS
   Node  970  Guide   Gap= .250 in.
-----------------------------------------------------------------------------
From  970  To  975 DY= -8.250 ft.  DZ= 8.250 ft.
BEND at "TO" end
   Radius= 63.000 in. (LONG)   Bend Angle= 45.000   Angle/Node @1= 22.50 974
   Angle/Node @2= .00 973   Miters= 4   Ftg Thk= .375 in.
RESTRAINTS
   Node  974  Y
   Node  974  X
-----------------------------------------------------------------------------
From  975  To  980 DZ= 7.000 ft.
RESTRAINTS
   Node  980  Y
   Node  980  X
-----------------------------------------------------------------------------
From  980  To  985 DZ= 5.000 ft.
-----------------------------------------------------------------------------
From  985  To  990 DZ= 12.000 ft.
   Dia= 84.000 in.   Wall= .375 in.
   Insul Thk= .000 in.
```

RESTRAINTS
  Node 990 Y
  Node 990 X
SIF's & TEE's
  Node 990 Unreinforced Tee
---
From 990 To 995 DZ= 20.000 ft.
RESTRAINTS
  Node 995 Y
  Node 995 X
---
From 995 To 998 DZ= 20.000 ft.
RESTRAINTS
  Node 998 Y
  Node 998 X
---
From 895 To 1000 DX= -4.000 ft.
  Dia= 42.000 in. Wall= .375 in.
  Insul Thk= .000 in.
RESTRAINTS
  Node 1000 Y
---
From 1000 To 1005 DX= -10.771 ft.
RESTRAINTS
  Node 1005 Y
---
From 1005 To 1010 DX= -4.229 ft.
SIF's & TEE's
  Node 1010 Unreinforced Tee
---
From 1010 To 1015 DZ= -2.750 ft.
FORCES & MOMENTS
  Node 1015 FY1= -330.00 lb.
---
From 1015 To 1020 DZ= -1.000 ft.
FORCES & MOMENTS
  Node 1020 FY1= -445.00 lb.
---
From 1010 To 1025 DZ= 2.750 ft.
FORCES & MOMENTS
  Node 1025 FY1= -330.00 lb.
---
From 1025 To 1030 DZ= 1.000 ft.
FORCES & MOMENTS
  Node 1030 FY1= -330.00 lb.
---
From 1030 To 1035 DZ= 2.917 ft.
RESTRAINTS
  Node 1035 Y
---
From 1035 To 1040 DZ= 11.583 ft.
RESTRAINTS
  Node 1040 Y
---
From 1040 To 1045 DZ= 11.500 ft.
RESTRAINTS
  Node 1045 Y
---

From 1045 To 1050 DZ= 2.083 ft.
---
From 1050 To 1055 DZ= 4.417 ft.
RIGID Weight= 955.00 lb.
---
From 1055 To 1060 DZ= 2.083 ft.
RESTRAINTS
  Node 1060 Y
---
From 1060 To 1065 DZ= 11.000 ft.
---
From 1065 To 1070 DZ= .167 ft.
EXPANSION JOINT
  Axial K= 100 lb./in. Trans K= 100 lb./in. Bend K= 100 in.lb./deg
  Tors K= 1,000 in.lb./deg Eff Dia= 41.250 in.
---
From 1070 To 1075 DZ= .833 ft.
RESTRAINTS
  Node 1075 Y
---
From 1075 To 1080 DZ= 1.500 ft.
---
From 1080 To 1085 DZ= 1.000 ft.
RIGID Weight= 2,085.00 lb.
---
From 1085 To 1090 DZ= 4.125 ft.
BEND at "TO" end
  Radius= 63.000 in. (LONG) Bend Angle= 45.000 Angle/Node @1= 22.50 1089
  Miters= 4 Ftg Thk= .375 in.
---
From 1090 To 1095 DY= -4.750 ft. DZ= 4.750 ft.
RESTRAINTS
  Node 1095 Guide Gap= .250 in.
---
From 1095 To 1100 DY= -8.250 ft. DZ= 8.250 ft.
BEND at "TO" end
  Radius= 63.000 in. (LONG) Bend Angle= 45.000 Angle/Node @1= 22.50 1099
  Angle/Node @2= .00 1098 Miters= 4 Ftg Thk= .375 in.
RESTRAINTS
  Node 1099 Y
  Node 1099 X
---
From 1100 To 1105 DZ= 5.000 ft.
BEND at "TO" end
  Radius= 63.000 in. (LONG) Bend Angle= 45.000 Angle/Node @1= 22.50 1104
  Miters= 3 Ftg Thk= .375 in.
RESTRAINTS
  Node 1104 Y
  Node 1104 X
---
From 1105 To 1110 DX= 7.071 ft. DZ= 7.071 ft.
RESTRAINTS
  Node 1110 Y
---
From 1110 To 1115 DX= 3.536 ft. DZ= 3.536 ft.
---
From 1115 To 990 DX= 8.393 ft. DY= .000 ft. DZ= 8.393 ft.
  Dia= 84.000 in. Wall= .375 in.

Insul Thk= .000 in.

# Summary of Support Loads

CASE 1 (SUS) W+P1+F1

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| 5 | | Rigid ANC | | | | | |
| | 1(SUS) | 55548 | -785 | 112 | 0.0 | 625.9 | 533.5 |
| | | | | | | | |
| | | | | | | | |
| 10 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -1553 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 45 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -33552 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 105 | | Rigid ANC | | | | | |
| | 1(SUS) | 110813 | -785 | 128 | 0.2 | 713.4 | 532.8 |
| | | | | | | | |
| | | | | | | | |
| 110 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -1550 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 145 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -53223 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 205 | | Rigid ANC | | | | | |
| | 1(SUS) | 110768 | -786 | 165 | -1.7 | 916.5 | 532.0 |
| | | | | | | | |
| | | | | | | | |
| 210 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -1546 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 245 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -64015 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 305 | | Rigid ANC | | | | | |
| | 1(SUS) | 110703 | -783 | 239 | -4.4 | 1332.8 | 534.5 |
| | | | | | | | |
| | | | | | | | |
| 310 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -1558 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 345 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -65536 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 405 | | Rigid ANC | | | | | |
| | 1(SUS) | 110586 | -780 | 356 | 1.3 | 1983.2 | 536.6 |
| | | | | | | | |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 410 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -1568 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 445 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -38035 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 505 | | Rigid ANC | | | | | |
| | 1(SUS) | 110419 | -784 | 435 | 3.7 | 2421.1 | 534.1 |
| | | | | | | | |
| | | | | | | | |
| 510 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -1556 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 545 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -38673 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 605 | | Rigid ANC | | | | | |
| | 1(SUS) | 110229 | -786 | 472 | 1.4 | 2625.5 | 532.4 |
| | | | | | | | |
| | | | | | | | |
| 610 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -1548 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 645 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -38939 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 705 | | Rigid ANC | | | | | |
| | 1(SUS) | 109916 | -785 | 483 | -0.5 | 2688.6 | 533.3 |
| | | | | | | | |
| | | | | | | | |
| 710 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -1553 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 745 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -32941 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 760 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 259307 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 770 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 572619 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 780 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -110158 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 785 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | 3688 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 805 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -74168 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 830 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | 7137 | 0 | 41838 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 834 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 34662 | 20123 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 840 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -18069 | 2880 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 850 | | Rigid GUI w/gap; Rigid GUI w/gap | | | | | |
| | 1(SUS) | -848190 | 0 | -49662 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 854 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -657364 | 11870 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 860 | | Rigid Y; Rigid Z | | | | | |
| | 1(SUS) | 0 | -17423 | -6436 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 865 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -111888 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 910 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -21971 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 915 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -5155 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 920 | | Rigid Y | | | | | |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | 1(SUS) | 0 | -3529 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 935 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -16488 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 950 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -9983 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 970 | | Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 974 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -12893 | -17194 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 980 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 11999 | -11835 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 990 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -2649 | -72491 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 995 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 354 | -62212 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 998 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -31 | -22152 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1000 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -6202 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1005 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -6004 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1035 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -11424 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1040 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -7216 | 0 | 0.0 | 0.0 | 0.0 |

| Node | Load Case | FX lb. | FY lb. | FZ lb. | MX ft.lb. | MY ft.lb. | MZ ft.lb. |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 1045 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -3206 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1060 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -16544 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1075 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -10104 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1095 | | Rigid GUI w/gap | | | | | |
| | 1(SUS) | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1099 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | -13765 | -19239 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1104 | | Rigid Y; Rigid X | | | | | |
| | 1(SUS) | 12464 | 726 | 0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| | | | | | | | |
| 1110 | | Rigid Y | | | | | |
| | 1(SUS) | 0 | -26594 | 0 | 0.0 | 0.0 | 0.0 |

```
Piping Code: B31.3      = B31.3 -2010, March 31, 2011


 CODE STRESS CHECK FAILED      : LOADCASE 1 (SUS) W+P1+F1

Highest Stresses: (lb./sq.in.)
Ratio (%):                  5770.8       @Node    765
Code Stress:             1154161.0       Allowable Stress:      20000.0
Axial Stress:              17259.4       @Node    844
Bending Stress:          1521795.4       @Node    765
Torsion Stress:             5295.6       @Node    355
Hoop Stress:               18535.0       @Node    865
Max Stress Intensity:    1534606.0       @Node    765
```

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 38.7 | 0.0 | 1.000 | 1.000 | 39.3 | 20000.0 | 0.2 | B31.3 | |
| 10 | 30.6 | -0.0 | 1.000 | 1.000 | 31.3 | 20000.0 | 0.2 | B31.3 | |
| | | | | | | | | | |
| 10 | 30.6 | 0.0 | 1.000 | 1.000 | 31.3 | 20000.0 | 0.2 | B31.3 | |
| 15 | 0.4 | -0.0 | 1.000 | 1.000 | 1.0 | 20000.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 15 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 20 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 20 | 0.5 | 0.0 | 1.000 | 1.000 | 1.2 | 20000.0 | 0.0 | B31.3 | |
| 25 | 73.1 | -0.0 | 1.000 | 1.000 | 73.7 | 20000.0 | 0.4 | B31.3 | |
| | | | | | | | | | |
| 25 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 30 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 30 | 469.9 | 0.0 | 1.000 | 1.000 | 470.5 | 20000.0 | 2.4 | B31.3 | |
| 35 | 905.5 | -0.0 | 1.000 | 1.000 | 906.2 | 20000.0 | 4.5 | B31.3 | |
| | | | | | | | | | |
| 35 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 40 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 40 | 1254.5 | 0.0 | 1.000 | 1.000 | 1255.2 | 20000.0 | 6.3 | B31.3 | |
| 45 | 2079.6 | -0.0 | 1.000 | 1.000 | 2080.2 | 20000.0 | 10.4 | B31.3 | |
| | | | | | | | | | |
| 45 | 2079.6 | 0.0 | 1.000 | 1.000 | 2080.2 | 20000.0 | 10.4 | B31.3 | |
| 50 | 1493.5 | -0.0 | 1.000 | 1.000 | 1494.2 | 20000.0 | 7.5 | B31.3 | |
| | | | | | | | | | |
| 50 | 1493.5 | 0.0 | 1.000 | 1.000 | 1494.2 | 20000.0 | 7.5 | B31.3 | |
| 55 | 236021.5 | -0.0 | 15.887 | 20.849 | 177016.8 | 20000.0 | 885.1 | B31.3 | * |
| | | | | | | | | | |
| 105 | 41.9 | 0.0 | 1.000 | 1.000 | 43.6 | 20000.0 | 0.2 | B31.3 | |
| 110 | 30.8 | -0.0 | 1.000 | 1.000 | 32.6 | 20000.0 | 0.2 | B31.3 | |
| | | | | | | | | | |
| 110 | 30.8 | 0.0 | 1.000 | 1.000 | 32.6 | 20000.0 | 0.2 | B31.3 | |
| 115 | 0.4 | -0.0 | 1.000 | 1.000 | 2.2 | 20000.0 | 0.0 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 115 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 120 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 120 | 0.6 | 0.0 | 1.000 | 1.000 | 2.3 | 20000.0 | 0.0 | B31.3 | |
| 125 | 73.8 | -0.0 | 1.000 | 1.000 | 75.5 | 20000.0 | 0.4 | B31.3 | |
| | | | | | | | | | |
| 125 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 130 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 130 | 470.6 | 0.0 | 1.000 | 1.000 | 472.4 | 20000.0 | 2.4 | B31.3 | |
| 135 | 906.4 | -0.0 | 1.000 | 1.000 | 908.1 | 20000.0 | 4.5 | B31.3 | |
| | | | | | | | | | |
| 135 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 140 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 140 | 1255.5 | 0.0 | 1.000 | 1.000 | 1257.2 | 20000.0 | 6.3 | B31.3 | |
| 145 | 2080.7 | -0.0 | 1.000 | 1.000 | 2082.5 | 20000.0 | 10.4 | B31.3 | |
| | | | | | | | | | |
| 145 | 2080.7 | 0.0 | 1.000 | 1.000 | 2082.5 | 20000.0 | 10.4 | B31.3 | |
| 150 | 4457.7 | -0.0 | 1.000 | 1.000 | 4459.4 | 20000.0 | 22.3 | B31.3 | |
| | | | | | | | | | |
| 150 | 2228.8 | 0.0 | 1.000 | 1.000 | 3818.1 | 20000.0 | 19.1 | B31.3 | |
| 155 | 11401.3 | -0.0 | 1.000 | 1.000 | 12990.5 | 20000.0 | 65.0 | B31.3 | |
| | | | | | | | | | |
| 150 | 2228.8 | 0.0 | 1.000 | 1.000 | 3818.1 | 20000.0 | 19.1 | B31.3 | |
| 155 | 11401.3 | -0.0 | 1.000 | 1.000 | 12990.5 | 20000.0 | 65.0 | B31.3 | |
| | | | | | | | | | |
| 205 | 49.8 | -0.0 | 1.000 | 1.000 | 52.8 | 20000.0 | 0.3 | B31.3 | |
| 210 | 31.7 | 0.0 | 1.000 | 1.000 | 34.7 | 20000.0 | 0.2 | B31.3 | |
| | | | | | | | | | |
| 210 | 31.7 | -0.0 | 1.000 | 1.000 | 34.7 | 20000.0 | 0.2 | B31.3 | |
| 215 | 0.5 | 0.0 | 1.000 | 1.000 | 3.5 | 20000.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 215 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 220 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 220 | 0.8 | -0.0 | 1.000 | 1.000 | 3.8 | 20000.0 | 0.0 | B31.3 | |
| 225 | 75.3 | 0.0 | 1.000 | 1.000 | 78.3 | 20000.0 | 0.4 | B31.3 | |
| | | | | | | | | | |
| 225 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 230 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 230 | 472.0 | -0.0 | 1.000 | 1.000 | 475.0 | 20000.0 | 2.4 | B31.3 | |
| 235 | 907.9 | 0.0 | 1.000 | 1.000 | 910.9 | 20000.0 | 4.6 | B31.3 | |
| | | | | | | | | | |
| 235 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 240 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 240 | 1257.2 | -0.0 | 1.000 | 1.000 | 1260.2 | 20000.0 | 6.3 | B31.3 | |
| 245 | 2082.6 | 0.0 | 1.000 | 1.000 | 2085.6 | 20000.0 | 10.4 | B31.3 | |
| | | | | | | | | | |
| 245 | 2082.6 | -0.0 | 1.000 | 1.000 | 2085.6 | 20000.0 | 10.4 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 250 | 6083.6 | 0.0 | 1.000 | 1.000 | 6086.6 | 20000.0 | 30.4 | B31.3 | |
| | | | | | | | | | |
| 250 | 3041.8 | -0.0 | 1.000 | 1.000 | 4631.7 | 20000.0 | 23.2 | B31.3 | |
| 255 | 14792.3 | 0.0 | 1.000 | 1.000 | 16382.2 | 20000.0 | 81.9 | B31.3 | |
| | | | | | | | | | |
| 250 | 3041.8 | -0.0 | 1.000 | 1.000 | 4631.7 | 20000.0 | 23.2 | B31.3 | |
| 255 | 14792.3 | 0.0 | 1.000 | 1.000 | 16382.2 | 20000.0 | 81.9 | B31.3 | |
| | | | | | | | | | |
| 305 | 67.5 | -0.1 | 1.000 | 1.000 | 72.4 | 20000.0 | 0.4 | B31.3 | |
| 310 | 35.3 | 0.1 | 1.000 | 1.000 | 40.2 | 20000.0 | 0.2 | B31.3 | |
| | | | | | | | | | |
| 310 | 35.3 | -0.1 | 1.000 | 1.000 | 40.2 | 20000.0 | 0.2 | B31.3 | |
| 315 | 0.8 | 0.1 | 1.000 | 1.000 | 5.7 | 20000.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 315 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 320 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 320 | 1.1 | -0.1 | 1.000 | 1.000 | 6.0 | 20000.0 | 0.0 | B31.3 | |
| 325 | 77.5 | 0.1 | 1.000 | 1.000 | 82.4 | 20000.0 | 0.4 | B31.3 | |
| | | | | | | | | | |
| 325 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 330 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 330 | 471.8 | -0.1 | 1.000 | 1.000 | 476.7 | 20000.0 | 2.4 | B31.3 | |
| 335 | 906.8 | 0.1 | 1.000 | 1.000 | 911.7 | 20000.0 | 4.6 | B31.3 | |
| | | | | | | | | | |
| 335 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 340 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 340 | 1255.6 | -0.1 | 1.000 | 1.000 | 1260.4 | 20000.0 | 6.3 | B31.3 | |
| 345 | 2080.2 | 0.1 | 1.000 | 1.000 | 2085.0 | 20000.0 | 10.4 | B31.3 | |
| | | | | | | | | | |
| 345 | 2080.2 | -0.1 | 1.000 | 1.000 | 2085.0 | 20000.0 | 10.4 | B31.3 | |
| 350 | 6319.1 | 0.1 | 1.000 | 1.000 | 6324.0 | 20000.0 | 31.6 | B31.3 | |
| | | | | | | | | | |
| 350 | 3159.6 | -0.1 | 1.000 | 1.000 | 4750.4 | 20000.0 | 23.8 | B31.3 | |
| 355 | 15275.5 | 0.1 | 1.000 | 1.000 | 16866.3 | 20000.0 | 84.3 | B31.3 | |
| | | | | | | | | | |
| 350 | 3159.6 | -0.1 | 1.000 | 1.000 | 4750.4 | 20000.0 | 23.8 | B31.3 | |
| 355 | 15275.5 | 0.1 | 1.000 | 1.000 | 16866.3 | 20000.0 | 84.3 | B31.3 | |
| | | | | | | | | | |
| 405 | 96.6 | 0.0 | 1.000 | 1.000 | 104.8 | 20000.0 | 0.5 | B31.3 | |
| 410 | 41.8 | -0.0 | 1.000 | 1.000 | 50.0 | 20000.0 | 0.3 | B31.3 | |
| | | | | | | | | | |
| 410 | 41.8 | 0.0 | 1.000 | 1.000 | 50.0 | 20000.0 | 0.3 | B31.3 | |
| 415 | 1.1 | -0.0 | 1.000 | 1.000 | 9.4 | 20000.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 415 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 420 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 420 | 1.7 | 0.0 | 1.000 | 1.000 | 9.9 | 20000.0 | 0.0 | B31.3 | |
| 425 | 83.7 | -0.0 | 1.000 | 1.000 | 91.9 | 20000.0 | 0.5 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 425 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 430 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 430 | 474.3 | 0.0 | 1.000 | 1.000 | 482.5 | 20000.0 | 2.4 | B31.3 | |
| 435 | 908.2 | -0.0 | 1.000 | 1.000 | 916.4 | 20000.0 | 4.6 | B31.3 | |
| | | | | | | | | | |
| 435 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 440 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 440 | 1256.4 | 0.0 | 1.000 | 1.000 | 1264.7 | 20000.0 | 6.3 | B31.3 | |
| 445 | 2080.2 | -0.0 | 1.000 | 1.000 | 2088.4 | 20000.0 | 10.4 | B31.3 | |
| | | | | | | | | | |
| 445 | 2080.2 | 0.0 | 1.000 | 1.000 | 2088.4 | 20000.0 | 10.4 | B31.3 | |
| 450 | 2185.2 | -0.0 | 1.000 | 1.000 | 2193.4 | 20000.0 | 11.0 | B31.3 | |
| | | | | | | | | | |
| 450 | 2185.2 | 0.0 | 1.000 | 1.000 | 2193.4 | 20000.0 | 11.0 | B31.3 | |
| 455 | 294350.8 | -0.0 | 15.887 | 20.849 | 220771.3 | 20000.0 | 1103.9 | B31.3 | * |
| | | | | | | | | | |
| 505 | 116.5 | 0.1 | 1.000 | 1.000 | 129.5 | 20000.0 | 0.6 | B31.3 | |
| 510 | 46.0 | -0.1 | 1.000 | 1.000 | 59.0 | 20000.0 | 0.3 | B31.3 | |
| | | | | | | | | | |
| 510 | 46.0 | 0.1 | 1.000 | 1.000 | 59.0 | 20000.0 | 0.3 | B31.3 | |
| 515 | 1.4 | -0.1 | 1.000 | 1.000 | 14.4 | 20000.0 | 0.1 | B31.3 | |
| | | | | | | | | | |
| 515 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 520 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 520 | 2.0 | 0.1 | 1.000 | 1.000 | 15.0 | 20000.0 | 0.1 | B31.3 | |
| 525 | 90.5 | -0.1 | 1.000 | 1.000 | 103.5 | 20000.0 | 0.5 | B31.3 | |
| | | | | | | | | | |
| 525 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 530 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 530 | 480.2 | 0.1 | 1.000 | 1.000 | 493.2 | 20000.0 | 2.5 | B31.3 | |
| 535 | 914.3 | -0.1 | 1.000 | 1.000 | 927.3 | 20000.0 | 4.6 | B31.3 | |
| | | | | | | | | | |
| 535 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 540 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 540 | 1262.8 | 0.1 | 1.000 | 1.000 | 1275.9 | 20000.0 | 6.4 | B31.3 | |
| 545 | 2087.3 | -0.1 | 1.000 | 1.000 | 2100.3 | 20000.0 | 10.5 | B31.3 | |
| | | | | | | | | | |
| 545 | 2087.3 | 0.1 | 1.000 | 1.000 | 2100.3 | 20000.0 | 10.5 | B31.3 | |
| 550 | 2280.6 | -0.1 | 1.000 | 1.000 | 2293.6 | 20000.0 | 11.5 | B31.3 | |
| | | | | | | | | | |
| 550 | 2280.6 | 0.1 | 1.000 | 1.000 | 2293.6 | 20000.0 | 11.5 | B31.3 | |
| 555 | 302444.4 | -0.1 | 15.887 | 20.849 | 226846.3 | 20000.0 | 1134.2 | B31.3 | * |
| | | | | | | | | | |
| 605 | 125.9 | 0.0 | 1.000 | 1.000 | 144.4 | 20000.0 | 0.7 | B31.3 | |
| 610 | 48.1 | -0.0 | 1.000 | 1.000 | 66.5 | 20000.0 | 0.3 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 610 | 48.1 | 0.0 | 1.000 | 1.000 | 66.5 | 20000.0 | 0.3 | B31.3 | |
| 615 | 1.5 | -0.0 | 1.000 | 1.000 | 19.9 | 20000.0 | 0.1 | B31.3 | |
| | | | | | | | | | |
| 615 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 620 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 620 | 2.2 | 0.0 | 1.000 | 1.000 | 20.6 | 20000.0 | 0.1 | B31.3 | |
| 625 | 94.1 | -0.0 | 1.000 | 1.000 | 112.5 | 20000.0 | 0.6 | B31.3 | |
| | | | | | | | | | |
| 625 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 630 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 630 | 483.6 | 0.0 | 1.000 | 1.000 | 502.1 | 20000.0 | 2.5 | B31.3 | |
| 635 | 917.9 | -0.0 | 1.000 | 1.000 | 936.4 | 20000.0 | 4.7 | B31.3 | |
| | | | | | | | | | |
| 635 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 640 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 640 | 1266.6 | 0.0 | 1.000 | 1.000 | 1285.1 | 20000.0 | 6.4 | B31.3 | |
| 645 | 2091.6 | -0.0 | 1.000 | 1.000 | 2110.1 | 20000.0 | 10.6 | B31.3 | |
| | | | | | | | | | |
| 645 | 2091.6 | 0.0 | 1.000 | 1.000 | 2110.1 | 20000.0 | 10.6 | B31.3 | |
| 650 | 2319.5 | -0.0 | 1.000 | 1.000 | 2338.0 | 20000.0 | 11.7 | B31.3 | |
| | | | | | | | | | |
| 650 | 2319.5 | 0.0 | 1.000 | 1.000 | 2338.0 | 20000.0 | 11.7 | B31.3 | |
| 655 | 305767.7 | -0.0 | 15.887 | 20.849 | 229344.2 | 20000.0 | 1146.7 | B31.3 | * |
| | | | | | | | | | |
| 705 | 128.8 | -0.0 | 1.000 | 1.000 | 156.3 | 20000.0 | 0.8 | B31.3 | |
| 710 | 49.0 | 0.0 | 1.000 | 1.000 | 76.4 | 20000.0 | 0.4 | B31.3 | |
| | | | | | | | | | |
| 710 | 49.0 | -0.0 | 1.000 | 1.000 | 76.4 | 20000.0 | 0.4 | B31.3 | |
| 715 | 1.5 | 0.0 | 1.000 | 1.000 | 29.0 | 20000.0 | 0.1 | B31.3 | |
| | | | | | | | | | |
| 715 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 720 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 720 | 2.3 | -0.0 | 1.000 | 1.000 | 29.7 | 20000.0 | 0.1 | B31.3 | |
| 725 | 94.7 | 0.0 | 1.000 | 1.000 | 122.1 | 20000.0 | 0.6 | B31.3 | |
| | | | | | | | | | |
| 725 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 730 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 730 | 483.5 | -0.0 | 1.000 | 1.000 | 510.9 | 20000.0 | 2.6 | B31.3 | |
| 735 | 917.5 | 0.0 | 1.000 | 1.000 | 944.9 | 20000.0 | 4.7 | B31.3 | |
| | | | | | | | | | |
| 735 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 740 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 740 | 1266.0 | -0.0 | 1.000 | 1.000 | 1293.4 | 20000.0 | 6.5 | B31.3 | |
| 745 | 2090.6 | 0.0 | 1.000 | 1.000 | 2118.1 | 20000.0 | 10.6 | B31.3 | |
| | | | | | | | | | |
| 745 | 2090.6 | -0.0 | 1.000 | 1.000 | 2118.1 | 20000.0 | 10.6 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 750 | 1429.5 | 0.0 | 1.000 | 1.000 | 1457.0 | 20000.0 | 7.3 | B31.3 | |
| | | | | | | | | | |
| 750 | 1429.5 | -0.0 | 1.000 | 1.000 | 1457.0 | 20000.0 | 7.3 | B31.3 | |
| 755 | 230048.3 | 0.0 | 16.011 | 21.015 | 172563.6 | 20000.0 | 862.8 | B31.3 | * |
| | | | | | | | | | |
| 755 | 36357.2 | -987.4 | 16.011 | 21.015 | 36433.0 | 20000.0 | 182.2 | B31.3 | * |
| 655 | 157642.1 | 987.4 | 15.887 | 20.849 | 127358.4 | 20000.0 | 636.8 | B31.3 | * |
| | | | | | | | | | |
| 655 | 156872.7 | -1911.5 | 15.887 | 20.849 | 126818.9 | 20000.0 | 634.1 | B31.3 | * |
| 760 | 16195.3 | 1911.5 | 1.000 | 1.000 | 25589.2 | 20000.0 | 127.9 | B31.3 | * |
| | | | | | | | | | |
| 760 | 16195.3 | -1911.5 | 1.000 | 1.000 | 25589.2 | 20000.0 | 127.9 | B31.3 | * |
| 555 | 320784.3 | 1911.5 | 15.887 | 20.849 | 249724.2 | 20000.0 | 1248.6 | B31.3 | * |
| | | | | | | | | | |
| 555 | 319856.4 | -2825.6 | 15.887 | 20.849 | 249058.7 | 20000.0 | 1245.3 | B31.3 | * |
| 455 | 666809.7 | 2825.6 | 15.887 | 20.849 | 509241.0 | 20000.0 | 2546.2 | B31.3 | * |
| | | | | | | | | | |
| 455 | 666098.6 | -3715.2 | 15.887 | 20.849 | 508727.0 | 20000.0 | 2543.6 | B31.3 | * |
| 765 | 903721.3 | 3715.2 | 15.887 | 20.849 | 686929.9 | 20000.0 | 3434.6 | B31.3 | * |
| | | | | | | | | | |
| 765 | 848219.3 | 5295.6 | 15.887 | 20.849 | 645798.9 | 20000.0 | 3229.0 | B31.3 | * |
| 355 | 37058.0 | -5295.6 | 1.000 | 1.000 | 47793.9 | 20000.0 | 239.0 | B31.3 | * |
| | | | | | | | | | |
| 355 | 37025.9 | 3393.8 | 1.000 | 1.000 | 47063.2 | 20000.0 | 235.3 | B31.3 | * |
| 770 | 29351.1 | -3393.8 | 1.000 | 1.000 | 39484.1 | 20000.0 | 197.4 | B31.3 | * |
| | | | | | | | | | |
| 770 | 29351.1 | 3393.8 | 1.000 | 1.000 | 39484.1 | 20000.0 | 197.4 | B31.3 | * |
| 775 | 23789.8 | -3393.8 | 1.000 | 1.000 | 34019.0 | 20000.0 | 170.1 | B31.3 | * |
| | | | | | | | | | |
| 775 | 23789.8 | 3393.8 | 1.000 | 1.000 | 34019.0 | 20000.0 | 170.1 | B31.3 | * |
| 255 | 20426.6 | -3393.8 | 1.000 | 1.000 | 30730.8 | 20000.0 | 153.7 | B31.3 | * |
| | | | | | | | | | |
| 255 | 20405.7 | 1552.2 | 1.000 | 1.000 | 30109.7 | 20000.0 | 150.5 | B31.3 | * |
| 155 | 8109.7 | -1552.2 | 1.000 | 1.000 | 17924.2 | 20000.0 | 89.6 | B31.3 | |
| | | | | | | | | | |
| 155 | 8092.6 | 132.7 | 1.000 | 1.000 | 17636.8 | 20000.0 | 88.2 | B31.3 | |
| 780 | 6702.2 | -132.7 | 1.000 | 1.000 | 16246.7 | 20000.0 | 81.2 | B31.3 | |
| | | | | | | | | | |
| 780 | 6702.2 | 132.7 | 1.000 | 1.000 | 16246.7 | 20000.0 | 81.2 | B31.3 | |
| 55 | 54894.3 | -132.7 | 15.887 | 20.849 | 50713.6 | 20000.0 | 253.6 | B31.3 | * |
| | | | | | | | | | |
| 55 | 54656.9 | -580.8 | 15.887 | 20.849 | 50547.1 | 20000.0 | 252.7 | B31.3 | * |
| 785 | 3123.4 | 580.8 | 1.000 | 1.000 | 12717.7 | 20000.0 | 63.6 | B31.3 | |
| | | | | | | | | | |
| 785 | 3123.4 | -580.8 | 1.000 | 1.000 | 12717.7 | 20000.0 | 63.6 | B31.3 | |
| 790 | 32838.5 | 580.8 | 15.887 | 20.849 | 34189.7 | 20000.0 | 170.9 | B31.3 | * |
| | | | | | | | | | |
| 790 | 12765.2 | 0.0 | 15.887 | 20.849 | 12750.7 | 20000.0 | 63.8 | B31.3 | |
| 795 | 0.0 | 0.0 | 1.000 | 1.000 | 3176.8 | 20000.0 | 15.9 | B31.3 | |
| | | | | | | | | | |
| 790 | 32838.5 | -542.2 | 15.887 | 20.849 | 34187.2 | 20000.0 | 170.9 | B31.3 | * |
| 800 | 1713.6 | 542.2 | 1.000 | 1.000 | 11306.8 | 20000.0 | 56.5 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 800 | 5301.0 | -1677.4 | 1.000 | 1.000 | 11694.7 | 20000.0 | 58.5 | B31.3 | |
| 805 | 5301.4 | 1677.4 | 1.000 | 1.000 | 11695.1 | 20000.0 | 58.5 | B31.3 | |
| | | | | | | | | | |
| 805 | 5301.4 | -1677.4 | 1.000 | 1.000 | 11695.1 | 20000.0 | 58.5 | B31.3 | |
| 810 | 4006.2 | 1677.4 | 1.000 | 1.000 | 10461.0 | 20000.0 | 52.3 | B31.3 | |
| | | | | | | | | | |
| 810 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 815 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 815 | 2991.8 | -1677.4 | 1.000 | 1.000 | 9505.7 | 20000.0 | 47.5 | B31.3 | |
| 820 | 1699.2 | 2198.2 | 1.000 | 1.000 | 8307.6 | 20000.0 | 41.5 | B31.3 | |
| | | | | | | | | | |
| 820 | 1699.2 | -2198.2 | 1.000 | 1.000 | 8307.6 | 20000.0 | 41.5 | B31.3 | |
| 824 | 9041.8 | 1404.6 | 3.356 | 3.356 | 12688.0 | 20000.0 | 63.4 | B31.3 | |
| | | | | | | | | | |
| 824 | 9041.8 | -1404.6 | 3.356 | 3.356 | 12688.0 | 20000.0 | 63.4 | B31.3 | |
| 825 | 5704.1 | 653.8 | 3.356 | 3.356 | 9496.3 | 20000.0 | 47.5 | B31.3 | |
| | | | | | | | | | |
| 825 | 1699.8 | -653.8 | 1.000 | 1.000 | 6951.6 | 20000.0 | 34.8 | B31.3 | |
| 830 | 1864.5 | 653.8 | 1.000 | 1.000 | 7104.1 | 20000.0 | 35.5 | B31.3 | |
| | | | | | | | | | |
| 830 | 1864.5 | -653.8 | 1.000 | 1.000 | 7104.1 | 20000.0 | 35.5 | B31.3 | |
| 833 | 1707.5 | 653.8 | 1.000 | 1.000 | 6938.3 | 20000.0 | 34.7 | B31.3 | |
| | | | | | | | | | |
| 833 | 5729.9 | -653.8 | 3.356 | 3.356 | 9494.4 | 20000.0 | 47.5 | B31.3 | |
| 834 | 6323.3 | 443.3 | 3.356 | 3.356 | 9665.4 | 20000.0 | 48.3 | B31.3 | |
| | | | | | | | | | |
| 834 | 6323.3 | -443.3 | 3.356 | 3.356 | 9376.5 | 20000.0 | 46.9 | B31.3 | |
| 835 | 1095.4 | 0.0 | 3.356 | 3.356 | 5318.2 | 20000.0 | 26.6 | B31.3 | |
| | | | | | | | | | |
| 835 | 326.4 | 0.0 | 1.000 | 1.000 | 4823.0 | 20000.0 | 24.1 | B31.3 | |
| 840 | 0.0 | 0.0 | 1.000 | 1.000 | 4496.6 | 20000.0 | 22.5 | B31.3 | |
| | | | | | | | | | |
| 765 | 1521795.4 | -2878.6 | 15.887 | 20.849 | 1154161.0 | 20000.0 | 5770.8 | B31.3 | * |
| 843 | 10824.8 | 2904.3 | 1.000 | 1.000 | 24328.3 | 20000.0 | 121.6 | B31.3 | * |
| | | | | | | | | | |
| 843 | 36325.8 | -2904.3 | 3.356 | 3.356 | 40463.3 | 20000.0 | 202.3 | B31.3 | * |
| 844 | 120817.8 | 525.9 | 3.356 | 3.356 | 107877.9 | 20000.0 | 539.4 | B31.3 | * |
| | | | | | | | | | |
| 844 | 120817.8 | -525.9 | 3.356 | 3.356 | 107877.9 | 20000.0 | 539.4 | B31.3 | * |
| 845 | 49993.2 | -547.0 | 3.356 | 3.356 | 46546.9 | 20000.0 | 232.7 | B31.3 | * |
| | | | | | | | | | |
| 845 | 14897.6 | 547.0 | 1.000 | 1.000 | 23961.8 | 20000.0 | 119.8 | B31.3 | * |
| 850 | 27172.2 | -547.0 | 1.000 | 1.000 | 36237.4 | 20000.0 | 181.2 | B31.3 | * |
| | | | | | | | | | |
| 850 | 27172.2 | 547.0 | 1.000 | 1.000 | 36237.4 | 20000.0 | 181.2 | B31.3 | * |
| 853 | 27171.1 | -547.0 | 1.000 | 1.000 | 36248.1 | 20000.0 | 181.2 | B31.3 | * |
| | | | | | | | | | |
| 853 | 90786.0 | 547.0 | 3.341 | 2.784 | 77157.7 | 20000.0 | 385.8 | B31.3 | * |
| 854 | 9954.3 | -373.8 | 3.341 | 2.784 | 12623.2 | 20000.0 | 63.1 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 854 | 9954.3 | 373.8 | 3.341 | 2.784 | 11832.9 | 20000.0 | 59.2 | B31.3 | |
| 855 | 6212.0 | -0.0 | 3.341 | 2.784 | 9155.6 | 20000.0 | 45.8 | B31.3 | |
| | | | | | | | | | |
| 855 | 1901.9 | 0.0 | 1.000 | 1.000 | 6398.5 | 20000.0 | 32.0 | B31.3 | |
| 860 | 0.0 | -0.0 | 1.000 | 1.000 | 4496.6 | 20000.0 | 22.5 | B31.3 | |
| | | | | | | | | | |
| 755 | 34523.2 | -290.9 | 16.011 | 21.015 | 35123.7 | 20000.0 | 175.6 | B31.3 | * |
| 865 | 2684.5 | 290.9 | 1.000 | 1.000 | 11925.1 | 20000.0 | 59.6 | B31.3 | |
| | | | | | | | | | |
| 865 | 2684.5 | -290.9 | 1.000 | 1.000 | 11925.1 | 20000.0 | 59.6 | B31.3 | |
| 870 | 1826.9 | 290.9 | 1.000 | 1.000 | 11068.6 | 20000.0 | 55.3 | B31.3 | |
| | | | | | | | | | |
| 870 | 1826.9 | -290.9 | 1.000 | 1.000 | 11068.6 | 20000.0 | 55.3 | B31.3 | |
| 875 | 6764.8 | 1207.8 | 1.000 | 1.000 | 11517.6 | 20000.0 | 57.6 | B31.3 | |
| | | | | | | | | | |
| 875 | 6764.8 | -1207.8 | 1.000 | 1.000 | 11517.6 | 20000.0 | 57.6 | B31.3 | |
| 880 | 82455.4 | 1207.8 | 13.095 | 13.095 | 66382.1 | 20000.0 | 331.9 | B31.3 | * |
| | | | | | | | | | |
| 880 | 82455.4 | -1207.8 | 13.095 | 13.095 | 66382.1 | 20000.0 | 331.9 | B31.3 | * |
| 885 | 5828.0 | 1207.8 | 1.000 | 1.000 | 10603.5 | 20000.0 | 53.0 | B31.3 | |
| | | | | | | | | | |
| 885 | 5828.0 | -1207.8 | 1.000 | 1.000 | 10603.5 | 20000.0 | 53.0 | B31.3 | |
| 890 | 5724.7 | 1207.8 | 1.000 | 1.000 | 10502.9 | 20000.0 | 52.5 | B31.3 | |
| | | | | | | | | | |
| 890 | 5724.7 | -1207.8 | 1.000 | 1.000 | 10502.9 | 20000.0 | 52.5 | B31.3 | |
| 895 | 54993.7 | 1207.8 | 10.071 | 13.095 | 45805.6 | 20000.0 | 229.0 | B31.3 | * |
| | | | | | | | | | |
| 895 | 28790.3 | -0.1 | 10.071 | 13.095 | 26086.1 | 20000.0 | 130.4 | B31.3 | * |
| 900 | 2537.8 | 0.1 | 1.000 | 1.000 | 7031.2 | 20000.0 | 35.2 | B31.3 | |
| | | | | | | | | | |
| 900 | 2537.8 | -0.1 | 1.000 | 1.000 | 7031.2 | 20000.0 | 35.2 | B31.3 | |
| 905 | 2482.4 | 0.1 | 1.000 | 1.000 | 6975.8 | 20000.0 | 34.9 | B31.3 | |
| | | | | | | | | | |
| 905 | 2482.4 | -0.1 | 1.000 | 1.000 | 6975.8 | 20000.0 | 34.9 | B31.3 | |
| 910 | 2536.2 | 0.1 | 1.000 | 1.000 | 7029.6 | 20000.0 | 35.1 | B31.3 | |
| | | | | | | | | | |
| 910 | 2536.2 | -0.1 | 1.000 | 1.000 | 7029.6 | 20000.0 | 35.1 | B31.3 | |
| 915 | 1694.7 | 0.1 | 1.000 | 1.000 | 6188.1 | 20000.0 | 30.9 | B31.3 | |
| | | | | | | | | | |
| 915 | 1694.7 | -0.1 | 1.000 | 1.000 | 6188.1 | 20000.0 | 30.9 | B31.3 | |
| 920 | 1082.4 | 0.1 | 1.000 | 1.000 | 5575.8 | 20000.0 | 27.9 | B31.3 | |
| | | | | | | | | | |
| 920 | 1082.4 | -0.1 | 1.000 | 1.000 | 5575.8 | 20000.0 | 27.9 | B31.3 | |
| 925 | 993.7 | 0.1 | 1.000 | 1.000 | 5487.1 | 20000.0 | 27.4 | B31.3 | |
| | | | | | | | | | |
| 925 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 930 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 930 | 1041.6 | -0.1 | 1.000 | 1.000 | 5535.0 | 20000.0 | 27.7 | B31.3 | |
| 935 | 1265.7 | 0.1 | 1.000 | 1.000 | 5759.1 | 20000.0 | 28.8 | B31.3 | |
| | | | | | | | | | |
| 935 | 1265.7 | -0.1 | 1.000 | 1.000 | 5759.1 | 20000.0 | 28.8 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 940 | 4.7 | 0.1 | 1.000 | 1.000 | 4498.1 | 20000.0 | 22.5 | B31.3 | |
| | | | | | | | | | |
| 940 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 945 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 945 | 4.4 | -0.1 | 1.000 | 1.000 | 4497.8 | 20000.0 | 22.5 | B31.3 | |
| 950 | 50.1 | 0.1 | 1.000 | 1.000 | 4543.5 | 20000.0 | 22.7 | B31.3 | |
| | | | | | | | | | |
| 950 | 50.1 | -0.1 | 1.000 | 1.000 | 4543.5 | 20000.0 | 22.7 | B31.3 | |
| 955 | 330.0 | 0.1 | 1.000 | 1.000 | 4823.4 | 20000.0 | 24.1 | B31.3 | |
| | | | | | | | | | |
| 955 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 960 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 960 | 499.8 | -0.1 | 1.000 | 1.000 | 4993.2 | 20000.0 | 25.0 | B31.3 | |
| 964 | 3063.1 | 66.6 | 3.341 | 3.341 | 6810.8 | 20000.0 | 34.1 | B31.3 | |
| | | | | | | | | | |
| 964 | 3063.1 | -66.6 | 3.341 | 3.341 | 6810.8 | 20000.0 | 34.1 | B31.3 | |
| 965 | 3316.0 | 144.7 | 3.341 | 3.341 | 6998.8 | 20000.0 | 35.0 | B31.3 | |
| | | | | | | | | | |
| 965 | 992.4 | -144.7 | 1.000 | 1.000 | 5505.9 | 20000.0 | 27.5 | B31.3 | |
| 970 | 1068.4 | 144.7 | 1.000 | 1.000 | 5531.6 | 20000.0 | 27.7 | B31.3 | |
| | | | | | | | | | |
| 970 | 1068.4 | -144.7 | 1.000 | 1.000 | 5531.6 | 20000.0 | 27.7 | B31.3 | |
| 973 | 1177.5 | 144.7 | 1.000 | 1.000 | 5535.6 | 20000.0 | 27.7 | B31.3 | |
| | | | | | | | | | |
| 973 | 3934.4 | -144.7 | 3.341 | 3.341 | 7307.1 | 20000.0 | 36.5 | B31.3 | |
| 974 | 4744.0 | -100.9 | 3.341 | 3.341 | 7964.0 | 20000.0 | 39.8 | B31.3 | |
| | | | | | | | | | |
| 974 | 4744.0 | 100.9 | 3.341 | 3.341 | 8098.1 | 20000.0 | 40.5 | B31.3 | |
| 975 | 2355.6 | -291.7 | 3.341 | 3.341 | 6287.2 | 20000.0 | 31.4 | B31.3 | |
| | | | | | | | | | |
| 975 | 705.0 | 291.7 | 1.000 | 1.000 | 5231.0 | 20000.0 | 26.2 | B31.3 | |
| 980 | 601.7 | -291.7 | 1.000 | 1.000 | 5128.4 | 20000.0 | 25.6 | B31.3 | |
| | | | | | | | | | |
| 980 | 601.7 | 291.7 | 1.000 | 1.000 | 5128.4 | 20000.0 | 25.6 | B31.3 | |
| 985 | 262.6 | -72.0 | 1.000 | 1.000 | 9378.5 | 20000.0 | 46.9 | B31.3 | |
| | | | | | | | | | |
| 985 | 262.6 | 72.0 | 1.000 | 1.000 | 9378.5 | 20000.0 | 46.9 | B31.3 | |
| 990 | 13371.9 | -72.0 | 15.887 | 20.849 | 19144.3 | 20000.0 | 95.7 | B31.3 | |
| | | | | | | | | | |
| 990 | 7283.3 | 0.0 | 15.887 | 20.849 | 14578.9 | 20000.0 | 72.9 | B31.3 | |
| 995 | 611.1 | 0.0 | 1.000 | 1.000 | 9727.5 | 20000.0 | 48.6 | B31.3 | |
| | | | | | | | | | |
| 995 | 611.1 | 0.0 | 1.000 | 1.000 | 9727.5 | 20000.0 | 48.6 | B31.3 | |
| 998 | 0.0 | 0.0 | 1.000 | 1.000 | 9116.4 | 20000.0 | 45.6 | B31.3 | |
| | | | | | | | | | |
| 895 | 41638.6 | 2.8 | 10.071 | 13.095 | 35680.1 | 20000.0 | 178.4 | B31.3 | * |
| 1000 | 3310.7 | -2.8 | 1.000 | 1.000 | 7761.8 | 20000.0 | 38.8 | B31.3 | |
| | | | | | | | | | |
| 1000 | 3310.7 | 2.8 | 1.000 | 1.000 | 7761.8 | 20000.0 | 38.8 | B31.3 | |
| 1005 | 2694.1 | -2.8 | 1.000 | 1.000 | 7145.2 | 20000.0 | 35.7 | B31.3 | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| 1005 | 2694.1 | 2.8 | 1.000 | 1.000 | 7145.2 | 20000.0 | 35.7 | B31.3 | |
| 1010 | 26361.7 | -2.8 | 10.071 | 13.095 | 24222.4 | 20000.0 | 121.1 | B31.3 | * |
| | | | | | | | | | |
| 1010 | 2476.6 | -0.0 | 10.071 | 13.095 | 6354.1 | 20000.0 | 31.8 | B31.3 | |
| 1015 | 19.7 | 0.0 | 1.000 | 1.000 | 4516.3 | 20000.0 | 22.6 | B31.3 | |
| | | | | | | | | | |
| 1015 | 19.7 | 0.0 | 1.000 | 1.000 | 4516.3 | 20000.0 | 22.6 | B31.3 | |
| 1020 | 0.0 | 0.0 | 1.000 | 1.000 | 4496.6 | 20000.0 | 22.5 | B31.3 | |
| | | | | | | | | | |
| 1010 | 26484.6 | -0.0 | 10.071 | 13.095 | 24363.3 | 20000.0 | 121.8 | B31.3 | * |
| 1025 | 2483.3 | 0.0 | 1.000 | 1.000 | 6983.2 | 20000.0 | 34.9 | B31.3 | |
| | | | | | | | | | |
| 1025 | 2483.3 | -0.0 | 1.000 | 1.000 | 6983.2 | 20000.0 | 34.9 | B31.3 | |
| 1030 | 2436.9 | 0.0 | 1.000 | 1.000 | 6936.8 | 20000.0 | 34.7 | B31.3 | |
| | | | | | | | | | |
| 1030 | 2436.9 | -0.0 | 1.000 | 1.000 | 6936.8 | 20000.0 | 34.7 | B31.3 | |
| 1035 | 2340.3 | 0.0 | 1.000 | 1.000 | 6840.1 | 20000.0 | 34.2 | B31.3 | |
| | | | | | | | | | |
| 1035 | 2340.3 | -0.0 | 1.000 | 1.000 | 6840.1 | 20000.0 | 34.2 | B31.3 | |
| 1040 | 1658.0 | 0.0 | 1.000 | 1.000 | 6157.8 | 20000.0 | 30.8 | B31.3 | |
| | | | | | | | | | |
| 1040 | 1658.0 | -0.0 | 1.000 | 1.000 | 6157.8 | 20000.0 | 30.8 | B31.3 | |
| 1045 | 1054.9 | 0.0 | 1.000 | 1.000 | 5554.7 | 20000.0 | 27.8 | B31.3 | |
| | | | | | | | | | |
| 1045 | 1054.9 | -0.0 | 1.000 | 1.000 | 5554.7 | 20000.0 | 27.8 | B31.3 | |
| 1050 | 969.0 | 0.0 | 1.000 | 1.000 | 5468.8 | 20000.0 | 27.3 | B31.3 | |
| | | | | | | | | | |
| 1050 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 1055 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 1055 | 1027.7 | -0.0 | 1.000 | 1.000 | 5527.5 | 20000.0 | 27.6 | B31.3 | |
| 1060 | 1258.8 | 0.0 | 1.000 | 1.000 | 5758.6 | 20000.0 | 28.8 | B31.3 | |
| | | | | | | | | | |
| 1060 | 1258.8 | -0.0 | 1.000 | 1.000 | 5758.6 | 20000.0 | 28.8 | B31.3 | |
| 1065 | 4.6 | 0.0 | 1.000 | 1.000 | 4504.4 | 20000.0 | 22.5 | B31.3 | |
| | | | | | | | | | |
| 1065 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 1070 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 1070 | 4.3 | -0.0 | 1.000 | 1.000 | 4504.1 | 20000.0 | 22.5 | B31.3 | |
| 1075 | 49.0 | 0.0 | 1.000 | 1.000 | 4548.8 | 20000.0 | 22.7 | B31.3 | |
| | | | | | | | | | |
| 1075 | 49.0 | -0.0 | 1.000 | 1.000 | 4548.8 | 20000.0 | 22.7 | B31.3 | |
| 1080 | 332.7 | 0.0 | 1.000 | 1.000 | 4832.6 | 20000.0 | 24.2 | B31.3 | |
| | | | | | | | | | |
| 1080 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| 1085 | 0.0 | 0.0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | B31.3 | |
| | | | | | | | | | |
| 1085 | 504.9 | -0.0 | 1.000 | 1.000 | 5004.7 | 20000.0 | 25.0 | B31.3 | |
| 1089 | 3098.1 | 65.0 | 3.341 | 3.341 | 6843.9 | 20000.0 | 34.2 | B31.3 | |
| | | | | | | | | | |

| Node | Bending Stress lb./sq.in. | Torsion Stress lb./sq.in. | SIF In Plane | SIF Out Plane | Code Stress lb./sq.in. | Allowable Stress lb./sq.in. | Ratio % | Piping Code | |
|---|---|---|---|---|---|---|---|---|---|
| 1089 | 3098.1 | -65.0 | 3.341 | 3.341 | 6843.9 | 20000.0 | 34.2 | B31.3 | |
| 1090 | 3338.9 | 141.2 | 3.341 | 3.341 | 7022.0 | 20000.0 | 35.1 | B31.3 | |
| | | | | | | | | | |
| 1090 | 999.3 | -141.2 | 1.000 | 1.000 | 5518.6 | 20000.0 | 27.6 | B31.3 | |
| 1095 | 1056.3 | 141.2 | 1.000 | 1.000 | 5525.4 | 20000.0 | 27.6 | B31.3 | |
| | | | | | | | | | |
| 1095 | 1056.3 | -141.2 | 1.000 | 1.000 | 5525.4 | 20000.0 | 27.6 | B31.3 | |
| 1098 | 1153.8 | 141.2 | 1.000 | 1.000 | 5517.9 | 20000.0 | 27.6 | B31.3 | |
| | | | | | | | | | |
| 1098 | 3855.3 | -141.2 | 3.341 | 3.341 | 7253.8 | 20000.0 | 36.3 | B31.3 | |
| 1099 | 4700.5 | -98.4 | 3.341 | 3.341 | 7938.2 | 20000.0 | 39.7 | B31.3 | |
| | | | | | | | | | |
| 1099 | 4700.5 | 98.4 | 3.341 | 3.341 | 8088.3 | 20000.0 | 40.4 | B31.3 | |
| 1100 | 2046.7 | -279.0 | 3.341 | 3.341 | 6060.6 | 20000.0 | 30.3 | B31.3 | |
| | | | | | | | | | |
| 1100 | 612.5 | 279.0 | 1.000 | 1.000 | 5142.8 | 20000.0 | 25.7 | B31.3 | |
| 1104 | 785.9 | -247.2 | 3.341 | 3.341 | 5023.4 | 20000.0 | 25.1 | B31.3 | |
| | | | | | | | | | |
| 1104 | 785.9 | 247.2 | 3.341 | 3.341 | 5120.2 | 20000.0 | 25.6 | B31.3 | |
| 1105 | 838.3 | -213.7 | 3.341 | 3.341 | 5158.8 | 20000.0 | 25.8 | B31.3 | |
| | | | | | | | | | |
| 1105 | 250.9 | 213.7 | 1.000 | 1.000 | 4782.4 | 20000.0 | 23.9 | B31.3 | |
| 1110 | 421.5 | -213.7 | 1.000 | 1.000 | 4952.3 | 20000.0 | 24.8 | B31.3 | |
| | | | | | | | | | |
| 1110 | 421.5 | 213.7 | 1.000 | 1.000 | 4952.3 | 20000.0 | 24.8 | B31.3 | |
| 1115 | 457.6 | -52.7 | 1.000 | 1.000 | 9582.4 | 20000.0 | 47.9 | B31.3 | |
| | | | | | | | | | |
| 1115 | 457.6 | 52.7 | 1.000 | 1.000 | 9582.4 | 20000.0 | 47.9 | B31.3 | |
| 990 | 6475.7 | -52.7 | 15.887 | 20.849 | 13981.4 | 20000.0 | 69.9 | B31.3 | |

**Tabular Results**

Results were generated with the finite element program FE/Pipe®. Stress results are post-processed in accordance with the rules specified in ASME Section III and ASME Section VIII, Division 2.

Analysis Time Stamp: Tue Nov 12 08:43:05 2013.


- Model Notes
- Load Case Report
- Solution Data
- ASME Code Stress Output Plots
- Region Data
- Stress Results - Notes
- ASME Overstressed Areas
- Highest Primary Stress Ratios
- Highest Secondary Stress Ratios
- Highest Fatigue Stress Ratios
- Stress Intensification Factors
- Allowable Loads
- Flexibilities
- Graphical Results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```
Model Notes

  Input Echo:

  Description:

         CDM Smith Project
          City of Houston - NEWWTP
          84" x 30" Branch Check

  Model Type                    : Cylindrical Shell

  Parent Outside Diameter       :      84.000 in.
         Thickness              :       0.375 in.

         Parent Properties:
         Cold Allowable         :     20000.0 psi
         Hot  Allowable         :     20000.0 psi
         Material ID #1         :  Low Carbon Steel
         Ultimate Tensile (Amb) :     65000.0 psi
         Yield Strength (Amb)   :     36000.0 psi
         Yield Strength (Hot)   :     36000.0 psi
         Elastic Modulus (Amb)  :  29000000.0 psi
         Poissons Ratio         :       0.300
         Expansion Coefficient  :  0.6000E-05 in./in./deg.
         Weight Density         :  0.0000E+00 lb./cu.in.(NOT USED)

  Nozzle Outside Diameter       :      30.000 in.
         Thickness              :       0.375 in.
         Length                 :      12.000 in.
         Nozzle Tilt Angle      :       0.000 deg.
         Distance from Top      :       0.000 in.
         Distance from Bottom   :       0.000 in.

         Nozzle Properties
         Cold Allowable         :     20000.0 psi
         Hot  Allowable         :     20000.0 psi
         Material ID #1         :  Low Carbon Steel
         Ultimate Tensile (Amb) :     65000.0 psi
         Yield Strength (Amb)   :     36000.0 psi
         Yield Strength (Hot)   :     36000.0 psi
         Elastic Modulus (Amb)  :  29000000.0 psi
         Poissons Ratio         :       0.300
         Expansion Coefficient  :  0.6000E-05 in./in./deg.
         Weight Density         :  0.0000E+00 lb./cu.in. (NOT USED)
```

```
Design Operating Cycles       :       7000.
Ambient Temperature (Deg.)    :       70.00

The following temperatures have been specified for the analysis:

Nozzle Inside  Temperature    :       70.00 deg.
Nozzle Outside Temperature    :       70.00 deg.
Vessel Inside  Temperature    :       70.00 deg.
Vessel Outside Temperature    :       70.00 deg.
Nozzle Pressure               :       100.0 psi
Vessel Pressure               :       100.0 psi

User Defined Load Input Echo:
Loads are given at the Nozzle/Header Junction
Loads are defined in Global Coordinates

Forces( lb.)  Moments (ft-lb)

Load Case        FX         FY         FZ         MX         MY         MZ
-------------------------------------------------------------------------------
 WEIGHT:   110229.0   -24104.0      472.0        1.4   -10853.6  -315796.1


FEA Model Loads:
These are the actual loads applied to the FEA model.
These are the User Defined Loads translated to the
end of the nozzle and reported in global coordinates.

Forces( lb.)  Moments (ft-lb)

Load Case        FX         FY         FZ         MX         MY         MZ
-------------------------------------------------------------------------------
 WEIGHT:   110229.0   -24104.0      472.0        1.4   -10381.6  -291692.1

The "top" or "positive" end of this model is "free" in
the axial and translational directions.

Stresses ARE nodally AVERAGED.

No weld dimensions have been given for the nozzle
connection to the shell. This will produce conservative
results for external loads and may tend to produce more
realistic inside surface pressure stresses.

The cylinder length or nozzle/branch location was adjusted
so that a better mesh could be generated at each end of the
cylinder. The nozzle is now located  105.00 in.
down the length of the cylinder and the total cylinder length
is  210.00 in.

Vessel Centerline  Vector     :  0.000   0.000   1.000
Nozzle Orientation Vector     :  1.000   0.000   0.000
```

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```
Load Case Report
Inner and outer element temperatures are the same
throughout the model.  No thermal ratcheting
calculations will be performed.

THE   9  LOAD CASES ANALYZED ARE:

  1   WEIGHT ONLY    (Wgt Only)

      Weight ONLY case run to get the stress range
      between the installed and the operating states.

      /-------- Loads in Case   1
        Loads due to Weight

  2   SUSTAINED      (Wgt+Pr)

      Sustained case run to satisfy local primary
      membrane and bending stress limits.

      /-------- Loads in Case   2
```

```
      Loads due to Weight
      Pressure Case    1

3   OPERATING

    Case run to compute the operating stresses used in
    secondary, peak and range calculations as needed.

    /-------- Loads in Case   3
      Pressure Case    1
      Loads from (Operating)

4   EXPANSION      (Fatigue Calc Performed)

    Expansion case run to get the RANGE of stresses.
    as described in NB-3222.2, 5.5.3.2, or 5.5.5.2.

    /-------- Combinations in Expansion Case   4
      Plus  Stress Results from CASE   3
      Minus Stress Results from CASE   1

5   Program Generated -- Force Only

    Case run to compute sif's and flexibilities.
    /-------- Loads in Case   5
      Loads from (Axial)

6   Program Generated -- Force Only

    Case run to compute sif's and flexibilities.
    /-------- Loads in Case   6
      Loads from (Inplane)

7   Program Generated -- Force Only

    Case run to compute sif's and flexibilities.
    /-------- Loads in Case   7
      Loads from (Outplane)

8   Program Generated -- Force Only

    Case run to compute sif's and flexibilities.
    /-------- Loads in Case   8
      Loads from (Torsion)

9   Program Generated -- Force Only

    Case run to compute sif's and flexibilities.
    /-------- Loads in Case   9
      Pressure Case    1
```

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Solution Data

```
Maximum Solution Row Size =     996
Number of Nodes           =    2184
Number of Elements        =     720
Number of Solution Cases  =       8
```

Summation of Loads per Case

| Case # | FX | FY | FZ |
|---|---|---|---|
| 1 | 110200. | -24102. | 472. |
| 2 | 108351. | -24102. | 549696. |
| 3 | -1849. | 0. | 549224. |
| 4 | 2650719. | 0. | 0. |
| 5 | 0. | 0. | 2. |
| 6 | 0. | 1. | 0. |
| 7 | 0. | 0. | 0. |
| 8 | -1849. | 0. | 549224. |

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---

ASME Code Stress Output Plots

1) Pl < (1.5)(S) (SUS,Membrane) Case 2

2) Qb < SPS (SUS,Bending) Case 2

3) S1+S2+S3 < 4S (SUS,S1+S2+S3) Case 2

4) Pl+Pb+Q < SPS (OPE,Inside) Case 3

5) Pl+Pb+Q < SPS (OPE,Outside) Case 3

6) Membrane < User (OPE,Membrane) Case 3

7) Bending < User (OPE,Bending) Case 3

8) Pl+Pb+Q+F < Sa (SIF,Outside) Case 5

9) Pl+Pb+Q+F < Sa (SIF,Outside) Case 6

10) Pl+Pb+Q+F < Sa (SIF,Outside) Case 7

11) Pl+Pb+Q+F < Sa (SIF,Outside) Case 8

12) Pl+Pb+Q+F < Sa (SIF,Outside) Case 9

13) Pl+Pb+Q < SPS (EXP,Inside) Case 4

14) Pl+Pb+Q < SPS (EXP,Outside) Case 4

15) Pl+Pb+Q+F < Sa (EXP,Inside) Case 4

16) Pl+Pb+Q+F < Sa (EXP,Outside) Case 4

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---

Region Data

Header Next to Nozzle Weld

```
  Cold Allowable ...........   20000.  psi
  Hot Allowable @  70 deg ..   20000.  psi
  Case   2
  Nominal Stress   (M/Z) ...   14712.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   3
  Nominal Stress   (M/Z) ...       0.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   4
  Nominal Stress   (M/Z) ...   14712.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   5
  Nominal Stress   (M/Z) ...   75949.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   6
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   7
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   8
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   9
  Nominal Stress   (M/Z) ...   11200.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Smallest Thickness .......   0.375   in.
  Stress Concentration .....   1.350
```

Branch Next to Header Weld

```
  Cold Allowable ...........   20000.  psi
  Hot Allowable @  70 deg ..   20000.  psi
  Case   2
```

```
  Nominal Stress   (M/Z) ...   14712.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   3
  Nominal Stress   (M/Z) ...       0.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   4
  Nominal Stress   (M/Z) ...   14712.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   5
  Nominal Stress   (M/Z) ...   75949.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   6
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   7
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   8
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   9
  Nominal Stress   (M/Z) ...   11200.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Smallest Thickness .......   0.375   in.
  Stress Concentration .....   1.350

Branch Transition

  Cold Allowable ...........   20000.  psi
  Hot Allowable @  70 deg ..   20000.  psi
  Case   2
  Nominal Stress   (M/Z) ...   14712.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   3
  Nominal Stress   (M/Z) ...       0.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   4
  Nominal Stress   (M/Z) ...   14712.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   5
  Nominal Stress   (M/Z) ...   75949.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   6
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   7
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   8
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   9
  Nominal Stress   (M/Z) ...   11200.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Smallest Thickness .......   0.375   in.
  Stress Concentration .....   1.350

Header away from Junction

  Cold Allowable ...........   20000.  psi
  Hot Allowable @  70 deg ..   20000.  psi
  Case   2
  Nominal Stress   (M/Z) ...   14712.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   3
  Nominal Stress   (M/Z) ...       0.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   4
  Nominal Stress   (M/Z) ...   14712.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   5
  Nominal Stress   (M/Z) ...   75949.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   6
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   7
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
```

```
  Case   8
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   9
  Nominal Stress   (M/Z) ...   11200.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Smallest Thickness .......   0.375   in.
  Stress Concentration .....   1.000

Branch away from Junction

  Cold Allowable ...........   20000.  psi
  Hot Allowable @  70 deg ..   20000.  psi
  Case   2
  Nominal Stress   (M/Z) ...   14712.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   3
  Nominal Stress   (M/Z) ...       0.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   4
  Nominal Stress   (M/Z) ...   14712.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   5
  Nominal Stress   (M/Z) ...   75949.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   6
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   7
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   8
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   9
  Nominal Stress   (M/Z) ...   11200.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Smallest Thickness .......   0.375   in.
  Stress Concentration .....   1.000
```

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```
Stress Results - Notes

- Results  in  this  analysis  were  generated using the finite
  element solution method.

- Using post 07 ASME Section VIII Division 2

- Use Polished Bar fatigue curve.

- Ratio between Operating and Design Pressure =  0.9000000
  Assume pressure increases all other stresses.
  Use operating pressure for occasional load cases.

- Assume free end displacements of attached pipe are
  secondary loads within limits of nozzle reinforcement.

- Use Equivalent Stress (Von Mises).

- S1+S2+S3 evaluation omitted from operating stress.
  Include S1+S2+S3 evaluation in primary case evaluation.
  Assume bending stress not local primary for S1+S2+S3.
```

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---

```
ASME Overstressed Areas

Header Next to Nozzle Weld

       Pl        (1.5)(S)     Primary Membrane Load Case 2
  160,949          30,000     Plot Reference:
      psi             psi     1) Pl < (1.5)(S) (SUS,Membrane) Case 2
```

```
          536%

       Qb            SPS     Primary Bending Load Case 2
  900,246         60,000     Plot Reference:
      psi            psi     2) Qb < SPS (SUS,Bending) Case 2

         1500%

 S1+S2+S3             4S     Part 5 (5.3.2) Load Case 2
  206,333         80,000     Plot Reference:
      psi            psi     3) S1+S2+S3 < 4S (SUS,S1+S2+S3) Case 2

          257%

  Pl+Pb+Q            SPS     Primary+Secondary (Inner) Load Case 4
  861,575         72,000     Plot Reference:
      psi            psi     13) Pl+Pb+Q < SPS (EXP,Inside) Case 4

         1196%

  Pl+Pb+Q            SPS     Primary+Secondary (Outer) Load Case 4
  929,283         72,000     Plot Reference:
      psi            psi     14) Pl+Pb+Q < SPS (EXP,Outside) Case 4

         1290%

Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Inner) Load Case 4
2,907,814     0.000 Life     Stress Concentration Factor = 1.350
      psi    99.000 Stress   Strain Concentration Factor = 5.000
                             Cycles Allowed for this Stress = 0.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
    8,285                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 22.
                             WRC 474 99% Probability Cycles = 5.
   35096%                    WRC 474 95% Probability Cycles = 7.
                             BS5500 Allowed Cycles(Curve F) = 0.
                             Membrane-to-Bending Ratio = 0.109
                             Bending-to-PL+PB+Q Ratio = 0.901
                             Plot Reference:
                             15) Pl+Pb+Q+F < Sa (EXP,Inside) Case 4

Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Outer) Load Case 4
3,136,331     0.000 Life     Stress Concentration Factor = 1.350
      psi    99.000 Stress   Strain Concentration Factor = 5.000
                             Cycles Allowed for this Stress = 0.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
    8,285                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 17.
                             WRC 474 99% Probability Cycles = 4.
   37855%                    WRC 474 95% Probability Cycles = 5.
                             BS5500 Allowed Cycles(Curve F) = 0.
                             Membrane-to-Bending Ratio = 0.109
                             Bending-to-PL+PB+Q Ratio = 0.901
                             Plot Reference:
                             16) Pl+Pb+Q+F < Sa (EXP,Outside) Case 4


Branch Next to Header Weld

       Pl        (1.5)(S)     Primary Membrane Load Case 2
  233,407         30,000     Plot Reference:
      psi            psi     1) Pl < (1.5)(S) (SUS,Membrane) Case 2

          778%

       Qb            SPS     Primary Bending Load Case 2
  852,504         60,000     Plot Reference:
      psi            psi     2) Qb < SPS (SUS,Bending) Case 2

         1420%

 S1+S2+S3             4S     Part 5 (5.3.2) Load Case 2
  274,168         80,000     Plot Reference:
      psi            psi     3) S1+S2+S3 < 4S (SUS,S1+S2+S3) Case 2

          342%

  Pl+Pb+Q            SPS     Primary+Secondary (Inner) Load Case 4
```

```
  856,901         72,000     Plot Reference:
      psi            psi     13) Pl+Pb+Q < SPS (EXP,Inside) Case 4

          1190%

  Pl+Pb+Q            SPS     Primary+Secondary (Outer) Load Case 4
  870,818         72,000     Plot Reference:
      psi            psi     14) Pl+Pb+Q < SPS (EXP,Outside) Case 4

          1209%

Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Inner) Load Case 4
2,892,040     0.000 Life     Stress Concentration Factor = 1.350
      psi    99.000 Stress   Strain Concentration Factor = 5.000
                             Cycles Allowed for this Stress = 0.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
    8,285                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 22.
                             WRC 474 99% Probability Cycles = 5.
   34906%                    WRC 474 95% Probability Cycles = 7.
                             BS5500 Allowed Cycles(Curve F) = 0.
                             Membrane-to-Bending Ratio = 0.174
                             Bending-to-PL+PB+Q Ratio = 0.852
                             Plot Reference:
                             15) Pl+Pb+Q+F < Sa (EXP,Inside) Case 4

Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Outer) Load Case 4
2,939,010     0.000 Life     Stress Concentration Factor = 1.350
      psi    99.000 Stress   Strain Concentration Factor = 5.000
                             Cycles Allowed for this Stress = 0.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
    8,285                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 21.
                             WRC 474 99% Probability Cycles = 5.
   35473%                    WRC 474 95% Probability Cycles = 7.
                             BS5500 Allowed Cycles(Curve F) = 0.
                             Membrane-to-Bending Ratio = 0.174
                             Bending-to-PL+PB+Q Ratio = 0.852
                             Plot Reference:
                             16) Pl+Pb+Q+F < Sa (EXP,Outside) Case 4


Branch Transition

       Pl        (1.5)(S)     Primary Membrane Load Case 2
   43,339         30,000     Plot Reference:
      psi            psi     1) Pl < (1.5)(S) (SUS,Membrane) Case 2

          144%

       Qb            SPS     Primary Bending Load Case 2
   70,560         60,000     Plot Reference:
      psi            psi     2) Qb < SPS (SUS,Bending) Case 2

          117%

  Pl+Pb+Q            SPS     Primary+Secondary (Inner) Load Case 4
   93,574         72,000     Plot Reference:
      psi            psi     13) Pl+Pb+Q < SPS (EXP,Inside) Case 4

          129%

Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Inner) Load Case 4
  101,015    13.778 Life     Stress Concentration Factor = 1.350
      psi     3.900 Stress   Strain Concentration Factor = 1.599
                             Cycles Allowed for this Stress = 508.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
   25,902                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 18,933.
                             WRC 474 99% Probability Cycles = 4,398.
     389%                    WRC 474 95% Probability Cycles = 6,107.
                             BS5500 Allowed Cycles(Curve F) = 1,400.
                             Membrane-to-Bending Ratio = 0.579
                             Bending-to-PL+PB+Q Ratio = 0.633
                             Plot Reference:
                             15) Pl+Pb+Q+F < Sa (EXP,Inside) Case 4

Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Outer) Load Case 4
   35,672     0.607 Life     Stress Concentration Factor = 1.350
```

```
      psi     1.377 Stress   Strain Concentration Factor = 1.000
                             Cycles Allowed for this Stress = 11,530.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
   25,902                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 173,697.
                             WRC 474 99% Probability Cycles = 40,352.
     137%                    WRC 474 95% Probability Cycles = 56,025.
                             BS5500 Allowed Cycles(Curve F) = 14,925.
                             Membrane-to-Bending Ratio = 0.579
                             Bending-to-PL+PB+Q Ratio = 0.633
                             Plot Reference:
                             16) Pl+Pb+Q+F < Sa (EXP,Outside) Case 4


Header away from Junction

       Pl       (1.5)(S)     Primary Membrane Load Case 2
  131,033         30,000     Plot Reference:
      psi            psi     1) Pl < (1.5)(S) (SUS,Membrane) Case 2

           436%

       Qb            SPS     Primary Bending Load Case 2
  600,933         60,000     Plot Reference:
      psi            psi     2) Qb < SPS (SUS,Bending) Case 2

          1001%

 S1+S2+S3             4S     Part 5 (5.3.2) Load Case 2
  215,460         80,000     Plot Reference:
      psi            psi     3) S1+S2+S3 < 4S (SUS,S1+S2+S3) Case 2

           269%

  Pl+Pb+Q            SPS     Primary+Secondary (Inner) Load Case 4
  549,695         72,000     Plot Reference:
      psi            psi     13) Pl+Pb+Q < SPS (EXP,Inside) Case 4

           763%

  Pl+Pb+Q            SPS     Primary+Secondary (Outer) Load Case 4
  629,812         72,000     Plot Reference:
      psi            psi     14) Pl+Pb+Q < SPS (EXP,Outside) Case 4

           874%

Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Inner) Load Case 4
1,374,238     0.000 Life     Stress Concentration Factor = 1.000
      psi    99.000 Stress   Strain Concentration Factor = 5.000
                             Cycles Allowed for this Stress = 0.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
    8,285                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 92.
                             WRC 474 99% Probability Cycles = 21.
   16586%                    WRC 474 95% Probability Cycles = 30.
                             BS5500 Allowed Cycles(Curve F) = 0.
                             Membrane-to-Bending Ratio = 0.184
                             Bending-to-PL+PB+Q Ratio = 0.844
                             Plot Reference:
                             15) Pl+Pb+Q+F < Sa (EXP,Inside) Case 4

Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Outer) Load Case 4
1,574,530     0.000 Life     Stress Concentration Factor = 1.000
      psi    99.000 Stress   Strain Concentration Factor = 5.000
                             Cycles Allowed for this Stress = 0.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
    8,285                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 54.
                             WRC 474 99% Probability Cycles = 13.
   19004%                    WRC 474 95% Probability Cycles = 18.
                             BS5500 Allowed Cycles(Curve F) = 0.
                             Membrane-to-Bending Ratio = 0.184
                             Bending-to-PL+PB+Q Ratio = 0.844
                             Plot Reference:
                             16) Pl+Pb+Q+F < Sa (EXP,Outside) Case 4
```

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Highest Primary Stress Ratios

Header Next to Nozzle Weld

```
       Qb            SPS     Primary Bending Load Case 2
  900,246         60,000     Plot Reference:
      psi            psi     2) Qb < SPS (SUS,Bending) Case 2

          1500%
```

Branch Next to Header Weld

```
       Qb            SPS     Primary Bending Load Case 2
  852,504         60,000     Plot Reference:
      psi            psi     2) Qb < SPS (SUS,Bending) Case 2

          1420%
```

Branch Transition

```
       Pl       (1.5)(S)     Primary Membrane Load Case 2
   43,339         30,000     Plot Reference:
      psi            psi     1) Pl < (1.5)(S) (SUS,Membrane) Case 2

           144%
```

Header away from Junction

```
       Qb            SPS     Primary Bending Load Case 2
  600,933         60,000     Plot Reference:
      psi            psi     2) Qb < SPS (SUS,Bending) Case 2

          1001%
```

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Highest Secondary Stress Ratios

Header Next to Nozzle Weld

```
  Pl+Pb+Q            SPS     Primary+Secondary (Outer) Load Case 4
  929,283         72,000     Plot Reference:
      psi            psi     14) Pl+Pb+Q < SPS (EXP,Outside) Case 4

          1290%
```

Branch Next to Header Weld

```
  Pl+Pb+Q            SPS     Primary+Secondary (Outer) Load Case 4
  870,818         72,000     Plot Reference:
      psi            psi     14) Pl+Pb+Q < SPS (EXP,Outside) Case 4

          1209%
```

Branch Transition

```
  Pl+Pb+Q            SPS     Primary+Secondary (Inner) Load Case 4
   93,574         72,000     Plot Reference:
      psi            psi     13) Pl+Pb+Q < SPS (EXP,Inside) Case 4

           129%
```

Header away from Junction

```
  Pl+Pb+Q            SPS     Primary+Secondary (Outer) Load Case 4
  629,812         72,000     Plot Reference:
      psi            psi     14) Pl+Pb+Q < SPS (EXP,Outside) Case 4
```

874%

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---

Highest Fatigue Stress Ratios

Header Next to Nozzle Weld

```
Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Outer) Load Case 4
3,136,331     0.000 Life     Stress Concentration Factor = 1.350
      psi    99.000 Stress   Strain Concentration Factor = 5.000
                             Cycles Allowed for this Stress = 0.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
    8,285                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 17.
                             WRC 474 99% Probability Cycles = 4.
   37855%                    WRC 474 95% Probability Cycles = 5.
                             BS5500 Allowed Cycles(Curve F) = 0.
                             Membrane-to-Bending Ratio = 0.109
                             Bending-to-PL+PB+Q Ratio = 0.901
                             Plot Reference:
                             16) Pl+Pb+Q+F < Sa (EXP,Outside) Case 4
```

Branch Next to Header Weld

```
Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Outer) Load Case 4
2,939,010     0.000 Life     Stress Concentration Factor = 1.350
      psi    99.000 Stress   Strain Concentration Factor = 5.000
                             Cycles Allowed for this Stress = 0.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
    8,285                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 21.
                             WRC 474 99% Probability Cycles = 5.
   35473%                    WRC 474 95% Probability Cycles = 7.
                             BS5500 Allowed Cycles(Curve F) = 0.
                             Membrane-to-Bending Ratio = 0.174
                             Bending-to-PL+PB+Q Ratio = 0.852
                             Plot Reference:
                             16) Pl+Pb+Q+F < Sa (EXP,Outside) Case 4
```

Branch Transition

```
Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Inner) Load Case 4
  101,015    13.778 Life     Stress Concentration Factor = 1.350
      psi     3.900 Stress   Strain Concentration Factor = 1.599
                             Cycles Allowed for this Stress = 508.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
   25,902                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 18,933.
                             WRC 474 99% Probability Cycles = 4,398.
     389%                    WRC 474 95% Probability Cycles = 6,107.
                             BS5500 Allowed Cycles(Curve F) = 1,400.
                             Membrane-to-Bending Ratio = 0.579
                             Bending-to-PL+PB+Q Ratio = 0.633
                             Plot Reference:
                             15) Pl+Pb+Q+F < Sa (EXP,Inside) Case 4
```

Header away from Junction

```
Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Outer) Load Case 4
1,574,530     0.000 Life     Stress Concentration Factor = 1.000
      psi    99.000 Stress   Strain Concentration Factor = 5.000
                             Cycles Allowed for this Stress = 0.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
    8,285                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 54.
                             WRC 474 99% Probability Cycles = 13.
   19004%                    WRC 474 95% Probability Cycles = 18.
                             BS5500 Allowed Cycles(Curve F) = 0.
                             Membrane-to-Bending Ratio = 0.184
                             Bending-to-PL+PB+Q Ratio = 0.844
                             Plot Reference:
                             16) Pl+Pb+Q+F < Sa (EXP,Outside) Case 4
```

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Stress Intensification Factors

Branch/Nozzle Sif Summary

| | Peak | Primary | Secondary |
|---|---|---|---|
| Axial : | 33.663 | 13.134 | 49.871 |
| Inplane : | 10.474 | 6.510 | 15.517 |
| Outplane: | 35.639 | 12.468 | 52.799 |
| Torsion : | 1.436 | 1.557 | 2.172 |
| Pressure: | 3.362 | 3.391 | 4.980 |

The above stress intensification factors are to be used in a beam-type analysis of the piping system. Inplane, Outplane and Torsional sif's should be used with the matching branch pipe whose diameter and thickness is given below. The axial sif should be used to intensify the axial stress in the branch pipe calculated by F/A. The pressure sif should be used to intensify the nominal pressure stress in the PARENT or HEADER, calculated from PD/2T.

| | | |
|---|---|---|
| Pipe OD : | 30.000 | in. |
| Pipe Thk: | 0.375 | in. |
| Z approx: | 258.486 | cu.in. |
| Z exact : | 255.296 | cu.in. |

B31.3 Branch Pressure i-factor = 18.825
Header Pressure i-factor = 6.723

The B31.3 pressure i-factors should be used with with F/A, where F is the axial force due to pressure, and A is the area of the pipe wall. This is equivalent to finding the pressure stress from (ip)(PD/4T).

| | | |
|---|---|---|
| B31.3 | | |
| Peak Stress Sif .... | 0.000 | Axial |
| | 15.887 | Inplane |
| | 20.849 | Outplane |
| | 1.000 | Torsional |
| B31.1 | | |
| Peak Stress Sif .... | 0.000 | Axial |
| | 20.424 | Inplane |
| | 20.424 | Outplane |
| | 20.424 | Torsional |
| WRC 330 | | |
| Peak Stress Sif .... | 0.000 | Axial |
| | 13.786 | Inplane |
| | 13.786 | Outplane |
| | 4.884 | Torsional |

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---

Allowable Loads

| SECONDARY Load Type (Range): | Maximum Individual Occuring | Conservative Simultaneous Occuring | Realistic Simultaneous Occuring |
|---|---|---|---|
| Axial Force (lb. ) | 42949. | 1384. | 2076. |
| Inplane Moment (in. lb.) | 1009698. | 22311. | 47329. |
| Outplane Moment (in. lb.) | 296746. | 6856. | 14544. |
| Torsional Moment (in. lb.) | 7367235. | 231947. | 347920. |
| Pressure (psi ) | 110.03 | 100.00 | 100.00 |

| PRIMARY Load Type: | Maximum Individual Occuring | Conservative Simultaneous Occuring | Realistic Simultaneous Occuring |
|---|---|---|---|
| Axial Force (lb. ) | 79719. | 0. | 0. |
| Inplane Moment (in. lb.) | 1176533. | 0. | 0. |
| Outplane Moment (in. lb.) | 614267. | 0. | 0. |
| Torsional Moment (in. lb.) | 4918558. | 0. | 0. |

| | | | | |
|---|---|---|---|---|
| Pressure | (psi ) | 78.99 | 100.00 | 100.00 |

NOTES:

1) Maximum Individual Occuring Loads are the maximum allowed values of the respective loads if all other load components are zero, i.e. the listed axial force may be applied if the inplane, outplane and torsional moments, and the pressure are zero.

2) The Conservative Allowable Simultaneous loads are the maximum loads that can be applied simultaneously. A conservative stress combination equation is used that typically produces stresses within 50-70% of the allowable stress.

3) The Realistic Allowable Simultaneous loads are the maximum loads that can be applied simultaneously. A more realistic stress combination equation is used based on experience at Paulin Research. Stresses are typically produced within 80-105% of the allowable.

4) Secondary allowable loads are limits for expansion and operating piping loads.

5) Primary allowable loads are limits for weight, primary and sustained type piping loads.

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Flexibilities

The following stiffnesses should be used in a piping, "beam-type" analysis of the intersection. The stiffnesses should be inserted at the surface of the branch/header or nozzle/vessel junction. The general characteristics used for the branch pipe should be:

Outside Diameter = 30.000 in.
Wall Thickness = 0.375 in.

| | | | |
|---|---|---|---|
| Axial Translational Stiffness | = | 279080. | lb./in. |
| Inplane Rotational Stiffness | = | 2602306. | in.lb./deg |
| Outplane Rotational Stiffness | = | 379632. | in.lb./deg |
| Torsional Rotational Stiffness | = | 63764996. | in.lb./deg |

Intersection Flexibility Factors for Branch/Nozzle

Find axial stiffness: K = 3EI/(kd)^3 lb./in.
Find bending and torsional stiffnesses: K = EI/(kd) in.lb.per radian.
The EI product is 0.11105E+12 lb.in.^2
The value of (d) to use is: 29.625 in..
The resulting bending stiffness is in units of force x length per radian.

| | | |
|---|---|---|
| Axial Flexibility Factor | (k) = | 3.581 |
| Inplane Flexibility Factor | (k) = | 25.142 |
| Outplane Flexibility Factor | (k) = | 172.341 |
| Torsional Flexibility Factor | (k) = | 1.026 |

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**Tabular Results**

Results were generated with the finite element program FE/Pipe®. Stress results are post-processed in accordance with the rules specified in ASME Section III and ASME Section VIII, Division 2.

Analysis Time Stamp: Tue Nov 12 08:53:16 2013.


- Model Notes
- Load Case Report
- Solution Data
- ASME Code Stress Output Plots
- Region Data
- Stress Results - Notes
- ASME Overstressed Areas
- Highest Primary Stress Ratios
- Highest Secondary Stress Ratios
- Highest Fatigue Stress Ratios
- Stress Intensification Factors
- Allowable Loads
- Flexibilities
- Graphical Results


---

```
Model Notes

  Input Echo:

  Description:

         CDM Smith Project
          City of Houston - NEWWTP
          84" x 30" Branch Check

  Model Type                    : Cylindrical Shell

  Parent Outside Diameter       :      84.000 in.
         Thickness              :       0.375 in.

         Parent Properties:
         Cold Allowable         :     20000.0 psi
         Hot  Allowable         :     20000.0 psi
         Material ID #1         :  Low Carbon Steel
         Ultimate Tensile (Amb) :     65000.0 psi
         Yield Strength (Amb)   :     36000.0 psi
         Yield Strength (Hot)   :     36000.0 psi
         Elastic Modulus (Amb)  :  29000000.0 psi
         Poissons Ratio         :       0.300
         Expansion Coefficient  :  0.6000E-05 in./in./deg.
         Weight Density         :  0.0000E+00 lb./cu.in.(NOT USED)

  Nozzle Outside Diameter       :      30.000 in.
         Thickness              :       0.375 in.
         Length                 :      12.000 in.
         Nozzle Tilt Angle      :       0.000 deg.
         Distance from Top      :       0.000 in.
         Distance from Bottom   :       0.000 in.

         Nozzle Properties
         Cold Allowable         :     20000.0 psi
         Hot  Allowable         :     20000.0 psi
         Material ID #1         :  Low Carbon Steel
         Ultimate Tensile (Amb) :     65000.0 psi
         Yield Strength (Amb)   :     36000.0 psi
         Yield Strength (Hot)   :     36000.0 psi
         Elastic Modulus (Amb)  :  29000000.0 psi
         Poissons Ratio         :       0.300
         Expansion Coefficient  :  0.6000E-05 in./in./deg.
         Weight Density         :  0.0000E+00 lb./cu.in. (NOT USED)
```

```
Design Operating Cycles       :       7000.
Ambient Temperature (Deg.)    :       70.00

The following temperatures have been specified for the analysis:

Nozzle Inside  Temperature    :       70.00 deg.
Nozzle Outside Temperature    :       70.00 deg.
Vessel Inside  Temperature    :       70.00 deg.
Vessel Outside Temperature    :       70.00 deg.
Nozzle Pressure               :       100.0 psi
Vessel Pressure               :       100.0 psi

User Defined Load Input Echo:
Loads are given at the Nozzle/Header Junction
Loads are defined in Global Coordinates

Forces( lb.)  Moments (ft-lb)

Load Case        FX         FY         FZ         MX         MY         MZ
-------------------------------------------------------------------------------
 WEIGHT:      -12.0     2513.0       -5.0     -119.0       71.2     4480.2


FEA Model Loads:
These are the actual loads applied to the FEA model.
These are the User Defined Loads translated to the
end of the nozzle and reported in global coordinates.

Forces( lb.)  Moments (ft-lb)

Load Case        FX         FY         FZ         MX         MY         MZ
-------------------------------------------------------------------------------
 WEIGHT:      -12.0     2513.0       -5.0     -119.0       66.2     1967.2

The "top" or "positive" end of this model is "free" in
the axial and translational directions.

Stresses ARE nodally AVERAGED.

No weld dimensions have been given for the nozzle
connection to the shell. This will produce conservative
results for external loads and may tend to produce more
realistic inside surface pressure stresses.

The cylinder length or nozzle/branch location was adjusted
so that a better mesh could be generated at each end of the
cylinder. The nozzle is now located  105.00 in.
down the length of the cylinder and the total cylinder length
is  210.00 in.

Vessel Centerline  Vector     :  0.000   0.000   1.000
Nozzle Orientation Vector     :  1.000   0.000   0.000
```

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```
Load Case Report
Inner and outer element temperatures are the same
throughout the model.  No thermal ratcheting
calculations will be performed.

THE   9  LOAD CASES ANALYZED ARE:

  1   WEIGHT ONLY    (Wgt Only)

      Weight ONLY case run to get the stress range
      between the installed and the operating states.

      /-------- Loads in Case   1
        Loads due to Weight

  2   SUSTAINED      (Wgt+Pr)

      Sustained case run to satisfy local primary
      membrane and bending stress limits.

      /-------- Loads in Case   2
```

```
      Loads due to Weight
      Pressure Case    1

3   OPERATING

    Case run to compute the operating stresses used in
    secondary, peak and range calculations as needed.

    /-------- Loads in Case   3
      Pressure Case    1
      Loads from (Operating)

4   EXPANSION      (Fatigue Calc Performed)

    Expansion case run to get the RANGE of stresses.
    as described in NB-3222.2, 5.5.3.2, or 5.5.5.2.

    /-------- Combinations in Expansion Case   4
      Plus  Stress Results from CASE   3
      Minus Stress Results from CASE   1

5   Program Generated -- Force Only

    Case run to compute sif's and flexibilities.
    /-------- Loads in Case   5
      Loads from (Axial)

6   Program Generated -- Force Only

    Case run to compute sif's and flexibilities.
    /-------- Loads in Case   6
      Loads from (Inplane)

7   Program Generated -- Force Only

    Case run to compute sif's and flexibilities.
    /-------- Loads in Case   7
      Loads from (Outplane)

8   Program Generated -- Force Only

    Case run to compute sif's and flexibilities.
    /-------- Loads in Case   8
      Loads from (Torsion)

9   Program Generated -- Force Only

    Case run to compute sif's and flexibilities.
    /-------- Loads in Case   9
      Pressure Case    1
```

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Solution Data

```
Maximum Solution Row Size =     996
Number of Nodes           =    2184
Number of Elements        =     720
Number of Solution Cases  =       8
```

Summation of Loads per Case

| Case # | FX | FY | FZ |
|---|---|---|---|
| 1 | -12. | 2513. | -5. |
| 2 | -1861. | 2513. | 549219. |
| 3 | -1849. | 0. | 549224. |
| 4 | 2650719. | 0. | 0. |
| 5 | 0. | 0. | 2. |
| 6 | 0. | 1. | 0. |
| 7 | 0. | 0. | 0. |
| 8 | -1849. | 0. | 549224. |

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---

ASME Code Stress Output Plots

1) Pl < (1.5)(S) (SUS,Membrane) Case 2

2) Qb < SPS (SUS,Bending) Case 2

3) S1+S2+S3 < 4S (SUS,S1+S2+S3) Case 2

4) Pl+Pb+Q < SPS (OPE,Inside) Case 3

5) Pl+Pb+Q < SPS (OPE,Outside) Case 3

6) Membrane < User (OPE,Membrane) Case 3

7) Bending < User (OPE,Bending) Case 3

8) Pl+Pb+Q+F < Sa (SIF,Outside) Case 5

9) Pl+Pb+Q+F < Sa (SIF,Outside) Case 6

10) Pl+Pb+Q+F < Sa (SIF,Outside) Case 7

11) Pl+Pb+Q+F < Sa (SIF,Outside) Case 8

12) Pl+Pb+Q+F < Sa (SIF,Outside) Case 9

13) Pl+Pb+Q < SPS (EXP,Inside) Case 4

14) Pl+Pb+Q < SPS (EXP,Outside) Case 4

15) Pl+Pb+Q+F < Sa (EXP,Inside) Case 4

16) Pl+Pb+Q+F < Sa (EXP,Outside) Case 4

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---

Region Data

Header Next to Nozzle Weld

```
  Cold Allowable ...........   20000.  psi
  Hot Allowable @  70 deg ..   20000.  psi
  Case   2
  Nominal Stress   (M/Z) ...     542.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   3
  Nominal Stress   (M/Z) ...       0.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   4
  Nominal Stress   (M/Z) ...     542.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   5
  Nominal Stress   (M/Z) ...   75949.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   6
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   7
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   8
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   9
  Nominal Stress   (M/Z) ...   11200.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Smallest Thickness .......   0.375   in.
  Stress Concentration .....   1.350
```

Branch Next to Header Weld

```
  Cold Allowable ...........   20000.  psi
  Hot Allowable @  70 deg ..   20000.  psi
  Case   2
```

```
  Nominal Stress   (M/Z) ...     542.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   3
  Nominal Stress   (M/Z) ...       0.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   4
  Nominal Stress   (M/Z) ...     542.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   5
  Nominal Stress   (M/Z) ...   75949.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   6
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   7
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   8
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   9
  Nominal Stress   (M/Z) ...   11200.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Smallest Thickness .......   0.375   in.
  Stress Concentration .....   1.350

Branch Transition

  Cold Allowable ...........   20000.  psi
  Hot Allowable @  70 deg ..   20000.  psi
  Case   2
  Nominal Stress   (M/Z) ...     542.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   3
  Nominal Stress   (M/Z) ...       0.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   4
  Nominal Stress   (M/Z) ...     542.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   5
  Nominal Stress   (M/Z) ...   75949.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   6
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   7
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   8
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   9
  Nominal Stress   (M/Z) ...   11200.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Smallest Thickness .......   0.375   in.
  Stress Concentration .....   1.350

Header away from Junction

  Cold Allowable ...........   20000.  psi
  Hot Allowable @  70 deg ..   20000.  psi
  Case   2
  Nominal Stress   (M/Z) ...     542.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   3
  Nominal Stress   (M/Z) ...       0.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   4
  Nominal Stress   (M/Z) ...     542.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   5
  Nominal Stress   (M/Z) ...   75949.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   6
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   7
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
```

```
  Case   8
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   9
  Nominal Stress   (M/Z) ...   11200.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Smallest Thickness .......   0.375   in.
  Stress Concentration .....   1.000

Branch away from Junction

  Cold Allowable ...........   20000.  psi
  Hot Allowable @  70 deg ..   20000.  psi
  Case   2
  Nominal Stress   (M/Z) ...     542.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   3
  Nominal Stress   (M/Z) ...       0.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   4
  Nominal Stress   (M/Z) ...     542.  psi
  Pressure Stress (Pd/2t) ..   11200.  psi
  Case   5
  Nominal Stress   (M/Z) ...   75949.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   6
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   7
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   8
  Nominal Stress   (M/Z) ...   10383.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Case   9
  Nominal Stress   (M/Z) ...   11200.  psi
  Pressure Stress (Pd/2t) ..       0.  psi
  Smallest Thickness .......   0.375   in.
  Stress Concentration .....   1.000
```

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---

```
Stress Results - Notes

- Results  in  this  analysis  were  generated using the finite
  element solution method.

- Using post 07 ASME Section VIII Division 2

- Use Polished Bar fatigue curve.

- Ratio between Operating and Design Pressure =  0.9000000
  Assume pressure increases all other stresses.
  Use operating pressure for occasional load cases.

- Assume free end displacements of attached pipe are
  secondary loads within limits of nozzle reinforcement.

- Use Equivalent Stress (Von Mises).

- S1+S2+S3 evaluation omitted from operating stress.
  Include S1+S2+S3 evaluation in primary case evaluation.
  Assume bending stress not local primary for S1+S2+S3.
```

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---

```
ASME Overstressed Areas

Header Next to Nozzle Weld

       Pl        (1.5)(S)     Primary Membrane Load Case 2
   37,916          30,000     Plot Reference:
      psi             psi     1) Pl < (1.5)(S) (SUS,Membrane) Case 2
```

```
          126%

Branch Next to Header Weld

       Pl       (1.5)(S)     Primary Membrane Load Case 2
   38,197         30,000     Plot Reference:
      psi            psi     1) Pl < (1.5)(S) (SUS,Membrane) Case 2

          127%

Header away from Junction

       Pl       (1.5)(S)     Primary Membrane Load Case 2
   31,063         30,000     Plot Reference:
      psi            psi     1) Pl < (1.5)(S) (SUS,Membrane) Case 2

          103%
```

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---

```
Highest Primary Stress Ratios

Header Next to Nozzle Weld

       Pl       (1.5)(S)     Primary Membrane Load Case 2
   37,916         30,000     Plot Reference:
      psi            psi     1) Pl < (1.5)(S) (SUS,Membrane) Case 2

          126%

Branch Next to Header Weld

       Pl       (1.5)(S)     Primary Membrane Load Case 2
   38,197         30,000     Plot Reference:
      psi            psi     1) Pl < (1.5)(S) (SUS,Membrane) Case 2

          127%

Branch Transition

       Pl       (1.5)(S)     Primary Membrane Load Case 2
    9,494         30,000     Plot Reference:
      psi            psi     1) Pl < (1.5)(S) (SUS,Membrane) Case 2

           31%

Header away from Junction

       Pl       (1.5)(S)     Primary Membrane Load Case 2
   31,063         30,000     Plot Reference:
      psi            psi     1) Pl < (1.5)(S) (SUS,Membrane) Case 2

          103%
```

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---

```
Highest Secondary Stress Ratios

Header Next to Nozzle Weld

  Pl+Pb+Q            SPS     Primary+Secondary (Inner) Load Case 4
   50,610         72,000     Plot Reference:
      psi            psi     13) Pl+Pb+Q < SPS (EXP,Inside) Case 4

           70%
```

Branch Next to Header Weld

```
  Pl+Pb+Q            SPS     Primary+Secondary (Inner) Load Case 4
   49,293         72,000     Plot Reference:
      psi            psi     13) Pl+Pb+Q < SPS (EXP,Inside) Case 4

            68%
```

Branch Transition

```
  Pl+Pb+Q            SPS     Primary+Secondary (Outer) Load Case 4
   14,988         72,000     Plot Reference:
      psi            psi     14) Pl+Pb+Q < SPS (EXP,Outside) Case 4

            20%
```

Header away from Junction

```
  Pl+Pb+Q            SPS     Primary+Secondary (Outer) Load Case 4
   30,653         72,000     Plot Reference:
      psi            psi     14) Pl+Pb+Q < SPS (EXP,Outside) Case 4

            42%
```

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---

Highest Fatigue Stress Ratios

Header Next to Nozzle Weld

```
Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Inner) Load Case 4
   34,162     0.524 Life     Stress Concentration Factor = 1.350
      psi     0.825 Stress   Strain Concentration Factor = 1.000
                             Cycles Allowed for this Stress = 13,365.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
   41,426                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 126,752.
                             WRC 474 99% Probability Cycles = 29,446.
      82%                    WRC 474 95% Probability Cycles = 40,883.
                             BS5500 Allowed Cycles(Curve F) = 16,993.
                             Membrane-to-Bending Ratio = 1.047
                             Bending-to-PL+PB+Q Ratio = 0.488
                             Plot Reference:
                             15) Pl+Pb+Q+F < Sa (EXP,Inside) Case 4
```

Branch Next to Header Weld

```
Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Inner) Load Case 4
   33,273     0.483 Life     Stress Concentration Factor = 1.350
      psi     0.803 Stress   Strain Concentration Factor = 1.000
                             Cycles Allowed for this Stress = 14,495.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
   41,426                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 136,011.
                             WRC 474 99% Probability Cycles = 31,597.
      80%                    WRC 474 95% Probability Cycles = 43,869.
                             BS5500 Allowed Cycles(Curve F) = 18,392.
                             Membrane-to-Bending Ratio = 1.159
                             Bending-to-PL+PB+Q Ratio = 0.463
                             Plot Reference:
                             15) Pl+Pb+Q+F < Sa (EXP,Inside) Case 4
```

Branch Transition

```
Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Outer) Load Case 4
   10,117     0.000 Life     Stress Concentration Factor = 1.350
      psi     0.244 Stress   Strain Concentration Factor = 1.000
                             Cycles Allowed for this Stress = 30,543,012.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
   41,426                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 5,719,920.
                             WRC 474 99% Probability Cycles = 1,328,815.
```

```
      24%                    WRC 474 95% Probability Cycles = 1,844,918.
                             BS5500 Allowed Cycles(Curve F) = 654,217.
                             Membrane-to-Bending Ratio = 0.514
                             Bending-to-PL+PB+Q Ratio = 0.660
                             Plot Reference:
                             16) Pl+Pb+Q+F < Sa (EXP,Outside) Case 4


Header away from Junction

Pl+Pb+Q+F    Damage Ratio    Primary+Secondary+Peak (Outer) Load Case 4
   15,326     0.029 Life     Stress Concentration Factor = 1.000
      psi     0.370 Stress   Strain Concentration Factor = 1.000
                             Cycles Allowed for this Stress = 239,944.
Allowable                    "B31" Fatigue Stress Allowable = 50000.0
   41,426                    Markl Fatigue Stress Allowable = 41701.0
      psi                    WRC 474 Mean Cycles to Failure = 572,893.
                             WRC 474 99% Probability Cycles = 133,091.
      36%                    WRC 474 95% Probability Cycles = 184,782.
                             BS5500 Allowed Cycles(Curve F) = 76,483.
                             Membrane-to-Bending Ratio = 2.468
                             Bending-to-PL+PB+Q Ratio = 0.288
                             Plot Reference:
                             16) Pl+Pb+Q+F < Sa (EXP,Outside) Case 4
```

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Stress Intensification Factors

Branch/Nozzle Sif Summary

| | Peak | Primary | Secondary |
|---|---|---|---|
| Axial : | 33.663 | 13.134 | 49.871 |
| Inplane : | 10.474 | 6.510 | 15.517 |
| Outplane: | 35.639 | 12.468 | 52.799 |
| Torsion : | 1.436 | 1.557 | 2.172 |
| Pressure: | 3.362 | 3.391 | 4.980 |

The above stress intensification factors are to be used in a beam-type analysis of the piping system. Inplane, Outplane and Torsional sif's should be used with the matching branch pipe whose diameter and thickness is given below. The axial sif should be used to intensify the axial stress in the branch pipe calculated by F/A. The pressure sif should be used to intensify the nominal pressure stress in the PARENT or HEADER, calculated from PD/2T.

```
Pipe OD :       30.000  in.
Pipe Thk:        0.375  in.
Z approx:      258.486  cu.in.
Z exact :      255.296  cu.in.

B31.3 Branch Pressure i-factor =       18.825
      Header Pressure i-factor =        6.723
```

The B31.3 pressure i-factors should be used with with F/A, where F is the axial force due to pressure, and A is the area of the pipe wall. This is equivalent to finding the pressure stress from (ip)(PD/4T).

```
B31.3
Peak Stress Sif ....    0.000         Axial
                       15.887         Inplane
                       20.849         Outplane
                        1.000         Torsional
B31.1
Peak Stress Sif ....    0.000         Axial
                       20.424         Inplane
                       20.424         Outplane
                       20.424         Torsional
WRC 330
Peak Stress Sif ....    0.000         Axial
                       13.786         Inplane
                       13.786         Outplane
                        4.884         Torsional
```

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Allowable Loads

| SECONDARY Load Type (Range): | | Maximum Individual Occuring | Conservative Simultaneous Occuring | Realistic Simultaneous Occuring |
|---|---|---|---|---|
| Axial Force | (lb. ) | 42949. | 1384. | 2076. |
| Inplane Moment | (in. lb.) | 1009698. | 22311. | 47329. |
| Outplane Moment | (in. lb.) | 296746. | 6856. | 14544. |
| Torsional Moment | (in. lb.) | 7367235. | 231947. | 347920. |
| Pressure | (psi ) | 110.03 | 100.00 | 100.00 |

| PRIMARY Load Type: | | Maximum Individual Occuring | Conservative Simultaneous Occuring | Realistic Simultaneous Occuring |
|---|---|---|---|---|
| Axial Force | (lb. ) | 79719. | 0. | 0. |
| Inplane Moment | (in. lb.) | 1176533. | 0. | 0. |
| Outplane Moment | (in. lb.) | 614267. | 0. | 0. |
| Torsional Moment | (in. lb.) | 4918558. | 0. | 0. |
| Pressure | (psi ) | 78.99 | 100.00 | 100.00 |

NOTES:

1) Maximum Individual Occuring Loads are the maximum allowed values of the respective loads if all other load components are zero, i.e. the listed axial force may be applied if the inplane, outplane and torsional moments, and the pressure are zero.

2) The Conservative Allowable Simultaneous loads are the maximum loads that can be applied simultaneously. A conservative stress combination equation is used that typically produces stresses within 50-70% of the allowable stress.

3) The Realistic Allowable Simultaneous loads are the maximum loads that can be applied simultaneously. A more realistic stress combination equation is used based on experience at Paulin Research. Stresses are typically produced within 80-105% of the allowable.

4) Secondary allowable loads are limits for expansion and operating piping loads.

5) Primary allowable loads are limits for weight, primary and sustained type piping loads.

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Flexibilities

The following stiffnesses should be used in a piping, "beam-type" analysis of the intersection. The stiffnesses should be inserted at the surface of the branch/header or nozzle/vessel junction. The general characteristics used for the branch pipe should be:

Outside Diameter = 30.000 in.
Wall Thickness = 0.375 in.

| | | | |
|---|---|---|---|
| Axial Translational Stiffness | = | 279080. | lb./in. |
| Inplane Rotational Stiffness | = | 2602306. | in.lb./deg |
| Outplane Rotational Stiffness | = | 379632. | in.lb./deg |
| Torsional Rotational Stiffness | = | 63764996. | in.lb./deg |

Intersection Flexibility Factors for Branch/Nozzle

Find axial stiffness: K = 3EI/(kd)^3 lb./in.
Find bending and torsional stiffnesses: K = EI/(kd) in.lb.per radian.
The EI product is 0.11105E+12 lb.in.^2

```
The value of (d) to use is:  29.625  in..
The resulting bending stiffness is in units of force x length per radian.

Axial Flexibility Factor     (k) =     3.581
Inplane Flexibility Factor   (k) =    25.142
Outplane Flexibility Factor  (k) =   172.341
Torsional Flexibility Factor (k) =     1.026
```

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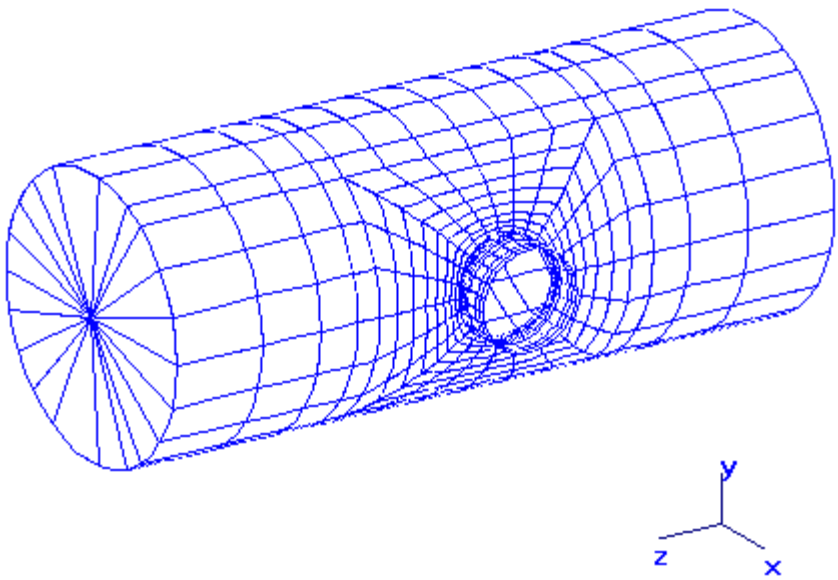
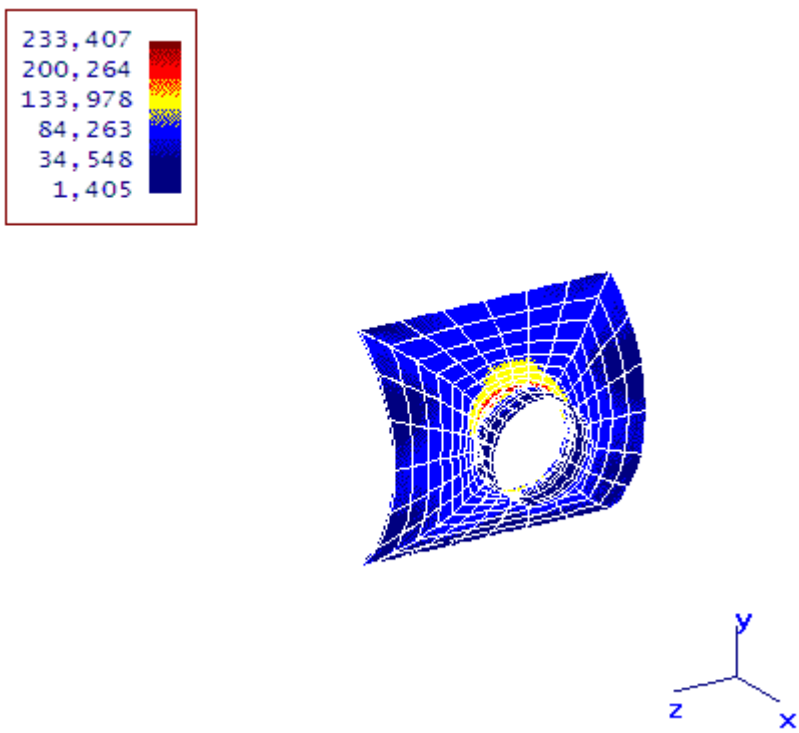
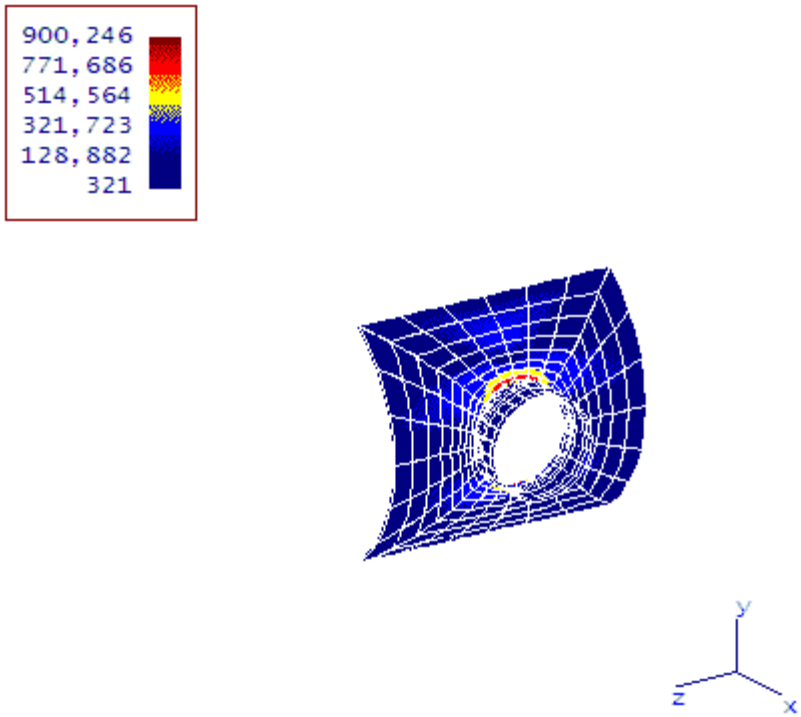
**Finite Element Model**



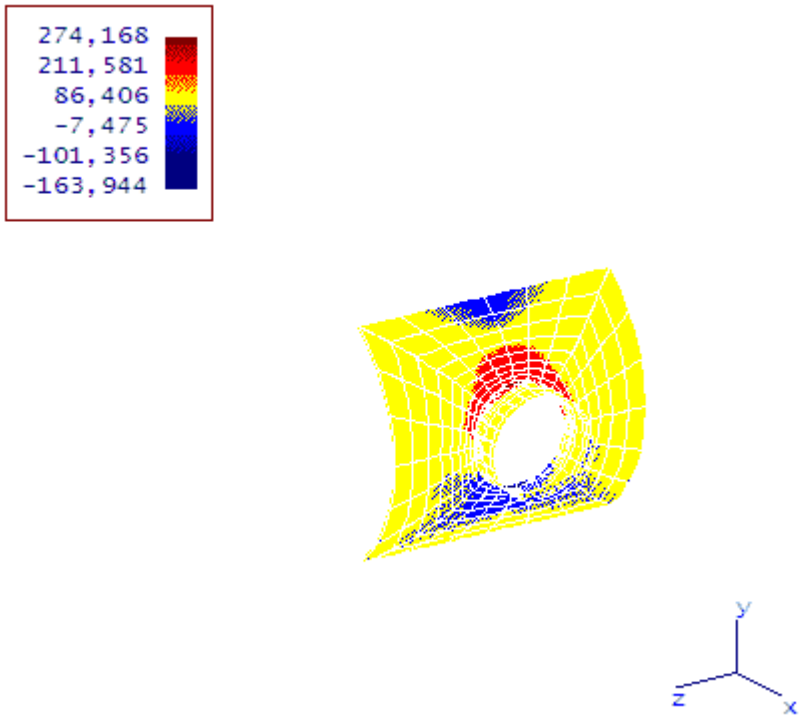

1) Pl < (1.5)(S) (SUS Membrane) Case 2



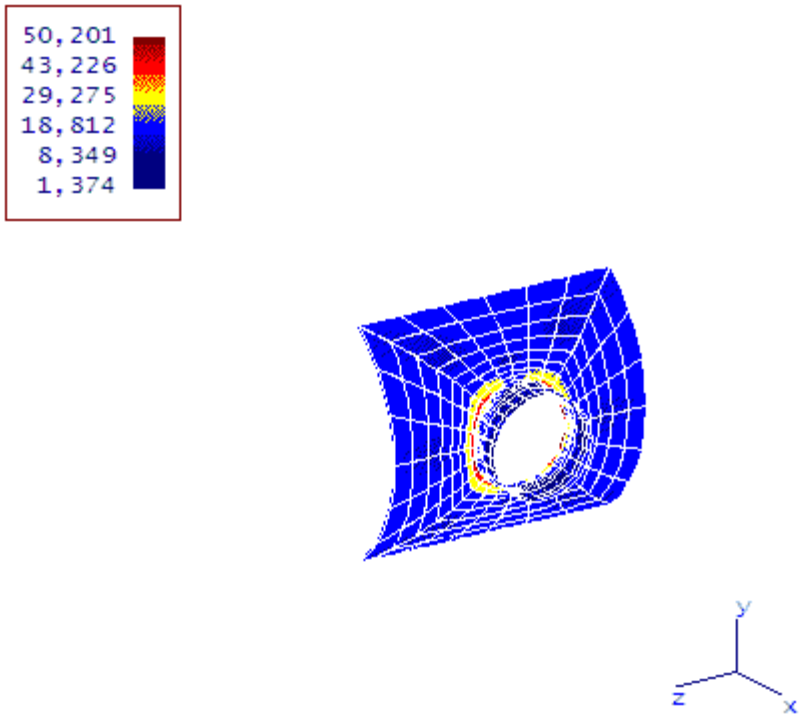
2) Qb < SPS (SUS Bending) Case 2




3) S1+S2+S3 < 4S (SUS S1+S2+S3) Case 2



4) Pl+Pb+Q < SPS (OPE Inside) Case 3

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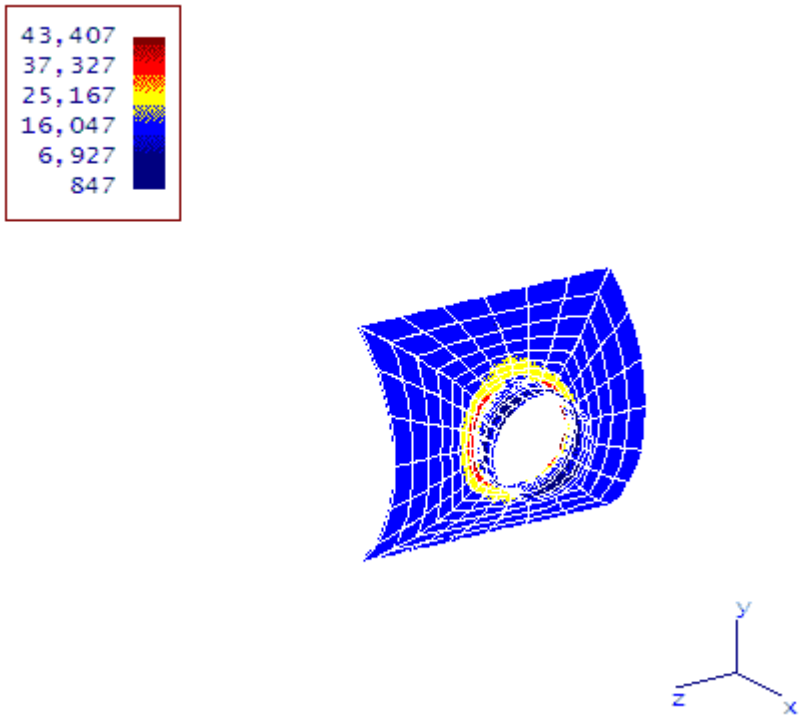
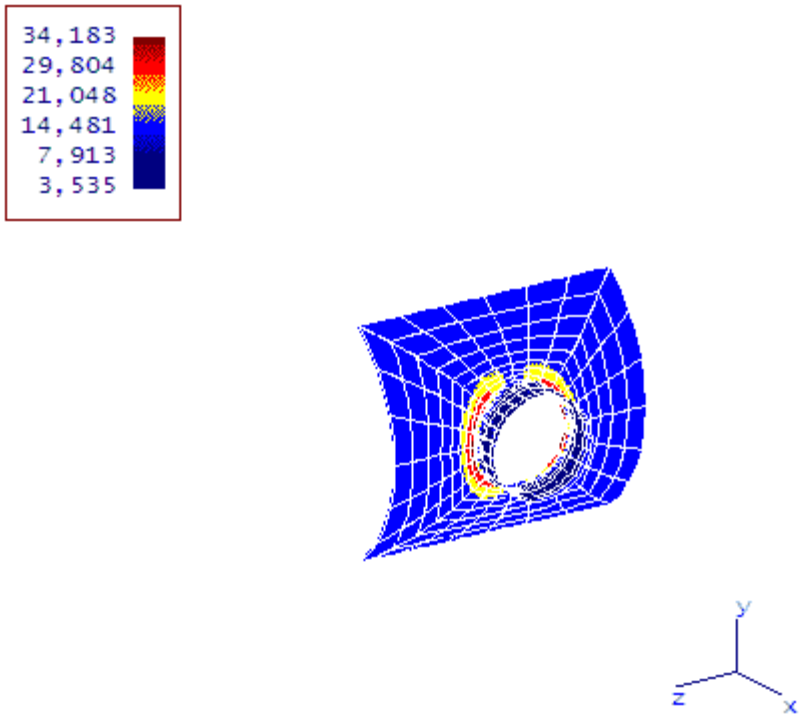
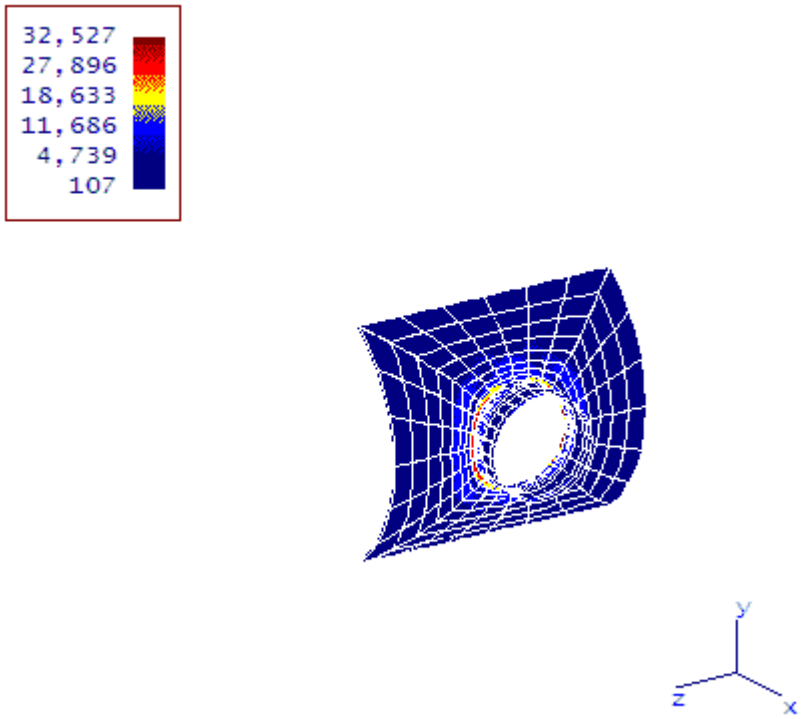


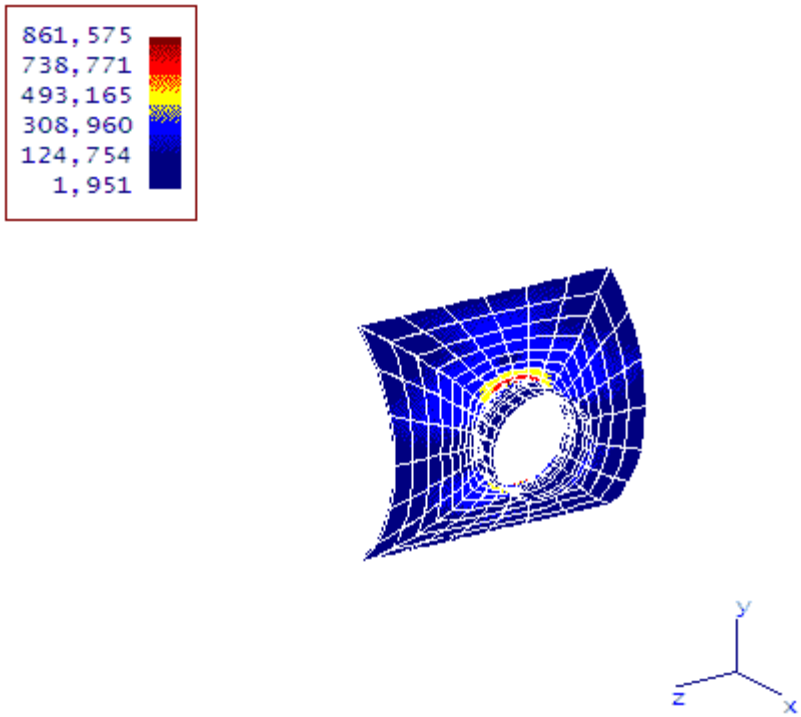
6) Membrane < User (OPE Membrane) Case 3



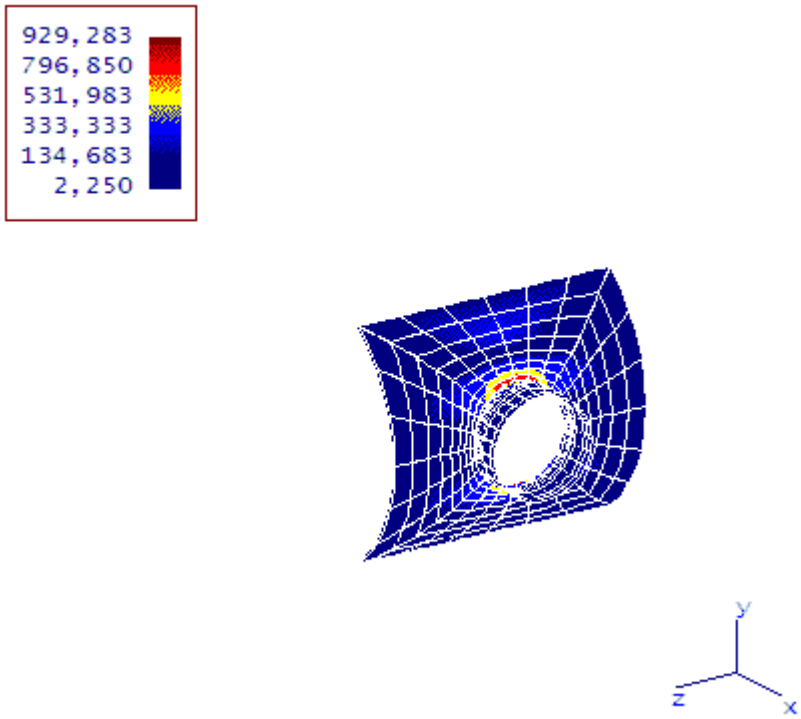

7) Bending < User (OPE Bending) Case 3



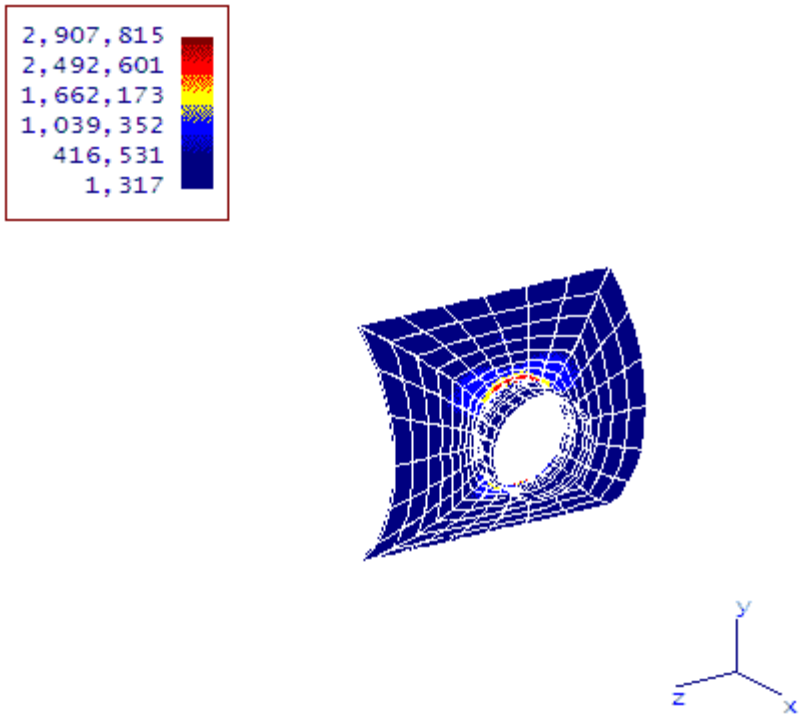
13) Pl+Pb+Q < SPS (EXP Inside) Case 4



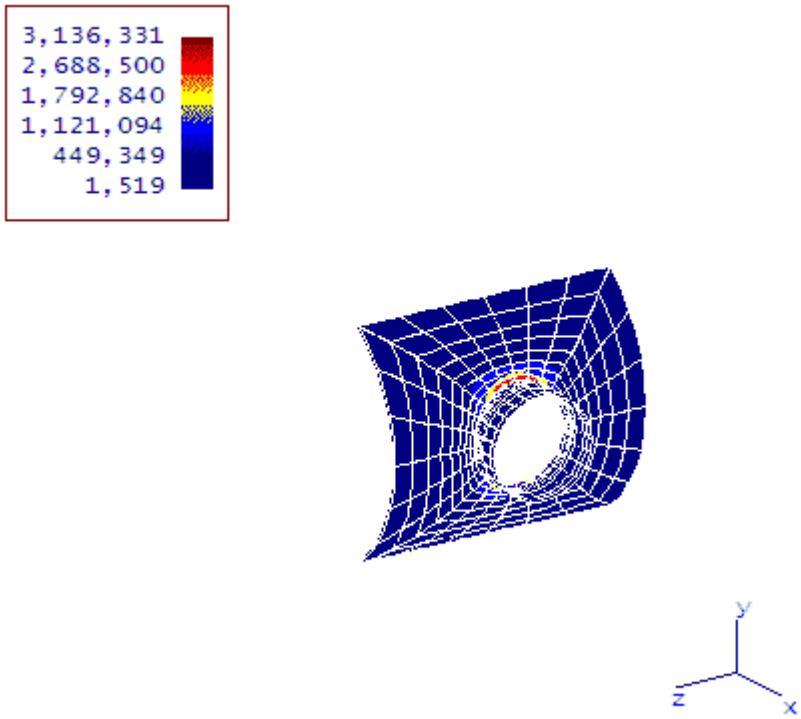

14) Pl+Pb+Q < SPS (EXP Outside) Case 4



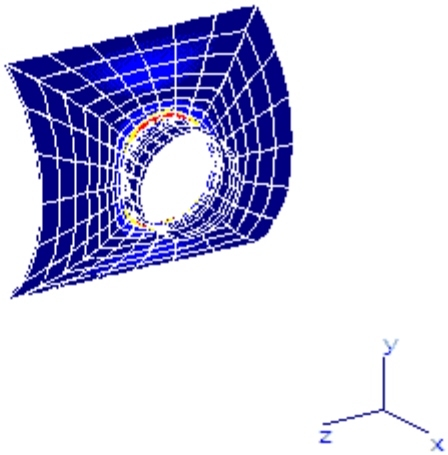
15) Pl+Pb+Q+F < Sa (EXP Inside) Case 4



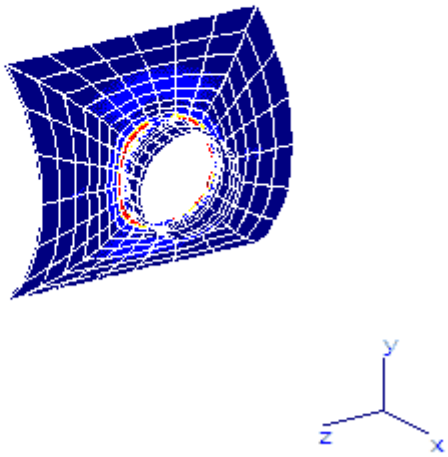

16) Pl+Pb+Q+F < Sa (EXP Outside) Case 4



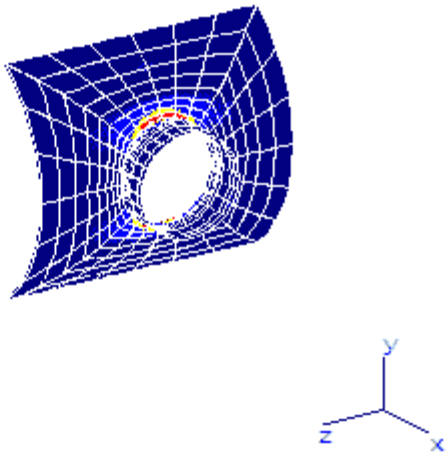
8) Pl+Pb+Q+F < Sa (SIF Outside) Case 5



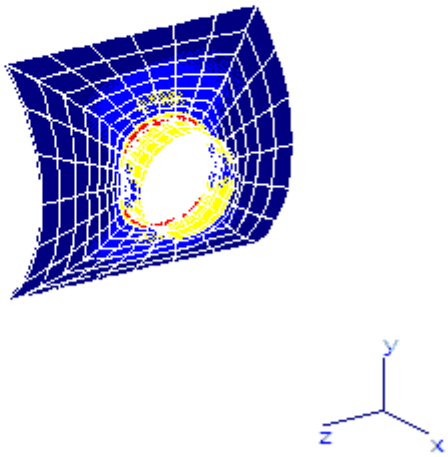

9) Pl+Pb+Q+F < Sa (SIF Outside) Case 6



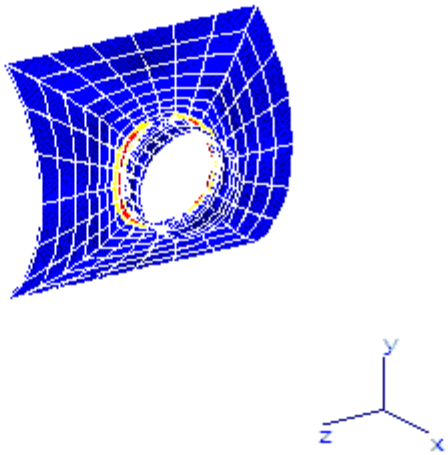
10) Pl+Pb+Q+F < Sa (SIF Outside) Case 7



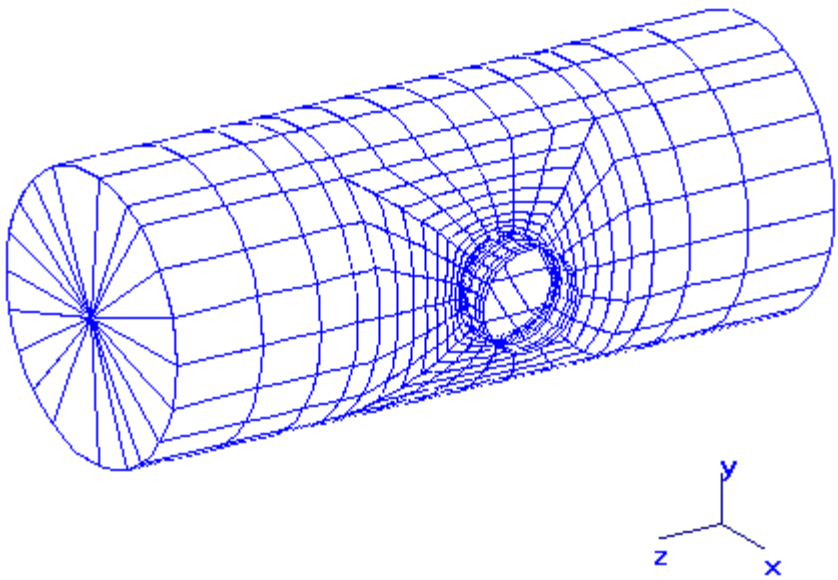

11) Pl+Pb+Q+F < Sa (SIF Outside) Case 8



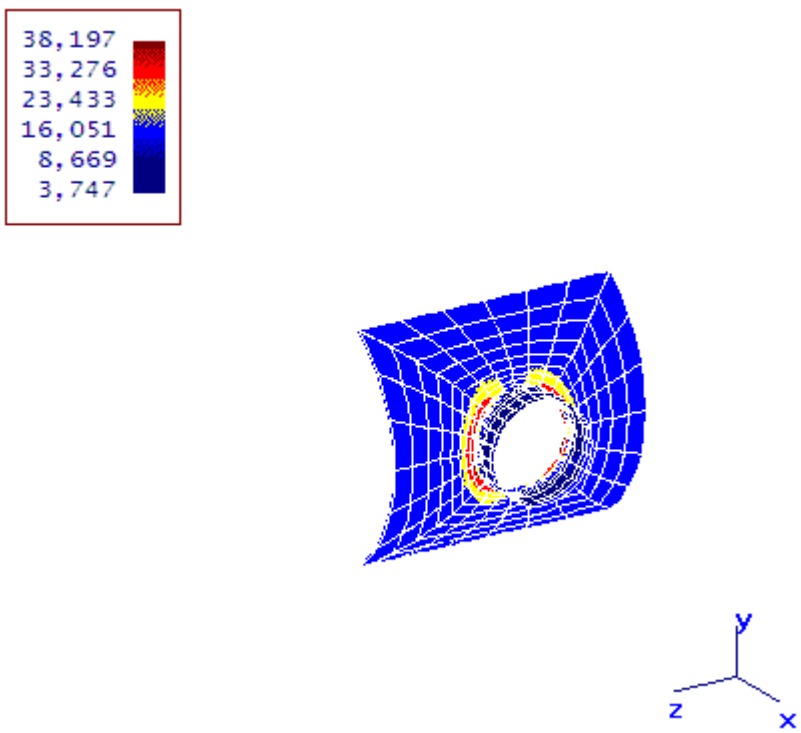
12) Pl+Pb+Q+F < Sa (SIF Outside) Case 9



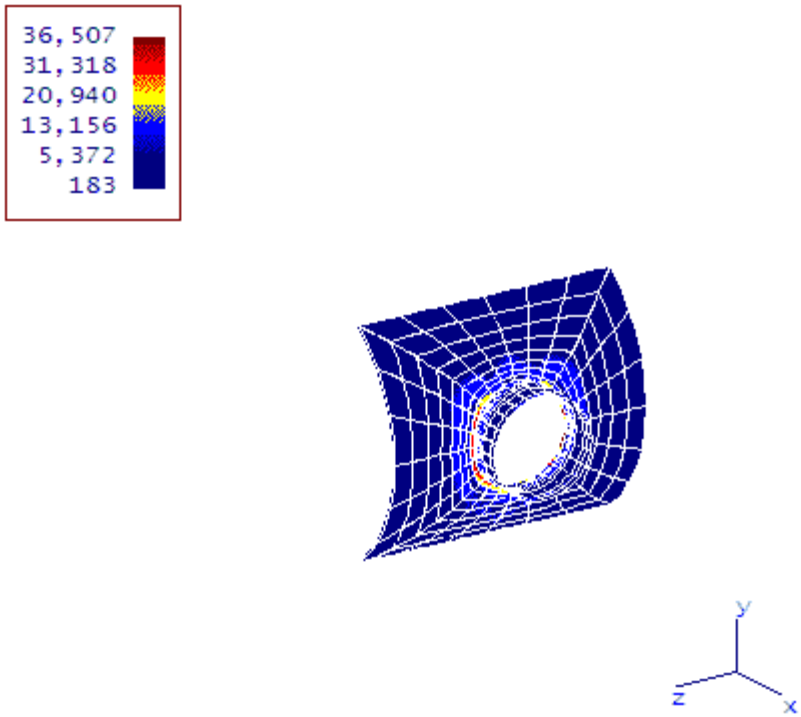
**Finite Element Model**



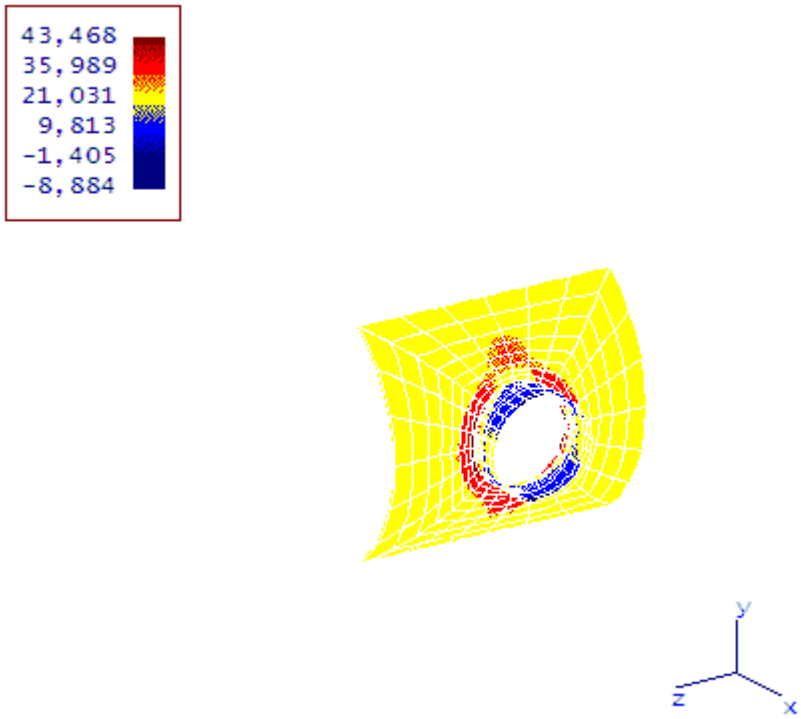

1) Pl < (1.5)(S) (SUS Membrane) Case 2



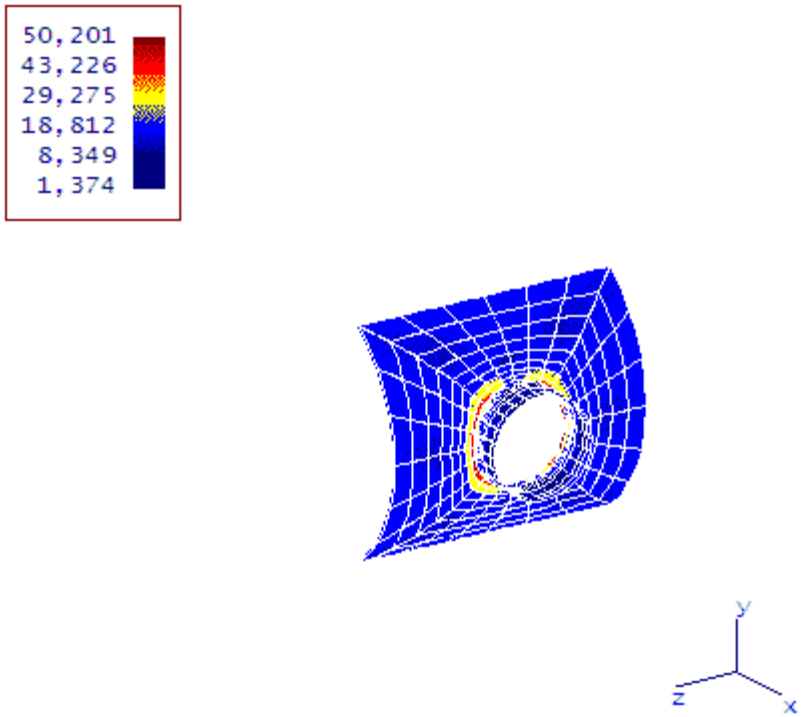
2) Qb < SPS (SUS Bending) Case 2



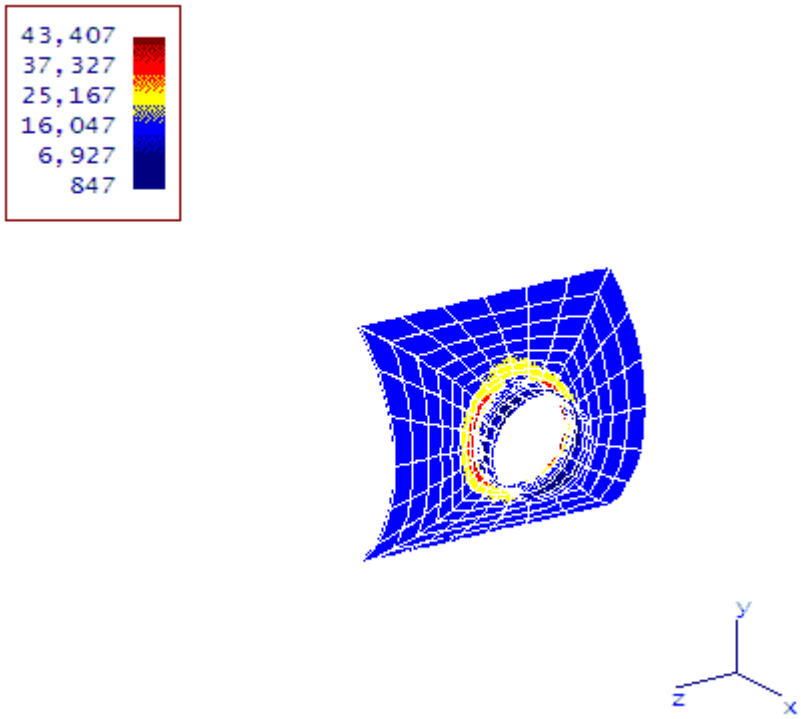

3) S1+S2+S3 < 4S (SUS S1+S2+S3) Case 2



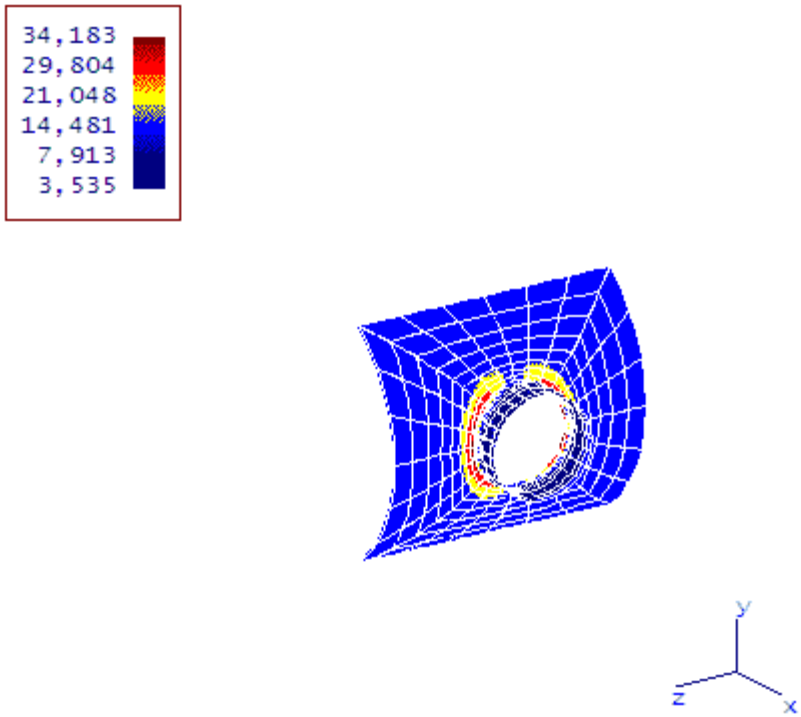
4) Pl+Pb+Q < SPS (OPE Inside) Case 3



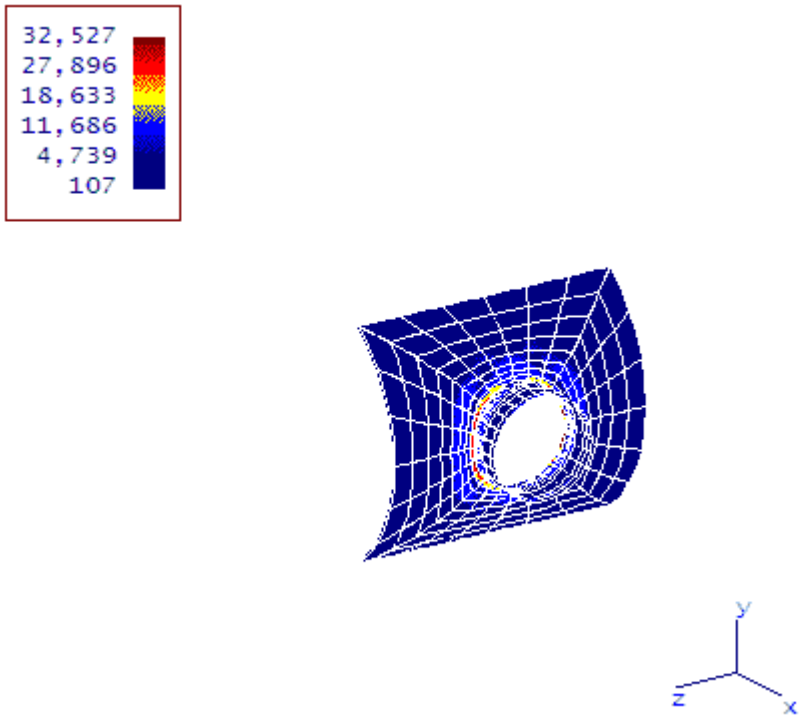

5) Pl+Pb+Q < SPS (OPE Outside) Case 3



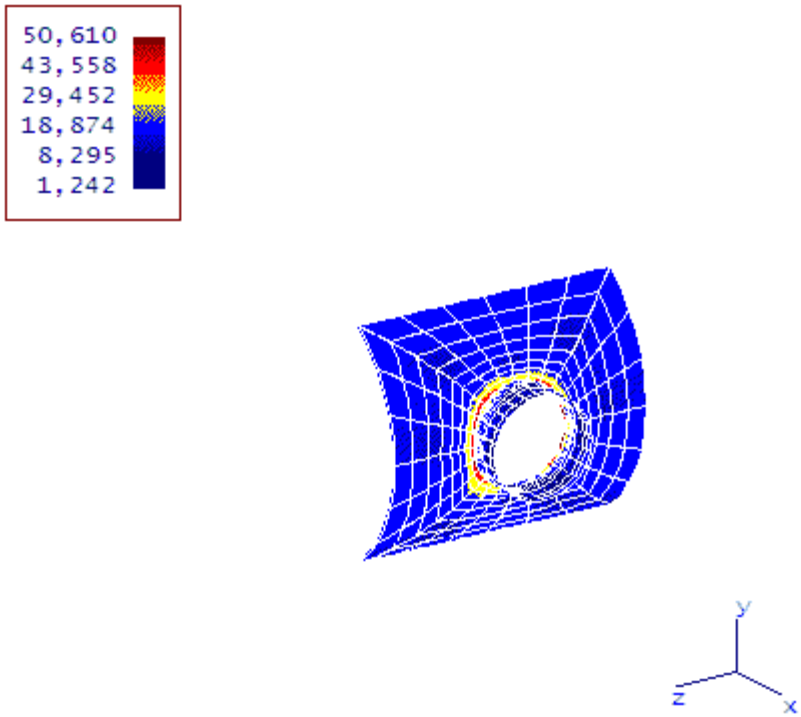
6) Membrane < User (OPE Membrane) Case 3




7) Bending < User (OPE Bending) Case 3



13) Pl+Pb+Q < SPS (EXP Inside) Case 4

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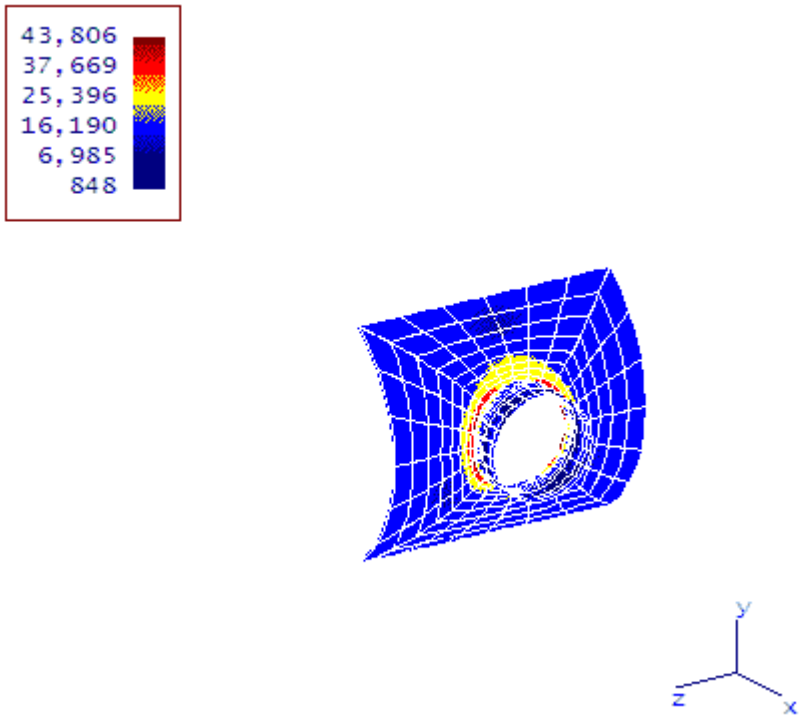

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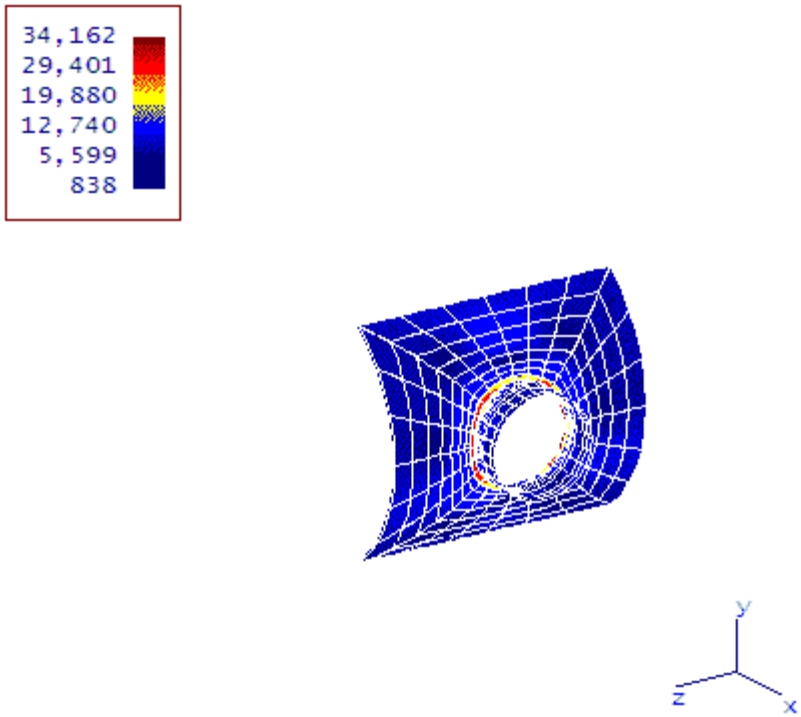


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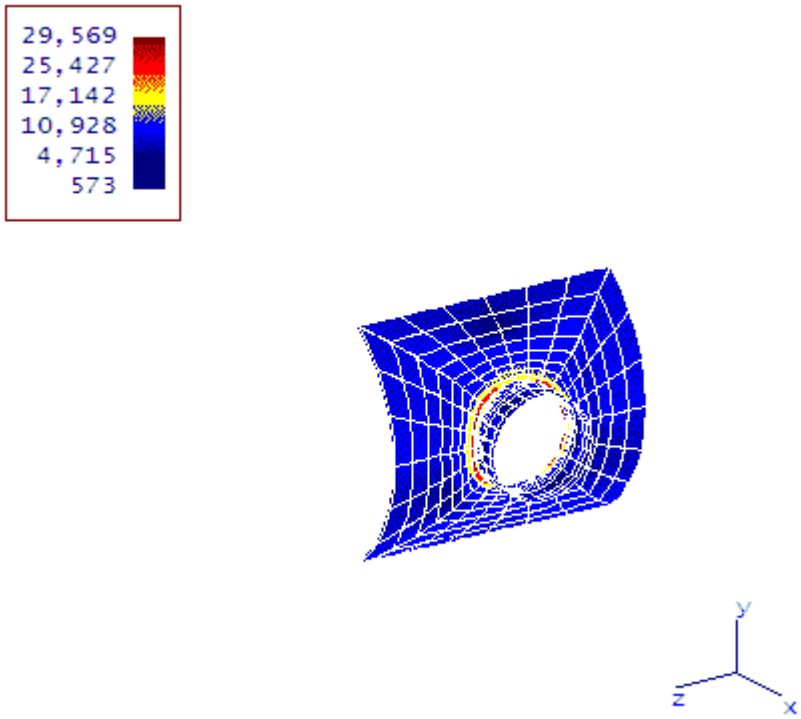
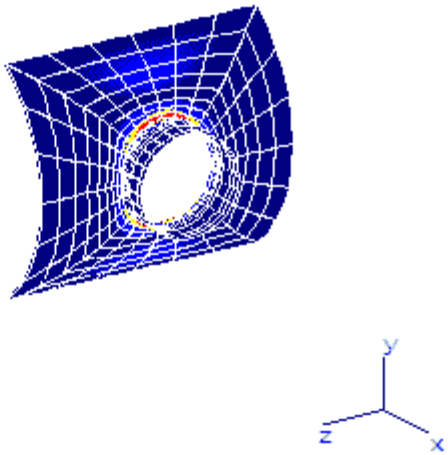
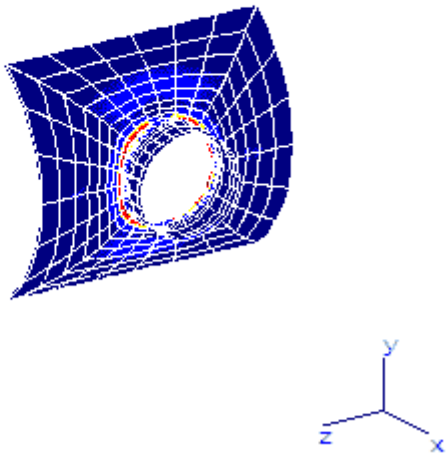


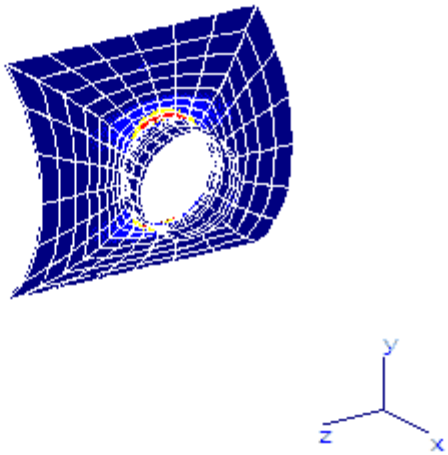
8) Pl+Pb+Q+F < Sa (SIF Outside) Case 5



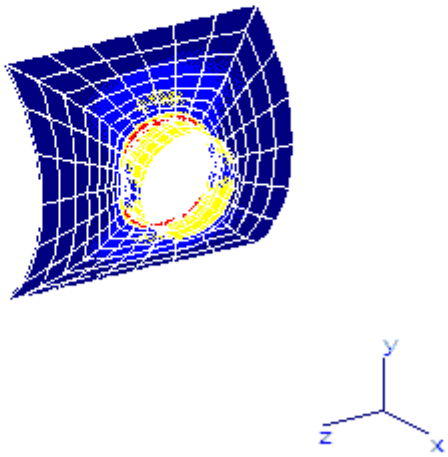
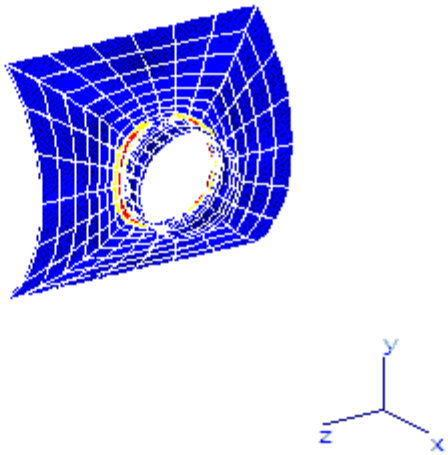

9) Pl+Pb+Q+F < Sa (SIF Outside) Case 6



10) Pl+Pb+Q+F < Sa (SIF Outside) Case 7




11) Pl+Pb+Q+F < Sa (SIF Outside) Case 8



12) Pl+Pb+Q+F < Sa (SIF Outside) Case 9