FABRICATION NEWS

April 1, 2023

BOARDMAN NEWSLETTER:

Your positive feedback to the newsletter we've sent out over the years is greatly appreciated. As STEWARDS for your Custom Fabrication needs, providing valuable education to the marketplace and building strong relationships is our primary focus. We promise to be your custom fabrication resource.

We hope you find this newsletter beneficial as we share tips in the pressure vessel design and construction process.

If there are any topics you would like us to address, please let us know

Nozzle Loads

Nozzle loads are the net forces and moments exerted on equipment nozzles from the weight, pressure, thermal expansion, occasional effects, etc. of connected piping and equipment.

Nozzle loads are a set of three forces and three moments with respect to three axes.

- Axial Load (Pr), Circumferential Shear (Vc), Longitudinal Shear (VL)
- Circumferential Moment (Mc), Longitudinal Moment (ML), Torsional Moment (Mt)

Nozzle Load Limits

Most EPC organizations follow a project-specific table as allowable values for the pressure vessel designer to use. Industry standards (such as API) may also be used, if allowable values are not provided. ASME VIII-1 provides design rules for nozzles subject to pressure. It also requires consideration of external loads such as those imposed by attached piping or equipment, but the Code does not provide rules for checking the external loads.

Nozzle load limits may be verified by the methods from WRC 107/537 and/or FEA.

External Loads Applied to Nozzle Standard Flange

When you consider external loadings on flange MAWP rating, you will determine an equivalent pressure for the specified nozzle loads and reduce the published ASME B16.5/B16.47 flange pressure rating by this value to determine the available working pressure. If the resultant pressure of the published ASME B16.5/B16.47 flange pressure rating minus the equivalent pressure for the specified nozzle loads is less than the MAWP of the vessel, this will cause the flange rating to increase.

ASME addressed external loads originally in Interpretation VIII-1-16-85, then Code Case 2901, and now in UG-44(b). UG-44(b) provides an analysis for evaluating external loads on standard B16.5/16.47 welding neck flanges. This analysis is very similar to the method describe in Appendix G of the "Pressure Vessel Design Manual" by Dennis R. Moss but with the inclusion of a "Moment Factor" (Fm). The moment factor applied in the analysis is obtained from Table UG-44-1.

Table UG-44-1
Moment Factor, F_M

Standard	Size Range	Flange Pressure Rating Class 150	300	600	900	1500	2500
ASME B16.5	≤NPS 12	1.2	0.5	0.5	0.5	0.5	0.5
	>NPS 12 and ≤NPS 24	1.2	0.5	0.5	0.3	0.3	...
ASME B16.47							
Series A	All	0.6	0.1	0.1	0.1	...	...
Series B	<NPS 48	[Note (1)]	[Note (1)]	0.13	0.13	...	...
	≥NPS 48	0.1	[Note (2)]	...	...	...	...

GENERAL NOTES:
(a) The combinations of size ranges and flange pressure classes for which this Table gives no moment factor value are outside the scope of this Table.
(b) The designer should consider reducing the moment factor if the loading is primarily sustained in nature and the bolted flange joint operates at a temperature where gasket creep/relaxation will be significant.

NOTES:
(1) $F_M = [0.1 + (48 - NPS)]/56$.
(2) $F_M = 0.1$, except for NPS 60, Class 300, in which case $F_M = 0.03$.

Question 1: Troubleshooting for a nozzle with high loads

Answer: Adjustments to consider during design:

- Increase weld size of neck to shell/head attachment
- Increase nozzle neck thickness
- Use a LWN, HB, etc. in lieu of pipe
- Add a repad
- Increase the welds for the pad and neck attachment
- Use any combination of the above

Question 2: What to do if the allowable nozzle loads increase your flange rating?
Answer: Boardman's engineering team will reach out in these situations to help find a solution. First, we will determine if increasing the flange rating is a possibility. If not, we will request the actual loads if the piping team has completed their analysis. If this information is unknown, we will provide the maximum values the flange can handle at the requested flange rating for your piping team to use in their design.

BOARDMAN'S 7th ANNUAL ENGINEERING SEMINAR: *PRESSURE VESSELS FOR THE 21ST CENTURY*

Boardman is COMMITTED TO EDUCATION for our clients and our employees. Our engineering seminar, *Pressure Vessels for the 21st Century* is recognized as the most impactful seminar for an engineer to deepen their ASME code knowledge and combine with the practical application of pressure vessel fabrication and shop experience. As *STEWARDS for YOUR Custom Fabrication Needs*, we are excited to have a great group attending our 2023 seminar on April 11-12! We will share the feedback from our 2023 event in our Q3 newsletter. If you have interest in upcoming seminars, or for Boardman to provide technical presentations at your location, please contact us.

We would love to hear from you and have an opportunity to quote your next project

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