Assumptions and Calculation Methodology for API 574, Fifth Edition Structural Thickness Tables

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1 Executive Summary

1.1 General

Pipe span calculations were performed to determine structural minimum thickness (T_{STRUCT}) values for various pipe sizes, pressure classes, materials, and temperatures. A large-scale finite element analysis (FEA) sensitivity study was performed to determine whether local stresses at pipe supports limit T_{STRUCT} for any cases. The intent was for the results to be used to update the structural thickness tables in API 574.

1.2 Critical Assumptions and Limitations

Critical assumptions were made to limit the number and complexity of the T_{STRUCT} calculations, resulting in limitations on using T_{STRUCT} results only for applicable piping systems. These critical limitations were developed in conjunction with the API 574 task group at the front end of this project through a series of meetings and are listed below:

a) Limited to 400 °F and 750 °F for carbon steel, 400 °F and 1000 °F for stainless steel, and 750 °F and 1100 °F for 1¼ Cr-½ Mo. Interpolation and extrapolation between tables and values is not advised.

b) Used the maximum allowable working pressure (MAWP) for the flange class per ASME B16.5 at the assessed temperature (e.g. carbon steel Class 300 used 635 psig at 400 °F).

c) The results assume an unsupported flange pair and valve at the midspan, plus an additional 250 lb:

   1) The 250 lb force was neglected for size NPS 2 and lower.

   2) The valve weight was neglected for pressure Classes 900 and greater. Tables are not applicable if the system has Class 900 and higher valves that are not individually supported.

   3) ASME B16.5 does not have standard flanges for pressure Class 2500 and sizes NPS 14 and greater; thus, flange weight was neglected. These tables are not applicable for systems with class 2500 NPS 14 and larger flanges.

d) The results are limited to the maximum span lengths listed in this technical report, which align with ASME B31.1 span lengths for water-filled piping but with a max span length of 20 ft. These tables are not applicable when your span lengths exceed those shown.

e) The results for 1¼ Cr-½ Mo assume a weld strength reduction factor equal to 1.0.

f) The results for Class 150 for stainless steel and 1¼ Cr-½ Mo materials may be limited by local support stresses not captured in these results.

   NOTE The local support FEA work was performed only for carbon steel pipe but was extended to stainless steel and 1¼ Cr-½ Mo materials.

g) The results for Class 150 and sizes less than NPS 10 may be limited by local support stresses not captured in these results.

   NOTE The local support FEA work was performed only for carbon steel pipe NPS 10 to NPS 24 to minimize the scope of work. It was expected that larger pipe with higher D/t ratios would govern this buckling check and the smaller sizes would not be limited by buckling. However, the results indicated buckling governed NPS 10 to NPS 24 for the Class 150 conditions. Local support stresses may govern at sizes lower than NPS 10 as the FEA results did not identify at what pipe size buckling would not govern.