Design Calculations for Pressure-containing Equipment

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Suggested revisions are invited and should be submitted to the Standards Department, API, 1220 L Street, NW, Washington, DC 20005, standards@api.org.

Contents

Introduction

This standard is intended to document the design methodology from the ASME *Boiler and Pressure Vessel Code*, Section VIII, Division 2, Appendix 4, which has been used in the oil and gas industry since the 15th Edition of API Specification 6A was published in 1986.

API 6A modified the rules of the ASME *Code* to permit higher stresses than were allowed by ASME. API 6A adopted a design stress intensity of two thirds of the minimum specified yield strength.

Shortly after the 15th Edition of API 6A was published, API released the First Edition of API Specification 16A, *Specification for Drill-through Equipment.* API 16A permitted higher stresses than API 6A at hydrostatic test. Where API 6A limited the membrane stress intensity to 83 % of the minimum specified yield strength, API 16A permitted 90 % of yield strength.

With the 19th Edition of API 6A in 2004, the design stress intensity of high-strength non-standard materials was changed to the lower of two thirds of the yield strength or one half of the tensile strength. API 16A did not make this change.

In 2007, ASME totally rewrote Section VIII, Division 2, using generally more liberal design requirements and more stringent material requirements. A joint task group from SC 6, SC 16, and SC 17 reviewed the new ASME *Code* and recommended that, since the earlier design and material requirements have been used successfully for over 25 years, API should continue to reference the 2004 ASME *Code*. This recommendation was accepted by SC 6, SC 16, and SC 17.

The methods included in this document are those of the 2004 ASME *Code*, as modified by an API Design Task Group.

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1 Scope

This standard describes a design analysis methodology and requirements that apply to design verification of certain pressure-containing products and equipment in the oil and gas industry. The methods included in this document apply to designs where normative reference to this standard is made in an API product specification and to those components for which the methods of this standard are required or permitted.

This standard is based on ASME *Boiler and Pressure Vessel Code*, Section VIII, Division 2, Appendix 4 (2004 edition with 2005 and 2006 addenda) but includes further limits established for oil and gas products as determined by API standardization committees. It includes closed-form solutions and methods for elastic analysis, elastic-plastic analysis, and guidance on finite element analysis methods. The methodology assumes ductile metallic material behavior and has no provision for material defects.

Fatigue analysis is outside the scope of this document.

2 Normative References

No other document is identified as indispensable or required for the application of this standard.

3 Terms, Definitions, and Symbols

3.1 Terms and Definitions

For the purpose of this document the following terms and definitions apply.

3.1.1
extreme conditions
Conditions due to specified events including seismic loading, wind loading, and wave loading in which loading is additive to the normal loading at operating conditions. See 4.4.2.4.

3.1.2
gross distortion
Distortion to the extent that the product no longer functions as intended.

3.1.3
gross structural discontinuity
Change in vessel shape, such as the junction of a cylinder and cone or a cylinder and head.

3.1.4
operating conditions
Any combination of internal and external pressures, temperatures, and applied loading to which the product is to be exposed in service, excluding hydrostatic shell testing.

3.1.5
pressure-containing
Component whose failure to function as intended results in a release of retained fluid to the atmosphere.

3.1.6
ratcheting
Progressive plastic deformation caused by cyclical thermal and/or mechanical stresses.