Materials and Fabrication of $1^{1}/_{4}$Cr-$^{1}/_{2}$Mo Steel Pressure Vessels for Service Above 825 °F (440 °C)

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Introduction

This standard applies to new pressure vessels in petroleum refining, petrochemical, industrial gas, and chemical facilities in which fluids are processed at temperatures in the 825 °F to 1150 °F (440 °C to 620 °C) range. It is based on decades of industry operating experience and the results of recent experimentation and testing conducted by independent manufacturers, fabricators, and users of pressure vessels for this service.

Licensors and owners of process units in which these pressure vessels are to be used may modify or supplement this standard with additional proprietary requirements.

Materials and Fabrication of 1¼Cr-½Mo Steel Pressure Vessels for Service above 825 ˚F (440 ˚C)

1 Scope

This standard includes materials and fabrication requirements for new 1¼Cr-½Mo and 1Cr-½Mo steel pressure vessels, including heat exchanger shells and channels for elevated temperature service. It applies to pressure vessels that are designed, fabricated, and documented in accordance with ASME Code Section VIII, Division 1 or Division 2 (hereafter referred to as “Code”).

This document may also be used as a resource when planning to modify existing pressure vessels.

Interior surfaces of these pressure vessels and heat exchangers (i.e., surfaces exposed to the process) may or may not have an austenitic stainless steel (SS), ferritic SS, or nickel alloy weld overlay or cladding to provide additional corrosion resistance.

Some 1¼Cr-½Mo and 1Cr-½Mo vessel components with thicknesses greater than 4 in. (100 mm) have been shown to have difficulty meeting the Code toughness requirements. This standard is primarily intended for wall thicknesses less than 4 in. (100 mm); a preferred option for thicker vessel components is to use 2¼Cr-1Mo alloys.

This standard is applicable to shell thicknesses greater than 1 in. (25 mm). Although outside of the scope, this document can be used as a resource for pressure vessels less than 1 in. (25 mm) in shell thickness, with changes defined by the purchaser.

This standard is intended for use for 1¼Cr-½Mo and 1Cr-½Mo equipment operating between 825 °F (440 °C) and 1150 °F (620 °C). The primary in-service materials degradation mechanism addressed by requirements herein is low creep ductility (LCD) cracking, which can occur at these operating temperatures if not properly addressed. LCD cracking is a form of reheat cracking.

In many cases, 1¼Cr-½Mo and 1Cr-½Mo steel equipment being designed for temperatures >825 °F (>440 °C) operate with stresses below the threshold for brittle fracture [i.e., below 10% of ultimate tensile strength (UTS) as reported in API 579-1/ASME FFS-1 and WRC 528 and 599].

Typical equipment covered by the scope of this standard includes catalytic reforming reactors and fluidized catalytic cracking (FCC) unit hot wall reactors. For information on 1¼Cr-½Mo and 1Cr-½Mo equipment operating at lower temperature ranges, refer to API 934-C. Since hydroprocessing units are typically operated at temperatures lower than 825 °F (440 °C), the guidelines in this standard (934-E) do not apply to most hydroprocessing units; instead, they are covered by API 934-A or API 934-C. Also, since coke drums typically are more susceptible to fatigue than LCD cracking, this standard excludes coke drums from the scope; they are addressed in API 934-G and API 934-J.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Recommended Practice 582, *Welding Guidelines for the Chemical, Oil, and Gas Industries*