

**Materials and Fabrication of  
2 1/4Cr-1Mo, 2 1/4Cr-1Mo-1/4V,  
3Cr-1Mo, and 3Cr-1Mo-1/4V  
Steel Heavy Wall Pressure  
Vessels for High-temperature,  
High-pressure Hydrogen Service**

API RECOMMENDED PRACTICE 934-A  
SECOND EDITION, MAY 2008

ADDENDUM 1, FEBRUARY 2010  
ADDENDUM 2, MARCH 2012



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**Downstream Segment**

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## Introduction

This recommended practice applies to new heavy wall pressure vessels in petroleum refining, petrochemical, and chemical facilities in which hydrogen or hydrogen-containing fluids are processed at elevated temperature and pressure. It is based on decades of industry operating experience and the results of experimentation and testing conducted by independent manufacturers and purchasers of heavy wall pressure vessels for this service.

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

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# Materials and Fabrication of 2 1/4Cr-1Mo, 2 1/4Cr-1Mo-1/4V, 3Cr-1Mo, and 3Cr-1Mo-1/4V Steel Heavy Wall Pressure Vessels for High-temperature, High-pressure Hydrogen Service

## 1 Scope

This recommended practice presents materials and fabrication requirements for new 2 1/4Cr and 3Cr steel heavy wall pressure vessels for high-temperature, high-pressure hydrogen service. It applies to vessels that are designed, fabricated, certified, and documented in accordance with ASME *BPVC*, Section VIII, Division 2, including Section 3.4, Supplemental Requirements for Cr-Mo Steels and ASME Code Case 2151, as applicable. This document may also be used as a resource when planning to modify an existing heavy wall pressure vessel.

A newer ASME *BPVC*, Section VIII, Division 3, is available and has higher design allowables, however it has much stricter design rules (e.g. fatigue and fracture mechanics analyses required) and material testing requirements. It is outside the scope of this document.

Materials covered by this recommended practice are conventional steels including standard 2-1/4Cr-1Mo and 3Cr-1Mo steels, and advanced steels which include 2 1/4Cr-1Mo-1/4V, 3Cr-1Mo-1/4V-Ti-B, and 3Cr-1Mo-1/4V-Nb-Ca steels. This document may be used as a reference document for the fabrication of vessels made of enhanced steels (steels with mechanical properties increased by special heat treatments) at purchaser discretion. However, no attempt has been made to cover specific requirements for the enhanced steels.

The interior surfaces of these heavy wall pressure vessels may have an austenitic stainless steel weld overlay lining to provide additional corrosion resistance. A stainless clad lining using a roll-bonded or explosion-bonded layer on Cr-Mo base metal may be acceptable, but is outside the scope of this document.

## 2 References

The following referenced documents are cited in 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 RP 582, *Welding Guidelines for the Chemical, Oil, and Gas Industries*

ASME<sup>1</sup> *Boiler and Pressure Vessel Code*, Section II—*Materials*; Part A—*Ferrous Material Specifications*; Part C—*Specifications for Welding Rods, Electrodes and Filler Metals*; Part D—*Properties*

ASME *Boiler and Pressure Vessel Code*, Section V—*Nondestructive Examination*

ASME *Boiler and Pressure Vessel Code*, Section VIII—*Rules for Construction of Pressure Vessels, Division 1*

ASME *Boiler and Pressure Vessel Code*, Section VIII—*Rules for Construction of Pressure Vessels, Division 2—Alternative Rules*

ASME *Boiler and Pressure Vessel Code*, Section IX—*Welding and Brazing Qualifications*

ASME Code Case 2151-1, *3 Chromium-1 Molybdenum-1/4 Vanadium-Columbium-Calcium Alloy Steel Plates and Forgings*

ASME SA-20, *Standard Specification for General Requirements for Steel Plates for Pressure Vessels*

<sup>1</sup>ASME International, 3 Park Avenue, New York, New York 10016, www.asme.org.