



**Recommended  
Practices for Welding of  
Chromium-Molybdenum  
Steel Piping and  
Tubing**



**American Welding Society**

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**Approved by**  
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# **Recommended Practices for Welding of Chromium-Molybdenum Steel Piping and Tubing**

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AWS Committee on Piping and Tubing

Under the Direction of  
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Approved by  
AWS Board of Directors

## **Abstract**

This document presents recommendations for welding chromium-molybdenum steel pipe and tubing to itself and to various other materials. Subjects covered in detail are filler metal selection, joint design, preheating, and postheating. Particular emphasis is placed on the importance of maintaining interpass temperature and dangers inherent in interrupted heating cycles.



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# Recommended Practices for Welding of Chromium-Molybdenum Steel Piping and Tubing

## 1. Scope

These recommended practices apply to the arc welding of the following base-metal combinations:

- (1) Similar chromium-molybdenum steels
- (2) Dissimilar chromium-molybdenum steels
- (3) Chromium-molybdenum to austenitic chromium-nickel stainless steels
- (4) Chromium-molybdenum to either carbon or carbon-molybdenum steels

In this document, the chromium-molybdenum steel alloys are referred to as Cr-Mo steels.

Cr-Mo steels are used extensively in the power, chemical, and petroleum industries. The properties of such piping and tubing materials and the applicable fabrication and inspection requirements are addressed in a wide range of documents, including:

- (1) ASTM Material Specifications
- (2) ASME Codes for Pressure Piping, B31
  - (a) Power Piping (ANSI/ASME B31.1)
  - (b) Chemical Plant and Petroleum Refinery Piping (ANSI/ASME B31.3)
- (3) ASME Boiler and Pressure Vessel Codes (Sections I, IIA, IIC, VIII, and IX)
- (4) NBIC National Board Inspection Code for Boilers and Pressure Vessels (ANSI/NB-23)
- (5) API Piping Inspection Code (Inspection, Repair, Alteration and Rerating of In-Service Piping Systems), (API 570).

## 2. Base Metals

**2.1 General.** Table 1 lists the types of steel considered and the nominal chemical compositions and abbreviations by which they will be identified in this document. If materials not listed in Table 1 are used, the contents of

**Table 1**  
**Base Metal Abbreviations**

| Types of Steel                   |                         |              |
|----------------------------------|-------------------------|--------------|
| Nominal Composition              | ASME/<br>ASTM<br>Grade* | Abbreviation |
| Carbon Steel (less than 0.35% C) | A, B, or C              | C-steel      |
| Carbon—1/2% Mo                   | P1 or T1                | C-Mo         |
| 1/2% Cr—1/2% Mo                  | P2 or T2                | 1/2 Cr-Mo    |
| 1% Cr—1/2% Mo                    | P12 or T12              | 1 Cr-Mo      |
| 1-1/4% Cr—1/2% Mo                | P11 or T11              | 1-1/4 Cr-Mo  |
| 2% Cr—1/2% Mo                    | T3b                     | 2 Cr-Mo      |
| 2-1/4% Cr—1% Mo                  | P22 or T22              | 2-1/4 Cr-Mo  |
| 3% Cr—1% Mo                      | P21 or T21              | 3 Cr-Mo      |
| 5% Cr—1/2% Mo                    | P5 or T5                | 5 Cr-Mo      |
| 7% Cr—1/2% Mo                    | P7 or T7                | 7 Cr-Mo      |
| 9% Cr—1% Mo                      | P9 or T9                | 9 Cr-Mo      |
| 9% Cr—1% Mo-V, Nb, and N         | P91 or T91              | 9Cr-Mo-V     |
| 18% Cr—8% Ni                     | TP-304                  | 304 S. S.    |
| 18% Cr—12% Ni-Mo                 | TP-316                  | 316 S. S.    |
| 18% Cr—10% Ni-Nb (Cb)            | TP-347                  | 347 S. S.    |
| 18% Cr—10% Ni-Ti                 | TP-321                  | 321 S. S.    |
| 25% Cr—20% Ni                    | TP-310                  | 310 S. S.    |

\*Table uses Symbols P (pipe), T (tube), and TP (tube or pipe). Other product forms with same nominal chemistry for which this document applies are CP (cast pipe), F (forging), FP (forged pipe), and WP (welded pipe).

this document may not apply. This will be especially true if the hardenability is increased by the presence of a higher carbon content. The carbon content of the materials listed is usually below 0.15 percent.

The primary factors governing the choice of filler metals are the composition of the base metals to be joined and the service conditions of the system. Generally, the filler metal composition and the mechanical properties of the deposited weld metal should match