

# Codes, Standards, Regulations & Recommended Practices

## United States

### American Society of Mechanical Engineers (ASME Codes)

ASME Section I ..... Power Boilers  
 ASME Section II ..... Materials  
 ASME Section III ..... Rules for Construction of Nuclear Power Plant Components  
 ASME Section IV ..... Heating Boilers  
 ASME Section V ..... Non-destructive Testing  
 ASME Section VI ..... Recommended Rules for Care and Operation of Heating Boilers  
 ASME Section VII ..... Recommended Guidelines for Care of Power Boilers  
 ASME Section VIII ..... Pressure Vessels - Division I  
 ASME Section IX ..... Welding and Brazing Qualifications  
 Section IX sets the requirements for writing a Welding Procedure Specification (WPS), testing the WPS through a Procedure Qualification Record and testing the weld through a Welder Performance Qualification. All of the ASME Codes refer to this document.  
 ASME Section X ... Fiber Reinforced Plastic Pressure Vessels  
 ASME Section XI ..... Rules for In-service Inspection of Nuclear Power Plant Components  
 ASME Section XII ..... Rules for the Construction and Continued Service of Transport Tanks  
 ASME B31.1 ..... Power Piping  
 Covers boiler external piping for steam or vapor above 15 psig and high temperature water exceeding 160 psig and/or temperatures exceeding 250 F. Full penetration is required for all groove welds. Visual Inspection is required for all welds. Radiographic Testing or Ultrasonic Testing is

required if the temperature exceeds 750 F or if the temperatures are between 350F and 750 F with pressures over 1025 psig.  
 ASME B31.2 ..... Fuel Gas Piping  
 Applies to piping systems for fuel gases. These gases include manufactured gas, liquefied petroleum gas, natural gas, and mixtures above the upper combustible limits. The piping systems that are covered by this code may be in or between buildings from the meter set to the first pressure containment valve.  
 ASME B31.3 ..... Process Piping  
 This code covers piping in chemical plants. The quality of the weld is set by the owner's determination of the safety aspects of the fluid being contained.  
 ASME B31.4 ..... Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids  
 This code covers piping for liquid petroleum products such as crude oil and gasoline.  
 ASME B31.5 ..... Refrigeration Piping and Heat Exchanger Components  
 This code applies to refrigerant and brine piping systems. It does not include self-contained or unit refrigeration systems that are subject to UL specifications.  
 ASME B31.8 ..... Gas Transmission and Distribution Piping Systems  
 Applies to regulating stations, gas compressor stations, gas mains and service lines up to the end users meter set.  
 ASME B31.9 ..... Building Services  
 Covers building services for heating and cooling water, condensing water, steam, vacuum, compressed air, combustible liquids and non-flammable gases. Boiler external piping has a max of 15 psig for steam boilers and for water heating units the max is 160 psig and 250F. There is a maximum size for materials. For example carbon steel can not exceed 30" NPS or 0.50" wall. All welds must be VT although 100% penetrant is not required.

### American Society for Non-Destructive Testing (ASNT Codes)

SNT-TC-1A-2011 ..... Recommended Practice No. SNT-TC-1A: Personnel Qualification and Certification in Non-Destructive Testing (2011)  
 This program is a guideline to assist employers to establish their own in-house certification program. It is a set of recommendations for the qualification and certification of NDT personnel. It also provides recommended educational, experience and training for the NDT methods.  
 ANSI/ASNT-CP 189-2011 ..... ASNT Standard for Qualification and Certification of Non-Destructive Testing Personnel (2011).  
 This document is a Standard which establishes minimum requirements for the qualification and certification of non-destructive testing and predictive maintenance personnel. It also details the minimum training, education, and experience requirements for NDT personnel and provides criteria for documenting qualifications and certification.

### American Welding Society (AWS Codes)

AWS D1.1 ..... Structural Welding Code - Steel  
 Covers the design, welding and examination of welded structural steel 1/8" and thicker. It allows for both pre-qualified and non-prequalified welding procedure.  
 AWS D1.2 ..... Structural Welding Code - Aluminum  
 Covers the welding of structural aluminum. All procedures must be qualified before use. This Code does not contain any pre-qualified welding procedures.  
 AWS D1.3 ..... Structural Welding Code - Sheet Steel  
 Covers the welding of structural sheet steel less than 3/16".  
 AWS D1.4 ..... Structural Welding Code - Reinforcing Steel  
 Covers the welding of Reinforcing Steel.

AWS D1.5 . . . . . Bridge Welding Code  
This code covers the welding fabrication requirements applicable to welded highway bridges. The Code does not apply to steels that are less than 3mm in thickness.

AWS D1.6 . . . . . Structural Welding Code - Stainless Steel  
This Code applies to the welding of structural stainless steel.

AWS D1.7 . . . . . Structural Welding Code - Strengthening and Repair

AWS D1.8 . . . Structural Welding Code - Seismic Supplement

AWS D1.9 . . . . . Structural Welding Code - Titanium

AWS D8.1 . . . . . Automotive Spot Welding Code

AWS D8.6 . . . . . Automotive Spot Welding Electrodes Supplement

AWS D8.7 . . . Automotive Spot Welding Recommendations Supplement

AWS D8.8 . . . . . Automotive Arc Welding (Steel) Code

AWS D8.9 . . . . . Automotive Spot Weld Testing

AWS D8.14 . . . . Automotive Arc Welding (Aluminum) Code

AWS D9.1 . . . . . Sheet Metal Welding Code

AWS D10.10 . . . . Heating Practices for Pipe and Tube

AWSD10.11 . . . . . Root Pass Welding for Pipe

AWSD10.12 . . . . . Pipe Welding (Mild Steel)

AWSD10.13 . . . . . Tube Brazing (Copper)

AWSD10.18 . . . . . Pipe Welding (Stainless Steel)

AWSD11.2 . . . . . Welding (Cast Iron) Code

AWSD14.1 . . . . . Industrial Mill Crane Welding

AWSD14.3 . . Earthmoving & Agricultural Equipment Welding

AWSD14.4 . . . . . Machinery Joint Welding

AWSD14.5 . . . . . Press Welding Code

AWS-D14.6 . . . . . Industrial Mill Roll Surfacing

AWSD15.1 . . . . . Railroad Welding Code

AWSD15.2 . . . . . Railroad Welding Practice Supplement

AWSD16.1 . . . . . Robotic Arc Welding Safety

AWSD16.2 . . . . . Robotic Arc Welding System Installation

AWSD16.3 . . . . . Robotic Arc Welding Risk Assessment

AWSD16.4 . . . . Robotic Arc Welder Operator Qualification

AWSD17.1 . . . . . Aerospace Fusion Welding

AWSD17.2 . . . . . Aerospace Resistance Welding

AWSD18.1 . . . . . Hygienic Tube Welding (Stainless Steel)

AWSD18.2 . . . . . Stainless Steel Tube Discoloration Guide

AWSD18.3 . . . . . Hygienic Equipment Welding

**American Petroleum Institute (API Codes)**

API Standard 1104 . . . . . Welding Pipelines and Related Facilities

API Standard 620 . . . . . Design and Construction of Large, Welded, Low Pressure Storage Tanks

API Standard 653 . . . . . Tank Inspection, Repair, Alteration and Reconstruction

API Standard 650 . . . . . Welded Steel Tanks for Oil Storage

API Spec 5L . . . . . Specification for Line Pipe

API Spec 6D . . . . . Specification for Pipeline Valves

**American Society for Testing and Materials (ASTM codes)**

E94-04(2010) . . . . . Standard Guide for Radiographic Examination

E114-10 . . . . . Standard Practice for Ultrasonic Pulse-Echo Straight-Beam Contact Testing

E164-08 . . . . . Standard Practice for Contact Ultrasonic Testing of Weldments

E165-09 . . . . . Standard Practice for Liquid Penetrant Examination for General Industry

E213-09 . . . . . Standard Practice for Ultrasonic Testing of Metal Pipe and Tubing

E273-10 . . . . . Standard Practice for Ultrasonic Testing of the Weld Zone of Welded Pipe and Tubing

E309-11 . . . . . Standard Practice for Eddy-Current Examination of Steel Tubular Products Using Magnetic Saturation

E426-98(2007) . . . . Standard Practice for Electromagnetic (Eddy-Current) Examination of Seamless and Welded Tubular Products, Austenitic Stainless Steel and Similar Alloys

E566-09 . . . . . Standard Practice for Electromagnetic (Eddy-Current) Sorting of Ferrous Metals

E587-10 . . . . . Standard Practice for Ultrasonic Angle-Beam Contact Testing

E703-09 . . . . . Standard Practice for Electromagnetic (Eddy-Current) Sorting of Nonferrous Metals

E709-08 . . . . . Standard Guide for Magnetic Particle Testing

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E797/E797M-10 . . . . . Standard Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method	E1570-11 . . . . . Standard Practice for Computed Tomographic (CT) Examination	E2662-09 . . . Standard Practice for Radiologic Examination of Flat Panel Composites and Sandwich Core Materials Used in Aerospace Applications
E999-10 . . . . Standard Guide for Controlling the Quality of Industrial Radiographic Film Processing	E1742/E1742M-11 . . . . . Standard Practice for Radiographic Examination	E2663-08 . . . . . Standard Practice for Digital Imaging and Communication in Non-Destructive Evaluation (DICONDE) for Ultrasonic Test Methods
E1000-98(2009) . . . . . Standard Guide for Radioscopy	E1815-08 . . . . . Standard Test Method for Classification of Film Systems for Industrial Radiography	E2698-10 . . . . . Standard Practice for Radiological Examination Using Digital Detector Arrays
E1030-05(2011) . . . Standard Test Method for Radiographic Examination of Metallic Castings	E1901-08 . . . . . Standard Guide for Detection and Evaluation of Discontinuities by Contact Pulse-Echo Straight-Beam Ultrasonic Methods	E2700-09 . . . . . Standard Practice for Contact Ultrasonic Testing of Welds Using Phased Arrays
E1032-06 . . . . . Standard Test Method for Radiographic Examination of Weldments	E2007-10 . . . . Standard Guide for Computed Radiography	E2736-10 . . . . . Standard Guide for Digital Detector Array Radiology
E1065-08 . . . . . Standard Guide for Evaluating Characteristics of Ultrasonic Search Units	E2033-99(2006) . . . . . Standard Practice for Computed Radiology (Photostimulable Luminescence Method)	
E1212-09 . . . . Standard Practice for Quality Management Systems for Non-Destructive Testing Agencies	E2192-08 . . . . . Standard Guide for Planar Flaw Height Sizing by Ultrasonics	
E1255-09 . . . . . Standard Practice for Radioscopy	E2373-09 . . . . Standard Practice for Use of the Ultrasonic Time of Flight Diffraction (TOFD) Technique	
E1316-11a . . . . . Standard Terminology for Non-Destructive Examinations	E2375-08 . . . . . Standard Practice for Ultrasonic Testing of Wrought Products	
E1411-09 . . . . . Standard Practice for Qualification of Radioscopic Systems	E2445-05(2010) . . . . . Standard Practice for Qualification and Long-Term Stability of Computed Radiology Systems	
E1416-09 . . . . . Standard Test Method for Radioscopic Examination of Weldments	E2446-05(2010) . . . . Standard Practice for Classification of Computed Radiology Systems	
E1417-05e1 . . . . . Standard Practice for Liquid Penetrant Testing	E2491-08 . . . . Standard Guide for Evaluating Performance Characteristics of Phased Array Ultrasonic Testing Instruments and Systems	
E1441-11 . . . . . Standard Guide for Computed Tomography (CT) Imaging		
E1444-05 . . . . . Standard Practice for Magnetic Particle Testing		

## Canada

### Canadian Standards Association (CSA Codes)

CSA W47.1 . . . . . Certification of Companies for Fusion Welding of Steel
CSA W59 . . . . . Welded Steel Construction (Metal Arc Welding)
CSA W59.2 . . . . . Welded Aluminum Construction

## Europe

### European Welding Standards

EN ISO 5817 . . . . . Welding – Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections

EN ISO 6520-1/2 . . . . . Welding and allied processes – Classification of geometric imperfections in metallic materials – Parts 1 and 2

EN ISO 6520-2

EN ISO 10863 . . . . . Non-destructive testing of welds – Use of time-of-flight diffraction technique (TOFD)

EN ISO 10893-112 . . . . . Non-destructive testing of steel tubes – Parts 1-12

EN ISO 10893-12

EN ISO 11666 . . . . . Non-destructive testing of welds – Ultrasonic testing of welded joints – Acceptance levels

prEN ISO 12932 . . . . . Welding – Laser-arc hybrid welding of steels, nickel and nickel alloys – Quality levels for imperfections

prEN ISO 13588 . . . . . Non-destructive testing of welds – Ultrasonic testing – Use of automated Phased Array technology

EN ISO/NP 17405 . . . . . Non-destructive testing - Ultrasonic testing - Technique of testing claddings produced by welding, rolling and explosion

EN ISO 17635 . . . . . Non-destructive testing of welds – General rules for metallic materials

prEN ISO 17636-1 . . . . . Non-destructive testing of welds – Radiographic examination of welded joints – Part 1: Industrial films

prEN ISO 17636-2 . . . . . Non-destructive testing of welds – Radiographic examination of welded joints – Part 2: Imaging plates

EN ISO 17637 . . . . . Non-destructive testing of welds – Visual testing of fusion-welded joints

EN ISO 17638 . . . . . Non-destructive testing of welds – Magnetic particle testing

EN ISO 17640 . . . . . Non-destructive testing of welds - Ultrasonic testing - Techniques, testing levels, and assessment

prEN ISO 19232-15 . . . . . Non-destructive testing – Image quality of radiographs – Parts 1-5: Image quality indicators (wire type) – Determination of image quality value

FprEN ISO 22825 . . . . . Non-destructive testing of welds – Ultrasonic testing – Testing of welds in austenitic steels and nickel-based alloys

EN ISO 23277 . . . . . Non-destructive testing of welds – Penetrant testing of welds – Acceptance levels

EN ISO 23278 . . . . . Non-destructive testing of welds – Magnetic particle testing of welds – Acceptance levels

EN ISO 23279 . . . . . Non-destructive testing of welds – Ultrasonic testing – Characterization of indications in welds

EN ISO 25239-5 . . . . . Friction stir welding – Aluminium – Part 5: Quality and inspection requirements

### ISO and European standards for non-destructive testing of welds

EN 1435 . . . . . Non-destructive examination of welds – Radiographic examination of welded joints

EN 4678 . . . . . Aerospace series - Weldments and brazements for aerospace structures - Joints of metallic materials by laser beam welding - Quality of weldments – Bilingual version

EN 12517-1 . . . . . Non-destructive testing of welds – Part 1: Evaluation of welded joints in steel, nickel, titanium and its alloys by radiography – Acceptance levels

EN 12517-2 . . . . . Non-destructive testing of welds – Part 2: Evaluation of welded joints in aluminium and its alloys by radiography – Acceptance levels

EN 12952-6 . . . . . Water-tube boilers and auxiliary installations – Part 6: Inspection during construction, documentation and marking of pressure parts of the boiler

prEN 13445-5 . . . . . Unfired pressure vessels – Part 5: Inspection and testing

EN 13480-5 . . . . . Metallic industrial piping – Part 5: Inspection and testing

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## Japan

### Japanese Welding Standards (WES)

WES 7101..... Welding Position and Range of Plate Thickness for Qualified Welder	WES 8105.....Standard for Certification of Welding Operator of PC Steel Rods	WES 8241..... Standard for Certification of Semi-automatic Welding Operator
WES 7102..... Recommended Practices for Inert Shielded Arc Welding (Titanium and Titanium alloy)	WES 8106.....Standard for Certification of Welding Operator of Foundation Piles	WES 8291..... Certification Procedure for Operators of Silver Alloy Brazing
WES 7103..... Recommended Practice for Oxyacetylene Welding of Cast Iron	WES 8107..... Standard for Certification of Welding Practitioner	WES 8302..... Certification Test Manual of Welders for the Processing Facility and Reprocessing Facility Based on the Reader Regulation Law
WES 7014..... Recommended Practice for Arc Welding of Cast Iron	WES 8109.....Standard for Certification of Micro-Soldering Personnel	WES 8312..... Certification Test Manual of Welding Procedure for the Processing Facility and Re-Processing Facility based on the Reactor Regulation Law
WES 7105..... Recommended Hard Facing Practice with Shielded Metal Arc Welding	WES 8110..... Standard Qualification Procedure for Robot Welding Operators of Building Structures	WES 8701..... Standard for Certification of Non-destructive Inspection Enterprise for Welded Structures
WES 7301..... Recommended Practice for Spot Welding (Low Carbon Steel and Low Alloy Steel)	WES 8111..... Certification Procedure for Robot Welding Operators of Building Structures	WES 8703..... Standard Qualification Procedure for Welding Robots for Building Structure
WES 7302..... Recommended Practice for Spot Welding (Aluminum and Aluminum Alloy)	WES 8201..... Standard for Certification of Manual Arc Welding Operator	WES 8704..... Certification Procedure for Welding Robots of Building Structures
WES 7303..... Recommended Practice for Spot Welding (Stainless Steel)	WES 8205..... Standard for Certification of Titanium Welding Operator	WES 8705..... Guideline for Accreditation of Non-destructive Testing Enterprise
WES 7601..... Recommended Practice for Field Welding of Foundation Piles	WES 8207..... Standard for Certification of Welders and Welding Operators for Power Plant Equipment	WES 8706..... Standard of Registration of Personnel in Non-destructive Testing Enterprise for Welded Construction
WES 7602..... Recommended Practices for Inert Gas Shielded Arc Welding of Titanium Clad Steel and for Titanium Lining	WES 8217..... Standard for Certification of Welding Procedure for Power Plant Equipment	
WES 8101..... Standard for Certification of Fillet Welding Operator	WES 8221..... Certification Procedure of Welders of Stainless Steels	
WES 8102..... Welder Performance Qualification (For Petroleum Industry)	WES 8231..... Certification Procedure of Welders of Plastics	
WES 8103..... Standard for Certification of Welding Coordination Personnel		

## China

### Chinese Welding Standards (GB Standards or Recommendations)

GB/T 12467 ..... Fusion Welding of Metallic Materials

GB/T 15169 ..... Qualification Test of Welders – Fusion  
for Welding Steels

GB 50235-97 ..... Chemical Metal Pipe Construction  
and Acceptance