

SECTION 05 05 23 WELDING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
 - a. BPVC SEC V, Nondestructive Examination.
 - b. BPVC SEC IX, Welding and Brazing Qualifications.
2. American Society of Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
3. ASTM International (ASTM): A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
4. American Welding Society (AWS):
 - a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 - b. A3.0, Standard Welding Terms and Definitions.
 - c. D1.1/D1.1M, Structural Welding Code—Steel.
 - d. D1.8/D1.8M, Structural Welding Code—Seismic Supplement.
 - e. D1.2/D1.2M, Structural Welding Code—Aluminum.
 - f. D1.3/D1.3M, Structural Welding Code—Sheet Steel.
 - g. D1.4/D1.4M, Structural Welding Code—Reinforcing Steel.
 - h. D1.6/D1.6M, Structural Welding Code—Stainless Steel.
 - i. QC1, Standard for AWS Certification of Welding Inspectors.

1.02 DEFINITIONS

A. CJP: Complete Joint Penetration.

B. CWI: Certified Welding Inspector.

1. Contractor's Welding Inspector: Contractor's CWI acts for, and on behalf of, the Contractor for all inspection and quality matters within the scope of the Contract Documents. Contractor is required to provide a welding inspector to oversee welding operations and be responsible for visual inspection and necessary correction of all deficiencies in materials and workmanship required to meet referenced welding codes. This type of Quality Control Inspection is not classified as Special Inspection.
2. Verification Inspector: This independent inspection is the prerogative of the Contracting Officer, who may employ their own, independent CWI, or waive this supplementary, independent CWI inspection.

- C. MT: Magnetic Particle Testing.
- D. NDE: Nondestructive Examination.
- E. NDT: Nondestructive Testing.
- F. PJP: Partial Joint Penetration.
- G. PQR: Procedure Qualification Record.
- H. PT: Liquid Penetrant Testing.
- I. Special Inspection: Nondestructive weld examination including MT, PT, UT, and RT.
 - 1. Special Inspection personnel report to, and are retained by the Contracting Officer, except as noted below:
 - a. Contractor and fabricator are required to complete nondestructive weld examinations for welded steel tanks, welded steel pipe, and process piping.
 - 2. See additional requirements in Section 01 45 33, Special Inspection, Observation, and Testing.
- J. RT: Radiographic Testing.
- K. UT: Ultrasonic Testing.
- L. VT: Visual Inspection/Testing.
- M. WPQ: Welder/Welding Operator Performance Qualification Record.
- N. WPS: Welding Procedure Specification.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Shop and field WPSs and PQRs.
 - b. NDT procedure specifications prepared in accordance with ASME BPVC SEC V.
 - c. Welding Data (Shop and Field): Submit welding data together with Shop Drawings as a complete package.
 - 1) Show on Shop Drawings, or on a weld map, complete information regarding base metal ASTM specifications, and location, type, size, and length of welds.
 - 2) Identify WPS to be used, and NDE requirements in tail of welding symbol.

- 3) Clearly distinguish between shop and field welds.
- 4) Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for welds.
- 5) Welding and NDE Symbols shall be in accordance with AWS A2.4. Welding terms and definitions shall comply with AWS A3.0.

B. Informational Submittals:

1. WPQs.
2. CWI credentials.
3. Testing agency NDE inspector credentials.
4. CWI visual inspection (VT) reports.
5. Welding Documentation: Submit on forms provided in referenced welding codes.

1.04 QUALIFICATIONS

- A. WPSs: In accordance with AWS D1.1/D1.1M (Annex J Forms) for shop or field welding; or ASME BPVC SEC IX (Forms QW-482 and QW-483) for shop welding only.
- B. WPQs: In accordance with AWS D1.1/D1.1M (Annex J Forms); or ASME BPVC SEC IX (Form QW-484).
- C. CWI: Certified in accordance with AWS QC1 and having prior experience with specified welding codes. Alternate welding inspector qualifications require prior approval by Contracting Officer.
- D. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.

1.05 SEQUENCING AND SCHEDULING

- A. Unless otherwise specified, Submittals required in this section shall be submitted and approved prior to commencement of welding operations.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

- A. Fabricator's CWI shall be present whenever shop welding is performed. CWI shall perform inspection at suitable intervals, prior to assembly, during

assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:

1. Verify conformance of specified job materials and proper storage.
2. Monitor conformance with approved WPSs.
3. Monitor welder performance and conformance with approved WPQs.
4. Inspect weld joint fit-up and perform in-process inspections.
5. Provide 100 percent visual inspection of completed welds.
6. Coordinate with nondestructive testing personnel and review NDE results.
7. Maintain records and prepare reports documenting results of CWI VT and required NDE complies with the Work and referenced welding codes.

PART 3 EXECUTION

3.01 GENERAL

- A. Welding and Fabrication by Welding: Conform to governing welding codes referenced in attached Welding and Nondestructive Testing Table.

3.02 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

A. Quality Control Inspection:

1. All Welds: 100 percent VT by Contractor's CWI.
2. Acceptance Criteria:
 - a. Structural Pipe and Tubing: AWS D1.1/D1.1M, Paragraph 10.24.
 - b. All Other Structural Steel: AWS D1.1/D1.1M, Paragraph 8.9, Visual Inspection, Statically Loaded Nontubular Connections.
 - c. Stud Connections: AWS D1.1/D1.1M, Paragraph 9.8.1.

B. Nondestructive Testing Requirements:

1. NDT frequency shall be as specified below, as required by referenced fabrication or welding codes, or as specified in the attached table. In case there is a conflict, the higher frequency level of NDT shall apply.
 - a. Nontubular Connections:
 - 1) CJP Butt Joint Groove Welds: 10 percent random RT Use UT for CJP butt joint groove welds that cannot be readily radiographed.
 - 2) All Other CJP Groove Welds: 10 percent random UT
 - 3) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.

- b. Tubular Connections:
 - 1) CJP butt joint groove welds made from one side without backing: 100 percent RT or UT in accordance with AWS D1.1/D1.1M, Paragraph 10.25.2 requirements.
 - 2) CJP Butt Joint Groove Welds made with back-gouging: 10 percent random RT.
 - 3) CJP Butt Joint Groove Welds made with backing and other butt joint groove welds that cannot be readily radiographed: 10 percent random UT.
 - 4) All Other CJP Groove Welds: 10 percent random UT.
 - 5) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.
- 2. NDT Procedures and Acceptance Criteria:
 - a. Nontubular Connections:
 - 1) RT: Perform in accordance with AWS D1.1/D1.1M, Clause 8, Part E. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.12.1.
 - 2) UT: Perform in accordance with AWS D1.1/D1.1M, Clause 8, Part F. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.13.1.
 - 3) PT and MT:
 - a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 8.14.4 and Paragraph 8.14.5.
 - b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.9, Visual Inspection, Statically Loaded Nontubular Connections.
 - b. Tubular Connections:
 - 1) RT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 10, Paragraph 10.27, and Paragraph 10.28.
 - 2) UT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 10, Paragraph 10.26, and Paragraph 10.29.
 - 3) PT and MT:
 - a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 8.14.4 and Paragraph 8.14.5.
 - b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 10.24.

3.03 FIELD QUALITY CONTROL

- A. The Contractor's CWI shall be present whenever field welding is being done and shall perform inspection, at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:
1. Verify conformance of specified job materials and proper storage.
 2. Monitor conformance with approved WPS.
 3. Monitor welder performance and conformance with approved WPQs.
 4. Inspect weld joint fit-up and perform in-process inspection.
 5. Provide 100 percent visual inspection of all welds in accordance with Paragraph Quality Control Inspection.
 6. Coordinate with nondestructive testing personnel and review test results.
 7. Maintain records and prepare reports confirming results of inspection and testing comply with the Work.

3.04 WELD DEFECT REPAIR

- A. Repair and retest rejectable weld defects until sound weld metal have been deposited in accordance with appropriate welding codes.

3.05 SUPPLEMENT

- A. The supplement listed below, following "End of Section," is a part of this specification:
1. Welding and Nondestructive Testing Table.

END OF SECTION

Welding and Nondestructive Testing						
Specification Section	Governing Welding Codes or Standards	Submit WPS	Submit WPQ	Onsite CWI Required?	Submit Written NDT Procedure Specifications	NDT Requirements
03 21 00 Steel Reinforcement	AWS D1.4/D1.4M, Structural Welding Code—Reinforcing Steel	Welding reinforcement not permitted.				
05 12 00 Structural Steel Framing	AWS D1.1/D1.1M, Structural Welding Code—Steel	Yes	Yes	Yes	Yes	100% VT and 10% UT or RT of all groove-and-butt joint welds; 10% MT of all fillet welds; also see Section 05 12 00
05 31 00 Steel Decking	AWS D1.1/D1.1M, Structural Welding Code—Steel or AWS D1.3/D1.3M, Structural Welding Code—Sheet Steel	Yes	Yes	Yes	Yes	100% VT; also see Section 05 31 00
05 50 00 Metal Fabrications	AWS D1.1/D1.1M, Structural Welding Code—Steel or AWS D1.2/D1.2M, Structural Welding Code—Aluminum or AWS D1.6/D1.6M, Structural Welding Code—Stainless Steel	Yes	Yes	Yes	Yes	100% VT; also see Section 05 50 00
05 52 16 Aluminum Railings	AWS D1.1/D1.1M, Structural Welding Code—Steel or AWS D1.2/D1.2M, Structural Welding Code—Aluminum	No	No	No	No	100% VT; also see Section 05 52 16
05 53 00 Metal Gratings	AWS D1.1/D1.1M, Structural Welding Code—Steel or AWS D1.2/D1.2M, Structural Welding Code—Aluminum	No	No	No	No	100% VT; also see Section 05 53 00
43 41 14 Welded Steel Tanks	ASME BPV Code, Section IX or AWS D1.1/D1.1M, Structural Welding Code—Steel	Yes	Yes	Yes	Yes	100% VT and AWWA D100; also see Section 43 41 14
40 27 00 Process Piping—General	ASME BPV Code, Section IX; and ASME B31.3 Normal Fluid Service Category	Yes	Yes	Yes	Yes	100% VT and 5% RT; also see Section 40 27 00

