

SECTION 05 05 23

WELDING, STRUCTURAL
07/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360 (2005) Specification for Structural Steel Buildings, with Commentary

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A (2006) Recommended Practice

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (2007) Standard Symbols for Welding, Brazing and Nondestructive Examination

AWS A3.0 (2001) Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting and Thermal Spraying

AWS D1.1/D1.1M (2008) Structural Welding Code - Steel

AWS Z49.1 (2005) Safety in Welding, Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM E 165 (2002) Standard Test Method for Liquid Penetrant Examination

ASTM E 709 (2001) Standard Guide for Magnetic Particle Examination

1.2 DEFINITIONS

Definitions of welding terms are in accordance with **AWS A3.0**. The following classifications Class 1 (highest class) to Class 6 (lowest class) indicate the project's class(es) of weld joints.

1.2.1 Class 1 Weld Joints

This covers complete penetration weld joints only. These weld joints apply where failure would cause a loss of the system and/or be hazardous to personnel. Class 1 weld joints are highly stressed (dynamic and cyclic loading) and characterized as a single point of failure with no redundancy

for the redistribution of stress into another member.

1.2.2 Class 2 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would reduce the overall efficiency of a system but loss of the system or a hazard to personnel would not be experienced.

1.2.3 Class 3 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would not affect the efficiency of a system nor create a hazard to personnel. Class 3 weld joints are connections of secondary members not subject to dynamic action and/or low stressed miscellaneous applications.

1.2.4 Class 4 Weld Joints

This covers weld joints applicable to welding reinforcing steel to primary structural members.

1.2.5 Class 5 Weld Joints

This covers weld joints applicable to welding concrete reinforcing steel splices (prestressing steel excepted), steel connection devices, and inserts and anchors required in concrete construction.

1.2.6 Class 6 Weld Joints

This covers plug and slot weld joints as applicable to the requirements of the project's code(s).

1.3 GENERAL REQUIREMENTS

Conform the design of welded connections to [AISC 360](#), unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Perform all testing at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.3.1 Pre-erection Conference

Hold a pre-erection conference prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (which the Contractor shall develop and submit for all welding, including welding done using pre-qualified procedures). Mandatory attendance is required by all Contractor's welding production and inspection personnel and appropriate Government personnel. Include as items for discussion: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within

the building); inspection requirements and procedures, both visual and ultrasonic; welding schedule; fabrication of mock-up model; and other items deemed necessary by the attendees.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Welding Procedure Qualifications; A/E
Welder, Welding Operator, and Tacker Qualification; A/E
Inspector Qualification; A/E
Previous Qualifications; A/E
Pre-qualified Procedures; A/E

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

SD-06 Test Reports

Quality Control; A/E

A quality assurance plan and records of tests and inspections.

1.5 WELDING PROCEDURE QUALIFICATIONS

Except for pre-qualified (per AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding shall record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform qualification of welding procedures to AWS D1.1/D1.1M and to the specifications in this section. Submit for approval copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Appendix E of AWS D1.1/D1.1M. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.5.1 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without re-qualification if the following conditions are met:

- a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.2 Pre-qualified Procedures

Welding procedures which are considered pre-qualified as specified in AWS D1.1/D1.1M will be accepted without further qualification. The Contractor shall submit for approval a listing or an annotated drawing to indicate the joints not pre-qualified. Procedure qualification is mandatory for these joints.

1.5.3 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, the procedure specification must be revised and re-qualified, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, must be submitted with the welding procedure.

1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

Each welder, welding operator, and tacker assigned to work on this contract must be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.6.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

- a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.
- b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.
- d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification must state the type of welding and positions

for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 3 copies.

1.6.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

- a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.
- b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.
- c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.
- d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker is required to pass the prescribed tack welding test.

1.7 INSPECTOR QUALIFICATION

Inspector qualifications must be in accordance with [AWS D1.1/D1.1M](#). Qualify all nondestructive testing personnel in accordance with the requirements of [ASNT RP SNT-TC-1A](#) for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to [ASNT RP SNT-TC-1A](#), and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

1.8 SYMBOLS

Symbols must be in accordance with [AWS A2.4](#), unless otherwise indicated.

1.9 SAFETY

Safe welding practices and safety precautions during welding must conform to [AWS Z49.1](#).

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes must be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of [AWS D1.1/D1.1M](#).

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360. When AWS D1.1/D1.1M and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M govern.

3.1.2 Identification

Identify all welds in one of the following ways:

- a. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.
- b. Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers is not allowed.

3.2 QUALITY CONTROL

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. Perform visual inspections to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M, ASTM E 165, ASTM E 709, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," are acceptable.

3.3 STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Perform nondestructive testing by visual inspection methods. The minimum extent of nondestructive testing must be random 50 percent of welds or joints, as indicated on the drawings.

3.3.1 Nondestructive Examination

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds shall meet the inspection requirements for the original welds. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

-- End of Section --