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WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

FIELD (JOB SITE) WELDER QUALIFICATION PROCEDURES FOR SHIELDED
METAL ARC WELDING, FLUX CORED ARC WELDING,
AND GAS METAL ARC WELDING

1.0 PURPOSE

- 1.1 To establish a uniform procedure for testing and qualification of welders who will perform work under the jurisdiction of the Division of Highways.
- 1.2 To establish an effective means for identifying and recognizing those individuals that possess the knowledge and ability to produce acceptable welds.
- 1.3 To make available to the appropriate Division of Highways personnel a list of qualified welders.

2.0 SCOPE AND LIMITATIONS

- 2.1 Welders qualified under the provisions of this Materials Procedure are qualified to weld steel sheet, plate, bars, and structural sections as documented and approved by the American Welding Society Structural Welding Code D1.1 as amended by the governing specifications. This procedure does not apply to the qualification of welders to weld pressure vessel or pressure piping.
- 2.2 Welding performed by welders qualified under the provisions of this Materials Procedure is limited to steel meeting the following specification requirements: AASHTO M-183 (ASTM A-36), AASHTO M-188 (ASTM A-441), AASHTO M-223 (ASTM A-572), Grades 42, 45, and 50 only, AASHTO M-222 (ASTM A-588). Should the occasion arise to weld grades of steel other than those listed above, the Materials Control, Soils and Testing Division should be consulted for proper welder qualification procedures.

2.3 The provisions of this Materials Procedure apply to welder qualification tests for the following welding processes only:

Shielded Metal Arc Welding (SMAW)
Flux Cored Arc Welding (FCAW)
Gas Metal Arc Welding (GMAW)

Flux cored arc welding and gas metal arc welding are considered semi-automatic welding processes.

2.4 Welders qualified for groove welding under the provisions of this Materials Procedure are qualified to weld only groove welds that will be welded from both sides or groove to be welded from one side against a steel back bar.

2.5 Qualification tests for vertical positions welds are administered with the direction of welding as vertical up. Should it become necessary for the welder to be weld vertical down, a re-qualification is necessary.

3.0 REQUEST FOR TESTS

3.1 Welder qualification tests are administered by appointment only. Contact appropriate personnel within the Materials Control, Soils and Testing Division for a test date and test time.

3.2 Requests for welder qualification test for personnel employed, or to be employed, by Contractors should be made by the Contractor or by the Division of Highways District Materials Section personnel.

3.3 Requests will also be honored from trade unions and individuals, but every effort should be made to make requests as outlined in paragraph 3.2 above.

3.4 Testing arrangements for Division of Highway personnel should be made by the District Materials Section.

3.5 Regardless of the origin of the request for testing, the following information must be supplied by the person making test arrangements:

- 3.5.1 Name of individual to be tested.
- 3.5.2 Welding process to be tested.
- 3.5.3 Nature of test requested; first test, re-test or re-certification.
- 3.5.4 Type of test requested; groove weld plate qualification test for plate of unlimited thickness; groove weld plate qualification test for plate of limited thickness; or fillet welds only.
- 3.5.5 Position of test welds.
- 3.5.6 AWS classification of electrode to be used in test.
- 4.0 TESTING LOCATION
 - 4.1 Welder qualification test are administered at the Division of Highways, Materials Control, Soils and Testing Division Laboratory, 312 Michigan Avenue, Charleston, WV 25311. The testing laboratory is located just off Michigan Avenue, approximately two blocks east of the State Capitol Complex.
 - 4.2 Qualification test can be arranged at other locations provided a minimum of four (4) welders are to be tested at one time. Facilities for testing in this case are to be the responsibility of the agency requesting the testing and are subject to approval of the Materials Control, Soils and Testing Division. Welding test plates and shielded metal arc welding electrodes will be provided by the Materials Control, Soils and Testing Division. All other facilities, supplies, and equipment must be provided by the agency requesting the tests.
- 5.0 TESTING COSTS
 - 5.1 All applicants requesting qualification testing will be charged a fee equal to the average cost per test. The fee will be determined by Materials Control, Soils and Testing Division based upon the cost of the previous years testing.

Current fees will be provided upon request by the Materials Control, Soils and Testing Division.

5.2 The charges for the Division of Highways personnel will be charged to the authorization provided by the requesting District or Division. All others must be paid prior to the test being administered. Payment shall be check or money order, made payable to WV Division of Highways. Cash monies will not be accepted under circumstances.

6.0 TEST EQUIPMENT AND MATERIALS

6.1 The following welding equipment and supplies are available at the Materials Control, Soils and Testing Division laboratory for conduct of a welder qualification test for the shielded metal arc welding process:

6.1.1 Welding Machine - 300 amp D.C. - Hobart motor generator.

6.1.2 All test plates required for limited practice and the performance test.

6.1.3 Welding hood, slag chipping hammer, ice pick, wire brush and miscellaneous hand tools. The use of power tools for cleaning welds between weld passes is not permitted.

6.1.4 Sufficient stock of 2.4 mm , 3.2 mm, and 4.0 mm shielded metal arc welding electrodes, AWS class E 7018. If the prospective welder desires a qualification test utilizing an electrode other than E 7018, he must provide his own electrodes.

6.2 Welding equipment is not available for the conduct of welder qualification tests in the gas metal arc welding process or the flux cored welding process. Prospective welders requesting a test in these processes must provide suitable welding equipment and welding consumables.

7.0 TESTING PROCEDURE

7.1 Limitations of Variables

- 7.1.1 The qualification tests described below are specially devised tests to determine the welder's ability to produce sound welds. The qualification tests are not intended to be used as a guide for welding during actual construction.
- 7.1.2 Qualification established with any one of the steels listed in paragraph 2.2 shall be considered as qualification to weld or tack weld any of the other steels. Qualification tests are currently conducted utilizing AASHTO M-183 (ASTM A-36) grade steel.
- 7.1.3 A welder must successfully complete a test in each welding process for which qualification is requested. Qualification in one welding process as described by paragraph 2.3 does not qualify the welder for the other process listed.
- 7.1.4 A welder qualified for shielded metal arc welding with an electrode identified in the following table shall be considered qualified to weld or tack weld with any other electrode in the same group designation and with any electrode listed in a numerically lower group designation:

Group Designation	AWS Electrode Classification*
F4	EXX15, EXX16, EXX18
F3	EXX10, EXX11
F2	EXX12, EXX13, EXX14
F1	EXX20, EXX24, EXX27, EXX28

*The letters 'XX' used in the classification designations in this table represent the various strength levels (60, 70, 80, 90, 100, and 120) of deposited weld metal.

- 7.1.5 A welder qualified with an approved electrode and shielding medium combination shall be considered qualified to weld or tack weld with any other approved electrode and shielding medium combination for the process used in the qualification test.

7.1.6 A change in the position of welding to one for which the welder is not already qualified shall require re-qualification.

7.1.7 Vertical position qualification tests are administered with the direction of welding as vertical up. When a specific need arises for vertical down welding on the construction site, the welder must be qualified with the direction of welding as vertical down and all qualification documents noted accordingly.

7.2 Qualification Tests Required

The welder qualification tests for manual and semi-automatic welding shall be as follows:

7.2.1 Groove Weld Plate Qualification Test for Plate of Unlimited Thickness

The joint detail shall be as follows: 25.4 mm plate, single V-groove, 45 degree included angle, 6.4 mm root opening with backing bar, (See Fig. 7.2.1a). For horizontal position qualification tests the joint detail will be as follows: Single-bevel groove, 45 degree angle, 6.4 mm root opening with backing (See Fig. 7.2.1b) Backing will be 9.5 mm by 75 mm. The length of the welding groove will be 175 mm.

7.2.2 Groove Weld Plate Qualification Test for Plate of Limited Thickness

The joint detail shall be as follows: 9.5 mm plate, Single V-groove, 45 degree included angle, 6.4 mm root opening with backing bar (See Fig. 7.2.2a). For horizontal position qualification tests the joint detail will be as follows: Single-bevel-groove, 45 degree angle, 6 mm root opening with backing (See Fig. 7.2.2b). Backing will be 9.5 mm by 75 mm. The length of the welding groove will be 175 mm.

7.2.3 Fillet Weld Qualification Test for Fillet Welds Only

For fillet weld qualifications only, the welder shall weld a T-test plate in accordance with Fig. 7.2.3.

7.3 Position of Test Welds (See Table 7.3)

7.3.1 Groove Plate Test Welds:

- (a) Qualification in the 1G (flat) position qualifies for flat position groove welding of plate and flat and horizontal position fillet welding of plate.
- (b) Qualification in the 2G (horizontal) position qualifies for flat, horizontal position groove and flat and horizontal position groove and flat and horizontal position fillet welding of plate.
- (c) Qualification in the 3G (vertical) position qualifies for flat, horizontal and vertical position groove and flat, horizontal and vertical position fillet of welding plate.
- (d) Qualification for the 4G (overhead) position qualifies for flat and overhead position groove and flat horizontal and overhead position fillet welding of plate.

7.3.2 Fillet Weld Tests:

- (a) Qualification in the 1F (flat) position qualifies for flat position fillet welding of plate.
- (b) Qualification in the 2F (horizontal) position qualifies for flat and horizontal position fillet welding of plate.
- (c) Qualification in the 3F (vertical) position qualifies for flat, horizontal, and vertical position fillet welding of plate.

7.4 Test Joint Welding Procedure

7.4.1 The welder shall follow a joint welding procedure applicable to the joint details being welded in the performance test. Electrode size, selection, current, voltage, travel speed, type of bead, electrode manipulation, etc. are at the welder's discretion and

should be chosen considering best known practice so as to provide the most acceptable weld joint possible under the testing conditions.

- 7.4.2 Weld cleaning shall be done with the test plates in the same position as the welding position being qualified. Weld cleaning must be accomplished utilizing the normal hand tools provided. The use of the power chisels, scalers, chipping hammers, brushes or grinders is not allowed for weld cleaning.
- 7.5 Test Specimens: Number, Type, Preparation
- 7.5.1 The type and number of test specimens that must be tested to qualify a welder by mechanical testing are shown in Table 7.5.1 together with the range of thickness that is qualified for use in construction based on the thickness of the test plate used in making qualification. Radiographic testing of the test weld may be used at the Division of Highways option in lieu of mechanical testing.
- 7.5.2 Guided bend test specimens shall be prepared by cutting the test plate as shown in Figs. 7.2.1a, 7.2.1b, 7.2.2a or 7.2.2b as applicable to form specimens approximately rectangular in cross section. The specimens shall be prepared for testing in accordance with Figs 5.10.13h or 5.10.2.3j as applicable of the AWS Structural Welding Code D1.1-75 Rev. 2-77.
- 7.5.3 The fillet weld break and macrotech test specimens shall be cut for the test joint as shown in Fig. 7.2.3. The end of the macrotech specimen shall be smooth for etching.
- 7.5.4 When radiographic testing is used in lieu of the prescribed bend test, the weld reinforcement need not be ground or otherwise smoothed for inspection unless its surface irregularities or juncture with the base metal would cause objectionable weld defects to be obscured in the radiograph. The backing need not be removed prior to radiographic testing.

7.6 Method of Testing Specimens

7.6.1 Root, Face, or Side-Bend Specimens

Root, face and side-bend specimens shall be tested in accordance with paragraph 5.27.1 of the AWS Structural Welding Code D1.1 Rev. 1-76.

7.6.2 Fillet - Weld - Break Test

The fillet-weld-break test specimens shall be tested in accordance with paragraph 5.27.2 of the AWS Structural Welding Code D1.1 Rev. 1-76.

7.6.3 Macrotech Test

The macrotech test specimens shall be tested in accordance with paragraph 5.27.3 of the AWS Structural Welding Code D1.1 Rev. 1-76.

7.6.4 Radiographic Test

The radiographic procedure and technique shall be in accordance with the requirements of Part B, Section 6 of the AWS Structural Welding Code D1.1-75. Only the center half of the length of the test plate will be evaluated for rejectable discontinuities.

7.7 Test Results Required

7.7.1 Root, Face, or Side - Ben Specimens

Root, face, and side - bend specimens, after testing, shall meet the requirements of paragraph 5.28.2 of the AWS Structural Welding Code D1.1 Rev. 1-76.

7.7.2 Fillet - Weld - Break

After testing, the fillet - weld - break test specimens shall meet the requirements of paragraph 5.28.2 of the AWS Structural Welding Code D1.1 Rev. 1-76.

7.7.3 Macrotech Test

After preparation, the macrotech test specimen shall meet the requirements of paragraph 5.28.3 of the AWS Structural Welding Code D1.1 Rev. 1-76.

7.7.4 Radiographic Test

To qualify, the weld, as revealed by the radiograph, shall conform to the requirements of paragraph 9.25 of the AWS Structural Welding Code D1.1 Rev. 2-77 as revised and/or amended by the AASHTO Standard Specifications for Welding of Structural Steel Highway Bridges - 1977, and as may be further revised and/or amended by the Division of Highways Standard Specifications, Supplemental Specifications or Special Provisions in effect at the time the welder qualification test is administered. The welder qualification test will be evaluated for quality based on the standards required for welds subject to tensile stress under any condition of loading.

7.7.5 Visual Inspection

For acceptable qualification, the welded test plates, when inspected visually shall conform to the requirements for visual inspection as contained in paragraph 9.25.1 of the AWS Structural Welding Code D1.1 Rev. 2-77 as revised and/or amended by the AASHTO Standard Specification for Welding of Structural Steel Highway Bridges - 1977, and as may be further revised and/or amended by the Division of Highways Standard Specifications or Special Provisions in effect at the time the welder qualification test administered.

8.0 RE-TESTS

8.1 In case a welder fails to meet the requirements of one or more test welds, immediate re-test, subject to scheduling limitations, may be made consisting of two (2) test welds of each type of which the welder failed. All re-test specimens shall meet all the specified requirements.


- 8.2 If a welder fails one or more of the test plates as specified in paragraph 8.1 above, he will be required to wait thirty (30) days before being eligible for a second re-test. The intent of this waiting period is to provide the prospective welder ample time to obtain additional training as may be necessary. After expiration of the thirty (30) day waiting period, the second re-test shall consist of a single specimen test weld in the appropriate welding position.
- 8.3 If a welder fails the second re-test as specified in paragraph 8.2 above, he will be required to wait one (1) year before being eligible for further re-testing. A welder failing the second re-test has welded four (4) test plates unsuccessfully and obviously is in need of considerable additional welding skill training. The one year waiting period is designed to provide the welder the opportunity to obtain this training and experience.
- 9.0 PERIOD OF EFFECTIVENESS
- 9.1 Once qualified, the welders qualification shall be considered as remaining in effect for a period of four years from the date of test.
- 9.2 Should a situation arise wherein the welder does not produce acceptable welds on the project site, or there is any reason to question the welders ability after qualification, the Division of Highways may require the welder to re-qualify by taking all, or a portion of the welder qualification test. Should the welder not successfully complete these re-qualification tests, his qualification will be revised accordingly or revoked as determined by the results of the re-testing. Administration of such tests will be at no expense to the welder. Successful completion of these tests will not extend the welder's qualification beyond the original expiration date.

10.0 DOCUMENTATION AND RECORDS

- 10.1 Form ST-6 (copy attached) will be used to document all data with regard to the welder qualification test. The welder will complete the personal data at the top of the form. All further entries will be made by Materials Control, Soils and Testing Division personnel and are self-explanatory. The ST-6 form will be signed, in the space provided, by the person administering the test. A laboratory number will be assigned and will serve as identification for the testing process.
- 10.2 Those welders who undergo the test will sign a blank Welder Qualification Card, Form ST-5 (copy attached) and will be photographed. Upon successful completion of the test, the Welder Qualification Card will be completed by the Materials Control, Soils and Testing Division and forwarded to the welder as his identification and proof of qualification. This card, Form ST-5 will provide sufficient personal data to establish proper identification. The card will also contain information relative to the welder's qualification such as welding process, welding positions qualified, type of welding qualified (groove and/or fillet), thickness limitations, and welding electrode limitations including the qualification expiration date.
- 10.3 In addition to the Welder Qualification Card, identification of qualified welders will be included in the List of Qualified Welders. The list contains necessary identification information as well as data relative to the Welders qualification limitations.
- 10.4 Welder Qualification Test Records (Form ST-6) and all other data relative to the welders qualification test will be maintained in the Materials Control, Soils and Testing Division files for a period of one (1) year after expiration of the qualification.

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These records are available for review by any person authorized to do so by applying in person to the Materials Control, Soils and Testing Division. Welding test plates and test specimens are not retained after testing is complete.



Gary L. Robson, Director
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and Testing Division

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Attachments