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

MATERIALS PROCEDURE
ACCEPTANCE CRITERIA FOR GENERAL INDUSTRIAL GRADE ELECTRICAL ITEMS.

1. PURPOSE

1.1 To establish procedures for qualifying general industrial grade electrical item vendors acceptable to supply items for use on West Virginia Division of Highways (WVDOH) projects.

1.2 To establish a procedure for maintaining a record of above items.

1.3 To establish a procedure for transmitting approval of such items to the Districts and to Contractors of WVDOH projects.

2. SCOPE

2.1 This procedure shall apply to all vendors who supply general electrical items such as copper wire, switches, conduit fittings, PVC conduit, industrial surge protectors, fuses and other items historically referred to as "miscellaneous" associated hardware.

2.2 This procedure shall apply to all vendors of electrical items furnished to West Virginia Division of Highways (WVDOH) projects and purchase orders. The Division may elect to use other control procedures when special conditions dictate.

3. APPLICABLE DOCUMENTS

3.1 WVDOH Specifications for Roads and Bridges Sections 715.42

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4. ACCEPTANCE PROCEDURE

4.1 With each shipment, the vendor of industrial grade electrical items shall provide shipping documents which comply with Section 631.2 of the West Virginia Division of Highways Standard Specifications, contain either the electrical vendor's approved source number, or the approval number that was assigned to the shipping document or invoice as per Section 6 of this document and letter certifying that the items described in the shipping documents meet all applicable specifications.

4.2 ACCEPTANCE PROCEDURE (APPROVED SOURCE)

4.3 For a vendor to be considered an approved source of general electrical items, the vendor must comply with the following requirements where applicable:

4.4 The prospective source shall be an active member of the National Association of Electrical Distributors "NAED"

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4.5 The vendor is to submit a written statement to the WVDOH Materials Control, Soils and Testing Division indicating the intention to be included on the WVDOH approved source list as an approved source for the specific general electrical item.

4.6 The prospective source shall submit a certified statement that all material shipped to the Division will conform to all NEMA, ASTM, ANSI, and UL specifications where applicable, and be a member in "NAED" The certified statement shall be signed by a representative of the vendor who has the authority to bind the company.

4.7 A yearly evaluation of materials at the vendor's facility will be conducted by Division personnel, or by its designee, to ensure confidence in the ability of the vendor to supply a quality product within WVDOH specifications. After evaluation, a materials inspection report "MIR" shall be generated detailing any issues of non-compliance

4.8 All aluminum, glass, iron, and steel materials at the prospective source must be melted and manufactured domestically, in accordance to Section 106.1.1 of the WVDOH Specifications

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4.9 Once the above requirements are met, an approval number will be assigned to the ____ vendor to indicate WVDOH conformance. This approval number shall be active for one year. Acceptance of a manufacturer's facility can be verified by accessing the WVDOH online approved source list.

4.10 Revocation of approved source status may result from material supplied to projects that does not comply with WVDOH Specifications.

4.11 "Approved Source" status may be reinstated at the discretion of the Materials Control, Soils and Testing Division based on the findings of an investigation. The reinstatement process will commence upon the receipt of a letter of request from the vendor to the Materials Control, Soils and Testing Division. The letter of request should indicate reasons for reinstatement and documentation to substantiate such reasons.

5. ACCEPTANCE PROCEDURES (NON-APPROVED SOURCE)

5.1 General electrical items used in highway construction will require an evaluation on a lot-by-lot basis, provided the material meets the following requirements:

5.1.1 All materials to be inspected must not have been incorporated into the project as per section 106.3 of the WVDOH Specifications, otherwise approval may not be granted.

5.1.2 An invoice or shipping document must be provided indicating items and quantities shipped. The document must have a unique tracking number affixed, and the Contract Identification Number (WVDOH Internal Tracking) of the highway project.

5.2 Certification will be required for non-standard items if requested, to indicate specifications being primarily to Section 715.42 but not limited to, the WVDOH Standard Specification. This MP excludes certain items that are covered by other specs/ etc.

5.3 Certification may be required indicating the material is melted and manufactured domestically conforming to section 106 of the WVDOH Standard Specifications.

5.4 If the results of the testing reveal that the material complies with all applicable specifications, a direct coverage approval number will be issued by the Division that shall be affixed to the invoice or shipping documents.

6. DOCUMENTATION REPORT

6.1 The approved source list for vendors of general electrical items shall be updated once a year If the need warrants, This list can be updated at any time with the addition of, or the removal of a vendor.

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6.2 A current approved list of vendors of general electrical items will be available to all contractors, fabricators, and suppliers by accessing the West Virginia Department of Transportation Approved Source Website.

Ronald L. Stanevich, P.E.
Director
Materials Control, Soils and Testing Division

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

MATERIALS PROCEDURE

QUALITY ASSURANCE OF REINFORCED CONCRETE CULVERT, STORM DRAIN, AND SEWER PIPE

1. PURPOSE

1.1 To set forth the procedures which govern the Quality Assurance of Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

1.2 To set forth manufacturers Quality Control requirements.

1.3 To set forth acceptance inspection procedures.

1.4 To set forth documentation and shipping procedures.

2. SCOPE

2.1 This procedure will apply to all manufacturers of Reinforced Concrete Culvert, storm pipe, and sewer pipe for use in West Virginia projects.

2.2 This procedure will establish the basis for acceptance of reinforced concrete pipe.

3. APPLICABLE SPECIFICATIONS

3.1 All standard types of reinforced concrete pipe are to be manufactured and tested in accordance with Section 714.2 of the Standard Specifications for Roads and Bridges.

3.2 Each LOT of reinforced concrete pipe having a wall thickness of 4.5 inches (115 mm) or less, which is manufactured in accordance with the applicable specifications is treated in the following manner to determine acceptability.

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3.2.1 The three-edge bearing test (AASHTO T 280) shall be used to determine the force required to produce the 0.01 inch (0.25 mm) crack and the minimum specified ultimate load.

3.2.1.1 50% of the LOTs of Class III and Class IV concrete pipe 24 inches (610 mm) in diameter and less, and conforming to WVDOT Specifications, will be accepted based on the Fabricator's certification, provided they are Q-Cast Certified by the ACPA. Testing of Class III and Class IV concrete pipe greater than 24 inches (610 mm) in diameter shall be witnessed by the Division.

3.2.1.2 50% of the LOTs of Class V Concrete Pipe with a diameter less than 24 inches, and conforming to WVDOT Specifications, will be accepted based on the Fabricator's certification, provided they are Q-Cast Certified by the ACPA. Testing of Class V Concrete Pipe, with a diameter greater than or equal to 24 inch, shall be witnessed by the Division.

3.2.2 The absorption test (AASHTO T 280) shall be conducted on samples selected from the wall of the pipe.

3.2.3 A plant inspection of the finished product is conducted to determine dimensional conformance and freedom from defects.

3.2.3.1 For LOTs of concrete pipe accepted on the Fabricator's certification, the inspection, including the three-edge-bearing test, will be performed and recorded by the Fabricator's Quality Control person. These LOTs shall be as defined in Table 1, but the sizes shall be based on the criteria in the Q-Cast Certification program.

3.3 Each LOT of reinforced concrete pipe fabricated with dry cast concrete having a wall thickness greater than 4.5 inches (115 mm), which is manufactured in accordance with the applicable specifications, is treated in the following manner to determine acceptability.

3.3.1 The compressive strength of the concrete will be determined by testing cores taken from the wall of the pipe. The manufacturer may choose to test this pipe as specified in Section 3.2.1, in which event the requirements for the 0.0.01 inch (0.25 mm) crack and the minimum specified ultimate load shall be met. This choice shall not be applied to a LOT (refer to Table 1) of pipe, which has been previously cored and found unacceptable.

3.3.2 The absorption test (AASHTO T 280) shall be conducted on samples selected from the wall of the pipe.

3.3.3 A plant inspection of the finished product will be conducted by the Division to determine dimensional conformance, and freedom from defects.

3.4 Each LOT of reinforced concrete pipe fabricated with wet cast concrete can be accepted on the basis of compressive strength from cylinder breaks (cylinders made per AASHTO T 23 and tested per AASHTO T 22) reaching the required 28-day compressive strength or by the three-edge bearing test (AASHTO T 280) as detailed in Section 3.2.1.

3.4.1 The absorption test (AASHTO T 280) for wet cast pipe shall be conducted on samples cored from the wall of the pipe or by making cylinders (4-inch x 8-inch minimum in accordance with AASHTO T 23).

3.5 Flared end sections will be accepted by either the inspection method or Fabricator certification method, with the same size criteria as outlined in Section 3.2.

3.5.1 Acceptance by the inspection method of precast concrete flared end sections is to be based on verification of compressive strength of concrete as determined from cylinders or cores. Flared end sections must also meet the dimensional requirements listed on the standard detail and on appearance. The testing frequency for compressive strength cores and steel verification coring is 1 out of every 40 pieces, but cylinders shall be

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fabricated and tested for each piece, if cylinders are used for strength acceptance instead of cores.

3.5.2 In order to accept flared end sections by the Fabricator certification method, the Fabricator must be Q-Cast Certified by the ACPA.. The fabricator will take photos/videos showing correct steel placement and cover. All flared end sections must be fabricated within the dimensions listed on the standard detail and have an acceptable finish free of bug holes, spalls, cracks and other surface defects.

TABLE 1

SAMPLING AND TESTING FREQUENCY FOR REINFORCED CONCRETE PIPE

A production "LOT" is defined as follows:

It is pipe of the same size and class that is manufactured using the same process and similar materials during continuous days of production. The production LOT shall not exceed the specified value of 1% of the LOT and the minimum number tested per LOT is as follows:

Number of Pipe Sections in the LOT	Number of Pipe Sections to be Tested
0 to 300	1
301 to 800	2
801 to 1500	3
over 1500	3 plus 1 section per each 600 pieces or fraction thereof over 1500 pc.

When the tests indicate that a production LOT is acceptable for WVDOH use, the LOT should be inspected by the Division's representative.

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4. QUALITY CONTROL REQUIREMENTS

4.1 Quality Control is the responsibility of the manufacturer and shall include the following:

4.1.1 Ensure all component materials used in the fabrication of the pipe have been sampled, tested, and approved (MP 603.02.10).

4.1.2 Ensure quality workmanship as well as a quality product throughout the production.

4.1.3 To scribe into each piece of pipe the following:

(a) Cast Date
(b) Class and Wall Type
(c) Manufacturer's Trademark

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4.1.4 Notify the Division's representative upon the completion of casting of a LOT (Refer to Table 1) of pipe so the Division may select a representative sample and witness the testing.

4.1.5 To conduct the three-edge bearing test or to secure cores to ensure strength requirements are met (Section 3.2 and 3.3).

4.1.6 To conduct the absorption test (AASHTO T 280) on samples selected from the wall of the pipe.

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4.1.7 Any LOT of pipe or portion of a LOT of pipe failing to meet the specification requirements will be stored separately from acceptable pipe.

4.1.8 Accurate inventory records containing the information required in Section 6.1.2 will be kept and maintained by the manufacturer.

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5. ACCEPTANCE CRITERIA

The Division will:

5.1 Sample and test the component materials to be used in the manufacturer of the reinforced concrete pipe in accordance with MP 603.02.10.

5.2 Select representative samples of the LOT to be tested and:

(a) Witness the three-edge bearing test and/or the coring procedure
(b) Verify dimensional conformance
(c) Verify actual steel placement
(d) Determine the steel area

5.3 Ensure each piece comprising the LOT is scribed as stated in 4.1.3.

5.4 Make a visual inspection of the LOT and designate unacceptable units to be removed or set apart from the approved pipe in the LOT.

6. SHIPPING REQUIREMENTS

6.1 The approved LOT of pipe or portion of the LOT can be shipped by the manufacturer providing the following provisions have been met:

6.1.1 The manufacturer will notify the Division's representative prior to each shipment so that the Division may maintain a current inventory with the manufacturing plant.

6.1.2 The manufacturer will supply one copy of the shipping invoice to Materials Control, Soils and Testing Division and one copy to the Division's representative at the project site. The invoice shall contain the following information.

(a) Cast date of the approved LOT
(b) Master laboratory reference number
(c) Size, class, and wall type
(d) Project number
(e) Number of pieces

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7. ACCEPTANCE PRACTICE

7.1 Ensure the information on the shipping invoice, as required in Section 6.1.2, agrees with the shipment it accompanies. (Number of pieces, class, size, and type, etc.).

7.2 Check each piece of pipe for the proper identification markings (Section 5.3) and make a visual inspection of each piece to ensure there is no evidence of damage during shipment.

8. COVERAGE REQUEST FROM PROJECT SITE

8.1 Request for coverage shall include the information as referenced on the shipping invoice, Section 6.1.2

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Director
Materials Control, Soils and Testing Division

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

MATERIALS PROCEDURE 402.XX.XX

GUIDE FOR USING THE LOCKED-WHEEL FRICTION TESTER TO MEASURE FRICTIONAL PROPERTIES OF PAVEMENT

1. SCOPE

1.1 This procedure establishes a process for collecting friction data of roadways using a Locked-Wheel Friction Tester. Friction measurements are obtained by locking a test tire on a device-wetted surface while traveling at a specific speed (typically 40 mph).

1.2 Tests are conducted using rib-tread and smooth-tread test tires. Ribbed tires are used as an indicator of the micro-texture properties of pavement. Smooth tires are used as an indicator of the macro-texture properties of pavement.

1.3 The resulting Friction Number (FN) is non-dimensional value and represents the average coefficient of friction measured across a test interval.

2. PURPOSE

2.1 To establish a procedure for safe operation of a Locked-Wheel Friction Tester and the collection of quality pavement friction data for WVDOH.

3. REFERENCED DOCUMENTS

a. *AASHTO T 242: Frictional Properties of Paved Surfaces Using a Full-Scale Tire*
b. *AASHTO M 261: Rib-Tread Standard Tire for Special-Purpose Pavement Frictional-Property Test.*
c. *AASHTO M 286: Smooth-Tread Standard Tire for Special-Purpose Pavement Frictional-Property Test.*
d. WVDOT Skid Measurement System Evaluation, Report Number TRC-625
e. WVDOH Construction Manual

4. DEFINITIONS

4.1 Locked-Wheel Friction Tester: The entire apparatus, including Tow Vehicle, attached Locked-Wheel Skid Trailer, and all supporting components such as the on-board computer, force transducers, instrumentation, air, water and braking systems, etc.

4.2 Tow Vehicle: The automotive vehicle, capable of towing the Locked-Wheel Skid Trailer and maintaining constant speed within ±1 mph while the Test Tire is completely locked.

4.3 Locked-Wheel Skid Trailer: The two-wheel trailer, pulled behind the Tow Vehicle, and equipped with a Test Tire mounted on the left (driver's) side.

4.4 Friction Number (FN): This represents the average coefficient of friction measured across a test interval. It is computed by the following formula:

$$\mathbf{FN} = 100 \times \mu = 100 \times (F / W)$$

Where: **FN** = Friction Number at the measured speed
μ = Coefficient of friction
F = Tractive horizontal force applied to the tire, lbs.
W = Vertical load applied to the tire, lbs.

4.5 Test Site: The location of the pavement to be tested, including all traffic lanes, defined by the beginning and ending mileposts of the project.

5. EQUIPMENT REQUIREMENTS

5.1 All electronic and mechanical components of the Locked-Wheel Friction Tester shall be adequately designed and built to meet or exceed the requirements set forth in AASHTO T 242 Section 4.

6. SAFETY PRECAUTIONS

6.1 The Locked-Wheel Friction Tester shall comply with all applicable State and Federal Laws. Additional precautions shall be taken beyond those imposed by law to ensure the safety of all personnel and the general public. At minimum the following conditions must be followed when testing with a Locked-Wheel Friction Tester:

a. Test lanes must be free of debris and obstructions.

b. Heavy acceleration and deceleration should be avoided while testing.

c. Test lanes may remain open to traffic unless deemed unsafe.

d. Testing shall only be conducted at speeds recommended by the manufacturer.

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7. CALIBRATION AND CORRELATION

7.1 The Locked-Wheel Friction Tester shall be calibrated and correlated annually at a federally recognized Evaluation and Field Test Center.

7.2 During calibration, the Locked-Wheel Friction Tester shall undergo, at minimum, the following tests to verify the systems are working properly:

a. Water delivery system
b. Speed measuring system
c. Distance measuring system
d. Force and load transducer measuring system
e. Ability of the brake to completely lock the test wheel

7.3 The Evaluation and Field Test Center maintains a Locked-Wheel Friction Test System which is considered a Skid Measurement Standard and is validated annually. During

correlation, the Locked-Wheel Friction Tester is operated on three separate test surfaces along with the Standard System. Statistical analysis is then performed on the test data to produce correlation equations. These equations are used to adjust future test results, allowing old and new data, as well as data from different systems to be compared.

7.4 An example of the calibration and correlation procedure of the Locked-Wheel Friction Test System is described in the referenced "WVDOT Skid Measurement System Evaluation, Report Number TRC-625".

7.5 Modifications and/or changes to the electrical or mechanical components will require the system to be re-calibrated and re-correlated.

8. DATA COLLECTION

8.1 Data is collected at the time of testing by the system computer. The data collected by the computer includes the location, speed and the calculated Friction Number (FN).

8.2 Do not test pavement if ambient and/or surface temperature is less than 45° F.

8.3 Do not test pavement if debris or standing water is present.

8.4 Pavement test sites shall be tested with both the Rib-Tread and Smooth-Tread tire. High Friction Surface Treatment locations shall be tested with the Rib-Tread tire only.

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9. PRE-TEST INSPECTION

9.1 Prior to testing, inspect all cable and hose connections from test vehicle to trailer. Ensure all fittings are secure, not leaking, worn, or dragging the ground.

9.2 Check safety lighting and ensure it is working properly.Inspect the test tires according to the referenced *AASHTO M 261* and *AASHTO M 286.*

9.3 Inspect the pavement surface for changes in texture, segregation, polishing, pushing or other issues which may affect friction. Areas of inconsistency shall be noted and explained in the Materials Inspection Report.

10. POSITION OF TESTS

10.1 Testing shall be conducted in the left wheel path of each lane of the test site.

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11. TEST SPEED

11.1 All reasonable efforts shall be made to perform tests at 40±1 mph. Tests conducted at less than 39 mph or greater than 41 mph will typically be considered invalid and will not be included when calculating the average friction values of the project.

11.2 If speed cannot be maintained at 40±1 mph due to safety or traffic conditions, the Engineer may approve testing at a different speed. In this case, the following formula is to be used to adjust the resulting Friction Number results:

FN (40) = FN (speed) – 0.5 * (40 – speed)

Where: FN (speed) = Friction Number from test at (speed) mph

FN (40) = Friction Number adjusted to 40 mph

12. NUMBER AND FREQUENCY OF TESTS

12.1 A minimum of five (5) tests shall be conducted with each tire in each lane-mile of each test site. Except for High Friction Surface Treatment locations which shall be tested with only the Rib-Tread tire as stated in 8.4.

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12.2 Tests shall be spaced evenly throughout the test site, as safety and traffic conditions permit.

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13. REPORTING OF TEST RESULTS

13.1 A Materials Inspection Report shall be submitted to the requesting agency.

13.2 The Report shall include the location, speed and calculated Friction Numbers from each test, as well as the average Friction Number for each lane at each test site.

13.3 The report shall also include weather conditions, areas of inconsistency in the pavement and general observations of the test site.

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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. 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. 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

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

Shielded Metal Arc Welding (SMAW) Gas Metal Arc Welding (GMAW)

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Gas metal arc welding are considered semi- automatic welding processes.

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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.

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3. 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.

3.4.1 Regardless of the origin of the request for testing, the following information must be supplied by the person making test arrangements: Name of individual to be tested.

3.4.2 Welding process to be tested.

3.4.3 Nature of test requested; first test, re-test or re-certification.

3.4.4 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.

3.4.5 Position of test welds.

3.4.6 AWS classification of electrode to be used in test.

4. TESTING LOCATION

4.1 Welder qualification test are administered at the Division of Highways, Materials Control, Soils and Testing Division Laboratory, 190 Dry Branch Drive, Charleston, WV 25306. The testing laboratory is located just off Michigan Avenue, approximately two blocks east of the State Capitol Complex.

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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.

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5. TESTING COSTS

5.1 All applicants requesting qualification testing will be charged $ 120.00 per test. This fee is determined by Materials Control, Soils and Testing Division.

5.2 Current fees of $120.00 will be provided upon request by the Materials Control, Soils and Testing Division.

5.3 The Division of Highways personnel will not be charged for welding test. 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 or credit card will not be accepted under circumstances.

6. 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: 275amp D.C. Lincoln Welder.

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 will be permitted.

6.1.4 Sufficient stock of 2.4 mm, (3/32") 3.2 mm, (1/8") and 4.0 mm, (5/32") shielded metal arc welding electrodes, AWS class E 7018.

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

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7. 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.

8. QUALIFICATION TESTS REQUIRED

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

8.1.1 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.

8.1.2 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.

8.1.3 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.

8.2 Position of Test Welds (See Table 7.3)

8.2.1 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 3G (vertical) position qualifies for flat, horizontal and vertical position groove and flat, horizontal and vertical position fillet of welding plate.

(c) Qualification for the 4G (overhead) position qualifies for flat and overhead position groove and flat horizontal and overhead position fillet welding of plate.

8.2.2 Fillet Weld Tests:

(d) Qualification in the 1F (flat) position qualifies for flat position fillet welding of plate.

(e) Qualification in the 3F (vertical) position qualifies for flat, horizontal, and vertical position fillet welding of plate.

8.3 Test Joint Welding Procedure

8.3.1 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.

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8.3.2 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.

8.4 Test Specimens: Number, Type, Preparation

8.4.1 The type and number of test specimens that must be tested to qualify a welder by mechanical testing 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.

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8.4.2 Guided bend test specimens shall be prepared by cutting the test plate as applicable to form specimens approximately rectangular in cross section. The specimens shall be prepared for testing in accordance with as applicable of the AWS Structural Welding Code D1.1.

Deleted: as shown in Figs. 7.2.1a, 7.2.1b, 7.2.2a or 7.2.2b

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8.4.3 The fillet weld break and macrotech test specimens shall be cut for the test joint. The end of the macrotech specimen shall be smooth for etching.

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8.4.4 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.

8.5 Method of Testing Specimens

8.5.1 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.

8.5.2 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

8.5.3 Macrotech Test

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

8.6 Test Results Required

8.6.1 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.

8.6.2 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.

8.6.3 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.

8.6.4 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.

9. RE-TESTS

9.1 In case a welder fails to meet the requirements of one or more test welds, immediate re-test, subject to scheduling limitations. All re-test specimens shall meet all the specified requirements.

9.2 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

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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.¶

Deleted: <#>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…

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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.

9.3 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 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.

9.4 If a welder is found to be welding his or her test plates in a different position than he or she is attempting to become certified in, that welder's test plates will be discarded and he or she will not be allowed to re-test for a period of one (1) year. If a welder is found to be welding out of position a second time, that welder will become permanently ineligible to re-test. Thus forfeiting their right to weld for the Division of Highways.

10. PERIOD OF EFFECTIVENESS

10.1 Once qualified, the welder's qualification shall be considered as remaining in effect for a period of four years from the date of test.

10.2 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.

11. DOCUMENTATION AND RECORDS

11.1 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. An identification number will be assigned and will serve as identification for the testing process.

11.2 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.

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11.3 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.

11.4 Welder Qualification Test Records (Form ST-6) and all other data relative to the welder's 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.

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Ronald L. Stanevich, P.E.
Director
Materials Control, Soils and Testing Division

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

MATERIALS PROCEDURE

MAINTAINING SPECIFIED LEVEL OF STRENGTH IN PORTLAND CEMENT CONCRETE

1. PURPOSE

1.1 The purpose of this procedure is to set forth a method of adjusting the cement content of portland cement concrete so that a reasonable conformance with the specified level of strength may be assured.

2. SCOPE

2.1 The procedure shall apply to all classes of concrete.

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3. PROCEDURE

3.1 Initial Cement Requirement

3.1.1 "Initial Cement Requirement" is the cement requirement determined by the formal laboratory design method outlined in MP 711.03.23.

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3.2 Reevaluating Cement Requirement

3.2.1 A concrete mix design referred to herein means a combination of particular source and type of materials and a cement factor which satisfies the requirement of the governing specification, said combination of materials and cement factor being formulated for the express purpose satisfying the requirement of a particular class of concrete specified for the work. The cement factor in a particular mix design may be changed without invalidating the design. If source or type of materials in a mix design are changed, then the mix design is considered changed, and two or more mix designs would result from such change(s).

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Strength data which represents two cement factors in one mix design may be processed collectively in the derivation of statistical parameters, average and standard deviation, for example, if it is felt that such a treatment does not significantly affect the statistics.

3.2.2 For the various classes of concrete which are designed in conformance with MP 711.03.23, the first reevaluation of cement requirement shall be made after at least ten pieces of strength data are available to evaluate the adequacy of the mix design. Thereafter, a reevaluation of cement requirement shall be made at monthly intervals at which time, the evaluation shall be based on the strength data developed during the preceding two months or on the last ten pieces of data developed, whichever is greater.

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3.3 Method of Evaluating Cement Requirement

3.3.1 The cement requirement for all classes of concrete governed by this procedure shall be the quantity necessary to maintain the average strength of the concrete within the range of the Design Strength (f'_c) plus K_1 standard deviations and the Design Strength (f'_c) plus K_2 standard deviations $\{(f'_c + K_1\sigma) < \bar{X} < (f'_c + K_2\sigma)\}$. The average strength ($\bar{X}$) and the standard deviation (σ) shall be calculated using the strength data developed during the previous two months or the last ten pieces of strength data, whichever is greater.

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3.3.2 If the average strength of concrete can be maintained at a level which is equal to or greater than the Design Strength plus K_2 standard deviations $\bar{X} > (f'_c + K_2\sigma)$, then the cement factor which causes this level of average strength to be developed may be reduced as indicated in Article 3.3.4.3 except that in no instance shall the cement factor be reduced below a level of the target specified cement factor minus 47 lbs. of cement per cubic yard.

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3.3.3 If the average strength of the concrete is maintained below the level of the Design Strength plus K_1 standard deviations, $\bar{X} < (f'_c + K_1\sigma)$, then the cement factor which causes this level of average strength to be developed shall be increased as indicated in Article 3.3.4.2.

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3.3.4 The relationship between the level of concrete strength (considered to be the average of all data developed during the preceding two months or the average of the last ten pieces of strength data, whichever is greater, and represented by $\bar{X}$), and the action which must be taken regarding the cement factor is as follows:

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3.3.4.1 If the average strength is maintained at a level between the Design Strength plus K_1 standard deviations and the Design Strength plus K_2 standard deviations $\{(f'_c+K_1\sigma) < \bar{X} < (f'_c+K_2\sigma)\}$ the cement factor shall be maintained without change.

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3.3.4.2 If the average strength falls below the Design Strength, plus K_1 standard deviations $\{\bar{X} < (f'_c+K_1\sigma)\}$ the cement factor shall be increased in accordance with the following formula:

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$$C_i = \frac{(f'_c + K_1\sigma) - \bar{X}}{200}$$

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Where C_i = Number of 23.5 lb. increments of cement increase per cubic yard, rounded up to a whole number.

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f'_c = Design Strength
K_1 = Factor from Table 1
σ = Standard Deviation
$\bar{X}$ = Average Strength

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3.3.4.2.1 When the cement factor for a certain mix design, which contains a Supplementary Cementitious Material (SCM), is required to be increased, the Concrete Producer has two options to meet the cement factor increase requirement.

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Option 1: Make the cement factor increase entirely with cement.

Option 2: Make the cement factor increase with the same cement/SCM ratio that is used in the subject mix design. For example, if 20% of the cementitious material in the subject mix design is fly ash and 80% of the cementitious material in the subject mix design is cement, and the cement factor was required to be increased by 23.5 pounds, the cement factor increase would consist of an additional 5 lbs. of fly ash and an additional 19 pounds of cement. Fractions of a pound that are 0.5 and above shall be rounded up, and fractions of a pound that are below 0.5 shall be rounded down.

3.3.4.3 If the average strength falls above the Design Strength plus K_2 standard deviations $\{\bar{X} > (f'_c+K_2\sigma)\}$ the cement factor may be decreased in accordance with the following formula:

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$$Cd = \frac{\bar{X} - (f'_c + K_2\sigma)}{200}$$

Where C_d = Number of 23.5 lb. increments of cement to be decreased per cubic yard, rounded to the nearest whole number.

K_2 = Factor from Table 1

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3.3.4.3.1 When the cement factor for a certain mix design, which contains a SCM, is permitted to be decreased, and if the Concrete Producer elects to decrease that cement factor, the cement factor shall be decreased with the same cement/SCM ratio that is used in the subject mix design. For example, if 20% of the cementitious material in the subject mix design is fly ash and 80% of the cementitious material in the subject mix design is cement, and the cement factor was permitted to be decreased by 23.5 pounds, the cement factor decrease would consist of a reduction of 5 lbs. of fly ash and a reduction of 19 pounds of cement. Fractions of a pound that are 0.5 and above shall be rounded up, and fractions of a pound that are below 0.5 shall be rounded down.

3.4 Reporting

Once each month, the Materials Control, Soils and Testing Division will publish a list of concrete producers (Commercial Suppliers and/or Contractors), with all concrete mix designs for each concrete producer, and their corresponding cement factor, determined in conformance with this MP.

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3.5 Reevaluating Concrete Mix Design

A concrete mix design which is approved for a particular project will remain valid to the extent that it satisfies the requirement for that particular project for its duration.

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A concrete mix design which is developed in accordance with MP 711.03.23 and maintained for a period of three years shall be re-approved in accordance with Section 6 of MP 711.03.23. It is the Contractor's responsibility to make adjustments to the design mix as necessary to maintain in the concrete proper placement properties, workability, finishability, yield, consistency, air content, and other requirements of the governing specification. The Contractor should be especially aware of this responsibility when the cement factor is changed in conformance with this procedure.

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TABLE 1
VALUES OF "K" FACTORS

NUMBER OF PIECES OF DATA	K1	K2
10	1.604	3.615
11	1.588	3.510
12	1.576	3.429
13	1.565	3.365
14	1.557	3.313
15	1.549	3.270
16	1.543	3.233
17	1.538	3.202
18	1.533	3.175
19	1.528	3.151
20	1.525	3.130
21	1.521	3.112
22	1.518	3.096
23	1.515	3.081
24	1.513	3.067
25	1.511	3.055
26	1.508	3.044
27	1.507	3.034
28	1.505	3.024
29	1.503	3.016
30	1.501	3.008
Above 30	1.500	3.000