

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

MATERIALS PROCEDURE

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GUIDE FOR QUALITY CONTROL AND ACCEPTANCE REQUIREMENTS  
FOR PORTLAND CEMENT CONCRETE

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1.0 PURPOSE

- 1.1 To establish minimum requirements for Contractor's quality control system and the Division's Acceptance Plan. It is intended that these requirements be used as a procedural guide in detailing the inspection, sampling, and testing deemed necessary to maintain compliance with the specification requirements.

2.0 REQUIREMENTS

2.1 General Requirements

The contractor shall provide and maintain a quality control system that will provide reasonable assurance that all materials and products submitted to the Division for acceptance will conform to the contract requirements whether manufactured or processed by the Contractor or procured from suppliers, subcontractors, or vendors. The contractor shall perform or have performed the inspections and tests required to substantiate product conformance to contract document requirements and shall also perform or have performed all inspections and tests otherwise required by the contract. The Contractor's quality control inspections and tests shall be documented and shall be available for review by the Engineer throughout the life of the contract. The Contractor shall maintain standard equipment and qualified personnel as required by the Specifications to assure conformance to contract requirements. Procedures will be subject to the review of the Division before the work is started.

2.2 Quality Control Plan(s):

- 2.2.1 The contractor shall prepare a Quality Control Plan detailing the type and frequency of inspection, sampling, and testing deemed necessary to measure and control the various properties of materials and construction governed by the Specifications. As

a minimum, the sampling and testing plan should detail sampling location, sampling techniques, and test frequency to be utilized. Quality control sampling and testing performed by the Contractor may be utilized by the Division for acceptance. The Quality Control Plan shall be submitted in writing to the Engineer at the preconstruction conference.

- 2.2.2 The Plan shall identify the personnel responsible for the Contractor's quality control. This should include the company official who will act as liaison with Division personnel, as well as the Certified Portland Cement Concrete Technician who will direct the inspection program. Certified Portland Cement Concrete Inspectors responsible for sampling and testing of the plastic as well as the hardened concrete shall also be listed on this Quality Control Plan.
- 2.2.3 The Class or Classes of concrete involved will be listed separately. If existing mix designs are to be utilized, the Mix Design Numbers shall be listed.
- 2.2.4 Process control sampling, testing, and inspection should be an integral part of the contractor's quality control system. In addition to the above requirements, the Contractor's quality control system should document the process control requirements shown in Table 1. The process control activities shown in Table 1 are considered to be normal activities necessary to control the production and placing of a given product or material at an acceptable quality level. To facilitate the Division's activities, the Contractor, as per ML-25, shall retain all completed gradation samples until further disposition is designated by the Division.
- 2.2.5 If the District (in which the Project is located) permits, and if the Contractor and Concrete Plant both elect to do so, the Contractor may submit a Quality Control Plan for field operations, and the Concrete Plant may submit a separate Quality Control Plan for plant operations as outlined below.
  - 2.2.5.1 The Quality Control Plan for plant operations shall be submitted to the District (in which the Concrete Plant is located) by the Plant on an annual basis. This Plant Quality Control plan shall be valid for the entire year and shall include all quality control information pertaining to operations at the plant. If there are any personnel or other quality control related changes at the Plant throughout the course of the year, the Plant shall submit an addendum to this annual Plant Quality Control Plan. If this Plant Quality Control Plan is deemed adequate, the District shall issue it a laboratory approval number separate from any Field Quality Control Plan.
  - 2.2.5.2 A Quality Control Plan for field operations shall be submitted to the District (in

which the Project is located) by the Contractor for each project. This Field Quality Control Plan shall include all quality control information pertaining to operations in the field, and shall include a copy of the approved Plant Quality Control Plan for the concrete plant that is supplying the concrete for the subject project. The Contractor shall state in the Field Quality Control Plan that he (she) has reviewed the Plant Quality Control Plan and whether or not he (she) concurs with it. If this Field Quality Control Plan is deemed adequate, the District shall issue it a separate laboratory approval number from the Plant Quality Control Plan. Even though the two Quality Control Plans may be submitted separately, the Contractor is ultimately responsible for ensuring that all quality control requirements and operations (both plant and field) are being upheld.

2.2.6 All sampling and testing shall be in accordance with the methods and procedures required by the specifications, and measuring and testing equipment shall be standard and properly calibrated as per the specified test procedure. If alternative sampling methods and procedures and inspection equipment are to be used, they shall be detailed in the Quality Control Plan.

2.2.6.1 When calculating the compressive strength of concrete cylinders in accordance with AASHTO T22, the following procedure shall be used:

$$CS = \frac{ML}{0.25 \times \pi \times D^2}$$

Where:

CS = Compressive strength of the specimen

ML = Maximum load carried by the specimen during the test

$\Pi$  = Mathematical constant  $\Pi$

D = Diameter of the cylinder being tested (in accordance with AASHTO T 22)

Note: The calculation for CS shall be performed in one continuous step (without any rounding), either by the testing machine, or by calculating device, and only the final value (CS) is permitted to be rounded (to the accuracy specified in AASHTO T 22).

The value for  $\Pi$  shall be the manufacturer's pre-programmed value in a calculating device or the testing machine.

## 2.3 Miscellaneous Concrete:

The contractor is not required to perform the process control testing required by Part C of Table 1 on miscellaneous concrete (as defined in section 2.3.1),

provided that the concrete in question is being supplied by an A1 or A2 plant (as defined in IM-18), and provided that the requirements of section 2.3.2 are met for each project on which the reduced testing of miscellaneous concrete is applied.

- 2.3.1 Miscellaneous concrete shall be defined as relatively small quantities, not exceeding 25 yd<sup>3</sup> (19 m<sup>3</sup>) per day, incorporated into items that will not adversely affect the traffic carrying capacity of a completed facility. Such items would not include any concrete intended for major structures, permanent mainline or ramp pavements, or any other structurally critical items.

The following items are suggested as a guideline in establishing items that may be categorized as miscellaneous concrete:

Note: Concrete testing for certain items below is waived, in some cases, by the referenced section of the specifications.

1. Sidewalks
2. Curb and Gutter
3. Concrete base course and concrete base course widening
4. Pavement patching, temporary pavements, and pipe crossings
5. Building floors and foundations
6. Slope paving and headers
7. Paved ditch or gutter
8. Guardrail anchorages (See section 715.12)
9. Metal pile shells (See section 614.5)
10. Small (less than 36" diameter) culvert headwalls
11. Fence posts (See section 715.12)
12. Catch basins, manhole bases, inlets, and junction boxes (and adjustments of such items) not located in the roadway
13. Foundations for breakaway supports
14. Thrust blocks
15. Utility trench fills
16. Cast-in-place survey markers
17. Slopewalls for under drain outlet pipes

- 2.3.2 A minimum of ten samples per month will be randomly selected from plant production (for each project receiving concrete from the subject plant) and tested for compressive strength, air content, and consistency. Yield will be checked on one of the above samples. On a minimum of four of the ten samples outlined above, the Division will observe the batching operation at the plant (that is producing the concrete to be sampled) and check the operational control. In the

event that production is estimated to be insufficient to fulfill the above requirements, a minimum of one sample per two days of production (for the same project) will be tested (beginning on the first day of production) for compressive strength, air content, and consistency. One yield test will be conducted per ten samples. On a minimum of forty percent of the samples outlined above, the Division will observe the batching operation at the plant (that is producing the concrete to be sampled) and check the operational control, except that not more than four such checks will be required in any one month.

2.3.3 Laboratory number 1345635 shall be used by the Districts for documentation and acceptance purposes for quantities of concrete designated as miscellaneous concrete.

2.4 Documentation:

The Contractor shall maintain adequate records of all inspections and tests. The records shall indicate the nature and number of observations made, the number and type of deficiencies found, the quantities approved and rejected, and the nature of corrective action taken as appropriate. The Contractor's documentation procedures will be subject to the review and approval of the Division prior to the start of the work and to compliance checks during the progress of the work.

2.4.1 Charts and Forms:

All conforming and non-conforming inspections and test results shall be kept complete and shall be available at all times to the Division during the performance work. Forms shall be on a computer-acceptable medium where required. Batch ticket data shall be documented in accordance with the applicable section of MP 601.03.50, with a copy to be submitted to the District Materials Section within 72 hours of the concrete placement. Gradation data shall be documented on WVDOT form T300 using the material codes listed in the online computer systems user guide. The original gradation data shall be submitted to the District Materials Section within 72 hours of obtaining the gradation sample. Test data for Portland cement concrete shall be charted in accordance with the applicable requirements of MP 601.03.52. Gradation test data shall be plotted in accordance with the applicable requirements of MP 300.00.51. The Contractor may use other types of control charts as deemed appropriate. It is normally expected that testing and charting will be completed within 48 hours after sampling. The Contractor shall also ensure that all Material Suppliers prepare and submit the HL-441 form (weekly supplier report) in a timely manner.

2.4.2 All charts and records documenting the Contractor's quality control inspections and tests shall become property of the Division upon completing of the work.

2.4.3 Batch Tickets

Each batch of Structural Concrete, including miscellaneous concrete (as defined in section 2.3.1), delivered at the project shall be accompanied by one batch ticket with all of the items of information listed in section 2.4.4 pre-printed on the ticket.

In the case of Portland Cement Concrete Pavement, each batch of concrete delivered at the project on which a test in accordance with Table 1 is to be performed shall be accompanied by a batch ticket. This batch ticket shall have all of the items listed in section 2.4.4 pre-printed on the ticket unless nonagitator trucks or truck agitators are used. In this case, the batch ticket shall have all of the items listed in section 2.4.5 pre-printed on the ticket.

2.4.4 All batch tickets for Structural Concrete and Portland Cement Concrete Pavement Concrete transported by truck mixers shall have all of the following items pre-printed on the ticket:

Source Code, Source Name, Source Location, Mix Design Number, Date, Sequence Number, Volume ( $\text{yd}^3/\text{m}^3$ ), Time Batched, Time Unloaded, Authorization Number, Material Code, Material Name, Water Allowed (Gallon/Liter), Water at Plant (Gallon/Liter), Water at Job (Gallon/Liter), Weight Cement (lb/kg), Weight Pozzolan (lb/kg), Temperature ( $^{\circ}\text{F}/^{\circ}\text{C}$ ), Cylinder I.D., Initial Counter, Final Counter, Target Consistency (in/mm), Actual Consistency (in/mm), Target Air (%), Actual Air (%), Truck Number

2.4.5 All batch tickets for concrete delivered by means of nonagitator trucks or truck agitators shall have all of the following items pre-printed on the ticket:

Source Name, Mix Design Number, Date, Sequence Number, Volume ( $\text{yd}^3/\text{m}^3$ ), Time Batched, Time Unloaded, Authorization Number, Material Code, Material Name, Water Allowed (Gallon/Liter), Water at Plant (Gallon/Liter), Weight Cement (lb/kg), Weight Pozzolan (lb/kg), Temperature ( $^{\circ}\text{F}/^{\circ}\text{C}$ ), Target Consistency (in/mm), Actual Consistency (in/mm), Target Air (%), Actual Air (%), Truck Number

2.4.6 The batch ticket in the case of either type of concrete shall be a pre-printed batch ticket prepared by the plant. This ticket may be either computer generated or a standard pre-printed form with blank spaces provided in which all of the required data shall be recorded. The data items listed above that are completed in the field (such as Time Unloaded, Actual Consistency, etc.) must have a space on the batch

ticket for completion. Volume is to be reported to the nearest 0.01 yd<sup>3</sup> (0.01 m<sup>3</sup>). Consistencies are to be reported to the nearest 0.25 inch (6 mm). Target and Actual Air are to be reported to the nearest 0.1% (to the nearest 0.25% if the volumetric method is used).

2.5 Corrective Action:

The Contractor shall take prompt action to correct conditions, which have resulted, or could result, in the submission to the Division of materials and products, which do not conform to the requirements of the Contract documents.

2.6 Non-Conforming Materials:

The contractor shall establish and maintain an effective and positive system for controlling non-conforming material, including procedures for its identification, isolation and disposition. Reclaiming or reworking of non-conforming materials shall be in accordance with procedures acceptable to the Division. All non-conforming materials and products shall be positively identified to prevent use, shipment, and intermingling with conforming materials and products. Holding areas, mutually agreeable to the Division and the Contractor shall be provided by the Contractor.

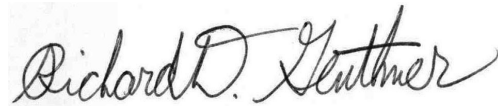
3.0 ACCEPTANCE SAMPLING AND TESTING

3.1 Acceptance sampling and testing is the responsibility of the Division. Quality control tests by the Contractor may be used for acceptance.

3.2 The Division shall sample and test for applicable items completely independent of the contractor at a frequency equal to approximately ten (10) percent of the frequency for testing given in the approved Quality Control Plan. Witnessing the contractor's sampling and testing activities may also be a part of the acceptance procedure, but only to the extent that such tests are considered "in addition to" the ten (10) percent independent tests.

3.3 Results from independent tests conducted by the Division for gradation, entrained air, consistency, and strength will be plotted on the Contractor's quality control charts with a red circle, but are not to be included in the moving average. When the Contractor's tests are witnessed, the results are circled on the control chart in red, and are to be included in the moving average calculations.

- 3.4 Results from both independent tests and witnessed tests will be evaluated in accordance with MP 700.00.54. If a dissimilarity is detected, an investigation shall be immediately initiated to determine the cause of the dissimilarity.



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RDG:Mb

Attachments

Table 1

CONTRACTOR'S PROCESS CONTROL REQUIREMENTS

STRUCTURAL CONCRETE AND  
PORTLAND CEMENT CONCRETE PAVEMENT

Minimum Frequency\*

A. PLANT AND TRUCKS

- |                                        |                                  |
|----------------------------------------|----------------------------------|
| 1. Mixer Blades                        | Prior to Start of Job and Weekly |
| 2. Scales                              |                                  |
| a. Tared                               | Daily                            |
| b. Calibrate                           | Prior to Start of Job            |
| c. Check Calibration                   | Weekly                           |
| 3. Gauges and Meters - Plant and Truck |                                  |
| a. Calibrate                           | Yearly                           |
| b. Check Calibration                   | Weekly                           |
| 4. Admixture Dispenser                 |                                  |
| a. Calibrate                           | Prior to Start of Job            |
| b. Check Operation and Calibration     | Daily                            |

B. AGGREGATES

- |                   |                                             |
|-------------------|---------------------------------------------|
| 1. Fine Aggregate |                                             |
| a. Gradation      | Per section 601.3.2.4 of the specifications |
| b. Moisture       | Daily                                       |

2. Coarse Aggregates

- |                                                                          |                                             |
|--------------------------------------------------------------------------|---------------------------------------------|
| a. Gradation                                                             | Per section 601.3.2.4 of the specifications |
| b. Percent Passing No. 75mm                                              | Daily                                       |
| c. $\bar{A}$ for Combined Coarse Aggregates, Fine Aggregates, and Cement | Per section 601.3.2.4 of the specifications |
| d. Moisture                                                              | Daily                                       |

C. PLASTIC CONCRETE

1. Entrained Air Content

- |                                                       |                                                                                                                     |
|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Pavement Concrete                                     | One per 500 yd <sup>3</sup> (380 m <sup>3</sup> ) or fraction thereof, with a minimum of two per day                |
| Structural Concrete<br>(except bridge superstructure) | One per 100 yd <sup>3</sup> (75m <sup>3</sup> ) or fraction thereof, with a minimum of one per 1/2 Day of Operation |
| Bridge Superstructure                                 | One per Batch                                                                                                       |

2. Consistency

- |                                                       |                                                                                                                     |
|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Pavement Concrete                                     | One per 500 yd <sup>3</sup> (380 m <sup>3</sup> ) or fraction thereof, with a minimum of two per day                |
| Structural Concrete<br>(except bridge superstructure) | One per 100 yd <sup>3</sup> (75m <sup>3</sup> ) or fraction thereof, with a minimum of one per 1/2 Day of Operation |
| Bridge Superstructure                                 | One for first batch and one for every fifth batch thereafter                                                        |

3. Temperature

Per Specifications

4. Yield

|                   |                                                                                                                        |
|-------------------|------------------------------------------------------------------------------------------------------------------------|
| Pavement Concrete | Per section 501.3 of the specifications and one for each five days of operation after the first five days of operation |
|-------------------|------------------------------------------------------------------------------------------------------------------------|

|                     |                                                                                                        |
|---------------------|--------------------------------------------------------------------------------------------------------|
| Structural Concrete | Per section 601.3.2.3 of the specifications and one for each ten sets of cylinders after the first ten |
|---------------------|--------------------------------------------------------------------------------------------------------|

5. Compressive Strength\*\*

|                   |                                           |
|-------------------|-------------------------------------------|
| Pavement Concrete | Per section 501.4.4 of the specifications |
|-------------------|-------------------------------------------|

|                     |                                                                                                                                                                                                |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Structural Concrete | For each class concrete delivered and placed on a calendar day from a single supplier, one set of concrete cylinders for each 100 yd <sup>3</sup> (75m <sup>3</sup> ) or fraction thereof. *** |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

\*Frequency for Process Control will vary with the size and type of aggregate or mixture and the batch-to-batch variability of the item.

\*\*The use of Materials Procedure MP 711.03.31, Predicting Potential Cement Concrete from Early Breaks, is encouraged due to the extensive and timely information furnished by this method.

\*\*\*All cylinders shall be made, cured, and shipped to the Laboratory in accordance with AASHTO T 23 and MP 601.04.20. They shall be tested in accordance with AASHTO T 22 and section 601.4.4 of the Standard Specifications.