

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

MATERIALS PROCEDURE

GUIDE FOR QUALITY CONTROL OF COMPACTION

1. PURPOSE

- 1.1 This procedure sets forth minimum guidelines for the Contractor's Quality Control (QC) Plan for embankment, subgrade, pipe and random fill used as structure backfill material and aggregate base courses. It is intended that these requirements be used as a procedural guide in detailing the inspection, sampling, and testing necessary to maintain compliance with the specification requirements.
- 1.2 To establish procedural guidelines for approval and documentation of a Master QC Plan.

2. SCOPE

- 2.1 This procedure is applicable to all items requiring compaction control except asphalt pavements. This outlines the QC procedures for Compaction items and includes procedures for approving and using Master and/or Project Specific QC Plans. This procedure also aids in documentation and retention of QC Plans in ProjectWise.

3. DEFINITIONS

- 3.1 Moisture/Density Gauge (Gauge) – Any gauge that has been approved for use on WVDOH projects. A list of these gauges and their applicable uses is available of the WVDOH MCST Webpage.
- 3.1.1 Moisture/Density Gauge is to replace all instances of the term “Nuclear Gauge” in all WVDOH documents.

4. REFERENCED DOCUMENTS

- 4.1 MP 100.00.03 - Method Of Evaluation of Non-Standard or Non-Conforming Materials in Construction Via DMIR
- 4.2 MP 109.00.21 - Basis for Charges for Non-Submittal of Sampling & Testing Documentation by the Established Deadline

- 4.3 MP 207.07.20 - Nuclear Field Density - Moisture Test for Random Material Having Less Than 40% of +3/4 Inch Material
 - 4.4 MP 700.00.24 - Nuclear Density Test by The Roller Pass Methods
 - 4.5 MP 700.00.50 - Procedure for Monitoring the Contractor's Compaction Testing of Bituminous Concrete, Base Course, Embankment, Sub-Grade and Pipe and Structural Backfill
 - 4.6 MP 712.21.26 - Procedure for Determining Random Location of Compaction Tests
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5. GENERAL REQUIREMENTS

- 5.1 The Contractor shall provide and maintain a QC system that will provide assurance that all materials submitted to the Division for acceptance will conform to the contract requirements whether natural, manufactured or processed by the Contractor, or procured from suppliers. The QC Plan should clearly describe the methods by which the QC Program will be conducted. For example, the items to be controlled, tests to be performed, testing frequencies, sampling locations and techniques all should be included etc. Each item should be listed separately.
 - 5.1.1 A detailed plan of action regarding disposition of non-specification material shall be included. Such a plan shall provide for immediate notification of the Division in the event of a non-conforming situation or instance.
 - 5.2 Inspection and testing records shall be maintained, kept current, and made available for review by the Engineer throughout the life of the contract. All other documentation, such as date of inspections, tests performed, temperature measurements, and any accuracy, calibration, or re-calibration checks performed on production or testing equipment shall be recorded and kept.
 - 5.3 The Contractor shall maintain standard calibrated equipment and qualified personnel in accordance with the contract and Specification requirements for the applicable material.
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6. QUALITY CONTROL PLAN

- 6.1 The Contractor shall prepare a QC Plan detailing the type and frequency of inspection, sampling, and testing necessary to measure and control the compaction 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. QC sampling and testing performed by the Contractor may be utilized by the Division for acceptance.
 - 6.1.1 A QC Plan shall be developed by the Contractor and submitted to the Engineer prior to the start of construction on every project. Acceptance of the QC Plan by the Engineer will be contingent upon its concurrence with these guidelines as listed in section 6.2 through 6.4.5.2.
 - 6.1.2 As work progresses, an addendum(s) may be required to a QC Plan to keep the QC program current. Personnel may be required to show proof of certification for testing.

6.2 QC PLAN MINIMUM REQUIREMENTS

- 6.2.1 The QC Plan should be on Company Letterhead, be addressed to the District which it pertains, and include the items to be controlled. An example/template is provided in Attachment 1.
- 6.2.2 Provide the name of the Person who is responsible for the Company's QC program and will be liaison with the Division's personnel.
- 6.2.3 List all inspectors' names performing compaction tests on the project and their date becoming a Certified Soils & Aggregate Compaction Inspector as per WVDOT Specification Section 106 Control of Materials.
- 6.2.4 Compaction field tests will be performed according to MP 207.07.20, MP 700.00.24, and Standard Specification 716.32.3
- 6.2.5 Soft shale tests shall be conducted according to Section 716 of the Standard Specifications.
- 6.2.6 Specify in the plan the methods by which each item will be tested. Table A and Table B summarize the different materials, minimum frequencies, and the appropriate test procedure or method for controlling each material.

Table A- COMPACTION CONTROL OF AGGREGATE BASE COURSES

TEST PROCEDURE	LOT SIZE	NUMBER OF TEST	MATERIAL TYPE			
			PORTLAND CEMENT TREATED AGGREGATE BASE COURSE	CRUSHED AGGREGATE BASES AND SUBBASE COURSES	HOT-MIX HOT- LAID BITUMINOUS TREATED BASE COURSE	SOIL CEMENT BASE COURSE
MP 700.00.24	2000 FEET	1 PER SUBLLOT 5 PER LOT	X	X	X	
MP 207.07.20	2000 FEET	1 PER SUBLLOT 5 PER LOT				X

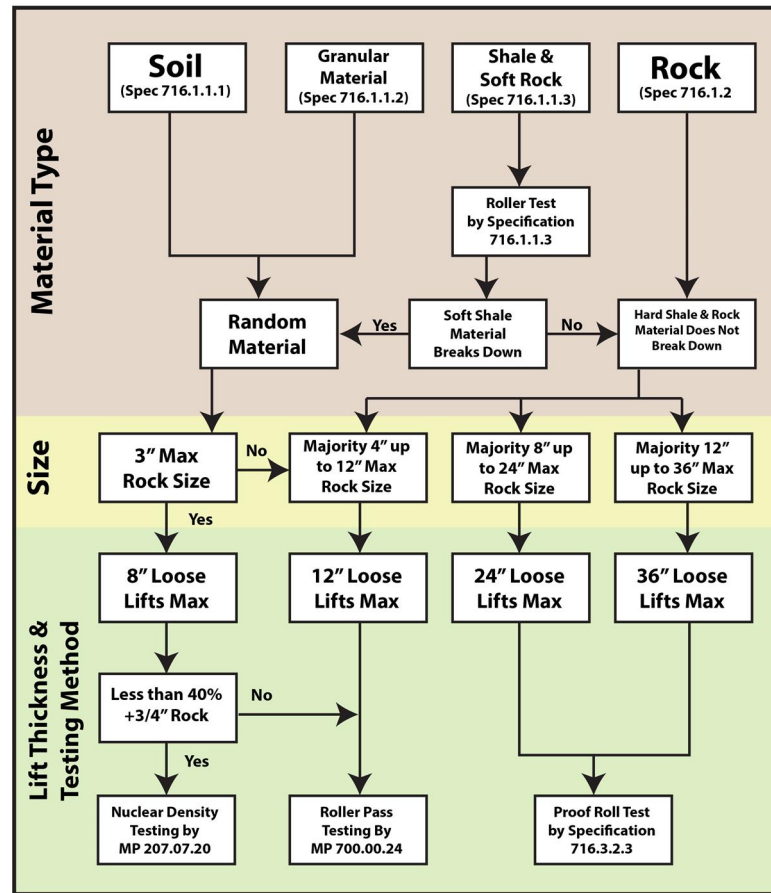
Table B - COMPACTION CONTROL OF EMBANKMENT BACKFILL AND SUBGRADE

TEST	LOT SIZE	NUMBER OF TESTS	MATERIAL WITH LESS THAN 40% RETAINED ON 3/4" (19.0 mm) SIEVE	MATERIAL WITH 40% OR MORE RETAINED ON 3/4" (19.0 mm) SIEVE AND CAN BE PLACED IN A 12" (300 mm) LOOSE LIFT OR LESS	MATERIAL THAT CAN BE PLACED IN A LOOSE LIFT GREATER THAN 12" (300 mm)	GRANULAR SUBGRADE	SELECT MATERIAL FOR BACKFILLING AND CLASS 1 AGGREGATE
				UNIFORM	NON-UNIFORM	ROCK HARD SHALE	
MP 207.07.20	SEE STD. SPECS.	1 PER SUBLOT 5 PER LOT	X				
MP 700.00.24	SEE STD. SPECS.	1 PER SUBLOT, 5 PER LOT		X [1]	X [1], [2]		X
PROOF Rolling		1 REPORT PER LIFT				X X	

1. If a hole for a direct transmission density reading cannot be readily made due to the coarse material, proof roll the lift.
2. If density readings vary above 105 percent or below 95 percent and the material appear to be non-uniform, proof roll the lift.

6.2.7 A flow chart for embankment material, Table C, shall serve as a guide for identifying material types, maximum rock size, lift thickness and compaction test method. This table shall be included in the QC Plan for making field decisions to ensure that each type of material is properly placed and compacted.

Table C – Guide for Quality Control of Embankment Material



- 6.2.8 The plan shall include a statement that all necessary testing equipment will be provided to perform the procedures outlined in MP 700.00.24, MP 207.07.20, and Specification 716.3.2. The plan shall list the make and model of equipment for proof rolling and its weight per Specification 716.3.2. The plan shall list the make, model and operating weight of the roller(s) to be used for the soft shale tests and per Specification 716.1.1.3.
- 6.2.9 List the type of gauge to be used. The calibration frequency must be acceptable to the Division. Gauges must be calibrated according to the manufacturer's requirements. This information shall be given to the Division upon their request.
- 6.2.10 If applicable, outline the procedure for performing a stability check on gauges that are not within the tolerance range for standard counts during the interval between calibrations. Standard counts derived during the stability check for stable gauges may be used in lieu of the manufacturer's standards. Gauges found to be unstable cannot be used until repaired and calibrated.
- 6.2.11 Include in the plan the lot and subplot sizes to be used for testing each type of installation. During construction, some flexibility in lot sizes may be made if the situation warrants in order to maintain a workable system. For example, two or more areas containing small quantities of embankment material might be combined into one lot at the Contractor's option and subject to the Division's approval.

- 6.2.12 Specify the maximum time period for completion of a lot of embankment material. As a guide, if the desired lot size cannot be obtained within seven calendar days, then the material placed up to that time would constitute the lot and the specified number of tests for a lot would still be performed.
- 6.2.13 Specify in the plan when quality control tests for base and subgrade will be performed. QC tests are to be performed after the material has been shaped and final rolling has been completed.
- 6.2.14 The Contractor is responsible for the accuracy of their individual testing and calculations.
- 6.2.15 List the forms and method of distribution for tests and measurements.
- 6.2.16 Compaction test results are reported on forms specified in MP 207.07.20 and MP 700.00.24. The forms are supplied by the Division and available on the [MCS&T Webpage](#)¹. The completed form shall be submitted to the Division's project supervisor, District Materials Lab, and a copy shall be retained for the Contractor's records.
- 6.2.17 Indicate the length of time after tests and measurements are completed that documentation will be provided.
 - 6.2.17.1 Test results and measurements shall be made available to project personnel for review on a daily basis. Formal submission of measurements should be made within 24 hours after the measurements are taken and test results within 24 hours after testing of a lot is completed.
 - 6.2.17.2 Tests performed in a lot before final rolling is completed should be submitted to the Project Supervisor and retained in the project files. This includes test documents for failing lots and moisture checks.
- 6.2.18 List the compaction equipment giving the quantity, make, model, and weight or applied force at which each roller will be operated. If ballast will be added to a roller, indicate the type and quantity of ballast and the method for verifying the gross weight. Attach the manufacturer's specifications for compaction capabilities for each roller to the plan or state the procedure for verifying the compaction capabilities of each roller in cases where the manufacturer's specifications are not available. This equipment shall meet the requirements of Section 207.7.5 of the Specifications.
- 6.2.19 Indicate in the plan that a minimum of a 10-ton (9.07 Mg) roller will be used for testing in accordance with MP 700.00.24 for soil and granular material only.
- 6.2.20 Rollers used to breakdown soft shale shall be in accordance with Section 716.1.1.3 of the Specifications and shall have a minimum of 1.5 tons per linear foot of roller drum width.

¹ <https://transportation.wv.gov/highways/mcst/Pages/tbox.aspx>

- 6.2.21 Specify the method by which proof rolling will be conducted on embankment materials. The materials to be proof rolled are summarized in Table B in Section 6.2.6.
- 6.2.22 List the number of passes to be made and corrective measures if soft areas are detected. Documentation should include the type of material, number of passes, and corrective action if soft areas are detected.
- 6.2.23 For equipment used for proof rolling explain how the gross weight will be determined for any ballast added to the operating weight. For alternate proof rollers, attach to the QC Plan the calculations used to determine that the roller meets specifications. Also, attach the manufacturer's specifications for all proof rollers to the Plan. The following calculation is used to determine if an alternate proof roller meets specifications:

ENGLISH	Metric
$c = \frac{\sqrt{(ab\pi)}}{2}$	$c = \frac{\sqrt{(ab\pi)}}{50.8}$

Where:

a = weight (force) on a single tire = pounds (kg x .009807 = kN)

b = operating tire pressure = psi (kPa)

c = weight (force) per inch (mm) width of tire = pounds per inch (Nm)

The weight (force) per inch (mm) width of tire must be equal to or greater than 1315 pounds (9.067 kN/mm).

- 6.2.24 Outline the procedure for notifying the Division when the test section in MP 700.00.24 will be performed. The Division shall be notified a minimum of 24 hours in advance unless other arrangements acceptable to the Division can be made.
- 6.2.25 Laboratory testing for random material is not required unless the material has unusual characteristics or differs from the soil and rock data used to develop the design. Testing to develop density curves, specific gravities, organic content, etc. may be required.
- 6.2.26 A list of test procedures is contained in Section 716 of the WVDOT Standard Specifications as a guideline for required testing should the need arise for random material.
- 6.2.27 Design a plan of action for the disposition of non-specification material, such as material with excessive moisture, excessive organic content, etc. These materials shall be stockpiled away from the embankment or fill placement areas. The Project Supervisor should be immediately notified in the event a nonconformance situation is detected.
- 6.2.28 List the method(s) and frequencies per Table D by which lift thickness measurements will be taken. If surveying of compacted lifts is not utilized, then the maximum loose lifts per Table C shall be measured.

TABLE D - LIFT THICKNESS MEASUREMENTS

MATERIAL TYPE	NUMBER OF MEASUREMENTS
EMBANKMENT	MINIMUM OF 3 PER LIFT
SUBGRADE	MINIMUM OF ONE PER 1200 FEET PER WORKING WIDTH
PIPE BACKFILL	MINIMUM OF ONE PER SIDE PER LIFT
STRUCTURE BACKFILL	MINIMUM OF ONE PER LIFT

6.3 TYPES OF QC PLAN

- 6.3.1 QC Plans which are intended for use on more than one project shall be defined as Master QC Plans. Section 6.4 outlines the procedures for Master QC Plan submittal and approval.
- 6.3.2 QC Plans which are intended for use on a single project shall be defined as Project Specific QC Plans. Project Specific QC Plans shall contain a cover letter which includes the following: project name/description, CID#, Federal and/or State Project Number.
- 6.3.3 A contractor may submit a Master QC Plan for field operations instead of a Project Specific QC Plan.
- 6.3.4 Once any QC Plan is approved for a project, the key date shall be entered in AASHTOWare software by the appropriate District Materials personnel. The first date entered shall be the date the Project QC Plan letter is received. The second date shall be when the District approves the QC Plan for use on the project.

6.4 MASTER QUALITY CONTROL PLAN

- 6.4.1 The intent of Master QC Plans is to facilitate the approval process in a more uniform manner. A Master QC Plan can be submitted to the Division/District by the Contractor when their work in a given District is routinely repetitive for the year. The Master Quality Control Plan is applicable for only the calendar year for which it has been approved.
- 6.4.2 The Contractor shall submit the Master Compaction QC Plan yearly to each District in which they have work in. If the Contractor does not have work in a given District for the year then no Master QC Plan shall be submitted to that District.
- 6.4.3 The District will review the submitted Master QC Plan and assign a laboratory reference number upon approval for future referencing. The District will acknowledge approval of Master QC Plan to the Contractor by letter (see Attachment #2 for an example), which will include the laboratory reference number and a copy of the approved Master QC Plan attached. This will then be scanned and placed in ProjectWise under the appropriate District's Org for that Contractor.

- 6.4.4 Once a project has been awarded, if a contractor elects to use the approved Master Compaction QC Plan on that project, the Contractor shall submit a letter requesting to use the Master QC Plan for that project. This letter must be on the Contractor's letterhead, be addressed to the District Engineer/Manager or their designee, and contain the following information: project number, CID#, project name/ description, type of Quality Control Plan and the laboratory reference number for the Master QC Plan (See Attachment #3 for an example).
- 6.4.5 The District shall review the referenced Master QC Plan to ensure that it covers all items in the project. If the referenced Master QC Plan is found to be insufficient for some items on the project, the District shall request the Contractor to submit additional information for QC of those items as an addendum on a project specific basis. When the District is satisfied with the QC Plan for this project, a letter shall be sent to the Contractor acknowledging approval (see Attachment #4 for an example), with the following attached: the Contractor's project QC Plan request letter and the Master QCP approval letter. This shall then be placed in the project's incoming-mail mailbox in ProjectWise.
- 6.4.5.1 A Master QC Plan that has been approved for project use shall be acceptable for the duration of that project, even if that project continues into subsequent calendar years, unless otherwise directed by the District.
- 6.4.5.2 For the use of Division Personnel, the District approval letter for this project must state the ProjectWise link to the referenced Master QC Plan for that Contractor. (i.e., WVDOT ORGS > District Organization #> Materials > Year>Master QC Plans...)

7. CERTIFICATION & ACCEPTANCE SAMPLING AND TESTING

- 7.1 The Contractor shall certify that compaction testing and sampling is in conformance with the approved QC plan, referenced MP's and referenced Standard Specifications in a letter format on the company's letterhead. The certification shall summarize what materials were encountered and the compaction method/lift thickness utilized. The letter shall state whether any deviations from the requirements of the QC plan, MP's, and Standard Specifications exist, and why.
- 7.2 Acceptance sampling and testing is the responsibility of the Division. QC tests by the Contractor may be used for acceptance.
- 7.3 The Division shall sample and test for applicable items completely independent of the contractor at a frequency equal to but not limited 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.
- 7.4 MP 700.00.50, MP 207.07.20, and Specification Section 716.3.2.3 outlines the procedures to be followed for acceptance of compaction testing.

8. ABSENT TESTING OF MATERIAL

- 8.1 If the Contractor fails to perform testing of the material in accordance with the Contractor's Division Approved Quality Control Plan, payment for the portion of the item represented by the absent test shall be withheld, pending the Engineer's decision whether or not to allow the material to remain in place. Testing includes both performing the test and submitting the results as per MP 109.00.21.
- 8.1.1 If the Engineer allows the material to remain in place, the Division shall not pay for the material represented by the absent test. However, the Division shall pay for the cost of the placement of the material, including labor and equipment. The invoice or material supplier cost (if applicable), determined at the time of shipment, shall be used to calculate the cost of material when evaluating the total cost of labor and equipment.
- 8.1.1.1 If there is no material cost, the deduction shall be assessed on the tonnage of material represented by the missing test via a District Materials Inspection Report (DMIR).

**Michael
Mance**

Digitally signed by Michael
Mance
Date: 2024.08.23 14:35:26
-04'00'

Michael A. Mance, P.E.
Interim Director
Materials Control, Soils & Testing Division

MP 717.04.21 Steward – Pavement Analysis & Evaluation Section
MM:A
ATTACHMENTS

ATTACHMENT 1 - EXAMPLE GUIDE FOR COMPACTION QUALITY CONTROL PLAN

The Acme Company
20 First St.
Somewhere, WV XXXXXXXX

Mr./Ms/Mrs. _____
WV Division of Highways
District ____ Engineer/Manager
_____, WV _____

RE: (YEAR) Master Compaction QC
Plan
DISTRICT: _____

Dear Mr./Ms/Mrs. _____

We are submitting our Compaction Quality Control Plan for field control, developed in accordance with sections 716 and 717 of the (year) WVDOH Standards and Specifications, (year) WVDOH Supplemental specifications, MP 700.0024, MP 207.07.20, MP 712.21.26 and MP 700.00.50.

The Quality Control Program is under the direction of _____. They can be contacted by telephone number _____, email _____ and/or in person.

- 1.) All testing will be performed by qualified personnel as per WVDOH Specification Section 106 Control of Materials. Proof of personnel certification shall be provided to WVDOH inspectors upon request.
- 2.) Specify the methods by which each item will be tested .(IE.. 207,307...etc). Table A and Table B (attached) summarizes the different materials, minimum frequencies, and the appropriate test procedure or method for controlling each material. A flow chart for embankment material, Table C (attached), is intended to serve as a guide for making field decisions to insure that each type of material is properly placed.
- 3.) Testing Equipment used will be as required in MP 700.00.24 and MP 207.07.20.

- 4.) Type of gauge to be used (IE.... Troxler 3430, etc). State that calibration information is available upon request by the Division/District.
- 5.) Outline the procedure for performing a stability check on nuclear gauges which are not within the tolerance range for standard counts during the interval between calibrations. Gauges found to be unstable cannot be used until repaired and calibrated.
- 6.) Include in the plan the lot and subplot sizes to be used for testing each type of installation.
- 7.) Specify the maximum time period for completion of a lot of embankment material.
- 8.) Specify in the plan when quality control tests for base and subgrade will be performed.
- 9.) List the forms and method of distribution for tests and measurements. (The forms are specified in MP 207.02.20 and MP 700.00.24.) State that test results will be made available to WVDOH personnel on a daily basis.
- 10.) List the compaction equipment giving the quantity, make, model, and weight or applied force at which each roller will be operated. If ballast will be added to a roller, indicate the type and quantity of ballast and the method for verifying the gross weight. Attach the manufacturer's specifications for compaction capabilities for each roller to the plan or state the procedure for verifying the compaction capabilities of each roller in cases where the manufacturer's specifications are not available.
- 11.) Indicate in the plan that a minimum of a 10 ton (9.07 Mg) roller will be used for testing as per 700.00.24.
- 12.) Indicate in the plan that when shale materials are encountered, the shale hardness test will be performed to determine if material is a soft shale as per 716.1.1.3 of the WVDOH Standards and Specifications.
- 13.) Specify the method by which proof rolling will be conducted on embankment materials. The materials to be proof rolled are summarized in Table B (attached).
- 14.) Laboratory testing for random material is not required unless the material has unusual characteristics or differs from the soil and rock data used to develop the design. Testing to develop density curves, specific gravities, organic content, etc. may be required. The Yearly Quality Control Plan should state that these additional tests must be performed by qualified Aggregate testing personnel as per as per WVDOH Specification Section 106 Control of Materials.

- 15.) Design a plan of action for the disposition of non-specification material.
- 16.) List the method(s) and frequencies by which the lift thickness measurements will be taken.

Very Truly Yours,

Title

ATTACHMENT 2

**** WVDOH LETTERHEAD ****

THE ACME COMPANY INC.
20 First St.
Somewhere, WV XXXXX

RE: Compaction Master QCP
Description: 20XX Year

Dear Mr./Ms/Mrs. _____,

Your Master Quality Control Plan(M# - #####) for Compaction has been reviewed and found to be acceptable for the following items:

- 207001-001	Unclassified Excavation	- 207002-001	Subgrade
- 211-001	- 307001 Items	- 604 items	
- 212 Items	- 605 items	-etc....	

As work progresses throughout the season an addendum(s) may be required to this QCP to keep the QC program current. **Please use M# - ##### when corresponding about this QC plan.** Please make sure that all appropriate personnel have a copy of this plan in their possession.

Very Truly Yours,

Title

ATTACHMENT 3

The ACME COMPANY
20 First St.
Somewhere, WV XXXXX

EXAMPLE

Mr./Ms/Mrs _____
WV Division of Highways
District ____ Engineer/Manager
_____, WV _____

RE: Compaction Quality Control plan
 for Field ---- Project

Fed. Project No _____
State Project No. _____
Contract ID No. _____
Description _____

Dear Mr./Ms/Mrs. _____,

We would like to use our approved Yearly Master Quality Control Plan, reference number _____ for the project referenced above. All Compaction items on the referenced project are covered by the Master Quality Control Plan.

The QC Plan is under the direction of _____,
_____ (title), and will be the company's contact representative to the Department of Highways District Materials and Construction Departments. He/She can be contacted in person at the project, by telephone _____ or at email account _____.

Very Truly Yours,

Title

ATTACHMENT 4

**** WVDOH LETTERHEAD ****

THE ACME COMPANY INC.
20 First St.
Somewhere, WV XXXXX

RE: Compaction QC Plan
Project CID#: #####
Fed/State Project #: NHPP- ## - #####.##
Description: Falling Slide
County : XXXXXXX

Dear Mr./Ms/Mrs. _____,

Your request to use Master Quality Control Plan (**M# - #####**) for compaction on the project referenced above, has been reviewed and found to be acceptable for the following items on the referenced project:

- 207001-001	Unclassified Excavation	- 207002-001	Subgrade
- 307001	Items	- 604 items	- 212 Items
			-etc....

As work progresses throughout this project an addendum(s) may be required to this QCP to keep the QC program current. **Please use M##### when corresponding about this QC plan.** Please make sure that all appropriate personnel have a copy of this plan in their possession.

For Division/District

The Master Quality Control Plan can be reviewed in ProjectWise folder shown below:

WVDOTORG> D0# > year > MASTERQCPLANS > Contractors >Contractor Name >
Name of Quality Control Plan

Very Truly Yours,

Title