DIVISION 700 – MATERIALS CONTROL

SECTION 701 – PURPOSES OF MATERIALS CONTROL

701.1 – COMPLIANCE WITH SPECIFICATIONS

An adequate and effective system for control of the materials used in a project is essential to ensure that the materials furnished and the completed work produced by the Contractor conform with the requirements of the Plans, Specifications, and Special Provisions, or are in reasonably close conformity, if permitted by the Specifications.

Control includes inspecting, sampling, testing, measuring, reporting of results, and any follow–up that may be necessary, especially in the case of test failures. Without any one of these actions, it is impossible for the Contract Administrator to have a complete and positive verification of compliance to the Plans, Specifications, and Special Provisions by the Contractor.

701.2 – UNIFORM RELATIONS WITH CONTRACTORS

The Plans, Specifications, and Special Provisions provide an equitable basis for bidding by Contractors, since they define the minimum requirements that are to be met. The Contractor is obligated to furnish materials and completed work that will equal or exceed such requirements.

The Contract Administrator must be satisfied, through materials control measures, that the State is receiving what it is entitled to under the Contract. The Contract Administrator should accept nothing less. To do so would not only be a disservice to the State, but would also be giving undue advantage to the Contractor. Other Contractors that had bid on the same work could contend that they would have offered a lower bid had they been able to anticipate that materials or work outside of the Specifications would be accepted.

It is essential that uniform materials control be applied by all Contract Administrators and Inspectors from project to project, so that all Contractors and suppliers are treated alike. To begin with, the Plans and Specifications should be prepared so that there will be the least possible difference of interpretation by Contractors and Department personnel. Beyond that, this Construction Manual provides guidance to Contract Administrators and Inspectors on the interpretation of the Specifications and the application of the materials control measures.

701.3 – DOCUMENTATION FOR EXPENDITURE OF PUBLIC FUNDS

When payment is to be made to the Contractor for materials furnished and work performed, the designated State officials must authorize disbursement of public funds for this purpose. The disbursing officer must depend upon others for evidence to support the expenditure. Through the materials control process, the Contract Administrator will acquire substantiating data, in the form of Certificates of Compliance, test results, inspection records and measurements necessary to justify the acceptance of the Contractor's work.

Thus, the Contract Administrator shall be assured that the Contractor's obligation to provide the quality of material specified in the Contract is fulfilled, and the Contract Administrator can furnish documentation to the officials responsible for authorizing payment that the Contractor is entitled to full payment.

In case of failure to meet the specified requirements, the materials control data will constitute the basis for rejection of work deemed unfit for acceptance, or it may be the basis for acceptance upon appropriate contract price adjustment, where this is permitted under the provisions of the Specifications.

Complete records, including Certificates of Compliance, measurements of work, and test and inspection reports covering acceptance or rejection, should be maintained in the project files. Copies should be furnished to the appropriate headquarters personnel for verification and as supporting evidence for payment documents.

SECTION 702 – GENERAL PROCEDURES FOR MATERIALS CONTROL

702.1 – DEFINITIONS OF ITEMS

A. Acceptance Sampling and Testing

All of the samples and tests performed by the Department project personnel or an approved Department representative (unless noted otherwise) are used for determining the quality and acceptability of materials and workmanship which have been or are being incorporated into the project. Acceptance tests determine the conformance of the material to the Contract Specifications. The results are used to determine acceptance or rejection and may be used to adjust the level of pay for the material.

B. Independent Assurance Program

Independent samples and tests or observation of test procedures are performed by the Bureau of Materials and Research (LAB) personnel who do not normally have direct responsibility for process control and Acceptance Sampling and Testing. The Independent Assurance Program is used for the purpose of making independent checks on the reliability of the results obtained in Acceptance Sampling and Testing and not for determining the quality and acceptability of the materials and workmanship directly.

C. Verification Samples and Tests

Samples and tests performed by the LAB personnel verify the results of certified tests or manufacturer's Certificates of Compliance for manufactured materials.

D. Process Control

This constitutes the inspection of equipment as well as sampling and testing procedures performed by the Contractor to control construction operations. State personnel may assist

with process control as defined in the NHDOT Guide to Frequency of Sampling and Testing, also referred to as the TEST GUIDE, which is a macro-enabled Excel® Spreadsheet, and may be found on the Bureau of Construction's *S:/Construction/Admin/Forms* network drive. Refer to *Subsection 703.4 – USING THE NHDOT GUIDE TO FREQUENCY OF SAMPLING AND TESTING SPREADSHEET* in this Division for more information.

E. Source Approval

The review and inspection of material sources is performed to ensure that the facility is capable of producing materials that will meet Specifications. Source approval includes inspection of the facilities, review of the source's quality control plan, and actual testing of the material produced. Sources include material mixture plants, producers of manufactured products, or may be naturally occurring. Preliminary approval at this level does not constitute acceptance because all final material acceptance tests are performed on in place materials.

702.2 – SPECIFICATIONS AND THEIR APPLICATION

Specifications are prepared to define the minimum requirements for materials that are considered suitable for specific purposes. When materials are furnished to meet these Specifications, tests must be made on the materials and compared against the requirements to determine acceptability. When this is not practical, materials may be accepted by a Certificate of Compliance or by their presence on the Department's Qualified Products List. Materials on the Qualified Products List still require a Certificate of Compliance, as do all man–made materials that are manufactured offsite.

Sampling, testing, and taking measurements must be done strictly in accordance with the procedures that are prescribed in the Specifications. Failure to comply with any of the required procedures can lead to serious discrepancies in the results.

702.3 – INSPECTOR'S RESPONSIBILITY FOR ACCEPTANCE SAMPLING AND TESTING

Acceptance sampling and testing is the responsibility of the Contract Administrator and will be conducted by Department project personnel or a representative employed by the Department who is responsible for the day–to–day inspection. No material should be incorporated into the work that has not been inspected, tested, and approved, unless it is listed on the Department's Qualified Products List.

Conditional acceptance of certain materials may be permitted when produced by a manufacturer having a good record of compliance. Materials of this type include portland cement, bituminous materials, certain aggregates, culvert pipe, and other selected items.

Therefore, the inspector is obligated to know the following:

- Which materials must be sampled
- When and where samples must be taken
- The required sample sizes
- The proper methods for obtaining samples
- The proper procedures for testing the samples

The Department's TEST GUIDE spreadsheet should be consulted for determining the frequency of Acceptance Sampling and Testing performance. The TEST GUIDE spreadsheet may be found on the Bureau of Construction's *S:/Construction/Admin/Forms* network drive.

702.4 – MATERIAL ACCEPTANCE

Acceptance of materials may be made on the basis of one or more of the following conditions:

- Sampling and Testing Acceptance: Sampling and testing for final acceptance shall be done at the project on materials in place. Preliminary acceptance by sampling and testing can be either by source testing, such as for wear tests, or by inspection of items such as concrete pipe and structural steel.
- Certification Acceptance: Materials may be accepted based upon the following documentation or inspection:
- Certificate of Compliance only
- Certificate of Compliance and verification tests as defined by the TEST GUIDE spreadsheet
- Listing on the Qualified Products List together with a Certificate of Compliance as required by the Specifications
- Consultant inspection
- Field Inspection Acceptance: Materials such as granite, fieldstone, mulch, and other natural materials not requiring testing or certifications, as designated by the District Construction Engineer, may be accepted by field inspection.
- Sampling, Testing, and Preliminary Approval of Materials prior to Incorporation into the Work: Manufactured materials tested at the plant or at the time of field delivery cannot practically be tested before incorporation into the work. Materials such as cement, concrete, and asphalt are included in this phase. This "initial" sampling and testing at the plant or at the time of delivery to the project site does not preclude the taking of samples or measurements of these manufactured materials in place when necessary.

The Contractor shall identify the sources of all manufactured materials. Samples for testing shall be submitted, or facilities shall be provided for sampling and testing, or both, as required in accordance with Specifications. Additional samples may be submitted by the Contractor or the Contract Administrator for progress reports as necessary to ensure quality control.

Project personnel may assist the Contractor in the taking of samples and by identifying, packaging, and forwarding the samples to the LAB for testing.

For materials requiring Certificates of Compliance, the Certificates should be submitted at the time of field delivery. The Contract Administrator will retain a copy of each Certificate of Compliance for the permanent project records.

Important: No payment will be made for any material until the required Certificate of Compliance has been received.

Some Certificates will cover only a partial quantity of the total item (i.e., reinforcing steel) and therefore payment for quantities above the certified amount shall not be made until additional Certificates have been received.

- Natural and Processed Materials: This covers the initial sampling and preliminary approval of all natural and processed materials and their sources before being incorporated into the work. Examples of these materials are borrow, sand, gravel, and crushed gravel. This "initial" sampling does not preclude additional sampling and in–place testing, as specified by the TEST GUIDE spreadsheet. An exception to this is the stone wear test, which is generally not repeated after preliminary approval unless the material changes. The Contractor shall identify the source(s) of all natural and processed material expected to be used. The Department may test the initial samples for informational purposes only.

Note: If material sampled either from the gravel pit or the initial stockpile does not meet specifications, any continuation of operations is entirely at the Contractor's risk.

- Sampling, Testing, and Approval of Material and Workmanship in Place: Except for those materials which are impractical to test after incorporation into the work, the TEST GUIDE spreadsheet will be the basis for determining the quality of material. This determination is accomplished by sampling and testing the finished work in place. This in–place sampling and testing is necessary to ensure that the material application or placement techniques have not significantly altered the material characteristics upon which the initial approval was based.

The test results should be made available to the Contractor for information and appropriate action.

702.5 – INDEPENDENT ASSURANCE SAMPLING AND TESTING

These tests are to be performed by personnel from the Bureau of Materials and Research to ensure that proper procedures and equipment are being used by Project personnel when they perform

Acceptance Sampling and Testing. The intent is to have two independent sets of tests run on similar samples, such that a direct comparison of test results will indicate divergence from or conformance to the specified testing procedures.

To achieve this, split sampling should be used with personnel from the Project and the Bureau of Materials and Research present. The location of the sampling will be as required in the TEST GUIDE spreadsheet. The TEST GUIDE spreadsheet may be found on the Bureau of Construction's *S:/Construction/Admin/Forms* network drive.

Independent Assurance Sampling and Testing may be done by observation of Acceptance Sampling and Testing procedures. However, most of the tests must be performed by Bureau of Materials and Research personnel using calibrated equipment. When Independent Assurance tests are performed by observation of Acceptance Sampling and Testing, both the Acceptance Tester and the Independent Assurance Tester shall sign the test report.

Independent Assurance personnel will make a prompt comparison of these sampling and testing results. Although the acceptability of the material is determined entirely by the Acceptance Sampling and Testing results, a "Guide to Acceptable Deviations" between the Acceptance Test results and Independent Assurance Test results has been established. Deviation beyond these prescribed limits will require a prompt review and resolution by Assurance personnel.

Some materials accepted on the basis of certified test results or Certificates of Compliance are also subject to verification sampling and testing by the Bureau of Materials and Research. This Independent Sampling and Testing verifies that the materials or products meet the supplier's claims as related to their Certificate of Compliance.

702.6 – NHDOT GUIDE TO FREQUENCY OF SAMPLING AND TESTING

The NHDOT Guide to Frequency of Sampling and Testing, also referred to as the TEST GUIDE spreadsheet, is provided for both Acceptance Sampling and Testing and Independent Assurance Sampling and Testing. It should be understood that the contents of the TEST GUIDE spreadsheet are guidelines and that the Contract Administrator should require additional sampling and testing as necessary to ensure the quality of materials incorporated in the work. The TEST GUIDE spreadsheet may be found on the Bureau of Construction's *S:/Construction/Admin/Forms* network drive.

702.7 – RECORDING, REPORTING, AND DOCUMENTATION

The Contract Administrator will use the following recording and reporting procedures:

- Carefully and completely document all sampling and testing, together with the corrective action taken. This will enable the Department to completely justify the use of these materials and the results obtained.

- Maintain a complete list for the permanent project records of all samples taken and tests, including field tests, made. This list should include the type, location, and date, and should indicate whether the sample was submitted by the Contractor or the Department.
- Package samples for delivery to the LAB in accordance with the approved standard procedure. Be sure to note the source of the material and the location where the sample was taken.
- Identify samples taken or requested by the FHWA by noting "FHWA's Sample report to FHWA and the Construction Bureau Administrator" on the shipping tag included with the sample.
- Retain all test reports. If the report is unsatisfactory, note any corrective action on the Corrective Action Report. Retain the original copy for the project records, give one copy to the Contractor and forward one copy to the Bureau of Materials & Research only upon their request.
- Fill out a Field Test Report on all field tests made. Retain the original copy for the project records, give one copy to the Contractor and forward one copy to the Bureau of Materials & Research only upon their request. Maintain a file of all work sheets used in field testing.
- Record on the Corrective Action Report corrective action taken as a result of unsatisfactory field tests. This Report will become a part of the permanent project records. Retain the original copy for the project records, give one copy to the Contractor and forward one copy to the Bureau of Materials & Research only upon their request. Attach a copy of the unsatisfactory test report with each copy of the Corrective Action Report.

The Bureau of Materials and Research will furnish necessary personnel and special equipment to assist the Contract Administrator in performing any specialized tests required.

The FHWA may require specialized tests at certain locations as part of the testing program. The following is FHWA's procedure as it relates to these tests.

- The FHWA will inspect the Contract Administrator's material test reports and observe construction methods during visits to projects. They will record and report their findings for the FHWA's Permanent Project Records.
- The FHWA may request during visits to projects that samples be taken of any or all materials at random locations designated by them. Retain the original reports for the project records and forward the results of these tests to the FHWA for their Permanent Project Records.

The job of designating sources of material rests primarily with the Contractor. It is the Contractor's responsibility that all items meet the standards set forth in the Plans and Specifications and that all materials are furnished sufficiently in advance to be examined and receive preliminary approval. The Contractor should anticipate the need for sampling and testing.

SECTION 703 – MATERIALS SAMPLING AND TESTING

703.1 – SAMPLING AND TESTING PROGRAM

Acceptance Sampling and Testing shall be the responsibility of the Department's Contract Administrator, unless otherwise noted. Test reports will be generated according to the recommended frequency of acceptance testing as shown in the TEST GUIDE spreadsheet.

Independent Assurance Sampling and Testing is to be performed by personnel from the Bureau of Materials and Research. The independent testing ensures that the proper sampling and testing methods are being followed, and that the testing equipment meets Specification requirements.

The location of the sampling shall be chosen as required in the TEST GUIDE spreadsheet. When split sampling is used, sampling must be performed in the presence of personnel from the LAB.

Independent Assurance Sampling and Testing can be done by observation, but at least 80% of the testing will be performed by LAB personnel using calibrated equipment. The sampling and testing of split samples and in–place densities will be documented. When Independent Assurance Tests are performed by observation, both the Acceptance Tester and the Independent Assurance Tester will sign the test report.

The Independent Assurance personnel will make a prompt comparison of test results. Any discrepancies between the results of the assurance and acceptance tests that are not within the acceptable range of deviations will be investigated, resolved, and documented.

Verification sampling and testing will be conducted by the LAB to verify that the results of certified tests or Certificates of Compliance are in compliance with the Specifications.

The Contractor is responsible for material process control. This includes maintaining production equipment in good working order, and all sampling and testing necessary to confirm that all materials being produced meet Specifications. NHDOT will assist the Contractor with process control to the extent defined in the TEST GUIDE spreadsheet.

The LAB is primarily responsible for source approval as outlined in the TEST GUIDE spreadsheet. This includes annual approval inspections of asphalt and concrete plants supplying NHDOT projects.

On small projects, defined as having 4000 yd^3 or less of select materials and/or embankment or if no provision is made for a lab facility in the Contract, the acceptance testing for soils and granular material will be done by the LAB, with no assurance testing required. A project may still be classified as being a small project if no more than one item exceeds 4000 yd^3, upon approval of the Bureau Administrators from the Construction Bureau and the Materials and Research Bureau.

A materials certificate will be prepared by the Materials and Research Bureau and submitted to the FHWA for each Federal–aid construction project.

703.2 – DETAILS OF SAMPLING AND TESTING PROGRAM

A. Embankments (Compaction)

Job Control: Compaction tests are to be made by project personnel at a recommended rate of one test per lift per 1500 ft in length. This means that a fill 500 ft long requires one compaction test for each three lifts.

This is an average frequency for testing. It is recommended that more frequent tests be made at the start of the project to determine the number of roller passes required to obtain the specified density. Once the required number of passes has been determined, fewer tests may be made in the same portion of the fill.

Each Proctor Density Curve shall be properly identified by number and source.

The station, distance right or left, elevation, and the applicable Proctor Curve Number shall be shown on each density test performed.

B. Sand

Job Control: Where sand is being used that is near the limits of the Specifications (i.e., silt content), more tests may be needed to ensure that the requirements are being met.

C. Gravel

Job Control: One sample should be obtained early and sent to the Lab and tested for L.A. Wear prior to approving of the quality of the source. All subsequent testing for gradation, density and compaction will be performed by project personnel on site.

The Contract Administrator should monitor the material coming from the gravel pit for changes. More testing may be required than what is shown in the TEST GUIDE spreadsheet. It is the Contractor's responsibility to supply material that passes the Specifications. This material will only be accepted after it has been placed and compacted to its required density.

D. Crushed Gravel

Job Control: Same as for Gravel, plus the percent of stones with fractured faces (by weight) must be determined.

Acceptance Test – Although this material may have met gradation requirements when sampled by the Contractor from the stockpile, it still may not be acceptable in place. Acceptance occurs only after the material has been placed and compacted to the required density.

E. Bituminous Pavement

Job Control: Aggregate from commercial sources for bituminous pavement shall be tested once per year. Aggregate produced on the project shall be sampled and tested by the Bureau of Materials and Research before use.

While the asphalt plant is operating, the hot bins shall be sampled at least once per day and the gradation of each bin shall be determined. Also, the cold feed piles shall be sampled periodically in order to maintain uniformity.

One sample of the completed mix is to be taken in the morning and one in the afternoon. Normally, the samples of the mix will be submitted to the Bureau of Materials and Research for analysis unless sufficient personnel are assigned to the plant so that complete extraction tests may be made in the field laboratory. When extraction tests are performed at the field laboratory, all test reports shall be submitted to the LAB.

The plant inspector shall procure a copy of the refinery certificate for each load of asphalt cement delivered to the plant each day. The certificate, together with a one quart sample

of liquid from not more than two loads per day, shall be delivered to the LAB for viscosity testing. Marshall blocks of the surface course must be fabricated each morning and afternoon for submission to the LAB for testing.

Note: Marshall blocks are not required for base and binder mixtures.

F. Structural Concrete

Job Control: Aggregate from commercial sources for structural concrete should be tested annually by the Bureau of Materials and Research and the information should be furnished to the project. The Contract Administrator is advised to request this information if it has not been furnished.

Job control of concrete requires that additional testing of aggregates takes place at the batching plant. The Plant Inspector shall check the Fineness Modulus of the sand once per day and the moisture content of the aggregates should be checked daily or as needed.

Each day that concrete is placed, the Contract Administrator will check the slump and air content and make test cylinders. Two cylinders (minimum) per pour are sufficient for the substructure, but at least three cylinders are required for deck placements. Additional cylinders should be made when early breaks are required.

Be sure to check that each transit mix truck has been approved for use, as evidenced by the current year's seal attached to each vehicle.

Refer to the chart in the TEST GUIDE spreadsheet for the recommended number of tests to be conducted. This is only a guide to the number of tests to be taken.

G. Cement

Job Control: A sample of the cement being used should be taken at the batch plant each day concrete is placed. This sample shall be properly tagged and submitted with a copy of the mill test report to the Bureau of Materials and Research. The cement sample is available should there be a problem with the 28–day concrete strength. The Bureau of Materials and Research arbitrarily chooses one of these samples for each class of concrete to perform the Blaine and cube tests.

H. Reinforcing Steel (Mechanical Connectors Only)

Job Control: Two complete mechanical splices shall be sampled from the delivery to include both the male and female pieces when used on the project. Samples shall be sent to the Bureau of Materials and Research for verification of tensile strength before being used in the project. It is also required that the supplier furnish Certificates of Compliance with each shipment.

I. Asphalt Cutback and Emulsions

Job Control: The driver of each truck delivering liquid asphalt to the project must give the Contract Administrator a delivery slip from the transporting company as well as a weight slip furnished to the transporting company by the refinery. The refinery or plant weight slip also serves as a Certificate of Compliance guaranteeing the quality of the load, provided that this is stated on the face of the slip.

A sample shall be taken from each load of asphalt delivered to the project. The Specifications require a sampling valve to be installed in all asphalt haulers. Allow a small quantity to escape from the valve before taking a one quart sample. The first sample shall be sent to the Bureau of Materials and Research for testing. Subsequent samples shall be taken until five are collected. One of these five samples shall be selected at random and sent to the LAB. This procedure of testing one sample out of five shall be continued for the length of the project. The remaining four samples out of each group of five shall be retained on the project until the project is accepted.

If the first sample of any group does not meet Specifications, the LAB may request that the remaining four samples be submitted for testing.

J. Paints

The Contract Administrator shall be furnished with a Certificate of Compliance for all paint used for shop coats prior to or upon delivery of painted structural steel to the project. The Certificate of Compliance shall be accompanied by a certified analysis of the paint identified by the information given on the label on the paint container.

Paint furnished for field use shall not be applied until tested and accepted by the LAB. The Contract Administrator may permit application of the paint in a shorter time upon approval by the LAB of the manufacturer's Certificate of Compliance.

Send the Certificate of Compliance to the LAB for approval together with the information on the label, which should include:

- New Hampshire (NH) paint number, name and color
- Lab and/or batch numbers
- Date of manufacture
- Volume of the contents in gallons
- Name and address of manufacturer

For testing at the laboratory, an unopened 5–gallon original container shall be provided. The unused paint will be returned to the Contractor.

Pavement marking paint should be sampled from the striping truck in air tight quart cans. These paint cans may be obtained from the LAB. The paint used for pavement markings must be from a batch that has been previously tested and approved by the LAB. The list of acceptable batch numbers may be received from the Construction Office of the LAB.

K. Epoxy Coating

Samples are not required for testing; however, materials furnished should be listed on the Department's Qualified Products List. A Certificate of Compliance is also required.

L. High Strength Bolts

The Contract Administrator may submit bolts, nuts, and washers to the LAB for hardness testing.

M. Neoprene Joint Materials

The Contract Administrator may submit a 6 in sample, when deemed necessary, to the Bureau of Materials and Research for verification of the presence of chloroprene, which is the primary component of neoprene.

This sample should be taken as soon as the material is received on the project so that it can be tested before use. A Manufacturer's Certificate of Compliance is required.

N. Catch Basin and Slope Paving Blocks

Samples should be taken at the start of the project from each supplier and sent to the Bureau of Materials and Research. A Certificate of Compliance is also required.

703.3 – SUMMARY OF NHDOT METHODS FOR MATERIALS ACCEPTANCE

A. Acceptance by Sampling and Testing

- Final Acceptance – Job Site
- Preliminary Acceptance – Source Testing & Inspection
- Source testing such as L.A. Wear tests

Inspection of items such as concrete pipe and structural steel

B. Acceptance by Certification

- Certificate of Compliance only

- Qualified Products List and Certificate of Compliance, as required by Specifications
- Verification tests and Certificate of Compliance as defined by the TEST GUIDE spreadsheet

C. Acceptance by Field Inspection

Granite, fieldstone, mulch and other natural materials not requiring testing or certification as designated by the District Construction Engineer will be accepted by field inspection.

703.4 – USING THE NHDOT GUIDE TO FREQUENCY OF SAMPLING AND TESTING SPREADSHEET

A. Working with the TEST GUIDE Spreadsheet

The NHDOT Guide to Frequency of Sampling and Testing is a macro-enabled Excel spreadsheet tool that identifies the minimum number of tests required when analyzing a specific sample. The Guide also summarizes and indicates trends of materials sampled and tested on the project. The TEST GUIDE spreadsheet, which may be found on the Bureau of Construction's *S:/Construction/Admin/Forms* network drive, should be used for all projects that will require the testing of materials.

Working with the TEST GUIDE spreadsheet involves input from project personnel of basic information about the project including the project's name, number, Contractor, and Contract Administrator. This information then populates the remaining worksheets in the TEST GUIDE spreadsheet, which are conveniently labeled by sections such as *Soils, Asphalt, Concrete*, etc. These individual sections require further input of quantities that can be found in the project estimate or Quantity Book. These quantities are used to generate the required minimum number of tests for a given material.

B. Opening the TEST GUIDE Spreadsheet

Navigate to the *S:/Construction/Admin/Forms* network drive and select the TEST GUIDE spreadsheet to open the Excel spreadsheet. The initial worksheet is *Index of Sheets* which provides access to the following requirements:

- Soils
- Asphalt
- Structures & Misc.
- Concrete

Sampling and testing for structural concrete is tracked by Bridge and Concrete Summaries, and the data is also compiled to indicate tends in concrete quality.

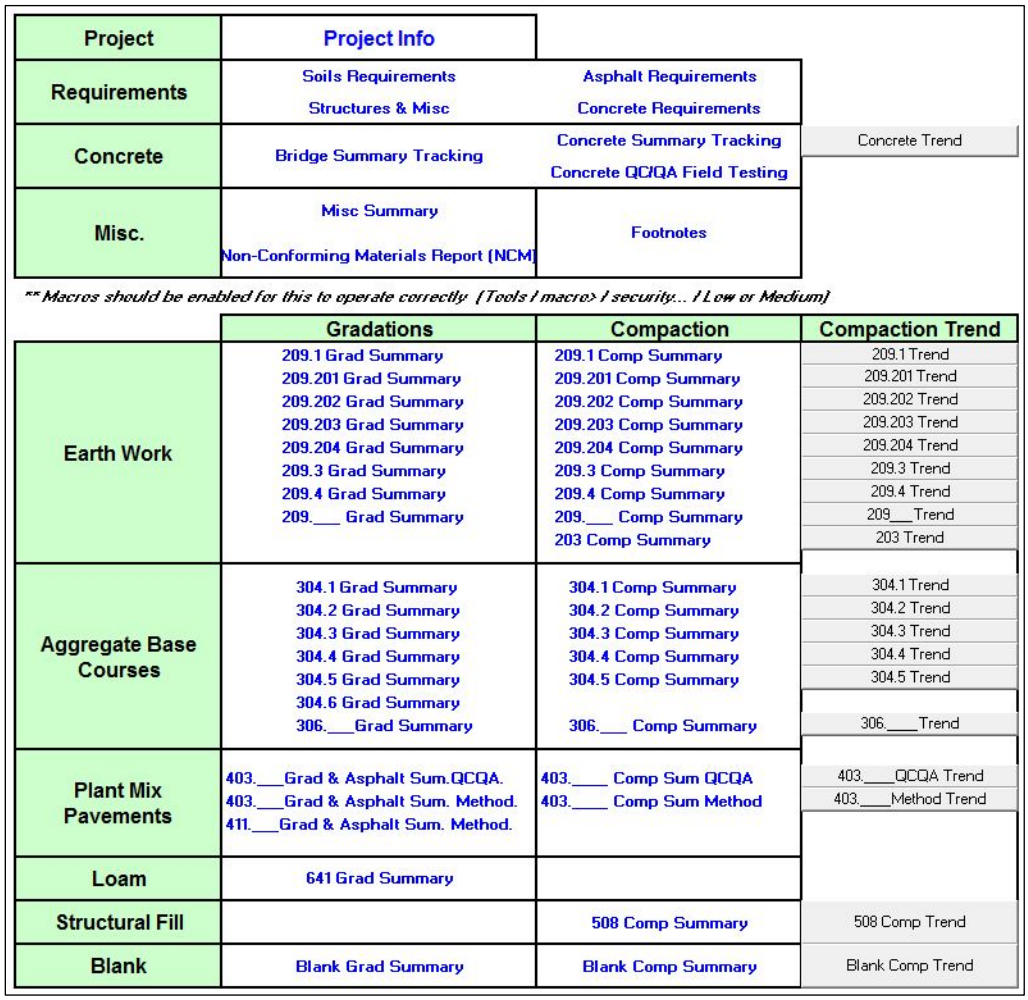
Miscellaneous and non-conforming materials are analyzed in separate reports.

Gradation and compaction requirements, as well as compaction tends, may be analyzed for the following materials:

- Earth Work
- Aggregate Base Courses
- Plant Mix Pavements
- Loam
- Structural Fill

Note: Navigate around the TEST GUIDE spreadsheet by selecting items from the *Index of Sheets* worksheet, or by clicking on the worksheet tabs at the bottom of the screen. Click the **Back** arrow to return to the previous worksheet.

The first worksheet, *Index of Sheets*, displays the following selections.



Project	Project Info		
Requirements	Soils Requirements Structures & Misc	Asphalt Requirements Concrete Requirements	
Concrete	Bridge Summary Tracking	Concrete Summary Tracking Concrete QC/QA Field Testing	Concrete Trend
Misc.	Misc Summary Non-Conforming Materials Report (NCM)	Footnotes	

** Macros should be enabled for this to operate correctly (Tools / macro> / security... / Low or Medium)

	Gradations	Compaction	Compaction Trend
Earth Work	209.1 Grad Summary 209.201 Grad Summary 209.202 Grad Summary 209.203 Grad Summary 209.204 Grad Summary 209.3 Grad Summary 209.4 Grad Summary 209.___ Grad Summary	209.1 Comp Summary 209.201 Comp Summary 209.202 Comp Summary 209.203 Comp Summary 209.204 Comp Summary 209.3 Comp Summary 209.4 Comp Summary 209.___ Comp Summary 203 Comp Summary	209.1 Trend 209.201 Trend 209.202 Trend 209.203 Trend 209.204 Trend 209.3 Trend 209.4 Trend 209___Trend 203 Trend
Aggregate Base Courses	304.1 Grad Summary 304.2 Grad Summary 304.3 Grad Summary 304.4 Grad Summary 304.5 Grad Summary 304.6 Grad Summary 306.___Grad Summary	304.1 Comp Summary 304.2 Comp Summary 304.3 Comp Summary 304.4 Comp Summary 304.5 Comp Summary 306.___ Comp Summary	304.1 Trend 304.2 Trend 304.3 Trend 304.4 Trend 304.5 Trend 306.____Trend
Plant Mix Pavements	403.___Grad & Asphalt Sum.QCQA. 403.___Grad & Asphalt Sum. Method. 411.___Grad & Asphalt Sum. Method.	403.____ Comp Sum QCQA 403.____ Comp Sum Method	403.____QCQA Trend 403.____Method Trend
Loam	641 Grad Summary		
Structural Fill		508 Comp Summary	508 Comp Trend
Blank	Blank Grad Summary	Blank Comp Summary	Blank Comp Trend

Figure 700 – 1: TEST GUIDE Spreadsheet – Index of Sheets Worksheet

C. Saving the TEST GUIDE Spreadsheet

Click **File**, **Save As**, and then select **Excel Macro-Enabled Workbook.** Enter a project-specific name for this particular version of the TEST GUIDE spreadsheet and save it to an appropriate project location.

D. Entering Project Data

Either click **Project Info**, or at the bottom of the screen, click the second worksheet tab, *Project Info*. Enter the appropriate project information on this worksheet.

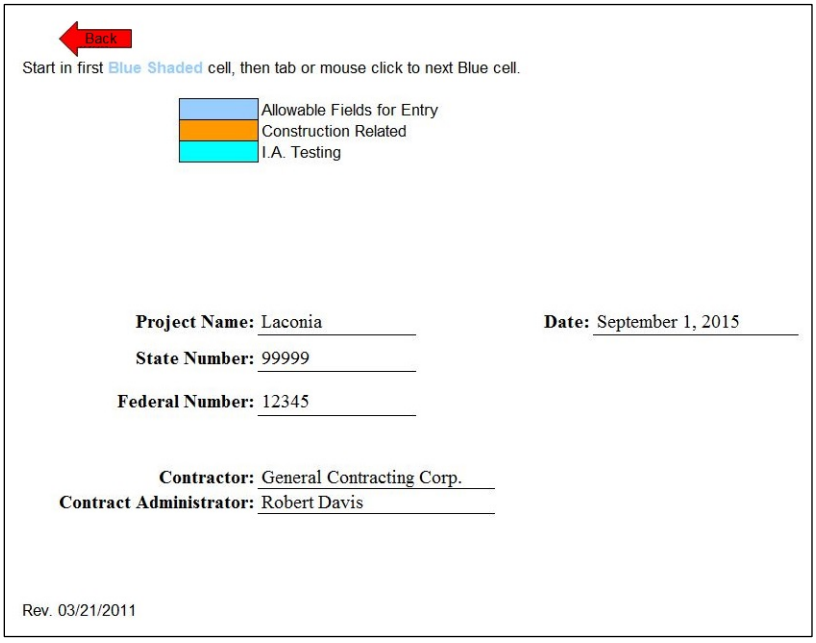
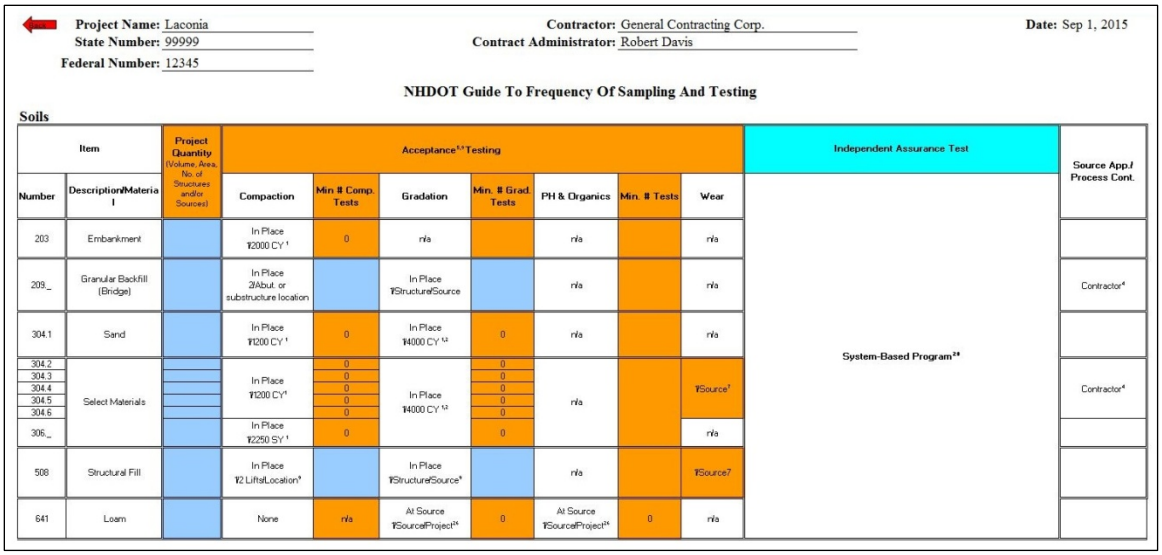


Figure 700 – 2: TEST GUIDE Spreadsheet – Project Info Worksheet

Click the Back arrow to return to the previous worksheet, or click the third worksheet tab, Soils.

The Soils worksheet provides data for Embankments, Granular Backfill (Bridge), Sand, selected Base Course Aggregates, Structural Fill, and Loam. The minimum number of required tests for compaction, gradation, soil pH and organics, and wear are displayed when material volumes are entered by project personnel.



Project Name: Laconia
State Number: 99999
Federal Number: 12345
Contractor: General Contracting Corp.
Contract Administrator: Robert Davis
Date: Sep 1, 2015

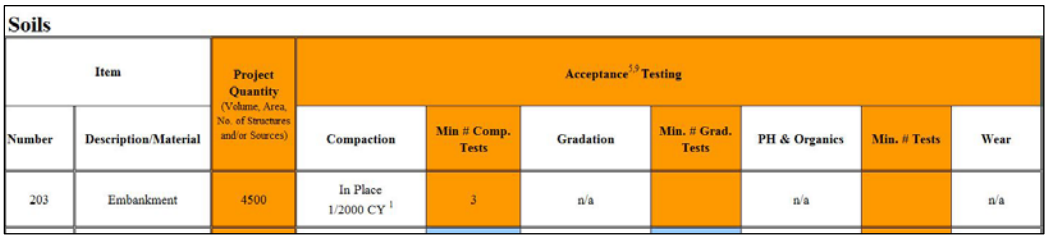
NHDOT Guide To Frequency Of Sampling And Testing

Soils

Item		Project Quantity (Volume, Area, No. of Structures and/or Sources)	Acceptance[5,9] Testing							Independent Assurance Test	Source Appr./ Process Cont.
Number	Description/Material		Compaction	Min # Comp. Tests	Gradation	Min. # Grad. Tests	PH & Organics	Min. # Tests	Wear		
203	Embankment		In Place ¶2000 CY [1]	0	n/a		n/a		n/a		
209_	Granular Backfill (Bridge)		In Place 2/Abut. or substructure location		In Place ¶Structure/Source		n/a		n/a		Contractor[4]
304.1	Sand		In Place ¶200 CY [1]	0	In Place ¶4000 CY [1,2]	0	n/a		n/a		
304.2	Select Materials		In Place ¶200 CY[1]	0	In Place ¶4000 CY [1,2]	0	n/a		¶Source[7]	System-Based Program[2,8]	Contractor[4]
304.3				0		0					
304.4				0		0					
304.5				0		0					
304.6				0		0					
306_			In Place ¶2250 SY [1]	0		0			n/a		
508	Structural Fill		In Place ¶2 Lifts/Location[3]		In Place ¶Structure/Source[3]		n/a		¶Source7		
641	Loam		None	n/a	At Source ¶Source/Project[2,6]	0	At Source ¶Source/Project[2,6]	0	n/a		

Figure 700 – 3: TEST GUIDE Spreadsheet – Soils Worksheet

The *Soils* worksheet allows for input of material volumes and returns data regarding testing frequency. The following figure shows Acceptance Testing calculations for Item 203, Embankment. Since every 2,000 yd3 of in–place compacted embankment material shall be tested, entering a volume of **4,500** yd^3 of material for *Project Quantity* will yield a *Minimum # of Compaction Tests* of **3**.



Soils

Item		Project Quantity (Volume, Area, No. of Structures and/or Sources)	Acceptance[5,9] Testing						
Number	Description/Material		Compaction	Min # Comp. Tests	Gradation	Min. # Grad. Tests	PH & Organics	Min. # Tests	Wear
203	Embankment	4500	In Place 1/2000 CY [1]	3	n/a		n/a		n/a

Figure 700 – 4: TEST GUIDE Spreadsheet – Soils Worksheet – Embankment Detail

The TEST GUIDE spreadsheet may be used to determine sampling and testing requirements for all of the remaining project materials as well. The other worksheets work in much the same way as the *Soils* worksheet, with user-input for material volumes returning the appropriate sampling and testing parameters.

SECTION 704 – STANDARD METHODS OF SAMPLING, TESTING, AND RECORDING TEST RESULTS

704.1 – SAMPLING OF AGGREGATES FOR GRADATION (AASHTO T 2)

► Reference: AASHTO T 2, Sampling of Aggregates

There are three primary methods used to collect samples of aggregates for gradation tests: sampling from a conveyor belt, sampling from a stockpile, and sampling from an open–face pit.

- Conveyor Belt: Remove three equal size samples from the belt at random locations. The belt must be stopped at each location before the sample is removed. Each sample should be taken from the entire cross section of the belt. Be sure all fines are collected off the conveyor belt and added to the sample. If necessary, use a brush to gather the fines. Combine the three samples to form one field sample.
- Stockpile:
- With Power Equipment – Have the power equipment (loader) remove material from different locations of the main pile. Mix this material into a small pile. Use the loader to level off this pile of mixed material before sampling it. Take several samples and combine them to form a field sample.
- Without Power Equipment – Take samples from the top third, midpoint, and bottom third of the main pile. Inserting a board above the sampling location may help in stopping segregation. Combine the samples to form a field sample.
- Open Pit Face: All sampling should be performed after all overburden has been removed. An area in the face should be channeled vertically from bottom to top. This blending should include all soil stratums. Testing is conducted on this blended material.

704.2 – TESTING FINE AND COARSE AGGREGATE FOR GRADATION (AASHTO T 27)

► Reference: AASHTO T 27, Sieve Analysis of Fine and Coarse Aggregates

Obtain a representative sample as described above. This sample may be taken from a bank, a test pit, or the roadway as required. Normally, a sample weighing between 40 and 50 lbs is used. The following figure shows a sample tag.

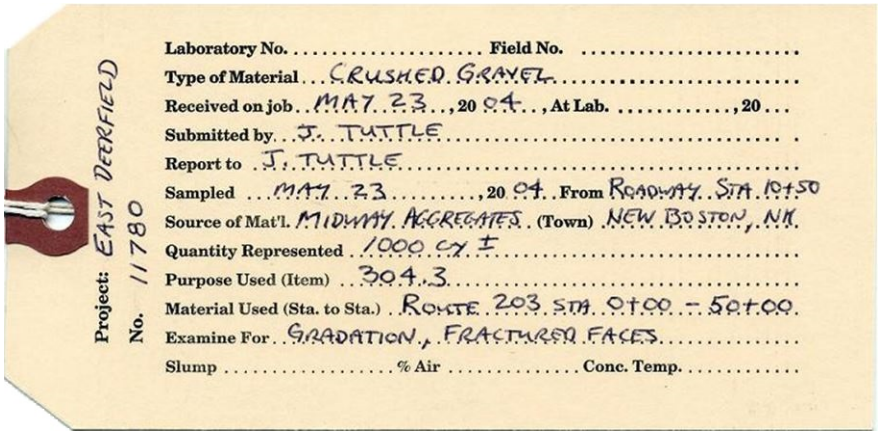


Figure 700 – 3: Sample Tag Example

Gradation Example: Assume for the purpose of illustration that a sample consists of a bag of 3 in crushed gravel weighing 44 lbs. Since the bag weighs about 0.4 lbs, the net weight of the sample is 43.6 lbs.

First, check the Specifications to see which sieve sizes are needed. For the crushed gravel, the necessary sizes are 3 in, 2 in, 1 in and #4. It is acceptable to also use a ½ in sieve to prevent overloading of the #4 sieve. *AASHTO T 27* requires the total sample to be dried prior to the sieving process. Moisture in the sample can cause the fines in the sample to stick to the larger stone during sieving, which can cause inaccurate results in determining gradation percentages.

Once the sample is dry, place it and the sieves in a shaker. Most field labs are equipped with a Gilson Mechanical Shaker for this purpose. If one is not available, this procedure may be done by hand using 18 in diameter hand riddles. The sieve trays are placed in the Gilson shaker, in descending order, starting with the largest, or 3 in, sieve on top. Clamp the trays securely and shake the sample for a minimum of seven minutes.

Loosen the trays and remove the various sizes of stone beginning with the 3 in size. Weigh each size to the nearest 0.1 lb in a container that has been weighed for its tare. Since the weights need to be cumulative to correctly determine the percentage of stone, weigh each size with the preceding size. Material passing the #4 sieve is considered the sand portion of the sample and is tested separately.

The gradation percentages are calculated to the nearest tenth of a percent as shown in the following table.

Testing Fine and Coarse Aggregate for Gradation				
Sieve Size	Cumulative Retained Weight, less Tare Weight (lbs)	% Retained	% Passing Sieve	Specifications
3 in	0.0	0.0	100.0	
2 in	0.7	1.6	98.4	
1 in	16.0	36.6	63.4	
#4	24.9	57.0	43.0	
Passing	18.8	Check	Check	Check
Total weight of sample = 43.7 lbs				

In the case of gravel, it is only necessary to run the total sample through a #4 sieve, of which 25% to 70% shall pass. The sand portion should then be checked for the percent passing the #200 sieve according to the following procedure.

- Percent of Aggregate Passing the #200 Sieve – Wash Method (*AASHTO T 11*)

► Reference: AASHTO T 11, Materials Finer than No. 200 (75 µm) Sieve in Mineral Aggregates by Washing

The maximum amount of fine aggregate allowed to pass the #200 sieve is 12% as a percent of only the material passing the #4 sieve. To determine the percent passing the #200 sieve, thoroughly mix the sand portion of the sample and obtain a representative sample of about 500 grams by using a sample splitter or by quartering.

Dry the sample on a hot plate, stirring frequently to prevent burning. After it has cooled, weigh the dry sample to the nearest gram. Place the sample in a deep pan, such as a bread pan, and add enough water to cover the sample. Stir this mixture with your fingers. Pour the silty water through a #200 sieve. Do not dump the whole sample on the sieve, just decant the silty water. Repeat this process until the water is fairly clear.

Next, wash any particles remaining on the #200 sieve back into the sample pan. A short piece of hose makes this much easier. Carefully pour off the excess water, being careful not to lose any material. Dry the sample on a hot plate, stirring to prevent boiling and burning.

When the sample has cooled, shake it through the 8 in diameter brass sieves. Use at least 4 sizes so no sieve is overloaded. For example: Use #10, #40, #100, and #200 sieves. Clamp the sieves in the shaker and shake for 10 minutes. Since only the percentage passing the #200 sieve into the

bottom pan is needed, all sieve sizes may be weighed together to the nearest gram to determine the retained weight after washing and sieving.

	□		Retained Weight after ⎤	
	⎣Original Sample Weight	□	Washing and Sieving ⎦	
% Passing #200 Sieve =				x 100
	Original Sample Weight			

- Percent of Aggregate Passing the #200 Sieve – Dry Method

  The current Specifications for sand, gravel, and crushed gravel allow a maximum of 12% passing the #200 sieve based only on the material passing the #4 sieve. The standard LAB method consists of first washing the sand over a #200 sieve, drying it, and then shaking it over a #200 sieve.

  Since this process is time consuming, the following field procedure may be used if the percentage passing the #200 sieve is at least 5% below the required Specification by the washed method; the dry method may be used the next time if the material is the same. The dry method dispenses with washing through a #200 sieve and saves time by not having to dry the sample a second time. The original drying and shaking procedure remains the same.

  To complete a gradation by the dry method, dry the representative sample on a hot plate. Allow it to cool and shake it for 10 minutes through the nested sieves. Compute the percent passing the #200 sieve the same way as indicated in the example for the washed method.

  The percent passing the #200 sieve calculated by this method will always be lower than by the washed method because some inefficiency of the sieves occurs with larger amounts of fine material. Washing the sample removes the majority of the minus #200 material before the final screening.

  The difference between washed and dry sieving becomes greater as the silt content of the sample increases. Samples with less than 5% of the material passing the #200 sieve may increase by only 1% to 2% if washed, while samples with 10% of the material passing the #200 sieve may have an increase of 5% or more when calculated after washing.

  Note: When the dry method is used, it should be stated on the field report.

Generally speaking, any select material's silt content will increase due to the process of trucking and constructing the base course. Although the amount of variance is dependent on the type of materials, this factor should be considered when testing from a stockpile. Silty samples are more prone to higher increases in material passing the #200 sieve.

The dry sieving test is not suitable for testing borrow which contains a high percentage of silt. For borrow with a high percentage of silt, the washed procedure must be used.

- Percent of Fractured Faces in Crushed Gravel

  The percentage of fractured faces in crushed gravel shall be determined by weight. This determination is made only on the portion of stone retained on and above the 1 in sieve.

  The total stone retained on and above the 1 in sieve shall be weighed and the weight recorded. All stones showing a fractured face shall be removed and weighed together.

	Weight of Fractured Stone on and above the 1in Sieve (lbs)	
% Fractured Faces =		× 100
	Weight of Total Stone on and above the 1 in Sieve (lbs)	

- Los Angeles Abrasion (Wear) Test (*AASHTO T 96*)

  ► Reference: AASHTO T 96, Resistance to Degradation of Small–Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

  Scope: Ideally, the sample should be obtained from the face of the pit after the face has been cleaned down and a quantity of fresh gravel representing the whole face is pulled down into a pile. This pile should be thoroughly mixed together before the sample is taken. If the pit varies considerably so that it is difficult to obtain one sample that represents the whole pit, more than one sample may be taken and identified as to the section of the pit where the sample was obtained.

  Field Procedure: The sample is obtained by discarding any stone remaining on the 1½ in screen and retaining all the stone remaining on the #4 screen. Send a full bag of stone to the Bureau of Materials and Research for testing.

  Laboratory Procedure: Obtain an 11 lb sample of stone according to the following table.

Sieve Size (in)	Weight Retained on each Sieve (lbs)
1	2.75
¾	2.75
½	2.75
⅜	2.75
Total Weight	11.00 lbs

Place the sample into the Los Angeles Drum with 12 steel balls and rotate for 500 revolutions. At the end of 500 revolutions, screen the stone through the #12 sieve and weigh the retained stone.

Use the following formula to determine the percentage of wear to the sample:

$$W_P = \frac{2\,(W_O - W_R)}{100}$$

where,

W_P = Wear percentage of the sample,

W_O = Sample's total original weight,

and

W_R = Sample's retained weight.

When all tests have been completed, enter all gradation and percentage fracture data on the back of the sample tag and on the Sieve Analysis worksheet. Also enter the results of the tests on the Construction Gradation Test Report sheets or the Testing Laboratory Report Sheets. Samples of these forms may be found on the following pages.

STATE OF NEW HAMPSHIRE / DEPARTMENT OF TRANSPORTATION										
Sieve Analysis Work Sheet (1)										
							Date	09/15/15		
Project	Laconia			Fed. No.		NHS 018–2 (104)		State No.	99999	
Contractor	Plow Brothers, Inc.					Contract Administrator		Ronald Tanner		
Material	Crushed Gravel					Location to be used		Sta. 70+00 – 73+20		
Source	Burton Pit					Town		Laconia		
Item No.	304.3					Field Test No.		28		
Total Weight	GRADATION (Sample #1)					Total Weight	GRADATION (Sample #2)			
	Acum.						Acum.			
43.6 lb	Weight	%	%	Required			Weight	%	%	Required
Sieve Size (in)	Retained	Retained	Passing	Spec.		Sieve Size (in)	Retained	Retained	Passing	Spec.
6 in						6 in				
3 in				100		3 in				
2 in	0.7	1.6	98.4	95–100		2 in				
1 ½ in						1 ½ in				
1 in	16.0	36.6	63.4	55–85		1 in				

STATE OF NEW HAMPSHIRE / DEPARTMENT OF TRANSPORTATION									
Sieve Analysis Work Sheet (2)									
Total	GRADATION (Sample #1)				Total	GRADATION (Sample #2)			
Weight	Acum.				Weight	Acum.			
43.6 lbs	Weight	%	%	Required		Weight	%	%	Required
Sieve Size (in)	Retained	Retained	Passing	Spec.	Sieve Size (in)	Retained	Retained	Passing	Spec.
¾ in					¾ in				
½ in					½ in				
⅜ in					⅜ in				
#4	24.9	57.0	43.0	27–52	#4				
Fr. Faces	13.4/16.0 x 100 = 83.8%			50–100	Fr. Faces				
Total	SAND OR MINUS 4.75 FRACTION				Total	SAND OR MINUS 4.75 FRACTION			
Weight	Acum.				Weight	Acum.			
530.0 g	Weight	%	%	Required		Weight	%	%	Required
Sieve Size	Retained	Retained	Passing	Spec.	Sieve Size	Retained	Retained	Passing	Spec.
⅜ in			100		⅜ in				
#4	0.00		100	100	#4				
#8					#8				
#16					#16				
#30					#30				
#50					#50				
#100	516	97.4	2.6		#100				
F.M.					F.M.				
#200	520	98.1	1.9	0–12	0.075				
Remarks: Informational Sample Only									
Meets Requirements for	Item 304.3 – Cr. Gravel				Tested by	Joe Merrow			

STATE OF NEW HAMPSHIRE / DEPARTMENT OF TRANSPORTATION												
Gradation Test Report (1)												
Project	Laconia					Field Test No.		304.1–062905a				
Type of Material	Sand					Reported		September 15, 2015				
Reported by	Ronald Tanner					Received by Lab						
Report to:	Project Files	☒	Lab	☒		Contractor		Plow Brothers, Inc.	☒			
Sampled	9/15/15					At (town)		Laconia				
Material Source	Rodd Pit											
Sample From	In–Place Material					Pit	☐	Roadway	☒	Sta.	19+80	
Quantity (Represented or Estimate)	1,500 yd^3 +/–											
Purpose / Location	Sand Rte 11 Eastbound									Item No.	304.1	
Tested for:	Gradation	☒	FM	☐	% Moisture	☐	Date:	September 1, 2015				

Sieve Size	Coarse Aggregates and Gravels							
	Size	%	Size	%	Size	%	Combined	Required
	% Passing		% Passing		% Passing		Results	Spec.
6 in								
3½ in								
3 in								
2½ in								
2 in								
1½ in								
1¼ in								
1 in								
¾ in								
½ in								

STATE OF NEW HAMPSHIRE / DEPARTMENT OF TRANSPORTATION								
Gradation Test Report (2)								
Sieve Size	Coarse Aggregates and Gravels							
	Size	%	Size	%	Size	%	Combined	Required
	% Passing		% Passing		% Passing		Results	Spec.
⅜ in								
#4								
#8								
#16								
#50								
#200								
% Fractured Faces								
	Fine Aggregates and Sands							
#4	98.4		98.2					70–100
#8								
#16								
#30								
#50								
#100								
FM								
#200 (in Sand)	4.4		4.2					0–12
% Moisture								

Remarks:			
Meets requirements for:	Sand – Item 304.1	See reverse	☐
	Tested by:		
	Signature:		

Project personnel are required to fill out a field test report on all field tests (record and informational). One copy should be retained on the project, one copy should be sent to the Lab upon request, and one copy should be given to the Contractor. The Contract Administrator's name should appear in the "reported by" line. This should be the rule for all samples submitted, either on samples reported from the laboratory or on the field test reports.

STATE OF NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION	
Gravel – Fine & Coarse – 304.2 (1)	
Sample ID:	AA07620
Project:	Enfield
Federal No:	STP–TE–BRZ–T–X–145(2)
Project No:	10652
Source:	Pike Industries
NH Lab No:	N/A
Project:	Enfield
Federal No:	STP–TE–BRZ–T–X–145(2)
Material:	Granular Backfill
Submittal:	9/15/2015 12:33:00
Sampled from:	200+62 RT SM
Sample	9/15/2015
Lot #:	Sampled by:
Purpose:	209.2 Granular Backfill
Analysis Validated by:	JA
Date:	9/15/2015
Sample Validated by:	ADP
Remarks:	

STATE OF NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION				
Gravel – Fine & Coarse – 304.2 (2)				
AASHTO Method	**Sieve Size**	**% Passing**	**Minimum**	**Maximum**
T27	6 in	100.0	100	
T27	3 in	100.0		
T27	2 in	92.8		
T27	1½ in	89.3		
T27	1 in	82.5		
T27	¾ in	77.4		
T27	½ in	72.9		
T27	#4	58.3	25	70
T27	#10	73.5		
T27	⅜ in	100.0		
T27	#20	41.9		
T27	#40	20.7		
T27	#100	2.6		
T11	#200	1.1	0	12
Tested By:	RD			
Comments:	See LIMS Report #AA07619 for *AASHTO T 96–A* % LA Wear Test = 30.4%.			

- Test Method for Determining the Amount of Material Finer than the #200 Sieve in Mineral Aggregates Combined with Bituminous Concrete

Note: This test method requires the use of the NHDOT S1 Worksheet.

Following *AASHTO T 27, Sieve Analysis of Fine and Coarse Aggregates*, obtain an original sample weight for gradation. The sample may be air dried prior to sieving if it is excessively wet, but it should not be oven–dried. Grade the air–dried sample through the applicable large sieves (plus #4). Immediately after sieving, remove all the lumps of bituminous concrete retained on the ¾" and larger sieves and record their weight. Subtract this weight from the original sample weight. This reduced sample weight will be used to calculate the percentage passing for the sample's gradation.

Obtain two representative samples of the sand portion (minus #4). One sample will be used for the percentage moisture determination, per *AASHTO T 265, Laboratory Determination of Moisture Content of Soils*. The other sample will be used for a gradation test. Record the weight for the moist gradation test sample; do not dry the sample.

Proceed with the *AASHTO T 265* test and determine the percentage moisture content of the sample's sand portion using the following formula:

Percent Moisture of Sand Portion

$$P = \frac{100\ (W - D)}{D}$$

where,

P = % moisture content of sand portion,

W= Original wet weight of moisture determination sample,

and

D = Dry weight of moisture determination sample.

The non–dried sand portion of the test sample should then be washed in accordance with *AASHTO T 11, Materials Finer than No. 200 (75 µm) Sieve in Mineral Aggregates by Washing*, with the exception that no dry weight will be obtained. This washed gradation sample will be oven dried before shaking in the 8" nesting sieves. After drying, proceed with the gradation per *AASHTO T 11*.

With the calculated % moisture from the moisture determination sample, P, reduce the wet weight of the sample's sand gradation test portion by this moisture percentage. Use this calculated dry weight to determine the % passing the # 200 sieve.

Calculated Dry Weight

$$C_{DW} = \frac{W_W - (P \times W_W)}{100}$$

where,

C_{DW}= Calculated dry weight of sand portion,

W_W = Recorded wet weight of sand portion,

and

P = % moisture of sand portion.

Example of a Gradation Method for
Calculating Percent Passing # 200 Sieve
in the TOTAL Sample
based on Fraction Passing the #4 Sieve

Given :

540.8 grams, the original dry weight of sand portion from fraction of sample passing the # 4 sieve, before AASHTO T11 washed gradation

501.6 grams, the accumulated weight retained on # 200 sieve after T27/T11

[501.6 g / 540.8 g] X 100 = 92.8 % retained on # 200 sieve

100 % - 92.8 % = 7.2 % passing the # 200 in the sand portion only

If 48.2 % previously passed (with, of course, 51.8 % retained on) the # 4 sieve in the same sample, then to obtain the percent passing the # 200 sieve in the TOTAL sample, use the following example calculation procedure :

[0.482 X 0.072] X 100 = 3.5 % in the TOTAL Sample

Basically, one converts the appropriate percentage values into decimal form, combines them by multiplication, and multiplies that result by 100 to round the answer into a total percentage.

The "Fractional Form" may have more meaning :

[48.2 / 100] X [7.2 / 100] = 347.04 / 10,000 = 0.034704

Convert to percent by multiplying 0.034704 by 100 to get 3.4704 % , or 3.5 % rounded. Multiplying by 100 converts the fractional form value to percentages that we can use in our gradation results.

There are other mathematical ways to reach the same In Total results for a gradation. Hopefully, the method presented here is useful too.

K. Cogswell
NHDOT, M&R Bureau
(revised 4/2007)

(Refer to Worksheet Example)

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION
BUREAU OF MATERIALS & RESEARCH

GRAIN SIZE ANALYSIS (MECHANICAL)

PROJECT: Nashua **PROJECT NO.:** 10623-X
LABORATORY NO.: AA 71701 **FIELD NO.:** 1
TYPE OF MATERIAL: Gravel **PURPOSE USED (ITEM):** Proposed Gravel, 304.2
SUBMITTED BY: J. Doe **REPORT TO:** R. Public
SAMPLED: 10/17/2006 **FROM:** Site Stockpile **QUANTITY REPRESENTED:** 1,000 CY ±
SOURCE OF MATERIAL: Brown Pit, and Project Mix **TOWN:** Nashua and Hudson
EXAMINE FOR: Gradation **TESTED BY:** A. Smith **DATE:** 10/18/2006

Test No.: (Tag #83)

Total Weight Sample 54.2 lbs. Sieve Size	Accum. Weight Retained	Percent Retained	Percent Passing	In Total Percent Passing
3"	0.0	0.0		100
2"	0.8	1.5		98
1-1/2"	3.9	7.2		93
1"	9.1	16.8		83
3/4"	14.3	26.4		74
1/2"	18.4	33.9		66
3/8"				
#4	28.1	51.8		48.2

Fractured Faces: NA

Minus #4 Fraction

Total Weight Sample 540.8 g Sieve Size	Accum. Weight Retained	Percent Retained	Percent Passing	In Total Percent Passing
#10	68.4	12.6	87.4	
#20	253.5	46.9	53.1	
#40	397.3	73.5	26.5	
#100	480.3	88.8	11.2	
#200	501.6	92.8	7.2	3.5

Percent Moisture: NA

% TOTAL GRADATION CALCULATIONS

#200 Sieve Results :

$\left[\frac{501.6\text{ g}}{540.8\text{ g}}\right] \times 100 = 92.8\%$ retained

$100\% - 92.8\% = 7.2\%$ passing

*

Use 48.2% passing #4 sieve to obtain the % passing #200 sieve in the Total Sample :

$[0.482 \times 0.072] \times 100 = 3.5\%$ passing in TOTAL Sample

*

'Fractional Form' Method :

$\frac{48.2}{100} \times \frac{7.2}{100} = \frac{347.04}{10,000} = 0.034704$

$0.034704 \times 100 = 3.5\%$, rounded

Multiplying by 100 converts value into common percentages

REMARKS: WORKSHEET EXAMPLE OF

PERCENT PASSING # 200 SIEVE IN THE TOTAL SAMPLE

BASED ON FRACTION PASSING THE # 4 SIEVE SIZE

[Refer to written explanation also]

704.3 – TESTING SOIL FOR MOISTURE–DENSITY RELATIONS (PROCTOR) (AASHTO T 99)

► Reference: AASHTO T 99, Moisture–Density Relations of Soils

A. "Method A" Sample

If the soil sample is damp when received from the field, dry it until it becomes friable under a trowel. The sample may be air–dried or a drying apparatus may be used, provided that the temperature of the sample does not exceed 140°F. When the sample is dry, thoroughly break up the lumps in such a manner as to avoid reducing the natural size of individual particles. Sieve an adequate quantity of the representative soil over the #4 sieve. Discard the coarse material, if any, retained on and above the #4 sieve. From the soil that passed the #4 sieve, select a representative sample weighing approximately 11 pounds (500 grams).

B. Procedure

Thoroughly mix the selected representative sample with sufficient water to dampen it to approximately four percentage points below optimum moisture content. Weigh the mold and the base plate (without the extension collar) and record to the nearest 0.01 lbs.

Form a specimen by compacting the prepared soil in the 4 in mold (with the collar attached) in three equal layers to give a total compacted depth of about 5 in. Compact each layer by 25 uniformly distributed blows from the 5.5 lb hammer, dropped free from a height of 12 in. During compaction, the mold should rest on a uniform, rigid base.

Following compaction, remove the extension collar and carefully trim the compacted soil level with the top of the mold by means of a straightedge. Holes developed in the surface caused by the trimming shall be patched with the smaller sized material that was struck off. Weigh the mold and material; multiply the weight of the compacted specimen minus the weight of the mold by 30 and record the result as the wet density in pounds per cubic foot of the compacted soil.

Remove the material from the mold and slice it vertically through the center. Take a representative sample of the material from one of the cut faces, weigh it immediately and dry it to a constant weight. The moisture content sample shall not weigh less than 250 grams. A "Speedy" moisture tester may be used for this purpose.

Thoroughly break up the remainder of the material until it will pass a #4 sieve, as judged by eye. Add water in sufficient amounts (about 3.5 oz to an 11 lb sample) to increase the moisture content of the soil sample by two percentage points, and repeat the above procedure for each increment of water added.

Continue this series of determinations until there is either a decrease or no change in the wet density of the compacted soil. This happens when water, lighter than soil, displaces the soil in the mold. The water will frequently leak from the base of the mold at this point. The moisture sample should be obtained from the pan after the sample leaks.

This procedure has been found to be satisfactory in most cases. However, in instances where the soil is a heavy–textured, clay material into which it is difficult to incorporate water, a separate and new sample shall be used in each trial compaction test.

In these cases, separate samples shall be thoroughly mixed with amounts of water sufficient to cause the moisture contents of the samples to vary by approximately two percentage points. The moistened soil thus provides samples which, when compacted, will increase in weight to the maximum density and then decrease in weight. The samples of soil–water mixtures shall be placed in covered containers and allowed to stand for not less than 12 hours before conducting the moisture–density test.

C. Moisture Content and Dry Weight Calculations

Calculate the moisture content and the dry weight of the soil compacted for each trial as follows:

$$M = \frac{A - B}{B - C} \times 100$$

where
M = Percentage of moisture in the specimen, based on dry weight of soil,
A = Weight of the container and wet soil (lbs),
B = Weight of the container and dry soil (lbs),
and
C = Weight of the container (lbs)
and

$$W = \frac{W_1}{M + 100} \times 100$$

where,
W = Dry density in lbs/ft^3 of compacted soil,
W1 = Wet density in lbs/ft^3 of compacted soil,
and
M = Percentage of moisture in the specimen, based on dry weight of soil.

- Moisture–Density Relationship: The calculations above shall be made to determine the moisture content and corresponding dry density for each of the compacted soil samples. The dry density of the soil shall be plotted on the y–axis of a graph, and the corresponding moisture contents shall be plotted on the x–axis (see the graph at the end of this Section).
- Optimum Moisture Content/Maximum Density: When the densities and corresponding moisture contents for the soil have been determined and plotted, connect the plotted points

with a smooth curve. Select the peak of the curve and record the moisture and dry density found at this point. This is the optimum moisture and maximum dry density with which to compare the field density.

STATE OF NEW HAMPSHIRE / DEPARTMENT OF TRANSPORTATION					
Proctor Maximum Dry Density					
Date:				09/15/15	
Project (Town)	Laconia	Fed. No.	NHS–018–2 (104)	State No.	99999
Contractor	Plow Brothers	Contract Administrator	R. Tanner		
Source of Material	Crystal Street	Soil Type	Fine Silt		
Proctor Number	RT–3	Location to be Used	Plummer Rd.		
Lab Number	—	Field No.	3		

A. Wt. Mold + Wet Soil (lbs)	13.07	13.17	13.31	13.47	13.36
B. Wt. Mold (lbs)	9.40	9.40	9.40	9.40	9.40
C. Wt. Wet Soil (A – B)	3.67	3.77	3.91	4.07	3.96
D. Wet Density (C × 30)	110.22	113.08	117.27	122.08	118.73
E. Moisture Container No.	1	2	3	4	5
F. Wet. Wt. + Tare (g)	303.7	248.8	209.4	228.4	256.7
G. Dry Wt. + Tare (g)	290.9	232.33	192.4	205.9	230.1
H. Tare Wt. (g)	88.3	47.8	46.3	49.1	72.1
I. Wt. of Water (F–G)	12.8	16.4	17.1	22.5	26.6
J. Wt. of Dry Soil (G–H)	202.6	185.2	146.1	156.8	158.0
K. % Moisture [(I/J) × 100]	6.3	8.9	11.7	14.4	16.8
L. Dry Density [(D × 100) (100 + K)]	103.69	103.84	104.99	106.71	101.65

Max. Wet Density	122.08	PCF
Max. Dry Density	106.71	PCF
Optimum Moisture	14.4	%
#4 Stone retained	0.0	%

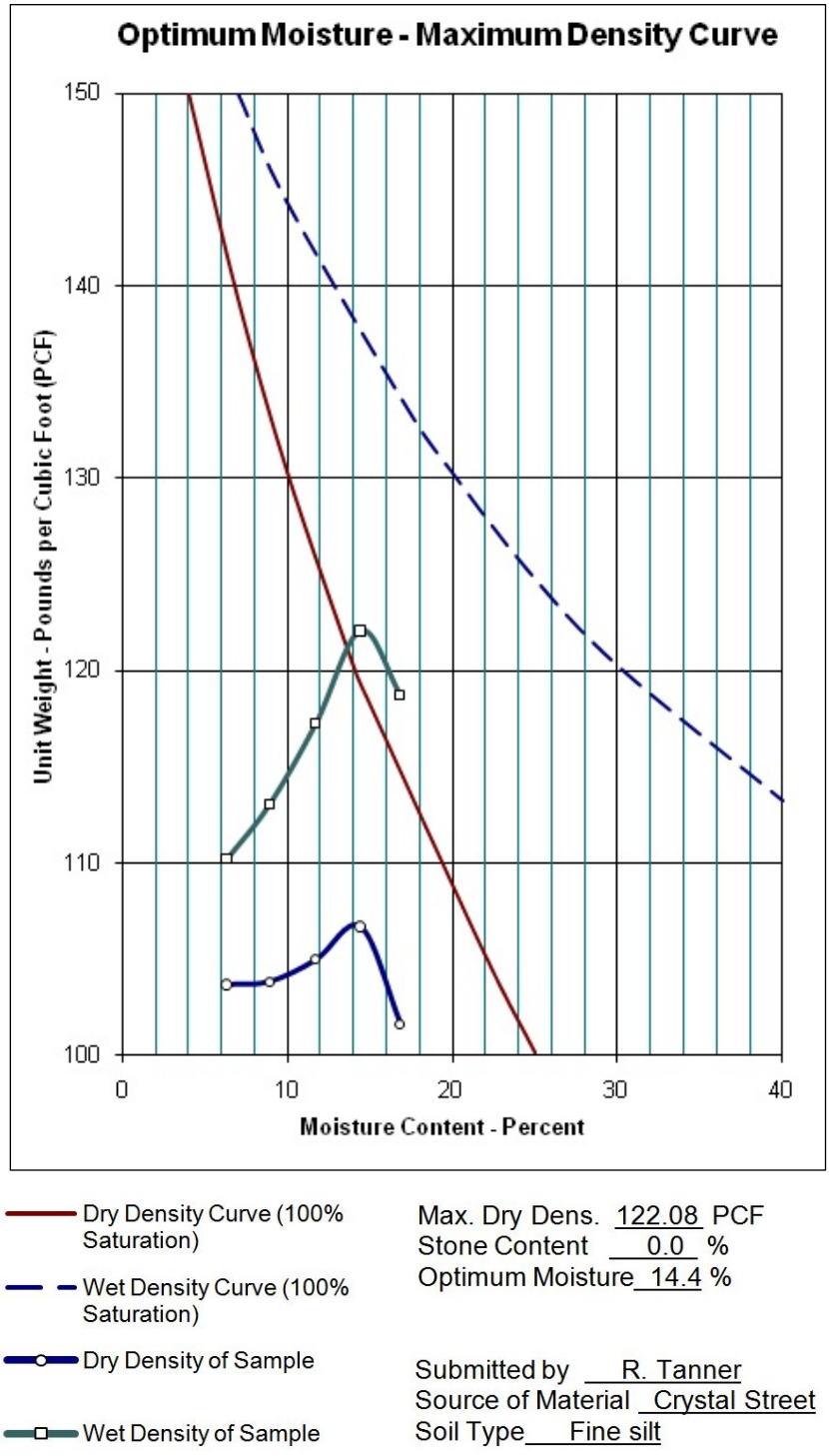


Figure 700 – 3: Sample Proctor Curve

704.4 – STANDARD METHOD OF CORRECTION FOR COARSE PARTICLES IN THE SOIL COMPACTION TEST (AASHTO T 224)

► Reference: AASHTO T 224, Correction for Coarse Particles in the Soil Compaction Test

A. Scope

This method describes a procedure whereby the maximum soil density determined by *AASHTO T 99* may be adjusted to compensate for differing percentages of coarse particles retained on the #4 sieve in the in–place density test.

B. Outline of Method

When "Method A" of *AASHTO T 99* is employed, the maximum density shall be determined on the soil fraction passing the #4 sieve. The percentage of coarse particles above the #4 sieve in the in–place sample being tested shall be determined. An adjusted value for the maximum density of the in–place material can then be obtained by entering the determined percentage onto the "Density Correction Chart for Difference in Stone Content" as shown in the following figure.

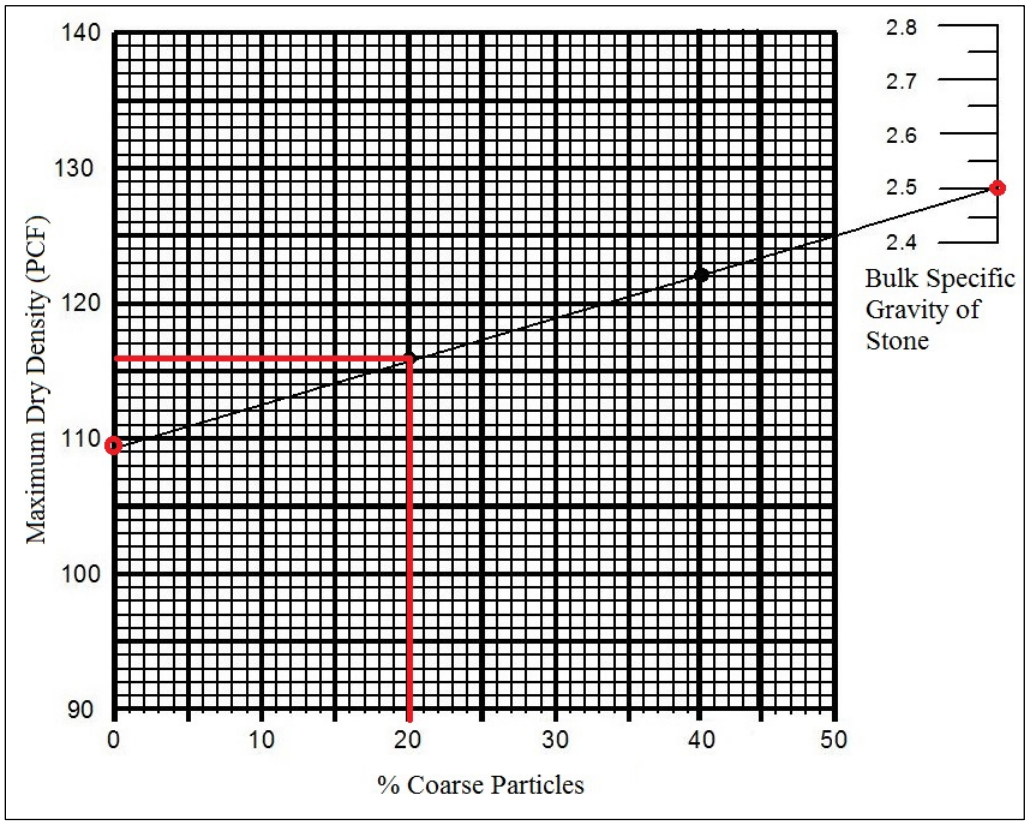


Figure 700 – 4: Density Correction Chart for Difference in Stone Content

Example

Given:

20% = % of stone larger than the #4 sieve in a field density sample

2.5 = Bulk specific gravity of stone

109.5 lbs/ft^3 = Maximum dry density per *AASHTO T 99* Proctor Test

C. Procedure

On the density correction chart, locate the point on the left axis for the maximum dry density at 0% stone of 109.5 lbs/ft^3, then draw a line to the point on the bulk specific gravity of stone scale at 2.5. On the 20% coarse particles vertical axis, locate the intersection of the drawn line and project horizontally to the dry density scale to find the corrected dry density of 115.8 lbs/ft^3.

% Compaction:

The in–place density of the material tested in the field is divided by this corrected density to find the percent compaction and then compared to the required Specification.

704.5 – DENSITY OF SOIL IN–PLACE BY THE NUCLEAR GAUGE METHOD (AASHTO T 238)

► Reference: AASHTO T 238, Standard Method of Test for Density of Soil and Soil–Aggregate In–Place by Nuclear Methods (Shallow Depth)

A. Scope

This method of testing may be used for determining the in–place density and moisture content of base courses and soils, especially glacial till soils compacted at moisture contents above optimum.

B. Special Precautions

The nuclear gauges used in this test rely on sources of radioactive isotopes. The isotopes are lead shielded and encased in the instrument. Extension of the source rod beyond the shielded instrument case permits the radioactive particles to escape. The quantities of radiation emitted are quite small, so the operator may safely use a gauge day after day without receiving any bodily damage due to radiation.

Note: All radioactive sources, no matter how small, must be handled with care.

New Hampshire state law requires that the operator of a nuclear gauge be licensed by the Department of Health's Radiation Control Section, Occupational Health Division. In order to obtain a license, the operator is required to complete a short course in Radiation Safety

given by the Manufacturer's Training Officer, a licensed Nuclear Regulatory Commission instructor.

In order to protect the operator from possible overexposure to radiation, the Department supplies a radiation monitoring dosimeter. The dosimeter must be worn at all times while using or transporting the nuclear gauge.

The operator must study and become knowledgeable in the contents of the instruction manual supplied with the nuclear gauge. Unauthorized access to the gauge should be prohibited at all times, and the gauge must be locked up or otherwise secured when not in use.

C. Apparatus

A factory–calibrated Nuclear Gauge, such as the *Troxler 3411*, should be used, along with the following items:

- Instruction manual
- Reference Standard (see following figure)
- Scraper plate (with drill rod guide) for smoothing the test site and drilling the access hole
- Drill rod
- 4 to 6 lb hammer for driving the drill rod
- #4 sieve
- Shovel
- Field scale

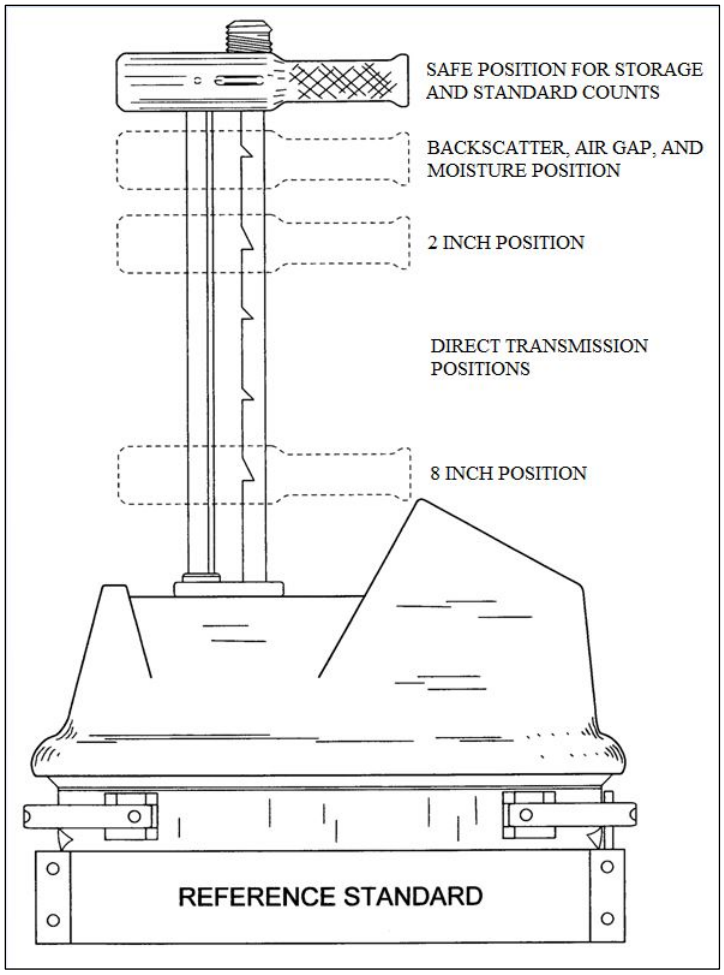


Figure 700 – 5: Nuclear Gauge Reference Standard

D. Determination of Maximum Dry Density on Crushed Stone Bases

The maximum dry density of a base course, such as a crushed stone base (Items 304.4 and 304.5) is obtained by the use of a test section. Material from the stockpile is spread on the project in an area approximately 200 ft long by 10 ft wide. The depth of the material should be such that after compaction to a thickness of 10 to 12 in is in place to allow for a test penetration of 8 in. Compact the area with a 27,000 lbs dynamic–force vibratory roller for a specific number of passes for each density test.

Nuclear gauge density data is obtained at the same location on each series of passes. The process of compaction passes and testing is continued until there is a decrease in dry density or the density remains the same for two tests in a row. The highest dry density obtained by this process is then considered the maximum dry density obtainable. All future tests for determining the percent compaction on the crushed stone base will be related to the maximum dry density obtained on the test section.

If the source of material changes substantially for any reason or compaction results suddenly become consistently low or high, a new test section shall be established and the

testing process shall be repeated. It is not necessary to correct the maximum dry density obtained on a test section of the crushed stone base material for the percent of stone retained on the #4 sieve.

E. Determination of Maximum Dry Density on Soil Materials

The maximum dry densities for coarse granular soils and glacial tills are obtained by the Proctor Test, previously described under the procedure "Testing Soil for Moisture–Density Relations." Correct the Proctor maximum dry densities for the percent of stone retained on the #4 sieve.

The following Nuclear Density Test Report forms are used for reporting nuclear gauge test data and results.

STATE OF NEW HAMPSHIRE / DEPARTMENT OF TRANSPORTATION											
Field Report on Nuclear Density Test											
Project	Laconia	Fed No.	NHS–018–2 (104)			State No.	99999				
Date:	09/15/15										
Material	Sand		Submitted By			R. Tanner					
Source	Ford Sand & Gravel		Town:			Belmont, NH					
Quantity Represented		1,000 yd^3 +/–			Item No.	304.1					
Report To:	☒	Project Files	☐	Lab	☒	Contractor:	Plow Bros., Inc.				
Test Number		7									
Test Depth (in)		8									
Station		123+50									
Location (Lt–Rt)		Lt 10 ft									
Height of Fill (Ft)		10 ft									
Wet Density (PCF)		121.9									
% #4 Stone Retained		0.0									
% Moisture		7.3									
Dry Density (PCF)		113.6									
Proctor or Test Strip		115.4									
Corrected Dry Density		115.4									
% Compaction		98.4									
% Required		95									
Remarks: Meets requirements for Item 304.1 Sand											
Tested By:		E. Welch			Date:	September 15, 2015					

STATE OF NEW HAMPSHIRE / DEPARTMENT OF TRANSPORTATION						
Bureau of Materials and Research						
Nuclear Density Test Report (1)						
Sample ID:	AA07713					
`	Enfield	Federal	STP–TE–BRZ–T–X–145(2)			
Project No:	10652	Source:	Pike Industries, W.			
NH Lab No:	03–0415KC1	Report:	Charles Flanders			
Material:	Granular Backfill	Submittal:	5/15/2015 2:15:00			
Sampled from:	B# 083/156, Shaker Hill	Sample:	5/15/2015			
Lot #:	21–A		Sampled by:	E.W. & K.C.		
Purpose:	209.201					
Analysis Validated	JA	Date:	5/15/2015			
Sample Validated	ADP	Date:	5/15/2015			
Remarks:	Geo Gauge informational comparison test(s) in same test location: 7.03 Avg. Stiffness					
Method	Analysis	Result	Units	Min.	Max.	Violation
Gauge ID:	20730					
Calibration/Verification Date:		06/30/2015				
Standardization	2043/672					
T310	Test Depth	8	in			
T310	Height of Fill	20	ft			
T310	Wet Density of soil	142.2	lbs/ft^3			
T27	#4 Sieve	55	% Retained			
T310	Weight of H_2O in Sample	4.8	lbs/ft^3			
T310	% Moisture	3.5	%			
T310	Dry Density	137.4	lbs/ft^3			

STATE OF NEW HAMPSHIRE / DEPARTMENT OF TRANSPORTATION						
Bureau of Materials and Research						
Nuclear Density Test Report (2)						
Method	Analysis	Result	Units	Min.	Max.	Violation
Gauge ID:	20730					
Calibration/Verification Date:		06/30/2015				
Standardization	2043/672					
T99	Maximum Dry Density	125	lbs/ft^3			
T224	Corr. Max. Dry Den.	138	lbs/ft^3			
% Compaction	99.6	%	95			
Tested By:	E.W. & K.C.					
T310	% Moisture (IA)	2.9	%			
Meets Comparison?		Satisfactory				
T310	Dry Density (IA)	138.2	lbs/ft^3			
Meets Comparison?		Satisfactory				
T310	Wet Density of Soil (IA)	142.3	lbs/ft^3			
Meets Comparison?		Satisfactory				
T310	Weight of Water in Sample (IA)	4.1	lbs/ft^3			
Meets Comparison?		Satisfactory				
Comments: Project T99–A Proctor MDD = 125 lbs/ft^3 @ 9% om; see LIMS Report #s AA07620 and AA07619 for test results from same sample location						

704.6 – STRAIGHT LINE ANALYSIS AND CHARTS

In order to readily evaluate whether materials and other necessary tests made on projects conform reasonably to the Specifications both during the construction phase and at the completion of the project, project personnel may use straight line analysis charts.

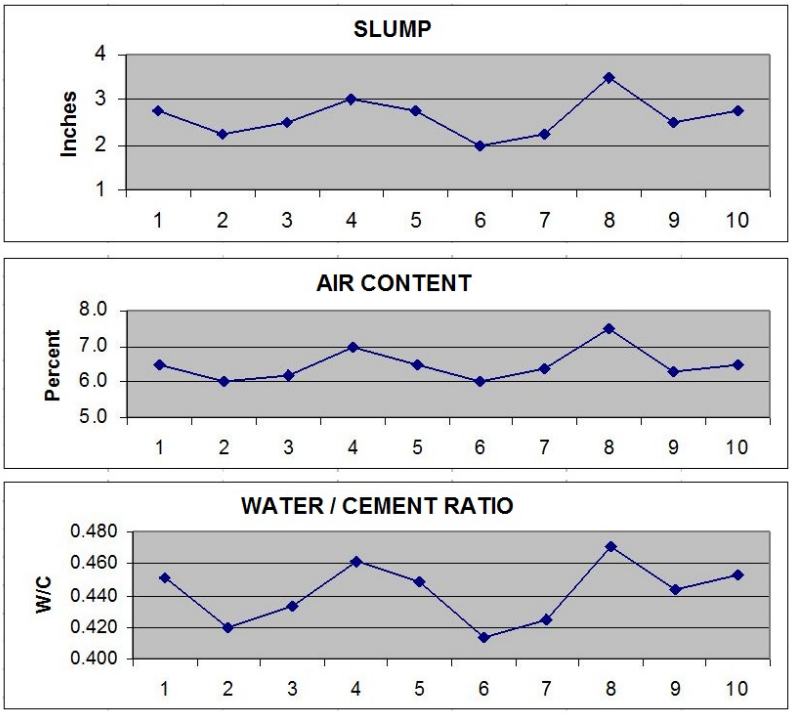
These charts can be of considerable visual value to the Department, both during field inspection by supervisory personnel and during the documentation of materials and tests for federal reimbursement upon completion of the project.

These charts are generally kept in files along with the test reports of the Item they represent. In order for these charts to be of value, they must be maintained in an up–to–date status and be available for field inspection by Contractors, suppliers, and/or the Federal Highway Administration.

Charts may be maintained on the following items, or on any other item with multiple test results that the Contract Administrator or District Construction Engineer designates:

- Fill: In–place density
- Sand: Gradation, in–place density
- Gravel: Gradation, in–place density
- Crushed Gravel: Gradation, fractured faces, in–place density
- Concrete: Slump, entrained air content, water/cement ratio, compressive strength, permeability, sand FM

An example of a Straight Line Analysis Chart for concrete test results is shown in the following figures.



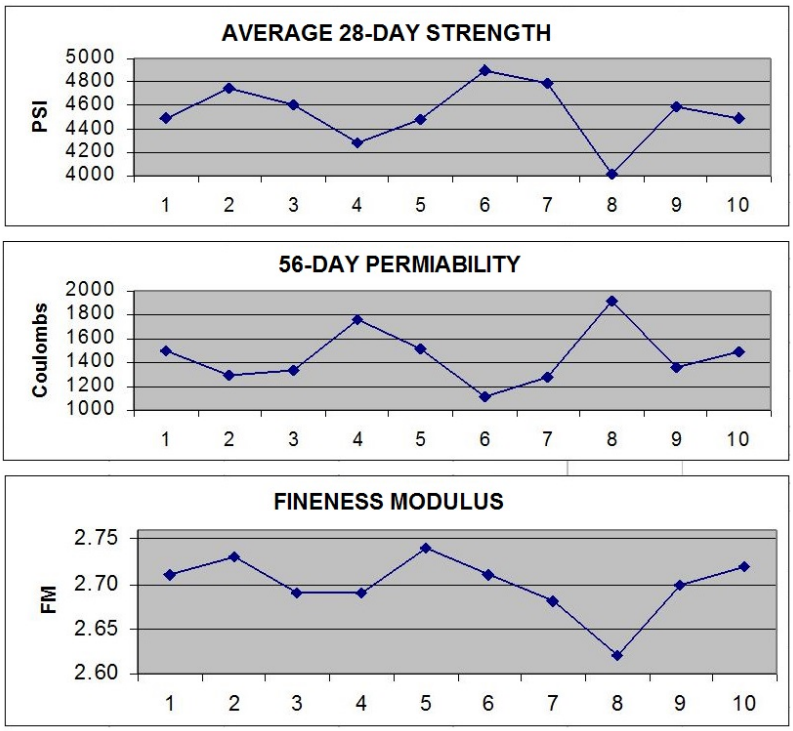


Figure 700 – 6: Straight Line Analysis Chart for Concrete Test Results

704.7 – STANDARD METHOD OF TESTING THE SLUMP OF PORTLAND CEMENT CONCRETE (AASHTO T 119, ASTM C143)

► Reference: AASHTO T 119, Standard Test Method for Slump of Hydraulic–Cement Concrete

► Reference: ASTM C143, Standard Test Method for Slump of Hydraulic–Cement Concrete

Scope: This test covers the procedure to be used for determining the slump of portland cement concrete, both in the laboratory and in the field.

A. Apparatus for Testing Slump

The mold in which to form the specimen shall be made of metal with a minimum thickness of 0.060 in. It should be in the form of a cone, and the base and the top should be open and parallel to each other. The base diameter of the apparatus should be 8 in, the top diameter should be 4 in, and the height should be 12 in tall. The mold should be provided with foot pieces and handles.

Slump Cone Apparatus

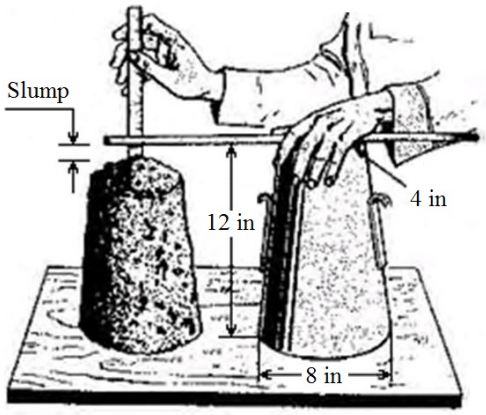


Figure 700 – 7: Slump Cone Apparatus and Testing Method

In addition, a round, straight steel tamping rod with a diameter of 5/8 inches and an approximate length of 24 in should be ready for use. One end of the rod should be rounded to a hemispherical tip.

B. Procedure for Testing Slump

A sample of concrete should be obtained per *ASTM C 172, Standard Practice for Sampling Freshly Mixed Concrete,* which will be a representative of the entire batch from which the test specimens will be made. The entire operation from the start of the filling through removal of the mold shall be carried out without interruption and should be complete within two and a half minutes.

Dampen the mold and place it on a flat, moist, non–absorbent, rigid surface. The operator shall hold the mold firmly in place during filling by standing on the two foot pieces. From the sample of concrete obtained in accordance with *ASTM C 172*, immediately fill the mold in three layers where each layer fills approximately one third of the volume of the mold. One third of the sample should fill the mold to a depth of 2 ⅝ in and two thirds should fill the mold to a depth of 6 ⅛ in.

"Rod" each layer with 25 strokes of the tamping rod. Uniformly distribute the strokes over the cross–section of each layer. For the bottom layer, this will necessitate inclining the rod slightly and making approximately half the strokes near the perimeter, and then progressing with vertical strokes spirally toward the center. Rod the bottom layer throughout its depth, then rod the second layer and the top layer each throughout their respective depths, so that the strokes just penetrate into the underlying layer.

In filling and rodding the top layer, heap the concrete above the mold before rodding is started. If the rodding operation results in subsidence of the concrete below the top edge of the mold, add additional concrete to keep an excess of concrete above the top of the mold at all times.

After the top layer has been rodded, strike off the surface of the concrete by means of a screeding and rolling motion of the tamping rod. Remove the mold immediately from the concrete by raising it carefully in a vertical direction. The operation of raising the mold should be performed in approximately 5 seconds by a steady upward lift with no lateral or torsional motion being imparted to the concrete.

Immediately measure the slump by determining the difference between the height of the mold and the height over the original displaced center of the top of the specimen. If an obvious falling away or shearing off of concrete from one side or portion of the mass occurs, discard the concrete test sample and start a new test sample per *ASTM C172*.

If two consecutive tests on a sample of concrete show a falling away or shearing off of a portion of the concrete from the mass of the specimen, the concrete probably lacks the necessary plasticity and cohesiveness for the slump test to be applicable.

C. Slump Report

Record the slump, which is the distance from top of the cone to the top of displaced center of sample in inches to the nearest ¼ in of subsidence of the specimen.

704.8 – DETERMINING ENTRAINED AIR IN CONCRETE WITH A PRESSURE METER (AASHTO T 152, ASTM C231)

► Reference: AASHTO T 152, Air Content of Freshly Mixed Concrete by the Pressure Method

► Reference: ASTM C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

The range of air content designated in the Specifications applies to the air content of the concrete as it is deposited into its final location. When the site of deposit is remote from the truck mixer, such as when the concrete is pumped or moved from the mixer to its final location by conveyer belt, air tests may be run at the mixer for informational purposes only to assist the Contractor in obtaining air contents within the Specification range at the point of deposit.

Type A pressure meters are less common than the Type B today and are typically not used in the field, but their function is still based on the same basic principle to measure entrained air content in the concrete.

A. Operating Instructions for Type B Pressure Meters

Place a sample of the concrete to be tested in the material container in three equal layers. Rod each layer 25 times uniformly over the area of the lift with the hemispherical end of a ⅝ in rod such that the rod slightly penetrates the prior lift. Tap the sides with a rubber mallet 10 to 15 times after rodding each layer to ensure that the voids left by the rod are filled.

Excess concrete should be removed by sliding the strike–off bar across the top flange of the material container, using a sawing motion, until the container is just level–full. Wipe the top rim of the container clean.

Place the lid on the material container and close the four clamps (close opposing clamps simultaneously).

- Type B Pressure Meter – Style 1

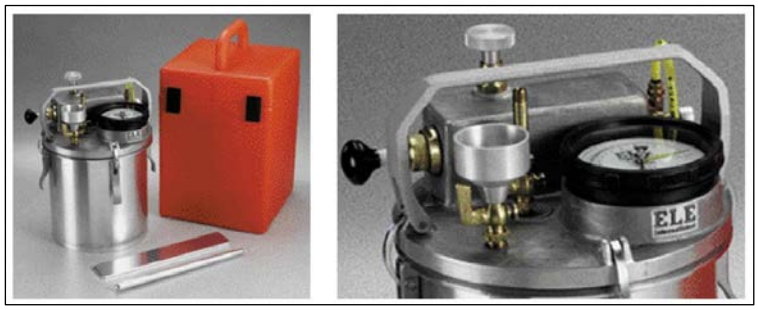


Figure 700 – 8: Type B Pressure Meter – Style 1

Close the main air valve located on top of the air receiver. Open both petcocks located on top of the lid. Pour water into the funnel until water comes out of the petcock in the center of the lid. Tip and gently jar the meter until no air bubbles come out through the center petcock.

Close the air bleeder valve in the end of the air receiver and gently pump air into the receiver until the gage hand comes to the red line. A little to one side or the other of the line will make no difference as long as the hand has gone past the initial starting point.

Tap the gage gently with one hand. At the same time, crack the bleeder valve in the end of the air receiver until the gage hand rests exactly on the initial starting point. Then quickly close the bleeder valve.

Close both petcocks. Open the main air valve between the air receiver and the material container, and tap the container smartly with the rubber mallet when pressure is on to allow for possible rearrangement of particles. Tap the gage gently until the hand comes to rest. This reading is the percent of air entrained. This type of meter will typically read up to 22% air.

Once the test is complete, open the petcocks before releasing air from the chamber or releasing the clamps.

- Type B Pressure Meter – Style 2

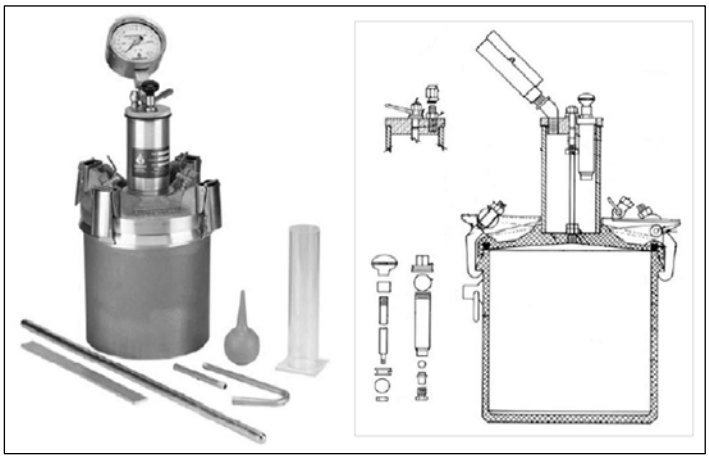


Figure 700 – 9: Type B Pressure Meter – Style 2

Open both petcocks located on the top of the lid. Inject water into one of the petcocks until water comes out of the other petcock. Tip and gently jar or roll the meter until no air bubbles come out through the opposite petcock.

Close the air bleeder valve at the top and gently pump air into the air chamber until the gage hand comes go beyond the initial pressure line (determined by calibration). Wait a few seconds and tap the gauge gently until the hand comes to rest. Use the bleeder valve or pump gently as necessary until the hand rests exactly on the initial pressure line.

Close both petcocks. Open the main air valve between the air chamber and the material container by pressing down on the lever located at the top of the chamber. Hold the lever down for several seconds and tap the container smartly with the rubber mallet to allow for possible rearrangement of particles. Tap the gage gently until the hand comes to rest. This direct reading is the percent of air entrained.

Once the test is complete, open the petcocks before releasing air from the chamber or releasing the clamps.

The "aggregate correction factor" is obtained by placing the amount of each size of aggregate used in the test in the material container with water and completing the regular determination for air content. This factor is typically insignificant but may be subtracted from the original air reading.

B. Field Calibration of Meter

The following procedures should be used for testing the calibration of the meter in the field prior to any concrete testing and monthly thereafter, or any time the calibration is in question.

- Type B Pressure Meter – Style 1

1. Fill the material container with water. Be sure the meter is in a level position. Remove the standpipe screwed into the petcock and screw it finger–tight into the funnel petcock opening on the underside of the lid.

2. Wipe the top rim of the container clean. Close the main air valve on the top of the air receiver. Open both petcocks on the top of the lid. Place the lid on the material container and close the four clamps.

3. Pour water into the funnel until water comes out of the petcock in the center of the lid. Jar the meter gently until no air bubbles come out through the center petcock.

4. Close the air bleeder valve in the end of the air receiver and gently pump air into the receiver until the gage hand comes to the red line. A little to one side or the other of the line will make no difference as long as the hand has gone past the initial starting point.

5. Tap the gage gently with one hand. At the same time, pump up gently or crack the bleeder valve in the end of the air receiver until the gage hand rests exactly on the initial starting point. Then quickly close the bleeder valve.

6. Close both petcocks and remove all water from the funnel with a syringe. Open the main air valve to the material container about one half turn and tap the gage until the hand comes to rest.

7. Gently crack the petcock under the funnel. When water has risen exactly to the line inside the funnel, close the petcock. Open the main valve to the material container about one half turn and tap the gage until the hand comes to rest.

8. If the meter is in perfect working order, the gage hand will come to rest on the proper, calibrated value. This value should be compared to the prior indicated value written on the back side of the gage.

   If the gage hand does not come to rest on the proper, calibrated value, the starting point arrow should be readjusted as outlined in the Notes below.

After the test, return the standpipe to its place in the center petcock.

Additional Notes for Style 1 Meters:

- Always close the main air valve before releasing pressure from either the material container or the air receiver. Failure to close this valve will cause

water to be drawn into the air receiver and future measurements will be in error.

- Should water be drawn into the air receiver, open the bleeder valve in the end of the receiver and tip the lid so that water runs out the bleeder valve. Several strokes of the pump handle will blow out the last traces of water.
- If it is suspected that air is leaking from the chamber through the handle, a clutching device in the knob, which allows the handle to skip, may be adjusted by closing the valve as far as it will go and giving the split–nut on top a clockwise turn. This will give added friction to the clutch and ensure positive closure of the needle valve without damage.

The pressure gage has an adjustable starting point. Should it become necessary to reset this initial pressure line (i.e., after replacement of the rubber gasket which makes the seal between the lid and the material container), the following procedure should be used:

- Perform the Field Check Test described above. If the gage hand does not fall on the proper, calibrated value, the starting point arrow will have to be adjusted. To reach the starting point arrow, unscrew the retaining ring from gage and remove the glass.
- If the gage hand falls below the proper calibrated value, advance the starting–point arrow counter–clockwise the same distance as the gage hand falls below it.
- If the gage hand goes beyond the proper calibrated value, adjust the starting–point arrow clockwise the same distance as the gage hand passes it.
- The gage hand should not extend more than ½ inch beyond red line limit.

- Type B Pressure Meter – Style 2

1. Fill the material container with water. Be sure the meter is in a level position. Screw the short straight section of tube into the threaded petcock opening on the underside of the lid.

2. Wipe the top rim of the container clean. Open both petcocks on the top of the lid. Place the lid on the material container and close the four clamps.

3. Inject water into one of the petcocks until water comes out of the other petcock. Tip and gently jar or roll the meter until no air bubbles come out through the opposite petcock.

4. Close the air bleeder valve at the top and gently pump air into the air chamber until the gage hand comes go beyond the initial pressure line. Wait a few seconds and

tap the gauge gently until the hand comes to rest. Use the bleeder valve or pump gently as necessary until the hand rests exactly on the initial pressure line.

5. Close both petcocks. Open the main air valve between the air chamber and the material container by pressing down on the lever located at the top of the chamber. Hold the lever down for several seconds and tap the gage gently until the hand comes to rest. At this point the gauge should read "0" percent. If two or more tests show a consistent variation from 0%, then change the initial pressure line to compensate. Use the newly established initial pressure line for subsequent tests.

6. Screw the curved tube into the threaded petcock on top of the lid and set the 5% calibration vessel under the discharge spout of the curved tube. Press the lever down and fill the calibration vessel by gently opening the petcock.

7. Release the air in the base through the opposite petcock and then open the petcock with the curved tube to allow water to run back into the base from the tube. There is now 5% air in the base.

8. Repeat the air test to verify that the meter reads 5%. If two or more tests show a consistent variation from 5% (± 0.2%), then remove the gauge glass and reset the dial hand to 5% by turning the recalibration screw located just below and to the right of the center.

9. When the gauge hand reads correctly at 5%, empty the calibration vessel and withdraw additional water in the same manner to check the gauge at 10% and again at 15%.

704.9 – METHOD FOR CASTING, CURING AND TRANSPORTING CONCRETE TEST CYLINDERS (AASHTO T 23, ASTM C31)

► Reference: AASHTO T 23, Making and Curing Concrete Test Specimens in the Field

► Reference: ASTM C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field

A. Scope

Concrete test cylinders are an important means of determining an estimation of the in–place material's ultimate strength and are often used to give an indication of when forms and falsework can be safely removed. A minimum of two 28–day strength cylinders should be cast from each placement.

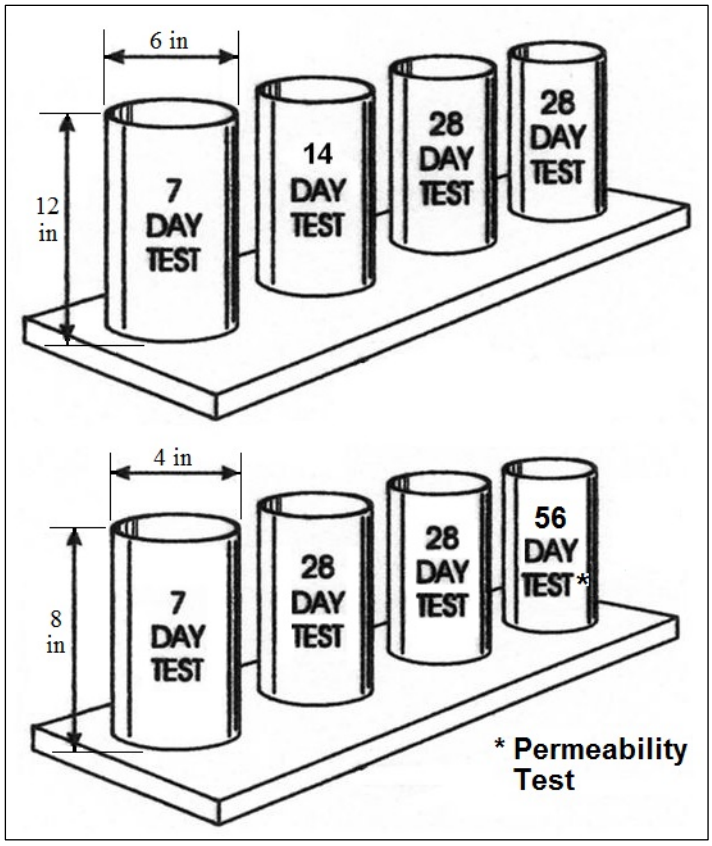


Figure 700 – 10: Concrete Test Cylinders

B. Apparatus

Plastic, steel or paraffin–sprayed cardboard molds are usually used for casting concrete cylinders in the field. 6 in diameter x 12 in high molds are acceptable, but 4 in diameter x 8 in high molds are becoming more and more common for most applications and are also used for casting 56–day permeability specimens. A scoop, strike–off bar and a hemispherical–end tamping rod with a diameter of ⅝ in are also required.

Note: When casting 4 in diameter cylinders, a tamping rod with a diameter of ⅜ in must be used.

C. Procedure

1. Annotate the exterior of each mold with project information, cast date, class, and number, and then place the molds on a smooth, firm, and level surface. After properly sampling the material, remix the sample to ensure uniformity.

2. Fill 6 in diameter molds in three equal layers and rod each layer 25 times uniformly over the area. Add two equal layers into 4 in diameter molds. Tap the sides of the molds after each lift to fill voids left by the rodding. When rodding the upper layers the rod should just penetrate the underlying layer.

3. After consolidating, finish the tops with a sawing motion of the strike–off bar until reasonably smooth. Do not over–finish the top surface. Place the molds into a level curing box maintained at 60–80°F and immediately cap them tightly.

The following sequential figure shows rodding the first layer, rodding the second layer, adding the third layer, and striking off the top.

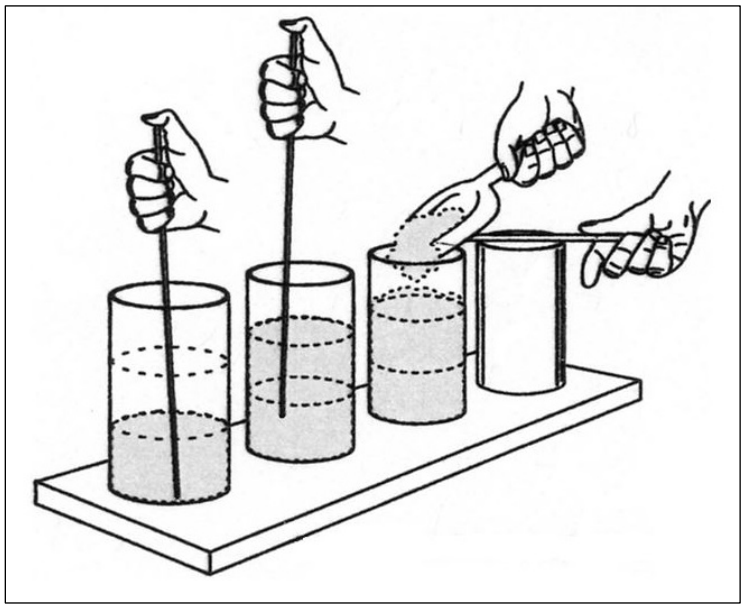


Figure 700 – 11: Sequential Procedure for Filling and Rodding Concrete Cylinders

D. Transporting

Test cylinders must be left in the curing box undisturbed until they have attained enough set strength to withstand handling. Generally, cylinders should be transported to the Lab within three days to finish their curing in the wet room. Caps should remain on the specimens for the entire duration of the trip to minimize any moisture loss.

Ideally, cylinders should be transported in a vertical position in a box specifically constructed and cushioned for such purpose, but they may be laid horizontally if they can be secured without rolling or rattling against each other. During cold weather, the cylinders must be kept warm, that is, transported in the vehicle's passenger compartment rather than the truck bed.

A tag with the project name and number, as well as any other pertinent information and test results must accompany each test cylinder. The cylinder numbers must be included, as well as when the testing is expected to be conducted.

E. NHDOT Modified Tests

The following test procedures are modified versions of AASHTO tests:

- NHDOT P1

Modify AASHTO T 23 – Making and Curing Test Specimens in the Field as follows:

Specimens that are to be transported to the Laboratory shall remain in the molds until received by the Laboratory.

- NHDOT P2

Modify ASTM D4832 – Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders, as follows:

Add to *Section 6.1, Single–use Cylindrical Molds* the following: Only 6 in x 12 in molds shall be used. Cylinder molds shall be modified by drilling a series of 1/16 in diameter holes in a circular pattern approximately ½ in apart in a 4 in radius about the center of the bottom of the mold. Two holes shall be drilled near the center of the bottom of the mold. Before placing the CLSM in the mold, the bottom of the mold shall be covered with filter paper.

Delete Sections 10, 11, 12, 13, 14, and 15.

Testing of CLSM test cylinders shall meet the requirements of AASHTO T 22, Compressive Strength of Cylindrical Concrete Specimens.

704.10 – TEST OF FINE AGGREGATE USED IN PORTLAND CEMENT CONCRETE

Scope – Fine aggregate used in the production of portland cement concrete has a definite effect on the design of a concrete mix.

Besides influencing the amount of mixing water required to make a workable mix, the mechanical composition of the aggregate is of concern since it affects the strength of the mix. As a result, engineers use an empirical index called the fineness modulus (FM) as a measure of the fineness of an aggregate. In general terms, a fine aggregate with a high FM is coarser than one with a lower FM. For State mix designs, test results of the fine aggregate should not vary from the design FM by more than ±0.2. If a greater variation occurs, a redesign of the concrete mix may be required, even though the FM is within specifications. Refer to *Section 520* for detailed examples of testing procedures for fine aggregate.

704.11 – TEST OF COARSE AGGREGATE USED IN PORTLAND CEMENT CONCRETE

Scope – In addition to the fine aggregate tests, the concrete plant inspector is also required to run a gradation on the coarse aggregate. The procedure is similar to that used to determine the gradation of the fine aggregate. Please refer to *Section 520* for detailed examples of testing procedures for coarse aggregate.

Reporting aggregate gradation test results should be made on the following forms and maintained in the project records.

STATE OF NEW HAMPSHIRE / DEPARTMENT OF TRANSPORTATION												
Gradation Test Report (1)												
Project:	Laconia				Field Test Numbers:		TCFA81205 & TCCA81205					
Type of Material:	Fine & Coarse Aggregate				Reported:		9/15/15					
Reported by:	Ronald Tanner				Received by Lab:			20				
Report to:	Project	☒	Lab	☒	Contractor:				☐			
Sampled:	9/15/15				At (Town):		F&S Transit Mix – Laconia					
Material Source:	J.J. Cronin S&G – Laconia											
Sample From:	Stock Bins				Pit	☐	Roadwa	☐	Sta.:			
Quantity (Represented or Estimate)	110 tons											
Purpose / Location	So. Abut, Wing Footings, Bridge #175/238								Item No.:	520.01		
Tested for:	Gradation	☒	FM	☒	% Moisture	☒			Date:	9/15/15		

Sieve	Coarse Aggregates and Gravels							
	Size ¾ in	60 %	Size ⅜ in	40 %	Size	%	Combined	Required
	% Passing		% Passing		% Passing		Results	Spec.
6 in								
3 ½ in								
3 in								
2 ½ in								
2 in								
1 ½ in								
1 ¼ in								

STATE OF NEW HAMPSHIRE / DEPARTMENT OF TRANSPORTATION								
Gradation Test Report (2)								
Sieve	Coarse Aggregates and Gravels							
	Size ¾ in	60 %	Size ⅜ in	40 %	Size	%	Combined	Required
	% Passing		% Passing		% Passing		Results	Spec.
1 in	60.0		40.0				100.0	100
¾ in	60.0		30.0				90.0	90–100
½ in								
⅜ in	34.6		11.9				46.4	20–55
#4	5.9		3.4				9.3	0–10
#8	1.8		0.5				2.3	0–5
#16								
#50								
#200 in Total								
% Fract'd Faces								
	Fine Aggregates and Sands							
	% Passing		Required Spec					
#4	99.9		95–100					
#8	87.5							
#16	70.5		45–80					
#30	47.2							
#50	23.0		10–30					
#100	5.7		2–10					
FM	2.57		2.62 + 0.2					
#200 in Sand	2.2		0–3					
% Moisture	3.6							
Remarks:	Moisture – 4.3% minus absorption factor of 0.746% = 3.6%							
Meets requirements for:			Fine & Coarse Aggregates				See Reverse	☐
Tested by:			Timothy Booney					

704.14 – TEST FOR THE DETERMINATION OF THE WATER/CEMENT RATIO OF CONCRETE BY MICROWAVE OVEN (NHDOT)

A. Scope

When the project requires testing the water/cement ratio of the concrete by microwave oven – generally projects involving 10 cubic yards or more, it is necessary to calibrate the microwave prior to any placements. This procedure is outlined as follows.

B. Apparatus

Use a microwave oven (700 Watt minimum) with variable power settings, and a Pyrex dish.

Sample aggregates as shown in the following table.

Calibration of the Microwave Oven	
Material	Weight (grams)
⅜ in Aggregate	910
Fine Aggregate	606
Cement	336
Water	±148

C. Sample Procedure

Use the following procedure to weigh and dry a representative sample:

1. Oven–dry the aggregates to a constant weight.
2. Weigh out samples of the aggregates, cement, and water to the weights shown.
3. Obtain the tare weight of the Pyrex dish.
4. Mix the aggregates and cement in the Pyrex dish. Add water and mix until a homogenous mixture is obtained.
5. Clean all materials from the mixing spoon with a rubber spatula or small steel spatula, ensuring that all materials are placed in the Pyrex dish.
6. Immediately weigh the mixture.
7. Place the Pyrex dish with the mixture in the center of the microwave oven and operate the oven at 50% cooking power. Set the oven to initially cook for 15 minutes then weigh the mixture. Additional five minute drying periods should be used until the mixture reaches a constant weight.

8. Subtract the constant weight from the original weight. The weight should be equal to the original weight of water added. If weight loss is greater than the original weight of water added, fines are being burned.

9. Reduce power by 10% increments and repeat the procedure until weight loss equals original weight of water added.

10. Record the power setting at which the weight loss equals the original weight of water added.

D. Test Procedure

Use the following procedure to test the sample:

1. Tare the microwave–safe container.

2. Place 2,000g (± 300g) sample of concrete into the container.

3. Weigh sample in container to the nearest gram.

4. Place sample and container into the microwave oven at 50% power (or as determined by the calibration procedure above) for 30 minutes.

5. Weigh container and sample to the nearest gram.

6. Place into the microwave oven at 50% power (or as calibrated) for ten minutes.

7. Weigh to the nearest gram.

8. Repeat steps 6 and 7 until a constant weight is achieved (1g or less).

E. Water/Cement Ratio Calculations

Calculate the Water/Cement Ratio as follows:

$$\frac{W}{C} = [(N+1) \times MD] - N \times [(ACA) \times (1 - FA) + (AFA) \times (FA)]$$

where,

MD = (Wet Weight – Dry Weight) / (Dry Weight) [concrete sample only],

N = Total Aggregate/Total Cementitious*,

FA = Ratio of Sand to Total Aggregate*,

ACA = Absorption of Coarse Aggregate [as decimal],
and
AFA = Absorption of Fine Aggregate [as decimal].

** Use actual batch weights whenever possible*

Report the test results on the following form.

(Rev 4/96)

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

MICROWAVE WATER/CEMENT RATIO

Project	Laconia	**Fed No.**	BRF-X-STP(003)	**State No.**	12345
Location	Abut B Backwall	**Class**	AA	**Date**	04/12/2005
Max Water (Gals/CY)		**Target**	0.400	**Load #**	1

Batch Weights From Mix Design or Truck Slip

	Batch Wt	Moisture		
CEMENT			2610	
POZZOLAN			2655	
COURSE AGGREGATE (3/8)				
COURSE AGGREGATE (3/4)	14320	0.015	14108.37	
COURSE AGGREGATE (1-1/2)				
FINE AGGREGATE	9960	0.053	9458.69	
ABSORPTION FACTOR COURSE AGGREGATE			0.0105	= ACA
ABSORPTION FACTOR FINE AGGREGATE			0.0052	= AFA

N = 4.476 **FA =** 0.401

Microwave Result Summary

	TIME (minutes)	WEIGHT (g) Sample + Tare	TARE (g)	Net Wt.	LOSS (g)	% DIFF.
Initial	0	2721.3	706.4	2014.9	N/A	N/A
	30	2581.5	706.4	1875.1	139.8	7.5
	45	2578.0	706.4	1871.6	143.3	0.2
	50	2576.6	706.4	1870.2	144.7	0.1
	55	2575.8	706.4	1869.4	145.5	0.0
Final	60	2575.2	706.4	1868.8	146.1	0.0

MD = 0.078

W/C = (N+1)MD - N[ACA(1-FA)+AFA(FA)] = 0.391

Actual - Target = -0.009

Miscellaneous Information

Slump	3.75"	Air Temp	48
% Air	6.1	Concrete Temp	65
Unit Wt.	142.4		
Yield	27.1	Tested By	TRB

Calculate the sample's water/cement ratio with the given information:

$$\frac{W}{C} = [(N+1) \times MD] - N \times [(ACA) \times (1 - FA) + (AFA) \times (FA)]$$

where

$$MD = \frac{\text{Wet Weight of Sample - Dry Weight of Sample}}{\text{Dry Weight of Sample}} = 0.0745,$$

$$N = \frac{\text{Total Aggregate Weight}}{\text{Cement Weight}} = 4.597,$$

FA* = Ratio of Sand to Total Aggregate = 0.40,

ACA* = Absorption of Coarse Aggregate = 0.0115,

and

AFA* = Absorption of Fine Aggregate = 0.0093

* Data found on Concrete Mix Design form

Calculate:

$$\frac{W}{C} = [(N+1) \times MD] - N \times [(ACA) \times (1 - FA) + (AFA) \times (FA)]$$

$$= [(4.597+1)(0.0745)]–(4.597)[(0.0115)(1–0.40)+(0.0093)(0.40)]$$

$$= [(5.597)(0.0745)]–(4.597)[0.0069+0.0037]$$

$$= 0.4170–0.0488$$

$$\frac{W}{C} = 0.368$$

Therefore, the sample's water/cement ratio is 0.368.

SECTION 705 – SAMPLE FORMS FROM THE BUREAU OF MATERIALS AND RESEARCH

The following pages are sample forms project personnel will receive from the Lab documenting the results of tests performed on concrete mix design samples received from the project.

STATE OF NEW HAMPSHIRE / DEPARTMENT OF TRANSPORTATION						
Bureau of Materials & Research						
Concrete Mix Design (1)						
Project:	Laconia		Lab No.:	391X96		
Federal No.:	NHS–018–2 (104)					
State No.:	99999					
Report to:	☒ Contract Administrator		Ronald Tanner	☐ FHWA	☒ Lab	
	☐ Other			☐		
Mix Type:	☐ Non–Vibrated		☒ Vibrated	☐ Air Entrained		
Class:	AA ☒	A ☐	B ☐	C ☐	T ☐	P ☐
Slump:	2 – 3 in		Max. H_2O/Bag Cement:	5.0 gal		
Fine Aggregate Source:	Coastal–Farmington					
Coarse Aggregate Source:	Coastal–Raymond					
Coarse Aggregate Type:	Gravel ☐		Rock ☒			
	Chem. Admix. Req. ☐		WRA or Retarder ☐			
Size of Coarse Aggregate:	#4 – ¾ in					
Fine Aggregate: FM	2.65		Absorption:	0.746 %		
Sp. Gr. (Sat. Surf. Dry)	2.632		Solid Wt. (A)	164.24 lbs/ft^3		
Coarse Aggregate: Rodded Weight (C)	95.0 lbs/ft^3		Absorption:	0.438 %		

STATE OF NEW HAMPSHIRE / DEPARTMENT OF TRANSPORTATION			
Bureau of Materials & Research			
Concrete Mix Design (2)			
Sp. Gr. (Sat. Surf. Dry)	2.687	Solid Wt. (B)	167.67 lbs/ft^3
Vol. Coarse Aggr. per Vol. of Concrete = b / b_o =	0.64	= (D) =17.28 ft^3	Vol. Coarse Aggr. per Vol. of Concrete = b / b_o =
Wt. Coarse Aggr. per yd^3 of Concrete = (D)	17.28	× (C) = 95.0	= (E) = 1,642 lbs
Solid Vol. of Coarse Aggregate = (E)	1,642	/ (B) = 167.67	= 9.79 ft^3
Solid Vol. of Cement =	6.91	Bags × 0.479 =	3.31 ft^3
Solid Vol. of Water =	34.6	Gal / 7.49 Gal/ft^3 =	4.62 ft^3
Volume of Air =	6.0	% × 27 =	1.62 ft^3
Total Solid Volume except Sand = (F) =		19.34 ft^3	
Volume of Sand = 27.00 – (F) = (G) =		7.66 ft^3	
Weight of Sand = (G) × (A) =		1,258 lbs	
Ratio of Sand to Total Aggregates	43 % by weight	Yield Adjustment to Design Mix	☐
Batch Weights (lbs/yd^3)			
Cement	325.0	lbs	
Slag	325.0	lbs	
Coarse Aggregate	657.0	#4 – ⅜ in	
Coarse Aggregate	985.0	⅜ – ¾ in	
Coarse Aggregate		¾ – 1½ in	

STATE OF NEW HAMPSHIRE / DEPARTMENT OF TRANSPORTATION		
Bureau of Materials & Research		
Concrete Mix Design (3)		
Batch Weights (lbs/yd^3)		
Fine Aggregate	1,258.0	lbs
Total Water	34.6	gal
Wet Density	142.15	lbs/ft^3
Note: The moisture content of the fine and coarse aggregates should be determined and the mix design adjusted prior to batching. The total weight of SSD fine and coarse aggregates remains constant.		
Respectfully,	Jim Amron	Concrete Supervisor
Respectfully,	Alan D. Primrose	Chief of Materials Technician
Date Reported:	9/15/2015	
Project:	Laconia / BR# 105/104	

SECTION 706 – CORRECTIVE ACTION

706.1 – CORRECTIVE ACTION

Corrective action must be taken for each failing test and a Corrective Action Report must be prepared in triplicate by the Contract Administrator documenting the corrective action taken. One copy of this report should be retained by the Contract Administrator for project records and attached to the unsatisfactory report. The following is a sample Corrective Action Report showing the proper way to fill out this report. This report is to be filled out for every Lab test that does not meet specifications.

State of New Hampshire / Department of Transportation					
Contract Administrator's Corrective Action Report					
Project:	Laconia	Reported by:		Ronald Tanner	
No.:	99999	Date:		9/15/2015	
Unsatisfactory Sample Test No.	1905–61	File	240	Material or Test:	Crushed Gravel
Date Sampled:		9/1/2015		Nature of Sample or Test:	Gradation–lacking large aggregate
Date submitted to Lab:		9/1/2015			
Date results rec'd. from Lab:		9/15/2015			
Corrective Action Taken: 1½" crushed stone added to in–place crushed gravel and worked in with grader at Sta. 66+80 to Sta. 67+80 (area of questionable material). Upon completion of mixing of the stone with previously placed gravel, a sample for gradation was taken that substantiated acceptable material. This area was then thoroughly compacted with a vibratory roller, with two more samples taken to test gradation.					
Lab No. of Check Sample:	1941–61	File	240	Date Sampled	9/1/2015
Date Submitted:		Date result rec'd.		9/30/2015	
Remarks:	Three areas resampled, tested, and found to be satisfactory. This report shall be prepared by the Contract Administrator and retained in the project records attached to any unsatisfactory material report submitted after completion of corrective action				

706.2 – NONCONFORMING MATERIAL REPORT

As stated in *Subsection 706.1*, corrective action must be considered for each failing test result. A "Corrective Action Report" must be completed to document the action taken. In some cases however, failing material may not be correctable and nonconforming material may be incorporated into the work (if deemed to be in the best interest of the State). This determination will be made based on sound engineering judgment, including situations where the failing material is considered "substantially conforming" or non–detrimental to the integrity of the work.

Contract Administrators shall complete the "Summary of Nonconforming Material" report for all projects, even if said materials were not incorporated. The form shall be submitted stating such to ensure acceptable documentation. When nonconforming materials are incorporated into the work, the Contract Administrator shall complete the form as shown in the example on the following page.

Include the test report date (date taken, if not reported), test number if appropriate, location of the test or structure, type of material and test performed, and an explanation for the acceptance (i.e. substantial conformance or non–detrimental). The summary shall be signed and dated by the Contract Administrator and submitted with the Project Records to Engineering Audit.

Note: This form is available to be filled out either manually or electronically for all projects.

Summary of Nonconforming Material				
Project::		Laconia	Contract Administrator:	Ronald Tanner
Project No.:		99999	Date:	10/1/2015
Federal No.:		NHS–018–2 (104)		
Date Reported:	Test No.:	Location/Bridge No.:	Material (Type of Test):	Explanation for Acceptance
9/15/2015	Cyl. #42	Br. #125/264	Concrete (Strength)	Substantially conforms
9/15/2015		Br. #172/216	Concrete (Air)	Substantially Conforms
9/15/2015	072896A	Sta. 100+50, Rt.40'	Embankment in Place (Density)	Non–detrimental – (Outside $1^1/_2$:1 slope influence line)

SECTION 707 – CEMENT MORTAR

707.1 – GENERAL

This item is most often used in conjunction with the following:

- Concrete Surface Finishing and Pointing
- Stone Masonry
- Brick and Block Masonry
- Concrete Pipe
- Manholes, Drop Inlets and Catch Basins
- Curbing

707.2 – CONSTRUCTION OPERATIONS

The Contract Administrator and field personnel should observe the workers mixing the mortar to ensure that a mix no weaker than one part cement to two parts sand by volume is used. Masonry operations should be suspended in rainy weather or under extremely hot or cold conditions unless the mortar can be protected. In hot and dry weather, mortar should be protected from the sun and kept moist for at least three days. In cold conditions, a housing should be provided which can maintain a temperature well above freezing for three days. Mortar should always be applied to clean, wetted surfaces to obtain a durable bond. Care should be taken to apply mortar to joints in such a way as to ensure that the joint is completely filled.