PREFACE

Materials Method 9.1 describes New York State Department of Transportation’s (NYSDOT’s) requirements and policies for inspection of Portland Cement Concrete (PCC) mixtures at the production facility (plant). These requirements include the responsibilities of the inspector, or Quality Assurance (QA) personnel assigned to the PCC plant.

Department personnel may suggest to a Producer methods for improving the operation of the plant, with the understanding that the suggestions do not bind NYSDOT to accepting material outside of specifications.

Note: This Materials Method (MM) may require the use of hazardous materials and safety sensitive procedures. This method does not address any of the safety problems associated with its use. It is the responsibility of the user of this method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.
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SECTION 1

INTRODUCTION

1-1 GENERAL

All Portland cement concrete ingredients shall be batched according to mix designs prepared by or approved by the Department. Unless otherwise specified or directed, the materials used in the concrete must appear on the Department’s Approved Lists prior to their use. The concrete shall be delivered to the project and point of deposition in approved mixing and/or haul units.

Concrete intended for use on Department projects shall be proportioned by an approved automated batching facility, or in an approved mobile concrete mixing unit. The batching of concrete is usually conducted under the inspection of a plant inspector assigned by the Regional Director, or his representative. Some of the responsibilities contained herein may be assigned to a designated person under an approved Quality Control / Quality Assurance (QC/QA) program. However, this manual may not be used exclusively as a Quality Control Plan. Other details, actions and procedures must be addressed for a QC plan to be considered acceptable.

When plant inspection is not feasible, small quantities of concrete produced at approved plants may be accepted based on a Producer’s certification that the concrete meets specifications. This option is limited to quantities less than 25 cubic yards (20 cubic meters), and must be pre-approved by the Regional Materials Engineer.

1-2 INSPECTION PROGRAM

The Department uses an inspection program which inspects the Portland cement concrete as it is manufactured at the plant to assure good quality material. This minimizes the risk to both the Department and the Contractor of placing unacceptable concrete in the work. A secondary purpose is to provide proper documentation of the acceptability of the concrete as it leaves the plant.

Although the inspection procedures are comprehensive, they are limited to sampling rates practical for one individual to accomplish. Therefore, it is possible to have unacceptable material delivered to the project. In such instances, it is the responsibility of the Engineer in Charge, or their representative, to reject any material found to be unacceptable.

It is recognized that in certain situations, the Inspector must devote his or her attention to one test or inspection procedure in order to insure correction of a particular plant deficiency. When this happens, the Inspector may need to deviate from the required testing frequencies provided he or she notes this situation in the Inspector’s diary.
1-3 PLANT INSPECTOR'S RESPONSIBILITY

Portland cement concrete may be mixed at the plant, at the placement site or in transit, depending upon the type of mixing and delivery system that is used. The Plant Inspector's responsibility is limited to inspecting the operations that take place at the plant. Once the mixer or haul unit departs from the plant, the Project Inspector assumes the responsibility of inspecting the remaining operation.

The Plant Inspector is particularly responsible for assuring specification compliance by the Producer by performing the following duties:

1. Assuring that only approved materials are incorporated in the concrete.

2. Inspecting plant production to provide assurance that the materials incorporated in the concrete are properly proportioned.

3. Inspecting plant equipment, mixers, haul units and operating procedures to assure uniform production.

4. Maintaining production records and adhering to other administrative procedures.
A Plant Inspector must be aware of all the pertinent criteria related to their work. The following is a listing of sources of information that must be consulted by the Inspector. The referenced documents and resources must be kept current. Many of the following resources are available on the Department’s internet website @ [www.dot.ny.gov/publications](http://www.dot.ny.gov/publications).

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYSDOT Standard Specifications, (including all Addenda, Engineering Instructions, Bulletins, or Directives, that pertain to material being produced for the project.)</td>
<td>Section 501 of the Standard Specifications including: Material Requirements, Concrete Batching Facility Requirements, Concrete Mixer and Delivery Unit Requirements, Proportioning, Handling, Measuring and Batching Materials, Concrete Mixing, Transporting and Discharging</td>
</tr>
<tr>
<td>Approved List of Products</td>
<td>Air Entraining Agents, Water Reducing and Set Retarding Admixtures; Portland Cement, Blended Cement, Fly Ash, Microsilica, HRP, GGBFS</td>
</tr>
<tr>
<td>Approved List of Sources of Fine and Coarse Aggregates</td>
<td>Aggregate Source Numbers; Aggregate Test Numbers; Aggregate Specific Gravities; Aggregate Absorptions; Aggregate Limitations for use</td>
</tr>
<tr>
<td>Materials Methods 10, 10.1, 10.1M, 10.3</td>
<td>Portland Cement Inspection and Sampling of Cement at Batch Plants</td>
</tr>
<tr>
<td>Materials Method 18.1</td>
<td>Sample Transmittal Instructions</td>
</tr>
<tr>
<td>MURK Part 1B</td>
<td>Construction Inspection Manual</td>
</tr>
<tr>
<td>Materials Procedure (MP) 09-02</td>
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<tr>
<td>Materials Method 28</td>
<td>Friction Aggregate Control and Test Procedures</td>
</tr>
<tr>
<td>ASTM E 29* (See also AASHTO R-11)</td>
<td>Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications</td>
</tr>
</tbody>
</table>

* It is recommended that, whenever numerical values are used in the determination of conformity with Department Specifications, the reported value should be rounded to the significant digits applicable for the specification by using the procedures designated in ASTM E29 (*Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*).
2-1 GENERAL

This section describes the procedures that the Plant Inspector shall use for inspecting, testing and controlling the batching and mixing of Portland cement concrete. Inspection procedures relating to approval of equipment by the Regional Materials Engineer or his representative are covered in Section 4.

Before any concrete production begins, the Plant Inspector should have information concerning the following items:

1. Annual plant approval with noted limitations.
2. Mix design (either design sheet or computer printout)
3. Explanation of symbols used for recordation purposes
5. Aggregate absorptions and restrictions (ie, “not for PCC wearing courses”, or “requires low alkali cement”, etc.) from the Approved List of Aggregate Sources.

2-2 MATERIALS

2-2.01 Aggregates

Aggregates used in the production of Portland cement concrete shall be approved for quality prior to their use. The gradation (including fine aggregate fineness modulus and % passing the #200 sieve), and moisture content shall be determined at the plant for acceptance and/or control. The aggregate gradation control procedures in this manual are established to control the aggregates by testing during production. However, the Regional Materials Engineer may choose to perform gradation tests on the aggregate as the stockpiles are made at the plant. When acceptance tests are performed while the stockpiles are being made, the aggregate gradations shall be within specifications for each size in order for the stockpile to be accepted. For either method of acceptance testing, the sampling and testing procedures and the test frequencies shall be the same. The test frequencies for stockpile acceptance shall be equivalent to those given for concrete production in Section 2-2.014.

When production includes aggregates for friction characteristics, Materials Method 28 must be consulted for Friction Aggregate Control and Test Procedures.
2-2.011 Evidence of Acceptability

Each Concrete Producer or Contractor shall submit to the Department prior to production, a certification indicating that all coarse and fine aggregates to be incorporated into the work are from approved sources. This certification shall be resubmitted annually. It shall be prepared and signed by a representative of the Contractor or Concrete Producer and it shall contain the following information for all coarse and fine aggregates:

1. Source Name and Number
   - As listed on the Department’s List of Approved Aggregate Sources

2. Test Number
   The aggregate sources used for Department projects are tested biennially. The first two digits of the biennial test number represent the year of testing. The two letters represent the type of aggregate. The last digits represent the laboratory log number. If the test number is more than two years old, contact the Materials Engineer to obtain the latest approval information from the Materials Bureau.

   Example of Test Numbers:
   06AF103 (Fine Aggregate)
   06AR 94 (Crushed Stone)
   06AG17C (Crushed Gravel)

3. NYSDOT Size Designation
   - As described in the specifications for the mix being produced.

A new certification is required whenever any of the following occur:

- When a different aggregate source is used.

- When additional aggregate sizes are introduced that have not already been included in the previous certifications for the year.

In addition to source certification, it may be necessary to require a delivery ticket to identify aggregates arriving at the plant site. Those concrete suppliers, receiving aggregate from more than one source, which cannot be differentiated by the Aggregate Visual Identification Test (Appendix F), may at the option of the Regional Director be required to provide a delivery ticket with each shipment of incoming aggregates. The ticket or a legible copy shall be kept on file by the Concrete Producer and available for inspection by the Department.
When used, the delivery ticket shall contain the following information:

1. Source Name and Number
2. NYSDOT Size Designation
3. Name and location of supplier if different from the aggregate source.
4. Quantity

2-2.012 Aggregate Stockpiles

Department approved aggregates shall be stockpiled separately from non-approved aggregates on bases approved by the Regional Materials Engineer. The base shall have adequate drainage and may be formed from aggregates, concrete, metal or wood. The stockpiles shall be made so that aggregate of different sizes and from different sources are separated and contamination from adjacent stockpiles is not possible. The Regional Materials Engineer may require that the stockpiles be clearly marked for identification.

2-2.013 Aggregate Sampling Procedures

Samples of aggregate may be taken from stockpiles, conveyor belts or from bin sampling devices installed in the batching plant. The selection of the sampling point for each plant shall be made by the Regional Materials Engineer. Samples for daily control testing, or any special testing purpose, shall be taken using procedures outlined in Appendix A, Sampling of Aggregates.

2-2.014 Aggregate Tests

The Plant Inspector shall be responsible for sampling aggregates at various frequencies and performing tests to verify that the aggregates are within specification compliance. The tests shall be performed prior to batching, and at the prescribed test frequency regardless of the class of concrete being produced.

The tests listed below are those performed by the Plant Inspector while the plant is in routine operation. A summary listing the frequencies of these tests and other pertinent information is given on page 4 of this manual under “Summary of Routine Inspection Activities”.

a. Coarse Aggregate Gradation Test

Well-graded coarse aggregates are necessary to produce satisfactory concrete. The gradation also needs to be uniform because large fluctuations drastically affect the workability of the mix, the mix water requirement and the amount of paste needed to bind the aggregates
together. The Department's specifications for concrete coarse aggregate gradations are
designed to provide suitable workability, strength and durability.

The coarse aggregate gradation test procedure is outlined in Appendix B, Coarse Aggregate
Gradation Test. The gradation of each aggregate component that is batched separately shall be
determined and then the combined gradation of all coarse aggregates shall be determined
mathematically. The action that shall be taken by the Plant Inspector as a result of the test is
given in the gradation control procedures outlined in Section 2-2.015, Aggregate Gradation
Control.

Routine Test Frequency - A minimum of one test per 500 cubic yards (375 m$^3$) for structural, or
1000 cubic yards (750 m$^3$) for pavement concrete production. At least one test per day shall be
performed, regardless of quantity produced.

b. Coarse Aggregate Cleanness Test

Coarse aggregates that contain deleterious material, (silt, clay, rock flour, etc.) due to
inadequate washing, may cause low concrete strength and poor durability. The coarse
aggregate cleanness test is performed to determine the amount of minus #200 sieve (75 \( \mu \text{m} \))
material.

The coarse aggregate cleanness test procedure is outlined in Appendix C, Coarse Aggregate
Cleanness Test. The Plant Inspector takes action on the test results according to the aggregate
gradation control procedures outlined in Section 2-2.015, Aggregate Gradation Control.

Routine Test Frequency - Any time a coarse aggregate appears dirty to the Plant Inspector. If a
coarse aggregate is within 0.20% of the maximum specification limit on the minus #200 (75
\( \mu \text{m} \)) material, increase the testing frequency to one test per day.

c. Fine Aggregate Gradation Test

Large variations in the fine aggregate gradation have an adverse affect on the workability and
finishing properties of the concrete. The variations also affect the air entraining capabilities of
the concrete mixture. For example, excessive amounts of minus #100 sieve and #200 sieve
material will often reduce the capability of the concrete mixture to entrain air.

The fine aggregate gradation test procedure is outlined in Appendix D, Fine Aggregate
Gradation Test. The Plant Inspector takes action on the test results according to the aggregate
gradation control procedure outlined in Section 2-2.015, Aggregate Gradation Control.

Routine Test Frequency – A minimum of one test per production day, plus:
For Structural Concrete: One additional test after each 500 cubic yards (375 m$^3$) produced.
For Pavement Concrete: One additional test after each 1000 cubic yards (750 m$^3$) produced.

d. Fine Aggregate Fineness Modulus Test

The fineness modulus of an aggregate is an index used to express the relative coarseness or fineness of its particles. The higher the fineness modulus, the coarser the aggregate is. The Department's concrete mix design includes the fineness modulus as part of its criteria.

Determine the Fineness Modulus each time the fine aggregate gradation test is performed. See Appendix E, Fine Aggregate Fineness Modulus Test. If the average of the three most recent test results has changed by more than 0.20 from the value used in the mix design, contact the Regional Materials Engineer to make the appropriate adjustments to the concrete mix design.

e. Aggregate Visual Identification Test

The aggregate visual identification test is performed to assure the Department that the aggregates certified by the Concrete Producer are actually being used. The test is a visual comparison between the aggregates being used and a control sample prepared from material from the certified source. Control samples are to be maintained on site, and changed periodically as the Plant Inspector performs this test in conjunction with coarse and fine aggregate gradation tests. The minimum frequency is one test per day.

The test procedures for the aggregate visual identification test are outlined in Appendix F, Aggregate Visual Identification Test. If the Plant Inspector detects a difference in color or particle shape, which indicates a change in the aggregates, contact the Regional Materials Engineer to verify that certified aggregates are being supplied.

f. Aggregate Free Moisture Content Test

The concrete mix design (batching weights) is computed based on a SSD (saturated surface dry) condition of all aggregates. The batch weights of sand, coarse aggregate and water must be adjusted to maintain the correct proportions of materials as the moisture in the aggregates varies. The adjustments are to be based on the most recent free moisture content determination required herein, for each aggregate used.

The Portland cement concrete batching plants are equipped with a moisture meter that measures the moisture in the fine aggregate bin. This meter provides a continuous reading of the free moisture (in excess of saturated surface dry) in the sand. The Plant Inspector determines the accuracy of the moisture meter by comparing the meter reading with the results of the moisture content test. With prior approval from the Regional Materials Engineer, adjustments to the batch weights of aggregates and water are permitted between (not during)
completed batches based on the most recent moisture meter reading in lieu of an actual moisture content test.

The aggregate moisture test procedure is outlined in Appendix G, Aggregate Free Moisture Content Test. The minimum frequencies at which the moisture content shall be determined are as follows:

<table>
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<tr>
<td>Coarse Aggregate</td>
<td>As Necessary</td>
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The frequency of the moisture testing shall be increased if visible signs indicate that aggregate moisture contents are variable. This would include a change in aggregate processing, after rainstorms, etc.

Whenever the fine aggregate moisture meter indicates that the moisture content has varied by more than 0.5% from the pre-programmed moisture content as entered in the automated batch mix design, an adjustment must be made to the programmed batching weights.

If the free moisture testing of the coarse aggregate indicates a variation of more than 1.0% from the programmed moisture content entered in the automated batch mix design, the Regional Materials Engineer should be notified.

If the fine aggregate has free moisture content in excess of 8 percent, the fine aggregate shall not be used until the free moisture stabilizes below 8 percent.

2-2.015 Aggregate Gradation Control

The aggregate gradation control is based upon the results of the aggregate gradation tests performed according to the procedures and at the frequencies given under Section 2-2.014, Aggregate Tests. Any time visual inspection or test results indicate that the gradation of the aggregate has changed, testing frequencies shall be increased to closely control the situation.

The concrete batching facility operates under one of three Phases: Phase I, II or III. Generally, placements may start only when the plant is in a Phase I condition for fine aggregate and in either a Phase I or II condition for coarse aggregate. The phase in which the plant will be operating at any point in time will depend upon its ability to maintain the gradation of the aggregates within the limits of the specifications.

At the discretion of the Regional Materials Engineer, it is sometimes in the best interest of the State to continue concrete production, (during sequential placements for a bridge deck for example), if the
aggregate gradation falls outside the specification limits. This may be considered, under coordination with the Engineer in Charge (EIC), provided the concrete mixture produced under this condition continues to meet the requirements of the specified mix design.

**PHASE I OPERATION (ROUTINE PRODUCTION)**

A concrete batching facility is in Phase I operation when the gradation of each individual stockpile is within its respective specification limit, and the combined gradation of more than one stockpile is within the general limits of the specifications. The gradation limits for the individual coarse and fine aggregates are given in Sections 703-02 and 703-07, and the concrete general limits in Section 501 of the General Specifications, unless otherwise specified on the project plans or in the proposal.

If the coarse aggregate gradation test results show that either the stockpiles or the combined gradation is outside of the specification limits, the Plant Inspector shall notify the Producer, then immediately resample and retest the stockpile(s) in question. Depending on the results of the retest, the production will either remain in Phase I or enter Phase II or Phase III.

If the fine aggregate gradation test results show that the stockpile is outside of the specification limits, the Plant Inspector shall notify the Producer, then immediately resample and retest the material. Depending on the results of the retest, the production will either return to Phase I, or be stopped unless the placement must continue (Phase III).

**PHASE II OPERATION**

Phase II pertains to coarse aggregate gradations only. This condition occurs when the individual stockpile gradations are outside of their respective specification limits, but the mathematically combined gradation is within the specification limits given in Section 501 of the General Specification or otherwise indicated in the project proposal.

The Plant Inspector shall take the following steps when a plant enters the condition of Phase II operations:

1. Inform the Producer that the plant is in Phase II condition and that he must start taking the necessary steps to return to the Phase I operation.
2. Inform the Regional Materials Engineer.
3. Increase the sampling and testing frequency to a minimum of one test for every 250 cubic yards (200 m³) for structural and 500 cubic yards (375 m³) for pavement concrete produced, or fraction thereof.

The length of time that the plant can operate in the Phase II condition shall be subject to the approval of the Regional Materials Engineer.
PHASE III OPERATION

If two consecutive coarse aggregate gradations tests show that the combined gradation or a combination of combined gradation and an individual stockpile, or two consecutive fine aggregate gradations, fail to meet specification limits while the plant is in production, the plant shall be considered in a Phase III condition and production for Department work should stop. At this point the Inspector shall notify the Project Engineer or his representative that the plant is in Phase III condition and that the concrete production should be stopped until the problem is corrected.

However, when the RME and the EIC agree that production for a critical placement should not be stopped, concrete production may continue if the project personnel assumes the responsibility for determining the acceptability of the concrete. This determination shall be made at the project in the following manner:

1. Conduct slump and air content tests according to Materials Method 9.2 for specification compliance on at least every two loads.
2. Check the placing and finishing operations for difficulties due to changes in workability, bleed water or other undesirable characteristics.

A plant may operate in the Phase III condition only to complete a concrete placement already in progress. The Producer shall not start producing concrete for new placements. Before concrete production can be resumed for new placements on any project(s), the Producer shall correct or replace the aggregates that are outside specification limits such that the requirements of Phase I or II operation are met.

2-2.02 Cements, Pozzolans, and High Reactivity Pozzolans (HRP)

Portland cement, Blended Portland cement, Pozzolans (Microsilica, Flyash or Ground Granulated Blast Furnace Slag), and HRP are supplied to the batching facility in bulk form transported usually either by truck, rail, or barge. The materials are either from mills or plants where the manufacturing process has been approved by the Department, or from mills or terminals where the material has been tested and accepted by the Department before shipment. Under extreme circumstances, bagged material may be allowed by the Engineer for remote project locations. This may be considered by the RME only when no batching facility is located within the hauling and discharging limits of the specifications.

2-2.021 Evidence of Acceptability

Cements or Pozzolans from mills approved to supply to Department projects under a certification program must be accompanied by a Cement Shipment Certification form (BR-280), or acceptable
equivalent created and signed by a representative of the manufacturer. These manufacturers are found on the Approved List of Materials, as maintained on the Department’s website.

Cement from mills approved to produce and supply only under Department inspection must arrive in a vehicle sealed by a Department representative and be accompanied by a Cement shipment Authorization form (BR-44) executed by the Department representative.

The details concerning certification, inspection and documentation of Portland cement are covered in Materials Method 10.0, 10.1, 10.1M and 10.3.

All Microsilica and HRP deliveries must be accompanied by a certification stating conformance with item 711-11, or 711-14 as described in Materials Procedure 90-1.

2-2.022 Cement Control

Any Portland cement that arrives at the plant without the proper evidence of acceptability shall not be used in Department work. Notify the producer, and the Regional Materials Engineer any time the Portland Cement, Microsilica, Fly Ash, GGBFS or HRP appears to be defective.

2-2.023 Cement Sampling

Cement shall be sampled according to Materials method 10.0 for deliveries made under the cement mill certification program; and cement that is inspected and tested by the Department before shipment shall be sampled according to Materials Method 10.3.

All cement samples shall be sent to the Materials Bureau for testing with a BR-240 form completed by the Plant Inspector. Instructions for completing the BR-240 form are located in Materials Method 18.1.

2-2.03 Admixtures

2-2.031 Evidence of Acceptability

The acceptability of admixtures shall be checked by comparing the brand name located on the container to the Approved List of Materials, as maintained on the Department’s website by the Materials Bureau. This list is updated monthly to show which admixtures are currently approved. Since products are continuously being evaluated by the Materials Bureau, contact the Regional Materials Engineer to determine whether a particular product has been recently approved, but has yet to appear on the Approved List.

2-2.032 Admixture Control
Admixtures must be stored and handled such that freezing will not occur. If the quality of an approved admixture is determined “suspect” due to freezing, separation, poor performance etc., notify the Producer and the Regional Materials Engineer immediately.

2-2.033 Admixture Sampling

Admixtures shall be sampled when requested by the Regional Materials Engineer. When samples are needed, they should be taken from the admixture delivery system bypass valve that is used for quantity calibration. The sample should be put into a clean, watertight one quart container. If samples must be taken directly from a large bulk storage tank, instructions on sampling should be obtained from the Regional Materials Engineer. All admixture samples shall be sent to the Materials Bureau for testing with a completed BR-240 form. Instructions for completing the BR-240 form are located in Materials Method 18.1.

2-2.04 Water

2-2.041 Evidence of Acceptability

Any water source that is used for human consumption is considered acceptable for the manufacture of concrete. Any other source should be sampled and tested for conformance with §712-01, unless the Regional Materials Engineer has evidence that the source is acceptable. The condition of water wells may change during periods of high production, especially during the summer construction season. Sediment levels may increase, which may adversely affect the quality of the concrete, and may indicate that the well is running dry. Any time the quality or quantity of the water supply to the plant becomes suspect, a sample should be taken. The sample should be examined for smell, discoloration, and pH before production resumes. A pH test kit is available by contacting the Materials Bureau. Any facility that uses Microsilica powder (711-11) is required to have a pH kit available in the inspection laboratory.

2-2.042 Water Sampling

A representative sample of water shall be put into a clean watertight, one gallon plastic container. The sample shall be accompanied by a completed BR-240 form and sent to the Materials Bureau for testing. Instructions for completing the BR-240 form are located in Materials Method 18.1.

2-3 BATCHING

The Plant Inspector shall inspect the batching operations to assure the Department that the materials incorporated in the concrete are properly proportioned. The batching equipment is inspected annually and then periodically throughout the season by the Regional Materials Engineer or his representative. However, it is essential that the Plant Inspector is acquainted with all of the
2-3.01 Weighing Units and Measuring Devices

Aggregates and cement are proportioned by weight while water and liquid admixtures are generally proportioned by volume. However, in some precast concrete batching facilities, where the concrete is mixed in a “tub” type mixer, the batch water is proportioned by weight.

Each measuring device shall be tested to assure that the accuracy meets the requirements given in Section 501 of the General Specifications. The accuracy of the water scale shall be the same as that specified for the cement and aggregate scales. These devices shall be checked annually prior to use for Department work, at intervals of not more than ninety (90) days, any time a plant changes location, or at any time chosen by the Regional Materials Engineer or Plant Inspector. The scale and water meter procedures are outlined in Materials Method 27, Scale and Meter Accuracy Checks. The Regional Materials Engineer may allow scale and meter checks to be performed by a qualified scale technician in accordance with Materials Procedure 01-01. If the weighing unit or measuring device shows that the accuracy is not within specifications, the Plant Inspector shall notify the Producer that the plant cannot produce concrete for Department projects until the device is corrected.

2-3.011 Scales

Scales are generally used to proportion the aggregates and cement. The aggregates are typically batched in a weigh hopper where the ingredients are weighed cumulatively. The cementitious materials are usually batched in their own weigh hopper. Some plants, however, have separate weigh hoppers for weighing each aggregate or cementitious material.

The Standard Specifications require that the scales have no less than 500, nor more than 2000 graduations, and the scale graduations be in multiples or sub-multiples of 1, 2, or 5 (ie. 0.01, 0.1, 1, 10, etc. or 0.02, 0.2, 2, 20 etc.) as per the National Institute of Standards and Technology (NIST) Handbook 44. The scales will be electronic load cells with digital displays. The digital displays must be located at the operator’s work station.

Example- Determination of scale graduations per the Standard Specifications: (Note: To reduce the confusion created by displaying dual units, the following example is being presented in USC units only)

CEMENT SCALE: 5,000 pound capacity

Try: 5,000 lb ÷ 2000 graduations = 2.5 lb/graduation (This does not meet the requirements of NIST Handbook 44, because the graduation must be a multiple or sub-multiple of 1, 2, or 5)
Try: $5,000 \text{ lb} \div 1500 \text{ graduations} = 3.33 \text{ lb/ graduation}$ (again, not acceptable per Handbook 44)

Try: $5,000 \text{ lb} \div 1000 \text{ graduations} = 5 \text{ lb/ graduation}$ (This is acceptable)

Also, try: $5,000 \text{ lb} \div 500 \text{ graduations} = 10 \text{ lb/ graduation}$ (This is also acceptable)

Note, that the minimum batch size for the plant is based on scale graduation size. Therefore, the smaller the graduation size, the smaller the minimum batch size. The producer would most likely choose the smallest graduation size possible (using the previous example, 5 lb is the smallest possible graduation size). Refer to Section 2- 3.033 for the determination of minimum batch size.

When cementitious material is blown into the storage silo, the vent for the silo must be working properly. If the vent is plugged, the pressure build-up in the silo may cause the cementitious material scale to give an erroneous reading during batching. Therefore, the Plant Inspector should periodically observe the cementitious material scale during the silo loading process.

2-3.012 Meters and Other Volumetric Measuring Devices

Meters are used to proportion admixtures and water. Admixture dispensing systems are required in all plants. Water meters are used at central mix plants and very often at transit mix plants. However, water may also be proportioned by weight.

a. Admixtures

Preset quantities of admixtures shall be pumped from the storage facility through a volumetric measuring device and discharged in such a manner that will provide uniform distribution of the material within the specified mixing time. Generally the admixtures are discharged separately into the fine aggregate bin of the weigh hopper or into the water line. Do not permit different types of admixtures to come into direct contact with each other.

The admixture dispensing system shall be equipped with a by-pass valve suitable for determining the accuracy of the system. The accuracy shall be within the delivery tolerance given in Section 501 of the General Specifications. The procedure for determining the accuracy of the admixture dispensing system is given in Materials Method 27.

b. Water

The accuracy of the water meter shall be within one (1) meter graduation, or $\pm 1\%$ by weight or volume of the indicated quantity on the batching display (whichever is larger). The procedures for determining the meter accuracy are described in Materials Method 27.
In some automatic proportioning systems, the meter is connected to a moisture compensation device which adjusts the amount of water delivered to account for the free moisture in the fine aggregate. The moisture compensation device must be set at zero when performing the accuracy check.

During an accuracy check, the delivered quantity of water to be checked may be obtained through the delivery system by one of the following:

1. Manually metered by the Operator by holding a “manual water feed” button until the desired quantity is reached.
2. A preset quantity is delivered when the Operator pushes a “manual feed button”.
3. Metered automatically by requesting a pre-programmed quantity in an automated batch where the only ingredient being called for is water.

2-3.02 Moisture Meter

Each batching plant must be equipped with a moisture sensing device that indicates on a readily visible scale or chart the free moisture content of the fine aggregate as it is batched. The Plant Inspector shall check the moisture meter daily by conducting a free moisture test on the fine aggregate as outlined in Appendix G, Aggregate Free Moisture Content Test and comparing the results to the meter reading. The moisture meter shall be adjusted to match the free moisture content of the fine aggregate by the Producer if there is a difference of more than 0.5 percent between the tested moisture and the meter reading. Note: the moisture meter should not be confused with a moisture compensation device. See Section 2-3.032 for the description and requirements of a moisture compensation device.

2-3.03 Automatic Proportioning Controls

Automated batching facilities shall be equipped with an automatic proportioning and cycling system to measure the quantity of aggregates, cement, admixtures and sometimes water. An example of a typical system is illustrated in Figure 3 (see page 32). The batching control automatically draws materials in a selected sequence in the amount of the pre-programmed weights or volumes set into the system by the Operator. After each material (except water) is drawn, the system automatically checks to determine if the quantity is within the batching or delivery tolerances given in Section 501 of the Standard Specifications. Whenever a weighing error in batching occurs (outside the batching tolerance interlocks), the automatic cycle shall be interrupted until corrective action is taken. Any out of tolerance condition that is accepted must be indicated on the batch recordation.

Automatic proportioning systems are required to batch each ingredient to the pre-programmed “target” weight as stated in the required mix design, and Section 501- 2.03E of the Standard Specifications, with allowances for errors in the weighing process as a result of “free falls” and “coasts”. These conditions are unavoidable, since the nature of a concrete batching facility operates
under the assumption that all ingredients are either falling onto a scale or flowing through a meter. “Free falls” are the allowance for any weighed material that is in the process of falling from a holding bin hopper to a weigh hopper (ie. scale), after the holding bin hopper gate has closed. “Coast” is the allowance for any liquid that continues to pass through a meter, after the system has signaled the delivery pump to stop pumping liquid. Any system that routinely accepts the smallest weight or volume allowed by the specification should be adjusted to seek a value closer to the target value.

The admixture dispensing system shall be interlocked with the automated proportioning equipment so that the quantity of admixture preset into the system has been batched and discharged. Otherwise, the automatic cycle shall be interrupted.

When water is batched automatically at the plant, the water shall be drawn until the pre-programmed target weight or volume is satisfied. The water batched at central mix plants shall be batched to the batching tolerance given in Section 501 of the Standard Specifications. However, no other requirements for batching tolerances or interlocks exist.

2-3.031 Batching Controls

The major batching control functions of automatic proportioning systems are generally accessed through the keyboard of a Personal Computer (PC). Some systems may also include a “manual panel” for manual batching if necessary. However, during automatic batching, the only manual operation that is allowed is a switch or button to initiate or discharge a batch. Refer to Materials Method 27 for specific details on Automatic Batching Controls.

2-3.032 Moisture Compensation Device

Some plants may have a moisture compensation device that adjusts the programmed weights of fine aggregate and water, when batched, to account for the free moisture in the fine aggregates. This control may only be used to adjust the target weights prior to the initiation of the batch. No adjustments will be permitted once the batching sequence has begun.

The moisture compensating device shall be checked by the following steps:

1. Set the design weight for the fine aggregate in the control panel.

2. Set a moisture content on the moisture compensator.

3. Select a nominal batch size.
4. Determine if the automation equipment adjusts the fine aggregate weight for the amount of free moisture indicated on the moisture compensator. The target weight for the fine aggregate should increase, and the target weight for the water should decrease accordingly. This adjustment must be within one scale graduation of the desired reading.

5. Repeat the above steps for moisture contents throughout the working range of the device.

2-3.033 Minimum Batch Size

The accuracy of the batching control equipment generally dictates the minimum batch weight calculations. The minimum batch size for any plant is based upon the smallest weights that can be accurately batched for aggregate and cementitious materials. The accuracy of the scale that gives the largest minimum batch weights shall be used to determine the minimum batch size for the plant. For normal operations, the control equipment shall be considered accurate to no less than two (2) scale gradations. This is to prevent frequent interruptions in the cycle during operation.

The method for determining minimum batch weights and subsequent minimum batch size are described by the following example:

(Note: To reduce the confusion created by displaying dual units, the following example is being presented in USC units only)

Minimum Batch Weights:

- Typical plant: 10.0 Cubic Yard batch plant.
- Aggregate Scale: 40,000 lb capacity using 20 lb increments.
- Cement Scale: 10,000 lb capacity using 5 lb increments.

Minimum batch weights are determined by allowing 2 graduations for each specific scale, divided by the materials batching tolerance.

The specified batching tolerances listed in Section 501 of the Standard Specifications are:

**Aggregates:** ±2.0% of the accumulated total weight.

**Cementitious Materials:** ± 1.0% of the accumulated total weight of Cement, Type SF Blended cement, and pozzolan (when microsilica is not weighed on the same scale).

**Cementitious Materials:** ± 0.50% of the accumulated total weight of Cement, Microsilica and pozzolan (when microsilica is weighed on the same scale).
AGGREGATE MINIMUM BATCH WEIGHT = (Scale grad. x 2) / .02
Example: (scale grad = 20 lb) \((20)(2) / .02 = 2000\) lb

CEMENT MINIMUM BATCH WEIGHT = (Scale grad. x 2) / .01
Example: (scale grad = 5 lb) \((5)(2) / .01 = 1000\) lb.

Minimum Batch Size:

Minimum batch size is determined by using the calculated minimum batch weight and dividing by an assumed concrete batch of 3000 lb of aggregate and 600 lb of cement per cubic yard, respectively.

\[
\text{Aggregate: } \frac{2000 \text{ lb (minimum calculated batch weight)}}{3000 \text{ lb (assumed weight of aggregate per yd}^3) } = 0.66 \text{ yd}^3
\]

\[
\text{Cement: } \frac{1000 \text{ lb (minimum calculated batch weight)}}{600 \text{ lb (assumed weight of cement per yd}^3) } = 1.66 \text{ yd}^3
\]

In this case, the minimum batch size is determined by the cement, and would be rounded to the nearest acceptable nominal size* (ie. 1.75 yd³).

*An automation system may be allowed to produce to 0.1 yd³ increments (ie 1.7 yd³) if the system is capable of displaying and printing:

- The individual ingredient target weights
- Each actual weight
- Each variation from each target weight (by % or weight)
  Or:
- The individual ingredient target weights
- Each actual weight with the high and low tolerance limits

The minimum batch weights are determined by the Materials Bureau personnel at the time of the automation equipment inspection. These minimum batch weights are stated in the approval letter sent either to the Regional Materials Engineer, or the Plan Administrator of a Precast Concrete Production facility. If a Department representative (RME or Auditor) finds that the batching cycle is frequently interrupted during the operation with the minimum batch weights based upon the 2 gradation accuracy, the scale graduations should be increased, and new minimum batch weights should be calculated.
The minimum allowable batch weights are also recorded on the form BR-180, *Annual Inspection Record - Portland Cement Concrete Batch Plant*.

**Batching Tolerances:**

Batching tolerances for all the materials are given in Section 501 of the Standard Specifications. These tolerances must be applied to each batching formula. The acceptable batching range for each ingredient must be determined by the automated batching system. The cement, admixture(s) and water batching tolerances shall be based upon the total amount of the respective materials in the batch. The aggregate batching tolerance, however, depends on whether the aggregates are weighed in a cumulative weigh hopper or in individual weigh hoppers. When aggregates are batched in a cumulative weigh hopper, the tolerance shall be based on the total weight of all aggregates. When aggregates are batched in individual weigh hoppers, the tolerance shall be based on the individual aggregate weights.

Since the allowable batching tolerances vary with batch size, most automation systems automatically adjust the batching tolerance interlock settings whenever a change is made to the batch size. Systems that cannot function this way must be set so that the tolerances are fixed, based on the minimum allowable batching weights.

**Zero Tolerance:**

The zero tolerance is the scale condition that must be satisfied before batching can start. The zero tolerance is based upon the minimum allowable batch weight for each scale multiplied by the batching tolerance for the material being drawn. If the automated batching system is set to recognize both positive and negative values at the beginning or end of a batch, it is possible to receive an "out of tolerance warning" when there is no material on the scale. This occurs when the scale returns to a negative value with an absolute value which is greater than the allowable zero tolerance for the scale.

Examples are given to illustrate the determination of allowable batching tolerances for the two aggregate weighing systems.

(Note: To reduce the confusion created by displaying dual units, the following examples are being presented in USC units only)

**Example 1 (CUMULATIVE WEIGH HOPPERS):**
Determine the batching, zero tolerances and the acceptable batching range for each draw weight. The facility has the capacity to batch 10.0 cubic yards with a cumulative aggregate weigh hopper. The minimum allowable batch weights as determined above are as follows:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Minimum Allowable Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate</td>
<td>2000 lb (using 20 lb graduations)</td>
</tr>
<tr>
<td>Cement</td>
<td>1000 lb (using 5 lb graduations)</td>
</tr>
</tbody>
</table>
Aggregate Batching Tolerance:

Assume 3000 lb of aggregate per cubic yard. The tolerance for each aggregate draw in a 10 cubic yard batch is: $10 \times 3000 \times 0.02 = \pm 600$ lb.

Cement Batching Tolerance:

Assume 600 lb of cement per cubic yard. (Note: This example does not include pozzolan and/or microsilica). The tolerance for the 10.0 cubic yard batch is $10 \times 600 \times 0.01 = \pm 60$ lb.

Zero Tolerance:

Aggregate: $2000 \text{ lb} \times 0.02 = \pm 40$ lb (which is 2 graduations)
Cement: $1000 \text{ lb} \times 0.01 = \pm 10$ lb (which is 2 graduations)

Batch weights with tolerances:

<table>
<thead>
<tr>
<th>Material</th>
<th>Cumulative Weight (lb)</th>
<th>Tolerance (lb)</th>
<th>Acceptable Range (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agg. 1</td>
<td>10000</td>
<td>± 600</td>
<td>9400 - 10600</td>
</tr>
<tr>
<td>Agg. 2</td>
<td>20000</td>
<td>± 600</td>
<td>19400 - 20600</td>
</tr>
<tr>
<td>Agg. 3</td>
<td>30000</td>
<td>± 600</td>
<td>29400 - 30600</td>
</tr>
<tr>
<td>Cement</td>
<td>6000</td>
<td>± 60</td>
<td>5940 - 6060</td>
</tr>
</tbody>
</table>

Example 2 (INDIVIDUAL WEIGH HOPPERS):

Determine the batching and zero tolerance and the acceptable batching range for each weight. The batching plant is a 10.0 cubic yard plant with an individual weigh hopper for each aggregate. The minimum allowable batch weights for this plant configuration, as determined above are as follows:

Aggregate: $2000 \text{ lb for each scale}$
Cement: $1000 \text{ lb}$

Aggregate Batching Tolerance:

<table>
<thead>
<tr>
<th>Weigh Hopper</th>
<th>Weight (lb)</th>
<th>Tolerance</th>
<th>Tolerance (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10000</td>
<td>± 0.02 %</td>
<td>± 200</td>
</tr>
<tr>
<td>2</td>
<td>10000</td>
<td>± 0.02 %</td>
<td>± 200</td>
</tr>
<tr>
<td>3</td>
<td>10000</td>
<td>± 0.02 %</td>
<td>± 200</td>
</tr>
</tbody>
</table>
Cement Batching Tolerance:

Assume 600 lb of cement per cubic yard. The tolerance for the 10.0 cubic yard batch is $10.0 \times 600 \times 0.01 = \pm 60$ lb.

Zero Tolerance:

- Aggregate - each scale: $2000 \text{ lb} \times 0.02 = \pm 40$ lb
- Cement: $1000 \text{ lb} \times 0.01 = \pm 10$ lb

Batch Weights with Tolerances

<table>
<thead>
<tr>
<th>Material</th>
<th>Individual</th>
<th>Tolerance (lb)</th>
<th>Acceptable Range (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agg. 1</td>
<td>10000</td>
<td>± 200</td>
<td>9800-10200</td>
</tr>
<tr>
<td>Agg. 2</td>
<td>10000</td>
<td>± 200</td>
<td>9800-10200</td>
</tr>
<tr>
<td>Agg. 3</td>
<td>10000</td>
<td>± 200</td>
<td>9800-10200</td>
</tr>
<tr>
<td>Cement</td>
<td>6000</td>
<td>± 60</td>
<td>5940-6060</td>
</tr>
</tbody>
</table>

2-3.034 Batching Interlocks:

All automatic batching control systems shall have interlocks to provide assurance that the batched quantities of aggregates, cement and admixture are within specifications. The interlocks shall interrupt the cycle whenever an error occurs during any of the following batching functions:

- Weighing the aggregate and cementitious materials.
- A scale or meter fails to return to zero tolerance.
- Measuring and discharging admixtures.
- Recording the batched quantities of aggregate, cementitious materials, and admixtures.
- Opening and closing of the holding bin gates and the weigh hopper discharge gate(s).
- Mixing time in central mix plants.

A. Weighing Tolerance Interlocks

The weighing tolerance interlocks shall be set at the “underweight” and “overweight” cut-off points. The automation system must be designed to seek the pre-programmed target weight, with allowable free-fall settings to account for material falling between the holding bin hopper and the weigh hopper (scale), during batching. In general, the “underweight” and “overweight” cut-off points will be equally distant from the programmed target weight. Some automation systems are designed to seek the lowest calculated tolerance weight as the material is being weighed. This
configuration does not wait for the pre-programmed target weight to be reached before it checks to see if the scale weight is in tolerance. It accepts any weight that is within the tolerance range.

However, the weight that it accepts is usually below the programmed target weight. Systems that function in this manner will be restricted so the “underweight” tolerance is set to one half of the allowable calculated tolerance.

Note: Some automation systems have “over-riding” or “global” tolerance settings. These systems apply the tolerance for material being weighed by accepting the larger of either the following:

- Example #3: (The cumulative target weight of the material for a particular “draw”).

<table>
<thead>
<tr>
<th>Material</th>
<th>Draw Weight (lb)</th>
<th>Tolerance (lb)</th>
<th>Acceptable Range (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agg. 1</td>
<td>10000</td>
<td>10000 x .02 = ±200</td>
<td>9800 - 10200</td>
</tr>
<tr>
<td>Agg. 2</td>
<td>20000</td>
<td>20000 x .02 = ±400</td>
<td>19600 - 20400</td>
</tr>
<tr>
<td>Agg. 3</td>
<td>30000</td>
<td>30000 x .02 = ±600</td>
<td>29400 - 30600</td>
</tr>
<tr>
<td>Cement</td>
<td>6000</td>
<td>6000 x .01 = ±60</td>
<td>5940 - 6060</td>
</tr>
</tbody>
</table>

*or…*

- Example #4: (The cumulative target weight for all material to be weighed on the scale).

<table>
<thead>
<tr>
<th>Material</th>
<th>Draw Weight (lb)</th>
<th>Tolerance (lb)</th>
<th>Acceptable Range (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agg. 1</td>
<td>10000</td>
<td>30000 x .02 = ±600</td>
<td>9400 - 10600</td>
</tr>
<tr>
<td>Agg. 2</td>
<td>20000</td>
<td>30000 x .02 = ±600</td>
<td>19400 - 20600</td>
</tr>
<tr>
<td>Agg. 3</td>
<td>30000</td>
<td>30000 x .02 = ±600</td>
<td>29400 - 30600</td>
</tr>
<tr>
<td>Cement</td>
<td>6000</td>
<td>6000 x .01 = ±60</td>
<td>5940 - 6060</td>
</tr>
</tbody>
</table>

Although rare, any automation system that does not have the capability of calculating and applying the tolerance range to various batch sizes shall be set at the tolerance range for the minimum allowable batch weight.

Checking the pre-programmed cut-off weights and interlocks requires the simulation of batching using potentiometer type dials (or an acceptable variation). These devices are commonly referred to as “simulators”. The simulators are connected to the load-cell inputs of the automation system. They replicate the electrical change of millivolts in the load cell which is indicated on the primary scale and/or batching screen. The simulators need to be of
appropriate design to operate all scales within their working range. Each scale must have its own simulator that has the sensitivity to check batching tolerance interlocks. All interlocks shall be set within one graduation of the desired cut-off points.

B. Zero Tolerance Interlock

The zero tolerance interlock prevents a new batch from being weighed until the weigh hopper is empty of the previous batch and the scale has returned within the zero tolerance. The interlock shall be set at the zero tolerance based upon the minimum batch weights allowed.

The position of the interlock can be checked by setting the simulator beyond the zero tolerance limit on the scale and trying to start a new batch. The interlock is okay if the new batch cannot be started. If the zero tolerance interlock can be “overridden” by the operator, there must be an indication on the batch record of the tare weight and/or that the zero tolerance was exceeded when the batch was started.

Some automation systems display the pre-programmed target weight as “TO GO” weight. These systems automatically include any tare weight on the scale at the beginning of a batch as batched material. Since the target weight of the material being called for includes this tare weight, the first material being drawn is reduced by the tare weight. This display feature does not change the target weight, nor does it subtract the tare weight from the load.

C. Admixture

The admixture dispensing system must be interlocked with the batching system so that:
- The completion of the batch is dependent upon complete dispensing of the admixtures.
- The timing of the mixer is dependent on complete discharge of admixtures.
- The recordation of the batch is dependent upon complete discharge of admixtures.

When functioning properly, the automation system should recognize;
- If the admixture is not being dispensed.
- If the admixture has not reached the pre-programmed quantity before batch completion.

Whenever these conditions exist, the batching sequence must be interrupted.

The batch recordation shall identify;
- Each admixture dispensed by either of the following:
  - by name of product (such as POZZ 100, DARAVOX, etc.)
  - by type (such as AEA, RETARDER etc.)
  - by another acceptable identifier (such as ADMIX 1, ADMIX 2 etc.)
b. The quantity of each admixture as it was dispensed
   c. Any out of tolerance condition that was “overridden” by the plant operator.

The interlocks generally associated with assuring that the quantity of admixture is batched and delivered are as follows:

When the admixture is metered and discharged directly into the truck, the only interlock needed is the one that prevents the recorder from printing until the programmed quantity of admixture is delivered through the meter.

When the admixture is metered, then stored in a holding vial, three interlocks are needed:

- To interrupt the batching sequence if the admixture in the vial is above the “zero probe” prior to initiation of the batch.
- To assure that the pre-programmed quantity has been delivered.
- To assure complete discharge of the admixture from the vial.

The admixture interlocks must be checked by simulating batching operations to see if the interlocks are functioning properly. A representative from the admixture supplier should be present when this is performed. (for safety, and to avoid damage to the dispensing system).

ADMIXTURE INTERLOCK CHECK:

1. Disconnect the delivery line from the storage tank.
   a. Ask for a batch that includes a quantity of the admixture under test that cannot be reached with the delivery line disconnected.
   b. Determine whether the meter will erroneously continue to count pulses after the admixture has ceased to flow through the meter.
   c. Determine whether the batch can be completed if the preprogrammed quantity of admixture has not been reached.
   d. Determine whether the batch recordation has been completed if the admixture had not completely discharged.

2. If the admixture is dispensed through vials or “bottles”, fill the bottle to a level above the zero probe, or electrically activate the “empty bottle” probe in the dispensing vials by “grounding out” the zero probe. These measures are designed to cause the automation system to detect a “not ready” condition in the admixture dispensing interlock circuitry. If operating correctly, the initiation of the batching cycle must be interrupted. The automation system must prevent the batch from starting until the condition is remedied, or overridden by the operator. If the condition is overridden by the operator, it must be indicated on the batch recordation. The meter pulses may be electrically simulated by either spinning the gears (if so equipped) in the meter, rotating the meter in its base, or electrically “pulsing” the terminal connections in the admixture control panel*.

Perform the steps listed in 1c and d above.
*WARNING! This procedure is potentially dangerous and must be performed by a qualified representative of the admixture company, the automation company, or the concrete producing company. Do not attempt this yourself.

D. Inlet and Discharge Gate Interlocks

The aggregate and cementitious materials’ inlet gates must be interlocked with the automatic cycle so that they cannot open while the weigh hopper discharge gates are open. Also, the weigh hopper discharge gates must be interlocked so that they cannot be opened while the inlet gates are open and the weigh hoppers are being filled.

The interlocks shall be checked by trying to activate these gates by simulating automatic production. The holding bins should be empty or the air or hydraulic system to the plant should be off when these checks are made. If the bins are empty and the air or hydraulics system is on, the Inspector can listen for the opening and closing of the gates. If the air or hydraulics system is off, the Inspector can listen for the “click” of the solenoids that control the air rams or hydraulic pistons.

The weigh hopper discharge gates for aggregate and cementitious materials must be interlocked so that they cannot be opened until the programmed quantity of cement, aggregate and admixture are within the batching tolerance. These interlocks can be checked by simulating the batching cycle.

E. Mix Timer Interlocks (Central Mix)

Central mix plants shall be equipped with a mix timer(s) that is interlocked with the automation so that it will not let a batch of concrete be discharged until the specified mix time has elapsed. If the mixing time interlock can be overridden, the batch recordation shall show a clear indication that the mixing time was interrupted. The mixing time begins after all materials are in the drum.

The Inspector shall determine the accuracy of the timer and that the mixer and timer are properly interlocked. Depending on what activates the timer, the Inspector may have to determine such things as belt lag time, charging time, etc.

2-3.04 Recorders

Recordation equipment shall be used to provide the Department with a legible visual record of the materials incorporated into the concrete mixture. It shall be electrically connected to the scales, meters, and batching controls such that the quantities of each aggregate component, cement, pozzolan, microsilica and HRP and water at central mix plants and the presence, type and quantity of admixture for each batch of concrete will be recorded. In addition, all records shall show the batch
number, mix identification, the day, month, year and time of day to the nearest minute for each batch so that the batch is permanently identified.

The Producer has two options in regard to the type of recordation equipment. These options are digital recordation on either a ticket or a tape. Digital tickets have become the most common form of recordation with modern PC driven automation equipment. Some of the recorded information is in code form. The Plant Inspector should have sample records and plant parameter screen prints, with the pertinent codes, indications and explanations, for each plant.

2-3.041 Digital Recorders

The quantities and other batch information shall be recorded by a digital printer. The information may be printed on either a ticket or a continuous tape. The principal difference between these two methods is that the ticket is multi-copy form with preprinted serial numbers. Tape recordation is a continuous roll of paper, similar to a recording calculator, which prints the batch identification number for each batch. For either method, the batch record shall contain the following information:

1. Individual aggregate identification and quantity
2. Cementitious materials identification and quantity
3. Water quantity (central mix plants)
4. Admixture identification and quantity
5. Time and date of batch
6. Mix identification
7. Batch number (ticket serial numbers)
8. Out of tolerance indications for all materials batched or mixed outside the specifications.

When the printed digital record is used as, or part of, the delivery ticket, the Producer shall provide the State with two copies. One copy accompanies the delivery to the project, the other copy is for the Plant Inspector.

Figure 4 is an example of a batch record with many of the possible error indications.
FIGURE 3
**A.B.C. CONCRETE Co. INC.**

**PLANT # 2**

**123 ELM ST. ANYTOWN NY, 12003**

<table>
<thead>
<tr>
<th>DATE</th>
<th>BATCH #</th>
<th>Serial No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/14/2004</td>
<td>00313</td>
<td>90210</td>
</tr>
</tbody>
</table>

**DESCRIPTION:** CLASS HP NYSDOT D289190 RTE 66 / CRIPPLE CREEK

**DIRECTIONS:** RTE 66 NB TO MAYBERRY RD EXIT - STAY BEHIND BARRIER

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>ACTUAL (lb)</th>
<th>TARGET (lb)</th>
<th>%VAR</th>
<th>% MOIST.</th>
<th>START TARE (lb)</th>
<th>END TARE (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 STONE</td>
<td>9700 *</td>
<td>10000</td>
<td>-3.0</td>
<td>0.00</td>
<td>AGG 60 *</td>
<td>20</td>
</tr>
<tr>
<td>SAND</td>
<td>19500 *</td>
<td>20430</td>
<td>-4.6</td>
<td>4.30</td>
<td>CEM 20 *</td>
<td>0</td>
</tr>
<tr>
<td>2 STONE TYPE1</td>
<td>29300 *</td>
<td>30430</td>
<td>-4.0</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLYASH</td>
<td>4910 *</td>
<td>5000</td>
<td>-1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILICA FUME</td>
<td>6350</td>
<td>6350</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATER</td>
<td>327 GAL</td>
<td>324 GAL</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AEA</td>
<td>120 oz.</td>
<td>120 oz.</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RETARDER</td>
<td>180 oz.</td>
<td>180 oz.</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REDUCER</td>
<td>175 oz.</td>
<td>175 oz.</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**BOTTLE 1 NOT EMPTY**

**MIXED 60 OF 90 SECONDS**

**FINISHED TIME: 02:21 PM**

**REPRINTED TICKET**

**SIMULATED BATCH**

FIGURE 4
The resolution of the digital recorder must be equal to or less than the scale graduations. The weight printed on the recordation shall agree within one scale graduation of the weight indicated on the primary scale display. A good time to check the recorder is when the weight tolerance interlock check is made.

2-3.05 Batching Inspection and Control

The Plant Inspector shall perform routine inspection prior to, and during the batching of Portland cement concrete mixture in the following manner:

1. Perform a fine aggregate moisture test. Direct the Plant Operator to set the proper moisture content in the batch set-up parameters before the production starts.

2. Check with the Plant Operator to see if the proper mix design is programmed, and all batching tolerances are set correctly

3. Observe the automatic batching controls and recordation soon after production starts to see if they are working properly.

4. Spot check the recordation to see if the weight tolerance interlocks are working.

During production, the Plant Inspector may encounter interruptions in the batching cycle, equipment malfunctions and other situations where the Plant Operator bypasses a cycle interruption by manipulating controls on the manual panel or keyboard. The Plant Inspector may be able to handle some of the situations by the procedures described in the next subsections.

2-3.051 Batching Cycle Interruptions

When the automatic control interrupts the cycle because the batched quantity is outside the tolerance interlock settings, the Plant Inspector shall take the following action:

1. If the interlock settings are set less than the allowable batching tolerance range for the batch in question, the Inspector shall accept the batch and note the acceptance on the recordation of the batch.

2. If the interlock settings are set at the allowable batching tolerance for the batch in question, the Inspector may do one of the following and note it on the recordation:

   **Aggregate “Overweight”**
   
   Reject the batch unless the load requires two batches of which the second batch weights can be adjusted to compensate for the weighing error on the first batch.
Cementitious Materials “Overweight”
Reject batch or hold back extra cement upon discharge.

Aggregate or Cementitious Materials “Underweight”
Add additional material by either automatic or manual cycle control.

Admixture Under Tolerance
Add additional material by either automatic or manual cycle control.

Admixture Over Tolerance
Reject the batch, or notify the Project Engineer (EIC). The air content test, per MM 9.2, may be performed to determine the acceptability of a load with excessive air entraining agent.

If the automatic batching cycle is frequently interrupted when the weight tolerance interlocks are fixed for the minimum allowable batch weights, the Plant Inspector should notify the Regional Materials Engineer. The Materials Engineer may increase the minimum batch weights and consequently, the minimum tolerance range, or increase the tolerance settings to meet Department requirements. See Section 2-3.033 Minimum Batch Size, for the computations.

2-3.052 Equipment Malfunctions and Breakdowns

When a breakdown in the automation and/or recordation occurs, the Plant Inspector shall notify the Regional Materials Engineer. If the concrete production is interrupted or the quality of the concrete is affected by the breakdown, the Plant Inspector should also notify the Project Engineer. The Materials Engineer may allow the Producer to batch and mix concrete mixtures for a period not exceeding 48 hours from the time of breakdown providing that acceptable concrete can be produced and recorded automatically or manually. The 48 hours are two consecutive calendar days (excluding Sundays and New York State legal holidays). Written permission of the Regional Director will be required for the Producer to operate without these instruments for periods longer than 48 hours.

When only portions of the batching or recordation equipment will not operate properly, it is the Inspector’s responsibility to determine the seriousness of the trouble. It may be possible for the Producer to correct the problem without having to enter the 48 hour breakdown period. Some of the problems that may occur and action that an Inspector can take immediately are as follows:

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>SUGGESTED ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Draw weights incorrect</td>
<td>Check formula settings</td>
</tr>
<tr>
<td>2. Draw weights incorrect, formula setting correct</td>
<td>Check scales for binding</td>
</tr>
</tbody>
</table>
3. Draw weights out of tolerance, batching not automatically stopped by interlocks
   Stop production, check tolerance and interlock settings

4. Draw weights in tolerance
   Batching stopped frequently by interlocks
   Check interlock settings

5. Scale display not returning within zero tolerance and batching continues
   Stop production, check zero tolerance and interlock setting, check for material caught in weigh hopper

6. Scale display returns to zero, batching stopped by zero interlock
   Check zero tolerance and interlock setting

7. Mechanical or electrical equipment malfunction or failure
   Stop production, notify producer and attempt to determine the cause of the malfunction or failure. Notify Materials Engineer

2-3.053 Department Seal Control

An automated concrete batching plant with interlock controls in proper operation will cause an interruption in the cycle whenever an error in batching occurs. Since a stoppage can be by-passed on most plants by manipulation of different controls or switches found on the panel, it is the responsibility of the Regional Materials Engineer and the Plant Inspector to insure that the interlock system will not be by-passed without the knowledge of the Inspector. The Materials Engineer may require Department seals to insure that the interlocks are not being by-passed.

When seals are used, they shall be broken only in the presence of the Plant Inspector. In some instances however, the Producer may need to break a seal in the Inspector’s absence. Any production that occurs after a Department seal has been broken without the knowledge and/or consent of the inspector is considered unacceptable until the Inspector verifies the acceptability of the material produced. The Inspector will verify the material’s acceptability by reviewing the recordation of all batches produced during this period. When digital display systems are used, the displays must be covered so that the scales cannot be easily manipulated.

2-3.06 Manual (Non-Automated) Proportioning

Plants that are approved to produce during a period of “Failure of Automatic Batching” as described in Section 501-3.02 of the Standard Specifications shall operate within the batching tolerances given in that section. Batches produced outside these tolerances must be either corrected or discarded.
The batching controls must be interlocked as follows:

1. The batching inlet gates cannot be opened while the weigh hopper discharge gates are open.

2. The batching discharge gates cannot be opened:
   - until the full batch weights are registered on the scales
   - while the weigh hopper is filled.
   - if the batch weights are over or under the specified batching tolerance.

3. A new batch cannot be weighed until the hopper is entirely empty of the previous batch and all scales have returned to within the allowable zero tolerance range.

Inspect the above noted interlocks to determine if they are working properly. The same inspection procedure described in Section 2-3.034, *Batching Interlocks*, can be used.

The moisture meter must function properly during the Non-Automated proportioning period.

2-4 MIXERS AND HAUL UNITS

Portland cement concrete is delivered to the project and point of deposition in approved mixing or hauling units. The following describes the concrete mixing and delivery systems normally used on Department Projects:

1. Transit Mixed Concrete

   This is defined as concrete mixed at the plant or in transit to the project in a truck mixer. The cement, aggregates, admixtures, and water are batched at the concrete plant and mixing commences shortly after batching. Some additional mixing water and/or water reducing admixture may be required at the placement site in order to achieve the proper consistency (slump). All additions at the placement site must be done in accordance with the requirements of Section 501 of the Standard Specifications.

2. Truck Mixed Concrete

   This is defined as concrete mixed on the project in a truck mixer. The cement, aggregates and admixtures are batched at a plant and hauled to the project in a truck mixer. Mixing water is from a tank on the truck and all mixing is accomplished at the placement site. Allowable haul time varies depending upon the method of batching used at the plant.
3. Central Mixed Concrete

This is defined as concrete mixed completely in a stationary mixer at the concrete plant. The mixed concrete is hauled to the project in either truck mixers or open haul units. When truck mixers are used, the drum revolves at agitating speeds while enroute to the placement site. Allowable haul time varies with the type of haul equipment used.

2-4.01 Concrete Mixing and Hauling Units Inspection

Prior to use for Department work, inspect the operating condition of the mixing and hauling equipment for conformance with Section 501 of the Standard Specifications. Notify the Producer of the required inspection procedures so that the Producer may prepare the delivery units for the inspection. Observe all pertinent safety procedures required by OSHA while the inspections are being performed. Notify the Producer and the Regional Materials Engineer of any deficiencies in the equipment so it is repaired before further use for Department work. Obtain the mixer charging or loading sequence from the Regional Materials Engineer. During production, periodically check the batching operation to be sure that the proper charging sequence is followed.

2-4.011 Transit Mixed Concrete

Inspect the transit truck mixer to see if it has a current inspection sticker (BR-275). The inspection sticker gives the allowable mixer capacity and the mixing speeds. The transit truck mixer must have an electric counting device which shows drum revolutions within the specified mixing range and total drum revolutions. The Revolution counter must be one that appears on the Department’s Approved List, as maintained by the Materials Bureau. The electric revolution counting device must be reset to zero by the Producer at the time of loading. Inspect the working condition of the revolution counter.

2-4.012 Truck Mixed Concrete

The Plant Inspector will inspect the truck mixer to see if it has a current inspection sticker (BR-275). The inspection sticker gives the allowable mixer capacity and the mixing speeds. The truck mixer must also have a counting device which, as a minimum, shows total drum revolutions in the direction of mixing. The revolution counter must be reset to zero by the Producer at the time of loading. Inspect the working condition of the revolution counter.
<table>
<thead>
<tr>
<th>Central Mixed Concrete</th>
<th>Transit Mixed Concrete</th>
<th>Truck Mixed Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Begin Batching</strong></td>
<td><strong>Begin Batching</strong></td>
<td><strong>REGULAR MIX</strong></td>
</tr>
<tr>
<td>Load mixer</td>
<td>Load materials through barrel hopper or hatch.</td>
<td>Load Aggregates (Drum may be rocked or rotated)</td>
</tr>
<tr>
<td><strong>End of Batching</strong></td>
<td><strong>End of Batching</strong></td>
<td><strong>LAYERED MIX</strong></td>
</tr>
<tr>
<td><strong>Begin Mixing</strong></td>
<td><strong>Begin Mixing</strong></td>
<td><strong>Begin Batching</strong></td>
</tr>
<tr>
<td>90 seconds minimum</td>
<td>90 minutes minimum</td>
<td>Load Aggregates (Drum may be rocked or rotated)</td>
</tr>
<tr>
<td>(after all materials are in the mixer)</td>
<td>(See note 3)</td>
<td>(Drum may be rocked)</td>
</tr>
<tr>
<td><strong>End of Mixing</strong></td>
<td><strong>End of Mixing</strong></td>
<td><strong>Load Cement</strong></td>
</tr>
<tr>
<td>Begin Discharge</td>
<td>Begin Discharge</td>
<td>(See note 3)</td>
</tr>
<tr>
<td>5 minutes maximum</td>
<td>30 minutes max.</td>
<td>Cement in Contact with Aggregates</td>
</tr>
<tr>
<td><strong>Completion of Discharge</strong></td>
<td><strong>Completion of Discharge</strong></td>
<td>90 minutes max.</td>
</tr>
<tr>
<td>(When concrete is transported in units approved for mixing, see Note 1)</td>
<td>(When concrete is transported in units approved for mixing, see Note 1)</td>
<td>Cement in Contact with Aggregates</td>
</tr>
</tbody>
</table>

**Note 1:** The remainder of the design water may be added at the work site to attain initial slump. When approved by the Regional Materials Engineer, only the first trucks may be adjusted to obtain initial slump using a water-reducing admixture (§711-08, ASTM Type A). Exceeding the maximum mixing revolutions or water addition requirements will not be permitted.

**Note 2:** For mixtures that do not contain a water-reducing and retarding admixture (§711-08, ASTM Type D), the 90 minute maximum time includes the time to initial strike-off, or placement of subsequent lifts.

**Note 3:** Add cement through hatch. Do not move drum while cement is being added.

**TABLE 1**
2-4.013 Central Mixed Concrete

The central mixer is approved as part of the batching equipment. The standard mixing time, given in Table 1 of this manual shall apply except for the case where a reduced mixing time has been granted by the Department. The reduced mixing time is based on the results of a “mixer efficiency test” performed according to the procedures given in Appendix H, Uniformity Test Procedure. The actual mix time should be periodically checked for accuracy.

Central mixed concrete may be delivered to the placement site in either open haul units (dump trucks with or without rotating paddles) or rotating drum units (conventional concrete trucks). Open haul units with smooth dump beds, free of concrete build-up, are considered acceptable. No inspection stickers are required on delivery units if the concrete is fully mixed at the plants, and water is not added at the placement site.

If water is permitted to be added to the concrete at the placement site, the rotating drum mixing units must meet the requirements of either transit or truck mixed concrete. In this case, insure that at least 90% of the design mixing water is added at the central mix batching facility.
INSPECTOR'S CHECKLIST

Materials

1. Do you have certifications for all aggregates and cementitious materials from the Manufacturer/Supplier showing all the required information?

2. Are the aggregate stockpiles identifiable and separated by sizes?

3. Have you performed tests on the aggregates before allowing production to begin?

4. Do the aggregates in the stockpile compare favorably to the reference sample by visual identification?

5. Do you understand the gradation control procedure depicted in Section 2-2.015?

6. Have you checked the Approved List to see if the cementitious materials (cements, Fly Ash, GGBFS, Microsilica & HRP) and admixtures are approved?

7. Do you know whether the water supply for the plant is acceptable?

8. If Microsilica or HRP powder is being incorporated in Department mixes, have you sampled and tested it for contamination using the latest issue of Materials Procedure 90-01?

9. If Corrosion Inhibitor is being incorporated in Department mixes, have you sampled and tested it for specific gravity using the latest issue of Materials Procedure 02-01?

Batching

10. Have you checked with the Materials Engineer to find out if the plant has limitations?

11. Have the scales and meters been tested for accuracy recently?

12. Does the moisture meter work?

13. Are the design weights properly programmed into the automated batching system?

14. Does the moisture compensation device, if any, work properly?

15. Do you know what the batching tolerances are?
INSPECTORS' CHECKLIST (cont.)

16. Are the weighing tolerance interlocks set and working properly?

17. Do you know what to do when a material weight is outside the interlock settings and the cycle is interrupted?

18. Do you know what the plant’s minimum batch weights are?

19. Do you know the codes or symbols for “out of tolerance” etc., on the recordation?

20. Do you know that the weighing tolerance interlocks set in the automation system may be set for less than the allowable tolerances for some batch sizes? This may result in “out of tolerance indications” on the recordation that may actually represent acceptable batch weights.

21. Do you know what information is required on the recordation?

22. Do you know what a breakdown is and when the 48 hour breakdown period begins and ends?

Mixing

23. Have you checked the condition of the blades in the mixing drums?

24. Do you know the mixer charging or loading sequence?

25. Do transit or truck mixers have current inspection stickers?

26. Do the revolution counters work properly on transit or truck mixers?

27. Do the revolution counters appear on the Department’s Approved List?

28. Do you know what the mixing time is for the central mixer and have you checked it?

29. Do you approve of the condition of the open haul units?

30. Have you checked to see that prior to loading of the constituents of the concrete mixture that the truck mixers or open haul units have been drained of wash water?
SECTION 3

ADMINISTRATIVE PROCEDURES AND RECORD KEEPING

3-1 GENERAL

The Plant Inspector is responsible for maintaining a diary, test records, production records and issuing acceptances of concrete production to projects. These records along with the material certifications and mix designs must be kept on file at the plant in an orderly manner so they can be readily consulted. The diary is used to record miscellaneous test data and information and to record conversations between the Plant Inspector and Producer. The diary is typically comprised of a bound notebook or journal with ruled paper.

For administrative purposes, concrete plants shall be in one of the two categories that follow:

1. Project Plant - A plant located on the project site for the purpose of serving the one project.

2. Non-Project Plant - A plant located off the project site. These are usually commercial plants capable of serving more than one project at a time.

3-2 DELIVERY TICKETS

Each vehicle delivering Portland cement concrete or its ingredients to a project shall be accompanied by a delivery ticket prepared by the Producer.

The following minimum information shall be included on delivery tickets:

1. Delivery ticket number

2. Plant identification (Plant name, location, and NYSDOT facility number)

3. Contract number

4. Concrete class or item number

5. Quantity (Nominal batch size)

6. Truck number

7. Batch number
8. An automatically applied time-date stamp which may consist of one of the following:
   
a. Time-date stamp by printing device on a regular ticket (when no recorded batch weights accompany the load).
   
b. Time-date printed by a batch weight recorder on a printed ticket.
   
c. Time-date printed by a batch weight recorder on a printed tape. A copy of the tape shall be affixed to the regular delivery ticket.

The Plant Inspector shall review delivery tickets at least three (3) times per day for each project served to ascertain that they contain the proper information. The Inspector shall write “Delivery Ticket OK” followed by his/her signature on each ticket reviewed.

3-3 PRODUCTION RECORDS

The acceptability of Portland cement concrete dispatched from the plant is based on evidence that the materials used in the mix were approved and that they were properly proportioned. The quantity of acceptable concrete is determined from records containing this information.

3-3.01 Materials Acceptance Records

The records that are kept on file at the plant during production relating to material acceptance include the following:

1. Aggregate certifications
2. Cement, Pozzolans, Microsilica, and HRP shipment certifications or authorizations
3. Aggregate test results
4. Diary (admixtures and water source)

For Project plants; a copy of the mix designs, the shipment certifications for aggregates, cements, pozzolans, microsilica, and HRP, and admixtures will be ultimately incorporated into project files. For non-project plants, all acceptance documents will be maintained in the plant records.

3-3.011 Batch Recordation

Recordation may be filed with plant records or may be filed with delivery tickets in project files, depending upon the system in use. One of the following procedures shall be followed:
<table>
<thead>
<tr>
<th>RECORDATION TYPE</th>
<th>DISPOSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Printed delivery ticket</td>
<td>Collected by the Project Inspector. Filed at project.</td>
</tr>
<tr>
<td>2. Printed tape</td>
<td>Collected daily by Plant Inspector. Filed at plant.</td>
</tr>
<tr>
<td>3. Printed tape affixed to delivery ticket</td>
<td>Collected by Project Inspector. Filed at project.</td>
</tr>
</tbody>
</table>

The adoption of either of the above procedures shall be based on an agreement between the Regional Materials Engineer, Project Engineer and the Producer.

3-4 CONCRETE ACCEPTANCE REPORT

A concrete acceptance report BR-316, *Daily Concrete Batch Plant Report* (shown in Figure 5) for concrete produced and authorized to be shipped to each project will be completed by the Plant Inspector at the end of each production day. Inspectors at project plants report this information to the Project Engineer at the end of the day. Inspectors at non-project plants issue a copy of the report to each project served by the plant, and retain the original for the plant records. The report is forwarded to the projects the morning following the reported production date. The reports are numbered consecutively by the Plant Inspector, with Report 1 beginning on the first production day of any calendar year. The job stamp is applied at the project.

3-4.01 Quantity Determination

The Plant Inspector determines the acceptable quantity of concrete for each project by reviewing the production records. Acceptable concrete batches are batches that are made with acceptable materials and are properly proportioned. A properly proportioned batch is one in which the material quantities are within allowable batching tolerances. At the end of each working day, the Plant Inspector should review the batch recordation and identify each class produced. The inspector should tally the number of acceptable batches of each class dispatched to each project. In some cases the Plant Inspector may have permitted a batch weight to be corrected during production. These batches are acceptable providing that the recordation is so noted by the Inspector at the time the correction is made. The acceptable quantity is based on the number of batches multiplied by the appropriate batch sizes.

When a plant is producing for a placement in the Phase III condition due to an aggregate gradation issue, the Plant Inspector should note the quantities under “Remarks” in the report for each project affected. These quantities are included in the total amount of “Authorized Shipments”.

When a standard class of concrete is used, the concrete is identified on the report by class. If the concrete is not a standard class, the concrete is identified by pay item number.
# Daily Concrete Batch Plant Report

**NEW YORK STATE**  
**DEPARTMENT OF TRANSPORTATION**

**DAILY CONCRETE BATCH PLANT REPORT**

**PLANT:** ABC CONCRETE  
**LOCATION:** ANYTOWN, NY

### MATERIALS

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
<th>Code Type</th>
<th>Source (Brand name, Manufacturer location)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEMENT/POZZOLAN(s)</td>
<td>C1</td>
<td>35</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>C2</td>
<td>D8</td>
<td>Fly Ash</td>
</tr>
<tr>
<td></td>
<td>C3</td>
<td>6022</td>
<td>Microsilica</td>
</tr>
<tr>
<td>ADMIXTURES</td>
<td>M1</td>
<td>1026</td>
<td>Air Entainer</td>
</tr>
<tr>
<td></td>
<td>M2</td>
<td>3015</td>
<td>Water Reducer</td>
</tr>
<tr>
<td></td>
<td>M3</td>
<td>2017</td>
<td>Retarder</td>
</tr>
<tr>
<td></td>
<td>M4</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

### AGGREGATE

<table>
<thead>
<tr>
<th>Item</th>
<th>Source No.</th>
<th>Source (Company name, Source location)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FINE</td>
<td>A1</td>
<td>G-39 F</td>
</tr>
<tr>
<td>COARSE</td>
<td>A2</td>
<td>G-1R</td>
</tr>
</tbody>
</table>

### WATER SUPPLY

- MUNICIPAL  
- WELL  
- POND  
- STREAM  
- OTHER (explain)

### AUTHORIZED SHIPMENTS

<table>
<thead>
<tr>
<th>Project</th>
<th>Class</th>
<th>Quantity</th>
<th>Materials Used in Concrete</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/5/19</td>
<td>HP</td>
<td>300 CY</td>
<td>0-2, 0-4, 0-8, C1, C2, C3, C4</td>
<td></td>
</tr>
<tr>
<td>12/8/19</td>
<td>A</td>
<td>100 CY</td>
<td>0-2, 0-4, 0-8, C1, C2, C3, C4</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:**

**PLANT INSPECTOR (signature):** [Signature]  
**PROJECT REVIEWER (signature):** [Signature]

---

**FIGURE 5**
3-5 ACCEPTANCE OF SMALL QUANTITIES BY PRODUCER’S CERTIFICATION

When it is not feasible to provide plant inspection for small quantities (up to 25 cubic yards), the Regional Materials Engineer and Project Engineer may agree to accept the concrete from an approved plant on the basis of a Producer's certification stating that the concrete conforms to specification. The certification shall be form BR-342 - *Materials Certification*, completed by the Producer as shown in Figure 6. The producer shall retain a legible copy of the delivery ticket for the Regional Materials Engineer. Also, recordation for each batch shall accompany the certification.

Small quantities of concrete may be certified for the following placements:

1. Sign foundations
2. Lighting structure foundation
3. Curbs
4. Gutters
5. Headwalls
6. Catch basins
7. Manholes
8. Drop Inlets
9. Field Inlets
10. Concrete Riprap
11. Concrete Driveways
12. Other similar placements
# Portland Cement Concrete Materials Certification

## SHIPPED FROM:
- **FACILITY NO.**: CO261
- **Plant**: R.U. REALE
- **Location**: Stafford Bridge
- **Date Shipped**: 09/11/01

## SHIPPED TO:
- **Project Number**: D299321
- **Location**: Rte 288 / Slug River

<table>
<thead>
<tr>
<th>Class/Mix Type*</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>555.0104 (Class A)</td>
<td>10 cubic yards</td>
</tr>
</tbody>
</table>

*I use Item Number when material is not designated by Class/Mix Type.*

I certify that the material delivered with the delivery ticket to the above noted project was proportioned in accordance with the requirements of the contract specifications for the specific Class/Mix/Item noted using New York State Department of Transportation approved materials.

**BY:** Robert P. Harty  
**TITLE:** Plant Superintendent  
**DATE:** 05/18/08  
**CERTIFICATION APPROVED**  
**BY:** T J Mulligan - Region 12

## CEMENT BRAND NAME & LOCATION
- **Cement**: Lafarge, North America, Ravena NY

<table>
<thead>
<tr>
<th>CEMENT TYPE:</th>
<th>CODE NUMBER:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) (2) (3) (4) (5) (6) other</td>
<td>35</td>
</tr>
</tbody>
</table>

**OTHER:** Flyash - Cranesville Materials, Eastlake, Ohio  
**CODE NUMBER:** 08

## ADMIXTURES:
- **AIR AGENT**: Sika AEA  
  **CODE NUMBER:** 1026
- **RETARDER**: Sika Plastiment NS  
  **CODE NUMBER:** 3015
- **WATER REDUCER:**
- **OTHER:**

## F.A. SOURCE NUMBER
- **F.A. SOURCE NUMBER**: 5-39 F
- **C.A. SOURCE NUMBER**: 5-1R

## DELIVERY TICKET NUMBER
- **DELIVERY TICKET NUMBER**: 66969

## REMARKS:

**FIGURE 6**
INSPECTOR’S CHECKLIST

1. Are your daily records neat, legible and properly filed?

2. Are you spot checking the delivery tickets to determine if they contain the proper information?

3. Do you know what an acceptable batch of concrete is?

4. Have you reviewed the batch records and identified the batches according to class and project destination?

5. Does the quantity listed under authorized shipment on form BR-316 represent only acceptable batches?

6. Have you noted under “Remarks” on form BR-316 the quantity of any concrete produced under the Phase III condition?
SECTION 4
PLANT AND MIXER APPROVALS

4-1 GENERAL

The concrete batching plant, including the testing facility and truck mixers shall be inspected and approved by the Department before production begins and then annually thereafter while the plant remains in the same location. The Regional Materials Engineer may require these annual inspections to take place prior to the construction season. The approvals shall be granted to the Producer upon compliance with the specifications. The approval procedures are described in this section.

The Regional Director may at any time, discontinue the use of any previously approved equipment, if non-conformance with the specifications results during the progress of the work. When the Regional Director discontinues the approval, the equipment will not be acceptable for Department work until corrections are made by the Producer.

4-2 PLANT APPROVAL

The plant inspection shall be performed by the Regional Materials Engineer or his representative. The requirements for the plant and testing facility are given in Section 501 of the Standard Specifications.

Plants found acceptable will be recommended for approval by the Regional Materials Engineer. A memorandum, documenting the results of the inspection will be forwarded to the Director of the Materials Bureau for approval. The details of the equipment and materials used at the plant, as well as any limitations imposed on the facility, will be recorded into the appropriate plant database. A copy of the approval memorandum, stating the plant’s limitations, if any, will be returned to the Region Office.

4-2.01 Automatic Batching Controls

The automatic batching and recording equipment shall be inspected by personnel from the Materials Bureau after the equipment is installed, but before the plant produces concrete for Department work. At the time of the inspection, the Producer shall have a person capable of making adjustments to the automatic controls. This person should be a technical representative from the automation company. A representative from each admixture company who has dispensing equipment at the plant should also be available to make adjustments and/or electrical connections to the dispensing system during the inspection.
After the automatic batching and recording equipment is found acceptable, the automation system will be approved in writing by the Director of the Materials Bureau.

After the initial inspection, further inspections are made by the Materials Bureau when:

1. Major changes are made in the scales, batching controls, admixture dispensing systems, or recorder. Major changes include, but are not limited to:
   - Changes in the automation system’s hardware or software that effects how the system proportions ingredients relative to the Standard Specifications.
   - Changes to the plant’s configuration (one stop vs. two stop; new admixture dispensing system, new plant using existing automation, etc.).
   - Change of plant location from one region to another.

2. Request for reduced mixing time for central mix facilities.

3. Any time the Regional Materials Engineer determines there is sufficient need.

An example of a typical annual automation inspection test is shown in Figure 8.

4-3 TRUCK MIXERS

An annual inspection of all truck mixers used for Department work during the construction season shall be made by the Regional Materials Engineer. The mixer shall meet the requirements given in Section 501 of the Standard Specifications and shall be properly identified with the Producer’s company name and a truck number.

If the requirements are met, the Materials Engineer shall affix an inspection sticker (BR-275 Approved Concrete Mixing/Delivery Unit) in a visible place within the truck cab. An example of the inspection sticker is shown in Figure 7. An example of a typical annual truck inspection sheet is shown in Figure 9.

Any time that an approval is discontinued, the inspection sticker shall be removed and replaced only after repairs have been made by the producer.
### FIGURE 7

(BR-275, TRUCK INSPECTION STICKER.)
NEW YORK STATE
DEPARTMENT OF TRANSPORTATION

ANNUAL AUTOMATION TEST

FACILITY NO. C0999

PLANT NAME/LOCATION __________________ A B C CONCRETE CO.

DATE 07/15/07 INSPECTOR T J MULLIGAN TITLE C E 1

AUTOMATION MAKE ANAKONGA PRINTER MAKE/MODEL OKIDOKI 300 XL

ZERO TOLERANCE SETTINGS: Go to batch parameters or setup screens, check to see that the tolerances do not exceed two scale graduations from zero. Then go to a test batch, and set scale simulators beyond allowable zero. Batch should not start without being overridden by operator. If so, check batch recordation for indication.

MOISTURE CALCS: Use 1000 lb./cubic yard (or approx. 600 kg./cubic meter) of aggregate under test. Ask for various batch sizes by placing the aggregate with moisture in the second draw. Check to see that moisture is being calculated properly.

(Example @ 4.5% moisture: 1000 lb. X 5.0 cy X 1.045 = 5125 lb. Add this adjusted sand weight to the target weight of the first aggregate. If inspecting a Central mix plant, check to see if the water target is adjusted by the weight of the water in the aggregate.

BATCH TOLERANCES: AGG: 2%, CEMENT: 1% (0.5% w/MICROSILICA), ADMIX: 3% (or 1 pulse), WATER: 1% (central mix only)

MAKE SURE AIR AND ELECTRIC TO PLANT GATES AND FEEDS ARE SHUT OFF PRIOR TO TEST

TEST #1 5.0 CUBIC YARD (METER) 4.5 % MOISTURE ZEROS: CEM. 10 lb (kg) AGG. 40 lb (kg)

<table>
<thead>
<tr>
<th>AGG # (2)</th>
<th>DESIRED TARGET WT.</th>
<th>ACTUAL TARGET WT.</th>
<th>OK/ N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>5000+125+5000 = 10125</td>
<td>10125</td>
</tr>
</tbody>
</table>

TEST #2 5.0 CUBIC YARD (METER) BATCH 4.5 % MOISTURE MIX ID: NYSDOT HP TEST

<table>
<thead>
<tr>
<th>INGREDIENT</th>
<th>UNDER WT. LIMIT (lb)</th>
<th>UNDER WT. TEST (lb)</th>
<th>PROGRAM WT. (lb)</th>
<th>OVER WT. TEST (lb)</th>
<th>OVER WT. LIMIT (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGG 1</td>
<td>4900</td>
<td>4900</td>
<td>5000</td>
<td>5100</td>
<td>5100</td>
</tr>
<tr>
<td>AGG 2</td>
<td>9922</td>
<td>9920 *</td>
<td>10125</td>
<td>10330 *</td>
<td>10328</td>
</tr>
<tr>
<td>AGG 3</td>
<td>14822</td>
<td>14820 *</td>
<td>15125</td>
<td>15430 *</td>
<td>15428</td>
</tr>
<tr>
<td>CEM 1</td>
<td>2488</td>
<td>2490 *</td>
<td>2500</td>
<td>2510 *</td>
<td>2512</td>
</tr>
<tr>
<td>CEM 2</td>
<td>3159</td>
<td>3160 *</td>
<td>3175</td>
<td>3190</td>
<td>3190</td>
</tr>
<tr>
<td>CEM 3</td>
<td>3358</td>
<td>3360 *</td>
<td>3375</td>
<td>3390</td>
<td>3390</td>
</tr>
<tr>
<td>ADMIX 1</td>
<td>126</td>
<td>127</td>
<td>130 OZ.</td>
<td>135</td>
<td>134</td>
</tr>
<tr>
<td>ADMIX 2</td>
<td>512</td>
<td>510</td>
<td>528 OZ.</td>
<td>545</td>
<td>544</td>
</tr>
</tbody>
</table>

RECORDATION OF BATCH: Check to see if batch weights for aggregates and cements are cumulative. Check for out of tolerance, manual feeds, early discharge (central mix plants), “bottle not empty”, etc. indications (See M.M.9.1).

Remarks Aggregate tolerance set for 2% of accumulated weight. Cement & Pozz tolerance set for 0.5% of accumulated weight. Microsilica is CEM 3, (last in weighing sequence). * tolerances were OK to within ½ grad of limits. ADMIXES OK

T J Mulligan 07/15/07

FIGURE 8
**BR 185**

NEW YORK STATE  
DEPARTMENT OF TRANSPORTATION  
CONCRETE TRUCK MIXER INSPECTION

YEAR: 2007  
COMPANY: ABC CONCRETE CO.

LOCATION: STONEY CREEK  
INSPECTOR: T. J. MULLIGAN

<table>
<thead>
<tr>
<th>TRUCK NO</th>
<th>BLADE CONDITION</th>
<th>WATER SYSTEM</th>
<th>RATING PLATE MIX</th>
<th>AGITATE</th>
<th>COUNTER TYPE</th>
<th>CONDITION</th>
<th>DATE TAGGED</th>
<th>MIX TYPE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>134</td>
<td>OK</td>
<td>OK</td>
<td>9 CY</td>
<td>12 CY</td>
<td>DUAL</td>
<td>OK</td>
<td>7/15/07</td>
<td>ALL</td>
<td></td>
</tr>
<tr>
<td>135</td>
<td>OK</td>
<td>OK</td>
<td>9 &quot;</td>
<td>12 &quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>136</td>
<td>OK</td>
<td>OK</td>
<td>9 &quot;</td>
<td>12 &quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>OK</td>
<td>OK</td>
<td>8.5 &quot;</td>
<td>11 &quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>OK</td>
<td>OK</td>
<td>8.5 &quot;</td>
<td>11 &quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>OK</td>
<td>OK</td>
<td>8.5 &quot;</td>
<td>11 &quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>COUNTER REPLACED 7/15/07</td>
</tr>
</tbody>
</table>

- **BLADES:** At least 80% of original blade area usable.
- **WATER SYSTEM:** Accurate gauge, no leaks.
- **RATING PLATE:** Enter rated capacities for mixing and agitating.
- **COUNTER:** Enter type (dual or single) and condition.
- **TAGGED:** Enter date tagged. If not tagged, leave this box blank and enter the date rejected and reason in the remarks column.
- **MIX TYPE:** Enter “ALL” if approved with dual readout counter, or “NO TRANSIT” if approved with single readout counter.

Note:  
Mixing speed: 6-18 RPM  
Agitating Speed: 2-6 RPM

FIGURE 9
APPENDIX A

SAMPLING OF AGGREGATES

A. SCOPE

This method describes procedures for obtaining and preparing a sample of aggregate that represents the material being used in the concrete.

B. GENERAL

The Regional Materials Engineer shall choose one of the sampling points given below for each plant. In choosing the sampling point, safety of the Plant Inspector shall be taken into consideration. The Inspector shall take samples from the selected point according to these procedures.

C. EQUIPMENT

The following equipment is generally used for sampling:

1. Pails
2. Square Shovel
3. Brushes (soft and coarse)
4. Sample Splitter with Pans

D. SAMPLING PROCEDURES

1. Stockpile Sampling
   a. Conical Stockpiles
      The sample shall be composed of material representing at least nine points in the stockpile. Samples shall be taken at third (1/3) points around the pile and at three levels (base, middle, and top). At each point, the face shall be exposed to a minimum depth of 1 foot prior to sampling. Care shall be taken so that aggregate adjacent to the sampling point does not fall into the sampling area.

   b. Other Stockpiles
      The details for conical stockpiles shall apply except that the sample shall be composed of material representing at least six points in the area of the stockpile being used for production. Samples shall be taken from two locations in reference to the base and at three levels, (base, middle, and top).
NYSDOT

2. **Belt Sampling**

A portion of aggregate large enough to comprise the required sample size shall be removed from the stopped belt with a square shovel and placed in a sample container. Care shall be taken to remove all the material on the belt in the sampling area. A brush may be used to remove the fine material clinging to the belt.

3. **Bin Sampling**

Though rarely performed, samples may also be obtained with a sampling device which allows the Inspector to obtain representative samples from the full width and depth of the discharge area from each bin while the plant is in operation. The device shall consist of a sampling tray of adequate capacity which is structurally supported during the sampling operation. A shovel is not satisfactory for this purpose.

E. **SAMPLE SIZE**

The amount of aggregate required for a representative sample and the size of sample for testing are given in the respective test methods.

When a non-standard aggregate size is used, the sample size shall be that of the closest standard primary size.

F. **SAMPLE PREPARATION**

In order to obtain a convenient sample size for sieving, or for other tests, a large bin, stockpile, or belt sample may be reduced by a sample splitter or by quartering. Any sample that has visible “free moisture” must be split by quartering, or treated as a miniature stockpile (fine aggregate only as per AASHTO T-248).

When using a sample splitter, the original sample shall be split into two fractions. If one of these fractions is too large for testing, a fraction can be split again. This splitting procedure can be used until the proper size sample for testing is achieved. The splitter must be configured for the maximum size of material under test.

If a sample splitter is not available, the sample shall be reduced by quartering using either of the following methods:
1. Place the original sample on a hard, clean, level surface where there will be neither loss of material nor the accidental addition of foreign material. Mix the material thoroughly by turning the entire sample over three times. With the last turning, shovel the entire sample into a conical pile by depositing each shovelful on top of the preceding one. Carefully flatten the conical pile to a uniform thickness and diameter by pressing down the apex with a shovel so that each quarter sector of the resulting pile will contain the material originally in it. The diameter should be approximately four to eight times the thickness. Divide the flattened mass into four equal quarters with a shovel or trowel and remove two diagonally opposite quarters, including all fine material, and brush the cleared spaces clean. Successively mix and quarter the remaining material until the sample is reduced to the desired size.

2. As an alternative to the procedure in Paragraph 1 when the floor surface is uneven, the field sample may be placed on a canvas blanket and mixed with a shovel as described in Paragraph 1, or by alternatively lifting each corner of the canvas and pulling it over the sample toward the diagonally opposite corner causing the material to be rolled. Flatten the pile as described in Paragraph 1. Divide the sample as described in Paragraph 1. Or, if the surface beneath the blanket is uneven, insert a stick or pipe beneath the blanket and under the center of the pile, then lift both ends of the stick, dividing the sample into two equal parts. Remove the stick leaving a fold of the blanket between the divided portions. Insert the stick under the center of the pile at right angles to the first division and again lift both ends of the stick, dividing the sample into four equal parts. Remove two diagonally opposite quarters, being careful to clean the fines from the blanket. Successively mix and quarter the remaining material until the sample is reduced to the desired size.

Figure A-1 illustrates splitting and quartering methods for reducing the sample size. Refer to AASHTO T-248 for further explanations and illustrations relative to reducing sample sizes.
FIGURE A-1

Splitting a sample with a sample splitter.

Covering a sample with a trowel and a piece of cloth.

Figure A-1
APPENDIX B

COARSE AGGREGATE GRADATION TEST

A. SCOPE

This test method prescribes the procedures for determining the gradation of coarse aggregates for individual aggregate sizes and combined gradation when more than one aggregate size is used in the concrete.

NOTE:
This method is intended for use when the requirements of 703-02 (Coarse Aggregates), and 501-2 (Coarse Aggregate Gradations) are specified. When producing concrete which does not require the gradation requirements of 703-02 or 501-2, the procedures and gradation requirements described in AASHTO T-27 may be used in lieu of these procedures, where appropriate.

B. SAMPLE

The samples shall be obtained and reduced to testing size in accordance with Appendix A, Sampling of Aggregates. The quantity of material needed for testing is as follows:

<table>
<thead>
<tr>
<th>AGGREGATE SIZE</th>
<th>ORIGINAL SAMPLE (minimum)</th>
<th>TEST SAMPLE (minimum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#3</td>
<td>120 lb (55 kg)</td>
<td>30 lb (14 kg)</td>
</tr>
<tr>
<td>#2</td>
<td>60 lb (28 kg)</td>
<td>15 lb (7 kg)</td>
</tr>
<tr>
<td>#1 &amp; #2 BLEND</td>
<td>60 lb (28 kg)</td>
<td>15 lb (7 kg)</td>
</tr>
<tr>
<td>#1A</td>
<td>8 lb (4 kg)</td>
<td>4 lb (2 kg)</td>
</tr>
</tbody>
</table>

C. EQUIPMENT

The following equipment is required for the coarse aggregate gradation test:

1. Power driven coarse aggregate sieve shaker with appropriate sieves and timer.

2. Large scale. Minimum 30 lb (14 kg) capacity. Maximum graduations: 0.01 lb (0.005 kg)

3. Oven or hot plates.
4. Pans

5. Brush

6. Stirring spoon

D. TEST PROCEDURE

1. Dry the sample to a constant weight.

   NOTE: The Materials Engineer may permit the Plant Inspector to test No. 3 and/or No. 2 size aggregate for gradation without drying the aggregate to a constant weight providing that the aggregate is relatively free of moisture. Indicate on the gradation form if the sample was not dried, i.e., “not dried”.

2. Allow sample to cool, then weigh. Record this weight as the original dried weight.

3. Sieve the sample using the sieve sizes for the particular aggregate for at least five (5) minutes. Do not combine different samples. Also, do not overload the sieves. As a guide, any sieve containing more than a single layer of aggregate at the end of the test is considered overloaded. When overloading occurs, sieve smaller portions of the sample at a time, and combine like sizes after sieving.

4. Carefully remove the material retained on each sieve by placing the retained material into a clean pan. Remove any particle which is caught in each sieve without using excessive force, so as to not damage the sieve. Weigh the material retained on each sieve and pan individually, to the nearest 0.01 lb (0.005 kg). Record each retained weights on the appropriate worksheet. The sum of the retained weights from each sieve and pan should agree closely with the weight of the original sample as determined in Step 2 above. The final weight of the sample, after sieving, should not vary by more than 0.3% of the original dried sample weight prior to sieving. Variations of more than 0.3% of the original dried weight indicate either loss of material due to overloading of sieves, or excessive material left retained in the sieves after cleaning and weighing.

E. CALCULATIONS

The calculations needed to determine the coarse aggregate gradation are described by examples given below. Example 1 shows the calculation for the gradation of an individual aggregate size; Example 2 shows the calculations for determining the combined gradation when two aggregate sizes are used in the concrete mixture. (Note: To reduce the confusion created by displaying dual units, the weights and calculations in the following examples are being presented in USC units only)
Example 1

A sample of No. 1 size aggregate was dried to a constant weight. After drying, the *Original Dried Weight* of the sample (before sieving) is 14.50 lb. The sample was then sieved on a mechanical sieve shaker. The weights of retained material are as follows:

<table>
<thead>
<tr>
<th>SIEVE</th>
<th>WEIGHT RETAINED (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot; (25 mm)</td>
<td>0</td>
</tr>
<tr>
<td>½&quot; (12.5 mm)</td>
<td>0.92</td>
</tr>
<tr>
<td>¼&quot; (6.3 mm)</td>
<td>12.18</td>
</tr>
<tr>
<td>Pan</td>
<td>1.40</td>
</tr>
<tr>
<td>TOTAL</td>
<td>14.50 * *</td>
</tr>
</tbody>
</table>

*NOTE: DIVIDE THE WEIGHT RETAINED BY THE ORIGINAL DRIED WEIGHT OF THE SAMPLE (NOT THE TOTAL WEIGHT AFTER SIEVING).* In this example, the *Total Weight Retained* is equal to the *Original Dried Weight*. However, this is not always the case.

**Step 1**

½" (12.5 mm) % Retained = 0.92 / 14.50 X 100 = 6.3%

¼" (6.3 mm) % Retained = 12.18 / 14.50 X 100 = 84.0%

PAN % Retained = 1.40 / 14.50 X 100 = 9.7% 100.0% **

**May sometimes be only within one or two tenths of 100.0% due to rounding. This may be neglected. However, the final weight must not vary by more than 0.3% from the original dried weight.**

**Step 2**

The gradation of the aggregate, in terms of percent passing each sieve is determined by subtracting the percent retained (starting with the largest sieve) from 100, then subtracting the percent retained from the next smaller sieve from this remainder, and so on. This is repeated through the remainder of the sieves, including the pan. For example:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot; (25 mm)</td>
<td>100 – 6.3 = 93.7%</td>
</tr>
<tr>
<td>½&quot; (12.5 mm)</td>
<td>93.7 – 84 = 9.7%</td>
</tr>
<tr>
<td>¼&quot; (6.3 mm)</td>
<td>9.7 – 9.7 = 0%</td>
</tr>
</tbody>
</table>
Example 2a

Class A concrete is being produced with coarse aggregate from separate stockpiles for the No. 1 and No. 2 sizes. The gradations for the separate stockpiles were performed in the same manner as described in Example 1 and are as follows:

<table>
<thead>
<tr>
<th>SIEVE</th>
<th>WEIGHT RETAINED (lb)</th>
<th>NO. 1 % RETAINED</th>
<th>% PASSING</th>
<th>WEIGHT RETAINED (lb)</th>
<th>NO. 2 % RETAINED</th>
<th>% PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1½&quot; (37.5 mm)</td>
<td>0.00</td>
<td>0</td>
<td>100</td>
<td>0.00</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>1&quot; (25 mm)</td>
<td>0.00</td>
<td>0</td>
<td>100</td>
<td>1.75</td>
<td>7.0</td>
<td>93.0</td>
</tr>
<tr>
<td>½&quot; (12.5 mm)</td>
<td>1.50</td>
<td>9.2</td>
<td>90.8</td>
<td>22.25</td>
<td>89.0</td>
<td>4.0</td>
</tr>
<tr>
<td>¼&quot; (6.3 mm)</td>
<td>13.25</td>
<td>81.5</td>
<td>9.3</td>
<td>1.00</td>
<td>4.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Pan</td>
<td>1.51</td>
<td>9.3</td>
<td>0.0</td>
<td>1.00</td>
<td>4.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>16.25*</td>
<td>100</td>
<td></td>
<td>25.00*</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Note:
*The total weight retained shown in this example calculation is equal to the original dry weight.

The batch weights for the coarse aggregate in a one cubic yard batch of concrete (using a 50-50 split of #1 and #2s) are as follows:

- No. 1 1010 lb.
- No. 2 1010 lb.

Determine the combined gradation for these two aggregates. Calculations for this example are also shown in Figure B-1.

Step 1
The batch weights of coarse aggregate are converted to percentages of the total coarse aggregate weight.

Whereas; \[ \% \text{ AGG 1} = \frac{\text{AGG WT. 1}}{\text{COMBINED AGG WT.}} \times 100 \]
So, for the #1 size: \[ \% \text{ AGG 1} = \frac{1010}{(1010 + 1010)} \times 100 = 50.0\% \]

and; \[ \% \text{ AGG 2} = \frac{\text{AGG WT. 2}}{\text{COMBINED AGG WT.}} \times 100 \]
So, for the #2 size: \[ \% \text{ AGG 2} = \frac{1010}{(1010 + 1010)} \times 100 = 50.0\% \]
December 2011

Materials Method 9.1

Step 2
The gradation for each coarse aggregate sieve (percent passing) is multiplied by the percentage of total coarse aggregate for the respective samples.

% Passing the ½" (12.5 mm) sieve in the No. 1 stockpile is 50 x 0.91 = 45.5%
% Passing the ½" (12.5 mm) sieve in the No. 2 stockpile is 50 x 0.04 = 2.0%
This calculation is repeated for each sieve size for both aggregates.

Step 3
The results obtained in Step 2 are added together for each sieve size to get the total percent passing for the combined gradation.

Total % Passing the ½" (12.5 mm) sieve:
   No. 1  45.5%
   No. 2  2.0%
   Total 47.5%

Example 2b
(Assume that the total weight of coarse aggregate remains at 2020 lb per cubic yard):

The same process could be used if the aggregates were to be split in a 60-40 blend (60% #1s, 40% #2s) to reach the combined gradation requirements:

Step 1
The No. 1 size: 60% of 2020 lb = 1210 lb.
The No. 2 size: 40% of 2020 lb = 810 lb.

Step 2
The % Passing the ½" (12.5 mm) sieve in the No. 1 stockpile is 60 x 0.91 = 54.6%
The % Passing the ½" (12.5 mm) sieve in the No. 2 stockpile is 40 x 0.04 = 1.6%

Step 3
The Total % Passing the ½" (12.5 mm) sieve = 54.6% + 1.6% = 56.2%

F. REPORT

Report the gradation test results on Form BR 317, Aggregate Tests - Portland Cement Concrete Plant. Round off the percent passing results to the nearest 0.1% percent.

G. ACTION

The gradation test results shall be compared to the specification limits. The Plant Inspector shall take the appropriate action described in Section 2-2.015, Aggregate Gradation Control.
<table>
<thead>
<tr>
<th>SIEVE SIZES (IN.)</th>
<th>NO. 3</th>
<th>NO. 2</th>
<th>NO. 1</th>
<th>NO. 1 &amp; NO. 2 (PREBLENDED)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WT.</td>
<td>PERCENT</td>
<td>SPEC. LIMITS</td>
<td>WT.</td>
</tr>
<tr>
<td>2 1/2</td>
<td>100</td>
<td>RET.</td>
<td>PASS</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>90-100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/4</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1</td>
<td>0-15</td>
<td>1.75</td>
<td>7.0</td>
<td>93.0</td>
</tr>
<tr>
<td>1/2</td>
<td>22.25</td>
<td>89.0</td>
<td>4.0</td>
<td>0-15</td>
</tr>
<tr>
<td>1/4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAN</td>
<td>1.00</td>
<td>4.0</td>
<td>0</td>
<td>1.51</td>
</tr>
<tr>
<td>TOTAL</td>
<td>25.00</td>
<td>100.0</td>
<td></td>
<td>16.25</td>
</tr>
</tbody>
</table>

**ORIG. DRIED WEIGHT:** 25.00 lb  16.25 lb

**COMBINED GRADATION**

<table>
<thead>
<tr>
<th>BIN</th>
<th>WEIGHT BATCHED</th>
<th>PERCENT BATCHED</th>
<th>PERCENT PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
<td>50.0</td>
<td>2.0</td>
</tr>
<tr>
<td>2</td>
<td>1010</td>
<td>50.0</td>
<td>46.5</td>
</tr>
<tr>
<td>1</td>
<td>1010</td>
<td>50.0</td>
<td>45.5</td>
</tr>
<tr>
<td>1 &amp; 2</td>
<td>1010</td>
<td>50.0</td>
<td>47.5</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>100.0</td>
<td>27-58</td>
</tr>
</tbody>
</table>

**GENERAL LIMITS**

<table>
<thead>
<tr>
<th></th>
<th>100</th>
<th>93-100</th>
<th>27-58</th>
<th>0-8</th>
</tr>
</thead>
</table>

**VISUAL IDENTIFICATION**

Compares favorably to certified aggregate reference sample? ☑ Yes ☐ No

T.J. Mulligan 7/16/07

FIGURE B-1
APPENDIX C

COARSE AGGREGATE CLEANNESS TEST

A. SCOPE

This test method prescribes the procedure for determining the percentage of material finer than the #200 (75 μm) sieve in the coarse aggregates.

B. SAMPLE

The sample shall be obtained and reduced to testing size in accordance with Appendix A, Sampling of Aggregates. The amount of aggregate required for a representative sample and the size of testing are as follows:

<table>
<thead>
<tr>
<th>AGGREGATE SIZE</th>
<th>ORIGINAL SAMPLE minimum</th>
<th>TEST SAMPLE minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>#3</td>
<td>40 lb (18 kg)</td>
<td>10 lb (4.5 kg)</td>
</tr>
<tr>
<td>#2</td>
<td>24 lb (11 kg)</td>
<td>6 lb (2.7 kg)</td>
</tr>
<tr>
<td>#1</td>
<td>12 lb (5 kg)</td>
<td>3 lb (1.4 kg)</td>
</tr>
<tr>
<td>#1A</td>
<td>12 lb (5 kg)</td>
<td>3 lb (1.4 kg)</td>
</tr>
</tbody>
</table>

C. EQUIPMENT

The following equipment is required for the coarse aggregate cleanness test:

1. Oven or hot plates
2. Pans: 3- 12” x 12” (305 x 305 mm)
3. Stirring Spoon: 12” (305 mm)
4. Brush
5. Large scale: Min. capacity: 30 lb (14 kg). Maximum graduations: 0.01 lb (0.005 kg).
6. Sieves: #16 and #200 (1.18 mm and 75 μm).

D. TEST PROCEDURE

1. Dry the test sample to constant weight.
2. Allow sample to cool, then weigh. Record this weight as “weight of original sample”.
3. Place the dried aggregate sample in a pan or vessel, cover with water.
4. Agitate vigorously to separate the fine particles from the coarse aggregate and bring the fine material into suspension.

5. Decant the wash water containing the suspended solids immediately through two nested sieves #16 and #200 (1.18 mm and 75 \( \mu \)m) taking care that none of the coarser particles are decanted into the sieves.

6. Continue Steps 2, 3 and 4 until the wash water is clear.

7. Return all material retained on the nested sieves (by flushing with water) to the washed sample in the pan.

8. Dry the washed sample to a constant weight.

9. Allow the sample to cool, then weigh the sample and record this weight as weight after washing.

E. CALCULATION

The percentage of minus #200 (75 \( \mu \)m) material is computed by the following equation:

\[
\% \text{ minus } #200 \ (75 \ \mu\text{m}) \ \text{Material} = \frac{(W_{\text{osd}} - W_{\text{wsd}})}{W_{\text{osd}}} \times 100
\]

\( W_{\text{osd}} \) = Weight of original sample after drying

\( W_{\text{wsd}} \) = Weight of washed sample after drying

An example is shown in Appendix G (Figure G-1).

F. REPORT

Report the percentage of material finer than the #200 (75 \( \mu \)m) sieve and the computations for each size coarse aggregate tested on Form BR 317 Aggregate Tests - Portland Cement Concrete Plant. Round off the test results to the nearest 0.1 percent.

G. ACTION

The percent of minus #200 (75 \( \mu \)m) material shall be compared to the specification limits of Section 501-2 and Item 703-02. The Plant Inspector shall take the appropriate action indicated under Section 2-2.014 (b), Coarse Aggregate Cleanness.
APPENDIX D

FINE AGGREGATE GRADATION TEST

A. SCOPE

This test method prescribes the procedure for determining the gradation of the fine aggregate. The percentage of material finer than the #200 (75 \( \mu \text{m} \)) sieve is part of the complete fine aggregate gradation test.

NOTE:
This method is intended for use when the requirements of 703-07 (Concrete Sand), and 501-2 (Aggregate Gradations) are specified. When producing concrete which does not require the gradation requirements of 703-07 or 501-2, the procedures and gradation requirements described in AASHTO T-27 may be used in lieu of these procedures, where appropriate.

B. SAMPLE

The sample shall be obtained and reduced to testing size in accordance with Appendix A, Sampling of Aggregates. The amount of aggregate required for a representative sample is a minimum of 10 lb (4.5 kg.) and the sample size required for testing is a minimum of 500 grams.

C. EQUIPMENT

The following equipment is required for the fine aggregate gradation test:

1. Power driven fine aggregate sieve shaker with appropriate sieves and timer

2. Small scale: Minimum 1500 gram capacity. Maximum graduations: 0.1 gram

3. Oven or hot plates

4. Pans or trays; 3- 12" x 12" (305 x 305 mm) minimum

5. Brushes (coarse and soft)

6. Stirring spoon: 12" (305 mm)

7. Sieves #16 and #200 (1.18 mm and 75 \( \mu \text{m} \)) for washing.

8. Sieves: 3/8", #4, #8, #16, #30, #50, #100, #200, and pan (9.5 mm, 4.75 mm, 2.36 mm, 1.18 mm, 600 \( \mu \text{m} \), 300 \( \mu \text{m} \), 150 \( \mu \text{m} \), 75 \( \mu \text{m} \), and pan) for dry sieving.
D. TEST PROCEDURE

A complete fine aggregate gradation test shall include a determination of the minus #200 (75 μm) material by a washed analysis. The Materials Engineer may allow a reduction of daily testing for minus #200 (75 μm) material via the washed analysis when at least 3 consecutive wash tests indicate that the minus #200 (75 μm) material is less than 1.0 %. However, the minus #200 (75 μm) wash test must be performed at least once per week as part of the complete gradation test.

When the Materials Engineer permits this reduced testing option, a #200 (75 μm) sieve shall be added to the nest of sieves (as described in step #9 below) when performing a dry gradation analysis. Steps # 3 through 8 are skipped when performing a reduced gradation. However, if the amount of material retained on the #200 sieve during the dry gradation test increases by more than 0.3% between two consecutive daily gradation tests; a full gradation test, including the minus #200 wash test be must be performed as follows:

1. Dry the sample until the weight is constant.

2. Allow the sample to cool, then weigh. Record this weight as “weight of original sample”.

3. Place the entire sample in a pan. Add sufficient water to cover the sample. Agitate the sample with sufficient vigor to separate all particles finer than the #200 (75 μm) sieve from the coarser particles, and to bring the fine material into suspension.

4. Immediately pour the wash water containing the suspended and dissolved solids over a nest of the #16 (1.18 mm) (on top) and #200 (75 μm) sieve. Take care to avoid the decantation of coarser particles of the sample.

5. Add a second charge of water to the sample in the pan, agitate and decant as in (4) above. Repeat this procedure until the wash water is clear.

6. Return all material retained on the nested sieves (by flushing with water) to the washed sample in the pan.

7. Dry the washed sample until the weight is constant.

8. Allow the sample to cool, then weigh. Record this weight as “dry weight after washing”.

9. Place the dried sample in the following nest of 8" (203 mm) diameter sieves: 3/8", #4, #8, #16, #30, #50, #100, #200, and pan (9.5 mm, 4.75 mm, 2.36 mm, 1.18 mm, 600 μm, 300 μm, 150 μm, 75 μm, and pan). Shake the sieves for at least 10 minutes. Care must be taken to not overload the sieves. As a guide, any 8" (203 mm) diameter fine aggregate sieve loaded with more than 200 grams of materials at the end of the test may be considered as overloaded. When overloading occurs, it will be necessary to sieve only portions of the sample at a time, or to introduce a sieve having larger openings above the critical sieve and add the results to obtain the total sample gradation.
10. Carefully weigh the material retained on each sieve and the pan. To determine the amount of material retained on each sieve, first empty the retained loose particles from each sieve into a pre-tared, steel bowl on the small laboratory scale*. Carefully clean each sieve by inverting the sieve into the bowl, then using a soft bristle brush, carefully dislodge the retained particles by brushing the screen and lightly tapping the sides of the sieve. Do not use excess force or use hard, sharp tools while attempting to clean the sieve. This may damage the sieve and invalidate the procedure for all future tests. Record the material retained on each sieve and pan on Form BR 317 Aggregate Tests - Portland Cement Concrete Plant.

Do not weigh the sieve with the retained material, or use a pre-recorded empty sieve (tare) weight. Not only is this poor practice, but an accumulation of particles over time will effect the empty weight of the sieve, and decrease the effective openings in the sieve.

Each sieve should be carefully cleaned and inspected after each gradation test.

* The bowl must be large enough to encompass the entire 8” sieve, so that no material is lost during the process.

When performing a full gradation test (including the wash test), combine the weight of the minus #200 material (material lost from the wash test) with the weight retained in the pan during dry sieving.

E. CALCULATIONS

The fine aggregate gradation is calculated by using results from the wet and dry sieving. The computations necessary to obtain "percent passing" are illustrated in the following example. Figure G-1, in Appendix G, shows how the calculations are reported on Form BR 317.
Example
(To reduce the confusion created by displaying dual units, the weights and calculations in the following example are being presented in metric units only).

A sample of fine aggregate has been tested and the following data obtained:

- **Dry Wt. - Original Sample:** 504.8 gms.
- **Dry Wt. - After Washing:** 502.3 gms.
- **Weight lost through washing:** 2.5 gms. (This is the minus #200 material)

To calculate the percent passing the #200 sieve, divide the “weight lost after washing” by the dry weight of the sample before washing, then multiply by 100 to express as a percent.

\[
\frac{2.5 \text{ gms.}}{504.8 \text{ gms.}} \times 100 = 0.49 \approx 0.5\% \text{ (rounded to the nearest 0.1%).}
\]

<table>
<thead>
<tr>
<th>SIEVE</th>
<th>WEIGHT RETAINED (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot; (9.5 mm)</td>
<td>0</td>
</tr>
<tr>
<td>#4 (4.75 mm)</td>
<td>40.9</td>
</tr>
<tr>
<td>#8 (2.36 mm)</td>
<td>62.1</td>
</tr>
<tr>
<td>#16 (1.18 mm)</td>
<td>93.9</td>
</tr>
<tr>
<td>#30 (600 μm)</td>
<td>115.0</td>
</tr>
<tr>
<td>#50 (300 μm)</td>
<td>85.8</td>
</tr>
<tr>
<td>#100 (150 μm)</td>
<td>81.3</td>
</tr>
<tr>
<td>#200 (75 μm)</td>
<td>23.4</td>
</tr>
<tr>
<td>Pan *including the minus #200 material from the wash test. (See step 1)</td>
<td>2.6</td>
</tr>
<tr>
<td><strong>Total weight:</strong></td>
<td><strong>505.0</strong></td>
</tr>
</tbody>
</table>

To calculate the fine aggregate gradation, use the following steps:

**Step 1**

Combine the value of the material retained in the pan (during dry sieving) with the value of the material lost from the wash test (0.1 + 2.5 = 2.6 grams). This result will be shown as the weight retained in the pan.

**Step 2**

The amounts **retained** are now expressed as percentages of the **original sample** (dry weight before washing).
<table>
<thead>
<tr>
<th>Sieve</th>
<th>% Retained</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot; (9.5 mm)</td>
<td>0%</td>
</tr>
<tr>
<td>#4 (4.75 mm)</td>
<td>8.1%</td>
</tr>
<tr>
<td>#8 (2.36 mm)</td>
<td>12.3%</td>
</tr>
<tr>
<td>#16 (1.18 mm)</td>
<td>18.6%</td>
</tr>
<tr>
<td>#30 (600 μm)</td>
<td>22.8%</td>
</tr>
<tr>
<td>#50 (300 μm)</td>
<td>17.0%</td>
</tr>
<tr>
<td>#100 (150 μm)</td>
<td>16.1%</td>
</tr>
<tr>
<td>75 μm</td>
<td>4.6%</td>
</tr>
<tr>
<td>Pan *</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

* This includes the actual weight of material retained in the pan from dry sieving, plus the amount of material lost during the minus #200 (wash) test.

** May sometimes be only within one or two tenths of 100.0% due to rounding. This may be neglected. However, the final weight must not vary by more than 0.3% from the original dried sample weight.

In this example, the variation between total weight of the material retained (on all sieves and the pan) and the Original Dried Weight is determined as follows:

Total Weight retained: 505.0
Original Dried Weight: 504.8
Difference: = 0.2 grams

Divide the difference by the original dried weight then multiply by 100 to express as a percent:

\[(0.2 \div 504.8) \times 100 = 0.04\%\] (In this example, the variation is within the 0.3% limit).
The percent passing is determined by subtracting the percent retained (starting from the largest sieve) from 100, then subtracting the percent retained for the next smaller sieve from this remainder, and so on. This is repeated through the nest of sieves, including the pan.

For example:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot; (9.5 mm)</td>
<td>100 – 0 = 100</td>
</tr>
<tr>
<td>#4 (4.75 mm)</td>
<td>100 – 8.1 = 91.9</td>
</tr>
<tr>
<td>#8 (2.36 mm)</td>
<td>91.9 – 12.3 = 79.6</td>
</tr>
<tr>
<td>#16 (1.18 mm)</td>
<td>79.6 – 18.6 = 61.0</td>
</tr>
<tr>
<td>#30 (600 μm)</td>
<td>61.0 – 22.8 = 38.2</td>
</tr>
<tr>
<td>#50 (300 μm)</td>
<td>38.2 – 17.0 = 21.2</td>
</tr>
<tr>
<td>#100 (150 μm)</td>
<td>21.2 – 16.1 = 5.1</td>
</tr>
<tr>
<td>#200 (75 μm)</td>
<td>5.1 – 4.6 = 0.5</td>
</tr>
<tr>
<td>Pan</td>
<td>0.5 – 0.5 = 0</td>
</tr>
</tbody>
</table>

**F. REPORT**

The gradation test results shall be determined and reported on Form BR 317, Aggregate Tests - Portland Cement Concrete Plant. Round off the percent passing results to the nearest 0.1% percent.

**G. ACTION**

The gradation test results shall be compared to the specification limits of NYSDOT Standard Specifications, Section 501-2 and Item 703-07. Based on the results of the gradation test, take the appropriate action described in Section 2-2.015, Aggregate Gradation Control.
APPENDIX E

FINE AGGREGATE FINENESS MODULUS TEST

A. SCOPE

This test method prescribes the procedure for determining the fineness modulus (FM) of a fine aggregate. The fineness modulus of an aggregate is an index of its relative fineness. The higher the fineness modulus, the coarser the aggregate is. The fineness modulus is used to compute the fine aggregate proportioning in the PCC mix design.

B. GENERAL

The fineness modulus is computed from data obtained from the fine aggregate gradation test under Appendix D, Fine Aggregate Gradation Test. All the sieve sizes are used except the 3/8” (9.5 mm) and the #200 (75 μm).

C. CALCULATION

The “% Passing” results representing the total percent passing each sieve are converted to total percent of material retained on each sieve. This is accomplished by subtracting the individual “% Passing” from 100. The fineness modulus is determined by summing these results and dividing by 100. The fineness modulus is computed below for the fine aggregate gradation example given in Appendix D, Fine Aggregate Gradation.

To reduce the confusion created by displaying dual units, the weights and calculations in the following example are being presented in metric units only. Also, this fineness modulus is illustrated on the BR 317 form shown in Figure G-1, Appendix G.

Step 1

<table>
<thead>
<tr>
<th>SIEVE</th>
<th>TOTAL % PASSING</th>
<th>TOTAL % RETAINED</th>
</tr>
</thead>
<tbody>
<tr>
<td>#4 (4.75 mm)</td>
<td>91.9</td>
<td>100 - 91.9 = 8.1</td>
</tr>
<tr>
<td>#8 (2.36 mm)</td>
<td>79.6</td>
<td>100 - 79.6 = 20.4</td>
</tr>
<tr>
<td>#16 (1.18 mm)</td>
<td>61.0</td>
<td>100 - 61.0 = 39.0</td>
</tr>
<tr>
<td>#30 (600 μm)</td>
<td>38.2</td>
<td>100 - 38.2 = 61.8</td>
</tr>
<tr>
<td>#50 (300 μm)</td>
<td>21.2</td>
<td>100 - 21.2 = 78.8</td>
</tr>
<tr>
<td>#100 (150 μm)</td>
<td>5.1</td>
<td>100 - 5.1 = 94.9</td>
</tr>
</tbody>
</table>

| TOTAL = 303.0 |

Step 2

The “Total % Retained” figures are then added. The fineness modulus is the sum divided by 100.

FM = (303.0) / 100 = 3.030
**D. REPORT**

The fine aggregate fineness modulus shall be determined and reported on *Form BR 317, Aggregate Tests - Portland Cement Concrete Plant*. Round off the fineness modulus results to the nearest 0.01.

**E. ACTION**

The fineness modulus shall be compared to the design value given on the mix design. If the average of the three most recent test results has changed by more than 0.20 from the value used in the mix design, contact the Regional Materials Engineer to make the appropriate adjustments to the concrete mix design. The Plant Inspector shall take the appropriate action described in Section 2-2.014 (d), Fine Aggregate Fineness Modulus.
APPENDIX F
AGGREGATE VISUAL IDENTIFICATION TEST

A. SCOPE

This test method describes the procedures for determining if the aggregates appear to be from the sources certified by the Producer. This visual test is generally performed in conjunction with the aggregate gradation tests. Any production that includes friction aggregates should also include the procedures outlined in Materials Method 28 – *Friction Aggregate Control and Test Procedures*.

B. GENERAL

The test is performed by comparing an aggregate sample representing the production to a reference sample for likeness in color, particle shape, etc. The reference sample shall be prepared as directed by the Regional Materials Engineer and placed in the testing laboratory at the plant. A duplicate sample may be required by the Regional Materials Engineer, to be submitted to the Main Office Geology Laboratory.

The reference sample shall be prepared by washing aggregate known to be from the approved source. The fine aggregate shall be dried; the coarse aggregate may be kept either dry or wet depending upon the preference of the Materials Engineer. The reference sample shall be identified by source name and number, test number, aggregate size, date prepared and the name of the person who prepared the sample.

C. SAMPLE

Coarse Aggregate

The aggregates retained on each sieve in the gradation test described in Appendix B, Coarse Aggregate Gradation Test shall be the samples used in this test.

Fine Aggregates

The aggregates retained in the #8 (2.36 mm), #16 (1.18 mm), #30 (600 \( \mu \text{m} \)) and #50 (300 \( \mu \text{m} \)) sieves in the gradation test described in Appendix D, Fine Aggregate Gradation Test shall be the samples used in this test.

D. EQUIPMENT

The following equipment is required for the coarse aggregate visual identification test:

1. Pans or trays: 4 - 12" x 12" (305 x 305 mm) minimum
2. Oven or hot plates
3. Stirring spoon: minimum length: 12" (305 mm)
E. TEST PROCEDURE

1. Wash the aggregates retained on each sieve and place the thoroughly washed aggregate in individual trays.

2. Dry the samples. Do not heat the aggregate excessively because the heat may cause the particles to change color.

   NOTE: If the reference samples for coarse aggregate are kept wet, the samples shall be compared wet.

3. Place the trays containing the test samples adjacent to corresponding samples of the reference material.

4. Compare each size visually for likeness in color, particle shape, etc. If the coarse aggregate used at the plant is gravel, visually examine the particles for fractured faces as per Section 703-02 of the Standard Specifications.

F. REPORT

The production sample shall be compared to the reference sample and the comparison shall be reported on Form BR 317, Aggregate Tests - Portland Cement Concrete Plant. Any differences shall be noted.

G. ACTION

If there appears to be a difference in the color, particle shape, or the amount of fractured faces in the crushed gravel (if applicable), contact the Regional Materials Engineer. The Materials Engineer may require further investigation of the aggregates used at the facility, including ASTM D 5821-Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.
APPENDIX G
AGGREGATE FREE MOISTURE CONTENT TEST

A. SCOPE

This method prescribes the procedure for determining the free moisture content of coarse and fine aggregates.

B. SAMPLE

The sample shall be obtained and reduced to testing size in accordance with Appendix A, Sampling of Aggregates. The amount of aggregate required for a representative sample and the size of sample for testing are as follows:

<table>
<thead>
<tr>
<th>SIZE</th>
<th>ORIGINAL SAMPLE (minimum)</th>
<th>TEST SAMPLE (minimum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Aggregate</td>
<td>12 lb (5.5 kg)</td>
<td>3 lb (1.35 kg)</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>5 lb (2.5 kg)</td>
<td>500 g</td>
</tr>
</tbody>
</table>

C. EQUIPMENT

The following equipment is required for the aggregate moisture content test:

1. Oven or hot plates
2. Pans or trays; 3-12" x 12" (305 x 305 mm) minimum
3. Stirring Spoon; 12" length (305 mm) minimum
4. Brushes
5. Small scale: Minimum capacity: 1500 grams. Maximum graduation: 0.1 gram
6. Large scale; minimum capacity of 30 lb (14 kg). Maximum graduation: 0.01 lb (0.005 kg)

D. TEST PROCEDURE

1. Weigh the aggregate sample. Record this weight as "weight of wet sample"
2. Dry the sample to a constant weight.
3. Allow the sample to cool, then weigh. Record this weight as "weight of dry sample."
4. Fill in the Absorption content (percent) on the BR 317 report, as obtained from the Regional Materials Engineer, or by consulting the latest edition of the Department’s Approved List of Sources of Fine and Coarse Aggregates.

NOTE: If the aggregate moisture content is less than saturated surface dry, the moisture content will be negative.

E. CALCULATIONS

The free moisture content is computed by using the following formula:

\[ M_f = (W_{\text{wet}} - W_{\text{dry}} + W_{\text{dry}}) - \% \text{ Abs.} \times 100 \]

Where:

- \( M_f \) = Free Moisture (%)
- \( W_{\text{wet}} \) = Weight of wet sample from stockpile, etc.
- \( W_{\text{dry}} \) = Weight of sample at a dry (constant) condition
- \( \% \text{ Abs.} \) = The % Absorption of the aggregate as listed in the latest Approved List of Aggregates.

F. REPORT

The aggregate moisture content shall be determined and reported on Form BR 317. Round off the moisture content to the nearest 0.1 percent.

G. ACTION

The plant Inspector shall take the appropriate action described in Section 2-2.014 (f), Aggregate Free Moisture Content. Any fine aggregate that has a free moisture content greater than 8 % by weight may not be used for producing mixes for Department Projects (as per § 501 -3.02 A.) An example of the free moisture test report is shown in Figure G-1.
### Materials Method 9.1

**BR 317 (10/2008)**

**NEW YORK STATE DEPARTMENT OF TRANSPORTATION**

**MATERIALS BUREAU AGGREGATE TESTS**

**PORTLAND CEMENT CONCRETE PLANT**

<table>
<thead>
<tr>
<th>PLANT #</th>
<th>ABC CONCRETE (C)</th>
<th>LOCATION</th>
<th>STAFFORD’S BRIDGE NY</th>
<th>REGION</th>
<th>12</th>
</tr>
</thead>
</table>

**DATE**

07/07/2007

**TIME OF SAMPLE**

12:12 PM

**CONCRETE CLASS**

HP

**TESTS:**

- □ routine
- □ retest

**INSPECTOR**

T. J. MULLIGAN

**CONTRACTS SERVED:**

D 299999

---

### Fine Aggregate Tests

<table>
<thead>
<tr>
<th>SIEVE</th>
<th>WT.</th>
<th>% RETAINED</th>
<th>% PASSING</th>
<th>SPEC. LIMITS</th>
<th>100- % PASS</th>
<th>Compares favorably to certified aggregate reference sample?</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>0.0</td>
<td>0.0</td>
<td>100</td>
<td>100</td>
<td></td>
<td>Yes □ No</td>
</tr>
<tr>
<td>#4</td>
<td>40.9</td>
<td>8.1</td>
<td>91.9</td>
<td>90-100</td>
<td>8.1</td>
<td></td>
</tr>
<tr>
<td>#8</td>
<td>62.1</td>
<td>12.3</td>
<td>79.6</td>
<td>75-100</td>
<td>20.4</td>
<td></td>
</tr>
<tr>
<td>#16</td>
<td>93.9</td>
<td>18.6</td>
<td>61.0</td>
<td>50-85</td>
<td>39.0</td>
<td></td>
</tr>
<tr>
<td>#30</td>
<td>115.0</td>
<td>22.8</td>
<td>38.2</td>
<td>25-60</td>
<td>61.8</td>
<td></td>
</tr>
<tr>
<td>#50</td>
<td>85.8</td>
<td>17.0</td>
<td>21.2</td>
<td>10-30</td>
<td>78.8</td>
<td></td>
</tr>
<tr>
<td>#100</td>
<td>81.3</td>
<td>16.1</td>
<td>5.1</td>
<td>1-10</td>
<td>94.9</td>
<td></td>
</tr>
<tr>
<td>#200</td>
<td>23.4</td>
<td>4.6</td>
<td>0.5</td>
<td>0-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAN</td>
<td>2.6</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>505.0</td>
<td></td>
<td>303.0</td>
<td>TOTAL</td>
<td>303.0</td>
<td>303.0 / 100 = 3.03 FM (MIXDESIGN) 2.96</td>
</tr>
</tbody>
</table>

**ORIGINAL DRIED WEIGHT:**

504.8 gms

FM = (TOTAL - WT. AFTER WASHING) / WT. ORIGINAL SAMPLE

**MINUS #200 Material**

\[
\text{Free Moisture Content} = \frac{2.5 \times 504.8 \times 100}{100} = 0.5 \%
\]

**Agg. Size**

<table>
<thead>
<tr>
<th>WT. ORIGINAL SAMPLE (DRY) (A)</th>
<th>504.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>WT. AFTER WASHING (DRY) (B)</td>
<td>502.3</td>
</tr>
<tr>
<td>WT. MINUS #200 MAT'L. (A-B)</td>
<td>2.5</td>
</tr>
</tbody>
</table>

**% ABS. (C)**

* From the Department’s Approved List of Aggregate Sources

<table>
<thead>
<tr>
<th>AGGREGATE SIZE DESIGNATION</th>
<th>FINE AGG.</th>
<th>AGG. SIZE</th>
<th>FINE</th>
<th>NO. 1</th>
<th>NO. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>WT. ORIGINAL SAMPLE (DRY) (A)</td>
<td>504.8</td>
<td>WT. (WET) (A)</td>
<td>510.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WT. AFTER WASHING (DRY) (B)</td>
<td>502.3</td>
<td>WT. (DRY) (B)</td>
<td>498.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WT. MINUS #200 MAT'L. (A-B)</td>
<td>2.5</td>
<td>% ABS. (C)</td>
<td>1.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**% FREE MOISTURE (A-B) x 100 – C B**

1.3

**Figure G-1**
APPENDIX H
UNIFORMITY TEST PROCEDURE

A. SCOPE

This appendix prescribes the procedure to be followed for conducting a concrete uniformity test. The uniformity test is also known as a mixer efficiency test.

B. GENERAL

This test is used to determine the ability of a mixer, conveyance system or hauling unit to mix and/or deliver uniform concrete. Samples of plastic concrete are taken from points near the beginning and near the end of discharge from a mixer, conveyance system or haul unit and a series of tests are conducted on each sample. These tests are slump, air content, air-free unit weight of concrete, mortar distribution and coarse aggregate distribution. The results of the tests taken from the “front” and “back” are compared to each other. If the concrete is uniform from “front” to “back”, the results will be similar to within allowable limits. The prescribed limits are listed at the end of this section, and in the Standard Specifications, Section 501-3.03. With prior approval from the Regional Materials Engineer, an abbreviated uniformity test may be conducted by testing the front and back samples for slump and air content only. Refer to Materials Method 9.2 for individual test procedures.

The uniformity test is used only in instances where it is required by the specifications. Table H-1 prescribes the application of uniformity testing procedures to the various concrete mixing and/or delivery systems.

C. EQUIPMENT

The following equipment is required to conduct a complete uniformity test:

1. Sample and Water Containers
2. Two (2) Slump Cones and Accessories
3. Two (2) Air Meters and Accessories
4. Washout Sieve, ¼” (6.3 mm) or #4 (4.75 mm)
5. Scale, 100 lb (45 kg) capacity
D. SAMPLE

Individual samples shall be taken after discharge of approximately 15 percent and 85 percent of the load. Due to the difficulty of determining the actual quantity of concrete discharged, the intent is to provide 2 samples that are representative of widely separated portions, but not the beginning and end of the load.

The samples shall be obtained directly from the discharge of mixers, conveyance system, or hauling equipment prior to any subsequent transportation, spreading or vibration operations.
**UNIFORMITY TEST APPLICATION**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>1. CENTRAL MIXERS</th>
<th>2. TRANSIT AND TRUCK MIXERS</th>
<th>3. HAUL UNITS AND CONVEYANCE UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PURPOSE:</td>
<td>To establish minimum mixing times</td>
<td>Check uniformity</td>
<td>Check uniformity of delivery</td>
</tr>
<tr>
<td>WHEN REQUIRED:</td>
<td>When there is a request to reduce mixing time</td>
<td>When ordered by the Engineer. Conduct further tests only when routine tests frequently fail or uniformity is detected visually</td>
<td>Same as 2. As per the requirements of Standard Specification 555-3.04</td>
</tr>
<tr>
<td>TEST SERIES:</td>
<td>1) Slump 2) Air 3) Unit Wt. (Air-Free) 4) Coarse Agg. Content 5) Air-Free Mortar</td>
<td>Same as Section #1 (Central Mixers) except that an abbreviated test series may be substituted as follows: 1) Slump 2) Air</td>
<td>Same as 2</td>
</tr>
<tr>
<td>CRITERIA:</td>
<td>The five tests in the above series are performed on seven consecutive batches for the desired mixing time. Six out of seven batches must meet the limits stated in the Concrete Uniformity Table in §501.</td>
<td>At least one series of tests are conducted for each unit in question. If a unit fails to meet the limits stated in the Concrete Uniformity Table in §501, the unit shall not be used until satisfactory corrective action has been taken</td>
<td>Same as 2</td>
</tr>
</tbody>
</table>

Each sample shall be large enough to perform both a slump test and an air test separately.

**TABLE H-1**
E. TEST PROCEDURE

The following procedure shall be followed when conducting a complete uniformity test:

Follow the procedures in Materials Method 9.2 for sampling, slump, and air content via the pressure meter.

**STEP**

1. Obtain front and back samples.
2. Conduct slump test on each sample.
3. Fill base of air meter with concrete. Obtain weight of base & concrete for each sample.
4. Conduct air tests on samples weighed in Step 3.
5. Transfer concrete in air meter base to washout sieve for each sample.
6. Remove all mortar from each sample by washing the concrete on the sieve in water.
7. Weigh the washout sieve containing the coarse aggregate submerged in water. This is accomplished by hanging the sieve from the scale by wires or rods. The entire sieve and its sample must be submerged.

F. EXAMPLE COMPUTATIONS

(Note: To reduce the confusion created by displaying dual units, the following example is being presented in USC units only)

<table>
<thead>
<tr>
<th></th>
<th><strong>FRONT SAMPLE</strong></th>
<th><strong>BACK SAMPLE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Slump</td>
<td>2&quot;</td>
<td>2 1/2&quot;</td>
</tr>
<tr>
<td>2. Air</td>
<td>7.0%</td>
<td>6.5%</td>
</tr>
<tr>
<td>3. Wt. of Concrete &amp; Base (in Air)</td>
<td>44.14 lb</td>
<td>44.65 lb</td>
</tr>
<tr>
<td>4. Wt. of Coarse Aggregate and Sieve (in Water)</td>
<td>16.14 lb</td>
<td>16.87 lb</td>
</tr>
</tbody>
</table>
The following additional data is required for the calculations:

1. Volume Air Meter Base 0.25 cubic feet
2. Wt. of Air Meter Base (in Air) 7.91 lb
3. Specific Gravity, Coarse Aggregate 2.70
4. Wt., Washout Sieve (in Water) 4.00 lb

B. Unit Weight Variation - Air-Free Basis

The following example is used to illustrate the calculations performed to determine the variation in the air-free unit weight of concrete:

1. Unit Weight

Where:

\[ U = \text{Unit weight of concrete air-free basis}. \]
\[ b = \text{Weight of concrete sample in air meter base. This is equal to the weight of the concrete and base minus the weight of the base}. \]
\[ v = \text{Volume of air meter base, cubic feet} \]
\[ A = \text{Air content of sample (percent)} \]

Using the example data:

Front Sample:

\[ U_F = \frac{44.14 - 7.91}{0.25\left(1 - \frac{7.0}{100}\right)} \]

\[ = \frac{36.23}{0.2325} = 155.83 \text{ lbs/cubic ft}. \]
Back Sample:

\[ U_B = \frac{44.65 - 7.91}{0.25 \left( 1 - \frac{6.5}{100} \right)} \]

\[ = \frac{36.74}{23375} = 157.18 \text{ lbs/cubic ft.} \]

2. Variation

Variation = \((U_F - U_B)\) or \((U_B - U_F)\)

Using the example data:

Variation = 157.18 - 155.83 = 1.35 lb/cubic feet

This falls below the maximum permissible variation of 2 lb/cubic feet (As per §501).

C. Coarse Aggregate Variation

The following example is used to illustrate the calculations performed to determine the percent variation in coarse aggregate:
1. **% Coarse Aggregate** -

\[ P = \frac{c}{b} \times 100 \]

Where:

\( P \) = % coarse aggregate by weight in concrete.

\( b \) = Weight of concrete sample in air meter base. This is equal to the weight of the concrete and base minus the weight of the base.

\( c \) = Saturated-surface-dry (SSD) weight of aggregate retained on sieve. This can be determined in the following manner:

\[ c = \frac{(\text{Wt. Sieve & Aggregate In Water} - \text{Wt. Sieve in Water}) \times (G)}{(G-1)} \]

Where:

\( G \) = Specific Gravity, Coarse Aggregate (from current NYSDOT Approved List of Aggregates).

Using the example data:

**Front Sample:**

\( b = 44.14 - 7.91 = 36.23 \)

\( c = \frac{(16.14 - 4.00) \times (2.70)}{(2.70 - 1)} = 19.28 \text{ lb} \)

\( P_F = \frac{19.28}{36.23} \times 100 = 53.22\% \)

**Back Sample:**

\( b = 44.65 - 7.91 = 36.74 \)

\( c = \frac{(16.87 - 4.00) \times (2.70)}{(2.70 - 1)} = 20.44 \text{ lb} \)

\( P_B = \frac{20.44}{36.74} \times 100 = 55.63\% \)
2. Variation -

Variation in % Coarse Aggregate = \((P_F - P_B)\) or \((P_B - P_F)\)

Using the example data:

Variation in % Coarse Aggregate = 55.63 % - 53.22 % = 2.41 %

This falls below the maximum permissible variation of 6% (As per §501).

D. Air - Free Mortar Variation

The following example is used to illustrate the calculations performed to determine the percent variation in the air-free mortar:

I. Unit Weight Air-Free Mortar -

\[
M = \frac{b-c}{V - \left( \frac{V(A) + \frac{c}{100 G (62.4)}}{G} \right)}
\]

Where:

\(M\) = Unit Weight air-free mortar, (lb per cubic yard)

\(b\) = Weight of concrete sample in air meter base. This is equal to the weight of the concrete and base minus the weight of the base.

\(c\) = Saturated-surface-dry (SSD) weight of aggregate retained on sieve.

\(G\) = Specific Gravity, Coarse Aggregate.

\(V\) = Volume of air meter base (cubic feet)

\(A\) = Air content of sample (percent)

Using the example data:

Front Sample:

\(b\) = 36.23

\(c\) = 19.28

\(G\) = 2.70

\(V\) = 0.25 ft³

\(A\) = 7.0 %
\[
M_F = \frac{36.23 - 19.28}{0.25 - \left[ \frac{(0.25)(7.0)}{100} + \frac{19.28}{(2.70)(62.4)} \right]} = 143.52 \text{ lbs/cubicft.}
\]

Back Sample:

\[
\begin{align*}
b &= 36.74 \\
c &= 20.44 \\
G &= 2.70 \\
V &= 0.25 \text{ ft}^3 \\
A &= 6.5 \%
\end{align*}
\]

\[
M_B = \frac{36.74 - 20.44}{0.25 - \left[ \frac{(0.25)(6.5)}{100} + \frac{20.44}{(2.70)(62.4)} \right]} = 144.89 \text{ lbs/cubicft}
\]

2. \% Variation -

\[
\text{% Variation in Air-Free Mortar} = \frac{M_F - M_B}{M_F + M_B} \times 100
\]

Using the example data:

\[
\text{% Variation} = \left( \frac{144.89 - 143.52}{144.89 + 143.52} \right) \times 100 = 0.95\%
\]

This falls below the maximum permissible variation of 1.6 \% (As per §501).
G. DATA SUMMARY AND CRITERIA

Upon completion of testing, the data is summarized and compared to the “uniformity criteria”. The following is an example of a data summarization for a “complete” uniformity test. The example that is shown below is from the 2008 Standard Specifications. It applies to central mixers and haul units. The Project specifications must be consulted to assure that the “job-specific” acceptance criteria have been considered.

<table>
<thead>
<tr>
<th>TEST</th>
<th>EXAMPLE VARIATION</th>
<th>PERMISSIBLE VARIATION per §501 (Samples taken at two locations in the batch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Weight per cubic foot, calculated to an Air-Free Basis</td>
<td>1.35 lb/ft³ (23 kg/m³)</td>
<td>2.0 lb/ft³ (32.0 kg/m³)</td>
</tr>
<tr>
<td>2. Air Content, % by volume of concrete</td>
<td>0.5%</td>
<td>1.0%</td>
</tr>
<tr>
<td>3. Slump:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average slump 4” (100 mm) or less</td>
<td>⅛” (14 mm)</td>
<td>1” (25 mm)</td>
</tr>
<tr>
<td>Ave. slump greater than 4” (100 mm)</td>
<td></td>
<td>1 ⅛” (40 mm)</td>
</tr>
<tr>
<td>4. Coarse aggregate content, portion by weight of each sample retained on a #4 (4.75 mm) sieve.</td>
<td>2.4 %</td>
<td>6.0 %</td>
</tr>
<tr>
<td>5. Unit weight of air-free mortars based on average for all comparative samples tested.</td>
<td>0.9 %</td>
<td>1.6 %</td>
</tr>
</tbody>
</table>

TABLE H-2