Chapter 1

Department Specifications for Bituminous Mixing Plants for Hot-Mixed, Hot-Laid Paving Mixtures

1. Scope

1.1 The Department requirements specified herein are intended for plants producing hot-mixed, hot-laid bituminous paving mixtures.

1.2 These requirements govern the acceptability of a plant and are considered specifications for initial plant approval and plant re-inspections. Approved producers of bituminous mixtures are listed in Bulletin 41 (Pub. 41).

2. General Requirements for All Plants

2.1 Uniformity and Control of Completed Mixtures. The plant shall be designed, operated and maintained such that it is capable of combining and mixing any required sizes of heated aggregate and reclaimed asphalt pavement (RAP) and/or recycled asphalt shingles (RAS), when required, from stockpiles or bins with asphalt binder (bituminous material); to produce mixtures within PENNDOT Publication 408 Specifications or within applicable Standard Special Provisions. A prepared quality control (QC) plan as specified in Sections 401.2 and 409.2 must be submitted and reviewed prior to producing any mixture for a PENNDOT project.

2.1.1 Plant Quality Control Laboratory and Equipment. All bituminous plants are required to have an inspector’s office, adequate laboratory equipment, space, and utilities as required for the performance of specified tests (See Chapters 2 and 2A) in place, approved and operating effectively.

The use of the Hot Mix Asphalt (HMA) Electronic State Book (ESB) is required at all approved Producers of Bituminous Mixtures listed in Bulletin 41. Each producer supplier code location is required to have a personal computer with Microsoft Excel capable of running the HMA ESB. As a minimum, the personal computer should have a 500 megahertz or higher processor, 128 Megabytes of RAM or higher and, 30 Megabytes of available hard drive space for installation of the program and should have the Windows XP operating system. As a minimum, the version of Microsoft Excel should be Version 7 released in 1995 and known as Excel 95 or later version. The current version of the HMA ESB will be available from the Engineering District or available for download from the Department’s Internet Website (http://www.penndot.gov) and following the links for “Design & Construction”, then “Construction” and then “Electronic Plant Book Version #” or available for download from the Pennsylvania Asphalt Pavement Association’s Internet Website (http://www.pahotmix.org). The HMA ESB must be used to record and document all production QC data and JMF data. The ESB contains tools to help with mixture analysis including calculations for gradation, asphalt content, apparent asphalt film thickness, and mixture volumetric analysis such as, Air Voids, VMA, and VFA. The HMA ESB must be available to Department plant inspectors during plant visits.
All plants shall be equipped with an asphalt binder ignition furnace, meeting the requirements of PTM No. 757. Ignition Furnace(s) shall be calibrated in accordance with the requirements of PTM No. 757. As an alternate to the ignition furnace, plants shall be equipped with all necessary equipment required to perform any alternate method specified in PTM No. 702, PTM No. 742 or approved by the Department, mechanical sieve shaker, and all other equipment necessary to determine the asphalt content of the mix, and gradation of the aggregates for verification of the design mix formula.

The plant shall also provide approved equipment which shall be present at the plant during operation for developing the design and conducting control tests in accordance with PENNDOT’s modified Marshall and/or Superpave methods, and including the following:

**Number of Each (Min.)**

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Automatic tester and Recorder (for flow and stability values).</td>
</tr>
<tr>
<td>1</td>
<td>Mechanical Compactor complete with 110-V AC (1/4 hp) Min. Motor, Chain Lift, Automatic Hammer Release, Frame, Mold Holder, and a 4.5 kg (10 lb) Compaction Hammer 457 mm (18 inch drop).</td>
</tr>
<tr>
<td>1</td>
<td>Compaction Pedestal, PTM No. 705.</td>
</tr>
<tr>
<td>8</td>
<td>Compaction Molds, PTM No. 705.</td>
</tr>
<tr>
<td>1</td>
<td>Extra Hammer, PTM No. 705.</td>
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</table>

**Number of Each (Min.)**

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Superpave Gyratory Compactor, AASHTO T 312.</td>
</tr>
<tr>
<td>2</td>
<td>Superpave Gyratory Molds, AASHTO T 312.</td>
</tr>
<tr>
<td>1</td>
<td>Superpave Gyratory Calibration Kit (Manufacturer supplied. Approved producers with multiple plants may share a calibration kit between locations if written permission is provided by the manufacturer of the gyratory compactor).</td>
</tr>
<tr>
<td>1</td>
<td>Balance or Scale with sufficient capacity to perform AASHTO T 209 and other required work, and a readability and sensitivity of 0.1g.</td>
</tr>
<tr>
<td>1</td>
<td>Oven capable of maintaining temperature within 0.5 °C, range between Room Temperature and 200 °C.</td>
</tr>
<tr>
<td>1</td>
<td>Water Bath, capable of maintaining temperature within +/- 0.5 °C up to 100 °C. Provide one additional Bath if necessary for Marshall mix designs or AASHTO T 283 tests.</td>
</tr>
<tr>
<td>1</td>
<td>Hot Plate, Low, Medium, and High Setting.</td>
</tr>
<tr>
<td>1</td>
<td>Thermometer.</td>
</tr>
<tr>
<td>1</td>
<td>Volumeter, PTM No. 715.</td>
</tr>
<tr>
<td>2</td>
<td>Vacuum Bowls or Vacuum Pycnometers, AASHTO T 209.</td>
</tr>
<tr>
<td>1</td>
<td>Vacuum Pump, AASHTO T 209.</td>
</tr>
<tr>
<td>1</td>
<td>Vacuum Measurement Device, AASHTO T 209.</td>
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<tr>
<td>1</td>
<td>Mechanical Shaker, AASHTO T 209 (variable frequency control is optional, but it is not required).</td>
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<tr>
<td>1</td>
<td>Suspension Bath (if required), PTM No. 715, AASHTO T 209.</td>
</tr>
<tr>
<td>1</td>
<td>Calculator.</td>
</tr>
<tr>
<td>1</td>
<td>Platform Scale, 100 kg (220 lb), with a readability and sensitivity of 0.5 kg (1 lb).</td>
</tr>
<tr>
<td>1</td>
<td>Bitumenometer (if necessary for PTM No. 702 Method).</td>
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</table>

All balances and scales shall be certified every year by an outside agency. All volumeters, bitumenometers, and pycnometers shall be calibrated according to PTM No. 703 and PTM No. 704 at least twice a year and documented in the plant book. The first calibration shall be conducted prior to mix design and production each year.

Mechanical sieve shakers that are used to test the gradation of aggregates in bituminous mixtures must be calibrated at the start of each season and when directed by the Department. The mechanical sieve shaker must be calibrated in accordance with the fine aggregate section of PTM No. 608.

**Superpave Gyratory Compactor(s) (SGC)**. Superpave Gyratory Compactor(s) (SGC) shall have calibrations and/or verifications as specified in AASHTO T 312 at the frequency as recommended by the manufacturer, except for internal angle calibration. Have the manufacturer provide a general equipment upkeep and maintenance guide or manual and follow recommendations. All items identified in AASHTO T 312 Section 6 shall be verified by the manufacturer, other approved agencies providing such services, or in-house personnel (if trained and certified through the manufacturer’s training program). Heavy use may necessitate more frequent calibrations/verifications due to component wear; consult manufacturer’s recommendations. Have the internal angle calibrated according to AASHTO TP 71 to 1.16 ± 0.03 degrees initially, and recalibrated at least every two years, or as directed. The difference between the inside diameter of the mold and the diameter of the mold plate face (side presented to the specimen) shall not exceed 0.50 mm. On SGC models where the loading head contacts the specimen, the difference between the inside diameter of the mold and the diameter of the loading head shall not exceed 0.50 mm. Verification of mold inside diameter should be performed using either a three-point micrometer or a dial bore gauge, accurate to ± 0.0025 mm. A 5-inch or 6-inch micrometer, accurate to ± 0.0025 mm should be used to verify mold plate diameter and can be used to field calibrate a dial bore gauge.

Anytime the difference between any two SGCs in average bulk specific gravity of a mixture is greater than 0.030 at $N_{des}$, an evaluation of the differences is recommended. A minimum of four specimens in each compactor, prepared by the same technician shall be considered in this evaluation. Detailed procedures required for this investigation are available from the Materials and Testing Division (MTD). The DMM/DME may at any time request a thorough evaluation be conducted by the MTD if gyratory compaction data is variable, inconsistent with design or questionable.
If at any time testing devices/equipment become inoperable or malfunction, an inspection of the plant laboratory may be conducted by the DMM/DME or designated representative, to assess the plant's continued operation. The DMM/DME may, at his discretion, restrict the plant's continued operation to a maximum of 48 hours from the time of breakdown, or until a new QC plan with corrective action(s) is submitted and approved. In any event, the producer shall specify in the original QC plan submission what procedures will be followed to provide required testing as specified, in a timely manner, during equipment failure.

2.1.2 **Plant Technicians.** The contractor shall provide certified plant technicians meeting the criteria specified in PENNDOT’s Publication 351, instructed and trained to perform all necessary tests and control the plant operation so that the completed mixture complies with the requirements in every respect. The Department may assign personnel similarly instructed and trained to verify tests necessary to control and accept the mixtures and to work in close cooperation with the technician.

2.1.3 **Control of Mixture Consistency.** The dried aggregates shall be uniformly combined in the mixer in the quantity of each fraction of aggregates required to meet the job-mix formula (JMF). The bituminous material shall be measured or gaged and introduced into the mixer in the quantity specified by the JMF. The temperature of the aggregate shall be controlled so that the temperature of the completed mixture taken at the plant shall be as required for proper placement and compaction behind the paver, but in no case shall the temperature of the mixture exceed the limits specified in PENNDOT Publication 408, Sections 401 and 409 or Publication 37 (Bulletin 25) for the particular bituminous material.

The percentage of the aggregate coated will be determined by AASHTO T 195, Determining Degree of Particle Coating in Bituminous-Aggregate Mixtures. The aggregate coating shall be 95%, except slag aggregate shall be 85%. If the required percentages are not achieved, the mixing time must be increased until the requirements are met. The finished mixture shall be such that it may be handled, placed, and compacted without stripping the bituminous material from the aggregate.

Perform the tests at the frequency specified in the approved QC plan. Document test results with control charts, including action points. Provide all documentation for review by Quality Assurance and District personnel.

2.1.4 **Printed Tickets.** Printed tickets may be used in place of the test for determining asphalt content of the completed mix as permitted in PENNDOT Publication 408, Sections 401.2 and 409.2. To use this method, request an evaluation of the plant operation and the QC program, and conform to the requirements of PENNDOT’s *Plant Printed Ticket Approval Procedure* (see Appendix F).

2.2 **Plant Types and Approval.** Only weight-proportioning batch or drum-mix plants are permitted. All plants shall be fully automated and recordated.
All plants shall be reinspected biennially for compliance and an inspection report (Form TR-498 or TR-498A) submitted by the District to the Bureau of Construction and Materials, Engineering Technology and Information (ETI) Division. When conditions warrant, plants shall be inspected annually.

After the initial approval has been made, the plant will remain on the approval list until such time as it is deleted for any of the following reasons:

1. The plant facilities fail to meet the specification requirements.
2. The operation is completely inactive for two years.
3. Major changes in equipment or procedures that will affect the quality of the product.
4. Removal of plant and facilities from its site. Relocation of portable plants will be permitted upon request to the appropriate Engineering District(s) responsible for the previous and new location of the portable plant and District notification to the Bureau of Construction and Materials, Engineering Technology and Information (ETI) Division.

2.3 Bituminous Material Supply and Control System. Storage tanks for bituminous material (asphalt binder) shall be equipped for heating the material with effective and positive control at all times. Avoid local overheating and provide a continuous supply of bituminous material to the mixer at a uniform temperature at all times, but within the range of temperatures specified for class and grade of bituminous material in PENNDOT Publication 408, Sections 401 and 409 or Publication 37 (Bulletin 25). Heating shall be by electricity, steam or oil coils, or other means such that the storage tank is not contacted by any flame.

Storage tank capacity shall be such as to ensure continuous operation of the plant and uniform temperature of the bituminous material when it is introduced into the aggregate. Tanks shall be calibrated accurately to 100-gallon (378.5-L) intervals and shall be accessible for measuring the volume of bituminous material at any time.

A circulating system for the bituminous material shall be of adequate capacity to provide proper and continuous circulation from storage tank to proportioning units and return to tank. The return end of the bituminous binder circulating pipe shall be kept below the surface of the bituminous material in the storage tank to prevent discharging the hot bituminous material into open air.

All pipe lines, meters, weigh buckets, spray bars, and other containers or flow lines, and fittings shall be steam or oil-jacketed, electrically heated, or otherwise properly insulated to prevent heat loss to ensure proper temperature control. An armored recording thermometer of suitable range shall be fixed in the bituminous material feed line at a suitable location near the discharge at the mixer unit.

The plant shall provide a sampling outlet in the bituminous material system readily accessible and free from obstructions. The outlet shall consist of a valve installed in such a manner that samples may be slowly withdrawn from the system at any time during plant operation. A drainage receptacle shall be provided for flushing the outlet prior to sampling. The sample valve shown in AASHTO T 40, Figure 1 is acceptable.
Also, see Chapter 2A, and the Department modifications to AASHTO M 323, Section 7 and specifically Section 7.6.5, Note 9B.

Means shall be provided for circulation and/or agitation to maintain a uniform product, if necessary. Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of bituminous material. Accuracy of the metering devices shall be within 1.0% of the actual weight being measured when that weight has been determined using another measuring device and shall be within 0.5% when that weight has been determined using test weights. Bituminous material scales shall conform to the requirements for aggregate scales, as specified in Section 3.3.

2.4 Cold Aggregate Feed System

2.4.1 Maximum Aggregate Size. Oversize aggregate shall be rejected by suitable methods or devices before the aggregate enters the cold feed, or by plant screens as specified in Section 3.1.

2.4.2 Cold Feed Bins. Adequate and convenient facilities shall be provided for obtaining samples of the full flow of aggregate from each cold feed bin and from the total cold feed. Adequate and convenient facilities shall be provided for diverting aggregate flow into trucks and other suitable containers to check the accuracy of the aggregate delivery system.

Control shall be based on frequent samples from each cold-feed bin and the total cold feed tested by PTM No. 616. Results of total cold-feed samples shall be checked for compliance with the tolerances and action points in the approved QC plan.

2.4.3 Cold Aggregate Feeder. The plant shall be provided with mechanical means for uniformly feeding the aggregates into the dryer so that uniform production and temperature may be assured. When aggregates must be blended from two or more bins at the cold feed to meet the requirements of PENNDOT Publication 408 specifications, a synchronized proportioning method shall be provided.

When recycling capability is selected, the plant shall be equipped with mechanical means for feeding the desired weight of RAP into the mix. Facilities shall be provided for obtaining samples of the RAP.

2.5 Mineral Filler System. If mineral filler is required, a separate dry storage bin and feeder shall be used. The feeder shall be interlocked with the aggregate feed and assure accurate proportioning. Baghouse fines recirculated into the mix shall be considered mineral filler.

2.6 Aggregate Dryer. A dryer of satisfactory design capable of drying and heating the aggregate to the moisture and temperature requirements of PENNDOT Publication 408, Sections 401 and 409 shall be provided.
Flames used for drying and heating shall be properly adjusted to avoid damage to the aggregate and result in no visible unburned oil or carbon residue on the aggregate when discharged from the dryer.

The plant shall be further equipped with approved recording thermometers, pyrometers, or other approved recording thermometric instruments at the discharge chute of the dryer and in the hot fines bin of batch plants to register and automatically record the temperature of the heated aggregate. A paperless recorder is acceptable as long as a printout can be made on demand. Data must be able to be stored electronically for at least two months.

2.7 **Emission Control System.** A dust collecting system shall be provided. The system shall be made to waste the collected material, or to return all or any part uniformly to the mixture.

Other emissions, such as smoke except for water vapor, shall be controlled in compliance with Pennsylvania Department of Environmental Protection’s (DEP) and any federal regulatory agency’s (e.g., EPA) applicable limits.

2.8 **Safety Requirements.** Adequate and safe stairways to the mixer platform shall be provided if necessary. Guarded ladders to other plant units shall be located where required. All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly protected.

Ample unobstructed space shall be provided on the mixing platform. Maintain an unobstructed passage at all times in and around the truck-loading area. This space shall be kept free of drippings from the mixing platform. A ladder or platform shall be located at the truck-loading area to permit easy and safe inspection of the mixture as it is delivered into the truck, if necessary. Overhead protections shall be provided where necessary.

2.9 **Truck Inspection/Sampling Platform.** A truck inspection/sampling platform shall be provided away from the plant operation; not under the pugmill or surge storage. Adequate access, safety features and lighting shall be incorporated such that easy and safe inspection, sampling and tarping of trucks, when necessary, can be accomplished.

2.10 **Surge Silo or Storage Systems and Approval.** Bituminous paving mixtures may be processed through or held in an approved surge silo/storage system, for use during the same day as manufactured. Only one mix (JMF) is permitted in any storage bin or silo at any given time, during production for Department work. The maximum holding period under any condition shall be eight hours. However, if the atmosphere in the silo is inert gas and/or the design of the storage silo inhibits asphalt hardening, storage shall be allowed up to 48 hours on approval by the MTD. Each individual surge silo or storage bin will be evaluated and approved on an individual basis. Following initial MTD approval for extended storage time, as a minimum, reapproval shall be required biennially. Samples for reapproval must be collected within 25 months of the release date on the CAMMS Test Report granting approval for extended storage time. Extended storage time will be allowed to continue until test results of the biennial evaluation are released from CAMMS. The mixture as delivered for the work shall
comply with all specified requirements. Since the asphalt binder on larger stone, lower asphalt content, base mixes may oxidize more rapidly than smaller stone, dense-graded wearing course type mixes, a silo storage system approved for base mix is approved for all other types of dense-graded (ID & Superpave) HMA, with the following exceptions. When PG-Binder is modified, or RAP and/or RAS or any other modifier or additive that its properties may be altered by the extended elevated temperatures, is included in the mix, extended storage time will be approved on a mix-by-mix basis. The approval of the storage system may be withdrawn whenever material processed through or held therein does not comply with the specification or when the Engineer visually determines the mixture to be lumpy or segregated or non-uniform due to drain down or excessive hardening. All unacceptable mixtures delivered to the project shall be rejected and removed.

For approval, samples of the bituminous paving mixture and all other samples and data as required in Appendix G, shall be obtained and submitted to the MTD. The samples of mix and binder shall be chilled immediately and maintained at 0 °C (32F) or less until tested by the MTD. The storage time permitted may be changed on the basis of these test results. In the event that an approved surge silo/storage system is changed or altered, the Engineer shall be notified of the modifications. Any departure from the approved system shall necessitate re-evaluation. Appendix G, *HMA Surge Silo or Storage System Approval Procedure*, provides complete details concerning system approval, sampling, submissions and reporting.

For storage system approval, the bituminous material recovered from the stored mix and tested at the applicable temperature for the grade of material specified for the mix application shall meet the following requirements as a minimum:

**Following Recovery**
- Dynamic Shear T 315: \( G^*/\sin \delta \), Minimum, 2.20 kPa @ 10 rad/s.

**Following PAV Aging**
- Dynamic Shear T 315: \( G^*\sin \delta \), Maximum, 5000 kPa @ 10 rad/s.
- Creep Stiffness, T 313: \( S \), Maximum, 300 MPa.
- M-Value, Minimum, 0.300 @ 60 s.

When recycled materials or heat sensitive modifiers or additives are included in the mix, additional requirements as deemed appropriate during the evaluation by the MTD may be utilized. Typically, additional criteria may include a maximum \( G^*/\sin \delta \) or maximum ratio of change (≥ 4 times) based on zero storage time and initial recovery. Also, mixture volumetric properties may be evaluated relative to storage time by MTD request.

In addition, the gradation on all sieves and the asphalt content of the samples used for the evaluation must be within the single sample (n=1) tolerances of Section 409, Table A for the results on the recovered binder to be valid.
Whenever abnormal or unclear results or trends are encountered including but, not limited to, when 24 hour results indicate higher aging stiffness when compared to 48 hour results, resubmission of samples and reevaluation may be required.

See Appendix I for additional QC testing requirements and criteria when surge/storage systems are approved and used.

2.11 **Recording Truck Scales.** Recording truck scales shall be required at each plant with a surge silo or storage bins. Truck scales are not required where trucks are loaded directly from a surge silo/storage bin equipped with a recording weigh hopper.

A weighmaster, licensed by the Bureau of Standard Weights and Measures, Pennsylvania Department of Agriculture, shall be provided by the producer. The weighmaster shall certify that the weight of the material as determined by the recording truck scales is correct.

Provisions shall be made so that the scales cannot be manually manipulated during the printing process and are interlocked to allow printing only when the scales have come to rest. Provision shall be made for constant zero compensation. The minimum scale graduation shall not be greater than 20 pounds and the scale tolerance shall not exceed +/- 1.5% of the total capacity. Equipment failure shall be governed by the provisions and criteria of Subsection 3.7.4.

A ticket printer shall be required on all truck scales. The printer shall produce a printed record of the gross, tare and net weights, and the time, date, truck identification and project number.

All trucks shall be tared prior to loading from any surge silo or storage bins using a truck scale. Unless the truck is tared automatically at each loading, the truck tare to be used in the weighing operation shall be the weight of the empty truck, without driver, determined with full tank capacity of fuel minus the computed weight of one half the tank capacity of fuel. The rated fuel tank capacity (volume in gallons) includes auxiliary tanks. The tare weight of the truck shall be recorded to the nearest 20 pounds. Trucks shall be tared once daily or more often as deemed necessary by the Engineer. The truck identification number shall be stenciled on each truck at a location clearly visible to the weighmaster.

All trucks scales shall be mounted on solid foundations to ensure their remaining plumb and level. All scales shall be inspected and certified annually, or as often as the Engineer deems necessary, by the Pennsylvania Department of Agriculture or an accredited independent scale testing service. A seal, showing the latest inspection data, shall be affixed to the scales in a conspicuous place and the inspection certificate shall be available at the scales. The Department will accept inspection and certification by out-of-state agencies when the mixing plant is located outside Pennsylvania.

3. **Requirements for Batch Plants.**

In addition to all general requirements specified in Section 2, meet the following requirements:
3.1 **Hot, Dry Aggregate Gradation Control.** The plant shall be equipped with plant screens located between the aggregate dryer and aggregate hot-bins.

The plant shall contain at least three bins into which the heated aggregate shall be screened. The separation, based on laboratory sieves, shall be as follows:

- Bin No. 1 – Passing No. 8
- Bin No. 2 – Passing ½”, retained No. 8
- Bin No. 3 – Passing 2”, retained ½”

Hot-bin storage capacity shall be such that continuous and uniform operation of the plant shall be ensured. Each compartment shall be provided with an overflow chute of such size and at such a location to prevent any backing up of material into other compartments or into contact with the screen.

Bins shall be equipped with “tell-tale” devices to indicate the position of the aggregate in the bins at the lower quarter points. An automatic weighing and batching sequence interrupt shall be provided to operate when any aggregate bin becomes empty. Adequate and convenient facilities shall be provided for obtaining aggregate samples from each bin.

Control shall be based on frequent bin samples tested in accordance with PTM No. 743. Aggregate in each bin, including mineral filler, shall be combined in proper proportions, and the composite shall be checked for compliance with PENNDOT Publication 408, Section 401.2 or Section 409.2.

3.2 **Weigh Box or Hopper.** Means shall be provided for weighing aggregate from each bin into a weigh box or hopper, suspended on scales, and ample in size to hold a full batch. Deviations in batch sizes will be permitted with written approval of the DMM/DME for mixing batches 20% below or 15% above the rated capacity of the mixer. The size of batches may be decreased to 50% below the rated capacity of the mixer with written approval from the MTD, following an evaluation of the mix and bituminous material recovered from the mix. Permission for mixing batches below the rated capacity will be granted based on the same criteria for bituminous material recovered from the mix specified for surge silo/storage systems approval in Section 2.10 including the requirement to meet gradation and asphalt content tolerances. All reduced batch sizes will be uniformly mixed and aggregates sufficiently coated to meet the requirements of Subsection 2.1.3. When slag coarse aggregate is used, no increase will be permitted in the size of the batch above the rated capacity of the mixer.

The weigh box or hopper shall be supported on load cells or fulcrums and knife edge that will not easily be thrown out of alignment or adjustment. Gates on the bins and the hopper shall not leak.

3.3 **Aggregate Scales.** Scales for any weigh box or hopper may be either load cells, beam or springless-dial type and shall be standard make and design. The accuracy of the weighing device shall be within 1.0% of the actual weight being measured when that weight has been determined using another measuring device and shall be within 0.5% when that weight has been determined using test weights.
The change in load required to noticeably alter the position of rest of the indicating element (or elements) of a non-automatic indicating scale shall not be greater than 0.1% of the nominal scale capacity. Beam type scales shall be equipped with a device to indicate that the required load is being approached. This device shall indicate at least the last 200 lb (91kg) of the load.

Graduation intervals for either beam or dial scales shall not be greater than 0.1% of the nominal scale capacity. Scale graduations and markings shall be plainly visible. On the dial scales, parallax effects shall be reduced to the practical minimum with clearance between the indicator index and scale graduations not exceeding 0.06 in. (1.5mm). Scales shall be equipped with adjustable pointers for marking the weight of each material to be weighed into the batch.

Not less than ten test weights, each of 50 lb (22.7 kg) nominal weight and each stamped with its actual weight to within 0.05%, shall be provided for the purpose of testing and calibrating the scales. For each scale a suitable cradle or platform shall be provided for applying the test loads. The test weights shall be kept clean and conveniently located for calibration of the scale.

3.4 **Bituminous Material Bucket.** The bucket shall be large enough to handle a batch in a single weighing. The filling system and bucket shall be of such design, size, and shape that the bituminous material will not overflow, splash, or spill outside the bucket during filling and weighing.

The bucket shall be steam or oil-jacketed or equipped with properly insulated electric heating units. It shall be arranged to deliver the bituminous material in a thin uniform sheet or in multiple sprays over the full length of the mixer.

The time required to add the bituminous material shall not exceed 20 seconds. Where the quantity of bituminous material is metered, provision shall be made to check the delivery of the meter by actual weight.

3.5 **Bituminous Material Scales.** Scales for the weighing of bituminous material shall meet the requirements for aggregate scales, as specified in 3.3 except a device to indicate at least the last 20 lb (9.1 kg) of the approaching total load shall be provided. Beam-type scales shall be equipped with a tare beam or adequate counterbalance for balancing the bucket and compensating periodically for the accumulation of bituminous material on the bucket.

3.6 **Mixer Unit.** Mixing shall be accomplished in an approved twin pugmill type mixer and shall be continued for a period of at least 25 seconds after all materials, including the bituminous material have been deposited in the mixer. When directed, the mixing period shall be increased until a bituminous concrete homogeneous in composition is obtained.

The blades in the mixer shall be of sufficient number and size, and so positioned to box the material around the mixer. They shall be increased until a bituminous concrete homogeneous in composition is obtained. The mixer shall be designed to provide means of adjusting the clearance between the mixer blades and liner plates to ensure
proper and efficient mixing. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust by dispersion. The mixer shall be constructed to prevent leakage of the contents.

The mixer shall be equipped with a positive means for governing mixing time and an accurate time lock to control the operation of a complete mixing cycle by locking the weigh-box gate after the charging of the mixer until the closing of the mixer gates at the completion throughout the dry-mixing period and shall lock the mixer gate throughout the dry and wet mixing periods.

The dry mixing period is defined as the interval of time between the opening of the weigh-box gate and the application of bituminous material. The wet-mixing period is the interval of time between the start of the application of bituminous material and the opening of the mixer gate. The timing control shall be flexible and capable of being set at intervals of not more than five seconds throughout cycles up to 3 minutes. If required by the specifications, a mechanical batch counter shall be installed as part of the timing device and shall be designed to register only completely mixed batches.

3.7 **Batch Automation and Recordation.** All bituminous concrete plants offered for Department approval shall be fully automated and recorded.

3.7.1 **Automatic Batch Control.** The automatic batch plant shall be controlled by means of an approved automatic batch selector set to control and deliver accurately, and in proper sequence, the designated weight of bituminous material and aggregates required for the bituminous concrete mixture (approved JMF) and for automatically timing the mixing operation.

For all mixture production for the Department, the batch component controls shall be locked in spec mode during operation. Manual controls must be disabled while in spec mode.

3.7.2 **Interlocks.** The plant shall be equipped with interlocking cut-off circuits to interrupt and stop the automatic cycling of the operation at any time an error in weighing or proportioning occurs, when any aggregate bin becomes empty, when the scale does not return to zero, or when there is a malfunction of any portion of the control system.

3.7.3 **Batch Recorder.** Each batch plant shall be equipped with a recorder, which will provide a permanent record of batching operations. The recorder shall indicate the following:

- Record of the JMF being produced
- Weight of each material batched
- Variations in batch quantities
- Date and time of day
- Zero return after each batch is emptied

Ticket printers shall record the proportions as indicated on the batching scale within an accuracy of 0.5 percent of the maximum batch size. Paper for the
recorders shall be furnished by the contractor. The records shall be removed as directed by the Engineer, and shall become the property of the Department.

3.7.4 **Equipment Failure.** If at any time the automatic proportioning or recording devices become inoperable or malfunction, an inspection of the batch plant will be conducted under the supervision of the DMM/DME within 48 hours of the breakdown. If the DMM/DME determines that the breakdown is not correctable within 48 hours of the breakdown due to unavailability of parts or service or any condition beyond the contractor’s control, verbal permission may be given to operate the plant for a period not to exceed seven days after the breakdown. The contractor shall specify in his original QC plan submission, what procedures will be followed in the event of equipment failure. Batching accuracy shall be maintained within the limits specified in Section 401.2 or 409.2 for the period of the breakdown.

In the case of recorder failure, the contractor shall provide the necessary personnel and facilities to identify each batch and record the quantities of each material batched utilizing the plant printout tickets. If the period of breakdown is expected to exceed seven consecutive calendar days, written permission authorizing this extension may be granted by the DMM/DME. If the DMM/DME determines that the breakdown is readily correctable or has been caused by some condition within the contractor’s control, the plant shall not be permitted to operate longer than 48 hours from the time of breakdown.

3.8 **Plant Tolerances.** All bituminous batch plants shall be capable of consistently delivering materials within the full range of batch sizes within the following tolerances:

<table>
<thead>
<tr>
<th>Component</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batch Aggregate Component</td>
<td>+/- 1.5% of Batch*</td>
</tr>
<tr>
<td>Mineral Filler</td>
<td>+/- 0.5% of Batch</td>
</tr>
<tr>
<td>Bituminous Material</td>
<td>+/- 0.1% of Batch</td>
</tr>
<tr>
<td>Zero Return (Aggregate)</td>
<td>+/- 0.5% of Batch</td>
</tr>
<tr>
<td>Zero Return (Bituminous Materials)</td>
<td>+/- 0.1% of Batch</td>
</tr>
</tbody>
</table>

*If separate tolerance controls are not provided for the batching of mineral filler, it will be necessary to reduce the aggregate tolerances to +/- 0.5% percent for those batches requiring mineral filler.

The electrical circuits for the above delivery tolerances of each cut-off interlock shall be capable of providing the total span for the full allowable tolerance for maximum batch size. Tolerance controls shall be automatically or manually adjustable to provide spans suitable for 50% less than full-size batches. The automatic controls and interlock cut-off circuits shall be capable of being consistently coordinated with the batching scale or meter within an accuracy of 0.2% of the nominal capacity (Note 1) of said scale or meter throughout the full range of the batch sizes.

Note 1: The term “nominal capacity” of a scale or meter where referred to herein is defined as the maximum quantity which the scale or meter is capable of measuring.
4. Requirements for Drum-Mix Plants.
   In addition to all general requirements specified in Section 2, meet the following requirements:

4.1 Aggregate Delivery System. All belt feeders shall be equipped with an electronically controlled flow switch device. An automatic plant shut-off shall be triggered when any flow switch device is activated for longer than twenty seconds.

   The total cold aggregate feed shall be weighed continuously by an approved belt scale. The accuracy of the weighing device shall be within 1.0% of the actual weight being measured when that weight has been determined using another measuring device and shall be within 0.5% when that weight has been determined using test weights.

   Provisions shall be made to conveniently collect the flow of material from the full width of the belt of each cold feed and the full width of the total cold feed belt for sampling purposes. Provisions shall also be made to divert aggregate flow for the purpose of calibrating each cold feed and the belt scale or provide by-pass calibration device that is acceptable to the DMM/DME.

   The plant shall be equipped with a moisture compensation control device located on the control panel. The device, when set by the plant operator, shall adjust the aggregate feed rate to compensate for moisture. A moisture probe shall be installed in the fine aggregate bins to continuously monitor the moisture. The amount of moisture shall be displayed on the control panel and at plant start up and during production the displayed moisture content shall be correlated with moisture percentage determined by ASTM C 70. During production, moisture tests shall be performed at least twice daily and in accordance with approved QC plan. The operator shall reestablish the feed rate when the compensation device indicates changes in moisture percentage equal to or exceeding 1%, compared to the last correlated reading.

   A scalping screen shall be placed in the aggregate delivery system prior to discharge of material into the dryer.

4.2 Bituminous Material System. Bituminous materials shall be introduced into the mix at a metered rate of flow and shall have an automatic bituminous material temperature control device. The bituminous material flow system shall be interlocked with the aggregate weighing device. The interlock shall be capable of adjusting the flow of bituminous material to compensate for any variation in the dry weight of aggregate flow.

4.3 Drum-Mix. The drum-mix plant shall be of satisfactory design, capable of drying and heating the aggregate to the moisture and temperature requirements set forth in PENNDOT Publication 408, Sections 401 and 409, and capable of producing a uniform mixture of aggregates and bituminous material. Provision shall be made to conveniently divert the flow of bituminous mixture from the full width of the belt at the discharge end of the drum.

   The plant shall be equipped with a minimum of one set of scales to control production. A second set of scales will be required for truck weighing unless trucks are loaded
directly from a surge silo or storage bin equipped with a recording weigh hopper (see Section 2.11).

The plant shall have a minimum of one surge bin. The surge bin shall be at least 45 tonnes (50 tons) capacity and comply with the requirements of Section 2.10.

4.4 Automation and Recordation. All bituminous concrete plants offered for Department approval shall be fully automated and recordated.

The aggregate-weighing system shall be automated and recordated and display the moisture-corrected mass of the total aggregate. The total cold feed rate shall be capable of being measured and displayed on demand. The belt rate recorded at five minute intervals shall be within +/- 3% of the sum of the individual bin feed rates (moisture-corrected, average feed rates if available). This tolerance encompasses the +/- 1% Plant Tolerances in Section 4.5.

Collector fines are to be proportioned into the mix uniformly with a tolerance of +/- 0.5%. If some of the collected fines are disposed of, the remaining amount added back into the mix shall be done uniformly and the amount shall be recorded. Adjustments shall be made to the asphalt delivery system so that the proper amount of asphalt cement is added to the mix.

Interlocks shall interrupt operation when:
- An error in proportioning occurs.
- An aggregate bin(s) becomes empty.
- A malfunction of any part of the control system occurs.

The recorder shall record in digital form the following at five minute intervals or on demand:
- Record of the JMF being produced
- Feed bin flow on each bin, clearly labeled, and converted from rpm to feed rate (tonnes (tons) per hour) or from weighing devices
- Dry tonnes (tons) per hour of combined aggregates moisture compensated from the weighing device
- Asphalt, percent of finished mix or tonnes (tons) per hour (metered)
- Date and time of day

Paper for the recorders shall be furnished by the contractor. The records shall be removed as directed by the Engineer, and shall become the property of the Department.

4.4.1 Equipment Failure. If at any time the automatic proportioning or recording devices become inoperable or malfunction, an inspection of the plant will be conducted under the supervision of the DMM/DME within 48 hours of breakdown. All the provisions and criteria of Subsection 3.7.4 shall apply.
4.5 **Plant Tolerances.** All bituminous drum plants shall be capable of consistently delivering materials within the following tolerances:

- Bituminous Material: +/- 0.5%
- Recycled Material: +/- 0.5%
- Individual Aggregate Feed: +/- 1.0%
- Total Aggregate Feed: +/- 1.0%

All drum plants shall be calibrated at the beginning of the paving season and may require additional calibrations if three consecutive QC tests are outside of the multiple sample limits. The asphalt pump or meter shall be calibrated at least every four months. Check the total aggregate belt scale bi-weekly to ensure compliance with the above tolerances.