

APPROVED:
Division Administrator

By: _____
FEDERAL HIGHWAY ADMINISTRATION

Supplemental Technical Specification for

Mixing Plants for Producing Asphalt Paving Mixtures

SCDOT Designation: SC-M-401 (07/21)

1. SCOPE

- 1.1 This specification covers requirements for plants suitable for producing asphalt paving mixtures.

2. REFERENCED DOCUMENTS

- 2.1 SCDOT Standard Specifications
- 2.1.1 Division 300, Division 400
- 2.2 AASHTO Standards
- 2.2.1 T27, T195
- 2.3 SCDOT Test Methods
- 2.3.1 SC-T-78, SC-T-79

3. REQUIREMENTS FOR ALL PLANTS

- 3.1 Uniformity:
- 3.1.1 Design and coordinate the plant within these specifications and in accordance with the job mix formula. Produce a mixture that meets specifications stated in sections 300 and 400 of the current SCDOT Standard Specifications, Supplemental Specifications, and Contract Special Provisions.
- 3.2 Equipment for Preparation of Asphalt Mixtures:
- 3.2.1 Equip binder storage tanks for heating the material, under effective and positive control at all times, to the temperature required in the paving mixture specifications. Heat tanks by steam or oil coils, electricity, or other means such that no flame shall be in direct contact with the heating tank.
- 3.2.2 Provide proper and continuous circulation between the storage tank and the proportioning units during the entire operating period.
- 3.2.3 Keep the discharge end of the binder circulating pipe below the surface of the binder in the storage tank to prevent discharging the hot binder into the open air.

- 3.2.4 Ensure that all pipe lines and fittings are properly insulated with either steam or oil-jackets to prevent heat loss. When the binder is emulsified asphalt, make provisions in the binder transfer system that will enable the operator to turn off or reduce the heat media from all lines, pumps, and jacketed binder buckets as soon as the system is open and circulating properly.
- 3.2.5 Supply proper storage tank capacity to ensure continuous operation of the plant and uniform temperature of the binder when it is introduced into the aggregate. Calibrate tanks accurately to 100 gallon intervals and provide accessibility for measuring the volume of the binder at any time.
- 3.2.6 Provide a sampling top and valve in the binder storage tank located approximately in the bottom one-third of the tank or in the feed line between the pump and the return line discharge. Make the sampling valve readily accessible and free from obstruction.
- 3.2.7 Provide means for circulation to maintain a uniform product when filled with Polymer Modified Asphalts (PMA).
- 3.2.8 Supply a sufficient number of tanks when more than one grade of binder is to be used.
- 3.3 Mineral Filler
 - 3.3.1 Supply dry storage for mineral filler, when required, and make provision for accurate proportioning. When re-circulated back into the mix, keep baghouse fines dry and introduce them back into the mixture at a constant rate, as needed. Control mineral filler systems by a proportioning device accurate to within plus or minus 10% of the amount required. Ensure that the mineral filler proportioning system consists of a continuous feeder system that will proportion the flow rate by actual weight. Interlock the feeding system to the plant control to notify the plant operator immediately if no flow is detected.
- 3.4 Cold Aggregate Feeders
 - 3.4.1 Provide a mechanical means for uniformly feeding the raw aggregates into the dryer so that uniform production and temperature may be assured. When aggregates must be blended, ensure a synchronized proportioning method. Provide a cold feed bin for each individual material as directed by the job mix formula for the mix being produced. Supply an additional feeder to deliver recycled asphalt material.
- 3.5 Dryer
 - 3.5.1 Provide a dryer of satisfactory design capable of drying and heating the aggregate to the moisture and temperature requirements set forth in the paving mixture specifications, without leaving any visible unburned oil or carbon residue on the aggregate when discharged from the dryer.

Clean the flights of the dryer as necessary to prevent the build-up of aggregate fines on the flights being introduced into the mixture. Some type of means, such as dams, may be installed for slowing the flow of material to ensure proper heating and allow ample time for drying of aggregate.
- 3.6 Binder Control Unit

- 3.6.1 Provide a satisfactory means, either by weighing or metering, to obtain the proper amount of binder material. Calibrate / verify metering devices to be within $\pm 0.5\%$ of the correct amount every 90 days or as directed by the Asphalt Materials Engineer (AME). Ensure that Liquid Asphalt Binder Scales conform to subsection 6.5 (Binder Scales).
- 3.6.2 Insulate pipelines, meters, weigh bucket, spray bars, and other containers or flow lines to maintain the specified temperature of the binder.
- 3.7 Thermometric Equipment
 - 3.7.1 Attach an armored recording thermometer of suitable range in the binder feed line at a suitable location near the discharge at the mixer unit.
 - 3.7.2 Connect a recording thermometer, pyrometer, or other recording thermometric instrument to the discharge chute of the dryer and, when applicable, in the hot fine aggregate bin to register and record automatically the temperature of the heated aggregate or heated mixture.
- 3.8 Emission Controls
 - 3.8.1 Provide a dust collection system that has a rated output in order to reduce airborne dust generated in the mix production process. Ensure that the system has means to waste the material collected, or to return all or any part uniformly to the mixture. Handle baghouse fines being recirculated into the mix in accordance with subsection 3.3 (Mineral Filler).
 - 3.8.2 Control other emissions such as potentially harmful smoke (steam is acceptable) in compliance with applicable limits.
- 3.9 Surge and Storage Bins
 - 3.9.1 Provide bins or silos for surge or storage capacity of mixtures.
 - 3.9.2 Use bins or silos for surge capacity during mixing and delivery periods so that the mixture discharged into delivery units meets the requirements of the paving mixture specifications. Empty the surge bin or silo at the cessation of each mixing and delivery period.
 - 3.9.3 Ensure that silos meet the requirements of subsection 9 (Storage of Mixtures) for storage between periods of production.
- 3.10 Safety Requirements
 - 3.10.1 Provide adequate and safe stairways to the mixer platform and guarded ladders to other plant units where required.
 - 3.10.2 Thoroughly protect gears, pulleys, chains, sprockets, and other dangerous moving parts.
 - 3.10.3 Ensure ample, unobstructed space on the mixing platform.
 - 3.10.4 Maintain an unobstructed passage at all times in and around the truck-loading space. Keep this space free of drippings from the mixing platform. Locate a ladder or platform at the truck-loading space to permit easy and safe inspection of the mixture as it is delivered into the trucks. Facilitate overhead protection where necessary.
- 3.11 Scales

- 3.11.1 Provide satisfactory platform truck scales at the plant site for use in obtaining the net weight of each load of finished mixture. Ensure that all platform scales are of sufficient size to permit the entire vehicle or combination of vehicles to rest on the scale platform while being weighed. Weigh combination vehicles as separate units provided they are disconnected while being weighed. Ensure scales are tested and sealed by an authorized public official or scale serviceperson at least each six (6) months and as often as the AME deems necessary to ensure their accuracy. When an asphalt plant is relocated, the scales must be tested and sealed by an authorized public official or scale serviceperson.
- 3.11.2 Ensure that a digital recorder is installed as a part of the platform truck scales and that the recorder produces a printed digital record on a ticket indicating the gross and tare weights of the delivery trucks along with a time and date print for each ticket. Ensure that provisions are made so that scales cannot be manually manipulated during the printing process. In addition, ensure that the system is interlocked as to allow printing only when the scale has come to rest. Ensure that scales and recorders are of sufficient capacity and size to accurately weigh the heaviest loaded trucks or tractor trailers that are used for the delivery of the asphalt mixtures.

4. REQUIREMENTS FOR PLANTS CONTROLLING GRADATION OF HOT, DRY AGGREGATES

- 4.1 Plant Screens
 - 4.1.1 Equip plants with plant screens having adequate capacity and size range to properly separate all of the aggregate into the sizes required for proportioning so that they may be recombined consistently within the specification limits.
 - 4.1.2 Select screens based on the target gradation of the job mix formula to ensure there are approximate equal proportions of aggregate delivered to each bin to prevent excessive waste during production. Ensure the screen type to have slotted or square openings, and the size of the screen over the fine bin must be a No. 6. Provide and utilize a scalping screen (maximum sieve size from job mix formula) to remove oversize aggregates, sticks, roots, or lumps without restricting the material flow through the plant.
 - 4.1.3 Base control on frequent bin samples tested by **AASHTO T27**.
- 4.2 Hot Aggregate Bins
 - 4.2.1 Provide hot-bin storage of sufficient capacity to ensure uniform and continuous operation. Divide bins into the specified number of compartments arranged to ensure separate and adequate storage of appropriate fractions of the aggregates.
 - 4.2.2 Equip each compartment 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.
 - 4.2.3 Equip bins with an indicator device to indicate the position of the aggregate in the bins at the lower quarter points. Provide an automatic plant shut-off to operate when any aggregate bin becomes empty.
 - 4.2.4 Provide adequate and convenient facilities for obtaining aggregate samples from each bin.

5. REQUIREMENTS FOR PLANTS CONTROLLING GRADATION OF COLD, DAMP AGGREGATES

- 5.1 Maximum Aggregate Size
 - 5.1.1 Reject oversize aggregate by suitable methods or devices before the aggregate enters the cold feed, or by plant screens complying with subsection 4.1 (Plant Screens).
- 5.2 Cold Feed Bins
 - 5.2.1 Equip cold feed bins with an indicator device to indicate the position of the aggregate in the bins at the lower quarter points. Provide an automatic plant shut-off or a warning horn located on the plant control panel to operate when any aggregate bin becomes empty or the flow from any bin gate becomes restricted.
 - 5.2.2 Ensure adequate and convenient facilities for obtaining samples of the full flow of aggregate from each cold feed bin and from the total cold feed.
 - 5.2.3 Ensure adequate and convenient facilities for diverting aggregate flow into trucks or other suitable containers to check the accuracy of the aggregate delivery system.
 - 5.2.4 Base control on frequent samples from each cold feed bin and the total cold feed tested by **AASHTO T27**.

6. REQUIREMENTS FOR BATCH PLANTS

- 6.1 Control of Aggregate Gradation- Equip the plant to control the aggregate gradation in accordance with the requirements of either Section 4 (Requirements for Plants Controlling Gradation of Hot, Dry Aggregates) or Section 5 (Requirements for Plants Controlling Gradation of Cold, Damp Aggregates).
- 6.2 Weigh Box or Weigh Hopper
 - 6.2.1 Provide means for weighing each bin size of aggregate into a weigh box or hopper, suspended on scales, and ample in size to hold a full batch without hand-raking or running over.
 - 6.2.2 Support the weigh box or hopper on fulcrums and knife edges that will not easily be thrown out of alignment or adjustment.
 - 6.2.3 Ensure no leakage on gates, both on the bins and the hopper.
- 6.3 Aggregate Scales
 - 6.3.1 Provide scales for any weigh box or hopper being either beam or spring-less dial type and being of standard make and design having tolerances on over-registration and under-registration not exceeding 0.5% of the indicated weight when tested for accuracy. Have the scale accuracy checked every 6 months of operation or as directed by the AME.
 - 6.3.2 Ensure the change in load required to alter noticeably the position of rest of the indicating element (or elements) of a non-automatic indicating scale is not greater than 1.0% of the nominal scale capacity.
 - 6.3.3 Equip beam type scales with a device to indicate that the required load is being approached. Ensure that this device indicates at least the final 200 lbs. of the load.
 - 6.3.4 Ensure graduation intervals for either beam or dial scales are not greater than 0.1% of the nominal scale capacity. Make plainly visible scale graduations and markings.

- 6.3.5 Reduce parallax effects on the dial scale to the practical minimum with clearance between the indicator index and scale graduations not exceeding 0.06 inches.
- 6.3.6 Equip scales with adjustable pointers for marking the weight of each material to be weighed into the batch.
- 6.3.7 Provide no less than 10 test weights, each of 50-lb nominal weight and each stamped with its actual weight to within $\pm 0.05\%$, for the purpose of testing and calibrating the scales. Equip each scale with a suitable cradle or platform for applying the test loads. Keep clean and conveniently locate the test weights for calibration of the scale.
- 6.4 Binder Weigh Bucket
 - 6.4.1 If a bucket is used, ensure it is large enough to handle a batch in a single weighing.
 - 6.4.2 Ensure the filling system and bucket to be of such design, size, and shape that the liquid asphalt binder will not overflow, splash, or spill outside the bucket during filling and weighing.
 - 6.4.3 Require the time to add the liquid asphalt binder so that it does not exceed 15 seconds for pugmills of 4,000 lbs. or less rated capacity and 25 seconds for pugmills of larger capacity. Where the quantity of binder is metered, make provisions to check the delivery of the meter by actual weight.
 - 6.4.4 Oil-jacket or steam the bucket or equip it with properly insulated electric heating units. Arrange it to deliver the binder in a thin uniform sheet or in multiple sprays of the full length of the mixer.
- 6.5 Binder Scales
 - 6.5.1 Ensure scales for the weighing of binder meet the requirement for aggregate scales, as specified in subsection 6.3 (Aggregate Scales), except provide a device to indicate at least the final 20 lbs. of the approaching total load. Equip beam-type scales with a tare beam or adequate counterbalance for balancing the bucket and compensation periodically for the accumulation of liquid asphalt binder on the bucket.
- 6.6 Mixer Unit for Batch Method
 - 6.6.1 Include in the plant a batch mixer of an approved twin-shaft pugmill type capable of producing a uniform mixture within the permissible job mix tolerances.
 - 6.6.1.1 Design the mixer to provide means of adjusting the clearance between the mixer blades and liner plates to ensure proper and efficient mixing.
 - 6.6.1.2 If not enclosed, equip the mixer box with an adjustable hood to prevent loss of dust by dispersion.
 - 6.6.1.3 Construct the mixer to prevent leakage of the contents.
 - 6.6.1.4 Ensure that mixer discharge does not cause noticeable segregation.
 - 6.6.2 Equip the mixer with a positive means for governing mixing time and an accurate time lock to control the operation of a complete mixing cycle; ensure that it locks the binder and the mixer gates throughout the dry and wet-mixing period.

- 6.6.2.1 The dry-mixing period is defined as the interval of time between the applications of binder. The wet-mixing time period is the interval of time between the start of the application of the binder and the opening of the mixer gate.
- 6.6.2.2 Make the timing control flexible and capable of being set at intervals of not more than 5 seconds throughout cycles up to 3 minutes. Set dry mixing time periods for a minimum of 2 seconds not to exceed 5 seconds with the wet mixing time period as a minimum of 35 seconds not to exceed 45 seconds.
- 6.7 Automation of Batching
 - 6.7.1 Install an automatic weighing, cycling, and monitoring system as part of the batching equipment.
 - 6.7.2 Include in the system equipment a means for accurately proportioning the various components of the mixture by weight, or by volume, in the proper order, and the proper equipment for controlling the cycle sequence and timing of mixture operations. Install auxiliary interlock cut-off circuits to interrupt and stop the automatic batching operations whenever an error exceeding the acceptable tolerance occurs in proportioning.
 - 6.7.3 Accuracy – Ensure that the automatic proportioning has the capability to consistently deliver materials within the full range of batch sizes within the following tolerances:

<u>Total Batch Weight of Paving Mix, %</u>	
Batch aggregate component	± 1.5
Mineral filler	± 0.5
Binder	± 0.1
Zero return (aggregate)	± 0.5
Zero return (binder)	± 0.1

Ensure that the electrical circuits for the above delivery tolerances of each cut-off interlock are capable of providing the total span for the full allowable tolerance for maximum batch size. Adjust tolerance controls, automatically or manually, to provide spans suitable for less than full-size batches (**Note 1**). Make the automatic controls and interlock cut-off circuits capable of being consistently coordinated with the batching scale or meter within accuracy of 0.2% of the nominal capacity (**Note 2**) of said scale or meter throughout the full range of the batch sizes.

Note 1 – Reduce the aggregate tolerances to ± 0.5% if separate tolerance controls are not provided for the batching of mineral filler

Note 2 – 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.

- 6.8 Recording of Batching
 - 6.8.1 Produce an automatic graphic or digital record for each batch of asphalt mixture indicating the proportions of each aggregate component (including RAP/RAS), mineral filler, and binder. Identify such records of the batches through a print of day and date. Record binder proportions, either as weight or volume. If recorded as volume, record the quantity either in gallons at 60°F, gallons converted to weight in pounds, or actual gallons with an additional recording of binder temperature.

- 6.8.2 Provide a loadout ticket displaying the weight in pounds from each hot bin and the weight in pounds of binder for each batch produced. Display for each batch the total batch weight on the ticket and display the accumulative total pounds of material produce for a particular project. If a loadout silo is used, provide the tickets printed or a printout displaying the same information on the batch ticket at the end of the production day along with the silo loadout tickets.
- 6.8.3 When using a digital tape or ticket recorder, record the proportions as indicated on the batching scale or meter with an accuracy of 0.5% of maximum batch size.
- 6.8.4 If graphical recording is used, design it so that the stylus will traverse at least 9 inches of the recorder width for the total aggregate weight and maximum binder weight or volume; the preceding based on maximum batch size.
- 6.8.5 Design the charts so that all quantities, including zero, can be read directly and have a resolution of at least 10 lines per inch. Set the chart speed so that individual aggregate weights, when batched cumulatively, can be clearly identified.
- 6.8.6 Ensure the recorder records the proportions as indicated on the batching scale or meter within accuracy of 0.5% of maximum batch size.

7. REQUIREMENTS FOR CONTINUOUS MIX PLANTS

- 7.1 Control of Aggregate Gradations – Equip the plant to control aggregate gradation in accordance with the requirements of either Section 4 (Requirements for plants controlling gradation of hot, dry aggregates) or Section 5 (Requirements for plants controlling gradation of cold, damp aggregates). Provide accurate means of checking the proportioning of each hot bin size by weight.
 - 7.1.1 Include in hot aggregate bins interlocked feeders mounted under the bin compartments. Equip the interlock feeders with a dust-proof revolution counter with minimum graduations of 1/10 of a revolution. Set up the mix proportions on the basis of the weight in pounds of each aggregate bin size per revolution.
 - 7.1.2 Ensure each bin to have a feeder mechanism, subject to control by positive mechanical means, to control the rate of flow of aggregate drawn from each respective bin compartment. Where the gate orifice type feeder is used ensure that it has at least one dimension adjustable by positive mechanical means. Provide locks on each gate. Provide calibrated gauges with minimum graduations of not more than 1/10 inch for each gate to establish gate openings.
 - 7.1.3 Furnish, when added mineral filler is specified, a separate bin and feeder with its drive interlocked with the aggregate feeders. Consider baghouse fines for re-circulation into the mix as mineral filler.
 - 7.1.4 Provide means to establish the rate of flow in pounds per revolution by scale weight.
- 7.2 Weight Calibration of Binder and Aggregate Feed – Include a means of calibrating gate openings and binder flow by weighing test samples in pounds per revolution.
 - 7.2.1 Bypass the aggregate fed out of the bins into suitable individual test boxes.
 - 7.2.2 Supply accessories so that the aggregate in each compartment may be weighed separately.
 - 7.2.3 Provide test containers of convenient size to obtain a composite weight of at least 600 lbs.

- 7.3 Synchronization of Aggregate and Binder Feed – Provide satisfactory controls to ensure positive interlocking or mechanical control between the flow of aggregate through the gates and the flow of binder material through the meter or other proportioning device. Initiate means to check the rate of flow of the binder by scale weight per revolution.
- 7.4 Mixer Unit for Continuous Method – Include in the plant a continuous mixer of an approved twin-shaft pugmill-type capable of producing a uniform mixture within the permissible job mix tolerances.
- 7.4.1 Ensure the paddles are adjustable for angular position on the shafts and reversible to retard the flow of the mix.
- 7.4.2 Equip mixers with discharge hoppers or other facilities to prevent segregation during discharge.
- 7.4.3 Display on the mixer a manufacturer’s plate giving the net volumetric contents of the mixer at the several heights, inscribed on a permanent gage.
- 7.4.4 Prepare charts giving the rate of aggregate feed per revolution and per minute at the plant operation speed.
- 7.4.5 Continuous mixers not complying in all respects with the above requirements, but capable of producing a uniform mixture within the job mix tolerances, may be considered by the AME for approval.
- 7.4.6 Determine the weight per unit volume relationship of the coated loose mix and the pugmill capacity at operating height by means of the volume gage on the side of the mixer.
- 7.4.7 Provide positive means for governing mixing time. Determine mixing time from the following equation (from **AASHTO T195**):
- $$\text{Mixing time, Seconds} = \frac{\text{Pugmill capacity, (lb.)}}{\text{Pugmill output, (lb./sec.)}}$$
- 7.5 Automation of Continuous Mixing Plants
- 7.5.1 Install devices capable of automatically sampling and weighing the quantity of each hot bin aggregate size and sampling, weighing, or metering the binder fed to the pugmill during either a known number or revolutions of the plant or a known interval of time as part of the plant equipment. In addition, ensure each aggregate hot bin, mineral filler bin, and the binder feed line to have interlocking circuits such that the plant operations will be stopped if either aggregate or binder flow is discontinued or reduced.
- 7.5.2 Ensure the plant introduces each size of aggregate to the pugmill with such accuracy that the weight of material from each hot bin does not deviate from the design value by an amount more than 1.5% of the total weight of the asphalt mixture delivered per revolution or interval of time. Where the separate addition of mineral filler is required, add it so that it does not deviate more than 0.5% on the basis stated above for aggregates. Add the binder so that it does not deviate more than 0.1% on the basis stated above for aggregates. In no case allow the total weight of asphalt mixture to vary from the design weight by more than ±2% of the design weight.
- 7.5.3 Make accurate, to within 0.20% of their normal capacities, the scales or meters, or both, used to determine the quantities of aggregates and binder per revolution or interval of time. Supply an aggregate sampling device with capacity of at least 1 lb. for each ton per hour of plant output capacity or 100 lb. whichever is greater.

- 7.6 Recording of Continuous Plants
- 7.6.1 Ensure the plant has an automatic graphic or digital recorder for recording the weights of samples of each hot bin aggregate size and binder, either individually or cumulatively. In addition to the recording of sample quantities, also record the time of sampling identified by a time and date accurate to the nearest minute.
- 7.6.2 If a digital tape or ticket recorder is used, make it capable of accurately recording weights to 0.1% of the nominal capacity of the weighing system.
- 7.6.3 If graphical recording is used, design it so that the stylus will traverse at least 9 inches of the recorder width for the maximum aggregate sample weight and maximum binder weight. Use charts such that all quantities, including zero, can be read directly and have a resolution of at least 10 lines per inch. Use a chart speed such that individual aggregate weights, when batched cumulatively, can be clearly identified.
- 7.6.4 Install a digital recorder as part of the platform truck scales. Have the recorder produce a printed digital record on a ticket of the gross and tare weights of the delivery trucks along with a time and date print for each ticket. Make provisions so that scales may not be manually manipulated during the printing process. In addition, interlock the system to allow printing only when the scale has come to rest. Ensure the scales and recorder to be of sufficient capacity and size to weigh accurately the heaviest loaded trucks or tractor-trailers that are used for delivery of binder paving mixtures from the plant.
- 7.6.5 Provide the Resident Construction Engineer with plant production ticket printouts displaying the percentage of aggregates from each cold feed bin used during production. Display on this ticket the following:
- Percent of moisture content of each aggregate or an average percent moisture content,
 - TPH of binder,
 - TPH dry aggregate,
 - TPH of recycled materials (RAP and RAS)
 - TPH lime at approximately 20-minute intervals.
- This recording will not be a running average but the actual percentages at the time of recording. When mineral filler or stabilizing fibers are used, interlock the system into the plant controls to ensure proper feed.

8. REQUIREMENTS FOR DRUM DRYER-MIXER PLANTS

- 8.1 Control of Aggregate Gradation – Equip the plant to control aggregate gradation in accordance with the requirements of Section 5 (Requirements for plants controlling gradation of cold, damp aggregates)
- 8.2 Aggregate Delivery System
- 8.2.1 Weigh the total cold aggregate continuously by an approved belt scale. When tested for accuracy, ensure that the weighing system registers within $\pm 0.5\%$ of the correct weight.
- 8.2.2 Make provisions for introducing the moisture content of the total cold feed into the belt weighing signal and correcting wet aggregate weight to dry aggregate weight.
- 8.2.3 Display an automatic digital record of the dry weight of the flow of aggregate, recorded and totaled in appropriate units of weight and time.

- 8.2.4 When mineral filler is specified, provide a separate bin and feeder with its drive interlocked with the aggregate feeders.
- 8.3 Binder System
- 8.3.1 Provide satisfactory means to ensure positive interlock between the dry weight of aggregate flow and the flow of binder through an approved meter. Ensure the interlock to be capable of adjusting the flow of binder material to compensate for any variation in the dry weight of aggregate flow.
- 8.3.2 Display an automatic digital record of the flow of binder, recorded and totaled in appropriate units of volume or weight and time.
- 8.3.3 Provide convenient means for diverting binder into distributor trucks or other containers for checking accuracy of delivery systems.
- 8.4 Drum Mixer
- 8.4.1 Supply a drum mixer of satisfactory design. Make it capable of drying and heating the aggregate to the moisture and temperature requirements set forth in the paving mixture specifications and capable of producing a uniform mixture of aggregates and binder.
- 8.4.2 Equip the plant with approved recording thermometers, pyrometers, or other approved recording thermometric instruments at the discharge chute of the drum mixer.
- 8.4.3 Facilitate the plant with means of diverting mixes at start-up and shutdowns or where mixing is not complete or uniform.
- 8.4.4 Provide a surge or storage system complying with Section 3.9 (Surge and Storage Bins).
- 8.4.5 Provide the Resident Construction Engineer with plant production ticket printouts displaying the percentage of aggregates from each cold feed bin used during production. Displayed on this ticket the following:
- Percent of moisture content of each aggregate or an average percent moisture content,
 - TPH of binder,
 - TPH dry aggregate,
 - TPH of recycled materials (RAP and RAS)
 - TPH lime at approximately 20-minute intervals.
- This recording will not be a running average but the actual percentages at the time of recording. When mineral filler or stabilizing fibers are used, interlock the system into the plant controls to ensure proper feed and provide a data recording system to document the percentage of fibers that are used.
- 8.4.6 Do not allow drum mixer plants to add recycled, startup, cleanout, or any other type of coated or uncoated material by the use of an auger system into the hot elevator or drum mixer.
- 8.4.7 Allow drum mixers to add an approved recycled material at the proper location into the drum-mixer as stated by the plant manufacturer.

9. STORAGE OF MIXTURES

- 9.1 Conditions of Use
 - 9.1.1 A plant may store asphalt mixture in a silo overnight after prior evaluation and approval by the AME. Approval is for a maximum of 18 hours if the materials meet all the requirements as stated in **SC-T-79**. Discard any material stored in a silo after the 18 hour period. Affix an indication device to each silo visible to the loading operator, and activate it when the material drops below the top of the sloped portion of the silo.
- 9.2 Approval Procedure
 - 9.2.1 Perform an evaluation of a unit to determine the degree of mix composition uniformity, temperature characteristics, and degree of binder hardening of mixture processed through the unit. Consideration for approval will be given for an operation that consistently results in mixtures having gradation and temperature properties of no less quality than specified mixtures discharged directly from the plant's mixing operation and resulting in asphalt hardening properties which do not exceed the limits specified in Section 9.3 (Limits of Storage of Asphalt Mixtures). Reject mixtures in which the AME determines visually to be segregated.
- 9.3 Limits for Storage of Asphalt Mixture
 - 9.3.1 Ensure that dense graded asphalt mixtures do not exceed 18 hours in storage. Ensure that open graded and SMA mixtures do not exceed 2 hours in storage. The indicated storage times may be reduced by the AME if it is determined that asphalt absorption is a problem. Do not allow storage of open graded mixtures if it is determined that migration of asphalt during the storage period is excessive.
 - 9.3.2 Take samples for binder property tests from trucks loaded from the storage unit or mixing operation.
- 9.4 Changes in System
 - 9.4.1 In the event that an approved storage unit is changed or altered, notify the AME of the modifications. Reevaluate any departure from the approved unit. This approval is good for a period of 2 years.

10. HYDRATED LIME SYSTEMS

- 10.1 Ensure that all lime systems to be used for the purpose of adding lime as an anti-strip additive meet the following:
 - 10.1.1 Use a separate silo -bin and feed system to store and proportion the lime in the mixture.
 - 10.1.2 Control hydrated lime systems by a proportioning device accurate to within plus or minus 10% of the amount required. Ensure that the lime proportioning system consists of a continuous feeder system that will proportion the flow rate of lime by actual weight.
 - 10.1.3 Control the lime weighing system and feeding system by a positive weigh system. Ensure the system to have the ability to continuously monitor the flow rate of dry aggregate and recycled materials (total aggregate) in tons per hour. Ensure the system automatically adjusts the flow of lime for any change in total aggregate flow rate. Do not use volumetrically controlled lime feeder systems.
 - 10.1.4 Enter the moisture content of the damp aggregate into the control and ensure that the system provides a total dry aggregate (including recycled materials) in tons per hour signal

to control the lime feed. Display on the control system the following: Percent Moisture in the Total Aggregate, the Tons Per Hour of Total Aggregate and Tons Per Hour or Pounds Per Minute of Lime. Ensure the display output is from actual continuous scale readings.

- 10.1.5 Ensure the system to have high and low out-of-tolerance sensing ability by weight. Interlock flow indicators or sensing devices for the hydrated lime system with the plant controls to interrupt mixture. Install a horn and ensure it sounds if the lime is not feeding or if the flow rate of lime is out of tolerance for no more than 60 seconds. The horn must be audible in the plant control room, field lab and at any location at the plant site. Provide a simple and convenient means of stopping the flow of lime near the silo, so that the monitoring system can be checked when the Department's representative deems necessary.
- 10.1.6 Provide a convenient means to divert the flow of lime from the feeder to an outside sample container to check the lime calibration. Instead of diverting lime from the feeders, the weighing system may be verified in accordance with **SC-T-78** by using multiple 50 lbs. weights. Facilitate all necessary equipment for checking the lime calibration, and ensure it remains at the plant site. Volumetric control will not be permitted, unless the system is installed on a batch plant ensuring that the lime is delivered to the weigh hopper with a minimum of a 5 second dry mix cycle in the pugmill.
- 10.1.7 Obtain approval of the AME for all lime systems, including the dry metering systems, before any mix is produced for use in the project.
- 10.2. Pugmill Systems:
 - 10.2.1 Make available a water spray delivery system to dampen the aggregates. Ensure that this system consists of a spray bar mounted over the cold feed gathering conveyor before adding the hydrated lime. Do not mount the water spray delivery system over the aggregate belt conveyor equipped with the weigh monitoring system. Pass all virgin aggregates being fed to the plant under the spray bar. Ensure that the spray bar has a minimum of 3 spray nozzles equally spaced across the width of the conveyor belt to provide a uniform coverage of moisture. Obtain a minimum of one moisture sample in the morning and one moisture sample in the afternoon so that the moisture can be adjusted if needed during the production process.
 - 10.2.2 Accomplish blending of the lime with the aggregates by a continuous single shaft or a twin shaft motorized continuous premixing pugmill before entering the dryer of the plant. Design the continuous premixing pugmill such that the aggregate and lime, upon entering the pugmill, are moved in a near horizontal direction by the mixing paddles, without the aid of a conveyor belt, for a distance of at least 3 ½ feet. Ensure the pugmill has adequate capacity to uniformly mix and coat the aggregate with the lime without interfering with the normal production rate of the asphalt plant. Allow no traces of unmixed lime after the aggregate and lime exit the pugmill.
 - 10.2.3 Adequately enclose the lime feeder system and continuous premixing pugmill to prevent lime from becoming airborne.
 - 10.2.4 Do not use an inverted twin-shafted-belt box mixer or any other type of belt mixing device. Do not use mixing devices that permit the aggregate to fall through the mixing paddles. Do not use volumetrically controlled lime feeder systems.
- 10.3. Dry Metering System:
 - 10.3.1 Introduce the lime directly into the mixing drum to prevent fugitive lime dust from becoming airborne around the cold feed belt or pugmill mixer.

- 10.3.2 Ensure the aggregate is uniformly coated with hydrate lime aggregate before adding the asphalt binder to the mixture. Deliver the lime by an auger or by blowing into the drum after the depleting weigh pod and vane feeder no closer than 18 inches from the introduction of PG binder in a drum mix plant. Ensure the addition of lime will not become entrained in the exhaust system of the drier or plant.
- 10.3.4 Interlock metering system with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and ensure mixture produced is properly treated with lime. Ensure the system will interrupt mixture production if the lime fails to meet the required target value after no longer than 60 seconds, but prior to the weigh pod reaches a zero reading.

11. Recycled Asphalt Pavement (RAP) and Recycled Asphalt Shingles (RAS)

- 11.1 Ensure that all recycled pavement systems to be used for the purpose of adding RAP / RAS or any other approved recyclable material to asphalt mixtures meets the following:
 - 11.1.1 The asphalt plant is capable of producing uniform homogeneous asphalt mixture when a recycled material is being introduced to a virgin asphalt mixture.
 - 11.1.2 The addition of any recycled material in a batch, drum, or continuous mix asphalt plant meets all applicable requirements.
 - 11.1.3 Ensure the plant meets all local, State and Federal pollution requirements.
 - 11.1.4 Provide means to divert the recycled material and virgin aggregates into trucks or other containers for verifying the accuracy of the cold feed delivery systems.
 - 11.1.5 Calibrate all systems prior to production for any Department project requiring the addition of any recyclable materials.
 - 11.1.6 Do not allow any device used to introduce plant overburden or coated or uncoated asphalt mix into the hot elevator.
- 11.2 Batch Plants
 - 11.2.1 Introduce RAP / RAS into the weigh hopper, hot elevator, or individual coater box at a maximum of 20% to ensure consistent mix quality.
 - 11.2.2 In the addition of RAP / RAS, do not exceed the allowable tolerance of the total batch weight per Section 6.7.3 (Accuracy).
 - 11.2.3 Ensure that the system can weigh, control, and monitor continuously the RAP / RAS accurate to $\pm 0.5\%$.
 - 11.2.4 Obtain and test moisture samples a minimum of 2 times per day, one in the morning and one in the afternoon.
 - 11.2.5 Make provisions to electronically introduce the determined moisture content of the cold feed materials (RAP / RAS and virgin aggregate) in the belt weighting system and automatically correct wet material weights to dry material weights.
 - 11.2.6 Print plant production printouts at a maximum of 20 minute intervals. Ensure that the printout states:

- Dry virgin aggregate rate in tons per hour
 - Dry RAP / RAS rate in tons per hour
 - Total tons per hour virgin aggregates
 - Date and time of recording
- 11.2.7 Make production printouts available on a daily basis to the Department's representatives. If a silo is used on a batch plant, provide the Department with the loadout ticket from the silo, the plant batching ticket and the plant productions ticket if the RAP / RAS system is in use.
- 11.3 Drum Mixing Plants
- 11.3.1 Continuously weigh, control and monitor the interlocked RAP / RAS cold feed rate and the virgin aggregate cold feed rate. Ensure an accuracy of 0.5% on the weighing system.
- 11.3.2 Make available means to divert the RAP / RAS and virgin aggregates into trucks or other containers for verifying the accuracy of the cold feed delivery systems.
- 11.3.3 Obtain moisture samples and test them a minimum of 2 times per day.
- 11.3.4 Make provisions to electronically introduce the determined moisture content of the cold feed materials (RAP/ RAS and virgin aggregate) in the belt weighting system and automatically correct wet material weights to dry material weights.
- 11.3.5 Introduce RAP / RAS in the plant at a location far enough inside the drum away from the burner flame and extremely hot gases.
- 11.3.6 Print plant production printouts at a maximum of 20 minute intervals. Ensure that these printouts state:
- Dry virgin aggregate rate in tons per hour
 - Dry RAP / RAS rate in tons per hour
 - Binder in tons hour
 - Date and time of recording
- 11.3.7 Make production printouts available on a daily basis to the Department's representatives.
- 11.4 Continuous Mix Plants
- 11.4.1 Provide means to continuously weigh, control, and monitor the interlocked RAP / RAS cold feed rate and the virgin aggregate cold feed rate. Ensure an accuracy of 0.5% on the weighing system.
- 11.4.2 Provide a means to divert the RAP / RAS and virgin aggregates into trucks or other containers for verifying the accuracy of the cold feed delivery systems.
- 11.4.3 Obtain samples of RAP / RAS and the virgin aggregates a minimum of 2 times per day; one in the morning and one in the afternoon, to accurately determine the percentage of moisture in the materials. Update the plant computers based on this information for accuracy in the adjustment for the binder.

12. Fiber and Ground Tire Rubber Supply System

- 12.1 Use a separate automated feed supply system that uniformly introduces and blends the stabilizing fibers or rubber into the mix during production at the rate specified on the job mix information sheet.
- 12.1.1 Control the proportion of the fibers or rubber accurately to within plus or minus 10% of the amount of fibers required
- 12.1.2 To verify the feed rate, equip the system to provide in-process monitoring, consisting of a printout of the feed rate, in pounds per minute, printed out at a 20-minute interval.
- 12.1.3 Provide and interlock flow indicators or sensing devices for the fiber or rubber system with the plant controls, so that an audible warning alarm sounds if introduction of the fibers or rubber fails, or if the output rate is not within the tolerance given above for more than 60 seconds.
- 12.1.4 Optional - Ensure a manufacturer's representative is onsite to manually weigh, batch, and mechanically or manually introduce fibers or rubber into the asphalt plant based on a consistent production rate. Obtain acceptance of this system by the AME prior to production on contracts with less than 5000 mix tons. Production must be stopped when no flow of fibers or rubber is detected in ensure mix quality is not compromised.
- 12.2 Batch Plant
- 12.2.1 When a batch plant is used, add the fibers or rubber to the aggregate in the weigh hopper or as approved and directed by the AME. Increase the batch dry mixing time by 8 to 12 seconds, or as directed by the AME, from the time the aggregate is completely emptied into the mixer.
- 12.2.2 Uniformly distribute the fibers or rubber before the injection of the binder into the mixer.
- 12.3 Drum Plant
- 12.3.1 When a drum plant is used, add the fibers or rubber to the aggregate and uniformly disperse them before the injection of the binder. Add the fibers in such a manner that they will not become entrained in the exhaust system of the drier or plant.