



## SECTION 404

### BITUMINOUS MIXING PLANTS

**404.1 Description.** This specification covers the requirements for mixing plants and equipment used in the production of bituminous mixtures.

#### **404.2 Requirements for All Plants.**

**404.2.1 Aggregate.** Sufficient storage space shall be provided for each size of aggregate. The different aggregate sizes shall be kept separated until delivery to the combined cold feed belt. The storage yard shall be maintained in a neat and orderly condition and the separate stockpiles shall be readily accessible for sampling.

**404.2.2 Asphalt Binder.** An asphalt binder storage tank shall be provided at the proportioning and mixing plant. If more than one storage tank is used to deliver asphalt binder to the proportioning unit, piping and valve arrangements shall permit material to be used from any one of the tanks without using from another at the same time.

**404.2.2.1 Storage.** Each tank used for storage from which asphalt binder is delivered to the proportioning unit shall be equipped for heating the material under effective and positive control at all times to the temperature requirements set forth in [Sec 1015](#). Heating shall not allow contact of flame with the heating tank. The contractor shall furnish a tank capacity chart calculated in increments suitable for verifying quantities used during a normal production period.

**404.2.2.2 Circulation.** A circulating system of adequate capacity shall provide proper and continuous circulation of the asphalt binder between the storage tank and proportioning units during the entire operating period. The discharge end of the circulating pipe shall be maintained below the surface of the asphalt binder in the storage tank to prevent discharging into the open air. All pipe lines and fittings shall be properly insulated to prevent heat loss.

**404.2.2.3 Binder Sampling.** The contractor shall provide a sampling outlet in the asphalt binder feed lines connecting the plant storage tanks to the proportioning or injection system. The sampling outlet shall be installed in a readily accessible location such that representative samples may be withdrawn safely and slowly at any time during plant operation. A drainage receptacle shall be provided for flushing the outlet prior to sampling.

**404.2.3 Cold Aggregate Feeder.** The plant shall be provided with an accurate mechanical means for uniformly feeding the aggregate into the drier to provide uniform production and temperature. A synchronized method of proportioning the aggregate at the cold feeder shall be provided.

**404.2.3.1 Cold Feed Calibration.** For all plants producing bituminous mixtures composed of more than one fraction of aggregate, the aggregate cold feeds shall be calibrated as required by the engineer. On the basis of the calibration, aggregate cold feeds shall be adjusted to ensure the proper percentage of the various aggregate fractions of the mix, as required by the job mix formula.

**404.2.3.2 Aggregate Sampling.** Safe, adequate and convenient facilities shall be provided for obtaining representative aggregate samples from the full width and length of the discharge flow of the combined cold feed, or from each hot bin on batch-type plants.

**404.2.4 Drier.** A drier of any satisfactory design for drying and heating the aggregate shall be provided. The drier shall be capable of drying and heating the aggregate to a temperature within the limits of the range specified in [Sec 1015](#) for the grade of asphalt binder used, without leaving any visible unburned oil or carbon residue on the aggregate. The mixture may be tested for contamination. Absorbed moisture in the aggregate shall be reduced to such a quantity that there is no visible segregation of asphalt binder resulting from escaping water vapor in the prepared mixture.

**404.2.5 Dust Collector.** An efficient dust collecting system shall be provided to prevent the loss of fine material into the surrounding environment. The material collected may be returned to the mixture at a uniform rate through a metering device or the dust may be wasted.

**404.2.6 Filler Storage.** If mineral filler or hydrated lime, or both, are required, adequate dry storage shall be provided and provisions shall be made for accurate proportioning.

**404.2.7 Asphalt Control Unit.** Satisfactory means, either by weighing (determining the mass) or metering, shall be provided to obtain the proper quantity of asphalt binder. Metering pumps for asphalt shall deliver accurately to within plus or minus 2.0 percent of the required quantity when tested for accuracy. Asphalt scales shall be in accordance with [Sec 404.3.4](#). If the quantity of asphalt binder is controlled by metering, provisions shall be made whereby the delivery meter may be readily checked by actual weight (mass).

**404.2.8 Thermometric Equipment.** A thermometer of suitable range shall be fixed in the asphalt feed line at a suitable location near the discharge at the mixer unit. The thermometer included in the asphalt metering unit shall be displayed in a location readily accessible to the engineer. An approved recording thermometer, pyrometer or other recording thermometric instrument shall be installed in plants in such manner that the temperature of the heated mixture or aggregate is automatically registered and recorded. The terminal shall be maintained free of accumulated mixture or aggregate to ensure accuracy. The thermometric instrument shall be installed in the discharge chute of drum mix plants and in at least one hot aggregate bin of batch plants. The terminals shall be located where the hot material will flow around the terminals during the proportioning operation and shall not be located near the corners of the bins or at points where the material will collect or pack around the terminals. This instrument shall be located in clear view of the plant operator. A chart shall continuously record both time and temperature. The smallest interval of time shall be a maximum of 15 minutes and the temperature graduations shall be no more than 10 F (5 C). The chart shall be furnished to the engineer at the end of each day's operation.

**404.2.9 Plant Calibration.** Personnel, scales and equipment necessary for calibrating the plant and for verifying the accuracy of proportions shall be furnished by the contractor and shall be available at all times. All scales used in the final measurement of the mixture shall be in accordance with [Sec 310](#). Records of all calibration shall be provided to the engineer.

**404.2.10 Safety Requirements.** A conveniently located, easily opened gate or door shall be provided in the mixer cover for observation of pugmill mixing operations. Adequate and safe stairways to the pugmill mixer platform and sampling points shall be provided. Guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required. Accessibility to the top of truck bodies shall be provided by a platform or other suitable device to enable the engineer to obtain samples and mixture temperature data. All gears, pulleys, chains, sprockets and other dangerous moving parts shall be thoroughly guarded and protected. Ample and unobstructed space shall be provided on the pugmill

mixing platform. A clear and unobstructed passage shall be maintained at all times in and around the truck loading area. This area shall be kept free from drippings from the mixing platform.

**404.2.11 Surge Bins.** Surge bins used in the production of bituminous mixtures shall maintain the temperature of the mixture within 25 F (15 C) of the contractor's designated temperature. Mixture shall not be stored more than 8 hours.

**404.2.12 Automatic Ticket Printer.** The asphalt plant shall be equipped with an automatic ticket printer connected to the weighing (mass determination) system in such a manner that the printer automatically detects and prints the weight (mass) determined by the system. The printer shall store and recall the tare weight (mass) when the operator enters the vehicle identification. The weight (mass) shall be shown to at least the nearest 20 pounds (10 kg) or nearest one one-hundredth of a ton (0.01 Mg)

**404.2.13 Ticket Information.** The printer shall be capable of keeping and printing cumulative totals for each project for each type of bituminous mixture. The printer shall produce a ticket in triplicate to accompany each load delivered to the project and shall be furnished to the engineer. The ticket shall show the following:

- (a) Gross and tare and/or net weights (masses).
- (b) Current date and time.
- (c) MoDOT job mix type.
- (d) Unique ticket number (may be preprinted on the ticket).
- (e) Job number, route and county.

**404.2.13.1 Net Weight.** The gross and tare weights (masses) will not be required when the net weight (mass) of bituminous mixture is determined by batch weights (masses).

**404.2.13.2 Gross Weight.** When the net weight (mass) of bituminous mixture is determined from the gross weight (mass) of the loaded delivery vehicle, the empty delivery vehicle weight (mass) shall be determined daily or from time to time during the day as directed by the engineer.

**404.2.13.3 Daily Total.** At the end of each day's operation, the contractor shall furnish to the engineer a total tonnage (quantity) of mixture produced by the asphalt plant in sufficient detail to determine the amount of asphalt binder used in that day's operation.

**404.2.13.4 Printer Failure.** In the event of automatic ticket printer failure, the contractor may be permitted, without approval from the engineer, to furnish manually written tickets to complete that day's operation.

#### **404.3 Requirements for Batch-Type Plants.**

**404.3.1 Automatic Batching.** For all contracts containing no more than 10,000 tons (9000 Mg) of bituminous mixture, standard manual batching methods approved by the engineer will be permitted. For contracts containing more than 10,000 tons (9000 Mg) of bituminous mixture, in accordance with [Sec 401](#) or [Sec 403](#), batching plants shall be equipped to operate automatically to the extent that the only manual operation required for the proportioning of all ingredients for one batch shall be a single actuation of a switch or starter. The equipment shall include devices capable of automatically proportioning each ingredient of

the mixture in the selected sequence and quantity. Interlocks shall be provided which will hold or delay the automatic batch cycling whenever the batched quantity of any ingredient is not within the specified tolerance. The weight (mass) setting and timing controls shall be suitably equipped so the controls may be locked when specified by the engineer. Manual operation will not be permitted beyond 24 hours after breakdown in the automatic equipment, except with written approval from the engineer.

**404.3.2 Aggregate Scales.** Scales for weighing (determining the mass of) aggregate and mineral filler or hydrated lime, or both, may be beam, springless dial or electronic digital weigh (mass determination) meter type, and shall be of standard make and design having tolerances on overregistration and underregistration not exceeding 0.4 percent of the indicated weight (mass) when tested for accuracy. Each aggregate fraction shall be measured within one percent of the total batch weight (mass) of the mixture. Mineral filler or hydrated lime, or both, shall be measured within 0.5 percent of the total batch weight (mass) of the mixture. The total weight (mass) of the batch shall be within 2.0 percent of the desired batch weight (mass). The change in load required to change the position of the rest of the indicating element or elements of a non-automatic indicating scale an observable amount shall be no greater than 0.1 percent of the nominal scale capacity. If manual batching methods are used, beam-type scales shall be equipped with a device to indicate to the operator that the required load is being approached. This device shall indicate at least the last 5 percent of the load weighed (determined) on any beam, except that this increment will not be required to be greater than 200 pounds (100 kg). Multiple beam-type scales shall be equipped with a tare beam and a separate beam for each size of aggregate. Dial scales shall be equipped with adjustable pointers for marking the weight (mass) of each material to be weighed (incorporated) into the batch. Graduation intervals for either beam or dial scales shall be no greater than 0.1 percent of the nominal scale capacity. Quantity indicators necessary for batching shall be in full view of the operator.

**404.3.3 Asphalt Bucket.** If a bucket is used for weighing (determining the mass of) the asphalt binder, the filling system and bucket shall be of such design, size and shape that asphalt will not overflow, splash or spill outside the confines of the bucket during filling and weighing (mass determination).

**404.3.4 Asphalt Scales.** Scales for weighing (determining the mass of the) asphalt binder shall be in accordance with [Sec 404.3.2](#), except a device to indicate at least the last 20 pounds (10 kg) of the approaching total load shall be provided. Asphalt binder shall be measured within 0.1 percent of the total batch weight (mass) of the mixture. Beam-type scales shall be equipped with a tare beam or adequate counter-balance for balancing the bucket and compensating periodically for the accumulation of asphalt on the bucket. Springless dial scales used for weighing (determining the mass of) asphalt binder shall have a tare beam and a dial graduated in increments not to exceed 0.1 percent of the nominal scale capacity and the maximum dial capacity shall be no more than 15 percent of the nominal capacity of the mixer.

**404.3.5 Mixer Unit.** The plant shall be capable of producing a uniform mixture. The mixer shall be heated and shall have a minimum capacity of 2000 pounds (900 kg) per batch. The mixer shall be constructed to prevent leakage of the contents and the mixer box shall be equipped with a hood to prevent loss of dust.

**404.3.5.1 Time Lock.** The mixer shall have 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 of the cycle. The time lock shall lock the asphalt bucket throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods.

**404.3.5.2 Mixer Rating Plate.** A rating plate designating the manufacturer's rated capacity shall be attached to the mixer. The quantity of mixture produced per batch shall not exceed the manufacturer's rated capacity.

**404.3.5.3 Mixing Times.** The mineral aggregate for mixtures specified in Secs 401 and 402 shall be mixed dry for at least 10 seconds and for mixtures specified in Sec 403 shall be mixed dry for at least 15 seconds. The dry mixing period shall start when all of the mineral aggregate has been charged into the mixer, and end when the introduction of the asphalt binder begins. After dry mixing, the asphalt binder shall be charged into the mixer in a manner that will uniformly distribute the asphalt over at least 3/4 of the full length of the mixer. The time required to add the asphalt binder shall not exceed 15 seconds. Wet mixing shall begin at the introduction of the asphalt binder and shall continue for at least 30 seconds, or longer if necessary, to produce a complete and uniform coating of the particles and a thorough distribution of the asphalt binder throughout the aggregate. The wet mixing period shall end when the discharge gate is opened.

#### **404.4 Requirements for Drum Mix Plants.**

**404.4.1 Drum Plant.** The plant shall be specifically designed for drum mixing and shall be capable of satisfactorily heating, drying and mixing bituminous mixtures. Heating shall be controlled to prevent damage to the aggregate or the asphalt binder. The temperature of the mixture when discharged from the mixer shall be within the range specified in Sec 1015 for the grade of asphalt binder being used. The rate of flow through the drum shall be controlled such that the bituminous material and aggregate shall be mixed until a homogeneous mixture with all particles uniformly coated is obtained, and in no case shall the quantity of mixture produced exceed the manufacturer's rated capacity.

**404.4.2 Feed Indicators.** Each feeding orifice shall have an adjustable gate with an indicator provided to reference the opening setting. A device shall be installed on each aggregate feeder to indicate when the flow of material from the bin is below the point where accurate proportioning through the feeder gates can be accomplished. These indicators shall be positive in action and shall actuate a clearly visible or audible signal to the plant operator, or stop the flow of material to the drum when the level of material in the bin is too low for accurate proportioning. A scalping screen mounted independent of other proportioning or weighing (mass determination) equipment shall be provided if directed by the engineer.

**404.4.3 Asphalt Meter.** Asphalt binder shall be introduced through a continuously registering cumulative indicating meter by a pump specifically designed for drum mix plants. The meter shall be located in the asphalt line so that the meter will continuously register the asphalt discharge to the mixer and such that the discharge through the meter can be readily diverted into a container for measurement. The meter shall be equipped with a nonsetback register and shall have an accuracy within 2 percent by weight (mass) of the material actually being measured in any given period of time. The nonsetback register shall register only the asphalt discharged to the mixer and shall not record asphalt circulated back to the storage tank. A device shall be provided in the asphalt storage tank to indicate when the supply of asphalt to the pump and metering device is such that accurate proportioning is not accomplished. The accuracy of the pump and meter shall be verified at periodic intervals as designated by the engineer.

**404.4.4 Mineral Filler.** If mineral filler or hydrated lime, or both, are used, a separate bin and feeder for each material shall be furnished and each material shall be dispensed by weight (mass) by continuous batching device. The batching device shall have a continuous weight (mass) display in clear view of the plant operator. The delivery system shall be variable speed and interlocked with the aggregate weigh belt so the total dry aggregate weight (mass), including mineral filler or hydrated lime, or both, is indicated to the asphalt proportioning

system. A continuously registering, cumulative, nonsetback register shall record the quantity of mineral filler or hydrated lime, or both, discharged into the mixer. Mineral filler and hydrated lime shall be introduced and uniformly dispersed into the drum mixer at the point of introduction of the asphalt binder without loss to the dust collection system. The mineral filler and hydrated lime proportioning and delivery system shall have an accuracy of 10 percent by weight (mass) of the material actually being measured in any given period of time.

**404.4.5 Belt Scales.** Positive weight (mass) measurement of the combined cold feed aggregate shall be by use of belt scales. The combined cold feed aggregate shall be continuously recorded on a nonsetback register. The belt scale shall have an accuracy within 2 percent by weight (mass) of the material actually being measured in any given period of time. The accuracy of the belt scales shall be verified at periodic intervals as directed by the engineer.

**404.4.6 Reclaimed Asphalt Pavement Weighing.** Positive weight (mass) measurement of reclaimed asphaltic pavement shall be by use of belt scales in accordance with [Sec 404.4.5](#).

**404.4.7 System Interlocks.** The aggregate feed system, reclaimed asphaltic pavement feed system if recycling is permitted, mineral filler or hydrated lime, or both if specified, and the asphalt flow shall be interlocked by a blending system which will automatically regulate the asphalt binder, mineral filler, hydrated lime and reclaimed asphaltic pavement flow, and shall cause synchronized corrections for variations in aggregate flow. The blending system shall include a moisture-compensating device to correct for moisture in the aggregate passing over the belt scales. Moisture determinations shall be made periodically during each day's operation. The blending system shall include a device to correct for changes in the specific gravity of the asphalt binder.

**404.4.8 Sampling.** Safe, adequate and convenient facilities shall be provided for obtaining representative samples of asphalt binder, cold aggregate and bituminous mixture. The plant shall be equipped with sampling devices capable of providing a sample of sufficient size from the full width of the combined aggregate flow and from the full width of the mixer discharge flow. Sampling devices shall be designed such that samples may be taken while the plant is operating at normal production rates.

**404.4.9 Calibration.** Safe, adequate and convenient facilities shall be provided for calibrating or verifying the asphalt binder, mineral filler, hydrated lime, reclaimed asphaltic pavement and the aggregate nonsetback registers. The manufacturer's recommendations shall be followed for calibration unless specified otherwise. The quantities of aggregate and asphalt binder measured in any given period of time shall vary no more than 2.0 percent by weight (mass) from the required quantity of each.

**404.5 Stone Matrix Asphalt Mixtures.** A homogeneous mixture shall be produced.

**404.5.1 Fibers in Batch Plants.** For batch plants, fibers shall be added to the mineral aggregate either in the weigh hopper or in the pugmill. The fibers shall be accurately added by weight (mass), either manually by bag or other measure, or by an approved weight (mass) metering device. If fibers are added in the weigh hopper, no fiber shall be added until mineral aggregate from at least one hot bin has been placed in the weigh hopper. If fibers are added in the pugmill, the fiber shall be added immediately after the mineral aggregate and before the asphalt binder is added.

**404.5.1.1 Dry Mixing.** The mineral aggregate and the fibers shall be dry mixed for at least 20 seconds.

**404.5.1.2 Wet Mixing.** The wet mixing time shall be no less than 35 seconds to allow the cellulose fibers to expand and to ensure adequate distribution of the fibers and asphalt binder.

**404.5.1.3 Uniformity.** Dry and wet mixing times and batch mixing temperatures shall be adjusted as necessary to achieve a uniform mixture.

**404.5.2 Fibers in Drum Plants.** For drum plants, fibers shall be introduced into the plant in either loose or pelletized form.

**404.5.2.1 Metering.** Equipment for metering fibers into the plant shall ensure a consistent, uniform blending of the fibers into the mixture. The metering system shall be variable speed, shall proportion the fibers by weight (mass), shall be accomplished as specified by the equipment manufacturer and be to the satisfaction of the engineer.

**404.5.2.2 Pelletized Fibers.** If used in a drum mix plant, pelletized fiber shall be added directly into the drum mixer through the recycle asphalt inlet.

**404.6 Liquid Anti-Strip Additive Systems.** Type I liquid anti-strip additives shall be blended into the asphalt binder. Type II additives shall be sprayed on the combined cold feed aggregate. Both shall be incorporated in a consistent and uniform manner.

**404.6.1 Calibration.** The method of adding an additive into the mix shall be accurate to within  $\pm 10$  percent of the amount to be added. Calibration of the blending system shall be provided to the engineer.

**404.6.2 Flow Interruption.** The feed system shall be equipped with a flow meter that signals if the additive is or is not being added. It shall be interlocked so that the operation will cease if the additive flow is interrupted or not within the allowable limits.

**404.6.3 Interlock.** The rate of application shall be interlocked with the plant to coincide with plant production rates when the additive is incorporated during mixture production.

**404.6.4 Type I Addition.** For Type I liquid anti-strip additive used in drum mix plants, the blending system shall add the material into a static in-line mixer between the asphalt binder storage tank and the asphalt binder flow meter. For batch plants, the blending system shall add the material into a static in-liner mixer between the asphalt binder storage tank and the mixing plant injection point. Controls shall be in place so that blended material is not permitted to recirculate back to the asphalt binder storage tank.

**404.6.5 Type II Addition.** For Type II liquid anti-strip blending systems, the blending system shall uniformly apply the material to the cold feed prior to the drum for continuous, batch and drum plants.

**404.7 Hauling Equipment.** Trucks used for hauling bituminous mixtures shall have tight, clean, smooth, metal beds that have been thinly coated with a minimum quantity of lime solution or an approved bituminous mixture release agent in accordance with [Sec 1071](#) to prevent the mixture from adhering to the beds. The release agent shall not be diluted less than the minimum rate specified by the manufacturer and shall be applied with equipment recommended by the manufacturer. Use of diesel fuel, fuel oil or other detrimental products as a bed coating or dilution agent will not be permitted. Each truck shall have a cover of canvas or other suitable material of such size to protect the mixture from the weather. The cover shall be securely fastened over all sides of the truck bed. Truck beds shall be insulated, when necessary, such that the mixture will be delivered on the road at the specified temperature.