Please Note – This Supplemental Specification replaces the entire Division 400

DIVISION 400 - PAVEMENTS

SECTION 401 -- PLANT MIX PAVEMENTS – GENERAL

Description

1.1 These specifications include general requirements that are applicable to all types of plant mix asphalt pavements irrespective of the gradation of aggregate, kind and amount of asphalt binder, or pavement use. Deviations from these general requirements will be indicated in the specific requirements for each type.

1.2 These specifications provide for the use of recycled asphalt shingle products, as identified on the NHDOT Qualified Products List and reclaimed asphalt pavement material in certain specified mixtures.

1.3 This work shall consist of the construction of one or more courses of asphalt pavement constructed on a prepared foundation in accordance with these specifications and the specific requirements of the type under contract. The work shall be in reasonably close conformance with the lines, grades, thickness, and typical cross-sections shown on the plans, within the tolerances specified or established by the Engineer.

1.4 These specification provide for both method and quality assurance specification work. Sections under the heading Quality Assurance are applicable on QC/QA items only. Sections marked Method are applicable for non-QC/QA items and those portions of QC/QA items that are not measured for pay adjustment. All sections under the heading General are for use with all items.

1.5 Quality Assurance

1.5.1 The work will be accepted under Quality Assurance (QA) provisions in accordance with these Specifications and the applicable requirements of 106.

(a) The QC/QA Tier 1 item is to be used on specified projects that are on new locations, interstate projects, full depth reconstruction projects in rural areas or on reclamation projects in rural areas.

(b) The QC/QA Tier 2 item is to be used on specified projects that are inlay type projects, full depth reconstruction projects with maintenance of traffic phasing, projects with intersecting streets, projects with pavement tapers, bridge projects with short approach paving, projects where there are many manhole/drainage structures or driveways (generally in urban and suburban areas).

QUALITY/PAY FACTORS TO BE ASSESSED

	Tier 1	Tier 2
Asphalt Content and Gradation	X	X
Cross Slope	X	
Density	X	X
Ride Quality	X	
Thickness	X	

Materials

2.1 Aggregates - General

2.1.1 Aggregates shall be uniform quality durable pebbles or fragments of rock, with or without sand or other inert finely divided mineral aggregate. All material shall be free from clay balls, organic matter, deleterious substances, and an excess of flat or elongated pieces as specified in ASTM D 4791. Washing will not be required, except when aggregate plants do not produce clean material by the dry process method. In order to obtain uniformity of color and appearance of the pavement throughout the project, the aggregate for all the wearing courses shall be obtained from the same material source. Sufficient material shall be on hand prior to starting daily operations to ensure uninterrupted processing for the working day.

2.1.2 Fine aggregate shall consist of sound durable particles of sand, crushed stone, or a combination thereof. Fine aggregate shall be free from clay balls and injurious amounts of organic matter. Stone screening shall be produced from stone at least equal in quality to that specified for coarse aggregate.

2.1.2.1 Fine aggregate may be 100 percent manufactured aggregate.

2.1.3 Mineral filler shall conform to AASHTO M 17 except that 100 percent shall pass the No 16 (1.18 mm) sieve, waiving the requirement for the No. 30 (0.600 mm) sieve.

2.1.4 Coarse aggregate shall be crushed stone or crushed gravel and shall have a percentage of wear as determined by AASHTO T 96 of not more than 45 percent unless otherwise specified by contract item. In each stockpile, not less than 50 percent by weight of the particles retained on the No. 4 (4.75 mm) sieve shall have at least one fractured face. Stockpiles consisting of a blend of crushed stone and crushed gravel will be permitted so long as the overall consistency of the stockpile is reasonably maintained and the lesser portion of coarse aggregate material does not exceed 10 percent of the total. This percentage shall be determined on the portion of the total sample by weight that is retained on the No. 4 (4.75 mm) laboratory sieve.

2.2 Bituminous Materials - General

2.2.1 Bituminous materials used for asphalt cement binder shall meet the properties specified in AASHTO M 320. The grade of asphalt cement binder to be used will be specified in a Special Provision contained in the Proposal.

2.2.2. Liquid binder samples shall be obtained by plant personnel in the presence of the Inspector/Technician. Samples shall be obtained during each days production.

2.2.3 Producers and suppliers of asphalt binders shall comply with the requirement of AASHTO R 26. Asphalt binder suppliers shall have a quality control plan approved by the Bureau of Materials and Research that complies with AASHTO R 26.

2.3 Approval of Materials - Method Requirements

2.3.1 At least five working days in advance of the date of starting operations, the Bureau of Materials & Research may request that representative samples of all materials proposed for use be submitted for testing.

2.4 Composition of Mixtures - General.

2.4.1 Hot mix asphalt shall be composed of a mixture of aggregate, filler if required, and asphalt binder. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula. The contractor shall use the Volumetric Mix Design Method in AASHTO Standard Practice R 35 as modified herein.

2.4.2 The Contractor shall have the option of utilizing asphalt pavement removed under the contract, if any, or old asphalt pavement from an existing stockpile or supplying all new materials for the production of asphalt pavement or any combination of the foregoing. If the job mix formula uses recycled materials, the mix shall meet the requirements of Reclaimed Asphalt Pavement as specified in 2.9.

2.4.3 The Department allows the use of recycled binder in mix designs, up to 0.8% Total Reused Binder (TRB) without any change in asphalt binder requirements as long as the mix design meets all volumetric mix design criteria. When a design has been completed using the maximum allowable percentage of TRB, one point verifications may be performed using decreasing percentages of TRB. If the design is not validated using a decreased amount of TRB, a new design will be required.

2.5 Job Mix - General

2.5.1 When a new volumetric mix design is required, the Contractor shall use the Volumetric Mix Design Method in AASHTO Standard Practice R 35 to develop a mix that meets the associated design criteria. The Mix design shall follow the procedure detailed in AASHTO with the following exceptions: Amend Table 1 Superpave Gyratory Compaction Effort to read as follows:

Design ESALs **(Million)**	N initial	N design	N max
0 < 10	**6**	**50**	**75**
≥10	**7**	**75**	**115**

Add the following:

Wearing course on ESAL designs of < 10 shall have a minimum binder content of 5.8% utilizing the 50 gyration N design mix

Wearing course on ESAL designs of > 10 shall have a minimum binder content of 5.5% utilizing the 75 gyration N design mix.

This required minimum asphalt content is based on the use of aggregate with a specific gravity of 2.65 to 2.70. The minimum asphalt content requirement may be adjusted when aggregate with a higher specific gravity is used.

Amend Table 3 in AASHTO M 323, referenced in AASHTO R 35, to read as follows:

Table 1 –Design Control Points *								
Standard Sieves	Nominal Maximum Aggregate Size							
	1 in (25 mm)		3/4 in (19 mm)		1/2 in (12.5 mm)		3/8 in (9.5 mm)	
	Max.	Min.	Max.	Min.	Max	Min.	Max.	Min.
In (mm)	Percentage by Weight Passing Criteria (Control Points)							
2 (50.0)								
1-1/2 (37.5)		100.0						
1 (25.0)	100.0	90.0		100.0				
3/4 (19.0)	90.0		100.0	90.0		100.0		
1/2 (12.5)			90.0		100.0	90.0		100.0
3/8 (9.5)					90.0		100.0	90.0
No. 4 (4.75)							90.0	
No. 8 (2.36)	45.0	19.0	42.0	32.0	52.0	42.0	56.0	46.0
No. 200 (0.075)	7.0	1.0	8.0	2.0	10.0	2.0	10.0	2.0

All mix designs shall be submitted to the Department for verification and approval.

* Superpave designs will be accepted through the restricted zone, pending verification and approval by the Bureau of Materials & Research. The contractor shall submit compaction data from trial blends at the optimum asphalt content and at 0.5% below and above the optimum asphalt content. The data shall include the temperature at which the HMA was aged.

2.5.2 The Design Information Shall Include:

(a) Asphalt Binder
PG Test Data
(b) Specific Gravity
Laboratory Mix/Compaction Temperature
(c) Aggregate
(d) Dry and Washed Gradation
(e) Bulk and Apparent Specific Gravity
All appropriate consensus properties
(f) Blends
Baghouse material from the plant shall be incorporated into the mix design. The amount of baghouse material should be based on estimated usage or experience.
(g) Moisture susceptibility according to AASHTO T 283.

Along with the design information, Materials & Research (M&R) requires 2 quarts of the designated asphalt binder, 4 preblended aggregate specimens for gyratory and 2 preblended aggregate specimens, suitable for AASHTO T-209 when mixed with the appropriate asphalt, in order to verify the design. M&R will accept the mix design based on the submitted information meeting the mix requirements and on verification of the mix volumetrics of the submitted specimen. If the verification samples indicated voids between 3.0 and 5.5 percent, and the Voids in Mineral Aggregate (VMA) and Voids Filled with Asphalt (VFA) fall within the specified limits, then the design will be accepted. Once accepted, the approved mix design is the job mix formula (JMF). If the voids are outside the aforementioned range or the VMA or VFA are outside the specified limits, the design will be rejected. M&R may elect to verify the design again.

2.5.3 The proposed mix designs and materials shall be submitted to the Engineer a minimum of 20 working days before placement for approval. It shall be the responsibility of the contractor to ensure all approved mix designs have been entered into the plant automation system before production begins. The contractor will also be required to post a copy of the JMF in the DOT testing laboratory.

2.5.4 Whenever the aggregate properties change enough to negate the project's existing design, a new design shall be submitted.

2.5.5 If it becomes necessary to change the asphalt binder grade or the source of aggregate, a new mix design shall be developed. Up to 14 calendar days will be required to evaluate a change. Approved changes in target values will not be applied retroactively for acceptance or payment. If it becomes necessary to change the source of asphalt binder, the Contractor must submit recent quality test results from the manufacturer for the asphalt binder including a temperature viscosity curve.

2.5.6 The Contractor shall perform a single point verification of an existing project mix design at the beginning of a new construction season to determine if the design remains valid. If the design is validated, the data from the single point verification shall be submitted to the Department. If the design cannot be validated, a new design shall be developed.

2.5.7 The Bureau of Materials and Research may require the use of certain chemical additives.

2.5.8 The laboratory performing the design shall be approved by the Department. To obtain the Departments approval, a laboratory must demonstrate that they are equipped, staffed, and managed so as to be able to produce job mix formulas and test hot asphalt mix in accordance with these Specifications. Approval for each laboratory shall remain in effect for a period of one year.

2.6 Method Requirements

2.6.1 Stockpiled coarse aggregate shall meet the requirements of Table 2.

Table 2 -- Percent Passing

Sieve Size	1-1/2 inch (37.5 mm)	3/4 inch (19 mm)	1/2 inch (12.5 mm)	3/8 inch (9.5 mm)
1-1/2 inch (37.5 mm)	100			
1-1/4 inch (31.5 mm)	90.0 - 100			
1 inch (25.0 mm)	50.0 - 85.0	100		
3/4 inch (19.0 mm)	10.0 - 50.0	90.0 - 100	100	
1/2 inch (12.5 mm)		15.0 - 55.0	90.0 - 100	100
3/8 inch (9.5 mm)			20.0 - 60.0	95.0 - 100
# 4 (4.75 mm)				22.0- 55.0
No. 8 (2.36 mm)	0 - 5.0	0 - 5.0	0 - 10.0	0 - 10.0

2.6.2 After the job mix formula is established, all mixtures furnished for the project shall conform within the following ranges of tolerances:

Passing No. 4 (4.75 mm) and larger sieves	±7.0 percent
Passing No. 8 (2.36 mm) to No. 100 (0.150 mm) sieves (inclusive)	±4.0 percent
Passing No. 200 (0.075 mm) sieve	±1.0 percent
Asphalt binder	±0.4 percent
Temperature of mixture	± 20 °F (11 °C)

2.6.3 When unsatisfactory results or other conditions make it necessary**,** it shall be the responsibility of the contractor to make all adjustments required to ensure the mix conforms to the JMF. Contractor quality control personnel will not be required to be on site during production of non-QC projects, but contact information shall be posted in the testing lab in the event problems arise. If two consecutive unsatisfactory results occur, the Engineer may stop production until satisfactory corrective action has been taken.

2.7 Quality Assurance

2.7.1 After any new changed job mix formula is established, all mixtures furnished for the project shall conform thereto, within the gradation and asphalt binder content reject limits in Table 6 in 3.19.1.1. Specification limits for pay adjustments under quality assurance provisions shall be as set forth in Table 5 in 3.19.1.1.

2.7.2 The general composition limits given in Table 1 in 411 indicate target value ranges of mixtures permissible under 411.The job mix formula shall lie within the target value ranges indicated for the particular type of hot asphalt mix.

2.8 General - Bridge pavement base course shall be 3/8 in.(9.5 mm) wearing course.

2.9 General - Non-modified asphalt cement shall contain silicone additive with the concentration being 3 parts per million plus or minus 1 part per million of silicone to asphalt cement, unless otherwise directed. Silicone additive shall be in liquid form and have a viscosity of 1,000 centipoises (1 Pas) at 77 ºF (25 ºC). Asphalt cement containing silicone shall meet the requirements of 401.2.2

2.10 Recycled Materials - General

2.10.1 Reclaimed asphalt pavement (RAP) and recycled asphalt shingle (RAS) products may be used individually or in combination in the production of hot mix asphalt. The allowed dust to asphalt ratio shall be as identified in AASHTO M 323. The maximum allowable total reused “asphalt” binder (TRB) in HMA mixes shall be as indicated below. The allowed RAP percentage shall be reduced proportionally, based on asphalt cement content, if RAS products are also used. Any changes in the combination of recycled materials shall require a new mix design unless otherwise approved by the Bureau of Materials & Research.

2.10.2 Reclaimed Asphalt Pavement (RAP). RAP shall consist of recycled asphalt pavement and shall be processed by crushing, cold milling, or other approved sizing techniques approved by the Bureau of Materials and Research to meet the required gradation specifications. The mixture of RAP and new aggregate shall meet the requirements specified in Table 1 for aggregate gradation. The RAP shall be tested every 1,000 tons for gradation and asphalt binder content as a stockpile is being built. These test results shall remain on file by the contactor until such time as the entire RAP stockpile has been utilized.

2.10.2.1 The PG grade of added asphalt shall be as specified by the Bureau of Materials and Research. The aggregate component of the RAP shall meet the requirements of Section 401.2.1. The bitumen component of the RAP shall be asphalt cement and shall be free of significant contents of solvents, tars, and other volatile organic compounds or foreign substances that will make the RAP unacceptable for recycling as determined by the Bureau of Materials and Research.

2.10.2.2 RAP and RAS materials may be rejected if deemed unsuitable for any reason or require an increase or decrease in the mix asphalt content. The Contractor shall submit representative samples, and gradation and asphalt cement content test results of the RAP to be incorporated into the Recycled Mixture for approval by the Bureau of Materials and Research at least 30 calendar days prior to the start of paving.

2.10.3 Recycled Asphalt Shingle (RAS) Products. RAS products shall consist of asphalt shingle products resulting from a process approved by the Department and identified on the NHDOT Qualified Products List. Effective virgin asphalt replacement from RAS products will be determined by Materials and Research. All gradation specifications of Table 1 shall be maintained for HMA produced with addition of RAS products.

2.10.3.1 The RAS products shall be tested every 500 tons for gradation and asphalt binder content as a stockpile is being built. These test results shall remain on file by the contactor until such time as the entire RAS product stockpile has been utilized. The Contractor shall submit representative samples, and gradation and asphalt cement content test results of the RAS product to be incorporated into the Recycled Mixture for approval by the Bureau of Materials and Research at least 30 calendar days prior to the start of paving.

2.10.4 For all designs containing TRB in an amount greater than 1% of the total binder:

(a) RAP stockpiles shall be covered by a roof. RAS product shall be kept dry.
(b) Prior to the start of production, the RAP and RAS product binder(s) shall be tested by the Contractor to determine the appropriate grade of virgin binder to be added. Composite binder PG grade compliance shall be verified for mixes containing RAS product prior to their use.
(c) When RAS product is included, a split sample of the mix will be taken from the delivery truck at the start of production, and every 10,000 tons thereafter for testing. The asphalt binder will be recovered from the mixture utilizing the AASHTO T 170 test method. Recovered asphalt binder will be tested in accordance with AASHTO M 320 Table 1 and NHDOT B-8 for compliance with specifications.

TRB MIX DESIGN CRITERIA

Maximum Allowable TRB			
Max. % RAP Asphalt Binder	Max. %RAS Product Asphalt Binder	Max. Combined % TRB	Application Requirements
0.8	0.6	0-0.8	a. RAP – only combinations: Virgin binder grade shall be as specified. b. Mixes containing RAS product: Composite binder shall meet the specified PG grade. Compliance of design shall be verified by split sample testing. c. Test RAP & RAS product for gradation & AC% every 1,000 & 500 tons respectively.
1.0	0.6	>0.8 – 1.0	a. RAP-only combinations, reduce specified virgin binder PG grade by one grade unless determined to not be required. b. Mixes containing RAS product: Composite binder shall meet the specified PG grade. Compliance of design shall be verified by split sample testing. c. Test RAP & RAS product for gradation & AC% every 1,000 & 500 tons respectively.
1.5	0.6	>1.0 – 1.5	a. Composite binder shall meet the specified PG grade. Compliance of design shall be verified by split sample testing. b. Cover RAP stockpiles. c. Only allowed in a drum mixer. d. Only allowed for binder & base courses. e. Test RAP & RAS product for gradation & AC% every 1,00- & 500 tons respectively. f. Run split samples at start of production, and every 10k tons thereafter for composite binder testing.

2.11. Asphalt Modifiers - General The generic type of each asphalt binder admixture and/or additive shall be identified on the certificate of analysis which will be furnished by the manufacturer for each load of asphalt delivered.

2.12 Pavement Joint Adhesive. Pavement Joint Adhesive, Item 403.6, shall be a product that is listed on the Department's Qualified Products List.

Construction Requirements

3.1 Mixing Plants

3.1.1 General.

- Course aggregates shall be furnished in at least two nominal sizes for mix types containing top size aggregates of 1/2 in (12.5 mm) and larger.

- RAP shall be fed into the plant by equipment specifically designed for recycling and approved by the Bureau of Materials and Research. In addition, all requirements pertaining to aggregates shall apply to RAP. Scalping screens, grizzlies, or similar devices shall be installed on the RAP feed bin(s) to remove any debris or other foreign materials in excess of 2" (50mm). If a drum mix plant is used, the RAP shall be fed into the drum so that it will not come in direct contact with the burner flame. Mixing of RAP with the new aggregate shall occur before the bituminous material introduction point. The final mix produced shall be visually free from any chunks of RAP.
- Plants shall be approved at least five days prior to operations and will be capable of maintaining an adequate supply of mixture to the project.

3.1.2 Method Requirements.

- The site shall have ample storage space for the required separate bins, stalls, or stockpiles to allow delivery of uncontaminated sized aggregates to the feeder. To prevent spillage from one pile or bin to the next, aggregate assigned to different stockpiles shall be separated by bulkheads or other satisfactory means.
- Stockpiles of coarse aggregate produced for use in drum mix plants having top size aggregates greater than 3/4 in (19 mm) shall be constructed in layers not to exceed 4 ft (1.2 m).
- All blending of aggregates shall be accomplished through separate bins at the cold elevator feeders and not in stockpiles.
- The plant shall be provided with a dust collector or collectors, designed to waste or return uniformly to the hot elevator all or part of the material collected, as directed. All plants shall have adequate covers and housing as may be necessary to ensure the proper collection of dust and the general cleanliness of the plant operation. The Contractor shall comply with all State and Federal environmental regulations.

3.1.3 Quality Assurance.

- Mixing plants shall conform to AASHTO M 156. An efficient dust collecting system shall be provided to prevent the loss of fine material. The material collected may be returned to the mixture at a uniform rate or discarded.

3.1.4 Safety Requirements for Inspection - General

3.1.4.1 Adequate and safe stairways to the mixer platform shall be provided, and guarded ladders to other plant units shall be located where required for accessibility to plant operations.

3.1.4.2 All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly guarded and protected.

3.1.4.3 Ample and unobstructed space shall be provided on the mixing platform. The plant operator shall have a clear and unobstructed view of the plant operations.

3.1.4.4 A platform shall be located in close proximity to the inspector's laboratory for the purpose of easily obtaining samples of the mixture from the trucks.

3.1.4.5 When the plant is to be operated in other than daylight hours, adequate lighting shall be provided in all areas frequented by the inspector during his normal routine. Specific areas to be illuminated

include the truck loading zone and sampling location. A light or lights shall also be located so as to allow the clear observance of the truck body lubrication operation.

3.1.5 Scheduling Inspection Personnel - General

3.1.5.1 The Contractor shall notify the Bureau of Materials and Research at least three working days in advance of starting paving operations to allow sufficient time to schedule required plant inspection personnel. When paving bridge decks that have barrier membranes, this notice shall include the name of the membrane product so that the mix temperature may be established.

3.1.6 Access to Production Facilities - General

3.1.6.1 The Engineer shall have access at any time to all parts of the plant for inspection of the conditions and operations of the plant, for confirmation of the adequacy of the equipment in use, for verification of proportions and character of materials, and for determination of temperatures being maintained in the preparation of the mixtures. The Contractors shall provide a suitable building, room, or trailer for exclusive use by the DOT Technician as a testing laboratory in which to house and use the testing equipment. Laboratories shall be in an approved location, with one laboratory provided for each plant.

3.1.7 Field Laboratories – General

3.1.7.1 Field laboratories shall meet the following minimum requirements:

Outside Dimensions:	Method Requirements: 16 ft long by 8 ft high [or equal] by 7 ft high (4.8 m long by 2.4 m wide by 2.1 m high). Performance Requirements (QC/QA): Laboratory shall consist of a minimum of 200 ft^2 (18.5 m^2) of floor space, laid out to accommodate shelves, benches, desk, equipment and personnel movement.
Windows:	Two, with locks and screens, providing cross ventilation.
Doors:	One, with lock and screen.
Electrical:	Adequate lighting and power outlets.
Air Conditioner:	Unit size shall be as recommended for size of the facility.
Heat:	Thermostatically controlled to maintain a minimum temperature of 68°F (20°C).
Weatherproofing:	Roof, sides, and floor shall be maintained weatherproof at all times.
Appurtenances:	(a) An exhaust fan and hood over the extractor. The hood shall be large enough to cover the extractor. The fan shall be a high-volume axial-flow fan, at least 10 in (250 mm) in diameter, and of sufficient capacity to adequately vent the fumes. (b) Free wall space of at least 12 ft^2 (1.3 m^2); or a bulletin board of equal area for posting notices and job mix formulas. Method Requirements: Suitable shelves and benches. One bench shall be approximately 24 in wide by 36 in high and at least 10 ft long (600 mm wide by 900 mm high and at least 3m long). The bench may extend the length of the building.) Quality Assurance (QC/QA): Suitable shelves and benches. Bench space shall be approximately 24 in. (600 mm) wide by 36 in. (900 mm) high. There shall be a minimum total length of 19.0 ft (6 m) of bench space.

3.1.7.2 The following office furnishings and testing equipment shall be provided:

(a) Electronic balance with tray, at least 300 oz (9000 gram) net capacity, sensitive to 0.003 oz (0.1 gram).
(b) Desk and chair in good working condition.
(c) Set of U.S. Standard brass sieves, each sieve being 12 in (300 mm) in diameter and 1- 1/2 in (37.5 mm) high. The set shall consist of one each of the following sizes: 1- 1/ 2 in, 1-1/4 in, 1 in, 3/4 in, 1/2 in, 3/8 in, No. 4, No. 8, No. 16, No. 30, No. 50, No. 100, No. 200, (37.5 mm, 31.5 mm, 25.0 mm, 19.0 mm, 12.5 mm, 9.5 mm, 4.75 mm, 2.36 mm, 1.18 mm, 600 mm, .300 mm, .150 mm, .075 mm, with pan and cover.
(d) Motor driven shaker for 12 in (300 mm) diameter sieves. Shaker shall meet the following requirements: Rotating turntable, tilt to 45 degree angle and have hammers to tap each sieve during operation.
(e) Motor driven centrifuge extractor, 100 oz (3000 gram) capacity with variable speed up to 3600 rpm, with filter rings and non-toxic solvent approved by the Bureau of Materials and Research.
(f) Tachometer readily available to check the speed of the extractor.
(g) Automatic timer with interval of 0 to 30 minutes.
(h) Bristle brush for cleaning No. 200 (0.075 mm) sieve.
(i) Brass brush for cleaning 8 in (200 mm) diameter sieves.
(j) Five pans or bowls, approximately 4 in (100 mm) high, 15 in (375 mm) round or square.
(k) Spatula, large spoon, garden trowel, measuring scoop, and 1 quart (1 L) pitcher.
(l) Fire extinguisher, minimum five pound (2.3 kg) dry chemical.
(m) Desk brush and floor broom.
(n) Sample splitter (riffle type), chute width 1- 1/2 to 2 in (38 to 50 mm).
(o) Microwave oven when drum mix plant is used.
(p) Minimum of one metal sample pail for each hot bin.
(q) Lavatory with toilet (See 698.2.2.4) and wash basin, unless approved otherwise.
(r) Water, hot and cold, and water suitable for drinking. (Fountain style will be acceptable).
(s) Telephone with private line.
(t) Drying oven, minimum of 3.5 ft^3 (0.10 m^3).*
(u) Equipment sufficient to perform AASHTO T 209.*
(v) Water cooled diamond saw capable of cutting 6 in (150 mm) road cores.
(w) High Speed Internet Connection - Each laboratory (on State-bid projects) will be provided with bi-directional Internet access having a minimum data rate of 256K bps.
(x) Wheelbarrow when a drum mix plant is used.

*****All ovens other than microwaves shall be vented to the outside.

3.1.7.3 All of the foregoing testing equipment shall be in good condition and shall be replaced or repaired by the Contractor if, during the duration of the project, it becomes unsuitable for testing purposes. Testing equipment shall be calibrated by the Contractor in accordance with 106.03. The above mentioned equipment is for operation of a single plant.

3.2 Storage of Asphalt Binder – General

3.2.1 Tanks for storage of asphalt binder shall be of minimum 10,000 gal (38,000 L) capacity and equipped for heating the material under effective and positive control at all times, to the temperature

requirements set forth in the specifications for the paving mixture. Heating shall be accomplished by steam or oil coils, electricity, or other means such that no flame shall come in contact with the heating tank.

3.2.2 A complete system providing for continuous circulation of the asphalt binder between the storage tank and the proportioning units shall be employed. The discharge end of the circulating pipe shall be maintained below the surface of the asphalt binder in the storage tank to prevent discharging the hot asphalt binder into the open air.

3.2.3 The Contractor shall provide in the asphalt binder feed lines connecting the plant storage tanks to the asphalt binder weighting system or spray bar a sampling outlet consisting of a valve installed in such a manner that samples may be withdrawn from the line slowly at any time during plant operation. The sampling outlet shall be installed between the pump and the return discharge line in such a location that it is readily accessible and free from obstruction. A drainage receptacle shall be provided for flushing the outlet prior to sampling.

3.3 Control of Asphalt Binder - General

3.3.1 Satisfactory means either by weighing or metering shall be provided to obtain the proper amount of bituminous material in the mix within the tolerance specified. Means shall be provided for checking the quantity or rate of flow of bituminous material into the mixer as follows:

(a) Metering devices for asphalt binder shall indicate accurately to within 1.0 percent the amount of asphalt binder delivered. The section of the asphalt binder flow line between the charging valve and the spray bar shall be provided with a three-way valve and outlet whereby the quantity delivered by the meter may be checked by actual weight. The valve controlling the flow of asphalt binder to the mixer shall close tightly to prevent asphalt binder from leaking into the pug mill during the mixing cycle. The meter shall be constructed so that it may be locked at any dial setting to 0.1 gal (0.4 L) and will automatically reset to this reading after the addition of asphalt binder to each batch. The dial shall be in full view of the mixer operator. The size and spacing of the spray bar openings shall provide a uniform application of asphalt binder the full length of the mixer in a thin uniform sheet or in multiple sprays.

(b) If a bucket is used for weighing the asphalt binder, the bucket shall be of sufficient capacity to hold and weigh the amount required for a batch in a single weighing. The filling system and bucket shall be of such design, size, and shape that asphalt binder will not overflow, splash, or spill outside the confines of the bucket during filling and weighing. The filling system and bucket shall be so arranged as to deliver the asphalt binder in a thin uniform sheet or in multiple sprays over the full length of the mixer. The time required to add the asphalt binder shall be not more than 15 seconds.

(c) Asphalt binder scales shall conform to the requirements for aggregate scales as specified in 3.1.6.7. 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 binder on the bucket.

3.3.2 Suitable means shall be provided, either by steam or oil jacketing or insulation, for maintaining the specified temperatures of the asphalt binder in the pipelines, meters, weigh buckets, spray bars, and other containers or flow line.

3.4 Batching Plants – General

3.4.1 All aggregate shall be delivered by belt driven feeders. All feeders shall provide for adjustment of the cold feed and shall be capable of being secured in any position.

3.4.2 Dryers shall continuously agitate the aggregate during the heating and drying process without leaving any visible unburned oily residue on the aggregate when it is discharged from the dryer. If unusually wet aggregate is being used, the input to the dryer shall be reduced to that amount which the dryer is capable of drying. Aggregates shall be free from coatings of dust after drying.

3.4.3 Plant screens shall be constructed and operated in such manner that all aggregates will be uniformly separated into the sizes required for proportioning. They shall have sufficient capacity to furnish the necessary quantity of each aggregate size required for continuous operation. Screen cloth that has become broken or has worn sufficiently to affect the gradation shall be replaced.

3.4.4 Thermometric equipment shall be provided as follows:

(a) An armored thermometer of suitable range shall be fixed in the asphalt binder feed line at a suitable location near the discharge at the mixer unit.
(b) The plant shall be further equipped with an approved thermometer, pyrometer, or other approved thermometric instrument that continuously indicates the temperature of the heated aggregate at the discharge chute of the dryer.

3.4.5 Hot bins shall consist of at least four separate aggregate compartments. One compartment shall be reserved for fine aggregate, and when required, one additional compartment shall be added for dry storage of mineral filler. Alternate bin systems may be utilized with prior approval from the Department. Provision shall be made for accurate proportioning. Each compartment shall contain the following features:

(a) Sufficient volume to supply the mixer at full rated capacity.
(b) An overflow pipe that shall be of such size and at such a location as to prevent any backing up of material into other bins or into contact with the screen. Overflow apparatus shall be equipped with a telltale device that alerts the operator and the inspector when the overflow equipment is full.
(c) Adequate telltale devices to indicate the position of the aggregate in the bins at the lower quarter points.
(d) Gates that cut off quickly and completely with no leakage.
(e) Adequate and convenient facilities including safe platforms for obtaining representative samples from each bin.

3.4.6 Weigh boxes shall be of sufficient size to hold the maximum required weight of aggregate for one batch without hand raking or running over. The weigh box shall be supported on fulcrums and knife edges so constructed that they remain in alignment or adjustment. All parts of the weigh box shall be free from contact with any supporting rods, columns, or other equipment that affects the proper functioning of the hopper or scale. Gates on both bins and weigh hopper shall be constructed to prevent leakage when closed.

3.4.7 Aggregate scales for any weigh box or hopper shall be of standard make and design and shall be accurate to 0.5 percent of the indicated load. The weight shall be indicated on a s digital display. Scales shall be substantially constructed and shall be installed in such a manner as to be free from vibration. The

display shall be in full view of the operator, and the numerals shall be of such a size that they can be easily read by the inspector. If the digital display is so located that it is not easily accessible to the inspector, a duplicate display will be required for exclusive viewing by the inspector. The job mix formula target weights shall continuously be part of the digital display during plant operations. The digital scale weight indications shall be displayed adjacent (in juxtaposition) to each target weight for easy comparison to the job mix formula. It shall be the responsibility of the Contractor to ensure that all scales are tested and sealed according to provisions as shown in the National Institute of Standards and Technology Handbook 44, at least on an annual basis. The work shall be accomplished by a competent commercial scale company prior to the start of the construction season. Scales shall be re-tested prior to use, after they have been moved. The Contractor shall have readily available at least ten standard 50 lb (eleven standard 20 kg, one standard 5 kg, and two standard 1 kg) weights, for checking the scales during operations.

3.4.8 The batch mixer shall be of an approved pug mill type, hot oil or steam jacketed, or heated by other approved means and capable of producing uniform mixtures within the specified tolerances. The mixer shall have a batch capacity of not less than 4,000 lb (1,800 kg) and be constructed so as to prevent leakage during the mixing cycle. The amount of material that may be mixed per batch shall not exceed the manufacturer's rated capacity. If the mixer does not mix properly at the rated capacity, or if its production does not coordinate with the other plant units, the Department reserves the right to reduce the size of the batch until the desired efficiency is obtained. The pug mill shall be equipped with a sufficient number of paddles operated at such speed as to produce a properly and uniformly mixed batch. If, in the course of mixing, two adjacent paddle tips become broken, immediate repair will be called for. If the paddle tips become broken at widely separated points, repair may be delayed until the end of the working day. The clearance of the tips from all fixed and moving parts shall not exceed 3/4 in (19 mm). Badly worn or defective tips shall not be used in mixing operations. The mixer shall be covered to prevent loss of fine material. The discharge gate shall be so designed that no uncoated material is retained at the gate opening during the mixing operation. Leakage from the pug mill gate during operation will not be permitted.

3.4.9 Each plant shall be equipped with an accurate time lock to control the operations of a complete mixing cycle. A mixing cycle shall consist of two periods, the dry mixing period and the wet mixing period. The dry mixing period shall be the interval of time between the opening of the aggregate weigh hopper gate and the start of the application of asphalt binder. The wet mixing period shall be the interval of time between the start of the application of asphalt binder and the opening of the mixer gate. The time lock shall be capable of being set at the intervals of five seconds or less throughout the mixing cycle and shall have a suitable case equipped with an approved lock. The setting of time intervals shall be performed in the presence and under the direction of the Engineer who may lock the case until such time as a change is to be made in timing periods. The time lock shall lock the asphalt binder bucket throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing period.

3.4.10 The use of a fully automatic batching plant will be required and shall meet the following requirements:

(a) The automatic proportioning controls shall include equipment for accurately proportioning batches of the various components of the mixture by weight in the specified sequence and for controlling and timing the mixing operation. Interlocks shall be provided that delay, stop, or lock out the automatic batch cycling whenever the batched quantity of any component weight or the total batch is not within the specified weight tolerance, or when there is a malfunction in any portion of the control system.

(b) The automatic control for each batching scale system shall be equipped with a device for stopping the automatic cycle in the underweight check position and in the overweight check position for each material so that the tolerance setting may be checked.

(c) Each dial scale system shall be equipped with a removable dial puller that can be attached to the dial lever system so that the dial can be moved smoothly and slowly through its range to check the settings of the automatic control system. The plant operator shall perform this automatic control system checkout procedure periodically as requested by the Engineer.

(d) The weigh batching controls shall meet the following tolerances for the various components weighed in each batch:

Component Weighed	Percentage of Total Batch Weight
Tare weight of aggregate weigh box	±0.5
Tare weight of asphalt binder weigh bucket	±0.1
Each aggregate component	±1.5
Mineral filler	±0.5
Asphalt	±0.1

(e) The total weight of the batch shall not vary by more than ±2.0 percent of the designated batch weight.

(f) Recording equipment shall be provided in all plants employing automatic proportioning. Each recorder shall include an automatic printer system. The printer shall be positioned so that the scale reading and the printer can be readily observed from one location by the plant inspector. The printer shall produce, in digital form, a weight slip conforming to the requirements of 109.01 and 401.3.8.1.

(g) If at anytime the automatic proportioning or recording system becomes inoperative, the plant will not be allowed to operate.

3.4.11 The aggregate shall be dried and heated to a minimum temperature of 260 °F (125 °C). The asphalt binder shall be heated to a temperature between 250º and 325°F (120º and 165°C). Each size of hot aggregate, the mineral filler if required, and the bituminous cement shall be measured separately and accurately to the proportions in which they are to be mixed. The mixture shall be made by charging the mixer with the hot aggregate, coarse sizes first, unless otherwise directed, which shall be dry mixed for 5 to 15 seconds. The asphalt binder shall be added and the mixing continued until a uniform coating is obtained and all particles of the aggregate are thoroughly coated. The total dry and wet cycle shall not be less than 35 seconds for base and binder mixtures and not less than 40 seconds for the wearing course. In no case shall the total mixing period exceed 75 seconds.

3.4.12 If the aggregate in the hot bins contains sufficient moisture to cause foaming in the mixture, such aggregate shall be removed from the bins, and production rate shall be reduced so as not to exceed the capacity of the dryer. Material having once gone through the mixing plant shall not be returned to the stockpiles.

3.5 Drum Mix Plants - General

3.5.1 The plant shall be specifically designed for the process and shall be capable of satisfactorily heating, drying, and uniformly mixing the bituminous material and aggregate in accordance with the job mix formula. The rate of flow through the drum shall be controlled in order that a homogeneous mixture is obtained with all particles uniformly coated. In no case shall the quantity of mix produced exceed the

manufacturer's rated capacity. If the percent of moisture in the mixture exceeds 1.0 percent by weight, the right is reserved to decrease the rate of production. The plant shall be equipped with automatic burner controls.

3.5.2 The cold bins shall be divided in at least five compartments and shall be designed to prevent the overflow of material from one bin to another. When reclaimed pavement is used, an additional bin designed for this purpose will be required. In event of an emergency this bin may be used to feed aggregate in an amount not to exceed 15% of material to complete the days production. Each cold bin shall be equipped with an orifice to feed the aggregate accurately and uniformly. The feeding orifice shall be adjustable, and indicators shall be provided to show the gate opening. An automatic plant shutoff device shall be provided to operate when any aggregate bin becomes empty or the flow from any bin gate becomes restricted. A vibrator or other suitable means may be required in order to ensure a uniform flow of materials. The order of aggregate feed onto the composite cold feed belt shall be from coarse to fine.

3.5.3 The total cold aggregate feed shall be weighed continuously by an approved belt scale. The weighing system shall register within +0.5 percent of the indicated load.

3.5.4 Proportioning controls for aggregate and asphalt binder shall be located at the panel that also controls the mixture and the temperature. The panel shall be equipped with automatic controls that shall display, in digital form, the percentages of asphalt binder, mineral filler if required, and each aggregate in the job mix formula. The panel shall also be equipped to raise and lower the production rate without having to reset the individual controls for each change in production rate. The controls shall maintain aggregate flow accuracy such that the total variation of all materials being drawn per interval of time shall not exceed an amount equal to 1.5 percent of the total weight of bituminous mixture per interval of time.

3.5.5 Provisions shall be made for introducing the moisture content of the total cold feed into the belt weighing system and correcting the wet aggregate weight to dry aggregate weight. The system shall be capable of adjusting the flow of bituminous material to compensate for any variation in the dry weight of the aggregate flow. It shall be the responsibility of the Contractor to monitor and determine accurate moisture contents of the aggregate and RAP stockpiles used for production of hot mixed asphalt. Accurate moisture contents shall be determined at a minimum every other day of production. In the event of rain, moisture contents shall be determined for all aggregates and RAP to be utilized before the next day's production.

3.5.6 The dry weight of the aggregate flow shall be displayed by automatic digital readout in units of weight per interval of time.

3.5.7 When mineral filler is specified, a separate bin and feeder shall be provided with a variable drive interlocked with the aggregate feeders. Mineral filler shall be introduced and uniformly dispersed into the mixture without loss to the dust collection system. A device shall be provided to indicate when the flow of filler into the delivery system stops or its specified volume is out of job mix tolerance. The rate of flow shall be accurate to within 0.5 percent by weight, of the total mix. Means shall be provided to readily divert the flow of mineral filler into a container for measurement.

3.5.8 The asphalt binder shall be introduced through a continuously registering cumulative indicating meter by a pump specifically designed for the plant. The meter shall be located in the asphalt line so that it continuously registers the asphalt discharge to the mixer and so that the discharge through the meter can be readily diverted into a suitable container for measurement by actual weight. The meter shall indicate

accurately to within 1.0 percent the amount of asphalt binder being delivered. The accuracy of the pump and meter shall be verified at periodic intervals as designated by the Engineer.

3.5.9 Satisfactory means shall be provided to ensure positive interlock between dry weight of aggregate flow and the flow of bituminous material through an approved meter.

3.5.10 The flow of bituminous material shall be displayed by automatic digital readouts in terms of volume or intervals of weight and time.

3.5.11 The plant shall have a means of diverting mixes at start up and shut down or where mixing is not complete or uniform.

3.5.12 A surge or storage system complying with 3.7 shall be provided.

3.6 Mixing Temperature

3.6.1 Method Requirements

3.6.1.1 The Engineer may adjust the job mix formula temperature within the limits of 260° and 350°F (125° and 180°C) according to the existing conditions. Material with a temperature at discharge outside the job mix formula tolerance may be rejected. In no case will a mixture be accepted with a discharge temperature in excess of 375°F (190°C).

3.6.1.2 During hot weather, the temperature of the mixture when discharged shall be as low as is consistent with proper mixing and placing. During cold weather, a temperature approaching the upper limit is desirable

3.6.2 Quality Assurance

3.6.2.1 The job mix formula temperature may be adjusted within the limits of 260 °F (125 °C) and 350 °F (175 °C) according to the existing conditions. Material with a temperature at discharge outside the job mix formula tolerance may be rejected. In no case will a mixture be accepted with a discharge temperature in excess of 375 °F (190 °C).

3.7 Hot Storage System -- General

3.7.1 Material may be placed in a storage silo for a period not to exceed 24 hours from the time of mixing. The upper and lower gates when closed shall create an airtight seal. The silo shall be filled to capacity. 24 hour storage will not be allowed if there is reason to believe there is a problem with the gate seals or excessive heat loss.

3.7.2 The hot storage system shall be capable of conveying the hot mix from the plant to insulated and enclosed storage bins and storing the hot mix without appreciable loss in temperature, asphalt migration, segregation, or oxidation.

3.7.3 The conveyer system may be a continuous type or skip bucket type. If the continuous type is used, it shall be enclosed to prevent a drop in mix temperature. If the skip bucket type is used, the bucket must be of sufficient capacity to transport an entire batch and mass dump it into the bins.

3.7.4 The storage bins shall be designed in such a manner as to prevent segregation of the hot mix during discharge from the conveyor into the bins and shall be equipped with discharge gates that do not cause segregation of the hot mix while loading the mix into the trucks. The storage bin heating system shall be capable of maintaining the mix temperature without localized heating (hot spots).

3.7.5 The bin shall be equipped with a light or indicator to show when the level of material reaches the top of the discharge cone. The bin shall not be emptied below the top of the discharge cone until the use of the bin is completed each day. The material remaining in the discharge cone may be rejected if there is evidence of segregation.

3.8 Weighing and Hauling - General

3.8.1 The Contractor shall provide an approved automatic printer system that prints the weights of the material delivered, provided the system is used in conjunction with an approved automatic batching and mixing control system. Such weights shall be evidenced by a weight slip for each load.

3.8.2 Weight slips shall include requirements as shown in 109.01 and the following for batch plants with automatic proportioning equipment:

(a) Tare weight of aggregate weigh box.
(b) Tare weight of asphalt binder weigh bucket.
(c) Accumulative weights as batched for each aggregate (total of last aggregate will be aggregate total).
(d) Weight of asphalt binder.
(e) Accumulated total weight of batch.

3.8.3 Each weight slip will show a consecutive load number and shall include an accumulative total of material delivered for each day.

3.9 Vehicles - General

3.9.1 The inside surfaces of vehicles may be lightly lubricated with a soap solution or non-petroleum release agent that will not be detrimental to the mix. Equipment that leaks oil, diesel fuel, gasoline, or any other substance detrimental to the pavement will not be allowed on the project.

3.9.2 The mixture shall be transported from the paving plant to the project in trucks having tight, smooth, metal beds previously cleaned of all foreign materials. Truck beds may be lined with a polyethylene type material designed and installed for hauling hot bituminous mixes. Each load shall be covered with canvas or other suitable material of sufficient size and thickness to retain heat and to protect it from weather conditions. The cover material when new shall weigh a minimum of 18 oz/yd^2 (0.6 kg/m^2) and it shall be a tightly woven or solid material. When necessary, so that the mixture can be delivered on the project at the specified temperature, truck beds shall be insulated, and covers shall be securely fastened.

3.10 Placing - General

3.10.1 Prior to placing of any mix, a pre-paving conference shall be held to discuss and approve the paving schedule, source of mix, type and amount of equipment to be used, sequence of paving pattern, rate of mix supply, traffic control, and general continuity of the operation. Special attention shall be made to the

paving pattern sequence to minimize cold joints. The field supervisors of the above mentioned operations shall attend this meeting.

3.10.2 The Contractor shall notify the Engineer at least five working days in advance of paving operations to allow sufficient time to schedule required site inspection and testing. All paving and compaction equipment shall be approved and on site prior to start up each day.

3.10.3 Crack sealing material to be covered by a 1 in (25 mm) or less overlay shall cure a minimum of 45 days prior to the placement of bituminous pavement.

3.10.4 When performing paving operations at night, in addition to the requirements of 3.1.4.5, the Contractor shall provide sufficient lighting at the work site to ensure the same degree of accuracy in workmanship and conditions regarding safety as would be obtained in daylight.

3.10.5 Quality Assurance. The Contractor shall provide the following equipment for testing and sampling at the project site. The equipment shall be in good condition and shall be replaced by the Contractor if, during the duration of the project, it becomes unsuitable for testing or sampling purposes.

Metal plate 12 in (300 mm) minimum each side, flat bottom scoop 3000-gram capacity minimum, and sample containers to perform NHDOT B-7 sampling.

3.10.6 Weather limitations.

3.10.6.1 General. In special instances, when the Engineer determines that it is in the best interest of the State, the Engineer may waive the requirements of 3.10.6.

3.10.6.2 Any material delivered to the spreader having a temperature lower than 250°F (120°C) shall not be used.

3.10.6.3 Method Requirements. Mixtures shall be placed only when the underlying surface is dry, frost free, and the surface temperature is above 40°F (5°C) for courses greater than or equal to 1-1/4 in (32 mm) in compacted depth and above 50°F (10°C) for courses less than 1-1/4 in (32 mm) in compacted depth. The Engineer may permit, in case of sudden rain, the placing of mixture then in transit from the plant, if laid on a base free from pools of water, provided motorist visibility is not impaired and all other specifications are met. No load shall be sent out so late in the day that spreading and compaction cannot be completed during the daylight, unless the requirements of 3.10.4 are met. If rapid surface cooling of the laid down mix is occurring due to wind, the Engineer may suspend operations for the day. Wearing course shall not be scheduled for placement after October 1st of any year without written approval by the Engineer. If it is determined to be in the best interest of the Department to schedule placement after October 1st, the above specified weather and surface conditions shall remain in effect.

3.10.6.4 Quality Assurance. Mixtures shall be placed only when the underlying surface is dry and frost free. Paving shall be placed only as stipulated in the approved Quality Control Plan. The Engineer may permit, in case of sudden rain, the placing of mixture then in transit from the plant, if laid on a base free from pools of water, provided motorist visibility is not impaired and all other specifications are met. No load shall be sent out so late in the day that spreading and compaction cannot be completed during the daylight, unless the requirements of 3.10.4 are met. The Engineer may suspend operations for the day when the contractor is unable to meet specifications. Wearing course shall not be scheduled for placement after October 1st of any year without written approval by the Engineer. If it is determined to be in the best

interest of the State to schedule placement after October 1st, the above specified conditions shall remain in effect.

3.10.7 At the beginning and end of the project or project section, the existing pavement shall be removed to a sufficient depth to allow the placing of the new pavement and construction of a transverse joint, which shall be painted with a suitable bituminous material. The underlying course shall be clean and free from foreign materials and loose bituminous patches and must present a dry, unyielding surface.

3.10.8 Sweeping - General. Existing pavement or previously laid courses shall be thoroughly dry and free from all dust, dirt, and loose material. Sweeping with a power broom, supplemented by hand brooming, may be necessary.

3.10.9 Tack coat - General. Surfaces of any pavement course shall have a tack coat of emulsified asphalt applied in accordance with the requirements of 410.3.4.2 and 410.3.4.2.1.

3.10.10 General - Drainage and utility structures within the limits of the pavement shall be set and raised in accordance with the provisions of 604.3.4. Contact surfaces of the drainage and utility castings as ordered shall be painted with a thin coating of suitable bituminous material.

3.11 Pavers

3.11.1 Method Requirements

3.11.1.1 All courses shall be spread and finished to the required thickness by approved, self-contained, self-propelled spreading and finishing machines (pavers). Pavers shall be provided with an adjustable, activated screed and shall be capable of spreading the mixtures with a finish that is smooth, true to the required cross-section, uniform in density and texture, and free from hollows, tears, gouges, corrugations, and other irregularities. Broadcasting behind the paver shall be held to a minimum. Pavers shall be capable of spreading and finishing courses of the required thicknesses and lane widths. Horizontally oscillating strike-off assemblies will not be approved.

3.11.1.2 The activated screed shall be of the vibrating or tamping bar type or a combination of both and shall operate without tearing, shoving, or gouging the mixture. The activated portion of the screed shall extend the full width of the mixture being placed in the traveled way and other areas with sufficient width to accommodate a paver. In other locations as permitted such as narrow shoulders, tapers, and areas adjacent to curbs, non-activated extensions to the screed will be allowed. The paver shall be equipped with a screed heater. The screed heater shall be used when starting a cold machine and for maintaining a suitable screed temperature when needed.

3.11.1.3 Blaw Knox Pavers shall be equipped with the manufacturer's material management kit. The paving contractor shall certify that this work has been done before using any Blaw Knox paver.

3.11.1.4 The paver hopper gates shall be adjusted to pass the correct amount of mix to the spreading screws so that the screws operate more or less continuously. The height of material shall be maintained at a constant level in front of the screed, to a point where approximately half of the auger shall be visible at all times.

3.11.1.5 When required by the Engineer pavers shall be equipped with the following automatic screed controls for each paver:

1. Two 24 ft (7 m) ski type devices or floating beams.
2. Two grade sensors
3. Two short skis (joint matchers)
4. Slope sensing control for transverse slope.

The sensors for either or both sides of the paver shall be capable of sensing grade from an outside reference line or from the surface using a ski type device and shall be capable of sensing transverse slope of the screed. The sensors shall provide automatic signals that operate the screed to maintain the desired grade and transverse slope. Pavers shall not be used until the automatic controls have been checked and approved by the Engineer.

3.11.1.6 The use of automatic grade and slope controls shall be required on all pavers.

3.11.1.7 Whenever a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually for the remainder of the normal working day on which the breakdown or malfunction occurred. This method of operation must meet all other specifications.

3.11.1.8 On projects or parts of projects where the Engineer deems that the use of automatic controls are impracticable, some or all of the controls listed in 3.11.1.5 may be waived.

3.11.1.9 The forward speed of the paver shall be adjusted to the rate of the supply of materials so that the paver operates without having to make stops except for emergencies. If the Engineer determines that the paving operations result in excessive stopping of the paver, the Engineer may suspend all paving operations until the Contractor makes arrangements to synchronize the rate of paving with the rate of delivery of materials.

3.11.2 Quality Assurance

3.11.2.1 Pavers shall be:

(a) Self-contained, power propelled units with adjustable vibratory screeds with full-width screw augers.
(b) Heated for the full width of the screed.
(c) Capable of spreading and finishing courses of hot asphalt mix in widths at least 12 inches (300 mm) more than the width of one lane.
(d) Equipped with a receiving hopper having sufficient capacity to ensure a uniform spreading operation.
(e) Equipped with automatic feed controls, which are properly adjusted to maintain a uniform depth of material ahead of the screed.
(f) Capable of being operated at forward speeds consistent with satisfactory laying of the mix.
(g) Capable of producing a finished surface of the required smoothness and texture without segregating, tearing, shoving, or gouging the mixture.
(h) Equipped with automatic screed controls with sensors capable of sensing the transverse slope of the screed, and providing the automatic signals that operate the screed to maintain grade and transverse slope from a reference such as a grade wire or ski type device, either a floating beam with a minimum length of 30 ft (9 m) or sonic averaging with a minimum length of 24 ft (7 m).

3.11.3 General - When patching existing pavement, the material shall be placed on the prepared clean underlying surface at the locations designated and shall be spread to produce a smooth and uniform patch. The patch material shall be thoroughly compacted and shall match the line and grade of the adjacent pavement.

3.11.4 General - Relatively small areas not accessible to the paver may be spread by hand, but extreme care shall be taken to create a surface texture similar to the machine work. Surface material shall be spread by lutes and not by rakes.

3.11.5 General-Unless otherwise authorized, the final wearing course shall not be placed until guardrail posts have been set and general cleanup has been completed.

3.11.6 General - When hot bituminous bridge pavement is to be placed over barrier membrane, the placing temperature shall be as specified in 538.3.5. A paver, mounted on rubber tracks or tires, shall be used to place the 1 in (25 mm) base course unless this procedure is found to cause damage to the membrane. When such damage is found to be evident, the hand method may be allowed. The hand method may also be allowed if the Engineer determines that the use of a paver for this work is impracticable. During warm weather, the above paving shall be done during the cool period of the day. A paver shall be used to place the wearing course.

3.11.7 General- Where pavement is placed adjacent to structural members such as expansion joints, the material in the top course shall be placed so that the compacted grade of the pavement is 1/4 to 3/8 in (6 to 10 mm) above the grade of the structural member.

3.12 Compaction.

3.12.1 Method Requirements.

3.12.1.1 Immediately after the hot asphalt mix has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The initial rolling shall be done with a static or vibratory steel-drum roller. Intermediate rolling shall be done by a pneumatic-tired roller. Final rolling shall be done with a static steel-drum roller or a roller of the steel-drum three-axle type, locked. The completed course shall be free from ridges, ruts, humps, depressions, objectionable marks, visible segregation, or irregularities and in conformance with the line, grade, and cross-section shown in the Plans or as established by the Engineer. Rollers must be in good mechanical condition, free from excessive backlash, faulty steering mechanism, or worn parts. The empty weight and the ballasted weight shall be properly marked on each roller. The minimum weight of static steel-drum rollers shall be 8 tons (7.3 metric tons). When a vibratory roller is being used, the vibration shall stop automatically when the roller is stopped or reversing direction of travel.

3.12.1.2 Pneumatic-tire rollers shall be self-propelled and shall be equipped with smooth tires of equal size and diameter. The wheels shall be so spaced that one pass of a two-axle roller accomplishes one complete coverage. The wheels shall not wobble and shall be equipped with pads that keep the tires wet. The rollers shall provide an operating weight of not less than 2,000 lb (900 kg) per wheel. All tires shall be maintained at a uniform pressure between 55 and 90 psi (380 and 620 kPa) with a 5 psi (35 kPa) tolerance between tires. A suitable tire pressure gauge shall be readily available.

3.12.1.3 Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the roadway center line, gradually progressing to the crown of the roadway. The overlap shall be

one-half the roller width for wheeled rollers and 6 in (150 mm) for vibrating rollers. No overlap is required for pneumatic-tired rollers. When paving in echelon or abutting a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure. On superelevated curves, the rolling shall begin at the low side and progress to the high side by overlapping of longitudinal passes parallel to the centerline.

3.12.1.4 Rollers shall move at a slow but uniform speed with the drive roll or drive wheels nearest the paver, except on steep grades. Static and pneumatic-tired rollers shall not operate at speeds in excess of 6 mph (10 km/h). All courses shall be rolled until all roller marks are eliminated, and a minimum density of 92% of maximum theoretical density as determined in accordance with AASHTO T 209 has been obtained. When ordered by the Engineer, cores shall be taken by the contractor and delivered to the technician at the plant laboratory for testing.

3.12.1.5 Any displacement occurring as a result of reversing the direction of a roller, or from other causes, shall be corrected at once by the use of lutes and the addition of fresh mixture when required. Care shall be exercised in rolling so as not to displace the line and grade of the edges of the bituminous mixture.

3.12.1.6 To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with very small quantities of detergent or other approved material. Excess liquid will not be permitted. All steel rollers shall be equipped with adjustable wheel scrapers.

3.12.1.7 Along forms, curbs, headers, and similar structures and other places not accessible to a normal full-sized roller, sidewalk rollers weighing at least 2,000 lb (900 kg) shall be used. Where rollers are impracticable, the mixture shall be thoroughly compacted with heated or lightly oiled hand tamps or vibrating plate compactors.

3.12.1.8 Unless the Engineer determines that for the weight and placement conditions a lesser number will be satisfactory to obtain the desired pavement densities, the following is the list of required compaction equipment. The output of each paver placing wearing course (Table 1) materials shall be compacted by the use of one each of the following complement of rollers as a minimum: a static or vibratory steel-wheel roller, a pneumatic-tired roller and a three-axle roller or a static steel-wheeled roller. If the required density is not being obtained with the rollers supplied, the use of additional rollers of the specified type may be ordered. Paving widths in excess of 16 ft (5 m) will require additional rollers as ordered.

3.12.2 Quality Assurance

3.12.2.1 Immediately after the hot asphalt mix has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted. The completed course shall be free from ridges, ruts, humps, depressions, objectionable marks, visible segregation, or irregularities and in conformance with the line, grade, and cross-section shown in the Plans or as established by the Engineer. If necessary, the mix design may be altered to achieve desired results.

3.12.2.2 All compaction units shall be operated at the speed, within manufacturers recommended limits, that will produce the required compaction. The use of equipment, which results in excessive crushing of the aggregate will not be permitted. Any asphalt pavement that becomes loose, broken, contaminated, shows an excess or deficiency of asphalt binder, or is in any way defective, shall be removed and replaced at no additional cost with fresh hot asphalt mix, which shall be immediately compacted to

conform with the surrounding area. Hot asphalt mix shall not be permitted to adhere to the roller drums during rolling.

3.12.2.3 The type of rollers to be used and their relative position in the compaction sequence shall be the Contractor's option, provided specification densities are attained and with the following stipulations:

(a) At least one roller shall be pneumatic-tired.
(b) Vibratory rollers shall not be operated in the vibratory mode under the following conditions: When checking or cracking of the mat occurs, when fracturing of aggregate occurs, and on bridge decks.

3.13 Joints - General.

3.13.1 Unless otherwise shown on the plans, the longitudinal wearing course joints shall be at the edge of lane placed, where the edge line, lane line and centerline pavement markings will be applied, and joints of other courses shall be offset approximately 6 in (150 mm).

3.13.2 The material being placed next to a previously paved lane shall be tightly crowded against the face of the abutting lane. The paver shall be positioned so that during spreading, the material will overlap the edge of the first lane by 1 to 2 in (25 to 50 mm) and shall be left sufficiently high such that finish pavement of the lane being placed is approximately 1/8 inch (3 mm) higher than the previously paved lane after compaction. The overlapped material shall be rolled without luting. Longitudinal joint compaction shall be achieved by rolling from the hot side to within 6 inches (150 mm) of the previously placed mat. The next roller pass will overlap onto the previously placed paved lane by 6 inches (150 mm). Further compactive effort shall be applied to all joints during the intermediate and final rolling.

3.13.3 Placing of the course shall be as continuous as possible while complying with Contract Traffic Control Plans. Transverse joints will be allowed at the end of each work shift or as required to provide properly bonded longitudinal joints.

3.13.3.1 No longitudinal joints greater than 1 1/2 inch (37 mm) in height shall be left open to traffic unless a tapered overlapping (“wedge”) joint is used. Centerline joints greater than ¾ inch (19 mm) shall be properly delineated by tubular marker and signed appropriately. Joints between traveled way and shoulder greater than ¾ inch (19 mm) shall be delineated by barrels. Tubular markers and barrels shall meet the requirements of 619. Tubular markers shall be secured to the pavement.

3.13.3.2 Unless otherwise precluded by weather conditions, longitudinal joints shall not remain open to traffic longer than 30 hours.

3.13.4 If a bulkhead is not used to form the transverse joint, the previously laid material shall be cut back to the designed slope and grade of the course. The joint face shall be coated with approved bituminous bonding material meeting the requirements of 410.2.1 before the fresh mixture is placed against it. Extreme care shall be taken to ensure that no unevenness occurs at the joint. If unsatisfactory riding qualities are obtained at the transverse joint in the wearing course, the joint shall be corrected by an approved method.

3.13.4.1 Prior to opening any lane(s) to traffic, transverse joints shall be ramped by means of an asphalt fillet at a minimum of 5 feet (1.5 m) horizontal to 1 inch (25 mm) vertical slope.

3.13.5 An approved bituminous bonding material meeting the requirements of 410.3.4.2 shall be applied to completely cover all joint contact surfaces.

3.13.5.1 When specified, a bituminous pavement joint adhesive, Item 403.6, shall be applied to the longitudinal joint. If joint adhesive has not been specified, an approved bituminous bonding material meeting the requirements of 410.3.4.2 shall be applied to completely cover all joint contact surfaces.

3.13.5.2 Joint adhesive shall be applied to the longitudinal joints so that the entire joint surface is covered with a minimum 1/8 inch thick layer of material. If a wedge joint is used the upper 4 inches of joint surface shall be covered with joint adhesive.

3.13.5.3 The joint face on which the joint adhesive is to be applied shall be dry, free from loose material, dust, or other debris that could interfere with adhesion. A hot air lance shall be used to dry and clean the joint face immediately prior to application of joint adhesive. If dust or debris adheres to the joint adhesive, it shall be cleaned or recoated as directed by the Engineer.

3.13.5.4 Trucks or traffic shall not drive across the joint adhesive until it has cooled sufficiently to prevent damage from tracking.

3.13.5.5 Joint adhesive shall be melted in a jacketed double boiler melting unit, which is equipped with an effective agitation system as recommended by the joint adhesive manufacturer. The joint adhesive shall be applied at the temperature specified by the manufacturer and shall not be heated above the safe heating temperature specified by the manufacturer.

3.13.5.6 Joint adhesive shall be applied using a pressure feed wand applicator system equipped with an applicator shoe as recommended by the manufacturer. A pour-pot applicator will be allowed on wedge joints only.

3.13.6 A tapered overlapping ("wedge") joint may be used on all longitudinal joints provided that the adjacent lane can be placed when the existing surface temperature is above 50° F (10 °C).

3.13.6.1 An inclined face (3:1) on the joint shall be formed in the first bituminous mat placed. The inclined face may be for the entire height or an inclined face with a 1/2 in (13 mm) maximum vertical face at the top of the mat.

3.13.6.2 After the initial mat is placed, the mat shall be rolled to the edge of the unconfined face.

3.13.6.3 When the adjoining mat is placed the initial longitudinal wedge shall be treated as in 3.13.5.

3.13.6.4 The joint matching and compaction shall be performed in accordance with 401.13.2.

3.13.7 The Contractor shall furnish and have available a 10 ft (3 m), light-weight metal straightedge with a rectangular cross-section of 2 by 4 in (50 by 100 mm) at the paver at all times during paving operations. All courses shall be tested with the straightedge laid parallel to the centerline and any variations from a true profile exceeding 3/16 in (5 m) shall be satisfactorily eliminated. The finished surface of the pavement shall be uniform in appearance, shall be free from irregularities in contour, and shall present a smooth-riding surface.

3.14 Replacement - General

3.14.1 If unsatisfactory areas are found in any course, the Contractor shall remove the unsatisfactory material and replace it with satisfactory material after coating the exposed edges with suitable bituminous material.

3.16 Finished Appearance - General

3.16.1 Any bituminous material remaining on exposed surfaces of curbs, sidewalks, or other structures shall be removed.

3.17 Quality Control

3.17.1 The Contractor shall operate in accordance with a Quality Control Plan, hereinafter referred to as the "Plan", sufficient to assure a product meeting the contract requirements. The plan shall meet the requirements of 106.03.1 and these special provisions.

3.17.2 The Plan shall address all elements which affect the quality of the Plant Mix Pavement including, but not limited to, the following:

(a) Job mix formula(s).
(b) Hot asphalt mix plant details.
(c) Stockpile Management.
(d) Make & type of paver(s).
(e) Make & type of rollers including weight, weight per inch (centimeter) of steel wheels, and average ground contact pressure for pneumatic tired rollers.
(f) Name of Plan Administrator.
(g) Name of Process Control Technician(s).
(h) Name of Quality Control Technician(s).
(i) Mixing & Transportation.
(j) Process Control Testing.
(k) Placing sequence and placing procedure for ride quality.
(l) Paving and Weather Limitations.
(m) Sequence for paving around catch basins, under guard rail, around curb, at bridges, and intersections, drives and minor approaches, to ensure a proper finish and drainage.
(n) Procedure for fine grading the top of the surface to be paved.

3.17.3 The Plan shall include the following personnel performing the described functions and meeting the following minimum requirements and qualifications:

A) **Plan Administrator** meeting one of the following qualifications:
   1) Professional Engineer with one year of highway experience acceptable to the Department.
   2) Engineer-In-Training with two years of highway experience acceptable to the Department.
   3) An individual with three years highway experience acceptable to the Department and with a Bachelor of Science Degree in Civil Engineering Technology or Construction.
   4) An individual with five years of paving experience acceptable to the Department.
   5) Plan Administrators shall also be certified as a QA Technologist by New England States Technician Certification Program (NETTCP).

B) **Process Control Technician(s) (PCT)** shall utilize test results and other quality control practices to assure the quality of aggregates and other mix components and control proportioning to meet the job mix formula(s). The PCT shall periodically inspect all equipment used in mixing to assure it is operating properly and that mixing conforms to the mix design(s) and other contract requirements. The Plan shall detail how these duties and responsibilities are to be accomplished and documented and whether more than one PCT is required. The Plan shall include the criteria utilized by the PCT to correct or reject unsatisfactory materials. The PCT shall be certified as a Plant Technician by the New England States Technician Certification Program or be a Materials Testing Technician in Training, working under the direct observation of a NETTCP certified Plant Technician.

C) **Quality Control Technician(s) (QCT)** shall perform and utilize quality control tests at the job site to assure that delivered materials meet the requirements of the job mix formula(s). The QCT shall inspect all equipment utilized in transporting, laydown, and compacting to assure it is operating properly and that all laydown and compaction conform to the contract requirements. The plan shall detail how these duties and responsibilities are to be accomplished and documented, and whether more than one QCT is required. The Plan shall include the criteria utilized by the QCT to correct or reject unsatisfactory materials. The QCT shall be certified as a HMA Paving Technician as certified by the New England States Technician Certification Program or be a Materials Testing Technician in Training, working under the direct observation of a NETTCP certified HMA Paving Technician.

3.17.4 The Plan shall detail the coordination of the activities of the Plan Administrator, the PCT and the QCT. The Plan shall also detail who has the responsibility to reject material, halt production or stop placement.

3.17.4.1 All issues agreed to at the Pre-Pave meeting shall be considered to be part of the Plan.

3.17.5 Asphalt pavement shall be sampled, tested, and evaluated by the Contractor in accordance with the minimum process control guidelines in Table 3.

Table 3 - Minimum Process Control Guidelines

PROPERTIES	TEST FREQUENCY	TEST METHOD
Temperature of Mix	6 per day at paver hopper and plant	
Surface Temperature	As needed	
Temperature of Mat	4 per day	
Density	1 per 500 tons (500 metric tons) or minimum 2 per day	AASHTO T 230 or ASTM D 2950 (Core or Nuclear)
Maximum Theoretical Specific Gravity	1 per day of operation	AASHTO T-209
Fractured Faces	1 per 2000 tons (1800 metric tons) for Gravel Sources only	AASHTO T 11 & AASHTO T 27
Aggregate Gradation & Asphalt Binder content	1 per 750 tons (700 metric tons) recommended	AASHTO T 164
Asphalt Binder	As needed	AASHTO M 226
Thickness	Contractor Defined	Contractor Defined

3.17.6 Rejection by Contractor. The Contractor may, prior to sampling, elect to remove any defective material and replace it with new material at no expense to the State.

3.17.6.1 No wearing course pavement shall be removed or repaired without prior approval of the Engineer.

3.17.7 The Contractor may utilize innovative equipment or techniques not addressed by the specifications or these provisions to produce or monitor the production of the mix, subject to approval by the Engineer.

3.18 Quality Assurance.

3.18.1 Asphalt pavement designated for acceptance under Quality Assurance (QA) provisions will be sampled once per sublot on a statistically random basis, tested, and evaluated by the Department in accordance with 106.03.2 and the acceptance testing schedule in Table 4. Testing shall not take place until the material has been placed and deemed acceptable by the Contractor.

Table 4 - Acceptance Testing Schedule

PROPERTIES	POINT OF SAMPLING	LOT SIZE	SUBLOT SIZE	TEST METHOD
Gradation	Behind paver & before rolling[4]	401.3.18.2	750 tons (700 metric tons)	AASHTO T 30 NHDOT B-1
Asphalt Binder content	Behind paver & before rolling[4]	401.3.18.2	750 tons (700 metric tons)	AASHTO T 164 NHDOT B-2 NHDOT B-6
Maximum theoretical specific gravity	Compacted Roadway[1] Core		750 tons (700 metric tons)	NHDOT B-8 AASHTO T 209
In Place Air Voids in total mix[5,6,7]	Compacted roadway[1] core	401.3.18.2	750 tons (700 metric tons)	NHDOT B-8 AASHTO T 269
Ride Smoothness[7]	Completion of wearing surface	Total project	0.1 lane mile (0.2 lane km)	401.3.19.4
Cross Slope[7]	Completion of wearing surface	Total project	1 per 5 full stations	401. 3.19.5
Thickness[2][5] [7]	Compacted roadway[1] core	Total project	750 tons (700 metric tons)	NHDOT B-8 ASTM D 3549

(1) Excluding bridge pavements.
(2) Measurements taken from full depth cores obtained for in place air voids determination.
(3) For leveling course, samples to be taken at the plant.
(4) Sampling and testing will not be done for leveling course.
(5) Not Including leveling course
(6) When the contractor is supplying mix to more than one paver simultaneously, contractor's personnel shall keep a running total of tonnage supplied to each paver on each paver.
(7) Tier 1 Item only

3.18.2 Lot Size. For purposes of evaluating all acceptance test properties a lot shall consist of the total quantity represented by each item listed under the lot size heading in the table above. Each lot will be broken down into at least 3 sublots.

The Contractor may request a change in the job mix formula. If the request is approved, all of the material produced prior to the change will be evaluated on the basis of available tests and a new lot will begin. Three sublots must be sampled and tested before a new lot may begin.

3.18.2.1 A lot for Gradation, Asphalt Content and In Place Air Voids shall be the total quantity represented by the job mix formula with the following exception; the shoulders will be evaluated as a separate lot for in place air voids.

3.18.3 Sublot Size. The quantity represented by each sample will constitute a sublot. The size of each sublot shall be as listed under the sublot size heading in Table 4. If there is insufficient quantity in a lot to make up at least three sublots of the designated size in Table 4, then the lot quantity will be divided into three equal sublots.

If there is less than one half of a sublot remaining at the end, then it shall be combined with the previous sublot. If there is more than one half sublot remaining at the end, then it shall constitute the last sublot and shall be represented by test results.

3.18.4 Test Results. The Engineer may calculate pay factors and pay adjustments at any time while a lot is being produced. This may be necessary for a partial estimate or to see if quality is falling to a point where immediate attention is required. Pay factors will be determined from all available acceptance tests for the lot being evaluated.

3.19 Quality Assurance Acceptance Testing

3.19.1 Gradation and Asphalt Binder Content. Samples for gradation and asphalt binder content shall be obtained from behind the paver in conformance with NHDOT procedure B-7 (see appendix A) and taken from each pavement layer by the Contractor in the presence of the Engineer. The sample locations will be established by selecting a random location within each sublot in accordance with 106. Sample locations (center of sample) will not be within 1 foot (0.3 meter) from an edge of pavement or within 4 feet (1.2 meters) from any structure. Sample locations falling within 4 feet (1.2 meters) from any structure will be relocated 4 feet (1.2 meters) from the structure along station at the same offset.

Where samples have been taken, new material shall be placed and compacted to conform to the surrounding area immediately after the samples are taken. Samples shall be accompanied by a sample tag containing the following information:

(a) Project name and number.
(b) Lot and sublot number.
(c) Material type.
(d) Date placed.
(e) Location in station and offset, tonnage
(f) Contract Administrator
(g) Sampler
(h) Item number

When the project exceeds 30 minutes travel time from the testing laboratory location, material samples will be taken and identified by NHDOT project personnel and shall be transported before cooling by the Contractor and delivered to NHDOT testing technicians at the testing laboratory location. Samples lost in transit will incur a penalty of 5% of the bid price for the entire sublot represented by that sample. Sublots with no test results due to a lost sample will not be evaluated and the total quantity represented by that sublot shall not be included in any positive pay factor.

3.19.1.1 Testing. Target values shall be as specified in the job mix formula. All sieve sizes specified in the job mix formula will be evaluated for gradation. The specification limits in Table 5 will be used for calculating pay factors for gradation and asphalt binder content.

Table 5 - Gradation and Asphalt Binder Specification Limits

PROPERTY	MAXIMUM AGGREGATE SIZE			
	1" (25.0 mm)	3/4" (19.0 mm)	1/2" (12.5 mm)	3/8" (9 mm)
	USL and LSL (Target +/- %)			
1 ½" (37.0 mm)	0			
1-1/4 in (31.5 mm)	8.0			
1 in (25.0 mm)	8.0	0		
3/4 in (19.0 mm)	7.0	5.0	0	
1/2 in (12.5 mm)	7.0	5.0	4.0	0
3/8 in (9.5 mm)	7.0	5.0	4.0	4.0
No. 4 (4.75 mm)	4.0	4.0	3.0	4.0
No. 8 (2.36 mm)	4.0	4.0	3.0	3.0
No. 16 (1.18 mm)	2.0	2.0	2.0	2.0
No. 30 (0.600 mm)	2.0	2.0	2.0	2.0
No. 50 (0.300 mm)	2.0	2.0	2.0	2.0
No. 100 (0.150 mm)	2.0	2.0	2.0	2.0
No. 200 (0.075 mm)	0.8	0.8	0.8	0.8
Asphalt Binder	0.4	0.4	0.4	0.4

Any sublot with a gradation or asphalt binder content falling outside the ranges of the reject limits in Table 6 will be either removed and replaced at the expense of the Contractor or require corrective action to the satisfaction of the Engineer. After replacement or correction, new samples will be taken and the old test results from that sublot will be discarded.

Table 6 - Gradation and Asphalt Binder Content Reject Limits (Deviation from Target)

SIEVE SIZE	1" (25.0 mm)	3/4 in (19 mm)	1/2 in (12.5 mm)	3/8 in (9.5 mm)
	Percent Passing By Weight – Combined Aggregate			
1-1/4 in (31.5 mm)				
1 in (25.0 mm)				
3/4 in (19.0 mm)	±12	(1)		
1/2 in (12.5 mm)	(1)	±10	(1)	

3/8 in (9.5 mm)	(1)	(1)	±10	(1)
No. 4 (4.75 mm)	±9	±9	±9	±9
No. 8 (2.36 mm)	±7	±7	±7	±7
No. 16 (1.18 mm)	±6	±6	±6	±6
No. 30 (0.600 mm)	(1)	(1)	(1)	(1)
No. 50 (0.300 mm)	(1)	(1)	(1)	(1)
No. 100 (0.150 mm)	(1)	(1)	(1)	(1)
No. 200 (0.075 mm)	±3	±3	±3	±3
Asphalt Binder: % of Mix	±1.0	±1.0	±0.8	±0.8

(1) Reject limits will be waived for these sieves.

The Contractor shall have the option of requesting a change in job mix formula (aim change) values used for calculating quality level to reflect actual production values after the placement of two sublots as long as no change in plant production values are made. A new lot is not needed for this change.

3.19.2 In Place Air Voids. In place air voids shall be determined in accordance with AASHTO T 269 using 150 mm (6 inch) diameter cores taken from each pavement layer by the Contractor in the presence of the Engineer. Core sampling shall be in conformance with AASHTO T 230 and NHDOT B-8 (see appendix A). Full depth cores containing all new pavement layers shall be required. Core locations (center of core) will be established by selecting a random location within each sublot in accordance with 106. Cores will not be located in the following areas:

(a) Within 1 foot (0.3 meter) from an edge of pavement.
(b) Within 4 feet (1.2 meters) from any structure. Core locations falling within this area will be relocated 4 feet (1.2 meters) from the structure along station at the same offset.
(c) Within shoulders 4 feet (1.2 meters) or less in width.
(d) Within 1 foot (0.3 meter) from any break in slope across the mat surface.

Cores shall be taken before opening pavement to traffic, except when location of core is within the last hour of that day's placement. Cores shall be taken within 24 hours after placement. Where cores have been taken, new material shall be placed and compacted to conform to the surrounding area the same day the samples are taken. Core samples shall be accompanied by a sample tag containing the following information:

(a) Project name & number.
(b) Lot and sublot number.
(c) Material Type.
(d) Date placed.
(e) Date sampled.
(f) Location in station and offset, and/or tonnage.
(g) Plan thickness.
(h) Contract Administrator
(i) Sampler
(j) Item number

The complete sample(s) (unseparated) shall be protected against damage, transported and delivered by the Contractor within one working day to NHDOT testing technicians at the testing lab location. Sublots where the core becomes lost or damaged will be resampled at the direction of the Engineer at the Contractor's expense.

The specification limits in Table 7 will be used for calculating pay factors for in place air voids for each lot:

Table 7 - In Place Air Voids Acceptance Limits

TARGET (%)	LSL	USL
Average of Samples	- 2.0%[1]	+2.0%[2]

[1] But not less than 3%
[2] But not more than 9%

When a core is less than 80% or more than 120% of the nominal thickness, a new core will be taken in the same sublot at a random location for the determination of in place air voids.

A sublot with a test result less than 2.0% for in place air voids will be rejected and subject to removal and replacement.

3.19.2.1 Maximum Theoretical Density (MTD). MTD shall be determined in conformance with AASHTO T 209 once per sublot from the core obtained for determining in place air voids.

3.19.2.2 Disputed Cores. If a Contractor believes that a core result is invalid for whatever reason, the Contractor shall notify the Engineer of this in writing within 24 hrs. Of being informed of the test result. After being informed of the disputed core result, the Engineer will select five random core locations, one in each fifth section of the disputed sublot at the same offset as the disputed core. The Contractor shall cut the cores at the selected locations and deliver them to the testing technician. If there are 10 or more cores already tested to date, the pay factor for voids in the lot will be calculated (without using the result of the disputed core). If less than ten cores have been tested in the disputed lot, the five cores shall be held until ten cores have been tested or the lot is complete, whichever comes first, at which time the pay factor will be calculated.

If the pay factor for the lot that contains the disputed result is 0.95 or greater, and the disputed test result is outside three standard deviations from the mean value of the lot (calculated without using the result of the disputed core), the five cores shall be tested and the average value of the five will be calculated.

If any of these five cores falls outside three standard deviations from the mean value for the lot (calculated without using the result of the disputed core), the original core test value will stand. If the five cores fall within three standard deviations of the mean value the average of the five cores will be used as the core result for the disputed sublot.

If the five cores are not used, the Contractor shall pay for the cost of testing.

3.19.3 Pavement Thickness. The thickness requirements contained herein shall apply only when each pavement layer is specified to be a uniform thickness greater than 3/4 inch (19 mm). The combined total thickness of the hot asphalt mix or mixes will be measured in conformance to ASTM D 3549 to determine compliance with the acceptance tolerance. Measurements shall be obtained from full depth cores containing all new pavement layers removed for determining in place air voids after the placement of the wearing surface. Cores shall include all new layers placed. A leveling course, or the first layer over a milled or existing surface, shall be excluded from thickness measurement.

3.19.3.1 Once each combined thickness measurement has been taken, a thickness index will be calculated. The thickness index is the actual deviation from target divided by the allowable tolerance. This will allow statistical comparisons to be made among measurements based on varying specified thickness. Thickness indexes will be established for the sole purpose of calculating pay factors. Thickness index shall be calculated under the following equation using the specification limits in Table 8.

$$TI = \frac{(M - ST)}{T}$$

where: TI = Thickness Index
ST = Specified Thickness
M = Core Measurement
T = ¼" per pavement course

Table 8 - Thickness Index Acceptance Limits

	TARGET	LSL	USL
Thickness Index	0.00	-1.00	+1.00

3.19.3.1 Disputed Thickness If a Contractor believes that a thickness result is invalid for whatever reason, the Contractor shall notify the Engineer of this in writing within 24 hrs of being informed of the test result. After being informed of the disputed result, the Engineer will select three random core locations in the disputed sublot and the Contractor shall cut the cores at the selected locations and deliver them to the testing technician. If there are 10 or more cores already tested to date, the pay factor for thickness in the lot will be calculated (without using the result of the disputed core). If less than ten cores have been tested in the disputed lot, the three cores shall be held until ten cores have been tested or the lot is complete, whichever comes first, at which time the pay factor will be calculated.

If the pay factor for the lot that contains the disputed result is 0.95 or greater, and the disputed test result is outside three standard deviations from the mean value of the lot (calculated without using the result of the disputed thickness), the three cores shall be measured and the average value of the three will be calculated.

If any of these three cores falls outside three standard deviations from the mean value for the lot (calculated without using the result of the disputed core), the original thickness test value will stand. If the three cores fall within three standard deviations of the mean value the average of the three measurements will be used as the thickness for the disputed sublot.

If the three cores are not used, the Contractor shall pay for the cost of testing.

3.19.4 Ride Smoothness.

3.19.4.1 The Contractor shall furnish and have available a 10 foot (3 meter), light weight metal straightedge with a rectangular cross section of 2" x 4" (50 x 100 mm) at the paver at all times during paving operations. All courses shall be tested with the straightedge laid parallel or perpendicular to the centerline and any variations from a true profile or cross section exceeding 3/16 of an inch (5 mm) shall be satisfactorily eliminated. The finished surface of the pavement shall be uniform in appearance, free from irregularities in contour and shall present a smooth-riding surface.

3.19.4.2 A GM type profilometer will be furnished by the Department for determination of pavement smoothness. This device provides a Ride Number in both wheel paths that are averaged to produce a ride number for the surface tested. In the event the Engineer feels that there is a significant difference in the wheel path profiles, a Ride Number evaluation of the individual wheel paths will be made. The surface will be tested within 30 days after the wearing surface and pavement markings for each discrete section of the project are complete. Immediately before testing, the Contractor will insure the surface is entirely free from any foreign matter that may affect the test results. No special considerations will be given to criteria such as degree of curve and vertical geometry. Ride Number will be calculated to the nearest one hundredth for each 0.1 mile (0.2 km) segment.

3.19.4.3 Profilometer testing will include all mainline paving including bridges with lanes at least 11 feet (3.3 meters) wide. Testing will begin 20 feet (6 meters) after the approach joint and end 20 feet (6 meters) before the departure joint. The pavement will not be evaluated over bridge expansion joints, tapers, raised pavement markings, and sections less than 0.1 mile (0.2 km) in lane length.

3.19.4. All areas with bumps or high points exceeding 0.3 inches in 25 feet (8 mm in 7.6 meters) shall be corrected by removal of a minimum of 1 inch (25 mm) of the full lane width by the length required (a minimum of 100 feet (30 meters)) and replaced at the Contractor's expense.

3.19.4.5 The Ride Number average of all sublots will be used to determine the final pay factor. The final pay factor shall not exceed 1.05 and will be computed as follows:

For Level 1 Projects: (Ride Number 4.20)
Pay Factor = RN (0.5)-1.1

For Level 2 Projects: (Ride Number 4.14)
Pay Factor = RN (0.5682) – 1.3523

3.19.4.6 A final Ride Number shall be established after the wearing surface is completed and striped. Separate completed sections of a project will be evaluated before the entire wearing surface is completed. Any sublot with a ride number less than 3.7 shall be repaired or replaced.

3.19.4.6.1 Any sublot that has an individual wheel path ride number less than 3.7 shall be repaired or replaced. The repair treatment shall be for the full width of the lane. Sublots that have been repaired or replaced shall be reevaluated for ride smoothness and then averaged with all other sublots to determine the final project pay factor. Construction joints resulting from repairs or replacement will be included.

3.19.4.6.2 Level 1 will generally be all interstate and limited access highways with the following exception:

(a) A single course overlay that has a before ride number average of less than 4.00

3.19.4.6.3 Level 2 will generally be all other highways with the following exceptions:

(a) Where the wearing course must be constructed in short sections (< 3 sublots).
(b) Projects shorter than one half mile in length.

(c) Projects with a posted speed of 35 MPH or less.
(d) Projects with many driveways and/or cross roads with constant traffic.
(e) District resurfacing projects.

3.19.5 Cross Slope.

3.19.5.1 Cross slope will be measured once per sublot behind the paver after final rolling of the wearing surface has taken place. Cross slope will only be evaluated when specific slopes and superelevations are shown on the plans for the entire project. Only travel lanes will be evaluated for cross slope. Measurements will be taken only in areas of normal tangent or full bank curves on even stations. The procedure for measuring the cross slope shall be by placing a 10 foot (3-meter) metal straight edge on the surface perpendicular to the traveled lane. A 4 foot (1.2 meter) direct reading level shall be placed on top of it. Percent cross slope shall be read and recorded. A second reading 180 degrees to the first shall be taken and recorded and the two shall be averaged for the test result.

3.19.5.2 Once a cross slope percentage has been measured, a cross slope index (CSI) will be calculated. The target cross slope shall be defined as the cross slope shown on the plans or as ordered to the nearest tenth of a percent. The CSI is the actual deviation from the target divided by the allowable tolerance of 0.5 percent. This will allow statistical comparisons to be made among measurements based on varying specified cross slopes. The CSI will be established for the sole purpose of calculating pay factors. The CSI shall be calculated under the following equation using the specification limits in Table 10.

$$\text{CSI} = \frac{(M - SCS)}{T}$$

where: CSI = Cross Slope Index
SCS = Specified Cross Slope in percent
M = Measured Cross Slope in percent
T = 0.50

Table 10 - Cross Slope Index Acceptance Limits

	TARGET	LSL	USL
Cross Slope Index	0.00	-1.00	+1.00

3.19.6 Rejection of Material.

3.19.6.1 An individual sublot. For any sublots with any test results exceeding the specified reject limits, the Engineer will:

(a) Require complete removal and replacement with hot asphalt mix meeting the contract requirements at no additional expense to the department, or
(b) Require corrective action to the satisfaction of the Engineer at no additional expense to the Department.

3.19.6.2 A lot in progress. The Engineer will shut down paving operations whenever:

(a) The pay factor for any property drops below .90 and the Contractor is taking no corrective action, or
(b) Three consecutive tests show that less than 50 percent by weight of the particles retained on the No. 4 (4.75 mm) sieve have at least one fractured face.

Paving operations shall not resume until the Engineer determines that material meeting the contract requirements can be produced. Corrective action will be considered acceptable by the Engineer if the pay factor for the failing property increases. If it is determined that the resumption of production involves a significant change to the production process, the current lot will be terminated and a new lot will begin.

3.19.6.3 Resampling and Retesting. All requests to resample and test a sublot shall be in writing to the Department of Transportation's Asphalt Paving QC/QA Coordinator.

Method of Measurement

4.1 Asphalt pavement mixture will be measured by the ton (metric ton) to the nearest 0.1 ton (0.1 metric ton), and in accordance with 109.01. Batch weights will be permitted as a method of measurement only when the provisions of 3.8.3 are met, in which case, payment will be based on the cumulative weight of all the batches. The quantity will be the weight used in the accepted pavement, and no deduction will be made for the weight of asphalt binder or additives in the mixture.

4.1.1 Due to possible variations in the specific gravity of the aggregates, and to possible field changes in areas to be paved, the quantity used may vary from the proposal quantities, and no adjustment in contract unit price will be made because of such variations.

4.2 Asphalt pavement, removed because of faulty workmanship or contamination by foreign materials, will not be included in the pay quantity.

4.3 Hot bituminous bridge pavement, base course of the depth and additional materials specified will not be measured, but shall be the ton (metric ton) final pay quantity in accordance with 109.11 for compacted material within the limits shown on the plans.

4.4 Pavement Joint Adhesive will be measured by the linear foot (linear meter) of material incorporated in the work.

Basis of Payment

5.1 All work performed and measured as prescribed above will be paid for at the contract unit price as provided in the respective sections for each type specified.

5.2 Tack coat material ordered under 3.10.9 will be subsidiary to the paving items.

5.3 Approved bituminous material ordered for the coating of contact surfaces and joints as specified will be subsidiary.

5.4 Plant or project lighting, or overtime required due to night operations will be subsidiary to the paving items.

Asphalt cement additives will be subsidiary to the paving items.

5.6 Implementtion of the Quality Control Plan and costs associated with obtaining core samples for acceptance testing shall be subsidiary. When items are to be accepted under Quality Assurance provisions, pay adjustment will be made in accordance with 106.03.2.4 as specified below.

5.6.1 Gradation composite pay factor (CPF). The total price for each lot will be adjusted by a composite pay factor (CPF) based on the gradation of the material after extraction using the pay factors for each sieve size and the sieve size weight factors in Tables 11, 11a & 11b.

Table 11 - Sieve Size Weight Factors 1 inch (25 mm)

PROPERTY		WEIGHT FACTOR "f"
	½ inch (12.5 mm)	6
	#30 (0.600 mm)	4
Gradation (each sieve)	#8 and #200 (2.36 mm 0.075 mm) sieves	8
	All other sieves (each)	2

Table 11a - Sieve Size Weight Factors ¾ inch (19 mm)

PROPERTY		WEIGHT FACTOR "f"
	3/8" (9.5 mm)	6
	#30 (0.600 mm)	4
Gradation (each sieve)	#8, and #200 (2.36 mm, 0.075 mm) sieves	8
	All other sieves (each)	2

Table 11b - Sieve Size Weight Factors ½ inch and $^3/_8$ inch (12.5 mm and 9.5 mm)

PROPERTY		WEIGHT FACTOR "f"
	No. 4 (4.75 mm)	6
	#30 (0.600 mm)	4
Gradation (each sieve)	#8, and #200 (2.36 mm, 0.075 mm) sieves	8
	All other sieves (each)	2

$$\text{Composite Pay Factor (CPF)} = \frac{[f_1(PF_1) + f_2(PF_2) + \ldots f_j(PF_j)]}{\Sigma f}$$

5.6.2 Pay Adjustment. The pay adjustment for each measured characteristic will be determined by the following equation:

$$PA_j = (Pf_j - 1)\frac{f_j}{\sum f}(Q)(P)$$

where: PA = Pay adjustment payment in dollars for each characteristic.
Pf = Pay factor or composite pay factor for each characteristic.
f = Weight factor from Table 12 for each characteristic.

$\sum f$ = Sum of weight factors.
Q = Quantity computed from all accepted delivery records for the lot.
P = Contract unit price per ton.

Table 12 – Tier 1 Weight Factors

MEASURED CHARACTERISTIC	WEIGHT FACTOR "f"
Gradation	0.15
Asphalt Binder Content	0.15
In Place Air Voids	0.20
Thickness	0.10
Cross Slope	0.10
Ride Smoothness	0.30

Table 13 – Tier 2 Weight Factors

MEASURED CHARACTERISTIC	WEIGHT FACTOR "f"
Gradation	0.25
Asphalt Binder Content	0.25
Air Voids	0.5

5.6.3 Pay adjustment, Hot Bituminous Pavement QC/QA Items. The pay adjustment for gradation, asphalt binder content, in place air voids, and ride quality (made up of the sum of all sublots) will be applied to item 1010.3. Pay adjustments may be applied at the end of each month based on all available test results for each lot.

5.7 Pavement Joint Adhesive will be paid for at the contract unit price per linear foot (linear meter), complete in place.

5.7.1 Recoating of the joint, as described in 3.13.5, shall be at the Contractor's expense.

Appendix A

NHDOT Test Procedure B-7
Sampling Bituminous Paving Mixtures For Acceptance Testing.

Sample shall be taken behind the paver after placement and before compaction

Sample location is randomly selected by the Contract Administrator

When paving over aggregate base course or cold planed surface, use a rectangular metal plate no less than 12 in. (300 mm) each side. Center plate on sample location.

After paver passes over plate, measure back to sample location.

Locate the edges of the plate.

Using a flat-bottomed scoop large enough to obtain up to a 3000 gram sample. Place scoop on plate and push across the mat (perpendicular to the center line), through the center of the plate, filling the scoop to obtain the sample size specified below.

Required Sample Size

Base Courses	2000-3000 grams
Binder Courses	1500-3000 grams
Surface Courses	1000-3000 grams
Sand Courses	500-3000 grams

When sampling over an existing pavement the plate is not required.

NHDOT Procedure B-8
Sampling and Testing Procedure for In Place Air Voids

Cores will be taken at random locations selected by the Contract Administrator.

Cores will be delivered intact by the contractor to the NHDOT inspector at the testing laboratory.

If Cores are lost or damaged, new cores shall be taken at the same location as the previous core

Cores shall be measured for thickness following ASTM D 3549

Bulk specific gravity shall be determined by AASHTO T 166

Maximum Theoretical Density will be determined using the core by AASHTO T 209

In Place Air Voids shall be determined by AASHTO T 2

SECTION 403 -- HOT BITUMINOUS PAVEMENT

Description

1.1 This work shall consist of constructing one or more courses of bituminous pavement on a prepared base as shown on the plans or as ordered. The methods may be classified as hand or machine.

1.1.1 Hand method shall include only the paving of raised islands, slopes, cattle passes, areas between rails at railroad crossings, existing sidewalks, drives, drive aprons, curb patch between concrete barrier and pavement, curb patch between granite curb and pavement, and paving of 50 tons (45 metric tons) or less added after the completion of paving operations.

1.1.2 Machine method shall include all paving not classified as hand method.

Materials

2.1 Materials and their use shall conform to the requirements of 401.2.

2.2 Temporary bituminous pavement shall conform to 401, Table 1. Thickness shall be as shown on the plans or as ordered by the Engineer.

Construction Requirements

3.1 Construction requirements shall be as prescribed in 401.3.

3.2 For temporary pavement only, amend portions of 401.3.12 as follows:

3.2.1 The requirements of 401.12.1.1 shall apply except rolling may be accomplished with a dual vibrating steel drum roller.

3.2.2 Delete 401.3.12.2.

3.3 For temporary bituminous pavement only delete 401.13.7.

3.4 Temporary bituminous pavement shall be removed when no longer needed.

Methods of Measurement

4.1 Hot bituminous pavement will be measured as prescribed in 401.4.

Basis of Payment

5.1 The accepted quantities of hot bituminous pavement will be paid for at the contract price per ton (metric ton) for the bituminous mixture, complete in place.

5.2 Bridge wearing course will be paid under machine method.

5.3 Hot bituminous bridge pavement, base course of the depth and additional materials specified is a final pay quantity item and will be paid for at the contract unit price per ton (metric ton) in accordance with 109.11.

5.4 The accepted quantity of temporary bituminous pavement will be paid for at the contract unit price per ton (metric ton) complete.

5.4.1 Removal of the temporary pavement will not be paid for under other items of the contract but will be subsidiary.

Pay items and units:

403.11	Hot Bituminous Pavement, Machine Method	Ton (Metric Ton)
403.119	Hot Bituminous Pavement, Machine Method (Night)	Ton (Metric Ton)
403.1199	Hot Bituminous Pavement, Machine Method, High Strength (Night)	Ton (Metric Ton)
403.12	Hot Bituminous Pavement, Hand Method	Ton (Metric Ton)
403.129	Hot Bituminous Pavement, Hand Method(Night)	Ton (Metric Ton)
403.351	Hot Bituminous Pavement, Aggregate 35 percent Wear, Machine Method	Ton (Metric Ton)
403.3519	Hot Bituminous Pavement, Aggregate 35 percent Wear, Machine Method (Night)	Ton (Metric Ton)
403.352	Hot Bituminous Pavement, Aggregate 35 percent Wear, Hand Method	Ton (Metric Ton)
403.51	Hot Bituminous Pavement, Aggregate 50 percent Wear, Machine Method	Ton (Metric Ton)
403.519	Hot Bituminous Pavement, Aggregate 50 percent Wear, Machine Method (Night)	Ton (Metric Ton)
403.52	Hot Bituminous Pavement, Aggregate 50 percent Wear, Hand Method	Ton (Metric Ton)
403.529	Hot Bituminous Pavement, Aggregate 50 percent Wear, Hand Method (Night)	Ton (Metric Ton)
403.6	Pavement Joint Adhesive	Linear Foot (linear Meter
403.98	Hot Bituminous Concrete Leveling, Machine Method	Ton (Metric Ton)
403.99	Temporary Bituminous Pavement	Ton (Metric Ton)
403.XXXX1	Bituminous Pavement, _____(QC/QA Tier 1)	Ton (Metric Ton)
403.XXXX2	Bituminous Pavement, _____ (QC/QA Tier 2)	Ton (Metric Ton)
1010.3	Quality Control/Quality Assurance (QC/QA) for Asphalt	Dollar

Pay items and units (English):

403.911	Hot Bituminous Bridge Pavement, 1 in Base Course (F)	Ton
403.91109	Hot Bituminous Bridge Pavement, 1 in Base Course (Night) (F)	Ton
403.9115	Hot Bituminous Bridge Pavement, 1 in Base Course, Aggregate 50 Percent Wear (F)	Ton

Pay items and units (Metric):

403.911	Hot Bituminous Bridge Pavement, 25mmBase Course (F)	Metric Ton
403.91109	Hot Bituminous Bridge Pavement, 25mmBase Course (Night) (F)	Metric Ton
403.9115	Hot Bituminous Bridge Pavement, 25 mm Base Course, Aggregate 50 Percent Wear (F)	Metric Ton

SECTION 410 -- BITUMINOUS SURFACE TREATMENT

Description

1.1 This work shall consist of preparing and applying one or more prime or seal coats of bituminous material to a gravel or stone course. This work shall also consist of a tack coat applied to a bituminous concrete surface or a Portland cement concrete surface.

Materials

2.1 Bituminous material shall be the type and grade specified or ordered and shall conform to the requirements of AASHTO M 140 or M 208.

2.2 Blotter material shall be natural sand composed of hard, durable particles, free from loam, showing uniform resistance to abrasion. Gradation shall conform to 520, Table 2.

Construction Requirements

3.1 Limitations. Bituminous material shall not be applied on a wet surface, or when weather conditions would prevent the proper application and curing of the coat. The quantities, rate of application, temperatures, and areas to be treated shall be approved before application of bituminous material.

3.2 Equipment. Equipment required for this work shall be as follows:

(a) A distributor shall be so designed, equipped, maintained, and operated such that bituminous material at even heat may be applied uniformly on variable widths of surface up to 24 ft (7.2 m), at readily determined and controlled rates from 0.02 to 2.0 gal/yd^2 (0.09 to 9L/m^2), with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.02 gal (0.08 L). Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump and with full circulation spray bars adjustable laterally and vertically. The spray bar shall contain spray nozzles providing a fan-shaped spray pattern adjusted so the vertical axis is perpendicular to the pavement surface. The spray pattern and spray bar height shall be adjusted to provide a uniform application of the tack coat without double coverage. The distributor shall be equipped with a mechanical device to adjust the spray height as material is discharged to keep a uniform height above the pavement for full coverage without overlapping. The distributor shall also be equipped with a hand-held spray attachment for applying the material to areas inaccessible to spray bars and to fill in irregular areas to provide full coverage. Approved sampling valves shall be installed in distributors and transport tank trucks to permit taking representative samples of the contents. The recommended location of the sampling valve is in the rear bulkhead of the tank roughly one-third of the height above the bottom. The inlet pipe shall project into the contained liquid as shown in AASHTO T 40. At least 1 qt (1 L) of material shall be drained off through the sampling valve and discarded before the desired sample is taken. New sample containers will be furnished by the Engineer. To prevent the loss of solvents, containers shall be sealed with a tight fitting cover immediately after being filled.
(b) A rotary power broom for sweeping treated surface.
(c) A steel-wheeled roller.
(d) A self-propelled pneumatic-tired roller.

(e) A sand spreader capable of spreading blotter material in sufficient quantity to prevent traffic pickup of the applied bituminous material.
(f) A steel-brush drag of an approved type.

3.3 Preparation of Surface to be Treated.

3.3.1 Prime coat. The surface to be primed shall be shaped to the required grade and section, shall be free from all ruts, corrugations, segregated material, or other irregularities, and shall be uniformly compacted in accordance with 304.3.6.

3.3.1.1 Immediately before applying the prime coat, the surface shall be loosened slightly by dragging with a steel-brush drag.

3.3.2 Tack coat. The existing surface shall be patched and shall be free of irregularities to provide a reasonably smooth and uniform surface to receive the treatment. Unstable corrugated areas shall be removed and replaced with suitable patching materials. The edges of existing pavements that are to be adjacent to new pavement shall be cleaned to permit the adhesion of bituminous materials.

3.4 Application of Bituminous Material.

3.4.1 Prime coat. Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor in a uniform, continuous spread. When traffic is maintained, not more then one-half of the width of the section shall be treated in one application. Care shall be taken that the application of bituminous material at junctions is not in excess of the specified amount. Excess material shall be squeegeed from the surface. Skipped areas or deficiencies shall be corrected.

3.4.1.1 When traffic is maintained, one-way traffic shall be permitted on the untreated portion of the roadbed. As soon as the bituminous material has been absorbed by the surface and no longer picks up, traffic shall be transferred to the treated portion, and the remaining width of the section shall be primed.

3.4.2 Tack coat. Bituminous material shall be uniformly applied with an approved applicator. When ordered, a pressure distributor shall be used. The tack coat shall be applied in such a manner as to offer the least inconvenience to traffic and to permit one-way traffic without pickup or tracking of the bituminous material.

3.4.2.1 A tack coat shall be applied immediately prior to placement of pavement. The rate of application of emulsified asphalt shall be between 0.02 and 0.05 gal/yd^2 (0.09 and 0.23 L/m^2), as determined by the Engineer depending on the relative absorbance and texture of the pavement surface.

3.5 Application of blotter material. If, after the application of the prime coat, the bituminous material fails to penetrate within the time specified and the roadway must be used by traffic, blotter material shall be spread in the amounts required to absorb any excess bituminous material. Care shall be taken not to cover a 6 in (150 mm) strip next to the centerline of the roadway until the untreated area has received the first application of bituminous material.

3.5.1 When the entire width of the surface has been treated with bituminous material and blotter material, it shall be dragged with a steel-brush drag. The surface shall be brushed only the amount necessary to distribute the blotter material uniformly.

3.5.2 When ordered, the entire treated surface shall be rolled until the materials are thoroughly bonded.

3.5.3 Sufficient extra blotter material shall be applied whenever necessary to prevent traffic and the roller from picking up the bituminous material.

3.5.4 Additional brush dragging may be required to keep the blotter material uniformly distributed until the bituminous material is thoroughly cured.

3.5.5 The primed surface shall be kept in repair. All holes, ravels, and deficient areas shall be patched and repaired with bituminous treated materials, as approved.

3.5.6 When the bituminous material is thoroughly cured, blotter material remaining on the treated area shall be removed by sweeping with an approved power broom. This operation must be accomplished before subsequent application of any seal coat.

3.6 Seal Coat.

3.6.1 When directed, a seal coat shall be applied at the rate in gallons per square yard (liters per square meter) specified on the plans or as ordered, and by the same method as the prime coat.

3.6.2 Blotter material at the rate ordered shall be applied before the bitumen has set; the entire treated surface shall be dragged, rolled and maintained. The remaining blotter material shall be removed, all by the same methods as specified for the prime coat.

3.7 Finished Appearance.

3.7.1 Any bituminous material splashed or sprayed onto exposed surfaces of curbs, sidewalks, or other masonry structures shall be removed by sandblasting at the Contractor's expense.

Method of Measurement

4.1 Bituminous material will be measured by the tom or pound (metric ton or kilogram), and in accordance with 109.01. Measurements by the ton (metric ton) will be made to the nearest 0.1 ton (0.1 metric ton) and by the pound (kilogram) to the nearest pound (kilogram).

4.2 Blotter material furnished will be subsidiary.

Basis of Payment

5.1 The accepted quantities of bituminous surface treatment will be paid for at the contract price per ton or pound (metric ton or kilogram) for bituminous material, complete in place.

5.2 Payment for patching existing pavements under 3.3.2 will be made at the contract unit price for Item 403.11 or Item 411.1, as ordered.

5.3 Emulsified asphalt for tack coat required under 401.3.5.5 will be subsidiary to the paving items.

Pay items and units:

410.21	Emulsified Asphalt for Tack Coat	Ton (Metric Ton)
410.22	Emulsified Asphalt for Tack Coat	Pound (Kilogram)
410.31	Asphalt Surface Treatment Including Blotter Material	Ton (Metric Ton)
410.41	Emulsified Surface Treatment Including Blotter Material	Ton (Metric Ton)

SECTION 411 -- PLANT MIX SURFACE TREATMENT

Description

1.1 This work shall consist of a leveling course when ordered and one or more courses of bituminous mixture constructed on an existing pavement.

Materials

2.1 Materials and their use shall conform to the requirements of 401.2 as amended below:

2.1.1 Unless a volumetric mix design has been performed by the contractor, the composition of the mixtures shall conform to historical gradation and binder content. Leveling course and ¾" (19 mm) PMST shall be Type H unless otherwise noted.

Table 1 - Composition of Mixtures - Master Ranges
Plant Mixed Surface Treatment

	Type G 3/8 in (9.5 mm)			Type H 3/8 in (9.5 mm)		
Sieve Size	Percentage by Weight Passing					
	Min	Desired	Max	Min	Desired	Max
3/8 in (9.5 mm)	--	--	--	95.0	100	100
No. 4 (4.75 mm)	99	100	100	70.0	77	84.0
No. 8 (2.36 mm)	76.0	84	93.0	54.0	59	65.0
No. 16 (1.18 mm)	55.0	65	74.0	35.0	43	51.0
No. 30 (0.600 mm)	34.0	45	55.0	20.0	28	36.0
No. 50 (0.300 mm)	17.0	25	35.0	10.0	15	20.0
No. 100 (0.150 mm)	6.0	10	15.0	5.0	8	11.0
No. 200 (0.075 mm)	2.0	4	6.0	2.0	4	6.0
	Percentage of Total Mix					
Asphalt Cement	6.5	7.0	7.5	6.25	6.7	7.25

2.1.4 Blotter materials shall be sand conforming to the requirements of Table 2.

Table 2 -- Blotter Material

Sieve Size	Percent by Weight Passing
No. 4 (4.75 mm)	100
No. 10 (2.00 mm)	70 - 92
No. 200 (0.075 mm)	0 - 6

Construction Requirements

3.1 Mixing plants shall be as prescribed in 401.3.1

3.2 Mixing and storage shall conform to 401.3.1.6.11, 401.3.6, and 401.3.7 with the following modifications:

3.2.1 If the aggregate contains sufficient moisture to cause foaming in the mixture, it shall be removed from the bins. The quantity of cold aggregate fed to the dryer shall be governed by the ability of the dryer to completely remove the moisture from the aggregate, as determined by the Engineer.

3.3 Weighing and hauling shall conform to 401.3.8

3.4 Placing shall conform to 401.3.10 with the following modifications:

3.4.1 The existing pavement shall be thoroughly dry and free from all dust, dirt, and loose material. Sweeping with a power broom supplemented by hand brooming may be required.

3.4.2 Existing pavement shall be treated with tack coat as prescribed in 410.3.4.2. When ordered, the existing pavement shall be treated as prescribed in 410.3.3.

3.4.3 A leveling course of hot bituminous concrete may be ordered to prepare the pavement for the finish course.

3.4.4 Any material delivered to the paver having a temperature lower than 250° F (121°C) shall not be used.

3.4.5 In those areas where the edges of the pavement are adjacent to paved or bituminous treated shoulders, the asphalt paving machine shall be equipped to produce a feathered edge, parallel to the direction of traffic, and a uniform longitudinal line shall be maintained at the outer edge of the applied pavement.

3.4.6 All bridges included within the limits of the work shall be treated curb to curb.

3.5 Compaction shall conform to 401.3.12 with the following modifications:

3.5.1 If necessary to prevent traffic pickup of the mixture, the surface of the work shall be given a light dusting of blotter material just prior to rolling with a pneumatic-tired roller. The surface shall be maintained thereafter by occasional back sanding and rolling as directed.

3.5.2 When more than 125 tons (115 metric tons) of mixture is being placed per hour, an additional steel-wheeled roller will be required.

3.5.3 Excess blotter material remaining on the pavement and on paved shoulders shall be removed prior to acceptance of the project.

3.5.4 After rolling has been completed, the edges of the pavement shall be trimmed as directed to secure a uniform line.

3.6 Only the last sentence of 401.3.13.7 shall apply to plant mix surface treatment.

Method of Measurement

4.1 Plant mix surface treatment will be measured as prescribed in 401.4.

4.2 Blotter material used on plant mix surface treatment will be subsidiary.

Basis of Payment

5.1 The accepted quantities of leveling course and plant mix surface treatment will be paid for at the contract unit price per ton (metric ton), complete in place.

5.1.1 Tack coat material required under 3.4.2 will be subsidiary to the leveling course and plant mix surface treatment items.

Pay items and units (English):

411.1	Hot Bituminous Concrete Leveling Course	Ton
411.15	Hot Bituminous Concrete Leveling Course, Aggregate 50 Percent Wear	Ton
411.19	Hot Bituminous Concrete Leveling Course(Night)	Ton
411.43	Plant Mix Surface Treatment(Asphalt Cement), 3/8 in	Ton
411.46	Plant Mix Surface Treatment(Asphalt Cement), 3/4 in	Ton

Pay items and units (Metric):

411.1	Hot Bituminous Concrete Leveling Course	Metric Ton
411.15	Hot Bituminous Concrete Leveling Course, Aggregate 50 Percent Wear	Metric Ton
411.19	Hot Bituminous Concrete Leveling Course (Night)	Metric Ton
411.410	Plant Mix Surface Treatment(Asphalt Cement), 9.5 mm	Metric Ton
411.419	Plant Mix Surface Treatment (Asphalt Cement), 19 mm	Metric Ton

SECTION 413 -- HOT-POURED CRACK SEALANT

Description

1.1 This work shall consist of filling the major cracks in the pavement with an approved sealant material. The cracks to be filled will be those designated by the Engineer.

Materials & Equipment

2.1 Material shall be of the hot-poured type and be a product as included on the Qualified Products List.

2.1.1 Material not covered by an asphalt pavement overlay shall meet the requirements of AASHTO M 301 (ASTM D 3405).

2.1.2 Material covered by an asphalt pavement overlay shall be low modulus conforming to ASTM D 3405, modified.

2.2 Equipment shall meet the approval of the Engineer and shall be maintained in good working condition at all times.

(a) Air compressors shall be portable and capable of furnishing not less than 100 ft^3 (3.0 m^3) of air per minute at not less than 90 psi (620 kPa) pressure at the nozzle. The compressor shall be equipped with traps that maintain the compressed air free from oil and water.
(b) Hand tools shall consist of brooms, shovels, metal bars with chisel-shaped ends, and any other tools that may be required to accomplish the work.
(c) Melting kettles shall be of the double-boiler, indirect-fired, portable type. The space between the inner and outer shells shall be filled with a suitable heat transfer oil or substitute having a flash point of not less than 530°F (280°C). The kettle shall be equipped with a satisfactory means for agitating the joint sealer. This may be accomplished by continuous stirring with mechanically operated paddles or by a continuous circulating gear pump attached to the heating unit, or by both paddles and a pump. The kettle shall be equipped with a thermostatic control calibrated between 200° and 550°F (95° and 290°C). The kettle shall be mounted on rubber tires and shall be equipped with a metal shield beneath the firebox to protect the pavement.
(d) Hand pouring pots shall be equipped with mobile carriages and rubber shoes and have flow control valves that allow all cracks to be filled to refusal.
(e) Routers for reshaping cracks shall be of the multiblade rotary cutter head type.
(f) Hot-air lances for blowing clean and drying cracks shall be an approved propane gas burner and compressed air device that does not allow the flame to touch the pavement.
(g) The wand applicator shall be connected to the holding tank through an applicator hose that ensures the safety of the operator and allows the operator to control the flow of material. A device shall be mounted to bypass material into the holding tank if the applicator nozzle is shut off.

Construction Requirements

3.1 All cracks greater than 1/8 in (3 mm) up to 3/4 in (19 mm) in width shall be shaped with a power router to a dimension of 3/4 in (19 mm) $\pm$1/8 in (3 mm) wide by 5/8 in (15 mm) deep rectangular shape and treated unless otherwise directed. Cracks greater than 3/4 in (19 mm) shall be treated but not routed. Router bits will be maintained to ensure that rectangular dimensions are achieved. A rounded shape will not be allowed.

3.2 All cracks ordered treated shall be hot-air lance cleaned of dirt, foreign material, and loose edges.

3.3 The material removed from the cracks shall be removed from the roadway surface prior to reopening the roadway to traffic.

3.4 The hot-poured sealant shall be applied at the temperature specified by the manufacturer and approved by the Engineer.

3.5 The hot-poured sealant shall be applied to the cracks using hand pouring pots or wand applicators immediately following hot-air lance cleaning. Only wand applicators shall be used for crack filling when cracks are not covered by an asphalt pavement overlay.

3.6 All cracks to be treated shall be filled to 1/16 in to 1/8 in (1 mm to 3 mm) below the pavement surface with hot-poured sealant with the sealant left slightly concave. Filling flush, overfilling, and over banding of cracks will not be allowed. Sealant shall tightly bond to the pavement. The sealant bond to

the pavement shall be checked. If the sealant does not bond to the pavement, sealant shall be removed and crack sealing operations discontinued until debonding problem is corrected.

3.7 No hot-air lance cleaning or crack sealing shall be performed when the pavement and cracks are wet or the ambient temperature is below 50°F (10°C).

3.8 All work shall be performed in a neat manner. The sealant shall be allowed to cool sufficiently to prevent lifting, sticking, and tracking prior to returning the pavement segment to traffic.

Method of Measurement

4.1 Hot-poured crack sealant will be measured by the pound (kilogram) of material incorporated in the work.

Basis of Payment

5.1 The accepted quantity of hot-poured crack sealant will be paid for at the contract unit price per pound (kilogram), complete in place.

5.2 Cleaning and routing will be subsidiary.

Pay item and unit:

413.1	Hot-Poured Crack Sealant	Pound (Kilogram)
413.2	Hot-Poured Crack Sealant (Low Modulus)	Pound (Kilogram)
413.3	Polyester Reinforced Mastic Crack Treatment	Square Yard (Square Meter)

SECTION 417 -- COLD PLANING BITUMINOUS SURFACES

Description

1.1 This work shall consist of the removal of existing bituminous pavement, by planing or milling type equipment, to the depth and grade shown on the plans or ordered.

1.2 This work shall also consist of removing existing rumble strips.

Equipment

2.1 Equipment used for planing of bituminous surfaces shall be a power-operated rotary planing or milling machine capable of uniformly removing the existing bituminous surfaces.

Construction Requirements

3.1 The existing bituminous surface shall be removed by a planing or milling machine capable of removing, in one or more passes, bituminous material to the depth specified. The equipment shall be capable of accurately establishing profile grades by an automatic grade control system referencing from either the existing pavement or from an established independent grade line.

3.1.1 The equipment shall have an effective means for controlling dust.

3.2 Material removed during this operation shall be transported and stockpiled for use or as directed.

3.3 When performing night operations, the Contractor shall provide sufficient lighting at the work site to ensure the same degree of accuracy in workmanship and conditions regarding safety as would be obtained in daylight.

3.4 Rumble Strips. Existing centerline and shoulder rumble strips scheduled for overlay shall be treated to eliminate their effects on the new pavement surface. Shoulder rumble strips on roadways receiving a full-width leveling or binder course prior to wearing course will not require any treatment, but centerline rumble strips will still require treatment.

3.4.1 Rumbles shall be removed prior to direct placement of the overlay by milling the full depth and width of the rumble strip.

3.4.2 In cases where the eliminated rumble strip will not be immediately overlayed, as for long-term temporary lane changes for routing detour traffic, the rumbles will be milled to a depth of one inch. The milled area shall be inlayed to match the existing pavement surface with hot bituminous pavement (hand method).

Method of Measurement

4.1 Cold planing bituminous surfaces, as shown on the plans or as ordered, will be measured by the square yard (square meter) as determined by the actual surface measurements of the lengths and widths of the bituminous areas removed.

The nominal depth of material removed will be as shown on the plans.

4.2 Cold planing existing rumble strips will not be measured, but shall be by the linear foot (linear meter) pay quantity in accordance with 109.11 for lengths shown on the plans.

4.2.1 The nominal depth of material removed will be as shown on the plans.

4.3 Cold planing existing rumble strips, 1" depth, as required in 417.3.4.2, will be measured by the linear foot (linear meter) to the nearest one tenth of a foot (meter) of roadway as specified by the item. Each rumble strip will be measured longitudinally along the traveled way.

Basis of Payment

5.1 The accepted quantities of cold planing of bituminous surfaces to the nominal depth specified will be paid for at the contract unit price per square yard (square meter).

5.1.1 Project lighting or overtime required due to night operations will be subsidiary to the cold planing.

5.2 Cold planing existing rumble strips is a final pay quantity item and will be paid for at the contract unit price per linear foot (linear meter) in accordance with 109.11.

5.3 The accepted quantity of cold planing existing rumble strips, 1" depth, will be paid for at the contract unit price per linear foot (linear meter) as specified by the item.

5.3.1 Inlayed pavement shall be paid under Item 403.12, Hot Bituminous Pavement, Hand Method.

Pay item and unit:

417.	Cold Planing Bituminous Surfaces	Square Yard (Square Meter)
417.19	Cold Planing Bituminous Surfaces (Night)	Square Yard (Square Meter)
417.51	Cold Planing Existing Rumble Strips (F)	Linear Foot (Linear Meter)
417.52	Cold Planing Existing Rumble Strips, 1" Depth	Linear Foot (Linear Meter)