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The requirements of Section 403 - Hot Mix Asphalt Concrete Pavement shall apply except as modified and/or revised below.

DESCRIPTION

This work shall consist of constructing rut avoidance asphalt concrete pavement courses in accordance with these specifications and in reasonably close conformity with the required lines, grades, thicknesses, and typical sections shown on the plans or established by the Engineer. The Contractor shall be responsible for continuous monitoring of the pavement density using a nuclear density gauge and pavement coring as required by the specification.

MATERIALS

The materials and composition for these mixtures shall meet the requirements specified for Type 3 binder course, Type 6F and Type 7F top course in Subsection 401-2.01 through 401-2.05, except as noted herein.

The contractor shall formulate and submit to the Regional Director, a job mix formula that satisfies the design general limits listed in Table 1 - Rut Avoidance Mix Composition. The production tolerances in Table 1 will be permitted to exceed the design general limits.

	BINDER		TOP			
	TYPE 3 RA		TYPE 6F RA		TYPE 7F RA	
Screen Size	Design General Limits % Passing	Production Tol. %	Design General Limits % Passing	Production Tol. %	Design General Limits % Passing	Production Tol. %
37.5 mm	100	--				
25.0 mm	95-100	--				
19.0 mm	74-93	±5	100	--		
12.5 mm	58-73	±5	95-100	--	100	--
6.3 mm	38-53	±5	58-72	±5	90-100	--
3.2 mm	26-40	±4	36-54	±4	45-70	±4
850 µm	9-23	±4	15-32	±4	15-40	±4
425 µm	4-18	±4	8-25	±4	8-27	±4
180 µm	3-13	±3	4-16	±3	4-16	±3
75 µm	2-6	±2	2-6	±2	2-6	±2
% Asphalt	4.0-6.0	--	5.0-6.2	--	5.2-7.2	–

Table 1 - Rut Avoidance Mix Composition

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Subsection 401-2.03 A. Coarse Aggregate and 401-2.03 B. Blending shall be deleted and replaced with the following:

A. **Coarse Aggregates**. Top Course Type 6F RA and Type 7F RA Hot Mix Asphalt mixtures shall be from approved sources and meet one of the following requirements:

1. Coarse aggregates shall be crushed limestone having an acid insoluble residue content of not less than 20.0%, excluding particles of chert and similar siliceous rocks.

2. Coarse aggregates shall be crushed dolomite having an acid insoluble residue content of not less than 17.0%, excluding particles of chert and similar siliceous rocks.

3. Coarse aggregates shall be crushed sandstone, granite, chert, traprock, ore tailings, slag or other similar non-carbonate materials. Non-carbonate particles are defined as those having an acid insoluble residue content not less than 80.0%.

4. Coarse aggregates shall be crushed gravel or blends of two or more of the following types of materials; crushed gravel, limestone, dolomite, sandstone, granite, chert, traprock, ore tailings, slag or other similar materials. These aggregates must meet the following requirements:

   For Type 6F RA mixes - not less than 10.0% (by weight with adjustments to equivalent volumes for materials of different specific gravities) of the total aggregate shall be plus 3.2 mm non-carbonate particles. In addition, not less than 20.0% of the plus 6.3 mm particles shall be non-carbonate.

   For Type 7F RA mixes - not less than 10.0% (by weight with adjustments to equivalent volumes for materials of different specific gravities) of the total aggregate shall be plus 3.2 mm non-carbonate particles.

   Non-carbonate particles are defined as those having an acid insoluble residue content not less than 80.0%.

B. **Blending**. Where coarse aggregates for these mixes are from more than one source or of more than one type of material, they shall be proportioned and blended to provide a uniform mixture.

C. **Mix Properties**. The mixtures shall meet the Marshall property criteria appearing in Table 2 - Marshall Mix Property Criteria.

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	Mix Criteria		
Mix Property	Type 3RA	Type 6FRA	Type 7FRA
Stability, N, min.	6700	6700	6700
Flow, 0.25 mm, min.	8	8	8
Marshall Quotient, (Stability/Flow), min.	670	670	670
Air Voids, percent	3.0 - 5.0	3.0 - 5.0	3.0 - 5.0
Voids in Mineral Agg. (VMA), percent min.	12.0	14.0	16.0
Voids Filled with Asphalt (VFA), percent	65-75	65-75	65-75

Table 2 - Marshall Mix Property Criteria

D. **Mix Preparation**. The Marshall specimens shall be prepared, mix properties determined, and completed mix design submitted in accordance with the procedures outlined by Department written instructions with the following modifications:

1. Compactive effort shall be 75 blows per side.

2. Five point asphalt cement content Marshall design is required prior to production. One point designs are not acceptable.

3. The minimum specified VMA shall be met at each of the five mix design asphalt cement contents.

4. The Marshall quotient is calculated as the corresponding ratio of corrected stability (N) to flow (0.25 mm).

5. The optimum asphalt cement content shall be determined by the "Range" method. Graphs shall be constructed for each of the specified mix design properties (stability, Marshall quotient, air voids, VMA, and VFA) using each property as the vertical axis and percent asphalt cement content as the horizontal axis. The plotted values in each graph shall be fitted with a smooth curve that obtains the "best fit" for all values. A vertical line is drawn at the point where the asphalt cement content provides the acceptable lower and upper limits for the properties of stability, flow, Marshall quotient, and air voids. The mid-point of the common overlap is the optimum asphalt cement content provided it does not fall on the positive slope of the VMA curve. When this occurs the low point of the VMA curve shall be the optimum asphalt cement content provided it falls within the common overlap of the

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specified stability, flow, Marshall quotient, and air voids ranges.

CONSTRUCTION DETAILS

The details of §401-3 Construction Details shall apply except as modified below:

Prior to paving operations for this item, construct a test section, as detailed in "Test Section" in this specification, on the project site at a location approved by the Engineer, using the same equipment and procedures to be used in the construction of the remainder of the course being laid, and stop.

The compaction equipment shall conform to the requirements of Subsection 401-3.06 Rollers. The Contractor will control the operation of the rollers during the placement of these items including the speed, the amplitude settings, the vibration frequency, and the weight of the rollers.

Subsection 401-3.12 Compaction shall be deleted and replaced with the following:

"Immediately after the hot mix asphalt (HMA) has been spread, struck off and surface irregularities adjusted, compact the mix by rolling thoroughly and uniformly. Roll the surface when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving. Initially roll the pavement with the roller traveling parallel to the centerline of the pavement beginning at the low edge and working toward the super-elevated edge.

Use a nuclear density gauge to monitor and record the pavement density in accordance with this section and Materials Procedure 96-01 M, "Nuclear Gauge Density Data Collection and Determination of Pavement Core Locations for Rut Avoidance Asphalt Concrete". The nuclear density gauge should consist of a radioactive source, scaler and other basic components housed in a single backscatter unit. The gauge must be operated by personnel trained in the principles of nuclear testing and safety practices. Only gauge(s) calibrated during the construction of the test section will be used during normal paving operation. If another nuclear gauge is to be used, a new test section must be constructed to calibrate that gauge and to establish a new PTD.

Compact the pavement sufficiently to achieve a minimum density of 96% of the PTD in a single test location and 98% of the PTD calculated as a moving average of the last 10 test locations as determined by a nuclear density gauge. Take nuclear gauge readings at each site, randomly selected by the Engineer, approximately every 60 m along the length of the pavement for each pass of the paver and record them on a BR340 M.

If the average of 4 nuclear density gauge measurements taken at 90° angles over two consecutive locations falls below 96% of the PTD or if the moving average of the last 10 nuclear gauge test sites falls below 98% of the PTD, stop routine paving operations and construct a new test strip. Normal production will only resume after establishing a new PTD.

Placement and compaction on shoulders, ramps, maintenance widening, crossovers, and bridges will be

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deemed satisfactory by the Engineer when the procedures used in these areas are the same as those used on the mainline pavement sections. Nuclear gauge(s) used to monitor the mainline paving should be used to monitor the above referenced areas to insure that the pavement density is between 92% to 97% of the mixture's average daily maximum theoretical density.

The Engineer may require additional daily density verification consisting of four cores, nuclear density readings at each core location, and two loose mix samples on any day during routine production with adequate notice. Deliver the cores, nuclear density readings, and loose mix samples to the Department Regional Laboratory no later than the day following placement. If the average density of the four cores is not between 92% and 97% of the mixture's average daily maximum theoretical density, a payment adjustments will be applied to the material placed between the time the Engineer requests additional pavement cores and the time the Regional Materials Engineer establishes as new PTD based on the core results, not to exceed 1 business day following delivery of the cores to the Department Regional Laboratory. The payment adjustments will be made according to Table 3 - Quality Adjustment Factors.

When the rolling operation is complete there should be no visible shallow ruts, ridges, other roller marks, or irregularities in the pavement. If these imperfections are present, correct the imperfections or relay the pavement to the satisfaction of the Engineer. Perform all corrective work at no additional cost to the Department.

Correct at once any displacement occurring as a result of reversing the direction of the roller, or from other causes, by the use of rakes and addition of fresh mixture as required. Exercise care in rolling not to displace the line and grade of the edges of the bituminous mixture. To prevent adhesion of the mixture to the drum(s) of the roller, properly moisten the drum(s) with water, or water mixed with small quantities of detergent or other Department approved asphalt release compounds. If a pneumatic tire roller is used, the pneumatic drive wheels may be coated with a fine mist spray of fuel oil or other similar materials to prevent pneumatic tire pickup. In all instances, protect the surface of the pavement from drippings of fuel oil or any other solvents used in paving, compaction or cleaning operations.

Unless otherwise directed by the Engineer, compact the longitudinal joint by using one of the pneumatic drive wheels to overlap the joint in two (2) passes with the drum operating static when vibratory rollers having pneumatic drive wheels are used. If dual vibrating drum rollers are used, compact the joint by overlapping the joints in two (2) passes with both drums operating static.

Along forms, curbs, headers, walls and other areas not accessible to the rollers, compact the mix thoroughly with mechanical tampers as directed by the Engineer. On depressed areas, a trench roller or small vibratory roller approved by the Engineer may be used. Cleated compression strips also may be used under the roller to transmit compression to the depressed area.

Remove any mixture that becomes loose and broken, mixed with dirt, or is in any way defective and replace with fresh hot mixture and compact to conform with the surrounding area. Correct any area showing an

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excess or deficiency of bituminous materials to the satisfaction of the Engineer.

If vibratory compaction equipment is used, the contractor assumes full responsibility for the cost repairing all damage which may occur to highway components and adjacent property including buried utility and service facilities.

When multiple paving operations are utilized with material production from a single plant each paving operation will be evaluated separately.

Routine paving operations will not begin unless both a project calibrated nuclear density gauge and an operator are present.

Backfill all core holes, with a similar HMA material as was cored, as soon as possible after coring, using a procedure approved by the Engineer."

Add the following to the end of §401-3:

Test Section. Prior to paving operations for this item, construct a test section on the project site at a location approved by the Engineer, using the same equipment and procedures to be used in the construction of the remainder of the course being laid, and stop. The amount of mixture prepared according to the job mix formula should be sufficient to construct a test section 500 centerline-meters long, the full width of pavement, and shall be of the same depth specified for the construction of the course which it represents. Routine paving will only begin after a Project Target Density (PTD) has been established by the Regional Materials Engineer based on testing of the pavement cores. The test section is for determining the Project Target Density (PTD) for this item and for calibration of the nuclear density gauge. The PTD will be established within one business day of the delivery of the four cores, the two loose mix samples, and the four nuclear density readings.

NOTE: Routine paving will only begin after a Project Target Density (PTD) has been established by the Regional Materials Engineer. Also, construction of a test section will not begin unless both a nuclear density gauge and an operator are present.

Use the first 150 linear meters of the test section to stabilize the paving operation. The remainder of the length will be used to determine the PTD. During construction of the test section, take two loose mix samples, in accordance with AASHTO T168-91. These samples will represent the material placed on this test section. At the conclusion of the test section, take four cores from the test section (excluding the initial 150 m) at locations randomly selected by the Engineer in accordance with Materials Procedure 96-01 M. If coring is performed the same day as placement, cool the pavement so that the core sample is not damaged during coring. At each core location, take density readings with a nuclear density gauge(s). A nuclear density reading at each core location will be the average of the four measurements taken at 90˚. Only gauge(s) calibrated during the construction of the test section will be allowed to be used during normal paving

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operations. Deliver the four cores, the two loose mix samples, and the four nuclear density readings to the Department Regional Laboratory. With the nuclear density readings, include gauge model number and serial number for each gauge calibrated on the test section. The Regional Materials Engineer will use the test section cores and nuclear gauge readings to establish the PTD.

OPTION: Paving may continue after completion of the test section using an interim PTD determined in accordance with Materials Procedure 96-01 M, "Nuclear Gauge Density Data Collection and Determination of Pavement Core Locations for Rut Avoidance Asphalt Concrete". If the average density of the four cores taken on the test section is not between 92-97% of the mixture's maximum theoretical density, payment adjustments will be applied to any material placed after the test section and before the Project Target Density (PTD) has been determined by the Regional Materials Engineer. The payment adjustments will be made according to Table 3 - Quality Adjustment Factors.

METHOD OF MEASUREMENT

The provisions of §401-4, §402-4 and §403-4, Method of Measurement shall apply including the following:

"The Department will test the cores from a test section or from any day the Engineer requests cores. If paving is continued using an interim PTD immediately after the conclusion of a test section, or if the Engineer requests additional cores on any day after the first day, full payment will be made if the average density of the four cores is between 92% and 97% of the mixture's average daily maximum theoretical density. If the average density fails to meet this limit, **the quantity placed** will be adjusted according to Table 3 - Quality Adjustment Factors shown below:

Average Core Density	Quality Adjustment Factor
91.0 ≤ Density < 92.0	0.95
90.0 ≤ Density < 91.0	0.90
88.0 ≤ Density < 90.0	0.85
< 88.0	0.60*

Table 3 - Density Quality Adjustment Factors

* The lot shall be evaluated by the Department to determine if it may remain in-place. The type of material produced (i.e. binder, top), the layer in which it was used, and the location of use (i.e., mainline or a non-critical area) will be primary considerations in the determination of whether the HMA can be left in-place. If the HMA cannot be left in-place it will be removed at no cost to the Department. However, if the Department determines that the HMA can be left in-place, the Quality Payment Adjustment will be

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calculated using a QAF of 0.60.

The quantity of the material subject to payment adjustments will be determined from typical sections shown in the plans. The payment adjustments will be applied to material placed on mainline but not shoulders, ramps, maintenance widening and crossovers, and bridges."

BASIS OF PAYMENT

The provision of subsection §403-5, Basis of Payment shall apply including the following:

"The unit bid price also includes the cost of all necessary equipment, labor and materials required in construction of the test sections, nuclear density testing, obtaining the pavement cores, filling all core holes with asphalt concrete and compacting these core holes satisfactorily to the Engineer.

Payment will be made under:

ITEM NO.	ITEM	PAY UNIT
18403.133602 M	Rut Avoidance Asphalt Concrete With In-Place Density Monitoring - Type 3 RA	Metric Ton
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18403.173612 M	Plant Production Quality Adjustment to 18403.173602 M	Quality Unit
18403.193602 M	Rut Avoidance Asphalt Concrete With In-Place Density Monitoring - Type 7F RA	Metric Ton
18403.193612 M	Plant Production Quality Adjustment to 18403.193602 M	Quality Unit