To:		*New York State Department of Transportation* **ENGINEERING INSTRUCTION**	**EI 96-040**

Title: **HOT MIX ASPHALT (HMA) SPECIFICATIONS FOR HEAVY DUTY AND RUT AVOIDANCE MIXES**

Distribution:

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Approved:

/s/ P. J. Clark — 08/19/96

P. J. Clark, Deputy Chief Engineer, Design Division — Date

This Engineering Instruction partially supersedes EI 96-023 (see discontinued item numbers shown below).

EFFECTIVE DATE: This Engineering Instruction will be effective on all Department contracts let on or after **January 9, 1997**.

PURPOSE: The purpose of this Engineering Instruction is to:

1) Transmit new Hot Mix Asphalt special specifications for Heavy Duty and Rut Avoidance mixes (Items 18403.XX18 M, Items 18403.XX18, Items 18403.XX34 M, Items 18403.XX34, listed below).
2) Delete previous versions of the Hot Mix Asphalt special specifications.

BACKGROUND: The specifications include modifications based on the comments from Project Engineers, Industry, Regional Materials Engineers and the evaluation of previously constructed pavements on which previous versions of these specifications were used. The changes are as follows:

a) Heavy Duty: The new specification revises the lower compaction limit from 91% to 92% of the mixture's maximum density.
b) Rut Avoidance: The new specification introduces performance based payment adjustments and revises the lower compaction limit from 91% to 92% of the mixture's maximum density.

TRANSMITTED MATERIAL: Attached are the following special specifications:

METRIC:

ITEM 18403.1318 M	HEAVY DUTY ASPHALT CONCRETE, TYPE 3 HD
ITEM 18403.1718 M	HEAVY DUTY ASPHALT CONCRETE, TYPE 6F HD
ITEM 18403.1918 M	HEAVY DUTY ASPHALT CONCRETE, TYPE 7F HD
ITEM 18403.1336 M	RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA
ITEM 18403.1736 M	RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA
ITEM 18403.1936 M	RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA

ENGLISH:

ITEM 18403.1318	HEAVY DUTY ASPHALT CONCRETE, TYPE 3 HD
ITEM 18403.1718	HEAVY DUTY ASPHALT CONCRETE, TYPE 6F HD
ITEM 18403.1918	HEAVY DUTY ASPHALT CONCRETE, TYPE 7F HD
ITEM 18403.1336	RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA
ITEM 18403.1736	RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA
ITEM 18403.1936	RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA

DISCONTINUED SPECIFICATIONS: The following special specifications are disapproved for use:

METRIC:

ITEM 18403.131701 M	HEAVY DUTY ASPHALT CONCRETE, TYPE 3 HD
ITEM 18403.171701 M	HEAVY DUTY ASPHALT CONCRETE, TYPE 6F HD
ITEM 18403.191701 M	HEAVY DUTY ASPHALT CONCRETE, TYPE 7F HD
ITEM 18403.133201 M	RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA
ITEM 18403.173201 M	RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA
ITEM 18403.193201 M	RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA

ENGLISH:

ITEM 18403.131701	HEAVY DUTY ASPHALT CONCRETE, TYPE 3 HD
ITEM 18403.171701	HEAVY DUTY ASPHALT CONCRETE, TYPE 6F HD
ITEM 18403.191701	HEAVY DUTY ASPHALT CONCRETE, TYPE 7F HD
ITEM 18403.133201	RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA
ITEM 18403.173201	RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA
ITEM 18403.193201	RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA

COST IMPACT: The cost impact will be as follows:

Heavy Duty - A cost increase is not anticipated with the use of the new Heavy Duty specifications since the new requirement was typically met on previous projects.

Rut Avoidance - Due to the changes made in the construction procedures, it is anticipated the average cost of the items will increase by $0.50 per ton or 1-2%. Also, it is anticipated that the pavement's service life will increase by approximately 1 year resulting in a 6-10% savings. The net savings to the Department is estimated to be 4-9%.

DESIGNER INFORMATION: Mix Selection Criteria for the Heavy Duty and Rut Avoidance HMA mixes will remain the same as noted in the EI 96-022 - MIX SELECTION CRITERIA FOR HOT MIX ASPHALT, TOP AND BINDER COURSES.

Project Designers shall replace the corresponding discontinued specifications with the transmitted special specifications on all applicable on-going design projects and in PS&E packages.

ACTIONS BY THE MAIN OFFICE DESIGN QUALITY ASSURANCE BUREAU:
The attached special specifications shall become main office inserts, replacing the older versions.

DISCONTINUED	REPLACED WITH
ITEM 18403.131701 M	ITEM 18403.1318 M
ITEM 18403.171701 M	ITEM 18403.1718 M
ITEM 18403.191701 M	ITEM 18403.1918 M
ITEM 18403.133201 M	ITEM 18403.1336 M
ITEM 18403.173201 M	ITEM 18403.1736 M
ITEM 18403.191701 M	ITEM 18403.1936 M
ITEM 18403.131701	ITEM 18403.1318
ITEM 18403.171701	ITEM 18403.1318
ITEM 18403.191701	ITEM 18403.1318
ITEM 18403.133201	ITEM 18403.1336
ITEM 18403.173201	ITEM 18403.1736
ITEM 18403.193201	ITEM 18403.1936

CONTACT PERSON: Any questions regarding these new specifications transmitted herein should be directed to Zoeb Zavery of the Materials Bureau at (518) 457-4582.

SPECIAL NOTE

ATTENTION

Rut Avoidance Asphalt Concrete with In-Place Density Monitoring

The Contractor should be aware that this is a performance-based specification in which the Contractor is responsible for compacting the pavement within a specified density range. The 36 series specification include payment adjustment factors and an increase of lower compaction limit from 91% to 92%. In order to successfully compact the pavement to the specified density range, the Contractor must be prepared to select, operate, and control the paving and compaction equipment, to monitor the results, and to make necessary adjustments (without direction from the Engineer) to achieve the desired results. Written instructions for determining pavement density and core locations are available from the Regional Materials Engineer or the Director, Materials Bureau.

ITEM 18403.1336 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA
ITEM 18403.1736 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA
ITEM 18403.1936 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA

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

ITEM 18403.1336 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA
ITEM 18403.1736 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA
ITEM 18403.1936 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA

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%, 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%, 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%.

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 20% (by weight with adjustments to equivalent volumes for materials of different specific gravities) of the total coarse aggregate particles (plus 3.2 mm material) shall be non-carbonate. In addition, not less than 20% of the plus 6.3 mm particles shall be non-carbonate. Non-carbonate particles are defined as those having an acid insoluble residue content not less than 80%.

   For Type 7F RA mixes - not less than 20% (by weight with adjustments to equivalent volumes for materials of different specific gravities) of the total coarse aggregate particles (plus 3.2 mm material) shall be non-carbonate. Non-carbonate particles are defined as those having an acid insoluble residue content not less than 80%.

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.

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

ITEM 18403.1336 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA
ITEM 18403.1736 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA
ITEM 18403.1936 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA

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 90E 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 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 - Quantity 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 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.

ITEM 18403.1336 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA
ITEM 18403.1736 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA
ITEM 18403.1936 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA

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 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 - Quantity Adjustment Factors.

ITEM 18403.1336 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA
ITEM 18403.1736 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA
ITEM 18403.1936 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA

METHOD OF MEASUREMENT

Subsection 403-4 Method of Measurement shall be deleted and replaced with the following:

"The pavement course shall be measured by the number of adjusted tons of compacted material placed in the accepted work.

Each delivery vehicle supplying Hot Mix Asphalt shall be accompanied by a delivery ticket indicating the tons of mixture being delivered to the work site. The tonnage on the ticket shall be determined either by:

A. Recorded batch weights,
B. Theoretical weights or
C. Truck scale weights.

The method of payment shall be subject to the approval of the Regional Director. Other information such as tare weights, plant and mix identification, project identification, and time and date shall be provided on the delivery tickets as directed by the Department. The Engineer or his representative shall be provided with the ticket prior to the spreading and finishing of the mixture.

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 - Quantity Adjustment Factors shown below:

Average Core Density	Quantity Adjustment Factors
90.0 # Density < 92.0	90%
88.0 # Density < 90.0	85%
< 88.0	Remove pavement section.

Table 3 - Quantity Adjustment Factors

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.

ITEM 18403.1336 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA

ITEM 18403.1736 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA

ITEM 18403.1936 M RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA

BASIS OF PAYMENT

Subsection 403-5 Basis of Payment shall be deleted and replaced with the following:

"The unit bid price per ton for the pavement course shall include the cost of furnishing all materials including asphalt cement and all equipment and labor necessary to complete the work, including the cost of any cleaning and tack coat applied pursuant to §401-3.01. Also to be included in the unit bid price is 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
18403.1336 M	Rut Avoidance Asphalt Concrete With In-Place Density Monitoring - Type 3 RA	Metric Ton
18403.1736 M	Rut Avoidance Asphalt Concrete With In-Place Density Monitoring - Type 6F RA	Metric Ton
18403.1936 M	Rut Avoidance Asphalt Concrete With In-Place Density Monitoring - Type 7F RA	Metric Ton

SPECIAL NOTE

ATTENTION

Rut Avoidance Asphalt Concrete with In-Place Density Monitoring

The Contractor should be aware that this is a performance-based specification in which the Contractor is responsible for compacting the pavement within a specified density range. The 36 series specification include payment adjustment factors and an increase of lower compaction limit from 91% to 92%. In order to successfully compact the pavement to the specified density range, the Contractor must be prepared to select, operate, and control the paving and compaction equipment, to monitor the results, and to make necessary adjustments (without direction from the Engineer) to achieve the desired results. Written instructions for determining pavement density and core locations are available from the Regional Materials Engineer or the Director, Materials Bureau.

ITEM 18403.1336 RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA

ITEM 18403.1736 RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA

ITEM 18403.1936 RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA

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. %
1 1/2"	100	--				
1"	95-100	--	--			
3/4"	74-93	±5	100	--	--	
1/2"	58-73	±5	95-100	--	100	--
1/4"	38-53	±5	58-72	±5	90-100	--
1/8"	26-40	±4	36-54	±4	45-70	±4
20	9-23	±4	15-32	±4	15-40	±4
40	4-18	±4	8-25	±4	8-27	±4
80	3-13	±3	4-16	±3	4-16	±3
200	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

ITEM 18403.1336 RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA

ITEM 18403.1736 RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA

ITEM 18403.1936 RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA

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%, 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%, 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%.

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 20% (by weight with adjustments to equivalent volumes for materials of different specific gravities) of the total coarse aggregate particles (plus 1/8" material) shall be non-carbonate. In addition, not less than 20% of the plus 1/4" particles shall be non-carbonate. Non-carbonate particles are defined as those having an acid insoluble residue content not less than 80%.

   For Type 7F RA mixes - not less than 20% (by weight with adjustments to equivalent volumes for materials of different specific gravities) of the total coarse aggregate particles (plus 1/8" material) shall be non-carbonate. Non-carbonate particles are defined as those having an acid insoluble residue content not less than 80%.

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.

	Mix Criteria		
Mix Property	Type 3RA	Type 6FRA	Type 7FRA
Stability, lb., min.	1500	1500	1500
Flow, .01 in., min.	8	8	8
Marshall Quotient, lb/.01 in., min.	150	150	150
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 (lbs.) to flow (.01 in.).

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

ITEM 18403.1336 RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA
ITEM 18403.1736 RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA
ITEM 18403.1936 RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA

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.

Delete Subsection 401-3.12 Compaction and replace 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, "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 200 feet along the length of the pavement for each pass of the paver and record them on a BR340.

If the average of 4 nuclear density gauge measurements taken at 90E 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 section. Normal production will only resume after establishing a new PTD.

Placement and compaction on shoulders, ramps, maintenance widening, crossovers, and bridges will be 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 - Quantity 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 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 1500 centerline-feet 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 the 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 500 linear feet 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 500 feet) at locations randomly selected by the Engineer in accordance with Materials Procedure 96-01. 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 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, "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 - Quantity Adjustment Factors."

METHOD OF MEASUREMENT

Subsection 403-4 Method of Measurement shall be deleted and replaced with the following:

"The pavement course shall be measured by the number of adjusted tons of compacted material placed in the accepted work.

Each delivery vehicle supplying Hot Mix Asphalt shall be accompanied by a delivery ticket indicating the tons of mixture being delivered to the work site. The tonnage on the ticket shall be determined either by:

A. Recorded batch weights,
B. Theoretical weights or
C. Truck scale weights.

The method of payment shall be subject to the approval of the Regional Director. Other information such as tare weights, plant and mix identification, project identification, and time and date shall be provided on the delivery tickets as directed by the Department. The Engineer or his representative shall be provided with the ticket prior to the spreading and finishing of the mixture.

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 - Quantity Adjustment Factors shown below:

Average Core Density	Quantity Adjustment Factors
90.0 # Density < 92.0	90%
88.0 # Density < 90.0	85%
< 88.0	Remove pavement section.

Table 3 - Quantity Adjustment Factors

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

ITEM 18403.1336 RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA

ITEM 18403.1736 RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA

ITEM 18403.1936 RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA

BASIS OF PAYMENT

Subsection 403-5 Basis of Payment shall be deleted and replaced with the following:

"The unit bid price per ton for the pavement course shall include the cost of furnishing all materials including asphalt cement and all equipment and labor necessary to complete the work, including the cost of any cleaning and tack coat applied pursuant to §401-3.01. Also to be included in the unit bid price is 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
18403.1336	Rut Avoidance Asphalt Concrete With In-Place Density Monitoring - Type 3 RA	Ton
18403.1736	Rut Avoidance Asphalt Concrete With In-Place Density Monitoring - Type 6F RA	Ton
18403.1936	Rut Avoidance Asphalt Concrete With In-Place Density Monitoring - Type 7F RA	Ton"

SPECIAL NOTE

ATTENTION

Heavy Duty Asphalt Specification

The Contractor should be aware that this is a performance-based specification in which the Contractor is responsible for compacting the pavement within a specified density range. The previous version of the Heavy Duty specification (17 series) had a 91-percent lower compaction limit, the lower compaction limit of the revised version (18 series) has been increased to **92-percent**. In order to successfully compact the pavement to the specified density range, the Contractor must be prepared to select, operate, and control the paving and compaction equipment, to monitor the results, and to make necessary adjustments (without direction from the Engineer) to achieve the desired results.

A Quantity Adjustment Factor will be applied to a majority of the paving to determine the amount of payment. The Contractor is cautioned that the Quantity Adjustment Factor is statistically-based upon both the average and variation of samples tested. The Quantity Adjustment Factor favors a close grouping of samples around the desired average (94% of maximum theoretical density) and conversely negatively affects wide variation of density. Written instructions for determining pavement density and quantity adjustment factors are available from the Regional Materials Engineer or the Director, Materials Bureau.

ITEM 18403.1318 HEAVY DUTY ASPHALT CONCRETE, TYPE 3 HD
ITEM 18403.1718 HEAVY DUTY ASPHALT CONCRETE, TYPE 6F HD
ITEM 18403.1918 HEAVY DUTY ASPHALT CONCRETE, TYPE 7F HD

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 Heavy Duty Asphalt concrete pavement courses in accordance with these specifications and in reasonable close conformity with the required lines, grades, thicknesses, and typical sections shown on the plans or established by the Engineer. This is a performance based specification in which the Contractor is responsible for compacting the pavement within a specified density range. Written instructions for determining pavement density and quantity adjustment factors are available from the Regional Materials Engineer or the Director, Materials Bureau.

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. Mixture requirements shall be as follows:

Formulate and submit to the Regional Director, a job mix formula that satisfies the design general limits listed in Table 1 - Heavy Duty Mix Composition. The production tolerances in Table 1 will be permitted to exceed the design general limits.

	BINDER		TOP			
	TYPE 3 HD		TYPE 6F HD		TYPE 7F HD	
Screen Size	Design General Limits, % Passing	Production Tol. %	Design General Limits, % Passing	Production Tol. %	Design General Limits, % Passing	Production Tol. %
1 1/2"	100	--				
1"	95-100	--				
3/4"	74-93	±5	100	--		
1/2"	58-73	±5	95-100	--	100	--
1/4"	38-53	±5	58-72	±5	90-100	--
1/8"	26-40	±4	36-54	±4	45-70	±4
20	9-23	±4	15-32	±4	15-40	±4
40	4-18	±4	8-25	±4	8-27	±4
80	3-13	±3	4-16	±3	4-16	±3
200	2-6	±2	2-6	±2	2-6	±2
% Asphalt	4.0-6.0	--	5.0-6.2	--	5.2-7.2	--

Table 1 - Heavy Duty Mix Composition

ITEM 18403.1318 HEAVY DUTY ASPHALT CONCRETE, TYPE 3 HD
ITEM 18403.1718 HEAVY DUTY ASPHALT CONCRETE, TYPE 6F HD
ITEM 18403.1918 HEAVY DUTY ASPHALT CONCRETE, TYPE 7F HD

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

"A. **Coarse Aggregates.** Top course Type 6F HD and Type 7F HD 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%, 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%, 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%.

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 HD mixes - not less than 20% (by weight with adjustments to equivalent volumes for materials of different specific gravities) of the total coarse aggregate particles (plus 1/8" material) shall be non-carbonate. In addition, not less than 20% of the plus 1/4" particles shall be non-carbonate. Non-carbonate particles are defined as those having an acid insoluble residue content not less than 80%.

   For Type 7F HD mixes - not less than 20% (by weight with adjustments to equivalent volumes for materials of different specific gravities) of the total coarse aggregate particles (plus 1/8" material) shall be non-carbonate. Non-carbonate particles are defined as those having an acid insoluble residue content not less than 80%.

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.

	Mix Criteria		
Mix Property	Type 3HD	Type 6FHD	Type 7FHD
Stability, lb., min.	1500	1500	1500
Flow, .01 in., min.	8	8	8
Marshall Quotient, lb/.01 in., min.	150	150	150
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 (lbs.) to flow (0.01 in.).

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

ITEM 18403.1318 HEAVY DUTY ASPHALT CONCRETE, TYPE 3 HD
ITEM 18403.1718 HEAVY DUTY ASPHALT CONCRETE, TYPE 6F HD
ITEM 18403.1918 HEAVY DUTY ASPHALT CONCRETE, TYPE 7F HD

CONSTRUCTION DETAILS

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

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 mixture has been spread, struck off and surface irregularities adjusted, thoroughly and uniformly compact by rolling. 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 each edge and working toward the super-elevated edge.

Compact the pavement sufficiently to achieve densities, expressed as a percentage of the mixture's average daily maximum theoretical density (%MADMTD), in a range of 92% to 97%. Pavement cores and mix samples will be tested and analyzed by the Department in accordance with Department written instructions to determine the loose mix sample MADMTD, pavement core bulk density, and the resultant pavement core percent of the MADMTD.

If consecutive lots are found to have a Quantity Adjustment Factor equal to or below 85%, paving operations for this item will be stopped and a new Test Section, constructed as described later in this section, will be required. Paving operations for this item will not be permitted until a new test section meets the acceptance criteria, a minimum Quantity Adjustment Factor of 100%.

The Quantity Adjustment Factor will not be applied to material placed on ramps with a uniform full width section of less than 1,250 feet in length, shoulders, maintenance widenings and crossovers, and bridges. Payment for these areas will be based on satisfactory placement and compaction as determined by the Engineer. Placement and compaction procedures will be deemed satisfactory by the Engineer when the procedures used in these areas are the same as those used on the main line pavement sections. Also, if a nuclear gauge(s) is used to monitor the main-line paving then the same gauge(s) should be used to monitor the above referenced areas to insure that the pavement density is between 92% to 97% of the MADMTD.

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

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 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 of repairing all damage which may occur to highway components and adjacent property including buried utility and service facilities.

Multiple plant production shall not be allowed unless each plant supplies material to a separate paving operation. When multiple paving operations are utilized with material production from a single plant each paving operation will be evaluated as individual paving lots."

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

"Sampling. Take four loose mix samples in accordance with AASHTO T168-91, Standard Test Method for Sampling Bituminous Paving Mixtures. The samples should be taken periodically throughout the day so as to represent the entire days production. When operational conditions cause production to be terminated before the specified number of samples have been taken the following procedures will be used:

1) If only three samples are taken the loose mix MADMTD will be based on the average of the three samples taken.

2) If only one or two samples are taken the days production will be added to the next days production and sublots determined based on the total quantity placed during the two days. Therefore a maximum of six loose mix samples may be used to determine the loose mix MADMTD.

The Engineer will select one pavement core location for each sublot in accordance with Department written instructions to represent each paving sublot. The Department's representative shall define a total of four six inch diameter coring locations using an appropriate method. The Department's pavement core samples must come from within the six inch diameter circles outlined. Under no circumstances will the Department's representative designate the coring locations before the rolling operation is complete. The rolling operation will be considered complete when all compaction equipment has moved off the lane to be cored. Obtain the four six inch diameter pavement core samples no later than the day following the lot's placement. If coring is performed the same day as placement, cool the pavement so that the core sample is not damaged during coring. Backfill the core holes, with a similar Hot Mix Asphalt material as was cored, as soon as possible after coring, using a procedure approved by the Engineer.

After procuring the four paving lot cores, secure them in accordance with Department written instructions for transport to the appropriate Regional Laboratory. Cores arriving at the Regional Laboratory for testing with a damaged or missing security seal will not be tested and new cores will be required from the same locations as the original cores. Take care to insure that the loose mix samples and cores are in an acceptable test condition when delivered to the Regional Laboratory. Damaged cores will require resampling. The Engineer will select the core locations in the same general vicinity, ±1 foot of the damaged core. Do not intentionally separate the pavement core course from the underlying material if the course does not debond during coring. The Department will separate the pavement core course, required for testing from the remainder of the core by sawing if necessary. Deliver the pavement core samples and the loose mix samples to the Department Regional Laboratory no later than the day following the lot's placement. If, for any reason, a delay occurs in the delivery of the lot samples for three consecutive lots, paving operations for this item will not be permitted to continue until the samples are delivered and tested.

A paving lot is defined as a days production providing a minimum of 4,000 lane-feet or 400 tons, whichever is less, are placed (a lane is defined as a travel lane, with a nominal width of 12 feet). When paving is continuous within a 24 hour period a new lot will result when a change occurs in the paving crew. If less than the minimum quantity is placed in any day, its placement will be combined with the next paving day to constitute a paving lot. If less than the minimum quantity is placed on the final paving day, the final day shall be evaluated as a paving lot regardless of size. Each paving lot will be equally divided into four sublots in accordance with Materials Procedure 96-04, Asphalt Concrete Statistical Pavement Density Determination.

Test Section. Prior to paving operations for this item, construct a test section on the project site at a location approved by the Engineer. The amount of mixture prepared according to the job mix formula should be sufficient to construct a test section at least 100 feet long and full width of pavement and shall be of the same depth specified for the construction of the course which it represents. The maximum test section length is 1500 centerline-feet long on roadways subject to Quantity Adjustment Factors for Heavy Duty mixes, otherwise there is no maximum length. Use equipment in the construction of the test section that is of the same type and weight to be used on the remainder of the course represented by the test section. If the test section is located on a roadway subject to Quantity Adjustment Factors for Heavy Duty mixes Table 3 - Quantity Schedule shall apply. The test section will be paid for at 1.5 times the actual quantity paved, up to 225 actual tons per test section, for no more than two test sections for each item. The 1.5 Test Section Adjustment does not apply to any additional required test sections.

Testing as described above will be performed on the test section to determine if it meets the mat acceptance criteria. Paving operations for this item will not be permitted until a test section meets the mat acceptance criteria, a minimum Quantity Adjustment Factor of 100%. Only one test section per item per day may be placed.

If the Quantity Adjustment Factor for a test section is less than 100%, make the necessary adjustments to the mix design, plant operation, and/or rolling procedures. Construct an additional test section as required above. This test section will be evaluated to determine if the mat acceptance criteria is met."

METHOD OF MEASUREMENT

Subsection 403-4 Method of Measurement shall be deleted and replaced with the following:

"The pavement course shall be measured by the number of adjusted tons of compacted material placed in the accepted work.

Each delivery vehicle supplying Hot Mix Asphalt shall be accompanied by a delivery ticket indicating the tons of mixture being delivered to the work site. The tonnage on the ticket shall be determined either by:

A. Recorded batch weights
B. Theoretical weights or
C. Truck scale weights.

The method of payment shall be subject to the approval of the Regional Director. Other information such as tare weights, plant and mix identification, project identification, and time and date shall be provided on the delivery tickets as directed by the Department. The Engineer or his representative shall be provided with the ticket prior to the spreading and finishing of the mixture.

The Department will determine the paving lot's Percent Within Limits (PWL) in accordance with Materials Procedure 96-04, Asphalt Concrete Statistical Pavement Density Determination. In order to receive 100% payment (minimum), pavement cores representing the paving lot must achieve statistically a minimum of 94% of the lot within the predescribed limits. If the above requirement is not met, the lot's quantities will be adjusted in accordance with Table 3 - Quantity Schedule. The quantity of the lot subject to possible adjustment will be determined based on an estimate of tonnage placed, determined from the typical sections shown in the plans.

Percent Within Limits (PWL)	Quantity Adjustment Factor (%)
94-100	.833(PWL) + 21.7
5-93	.449(PWL) + 57.8
<5	*

* The lot shall be removed and replaced to meet specification requirements as ordered by the Engineer.

Table 3 - Quantity Schedule

When the Quantity Adjustment Factor is over 100%, the additional tonnage will be calculated and paid for on a daily basis. The total tonnage paid for under this item will not exceed 105% of the actual tons of materials placed.

The Quantity Adjustment Factor listed in Table 3 will be applied to each paving lot to determine the percentage of that production received at the unit bid price. The Quantity Adjustment Factor will not be applied to material placed on ramps with a uniform full width section of less than 1250 feet in length, shoulders, maintenance widenings and crossovers, and bridges. Payment in these areas will be based on satisfactory placement and compaction as determined by the Engineer. Placement and compaction procedures will be deemed satisfactory by the Engineer when the procedures used in these areas are the same as those used on the main line pavement sections."

ITEM 18403.1318 HEAVY DUTY ASPHALT CONCRETE, TYPE 3 HD
ITEM 18403.1718 HEAVY DUTY ASPHALT CONCRETE, TYPE 6F HD
ITEM 18403.1918 HEAVY DUTY ASPHALT CONCRETE, TYPE 7F HD

BASIS OF PAYMENT

Subsection 403-5 Basis of Payment shall be deleted and replaced with the following:

"The unit bid price per ton for the pavement course shall include the cost of furnishing all materials including asphalt cement and all equipment and labor necessary to complete the work, including the cost of any cleaning and tack coat applied pursuant to §401-3.01. Also to be included in the unit bid price is the cost of all necessary equipment, labor and materials required in obtaining the pavement cores, filling all core holes with asphalt concrete and compacting these core holes in a manner satisfactory to the Engineer.

Payment will be made under:

ITEM NO.	ITEM	PAY UNIT
18403.1318	Heavy Duty Asphalt Concrete - Type 3HD	Ton
18403.1718	Heavy Duty Asphalt Concrete - Type 6F HD	Ton
18403.1918	Heavy Duty Asphalt Concrete - Type 7F HD	Ton"

SPECIAL NOTE

ATTENTION

Heavy Duty Asphalt Specification

The Contractor should be aware that this is a performance-based specification in which the Contractor is responsible for compacting the pavement within a specified density range. The previous version of the Heavy Duty specification (17 series) had a 91-percent lower compaction limit, the lower compaction limit of the revised version (18 series) has been increased to **92-percent**. In order to successfully compact the pavement to the specified density range, the Contractor must be prepared to select, operate, and control the paving and compaction equipment, to monitor the results, and to make necessary adjustments (without direction from the Engineer) to achieve the desired results.

A Quantity Adjustment Factor will be applied to a majority of the paving to determine the amount of payment. The Contractor is cautioned that the Quantity Adjustment Factor is statistically-based upon both the average and variation of samples tested. The Quantity Adjustment Factor favors a close grouping of samples around the desired average (94% of maximum theoretical density) and conversely negatively affects wide variation of density. Written instructions for determining pavement density and quantity adjustment factors are available from the Regional Materials Engineer or the Director, Materials Bureau.

ITEM 18403.1318 M HEAVY DUTY ASPHALT CONCRETE, TYPE 3 HD
ITEM 18403.1718 M HEAVY DUTY ASPHALT CONCRETE, TYPE 6F HD
ITEM 18403.1918 M HEAVY DUTY ASPHALT CONCRETE, TYPE 7F HD

The requirements of Section 403 - Hot Mix Asphalt Concrete Pavement of the Standard Specifications of January 2, 1995 shall apply except as modified and/or revised below.

DESCRIPTION

This work shall consist of constructing Heavy Duty Asphalt concrete pavement courses in accordance with these specifications and in reasonable close conformity with the required lines, grades, thicknesses, and typical sections shown on the plans or established by the Engineer. This is a performance based specification in which the Contractor is responsible for compacting the pavement within a specified density range. Written instructions for determining pavement density and quantity adjustment factors are available from the Regional Materials Engineer or the Director, Materials Bureau.

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. Mixture requirements shall be as follows:

Formulate and submit to the Regional Director, a job mix formula that satisfies the design general limits listed in Table 1 - Heavy Duty Mix Composition. The production tolerances in Table 1 will be permitted to exceed the design general limits.

	BINDER		TOP			
	TYPE 3 HD		TYPE 6F HD		TYPE 7F HD	
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 - Heavy Duty Mix Composition

ITEM 18403.1318 M HEAVY DUTY ASPHALT CONCRETE, TYPE 3 HD
ITEM 18403.1718 M HEAVY DUTY ASPHALT CONCRETE, TYPE 6F HD
ITEM 18403.1918 M HEAVY DUTY ASPHALT CONCRETE, TYPE 7F HD

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

"A. **Coarse Aggregates.** Top course Type 6F HD and Type 7F HD 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%, 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%, 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%.

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 HD mixes - not less than 20% (by weight with adjustments to equivalent volumes for materials of different specific gravities) of the total coarse aggregate particles (plus 3.2 mm material) shall be non-carbonate. In addition, not less than 20% of the plus 6.3 mm particles shall be non-carbonate. Non-carbonate particles are defined as those having an acid insoluble residue content not less than 80%.

   For Type 7F HD mixes - not less than 20% (by weight with adjustments to equivalent volumes for materials of different specific gravities) of the total coarse aggregate particles (plus 3.2 mm material) shall be non-carbonate. Non-carbonate particles are defined as those having an acid insoluble residue content not less than 80%.

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.

	Mix Criteria		
Mix Property	Type 3HD	Type 6FHD	Type 7FHD
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 specified stability, flow, Marshall quotient, and air voids ranges."

CONSTRUCTION DETAILS

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

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 mixture has been spread, struck off and surface irregularities adjusted, thoroughly and uniformly compact by rolling. 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 each edge and working toward the super-elevated edge.

Compact the pavement sufficiently to achieve densities, expressed as a percentage of the mixture's average daily maximum theoretical density (%MADMTD), in a range of 92% to 97%. Pavement cores and mix samples will be tested and analyzed by the Department in accordance with Department written instructions to determine the loose mix sample MADMTD, pavement core bulk density, and the resultant pavement core percent of the MADMTD.

If consecutive lots are found to have a Quantity Adjustment Factor equal to or below 85%, paving operations for this item will be stopped and a new Test Section, constructed as described later in this section, will be required. Paving operations for this item will not be permitted until a new test section meets the acceptance criteria, a minimum Quantity Adjustment Factor of 100%.

The Quantity Adjustment Factor will not be applied to material placed on ramps with a uniform full width section of less than 400 m in length, shoulders, maintenance widenings and crossovers, and bridges. Payment for these areas will be based on satisfactory placement and compaction as determined by the Engineer. Placement and compaction procedures will be deemed satisfactory by the Engineer when the procedures used in these areas are the same as those used on the main line pavement sections. Also, if a nuclear gauge(s) is used to monitor the main-line paving then the same gauge(s) should be used to monitor the above referenced areas to insure that the pavement density is between 92% to 97% of the MADMTD.

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

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 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.

Multiple plant production shall not be allowed unless each plant supplies material to a separate paving operation or when multiple paving operations are utilized with material production from a single plant each paving operation will be evaluated as individual paving lots."

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

"Sampling. Take four loose mix samples in accordance with AASHTO T168-91, Standard Test Method for Sampling Bituminous Paving Mixtures. The samples should be taken periodically throughout the day so as to represent the entire days production. When operational conditions cause production to be terminated before the specified number of samples have been taken the following procedures will be used:

1) If only three samples are taken the loose mix MADMTD will be based on the average of the three samples taken.

2) If only one or two samples are taken the days production will be added to the next days production and sublots determined based on the total quantity placed during the two days. Therefore a maximum of six loose mix samples may be used to determine the loose mix MADMTD.

The Engineer will select one pavement core location for each sublot in accordance with Department written instructions to represent each paving sublot. The Department's representative shall define a total of four 150 mm diameter coring locations using an appropriate method. The Department's pavement core samples must come from within the 150 mm diameter circles outlined. Under no circumstances will the Department's representative designate the coring locations before the rolling operation is complete. The rolling operation will be considered complete when all compaction equipment has moved off the lane to be cored. Obtain the four 150 mm diameter pavement core samples no later than the day following the lot's placement. If coring is performed the same day as placement, cool the pavement so that the core sample is not damaged during coring. Backfill the core holes, with a similar Hot Mix Asphalt material as was cored, as soon as possible after coring, using a procedure approved by the Engineer.

After procuring the four paving lot cores, secure them in accordance with Department written instructions for transport to the appropriate Regional Laboratory. Cores arriving at the Regional Laboratory for testing with a damaged or missing security seal will not be tested and new cores will be required from the same locations as the original cores. Take care to insure that the loose mix samples and cores are in an acceptable test condition when delivered to the Regional Laboratory. Damaged cores will require resampling. The Engineer will select the core locations in the same general vicinity, ±0.5 m of the damaged core. Do not intentionally separate the pavement core course from the underlying material if the course does not debond during coring. The Department will separate the pavement core course, required for testing from the remainder of the core by sawing if necessary. Deliver the pavement core samples and the loose mix samples to the Department Regional Laboratory no later than the day following the lot's placement. If, for any reason, a delay occurs in the delivery of the lot samples for three consecutive lots, paving operations for this item will not be permitted to continue until the samples are delivered and tested.

A paving lot is defined as a days production providing a minimum of 1,200 lane-meters or 400 metric tons, whichever is less, are placed (a lane is defined as a travel lane, with a nominal width of 3.6 m). When paving is continuous within a 24 hour period a new lot will result when a change occurs in the paving crew. If less than the minimum quantity is placed in any day, its placement will be combined with the next paving day to constitute a paving lot. If less than the minimum quantity is placed on the final paving day, the final day shall be evaluated as a paving lot regardless of size. Each paving lot will be equally divided into four sublots in accordance with Materials Procedure 96-04, Asphalt Concrete Statistical Pavement Density Determination.

Test Section. Prior to paving operations for this item, construct a test section on the project site at a location approved by the Engineer. The amount of mixture prepared according to the job mix formula should be sufficient to construct a test section at least 50 m long and full width of pavement and shall be of the same depth specified for the construction of the course which it represents. The maximum test section length is 500 centerline-meters long on roadways subject to Quantity Adjustment Factors for Heavy Duty mixes, otherwise there is no maximum length. Use equipment in the construction of the test section that is of the same type and weight to be used on the remainder of the course represented by the test section. If the test section is located on a roadway subject to Quantity Adjustment Factors for Heavy Duty mixes Table 3 - Quantity Schedule shall apply. The test section will be paid for at 1.5 times the actual quantity paved, up to 200 actual metric tons per test section, for no more than two test sections for each item. The 1.5 Test Section Adjustment does not apply to any additional required test sections.

Testing as described above will be performed on the test section to determine if it meets the mat acceptance criteria. Paving operations for this item will not be permitted until a test section meets the mat acceptance criteria, a minimum Quantity Adjustment Factor of 100%. Only one test section per item per day may be placed.

If the Quantity Adjustment Factor for a test section is less than 100%, make the necessary adjustments to the mix design, plant operation, and/or rolling procedures. Construct an additional test section as required above. This test section will be evaluated to determine if the mat acceptance criteria is met."

METHOD OF MEASUREMENT

Subsection 403-4 Method of Measurement shall be deleted and replaced with the following:

"The pavement course shall be measured by the number of adjusted metric tons of compacted material placed in the accepted work.

Each delivery vehicle supplying Hot Mix Asphalt shall be accompanied by a delivery ticket indicating the metric tons of mixture being delivered to the work site. The tonnage on the ticket shall be determined either by:

A. Recorded batch weights
B. Theoretical weights or
C. Truck scale weights.

The method of payment shall be subject to the approval of the Regional Director. Other information such as tare weights, plant and mix identification, project identification, and time and date shall be provided on the delivery tickets as directed by the Department. The Engineer or his representative shall be provided with the ticket prior to the spreading and finishing of the mixture.

The Department will determine the paving lot's Percent Within Limits (PWL) in accordance with Materials Procedure 96-04, Asphalt Concrete Statistical Pavement Density Determination. In order to receive 100% payment (minimum), pavement cores representing the paving lot must achieve statistically a minimum of 94% of the lot within the predescribed limits. If the above requirement is not met, the lot's quantities will be adjusted in accordance with Table 3 - Quantity Schedule. The quantity of the lot subject to possible adjustment will be determined based on an estimate of tonnage placed, determined from the typical sections shown in the plans.

Percent Within Limits (PWL)	Quantity Adjustment Factor (%)
94-100	.833(PWL) + 21.7
5-93	.449(PWL) + 57.8
<5	*

* The lot shall be removed and replaced to meet specification requirements as ordered by the Engineer.

Table 3 - Quantity Schedule

When the Quantity Adjustment Factor is over 100%, the additional tonnage will be calculated and paid for on a daily basis. The total tonnage paid for under this item will not exceed 105% of the actual metric tons of materials placed.

The Quantity Adjustment Factor listed in Table 3 will be applied to each paving lot to determine the percentage of that production received at the unit bid price. The Quantity Adjustment Factor will not be applied to material placed on ramps with a uniform full width section of less than 400 meters in length, shoulders, maintenance widenings and crossovers, and bridges. Payment in these areas will be based on satisfactory placement and compaction as determined by the Engineer. Placement and compaction procedures will be deemed satisfactory by the Engineer when the procedures used in these areas are the same as those used on the main line pavement sections."

ITEM 18403.1318 M HEAVY DUTY ASPHALT CONCRETE, TYPE 3 HD
ITEM 18403.1718 M HEAVY DUTY ASPHALT CONCRETE, TYPE 6F HD
ITEM 18403.1918 M HEAVY DUTY ASPHALT CONCRETE, TYPE 7F HD

BASIS OF PAYMENT

Subsection 403-5 Basis of Payment shall be deleted and replaced with the following:

"The unit bid price per metric ton for the pavement course shall include the cost of furnishing all materials including asphalt cement and all equipment and labor necessary to complete the work, including the cost of any cleaning and tack coat applied pursuant to §401-3.01. Also to be included in the unit bid price is the cost of all necessary equipment, labor and materials required in obtaining the pavement cores, filling all core holes with asphalt concrete and compacting these core holes in a manner satisfactory to the Engineer.

Payment will be made under:

ITEM NO.	ITEM	PAY UNIT
18403.1318 M	Heavy Duty Asphalt Concrete - Type 3HD	Metric Ton
18403.1718 M	Heavy Duty Asphalt Concrete - Type 6F HD	Metric Ton
18403.1918 M	Heavy Duty Asphalt Concrete - Type 7F HD	Metric Ton"