| To: | | | | |
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| SUPERSEDED BY EI 15-010 EFFECTIVE 9/1/15 MODIFIED BY EI 96-040 EFFECTIVE 1/9/97 | | *New York State Department of Transportation* ENGINEERING INSTRUCTION | EI 96-023 |

Title: **CHANGES TO THE COARSE AGGREGATE REQUIREMENTS FOR HOT MIX ASPHALT TOP COURSE MIXES**

Distribution:

- ☐ Manufacturers (18)
- ☒ Main Office (30)
- ☐ Local Govt. (31)
- ☒ Regions/Agencies (32)
- ☐ Surveyors (33)
- ☒ Consultants (34)
- ☐ Contractors/AGC (39)
- ☐ _____( )

Approved:

P.J. Clark, Deputy Chief Engineer
Design Division

04/12/96
Date

**EFFECTIVE DATE:** This Engineering Instruction will be effective on all Department contracts let on or after **July 25, 1996**.

**PURPOSE:** The purposes of this Engineering Instruction are:

1) Modify the coarse aggregate requirements of numerous Hot Mix Asphalt special specifications, which are listed below (Both Metric and English).
2) Establish four new Hot Mix Asphalt special specifications (Type 7FX , Type 7FX M, and 10FX, Type 10FX M) which contain new coarse aggregate requirements.
3) Delete numerous Hot Mix Asphalt special specifications which contain outdated coarse aggregate requirements.

**TRANSMITTED MATERIAL:**

Attached are the following special specifications with revised coarse aggregate requirements:

**METRIC:**

| | |
|---|---|
| ITEM 18403.170201 M | ASPHALT CONCRETE TYPE 6FX (SPECIAL HIGH FRICTION AGGREGATE) |
| ITEM 18403.1901 M | ASPHALT CONCRETE TYPE 7FX (SPECIAL HIGH FRICTION AGGREGATE) |
| 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 |
| ITEM 18403.1335 M | RUT AVOIDANCE ASPHALT CONCRETE, TYPE 3 RA |
| ITEM 18403.1735 M | RUT AVOIDANCE ASPHALT CONCRETE, TYPE 6F RA |
| ITEM 18403.1935 M | RUT AVOIDANCE ASPHALT CONCRETE, TYPE 7F RA |
| ITEM 15403.200401 M | ASPHALT CONCRETE - TYPE 10FX OPEN-GRADED SURFACE COURSE |

**ENGLISH:**

| | |
|---|---|
| ITEM 18403.170201 | ASPHALT CONCRETE TYPE 6FX (SPECIAL HIGH FRICTION AGGREGATE) |
| ITEM 18403.1901 | ASPHALT CONCRETE TYPE 7FX (SPECIAL HIGH FRICTION AGGREGATE) |
| 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 |
| ITEM 18403.1335 | RUT AVOIDANCE ASPHALT CONCRETE, TYPE 3 RA |
| ITEM 18403.1735 | RUT AVOIDANCE ASPHALT CONCRETE, TYPE 6F RA |
| ITEM 18403.1935 | RUT AVOIDANCE ASPHALT CONCRETE, TYPE 7F RA |
| ITEM 15403.200401 | ASPHALT CONCRETE - TYPE 10FX OPEN-GRADED SURFACE COURSE |

**NOTE:** For Rut Avoidance and Heavy Duty Asphalt Concrete, the new coarse aggregate requirements *only* apply to top course mixes.

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

**METRIC:**

| | |
|---|---|
| ITEM 18403.1702 M | ASPHALT CONCRETE - TYPE 6FX (SPECIAL HIGH FRICTION AGGREGATE) |
| ITEM 18403.1317 M | HEAVY DUTY ASPHALT CONCRETE, TYPE 3 HD |
| ITEM 18403.1717 M | HEAVY DUTY ASPHALT CONCRETE, TYPE 6F HD |
| ITEM 18403.1917 M | HEAVY DUTY ASPHALT CONCRETE, TYPE 7F HD |
| ITEM 18403.1332 M | RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA |
| ITEM 18403.1732 M | RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA |
| ITEM 18403.1932 M | RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA |
| ITEM 18403.1333 M | RUT AVOIDANCE ASPHALT CONCRETE, TYPE 3 RA |
| ITEM 18403.1733 M | RUT AVOIDANCE ASPHALT CONCRETE, TYPE 6F RA |
| ITEM 18403.1933 M | RUT AVOIDANCE ASPHALT CONCRETE, TYPE 7F RA |
| ITEM 15403.2003 M | ASPHALT CONCRETE - TYPE 10F OPEN-GRADED SURFACE COURSE |

**ENGLISH:**

| | |
|---|---|
| ITEM 18403.1702 | ASPHALT CONCRETE - TYPE 6FX (SPECIAL HIGH FRICTION AGGREGATE) |
| ITEM 18403.1317 | HEAVY DUTY ASPHALT CONCRETE, TYPE 3 HD |
| ITEM 18403.1717 | HEAVY DUTY ASPHALT CONCRETE, TYPE 6F HD |
| ITEM 18403.1917 | HEAVY DUTY ASPHALT CONCRETE, TYPE 7F HD |
| ITEM 18403.1332 | RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 3 RA |
| ITEM 18403.1732 | RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 6F RA |
| ITEM 18403.1932 | RUT AVOIDANCE ASPHALT CONCRETE WITH IN-PLACE DENSITY MONITORING, TYPE 7F RA |
| ITEM 18403.1333 | RUT AVOIDANCE ASPHALT CONCRETE, TYPE 3 RA |
| ITEM 18403.1733 | RUT AVOIDANCE ASPHALT CONCRETE, TYPE 6F RA |
| ITEM 18403.1933 | RUT AVOIDANCE ASPHALT CONCRETE, TYPE 7F RA |
| ITEM 15403.2003 | ASPHALT CONCRETE - TYPE 10F OPEN-GRADED SURFACE COURSE |

**COST IMPACT:** No cost increases are anticipated to Hot Mix Asphalt items due to the changes in their coarse aggregate requirements.

**DESIGNER INFORMATION:** Mix Selection Criteria for the above listed items may be found in the attachments to EI 96-022 - MIX SELECTION CRITERIA FOR HOT MIX ASPHALT , TOP AND BINDER COURSES.

The transmitted special specifications containing revised coarse aggregate requirements shall be used to replace the corresponding discontinued specifications.

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

**CONTACT PERSON:** Any questions regarding the new coarse aggregate requirements found in the specifications transmitted herein should be directed to William Skerritt of the Materials Bureau (Geology Section) at (518) 457-1038.

## ITEM 18403.170201 M ASPHALT CONCRETE TYPE 6FX (SPECIAL HIGH FRICTION AGGREGATE)

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 an asphalt concrete pavement course 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.

### MATERIALS

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

"A. **Coarse Aggregates**. Coarse aggregates used shall be from approved sources and shall 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 6FX 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%.

## ITEM 18403.170201 M ASPHALT CONCRETE TYPE 6FX (SPECIAL HIGH FRICTION AGGREGATE)

**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 Section 401-2.02 Composition of Mixtures.

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

2. 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, flow, air voids, and VMA) 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, air voids and VMA. The mid-point of the common overlap is the optimum asphalt cement content."

### CONSTRUCTION DETAILS

The provisions of Section 401-3 Construction Details shall apply.

### METHOD OF MEASUREMENT

The provisions of Section 401-4 Method of Measurement shall apply.

### BASIS OF PAYMENT

The provisions of Section 401-5 Basis of Payment shall apply.

**Payment will be made under:**

| ITEM NO. | ITEM | PAY UNIT |
|---|---|---|
| 18403.170201 M | Asphalt Concrete Type 6FX (Special High Friction Aggregate) | Metric Ton |

## ITEM 18403.1901 M ASPHALT CONCRETE TYPE 7FX (SPECIAL HIGH FRICTION AGGREGATE)

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 an asphalt concrete pavement course 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.

### MATERIALS

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

A. **Coarse Aggregates**. Coarse aggregates used shall be from approved sources and shall 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 7FX 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 Section 401-2.02 Composition of Mixtures.

## ITEM 18403.1901 M ASPHALT CONCRETE TYPE 7FX (SPECIAL HIGH FRICTION AGGREGATE)

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

2. 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, Flow, air voids, and VMA) 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, 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, and air void ranges.

### CONSTRUCTION DETAILS

The provisions of Section 401-3 Construction Details shall apply.

### METHOD OF MEASUREMENT

The provisions of Section 401-4 Method of Measurement shall apply.

### BASIS OF PAYMENT

The provisions of Section 401-5 Basis of Payment shall apply.

**Payment will be made under:**

| ITEM NO. | ITEM | PAY UNIT |
|---|---|---|
| 18403.1901 M | Asphalt Concrete Type 7FX (Special High Friction Aggregate) | Metric Ton |

**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**

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:

The Contractor shall 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 18403.131701 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**

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 asphalt concrete mixtures shall be from approved sources and shall 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 value (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, flow, 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, air voids, VMA, and VFA. The mid-point of the common overlap is the optimum asphalt cement content."

**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**

## 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 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 will be controlled by the Contractor.

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. The types of rollers used, the number of rollers used, and the number of roller passes made will be controlled by the Contractor.

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 91% 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 evaluated 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 mat acceptance criteria, a minimum Quantity Adjustment Factor of 100%.

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 materials. 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, vibratory rollers having pneumatic drive wheels shall 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. Unless otherwise directed by the Engineer, dual vibrating drum rollers shall 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.

The Contractor should note that if he elects to use vibratory compaction equipment, he 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. 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 T 168-91, 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 were taken the loose mix MADMTD will be based on the average of the three samples taken.

2) If only one or two samples were 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. 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. Deliver the pavement core samples and the loose mix samples to the appropriate Department Region 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. Take care to insure that the loose mix samples and cores are in an acceptable test condition when delivered to the Region Laboratory. Damaged cores will require resampling. The Engineer will select the cores location 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.

A paving lot is defined as a days production providing a minimum of 1200 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). 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 91-1M, 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 m long on roadway 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 metric tons actually paved 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 strip 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 weight,
B. Theoretical weight or
C. Truck scale weight.

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 91-1M, Asphalt Concrete Statistical Pavement Density Determination. In order for the Contractor 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. Asphalt and Fuel price adjustments for these items shall be based upon the adjusted quantity computed under this provision and not the actual quantity placed.

**TABLE 3**
**QUANTITY SCHEDULE**

| Percent Within Limits (PWL) | Quantity Adjustment Factor Percent |
|---|---|
| 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.

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 the Contractor will receive 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 m 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."

## 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 |
|---|---|---|
| 18403.131701 M | Heavy Duty Asphalt Concrete - Type 3HD | Metric Ton |
| 18403.171701 M | Heavy Duty Concrete -Type 6F HD | Metric Ton |
| 18403.191701 M | Heavy Duty Asphalt Concrete - Type 7F HD | 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. 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 18403.133201 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**

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 rut avoidance 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. 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. Mixture requirements shall be as follows:

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 18403.133201 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

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 asphalt concrete mixtures shall be from approved sources and shall 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.

**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

| | 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 value (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, flow, 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, air voids, VMA, and VFA. The mid-point of the common overlap is the optimum asphalt cement content.

| | |
|---|---|
| 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 |

## CONSTRUCTION DETAILS

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

The requirements of Subsection of 401-3.06 Rollers apply. The operation of the rollers during the placement of this item including the speed, the amplitude settings, the vibration frequency, and the weight of the rollers will be controlled by the Contractor.

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. The types of rollers used, the number of rollers used, and the number of roller passes made will be controlled by the Contractor.

Use a nuclear density gauge to monitor and record the pavement density in accordance with this section and Materials Procedure 94-01M, "Nuclear Gauge Density Data Collection and Determination of Pavement Core Locations for Rut Avoidance Asphalt Concrete." Compact the pavement sufficiently to achieve a minimum density of 96% of the PROJECT TARGET DENSITY (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 and record nuclear gauge readings on BR 340M at each site, randomly selected by the Engineer, approximately every 200 m along the length of the pavement for each pass of the paver.

If the average of 4 nuclear density gauge readings taken at 90° angles over two consecutive locations falls below 96% of the PTD or 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 to establish a new PTD. If another nuclear gauge is to be used other than the one used for the test section, then construct a new test section to establish a new PTD.

At the conclusion of any day in which a test strip is constructed, take four cores randomly selected by the Engineer in accordance with Materials Procedure 94-01M to assure that adequate density is being achieved. Also, obtain two loose mix samples in accordance with ASTM D979. These samples should be taken periodically throughout the day so as to represent the entire day's production. Deliver the pavement core samples and the loose mix samples for analysis to the appropriate Department Regional Laboratory no later than the day following placement. The density will be determined by the Engineer. If the density of each core is between 91% to 97% of the mixture's maximum theoretical density, compaction will be deemed to be acceptable and no additional coring will be required. However, the Engineer may request the Contractor take four cores and two loose mix samples per day at any time during normal production with adequate notice. If insufficient density is determined from the pavement cores, a new test section will be required.