SECTION 401 - PLANT MIX PAVEMENTS - GENERAL

401-1 DESCRIPTION. These general specifications apply to all plant mixed bituminous concrete irrespective of aggregate gradation, kind and amount of bituminous material or use. Modifications of these general requirements will be indicated in the specific requirements for each item.

This work shall consist of one or more courses of bituminous concrete constructed on the prepared foundation in accordance with these specifications and the specific requirements of the item under contract, and in reasonably close conformance with the lines, grades, thickness and typical sections shown on the plans or established by the Engineer.

The Contractor may use any standard Department mixture in lieu of the specified mixture for a particular item of incidental construction where permitted by the Engineer. The proposed mix shall have a surface texture, when compacted, similar to that of the specified mixture. Also the drainage properties of the compacted mixture shall be similar to those of the adjacent courses when used as a base or binder course in the roadway pavement.

401-2 MATERIALS

401-2.01 General. The Contractor shall obtain Department approval of materials before any material is mixed at any bituminous mixing plants. Approval of sources of supply of the coarse and fine mineral aggregates shall be obtained from the Regional Director. Bituminous material, mineral filler or any other materials that are used in the mix shall be accepted according to Department written instructions.

401-2.02 Composition of Mixtures. The bituminous plant mix shall generally be composed of a mixture of aggregate, filler if required, and bituminous material. For any bituminous mixture required by the plans or itemized proposal, the Contractor shall formulate and submit to the Regional Director, a job mix formula that satisfies the General Limits imposed by Table 401-1, Composition of Bituminous Plant Mixtures. In addition, the formula shall state the mineral aggregate sources, and the grade of bituminous material used in the mixture. The optimum asphalt cement content for the proposed gradation shall be determined by the Contractor using the Marshall Mix Design Method for Type 6F and Type 7F top course mixtures requiring Marshall Mix Design.

The resultant mixture shall meet the following Marshall Properties:

<table>
<thead>
<tr>
<th>Marshall Mix Property Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mix Property</td>
</tr>
<tr>
<td>Stability, N, min.</td>
</tr>
<tr>
<td>Flow, 0.25 mm, min.</td>
</tr>
<tr>
<td>Air Voids, %</td>
</tr>
<tr>
<td>Voids in Mineral Agg. (VMA), %, min.</td>
</tr>
</tbody>
</table>

The Marshall specimens shall be prepared, mix properties determined, and completed mix design submitted in accordance with the procedures outlined by Department written instructions. The mix design
§ 401-2

shall be submitted to the Regional Director or the authorized representative a minimum of four (4) weeks prior to the scheduled start of work.

For any standard mix given in Table 401-1, except for those requiring high friction aggregates, the Regional Director shall review the submitted formulas and grant approval when all requirements are satisfied. All other job mix formulas, upon favorable recommendation by the Regional Director, shall be submitted for approval to the Director, Materials Bureau.

Once approved, the mix shall be produced within the job mix formula tolerances set forth in the Table 401-1. The aggregate tolerances shall be based on the total weight of the aggregate and the bituminous material tolerances shall be based on the total weight of the mix.

However, in no case shall the job mix tolerances fall outside the general limits for a particular mixture. If for any reason, a change in gradation or materials occurs or is contemplated, a separate job mix formula and Marshall Design when appropriate shall be prepared to fit each change in materials or gradation. The Regional Director or the authorized representative may order increases or decreases in the bituminous material quantity without changing the job mix formula providing that any changes stay within the approved job mix formula range for the bituminous material. Changes in asphalt content for mixtures requiring Marshall Design, can be made by the Regional Director or the authorized representative providing the resultant mixture has properties within the specified Marshall criteria and the asphalt content is within the general limits listed in Table 401-1.

The mixture shall be produced, delivered to the work site, and incorporated into the work within 10EC of the temperature specified by the Engineer but within the mixing and placing temperature range listed in Table 401-1.

The aggregates shall be those approved for use by the approved job mix formulas and will be accepted at the plant site. The bituminous material will be conditionally accepted at the supplier's source and at the plant on the basis of certification. Samples taken at the plant will be tested by the Department to determine specification compliance. The gradation of the plant mixed material will be tested to determine compliance with the job mix formula during the production of the material. The plant mixed material will be accepted after blending and mixing at the plant. The pavement courses will be accepted after all paving operations are completed.

401-2.03 Aggregates. Fine aggregate shall consist of materials conforming to the requirements of §703-01, Fine Aggregate. In addition, screenings, free from deleterious materials and manufactured from sources of stone, gravel, or slag meeting the requirements §703-02, Coarse Aggregate, may be used as fine aggregate.

Coarse aggregate shall consist of crushed stone, crushed gravel, or crushed slag conforming to the requirements of §703-02, Coarse Aggregate, except for gradation.

When aggregates from approved natural fine sand sources are combined with coarse aggregates in the mixture, aggregate particles shall meet additional requirements as follows:

1. Particles in the No. 1A and No. 1 primary sizes shall meet the quality requirements of §703-02 and shall have a minimum of 85 percent, by weight, of the particles with at least two fractured faces.

2. Particles in the No. 2, No. 3 and No. 3A primary sizes shall meet the quality requirements of §703-02 and shall have a minimum of 75 percent, by weight, of the particles with at least one fractured face.

Slag aggregate may be used on Department projects only when an alternate pay item which takes the mix yield differential into account is included on the plans or in the itemized proposal.
<table>
<thead>
<tr>
<th>Screen Sizes</th>
<th>General Limits % Passing Job Mix Tol. %</th>
<th>General Limits % Passing Job Mix Tol. %</th>
<th>General Limits % Passing Job Mix Tol. %</th>
<th>General Limits % Passing Job Mix Tol. %</th>
<th>General Limits % Passing Job Mix Tol. %</th>
<th>General Limits % Passing Job Mix Tol. %</th>
<th>General Limits % Passing Job Mix Tol. %</th>
<th>General Limits % Passing Job Mix Tol. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0 mm</td>
<td>100 -</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>37.5 mm</td>
<td>90-100 -</td>
<td>75-100 ±7</td>
<td>100 -</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100 -</td>
<td>-</td>
</tr>
<tr>
<td>25.0 mm</td>
<td>78-95 ±5</td>
<td>55-80 ±8</td>
<td>95-100 -</td>
<td>-</td>
<td>-</td>
<td>100 -</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12.5 mm</td>
<td>57-84 ±6</td>
<td>23-42 ±7</td>
<td>70-90 ±6</td>
<td>-</td>
<td>95-100 -</td>
<td>100 -</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.3 mm</td>
<td>40-72 ±7</td>
<td>5-20 ±6</td>
<td>48-74 ±7</td>
<td>100 -</td>
<td>65-85 ±7</td>
<td>90-100 -</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3.2 mm</td>
<td>26-57 ±7</td>
<td>2-15 ±4</td>
<td>32-62 ±7</td>
<td>80-100 ±6</td>
<td>36-65 ±7</td>
<td>45-70 ±6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>850 µm</td>
<td>12-36 ±7</td>
<td>-</td>
<td>15-39 ±7</td>
<td>32-72 ±7</td>
<td>15-39 ±7</td>
<td>15-40 ±7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>425 µm</td>
<td>8-25 ±7</td>
<td>-</td>
<td>8-27 ±7</td>
<td>18-52 ±7</td>
<td>8-27 ±7</td>
<td>8-27 ±7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>180 µm</td>
<td>4-16 ±4</td>
<td>-</td>
<td>4-16 ±4</td>
<td>7-26 ±4</td>
<td>4-16 ±4</td>
<td>4-16 ±4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>75 µm</td>
<td>2-8 ±2</td>
<td>-</td>
<td>2-8 ±2</td>
<td>2-12 ±2</td>
<td>2-6 ±2</td>
<td>2-6 ±2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Asphalt Content, %&lt;sup&gt;3,4&lt;/sup&gt;</td>
<td>4.0-6.0 ±0.4</td>
<td>2.5-4.5 ±0.4</td>
<td>4.5-6.5 ±0.4</td>
<td>7.0-9.5 ±0.4</td>
<td>5.8-7.0 ±0.4</td>
<td>6.0-8.0 ±0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asphalt Cement Grade &amp; No.</td>
<td>AC-20 5.6 &amp; 7 702-0500</td>
<td>AC-20 5.6 &amp; 7 702-0500</td>
<td>AC-20 5.6 &amp; 7 702-0500</td>
<td>AC-20 5.6 &amp; 7 702-0500</td>
<td>AC-20 5.6 &amp; 7 702-0500</td>
<td>AC-20 5.6 &amp; 7 702-0500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixing and placing Temperature Range EA</td>
<td>120-165</td>
<td>110-150</td>
<td>120-165</td>
<td>120-165</td>
<td>120-165</td>
<td>120-165</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description and Typical Uses</td>
<td>dense base course with relatively low permeability</td>
<td>open base course with relatively high permeability</td>
<td>dense intermediate course with relatively low permeability</td>
<td>dense, smooth texture sand asphalt for leveling where feathered edge is required</td>
<td>dense, granular texture for rural suburban, and urban arterial roadways</td>
<td>dense, gritty texture for single course resurfacing of rural, suburban, and urban arterial</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTES:

1. All aggregate percentages are based on the total weight of the aggregate. The asphalt content is based on the total weight of the mix.
2. The “F” designation in the mix type indicates that high friction coarse aggregates are required.
3. When slag aggregates are used in the mix, the asphalt content shall be increased accordingly minimum 25 percent for an all slag mix.
4. The asphalt content job mix tolerance of ±0.4% shall not apply to Marshall Design mixtures.
5. A asphalt cement 702-0600 may be substituted for 702-0500 in the counties of Clinton, Essex, Franklin, Hamilton, Jefferson, Lewis, St. Lawrence, Warren, and the portion of Herkimer north of a line.
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formed by New York Route 365 and New York Route 8 (from the intersection of Route 365 east of Hamilton County).

6. A asphalt cement 702-0400 may be substituted for 702-0500 in all counties and portions thereof west of north-south line formed by New York Route 14 beginning at the Pennsylvania State line in Chemung County and ending at Sodus Point in Wayne County.

7. A silicone additive approved by the Director, Materials Bureau shall be introduced into the asphalt cement, in accordance with manufacturer’s recommendations, either at the refinery, terminal, or at the mixing plant storage tank. The silicone shall be added at a dosage rate of one gram per 639 liters. A asphalt cement treated with silicone shall conform to the requirements for untreated asphalt cement.

8. The asphalt cement shall be introduced into the pugmill at a temperature compatible with that of the aggregate as determined by the Regional Director or the authorized representative, between the limits of 110EC and 175EC.

In addition to the above requirements coarse aggregates used in mixes Type 6F and Type 7F shall meet the following high friction requirements:

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 dolomite or crushed limestone. Limestone shall have an acid insoluble residue content of not less than 20%, excluding particles of chert and similar siliceous rocks.
2. Coarse aggregates shall be crushed sandstone, granite, chert, traprock, ore tailings, slag or other similar materials.
3. 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 shall meet the following requirements:

For Type 6F 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%. In addition, not less than 20 % of the plus 6.3 mm particles shall be non-carbonate.

For Type 7F - 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.

401-2.04 Mineral Filler. Mineral filler, if required in the mix to meet gradation requirements, shall conform to the requirements of §703-08, Mineral Filler.

401-2.05 Bituminous Materials. The type and grade of bituminous material shall be as specified in the Table 401-1, Composition of Bituminous Plant Mixtures, unless otherwise indicated on the plans or in the itemized proposal. If a bituminous mixing plant is supplying projects in more than one area, the Contractor may apply to use one asphalt cement grade only by submitting a job mix formula.

The bituminous material shall meet the applicable requirements of §702, Bituminous Materials and shall not be delivered to the Bituminous Mixing Plant at a temperature in excess of 175EC.
Reclaimed Asphalt Pavement. Reclaimed Asphalt Pavement shall meet the applicable requirements of §703-09 Reclaimed Asphalt Pavement (RAP).

401-3 CONSTRUCTION DETAILS

401-3.01 Weather and Seasonal Limitations. Bituminous plant mix shall not be placed on any wet surface or when the surface temperature is less than specified in Table 401-2, Temperature and Seasonal Requirements, or when weather conditions otherwise prevent the proper handling or finishing of the bituminous mixtures as determined by the Engineer. The pavement surface course shall be paved within the seasonal limitations indicated in Table 401-2, Temperature and Seasonal Requirements.

The surface temperatures in Table 401-2 shall apply for both pavement surface and shoulder surface courses. Paving shall be discontinued as soon as the temperature falls below the requirements.

Bituminous pavement for temporary detours, which are not and will not become part of the permanent pavement, will not be subject to the above requirements in regard to temperature and seasonal limitations, but must be placed as approved by the Engineer.

Bituminous paving mixtures for curbs, driveways, sidewalks, gutters, and other incidental construction shall be placed on surfaces having a temperature of 8°C or greater unless otherwise authorized by the Engineer. Placing of these items are not subject to seasonal limitations.

**TABLE 401-2**

<table>
<thead>
<tr>
<th>Nominal Compacted Lift Thickness</th>
<th>Surface Temperature Minimum (Note 1)</th>
<th>Seasonal Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 mm or greater</td>
<td>5°C</td>
<td>None</td>
</tr>
<tr>
<td>Greater than 25 mm but less than 75 mm</td>
<td>8°C</td>
<td>(Notes 2 &amp; 3)</td>
</tr>
<tr>
<td>25 mm or less</td>
<td>10°C</td>
<td>(Notes 2 &amp; 3)</td>
</tr>
</tbody>
</table>

**NOTES:**

1. All temperatures shall be measured on the surface where the paving is to be placed and the controlling temperature shall be the average of three temperature readings taken at locations 8± meters apart in accordance with the Department written instructions.

2. Top Course shall be placed only during the period of April 1st up to and including the third Saturday of November in the counties of Dutchess, Orange, Rockland, Putnam, Westchester, Nassau, Suffolk, and the City of New York.

3. Top Course shall be placed only during the period of May 1st up to and including the third Saturday of October in all counties except as noted in Note 2.

The Contractor shall schedule the paving operations such that all paving necessary to provide safe and adequate maintenance and protection of traffic or for protection of previously laid courses is completed within the weather and seasonal limitations. Such scheduling shall include expediting construction operations to permit paving before the seasonal limitations or by limiting the length of work to that which can be completed before the seasonal shut-down. The cost of scheduling and sequencing of work to conform with the seasonal limitations shall be reflected in the unit bid prices for the related contract items. If the Contractor fails to complete the necessary paving operations prior to weather and seasonal limitations, all temporary materials and work which become necessary as a result of such failure, such as the shimming of castings and protrusions, drainage of the roadway, providing acceptable rideability, and other work needed for the adequate maintenance and protection of traffic until paving operations can be completed the following paving season, shall not be reimbursable by the State. In addition, any binder course, placed by the Contractor, which will be permanently incorporated into the work and left open to

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traffic over the winter shall be cleaned in accordance with Section 633 - Conditioning Existing Pavement, and tack coated in accordance with Section 407 - Tack Coat. Cleaning and tack coating shall be done immediately prior to overlaying at no additional expense to the State.

If the Contractor requests a waiver of the seasonal limitations and the Engineer determines it to be in the public interest, the seasonal limitations may be waived for a very limited period upon the recommendation by the Regional Director and only upon written approval of the Deputy Chief Engineer, Construction, subject to the specific temperature, time and other conditions imposed by the D.C.E.C. in connection with such approval.

Such conditions shall include, but not be limited to, the withholding of payment for work performed beyond the seasonal limitation date pending a determination of the pavement condition and performance during the following spring. Where a contract is eligible for acceptance, such withholding of payment may be implemented pursuant to Section 109-10, Uncompleted Work Agreement. The reduction of construction costs to the Contractor will not be considered as a valid reason for waiving the seasonal and weather limitations. The Contractor shall have no claim against the State for any costs attributable to a disapproval of his request for a waiver.

Any pavement damage which occurs as a result of the Contractor either not protecting previously laid courses or the construction of any pavement course outside the specified weather and seasonal requirements whether or not a waiver was granted, shall be repaired by the Contractor at no expense to the State. All repairs shall be performed to the satisfaction of the Engineer.

401-3.02 Bituminous Mixing Plant. The type of plant used for the manufacture of bituminous concrete mixtures may be either a batch plant or drum mix plant. All plants shall conform to the requirements under A. In addition, batch type mix plants shall conform to the requirements under B; and drum mix plants shall conform to the requirements under C.

A. Requirements for All Plants

1. Acceptance and Uniformity. Each bituminous mixing plant shall be approved by the Director, Materials Bureau. The Regional Director may discontinue at any time the use of any previously approved equipment if any non-conformance of specifications results during the progress of the work. When the Regional Director discontinues the use of the plant, production will not be acceptable for Department work until corrective measures, satisfactory to the Regional Director, are carried out. The mixing plant shall be designed, operated and coordinated so as to provide, as nearly as possible, continuous plant production. The mixture produced shall be uniform and in sufficient quantity for the bituminous construction specified. The Regional Director may require the locking or sealing of any automated proportioning equipment that may be manually manipulated.

2. Failure of Automated Proportioning and Recording Equipment. If at any time the automatic proportioning of recording devices become inoperative, the plant may, with the approval of the Regional Director or the authorized representative, be allowed to proportion and mix bituminous mixtures for a period not exceeding 48 hours from the time of the breakdown. Written permission of the Regional Director will be required for periods of operation longer than 48 hours.

3. Plant Scales and Meters. All plant scales, vehicle scales and meters shall be tested at the contractor’s expense by a competent technician as follows:
   a. Annually, prior to use for Department work.
   b. At intervals of not more than 90 calendar days for plant batching scales, meters and vehicle scales.
   c. Whenever the plant changes location.
   d. At any time directed by the Regional Director or the authorized representative.
Standard test weight and a platform, cradle or hanger approved by the Regional Director or the authorized representative shall be provided for testing each scale. At least 10 standard 25 kg test weights shall be provided for testing the springless dial or load cell type scales. A sufficient number of test weights shall be provided to test belt scales within the production range. The use of a set of test weights for two or more plants will be permitted only when they can be readily available within one hour. Distributor trucks or other suitably large containers shall be provided to test meters within the production range. The method for testing scales and meters shall be according to Department written instructions.

4. Equipment for Preparation of Bituminous Material. Tanks for the storage of bituminous material shall be capable of heating and holding the material at the required temperatures. Where bitumen meters are used, the temperature of the bitumen passing through the meter shall be within ± 15EC of the temperature for which the meter is calibrated. The heating shall be accomplished by steam or oil coils, electricity or other approved means so that no flame will be in contact with the tank. Separate tanks and pipe lines shall be provided when mixtures containing asphalt cement and liquid asphalt materials are to be mixed in the same mixer. When tar products or emulsified asphalts are to be used, separate storage tanks and pipe lines shall be provided.

All mixing plants shall be equipped with a sampling valve so designed and installed as to be non-clogging, safe and completely divorced from any solvent clean-out operations. The type of valve and its general location shall be approved by the Director, Materials Bureau. When samples are taken through such valves in accordance with Department written instructions, they shall be considered representative of all material used by the plant until the time of the next sampling.

5. Aggregate Cold Feed Bins. The plant shall have a separate cold feed bin for each aggregate size used in the production of standard Department mixes unless blending is permitted by methods approved by the Regional Director or the authorized representative. The capacities of the cold feed bins shall be sufficient to maintain a continuous flow of material. Each bin shall have a mechanical device for uniform feeding of the aggregate.

6. Bituminous Control Unit. Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of bituminous material in the mix within the tolerance specified. Suitable means shall be provided for maintaining the required temperatures of the bituminous materials in the pipelines, meters, weigh buckets, spray bars, and other containers or flow lines.

Where metering is used to proportion bituminous materials, a suitable valve and by-pass shall be provided so that the meter may be conveniently checked for quantity or rate of flow of material into the mixer.

7. Thermometric Equipment. An armored thermometer of adequate range in temperature reading shall be fixed in the bituminous feed line at a suitable location near the charging valve at the mixer unit. The plant shall also be equipped with approved thermometric equipment placed in the discharge chute of the drier and in the lower quarter of the fine aggregate bin so as to indicate the temperature of the heated aggregates in batch and continuous type mix plants. A thermometer shall be located at the point of discharge of the mixing unit on drum mix type plants. All thermometric equipment shall be accurate within ± 3EC.

8. Dust Collector. All plants shall be equipped with adequate dust collectors constructed to remove or return uniformly all or portions of the collected dust to the system.

9. Truck Scales. Truck scales shall be a platform scale conforming to the requirements of National Institute of Standards and Technology Handbook 44 and of sufficient capacity and size to weigh the largest vehicle in one weighing.
In addition, any truck scale used for determining delivered quantity at the bituminous mixing plant site shall be equipped with an approved recording device of a type approved by the Director, Materials Bureau. The recorder shall produce a ticket with a time-date print and any two of the following weights: gross, net or tare.

Tare weights shall be printed either by weighing each truck empty for each delivery, or the tare weight may be preset and printed or manually entered on the ticket. When the tare weight is not printed by weighing each truck empty for each delivery, tare weights for each truck shall be checked twice a day or more frequently as required by the Regional Director or the authorized representative. Provisions shall be made so that scales may not be manually manipulated during the printing process. In addition, the system shall be interlocked to allow printing only when the scale has come to a complete rest.

10. Safety Requirements. Adequate and safe stairways and platforms leading to sampling points shall be provided with railings. Guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required. Accessibility to the top of truck bodies shall be provided by a platform or other suitable device to enable the Inspector to obtain samples and mixture temperature data. All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly guarded and protected. Ample and unobstructed space shall be provided on the mixing platform.

11. Inspection Facilities. Each Bituminous Concrete Plant Site shall have a weatherproof building or trailer type unit for use as a plant inspector’s testing laboratory and office. The inspection facility shall meet all applicable uniform fire prevention and building code requirements. The office area shall be partitioned from the testing laboratory. The inspection facility shall have a minimum gross area of 22 square meters with a layout providing a minimum internal width of 2.1 meters and a ceiling height of not less than 2.3 meters. The laboratory shall have tables, work benches, shelving, and other necessary equipment required for testing Bituminous Concrete mixes according to the Department’s written instructions. Should the producer elect to or be required to provide additional testing equipment, the internal area shall be increased proportionally to house and operate the additional testing equipment.

When there are multiple plants at one site, the inspection facility shall be proportionally larger. The increased portion of the laboratory and office space shall be sufficiently sized to accomplish an acceptable performance of inspection duties during all production circumstances. The inspection facility shall be used exclusively for its intended purpose and be protected from a noise level greater than an 8 hour time weighted average of 85 dBA. When the inspection facility is used by more than one inspection authority, the Department shall have priority use.

The inspection facility and location shall be subject to the approval of the Regional Materials Engineer.

The inspection facility shall be equipped with the following:

A. **Office Equipment** - A standard size office desk with drawers and a chair. A file cabinet with at least two lockable drawers and two keys. All office equipment shall be for the exclusive use of Department personnel.

B. **First Aid Kit** - An adequately stocked first aid kit shall be available at the plant site. An emergency eye wash station shall be located in the laboratory area.

C. **Toilet** - A flush type toilet shall be located at the plant site. The toilet shall be enclosed in a separate room properly vented and complying with applicable sanitary codes. A lavatory with running water shall be provided. When a facility is set up on a temporary basis for a specific project, a portable toilet may be substituted in lieu of the above.

D. **Lighting** - Electric lights, non-glare type to provide a minimum illumination level of 1100 lux at desk and work bench level.

E. **Laboratory Sink** - Sink and faucet having an adequate supply of clean running water.
F. Heating and Cooling - Adequate heating and air conditioning equipment to maintain an ambient temperature of 20°C ± 3°C.

G. Ventilation - Adequate equipment vented to the atmosphere to remove dust and fumes. A 6 m³/min. (minimum) exhaust hood vented to the atmosphere shall be located over the extractor and sample drying area.

H. Telephone - A telephone for the exclusive and private use of Department personnel shall be located in the laboratory office.

I. Potable Water - A water cooler or other source of potable water shall be available at the inspection facility or plant site.

J. Maintenance - The inspection facility, office, and testing equipment shall be maintained in good operating condition by the facility owner. The owner is responsible for keeping the facility clean. The Department's inspector is responsible for routine cleaning during the inspection period.

K. Fire Extinguisher - A 4.5 kg capacity multi-class ABC fire extinguisher shall be furnished, properly maintained and located in the laboratory area.

L. Bitumen Extractor - Bituminous mixing plants producing recycled mixtures shall be equipped with a power driven centrifuge or reflux extractor having a minimum capacity of 3,000 grams.

M. Coarse Aggregate Sieve Shaker - A power driven coarse aggregate sieve shaker anchored to a firm base with a minimum clear sieve area of 0.21 square meters. The shaker shall impart a vertical, or lateral and vertical motion and be equipped with an automatic timing shut-off device and dust cover. When the shaker is located outside the inspection facility, it must be fully enclosed and weatherproof.

N. Fine Aggregate Sieve Shaker - A power driven fine aggregate sieve shaker independent of the coarse aggregate shaker, for 200 mm minimum diameter sieves. The shaker shall impart a vertical, or lateral and vertical motion and be equipped with an automatic timing shut-off device.

O. Sample Splitter - The aggregate sample splitter shall be capable of splitting samples having a maximum particle size of 13 mm for batch plants, and 40 mm for drum mix plants.

P. Large Scale - The scale shall have a minimum capacity of 14 kilograms with a maximum graduation of 0.005 kilograms.

Q. Small Scale - The scale shall have a minimum capacity of 1500 grams (3000 grams for drum mix plants and all plants producing recycled mixes) with a maximum graduation of 0.1 g.

R. Sample Drying Appliance - The appliance shall be either a stove or hot plate of sufficient size for rapidly drying aggregate samples.

S. Miscellaneous Testing Equipment - Miscellaneous items shall include approved solvents, filter paper, sample containers, scoops, and other necessary accessory equipment. The sieves shall be of proper size for all mixes produced. For drum mix plants, screen sizes listed in table 401-1, “Composition of Bituminous Plant Mixtures” shall be provided for the Coarse Aggregate Sieve Shaker.

T. Marshall Compactor - The compactor shall meet the requirements of A.S.T.M. D-1559. The compactor shall be mounted on a solid base, automatically driven, equipped with a stroke counter, and be capable of automatically stopping after the desired number of strokes have been applied. The compaction hammer shall weigh 4.536 kilograms (± 0.009 kg).

U. Marshall Specimen Mold Assembly - The specimen mold assembly shall meet the requirements of A.S.T.M. D-1559. The assembly shall consist of a compaction mold, base plate, and collar. A minimum of three (3) specimen mold assemblies and an adequate supply of 100 mm paper discs shall be provided.

V. Marshall Specimen Extractor - The extractor, meeting the requirements of A.S.T.M. D-1559 shall be supplied to extract the 100 mm marshall specimens from the compaction molds.

W. Oven - A thermostatically controlled convection type oven having a minimum capacity of 0.04 cubic meter shall be supplied to preheat the marshall specimen mold assemblies and asphalt.
mix samples. The oven shall have a controlled temperature range up to 200°C with a ± 3°C accuracy throughout the range.

X. Hot Plate - A hot plate suitable for heating the marshall compaction hammer shall be supplied. A hot plate supplied under “Sample Drying Appliance” described in R. above meets this requirement.

B. Requirements for Batching Plants

1. Drier. The plant shall be equipped with a drier or driers which continuously agitate the aggregate during the heating and drying process. The drier equipment shall be capable of supplying uniformly heated and dried material in sufficient quantities equivalent to the operating capacity of the plant.

2. Screens. Plant screens, capable of screening all aggregates to the specified sizes and proportions and having nominal capacities in excess of the full capacity of the mixer, shall be provided.

3. Hot Bins. The plant shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. There shall be at least four storage bins so arranged to assure separate and adequate storage of the appropriate fractions of the aggregates required to give proper proportioning of the mix. Separate dry storage shall be provided for mineral filler when used at the plant and the plant shall be equipped to feed such material into the mixer. Each bin shall be provided with overflow chutes, of such size and at such location as to prevent backing up of material into other compartments or bins. Each compartment shall be provided with its individual outlet gate, constructed so that when closed there shall be no leakage. The gates shall quickly and completely cut off the flow of material. Bins shall be equipped with adequate tell-tale devices in the bins at the lower quarter points to indicate when the aggregates fall below this point.

4. Hot Bin Sampling Devices. Adequate facilities shall be provided which allow the Inspector to obtain representative aggregate samples from the full width and depth of the discharge area from each aggregate hot storage bin while the plant is in operation. The device shall consist of a sampling tray of adequate capacity which is structurally supported during the sampling operation. Alternate sampling facilities may be provided subject to the approval of the Director, Materials Bureau. Access to the sampling facilities shall meet the requirements of §401-3.02A10, Safety Requirements.

5. Weigh Box or Hopper. The equipment shall include means for accurately weighing each size of aggregate in a weigh box or hopper suspended on scales and of ample size to hold a full batch without hand raking or running over. The gate shall close tightly so that no material is allowed to leak into the mixer while a batch is being weighed.

6. Aggregate Scales. Scales for any weigh box or hopper shall be of the springless dial type or other weighing devices approved by the Director, Materials Bureau. They shall be accurate to 0.5 percent, have minimum graduations not greater than 0.5 percent and shall be readable and sensitive to 0.25 percent or less, the preceding percentages being based on total batch weight. The minimum resolution of repeating dials or digital displays shall be equivalent to or less than the minimum graduations on the primary scale. Repeating dials or digital displays shall match the primary scale within one graduation. Scales shall be so located as to be easily readable by direct or sight or through repeating dials from the operator’s normal work station. If directed by the Regional Director or the authorized representative, provisions shall be made for locking all scales against tampering.

Scales installed on or after January 2, 1987 shall be either the springless dial or load cell type and shall indicate the load at all stages of the weighing operation from zero to full capacity.
Scales shall conform to the requirements of the National Institute of Standards and Technology Handbook 44 except that the number of scale divisions shall not be less than 500 nor greater than 2000.

7. **Bituminous Material Bucket.** If a bituminous bucket is used, it shall be large enough to handle a batch in a single weighing. The filling system and bucket shall be of such design, size and shape, that the bituminous material will not overflow, splash, or spill outside the bucket during filling and weighing. The bucket shall be steam or oil jacketed or equipped with properly installed electric heating units. It shall be arranged to deliver the bituminous material in a thin uniform sheet or in multiple sprays over the full length of the mixer.

8. **Bituminous Material Measuring Devices.** All measuring devices including scales and meters shall be accurate to 0.1 percent, having minimum graduations not greater than 0.05 percent and shall be readable and sensitive to 0.025 percent or less, the preceding percentages being based on total batch weight. The minimum resolution of repeating dials or digital displays shall be equivalent to or less than the minimum graduations on the primary scale or meter. Repeating dials or digital displays shall match the primary scale or meter within one graduation. The devices shall be so located as to be easily readable by direct sight or through repeating dials from the operator's normal work station. Where bituminous materials are proportioned by weight, the scales shall be of the springless dial type or other weighing devices approved by the Director, Material Bureau. If directed by the Regional Director or the authorized representative, provision shall be made for locking all scales against tampering. All measuring devices installed on or after January 2, 1987 shall conform to the requirements of the National Institute of Standards and Technology Handbook 44 except that the number of scale divisions shall not be less than 500 nor greater than 2000. They shall indicate the load at all stages of the operation from zero to full capacity. Scales shall be either the springless dial or load cell type. Bituminous material measured by a meter shall be converted to weight in kilograms.

9. **Automation of Batching.** All plants shall be equipped with an automatic weighing, cycling, and monitoring system approved by the Director, Materials Bureau, and installed as part of the batching equipment unless otherwise indicated in the contract documents.

The system shall include equipment for accurately proportioning the various components of the mixture by mass or by volume in the proper order, and equipment for controlling the cycle sequence and timing of mixing operations. The entire batching and mixing cycle shall be continuous and not require any manual operations. There shall be auxiliary interlock cut-off circuits to interrupt and stop the automatic batching operations whenever an error exceeding the acceptable tolerance occurs in proportioning.

The automatic proportioning system shall be capable of consistently delivering materials within the full range of batch sizes with the following tolerances:

<table>
<thead>
<tr>
<th>Material Component</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each Aggregate Component</td>
<td>± 1.5%</td>
</tr>
<tr>
<td>Mineral Filler</td>
<td>± 0.5%</td>
</tr>
<tr>
<td>Bituminous Material</td>
<td>± 0.1%</td>
</tr>
<tr>
<td>Zero Return (Aggregate)</td>
<td>+ 0.5%</td>
</tr>
<tr>
<td>Zero Return (Bituminous M)</td>
<td>+ 0.1%</td>
</tr>
</tbody>
</table>

The preceding percentages are based on the total batch weight of bituminous mix except that the zero return tolerance shall be based on the minimum batch size. For systems not equipped to automatically adjust tolerances, the tolerance span shall be set for the minimum approved batch size.

If mineral filler is used, the allowable tolerance for the aggregate component weighed just prior to the filler in a cumulative weighing system shall be ± 0.5 percent. If a separate tolerance control is not provided for the batching of mineral filler, it will be necessary to reduce the
aggregate tolerances to ± 0.5 percent for all aggregate components in batches requiring mineral filler.

The automatic controls and interlock cut-off circuits shall be capable of being consistently coordinated with the primary scale or meter within one scale or meter graduation throughout the full range of the batch sizes. If repeating dials are used, they shall be coordinated with the primary scale or meter within one scale or meter gradation.

10. Recording of Batching. All plants shall be equipped with automatic digital recording devices approved by the Director, Materials Bureau, and shall be so located as to be readily accessible and readable to the operator from his normal work station. The recording device shall be designed to record the quantities of aggregate, mineral filler, and bituminous material and the total weight of each batch of bituminous mixture produced. All recording of batches shall show the date, including day, month and year, and time to the nearest minute for each batch and shall be so marked that each batch may be permanently identified. The Department shall be provided with a clear and legible copy of the recording for each batch.

Bituminous material quantities shall be recorded separate from aggregate and filler and shall be recorded as weight. If measured in liters, it shall be converted to weight in kilograms.

Weights shall be recorded as indicated on the batching scale or display within an accuracy of ±1 scale graduation or increment. The minimum resolution of digital recorders shall be equivalent to or less than the minimum graduation or increment on the scale or display.

When the automation system is capable of producing other than standard size batches (full, half or quarter metric ton increments), the recordation requirements shall be in accordance with written directives from the Director, Materials Bureau.

On automation systems installed on or after January 2, 1987, a clear and identifiable indication shall appear on the recordation, whenever a batch is initiated without all conditions being satisfied for fully automated production under these specifications or a system is taken out of the fully automated mode during the batching sequence.

11. Mixer Unit. The plant shall include a batch mixer of an approved pugmill type capable of producing a uniform mixture within the permissible job-mix tolerances. The mixer shall have a capacity of not less than one metric ton. The blades of the mixer shall have a clearance not in excess of 20 mm from all fixed and moving parts. Paddle blades worn in excess of 25 percent in face area from their new condition shall be replaced. If not enclosed, the mixer shall be equipped with a dust hood to prevent loss of dust. The mixer shall be constructed to prevent leakage of the contents. Mixer discharge shall not cause significant segregation.

12. Control of Mixing Time. The mixer shall be equipped with an accurate time lock properly coordinated with the automation of batching equipment to control the operations of a complete mixing cycle. It shall lock the weigh box after charging of the mixer until the closing of the mixer gate at the completion of the cycle. It shall lock the bituminous material delivery system throughout the dry mixing period and lock the mixer gate throughout the complete mixing period.

In plants designed to simultaneously feed aggregate and asphalt to the pugmill, the dry mixing time requirement and the bituminous material delivery system locking requirement during the dry mixing time do not apply.

The following terms related to the timing of the mixing cycle are defined as follows:

a. Cycle Time. The interval of time between successive openings of the mixer discharge gate for succeeding batches.

b. Mixing Time. The interval of time between the opening of the aggregate weigh box gate and the opening of the mixer discharge gate.
c. **Dry Mixing Time.** The interval of time between the opening of the aggregate weigh box gate and the beginning of application of bituminous material.

d. **Wet Mixing Time.** The interval of time between the beginning of application of bituminous material and the opening of the mixer discharge gate.

e. **Finish Mixing Time.** The interval of time between the termination of application of bituminous material and the opening of the mixer discharge gate.

The control of the timing shall be flexible and capable of being set at intervals of 5 seconds or less throughout the total cycle time. Access to the control of the time locking device shall not be readily accessible to the plant operator during production for Department work.

C. **Requirements for Drum Mix Plants**

1. **Aggregate Cold Bin Feeders.** The cold bins shall be designed to prevent the overflow of material from one bin to another. Scalping screens or similar devices shall be installed on each bin to remove any debris or other foreign material in excess of 100 mm. Individual bins shall be labeled for the aggregate sizes being used.

   Each cold feed bin shall have a device to feed the aggregate accurately and uniformly. No gravity type feeders will be permitted. The feeding orifice shall be adjustable and indicators provided to show the gate opening. Each feeder shall be interlocked so that production is interrupted within 5 seconds if any cold bin becomes empty or the flow is obstructed.

2. **Mineral Filler System.** When mineral filler is to be added, it shall be fed from a bin and feeder separate from the aggregate cold bins. The system shall have a device to feed the mineral filler at adjustable rates accurately and uniformly. When mineral filler is proportioned separately, the delivery system shall be accurate to 0.25 percent based on the total weight of the bituminous mixture. The feeder shall be interlocked in such a manner that production is interrupted within 5 seconds if the bin becomes empty or the flow is obstructed. The filler shall be fed in a manner such that no filler is lost in the form of fugitive dust.

3. **Aggregate Weighing Equipment.** All aggregates including mineral filler shall be weighed by a continuous weighing device either as it is proportioned by the individual feeders or after all materials have been deposited on a common belt. Belt scales shall meet the requirements of National Institute of Standards and Technology Handbook 44 subject to the following modifications:

   a. Acceptance Tolerance shall be 0.5% of test load.

   b. Maintenance Tolerance shall be 1.0% of test load.

   c. Acceptance Tolerance shall apply to the initial installation of the equipment, to the annual inspection prior to production, and whenever the equipment fails to meet the Maintenance Tolerance.

   d. Maintenance Tolerance shall apply at all other times.

   All belt scales shall be installed according to the scale manufacturer’s recommendation. Means shall be provided for diverting the aggregate after passing over the belt scale and prior to entry into the drum. The belt scale(s) shall be tested according to Department written instructions for compliance with accuracy requirements. The amount of material passing over the belt scale during testing shall be readable to the nearest 0.01 metric tons.

   Any other weighing device shall be approved by the Director, Materials Bureau.

4. **Bitumen Delivery System.** The bitumen shall be proportioned by a meter and the meter shall be accurate to 0.1 percent based on the total weight of the bituminous mixture. The system shall be interlocked so that production is interrupted within 5 seconds if the bitumen flow to the
mixer unit ceases. A temperature compensating device shall be installed in conjunction with the meter to correct the quantity of asphalt to 15°C.

5. **Proportioning Controls.** All proportioning controls for aggregates, including mineral filler, and bitumen shall be located at the panel which also controls the mixer and temperature. The panel shall have a master control which will increase or decrease the production rate without having to reset the individual controls for each change in production rate.

   a. **Aggregate Feed Rate Control.** The plant shall have an adjustable feed rate control for each aggregate bin feeder and mineral filler feeder. The controls shall maintain an aggregate flow accuracy such that the total variation of all materials being drawn per interval of time shall not exceed an amount equal to 1.5 percent of total weight of bituminous mixture per interval of time. Where the separate addition of mineral filler is required, it shall be added with a maximum variation of 0.5 percent on the basis stated above for aggregates.

      The flow rate of aggregate shall be continuously displayed in the control room in metric tons per hour. The maximum resolution shall be 1 metric ton per hour for dry aggregate and 0.1 metric ton per hour for mineral filler if added separately.

   b. **Aggregate Weight Indicator(s).** Weight indicators shall display in the control room, the weights of dry aggregate and mineral filler in metric tons, and shall continuously accumulate the weights of material during the production period in the day. Where mineral filler is included in the aggregate passing over the belt scale, only one indicator will be required. The maximum resolution shall be 0.1 metric tons for dry aggregate and 0.01 metric tons for mineral filler if added separately. The indicators shall be resettable to zero and lockable.

   c. **Aggregate Moisture Compensator.** A moisture compensation device shall be capable of electronically changing the wet weight of aggregate to dry aggregate weight. The compensator may be set manually based on moisture tests performed on composite aggregate samples. The maximum graduations on the compensator shall be 0.1 percent.

   d. **Bitumen Control.** The bitumen control shall be capable of presetting the actual bitumen content directly as a percentage based on total weight of mixture. The maximum graduation on the bitumen control shall be 0.1 percent. The asphalt delivery system shall be coupled with the aggregate delivery system to automatically maintain the required proportions as the aggregate flow varies. The delivery tolerance for bitumen shall be ± 0.1 percent of the total mixture weight. The flow rate of bitumen shall be continuously displayed in the control room in metric tons per hour and shall have a maximum resolution of 0.1 metric ton per hour.

   e. **Bitumen Quantity Indicator.** A bitumen quantity indicator shall display in the control room the quantity of bitumen in metric tons and shall continuously accumulate the quantity of bitumen during the production period in the day. The maximum resolution shall be 0.01 metric tons. The indicator shall be resettable to zero and lockable.

6. **Recordation of Proportions.** The plant shall be equipped with an automatic digital recording device approved by the Director, Materials Bureau, that simultaneously records the accumulated weights of dry aggregate, mineral filler if added separately and bitumen at five minute intervals during production time and on demand. The recordation shall include the actual bitumen content based upon the bitumen quantity as a percentage of the total mixture weight. The maximum resolution shall be 0.1 metric tons for dry aggregate, 0.01 metric tons for mineral filler if added separately, 0.01 metric tons for bitumen, and 0.1% for bitumen content. All recordings shall show the date, including day, month and year, and time to the nearest minute for each print. The Department shall be provided with a clear and legible copy of the recording.
On automation systems installed on or after January 2, 1992, a clear and identifiable indication shall appear on the recordation, whenever production is initiated without all conditions being satisfied for fully automated production under these specifications or a system is taken out of the fully automated mode during the production sequence.

7. **Calibration of Feed Rates.** The feed rates of aggregates from the cold bins, mineral filler when used, and bitumen shall be established for each mix type initially by passing the individual aggregates and mineral filler over the continuous weighing device and the bitumen through the meter respectively. The feed rates shall be checked periodically according to Department written instructions.

8. **Automatic Aggregate Sampling Device.** A automatic aggregate sampling device shall be provided which will divert a representative combined aggregate sample into a hopper or container for the purpose of gradation testing. The device shall effectively sample the full width and depth of the aggregate flow without losing any portion of the sample. The sampling point shall be after the aggregate is proportioned and prior to its mixing with bitumen.

9. **Mixer Unit.** The plant shall include a continuous mixer of a type approved by the Director, Materials Bureau, having an automatic burner control and capable of producing a uniform mixture within the job-mix tolerances. Flights within the drum which are missing, loose, broken, bent, scalloped or worn excessively from their new condition shall be repaired or replaced to the satisfaction of the Regional Director or his representative. The mixture shall be discharged into a hot bituminous mixture holding bin meeting the requirements of §401-3.03, Hot Bituminous Mixture Holding Bins.

10. **Truck Scales.** Each drum mix plant site shall have a platform scale conforming to the requirements of the National Institute of Standards and Technology Handbook 44 and of sufficient capacity and size to weigh the largest vehicle in one weighing.

### 401-3.03 HOT BITUMINOUS MIXTURE HOLDING BINS.

Hot bituminous mixtures may be held in bins especially designed for that purpose at the mixing plant site. Each holding bin shall be inspected and/or tested by the Department to determine acceptance at specific holding times. Acceptance shall be based upon the ability of the holding bin to: (1) hold and discharge mixes within the quality criteria given in paragraph B below, and (2) measure and record the quantity of mixture discharged from the bin as outlined in paragraph C below.

A. **Holding Times.** Holding time is defined as the time interval beginning with the introduction of bituminous concrete into the bin to the time of completion of discharge from the bin. Holding bins will be approved to store mixtures for standard holding times 12, 24, or 48 hours; and approved to surge mixtures for the standard holding time of 6 hours.

The establishment of those times will be based upon the Department’s evaluation of each bin as outlined in paragraph D below.

B. **Acceptance Criteria for Mix Quality.** The mixtures, after storage, shall meet the following criteria:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Temperature</td>
<td>± 10°C from pugmill discharge temperature.</td>
</tr>
<tr>
<td>2. Gradation</td>
<td>Within Job Mix Formula tolerances (applied to pugmill discharge mean gradation).</td>
</tr>
<tr>
<td>3. Asphalt Content</td>
<td>± 0.4% (applied to pugmill discharge mean asphalt content).</td>
</tr>
<tr>
<td>4. Asphalt Cement Recovered from Mixtures:</td>
<td></td>
</tr>
</tbody>
</table>
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a. Penetration @ 25EC  Loss not to exceed 50% of the penetration of the asphalt sampled from the plant prior to mixing.

b. Viscosity @ 60EC  Viscosity not to exceed four times (five for Boscan crude asphalt) the viscosity of the asphalt sampled from the plant prior to mixing.

C. Quantity Documentation. The quantity of mixture drawn from holding bins and delivered to Department projects shall be measured and the amount recorded by one of the following:

1. A truck scale conforming to the requirements of §401-3.02, A9, Truck Scales.

2. A weight box or hopper suspended beneath the holding bin. Scales for the weight box or hopper shall be of the springless dial type or other weighing devices approved by the Director, Materials Bureau. The scale shall measure the actual weight to within an accuracy of 0.1 percent of full scale or one graduation, whichever is less. The minimum graduation shall have a value not exceeding 10 kg or 0.01 metric tons. The minimum resolution of repeating dials or digital displays shall be equivalent to or less than the minimum graduations on the primary. There shall be an interlock cutoff circuit to prevent the commencement of the (re)weighing operation if the scale is outside of the zero return tolerance. The zero return tolerance shall be from 0 to a maximum of plus 70 kilograms or 0.07 metric tons whichever is applicable.

Each installation shall be equipped with a recording device approved by the Director, Materials Bureau. The recorder shall produce a ticket with a time-date print and the total amount of mixture discharged into the truck. The minimum resolution of the recorder shall be equivalent to or less than the minimum graduations on the scale or digital display. Provisions shall be made so that scales may not be manually manipulated during the weighing and printing process. In addition, the system shall be interlocked to allow printing only when the scale has come to a complete rest.

D. Holding Bin Evaluation and Approval. Prior to its initial use on Department projects, each holding bin shall be evaluated and approved by the Director, Materials Bureau. The scope of the evaluation conducted will be dependent upon the standard holding time(s) requested by the Contractor. The evaluation will be based on sampling and testing of mixtures held in the bin unless otherwise directed.

If the mixture drawn from a bituminous holding bin shows signs of detrimental aggregate segregation, asphalt migration, asphalt hardening, or improper temperature control, the Engineer may discontinue delivery from the holding bins until satisfactory results can be achieved.

The Department shall reserve the right to reevaluate any approved bin at any time.

401-3.04 Hauling Equipment. The hot bituminous mixture shall be transported to the work site in vehicles having clean, smooth and tight metal beds. During transporting, the mixture shall be completely covered. The cover shall be of canvas or other suitable material and overlap the vehicles sideboards and be securely fastened. When necessary to deliver the mixture at the specified temperature, the truck bodies shall be properly insulated or heated. The haul units shall be subject to the approval of the Regional Materials Engineer.

The inside surface of the truck body may be lightly coated with an approved asphalt release agent. The name of any release agents used shall appear on the Department’s Approved List.

401-3.05 Bituminous Pavers. Bituminous pavers shall be self-powered units, provided with an activated screed or strike-off assembly. The machine shall be capable of spreading and finishing courses of bituminous plant material in lane widths applicable to the specified typical section and thicknesses shown on the plans. When screed extensions are permitted by the Engineer for placement of mainline pavement, such extensions shall be of the same design as the main screed. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of bituminous plant material.
in widths shown on the plans. The paver shall have a receiving hopper with sufficient capacity for uniform spreading operation and with automatic flow controls to place the mixture uniformly in front of the screed. The screed or strike-off assembly shall be heated as necessary to produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture. When laying mixtures, the paver shall be capable of operating at forward speeds consistent with satisfactory placement of the mixtures.

All bituminous pavers, used to place base, binder, and surface courses shall be equipped with approved automatic transverse slope and longitudinal grade screed controls. The controls shall automatically adjust the screed and increase or decrease the mat thickness to compensate for irregularities that are in the surface being paved. The controls shall be capable of maintaining the proper transverse slope and be readily adjustable so transitions and super-elevated curves can be satisfactorily paved. The controls shall operate from suitable fixed or moving references as prescribed in §401-3.11. Widths in excess of 5.2 meters shall have approved automatic transverse slope and longitudinal grade screed controls that operate from references on both sides of the paver.

The transverse slope and longitudinal grade screed controls of the bituminous paver may be manually adjusted, where permitted by the Engineer, according to the requirements of §401-3.11, Spreading and Finishing. The bituminous pavers shall be at the job site sufficiently ahead of the start of paving operations to be examined and approved by the Engineer. Any paver found worn or defective either before or during its use shall be immediately repaired to the satisfaction of the Engineer or replaced.

**401-3.06 Rollers.** All rollers shall be either an approved vibrator type or static steel wheel or pneumatic tire type used according to the requirements of subsection 401-3.12. The rollers shall be in good mechanical condition, free from excessive backlash, and capable of operating at speeds slow enough to avoid displacement of the mixture. The number and weight of rollers shall be sufficient to satisfactorily compact the mixture while it is still in a workable condition. The use of equipment which results in excessive crushing of aggregate will not be permitted.

Vibratory rollers shall be of a type that are specifically designed for the compaction of bituminous concrete. Vibratory roller models satisfying the specification requirements contained herein will be evaluated by the Materials Bureau to determine compaction capabilities. Testing will be performed according to the Department’s written instructions. If acceptable test results are obtained, the roller model will be placed on the Department’s current Approved List Bituminous Concrete Vibratory Compaction Equipment. Only vibratory roller models appearing on this list shall be used on Department projects.

Vibratory rollers shall meet the following requirements:

- **Nominal Amplitude** - 1.25 mm maximum.
- **Vibration Frequency** - 1500 vpm minimum.
- **Drum Width** - 1372 mm, minimum, dual vibrating drums
  - 2134 mm, minimum, single vibrating drum

The application of material to pneumatic drive wheels for the prevention of tire pickup shall be controlled by a momentary contact switch. Controls which provide a continuous flow of material will not be permitted.

All vibratory rollers shall be equipped with a speedometer that accurately indicates roller speed in either 1 km/hr. or 15 m/min. increments (maximum) throughout the specified operating range. Vibratory rollers shall also be equipped with a speed control device which shall be set by the Contractor to prevent the roller from travelling in excess of 4 km/hr. or 67 m/min. when the roller is in vibratory mode. The type of speed control device will be subject to the approval of the Director, Materials Bureau.

Static steel wheel rollers shall be self propelled and be either 9 to 11 metric ton tandem three axle type or 7 to 9 metric ton tandem two axle type.
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Pneumatic rubber-tired rollers shall be self-propelled and consist of two axles on which are mounted multiple pneumatic-tired wheels in such a manner that the rear wheels will not follow in the tracks of the forward wheels and will be spaced to give essentially uniform coverage with each pass. The axles shall be mounted in a rigid frame provided with means for adding ballast. The wheels shall be so mounted as to oscillate individually or in pairs. The tires shall be smooth and show no tread pattern, be of equal size and diameter, and be uniformly inflated. Pneumatic rollers shall meet the following requirements unless otherwise approved:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Wheel Load</td>
<td>2600 kg</td>
</tr>
<tr>
<td>Tire Compression on Pavement</td>
<td>550 ± 35 Kpa</td>
</tr>
<tr>
<td>Maximum Axle Load</td>
<td>1600 kg</td>
</tr>
</tbody>
</table>

Alternate types of rollers may be approved by the Deputy Chief Engineer, Construction Division, if field tests or other data demonstrates that satisfactory results can be achieved.

401-3.07 Conditioning of Existing Surface. The surface of the existing pavement shall be cleaned, joints and cracks filled, and the surface leveled to a uniform grade and cross slope in areas designated by the Engineer prior to the application of a new bituminous concrete course. The surface shall be cleaned and the joints and cracks filled under the provisions of section 633, Conditioning Existing Pavement. The expense for cleaning foreign material from the pavement as a result of construction operations shall be borne by the contractor. Leveling of the surface shall be in conformance with the requirements stated below.

Contact surfaces between bituminous mixtures and Portland Cement concrete such as adjacent pavement edges, curbing, gutters, manholes and other structures shall be painted with a thin, uniform coating of bituminous material prior to the bituminous mixture being placed against them.

If an Asphalt Concrete Truing and Leveling Course is specified on the plans or in the itemized proposal, the work shall consist of placing a course of the minimum variable thickness of proper plant mix necessary to bring the surface of the existing pavement to the same transverse slope and longitudinal grade required for the finished pavement surface. The work shall consist of removing irregularities in the old pavement, filling and patching holes, correcting variations in banked pavement, establishing pavement crowns, etc. All depressions and wheel path ruts shall be filled prior to the paving of the truing and leveling course, as directed by the Engineer. For compacted thickness up to 40 mm, a top course or shim course mix shall be used. For compacted thickness in excess of 40 mm, the dense binder course mix shall be used; however, where compacted thicknesses 100 mm or greater are required, the Engineer may approve the use of the dense base course mix. Special attention shall be paid to the proper compaction of thin sections. The surface of this course shall be tested in the same manner prescribed in §401-3.14, except that the allowable variation from the true surface after compaction shall not exceed 10 mm.

401-3.08 Preparation of Bituminous Material. The bituminous material shall be heated to the specified temperature in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature at all times.

401-3.09 Preparation of Aggregates

A. Requirements for All Plants. Department approved aggregates from different sources shall be separated from each other unless otherwise approved by the Regional Director or his representative. Department approved aggregates shall be separated from non-approved aggregates.

B. Requirements for Batch Plants. Aggregates shall be stockpiled on free draining bases and the aggregates shall be reclaimed from the stockpiles without contamination by foreign materials. Where a batch or continuous mixing plant is located at an approved aggregate processing plant, direct transfer from the process discharge point to the cold feed bin will be permitted. However, if the
Regional Director or the authorized representative determines that non-uniform results occur in gradation or moisture content, the use of the direct transfer method shall be discontinued.

The aggregates for the mixture shall be dried and heated to the required temperature. Any aggregate shall be considered dry when its moisture content just prior to batching does not exceed 0.5 percent of oven dried weight. Flames used for drying and heating shall be properly adjusted to avoid damage to the aggregate and to avoid contamination of the aggregate. Immediately after heating and drying, the aggregate shall be screened into the number of fractions required and conveyed into separate compartments ready for batching and mixing with bituminous material. Mineral filler shall not be passed through the drier, but it shall be fed unheated by elevator or other acceptable means to its designated bin.

C. Requirements for Drum Mix Plants. Aggregates shall be stockpiled on free draining bases in such a manner that intermingling of different sizes will not occur and reclaimed without contamination by foreign materials. Direct transfer from an aggregate processing plant discharge point to cold feed bin will not be permitted.

The aggregates for the mixture shall be from supplies having a uniform gradation and moisture content. The mixture shall consist of a combination of fine and coarse aggregates. Prior to production, the Contractor shall submit the stockpile gradations to the Department. The deviation in gradation on any sieve during production shall not exceed ±5 percent. The sieves used for coarse aggregate sizes shall be those listed in Table 703-4, Sizes of Stone, Gravel and Slag unless otherwise approved by the Director, Materials Bureau. Coarse aggregates not meeting these uniformity requirements will be rejected. Fine aggregate having variations that would cause unacceptable gradations in the mixture will be rejected. The Contractor shall discontinue the use of the rejected aggregates. Reworking the rejected stockpiles to achieve a uniform gradation may be permitted by the Regional Director or the authorized representative.

The aggregates shall have stable moisture contents as determined by the Inspector prior to their use in the manufacture of bituminous concrete.

The final acceptance for aggregate gradation shall be determined from samples of the composite aggregate taken by the automatic sampling device described in §401-3.02C8, Automatic Aggregate Sampling Device.

401-3.10 Mixing. The aggregates, including mineral filler, shall be combined in the mixer in the amount of each fraction required to meet the job-mix formula. The bituminous material shall be proportioned and introduced into the mixer in the amount specified by the Regional Director or the authorized representative within the job-mix formula range. The mixer shall be capable of producing a well-coated and homogeneous mixture at the specified temperature.

The finished mixture shall contain the minimum percentage of fully coated particles as follows: base course, 85 percent; binder and top courses, 95%. The test procedure for determining the particle coating will be according to Department written instructions.

In addition to these general requirements for mixing, specific requirements are given in the following paragraphs for various types of mixing units.

A. Requirements for Batching Plants. The volume of mineral aggregates and bituminous material, when placed in the mixer, shall not be so great as to extend above the tips of the mixer blades nor such as to exceed the manufacturer’s rated capacity of the mixer. In no case shall the total quantity of material mixed be less than 50 percent of the manufacturer’s rated capacity of the mixer.

Standard dry and wet mixing times for any batch plant mixed bituminous mixture shall be 15 and 45 seconds, respectively.

Any deviation from standard mixing times shall meet the requirements outlined below and shall be approved in writing by the Regional Director.

Base course mixes shall be dry mixed for at least the period of time necessary to discharge all aggregates into the mixer. The wet mixing period shall then commence and continue at least until 85
percent of the coarse aggregate particles are fully coated or the finish mixing time exceeds 10
seconds, whichever is longer. Top and binder course mixes shall be dry mixed for at least the period
of time necessary to discharge all aggregates into the mixer or 10 seconds, whichever is longer. The
wet mixing period shall then commence and continue until at least 95 percent of the coarse aggregate
particles are fully coated or the finish mixing time exceeds 10 seconds, whichever is longer.

The Regional Director may approve bituminous mixing plants to operate without dry mixing time
provided that the plant is designed to simultaneously feed asphalt and aggregates into the pugmill.
Plants producing mixture under this condition shall yield a mixture equal to that produced by standard
mixing in terms of uniformity and bituminous coating on the aggregate particles.

In no case shall the cycle time be so short as to result in a rate of production exceeding the 10
operating capacities of the plant.

B. Requirements for Drum Mix Plants. The moisture content of the mixture upon discharge
into the haul unit shall not exceed 0.5 percent when tested in accordance with Department written
instructions.

401-3.11 Spreading and Finishing. Base, binder and surface course bituminous concrete mixtures
may be delivered from more than one plant providing that no placing or compaction difficulties are
evident to the Engineer. In addition, when the surface course mixture is delivered from more than one
plant, the mixtures shall be capable of yielding a pavement surface having a uniform color and texture
as determined by the Regional Director or the authorized representative.

The mixture shall be laid upon an approved clean, dry surface, spread and struck off to the 20
established grade and elevation. A approved bituminous pavers shall be used to distribute the mixture either
over the entire width or over such partial width as may be practicable. Bituminous pavers shall be in the
charge of an experienced operator. Placing of the mixture shall be continuous at a desired rate of not less
than 45 metric tons per hour. The Engineer may permit a lesser rate if satisfactory results are achieved.
Upon arrival at the site, the mixture shall be dumped into the paver and immediately spread and struck
25 off to the width required and to such appropriate loose depth that when the work is completed, the
required compacted thickness of mixture will be obtained.

For the initial pavement course laid with automatic bituminous pavers, the paver shall be guided by
a taut reference line positioned at or near the pavement centerline or edge. The reference line shall be
supported at approximately 8 meter intervals on tangent sections and at closer intervals on curves. The 30
line shall be tensioned sufficiently to remove any sags. The Contractor shall erect and maintain the
reference line to the satisfaction of the Engineer. A moving reference of at least 9 meters in length,
unless otherwise permitted by the Engineer, such as a floating beam, ski, or other suitable type may be
substituted for the reference line if the surface to be paved is sufficiently even and satisfactory results
can be achieved. A short ski or shoe may also be used for the initial course with the permission of the 35
Engineer if a satisfactory fixed reference such as a curb, gutter or other fixed reference is adjacent to
the pavement. When the Contractor proposes to use either the floating beam or short ski in place of the
taut reference line, the Engineer may disapprove of the substitution if results are not similar to those
obtained using the taut reference.

Subsequent pavement courses placed over the initial course shall be placed using one of the above 40
methods. In addition, any course in an adjacent lane may be used as the reference for the use of a short
ski. Whatever method the Contractor uses must be approved by the Engineer.

The automatic screed controls will not be required where existing grades at roadway intersection or
drainage structure must be met, for shoulders, temporary detours, behind curbs, or in other areas where
its use is impractical as determined by the Engineer.

If there are less than 1250 square meters in the contract, or the areas to be paved are small and
scattered, a paver may be dispensed with and the course spread by hand methods as directed by the
Engineer. For such areas, the mixture shall be dumped, spread and screeded to give the required section
and compacted thickness.
Before any rolling is started, the loose mat shall be checked, any irregularities adjusted, and all unsatisfactory material shall be removed and replaced.

Type 5 Shim Course used to fill wheel ruts in an existing pavement shall be placed such that each wheel path rut is paved separately. The placement equipment shall be of a drag box configuration or approved equal having side forms. The equipment shall spread and strike off the shim course material to a uniform width of approximately 1.2 meters. The intent of the operation is to fill the low area only; it is not intended that the material be placed for the pavement’s full lane width. The placement equipment wheels and/or other appurtenances shall not interfere with the distribution and placement of the shim course material. The placement equipment shall be at the job site sufficiently prior to the placing operation to be examined and approved by the Engineer.

401-3.12 Compaction. Immediately after the bituminous mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving. All courses shall be initially rolled with the roller traveling parallel to the centerline of the pavement beginning at each edge and working toward the center. Banked curves shall be rolled starting at the low side edge and working toward the super-elevated edge. When the compaction procedure used by the Contractor fails to produce results acceptable to the Engineer, the procedure shall be adjusted to obtain the desired results. Rollers shall move at a slow and uniform speed. The roller drive roll or wheel shall be nearest the paver.

Any displacement occurring as a result of reversing the direction of the roller, or from other causes, shall be corrected at once by the use of rakes and addition of fresh mixture as required. Care shall be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture. To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with small quantities of detergent or other approved material, but in no case shall a solvent having an effect upon the bituminous pavement be used.

Along forms, curbs, headers, walls and other areas not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers as directed by the Engineer. On depressed areas, a trench roller or a 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.

Suitable means shall be provided to keep pavers and other equipment and tools free from bituminous accumulations. The surface of the pavement shall be protected from drippings of oil, kerosene, or other materials.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture which shall be compacted to conform with the surrounding area. Any area showing an excess or deficiency of bituminous material shall be corrected to the satisfaction of the Engineer.

The Contractor shall use any of the compaction options listed below except for the following:

1. Type 5 Shim Course shall be compacted with a minimum of three passes of a pneumatic rubber-tired roller unless otherwise approved by the Engineer.

2. Option B - Vibratory Compaction is not permitted when compacting bituminous concrete courses on structural bridge decks.

Option A - Three Roller Compaction Train. Under this option, all bituminous concrete courses shall be initially rolled with an approved steel-wheel roller. The roller shall overlap the previous roller pass by one-half the width of the roller.

Immediately following the initial rolling the courses shall be rolled with an approved pneumatic rubber-tired roller. A minimum of 3 passes of the rubber-tired roller will be required. One pass shall be defined as one movement of the roller over any point of the pavement in either direction.

Immediately following the intermediate rolling the courses shall be finish rolled with a steel-wheel tandem roller. This final rolling shall be both longitudinal and diagonal as directed by the Engineer and
shall remove all shallow ruts and ridges and other irregularities from the surface. Rolling shall be
continued until all roller marks are eliminated.

Under this option, no pavement course shall be compacted to thicknesses in excess of 100 mm. No
rollers shall move at speeds in excess of 5 kilometers per hour unless otherwise approved. When paving
multiple lanes simultaneously, the Contractor shall increase the required number of rollers proportionately for each additional full lane width unless otherwise permitted by the Engineer.

Option B - Vibratory Compaction. Under this option, the Contractor shall use vibratory compaction
equipment appearing on the current Approved List - Bituminous Concrete Vibratory Compaction
Equipment. The various bituminous courses shall be compacted according to the following requirements.

Open-Graded and Dense Base Course. The Contractor may substitute one vibratory roller for
compacting Base in lieu of the conventional three (3) roller compaction train stipulated under Option
A. One roller shall be provided for each nominal 3.60 meter width of paving. Base may be
constructed in a single lift to the compacted thickness shown on the plans. Under this option, no
additional compaction equipment is required.

If the Engineer determines that unsatisfactory results are being obtained using the single lift base
course placement, the Contractor shall cease using this procedure and begin using multiple lifts. No
additional payment will be made for the cost of changing procedures.

Top and Dense Binder Courses. The Contractor may substitute one vibratory roller in lieu of the
initial roller and the pneumatic roller in the conventional three (3) roller compaction train
stipulated under Option A. Under this option, the course shall be finish rolled with a steel-wheel
tandem roller having a minimum weight of 7 metric tons. This finish roller shall add a minimum of
two passes closely following the vibratory roller or as directed by the Engineer.

One vibratory roller and one steel-wheel tandem roller shall be provided for each nominal 3.6
meter width of paving. Dual vibrating drum rollers meeting the requirements of a steel-wheel tandem
roller and operating in the static mode may be used as the finish roller. However, this single vibratory
roller shall not be used as both the initial roller and the finish roller.

All Courses - General Requirements. For each project where a vibratory roller is used, the
Contractor shall furnish a vibrating reed tachometer for the exclusive use of the Engineer. The
vibrating reed tachometer shall have a frequency range of 17 Hz to 67 Hz with a minimum reed
interval of 1 Hz between 17 Hz and 33 Hz and a minimum reed interval of 2 Hz between 33 Hz and 67 Hz.

Vibratory rollers shall operate at a uniform speed not exceeding 4 kilometers per hour (67 meters
per minute) on all pavement courses. All turning of the compaction equipment shall be completed on
material which has had a minimum of one roller pass.

The required number of passes listed in Table 401-3 are minimum and may be increased by the
Engineer. One pass shall be defined as one movement of the roller over any point of the pavement
in either direction. Static roller passes shall continue until all ruts, ridges, roller marks or other
irregularities are removed from the surface. The Engineer may alter the compaction procedures for
small areas where the specified procedures are not practical.

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 passes with both drums operating
static.

To prevent adhesion of the mixture to the drum(s), the drum(s) shall be kept properly moistened
with water, or water mixed with small quantities of detergent or other Department approved
materials. If required to prevent pneumatic tire pickup, the pneumatic drive wheels may be coated
with a fine mist spray of fuel oil or other similar material. In all instances, the surface of the
pavement shall be protected from drippings of fuel oil or any other solvents used in paving.
### TABLE 401-3
REQUIRED NUMBER OF PASSES (MINIMUM)

<table>
<thead>
<tr>
<th>Pavement Courses</th>
<th>Vibratory Roller</th>
<th>Steel-Wheel Tandem Finish Roller</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vibrating Passes</td>
<td>Static Passes</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Base (Open Graded Each Lift)</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Base (Dense-Graded)</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Binder (Dense-Graded)</td>
<td>2</td>
<td>Not Required</td>
</tr>
<tr>
<td>Top (Dense-Graded All Types)</td>
<td>2</td>
<td>Not Required</td>
</tr>
</tbody>
</table>

**NOTES:**

1. The required number of vibrating passes shall be reduced by one-half (1/2) for dual vibrating drum rollers when the drums are tandem and are both in the vibrating mode.

2. The required number of static passes may be completed by the vibratory roller operating in the static mode.

3. Compaction or cleaning operations.

   If the Engineer determines that unsatisfactory compaction is being obtained or damage to highway components and/or adjacent property is occurring using vibratory compaction equipment, the Contractor shall immediately cease using this equipment and proceed with the work in accordance with the conventional compaction procedures stipulated under Option A at no additional cost.

The Contractor should note that if vibratory compaction equipment is elected, full responsibility for the cost of repairing all damages which may occur to highway components and adjacent property will be borne by the Contractor.

401-3.13 JOINTS. The finished pavement at all joints shall comply with the surface smoothness requirements and exhibit the same uniformity of texture and compaction as other sections of the course. Rollers shall not pass over the unprotected edges of a freshly laid mixture unless permitted by the Engineer.

In the formation of all joints, the exposed edge of the existing layer that will become part of the joint shall be the full thickness of the layer and straight. If the existing edge is unacceptable as determined by the Engineer, the edge shall be corrected by using a power driven saw or other approved tools to cut a neat line. When directed by the Engineer, a light coat of bituminous material meeting the requirements of Section 702 shall be applied to existing pavement edges in order to provide bond with newly laid pavement.

The pavement of successive courses shall be such that all joints are offset at least 150 mm from the joint of the lower pavement course, unless otherwise approved by the Engineer.

A. Transverse. The placement of the courses shall be as continuous as possible to limit the number of transverse joints. The transverse joints in adjacent lanes shall be staggered a minimum of 3 meters. The transverse joint shall be formed by cutting back on the previous run to expose the full depth of the course.

The paver shall be set-up such that material is laid to overlap the previously placed edge by 50 mm to 75 mm. The thickness of the overlap material shall be approximately 1/4 the compacted thickness of the course, so as to result in a smooth and well compacted joint after rolling. The overlapped material shall be broomed back onto the hot mat so that the roller operator can crowd the small excess into the hot side of the joint. If the overlap is excessive, the excess material shall be
trimmed off so that the material along the joint is uniform. The coarse particles of aggregate in the overlap material shall be removed and wasted if deemed necessary by the Engineer.

Compaction of the transverse joint shall be done in the static mode. The roller shall run parallel to the joint and perpendicular to traffic. Boards of proper thickness shall be placed at the edge of the pavement for the off pavement movement of the roller. The first pass shall be made with the roller operating on the previously laid material with 150 to 200 mm of its drum(s) projecting onto the uncompacted mix. Successive passes shall then be made with roller drum(s) moving approximately 300 mm per pass onto the hot material until half the width of the roller is on the hot mat.

If a vibratory roller with pneumatic drive wheels is used, the first pass shall be with one of the pneumatic wheels aligned directly on the joint and the drum operating in the static mode. Successive passes shall then be made with the roller drum moving approximately 300 mm per pass onto the hot material until half the width of the roller is on the hot mat.

B. Longitudinal. Placement of the surface course shall be carefully planned to assure that the longitudinal joints in the surface course will correspond with edges of proposed traffic lanes. Other joint arrangements will require approval of the Engineer. When traffic is maintained on the roadway during paving operations the mixture shall be laid such that no more than 30 meters of the pavement edge will be exposed at the end of the working day. The Engineer may permit an exposed edge of this type in excess of 30 meters providing that the edge is adequately protected against damage by vehicles and equipment.

When paving adjoining lanes, the asphalt concrete shall be laid such that it uniformly overlaps the adjacent lane 50 to 75 mm. The thickness of the overlap material shall be approximately 1/4 the compacted thickness of the course, so as to result in a smooth and well compacted joint after rolling. The overlapped material shall be broomed or raked back onto the adjacent hot lane so that the roller operator can crowd the small excess into the hot side of the joint. If the overlap is excessive, the excess material shall be trimmed off so that the material along the joint is uniform. The coarse particles of aggregate in the overlap material shall be removed and wasted if deemed necessary by the Engineer.

Compaction of the longitudinal joint shall be done in static mode and as close to the paver as possible. The first pass shall be made with the roller travelling toward the paver and operating on the previously placed lane with 150 to 200 mm of the roller drum protruding onto the hot mat. The roller shall apply a second pass to the joint as it travels back away from the paver. All turning movements of the roller shall be done on previously compacted material. After applying two roller passes on the longitudinal joint, the roller shall then proceed to the low side of the lane and compact as described in §401-3.12 Compaction. If a single drum vibratory roller with pneumatic drive wheels is used, the roller shall be in the static mode and the same procedure shall be followed except that the roller shall be aligned on the joint so that the pneumatic drive wheels travel on the joint.

401-3.14 Surface Tolerance. The pavement surface shall be constructed to a 6 mm tolerance. If, in the opinion of the Engineer, the pavement surface is not being constructed or has not been constructed to this tolerance based upon visual observation or upon riding quality, the Engineer may test the surface with a 5 meter straight edge or string line placed parallel to the centerline of the pavement and with a 3 meter straight edge or string line placed transversely to the centerline of the pavement on any portion of the pavement. Variations exceeding 6 mm shall be satisfactorily corrected or the pavement relaid at no additional cost to the Department as ordered by the Engineer.

401-3.15 Thickness Tolerance. The thickness indicated for each of the various courses of bituminous pavement is the nominal thickness. The pavement shall be so constructed that the final compacted thickness is as near to the nominal thickness as is practical, and within the tolerances specified below.

Determinations for final acceptance and payment will be made from cores or thickness measurements taken on the completed pavement. The Contractor shall fill all core holes with bituminous concrete and compact the mixture in a manner satisfactory to the Engineer.
Material which is part of a truing or leveling course as described in §401-3.07, Condition of Existing Surface, will not be considered in pavement thickness determinations.

A tolerance not to exceed 6 mm from the nominal thickness required for the course specified under one pay item will be acceptable where the required nominal thickness is 100 mm or less. A tolerance not to exceed 13 mm from the nominal thickness required for the course or courses specified under one pay item will be acceptable where the required nominal thickness is over 100 mm. In addition, the sum total thickness of all bituminous mixture courses shall not vary from the total of the nominal thickness indicated on the plans by more than 6 mm where the total nominal thickness is 100 mm or less; or more than 13 mm where the total nominal thickness is over 100 mm but not more than 200 mm; and by not more than 16 mm where the total nominal thickness is more than 200 mm.

When the bituminous mixture is placed on newly constructed subbase material, an additional tolerance of plus 6 mm will be allowed both in the nominal thickness of the course placed directly on the subbase and the total pavement thickness.

No payment will be made for any extra thickness placed over and above the permissible tolerance except as provided herein. Tolerances indicated for the thicknesses of individual layers of multilayer pavements (including composite pavements) are basically guides which should be met as closely as practical. Tolerance for the total thickness of such pavement is also a guide. In order to attain the ultimate objective of a smooth riding pavement substantially true to line and grade, pavements which substantially conform to the plans and specifications, even though the thickness tolerance may not be exactly met, may be accepted and paid for under the following conditions: Where the total thickness of such pavements is less than the specified thickness including tolerances, the Regional Director, may with approval of the Deputy Chief Engineer, Construction Division, approve, accept and pay for such pavements; where the total thickness of such pavements is greater than the specified thickness, the Regional Director may accept and pay for such pavements when the excess thickness was necessary to attain a smooth riding pavement surface. Payment for excess thickness necessary to achieve a smooth riding surface shall be considered only in cases where an existing pavement surface has been resurfaced.

401-4 METHOD OF MEASUREMENT. Plant mix bituminous pavement mixture will be measured by the number of metric tons of compacted mixture placed in the accepted work.

Each delivery vehicle supplying bituminous mixtures shall be accompanied by a delivery ticket indicating the metric tons of mixture being delivered to the work site. The metric 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 inspector shall be provided with the ticket prior to the spreading and finishing of the mixture.

When shoulders are placed under the optional flexible shoulder item, and the Contractor has elected to place both the shoulder and traveled way pavement courses simultaneously in a single operation; then the following shall apply:

The number of metric tons of material to be measured shall be the total number of metric tons of compacted material in place on both the traveled way and the optional shoulder, less the number of metric tons of material determined to have been placed in the shoulder. The number of metric tons of material placed in the optional shoulder shall be considered to be the product of the theoretical volume within the payment lines occupied by the shoulder course expressed in cubic meters times the factor of 2.25 metric tons per cubic meter.
§ 401-4

401-5 BASIS OF PAYMENT. The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily perform the work, including the cost of any cleaning and tack coat applied pursuant to §401-3.01.

SECTION 402 (VACANT)

SECTION 403 - HOT MIX ASPHALT CONCRETE PAVEMENT

403-1 DESCRIPTION. This work shall consist of constructing a pavement course of hot, plant-mixed asphalt concrete on a prepared base in accordance with these specifications and in reasonable close conformity with the required lines, grades, thickness and typical sections shown on the plans or established by the Engineer.

The various type of courses included under this work are specified as:

Asphalt Concrete - Type 1 Base
Asphalt Concrete - Type 2 Base
Asphalt Concrete - Type 3 Binder
Asphalt Concrete - Type 5 Shim
Asphalt Concrete - Type 6 Top
Asphalt Concrete - Type 6F Top (High Friction)
Asphalt Concrete - Type 7 Top
Asphalt Concrete - Type 7F Top (High Friction)
Asphalt Concrete - Truing and Leveling

403-2 MATERIALS. The materials and composition for the respective courses shall meet the requirements specified in §401-2.01 through 401-2.06 except that, unless otherwise specified in the contract plans or proposal, high friction aggregates and Marshall Mix Design for Type 6F or Type 7F top mixes shall not be required for those items when used on shoulders.

403-3 CONSTRUCTION DETAILS. The construction details shall comply with the requirements specified in §401-3.01 through §401-3.15.

403-4 METHOD OF MEASUREMENT. The provision of §401-4 shall apply.

403-5 BASIS OF PAYMENT. The unit price bid per ton for the various pavement courses shall include the cost of furnishing all materials including asphalt cement, any cleaning and tack coat applied pursuant to §401-3.01, and all equipment and labor necessary to complete the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>403.11 M</td>
<td>Asphalt Concrete - Type 1 Base Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.12 M</td>
<td>Asphalt Concrete - Type 2 Base Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.13 M</td>
<td>Asphalt Concrete - Type 3 Binder Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.15 M</td>
<td>Asphalt Concrete - Type 5 Shim Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.16 M</td>
<td>Asphalt Concrete - Type 6 Top Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.17 M</td>
<td>Asphalt Concrete - Type 6F Top Course (High Friction) Marshall Design</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.18 M</td>
<td>Asphalt Concrete - Type 7 Top Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.19 M</td>
<td>Asphalt Concrete - Type 7F Top Course (High Friction) Marshall Design</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>403.21 M</td>
<td>Asphalt Concrete - Truing and Leveling Course</td>
<td>Metric Ton</td>
</tr>
</tbody>
</table>

SECTION 404 (VACANT)
SECTION 405 - COLD MIX BITUMINOUS PAVEMENT (OPEN GRADED)

405-1 DESCRIPTION. This work shall consist of constructing one or more courses of cold mix bituminous pavement on a prepared base in accordance with these specifications and in substantial conformance with the lines, grades, thicknesses, and typical cross-sections shown on the plans or established by the Engineer.

405-2 MATERIALS

405-2.01 Bituminous Material. The bituminous materials required for mixing and for sealing shall meet the requirements of section 702, Bituminous Materials. The type and grade of bituminous material shall be that indicated on the plans or in the proposal.

405-2.02 Aggregates. The aggregates shall be Department approved aggregates meeting the requirements of subsection 703-02, Coarse Aggregates, for the sizes specified. Screened gravel shall not be permitted unless specified on the plans or in the proposal.

405-2.03 Composition of Mixtures. The bituminous cold mix shall be composed of a mixture of aggregate and bituminous material as ordered and approved by the Engineer. The mix shall be proportioned as specified in Table 405-1, Composition of Cold Bituminous Mixtures.

### TABLE 405-1
COMPOSITION OF COLD BITUMINOUS MIXTURES

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Mixes</th>
<th>Mixes</th>
<th>Mixes</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Type 1 General Limits % passing (1)</td>
<td>Type 2 General Limits % passing (1)</td>
<td>Type 3 General Limits % passing (1)</td>
</tr>
<tr>
<td>50 mm</td>
<td>100</td>
<td>75 - 100</td>
<td>75 - 100</td>
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<tr>
<td>37.5 mm</td>
<td>100</td>
<td>90 - 100</td>
<td>50 - 80</td>
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<tr>
<td>25 mm</td>
<td>100</td>
<td>15 - 45</td>
<td>0 - 15</td>
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<tr>
<td>12.5 mm</td>
<td>90 - 100</td>
<td>15 - 45</td>
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<tr>
<td>6.3 mm</td>
<td>15 - 45</td>
<td>0 - 10</td>
<td>-</td>
</tr>
<tr>
<td>3.2 mm</td>
<td>0 - 10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>75 µm</td>
<td>0 - 1.0</td>
<td>0 - 1.0</td>
<td>0 - 1.0</td>
</tr>
<tr>
<td>Bituminous Material (2) (3)</td>
<td>4.7 - 7.0</td>
<td>4.0 - 6.0</td>
<td>3.5 - 5.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Open, Coarse texture</th>
<th>Open, Coarse texture</th>
<th>Open, Coarse texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Uses</td>
<td>Surface Course</td>
<td>Intermediate</td>
<td>Base Course</td>
</tr>
</tbody>
</table>

(1) Percentage based on total aggregate weight.
(2) Total Emulsion Percentage based on total mix weight.
(3) When crushed air-cooled blast furnace slag aggregate is selected, the above bituminous material content shall be increased approximately 25%.

405-3 CONSTRUCTION REQUIREMENTS

405-3.01 Weather Limitations. Bituminous material or mixture shall not be applied on any soft surfaces, when the surface is wet, when the temperature of the surface on which the mixture is to be placed is below 7EC, or when other weather conditions would prevent proper construction of the pavement.
§ 405-3

405-3.02 Equipment. The following equipment shall be required:
- Either central pugmill mixer and bituminous paver or Travel plant mixer
- Bituminous material distributor
- Steel wheeled roller, 7-11 Metric Ton or Approved vibratory roller
- Chip spreader
- Power broom
- Motor grader, if required
- Miscellaneous equipment to perform the work

All equipment and the condition of the equipment for this work shall be subject to approval of the Engineer at all times.

Mixing shall be done with a rotating twin paddle shaft pugmill providing suitable pressure-kneading action in mixing. Mixing by blading, shoveling and/or scooping will not be permitted.

The materials shall be mixed either by the travel mix plant method or in a central pugmill mixer. The mixer shall be either a continuous traveling type, central continuous or batch type pugmill designed to accurately proportion wither by volume or by weight, so that when the aggregate and bituminous materials are incorporated in the mix, a thorough and uniform coating will result. The mixer shall be equipped to mechanically or electrically interlock the bituminous feed with the aggregate feed such that uniformity of the mixture is assured at all times. The pugmill mixer, either traveling or central type, shall be provided with weighing, volumetric or other gaging equipment which shall be capable of providing accurate control at all times of the amount of aggregate entering the mixer per time interval. On the central continuous type pugmill a mechanically operated discharge hopper of at least 0.76 cubic meters capacity shall be provided. The mixer shall be equipped with a positive displacement metering system capable of totaling the quantity of bituminous material applied to the mixing chamber.

405-3.03 Preparation of the Base. The roadway surface to be covered shall be free from holes, depressions, bumps, waves and corrugations. Any unsuitable surface areas shall be repaired by replacement of the unstable materials or by patching with a material to produce a tight surface having the same elevation as the surrounding surface. The roadway surface shall be broomed when ordered by the Engineer to remove loose material.

405-3.04 Mixing and Spreading. The aggregate and asphalt shall be thoroughly mixed so that the bituminous material is uniformly distributed throughout and all aggregate particles are uniformly coated.

The mixture shall be deposited on the prepared base either in a windrow at the back of the travel mixer or mechanically spread in a uniform layer so as to produce the specified thickness after compaction. If deposited in a windrow, it shall be spread over the entire roadway surface by motor grader or other approved spreader to produce the specified thickness after compaction. The maximum allowable compacted thickness shall be 50 mm for the Type 1 mix (Table 405-1) and 100 mm for the Type 2 and Type 3 mixes (Table 405-1).

405-3.05 Compaction. After spreading, the mixture shall be thoroughly and uniformly compacted with a self-propelled steel-wheeled roller or an approved vibratory roller to obtain a thoroughly compacted pavement. The number of roller passes to achieve the desired compaction shall be approved by the Engineer.

405-3.06 Surface Testing. The finished surface of the pavement shall be tested with a 5 meter straight edge laid parallel with the center line of the pavement. Any area exceeding a 6 mm variation from the surrounding area shall be satisfactorily corrected or removed and replaced.

405-3.07 Pavement Sealing. Either prior to initial compaction or immediately after compacting the mix, No. 1A size key stone meeting the requirements of subsection 703-02, Coarse Aggregates, shall be uniformly spread upon the surface at the rate of 5-8 kilograms per square meter and the course rolled. No. 1 size key stone meeting the requirements of subsection 703-02, Coarse Aggregates, at the rate of 5-10 kilograms per square meter, may be used for key stone on the base course mixes. After placement
of the No. 1A size key stone, the pavement shall be opened to traffic for a minimum of 3 days before placing the seal coat.

Prior to the application of the seal coat, the pavement surface shall be thoroughly swept and cleaned of all excess material. The seal coat shall be bituminous material asphalt emulsion meeting the requirements of subsection 702-3101 or subsection 702-4001 applied at the rate of 1.4 to 2.3 liters per square meter (Type 1 mix, Table 405-1) or 2.3 to 2.9 liters per square meter (Type 2 mix, Table 405-1). This shall be immediately followed by an application of No. 1A cover aggregate at the rate of 8-10 kilograms per square meter which shall then be rolled. In the case where multiple lifts of Cold Mix Bituminous Pavements are used, only the surface of the top course shall require a seal coat. In multiple lift construction, each lift requires an application of key stone to fill voids in the mat.

**405-4 METHOD OF MEASUREMENT.** The bituminous cold mix pavement shall be measured by the number of metric tons compacted aggregate, including key and cover stone, placed in accordance with the specifications.

The liquid bituminous material shall be measured by the liter.

**405-5 BASIS OF PAYMENT.** The unit price bid per metric ton shall include the preparation of base, the cost of furnishing all the aggregate, the mixing, placing, compaction and all labor and equipment necessary to complete the work. The bituminous material will be paid for under its appropriate item.

**Payment will be made under:**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>405.01 M</td>
<td>Cold Mix Bituminous (Open Graded)</td>
<td>Metric Ton</td>
</tr>
</tbody>
</table>

**SECTION 406 (VACANT)**

**SECTION 407 - TACK COAT**

**407-1 DESCRIPTION.** This work shall consist of preparing and treating an existing bituminous or portland cement concrete surface with bituminous tack coat in accordance with these specifications and in reasonably close conformity with the limits shown on the plans or established by the Engineer.

**407-2 MATERIALS.** The bituminous tack coat shall meet the requirements of the following designation:

- Asphalt Emulsion for Tack Coat 702-90

The bituminous tack coat will be sampled and tested in accordance with the Department’s written instruction.

**407-3 CONSTRUCTION DETAILS.**

**407-3.01 Equipment.** The Contractor shall provide a distributor for applying tack coat.

The distributor shall be designed, equipped, maintained and operated so that the tack coat can be heated and applied uniformly on variable widths of surface up to 4.5 meters at readily determined and controlled rates from 0.14 to 9.10 liters per square meter, with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.10 liters per square meter. Distributor equipment shall include a tachometer, accurate metering device or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump, and full circulation spray bars adjustable laterally and vertically.

The distributor may be equipped with an attached bristle broom designed such that it drags on the pavement behind the spray bars. If the broom is used, it shall be adjustable laterally and vertically so that the full width of the applied tack coat is broomed uniformly into the pavement surface.
§ 407-3

Distributors shall be equipped with an approved bituminous material sampling valve. The valve shall be installed as described in Department written instructions. When samples are taken through such valves, they shall be considered representative of all material in the tank.

Smaller power spray units of hand spray equipment will be permitted only in areas where the Engineer determines the use of a distributor is impractical.

407-3.02 Application of Bituminous Material. The tack coat shall be uniformly applied by a pressure distributor to a prepared clean pavement. The tack coat shall be applied as approved by the Engineer to offer the least inconvenience to traffic and to permit the one-way traffic, where practical, to prevent pickup or tracking of the bituminous material.

The tack coat shall not be applied on a wet pavement surface when the temperature is below 7EC. The temperature and areas to be treated shall be approved by the Engineer prior to application. The application rate shall be 0.14 to 0.32 liters per square meter as approved by the Engineer.

407-4 METHOD OF MEASUREMENT. The quantity to be paid for will be the number of liters of asphalt emulsion for tack coat measured at 15EC incorporated into the work.

407-5 BASIS OF PAVEMENT. The unit price bid per liter for tack coat shall include the cost of furnishing materials and all equipment and labor necessary to complete the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>407.01 M</td>
<td>Tack Coat</td>
<td>Liter</td>
</tr>
</tbody>
</table>

SECTIONS 408 and 409 (VACANT)

SECTION 410 - BITUMINOUS SURFACE TREATMENT - SINGLE COURSE

410-1 DESCRIPTION. The work shall consist of the construction of a single bituminous surface treatment for both pavements and shoulders in accordance with these specifications in substantial conformance with the limits shown on the plans or established by the Engineer.

410-2 MATERIALS

410-2.01 Bituminous Materials. All the provisions of Section 618b shall apply with the following additions:

A. Bituminous Material Approval The bituminous material shall be obtained from a storage facility that has been approved by the Director, Materials Bureau within the current calendar year prior to the start of work.

B. Bituminous Material Selection The selected bituminous material shall be compatible with the aggregate to be used. It's the contractor's responsibility to ensure compatibility between the bituminous material and aggregate. The selection of bituminous material shall also be subject to the approval of the Engineer. Under the work the Contractor shall select, furnish and apply to a prepared surface one of the following bituminous materials.

1. Bituminous Surface Treatment - Pavement

702-3101 - RS-2 - Rapid Setting Asphalt Emulsion
702-3102 - HFRS-2 - High Float Rapid Setting Asphalt Emulsion
702-4101 - CRS-2 - Cationic Rapid Setting Asphalt Emulsion
2. Bituminous Surface Treatment - Shoulders

702-3101 - RS-2 - Rapid Setting Asphalt Emulsion
702-3102 - HFRS-2 - High Float Rapid Setting Asphalt Emulsion
702-3301 - HFMS-2 - High Float Medium Setting Asphalt Emulsion
702-4101 - CRS-2 - Cationic Rapid Setting Asphalt Emulsion

410-2.02 Aggregates. The aggregates for bituminous surface treatments shall conform to the requirements of Section 703-02, “Coarse Aggregate” and be from an approved source.

A. Bituminous Surface Treatment - Pavement. The aggregate size shall be No. 1ST and meet one of the following:

1. Coarse aggregate shall be crushed limestone or dolomite that have an acid soluble content of not less than 10%.
2. Coarse aggregates shall be crushed sandstone, granite, trap rock, ore tailings or other similar materials.
3. Coarse aggregates shall be crushed gravel or blend of two or more of the following types of material; crushed gravel, limestone, dolomite, sandstone, granite, trap rock, ore tailings or other similar materials. Not less than 20% of the coarse aggregate shall be non-carbonate. Non-carbonate particles are defined as those having an acid insoluble content not less than 80%.

Where aggregates for pavement surface treatment 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. The procedure used for proportioning shall be approved by the Regional Director or the authorized representative. Aggregates used for pavement surface treatment shall not contain more than 5% chert.

B. Bituminous Surface Treatment - Shoulders. The required aggregate size shall meet the following gradation requirements:

<table>
<thead>
<tr>
<th>Screen Sizes</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5 mm</td>
<td>100</td>
</tr>
<tr>
<td>6.3 mm</td>
<td>85-100</td>
</tr>
<tr>
<td>3.2 mm</td>
<td>0-15</td>
</tr>
</tbody>
</table>

410-3 CONSTRUCTION DETAILS

410-3.01 Bituminous Surface Treatment - Pavements

A. Weather and Seasonal Limitations. Bituminous material shall not be applied to a pavement surface when the:

1. Surface is wet
2. Ambient temperature is less than 10°C in the shade
3. Ambient temperature is greater than 35°C
4. Weather conditions would prevent proper construction of the surface treatment

The surface on which the bituminous material is applied shall have a temperature of 20°C or higher. Surface treatments shall be placed during the period of May 1st up to and including the first Saturday after Labor Day.

B. Equipment. The following equipment shall be required:

1. Self-propelled rotary power broom
2. Bituminous material distributor
3. Self-propelled aggregate spreader
Pneumatic tire roller

A self-propelled rotary power broom shall be designed, equipped, maintained and operated so that the pavement surface can be swept clean. The broom shall have an adjustment to control the downward pressure. The power broom shall meet the approval of the Engineer.

The bituminous material distributor shall be equipped, maintained, and operated so that the bituminous material can be applied at controlled temperature rates from 0.23 to 9.10 liters per square meter. The distributor shall be capable of applying bituminous material on variable widths up to 4.5 meters. The distributor shall uniformly apply the bituminous material to the specified rate with a maximum allowed variation of 0.10 liters per square meter. Distributor equipment shall include tachometer, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a separate power unit for the pump, and full circulation spray bars adjustable laterally and vertically.

The distributor and/or transport shall be equipped with a sampling valve so designed and installed as to be non-clogging and safe. The type of valve and its general location shall be according to Department written instructions. When samples are taken through such valves in accordance with Department instructions, they shall be considered representative of all material in the tank.

The aggregate spreader shall be a self-propelled unit capable of uniformly spreading the aggregate at the required rate on a minimum width of 150 mm wider than the width of the lane to be treated. The spreader shall meet the approval of the Engineer.

A minimum of two pneumatic tire rollers will be required for each project. The Engineer will require a sufficient number of pneumatic tire rollers to permit initial rolling of the aggregate to occur within 5 minutes of the application of the bituminous material and the final of the three coverages to be completed within 30 minutes of the application of the bituminous material. The pneumatic tire rollers shall be self-propelled and have oscillating wheels with smooth tread tires. The tire pressure for all wheels shall be uniform ± 0.034 MPa. The rollers shall be operated at a maximum speed of 8 kilometers per hour. To prevent pick-up of the aggregate to the tires, the tires shall be kept properly moistened with water mixed with small quantities of detergent or other material approved by the Engineer. In no case shall a solvent having affect upon the surface treatment be used.

C. Determination of the Quantities of Materials to be Applied. The Contractor shall place a minimum of three test patches at locations determined by the Engineer. The site or sites selected to apply the test patches should be representative of the various road surfaces on which the surface treatment is to be applied. The detailed instructions for test patch installations are as follows:

Test Patch Installation:

1. The test patch section shall consist of a minimum of three test patches at varying application rates. Recommended variation of 2.3 L/m² both sides of the selected target as suggested in 2.a.1. (below).

2. The test patch shall be a minimum of 1 x 3 meters or big enough to cover sufficient lane width so traffic will drive over it.

   a. Suggested Application for Emulsion and Aggregates

      1. Emulsion
         1.6 liters/meter² for high volume traffic, tight surfaces
         2.0 liters/meter² for low volume, porous surfaces

      2. Aggregate - 1ST (11-13kg/m²)

      The actual amount of aggregate should be determined by weighing the amount of aggregate required to completely cover a one square meter area one aggregate layer thick.
b. Determination of Application Quantities

1. Kilograms of Emulsion Per Patch = Application Rate (liters per square meter) \times\text{Size of Test Patch (square meters)} \times \text{Unit Weight of Emulsion (1.0 kilogram per liter)}.

2. Kilograms of Aggregate Per Patch = Application Rate (kilograms per square meter) \times \text{Size of Patch (square meters)}.

c. Layout Procedure

1. Clean patch area.
2. Mark out patch with chalk and straight edge.
3. In a pre-tared container weigh out determined amount of aggregate for patch.
4. In a pre-tared container, weight out determined amount of emulsion for patch. The emulsion should be at the application temperature and work should proceed rapidly to maintain temperature.
5. Immediately pour the emulsion on the marked patch area, spread with a squeegee until emulsion is evenly spread at uniform thickness throughout the patch area. Squeegeeing should be kept to a minimum to minimize breaking of the emulsion. This whole operation should be done quickly to insure the emulsion doesn't set before cover aggregate is applied.
6. Spread preweighed cover aggregate, by hand, over patch area.
7. With pneumatic tire roller, roll the patch area a minimum of three complete passes.

d. Evaluation of Test Patches.

After a minimum of 14 days of traffic over the test patches, the Engineer will evaluate the test patches for aggregate retention, flushing or bleeding, aggregate embedment and bonding to the existing pavement.

The selected patch should retain a minimum of 95% of the cover aggregate, show no signs of flushing or bleeding, have 70% embedment of aggregate into the emulsion residue and be securely bonded to the existing pavement.

D. Preparation of Surface. A self-propelled power broom shall be used to clear any loose material from the pavement surface immediately prior to the application of bituminous material. Potholes shall be patched with an appropriate asphalt concrete truing and leveling course approved by the Engineer. These patched areas shall be fog sealed with the same bituminous material selected for the project at a rate of 1.40 liters/square meter.

Manhole covers, drop inlets, catch basins, curb any other structure within the roadway area shall be protected against the application of surface treatment material.

E. Application of Bituminous Material. Bituminous material shall be applied by means of a pressure distributor in a uniform, continuous spread over the section to be treated and within the temperature range specified. The quantity of bituminous material to be used shall be that established by the test patch unless modified by the Engineer. The allowable variation from this quantity shall not exceed 0.10 liters per square meter. A strip of building paper, at least 1 meter in width and with a length equal to that of the spray bar of the distributor plus 300 millimeters, shall be used at the beginning of each spread. If the cut-off is not positive, the use of paper may be required at the end of each spread. The paper shall be removed and disposed of in a satisfactory manner. The distributor shall be moving forward at the proper application speed at the time the spray bar is opened. If any skipped areas or deficiencies occur, the operation shall be immediately stopped. Junctions of spreads
shall be carefully made to assure a smooth riding surface and the deficient areas corrected in a 

manner approved by the Engineer.

The bituminous material shall not be applied more than 60 meters in advance of the self-propelled 

stone spreader.

Under no circumstances shall operations proceed in such a manner that bituminous material will 5 

be allowed to chill, set up, dry, or otherwise impair retention of the cover aggregate. Traffic will not 

be allowed to run on uncovered bituminous material.

The distributor, when not spreading, shall be parked so that the spray bar or mechanism will not 

drip bituminous material on the surface of the traveled way.

F. Application of the Cover Aggregate. Immediately following the application of bituminous 10 

material, cover aggregate shall be spread at the rate established for the test patch unless modified by 

the Engineer. The allowable variation from this rate shall not exceed two kilograms per square meter. 

All aggregate used for bituminous surface treatment shall be clean as determined by the Engineer at 

the time of placement.

Spreading shall be accomplished in such a manner that the tires of the aggregate spreader at no 15 
time contact the uncovered and newly applied bituminous material.

Immediately after the cover aggregate is spread, any deficient areas shall be covered by additional 

material. Pneumatic tire rolling shall begin immediately. The initial pass shall be completed within 

5 minutes of the application of the bituminous material and shall be continued until three complete 

coverages are obtained within 30 minutes of the application of the bituminous material. Pneumatic 20 
tire rollers shall come to a complete stop prior to reversing direction.

Any free bituminous material on the surface caused by a deficient amount of cover aggregate shall 

be covered by broadcasting additional aggregate over the deficient area. Any excess aggregate 

material shall be swept from the surface in a manner acceptable to the Engineer.

G. Opening to Traffic. “Loose Stone” signs meeting requirements of NYS MUTCD shall be 25 

posted at 1.6 kilometer intervals throughout the length of the project. These signs shall be erected 

before surface treatment starts and removed after contract is accepted.

Unless otherwise specified, the highway shall be kept open to traffic at all times. Traffic shall be 

discontinued on the lane being surface treated; and as soon as the final layer is applied and rolled, 

controlled traffic may be permitted thereon. Traffic shall be maintained at a speed not to exceed 24 30 

km/h for a period of four hours after placement of the surface treatment by the use of two-way radio 

equipped patrol vehicles in accordance with the maintenance and protection of traffic details shown 

on the plans. All patrol vehicles shall be equipped with signs meeting the requirements of Section 

254.5 of the Manual of Uniform Traffic Control Devices. The required number of two-way radio-

equipped patrol vehicles shall be as follows:

<table>
<thead>
<tr>
<th>Lane Kilometers Length of Surfacing for past 4 hours</th>
<th>Number of Patrol Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6</td>
<td>1</td>
</tr>
<tr>
<td>3.2</td>
<td>3</td>
</tr>
<tr>
<td>4.8 or more</td>
<td>4</td>
</tr>
</tbody>
</table>

Immediately after completion of surface treatment, the section shall be posted for speed limit 

of 48 km/h for a period of three days. The signs should be posted at 800 meter intervals and signs 

showing other speed limitations should be covered for this period. All construction signs shall meet 

the requirements of the NYS MUTCD.

410-3.02 - Bituminous Surface Treatment - Shoulders. The requirements of §410-3.01 shall apply 45 

except that the sections labeled “A. Weather and Seasonal Limitations,” “C. Determinations of the 

Quantities of Material to be Applied” and “G. Opening to Traffic” do not apply. The following
modifications to A. Weather and Seasonal Limitations and C. Determination of the Quantities of Materials to be applied do apply in their place.

A. Weather and Seasonal Limitations. Bituminous material shall not be applied on a wet surface, when the ambient temperature is less than 10°C and rising, or when weather conditions would prevent proper construction of the surface treatment. The surface on which the bituminous material is applied shall be placed only during the period of May 1st up to and including the last Saturday of September.

C. Determination of the Quantities of Materials to be Applied. The quantity of bituminous material to be used shall be in the range of 1.6-2.3 liters/square meter unless otherwise directed by the Engineer. The cover aggregate shall be spread in a single stone thickness in the range of 8 to 14 kilograms/square meter for the indicated aggregate unless otherwise directed by the Engineer. The actual quantity of bituminous material shall be such that a minimum of 70% of the aggregate particle is embedded in the bituminous material. The actual quantities used will be determined visually by the Engineer at the time of placement.

410-4 METHOD OF MEASUREMENT. Bituminous surface treatments for pavement and shoulders will be measured by the number of square meters of compacted material in place making no deductions for minor untreated areas such as catch basins and manholes. The bituminous material will be measured by the number liters used.

410-5 BASIS OF PAYMENT

410-5.01 Bituminous Surface Treatment-Pavement and Shoulders. The unit price bid per square meter shall include the cost of all labor, materials, and equipment necessary to perform the work except:

1. Bituminous material used for treatment will be paid under separate item.
2. Patching material will be paid for under the item for Truing and Leveling.
3. Construction signs will be paid for under appropriate items.

The cost of installing test patches and furnishing patrol vehicles when surface treating pavements shall be included in the unit bid price for the surface treatment.

410-5.02 Bituminous Material - Pavement and Shoulders. The unit price bid per liter shall include all the cost of labor, materials, and equipment necessary to perform the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>410.04 M</td>
<td>Bituminous Surface Treatment (Pavement)</td>
<td>Square Meter</td>
</tr>
<tr>
<td>410.05 M</td>
<td>Bituminous Surface Treatment (Shoulders)</td>
<td>Square Meter</td>
</tr>
<tr>
<td>410.07 M</td>
<td>Bituminous Material (Pavement and Shoulders)</td>
<td>Liter</td>
</tr>
</tbody>
</table>

SECTION 411 - STABILIZED GRAVEL SURFACE COURSE

411-1 DESCRIPTION. The work shall consist of placing a stabilized gravel surface course with additive, if specified, on a prepared base in accordance with these specifications and in conformance with the lines and grades shown on the plans or as directed by the Engineer.

411-2 MATERIALS

411-2.01 Gravel. The gravel shall conform to the following gradation requirements:
§411-2

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 mm</td>
<td>100</td>
</tr>
<tr>
<td>6.3 mm</td>
<td>30 - 65</td>
</tr>
<tr>
<td>75 µm</td>
<td>10 - 20</td>
</tr>
</tbody>
</table>

Particles passing the 425 µm sieve size shall have a maximum liquid limit of 30 and a plasticity index ranging from 3 to 8. The maximum loss in 4 cycles of the Magnesium Sulfate Soundness Test shall be 30. If the gravel as obtained from the bank is deficient in any of the requirements specified, such deficiency shall be corrected by screening, processing and/or blending with other acceptable materials before stockpiling. The requirements of §304-2.03, Stockpiling shall apply to all gravel furnished for this work.

411-2.02 Chemical Additives. Chemical additives, if required, shall meet the applicable requirements of the following sections:

- Calcium Chloride
- Sodium Chloride

411-3 CONSTRUCTION DETAILS

411-3.01 Placement. After the base has been brought to grade and cross section, as shown on the plans, thoroughly compacted, and approved by the Engineer, the Contractor shall place the stabilized gravel surface course.

When calcium or sodium chloride additives are specified, they shall be added by an approved mechanical distributor after the gravel has been spread and prior to the addition of water. Calcium chloride shall be added in the amount of 10 grams per square meter per millimeter of compacted thickness of the course. Sodium chloride shall be added at a rate of 40 grams per square meter per millimeter of compacted thickness of the course which is equivalent to approximately 2% of sodium chloride based on dry weight of aggregate. Water shall then be added to the material in amounts as directed by the Engineer.

If the Contractor so elects, only the calcium chloride may be added to the gravel material as a water solution. In such cases, however, the Contractor shall submit to the Engineer a detailed description in writing, of proposed procedure of operations, and construction shall not be started until the Engineer’s approval is obtained in writing.

411-3.02 Mixing

A. Gravel Without Additive. Water shall be thoroughly dispersed by any appropriate methods which will insure a uniform consistency and moisture content within the limits for proper compaction.

B. Gravel With Additive. The water and the chemical additive shall be thoroughly and uniformly incorporated with the gravel for the full depth of the course, by mixing with an approved power-driven rotary type mixing machine. Mixing shall continue until the material is of uniform composition. The Contractor may elect to mix the materials in an approved plant of the pugmill type. Mixing by blading, shoveling and/or scooping will not be permitted.

411-3.03 Compaction. When the in-place material is of uniform consistency and has a moisture content within the limits for proper compaction, as determined by the Engineer, it shall be thoroughly compacted by the use of self-propelled pneumatic tired or vibratory compactor in accordance with the requirements of §203-3.12. During the compaction operation, light grading shall be done as required to maintain the surface of the course true to grade and cross-section. In confined areas, inaccessible to rollers, mechanical rammers shall be used to obtain the compaction required in §203-3.12. The finished surface of the stabilized gravel course shall be rolled in a float of free water with a smooth steel wheeled...
roller weighing not less than nine metric tons. In all cases, the material must be so thoroughly compacted that it will not displace under the roller.

This course shall not be placed in excess of 150 linear meters without being shaped, compacted and finish rolled.

When posts for guide railing are to be installed adjacent to a stabilized gravel surface course, extreme care shall be taken during installation of the posts so that the stabilized gravel surface course is not disturbed.

411-3.04 Surface Preparation for Treatment

A. Calcium Chloride Stabilized Gravel Surface Course. After the calcium chloride stabilized gravel surface course has been completed, water shall be applied to the surface in amounts as directed by the Engineer. Immediately following the application of water, calcium chloride shall be applied on the surface with an approved mechanical spreader at the rate of one-quarter kilogram per square meter.

B. Sodium Chloride Stabilized Gravel Surface Course. After the sodium chloride stabilized gravel surface course has been brought to final grade and cross section and rolling has been completed, the course shall be permitted to cure for a minimum of 10 days at a minimum temperature of 15°C before any additional pavement courses are applied. The cured completed surface course shall be broomed to remove dust, before application of the overlying course.


411-4 METHOD OF MEASUREMENT. The quantity for payment, in cubic meters of material, shall be computed within the payment lines shown on the plans or otherwise ordered in writing by the Engineer, and in accordance with the plans and specifications.

411-5 BASIS OF PAYMENT. The unit bid price per cubic meter shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, except that the water, the calcium chloride, and the sodium chloride shall be paid for under their appropriate items. No direct payment will be made for any losses of material which may result from shrinkage, compaction, foundation settlement, waste, overflow, erosion, leakage, or any other causes; the cost of such losses shall be included in the price bid for this work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>411.01 M</td>
<td>Stabilized Gravel Surface Course</td>
<td>Cubic M</td>
</tr>
<tr>
<td>411.02 M</td>
<td>Calcium Chloride Stabilized Gravel Surface Course</td>
<td>Cubic M</td>
</tr>
<tr>
<td>411.03 M</td>
<td>Sodium Chloride Stabilized Gravel Surface Course</td>
<td>Cubic M</td>
</tr>
</tbody>
</table>

SECTIONS 412 THRU 489 (VACANT)

SECTION 490 - COLD MILLING

490-1 DESCRIPTION. This work shall consist of the milling, shaping and removal of portions of existing surfaces by a cold milling process, and subsequent cleaning, utilizing equipment and procedures meeting the requirements in this specification.

The work shall consist of Miscellaneous Cold Milling or Production Cold Milling of bituminous or portland cement concrete as indicated in the contract documents and as shown on the plans.
§490-2 MATERIALS

490-2.01 Equipment. Milling machines shall be power operated, self-propelled machines capable of removing the desired thickness of existing surfaces. The machines shall have sufficient power, traction and stability to accurately maintain depth of cut and slope. They shall be capable of producing a finished profile and cross slope to within 6 mm of that required and shall produce a uniform surface texture free from gouges and ridges greater than 10 mm in depth.

The machines shall be equipped with a means to control dust and other particulate matter created by the cutting action.

The machines shall have an integral loading system or sufficient equipment shall be provided to accomplish complete removal of milled material at a rate equivalent to the milling rate.

Vacuum trucks, street sweepers or power brooms shall be used to clean the milled surfaces. The Engineer may disallow the use of power brooms in urban, residential or other sensitive areas if the dust raised by the broom is deemed by the Engineer to be objectionable.

490-2.02 Disposal of Material. Material removed during the milling process, including foreign debris within or on the pavement, shall become the property of the Contractor and shall be disposed of at a site obtained by the Contractor.

490-3 CONSTRUCTION DETAILS

490-3.01 General. Milling shall be performed at the locations and in accordance with the details indicated on the plans.

When indicated on the plans, profile and cross slope shall be controlled by a taut reference string line. The reference elevation and string line shall be established by the Contractor and subject to the approval of the Engineer.

Areas not accessible to the milling machine, such as around and/or adjacent to inlets, manholes, curbs and transverse joints on structures, may be removed by a small milling machine, handwork or other methods approved by the Engineer.

All milled material, including that removed by other means, shall be immediately removed from the milled surfaces and adjacent surfaces. Surfaces shall be cleaned of all fines and dust prior to opening to traffic. The Contractor shall conduct operations in such a manner that dust is controlled and is not objectionable. Milled and adjacent surfaces shall be cleaned again, as directed by the Engineer, prior to the placement of tack coats, or pavement courses if traffic has been allowed on the milled surface and/or if more than 48 hours have elapsed since the initial cleaning.

Milled longitudinal or transverse vertical faces exceeding 30 mm in height that would be exposed to traffic during non-work hours shall be sloped or tapered in a manner approved by the Engineer so as not to create a traffic hazard. Milling operations shall be conducted to preclude the possibility of pavement runoff collecting along milled joints and creating a traffic hazard.

The Contractor shall maintain drainage at catch basins, according to the details shown on the plans, or in a manner approved by the Engineer.

When working adjacent to traffic, the Contractor shall immediately remove material that is spilled on the traveled way.

Milled surfaces to be overlaid with asphalt concrete shall be covered with at least a single course of asphalt concrete before the end of the paving season. Portland cement concrete overlays shall be completed over milled surfaces before the end of the paving season. Damage to milled surfaces resulting from traffic or other causes such as, but not limited to, raveling, fuel spillage or any contaminants which would inhibit bond, shall be repaired or remilled by the Contractor in a manner approved by the Engineer.

490-3.02 Production Cold Milling. Production cold milling of bituminous or portland cement surfaces shall be performed in accordance with the details and at the locations indicated on the plans.
**490-3.03 Miscellaneous Cold Milling.** Miscellaneous cold milling of bituminous or portland cement surfaces shall be performed in accordance with the details and at the locations indicated on the plans.

**490-4 Method of Measurement**

The quantity shall be measured as the number of square meters of pavement surface milled in accordance with the plans and this specification.

In no case will a deduction in area be made for minor unmilled areas due to catch basins, manholes, transverse joints, or minor low areas in pavements from the measured surface area that has been milled. Minor unmilled or low areas are those areas of 10 square meters or less.

**490-5 Basis of Payment**

The unit price bid per square meter shall include the cost of furnishing all labor and equipment necessary to complete the milling, including the removal of pavement by other means, the removal and disposal of milled material, the removal and hauling of milled material to a designated storage area when indicated in the contract documents and cleaning the resultant surface after milling. No payment will be made for additional cleaning that may be necessary just prior to placement of any overlaying pavement courses or tack coats. The cost of maintaining drainage shall be included in the price bid for maintenance and protection of traffic. The cost of providing temporary pavement wedges of asphalt concrete around drainage structures, manholes, valve boxes, bridge abutments and beginning and ends of milled pavement shall be paid for as outlined in §619-5.12 of the Standard Specifications.

Tack coats and overlay courses shall be paid for under their respective items.

**Payment will be made under:**

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<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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<tr>
<td>490.10 M</td>
<td>Production Cold Milling Concrete</td>
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<td>Production Cold Milling of Portland Cement Concrete</td>
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<td>Miscellaneous Cold Milling of Bituminous Concrete</td>
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<tr>
<td>490.40 M</td>
<td>Miscellaneous Cold Milling of Portland Cement Concrete</td>
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