## Item TNP-401 State Material Specification for Asphalt Mix Pavement

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This specification can be used for the base and surface courses for airfield flexible pavements subject to aircraft loadings of gross weights less than 60,000 pounds (27216 kg) for projects approved to use federal funding. The Tennessee Aeronautics Division (TAD) has requested and received FAA approval to use this specification.

The dimensions and depth of the pavement this specification applies to shall be as defined by the Engineer’s pavement design performed in accordance with advisory circular (AC) 150/5320-6, Airport Pavement Design and Evaluation and FAARFIELD, the FAA’s pavement design software. The current version of FAARFIELD is available at: [www.faa.gov/airports/engineering/design\_software/](http://www.faa.gov/airports/engineering/design_software/)

Based on TAD guidance and this State Material Specification, TDOT D Mix is to be used as a surface course for pavements. For any lift of asphalt 2 inches or more below the final surface lift elevation, TDOT BM-2 is to be used as a base course.

This specification requires the job mix formula be prepared according to Tennessee DOT Materials and Tests Standard Operating Procedure (SOP) 3-4 Submittal and Approval of Hot Mix Asphalt Mix Designs.

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DESCRIPTION

**TNP 401-1.1** This item shall consist of pavement courses composed of mineral aggregate and asphalt binder mixed in a central mixing plant and placed on a prepared base or stabilized course in accordance with these specifications and shall conform to the lines, grades, thicknesses, and typical cross-sections shown on the plans. Each course shall be constructed to the depth, typical section, and elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course.

MATERIALS

**TNP 401-2.1 Aggregate.** Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, natural sand, and mineral filler, as required. The aggregates should have no known history of detrimental pavement staining due to ferrous sulfides, such as pyrite. Coarse aggregate is the material retained on the No. 4 (4.75 mm) sieve. Fine aggregate is the material passing the No. 4 (4.75 mm) sieve.

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Some aggregates may contain ferrous sulfides and iron oxides which can cause stains on exposed surfaces. In areas where staining has been a problem or is suspected, the Engineer should verify that producers and aggregate suppliers have taken steps to minimize the inclusion of any ferrous sulfides or iron oxides in aggregate to be used in the project.

On large projects and/or projects that span multiple construction seasons, additional aggregate tests may be necessary to validate consistency of aggregate produced and delivered for the project.

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**a. Coarse aggregate.** Coarse aggregate shall consist of sound, tough, durable particles, free from films of matter that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. Coarse aggregate material requirements are given in the table below.

Coarse Aggregate Material Requirements

| Material Test | Requirement | Standard |
| --- | --- | --- |
| Resistance to Degradation  | Loss: 40% maximum  | ASTM C131 |
| Soundness of Aggregates by Use of Sodium Sulfate **or** Magnesium Sulfate | Loss after 5 cycles:9% maximum using Sodium sulfate  | ASTM C88 |
| Clay lumps and friable particles | 1.0 % maximum | ASTM C142 |
| Percentage of Fractured Particles | Minimum 70% by weight of particles with at least two fractured faces and 65% with at least one fractured face1 | ASTM D5821 |
| Flat, Elongated, or Flat and Elongated Particles | 10% maximum, by weight, of flat, elongated, or flat and elongated particles at 5:1 2 | ASTM D4791 |
| Bulk density of slag 3 | Weigh not less than 70 pounds per cubic foot (1.12 Mg/cubic meter)  | ASTM C29.  |

1 The area of each face shall be equal to at least 75% of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.

2 A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

3 Only required if slag is specified.

**b. Fine aggregate.** Fine aggregate shall consist of clean, sound, tough, durable, angular shaped particles produced by crushing stone, slag, or gravel and shall be free from coatings of clay, silt, or other objectionable matter. Natural (non-manufactured) sand may be used to obtain the gradation of the fine aggregate blend or to improve the workability of the mix. Fine aggregate material requirements are listed in the table below.

Fine Aggregate Material Requirements

| Material Test | Requirement | Standard |
| --- | --- | --- |
| Liquid limit | 25 maximum | ASTM D4318 |
| Plasticity Index | 4 maximum | ASTM D4318 |
| Soundness of Aggregates by Use of Sodium Sulfate **or** Magnesium Sulfate | Loss after 5 cycles:12% maximum using Sodium sulfate  | ASTM C88 |
| Clay lumps and friable particles | 1.0% maximum | ASTM C142 |
| Sand equivalent | **[**45 minimum**]** | ASTM D2419 |
| Natural Sand | 25 % maximum by weight of total aggregate | ASTM D1073 |

**c. Sampling.** ASTM D75 shall be used in sampling coarse and fine aggregate.

**TNP 401-2.2 Mineral filler.** Mineral filler (baghouse fines) may be added in addition to material naturally present in the aggregate. Mineral filler shall meet the requirements of ASTM D242.

Mineral Filler Requirements

| Material Test | Requirement | Standard |
| --- | --- | --- |
| Plasticity Index | 4 maximum | ASTM D4318 |

**TNP 401-2.3 Asphalt binder.** Asphalt binder shall conform to TDOT Section 904 Performance Grade (PG) **[**      **]**.

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The Engineer should use the following guidance in selecting the asphalt binder PG to include in the above paragraph. Typical TDOT mixtures use a base asphalt grade of PG 64-22 .

Prior to bumping for traffic, the initial asphalt binder PG should be consistent with the recommendations of the applicable State DOT requirements for pavement environmental conditions.

Required Grade Bump (and the suggested PG binder for Tennessee mixtures)

| **Aircraft Gross Weight** | **High Temperature Adjustment to Asphalt binder Grade** |
| --- | --- |
| **All Pavement Types**  | **Pavement area with slow or stationary aircraft** |
| **≤ 12,500 lbs (5670 kg)**  | **PG 64-22**  | **1 Grade (PG 70-22)** |
| **< 60,000 lbs (27216 kg)** | **1 Grade (PG 70-22)** | **2 Grade (PG 76-22)** |

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**TNP 401-2.4 Anti-stripping agent.** Any anti-stripping agent or additive (anti-strip) shall be heat stable and shall not change the asphalt binder grade beyond specifications. Anti-strip shall be an approved material of the Tennessee Department of Transportation.

COMPOSITION

**TNP 401-3.1 Composition of mixture(s).** The asphalt mix shall be composed of a mixture of aggregates, filler and anti-strip agent if required, and asphalt binder. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF).

**TNP 401-3.2 Job mix formula (JMF) laboratory.** The laboratory used to develop the JMF shall be qualified under the Tennessee DOT Materials and Tests Standard Operating Procedure (SOP 1-4) *Laboratory Qualification Requirements.*  A copy of the laboratory’s current qualification documentation and qualification test methods shall be submitted to the Resident Project Representative (RPR) prior to start of construction.

**TNP 401-3.3 Job mix formula (JMF).** No asphalt mixture shall be placed until an acceptable mix design has been submitted to the RPR for review and accepted in writing. The RPR’s review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

When the project requires asphalt mixtures of differing aggregate gradations and/or binders, a separate JMF shall be submitted for each mix. Add anti-stripping agent to meet tensile strength requirements.

The JMF shall be prepared by an accredited laboratory that meets the requirements of paragraph TNP 401-3.2. The asphalt mixture shall be designed and submitted using procedures contained in Tennessee DOT Materials and Tests Standard Operating Procedure (SOP) 3-4 *Submittal and Approval of Hot Mix Asphalt Mix Designs***.**

Should a change in sources of materials be made, a new JMF must be submitted to the RPR for review and accepted in writing before the new material is used. After the initial production JMF has been approved by the RPR and a new or modified JMF is required for whatever reason, the subsequent cost of the new or modified JMF, including a new control strip when required by the RPR, will be borne by the Contractor.

The RPR may request samples at any time for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

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Select the method for mix design, Marshall Method, ASTM D6926 or Gyratory Method, ASTM D6925.

The design criteria in Table 1 are target values necessary to meet the acceptance requirements contained in paragraph TNP 401-6.2. The criteria is based on a production process which has a material variability with the following standard deviations: Air Voids = 0.65%.

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The JMF shall be submitted in writing by the Contractor at least [   30   ] days prior to the start of paving operations. The JMF shall be developed within the same construction season using aggregates proposed for project use.

The JMF shall be dated, and stamped or sealed by the Certified Laboratory Technician of the laboratory and shall include the following items as a minimum:

* Manufacturer’s Certificate of Analysis (COA) for the asphalt binder used in the JMF in accordance with paragraph TNP 401-2.3.  Certificate of asphalt performance grade is with modifier already added, if used and must indicate compliance with ASTM D6373. For plant modified asphalt binder, certified test report indicating grade certification of modified asphalt binder.
* Manufacturer’s Certificate of Analysis (COA) for the anti-stripping agent if used in the JMF in accordance with paragraph TNP 401-2.4.
* Certified material test reports for the course and fine aggregate and mineral filler in accordance with paragraphs TNP 401-2.1.
* Percent passing each sieve size for individual gradation of each aggregate cold feed and/or hot bin; percent by weight of each cold feed and/or hot bin used; and the total combined gradation in the JMF.
* Specific Gravity and absorption of each coarse and fine aggregate.
* Percent natural sand.
* Percent fractured faces.
* Percent by weight of flat particles, elongated particles, and flat and elongated particles (and criteria).
* Percent of asphalt.
* Number of blows or gyrations
* Laboratory mixing and compaction temperatures.
* Supplier-recommended field mixing and compaction temperatures.
* Plot of the combined gradation on a 0.45 power gradation curve.
* Graphical plots of air voids, voids in the mineral aggregate (VMA), and unit weight versus asphalt content. To achieve minimum VMA during production, the mix design needs to account for material breakdown during production.
* Tensile Strength Ratio (TSR).
* Type and amount of Anti-strip agent when used.
* Asphalt Pavement Analyzer (APA) results.
* Date the JMF was developed. Mix designs that are not dated or which are from a prior construction season shall not be accepted.
* **[** Percentage and properties (asphalt content, asphalt binder properties, and aggregate properties) of reclaimed asphalt mix pavement (RAP) in accordance with paragraph TNP 401-3.4.**]**
* **[**      **]**

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Delete if RAP is not allowed per paragraph TNP 401-3.4.

The Owner may add additional testing to meet local conditions with FAA concurrence.

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Table 1. Asphalt Design Criteria

| Test Property | Value | Test Method |
| --- | --- | --- |
| Number of blows or gyrations | 75 blows or 65 gyrations |  |
| Air voids (%) | 4.0 +/- 0.2 percent | ASTM D3203 |
| Percent voids in mineral aggregate (VMA), minimum | See Table 2 | ASTM D6995 |
| Tensile Strength Ratio (TSR)1 | not less than 80 at a saturation of 70-80% | ASTM D4867 |

1. Test specimens for TSR shall be compacted at 7 ± 1.0 % air voids. In areas subject to freeze-thaw, use freeze-thaw conditioning in lieu of moisture conditioning per ASTM D4867.

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75 blows or 65 gyrations shall be specified for all airports.

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The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory sieves, will conform to the gradation or gradations specified in Table 2 when tested in accordance with ASTM C136 and ASTM C117.

The gradations in Table 2 represent the limits that shall determine the suitability of aggregate for use from the sources of supply; be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa.

Table 2. Aggregate - Asphalt Pavements

| Sieve Size | Percentage by WeightPassing Sieve |
| --- | --- |
| 1.25 inch (37.5 mm) | \* |
| 3/4 inch (19.0 mm) | \* |
| 1/2 inch (12.5 mm) | \* |
| 3/8 inch (9.5 mm) | \* |
| No. 4 (4.75 mm) | \* |
| No. 8 (2.36 mm) | \* |
| No. 16 (1.18 mm) | \* |
| No. 30 (600 µm) | \* |
| No. 50 (300 µm) | \* |
| No. 100 (150 µm) | \* |
| No. 200 (75 µm) | \* |
| **Minimum Voids in Mineral Aggregate (VMA)1** | \* |
| Asphalt Percent: |
|  Stone or gravel | \* |
|  Slag | \* |
| **Recommended Minimum Construction Lift Thickness** | \* |

1To achieve minimum VMA during production, the mix design needs to account for material breakdown during production.

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The aggregate gradation shall be specified by the Engineer from the gradations shown in this note. The gradation shall be inserted into Table 2. Asterisks denote insert points.

Table 2. Aggregate - Asphalt Pavements

| Sieve Size | Percentage by Weight Passing Sieves |
| --- | --- |
| TDOT D Mix1 | TDOT BM2 Mix1 |
| **1.25 inch (37.5 mm)** | **-** | **100** |
| **3/4 inch (19.0 mm)** | **100** | **81-93** |
| **1/2 inch (12.5 mm)** | **95-100** | **-** |
| **3/8 inch (9.5 mm)** | **80-93** | **57-73** |
| **No. 4 (4.75 mm)** | **54-76** | **40-56** |
| **No. 8 (2.36 mm)** | **35-57** | **28-43** |
| **No. 16 (1.18 mm)** | **-** | **-** |
| **No. 30 (600 µm)** | **17-29** | **13-25** |
| **No. 50 (300 µm)** | **10-18** | **9-19** |
| **No. 100 (150 µm)** | **3-10** | **6-10** |
| **No. 200 (75 µm)** | **0-6.5** | **2.5-6.5** |
| **Minimum Voids in Mineral Aggregate (VMA)** | **14** | **13.5** |
| **Asphalt percent by total weight of mixture:** |
| **Stone or gravel** | **5.7-7.0** | **4.2 - 6.2** |
| **Recommended Minimum Construction Lift Thickness** | **2 inch** | **2.5 inch** |

1. The TDOT D and BM2 Mixtures shall be designed based on section 307, 407, 411, 903, and 904 of the most current *Tennessee Standard Specifications for Road and Bridge Construction* or as amended by supplemental specification. Once the asphalt content is set and the JMF approved, the requirements in this State Airport Material Specification. supersede TDOT standard construction requirements where they differ.

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TNP 401-3.4 Reclaimed asphalt pavement (RAP). Reclaimed asphalt shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt. The RAP shall be of a consistent gradation and asphalt content and properties. RAP shall be processed over more than one screen, producing sources of various maximum particle sizes (e.g., ¾ to ½ inch, ½ inch to #4, etc.). When RAP is fed into the plant, the maximum RAP size shall not exceed one inch (25 mm). The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D2172 using the appropriate dust correction procedure. The JMF shall meet the requirements of paragraph TNP 401-3.3. The amount of RAP shall be limited to 20 percent maximum. In addition to the requirements of paragraph TNP 401-3.3, the JMF shall indicate the percent of reclaimed asphalt pavement and the percent and grade of new asphalt binder.

RAP containing Coal Tar shall not be used. Coal Tar surface treatments must be removed prior to recycling underlying asphalt material.

Recycled asphalt shingles (RAS) shall not be used.

**TNP 401-3.5 Control Strip. [**A control strip is not required.**] [** Full production shall not begin until an acceptable control strip has been constructed and accepted in writing by the RPR**.**  The Contractor shall prepare and place a quantity of asphalt according to the JMF. The underlying grade or pavement structure upon which the control strip is to be constructed shall be the same as the remainder of the course represented by the control strip.

The Contractor will not be allowed to place the control strip until the Contractor quality control program (CQCP), showing conformance with the requirements of paragraph TNP 401-5.1, has been accepted, in writing, by the RPR.

The control strip will consist of at least 250 tons (227 metric tons) or 1/2 sublot, whichever is greater. The control strip shall be placed in two lanes of the same width and depth to be used in production with a longitudinal cold joint. The cold joint must be cut back in accordance with paragraph TNP 401-4.14 using the same procedure that will be used during production. The cold joint for the control strip will be an exposed construction joint at least four (4) hours old or when the mat has cooled to less than 175°F (71°C). The equipment used in construction of the control strip shall be the same type, configuration and weight to be used on the project.

The control strip will be considered acceptable by the RPR if the gradation, asphalt content, and VMA are within the action limits specified in paragraph TNP 401-5.5a; and Mat density greater than or equal to 94.5%, air voids 3.5% +/- 1%, and joint density greater than or equal to 92.5%.

If the control strip is unacceptable, necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made and another control strip shall be placed. Unacceptable control strips shall be removed at the Contractor’s expense.

The control strip will be considered one lot for payment based upon the average of a minimum of 3 samples (no sublots required for control strip). Payment will only be made for an acceptable control strip in accordance with paragraph TNP 401-8.1 using a lot pay factor equal to 100.   **]**

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For small projects, less than 3,000 tons (2722 metric tons), a control strip is not required.

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CONSTRUCTION METHODS

**TNP 401-4.1 Weather limitations.** The asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 4. The temperature requirements may be waived by the RPR, if requested; however, all other requirements including compaction shall be met.

Table 4. Surface Temperature Limitations of Underlying Course

| Mat Thickness | Base Temperature (Minimum) |
| --- | --- |
| °F | °C |
| 3 inches (7.5 cm) or greater | 40 1 | 4  |
| Greater than 2 inches (50 mm)but less than 3 inches (7.5 cm) | 45 | 7  |

**TNP 401-4.2 Asphalt plant.** Plants used for the preparation of asphalt shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M156 including the following items.

**a. Inspection of plant.** The RPR, or RPR’s authorized representative, shall have access, at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant: verifying weights, proportions, and material properties; and checking the temperatures maintained in the preparation of the mixtures.

**b. Storage bins and surge bins.** The asphalt mixture stored in storage and/or surge bins shall meet the same requirements as asphalt mixture loaded directly into trucks. Asphalt mixture shall not be stored in storage and/or surge bins for a period greater than twelve (12) hours. If the RPR determines there is an excessive heat loss, segregation, or oxidation of the asphalt mixture due to temporary storage, temporary storage shall not be allowed.

**TNP 401-4.3 Aggregate stockpile management.** Aggregate stockpiles shall be constructed in a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the asphalt batch plant. Aggregates that have become segregated or mixed with earth or foreign material shall not be used.

A continuous supply of materials shall be provided to the work to ensure continuous placement.

**TNP 401-4.4 Hauling equipment.** Trucks used for hauling asphalt shall have tight, clean, and smooth metal beds. To prevent the asphalt from sticking to the truck beds, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other material approved by the RPR. Petroleum products shall not be used for coating truck beds. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers shall be securely fastened.

**TNP 401-4.4.1 Material transfer vehicle (MTV).** **[**Material transfer vehicles used to transfer the material from the hauling equipment to the paver, shall use a self-propelled, material transfer vehicle with a swing conveyor that can deliver material to the paver without making contact with the paver. The MTV shall be able to move back and forth between the hauling equipment and the paver providing material transfer to the paver, while allowing the paver to operate at a constant speed. The Material Transfer Vehicle will have remixing and storage capability to prevent physical and thermal segregation.**] [**Material transfer vehicles are not required.**]**

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An MTV is recommended for all pavements where the weight of the MTV will not damage the pavement structure. The use of an MTV is optional for shoulder construction.

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**TNP 401-4.5 Asphalt pavers.** Asphalt pavers shall be self-propelled with an activated heated screed, capable of spreading and finishing courses of asphalt that will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface. The asphalt paver shall be equipped with a control system capable of automatically maintaining the specified screed grade and elevation.

If the spreading and finishing equipment in use leaves tracks or indented areas, or produces other blemishes in the pavement that are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued.

The paver shall be capable of paving to a minimum width specified in paragraph TNP 401-4.12.

**TNP 401-4.6 Rollers.** The number, type, and weight of rollers shall be sufficient to compact the asphalt to the required density while it is still in a workable condition without crushing of the aggregate, depressions or other damage to the pavement surface. Rollers shall be in good condition, clean, and capable of operating at slow speeds to avoid displacement of the asphalt. All rollers shall be specifically designed and suitable for compacting asphalt concrete and shall be properly used. Rollers that impair the stability of any layer of a pavement structure or underlying soils shall not be used.

**TNP 401-4.7 Density device.** The Contractor shall have on site a density gauge during all paving operations in order to assist in the determination of the optimum rolling pattern, type of roller and frequencies, as well as to monitor the effect of the rolling operations during production paving. The Contractor shall supply a qualified technician during all paving operations to calibrate the gauge and obtain accurate density readings for all new asphalt. These densities shall be supplied to the RPR upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician.

**TNP 401-4.8 Preparation of asphalt binder.** The asphalt binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the asphalt binder to the mixer at a uniform temperature. The temperature of unmodified asphalt binder delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles, but shall not exceed 325°F (160°C) when added to the aggregate. The temperature of modified asphalt binder shall be no more than 350°F (175°C) when added to the aggregate.

**TNP 401-4.9 Preparation of mineral aggregate.** The aggregate for the asphalt shall be heated and dried. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates. The temperature of the aggregate and mineral filler shall not exceed 350°F (175°C) when the asphalt binder is added. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

**TNP 401-4.10 Preparation of Asphalt mixture.** The aggregates and the asphalt binder shall be weighed or metered and mixed in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to achieve 95% of coated particles. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. The moisture content of all asphalt upon discharge shall not exceed 0.5%.

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For batch plants, wet mixing time begins with the introduction of asphalt binder into the mixer and ends with the opening of the mixer discharge gate. Mixing time should be the shortest time required to obtain uniform distribution of aggregate sizes and thorough coating of aggregate particles with asphalt binder.

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**TNP 401-4.11 Application of Prime and Tack Coat.** Immediately before placing the asphalt mixture, the underlying course shall be cleaned of all dust and debris.

**[** A prime coat in accordance with Item TNP-602 shall be applied to aggregate base prior to placing the asphalt mixture. **]**

A tack coat shall be applied in accordance with Item TNP-603 to all vertical and horizontal asphalt and concrete surfaces prior to placement of the first and each subsequent lift of asphalt mixture.

**TNP 401-4.12 Laydown plan, transporting, placing, and finishing.** Prior to the placement of the asphalt, the Contractor shall prepare a laydown plan with the sequence of paving lanes and width to minimize the number of cold joints; the location of any temporary ramps; laydown temperature; and estimated time of completion for each portion of the work (milling, paving, rolling, cooling, etc.). The laydown plan and any modifications shall be approved by the RPR.

Deliveries shall be scheduled so that placing and compacting of asphalt is uniform with minimum stopping and starting of the paver. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to approximately ambient temperature. The Contractor, at their expense, shall be responsible for repair of any damage to the pavement caused by hauling operations.

Contractor shall survey each lift of asphalt surface course and certify to RPR that every lot of each lift meets the grade tolerances of paragraph TNP 401-6.2d before the next lift can be placed.

Edges of existing asphalt pavement abutting the new work shall be saw cut and the cut off material and laitance removed. Apply a tack coat in accordance with TNP-603 before new asphalt material is placed against it.

The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Placement of the asphalt mix shall begin along the centerline of a crowned section or on the high side of areas with a one way slope unless shown otherwise on the laydown plan as accepted by the RPR. The asphalt mix shall be placed in consecutive adjacent lanes having a minimum width of **[**      **]** feet (m) except where edge lanes require less width to complete the area. Additional screed sections attached to widen the paver to meet the minimum lane width requirements must include additional auger sections to move the asphalt mixture uniformly along the screed extension. **[**      **]**

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The Engineer should specify the widest paving lane practicable in an effort to hold the number of longitudinal joints to a minimum. Additional job specific construction limitations may be added as necessary covering such items as echelon paving, hot joint construction, etc.

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The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least one foot (30 cm); however, the joint in the surface top course shall be at the centerline of crowned pavements. Transverse joints in one course shall be offset by at least 10 feet (3 m) from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet (3 m).On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the asphalt may be spread and luted by hand tools.

The RPR may at any time, reject any batch of asphalt, on the truck or placed in the mat, which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or overheated asphalt mixture. Such rejection may be based on only visual inspection or temperature measurements. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the RPR, and if it can be demonstrated in the laboratory, in the presence of the RPR, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

Areas of segregation in the surface course, as determined by the RPR, shall be removed and replaced at the Contractor’s expense. The area shall be removed by saw cutting and milling a minimum of the construction lift thickness as specified in paragraph TNP 401-3.3, Table 2 for the approved mix design. The area to be removed and replaced shall be a minimum width of the paver and a minimum of 10 feet (3 m) long.

**TNP 401-4.13 Compaction of asphalt mixture.** After placing, the asphalt mixture shall be thoroughly and uniformly compacted by self-propelled rollers. The surface shall be compacted as soon as possible when the asphalt has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any surface defects and/or displacement occurring as a result of the roller, or from any other cause, shall be corrected at the Contractor’s expense.

Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross-section, and the required field density is obtained. To prevent adhesion of the asphalt to the roller, the wheels shall be equipped with a scraper and kept moistened with water as necessary.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with approved power tampers.

Any asphalt that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor’s expense. Skin patching shall not be allowed.

**TNP 401-4.14 Joints.** The formation of all joints shall be made to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

The roller shall not pass over the unprotected end of the freshly laid asphalt except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods, all contact surfaces shall be coated with an asphalt tack coat before placing any fresh asphalt against the joint.

Longitudinal joints which have been left exposed for more than four (4) hours; the surface temperature has cooled to less than 175°F (80°C**)**; or are irregular, damaged, uncompacted or otherwise defective shall be cut back with a cutting wheel or pavement saw a maximum of 3 inches (75 mm) to expose a clean, sound, uniform vertical surface for the full depth of the course. All cutback material and any laitance produced from cutting joints shall be removed from the project. Asphalt tack coat in accordance with TNP-603 shall be applied to the clean, dry joint prior to placing any additional fresh asphalt against the joint. The cost of this work shall be considered incidental to the cost of the asphalt.

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Cut back of all cold joints is required as specified above.

The Contractor may provide additional joint density QC by use of joint heaters at the Contractor’s expense. Electrically powered infrared heating equipment should consist of one or more low-level radiant energy heaters to uniformly heat and soften the pavement joints. The heaters should be configured to uniformly heat an area up to 18 inches (0.5 m) in width and 3 inches (75 mm) in depth. Infrared equipment shall be thermostatically controlled to provide a uniform, consistent temperature increase throughout the layer being heated up to a maximum temperature range of 200 to 300°F (93 to 150°C).

Propane powered infrared heating equipment shall be attached to the paving machine and the output of infrared energy shall be in the one to six-micron range. Converters shall be arranged end to end directly over the joint to be heated in sufficient numbers to continuously produce, when in operation, a minimum of 240,000 BTU per hour. The joint heater shall be positioned not more than one inch (25 mm) above the pavement to be heated and in front of the paver screed and shall be fully adjustable. Heaters will be required to be in operation at all times.

The heaters shall be operated so they do not produce excessive heat when the units pass over new or previously paved material.

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**TNP 401-4.15 Saw-cut grooving.** Saw-cut grooves shall be provided as specified in Item P-621. **[**Saw-cut grooving is not required.**]**

**TNP 401-4.16 Diamond grinding.** Diamond grinding shall be completed prior to pavement grooving. Diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive.

Diamond grinding shall be performed with a machine designed specifically for diamond grinding capable of cutting a path at least 3 feet (0.9 m) wide. The saw blades shall be 1/8-inch (3-mm) wide with a sufficient number of blades to create grooves between 0.090 and 0.130 inches (2 and 3.5 mm) wide; and peaks and ridges approximately 1/32 inch (1 mm) higher than the bottom of the grinding cut. The actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Equipment or grinding procedures that cause ravels, aggregate fractures, spalls or disturbance to the pavement will not be permitted. Contractor shall demonstrate to the RPR that the grinding equipment will produce satisfactory results prior to making corrections to surfaces. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The slurry resulting from the grinding operation shall be continuously removed and the pavement left in a clean condition. The Contractor shall apply a surface treatment per P-608 to all areas that have been subject to grinding.

**TNP 401-4.17 Nighttime paving requirements.** The Contractor shall provide adequate lighting during any nighttime construction. A lighting plan shall be submitted by the Contractor and approved by the RPR prior to the start of any nighttime work. All work shall be in accordance with the approved CSPP and lighting plan.

CONTRACTOR QUALITY CONTROL (CQC)

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All federally funded projects over $500K dollars where paving is the major work item must have a CQCP. It is strongly encouraged that a Contractor Quality Control Program (CQCP) be developed for all projects.

For projects that do not include a formal CQCP, this section can be edited to remove reference to a CQCP. However, QC testing is still required regardless of project size.

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**TNP 401-5.1 General.** **[** The Contractor shall develop a Contractor Quality Control Program (CQCP) in accordance with Item C-100. No partial payment will be made for materials without an approved CQCP. **]**

**TNP 401-5.2 Contractor quality control (QC) facilities.** **[** The Contractor shall provide or contract for testing facilities in accordance with Item C-100. The RPR shall be permitted unrestricted access to inspect the Contractor’s QC facilities and witness QC activities. The RPR will advise the Contractor in writing of any noted deficiencies concerning the QC facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected. **]**

**TNP 401-5.3 Contractor QC testing.** The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to these specifications **[** and as set forth in the approved CQCP. The testing program shall include, but not necessarily be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, and surface smoothness. A QC Testing Plan shall be developed as part of the CQCP. **]**

**a. Asphalt content.** A minimum of two tests shall be performed per day in accordance with ASTM D6307 or ASTM D2172 for determination of asphalt content. When using ASTM D6307, the correction factor shall be determined as part of the first test performed at the beginning of plant production; and as part of every tenth test performed thereafter. The asphalt content for the day will be determined by averaging the test results.

**b. Gradation.** Aggregate gradations shall be determined a minimum of twice per day from mechanical analysis of extracted aggregate in accordance with ASTM D5444, ASTM C136, and ASTM C117.

**c. Moisture content of aggregate.** The moisture content of aggregate used for production shall be determined a minimum of once per day in accordance with ASTM C566.

**d. Moisture content of asphalt.** The moisture content shall be determined once per day in accordance with AASHTO T329 or ASTM D1461.

**e. Temperatures.** Temperatures shall be checked, at least four times per day, at necessary locations to determine the temperatures of the dryer, the asphalt binder in the storage tank, the asphalt at the plant, and the asphalt at the job site.

**f. In-place density monitoring.** The Contractor shall conduct any necessary testing to ensure that the specified density is being achieved. A nuclear gauge may be used to monitor the pavement density in accordance with ASTM D2950.

**g. Smoothness for Contractor Quality Control.**

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Note change in deviations on final surface course that require grinding, limited to deviations greater than 1/4 inch that trap water, intent here is to focus on areas that may cause issues with the safe operation of aircraft and to minimize grinding if it will not improve safety

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The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than ¼ inch in 12 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues

The Contractor may use a 12-foot (3.7 m) “straightedge, a rolling inclinometer meeting the requirements of ASTM E2133 or rolling external reference device that can simulate a 12-foot (3.7m) straightedge approved by the RPR. Straight-edge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement.  Testing shall be continuous across all joints. The surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between the two high points.  If the rolling inclinometer or external reference device is used, the data may be evaluated using either the FAA profile program, ProFAA, or FHWA ProVal, using the 12-foot straightedge simulation function.

Smoothness readings shall not be made across grade changes or cross slope transitions. The transition between new and existing pavement shall be evaluated separately for conformance with the plans.

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Include detail for transition between new and existing pavement including smoothness and grade limitations.

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**(1) Transverse measurements.**  Transverse measurements shall be taken for each day’s production placed.  Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet (15 m) or more often as determined by the RPR.  The joint between lanes shall be tested separately to facilitate smoothness between lanes.

**(2) Longitudinal measurements.**  Longitudinal measurements shall be taken for each day’s production placed.  Longitudinal tests shall be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet (6 m); and at the third points of paving lanes when widths of paving lanes are 20 ft (6 m) or greater. When placement abuts previously placed material the first measurement shall start with one half the length of the straight edge on the previously placed material.

 Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than 1/4 inch (6 mm) shall be corrected with diamond grinding per paragraph TNP 401-4.16 or by removing and replacing the surface course to full depth. Grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed shall be subject to the final pavement thickness tolerances specified in paragraph TNP 401-6.1d(3). Areas that have been ground shall be sealed with a surface treatment in accordance with Item P-608. To avoid the surface treatment creating any conflict with runway or taxiway markings, it may be necessary to seal a larger area.

Control charts shall be kept to show area of each day’s placement and the percentage of corrective grinding required. Corrections to production and placement shall be initiated when corrective grinding is required. If the Contractor’s machines and/or methods produce significant areas that need corrective actions in excess of 10 percent of a day’s production, production shall be stopped until corrective measures are implemented by the Contractor.

**h. Grade.** Grade shall be evaluated daily to allow adjustments to paving operations when grade measurements do not meet specifications. As a minimum, grade shall be evaluated prior to and after the placement of the first lift and after placement of the surface lift.

Measurements will be taken at appropriate gradelines (as a minimum at center and edges of paving lane) and longitudinal spacing as shown on cross-sections and plans. The final surface of the pavement will not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically **[** and 0.1 feet (30 mm) laterally**]**. The documentation will be provided by the Contractor to the RPR **[** within 24 hours**]** **[** by the end of the following working day**]**.

Areas with humps or depressions that exceed grade or smoothness criteria and that retain water on the surface must be ground off provided the course thickness after grinding is not more than 1/2 inch (12 mm) less than the thickness specified on the plans. Grinding shall be in accordance with paragraph TNP 401-4.16.

The Contractor shall repair low areas or areas that cannot be corrected by grinding by removal of deficient areas to the depth of the final course plus ½ inch and replacing with new material. Skin patching is not allowed.

**TNP 401-5.4 Sampling.** When directed by the RPR, the Contractor shall sample and test any material that appears inconsistent with similar material being sampled, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

**TNP 401-5.5 Control charts.** The Contractor shall maintain linear control charts for both individual measurements and range (i.e. difference between highest and lowest measurements) for aggregate gradation, asphalt content, and VMA. The VMA for each day will be calculated and monitored by the QC laboratory.

Control charts shall be posted in a location satisfactory to the RPR and kept current. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter, and the Contractor’s test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor’s projected data during production indicates a problem and the Contractor is not taking satisfactory corrective action, the RPR may suspend production or acceptance of the material.

**a. Individual measurements.** Control charts for individual measurements shall be established to maintain process control within tolerance for aggregate gradation, asphalt content, and VMA. The control charts shall use the job mix formula target values as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:

Control Chart Limits for Individual Measurements

| Sieve | Action Limit | Suspension Limit |
| --- | --- | --- |
| 3/4 inch (19.0 mm) | ±6% | ±9% |
| 1/2 inch (12.5 mm) | ±6% | ±9% |
| 3/8 inch (9.5 mm) | ±6% | ±9% |
| No. 4 (4.75 mm) | ±6% | ±9% |
| No. 16 (1.18 mm) | ±5% | ±7.5% |
| No. 50 (300 µm) | ±3% | ±4.5% |
| No. 200 (75 µm) | ±2% | ±3% |
| **Asphalt Content** | ±0.45% | ±0.70% |
| **Minimum VMA** | -0.5% | -1.0% |

**b. Range.** Control charts shall be established to control gradation process variability. The range shall be plotted as the difference between the two test results for each control parameter. The Suspension Limits specified below are based on a sample size of n = 2. Should the Contractor elect to perform more than two tests per lot, the Suspension Limits shall be adjusted by multiplying the Suspension Limit by 1.18 for n = 3 and by 1.27 for n = 4.

Control Chart Limits Based on Range

| Sieve | Suspension Limit  |
| --- | --- |
| 1/2 inch (12.5 mm) | 11% |
| 3/8 inch (9.5 mm) | 11% |
| No. 4 (4.75 mm) | 11% |
| No. 16 (1.18 mm) | 9% |
| No. 50 (300 µm) | 6% |
| No. 200 (75 µm) | 3.5% |
| **Asphalt Content** | 0.8% |

**c. Corrective Action. [** The CQCP shall indicate that appropriate action shall be taken when the process is believed to be out of tolerance. The Plan shall contain rules to gauge when a process is out of control and detail what action will be taken to bring the process into control. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:

(1) One point falls outside the Suspension Limit line for individual measurements or range; or

(2) Two points in a row fall outside the Action Limit line for individual measurements. **]**

**TNP 401-5.6 QC reports.** The Contractor shall maintain records and shall submit reports of QC activities daily **[** , in accordance with Item C-100**]**.

MATERIAL ACCEPTANCE

**TNP 401-6.1 Acceptance sampling and testing.** Unless otherwise specified, all acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the RPR at no cost to the Contractor except that coring as required in this section shall be completed and paid for by the Contractor.

**a. Quality assurance (QA) testing laboratory**. The QA testing laboratory performing these acceptance tests will be accredited in accordance with ASTM D3666. The QA laboratory accreditation will be current and listed on the accrediting authority’s website. All test methods required for acceptance sampling and testing will be listed on the lab accreditation.

**b. Lot size.** A standard lot will be equal to one day’s production divided into approximately equal sublots of between 400 to 600 tons. When only one or two sublots are produced in a day’s production, the sublots will be combined with the production lot from the previous or next day.

Where more than one plant is simultaneously producing asphalt for the job, the lot sizes will apply separately for each plant.

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For large projects with high production rates, the Engineer may adjust the lot size to be ½ days production.

For small projects, with multiple small placements or if the total project size is less than 3000 tons (2270 metric tons), acceptable material will be paid for by the ton (metric ton) placed per day.

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**c. Asphalt air voids.** Plant-produced asphalt will be tested for air voids on a sublot basis.

**(1) Sampling.** Material from each sublot shall be sampled in accordance with ASTM D3665. Samples shall be taken from material deposited into trucks at the plant or at the job site in accordance with ASTM D979. The sample of asphalt may be put in a covered metal tin and placed in an oven for **[**not less than 30 minutes nor more than 60 minutes**]** to maintain the material at or above the compaction temperature as specified in the JMF.

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Engineer should increase hold times to not less than 60 minutes and not more than 90 minutes when absorptive aggregates are used.

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**(2) Testing.** Air voids will be determined for each sublot in accordance with ASTM D3203 for a set of three compacted specimens prepared in accordance with **[** ASTM D6926**]** **[**ASTM D6925**]**.

**d. In-place asphalt mat and joint density.** Each sublot will be tested for in-place mat and joint density as a percentage of the theoretical maximum density (TMD).

**(1) Sampling**. The **[** Contractor**]** **[** RPR**]** will cut minimum 5 inch (125 mm) diameter samples in accordance with ASTM D5361. The Contractor shall furnish all tools, labor, and materials for cleaning, and filling the cored pavement. Laitance produced by the coring operation shall be removed immediately after coring, and core holes shall be filled within one day after sampling in a manner acceptable to the RPR.

**(2) Bond.** Each lift of asphalt shall be bonded to the underlying layer. If cores reveal that the surface is not bonded, additional cores shall be taken as directed by the RPR to determine the extent of unbonded areas. Unbonded areas shall be removed by milling and replaced at no additional cost as directed by the RPR.

**(3) Thickness.** Thickness of each lift of surface course will be evaluated by the RPR for compliance to the requirements shown on the plans after any necessary corrections for grade. Measurements of thickness will be made using the cores extracted for each sublot for density measurement. The maximum allowable deficiency at any point will not be more than 1/4 inch (6 mm) less than the thickness indicated for the lift. Average thickness of lift, or combined lifts, will not be less than the indicated thickness. Where the thickness tolerances are not met, the lot or sublot shall be corrected by the Contractor at his expense by removing the deficient area and replacing with new pavement. The Contractor, at his expense, may take additional cores as approved by the RPR to circumscribe the deficient area.

**(4) Mat density**. One core shall be taken from each sublot. Core locations will be determined by the RPR in accordance with ASTM D3665. Cores for mat density shall not be taken closer than one foot (30 cm) from a transverse or longitudinal joint. The bulk specific gravity of each cored sample will be determined in accordance with ASTM D2726. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each sublot sample by the TMD for that sublot.

**(5) Joint density**. One core centered over the longitudinal joint shall be taken for each sublot that has a longitudinal joint. Core locations will be determined by the RPR in accordance with ASTM D3665. The bulk specific gravity of each core sample will be determined in accordance with ASTM D2726. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each joint density sample by the average TMD for the lot. The TMD used to determine the joint density at joints formed between lots will be the lower of the average TMD values from the adjacent lots.

TNP 401-6.2 Acceptance criteria.

**a. General.** Acceptance will be based on the implementation of the Contractor Quality Control Program (CQCP) and the following characteristics of the asphalt and completed pavements: air voids, mat density, joint density, grade **[**and Profilograph roughness**].**

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Only include profilograph roughness for runway and/or taxiway pavement projects greater than 500 feet (150 m) in length.

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**b. Air Voids and Mat density.** Acceptance of each lot of plant produced material for mat density and air voids will be based on the percentage of material within specification limits (PWL). If the PWL of the lot equals or exceeds 90%, the lot will be acceptable. Acceptance and payment will be determined in accordance with paragraph TNP 401-8.1.

**c. Joint density.** Acceptance of each lot of plant produced asphalt for joint density will be based on the PWL. If the PWL of the lot is equal to or exceeds 90%, the lot will be considered acceptable. If the PWL is less than 90%, the Contractor shall evaluate the reason and act accordingly. If the PWL is less than 80%, the Contractor shall cease operations and until the reason for poor compaction has been determined. If the PWL is less than 71%, the pay factor for the lot used to complete the joint will be reduced by five (5) percentage points. This lot pay factor reduction will be incorporated and evaluated in accordance with paragraph TNP 401-8.1.

d. Grade. The final finished surface of the pavement shall be surveyed to verify that the grade elevations and cross-sections shown on the plans do not deviate more than 1/2 inch (12 mm) vertically **[** or 0.1 feet (30 mm) laterally**]**.

Cross-sections of the pavement shall be taken at a minimum **[** 50-foot (15-m) **]** longitudinal spacing, at all longitudinal grade breaks, and at start and end of each lane placed. Minimum cross-section grade points shall include grade at centerline, **[** ± 10 feet of centerline**]**, and edge of **[** runway**]** **[**taxiway**]** pavement.

The survey and documentation shall be stamped and signed by a licensed surveyor. Payment for lots that do not meet grade for over 25% of the lot shall not be more than 95%.

e**. Profilograph roughness for QA Acceptance.** **[** The final profilograph shall be the full length of the project to facilitate testing of roughness between lots. The **[**Contractor, in the presence of the RPR shall **]** **[**RPR will**]** perform a profilograph roughness test on the completed project with a profilograph meeting the requirements of ASTM E1274 or a Class I inertial profiler meeting ASTM E950. Data and results shall be provided within **[**48 hrs**]** of profilograph roughness tests.

The pavement shall have an average profile index less than 15 inches per mile per 1/10 mile. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate “must grind” bumps and the Profile Index for the pavement using a 0.2-inch (5 mm) blanking band. The bump template must span one inch (25 mm) with an offset of 0.4 inches (10 mm). The profilograph must be calibrated prior to use and operated by a factory or State DOT approved, trained operator. Profilograms shall be recorded on a longitudinal scale of one inch (25 mm) equals 25 feet (7.5 m) and a vertical scale of one inch (25 mm) equals one inch (25 mm). Profilograph shall be performed one foot right and left of project centerline and 15 feet (4.5 m) right and left of project centerline. Any areas that indicate “must grind” shall be corrected with diamond grinding per paragraph TNP 401-4.16 or by removing and replacing full depth of surface course. as directed by the RPR. Where corrections are necessary, a second profilograph run shall be performed to verify that the corrections produced an average profile index of 15 inches per mile per 1/10 mile or less. **]** **[** Not used. **]**

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Edit as required for the project.

Profilograph roughness and acceptance paragraphs only apply when the overall project is a new and/or reconstructed runway(s) and/or taxiway(s) greater than 500 feet (152 m) in length.

Profilograph roughness is not applicable to aprons and should be used with caution on projects to rehabilitate runways and/or taxiways unless the project includes provisions to correct existing deficiencies.

Any changes to the profilograph roughness acceptance limits requires a modification to standards in accordance with FAA Order 5300.1, [Modifications to Agency Airport Design, Construction, and Equipment Standards](http://www.faa.gov/documentLibrary/media/Order/construction_5300_1f.pdf).

The Engineer must select who will provide the specified equipment and the timeframe for receiving the test data. The Airport should retain a copy of the profilograph roughness test and reports for inclusion in the Airport’s Pavement Maintenance Management Program (PMP).

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**TNP 401-6.3 Percentage of material within specification limits (PWL).** The PWL will be determined in accordance with procedures specified in Item C-110. The specification tolerance limits (L) for lower and (U) for upper are contained in Table 5.

**Table 5. Acceptance Limits for Air Voids and Density**

| **Test Property** | **Pavements Specification Tolerance Limits** |
| --- | --- |
|  | **L** | **U** |
| **Air Voids Total Mix (%)** | 2.0 | 5.0 |
| **Surface Course Mat Density (%)** | 92.8 | **-** |
| **Base Course Mat Density (%)** | 92.0 | **-** |
| **Joint density (%)** | 90.5 | -- |

**a. Outliers.** All individual tests for mat density and air voids will be checked for outliers (test criterion) in accordance with ASTM E178, at a significance level of 5%. Outliers will be discarded, and the PWL will be determined using the remaining test values. The criteria in Table 5 is based on production processes which have a variability with the following standard deviations: Surface Course Mat Density (%), 1.30; Base Course Mat Density (%), 1.55; Joint Density (%), 1.55.

The Contractor should note that (1) 90 PWL is achieved when consistently producing a surface course with an average mat density of at least 94.5% with 1.30% or less variability, (2) 90 PWL is achieved when consistently producing a base course with an average mat density of at least 94.0% with 1.55% or less variability, and (3) 90 PWL is achieved when consistently producing joints with an average joint density of at least 92.5% with 1.55% or less variability.

**TNP 401-6.4 Resampling pavement for mat density.**

**a. General.** Resampling of a lot of pavement will only be allowed for mat density, and then, only if the Contractor requests same, in writing, within 48 hours after receiving the written test results from the RPR. A retest will consist of all the sampling and testing procedures contained in paragraphs TNP 401-6.1d and TNP 401-6.2b. Only one resampling per lot will be permitted.

**(1)** A redefined PWL will be calculated for the resampled lot. The number of tests used to calculate the redefined PWL will include the initial tests made for that lot plus the retests.

**(2)** The cost for resampling and retesting shall be borne by the Contractor.

**b. Payment for resampled lots.** The redefined PWL for a resampled lot will be used to calculate the payment for that lot in accordance with Table 6.

**c. Outliers.** Check for outliers in accordance with ASTM E178, at a significance level of 5%.

**[   TNP 401-6.5 Leveling course**. The leveling course is the first variable thickness lift placed to correct surface irregularities prior to placement of subsequent courses. The leveling course shall meet the aggregate gradation for a TDOT 307 C mixture. The leveling course mixtures shall be designed based on section 307, 407, 411, 903, and 904 of the most current Tennessee Standard Specifications for Road and Bridge Construction or as amended by supplemental specification, TNP 401-6.2b for air voids, but shall not be subject to the density requirements of paragraph TNP 401-6.2b for mat density and TNP 401-6.2c for joint density. The leveling course shall be compacted with the same effort used to achieve density of the control strip. The leveling course shall not exceed 2 inch thickness.**]**

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Use this paragraph only when there is a need to restore proper cross-section prior to overlaying. Areas of the pavement requiring a leveling course shall be shown on the plans.

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METHOD OF MEASUREMENT

**TNP 401-7.1 Measurement.** Asphalt shall be measured by the number of tons **[**kg**]** of asphalt used in the accepted work. Batch weights or truck scale weights will be used to determine the basis for the tonnage.

BASIS OF PAYMENT

**TNP 401-8.1 Payment.** Payment for a lot of asphalt meeting all acceptance criteria as specified in paragraph TNP 401-6.2 shall be made based on results of tests for mat density and air voids. Payment for acceptable lots shall be adjusted according to paragraph TNP 401-8.1c for mat density and air voids; and paragraph TNP 401-6.2c for joint density, subject to the limitation that:

**a.** The total project payment for plant mix asphalt pavement shall not exceed **[**      **]** percent of the product of the contract unit price and the total number of tons (kg) of asphalt used in the accepted work.

**b.** The price shall be compensation for furnishing all materials, for all preparation, mixing, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

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The Engineer shall specify a value ranging from 100% to the maximum lot pay factor amount of 106%.

For mixtures that contain RAP, do not include separate payment for asphalt binder.

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**c. Basis of adjusted payment.** The pay factor for each individual lot shall be calculated in accordance with Table 6. A pay factor shall be calculated for both mat density and air voids. The lot pay factor shall be the higher of the two values when calculations for both mat density and air voids are 100% or higher. The lot pay factor shall be the product of the two values when only one of the calculations for either mat density or air voids is 100% or higher. The lot pay factor shall be the lower of the two values when calculations for both mat density and air voids are less than 100%. If PWL for joint density is less than 71% then the lot pay factor shall be reduced by 5% but be no higher than 95%.

For each lot accepted, the adjusted contract unit price shall be the product of the lot pay factor for the lot and the contract unit price. Payment shall be subject to the total project payment limitation specified in paragraph TNP 401-8.1a. Payment in excess of 100% for accepted lots of asphalt shall be used to offset payment for accepted lots of asphalt pavement that achieve a lot pay factor less than 100%.

Payment for sublots which do not meet grade in accordance with paragraph TNP 401-6.2d after correction for over 25% of the sublot shall be reduced by 5%.

Table 6. Price adjustment schedule1

| Percentage of material within specification limits (PWL) | Lot pay factor (percent of contract unit price) |
| --- | --- |
| 96 – 100 | 106 |
| 90 – 95 | PWL + 10 |
| 75 – 89 | 0.5 PWL + 55 |
| 55 – 74 | 1.4 PWL – 12 |
| Below 55 | Reject 2 |

1 Although it is theoretically possible to achieve a pay factor of 106% for each lot, actual payment above 100% shall be subject to the total project payment limitation specified in paragraph TNP 401-8.1a.

2 The lot shall be removed and replaced. However, the RPR may decide to allow the rejected lot to remain. In that case, if the RPR and Contractor agree in writing that the lot shall not be removed, it shall be paid for at 50% of the contract unit price and the total project payment shall be reduced by the amount withheld for the rejected lot.

**d. Profilograph Roughness.[**The Contractor will receive full payment when the profilograph average profile index is in accordance with paragraph TNP 401-6.2e. When the final average profile index for the entire length of pavement does not exceed 15 inches per mile per 1/10 mile, payment will be made at the contract unit price for the completed pavement. **]** **[**Not used. **]**

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Edit as required for project.

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**TNP 401-8.1 Payment.**

Payment will be made under:

Item TNP 401-8.1 Asphalt Surface Course - per ton (kg)

Item TNP 401-8.2 Asphalt Base Course - per ton (kg)

Item TNP 401-8.4 Asphalt Leveling Course - per ton (kg)

References

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C29 Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate

ASTM C88 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

ASTM C117 Standard Test Method for Materials Finer than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C127 Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate

ASTM C131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C136 Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates

ASTM C142 Standard Test Method for Clay Lumps and Friable Particles in Aggregates

ASTM C566 Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying

ASTM D75 Standard Practice for Sampling Aggregates

ASTM D242 Standard Specification for Mineral Filler for Bituminous Paving Mixtures

ASTM D946 Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction

ASTM D979 Standard Practice for Sampling Asphalt Paving Mixtures

ASTM D1073 Standard Specification for Fine Aggregate for Asphalt Paving Mixtures

ASTM D1188 Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples

ASTM D2172 Standard Test Method for Quantitative Extraction of Bitumen from Asphalt Paving Mixtures

ASTM D1461 Standard Test Method for Moisture or Volatile Distillates in Asphalt Paving Mixtures

ASTM D2041 Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures

ASTM D2419 Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate

ASTM D2489 Standard Practice for Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures

ASTM D2726 Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures

ASTM D2950 Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods

ASTM D3203 Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures

ASTM D3381 Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction

ASTM D3665 Standard Practice for Random Sampling of Construction Materials

ASTM D3666 Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D4552 Standard Practice for Classifying Hot-Mix Recycling Agents

ASTM D4791 Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

ASTM D4867 Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures

ASTM D5361 Standard Practice for Sampling Compacted Asphalt Mixtures for Laboratory Testing

ASTM D5444 Standard Test Method for Mechanical Size Analysis of Extracted Aggregate

ASTM D5821 Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate

ASTM D6084 Standard Test Method for Elastic Recovery of Bituminous Materials by Ductilometer

ASTM D6307 Standard Test Method for Asphalt Content of Hot Mix Asphalt by Ignition Method

ASTM D6373 Standard Specification for Performance Graded Asphalt Binder

ASTM D6752 Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method

ASTM D6925 Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the SuperPave Gyratory Compactor.

ASTM D6926 Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus

ASTM D6927 Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures

ASTM D6995 Standard Test Method for Determining Field VMA based on the Maximum Specific Gravity of the Mix (Gmm)

ASTM E11 Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves

ASTM E178 Standard Practice for Dealing with Outlying Observations

ASTM E1274 Standard Test Method for Measuring Pavement Roughness Using a Profilograph

ASTM E950 Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference

ASTM E2133 Standard Test Method for Using a Rolling Inclinometer to Measure Longitudinal and Transverse Profiles of a Traveled Surface

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M156 Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

AASHTO T329 Standard Method of Test for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method

AASHTO T324 Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures

AASHTO T 340 Standard Method of Test for Determining the Rutting Susceptibility of Hot Mix Asphalt (APA) Using the Asphalt Pavement Analyzer (APA)

Asphalt Institute (AI)

Asphalt Institute Handbook MS-26, Asphalt Binder

Asphalt Institute MS-2 Mix Design Manual, 7th Edition

AI State Binder Specification Database

Federal Highway Administration (FHWA)

Long Term Pavement Performance Binder Program

Advisory Circulars (AC)

AC 150/5320-6 Airport Pavement Design and Evaluation

FAA Orders

5300.1Modifications to Agency Airport Design, Construction, and Equipment Standards

Software

FAARFIELD

Tennessee Department of Transportation (TDOT)

Tennessee Department of Transportation. *Standard Specifications for Road and Bridge Construction*. Nashville, Tennessee. January 1, 2021.

Section 307 BITUMINOUS PLANT MIX BASE (HOT MIX)

Section 407 BITUMINOUS PLANT MIX PAVEMENTS (GENERAL)

Section 411 ASPHALTIC CONCRETE SURFACE (HOT MIX)

Section 903 AGGREGATES

Section 904 BITUMINOUS MATERIALS

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