SPECIFICATION P–401. PLANT MIX BITUMINOUS PAVEMENTS

DESCRIPTION

401–1.1 This Work consists of a surface, base, or leveling course composed of mineral aggregate and bituminous material mixed in a central mixing plant and placed on a prepared course in accordance with these Specifications and shall conform to the lines, grades, thickness, and typical cross sections shown on the Plans. Construct each course to the depth, typical section, or elevation required by the Plans and have it rolled, finished, and approved before the placement of the next course.

NOTE TO SPECIFIER:
This specification is intended to be used for pavements subject to aircraft loadings. State highway department specifications may be used for access roads, perimeter roads, and other pavements not subject to aircraft loading.

See note in paragraph 401–3.2 regarding pavements designed for aircraft gross weights of 12,500 pounds (5,662 kg) or less.

MATERIALS

401-2.2 AGGREGATE. Aggregates shall consist of crushed stone or crushed gravel with or without sand or other inert finely divided mineral aggregate. The portion of materials retained on the No. 8 sieve is coarse aggregate. The portion passing the No. 8 (2.36 mm) sieve and retained on the No. 200 (0.075 mm) sieve is fine aggregate, and the portion passing the No. 200 (0.075 mm) sieve is mineral filler.

a. Coarse Aggregate. Coarse aggregate consists of sound, tough, durable particles, free bituminous material and is free from organic matter and other deleterious substances. The percentage of wear shall not be greater than 40 percent when tested in accordance with ASTM C 131. The sodium sulfate soundness loss shall not exceed 10 percent, or the magnesium sulfate soundness loss shall not exceed 13 percent, after five cycles, when tested in accordance with ASTM C 88.

NOTE TO SPECIFIER:
The FAA recommendations for percentage of wear, sodium sulfate loss, and magnesium sulfate soundness loss have been included in the Standard Specification. Aggregates with a higher percentage loss or wear may be specified in the Special Provisions, provided a satisfactory service record under similar conditions of service and exposure has shall have been demonstrated.

Specifier should check the paverment design and indicate the aircraft gross weight on the Plans or in the Special Provisions.

Aggregate for pavements designed for aircraft gross weights of 60,000 pounds (27,000kg) or more, shall contain at least 70 percent by weight of individual pieces having two or more fractured faces and 85 percent by weight having at least one fractured face. Aggregate for pavements designed for aircraft gross weights less than 60,000 pounds (27,000kg), shall contain at least 50 percent by weight of individual pieces having at least two fractured faces and 65 percent by weight having at least one fractured face. If the aircraft gross weight for pavement design is not specified on the Plans or in the Special Provisions, the requirements for aircraft gross weights of 60,000 pounds (27,200 kg) or more shall apply for pavement constructed under this Specification. The area of each face shall be equal to at least 75 percent of the smallest midsection 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. Fractured faces shall be obtained by crushing.

The aggregate shall not contain more than 8 percent, by weight, of flat or elongated pieces, when tested in accordance with ASTM D 4791. A flat or elongated piece is one having a ratio, between the maximum and minimum dimensions of a circumscribing rectangular prism, exceeding five to one.

NOTE TO SPECIFIER:
The Engineer shall specify the design aircraft gross weight on the Plans or in the Special Provisions. The following FAA requirements were incorporated into the Standard Specification.

For pavements designed for aircraft gross weights of 60,000 pounds (27,200 kg) or more the Engineer shall specify 70 percent for two fractured faces and 85 percent for one fractured face. For pavements designed

for aircraft gross weights less than 60,000 pounds (27,200 kg), the Engineer shall specify 50 percent for two fractured faces and 65 percent for one fractured face.

b. Fine Aggregate. Fine aggregate shall consist of clean, sound, durable, angular shaped particles produced by crushing stone or gravel that meets the requirements for wear and soundness specified for coarse aggregate. The aggregate particles shall be free from coatings of clay, silt, or other objectionable matter and shall contain no clay balls. The fine aggregate, including any blended material for the find aggregate, shall have a plasticity index of not more than 6 and a liquid limit of not more than 25 when tested in accordance with ASTM D 4318.

Natural (non-manufactured) sand may be used to obtain the gradation of the aggregate blend or to improve the workability of the mix. The amount of sand to be added will be adjusted to produce mixtures conforming to requirements of this specification. The fine aggregate shall not contain more than 20 percent natural sand by weight of total aggregates.

The aggregate shall have sand equivalent values of 35 or greater when tested in accordance with ASTM D 2419.

NOTE TO SPECIFIER:
The addition of natural sand to a mix containing all crushed coarse and fine aggregates will normally increase its workability and compactability. However, the addition of excessive amounts of natural sand tends to decrease the stability of the mixture. The requirement for a maximum of 20 percent natural sand may be included for locations where low stabilities are a chronic problem. This requirement was included in the Standard Specification.

c. Sampling. ASTM D 75 shall be used in sampling coarse and fine aggregate, and ASTM C 183 shall be used in sampling mineral filler.

401–2.2 MINERAL FILLER. If filler, in addition to that naturally present in the aggregate, is necessary, it shall meet the requirements of ASTM D 242.

401–2.3 BITUMINOUS MATERIAL. Provide bituminous material either conforming to ASTM D 946, penetration grade 85–100, or conforming to ASTM D 3381, viscosity grade AC–10, , unless otherwise specified on the Plans or in the Special Provisions.

NOTE TO SPECIFIER:
The Engineer shall prepare a Special Provision for the grade and ASTM specification of bituminous material, if different specifications are required from those given, based on geographical location and climatic conditions. The Engineer shall specify both the penetration grade and the viscosity grade of the asphalt material. (Example Special Provision. The Asphalt Material for Plant Mix Bituminous Pavements shall conform to ASTM D 946, penetration grade _____, or conform to ASTM D 3381, viscosity grade _____.) Table VI–1, Selecting Asphalt Grade, contained in the Asphalt Institute's Manual Series–1 (MS–1) provides guidance on the selection of asphalt type. For cold climates, Table 2 of ASTM D 3381 may be specified to minimize the susceptibility for thermal cracking. Other specifications to minimize cracking, such as the addition of Penetration Index, Pen–Vis number, or performance based asphalts (PBA) can also be specified with approval of the Federal Aviation Administration. Grades of some materials are listed below:

Furnish vendor's certified test reports for each lot of bitumen shipped to the project. The vendor's certified test report for the bituminous material can be used for acceptance or tested independently by the Engineer.

401–2.4 PRELIMINARY MATERIAL ACCEPTANCE. Prior to delivery of materials to the job site, submit certified test reports to the Engineer for the following materials:

a. Coarse Aggregate.

(1.) Percent of wear.
(2.) Soundness.

b. Fine Aggregate.

(1.) Liquid limit.
(2.) Plastic index.

c. Mineral Filler.

d. Bituminous Material.

The certification(s) must show the appropriate ASTM test(s) for each material, the test results, and a statement that the material meets the Specification requirement.

The Engineer may request samples for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable Specifications.

COMPOSITION

401–3.1 COMPOSITION OF MIXTURE. The bituminous plant mix shall be composed of a mixture of well–graded aggregate, filler if required, and bituminous material. The several 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).

401–3.2 JOB MIX FORMULA. Do not produce bituminous mixture for payment until a job mix formula has been approved by the Engineer. Design the bituminous mixture using procedures contained in Chapter 5, Marshall Method of Mix Design, of the Asphalt Institute's Manual Series No. 2 (MS–2), Mix Design Methods for Asphalt Concrete, and meet the requirements of Tables 1 and 2.

The design criteria in Table 1 are target values necessary to meet the acceptance requirements contained in Paragraph 401–5.2b. The criteria is based on a production process which has a material variability with the following standard deviations:

Stability (lbs.) = 270
Flow 0.01 inch(0.25 mm) = 1.5
Air Voids (%) = 0.65

If material variability exceeds the standard deviations indicated, the job mix formula and subsequent production targets should be based on a stability greater than shown in Table 1, and the flow and air voids should be targeted close to the mid–range of the criteria in order to meet the acceptance requirements.

If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867, is less than 75, reject the aggregates or the treat asphalt with an approved anti–stripping agent. Have a sufficient amount of anti–stripping agent added to the asphalt to produce a TSR of not less than 75. If an antistrip agent is required, provide it at no additional cost.

Submit the job mix formula to the Engineer at least 10 days prior to the start of paving operations and include as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt cement.

c. Asphalt viscosity or penetration grade.

d. Number of blows of hammer compaction per side of molded specimen.

e. Mixing temperature.

f. Compaction temperature.

g. Temperature of mix when discharged from the mixer.

h. Temperature–viscosity relationship of the asphalt cement.

i. Plot of the combined gradation on the Federal Highway Administration (FHWA) 45 power gradation curve.

j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content.

k. Percent natural sand.

l. Percent fractured faces.

m. Percent elongated particles.

n. Tensile Strength Ratio (TSR).

o. Antistrip agent (if required).

Submit samples to the Engineer, upon request, for job mix formula verification testing.

The job mix formula for each mixture is effective until modified in writing by the Engineer. Should a change in sources of materials be made, a new job mix formula must be approved by the Engineer before the new material is used.

NOTE TO SPECIFIER:
The Engineer may change the number of days the JMF shall be submitted prior to beginning paving by Special Provision.

The Marshall Design Criteria recommended by FAA are included in Table 1. The 75 blow Marshall design is specified; if the 50 blow design is desired, it should be specified in a Special Provision.

TABLE 1. MARSHALL DESIGN CRITERIA

Test Property	*Pavements Designed for Aircraft Gross Weights of 60,000 lbs (27,000 kg). or More or Tire Pressures of 100 psi (690 Pa) or More*	*Pavements Designed for Aircraft Gross Weight Less than 60,000 lbs (27,000 kg). or Tire Pressure Less Than 100 psi (690 Pa)*
Number of blows	75	50
Stability, lbs (N)	2150 (9560)	1350 (6000)
Flow, 0.01 in. (0.25 mm)	10–14	10–18
Air voids (percent)	2.8–4.2	2.8–4.2
Percent Voids in mineral aggregate	See Table 2	See Table 2

Utilize the 75 blow Marshall Mix Design for pavements designed for aircraft gross weights of 60,000 lbs. (27,000 kg) or more or tire pressures of 100 psi (690 Pa) or more unless otherwise specified in the Contract Documents.

TABLE 2. MINIMUM PERCENT VOIDS IN MINERAL AGGREGATE

	Maximum Particle Size		*Minimum Voids in Mineral Aggregate, percent*
Gradation No.	*in.*	*mm.*	*Percent*
1	1–1/4	(30.0)	11
2	1	(25.0)	12
3	3/4	(19.0)	13
4	1/2	(12.5)	14

The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory screens, will conform to the gradation or gradations specified in Table 3 when tested in accordance with ASTM C 136 and C 117.

The gradations in Table 3 represent the limits that determine the suitability of aggregate for use from the sources of supply. The aggregate, as selected (and used in the JMF), shall have a gradation within the limits designated in Table 3 and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa, but shall be well graded from coarse to fine.

Deviations from the final approved mix design for bitumen content and gradation of aggregates shall be within the action limits for individual measurements as specified in Paragraph 401–6.5a. The limits still will apply if they fall outside the master grading band in Table 3.

The maximum size aggregate used cannot be more than one–half of the thickness of the course being constructed.

TABLE 3. AGGREGATE – BITUMINOUS PAVEMENTS

Percentage by Weight Passing Sieves					
Sieve Size		*Gradation Number*			
in.	mm.	No. 1 (1–1/4" max.)	No. 2 (1" max.)	No. 3 (3/4" max.)	No. 4 (1/2" max.)
1–1/4	30.0 mm	100	—	—	—
1	24.0 mm	86–98	100	—	—
3/4	19.0 mm	68–93	76–98	100	—
1/2	12.5 mm	57–81	66–86	79–99	100
3/8	9.5 mm	49–69	57–77	68–88	79–99
No. 4	4.75 mm	34–54	40–60	48–68	58–78
No. 8	2.36 mm	22–42	26–46	33–53	39–59
No. 16	1.18 mm	13–33	17–37	20–40	26–46
No. 30	0.600 mm	8–24	11–27	14–30	19–35
No. 50	0.300 mm	6–18	7–19	9–21	12–24
No. 100	0.150 mm	4–12	6–16	6–16	7–17
No. 200	0.075 mm	3–6	3–6	3–6	3–6
Asphalt Percent		4.5–7.0	4.5–7.0	5.0–7.5	5.5–8.0

The aggregate gradations shown are based on aggregates of uniform specific gravity. Correct the percentages passing the various sieves when aggregates of varying specific gravities are used, as indicated in the Asphalt Institute Manual Series No. 2 (MS–2), Chapter 3. Use Gradation No. 2 or No. 3 unless otherwise specified in the Contract Documents.

NOTE TO SPECIFIER:
The aggregate gradation may be changed by Special Provision.

Where locally–available aggregates cannot be economically blended to meet the grading requirements of the gradations shown, the gradations may be modified to fit the characteristics of such local aggregates with approval of the FAA. The modified gradation must produce a paving mixture that satisfies the mix design requirements.

For pavements designed to accommodate aircraft gross weights of 12,500 pounds (5,662 kg) or less, state highway department specifications for high–quality, hot–mix bituminous pavements that have a satisfactory performance record under equivalent loadings and exposure may be used.

401–3.3 RECYCLED ASPHALT CONCRETE. Recycled asphalt concrete shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, asphalt cement, and recycling agent, if necessary. RAP may be used for all courses.

The RAP shall be of a consistent gradation and asphalt content and may be obtained from the job site or an existing source.

All new aggregates used in the recycled mix shall meet the requirements of Paragraph 401–2.1, Aggregate. New bituminous material shall meet the requirements of Paragraph 401–2.3, Bituminous Material. Recycling agents shall meet the requirements of ASTM D 4552.

Design the recycled asphalt concrete mix using procedures contained in the Asphalt Institute's Manual Series Number 20 (MS–20), Asphalt Hot–Mix Recycling, in conjunction with MS–2. Meet the requirements of Paragraph 401–3.2, Job Mix Formula. In addition to the requirements of Paragraph 401–3.2, indicate the percent of reclaimed asphalt pavement, the percent and viscosity grade of new asphalt, the percent and grade of hot–mix recycling agent (if used), and the properties (including viscosity and penetration) of the asphalt blend.

Submit documentation to the Engineer, indicating that the mixing equipment proposed for use is adequate to mix the percentage of RAP shown in the job mix formula and meets all local and national environmental regulations.

NOTE TO SPECIFIER:
Delete this paragraph if recycled asphalt pavement is not to be allowed and include a sentence that RAP will not be permitted to be used in the Special Provisions or on the Plans.

Recycling agents should be used when the desired viscosity of the asphalt blend cannot be obtained using only a soft asphalt.

401–3.4 TEST SECTION. Prior to full production, prepare and place a quantity of bituminous mixture according to the job mix formula. Prepare enough mixture to construct a test section 300 feet (90 m) long and 20 to 30 feet (6 to 9 m) wide placed in two lanes, with a longitudinal cold joint, and to the same depth specified for the construction of the course that it represents. The underlying grade or pavement structure upon which the test section is to be constructed must be the same as the course to be constructed. Use the same type and weight equipment in construction of the test section on the remainder of the course represented by the test section.

Random samples will be taken at the plant and tested for stability, flow, and air voids in accordance with Paragraph 401–5.1a(2). Test for aggregate gradation and asphalt content in accordance with Paragraphs 401–6.3a and 3b, and evaluate in accordance with Paragraphs 401–6.5a and 5b. Take three randomly selected cores from the finished pavement mat, and three from the longitudinal joint. These will be tested in accordance with Paragraph 401–5.1b(4). Random sampling will be in accordance with procedures contained in ASTM D 3665.

Mat density and air voids will be evaluated in accordance with Paragraph 401–5.2f(1). Stability and flow will be evaluated in accordance with Paragraph 401–5.2f(2). Joint density will be evaluated in accordance with Paragraph 401–5.2f(3).

Voids in the mineral aggregate (VMA), for each plant sample, will be computed in accordance with procedures contained in Chapter 5, Marshall Method of Mix Design, of the Asphalt Institute's Manual Series No. 2 (MS–2), Mix Design Methods for Asphalt Concrete.

The test section will be considered acceptable if:

a. Stability, flow, mat density, air voids, and joint density are 90 percent or more within limits,

b. Gradation and asphalt content are within the action limits specified in Paragraphs 401–6.5a and 6.5b, and

c. The VMA is within the limits of Table 2.

If the initial test section should prove to be unacceptable, make the necessary adjustments to the job mix formula, plant operation, placing procedures, and/or rolling procedures. Place a second test section. If the second test section also does not meet Specification requirements, remove both sections at the Contractor's expense. Construct and evaluate additional test sections, as required, for conformance to the Specifications. Remove additional sections that are not acceptable at the Contractor's expense. Do not begin full production until an acceptable section has been constructed and accepted by the Engineer. The initial test section, whether acceptable or unacceptable, and any subsequent section that meets Specification requirements will be paid for in accordance with Paragraph 401–8.1 and 401–8.2.

Perform job mix control testing at the start of Plant production and in conjunction with the calibration of the plant for the job mix formula. Recognize that the aggregates produced by the Pant may not satisfy the gradation requirements or produce a mix that exactly meets the job mix formula. In those instances, it will be necessary to reevaluate and redesign the mix using plant–produced aggregates. Prepare specimens and determine the optimum bitumen content in the same manner as for the original design tests.

NOTE TO SPECIFIER:
The Standard Specification includes the FAA recommendation for a minimum test section of 300 feet (90 m) long and 20 feet to 30 (6 m to 9) wide. The test section affords the Contractor and the Engineer an opportunity to determine the quality of the mixture in place, as well as performance of the plant and laydown equipment.

Until the plant is producing the desired mix consistency, frequent testing may be necessary.

401–3.5 TESTING LABORATORY. The laboratory used to develop the job mix formula shall meet the requirements of ASTM D 3666. Submit a certification signed by the manager of the laboratory stating that it meets these requirements to the Engineer prior to the start of construction. The certification shall contain as a minimum:

a. Qualifications of personnel: laboratory manager, supervising technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix.

c. A copy of the laboratory's quality control system.

d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

CONSTRUCTION METHODS

401–4.1 WEATHER LIMITATIONS. Do not place the bituminous mixture on 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 Engineer, if requested; however, meet all other requirements including compaction.

TABLE 4. BASE TEMPERATURE LIMITATIONS

Mat Thickness	*Base Temperature (Minimum)*	
	Deg. F	*Deg. C*
3 in. (75 mm) or greater	40	4
Greater than 1 in. (25 mm) but less than 3 in. (75 mm)	45	7
1 in. (25 mm) or less	50	10

401–4.2 BITUMINOUS MIXING PLANT Plants used for the preparation of bituminous mixtures shall conform to the requirements of ASTM D 995 with the following changes:

a. Requirements for All Plants.

(1.) Truck Scales. The bituminous mixture shall be weighed on approved scales furnished by the Contractor, or on public scales at the Contractor's expense. The scales will be inspected and sealed as often as the Engineer deems necessary to assure their accuracy. Scales shall conform to the requirements of the General Requirements and Covenants, Section 90–01, Measurement of Quantities.

(2.) Testing Facilities. Provide laboratory facilities at the plant or on the job site for the use of the Engineer's acceptance testing and the Contractor's quality control testing, in accordance with Paragraph 401–6.2, Testing Laboratory.

(3.) Inspection of Plant. The Engineer, or Engineer'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 proportions; and checking the temperatures maintained in the preparation of the mixtures.

(4.) Storage Bins and Surge Bins. Paragraph 3.9 of ASTM D 995 is deleted. Instead, the following applies. Use of surge bins or storage bins for temporary storage of hot bituminous mixtures will be permitted as follows:

(a.) The bituminous mixture may be stored in surge bins for a period of time not to exceed 3 hours,

(b.) The bituminous mixture may be stored in insulated storage bins for a period of time not to exceed 24 hours.

Mix drawn from the bins must meet the same requirements as mix loaded directly into trucks.

If the Engineer determines that there is an excessive amount of heat loss, segregation, or oxidation of the mixture due to temporary storage, no overnight storage will be allowed.

401–4.3 HAULING EQUIPMENT. Use trucks for hauling bituminous mixtures with tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, lightly coat the truck beds with a minimum amount of paraffin oil, lime solution, or other approved material. Provide each truck with 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, insulate truck beds and securely fasten covers.

401–4.4 BITUMINOUS PAVERS. Provide self-propelled bituminous pavers, with an activated screed, heated if necessary, and capable of spreading and finishing courses of bituminous plant mix material 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 paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed must effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

Equip the paver with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor–directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent.

The controls must be capable of working in conjunction with any of the following attachments:

a. Ski–type device of not less than 30 feet (9.14 m) in length.

b. Taut stringline (wire) set to grade.

c. Short ski or shoe

d. Laser control.

NOTE TO SPECIFIER:
The FAA recommendation to require automatic grade controls for pavements serving aircraft over 60,000 pounds (27 200 kg) or more gross weight and on all runways was included in the standard specification. In some instances it may be advisable to specify the type of attachment required to guide the automatic control.

401–4.5 ROLLERS. Rollers of the vibratory, steel wheel, or pneumatic–tired type may be used as long as they are in good condition, capable of operating at slow speeds to avoid displacement of the bituminous mixture. Provide a sufficient number, type, and weight of rollers to compact the mixture to the required density while the mixture is still in a workable condition.

Do not use equipment that causes excessive crushing of the aggregate.

401–4.6 PREPARATION OF BITUMINOUS MATERIAL. Heat the bituminous material in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature. The temperature of the bituminous material 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).

401–4.7 PREPARATION OF MINERAL AGGREGATE. Heat and dry the aggregate for the mixture prior to introduction into the mixer. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates. Do not exceed a temperature of 350°F (175°C) for the aggregate and mineral filler when the asphalt is added. Take particular care 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.

401–4.8 PREPARATION OF BITUMINOUS MIXTURE. Weigh or meter the aggregates and the bituminous material and introduce it into the mixer in the amount specified by the job mix formula.

Mix the combined materials until the aggregate obtains a uniform coating of bitumen and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture. Establish the wet mixing time for all plants, based on the procedure for determining the percentage of coated particles described in ASTM D 2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to achieve 95 percent of coated particles. For continuous mix plants, determine the minimum mixing time by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. Do not exceed a 0.5 percent moisture content of all bituminous mix upon discharge.

NOTE TO SPECIFIER:
For batch plants, wet mixing time begins with the introduction of bituminous material into the mixer and ends with the opening of the mixer discharge gate. Distribution of aggregate and bituminous material as they enter the pugmill, speed of mixer shafts, and arrangement and pitch of paddles are factors governing efficiency of mixing. Prolonged exposure to air and heat in the pugmill harden the asphalt film on the aggregate. Mixing time, therefore, should be the shortest time required to obtain uniform distribution of aggregate sizes and thorough coating of aggregate particles with bituminous material.

401–4.9 PREPARATION OF THE UNDERLYING SURFACE. Clean all dust and debris from the underlying course immediately before placing the bituminous mixture. If required by the Contract Specifications, apply a prime coat or tack coat in accordance with Specification P–602 or P–603.

NOTE TO SPECIFIER:
Specifications for prime and tack coat are included in the Standard Specifications. If prime or tack coats are desired on a project, the appropriate Pay Items should be included in the Schedule of Prices. Refer to Items P–602 and P–603 for comments on appropriate usage of these Items.

401–4.10 TRANSPORTING, SPREADING, AND FINISHING. Transport the bituminous mixture from the mixing plant to the site in vehicles conforming to the requirements of Paragraph 401–4.3, Hauling Equipment. Schedule deliveries so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Provide adequate artificial lighting during night placements. Do not permit hauling over freshly placed material until the material has been compacted, as specified, and allowed to cool to ambient atmospheric temperature.

NOTE TO SPECIFIER:
The FAA will allow use of a material transfer vehicle. A material transfer vehicle allows the paver to be operated almost continuously without stopping between truckloads of mix, if a continuous supply of mix is available from the asphalt plant.

Place and compact the mix at a temperature suitable for obtaining density, surface smoothness, and other specified requirements but not less than 250°F (107°C).

Upon arrival, spread the mixture to the full width by an approved bituminous paver. Strike it off in a uniform layer of a depth that, when the work is completed, it will have the required thickness and conform to the grade and contour indicated. Regulate the speed of the paver to eliminate pulling and tearing of the bituminous mat. Unless otherwise directed, begin placement of the mixture along the centerline of a crowned section or on the high side of areas with a one–way slope. Place the mixture in consecutive adjacent strips having a minimum width of 12.5 feet except where edge lanes require less width to complete the area. The longitudinal joint on new pavement in one course must offset the longitudinal joint in the course immediately below by at least 1 foot (300 mm); however, the joint in the top course shall be at the centerline of the pavement. Offset transverse joints in one course by at least 10 feet (3 m) from transverse joints in the previous layer.

Offset transverse joints in adjacent lanes 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 mixture may be spread, raked, and luted by hand tools.

NOTE TO SPECIFIER:
The Engineer should specify the widest paving lane practicable in an effort to hold the number of longitudinal joints to a minimum. The Standard Specification required a minimum 12.5 foot paving lane. This could be changed by Special Provision if runway width and other conditions make it desirable.

401–4.11 COMPACTION OF MIXTURE. After placing, thoroughly and uniformly compact the mixture by rolling. Compact the surface as soon as possible when the mixture 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 is at the discretion of the Contractor.

Drive the roller slowly at all times, to avoid displacement of the hot mixture and to be effective in compaction. Immediately correct displacement occurring as a result of reversing the direction of the roller, or from other causes.

Furnish sufficient rollers to handle the output of the Plant. Continue rolling until the surface texture is uniform, true to grade and cross section, and the required field density is obtained.

To prevent adhesion of the mixture to the roller, keep the wheels properly moistened (and scrapers used), but do not use excessive water.

In areas not accessible to the roller, thoroughly compact the mixture with hot hand tampers.

Remove and replace mixture that becomes loose and broken, mixed with dirt, contains check–cracking, or is otherwise defective with fresh hot mixture and compact it immediately to conform to the surrounding area. Do this Work at the Contractor's expense. Skin patching is not allowed.

401–4.12 JOINTS. Form joints to ensure a continuous bond between the courses and to obtain required density. Make the joints with the same texture as other sections of the course and meet the requirements for smoothness and grade.

Do not allow the roller to pass over the unprotected end of the freshly laid mixture except when necessary to form a transverse joint. When necessary to form a transverse joint, make it by means of placing a bulkhead or by tapering the course. Cut back the tapered edge to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods give all contact surfaces a tack coat of bituminous material before placing any fresh mixture against the joint.

Cut back longitudinal joints that are irregular, damaged, or defective to expose a clean, sound surface for the full depth of the course. Tack all contact surfaces a with coat of bituminous material prior to placing any fresh mixture against the joint.

Tack coat for joints is considered incidental and the cost included in the price for Bituminous Surface Course.

MATERIAL ACCEPTANCE

401–5.1 ACCEPTANCE SAMPLING AND TESTING. All acceptance sampling and testing necessary to determine conformance with the requirements specified in this Section will be performed by the Engineer at no cost to the Contractor (except coring as required in this Specification shall be completed by Contractor). Testing organizations performing these tests shall meet the requirements of ASTM D 3666.

a. Plant–Produced Material. Plant–produced material will be tested for stability, flow, and air voids on a lot basis. Sampling will be from material deposited into trucks at the plant or from trucks at the job site. A lot will consist of:

One day's production not to exceed 2,000 tons (1,814,000 kg) or

A half day's production where a day's production is expected to consist of between 2,000 and 4,000 tons (1,814,000 and 3,628,000 kg), or

Similar subdivisions for tonnages over 4,000 tons (3,628,000 kg).

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

(1.) Sampling. Each lot will consist of four equal sublots Sufficient material for preparation of test specimens will be sampled by the Engineer on a random basis, in accordance with the procedures contained in ASTM D 3665. One set of laboratory compacted specimens will be prepared for each sublot in accordance with ASTM D 1559, Paragraph 4.5, at the number of blows required by Paragraph 401–3.2, Table 1. Each set of laboratory compacted specimens will consist of three test portions prepared from the same sample increment.

The sample of bituminous mixture may be put in a covered metal tin and placed in an oven for not more than 30 minutes to maintain the heat. The compaction of the specimens should be as specified in the job mix formula.

(2.) Testing. Sample specimens will be tested for stability and flow in accordance with ASTM D 1559, Paragraph 5. Air voids will be determined by the Engineer in accordance with ASTM D 3203.

Prior to testing, the Engineer will measure the bulk specific gravity of each test specimen in accordance with ASTM D 2726 or D 1188, whichever applies, for use in computing air voids and pavement density.

For air voids determination, the theoretical maximum specific gravity of the mixture will be measured twice for each lot in accordance with ASTM D 2041, Type C or D container. Samples will be taken on a random basis in accordance with ASTM D 3665. The value used in the voids computation for each sublot will be the average of the two maximum specific gravity measurements for the lot.

The stability, flow, and air voids for each sublot will be computed by averaging the results of the three test specimens representing that sublot.

(3) Acceptance. The Engineer will determine acceptance of plant produced material for stability, flow, and air voids in accordance with the requirements of Paragraph 401–5.2b.

b. Field Place Material. Material placed in the field will be tested for mat and joint density on a lot basis.

(1.) Mat Density. The lot size will be the same as that indicated in Paragraph 401–5.1a and will be divided into 4 equal sublots. Take one core of finished, compacted materials from each sublot. The Engineer will determine core locations on a random basis in accordance with procedures contained in ASTM D 3665. Do not take cores closer than one foot from a transverse or longitudinal joint.

(2.) Joint Density. The lot size will be the total length of longitudinal joints constructed by a lot of material as defined in Paragraph 401–5.1a. The lot will be divided into 4 equal sublots.

Take one core of finished, compacted materials from each sublot. The Engineer will determine core locations on a random basis in accordance with procedures contained in ASTM D 3665.

(3.) Sampling. Cut samples neatly with a core drill. Use a core drill bit with a cutting edge of hardened steel or other suitable material with diamond chips embedded in the metal cutting edge. The minimum diameter of the sample shall be 3 inches. Discard samples that are clearly defective, as a result of sampling, and take another sample. Furnish all tools, labor, and materials for cutting samples and filling the cored pavement. Fill cored holes in a manner acceptable to the Engineer and within one day after sampling.

(4.) Testing. The bulk specific gravity of each cored sample will be measured by the Engineer in accordance with ASTM D 2726 or D 1188, whichever is applicable. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each sublot sample by the average bulk specific gravity of all laboratory prepared specimens for the lot, as determined in Paragraph 401–5.1a(2).

(5.) Acceptance. The Engineer will determine acceptance of field placed material for mat density in accordance with the requirements of Paragraph 401–5.2c. Acceptance for joint density will be determined in accordance with the requirements of Paragraph 401–5.2d.

c. Partial Lots – Plant–Produced Material. When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot, the following procedure will be used to adjust the lot size and the number of tests for the lot.

The last batch produced where production is unexpectedly halted will be sampled and its properties will be considered as representative of the particular sublot from which it was taken. Where three sublots are produced, they shall constitute a lot. Where one or two sublots are produced, they shall be incorporated into the next lot and the total number of sublots shall be used in the acceptance plan calculation, i.e., n = 5 or n = 6, for example.

d. Partial Lots – Field Placed Material. The lot size for field placed material will correspond to that of the plant material, except that in no case shall less than three (3) cored samples be obtained, i.e., n=3.

401–5.2 ACCEPTANCE CRITERIA.

a. General. Acceptance will be based on the following characteristics of the bituminous mixture and completed pavement as well as the implementation of the Contractor's Quality Control Plan and test results:

(1.) Stability
(2.) Flow
(3.) Air voids
(4.) Mat density
(5.) Joint density
(6.) Thickness
(7.) Smoothness
(8.) Grade

Stability, flow, and air voids will be evaluated for acceptance in accordance with Paragraph 401–5.2b. Mat density will be evaluated for acceptance in accordance with Paragraph 401–5.2c. Joint density will be evaluated for acceptance in accordance with Paragraph 401–5.2d.

Acceptance for mat density and air voids will be based on the criteria contained in Paragraph 401–5.2f(1). Acceptance for stability and flow will be based on the criteria contained in Paragraph 401–5.2f(2). Acceptance for joint density will be based on the criteria contained in Paragraph 401–5f(3). The Engineer will evaluate thickness for compliance in accordance with Paragraph 401–5.2f(4). Acceptance for smoothness will be based on the criteria contained in Paragraph 401–5.2f(5). Acceptance for grade will be based on the criteria contained in Paragraph 401–5.2f(6).

The Engineer may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of bituminous mixture which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or improper mix temperature. 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 Engineer, and if it can be demonstrated in the laboratory, in the presence of the Engineer, that the material was erroneously rejected, payment will be made for the material at the Contract unit price.

b. Stability, Flow, Air Voids. Acceptance of each lot of plant produced material for stability, flow, and air voids will be based on the percentage of material within specification limits (PWL). The PWL plan considers the variability (standard deviation) of the material and the testing procedures, as well as the average (mean) value of the test results. If a material with high variability is produced, the production target must be adjusted as outlined in Paragraph 401–3.2 to achieve a PWL of 90 or more.

c. Mat Density. Acceptance of each lot of in–place pavement for mat density will be based on the percentage of material within specification limits (PWL). If a material with high variability is produced, then a higher target density must be maintained in order to achieve a PWL of 90 or more.

d. Joint Density. Acceptance of each lot of in–place pavement for joint density will be based on the percentage of material within specification limits (PWL). If a material with high variability is produced, then a higher target density must be maintained in order to achieve a PWL of 90 or more.

e. Percentage of Material Within Specification Limits (PWL). The percentage of material within specification limits (PWL) will be determined in accordance with procedures specified in Section 110 of the General Provisions. The specification tolerance limits (L) and (U) are contained in Table 5.

f. Acceptance Criteria.

(1.) Mat Density and Air Voids. If the PWL of the lot equals or exceeds 90 percent, the lot will be acceptable. If the PWL is less than 90 percent, payment will be made in accordance with Paragraph 401–8.1a.

(2.) Stability and Flow. If the PWL of the lot equals or exceeds 90 percent, the lot will be acceptable. If the PWL is less than 90 percent, determine the reason and take corrective action. If the PWL is below 80 percent, stop production and make adjustments to the mix.

(3.) Joint Density. If the PWL of the lot equals or exceeds 90 percent, the lot will be acceptable. If the PWL is less than 90 percent, evaluate the method of compacting joints. If the PWL is below 80 percent, stop production until the reason for poor compaction can be determined and corrected.

(4.) Thickness. Thickness will be evaluated for compliance by the Engineer to the requirements shown on the Plans. Measurements of thickness will be made by the Engineer using the cores extracted for each sublot for density measurement.

(5.) Smoothness. The finished surfaces of the pavement cannot vary more than 1/4 inch for the surface course or 3/8 inch for base course. Each lot will be evaluated with a 12–foot (3.6 m) straightedge. The lot size shall be 2,000 square yards (1,650 square meters). Measurements will be made perpendicular and parallel to the centerline at distances not to exceed 50 feet (15.2 m). When more than 15 percent of all measurements within a lot exceed the specified tolerance, remove the deficient area and replace with new material. Remove sufficient material to allow at least one inch of asphalt concrete to be placed. Skin patching is not permitted. High points may be ground off.

NOTE TO SPECIFIER:
The FAA recommendation to require a smoothness specification of 3/8 inch (9.5 mm) for base course and 1/4 inch (6.2 mm) for surface course was included in the standard specification.

A recommended lot size of 2,000 square yards (1,650 square meters) was also included.

(6.) Grade. Do not vary the finished surface of the pavement from the gradeline elevations and cross sections shown on the Plans by more than 1/2 inch (12.70 mm). The finished grade of each lot will be determined by running levels at intervals of 50 feet (15.2 m) or less longitudinally and transversely to determine the elevation of the completed pavement. The lot size will be 2,000 square yards (1,650 square meters). When more than 15 percent of all the measurements within a lot are outside the specified tolerance, remove the deficient area and replace with new material. Remove sufficient material to allow at least one inch of asphalt concrete to be placed. Skin patching for correcting low areas is not be permitted. High points may be ground off.

NOTE TO SPECIFIER:
A minimum lot size of 2,000 square yards (1,650 square meters) is recommended by FAA and was included in the Standard Specification. The size may be changed by Special Provision.

TABLE 5. ACCEPTANCE LIMITS STABILITY, FLOW, AIR VOIDS, DENSITY

Test Property	*Pavements Designed for Aircraft Gross Weights of 60,000 lbs.(27,000 kg) or More or Tire Pressure Greater Than 100 psi (690 Pa)*		*Pavements Designed for Aircraft Gross Weight Less than 60,000 lbs.(27,000 kg) or Tire Pressure Less Than 100 psi (690 Pa)*	
Number of Blows	75		50	
	Specification Tolerance		Specification Tolerance	
	L	U	L	U
Stability, min. pounds (N)	1800 (8000)	—	1000 (4450)	—
Flow, 0.01–inch (0.25 mm)	8	16	8	20
Air voids total mix (percent)	2.0	5.0	2.0	5.0
Density (percent)	96.3	—	96.3	—
Joint density (percent)	93.3	—	93.3	—

401–5.3 RESAMPLING PAVEMENT.

a. General. Resampling of a lot of pavement for mat density will be allowed if the Contractor requests, in writing, within 48 hours after receiving the written test results from the Engineer. A retest will consist of all the sampling and testing procedures contained in Paragraphs 401–5.1b and 401–5.2c. 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 is the responsibility of 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 8.

c. Outliers. If the tests within a lot include a very large or a very small value which appears to be outside the normal limits of variation, check for an outlier in accordance with ASTM E 178, at a significance level of 5 percent, to determine if this value should be discarded when computing the PWL.

401–5.4 LEVELING COURSE. A pavement course used for trueing and leveling shall meet the requirements of Paragraph 401–3.2 and 5.2b, but shall not be subject to the density requirements of Paragraph 401–5.2c and d. Compact the leveling course with the same effort used to achieve density of the test section. The trueing and leveling course shall not exceed a nominal thickness of 1–1/2 inches (38 mm). Areas of pavement requiring a leveling course are shown on Plans.

NOTE TO SPECIFIER:
Areas of the pavement requiring a leveling course shall be shown on the Plans.

CONTRACTOR QUALITY CONTROL

401–6.1 GENERAL. Develop a Quality Control Program in accordance with Section 100 of the General Provisions. The program shall address all elements which affect the quality of the pavement including, but not limited to:

a. Mix Design

b. Aggregate Grading

c. Quality of Materials

d. Stockpile Management

e. Proportioning

f. Mixing and Transportation

g. Placing and Finishing

h. Joints

i. Compaction

j. Surface smoothness

401–6.2 TESTING LABORATORY. Provide a fully equipped asphalt laboratory located at the Plant or job site. Use it for quality control testing and provide adequate equipment for the performance of the tests required by these Specifications. Provide the Engineer a separate field laboratory under Specification P–632 for acceptance testing.

NOTE TO SPECIFIER:
Include a Pay Item for a field laboratory under Specification P–632 for use by Engineer for acceptance testing. Specification P–632 is similar to the Wisconsin DOT Highways Specification for field offices and laboratories.

Keep laboratory facilities clean and maintain all equipment in proper working condition. Permit unrestricted access to the Engineer to inspect the Contractor's laboratory facility and witness quality control activities. The Engineer will advise the Contractor in writing of noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, immediately suspend the incorporation of the materials into the Work and do not resume until the deficiencies are satisfactorily corrected.

401–6.3 QUALITY CONTROL TESTING. Perform all quality control tests necessary to control the production and construction processes applicable to these Specifications and as set forth in the Quality Control Program. The testing program shall include, but is not necessarily limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, and surface smoothness. Develop a Quality Control Testing Plan as part of the Quality Control Program.

a. Asphalt Content. Perform a minimum of two extraction tests per lot in accordance with ASTM D 2172 for determination of asphalt content. Determine the weight of ash portion of the extraction test, as described in ASTM D 2172, as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. Use the last weight of ash value obtained in the calculation of the asphalt content for the mixture.

The use of the nuclear method for determining asphalt content in accordance with ASTM D 4125 is permitted, provided that it is calibrated for the specific mix being used.

b. Gradation. Determine aggregate gradations a minimum of twice per lot from mechanical analysis of extracted aggregate in accordance with AASHTO T 30 and ASTM C 136 (dry sieve). When asphalt content is determined by the nuclear method, determine aggregate gradation from hot bin samples on batch plants, or from the cold feed on drum mix or continuous mix plants, and test it in accordance with ASTM C 136 (dry sieve) using actual batch weights to determine the combined aggregate gradation of the mixture.

c. Moisture Content of Aggregate. Determine the moisture content of aggregate used for production a minimum of once per lot in accordance with ASTM C 566.

d. Moisture Content of Mixture. Determine the moisture content of the mixture once per lot in accordance with ASTM D 1461.

e. Temperatures. Check temperatures at least four times per lot, at necessary locations to determine the temperatures of the dryer, the bitumen in the storage tank, the mixture at the plant, and the mixture at the job site.

f. In–Place Density Monitoring. Conduct 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 D 2950.

g. Additional Testing. Additional testing that the Contractor deems necessary to control the process is optional.

h. Monitoring. The Engineer reserves the right to monitor the above testing.

401.6.4 SAMPLING. When directed by the Engineer, sample and test material which appears inconsistent with similar material being sampled, unless the material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

401–6.5 CONTROL CHARTS. Maintain linear control charts both for individual measurements and range (i.e., difference between highest and lowest measurements) for aggregate gradation and asphalt content.

Post control charts in a location satisfactory to the Engineer and keep it current. As a minimum, identify in the control charts the project number, the Contract Pay Item number, the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter, and the Contractor's test results. Use the control charts as part of a process control system for identifying potential problems. The Engineer may suspend production or acceptance of the material, if satisfactory corrective action is not taken.

a. Individual Measurements. Establish control charts for individual measurements to maintain process control within tolerance for aggregate gradation and asphalt content. Use the job mix formula target values on the control charts as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:

TABLE 6. CONTROL CHART LIMITS FOR INDIVIDUAL MEASUREMENTS

Gradation		*1 & 2 (1 Inch and Greater Aggregate Size)*		*3 (3/4 Inch Maximum Aggregate Size)*		*4 (1/2 Inch Maximum Aggregate Size)*	
Sieve Size		*Action Limit*	*Suspension Limit*	*Action Limit*	*Suspension Limit*	*Action Limit*	*Suspension Limit*
in.	*mm.*						
1 and greater	25 and greater	0%	0%	—	—	—	—
¾	19.0	±6%	11%	0%	0%	—	—
½	12.5	±6%	±9%	±6%	±9%	0%	0%
3/8	9.5	±6%	±9%	±6%	±9%	±6%	±9%
No. 4	4.75	±6%	±9%	±6%	±9%	±6%	±9%
No. 16	1.18	±5%	±7.5%	±5%	±7.5%	±5%	±7.5%
No. 50	0.30	±13%	±4.5%	±13%	±4.5%	±13%	±4.5%
No. 200	0.075	±2%	±3%	±2%	±3%	±2%	±3%
Asphalt Content		±0.45%	±0.70%	±0.45%	±0.70%	±0.45%	±0.70%

b. Range. Establish control charges for range to control process variability for the test parameters and Suspension Limits listed below. Establish the range to control process variability for the test parameters and Suspension Limits listed below. Compute the range for each lot 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, adjust the Suspension Limits by multiplying the Suspension Limit by 1.18 for n = 3 and by 1.27 for n = 4.

TABLE 7. CONTROL CHART LIMITS BASED ON RANGE
(Based on n = 2)

Sieve		*Suspension Limit, Percent*
in.	*mm.*	
1/2 inch	12.5	11
3/8 inch	9.5	11
No. 4	4.75	11
No. 16	1.18	9
No. 50	0.30	6
No. 200	0.075	3.5
Asphalt Content		0.8

c. Corrective Action. Indicate the appropriate action to be taken in the Quality Control Plan when the process is believed to be out of tolerance. Provide a set of rules in the Plan 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.

NOTE TO SPECIFIER:

The aggregate control chart parameters and Suspension and Action Limits contained in the above paragraphs are originally based on 3/4 inch (19.0 mm) maximum size aggregate gradation. For 1–inch (25.0 mm) or 1–1/4 inch (31.2 mm) maximum size aggregate, the Individual Measurements Chart requirements were amended as follows:

Sieve	Action Limit	Suspension Limit
1 or 1–1/4 inch	0%	0%
3/4 inch sieve	±6%	11%

For 1/2–inch (12.5 mm) maximum size aggregate, the 3/4–inch (19.0 mm) and 1–inch (25.0 mm) sieves were deleted from the Individual Measurements Chart and the 1/2–inch (12.5 mm) sieve Action and Suspension Limits were changed to 0%. For the 1/2–inch (12.5 mm) gradation, the 1/2–inch sieve were deleted from the Range Chart.

METHOD OF MEASUREMENT

401–7.1 Plant mix bituminous concrete pavement will be measured by the number of tons of Bituminous Surface Course, Bituminous Leveling Course, or Bituminous Base Course and the number of tons of Bituminous Material used in the accepted Work.

a. Recorded batch weights or truck scale weights will be used to determine the basis for the tonnage of Bituminous Surface Course, Bituminous Leveling Course, or Bituminous Base Course.

b. Measurement of Bituminous Material by the ton will be based on the net weights of material shipments, except when batch weights are recorded or the job operations require the delivery of bituminous mixtures to be intermittent or in such minor quantities that the measurement of the bituminous materials based on net weights would be impractical. In the latter case, the measurement may be based on the theoretical percentage of bituminous material in the mixture or on the weight of bituminous material contained in each batch.

When batch weights are recorded, the measurement may be based on the batch weight of bituminous material.

Deductions will be made for quantities which are wasted or are not actually incorporated in the Work in accordance with the Contract.

c. Measurement for Bituminous Pavement Contractor Quality Control Program will be measured by the ton of Bituminous Surface Course, Bituminous Leveling Course, or Bituminous Base Course constructed. The weight of bituminous material will not be deducted from the weight of Bituminous Surface Course, Bituminous Leveling Course, or Bituminous Base Course measured for payment.

BASIS OF PAYMENT

401–8.1 PAYMENT. Payment for an accepted lot of bituminous concrete pavement will be made at the Contract unit price per ton for Bituminous Surface Course, Bituminous Leveling Course, or Bituminous Base Course and Bituminous Material adjusted according to Paragraph 401–8.1a. The price will 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 Work.

a. Basis of Adjusted Payment. Each lot will be accepted at the full Contract Price when the percent within limits (PWL) for mat density and air voids equals or exceeds 90 percent. Each lot not meeting the 90 percent PWL requirements will be accepted at an adjusted Contract unit price in accordance with Table 6. Payment will be calculated for both mat density and air voids, and payment will be based on the lower of the two values. **The price adjustment will apply to the price for the bituminous course, but not the price for bituminous material.**

TABLE 8. PRICE ADJUSTMENT SCHEDULE	
Percentage of Material Within the Specification Limit (PWL)	*Percent of Contract Unit Price to be Paid*
90–100	100
80–90	0.5 PWL + 55.00
65–80	2.0 PWL – 65.0
Below 65	*

* The lot shall be removed and replaced. However, the Engineer may decide to accept the deficient lot. In that case, if the Engineer and Contractor agree in writing that the lot shall not be removed, it will be paid for at 50 percent of the Contract Price.

401–8.2 BITUMINOUS MATERIAL. The number of tons of bituminous materials, measured as provided, will be paid for at the Contract unit price per ton for the Pay Item Bituminous Material. The price will be full compensation for furnishing, heating, unloading, transporting and placing in the mixer; and for all labor, tools, equipment, and incidentals necessary to complete the Work.

401–8.3 CONTRACTOR QUALITY CONTROL PROGRAM. Payment for Bituminous Pavement Contractor Quality Control Program will be made at the Contract unit price per ton and will be full compensation for providing services to conduct the quality control program, including testing services, inspection, supervision, control charts, adjustment to production, and all incidental items.

401–8.4 Standard Pay Items for Work covered by this Specification are as follows:

Pay Item P40101	Bituminous Surface Course, per ton.
Pay Item P40102	Bituminous Leveling Course, per ton.
Pay Item P40103	Bituminous Base Course, per ton.
Pay Item P40104	Bituminous Material, per ton.
Pay Item P40105	Bituminous Pavement Contractor Quality Control Program, per ton.

Measurement and Payment will only be made for Pay Items contained in the Schedule of Prices. The cost of all Work required by the Contract Documents will be included in the Pay Items contained in the Schedule of Prices.

TESTING REQUIREMENTS

ASTM C 29	Unit Weight of Aggregate
ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	Test Method for Materials Finer than 75–mm (No.200) Sieve in Mineral Aggregates by Washing
ASTM C 131	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C 183	Sampling Hydraulic Cement
ASTM C 566	Total Moisture Content of Aggregate by Drying
ASTM D 75	Sampling Aggregates
ASTM D 995	Requirements for Mixing Plants for Hot–Mixed Hot–Laid Bituminous Paving Mixtures
ASTM D 1118	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin–Coated Specimens
ASTM D 1461	Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 1559	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2041	Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2419	Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2489	Degree of Particle Coating of Bituminous–Aggregate Mixtures
ASTM D 2726	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface–Dry Specimens
ASTM D 3203	Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D 2950	Density of Bituminous Concrete in Place by Nuclear Method

ASTM D 3665	Random Sampling of Paving Materials
ASTM D 3666	Inspection and Testing Agencies for Bituminous Paving Materials
ASTM D 4125	Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4791	Flat or Elongated Particles in Coarse Aggregate
ASTM D 4867	Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM E 178	Practice for Dealing With Outlying Observations
AASHTO T 30	Mechanical Analysis of Extracted Aggregate
The Asphalt Institute's Manual No. 2 (MS–2)	Mix Design Methods for Asphalt Concrete
The Asphalt Institute's Manual No. 20 (MS–20)	Hot–Mix Recycling

MATERIAL REQUIREMENTS

ASTM D 242	Mineral Filler for Bituminous Paving Mixtures
ASTM D 946	Asphalt Cement for Use in Pavement Construction
ASTM D 3381	Viscosity–Graded Asphalt Cement for Use in Pavement Construction
ASTM D 4552	Classifying Hot–Mix Recycling Agents