



SECTION 36 – PLANT-MIX BITUMINOUS PAVEMENTS (FAA P-403)

36-1 GENERAL

The Contractor shall perform all work required by the plans and specifications for construction of plant mix bituminous pavement for base course for runways and taxiways, and for surface course for runway shoulders, taxiway shoulders, apron shoulders, and roadway surfaces, in accordance with Sections 203 and 302 of the Standard Specifications, except as specified otherwise in FAA Specification Item P-403 as included and modified hereafter, and as shown on the Plans.

Unless otherwise specified, the Contractor may elect to provide “Caltrans Asphalt”, as specified in Section 36-3, in lieu of P-403 as hereinafter specified.

Bituminous Surface Course for runway or taxiway surfaces shall be constructed under Section 34 Plant Mix Bituminous Pavements (FAA P-401) of these specifications.

***ITEM P-403 PLANT MIX BITUMINOUS PAVEMENTS
(Base, Leveling or Surface Course)***

DESCRIPTION

403-1.1 This item shall consist of a [] 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, 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.

Specify base and/or leveling course(s). Surface course may also be specified but only for those pavements designed to accommodate aircraft of gross weights less than or equal to 12,500 pounds or for surface course of shoulders, blast pads, service roads, etc. Item P-401 is to be specified for surface courses for pavements designed to accommodate aircraft gross weights greater than 12,500 pounds.

This specification is to be used as a base or leveling course for pavements designed to accommodate aircraft of gross weights greater than 12,500 pounds. State highway department specifications may be used in lieu of this



specification for access roads, perimeter roads, stabilized base courses under Item P-501, and other pavements not subject to aircraft loading, or for pavements designed for aircraft gross weights of 12,500 pounds (5,670 kg) or less.

Where a state highway department specification is to be used in lieu of this specification, the state specification must have a demonstrated satisfactory performance record under equivalent loadings and exposure. When a density requirement is not specified by a state specification, it is to be modified to incorporate the language found in paragraphs 403-5.1, 403-5.2 and 403-5.3. When state highway specification are approved, include all applicable/approved state specifications in the contract documents.

MATERIALS

403-2.1 AGGREGATE. *Aggregates shall consist of crushed stone, crushed gravel, or crushed slag with or without natural sand or other inert finely divided mineral aggregate. The portion of combined materials retained on the No. 4 sieve is coarse aggregate. The portion of combined materials passing the No. 4 sieve and retained on the No. 200 sieve is fine aggregate, and the portion passing the No. 200 sieve is mineral filler.*

a. Coarse Aggregate. *Coarse aggregate shall consist of sound, tough, durable particles, free from adherent films of matter that would prevent thorough coating and bonding with the bituminous material and be 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.*

Aggregate 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. The area of each face shall be equal to at least 75 percent of the smallest midsectional 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 a total of 8 percent, by weight, of flat particles, elongated particles, and flat and elongated particles, when tested in accordance with ASTM D 4791 with a value of 5:1.



b. Fine Aggregate. Fine aggregate shall consist of clean, sound, durable, angular shaped particles produced by crushing stone, slag, 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 fine 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 (nonmanufactured) 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 15 percent natural sand by weight of total aggregates. If used, the natural sand shall meet the requirements of ASTM D 1073 and 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.

The aggregate shall have sand equivalent values of 45 or greater when tested in accordance with ASTM D 2419.

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.

d. Sources of Aggregates. Sources of aggregates shall be selected well in advance of the time the materials are required in the work. When the aggregates are obtained from a previously approved source, or an existing source producing aggregates that has a satisfactory service record in airport bituminous pavement construction for at least 5 years, samples shall be submitted 21 days prior to start of production. An inspection of the producer's operation will be made by the Engineer. When new sources are to be developed, the Contractor shall indicate the sources and shall submit a plan for operation 30 days in advance of starting production. Samples from test pits, borings, and other excavations shall be submitted at the same time. Approval of the source of aggregate does not relieve the Contractor in any way of the responsibility for delivery at the job site of aggregates that meet the requirements specified herein.

e. Samples of Aggregates. Samples of aggregates shall be furnished by the Contractor at the start of production, and at intervals during production of bituminous mixtures. The sampling points and intervals will be designated by the Engineer. The samples will be the basis of approval of specific lots of aggregates from the standpoint of the quality requirements of this section. The Contractor shall furnish documentation and samples to the Engineer confirming that the aggregates meet the specification requirements.



403-2.2 MINERAL FILLER. *If filler, in addition to that naturally present in the aggregate, is necessary, it shall meet the requirements of ASTM D 242.*

403-2.3 BITUMINOUS MATERIAL. *Bituminous material shall conform to the following requirements: AASHTO M320 Performance Grade PG 70-10.*

The Contractor shall furnish vendor's certified test reports for each lot of bituminous material 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.

403-2.4 PRELIMINARY MATERIAL ACCEPTANCE. *Prior to delivery of materials to the job site, the Contractor shall submit certified test reports to the Engineer for the following materials:*

a. Coarse Aggregate.

- (1) *Percent of wear.*
- (2) *Soundness.*
- (3) *Unit weight of slag.*
- (4) *Percent fractured faces*

b. Fine Aggregate.

- (1) *Liquid limit.*
- (2) *Plasticity index.*
- (3) *Sand equivalent.*

c. Mineral Filler.

d. Bituminous Material. *Test results for bituminous material shall include temperature/viscosity charts for mixing and compaction temperatures.*

The certification(s) shall 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.

403-2.5 ANTI-STRIPPING AGENT. *Any anti-stripping agent or additive if required shall be heat stable, shall not change the asphalt cement viscosity beyond specifications, shall contain no harmful ingredients, shall be added in*



recommended proportion by approved method, and shall be a material approved by the Department of Transportation of the State in which the project is located.

COMPOSITION

403-3.1 COMPOSITION OF MIXTURE. *The bituminous plant mix shall be composed of a mixture of well-graded aggregate, filler and anti-strip agent 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).*

403-3.2 JOB MIX FORMULA. *No bituminous mixture for payment shall be produced until a job mix formula has been approved in writing by the Engineer. The bituminous mixture shall be designed 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, sixth edition, and shall meet the requirements of Tables 1, 2 and 3.*

Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867, shall not be less than 75. Anti-stripping agent shall be added to the asphalt, as necessary, to produce a TSR of not less than 75. If an antistripping agent is required, it will be provided by the Contractor at no additional cost to the Owner.

The job mix formula shall be submitted in writing by the Contractor to the Engineer at least 15 days prior to the start of paving operations and shall include as a minimum:

- a. Percent passing each sieve size for total combined gradation, individual gradation of all aggregate stockpiles and percent by weight of each stockpile used in the job mix formula.*
- b. Percent of asphalt cement.*
- c. Asphalt performance, viscosity or penetration grade, and type of modifier if used.*
- 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 by weight of flat particles, elongated particles, and flat and elongated particles (and criteria).*
- n. Tensile Strength Ratio (TSR).*
- o. Antistrip agent (if required).*

The Contractor shall submit to the Engineer the results of verification testing of three (3) asphalt samples prepared at the optimum asphalt content. The average of the results of this testing shall indicate conformance with the job mix formula requirements specified in Tables 1, 2 and 3.

When the project requires asphalt mixtures of differing aggregate gradations, a separate job mix formula and the results of job mix formula verification testing must be submitted for each mix.

The job mix formula for each mixture shall be in effect until a modification is approved in writing by the Engineer. Should a change in sources of materials be made, a new job mix formula must be submitted within 10 days and approved by the Engineer in writing before the new material is used. After the initial production job mix formula(s) has/have been approved by the Engineer and a new or modified job mix formula is required for whatever reason, the subsequent cost of the Engineer's approval of the new or modified job mix formula will be borne by the Contractor. There will be no time extension given or considerations for extra costs associated with the stoppage of production paving or restart of production paving due to the time needed for the Engineer to approve the initial, new or modified job mix formula.



TABLE 1. MARSHALL DESIGN CRITERIA	
TEST PROPERTY	
<i>Number of blows</i>	75
<i>Stability, pounds minimum</i>	2,150
<i>Flow, 0.01 in.</i>	10-14
<i>Air voids (percent)</i>	2.8 – 4.2
<i>Percent voids in mineral aggregate, minimum</i>	See Table 2

TABLE 2 MINIMUM PERCENT VOIDS IN MINERAL AGGREGATE	
<i>Maximum Particle Size</i>	<i>Minimum Voids in Mineral Aggregate</i>
<i>in.</i>	<i>Percent</i>
1/2	14
3/4	13
1	12
1-1/4	11

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 3 when tested in accordance with ASTM C 136 and C 117.

The gradations in Table 3 represent the limits that shall 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.



Table 3			
AGGREGATE – BITUMINOUS PAVEMENTS – SURFACE COURSE			
Sieve Size	Percentage by Weight Passing Sieves		
	1-1/4 inch Max	1 inch Max	3/4 inch Max
<i>1-1/4 in.</i>	100	-	-
<i>1 in.</i>	86–98	100	-
<i>3/4 in.</i>	68–93	76-98	100
<i>1/2 in.</i>	57–81	66-86	79-99
<i>3/8 in.</i>	49–69	57-77	68-88
<i>No. 4</i>	34–54	40-60	48-68
<i>No. 8</i>	22–42	26-46	33-53
<i>No. 16</i>	13–33	17-37	20-40
<i>No. 30</i>	8–24	11-27	14-30
<i>No. 50</i>	6–18	7-19	9-21
<i>No. 100</i>	4–12	6-16	6-16
<i>No. 200</i>	3–6	3-6	3-6
<i>Asphalt percent</i>	4.5–7.0	4.5-7.0	5.0-7.5

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 403-6.5a. The limits still will apply if they fall outside the master grading band in Table 3.

The maximum size aggregate used shall not be more than one-half of the thickness of the course being constructed except where otherwise shown on the plans or ordered by the Engineer.

403-3.3 RECYCLED ASPHALT CONCRETE. *If approved for use on the project, recycled HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. The RAP shall be of a consistent gradation and asphalt content and properties. When RAP is fed*



into the plant, the maximum RAP chunk size shall not exceed 2 inches. The recycled HMA mix shall be designed using procedures contained in AI MS-02. The recycled asphalt concrete mix shall be designed using procedures contained in the Asphalt Institute's Manual Series Number 2 (MS-2). The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D 2172 using the appropriate dust correction procedure. The job mix shall meet the requirements of paragraph 403-3.2 RAP should only be used for shoulder surface course mixes and for any intermediate courses. The amount of RAP shall be limited to 30 percent.

In addition to the requirements of paragraph 403-3.2, the job mix formula shall indicate the percent of reclaimed asphalt pavement and the percent and viscosity grade of new asphalt. The Contractor shall submit documentation to the Engineer, indicating that the mixing equipment proposed for use is adequate to mix the percent of RAP shown in the job mix formula and meet all local and national environmental regulations.

The blend of new asphalt cement and the RAP asphalt binder shall meet the requirements in paragraph 403-2.3. The virgin asphalt cement shall not be more than two standard asphalt material grades different than that specified in paragraph 403-2.3

403-3.4 TEST SECTION. *Prior to full production, the Contractor shall prepare and place a quantity of bituminous mixture according to the job mix formula. The amount of mixture shall be sufficient to construct a test section 300 feet long and 20 feet wide, placed in two lanes, with a longitudinal cold joint, and shall be of the same depth specified for the construction of the course which it represents. A cold joint is an exposed construction joint at least 4 hours old or whose mat has cooled to less than 160°F. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment used in construction of the test section shall be the same type and weight to be used on the remainder of the course represented by the test section.*

The test section shall be evaluated for acceptance as a single lot in accordance with the acceptance criteria in paragraph 401-5.1 and 401-6.3. the test section shall be divided into equal sublots. as a minimum the test section shall consist of 3 sublots.

The test section shall be considered acceptable if the average mat density of the test section cores is greater than or equal to 98 percent and the average joint density of the test section cores is greater than or equal to 95 percent.

If the initial test section should prove to be unacceptable, the necessary adjustments to the job mix formula, plant operation, placing procedures, and/or



rolling procedures shall be made. A second test section shall then be placed. If the second test section also does not meet specification requirements, both sections shall be removed at the Contractor's expense. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Any additional sections that are not acceptable shall be removed at the Contractor's expense. Full production shall not begin until an acceptable section has been constructed and accepted in writing by the Engineer. Once an acceptable test section has been placed, payment for the initial test section and the section that meets specification requirements shall be made in accordance with paragraph 403-8.1.

Job mix control testing shall be performed by the Contractor at the start of plant production and in conjunction with the calibration of the plant for the job mix formula. If the aggregates produced by the plant do not satisfy the gradation requirements or produce a mix that meets the JMF, it will be necessary to reevaluate and redesign the mix using plant-produced aggregates. Specimens shall be prepared and the optimum bitumen content determined in the same manner as for the original design tests.

Contractor will not be allowed to place the test section until the Contractor Quality Control Program, showing conformance with the requirements of Paragraph 401-6.1, has been approved, in writing, by the Engineer.

403-3.5 TESTING LABORATORY. *The Contractor's laboratory used to develop the job mix formula shall meet the requirements of ASTM D 3666 including the requirement to be accredited by a national authority such as the National Voluntary Laboratory Accreditation Program (NVLAP), the American Association for Laboratory Accreditation (AALA), or AASHTO Accreditation Program (AAP). A certification signed by the manager of the laboratory stating that it meets these requirements shall be submitted 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.*
- e. ASTM D 3666 certification of accreditation by a nationally recognized accreditation program.*



CONSTRUCTION METHODS

403-4.1 WEATHER LIMITATIONS. *The bituminous mixture 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 Engineer, if requested; however, all other requirements including compaction shall be met.*

Table 4 BASE TEMPERATURE LIMITATIONS	
Mat Thickness	Deg. F (Deg. C)
<i>3 in. or greater</i>	<i>40 (4)</i>
<i>Greater than 1 in. but less than 3 in.</i>	<i>45 (7)</i>
<i>1 in. or less</i>	<i>50 (10)</i>

403-4.2 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 certified public scales at the Contractor's expense. Scales shall be inspected and sealed as often as the Engineer deems necessary to assure their accuracy. Scales shall conform to the requirements of the General Provisions.*

In lieu of scales, and as approved by the Engineer, asphalt mixture weights may be determined by the use of an electronic weighing system equipped with an automatic printer that weighs the total paving mixture. Contractor must furnish calibration certification of the weighing system prior to mix production and as often thereafter as requested by the Engineer.

(2) Testing Facilities. *The Contractor shall provide laboratory facilities at the plant for the use of the Engineer's acceptance testing and the Contractor's quality control testing. The Engineer will always have priority in the use of the laboratory. The lab shall have sufficient space and equipment so that both testing representatives (Engineer's and Contractor's) can operate efficiently. The lab shall also meet the requirements of ASTM D 3666.*

The plant testing laboratory shall have a floor space area of not less than 150 square feet, with a ceiling height of not less than 7-1/2 feet. The laboratory shall



be weather tight, sufficiently heated in cold weather, air-conditioned in hot weather to maintain temperatures for testing purposes of 70 degrees F +/- 5 degrees F. The plant testing laboratory shall be located on the plant site to provide an unobstructed view, from one of its windows, of the trucks being loaded with the plant mix materials.

Laboratory facilities shall be kept clean, and all equipment shall be maintained in proper working condition. The Engineer shall be permitted unrestricted access to inspect the Contractor's laboratory facility and witness quality control activities. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the laboratory 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.

As a minimum, the plant testing laboratory shall have:

- (a) Adequate artificial lighting*
- (b) Electrical outlets sufficient in number and capacity for operating the required testing equipment and drying samples.*
- (c) Fire extinguishers (2), Underwriter's Laboratories approved*
- (d) Work benches for testing, minimum 2-1/2 feet by 10 feet.*
- (e) Desk with 2 chairs*
- (f) Sanitary facilities convenient to testing laboratory*
- (g) Exhaust fan to outside air, minimum 12 inch blade diameter*
- (h) A direct telephone line and telephone including a FAX machine operating 24 hours per day, seven days per week*
- (i) File cabinet with lock for Engineer*
- (j) Sink with running water, attached drain board and drain capable of handling separate material*
- (k) Metal stand for holding washing sieves*
- (l) Two element hot plate or other comparable heating device, with dial type thermostatic controls for drying aggregates*
- (m) Mechanical shaker and appropriate sieves (listed in JMF, Table 3) meeting the requirements of ASTM E-11 for determining the gradation of coarse and fine aggregates in accordance with ASTM C 136*
- (n) Marshall testing equipment meeting ASTM D 6926, ASTM D 6927, or ASTM D 5581 as necessary, automatic compaction equipment capable of compacting three specimens at once and other apparatus as specified in ASTM C 127, D 2172, D 2726, and D 2041*
- (o) Oven, thermostatically controlled, inside minimum 1 cubic foot*
- (p) Two volumetric specific gravity flasks, 500 CC*
- (q) Other necessary hand tools required for sampling and testing*



- (r) *Library containing contract specifications, latest ASTM volumes 4.01, 4.02, 4.03 and 4.09, AASHTO standard specification parts I and II, and Asphalt Institute Publication MS-2.*
- (s) *Equipment for Theoretical Specific Gravity testing including a 4,000 cc pycnometer, vacuum pump capable of maintaining 30 ml mercury pressure and a balance, 16-20 kilograms with accuracy of 0.5 grams*
- (t) *Extraction equipment, centrifuge and reflux types and ROTOflex equipment*
- (u) *A masonry saw with diamond blade for trimming pavement cores and samples*
- (v) *Telephone*

Approval of the plant and testing laboratory by the Engineer requires all facilities and equipment to be in good working order during production, sampling and testing. Failure to provide the specified facilities shall be sufficient cause for disapproving bituminous plant operations.

The Owner shall have access to the lab and at the plant whenever Contractor is producing asphalt for the project.

(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 properties; and checking the temperatures maintained in the preparation of the mixtures.*

(4) Storage Bins and Surge Bins. *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.*

The bins shall be such that mix drawn from them meets 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 temporary storage will be allowed.

403-4.3 HAULING EQUIPMENT. *Trucks used for hauling bituminous mixtures shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of an approved asphalt release agent. 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.

403-4.4 BITUMINOUS PAVERS. Bituminous pavers shall be self-propelled with an activated heated screed, 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 shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

The paver shall be equipped 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 that 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 shall 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.

If, during construction, it is found that the spreading and finishing equipment in use leaves tracks or indented areas, or produces other blemishes in the pavement and/or base course that are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued and satisfactory equipment shall be provided by the Contractor.

403-4.5 ROLLERS. Rollers of the vibratory, steel wheel, and pneumatic-tired type shall be used. They shall be in good condition, capable of operating at slow speeds to avoid displacement of the bituminous mixture. The number, type, and



weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition.

All rollers shall be specifically designed and suitable for compacting hot mix bituminous 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. Depressions in pavement surfaces caused by rollers shall be repaired by the Contractor at its own expense.

The use of equipment that causes crushing of the aggregate will not be permitted.

***a. Nuclear Densometer.** The Contractor shall have on site a nuclear densometer 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 also supply a qualified technician during all paving operations to calibrate the nuclear densometer and obtain accurate density readings for all new bituminous concrete. These densities shall be supplied to the Engineer upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician.*

***403-4.6 PREPARATION OF BITUMINOUS MATERIAL.** The bituminous material shall be heated 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 degrees F (160 degrees C), unless otherwise required by the manufacturer.*

***403-4.7 PREPARATION OF MINERAL AGGREGATE.** The aggregate for the mixture shall be heated and dried prior to introduction into the mixer. 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 degrees F (175 degrees C) when the asphalt 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.*

***403-4.8 PREPARATION OF BITUMINOUS MIXTURE.** The aggregates and the bituminous material shall be weighed or metered and introduced into the mixer in the amount specified by the job mix formula.*

The combined materials shall be mixed 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, 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 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, 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 bituminous mixtures upon discharge shall not exceed 0.5 percent.

403-4.9 PREPARATION OF THE UNDERLYING SURFACE. *Immediately before placing the bituminous mixture, the underlying course shall be cleaned of all dust and debris. A prime coat or tack coat shall be applied in accordance with Sections 39 and 40 of these specifications (FAA Items P-602 or P-603, respectively). A tack coat shall be applied in accordance with Section 33 (FAA Item P-603) when paving on existing paved surfaces, including asphalt base course, and between all lifts of multiple lift asphalt paving.*

403-4.10 LAYDOWN PLAN, TRANSPORTING, PLACING, AND FINISHING. *Prior to the placement of the bituminous mixture, the Contractor shall prepare a laydown plan for approval by the Engineer. This is to minimize the number of cold joints in the pavement. The laydown plan shall include the sequence of paving laydown by stations, width of lanes, temporary ramp location(s), and laydown temperature. The laydown plan shall also include estimated time of completion for each portion of the work (i.e. milling, paving, rolling, cooling, etc.). Modifications to the laydown plan shall be approved by the Engineer.*

The bituminous mixture shall be transported from the mixing plant to the site in vehicles conforming to the requirements of paragraph 403-4.3. Deliveries shall be scheduled so that placing and compacting of mixture 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 atmospheric temperature.

The Contractor may elect to use a material transfer vehicle to deliver mix to the paver.

Paving during nighttime construction shall require the following:

- a. All paving machines, rollers, distribution trucks and other vehicles required by the Contractor for his operations shall be equipped with artificial illumination sufficient to safely complete the work.*



- b. Minimum illumination level shall be twenty (20) horizontal foot candles and maintained in the following areas:*
- (1) An area of 30 feet wide by 30 feet long immediately behind the paving machines during the operations of the machines.*
 - (2) An area 15 feet wide by 30 feet long immediately in front and back of all rolling equipment, during operation of the equipment.*
 - (3) An area 15 feet wide by 15 feet long at any point where an area is being tack coated prior to the placement of pavement.*
- c. As partial fulfillment of the above requirements, the Contractor shall furnish and use, complete artificial lighting units with a minimum capacity of 3,000 watt electric beam lights, affixed to all equipment in such a way to direct illumination on the area under construction.*
- d. In addition, the Contractor shall furnish four portable floodlight units similar or equal to the equipment-mounted lights.*

The initial placement and compaction of the mixture shall occur at a temperature suitable for obtaining density, surface smoothness, and other specified requirements but not less than 250°F (121°C).

Edges of existing bituminous pavement abutting the new work shall be saw cut and carefully removed as shown on the drawings and painted with bituminous tack coat before new material is placed against it.

Upon arrival, the mixture shall be placed to the full width by a bituminous paver. It shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the bituminous mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 10 feet except where edge lanes require less width to complete the area. Additional screed sections shall not be attached to widen paver to meet the minimum lane width requirements specified above unless additional auger sections are added to match. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot; 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 from transverse joints in the previous course.

Transverse joints in adjacent lanes shall be offset a minimum of 10 feet.



On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools. Areas of segregation in the course, as determined by the Engineer, shall be removed and replaced at the Contractor's expense. The area shall be removed by saw cutting and milling a minimum of 2 inches deep. The area to be removed and replaced shall be a minimum width of the paver and a minimum of 10 feet long.

If the Contractor places any out of specification mix in the project work area, he will be required to remove it at his own expense, to the satisfaction of the Engineer. If the Contractor has to continue placing non-payment bituminous concrete, as directed by the Engineer, to make the surfaces safe for aircraft operations, the Contractor shall do so to the satisfaction of the Engineer. It is the Contractor's responsibility to leave the facilities to be paved in a safe condition ready for aircraft operations. No consideration for extended closure time of the area being paved will be given. As a first order of work for the next paving shift, the Contractor shall remove all out of specification material and replace with approved material to the satisfaction of the Engineer. When the above situations occur, there will be no consideration given for additional construction time or payment for extra costs.

403-4.11 COMPACTION OF MIXTURE. *After placing, the mixture shall be thoroughly and uniformly compacted by power rollers. The surface shall be compacted 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 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 displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once.*

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 mixture to the roller, the wheels shall be equipped with a scraper and kept properly moistened using a water soluble asphalt release agent approved by the engineer.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with approved power driven tampers. Tampers shall weigh not less than 275 pounds, have a tamping plate width not less than 15 inches, be rated at not less than 4,200 vibrations per minute, and be suitably equipped with a standard tamping plate wetting device.



Any mixture 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.

403-4.12 JOINTS. *The formation of all joints shall be made in such a manner as 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 mixture 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 given a tack coat of bituminous material before placing any fresh mixture against the joint.

Longitudinal joints which are irregular, damaged, uncompacted, or otherwise defective, or which have been left exposed for more than 4 hours, or whose surface temperature has cooled to less than 160⁰ F, shall be cut back 6 inches to expose a clean, sound surface for the full depth of the course. All contact surfaces shall be cleaned and dry and given a tack coat of bituminous material prior to placing any fresh mixture against the joint. The cost of this work and tack coat shall be considered incidental to the cost of the bituminous course.

MATERIAL ACCEPTANCE

403-5.1 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 Engineer at no cost to the Contractor. Testing organizations performing these tests shall meet the requirements of ASTM D 3666. All equipment in Contractor furnished laboratories shall be calibrated by the testing organization prior to the start of operations.*

a. Field Placed Material. *Material placed in the field shall be tested for mat and joint density on a lot basis. A lot will consist of:*

- *one day or shift's production not to exceed 2,000 tons, or*
- *a half day or shift's production where a day's production is expected to consist of between 2,000 and 4,000 tons, or*



- similar subdivisions for tonnages over 4,000 tons.

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

(1) Mat Density. The lot shall be divided into four equal sublots. One core of finished, compacted materials shall be taken by the Contractor from each subplot. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D 3665. Cores shall not be taken closer than one foot from a transverse or longitudinal joint.

(2) Joint Density. The lot shall be divided into four equal sublots. One core of finished, compacted materials shall be taken by the Contractor from each subplot. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D 3665. Edge of cores will be taken within 6 inches of the joint of the same lot material but not directly on the joint.

(3) Sampling. Samples shall be neatly cut with a core drill. The cutting edge of the core drill bit shall be of hardened steel or other suitable material with diamond chips embedded in the metal cutting edge. The minimum diameter of the sample shall be five inches. Samples that are clearly defective, as a result of sampling, shall be discarded and another sample taken. The Contractor shall furnish all tools, labor, and materials for cutting samples, cleaning, and filling the cored pavement. Cored pavement shall be cleaned and core holes shall be filled 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 ASTM D 1188, whichever is applicable. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each subplot sample by the average bulk specific gravity of all laboratory prepared specimens for the lot, as determined as follows:

(a) Sufficient material for preparation of test specimens for all testing 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 subplot in accordance with ASTM D 6926, at the number of blows required by paragraph 403-3.2, 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 less than 30 minutes or more than 60 minutes to stabilize to compaction temperature. The compaction temperature of the specimens shall be as specified in the job mix formula.



(b) *The bulk specific gravity of each test specimen shall be measured by the Engineer in accordance with ASTM D 2726 using the procedure for laboratory-prepared thoroughly dry specimens, or ASTM D 1188, whichever is applicable, for use in computing pavement density.*

(c) *The bulk specific gravity used to determine the joint density at joints formed between different lots shall be the lowest of the bulk specific gravity values from the two different lots.*

(5) **Acceptance.** *Acceptance of field placed material for mat and joint density will be determined by the Engineer in accordance with the requirements of paragraph 403-5.2b.*

b. Partial Lots — Field Placed Material. *When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot, or when the Contractor and Engineer agree in writing to allow overages or other minor tonnage placements to be considered as partial lots, 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 halted will be sampled, and its properties shall be considered as representative of the particular subplot from which it was taken. In addition, an agreed to minor placement will be sampled, and its properties shall be considered as representative of the particular subplot 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. Partial lots at the end of asphalt production on the project shall be included with the previous lot.

403-5.2 ACCEPTANCE CRITERIA.

a. General. *Acceptance will be based on the following characteristics of the bituminous mixture and completed pavement and test results:*

- (1) *Mat density*
- (2) *Joint density*
- (3) *Thickness*
- (4) *Smoothness*
- (5) *Grade*

Mat density will be evaluated for acceptance in accordance with paragraph 403-5.2b(1). Joint density will be evaluated for acceptance in accordance with paragraph 403-5.2b(2).



Thickness will be evaluated by the Engineer for compliance in accordance with paragraph 403-5.2b(3). Acceptance for smoothness will be based on the criteria contained in paragraph 403-5.2b(4). Acceptance for grade will be based on the criteria contained in paragraph 403-5.2b(5).

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 such material was erroneously rejected, payment will be made for the material at the contract unit price.

b. Acceptance Criteria.

(1) Mat Density. Acceptance of each lot of plant produced material for mat density shall be based on the average of all of the densities taken from the sublots. If the average mat density of the lot so established equals or exceeds 96 percent, the lot shall be acceptable. If the average mat density of the lot is below 96 percent, the lot shall be removed and replaced at the Contractor's expense.

(2) Joint Density. Acceptance of each lot of plant produced material for joint density shall be based on the average of all of the joint densities taken from the sublots. If the average joint density of the lot so established equals or exceeds 94 percent, the lot shall be acceptable. If the average joint density of the lot is less than 94 percent, the Contractor shall stop production and evaluate the method of compacting joints. Production may resume once the reason for poor compaction has been determined and appropriate measures have been taken to ensure proper compaction.

(3) Thickness. Thickness of each course shall be evaluated by the Engineer for compliance to the requirements shown on the plans. Measurements of thickness shall be made by the Engineer using the cores extracted for each subplot for density measurement. The maximum allowable deficiency at any point shall not be more than $\frac{1}{4}$ inch less than the thickness indicated for the lift. Average thickness of lift, or combined lifts, shall not be less than the indicated thickness. Where thickness deficiency exceeds the specified tolerances, the lot or subplot 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 Engineer to circumscribe the deficient area.



(4) Smoothness. *The final surface shall be free from roller marks. The finished surfaces of each course of the pavement, except the finished surface of the final surface course, shall not vary more than $\frac{3}{8}$ inch when evaluated with a 16 foot straightedge. The finished surface of the final surface course shall not vary more than $\frac{1}{4}$ inch when evaluated with a 16 foot straightedge. The lot size shall be 2,000 square yards. Smoothness measurements shall be made at 50 foot intervals and as determined by the Engineer. In the longitudinal direction, a smoothness reading shall be made at the center of each paving lane. In the transverse direction, smoothness readings shall be made continuously across the full width of the pavement. However, transverse smoothness readings shall not be made across designed grade changes. At warped transition areas, straightedge position shall be adjusted to measure surface smoothness and not design grade transitions. When more than 15 percent of all measurements within a lot exceed the specified tolerance, the Contractor shall remove the deficient area to the depth of the course of pavement and replace with new material. Skin patching shall not be permitted. Isolated high points may be ground off providing the course thickness complies with the thickness specified on the plans. High point grinding will be limited to 15 square yards. Areas in excess of 15 square yards will require removal and replacement of the course in accordance with the limitations noted above.*

(5) Grade. *The finished surface of the pavement shall not vary from the gradeline elevations and cross sections shown on the plans by more than $\frac{1}{2}$ inch. The finished grade of each lot will be determined by running levels at intervals of 50 feet or less longitudinally and all breaks in grade transversely (not to exceed 50 feet) to determine the elevation of the completed pavement. The Contractor shall pay the cost of surveying of the level runs that shall be performed by a licensed surveyor. The documentation, stamped and signed by a licensed surveyor, shall be provided by the Contractor to the Engineer. The lot size shall be 2,000 square yards. When more than 15 percent of all the measurements within a lot are outside the specified tolerance, or if any one shot within the lot deviates $\frac{3}{4}$ inch or more from planned grade, the Contractor shall remove the deficient area to the depth of the final course of pavement and replace with new material. Skin patching shall not be permitted. Isolated high points may be ground off providing the course thickness complies with the thickness specified on the plans. High point grinding will be limited to 15 square yards. The surface of the ground pavement shall have a texture consisting of grooves between 0.090 and 0.130 inches wide. The peaks and ridges shall be approximately $\frac{1}{32}$ inch higher than the bottom of the grooves. The pavement shall be left in a clean condition. The removal of all of the slurry resulting from the grinding operation shall be continuous. The grinding operation should be controlled so the residue from the operation does not flow across other lanes of pavement. Areas in excess of 15 square yards will require removal and replacement of the pavement in accordance with the limitations noted above.*



*c. **Density Outliers.** If the tests within a lot include a very large or a very small value that 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.*

403-5.3 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 Engineer. A retest will consist of all the sampling and testing procedures contained in paragraphs 403-5.1b(1). Only one resampling per lot will be permitted.*

(1) A redefined mat density shall be calculated for the resampled lot. The number of tests used to calculate the redefined mat density shall 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 mat density for a resampled lot shall be used to evaluate the acceptance of that lot in accordance with Paragraph 403-5.2.*

***403-5.4 LEVELING COURSE.** Any course used for truing and leveling shall meet the requirements of paragraph 403-3.2, but shall not be subject to the density requirements of paragraph 403-5.1. The leveling course shall be compacted with the same effort used to achieve density of the test section. The truing and leveling course shall not exceed a nominal thickness of 1-1/2 inches. The leveling course is the first variable thickness lift of an overlay placed prior to subsequent courses.*

CONTRACTOR QUALITY CONTROL

***403-6.1 GENERAL.** The Contractor shall perform quality control sampling, testing, and inspection during all phases of the work and shall perform them at a rate sufficient to ensure that the work conforms to the contract requirements, and at minimum test frequencies required by paragraph 403-6.3, 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*

403-6.2 TESTING LABORATORY. *The Contractor shall provide a fully equipped asphalt laboratory for conducting quality control testing. The laboratory shall meet the requirements of paragraph 403-3.5 and 403-4.2a(2) and shall be located at the plant or job site. The Contractor shall provide the Engineer with certification stating that all of the testing equipment to be used is properly calibrated and will meet the specifications applicable for the specified test procedures.*

403-6.3 QUALITY CONTROL TESTING. *The Contractor shall perform all quality control tests necessary to control the production and construction processes applicable to these specifications and as set forth in the approved Quality Control Program. 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. Asphalt Content. *A minimum of two tests shall be performed per lot in accordance with ASTM D 2172 for determination of asphalt content. The weight of ash portion of the test, as described in ASTM D 2172, 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, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture. The asphalt content for the lot will be determined by averaging the test results.*

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. *Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of extracted aggregate in accordance with ASTM D 5444 and ASTM C 136 (Dry Sieve). When asphalt content is determined by the nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix or continuous mix plants, and tested 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. *The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C 566.*



*d. **Moisture Content of Mixture.** The moisture content of the mixture shall be determined once per lot in accordance with ASTM D 1461 or AASHTO T110.*

*e. **Temperatures.** Temperatures shall be checked, 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.** 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 D 2950.*

*g. **Additional Testing.** Any additional testing that the Contractor deems necessary to control the process may be performed at the Contractor's option.*

*h. **Monitoring.** The Engineer reserves the right to monitor any or all of the above testing.*

403-6.4 SAMPLING. *When directed by the Engineer, 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.*

403-6.5 CONTROL CHARTS. *The Contractor shall maintain linear control charts both for individual measurements and range (i.e., difference between highest and lowest measurements) for aggregate gradation and asphalt content.*

Control charts shall be posted in a location satisfactory to the Engineer and shall be 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 Engineer 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 and asphalt content. 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		
<i>Sieve</i>	<i>Action Limit</i>	<i>Suspension Limit</i>
<i>3/4 inch</i>	<i>0%</i>	<i>0%</i>
<i>1/2 inch</i>	<i>±6%</i>	<i>±9%</i>
<i>3/8 inch</i>	<i>±6%</i>	<i>±9%</i>
<i>No. 4</i>	<i>±6%</i>	<i>±9%</i>
<i>No. 16</i>	<i>±5%</i>	<i>±7.5%</i>
<i>No. 50</i>	<i>±3%</i>	<i>±4.5%</i>
<i>No. 200</i>	<i>±2%</i>	<i>±3%</i>
<i>Asphalt Content</i>	<i>±0.45%</i>	<i>±0.70%</i>

b. Range. Control charts for range shall be established to control process variability for the test parameters and Suspension Limits listed below. The range shall be computed 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, 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 (Based on $n = 2$)	
<i>Sieve</i>	<i>Suspension Limit</i>
<i>1/2 inch (12.5 mm)</i>	<i>11 percent</i>
<i>3/8 inch (9.5 mm)</i>	<i>11 percent</i>
<i>No. 4 (4.75 mm)</i>	<i>11 percent</i>
<i>No. 16 (1.18 mm)</i>	<i>9 percent</i>
<i>No. 50 (0.30 mm)</i>	<i>6 percent</i>
<i>No. 200 (0.075 mm)</i>	<i>3.5 percent</i>
<i>Asphalt Content</i>	<i>0.8 percent</i>

c. Corrective Action. The Contractor Quality Control Program shall indicate that appropriate action shall be taken when the process is believed to be out of tolerance. The Plan shall contain sets of 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.

The aggregate control chart parameters and Suspension and Action Limits contained in the above paragraphs are based on 3/4 inch (19.0 mm) maximum size aggregate gradation. When 1-inch (25.0 mm) or 1-1/4 inch (31.2 mm) maximum size aggregate greater than 3/4" is specified, the Individual Measurements Chart requirements should be amended as follows:

Sieve	Action Limit	Suspension Limit
1 inch or 1-1/2 inch	0%	0%
3/4 inch	6%	11%

403-6.6 QUALITY CONTROL REPORTS. The Contractor shall maintain records and shall submit reports of quality control activities daily, in accordance with the Contractor Quality Control Program described in General Provisions, Section 12 (FAA 100).

METHOD OF MEASUREMENT

403-7.1 MEASUREMENT. See Section 36-3.

BASIS OF PAYMENT

403-8.1 PAYMENT. See Section 36-4.

TESTING REQUIREMENTS

ASTM C 29 Bulk Density (“Unit Weight”) and Voids in Aggregate

ASTM C 88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate



<i>ASTM C 117</i>	<i>Materials Finer than 75μm (No.200) Sieve in Mineral Aggregates by Washing</i>
<i>ASTM C 127</i>	<i>Specific Gravity and Absorption of Coarse Aggregate</i>
<i>ASTM C 131</i>	<i>Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine</i>
<i>ASTM C 136</i>	<i>Sieve Analysis of Fine and Coarse Aggregates</i>
<i>ASTM C 183</i>	<i>Sampling and the Amount of Testing of Hydraulic Cement</i>
<i>ASTM C 566</i>	<i>Total Evaporable Moisture Content of Aggregate by Drying</i>
<i>ASTM D 75</i>	<i>Sampling Aggregates</i>
<i>ASTM D 979</i>	<i>Sampling Bituminous Paving Mixtures</i>
<i>ASTM D 995</i>	<i>Mixing Plants for Hot-Mixed Hot-Laid Bituminous Paving Mixtures</i>
<i>ASTM D 1073</i>	<i>Fine Aggregate for Bituminous Paving Mixtures</i>
<i>ASTM D 1074</i>	<i>Compressive Strength of Bituminous Mixtures</i>
<i>ASTM D 1188</i>	<i>Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens</i>
<i>ASTM D 1461</i>	<i>Moisture or Volatile Distillates in Bituminous Paving Mixtures</i>
<i>ASTM D 2041</i>	<i>Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures</i>
<i>ASTM D 2172</i>	<i>Quantitative Extraction of Bitumen from Bituminous Paving Mixtures</i>
<i>ASTM D 2419</i>	<i>Sand Equivalent Value of Soils and Fine Aggregate</i>



<i>ASTM D 2489</i>	<i>Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures</i>
<i>ASTM D 2726</i>	<i>Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures</i>
<i>ASTM D 2950</i>	<i>Density of Bituminous Concrete in Place by Nuclear Methods</i>
<i>ASTM D 3203</i>	<i>Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures</i>
<i>ASTM D 3665</i>	<i>Random Sampling of Construction Materials</i>
<i>ASTM D 3666</i>	<i>Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials</i>
<i>ASTM D 4125</i>	<i>Asphalt Content of Bituminous Mixtures by the Nuclear Method</i>
<i>ASTM D 4318</i>	<i>Liquid Limit, Plastic Limit, and Plasticity Index of Soils</i>
<i>ASTM D 4791</i>	<i>Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate</i>
<i>ASTM D 4867</i>	<i>Effect of Moisture on Asphalt Concrete Paving Mixtures</i>
<i>ASTM D 5444</i>	<i>Mechanical Size Analysis of Extracted Aggregate</i>
<i>ASTM D 5581</i>	<i>Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6" Diameter Specimen)</i>
<i>ASTM D 6926</i>	<i>Preparation of Bituminous Specimens Using MARSHALL Apparatus</i>
<i>ASTM D 6927</i>	<i>MARSHALL Stability and Flow of Bituminous Mixtures</i>
<i>ASTM E 11</i>	<i>Wire-Cloth Sieves for Testing Purposes</i>
<i>ASTM E 178</i>	<i>Dealing with Outlying Observations</i>
<i>AASHTO T 30</i>	<i>Mechanical Analysis of Extracted Aggregate</i>



[AASHTO T 110

Moisture or Volatile Distillates in Bituminous Paving Mixtures]

The Asphalt Institute's Manual No. 2 (MS-2)

Mix Design Methods for Asphalt Concrete

MATERIAL REQUIREMENTS

ASTM D 242

Mineral Filler for Bituminous Paving Mixtures

ASTM D 946

Penetration Graded 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

AASHTO MPI

Performance Graded Binder Designation

END OF ITEM P-403

36-2 CALTRANS ASPHALT CONCRETE

In lieu of P-403 plant mix bituminous pavements, as specified above, the Contractor may provide asphalt concrete conforming to Section 39 of the Caltrans Standard Specifications, 2006 edition. Mix shall be Type A, ¾' Max Aggregate, Coarse. Binder shall be PG 70-10. All provisions of Section 39 shall apply, except that the compacted mix shall conform to the acceptance criteria in sections of 403-5.1, 403-5.2 and 403-5.3, herein.

36-3 METHOD OF MEASUREMENT

Plant mix bituminous concrete pavement shall be measured by the number of tons of bituminous mixture, of the type listed in the bid schedule, used in the accepted work. Recorded batch weights or truck scale weights will be used to determine the basis for the tonnage

36-4 BASIS OF PAYMENT

Payment for an accepted lot of bituminous concrete pavement shall be made at the contract unit price per ton for bituminous mixture of the type indicated in the bid schedule. 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.



Payment will be made under:

- Item 36.1 Bituminous [Surface] [Base] [Binder] [Leveling] Course P-403 per ton
- Item 36.2 Caltrans Asphalt..... per ton

END OF SECTION 36