

**DIVISION 400**  
**Bituminous Pavements**

## Section 401—Major Hot Asphalt Concrete Pavement With Pay Factor

### Description

**401.01 Work.** Construct one or more courses of hot asphalt concrete pavement as SHOWN ON THE DRAWINGS. Have the surface approved in writing by the CO before placing the hot asphalt concrete pavement.

Hot asphalt concrete pavement classes are designated as shown in table 401-1. Hot asphalt concrete pavement aggregate grading is designated as shown in table 703-4. State asphalt concrete pavement classes are designated by local State department of transportation designations. Superpave asphalt concrete pavement nominal size and grading are designated as shown in table 703-10, 703-11, or 703-12.

Table 401-1.—Asphalt concrete mixture requirements.

Design Parameters	Class of Mixture		
	A	B	C
(a) <b>Hveem (AASHTO T 246 and T 247):</b>			
(1) Stabilometer, min.	37	35	30
(2) Air voids, % <sup>a</sup>	3-5	3-5	3-5
(3) Voics in Mineral Aggregate (VMA), min. %	See table 401-2		
(b) <b>Marshall (AASHTO T 245)<sup>b</sup>:</b>			
(1) Stability, kN min.	8.0	5.3	4.4
(2) Flow, 0.25 mm	8-14	8-16	8-20
(3) Air voids, % <sup>a</sup>	3-5	3-5	3-5
(4) VMA, min. %	See table 401-2		
(5) Compaction, number of blows each end of test specimen	75	50	50
(c) <b>Immersion-Compression (AASHTO T 165 and T 167)</b>			
(1) Compressive strength, MPa min.	2.1	1.7	1.4
(2) Retained strength, min. %	70	70	70
(d) <b>Root-Turniciff (ASTM D 4867):</b>			
(1) Tensile strength ratio, min. %	70	70	70
(e) <b>Dust/asphalt ratio<sup>c</sup></b>	0.6-1.3	0.6-1.3	0.6-1.3

a. The percent of air voids is based on AASHTO T 166, AASHTO T 209, and AASHTO T 269. Maximum specific gravity will be based on AASHTO T 209.

b. Following mixing, asphalt cement mixtures will be cured in an oven maintained at 12 °C to 18 °C above the compaction temperature for 90 ± 10 minutes.

c. Dust/asphalt ratio is defined as the percent of material, including nonliquid antistriper and mineral filler, that passes the 75-µm sieve, divided by the percent of asphalt (calculated by weight of mix).

Table 401-2.—VMA for Marshall, Hveem, and Superpave mix design.

Sieve Size <sup>a</sup>	Minimum Voids <sup>b,c</sup> (%)		
	Marshall	Hveem	Superpave
2.36 mm	21	19	—
4.75 mm	18	16	—
9.5 mm	16	14	15
12.5 mm	15	13	14
19 mm	14	12	13
25 mm	13	11	12
37.5 mm	12	10	11
50 mm	11.5	9.5	10.5

a. The largest sieve size listed in the applicable specification upon which any material is permitted to be retained.

b. VMA to be determined in accordance with Asphalt Institute (AI) Manual Series number 2 (MS-2).

c. When a mineral filler or nonliquid antistriper is used, include the percentage specified in the calculation for compliance with the VMA.

Asphalt cement grade is designated as shown in AASHTO M 20, M 226, or MP 1, or in applicable State department of transportation specifications for asphalt materials for the grade specified.

A prepping conference will be held at least 10 working days prior to the beginning of paving operations. At that time, the Contractor and the CO will discuss methods of accomplishing all phases of the paving work, including laydown operations, work schedules, work force, quality control systems, spill prevention and contingency plans, and asphalt concrete mix delivery.

## Materials

**401.02 Requirements.** Ensure that material conforms to specifications in the following subsections:

Antistriper Additive .....	702.07
Asphalt Cement .....	702.01
Hot Asphalt Concrete Pavement Aggregate .....	703.07
Mineral Filler .....	725.05
Recycling Agent .....	702.05
Superpave Asphalt Concrete Pavement Aggregate .....	703.14

Ensure that reclaimed asphalt pavement material conforms to the following:

- (a) 100 percent passes the 50-mm screen.
- (b) The material consists of asphalt cement and asphalt cement-coated aggregate.

**Construction**

**401.03 Composition of Mixture (Job-Mix Formula).** Up to 20 percent reclaimed asphalt pavement material may be used, subject to approval of a Contractor quality control plan and submission of test data demonstrating that the mixture will meet the requirements specified in this section.

Furnish the appropriate mixture as follows:

*(a) Hot Asphalt Concrete Pavement Mixture.* Furnish aggregate, asphalt, additives, and, when applicable, reclaimed asphalt pavement material that meet the applicable aggregate gradation requirement shown in table 703-4, and design parameters (a) or (b); (c) or (d); and (e) shown in table 401-1.

*(b) Superpave Asphalt Concrete Pavement Mixture.* Furnish aggregate, asphalt, and additives that meet applicable gradation and material requirements specified in Subsection 703.14, and the appropriate design parameters shown in tables 401-2 and 401-2A. Compact specimens with the gyratory compactive effort specified in table 401-2B for the specified air temperature as SHOWN ON THE DRAWINGS.

Table 401-2A.—Superpave asphalt concrete mixture requirements.

Design Parameters	Requirement
Percent air voids, design gyrations, $N_{des}$	4.0
Percent maximum density, initial gyrations, $N_{init}$	89 max.
Percent maximum density, maximum gyrations, $N_{max}$	98 max.
Tensile strength ratio (AASHTO T 283)	80 min.
Voids Filled With Asphalt	70-80%
Dust/asphalt <sup>a</sup> ratio	0.6 - 1.2

a. Dust/asphalt ratio is defined as the percent of material passing the 75- $\mu$ m sieve, divided by the effective asphalt content as calculated by weight of mix.

Table 401-2B.—Gyratory compactive effort.

Average Design High Air Temperature	$N_{init}$	$N_{des}$	$N_{max}$
< 39 °C	7	68	104
39–40 °C	7	74	114
41–42 °C	7	78	121
43–44 °C	7	82	127

**(c) State Asphalt Concrete Pavement Mixture.** Furnish aggregate, asphalt, and additives that meet the applicable aggregate gradation and aggregate quality specified by the local State department of transportation, and design parameters (a) or (b); (c) or (d); and (e) shown in table 401-1. Local State department of transportation design parameters in lieu of those shown in table 401-1 may be used if approved by the CO.

Submit written job-mix formulas for approval at least 21 days before production. For each job-mix formula, submit the following:

- (1) Aggregate and mineral filler, including:
  - (a) TV for percent passing each sieve size for the aggregate blend. Ensure that the gradation of the blended aggregate and reclaimed asphalt pavement material falls within the gradation band for each sieve size designated in the specified grading.
  - (b) Source and percentage of each aggregate stockpile to be used.
  - (c) Average gradation of each aggregate stockpile.
  - (d) Results of aggregate quality tests.
  - (e) Samples, when SHOWN ON THE DRAWINGS.
- (2) Asphalt cement, including:
  - (a) TV for percent of asphalt cement based on total weight of mix.
  - (b) Recent quality test results from the manufacturer for the asphalt cement, including a temperature/viscosity curve.
  - (c) Material safety data sheets.
  - (d) Samples, when SHOWN ON THE DRAWINGS.
- (3) Antistrip additives. When applicable, furnish:
  - (a) Type and TV for percent of antistrip additive.
  - (b) Material safety data sheet.
  - (c) Samples, when SHOWN ON THE DRAWINGS.
- (4) Mix temperatures, including:
  - (a) Temperature leaving the mixer.

- (b) Temperature immediately preceding initial compaction.
- (5) Maximum specific gravity, determined according to AASHTO T 209 at the asphalt cement TV.
- (6) Reclaimed asphalt pavement material; when applicable, the percent reclaimed asphalt pavement material and the type and percent of recycling agent.
- (7) Asphalt mixtures; when applicable, the location of all commercial mixing plants to be used. A job-mix formula is needed for each plant.

The CO will evaluate the suitability of the material and the proposed job-mix formula. After reviewing the proposed job-mix formula, the CO will develop a TV for the asphalt cement content and determine the need for antistrip additive, the specific gravity in accordance with AASHTO T 209, and the discharge temperature range.

If a job-mix formula is rejected, submit a new job-mix formula as described above.

Changes to an approved job-mix formula require approval before production. Allow up to 14 days to evaluate a change. Approved changes in TV's will not be applied retroactively for payment.

**401.04 Mixing Plant.** Use mixing plants that conform to ASTM D 995, unless producing approved material for a local State department of transportation. Supplement mixing plant as follows:

(a) *All Plants.* For all plants, use:

- (1) *Automated Controls.* Automatically control the proportioning, mixing, and discharging of the mixture.
- (2) *Emission Controls.* If a wet scrubber is used, circulate the collected material through sludge pits or settling tanks. Remove the resultant sediment from the project or bury according to Subsection 202.04.

(b) *Drum Dryer-Mixer Plants.* For drum dryer-mixer plants, use:

- (1) *Bins.* Provide a separate bin in the cold aggregate feeder for each individual aggregate stockpile in the mixture. Use bins of sufficient size to keep the plant in continuous operation, and of proper design to prevent overflow of material from one bin to another.

(2) *Stockpiling Procedures.* Separate aggregate into at least two stockpiles with different gradations. At a minimum, designate one stockpile to contain mostly coarse material, and one stockpile to contain mostly fine material. Stockpile material according to Subsections 305.03 and 305.04.

(3) *Reclaimed Asphalt Pavement Material.* Modify drum dryer-mixer plants to prevent direct contact of the reclaimed asphalt pavement material with the burner flame and to prevent overheating of the reclaimed asphalt pavement material. Stockpile the material according to Subsection 305.03 and 305.04.

(c) ***Batch & Continuous Mix Plants.*** For batch and continuous mix plants, use:

(1) *A Hot Aggregate Bin.* Provide a bin with three or more separate compartments for storage of the screened aggregate fractions to be combined for the mixture. Make the partitions between the compartments tight and of sufficient height to prevent spillage of aggregate from one compartment into another.

(2) *Load Cells.* Calibrated load cells instead of scales may be used in batch plants.

(3) *Reclaimed Asphalt Pavement Material.* Modify batch plants to allow the introduction of reclaimed asphalt pavement material into the mixture using methods that bypass the dryer. Design the cold feed bin, conveyor system, and special bin adjacent to the weigh hopper, if used, to avoid segregation and sticking of the reclaimed asphalt pavement material. Heat the new aggregate and/or reclaimed aggregate material to a temperature that will transfer sufficient heat to the reclaimed asphalt pavement material to produce a mix of uniform temperature within the range specified in the approved job-mix formula.

**401.05 Pavers.** Use pavers that are:

- (a) Self-contained, power-propelled units with adjustable vibratory screeds with full-width screw augers.
- (b) Heated for the full width of the screed.
- (c) Capable of spreading and finishing courses of asphalt mixture in widths at least 300 mm more than the width of one lane.
- (d) Equipped with a receiving hopper with sufficient capacity to ensure a uniform spreading operation.
- (e) Equipped with automatic feed controls that are properly adjusted to maintain a uniform depth of material ahead of the screed.
- (f) Capable of being operated at forward speeds consistent with satisfactory laying of the mixture.

- (g) Capable of producing a finished surface with the required smoothness and texture without segregating, tearing, shoving, or gouging the mixture.
- (h) Equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing the automatic signals that operate the screed to maintain grade and transverse slope.

**401.06 Surface Preparation.** Prepare the surface in accordance with Section 304, 306, 307, or 308, as applicable. Apply an asphalt tack coat to contact surfaces of curbing, gutters, manholes, and other structures, in accordance with Section 407.

**401.07 Weather Limitations.** Place hot asphalt concrete pavement on a dry, unfrozen surface when the air temperature in the shade is above 2 °C and rising, and when the temperature of the road surface in the shade, the lift thickness, and the minimum laydown temperature are as shown in table 401-3.

Table 401-3.—Minimum laydown temperature<sup>a</sup> for hot asphalt concrete mixture placement (°C).

Road Surface Temperature (°C)	Lift Thickness		
	≤50 mm	50–75 mm	≥ 75 mm
< 2	_b	_b	_b
2–3.9	_b	_b	138
4–9.9	_b	141	135
10–14.9	146	138	132
15–19.9	141	135	129
20–24.9	138	132	129
25–29.9	132	129	127
≥30	129	127	124

a. Never heat the asphalt concrete mixture above the temperature specified in the approved mix design.

b. Paving not allowed.

**401.08 Asphalt Preparation.** Uniformly heat the asphalt cement to provide a continuous supply of the heated asphalt cement from storage to the mixer. Do not heat asphalt cement above 175 °C.

If the job-mix formula requires a liquid heat-stable antistrip additive, meter it into the asphalt cement transfer lines at a bulk terminal or mixing plant. Inject the additive for at least 80 percent of the transfer or mixing time to obtain uniformity.

**401.09 Aggregate Preparation.** If nonliquid antistrip is used, adjust the aggregate moisture to at least 4 percent by weight of aggregate. Mix the antistrip uniformly



with the aggregate before introducing the aggregate into the dryer or dryer drum. Use calibrated weighing or metering devices to measure the amount of antistripping and moisture added to the aggregate.

For batch plants, heat, dry, and deliver aggregate for pugmill mixing at a temperature sufficient to produce a mixture temperature within the approved range. Adjust flames used for drying and heating to prevent damage to and contamination of the aggregate.

Control plant operations so the moisture content of the mixture behind the paver is 0.5 percent or less, in accordance with AASHTO T 110.

**401.10 Mixing.** Measure the aggregate and asphalt into the mixer in accordance with the approved job-mix formula. Mix until all the particles are completely and uniformly coated with asphalt, in accordance with ASTM D 995. Maintain the discharge temperature within the approved range.

**401.11 Hauling.** Use vehicles with tight, clean, and smooth metal beds for hauling asphalt concrete mixtures.

Thinly coat the beds with an approved material to prevent the mixture from adhering to the beds. Do not use petroleum derivatives or other coating material that contaminates or alters the characteristics of the mixture. Drain the bed before loading.

Equip each truck with a canvas cover or other suitable material of sufficient size to protect the mixture from the weather. When necessary to maintain temperature, use insulated truck beds and securely fastened covers. Provide access ports or holes for checking the temperature of the asphalt mixture in the truck.

**401.12 Placing & Finishing.** Do not use mixtures produced from different plants unless the mixtures are produced in accordance with the same job-mix formula, contain material from the same sources, and are approved.

Place asphalt concrete mixture at a temperature conforming to table 401-3. Measure temperature of the mixture in the hauling vehicle just before dumping into spreader, or measure it in the windrow immediately before pickup.

Place the mixture with a paver that conforms to specifications in Subsection 401.05. Control horizontal alignment using a reference line. Automatically control the grade and slope from reference lines, a ski and slope control device, dual skis. Use skis with a minimum length of 6 m.

Limit the compacted thickness to 75 mm, unless otherwise SHOWN ON THE DRAWINGS.

On areas where mechanical spreading and finishing is impractical, place and finish the mixture with other equipment to produce a uniform surface closely matching the surface obtained when using a mechanical paver.

Offset the longitudinal joint of one layer at least 150 mm from the joint in the layer immediately below. Make the longitudinal joint in the top layer along the centerline of two-lane roadways, or at the lane lines of roadways with more than two lanes. Offset transverse joints in adjacent lanes and in multiple lifts by at least 3 m.

The CO will designate the job-mix formula to be used for wedge and leveling courses at each location unless DESIGNATED IN THE SCHEDULE OF ITEMS. Place wedge and leveling courses in maximum 75-mm lifts and compact with a pneumatic-tire roller meeting the requirements of Subsection 203.15(d). Complete the wedge and leveling before starting normal paving operations.

**401.13 Compacting.** Furnish at least three rollers, one each for breakdown, intermediate, and finish rolling. Furnish at least one roller with pneumatic tires. Size the rollers to achieve the required results. Operate rollers in accordance with manufacturer's recommendations.

Thoroughly and uniformly compact the asphalt surface by rolling. Do not cause undue displacement, cracking, or shoving. Continue rolling until all roller ridges, ruts, and humps are eliminated and the required compaction is obtained. Do not vibratory roll the mixture after its surface cools below 80 °C.

Along forms, curbs, headers, walls, and other places not accessible to the rollers, compact the mixture with other equipment to obtain the minimum compaction.

**401.14 Joints, Trimming Edges, & Cleanup.** At connections to existing pavements and previously placed lifts, make the transverse joints vertical to the depth of the new pavement. Form transverse joints by cutting back on the previous run to expose the full depth course. Dispose of trimmed asphalt material in accordance with Subsection 202.04 (a).

Apply an asphalt tack coat to the edge of the joint for both transverse and longitudinal joints, and where SHOWN ON THE DRAWINGS, in accordance with Section 407.

Place the asphalt concrete mixture as continuously as possible. Do not pass rollers over the unprotected end of a freshly laid mixture.

**401.15 Acceptance.** Provide a quality control plan and then sample, test, and maintain records according to Section 160. See table 401-4 for minimum sampling and testing requirements. Sample to ensure that:

Table 401-4.—Sampling and testing.

Type of Acceptance	Material or Product	Property or Characteristic	Test Method or Specification	Frequency	Sampling Point
Production certification (Subsection 105.04)	Asphalt cement	Contract requirements	AASHTO M 20, M 226, or MP 1, as applicable	Daily	—
Tested conformance	Material source	Los Angeles abrasion	AASHTO T 96	Three times for each undeveloped source, <sup>b</sup> or once for all other sources	Material source
		Sodium sulfate soundness loss	AASHTO T 104		
		Durability index (coarse and fine)	AASHTO T 210		
	Aggregate	Fractured faces (coarse) <sup>a</sup>	FLH T 507	Three times for each undeveloped source, <sup>b</sup> or once for all other sources	Cold feed prior to entering dryer
		Sand equivalent value (fine)	AASHTO T 176, alternate method number 2 (referee method)		
	Asphalt cement	Sample	Subsection 105.04(b)	Once for each 500 t of mix, and not more than three times per day	At point of shipment delivery
Job-mix formula	Contract requirements	Subsection 401.03	Once for each product or material change	—	
Mix evaluation	Hot asphalt concrete pavement	Asphalt content	AASHTO T 164, method B or E	Once for each 500 t, and not more than three times per day	At plant, in hauling units, or behind laydown machine before rolling
		Gradation	AASHTO T 30		
	Compaction	ASTM D 2950, "Procedure"	Five times for each 500 t, and not less than five times per day	In-place after compaction	
	Maximum specific gravity	AASHTO T 209	Once for each 1,000 t	At plant, in hauling units, or behind laydown machine before rolling	

a. Use only for gravel sources.

b. An undeveloped source is a source that has not supplied aggregate for asphalt concrete within 365 days of the start of producing asphalt concrete for this particular project.

- The sample size is adequate to provide a duplicate to the CO and to meet potential need for retesting as specified in Subsection 401.18.
- Samples are prepared according to AASHTO T 248 or other procedures applicable to the item being sampled.
- The sample is adequately identified and placed in CO-approved containers provided by the Contractor.

The CO may perform quality assurance testing, and these tests will be made available to the Contractor upon request.

A lot is defined as the number of tons of material or work produced and/or placed under one set of TV's. The lot will be represented by randomly selected samples tested for acceptance. Plant and equipment operators will not be advised ahead of time when samples are taken.

Acceptance will be evaluated as follows:

**(a) Asphalt Cement.** Asphalt cement will be evaluated for acceptance under Subsection 106.05.

**(b) Pavement Smoothness.** Use a 3-m metal straightedge to measure at right angles and parallel to the centerline at designated sites. Defective areas are surface deviations in excess of 10 mm between any two contacts of the straightedge with the surface. Correct defective areas using approved methods.

**(c) Thickness & Width.** Ensure that the thickness and width of the compacted mixture conform to the dimensions SHOWN ON THE DRAWINGS and meet the following requirements:

- (1) The maximum variation from the specified thickness is less than 6 mm for the wearing course or 12 mm for the base course.
- (2) The compacted width has a +150-mm tolerance.
- (3) The compacted thickness and width are not consistently above or below the specified dimensions.

**(d) Asphalt Concrete Mixture Gradation and Asphalt Content.** Gradation and asphalt content will be evaluated for acceptance under Subsection 401.16.

**(e) Asphalt Concrete Pavement Compaction.** Compaction will be evaluated for acceptance under Subsection 401.17.

**401.16 Acceptance Sampling & Testing of Asphalt Concrete Mixture**

**Gradation & Asphalt Content.** Take statistically random samples in accordance with the tests specified in table 401-4. Take a minimum of three tests per lot. Acceptance or rejection of completed work will be on a lot basis. If the Contractor's quality control tests required in table 401-4 are validated by the CO in accordance with Subsection 401.18 (Test Result Validation Procedure), then the Contractor's tests will be used for acceptance tests.

Obtain samples of the mixture at the plant in approved State department of transportation sampling devices, or after the mixture has been discharged into hauling units or placed on the road in accordance with AASHTO T 168. Test samples for asphalt content by means of AASHTO T 164, method B (Reflux Method) or method E (Vacuum Extraction). Other methods, including nuclear, require approval in writing by the CO and may require an increased sampling and testing frequency. Report the asphalt content to the nearest 0.01 percent. Determine gradation of the entire quantity of extracted material in accordance with AASHTO T 30, except that results shall be reported to the nearest 0.1 percent for all sieves except the 75- $\mu$ m sieve. Report this sieve to the nearest 0.01 percent. Determine the percent moisture in the asphalt mixture in accordance with AASHTO T 110.

If samples are tested for asphalt content by means of AASHTO T 164, determine an Extraction Retention Factor based on the average difference between at least three samples of known asphalt content, and corresponding asphalt content by the same procedure that will be used for acceptance. Prepare the samples in accordance with table 401-1, (b) Marshall, unless otherwise approved by the CO.

If areas of isolated defect are identified by the CO, treat these areas as a separate lot.

The mix tolerance, also referred to as the upper and lower specification limits (USL's and LSL's), is as shown in table 401-5. For Superpave asphalt concrete pavement, the sieve tolerances will follow the allowable deviations in Subsection 703.14 for the designated nominal size.

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Table 401-5.—Mix tolerances.

Mixture Characteristic	Tolerances
Bitumen content	TV $\pm$ 0.5
Sieve size:	
4.75 mm and larger	TV $\pm$ 6.0
600 $\mu$ m to 4.74 mm	TV $\pm$ 4.0
300 to 599 $\mu$ m	TV $\pm$ 3.0
75 to 299 $\mu$ m	TV $\pm$ 2.0

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The Contractor may request a change in TV's subject to the provisions in Subsection 401.03. If the TV's are changed, evaluate all of the material produced up to the time of the change as a lot, and begin a new lot.

The lot will be accepted with respect to gradation and asphalt content using statistical evaluation procedures in accordance with Subsection 401.19.

**401.17 Acceptance Sampling & Testing of Asphalt Concrete Pavement Compaction.** Take statistically random samples in accordance with the tests specified in table 401-4. Take a minimum of five tests per lot. Acceptance or rejection of completed work will be on a lot basis. If the Contractor's quality control tests required in table 401-4 are validated by the CO in accordance with Subsection 401.18 (Test Result Validation Procedure), then the Contractor's tests will be used for acceptance tests.

Use the nuclear gauge for acceptance. Calibrate the nuclear gauge in accordance with ASTM D 2950, Calibration section, within 6 months prior to use on this project, and check the standard and reference on each day of use in accordance with ASTM D 2950, Standardization and Reference Check sections. Do not take acceptance samples within 0.3 m from the edges of the panel. Determine the LSL for compaction using either the control strip method or the maximum density method as follows:

**(a) Control Strip Method.** Use a control strip to establish the LSL. To determine the LSL, construct a control strip at the beginning of work on each type of material to be compacted. Leave each control strip, constructed to acceptable density and surface tolerances, in place to become a section of the completed roadway. Correct or remove unacceptable control strips and replace them at the Contractor's expense. Construct a control strip at least 100 m long and one lane wide, and of the designated lift thickness SHOWN ON THE DRAWINGS.

Ensure that the materials used in the construction of the control strip meet the specification requirements. Furnish them from the same source and of the same type and asphalt content used in the remainder of the course represented by the control strip.

Use equipment in the construction of the control strip that meets the requirements of specified in Subsections 401.05 and 401.13, and that is of the same type and weight as that used on the remainder of the course represented by the control strip.

Begin compaction of the control strips immediately after the course has been placed to the specified thickness. Ensure that compaction is continuous and uniform over the entire surface. Continue compaction of the control strip until no discernible increase in density can be obtained by additional compactive effort.

Upon completion of the compaction, determine the mean density of the control strip by averaging the results of 10 consecutive nuclear density tests taken at randomly selected sites within the control strip. The mean density of the control strip must equal or exceed the density shown in table 401-6.

Table 401-6.—Compaction requirements.

Road Grade (%)	% of AASHTO T 209 converted to density
≤ 8	90
8–12	89
> 12	88

Cease paving if three consecutive control strips fail to achieve the specified minimum density. Take all necessary actions to resolve compaction problems. Do not resume paving without approval of the CO. The LSL shall then be 98 percent of the mean density of the control strip. Construct a new control strip if any of the following occur:

- (1) A change in the properties of the material.
- (2) A change in the rollers.
- (3) A new layer.
- (4) Changes in grade as indicated in table 401-6.

**(b) Maximum Density Method.** The LSL shall be as shown in table 401-6.

After the bituminous mixture has been placed and compacted, the lot will be accepted with respect to compaction using statistical evaluation procedures in accordance with Subsection 401.19. The maximum pay factor for compaction will be 1.00 for the control strip method and 1.05 for the maximum density method. If areas of isolated defect are identified by the CO, these areas will be treated as a separate lot.

**401.18 Test Result Validation Procedure.** Provide the CO with a duplicate of all required samples, specified in table 401-4. If the Government decides to run assurance tests on the duplicate samples, the CO will determine the number to be run. Normally, the first three samples submitted will be tested, and 10 percent thereafter.

As testing is completed, the CO will evaluate all the Contractor testing. If Contractor testing is verified by Government testing, the Contractor's test results may be used by the Government to evaluate work for acceptance. If Contractor testing is not verified by Government testing, the Contractor has the option of either retesting or having the Government test the duplicate sample. The Contractor or the CO may witness the testing of the remaining sample portions. If the Contractor retests the sample, the test results will again be evaluated based on Government verification testing. If the test results are not valid, the Government test results will then be used for acceptance.

If it becomes necessary for the Government to test all of the samples for a work item due to the Contractor's tests being declared invalid, a payment deduction equal to the total cost of performing all of the testing for the applicable item will be made.

If the Contractor's test results are shown to be valid, but significant differences or shifts make the test results questionable, the CO will review the Contractor's equipment and test procedures.

If any deficiencies are identified that would account for the significant differences or shifts, the CO will suspend acceptance of all material until the deficiencies have been corrected. If no deficiencies that would account for the significant differences or shifts in test results can be identified, continue testing. In order to identify the deficiencies, the CO will increase testing frequency of sample portions.

**401.19 Statistical Evaluation of Materials for Acceptance.** Analyze all test results for a lot collectively and statistically by the Quality Level Analysis—Standard Deviation Method, using the procedures listed to determine the total estimated percent of the lot that is within specification limits. Quality Level Analysis is a statistical procedure for estimating the percent compliance to a specification. This procedure is affected by shifts in the arithmetic mean ( $X$ ) and by the sample standard deviation(s). The analysis of each test parameter is based on an Acceptable Quality Level (AQL) of 95.0 and a producer's risk of 5 percent. The AQL may be viewed as the lowest percent of material inside the specification limit that is acceptable at the contract price. The producer's risk is the probability that when the Contractor is producing material at exactly the AQL, the material will receive less than a 1.00 pay factor. As an incentive to produce uniform quality material, payment of up to 5 percent more than the contract unit price may be obtained.

Quality Level Analysis—Standard Deviation Method Procedures are as follows:



- (a) Determine the arithmetic mean ( $X$ ) of each component tested:

$$X = \Sigma x/n$$

where

$\Sigma x$  = summation of individual test values  
 $n$  = total number test values

- (b) Compute the sample standard deviation(s):

$$s = \sqrt{\left(\frac{\Sigma x^2 - nX^2}{n-1}\right)}$$

where

$\Sigma x^2$  = summation of the squares of individual test values  
 $X^2$  = arithmetic mean squared  
 $n$  = total number test values

- (c) Compute the upper quality index ( $Q_U$ ):

$$Q_U = \frac{USL - X}{s}$$

where

$USL$  = TV plus allowable deviation  
 $s$  = sample standard deviation

- (d) Compute the lower quality index ( $Q_L$ ):

$$Q_L = \frac{X - LSL}{s}$$

where

$LSL$  = TV minus allowable deviation  
 $s$  = sample standard deviation

- (e) Determine  $P_U$  (the percent within the  $USL$  that corresponds to a given  $Q_U$ ) from table 401-7. Note that if a  $USL$  is not specified,  $P_U$  will be 100.

Table 401-7.—Quality Level Analysis by the Standard Deviation Method.

Estimated % Inside Specification Limit ( $P_U$ and/or $P_L$ )	Upper Quality Index ( $Q_U$ ) or Lower Quality Index ( $Q_L$ )															
	$n=3$	$n=4$	$n=5$	$n=6$	$n=7$	$n=8$	$n=9$	$n=10$ to $n=11$	$n=12$ to $n=14$	$n=15$ to $n=18$	$n=19$ to $n=25$	$n=26$ to $n=37$	$n=38$ to $n=69$	$n=70$ to $n=200$	$n=200$ to $n=999$	
100	1.16	1.05	1.79	2.03	2.23	2.39	2.53	2.65	2.83	3.03	3.20	3.38	3.54	3.70	3.83	
99	—	1.47	1.67	1.80	1.89	1.95	2.00	2.04	2.09	2.14	2.18	2.22	2.26	2.29	2.31	
98	1.15	1.44	1.60	1.70	1.76	1.81	1.84	1.86	1.91	1.93	1.96	1.99	2.01	2.03	2.05	
97	—	1.41	1.54	1.62	1.67	1.70	1.72	1.74	1.77	1.79	1.81	1.83	1.85	1.86	1.87	
96	1.14	1.38	1.49	1.55	1.59	1.61	1.63	1.65	1.67	1.68	1.70	1.71	1.73	1.74	1.75	
95	—	1.35	1.44	1.49	1.52	1.54	1.55	1.56	1.58	1.59	1.61	1.62	1.63	1.63	1.64	
94	1.13	1.32	1.39	1.43	1.46	1.47	1.48	1.49	1.50	1.51	1.52	1.53	1.54	1.55	1.55	
93	—	1.29	1.35	1.38	1.40	1.41	1.42	1.43	1.44	1.44	1.45	1.46	1.46	1.47	1.47	
92	1.12	1.26	1.31	1.33	1.35	1.36	1.36	1.37	1.37	1.38	1.39	1.39	1.40	1.40	1.40	
91	1.11	1.23	1.27	1.29	1.30	1.30	1.31	1.31	1.32	1.32	1.33	1.33	1.33	1.34	1.34	
90	1.10	1.20	1.23	1.24	1.25	1.25	1.26	1.26	1.26	1.27	1.27	1.27	1.28	1.28	1.28	
89	1.09	1.17	1.19	1.20	1.20	1.21	1.21	1.21	1.21	1.22	1.22	1.22	1.22	1.22	1.23	
88	1.07	1.14	1.15	1.16	1.16	1.16	1.16	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	
87	1.06	1.11	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.13	1.13	
86	1.04	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	
85	1.03	1.05	1.05	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	
84	1.01	1.02	1.01	1.01	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	
83	1.00	0.99	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.95	0.95	0.95	
82	0.97	0.96	0.95	0.94	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
81	0.96	0.93	0.91	0.90	0.90	0.89	0.89	0.89	0.89	0.88	0.88	0.88	0.88	0.88	0.88	
80	0.93	0.90	0.88	0.87	0.86	0.86	0.86	0.85	0.85	0.85	0.85	0.84	0.84	0.84	0.84	
79	0.91	0.87	0.85	0.84	0.83	0.82	0.82	0.82	0.82	0.81	0.81	0.81	0.81	0.81	0.81	
78	0.89	0.84	0.82	0.80	0.80	0.79	0.79	0.79	0.78	0.78	0.78	0.78	0.78	0.78	0.78	
77	0.87	0.81	0.78	0.77	0.76	0.76	0.76	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	

Table 401-7.—Quality Level Analysis by the Standard Deviation Method (cont.).

76	0.84	0.78	0.75	0.74	0.73	0.73	0.72	0.72	0.72	0.71	0.71	0.71	0.71	0.71	0.71
75	0.82	0.75	0.72	0.71	0.70	0.70	0.69	0.69	0.69	0.68	0.68	0.68	0.68	0.68	0.68
74	0.79	0.76	0.69	0.68	0.67	0.66	0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.64	0.64
73	0.76	0.69	0.66	0.65	0.64	0.63	0.63	0.63	0.62	0.62	0.62	0.62	0.62	0.61	0.61
72	0.74	0.66	0.63	0.62	0.61	0.60	0.60	0.60	0.59	0.59	0.59	0.59	0.59	0.58	0.58
71	0.71	0.63	0.60	0.59	0.58	0.57	0.57	0.57	0.57	0.56	0.56	0.56	0.56	0.55	0.55
70	0.68	0.60	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.52
69	0.65	0.57	0.54	0.53	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.50	0.50	0.50	0.50
68	0.62	0.54	0.51	0.50	0.49	0.49	0.48	0.48	0.48	0.48	0.47	0.47	0.47	0.47	0.47
67	0.59	0.51	0.47	0.47	0.46	0.46	0.46	0.45	0.45	0.45	0.45	0.44	0.44	0.44	0.44
66	0.56	0.48	0.45	0.44	0.44	0.43	0.43	0.43	0.42	0.42	0.42	0.42	0.41	0.41	0.41
65	0.52	0.45	0.43	0.41	0.41	0.40	0.40	0.40	0.40	0.39	0.39	0.39	0.39	0.39	0.39
64	0.49	0.42	0.40	0.39	0.38	0.38	0.37	0.37	0.37	0.37	0.36	0.36	0.36	0.36	0.36
63	0.46	0.39	0.37	0.36	0.35	0.35	0.35	0.34	0.34	0.34	0.34	0.34	0.33	0.33	0.33
62	0.43	0.36	0.34	0.33	0.35	0.32	0.32	0.32	0.31	0.31	0.31	0.31	0.31	0.31	0.31
61	0.39	0.33	0.31	0.30	0.32	0.29	0.29	0.29	0.29	0.29	0.28	0.28	0.28	0.28	0.28
60	0.36	0.30	0.28	0.27	0.30	0.27	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.25	0.25
59	0.32	0.27	0.25	0.25	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23
58	0.29	0.24	0.23	0.22	0.21	0.21	0.21	0.21	0.21	0.21	0.20	0.20	0.20	0.20	0.20
57	0.25	0.21	0.20	0.19	0.19	0.19	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.18
56	0.22	0.18	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.15
55	0.18	0.15	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
54	0.14	0.12	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
53	0.11	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
52	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
51	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: If the value of  $Q_u$  or  $Q_L$  does not correspond to a value in the table, use the next lower value. If  $Q_u$  or  $Q_L$  are negative values,  $P_u$  or  $P_L$  is equal to 100 minus the table value for  $P_u$  or  $P_L$ . If the value of  $Q_u$  or  $Q_L$  does not correspond exactly to a figure in the table, use the next higher figure.

- (f) Determine  $P_L$  (the percent within the  $LSL$  that corresponds to a given  $Q_L$ ) from table 401-7. Note that if an  $LSL$  is not specified,  $P_L$  will be 100.
- (g) Determine the Quality Level (the total percent within specification limits) as follows:

$$\text{Quality Level} = (P_U + P_L) - 100$$

- (h) Using the Quality Level from step (g), determine the pay factor ( $PFi$ ) from table 401-8 for each constituent tested.

The contract unit price will be paid for any lot for which at least three samples have been obtained and all of the test results meet the appropriate criteria listed below:

- All test results are within the allowable deviations specified for the item, or
- All test results are greater than or equal to a minimum specification limit, or
- All test results are less than or equal to a maximum specification limit.

Compute the Quality Level and composite pay factor (CPF) in these instances to determine the amount of any bonus that might be warranted.

If less than three samples have been obtained at the time a lot is terminated, include the material in this shortened lot as part of an adjacent lot at the pay factor computed for the revised lot.

If the lot does not meet the criteria for payment at the contract unit price, the lot will be accepted if the CPF is greater than 0.75, provided there are no isolated defects identified by the CO. If a lot contains a CPF less than 0.75, the lot will be rejected. The CO may permit one or more of the following:

- Require complete removal and replacement with specification material at no cost to the Government.
- At the Contractor's written request, allow corrective work at no additional cost to the Government, and then apply an appropriate price reduction that may range from no reduction to no payment.
- At the Contractor's written request, allow material to remain in place with an appropriate price reduction that may range from a designated percentage reduction to no payment.

Table 401-8.—Required quality level for a given sample size (*n*) and a given pay factor (*PFi*).

<i>PFi</i>	<i>n</i> =3		<i>n</i> =4		<i>n</i> =5		<i>n</i> =6		<i>n</i> =7		<i>n</i> =8		<i>n</i> =9		<i>n</i> =10 to <i>n</i> =11	<i>n</i> =12 to <i>n</i> =14	<i>n</i> =15 to <i>n</i> =18	<i>n</i> =19 to <i>n</i> =25	<i>n</i> =26 to <i>n</i> =37	<i>n</i> =38 to <i>n</i> =69	<i>n</i> =70 to <i>n</i> =200	<i>n</i> =201 to 999
	1.05	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1.04	90	91	92	93	93	93	94	94	94	95	95	95	96	96	96	96	96	96	97	97	97	99
1.03	80	85	87	88	89	90	91	91	92	93	93	94	95	96	97	97	97	97	97	97	97	99
1.02	75	80	83	85	86	87	88	88	89	90	91	92	93	94	95	95	95	95	95	95	95	99
1.01	71	77	80	82	84	85	85	86	87	88	88	89	90	91	91	91	91	91	91	91	91	94
1.00	68	74	78	80	81	82	83	84	85	86	87	89	90	91	91	91	91	91	91	91	91	93
0.99	66	72	75	77	79	80	81	82	83	85	86	87	88	90	90	90	90	90	90	90	90	92
0.98	64	70	73	75	77	78	79	80	81	83	84	85	87	88	88	88	88	88	88	88	88	90
0.97	62	68	71	74	75	77	78	78	80	81	83	84	85	87	87	87	87	87	87	87	87	89
0.96	60	66	69	72	73	75	76	77	78	80	81	83	84	86	86	86	86	86	86	86	86	88
0.95	59	64	68	70	72	73	74	75	77	78	80	81	83	85	85	85	85	85	85	85	85	87
0.94	57	63	66	68	70	72	73	74	75	77	78	80	81	83	83	83	83	83	83	83	83	86
0.93	56	61	65	67	69	70	71	72	74	75	77	78	80	82	82	82	82	82	82	82	82	84
0.92	55	60	63	65	67	69	70	71	72	74	75	77	79	81	81	81	81	81	81	81	81	83
0.91	53	58	62	64	66	67	68	69	71	73	74	76	78	80	80	80	80	80	80	80	80	82
0.90	52	57	60	63	64	66	67	68	70	71	73	75	76	79	79	79	79	79	79	79	79	81
0.89	51	55	59	61	63	64	66	67	68	70	72	73	75	77	77	77	77	77	77	77	77	80
0.88	50	54	57	60	62	63	64	65	67	69	70	72	74	76	76	76	76	76	76	76	76	79
0.87	48	53	56	58	60	62	63	64	66	67	69	71	73	75	75	75	75	75	75	75	75	78
0.86	47	51	55	57	59	60	62	63	64	66	68	70	72	74	74	74	74	74	74	74	74	77
0.85	46	50	53	56	58	59	60	61	63	65	67	69	71	73	73	73	73	73	73	73	73	76
0.84	45	49	52	55	56	58	59	60	62	64	65	67	69	71	71	71	71	71	71	71	71	75
0.83	44	48	51	53	55	57	58	59	61	63	64	66	68	71	71	71	71	71	71	71	71	74
0.82	42	46	50	52	54	55	57	58	60	61	63	65	67	70	70	70	70	70	70	70	70	72
0.81	41	45	48	51	53	54	56	57	58	60	62	64	66	69	69	69	69	69	69	69	69	71
0.80	40	44	47	50	52	53	54	55	57	59	61	63	65	67	67	67	67	67	67	67	67	70
0.79	38	43	46	48	50	52	53	54	56	58	60	62	64	66	66	66	66	66	66	66	66	69
0.78	37	41	45	47	49	51	52	53	55	57	59	61	63	65	65	65	65	65	65	65	65	68
0.77	36	40	43	46	48	50	51	52	54	56	57	60	62	64	64	64	64	64	64	64	64	67
0.76	34	39	42	45	47	48	50	51	53	55	56	58	61	63	63	63	63	63	63	63	63	66
0.75 <sup>a</sup>	33	38	41	44	46	47	49	50	51	53	55	57	59	62	62	62	62	62	62	62	62	65

Note: If the computed Quality Level does not correspond exactly to a figure in the table, use the next lower value.

a. Reject quality levels less than those specified for a 0.75 pay factor.

Determine the CPF for each lot as follows:

$$CPF = \frac{[f_1(PF_1) + f_2(PF_2) + \dots + f_i(PF_i)]}{\sum f_i}$$

where

*PF<sub>i</sub>* = pay factor for each constituent tested

*f<sub>i</sub>* = weighting factor listed below for the applicable material:

Item	Weighting factor ( <i>f<sub>i</sub></i> )
9.5-mm and larger material	1
4.75-mm to 9.49-mm material	3
2.36-mm to 4.74-mm material	5
74-µm to 2.35-mm material	3
75-µm material	12
Asphalt content	29
Compaction	45

**Measurement**

**401.20 Method.** Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Calculate tonnage as the weight used in the accepted pavement. No deduction will be made for the weight of asphalt cement in the mixture.

**Payment**

**401.21 Basis.** The accepted quantities will be paid for at the contract unit price for each PAY ITEM listed below that is DESIGNATED IN THE SCHEDULE OF ITEMS, with the following exceptions:

- (a) Payment for hot asphalt concrete pavement and asphalt cement will be made at a price determined by multiplying contract unit bid price by the CPF, as determined in Subsection 401.19.
- (b) Payment for sampling and testing will be made as follows:
  - (1) Twenty-five percent of the lump sum, not to exceed 0.5 percent of the original contract amount, will be paid after all the testing facilities are in place, qualified sampling and testing personnel are identified, and the work being tested has started.

- (2) Payment for the remaining portion of the lump sum will be prorated based on the total work completed.
- (3) Payment for all or part of this PAY ITEM may be retained if the Government assurance tests invalidate the Contractor's testing.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
401 (01) Hot asphalt concrete pavement, class ____, grading ____ .....	Ton
401 (02) Superpave asphalt concrete pavement, nominal size ____ .....	Ton
401 (03) State asphalt concrete pavement, class ____ .....	Ton
401 (04) Hot asphalt concrete pavement, class ____, grading ____, wedge and leveling course .....	Ton
401 (05) Asphalt cement, grade ____ .....	Ton
401 (06) Asphalt cement, State department of transportation grade ____ .....	Ton
401 (07) Sampling and testing .....	Lump Sum

## Section 402—Major Hot Asphalt Concrete Pavement

### Description

**402.01 Work.** Construct one or more courses of hot asphalt concrete pavement as SHOWN ON THE DRAWINGS. Have the surface approved by the CO in writing before placing the hot asphalt concrete pavement.

Hot asphalt concrete pavement classes are designated as shown in table 402-1. Hot asphalt concrete pavement aggregate grading is designated as shown in table 703-4. State asphalt concrete pavement classes are designated by local State department of transportation designations.

Asphalt cement grade is designated as shown in AASHTO M 20, M 226, or MP 1, or in applicable State department of transportation specifications for asphalt materials for the grade specified.

A prepaving conference will be held at least 10 working days prior to the beginning of paving operations. At that time, the Contractor and the CO will discuss methods of accomplishing all phases of the paving work, including laydown operations, work schedules, work force, quality control systems, spill prevention and contingency plans, and asphalt concrete mix delivery.

### Materials

**402.02 Requirements.** Ensure that material conforms to the requirements specified in the following subsections:

Antistrip Additive .....	702.07
Asphalt Cement .....	702.01
Hot Asphalt Concrete Pavement Aggregate .....	703.07
Mineral Filler .....	725.05
Recycling Agent .....	702.05

Ensure that reclaimed asphalt pavement material conforms to the following:

- (a) 100 percent passes the 50-mm screen.
- (b) The material consists of asphalt cement and asphalt cement-coated aggregate.



Table 402-1—Asphalt concrete mixture requirements.

Design Parameters <sup>a</sup>	Class of Mixture		
	A	B	C
(a) Hveem (AASHTO T 246 and T 247):			
(1) Stabilometer, min.	37	35	30
(2) Air voids, % <sup>a</sup>	3–5	3–5	3–5
(3) VMA, min. %	See table 402-2		
(b) Marshall (AASHTO T 245): <sup>b</sup>			
(1) Stability, kN min.	8.0	5.3	4.4
(2) Flow, 0.25 mm	8–14	8–16	8–20
(3) Air voids, % <sup>a</sup>	3–5	3–5	3–5
(4) VMA, min. %	See table 402-2		
(5) Compaction, number of blows each end of test specimen	75	50	50
(c) Immersion-Compression (AASHTO T 165 and T 167):			
(1) Compressive strength, MPa min.	2.1	1.7	1.4
(2) Retained strength, min. %	70	70	70
(d) Root–Tunnicliff (ASTM D 4867):			
(1) Tensile strength ratio, min. %	70	70	70
(e) Dust/asphalt ratio <sup>c</sup>	0.6–1.3	0.6–1.3	0.6–1.3

a. Percent of air voids is based on AASHTO T 166, AASHTO T 209, and AASHTO T 269. Maximum specific gravity will be based on AASHTO T 209.

b. Following mixing, asphalt cement mixtures will be cured in an oven maintained at 12 °C to 18 °C above the compaction temperature for 90 ± 10 minutes.

c. Dust/asphalt ratio is defined as the percent of material, including nonliquid antistriper and mineral filler, that passes the 75-µm sieve, divided by the percent of asphalt (calculated by weight of mix).

## Construction

**402.03 Composition of Mixture (Job-Mix Formula).** Up to 20 percent reclaimed asphalt pavement material may be used, subject to approval of a Contractor quality control plan and submission of test data demonstrating that the mixture will meet the requirements specified in this section.

Furnish the appropriate mixture as follows:

(a) **Hot Asphalt Concrete Pavement Mixture.** Furnish aggregate, asphalt additives, and, when applicable, reclaimed asphalt pavement material that meet the applicable aggregate gradation requirement shown in table 703-4, and design parameters (a) or (b); (c) or (d); and (e) shown in table 402-1.

Table 402-2.—VMA for Marshall or Hveem mix design.

Size <sup>a</sup>	Minimum Voids <sup>b,c</sup> (%)	
	Marshall	Hveem
2.36 mm	21	19
4.75 mm	18	16
9.5 mm	16	14
12.5 mm	15	13
19 mm	14	12
25 mm	13	11
37.5 mm	12	10
50 mm	11.5	9.5

a. The largest sieve size listed in the applicable specification upon which any material is permitted to be retained.

b. VMA to be determined in accordance with AI Manual Series number 2 (MS-2).

c. When a mineral filler or nonliquid antistriper is used, include the percentage specified in the calculation for compliance with the VMA.

**(b) State Asphalt Concrete Pavement Mixture.** Furnish aggregate, asphalt, and additives that meet applicable aggregate gradation and aggregate quality requirements of the local State department of transportation, and design parameters (a) or (b); (c) or (d); and (e) shown in table 402-1. Local State department of transportation design parameters in lieu of those in table 402-1 may be used if approved by the CO.

Submit written job-mix formulas for approval at least 21 days before production. For each job-mix formula, submit the following:

- (1) Aggregate and mineral filler, including:
  - (a) TV for percent passing each sieve size for the aggregate blend. Ensure that the gradation of the blended aggregate and reclaimed asphalt pavement falls within the gradation band for each sieve size designated in the specified grading.
  - (b) Source and percentage of each aggregate stockpile to be used.
  - (c) Average gradation of each aggregate stockpile.
  - (d) Results of aggregate quality tests.
  - (e) Samples, when SHOWN ON THE DRAWINGS.

- (2) Asphalt cement, including:
  - (a) TV for percent of asphalt cement based on total weight of mix.
  - (b) Recent quality test results from the manufacturer for the asphalt cement, including a temperature-viscosity curve.
  - (c) Material safety data sheets.
  - (d) Samples, when SHOWN ON THE DRAWINGS.
- (3) Antistrip additives. When applicable, furnish:
  - (a) Type and TV for percent of antistrip additive.
  - (b) Material safety data sheet.
  - (c) Samples, when SHOWN ON THE DRAWINGS.
- (4) Mix temperatures, including:
  - (a) Temperatures leaving the mixer.
  - (b) Temperature immediately preceding initial compaction.
- (5) Maximum specific gravity, determined according to AASHTO T 209 at the asphalt cement TV.
- (6) Reclaimed asphalt pavement material; when applicable, the percent reclaimed asphalt pavement material and type and percent of recycling agent.
- (7) Asphalt mixtures; when applicable, the location of all commercial mixing plants to be used. A job-mix formula is needed for each plant.

The CO will evaluate the suitability of the material and the proposed job-mix formula. After reviewing the proposed job-mix formula, the CO will develop a TV for the asphalt cement content and determine the need for antistrip additive, the specific gravity in accordance with AASHTO T 209, and the discharge temperature range.

If a job-mix formula is rejected, submit a new job-mix formula as described above.

Changes to an approved job-mix formula require approval before production. Allow up to 14 days to evaluate a change. Approved changes in TV's will not be applied retroactively for payment.

**402.04 Mixing Plant.** Use mixing plants that conform to ASTM D 995, unless producing approved materials for a local State department of transportation. Supplement mixing plant as follows:

(a) **All Plants.** For all plants, use:

(1) **Automated Controls.** Automatically control the proportioning, mixing, and discharging of the mixture.

(2) **Emission Controls.** If a wet scrubber is used, circulate the collected material through sludge pits or settling tanks. Remove the resultant sediment from the project or bury according to Subsection 202.04.

(b) **Drum Dryer-Mixer Plants.** For drum dryer-mixer plants, use:

(1) **Bins.** Provide a separate bin in the cold aggregate feeder for each individual aggregate stockpile in the mixture. Use bins of sufficient size to keep the plant in continuous operation, and of proper design to prevent overflow of material from one bin to another.

(2) **Stockpiling Procedures.** Separate aggregate into at least two stockpiles with different gradations. As a minimum, one stockpile shall contain mostly coarse material, and one stockpile shall contain mostly fine material.

(3) **Reclaimed Asphalt Pavement Material.** Modify drum dryer-mixer plants to prevent direct contact of the reclaimed asphalt pavement material with the burner flame and to prevent overheating of the reclaimed asphalt pavement material.

(c) **Batch & Continuous Mix Plants.** For batch and continuous mix plants, use:

(1) **A Hot Aggregate Bin.** Provide a bin with three or more separate compartments for storage of the screened aggregate fractions to be combined for the mixture. Make the partitions between the compartments tight and of sufficient height to prevent spillage of aggregate from one compartment into another.

(2) **Load Cells.** Calibrated load cells instead of scales may be used in batch plants.

(3) **Reclaimed Asphalt Pavement Material.** Modify batch plants to allow the introduction of reclaimed asphalt pavement material into the mixture using methods that bypass the dryer. Design the cold feed bin, conveyor system, and special bin adjacent to the weigh hopper, if used, to avoid segregation and sticking of the reclaimed asphalt pavement material. Heat the new aggregate and/or reclaimed

aggregate material to a temperature that will transfer sufficient heat to the reclaimed asphalt pavement material to produce a mix of uniform temperature within the range specified in the approved job-mix formula.

**402.05 Pavers.** Use pavers that are:

- (a) Self-contained, power-propelled units with adjustable vibratory screeds with full-width screw augers.
- (b) Heated for the full width of the screed.
- (c) Capable of spreading and finishing courses of asphalt mixture in widths at least 300 mm more than the width of one lane.
- (d) Equipped with a receiving hopper with sufficient capacity to ensure a uniform spreading operation.
- (e) Equipped with automatic feed controls that are properly adjusted to maintain a uniform depth of material ahead of the screed.
- (f) Capable of being operated at forward speeds consistent with satisfactory laying of the mixture.
- (g) Capable of producing a finished surface of the required smoothness and texture without segregating, tearing, shoving, or gouging the mixture.
- (h) Equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing the automatic signals that operate the screed to maintain grade and transverse slope.

**402.06 Surface Preparation.** Prepare the surface in accordance with Section 304, 306, 307, or 308, as applicable. Apply an asphalt tack coat to contact surfaces of curbing, gutters, manholes, and other structures in accordance with Section 407.

**402.07 Weather Limitations.** Place hot asphalt concrete pavement on a dry, unfrozen surface when the air temperature in the shade is above 2 °C and rising, and the temperature of the road surface in the shade, the lift thickness, and the minimum laydown temperature are as shown in table 402-3.

**402.08 Asphalt Preparation.** Uniformly heat the asphalt cement to provide a continuous supply of the heated asphalt cement from storage to the mixer. Do not heat asphalt cement above 175 °C.

Table 402-3.—Minimum laydown temperature<sup>a</sup> for hot asphalt concrete mixture placement (°C).

Road Surface Temperature (°C)	Lift Thickness		
	≤ 50 mm	50–75 mm	≥ 75 mm
< 2	—b	—b	—b
2–3.9	—b	—b	138
4–9.9	—b	141	135
10–14.9	146	138	132
15–19.9	141	135	129
20–24.9	138	132	129
25–29.9	132	129	127
≥ 30	129	127	124

a. Never heat the asphalt concrete mixture above the temperature specified in the approved mix design.  
b. Paving not allowed.

If the job-mix formula requires a liquid heat-stable antistrip additive, meter it into the asphalt cement transfer lines at a bulk terminal or mixing plant. Inject the additive for at least 80 percent of the transfer or mixing time to obtain uniformity.

**402.09 Aggregate Preparation.** If nonliquid antistrip is used, adjust the aggregate moisture to at least 4 percent by weight of aggregate. Mix the antistrip uniformly with the aggregate before introducing the aggregate into the dryer or dryer drum. Use calibrated weighing or metering devices to measure the amount of antistrip and moisture added to the aggregate.

For batch plants, heat, dry, and deliver aggregate for pugmill mixing at a temperature sufficient to produce a mixture temperature within the approved range. Adjust flames used for drying and heating to prevent damage to, and contamination of, the aggregate.

Control plant operations so the moisture content of the mixture behind the paver is 0.5 percent or less, in accordance with AASHTO T 110.

**402.10 Mixing.** Measure the aggregate and asphalt into the mixer in accordance with the approved job-mix formula. Mix until all the particles are completely and uniformly coated with asphalt in accordance with ASTM D 995. Maintain the discharge temperature within the approved range.

**402.11 Hauling.** Use vehicles with tight, clean, smooth metal beds for hauling asphalt concrete mixtures.

Thinly coat the beds with an approved material to prevent the mixture from adhering to the beds. Do not use petroleum derivatives or other coating material that contaminates or alters the characteristics of the mixture. Drain the bed before loading.

Equip each truck with a canvas cover or other suitable material of sufficient size to protect the mixture from the weather. When necessary to maintain temperature, use insulated truck beds and securely fastened covers. Provide access ports or holes for checking the temperature of the asphalt mixture in the truck.

**402.12 Placing & Finishing.** Do not use mixtures produced from different plants unless the mixtures are produced in accordance with the same job-mix formula, use material from the same sources, and are approved.

Place asphalt concrete mixture at a temperature that conforms to table 402-3. Measure temperature of the mixture in the hauling vehicle just before dumping into spreader, or measure it in the windrow immediately before pickup.

Place the mixture with a paver that conforms to specifications in Subsection 402.05. Control horizontal alignment using a reference line. Automatically control the grade and slope from reference lines, a ski and slope control device, dual skis. Use skis with a minimum length of 6 m.

Limit the compacted thickness to 75 mm, unless otherwise SHOWN ON THE DRAWINGS.

On areas where mechanical spreading and finishing is impractical, place and finish the mixture with alternate equipment to produce a uniform surface closely matching the surface obtained when using a mechanical paver.

Offset the longitudinal joint of one layer at least 150 mm from the joint in the layer immediately below. Make the longitudinal joint in the top layer along the centerline of two-lane roadways or at the lane lines of roadways with more than two lanes. Offset transverse joint in adjacent lanes and in multiple lifts at least 3 m.

The CO will designate the job-mix formula to be used for wedge and leveling courses at each location unless DESIGNATED IN THE SCHEDULE OF ITEMS. Place wedge and leveling courses in maximum 75-mm lifts and compact with a pneumatic-tire roller meeting the requirements of Subsection 203.15(d). Complete the wedge and leveling before starting normal paving operations.

**402.13 Compacting.** Furnish at least three rollers, one each for breakdown, intermediate, and finish rolling. Furnish at least one roller with pneumatic tires. Size the rollers to achieve the required results. Operate rollers in accordance with manufacturer's recommendations.

Thoroughly and uniformly compact the asphalt surface by rolling. Do not cause undue displacement, cracking, or shoving. Continue rolling until all roller marks are eliminated and the required compaction is obtained. Do not vibratory roll the mixture after its surface cools below 80 °C.

Along forms, curbs, headers, walls, and other places not accessible to the rollers, use other equipment to obtain the minimum compaction of the mixture.

**402.14 Joints, Trimming Edges, & Cleanup.** At connections to existing pavements and previously placed lifts, make the transverse joints vertical to the depth of the new pavement. Form transverse joints by cutting back on the previous run to expose the full depth course. Dispose of trimmed asphalt material in accordance with Subsection 210.02(a).

Apply an asphalt tack coat to the edge of the joint for both transverse and longitudinal joints, and where SHOWN ON THE DRAWINGS, in accordance with Section 407.

Place the asphalt concrete mixture as continuously as possible. Do not pass rollers over the unprotected end of a freshly laid mixture.

**402.15 Acceptance.** Provide a quality control plan, and then sample, test, and maintain records according to Section 160. See table 402-4 for minimum sampling and testing requirements. Sample to ensure that:

- (a) The sample size is adequate to provide a duplicate to the CO and to meet potential need for retesting as specified in Subsection 402.18.
- (b) Samples are prepared according to AASHTO T 248 or other procedures applicable to the item being sampled.
- (c) The sample is adequately identified and placed in CO-approved containers provided by the Contractor.

The CO may perform quality assurances testing, and these tests will be made available to the Contractor upon request.

A lot is defined as the number of tons of material or work produced, and/or placed under one set of TV's. The lot will be represented by randomly selected samples tested for acceptance. Plant and equipment operators will not be advised ahead of time when samples are taken.

Acceptance will be evaluated as follows:

(a) **Asphalt Cement.** Asphalt cement will be evaluated for acceptance under Subsection 106.05.



Table 402-4.—Sampling and testing.

Type of Acceptance	Material or Product	Property or Characteristic	Test Method or Specification	Frequency	Sampling Point
Production certification (Subsection 105.04)	Asphalt cement	Contract requirements	AASHTO M 20, M 226, or MP 1, as applicable	Daily	—
Tested conformance	Material source	Los Angeles abrasion	AASHTO T 96	Three times for each undeveloped source, <sup>b</sup> or once for all other sources	Material source
		Sodium sulfate soundness loss	AASHTO T 104		
		Durability index (coarse and fine)	AASHTO T 210		
	Aggregate	Fractured faces (coarse) <sup>a</sup>	FLH T 507	Three times for each undeveloped source, <sup>b</sup> or once for all other sources	Cold feed prior to entering dryer
		Sand equivalent value (fine)	AASHTO T 176, alternate method number 2 (referee method)		
	Asphalt cement	Sample	Subsection 105.04(b)	Once for each 500 t of mix, and not more than three times per day	At point of shipment delivery
Job-mix formula	Contract requirements	Subsection 402.03	Once for each product or material change	—	
Mix evaluation	Hot asphalt concrete pavement	Asphalt content	AASHTO T 164, method B or E	Once for each 500 t, and not more than three times per day	At plant, in hauling units, or behind laydown machine before rolling
		Gradation	AASHTO T 30		
		Compaction	ASTM D 2950, "Procedure"	Five times for each 500 t, and not less than five times per day	In-place after compaction
		Maximum specific gravity	AASHTO T 209	Once for each 1,000 t	At plant, in hauling units, or behind laydown machine before rolling

a. Use only for gravel sources.

b. An undeveloped source is a source that has not supplied aggregate for asphalt concrete within 365 days of the start of producing asphalt concrete for this particular project.

(b) **Pavement Smoothness.** Use a 3-m metal straightedge to measure at right angles and parallel to the centerline at designated sites. Surface deviations in excess of 10 mm between any two contacts of the straightedge with the surface are defective areas. Correct these areas using approved methods.

(c) **Thickness & Width.** Ensure that the thickness and width of the compacted mixture conform to the dimensions SHOWN ON THE DRAWINGS and meet the following requirements:

- (1) The maximum variation from the specified thickness is less than 6 mm for the wearing course or 12 mm for the base course.
- (2) The compacted width has a +150-mm tolerance.
- (3) The compacted thickness and width are not consistently above or below the specified dimension.

(d) **Asphalt Concrete Mixture Gradation and Asphalt Content.** Gradation and asphalt content will be evaluated for acceptance under Subsection 402.16.

(e) **Asphalt Concrete Pavement Compaction.** Compaction will be evaluated for acceptance under Subsection 402.17.

**402.16 Acceptance Sampling & Testing of Asphalt Concrete Mixture Gradation & Asphalt Content.** Take statistically random samples in accordance with the tests specified in table 402-4. Take a minimum of three tests per lot. Acceptance or rejection of completed work will be on a lot basis. If the Contractor quality control tests required in table 402-4 are validated by the CO in accordance with Subsection 402.18 (Test Result Validation Procedure), then the Contractor tests shall be used for acceptance tests. Take samples of the mixture at the plant in approved State department of transportation sampling devices, or after the mixture has been discharged into hauling units or placed on the road in accordance with AASHTO T 168. Test the samples for asphalt content by means of AASHTO T 164, method B (Reflux Method) or method E (Vacuum Extraction). Other methods, including nuclear, require approval in writing by the CO, and may require an increased sampling and testing frequency. Report the asphalt content to the nearest 0.01 percent. Determine gradation of the entire quantity of extracted material in accordance with AASHTO T 30, but report results to the nearest 0.1 percent for all sieves except the 75- $\mu$ m sieve; report this sieve to the nearest 0.01 percent. Determine the percent moisture in the asphalt concrete mixture in accordance with AASHTO T 110.

If samples are tested for asphalt content by means of AASHTO T 164, determine an Extraction Retention Factor based on the average difference between at least three

samples of known asphalt content and corresponding asphalt content by the same procedure that will be used for acceptance. Prepare the samples in accordance with table 402-1, (b) Marshall, unless otherwise approved by the CO.

If areas of isolated defect are identified by the CO, treat these areas as a separate lot.

The Contractor may request a change in TV's subject to the provisions in Subsection 402.03. If the TV's are changed, evaluate all of the material produced up to the time of the change as a lot, and begin a new lot.

The lot will be accepted with respect to gradation and asphalt if the average of all test results fall within the tolerances shown in table 402-5.

Table 402-5.—Mix tolerances.

Mixture Characteristic	Tolerances
Bitumen content	TV $\pm$ 0.5
Sieve size:	
4.75 mm and larger	TV $\pm$ 6.0
600 $\mu$ m to 4.74 mm	TV $\pm$ 4.0
300 to 599 $\mu$ m	TV $\pm$ 3.0
75 to 299 $\mu$ m	TV $\pm$ 2.0
Temperature:	
Leaving the mixture	TV + 6 °C
Placed on the road	TV $\pm$ 8 °C

#### 402.17 Acceptance Sampling & Testing of Asphalt Concrete Pavement

**Compaction.** Take statistically random samples in accordance with the tests specified in table 402-4. Take a minimum of five tests per lot. Acceptance or rejection of completed work will be on a lot basis. If the Contractor's quality control tests required in table 402-4 are validated by the CO in accordance with Subsection 402.18 (Test Result Validation Procedure), then the Contractor's tests will be used for acceptance tests.

Use the nuclear gauge for acceptance. Calibrate the nuclear gauge in accordance with ASTM D 2950, Calibration section, within 6 months prior to use on this project, and check the standard and reference on each day of use in accordance with ASTM D 2950, Standardization and Reference Check sections. Do not take acceptance samples within 0.3 m from the edges of the panel. Determine the TV for

compaction using either the Control Strip Method or the Maximum Density Method as follows:

**(a) Control Strip Method.** Construct a control strip at the beginning of work on each type of material to be compacted. Construct each control strip to acceptable density and surface tolerances, and leave it in place to become a section of the completed roadway. Correct or remove unacceptable control strips, and replace them at the Contractor's expense. Construct a control strip at least 100 m long and one lane wide, and at the compacted lift thickness SHOWN ON THE DRAWINGS.

Ensure that the materials used in the construction of the control strip meet the specification requirements. Furnish them from the same source and of the same type and asphalt content used in the remainder of the course represented by the control strip.

Use equipment in the construction of the control strip that meets the requirements specified in Subsections 402.05 and 402.13, and is of the same type and weight as that to be used on the remainder of the course represented by the control strip.

Begin compacting the control strips immediately after the course has been placed to the specified thickness. Ensure that compaction is continuous and uniform over the entire surface. Continue compaction of the control strip until no discernible increase in density can be obtained by additional compactive effort.

Upon completion of the compaction, determine the mean density of the control strip by averaging the results of 10 consecutive nuclear density tests taken at randomly selected sites within the control strip. The mean density of the control strip must equal or exceed the density shown in table 402-6. The TV shall then be 98 percent of the mean density of the control strip.

Table 402-6.—Compaction requirements.

Road Grade (%)	% of AASHTO T 209 converted to density
≤ 8	90
8–12	89
> 12	88

Cease paving if three consecutive control strips fail to achieve the specified minimum density. Take all necessary actions to resolve compaction problems. Do not resume paving without approval by the CO. Construct a new control strip in case of any of the following:

- (1) Any change in the properties of the material.

- (2) Any change in the rollers.
- (3) A new layer.
- (4) Or changes in grade as indicated in table 402-6.

(b) **Maximum Density Method.** The TV shall be as shown in table 402-6.

After the bituminous mixture has been placed and compacted, compaction for the lot will be accepted if both of the following apply:

- (1) All individual test results equal or exceed 98 percent of the TV.
- (2) The average of all tests equals or exceeds the TV.

**402.18 Test Result Validation Procedure.** Provide the CO with a duplicate of all samples specified in table 402-4. If the Government decides to run assurance tests on the duplicate samples, the CO will determine the number to be run. Normally, the first three samples submitted will be tested, and 10 percent thereafter.

As testing is completed, the CO will evaluate all the Contractor testing. If Contractor testing is verified by Government testing, the Contractor's test results may be used by the Government to evaluate work for acceptance. If Contractor testing is not verified by Government testing, the Contractor has the option of either retesting or having the Government test the duplicate sample. The Contractor or the CO may witness the testing of the remaining sample portions. If the Contractor retests the sample, the test results will again be evaluated based on Government verification testing. If the test results are not valid, the Government test results will then be used for acceptance.

If it becomes necessary for the Government to test all of the samples for a work item due to the Contractor's tests being declared invalid, a payment deduction equal to the total cost of performing all of the testing for the applicable item will be made.

If the Contractor's test results are shown to be valid, but significant differences or shifts make the test results questionable, the CO will review the Contractor's equipment and test procedures.

If any deficiencies are identified that would account for the significant differences or shifts, the CO will suspend acceptance of all material until the deficiencies have been corrected. If no deficiencies that would account for the significant differences or shifts in test results can be identified, continue testing. In order to identify the deficiencies, the CO will increase testing frequency of sample portions.

**Measurement**

**402.19 Method.** Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Calculate the tonnage as the weight used in the accepted pavement, and make no deduction for the weight of asphalt cement in the mixture.

**Payment**

**402.20 Basis.** The accepted quantities will be paid at the contract unit price for each PAY ITEM listed below that is DESIGNATED IN THE SCHEDULE OF ITEMS, except that payment for sampling and testing will be made as follows:

- (a) Twenty-five percent of the lump sum, not to exceed 0.5 percent of the original contract amount, will be paid after all the testing facilities are in place, qualified sampling and testing personnel are identified, and the work being tested has started.
- (b) Payment for the remaining portion of the lump sum will be prorated based on the total work completed.
- (c) Payment for all or part of this PAY ITEM may be retained if the Government assurance tests invalidate the Contractor’s testing.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
402 (01) Hot asphalt concrete pavement, class _____, grading _____ .....	Ton
402 (02) State asphalt concrete pavement, class _____ .....	Ton
402 (03) Hot asphalt concrete pavement, class _____, grading _____, wedge, and level course .....	Ton
402 (04) Asphalt cement, grade _____ .....	Ton
402 (05) Asphalt cement, State department of transportation grade _____ .....	Ton
402 (06) Sampling and testing .....	Lump Sum

## Section 403—Minor Hot Asphalt Concrete Pavement

### Description

**403.01 Work.** Construct one or more courses of hot asphalt concrete plant mix on a prepared surface as SHOWN ON THE DRAWINGS. Have the surface approved by the CO in writing prior to placing hot asphalt concrete plant mix.

### Materials

**403.02 Asphalt Cement.** Ensure that asphalt cement meets the requirements specified in Subsection 702.01. The exact percent of asphalt cement and the grade to be used will be furnished by the CO after requirements in Subsection 403.05 have been reviewed and evaluated. Ensure that mixing temperatures meet the requirements specified in Subsection 702.04.

**403.03 Aggregate.** Ensure that aggregate meets the requirements specified in Subsection 703.07, except for aggregate gradation. Maximum gradation size or suggested gradation designations will be SHOWN ON THE DRAWINGS.

**403.04 Additives.** Additives, such as filler, hydrated lime, and antistripping agents, may be used as necessary to meet specifications. Ensure that filler meets the requirements of AASHTO M 17, hydrated lime meets the requirements of AASHTO M 216, type N, and antistripping materials meet the requirements specified in Subsection 702.07.

**403.05 Job-Mix Formula.** Submit a job-mix formula and supporting documentation, test results, and calculations for the material to be incorporated into the work. Include copies of laboratory test results and mix design data that demonstrate that the properties of the aggregate, additives, and mixture meet those requirements and criteria of local public agencies or the AI. After reviewing the Contractor's proposed job-mix formula, the CO will determine the final values for the job-mix formula to be used and notify the Contractor in writing.

### Construction

**403.06 Asphalt Mixing Plant.** Ensure that plants used for preparing hot asphalt concrete mixtures are manufactured for that purpose, in good repair, and capable of mixing the material to a uniform consistency.

**403.07 Hauling Equipment.** Ensure that trucks used for hauling asphalt concrete mixtures have tight, clean, smooth metal beds that have been thinly coated with a material to prevent the mixture from adhering to the beds. Do not use petroleum

derivatives or other coating material that contaminates or alters the characteristics of the mixture. Drain truck beds prior to loading, and ensure that each truck has a cover to protect the mixture from weather. When necessary to ensure that the mixture will be delivered at the specified temperature, ensure that truck beds are insulated and covers securely fastened.

**403.08 Pavers.** Use pavers that are in good working order and have an adjustable vibrating screed or strike-off assembly, heated if necessary, and an auger ahead of the screed to distribute the mixture. Use pavers that are capable of spreading and finishing courses of asphalt concrete plant mix material in lane widths and thickness SHOWN ON THE DRAWINGS. Unless otherwise SHOWN ON THE DRAWINGS, towed-type pavers and Layton-type pavers or graders may be used to place and spread the asphalt concrete plant mix material.

**403.09 Rollers.** Ensure that all rollers meet the requirements specified in Subsections 203.15(b), (c), and (d). Where it is impractical to operate larger rollers, 3- to 5-t rollers may be used. On walkways, 1-t rollers may be used.

**403.10 Weather Limitations.** Do not place the asphalt concrete mixture when weather conditions prevent the proper compaction of the mixture, the base course is frozen, or the average temperature of the underlying surface upon which the asphalt concrete mixture is to be placed is less than 7 °C, or when it is raining or snowing.

**403.11 Conditioning of Existing Surface.** Immediately before placing the asphalt concrete mixture, clean the existing surface of loose or deleterious material.

Before placing the asphalt concrete mixture, paint the contact surfaces of curbing, gutters, manholes, and other structures with a thin, uniform coating of asphalt material.

**403.12 Control of Asphalt Concrete Mixture.** Supply a certification from the mixing plant stating that the mix conforms to the approved job-mix formula. The CO may reject any batch, load, or section of roadway that appears defective in gradation, asphalt cement content, or moisture content. Do not incorporate material rejected before placement into the pavement. Remove any rejected section of roadway. No payment will be made for the rejected materials or the removal of the materials, unless the Contractor requests that the rejected material be tested, at the Contractor's expense, under the following provisions:

- (a) Obtain three representative samples and have them tested at a laboratory approved by the CO.
- (b) If test results show that the material conforms to the tolerance shown in table 403-1, payment will be made for the material, and for its removal and testing.



Table 403-1.—Allowable tolerances.

Mixture Characteristic	Tolerances
Asphalt content	Job-mix formula $\pm$ 0.5
Sieve size:	
9.5 mm and larger	Job-mix formula $\pm$ 5.0
4.75 to 9.49 mm	Job-mix formula $\pm$ 7.0
76 $\mu$ m to 4.74 mm	Job-mix formula $\pm$ 5.0
75 $\mu$ m	Job-mix formula $\pm$ 2.0

**403.13 Transporting, Spreading, & Finishing.** Transport the mixture from the mixing plant to the point of use in vehicles that meet the requirements specified in Subsection 403.07.

Spread the mixture and strike it off to the grade and elevation established. Provide a maximum compacted lift thickness of 100 mm unless otherwise SHOWN ON THE DRAWINGS.

Ensure that the longitudinal joint in any layer offsets that in the layer immediately below by approximately 150 mm. Where laydown requires placement of two adjacent panels to cover the surface of a traveled way, ensure that the longitudinal joint of the top layer is at the centerline. This requirement does not apply to turnouts, extra widening, or parking areas. Offset transverse joints in succeeding layers and in adjacent lanes at least 3 m, where possible.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture may be placed and finished using hand tools.

**403.14 Compaction.** Thoroughly and uniformly compact the surface with rollers that meet the requirements specified in Subsection 403.09, and perform initial compaction while the mixture is above 120 °C. Perform finish rolling with steel-wheel rollers and continue until no roller tracks remain.

### Measurement

**403.15 Method.** Use the method of measurement that is DESIGNATED IN THE SCHEDULE OF ITEMS.

Calculate the quantity of hot asphalt concrete mix that is the tonnage of combined aggregate and asphalt cement used in the accepted work. No separate payment will be made for asphalt cement used in the mixture.

**Payment**

**403.16 Basis.** The accepted quantities will be paid for at the contract unit price for each PAY ITEM DESIGNATED IN THE SCHEDULE OF ITEMS.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
403 (01) Hot asphalt concrete plant mix .....	Ton
403 (02) Hot asphalt concrete plant mix .....	Square Meter