

## 400 FLEXIBLE PAVEMENT

### ITEM 401 ASPHALT CONCRETE PAVEMENTS—GENERAL

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**401.01 Description.** This specification is applicable to all types of asphalt concrete pavements irrespective of gradation of aggregate, kind, and amount of asphalt binder, or pavement use. Deviations from these general requirements are covered in the specific requirements for each type according to the appropriate contract item or items.

Work consists of one or more courses of asphalt concrete constructed on a prepared foundation. The asphalt concrete consists of a mixture of uniformly graded aggregate and specified type and grade of asphalt binder.

Control all production processes to assure the Engineer that the mixture delivered to the paving site is uniform in composition, conforms to the specification requirements and that the placed mixture is free of any defect (ex. segregation, tenderness, lack of mixture and texture uniformity, raveling, flushing, rutting, holes, debris etc.) within the Contractor's control at project completion.

The asphalt concrete pavement thickness shown on the plans or stated in the Proposal is for the exclusive use in calculating the weight required to be placed per unit of surface area.

**401.02 Mix Design and Quality Control.** Use an approved Job Mix Formula (JMF). The quality control and acceptance requirements of Item 403 apply unless otherwise specified.

**401.03**

If required to perform the mix design or quality control, provide a laboratory and personnel meeting the requirements of City Supplement 1041 to perform mix design and quality control tests.

Calibrate asphalt content nuclear gauges according to City Supplement 1043 using personnel with a minimum Level 2 rating according to City Supplement 1041. Mix and test the calibration verification sample with a City employee present.

Provide and dispose of the solvent used for cleaning the asphalt content nuclear gauge pans.

**401.03 Materials.** Furnish materials conforming to:

Asphalt binder (asphalt concrete, 401.14, 401.15).....	702.01
Asphalt material (401.14, 401.18) .....	702.01, 702.04, or 702.13
Aggregates (base courses) .....	703.04
Aggregates (intermediate and surface courses).....	703.05
Mineral filler .....	703.07

Sample aggregate, asphalt binder, asphalt material, and mineral filler according to 106.01.

Take prompt corrective action if mixture delivered to the paving site is not uniform in composition, does not conform to the specification requirements or is not free of any defect (e.g. segregation, tenderness, lack of mixture and texture uniformity, raveling, flushing, rutting, holes, debris etc.) within the Contractor’s control as determined by the Engineer. The Engineer will stop conditional acceptance of the asphalt concrete for failure to correct problems.

**401.04 Reclaimed Asphalt Concrete Pavement.**

The Contractor may blend reclaimed asphalt concrete pavement (RAP) into the mix according to the following requirements. Failure to follow these requirements will result in a rejection of the Contractor QCP (403.03); restriction of RAP use at the facility; or shutting down production at the facility.

**Job Mix Formula.** The Contractor may use a blend of new materials in combination with RAP obtained from verifiable City of Columbus or ODOT projects. If the RAP is not from the above sources or the source is unknown, process and blend the RAP into a single uniform stockpile, test according to Level 3 Mix Design requirements and obtain City approval for use. Obtain Laboratory written approval for use of unusually large, old RAP stockpiles of unknown content, age, or both. Include approved methods in the QCP for ongoing processing and testing of these piles. Ensure no foreign or deleterious material (703.04, 703.05) is present in RAP.

Ensure that the JMF falls within the quality, gradation and asphalt binder content limits of the required mix item. For Contractor designed mixes, ensure the JMF submittal includes the percentages of RAP, virgin aggregates, and virgin asphalt binder required for the mix item. Report all RAP test results and an average in the JMF submittal. Identify the RAP in the JMF submittal as to project origin and mix type(s).

Determine RAP properties and uniformity as follows. Determine final RAP gradation and asphalt binder content on a minimum of four separate stockpile (or roadway for concurrent grinding) samples all agreeing within 0.4 percent for asphalt binder content and 5 percent passing the No. 4 (4.75 mm) sieve. If fractionated RAP is used use a suitable sieve for determining gradation uniformity.

**RAP Usage Limits and Requirements.** Process and use RAP by one of the following two methods. Note on the JMF submittal RAP page which of the two methods described below apply to the RAP.

**Method 1 Standard RAP.** Include RAP in a JMF submittal per the Standard RAP Limits Table 401.04-1 unless specified differently in the applicable mix specification. For mixes that will contain up to 10 percent RAP the JMF submittal is not required to include the RAP except when a virgin polymer asphalt binder is used in a surface course. For surface JMFs having polymer asphalt binder only submit at 0 or 10% RAP. If greater than 20 percent RAP is used in a JMF submittal include an analysis of the recovered asphalt binder and blend per Level 3 Mix Design procedures to determine the grade of virgin asphalt binder to use.

**TABLE 401.04-1  
Method 1 – Standard RAP Limits**

<b>Asphalt Mix Application</b>	<b>Percent RAP by Dry Weight of Mix</b>	<b>Minimum Virgin Asphalt Binder Content</b>	<b>Comments</b>
Heavy Traffic Polymer Surface Course	10 max		For non-polymer virgin binder allow 20% max RAP
Medium Traffic Surface Course	20 max	5.0	Polymer or non-polymer virgin.
Light Traffic Surface Course		5.2	
Intermediate Course	35 max		Any mix type used as an intermediate course.
Base Course 301	50 max		The Laboratory will establish the asphalt binder content.
Base Course 302	40 (30) max		A lower limit of 30 percent will be required if poor production mixing or coating is evident.

**RAP Processing for Table 401.04-1 Method 1-Standard RAP.** For surface courses process RAP to less than 0.75 inch (19 mm) and place a 0.75 inch (19 mm) screen on the cold feed. For other courses place a 2-inch (50 mm) screen on the cold feed. Ensure that the RAP is the proper size to allow for complete breakdown in the plant. If mixing is incomplete, place a smaller screen on the cold feed.

**Method 2 Extended RAP.** Include RAP in a JMF submittal per the Extended RAP Limits Table 401.04-2 unless specified differently in the applicable mix specification. Only use Method 2 with counter flow drum plants or mini-drum batch plant

**401.04**

configurations meeting 402. For mixes that will contain up to 15 percent RAP the JMF submittal is not required to include the RAP unless a virgin polymer asphalt binder is used in a surface course. For JMFs having polymer asphalt binder do not submit at 1 thru 9% RAP.

If greater than 25 percent RAP is used in a JMF submittal include an analysis of the recovered asphalt binder and blend per Level 3 Mix Design procedures to determine the grade of virgin asphalt binder to use. If the blending shows a grade change is required use a PG64-28 for heavy intermediate courses or PG 58-28 or 64-28 for medium intermediate or base courses. No grade change is required with RAP at 26% to 40% if Warm Mix Asphalt (WMA) technology is used in a manner to maintain the mix temperature below 275 °F (135°C). Use WMA technology meeting 402.09. Other WMA technologies must be approved by the Laboratory. If desired, WMA may be used to control plant temperatures when producing mixes using RAP above 40% but a grade change is required if shown necessary by the blending index.

**TABLE 401.04-2  
Method 2-Extended RAP Limits**

<b>Asphalt Mix Application</b>	<b>Percent RAP by Dry Weight of Mix</b>	<b>Minimum Virgin Asphalt Binder Content</b>	<b>Comments</b>
Heavy Traffic Polymer Surface Course	15 max	5.0	For non-polymer binder allow 25% max RAP and 4.6 min virgin.
Medium Traffic Surface Course	25 max	4.8	Polymer or non-polymer virgin.
Light Traffic Surface Course		5.0	
Intermediate Course	40 max	3.0	Any mix type used as an intermediate course.
Base Course 301	55 max		The Laboratory will establish the asphalt binder content.
Base Course 302	45 (40) max	1.8	A lower limit of 40 percent will be required if poor coating is evident. The virgin requirement of 302.02 does not apply.

**RAP Processing for Table 401.04-2 Method 2-Extended RAP.** Process RAP by means of fractionation or by additional in line processing. Include in the QCP additional methods and procedures to dictate how this is to be accomplished at plants. Specify documentation method for RAP measurement. Fractionation is the process of creating separate piles of RAP from one pile when split over a specific sieve or sieves. Test fractionated piles to show uniformity. For additional in line processing only process RAP from a uniform, tested and approved stockpile by passing the RAP over a double deck screen placed in-line between the RAP cold feed bin and the mixer. Use a 9/16

inch (14.3 mm) screen for surface and intermediate mixes and a 1.5 inch screen for base mixes. Do not use concurrent project RAP in a stream process.

**RAP QC and Management Requirements.** Always note on the daily quality control report how much RAP is actually being used. Apply a tolerance of +/-5.0% on the amount of RAP used if needed for a quality control adjustment but do not exceed the limits of Table 401.04-1 or Table 401.01-2, whichever applies. If this adjustment is not adequate for maintaining control of the mix submit a new JMF for approval.

Include in the QCP methods to be used to meet Method 1 and Method 2 requirements above and the following requirements:

1. Provide enough space for meeting all RAP handling requirements at a hot mix facility.
2. Provide a clean, graded base for stockpiles that does not collect water.
3. Test blended RAP stockpiles to ensure uniform gradation and asphalt binder content.
4. Ensure uniform stockpile properties match the JMF submitted RAP properties unless the uniform stockpile will be processed into the asphalt plant using plant cold feed in line processing.

If the uniform stockpile will be processed into the asphalt plant using plant cold feed in line processing determine the processed RAP properties for use in the mix design. Record in the JMF submittal both the uniform stockpile and in line processed RAP properties.

When applying Method 1 Standard RAP requirements, the Contractor may use concurrent City or ODOT project RAP in a stream process in place of stockpiling and testing for uniformity. Take concurrent project RAP from one existing mix type on the concurrent project or two existing mix types if both mix types are taken at the same time in one pass of the milling machine. Submit a new JMF for each existing mix type on the project (or each milling pass of two types) desired for use as concurrent project RAP. Include in the QCP methods of validating RAP properties when using concurrent project RAP. If these requirements are not met, blend and test for uniformity and apply the stockpile requirements of this specification.

Maintain in the plant lab and control room an up to date and dated site map of all tested and untested RAP stockpiles. Give each stockpile a unique identification. Provide in the plant lab RAP properties for each uniform, blended stockpile cross referenced with its identification. In addition, provide the date the stockpile processing was completed and the stockpile estimated size in tons (metric tons). The Engineer may require RAP pile staking for failure to maintain the above. Do not add to a stockpile once it is tested for uniformity. Provide signage at all uniform stockpiles to inform haulers that uniform piles are not to be added to.

Stockpiles and processing methods are subject to inspection and approval by the Engineer at any time. The Engineer may reject stockpiles for the presence of foreign or deleterious materials, lack of uniformity, incomplete mixing in the asphalt mixture, adding to piles, or moving RAP in a way not traceable thru the QCP records and methods. The Laboratory will resolve disputes over acceptability of RAP.

**401.05**

**401.05 Mixing Plants.** The City will approve mixing plants before preparation of the mixtures. General requirements for asphalt concrete mixing plants are specified in Item 402.

Set the asphalt binder controls for the computerized plant at the virgin asphalt binder content of the JMF at all times unless change is authorized by the Laboratory.

Asphalt mixtures may be produced using the warm mix asphalt method according to 402.09 except as restricted by specification.

**401.06 Weather Limitations.** Place asphalt concrete only if the surface is dry and if weather conditions are such that proper handling, finishing, and compaction can be accomplished. Never place asphalt concrete if the surface temperature is below the minimum established in Table 401.06-1.

**TABLE 401.06-1**

<b>Course Thickness</b>	<b>Minimum Surface Temperature</b>	
3.0 inches (75 mm) and over	36 °F <sup>[1]</sup>	(2 °C <sup>[1]</sup> )
1.5 to 2.9 inches (38 to 74 mm)	40 °F	(5 °C)
1.0 to 1.4 inches (25 to 37 mm)	50 °F	(10 °C)
Less than 1.0 inch (25 mm)	60 °F	(16 °C)
Variable Intermediate, 0 to 3.0 inches (0 to 75 mm)	40 °F	(5 °C)

[1] Instead of 36 °F (2 °C), use a minimum air temperature of 40 °F (5 °C) if paving on an aggregate base or subgrade.

In addition to the above surface temperature requirements, do not place surface courses if the air temperature is less than 40 °F (5 °C).

For any surface course with a polymer modified asphalt binder, ensure that the surface of the existing pavement is at least 50 °F (10 °C) and the air temperature is at least 50 °F (10 °C).

Do not schedule the placement of any surface course with a polymer modified asphalt binder after November 1, regardless of pavement or air temperature.

**401.07 Notification.** Notify the Engineer at least 24 hours before starting paving on a project. After starting paving, if paving operations are stopped for 1 week or more, notify the Engineer at least 24 hours before resuming paving on a project.

**401.08 Asphalt Binder.** Heat the asphalt binder and deliver it to the mixer within the temperature range specified in Table 702.00-1. Do not use asphalt binder while it is foaming in a storage tank. Take samples using correct new containers from the binder line between the last piping ‘tee’ and inlet into the plant unless a different storage method requires a different sampling location.

**401.09 Aggregate Preparation.** Feed aggregates in their proper proportions and at a rate to permit correct and uniform control of heating and drying. Remove all aggregates in the plant that will produce a mix outside the temperature limits or that contain excessive moisture or expanding gases causing foaming in the mixture, and return them to the proper stockpiles.

**401.10 Mixing.** Maintain the temperature of the mix at the plant within the range set by the Laboratory for the JMF or per specification. The Engineer will determine the required temperature of the mixture on arrival at the project site based on the temperature range set for the mix design and heat losses in transit.

For batch plants, after all of the aggregate is in the mixer, add the asphalt binder in an evenly spread sheet over the full length of the mixer. The mixing time is defined as the interval between the start of application of the asphalt binder and the opening of the mixer gate. Discharge all asphalt binder required for one batch in not more than 30 seconds. After the asphalt binder is added, the Laboratory will establish a minimum mixing time, which will not be less than 30 seconds.

**401.11 Hauling.** Use trucks for hauling asphalt concrete that have tight, clean, smooth metal beds from which the entire quantity of mixture is discharged smoothly into the spreading equipment.

Before loading, apply a thin coating of an approved release agent to the inside surfaces of the truck bed to prevent adhesion of mixture to the bed surfaces. The Laboratory maintains a list of approved release agents. Do not use fuel oil for this purpose. Drain truck beds before loading.

Provide a place off the project for cleaning trucks when hauling polymer modified asphalt binder mixes or when excessive sticking of material in truck beds occurs. If the Contractor does not resolve excessive sticking of material in truck beds in a reasonable time and the sticking is in areas of the truck that would indicate excessive cooling of the mix (front corners, bottom, etc.) due to a long haul, the Engineer will require an insulated bed. The Contractor may only make changes in policy regarding release agents for beds or other procedure changes for better mix handling at the discretion of the Laboratory.

Equip each truck with a securely fastened, waterproof cover of suitable material to adequately protect the mixture from wind and weather. At the request of the Engineer, remove covers before dumping into the paver.

If transporting hot asphalt concrete at prevailing air temperatures below 50 °F (10 °C) or if the length of haul exceeds 20 miles (32 km), insulate all truck beds to maintain workable mix temperature, and ensure that all covers are fastened to exclude the wind. Do not exceed a distance of 50 miles (80 km) from the asphalt concrete plant to the paving site except by specific permission of the City.

**401.12 Spreading Equipment.** Use self-contained spreading equipment of sufficient size, power, and stability to receive, distribute, and strike-off the asphalt concrete at rates and widths meeting the typical sections and other details shown on the plans. Use spreading equipment that has automatic control systems that maintain the screed in a constant position relative to profile and cross-slope references. Ensure control of the screed position is reasonably independent of irregularities in the underlying surface and of the spreader operation. Equip asphalt spreading equipment to prevent the segregation of coarse aggregate from the remainder of the asphalt concrete when the material moves from the hopper to the screed. Use means and methods approved by the asphalt spreader manufacturer consisting of but not limited to any combination of chain curtains, deflector plates, or other such devices.

**401.13**

For the following asphalt spreaders perform the listed modifications:

A. Equip Blaw-Knox asphalt spreaders with the Blaw-Knox Materials Management Kit (MMK) or an alternate equivalent kit. If an alternate kit is used provide documentation showing the Blaw-Knox means and methods and that the alternate methods used are equivalent.

B. Only use Cedar Rapids asphalt spreaders manufactured after 1988.

C. Equip Caterpillar asphalt spreaders with deflector plates as identified in the Caterpillar December 2000 Service Magazine entitled “New Asphalt Deflector Kit {6630, 6631 or 6640}”.

Provide a letter to the Engineer identifying modified asphalt spreaders to be used and provide a certification statement and signature that the above modifications were implemented on the listed asphalt spreaders.

The Engineer will base final approval of spreading equipment on the demonstrated capability of the equipment to place the mixture to the required cross-section, profile and alignment in an acceptable, finished condition ready for compaction.

Where the use of standard full-scale spreading equipment is impractical due to the size or irregularity of the area to be paved, use specialized equipment or hand methods approved by the Engineer to spread the asphalt concrete.

**401.13 Rollers.** Use only steel wheel and pneumatic tire types of rollers meeting the minimum requirements of the following tables. Conform to manufacturer’s specifications for all ballasting.

**TABLE 401.13-1 ROLLER CAPACITY**

<b>Roller Type</b>	<b>Maximum Capacity square yards per hour (m<sup>2</sup>/hr)</b>
Tandem	700 (600)
Three-Wheel	700 (600)
Trench	15 per inch width (13 per 25 mm width)
Pneumatic Tire, Type 1	1000 (850)
Pneumatic Tire, Type 2	700 (600)
Vibratory, Vibrating Roll	15 per inch width (13 per 25 mm width)
Vibratory, Static Roll (not vibrating)	3 per inch width (3 per 25 mm width)

**TABLE 401.13-2 STEEL WHEEL ROLLERS**

<b>Roller Type</b>	<b>Three-Wheel</b>	<b>Tandem</b>	<b>Vibratory Static</b>	<b>Trench</b>
Total weight, tons (metric tons)	10 (9)	8 to 12 (7 to 11)	8 to 12 (7 to 11)	
Compression rolls, pounds per inch width (kN/m), minimum	300 (53)	200 (35)	120 (21)	300 (53)

**TABLE 401.13-3 PNEUMATIC TIRE ROLLERS**

<b>Type I</b>	
Tire size, minimum	9.00 × 20 in (229 × 508 mm)
Wheel load, minimum	5000 lb (2250 kg)
Average tire contact pressure, minimum	85 psi (590 kPa)
<b>Type II</b>	
Tire size, minimum	7.50 × 15 in (191 × 381 mm)
Wheel load, minimum	2000 lb (900 kg)
Average tire contact pressure, minimum	55 psi (380 kPa)

For pneumatic tire rollers, use self-propelled, reversible units with vertical oscillation on all wheels on at least one axle. Determine the tire inflation pressure necessary to meet the specified minimum contact area and contact pressure requirements. Furnish the tire manufacturer's charts or tabulations to the Engineer for verification of the required inflation pressure. Check tire inflation pressure as the Engineer directs, and maintain it within 5 pounds per square inch (35 kPa) of the required pressure.

Provide rolls and wheels with the necessary accessories to prevent adhesion of the mixture, and keep them properly moistened with water, water containing a detergent, or water containing an approved additive. Do not use excess liquid.

**401.14 Conditioning Existing Surface.** Clean the surface on which the asphalt concrete is to be placed, and keep it free of accumulations of materials that would, in the judgment of the Engineer, contaminate the mixture, prevent bonding, or interfere with spreading operations. Where approved subgrade or pavement courses previously constructed under the Contract become loosened, rutted, or otherwise defective, correct the deficiency according to the contract item or items involved before the spreading of a subsequent pavement course.

If a quantity of asphalt concrete is specified for use in spot leveling or patching an existing pavement surface, spread and compact the material needed to effect the corrections as directed by the Engineer.

Paint contact surfaces of curbing, gutters, manholes, and other structures with a thin, uniform coating of asphalt material before placing the asphalt concrete against them.

#### 401.15

If placing asphalt concrete against the vertical face of an existing pavement structure, clean the vertical face of foreign material and apply asphalt material that results in a coating of approximately 0.25 gallon per square yard (1 L/m<sup>2</sup>).

Before placing a surface course onto an intermediate course, apply a tack coat to the intermediate course according to 407.06.

In areas where the surface is required to be feathered to meet an adjoining surface, coat the existing surface uniformly with a thin coat of asphalt binder.

#### **401.15 Spreading, Finishing and Night Work.**

**A. Spreading and Finishing.** Spread the mixture at a rate calculated using the specified thickness and the compacted width of the pavement course being placed, and the weight-to-volume conversion factors established in 401.21. Maintain the actual rate of spreading the mixture equal to the required calculated rate within the tolerance specified in 401.19. For pavement courses specified for leveling an existing pavement surface, the actual rate of spreading the mixture may vary from the required calculated rate as approved by the Engineer to accomplish the intended purpose.

For intermediate courses, make the maximum compacted depth of any one layer 3 inches (75 mm).

Spread and finish the mixture using approved equipment or methods such that compaction can follow immediately. Preheat screeds and extensions before placing any asphalt concrete. Use side plates sufficient to contain the mixture laterally during spreading. Use only screed extensions, rigid or extendable, having the same features as the main screed including, but not limited to, vibration, heating, pre strikeoffs, and tamping bars. When using front-mounted hydraulically extendable screeds at a fixed paving width, use full width auger extensions and full tunnel extensions. When using fixed screed extensions, use full width auger extensions and full tunnel extensions. Do not allow a buildup of excess material in front of any extended screed. Where excessive buildup of material is not controlled in front of the extended screed, the Engineer will require paver changes to correct the problem. The Contractor may use strike-off plates/extensions on irregular areas such as mailbox turnouts, driveway turnouts, and other irregular non-travelled roadway areas. The Engineer may approve the use of strike-off plates/extensions on variable width shoulders if the use of a standard extendable screed extension with the same features as the main screed is not practicable. Perform supplemental hand forming and tamping where irregularities develop and where placing the mixture by hand methods.

Take prompt corrective action if placed mixture is not free of any defect (e.g. segregation, tenderness, lack of mixture and texture uniformity, raveling, flushing, rutting, holes, debris etc.) within the Contractor's control and as determined by the Engineer. Remove and replace, or otherwise correct, any portion of the pavement course found to be defective in surface texture or composition before or after compaction in a manner satisfactory to the Engineer. Coordinate the spreading operation with the rate of production and delivery of the mixture to attain uniform, continuous progress. Avoid erratic spreader operation due to irregular contact with the hauling vehicle, surging in the feed and distribution of the mixture, or other cause. Maintain sufficient control of the spreading equipment with regard to line and grade

references so that the pavement course, when compacted as specified, is in reasonable conformance with the Contract Documents.

Do not displace or damage bridge deck waterproofing membranes during spreading operations on the membranes.

Do not allow traffic on the compacted mixture until it has cooled sufficiently to prevent glazing as determined by the Engineer.

After completion of the surface course, seal gutters with asphalt binder as directed by the Engineer. Apply the material at a uniform width of approximately 4 inches (100 mm) and at a rate just sufficient to fill surface voids.

**B. Night Work.** Do not start night work or carry on day work into night work without operating an adequate and approved lighting system. Night work is defined as work performed from 30 minutes before sunset to 30 minutes after sunrise.

Operation of adequate lighting system consists of furnishing, installing, operating, maintaining, moving, and removing night time lighting to illuminate construction work areas for night work. Obtain the Engineer's approval of the lighting at the beginning of the project and before starting the paving operation by measuring the luminance.

Provide an illuminated zone around all operating machinery. Provide an illuminated zone of at least 5 foot-candles (55 lux) of lighting luminance in the immediate vicinity of pavers, rollers, grinding equipment, material transfer vehicles, etc., and at least 1 foot-candle (10 lux) at 25 feet (7.6 m) from this equipment. Provide an illuminated zone of at least 5 foot-candles (55 lux) of lighting luminance in the immediate vicinity of coring equipment and at least 1 foot-candle (10 lux) at 10 feet (3m). Position the light sources so they do not interfere with or impede traffic in any direction and do not cause glare for motorists or point onto adjacent properties. Provide a photometer capable of measuring the level of luminance on each night project. Take luminance measurements at a height of 20 inches (500 millimeters) above the roadway.

Obtain the luminance level any time requested by the Engineer. Test the illumination levels on the site each time a change in lighting configuration is made. Replace non-functioning lamps immediately. Check the luminaires aiming daily. Clean the luminaires regularly. Correct any deficient lighting within one hour or the Engineer will terminate construction activities.

**401.16 Compaction.** Immediately after spreading the asphalt concrete and adjusting any surface irregularities, compact the mixture uniformly using rollers conforming to 401.13. Do not use a spreading rate that exceeds the total of the specified capacities of the rollers in use. However, if compacting a mixture spread as an intermediate or pre-leveling course less than 1 inch (25 mm) thick, do not use a spreading rate that exceeds twice the total capacity of the rollers in use.

Coordinate the spreading of the mixture with the required roller coverage, considering the rate of cooling of the mixture as affected by lift thickness and environmental conditions. Complete the required roller coverage during the period of time in which the temperature of the mixture is sufficient for the roller coverage to be effective in compacting the mixture.

#### 401.17

Compact base mixtures using a combination of both steel and Type I pneumatic tire rollers; however, in small areas, compact these mixtures as approved by the Engineer using any of the rollers specified in 401.13.

Compact intermediate and surface mixtures using a three-wheel roller in the breakdown position (roller immediately behind the paver) of the roller train; however, in small areas, compact these mixtures as approved by the Engineer using any of the roller types specified in 401.13.

Compact variable depth courses using a combination of both steel and pneumatic tire rollers; however, in small areas, compact these mixtures as approved by the Engineer using any of the roller types specified in 401.13.

For surface courses using a polymer modified asphalt binder, give a copy of the JMF approval letter containing the design compaction temperature to the Laboratory before any mix is placed. Unless otherwise specified, ensure that the mix temperature immediately before rolling is not less than 290 °F (145 °C) if placing hot mix asphalt, and not less than 250 °F (121 °C) if placing warm mix asphalt according to 402.09. Do not compact polymer asphalt concrete surface courses with pneumatic tire rollers. Do not use vibratory rollers on courses with a thickness under 1 1/2 inches (38 mm).

When using pneumatic tire rollers, ensure for any mix, that surface deviations and deformations caused by the tires are removed with steel wheel rollers. Do not use pneumatic tire rollers if any resultant surface deformations cannot be removed.

Unless otherwise directed, begin rolling at the sides and proceed longitudinally parallel to the centerline at a slow, uniform speed. After each coverage or complete round trip, move the roller towards the crown of the road to begin its next pass, overlapping the previous pass by at least one-half the width of the previous pass. On superelevated curves, begin rolling at the low side and progress toward the high side. Where a longitudinal joint is being made, roll the joint and then follow the applicable rolling procedure.

Continue rolling until full coverage of the course is complete and all roller marks are eliminated. Take care to prevent displacement of the edgeline and grade. Where displacement occurs, correct the area immediately in a manner satisfactory to the Engineer.

Along curbs, headers, walls, and in other areas not accessible to rollers, thoroughly compact the mixture with hot, hand tampers or with mechanical tampers. On depressed areas, the Contractor may use trench rollers or rollers fitted with compression strips.

Replace mixture that becomes loose, broken, contaminated, or otherwise defective with fresh, hot mixture. Compact it to match with the surrounding area.

**401.17 Joints.** Place the asphalt concrete mixture as continuous as possible. Set up joints at the proper height above the adjacent construction to receive maximum compaction. Where the edge of the new surface has been significantly rounded by the action of traffic, trim it to a vertical face before placing the adjacent pavement. On projects where traffic is allowed to cross the edge of the new pavement lane, complete the longitudinal joint of the adjacent lane or berm within 24 hours.

Form hot longitudinal joints using pavers operating in contiguous lanes, one just ahead of the other. Maintain the distance between pavers in adjacent lanes such that it

does not exceed the distance that a normal size load of mixture will cover. Alternate loads of mixture between the pavers. Do not allow rollers performing the initial rolling operation in one lane closer than 12 inches (0.3 m) to the longitudinal joint until the adjacent lane is placed.

Instead of hot joint construction using multiple pavers, the Contractor may use full width construction with a single unit paver.

Compact all cold longitudinal joints on intermediate and surface courses using a three-wheel roller.

For surface courses, form or cut all transverse construction joints to a vertical.

Seal all cold longitudinal construction joints by coating the entire face of the cold joint with a certified 702.01 PG binder or 702.13 SBR Asphalt Emulsion to provide 100 percent coverage of the joint. Overlap the joint edges by at least 1/2 inch (13 mm). Seal all cold transverse construction joints with a certified 702.01 PG binder or 702.13 Rubberized Asphalt Emulsion to provide 100 percent coverage of the joint or with a certified 702.04 asphalt material applied at a rate of 0.25 gallon per square yard (1 L/m<sup>2</sup>).

**401.18 Asphalt Binder Compatibility.** If excess fat spots, regular random areas of flushing, or excess drain down occur on a project that are not attributable to over rolling, plant operation, or mix quality compared to the JMF, the City will consider the asphalt binder incompatible. The City will reject any on-hand asphalt binder because of incompatibility. The City may use its discretion in determining if problem areas can be corrected, but if an unsafe condition exists, remove and replace the area in question. Demonstrate to the Laboratory through reporting actual testing analysis the compatibility of another asphalt binder and that proper equipment is in place in order to be allowed to resume.

**401.19 Spreading and Surface Tolerances.** If a uniform course is specified, make checks and adjustments to maintain the rate of spreading within a tolerance of  $\pm 5$  percent of the required calculated weight per unit of area.

If a variable depth course is specified, place the mixture as shown on the plans.

If a longitudinal profile is specified by elevations on the plans, do not allow the completed pavement surface to deviate more than 1/2 inch (13 mm) from the plan elevation at any point. Before placing the surface course, check the profile of the preceding course at 50-foot (15 m) intervals along the outside edge of each traffic lane and along any additional line described in superelevation tables, and submit a tabulation of all results that includes documentation of all deviations from the above tolerance to the Engineer for approval. Perform corrective work necessary for compliance with the profile tolerance before placing the surface course. The requirements of this paragraph do not apply to small incidental areas of pavement less than 500 feet (150 m) in length.

Do not vary the transverse slope of the surface of the completed course from the specified slope by more than 3/8 inch in 10 feet (10 mm in 3 m).

Do not vary the surface of each completed intermediate or surface course from the testing edge of a 10-foot (3 m) rolling straightedge by more than 1/4 inch (6 mm). Furnish straightedges, straightedges equipped with levels, or other devices. Equipment will be satisfactory to the Engineer.

## 401.20

Check the surface course for variations in slope or surface at locations where bumps are suspected when directed by the Engineer.

Correct variations in excess of slope or surface tolerance by removing mixture to neat lines and replacing, or by surface grinding in a manner satisfactory to the Engineer.

**401.20 Asphalt Binder Price Adjustment.** A Contract Item is eligible for a price adjustment when the Contract's Proposal specifically includes an Asphalt Binder Price Adjustment note and the Contract Item meets the quantity limitations of the ODOT proposal note for Asphalt Binder Price Adjustments for Single Year or Multi-Year, as applicable.

**401.21 Method of Measurement.** The Contractor is responsible for recording the net weight of each truckload of mixture to the nearest 100 pounds (50 kg) in triplicate on plant ticket forms approved by the City. If the pay quantities are established by platform scales, provide a tare weight for each truck at the beginning of each day's operation and a minimum of every 4 hours of operation each day. The Engineer may require additional tare weight measurements at any time. The Engineer will have the right to monitor all weighing operations and may require reweighing trucks at any time or location. Correct any discrepancies immediately. Continued non-compliance will result in the City taking necessary and appropriate action, such as, but not limited to, assigning a City ticket writer to the plant. Send one copy of the plant ticket with each load delivered to the paver and present it to the Engineer.

The Engineer will convert the total of the weights recorded on the plant tickets representing mixture finished according to contract requirements to cubic yards (cubic meters) using a conversion factor established by the Laboratory. The Laboratory will establish this conversion factor from the approved JMF. However, if a mix design is not available, the Laboratory will use the conversion factors in Table 401.21. If a uniform course is specified, the City will not pay for a number of cubic yards (cubic meters) that exceeds the quantity calculated from plan lines and dimensions.

**TABLE 401.21**

<b>Aggregate</b>	<b>lb/yd<sup>3</sup></b>	<b>(kg/m<sup>3</sup>)</b>
Gravel and stone	4000	(2370)
Slag less than 90 lb/yd <sup>3</sup> (less than 1450 kg/m <sup>3</sup> ) <sup>[1]</sup>	3600	(2135)
Slag 90 to 100 lb/yd <sup>3</sup> (1450 to 1600 kg/m <sup>3</sup> ) <sup>[1]</sup>	4000	(2370)
Slag more than 100 lb/yd <sup>3</sup> (more than 1600 kg/m <sup>3</sup> ) <sup>[1]</sup>	4300	(2550)

[1] Based on average dry rodded weight at the Laboratory.

**401.22 Basis of Payment.** The City will pay for all work performed and measured as specified above according to the appropriate contract items for each type.

The cost of sealing the joints is included in the unit price bid for the asphalt concrete.

The City will assess all costs against the Contractor that it incurs as a result of taking necessary and appropriate action due to the Contractor's continued non-compliance.

If an unsafe condition exists, the City will not pay for removing and replacing incompatible asphalt binder areas.