

400 FLEXIBLE PAVEMENT

ITEM 401 - PLANT MIX PAVEMENTS - GENERAL

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401.01 Description. These specifications include general requirements applicable to all types of plant mix bituminous pavements irrespective of gradation of aggregate, kind and amount of bituminous material, or pavement use. Deviations from these general requirements will be covered in the specific requirements for each type.

This work shall consist of 1 or more courses of bituminous mixture constructed on the prepared foundation in accordance with these specifications and the specific requirements of the type under contract, and in reasonably close conformity with the lines, grades, and typical cross sections shown on the plans or established by the Engineer.

Bituminous plant mix pavement thickness shown on the plans or stated in the proposal is for exclusive use in calculating the weight required to be placed per unit of surface area.

401.02 Composition. The bituminous plant mix shall be composed of a mixture of uniformly graded aggregate and specified type and grade of bituminous material.

The composition table for the type under contract specifies the limits within which the job-mix formula will be set. Should the Contractor propose to change the source of the materials, a new job mix formula will be required.

The Suppliers' Engineer will establish a job-mix formula using the Marshall Mix Design Method per the Asphalt Institute's Manual MS-2, will produce a satisfactory mix. No change shall be made unless authorized by the Engineer or Laboratory. These mixes shall be submitted annually for review by the Engineer and/or Laboratory.

During production, variation from the job mix formula of plus or minus 3 percent passing the No. 4 (4.75 mm) sieve or plus or minus 0.3 percent bitumen shall be investigated and corrected by the Contractor.

A variation from the job-mix formula of plus or minus 5 percent passing the No. 4 (4.75 mm) sieve or plus or minus 0.5 percent bitumen shall be sufficient cause for the Engineer to order production discontinued until the cause of the variation is corrected.

401.03 Materials. Materials shall be:

Aggregates (intermediate and surface courses)	703.05
Aggregates (base courses).....	703.04
Bituminous Material (301, 402, 403, 404, 412, 415, 416).....	702.01
Bituminous Material (401.13, 401.16)	702.01, 702.02 or 702.04

Aggregate and bituminous material shall be sampled in accordance with 106.01.

401.04 Use of Reclaimed Materials. The Contractor may use a blend of new materials in combination with reclaimed materials. A maximum of 10 percent of reclaimed materials may be used. This percentage is based on the dry weight of all the materials used. The addition of the reclaimed materials can be made without adjusting the job-mix formula. The combined mixture shall fall within the limits of the item specified.

The Contractor shall identify the reclaimed material as to type, source, gradation and bitumen content. The stockpile shall be free of contamination and uniform in composition. Prior to stockpiling, the proposed sites for storing the reclaimed material shall be cleaned, graded and compacted for approval by the Engineer prior to use. Additional reclaimed material shall not be added to an approved stockpile, except when the reclaimed material proposed for use is being reclaimed concurrently with the production of the recycled mixture.

The reclaimed material shall be of proper size to allow for complete breakdown of material in the plant. Incomplete mixing shall be reason to require a 2 inch (50 mm) screen to be placed on the cold feed. Incomplete mixing shall be reason to require a smaller screen to be placed on the cold feed. Due to variations in the reclaimed material gradation, a maximum of 5 percent oversize material will be tolerated in the completed mix, provided it can be incorporated into the work with satisfactory results.

When reclaimed pavement is used in a surface course, the reclaimed material shall be processed to a maximum size of 3/4 inch (19 mm) before incorporating the reclaimed pavement into the mix. Metal separation shall be incorporated into the process to properly remove all metal materials and fragments from the reclaimed pavement. Material that does not pass the 3/4 inch (19 mm) maximum size must be reintroduced at the material entry point to be recycled through the crushing and separating stages until it meets the gradation requirements.

401.05 Mixing Plants. Plants shall be approved by the Engineer prior to preparation of the mixture. A statement of general requirements for bituminous concrete mixing plants is available from the office of the Manager of Testing.

401.051 Field Laboratory. The Contractor shall provide an approved building or room for the plant inspector to use in the performance of the required tests. The building shall be floored and provide a minimum floor area of 130 square feet (12m²) of suitable working space. It shall have windows on at least three sides to provide suitable light and cross ventilation and an outside door. Windows in one wall shall provide a direct view of the mixing platform. The windows and door shall be provided with locks.

The building shall have satisfactory lighting and grounded electrical switches and outlets. An exhaust fan shall be provided and located so as to adequately ventilate areas where solvent is stored and used. The ventilation shall be such that there is no odor or solvent in the breathing zone of the plant inspector.

Heating and cooling equipment shall be provided that will maintain a temperature range of 70° to 80° F (21° to 26° C) during working hours when the exhaust fan is in operation. Open flame heaters shall not be used.

The building shall have suitable work benches for weighing, sieving and AC Gauge operations. Work benches shall have drawers. A desk or suitable table for office work shall be provided.

The site shall have conveniently accessible telephone facilities over which conversations can be plainly heard.

401.06 Weather Limitations. Bituminous plant mixture shall only be placed when the surface is dry and when weather conditions are such that proper handling, finishing and compaction can be accomplished. In no case, however, shall bituminous plant mixtures be placed when the air temperature is below the minimum established in the following table:

Course Thickness

Minimum Air Temperature

3 inches (76 mm) and over	35° F (2° C)
1 to 3 inches (25-76 mm)	40° F (4° C)
Variable Intermediate Surface	
0 to 3 inches (0-76 mm)	40° F (4° C)
Surface - Less than 1 inch (25 mm)	50° F (10° C)
Surface - Fiberized Asphalt	50° F (10° C)

The Director shall establish a cut-off date for the placement of Bituminous Plant Mixes for City and private subdivision work.

401.07 Bituminous Material Preparation. The bituminous material shall be heated and delivered to the mixer within the temperature specified in 702. Bituminous material shall not be used while foaming.

401.08 Aggregate Preparation. Aggregates shall be fed to the cold elevator in their proper proportions and at a rate to permit correct and uniform control of heating and drying. All aggregates in the hot bins that will produce a mix outside the temperature limits or that contain sufficient moisture or expanding gases to cause foaming in the mixture shall be removed and returned to the proper stockpiles.

401.09 Mixing. When batch mixing is used, the order or sequence in which the several aggregates are drawn or weighed shall be determined by the Engineer. After all of the aggregate is in the mixer, the bituminous material shall be added in an evenly spread sheet over the full length of the mixer. The mixing time shall be the interval between the start of application of the bituminous material and the opening of the mixer gate. All bituminous material required for one batch shall be discharged in not more than 30 seconds. The Engineer will establish minimum mixing time of not less than 30 seconds.

When continuous mixing is used the bituminous material shall be added in an evenly spread sheet over the full width of the mixer at the charging end. The Engineer shall establish mixing time of not less than 30 seconds. The mixing time is a ratio of pounds (kilograms) of dead-load of the mixer to the pounds (kilograms) per second delivered. The dead-load shall be determined by weighing a mixer full of material. The pounds (kilograms) per second delivered shall be determined by timing and weighing a load of mixed material.

Temperatures of the several mixtures at the plant shall be maintained within the ranges set by the Engineer for the mix design. The temperature of the mixture on arrival at the project site shall be as determined by the Engineer in keeping with the temperature range set in 401.15 and 415.06.

401.10 Hauling. Trucks used for hauling bituminous mixtures shall have tight, clean, smooth metal beds which have been thinly coated with a minimum amount of approved material to prevent the mixture from adhering to the beds. Each truck shall have a securely fastened, waterproof

cover of suitable material to adequately protect the mixture from the weather. At the request of the Engineer covers shall be removed prior to dumping into the paver.

When hot mixtures are being transported at prevailing air temperatures below 50° F (10° C) or when the length of haul exceeds 20 miles (32 km), all truck beds shall be insulated to maintain workable temperature of the mixture, and all covers shall be fastened as to exclude all wind. The maximum distance mixtures may be transported from mixing plant to paving site shall not exceed 50 miles (80 km) except by specific permission of the Engineer.

401.11 Spreading Equipment. Spreading equipment shall be self contained and of sufficient size, power and stability to receive, distribute and strike-off the bituminous mixture at rates and widths commensurate with the typical sections and other details shown on the plans. The spreading equipment shall have automatic control systems which maintain the screed in a constant position relative to profile and cross-slope references. These references shall be such that control of the screed position is reasonably independent of irregularities in the underlying surface and of the spreader operation. Approval of spreading equipment by the Engineer will be based 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. Specialized equipment or hand methods approved by the Engineer may be employed to spread the bituminous mixture where the use of standard full scale spreading equipment is impractical due to the size or irregularity of the area to be paved.

401.12 Rollers. Rollers shall be of the standard steel wheel and pneumatic tire types meeting the minimum requirements of the following tables. All ballasting shall conform to manufacturer's specifications.

STEEL WHEEL ROLLERS

Three Roller Type	Wheel	Three-Axle Tandem	Tandem	Trench
Total weight, ton (metric ton)	10 (9)	8-12 (7-11)	12-20 (11-18)	
Compression rolls, pounds per inch (kN/m) width, min.	300 (53)	200 (35)	240 (42)	300 (53)
Capacity, S.Y. (m ²) per hour of mixture placed, max.	700 (600)*	700 (600)*	700 (600)*	15 per inch width (13 per 25 mm)*

PNEUMATIC TIRE ROLLERS

Roller Designation	P-1	P-2
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Tire size, minimum	9:00x20 (229x508 mm)	7:50x15 (191x381 mm)
Wheel load, minimum	5000 pounds (2250 kg)	2000 pounds (900 kg)
Average tire contact pressure, minimum	85 lbs. per sq. inch (590 kPa)	55 lbs. per sq. inch (380 kPa)

Capacity, S.Y. (m²) per hour
of mixture place, maximum 1000 (850)* 700 (600)*

* For reference purposes only the above square yard (m²) per hour convert to approximately the following tons (metric tons) per hour:

Placement

Thickness,

inches (mm) S.Y./HR. (m²/HR) TONS/HR (Metric Tons/HR)

Varies	15 (13 per 25 mm)	1± (0.9)
1-1/4 (32)	700 (600)	50± (45)
1-1/4 (32)	1000 (850)	70± (64)
1-1/2 (38)	700 (600)	60± (54)
1-1/2 (38)	1000 (850)	85± (77)

Pneumatic tire rollers shall be self-propelled, reversible units with vertical oscillation on all wheels on at least 1 axle. Tire inflation pressure shall be determined by the Contractor to meet the specified minimum contact area and contact pressure requirements. The Contractor shall furnish tire manufacturers' charts or tabulations for verification of the required inflation pressure by the Engineer. Tire inflation pressure shall be checked by the Contractor as directed by the Engineer and shall be maintained within 5 pounds per square inch (35 kPa) of the required pressure.

Rolls and wheels shall be provided with the necessary accessories to prevent adhesion of the mixture and shall be kept properly moistened with water or water containing a detergent or other approved additive. The use of excess liquid will not be permitted.

401.13 Conditioning Existing Surface. Immediately prior to the arrival of pavement mixtures, the base, leveling course or old pavement shall have been thoroughly cleaned of all soil, grass, dirt or other foreign materials. All unstable or fatty patches of surplus bituminous material shall be removed from the old pavement and replaced, where necessary, with suitable material, before spreading of any of the bituminous mixtures.

When the surface of the existing pavement is irregular, it shall be brought to uniform grade and cross section as directed using the material specified. Contact surfaces of curbing, gutters, manholes, and other structures shall be painted with a thin, uniform coating of approved bituminous material prior to the bituminous mixture being placed against them.

Where mixture is to be placed against the vertical face of rigid pavement, the vertical face shall be cleaned of foreign material and given an application of approved bituminous material in a manner which results in a coating of approximately 1/4 gallon per square yard. (1 L/m²)

401.14 Spreading and Finishing. The mixture shall be spread on an approved surface with bituminous pavers or spreaders in accordance with a weight to volume conversion at the rate of 4,000 pounds per cubic yard (2,370 kg/m³) for stone or gravel aggregate. The weight required to be placed per unit of area shall be calculated from plan lines and dimensions. Variable depth courses shall be placed as required on the plan or as directed by the Engineer.

Immediately after the mixture is spread, irregularities in grade and alignment shall be corrected by the addition or removal of mixture before compaction is started.

Any areas showing an excess or deficiency of bituminous material before or after compaction shall be removed and replaced.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading or finishing equipment impracticable, the mixture may be spread, raked, and luted by hand tools. For such areas the mixture shall be dumped, spread, and screened to give the required weight per unit of area.

401.15 Compaction. The bituminous mixture shall have a minimum temperature of 270° F (132° C) prior to placing in the paver. Immediately after the bituminous mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. Final rolling shall be completed before the pavement reaches a temperature of 180° F (82° C).

For all hot bituminous mixtures, the number and type of rollers shall be sufficient to compact the mixture at the hourly rate of spreading without exceeding the capacity of the rollers in operation established in 401.12. Base, intermediate and surface courses shall be compacted with a combination of both steel and Type I pneumatic tire rollers, except in small areas which may be compacted by a method approved by the Engineer. For surface courses, a 3 wheel roller shall be used for the initial rolling and a tandem roller for the final rolling. These rollers shall be supplemented by additional steel wheel rollers and/or by pneumatic tire rollers operating in the intermediate position. In small areas a single tandem roller may be used.

Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the centerline at a slow, uniform speed. After each coverage or complete round trip, the roller shall progress toward the crown of the road by overlapping the previous pass by at least one-half the width of the compression roll. On super-elevated curves, the rolling shall begin at the low side and progress toward the high side. In all cases where a longitudinal joint is being made, it shall be rolled first and then followed by the applicable rolling procedure.

Rolling shall be continued until full coverage of the course has been completed and all roller marks are eliminated. Care shall be taken to prevent displacement of the edge line and grade. Where displacement occurs, the area shall be corrected immediately in a manner satisfactory to the Engineer.

Along curbs, headers, walls and in other areas not accessible to rollers, the mixture shall be thoroughly compacted with hand tampers or with mechanical tampers. On depressed areas, trench rollers or rollers fitted with compression strips may be used.

Mixture that becomes loose, broken, contaminated or otherwise defective shall be replaced with fresh, hot mixture compacted to conform with the surrounding area.

401.151 In-Place Density Requirements. At the option of the City, in-place core samples of the compacted mix may be randomly selected to verify the actual degree of compaction being obtained. When Item 416 is specified, this density specification will be a requirement not an option.

Core samples will be correlated to Marshall pill specimens prepared by the laboratory at the production facility. Should the core samples fall below 96 percent of the Marshall specimens, the paving operations may be suspended until the mix and compaction procedures have been evaluated and corrective action has been taken to assure compliance with the 96 percent minimum requirement. The cores will be taken within 6 hours after commencement of daily placement operations and should work stoppage be necessary, the Contractor will be notified of test results prior to 5:00 p.m. of the day of placement.

The in-place density of the compacted mixture shall be a minimum of 96 percent of the average of 3 Marshall specimens prepared at the plant. Three field samples (cores) will be obtained by the Laboratory each 3,000 square yards (2,508 m²) of pavement. Locations will be randomly selected by the Engineer or Inspecting Authority. A minimum of one set of 3 Marshall specimens will be prepared for each days production. Marshall Pills will not be prepared until all other control tests have been completed, and indicates that the mix conforms to the specification requirements.

401.152 Pavement Thickness. The City reserves the right to determine the thickness of the asphalt street pavement by the measurement of cores as per 451.16. *All City streets composed of full depth asphalt or asphalt compacted on aggregate base, shall be verified for thickness.*

401.16 Joints. Placing of the bituminous paving shall be as continuous as possible. Longitudinal and transverse joints shall be made in a careful manner. Joints shall be "set up" at the proper height above the adjacent construction to receive maximum compaction. A well bonded and sealed joint is required; if necessary to achieve this result, the joint shall be painted with the bituminous material used in the mixture as directed by the Engineer. New joints shall be offset 6 inches (152 mm) from old joints.

401.17 Spreading and Surface Tolerances. When a uniform course is specified, the Contractor shall continuously maintain the weight-area placement within a tolerance of plus or minus 5 percent of the required calculated weight. The Engineer will make periodic checks and may direct changes found to be necessary.

When variable depth courses are specified, the Contractor shall place the mixture at rates in accordance with the intent of the plans or as directed by the Engineer.

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

The surface of each completed course shall not vary from the testing edge of a 10 foot (3.0 m) straightedge by more than the tolerance specified for the type under contract. The Contractor shall furnish straightedges and straightedges equipped with levels or other devices satisfactory to the Engineer and shall check the surface for conformance with requirements.

Portions of the completed pavement that are defective in surface, compression or composition shall be removed and replaced or otherwise corrected in a manner satisfactory to the Engineer.

401.18 Method of Measurement. The number of tons (metric tons) of asphalt concrete or bituminous aggregate base to be paid for under this item shall be the number of tons (metric tons) placed, completed and accepted according to plant batch weight or truck scale weight tickets. When uniform courses are specified, the number of tons (metric tons) to be paid for shall not exceed the quantity calculated from plan lines and dimensions.

401.19 Basis of Payment. All work performed and measured as prescribed above will be paid for as provided in the respective items for each type.

