**SECTION 401**

**PLANT MIX BITUMINOUS BASE AND PAVEMENT**

**401.1 Description.** This work shall consist of a bituminous mixture placed, spread and compacted as shown on the plans or as directed by the engineer.

**401.2 Material.** The grade of asphalt binder will be specified in the contract. All material shall be in accordance with [Division 1000](http://sharepoint/systemdelivery/CM/FieldOffice/Shared%20Documents/Text/Div1000.xhtml#toc_marker-1), Material Details, and specifically as follows:

|  |  |
| --- | --- |
| **Item** | **Section** |
| Bituminous Asphalt Mixes | 490 |
| Coarse Aggregate | [1004.2](http://sharepoint/systemdelivery/CM/FieldOffice/Shared%20Documents/Text/Sec1004.xhtml#S1004_2) |
| Fine Aggregate | [1002.3](http://sharepoint/systemdelivery/CM/FieldOffice/Shared%20Documents/Text/Sec1002.xhtml#S1002_3) |
| Mineral Filler | [1002.4](http://sharepoint/systemdelivery/CM/FieldOffice/Shared%20Documents/Text/Sec1002.xhtml#S1002_4) |
| Hydrated Lime | [1002.5](http://sharepoint/systemdelivery/CM/FieldOffice/Shared%20Documents/Text/Sec1002.xhtml#S1002_5) |
| Asphalt Binder, Asphalt Emulsion | [1015](http://sharepoint/systemdelivery/CM/FieldOffice/Shared%20Documents/Text/Sec1015.xhtml#S1015) |















**401.2.1 Job Mix Formula (JMF).**  At least 30 days prior to placing any mixture on the project, the contractor shall submit a mix design in accordance with Sec 490 for approval by Construction and Materials. Bituminous Base (BB) and Bituminous Pavement (BP-1, BP-2, or BP-3) mixtures as designated by the plans are used for Section 401 pay items.

**401.2.1.1 Mixture Approval.** No mixture will be accepted for use until the job mix formula for the project is approved by Construction and Materials. The job mix formula approved for each mixture shall be in effect until modified in writing by the engineer. When unsatisfactory results or other conditions occur, or should a source of material be changed, a new job mix formula may be required.

**401.2.1.2 Mixture Adjustments.**  In producing mixtures for the project, the plant shall be operated such that no intentional deviations from the job-mix formula are made except as follows. Aggregate only bin changes are allowable so long as the original gradation tolerances and non-carbonate requirements are met. Anytime the gradation tolerances are exceeded or there is a change to binder providing components, the contractor shall verify the mix still meets the Sec 490 requirements for recycle contribution, VMA and VFA with the adjusted Gsb, D/B ratio, and non-carbonate aggregates. The contractor shall provide a record of the time and tonnage of all mixture adjustments as well as all verification testing to the engineer.

**401.2.2 Substitutions.**  At the option of the contractor and at no cost to the Commission, the contractor may use a [Sec 401](#S401) mixture with a smaller nominal maximum size aggregate or an approved [Sec 403](http://sharepoint/systemdelivery/CM/FieldOffice/Shared Documents/Text/Sec403.xhtml) mixture, design level C, E, or F with the same or smaller nominal maximum size aggregate in lieu of any Sec 401 mixture.  When a [Sec 403](http://sharepoint/systemdelivery/CM/FieldOffice/Shared Documents/Text/Sec403.xhtml) mixture is substituted, all Sec 401 requirements including QC/QA requirements shall remain except the layer thickness requirements of [Sec 403](http://sharepoint/systemdelivery/CM/FieldOffice/Shared Documents/Text/Sec403.xhtml) shall apply.

**2.3**A mixture other than those approved following Sec. 490 may be used iasor for temporary construction that is to be maintained at the contractor's expense and removed prior to completion of the contract. The plant requirements of [Sec 404](http://sharepoint/systemdelivery/CM/FieldOffice/Shared Documents/Text/Sec404.xhtml" \l "S404) will not be required. A field laboratory will not be required. mixture shall be d, transported, and placed accordance with [Sec 401.5](#S401_7) to be , and .the contractor shall supply adetailing the components and proportions usedAcceptance of commercial mixture will be by visual inspection.











**401.2.4 Contamination.** The bituminous mixture shall not be contaminated with deleterious agents such as unburned fuel, objectionable fuel residue or any other material not inherent in the job mix formula.

**401.3 Mixing Plants and Hauling Equipment.** Bituminous mixing plants, trucks used for hauling bituminous mixtures, and preparation of material and mixtures shall be in accordance with [Sec 404](http://sharepoint/systemdelivery/CM/FieldOffice/Shared Documents/Text/Sec404.xhtml" \l "S404).

**401.4 Field Laboratory.** The contractor shall provide a Type 3 field laboratory in accordance with [Sec 601](http://sharepoint/systemdelivery/CM/FieldOffice/Shared%20Documents/Text/Sec601.xhtml#S601). The contractor shall furnish the bituminous mixture equipment to perform all required test methods for QC and QA work. A field laboratory shall not be required for small quantity work.

**401.5 Construction Requirements.**

**401.5.1** **Weather Limitations.** Bituminous mixtures shall not be placed on any wet surface or frozen pavement.

**401.5.2 Subgrade or Surface Preparation.** The subgrade upon which the bituminous mixture is to be placed shall be prepared in accordance with [Sec 209](http://sharepoint/systemdelivery/CM/FieldOffice/Shared%20Documents/Text/Sec209.xhtml#Sec209) and primed as specified in the contract in accordance with [Sec 408](http://sharepoint/systemdelivery/CM/FieldOffice/Shared%20Documents/Text/Sec408.xhtml#S408), as applicable. All material requirements of a tacked surface shall be in accordance with [Sec 407](http://sharepoint/systemdelivery/CM/FieldOffice/Shared%20Documents/Text/Sec407.xhtml#S407).

**401.5.2.1 Base Widening.**  For base widening work, the bottom of the trench shall be compacted until further consolidation is not visually evident, by use of a trench roller having a weight of no less than 300 psi of width of rear roller, or by mechanical tampers or other methods approved by the engineer. Suitable excavated material may be used in shouldering operations. On the outside of curves, the design depth of trench at the beginning of the superelevation transition shall be varied gradually to the minimum depth at the end of the superelevation transition. Slight transitioning of the width of the base widening will be necessary to permit the indicated angle of repose or shear angle outside of the ultimate edge of surface. The bottom of the trench shall in no case be less than 3 inches below the surface of the existing pavement. All surplus excavated material shall be disposed of by the contractor in areas to be secured by the contractor beyond the right of way limits. An acceptable written agreement with the property owner on whose property the material is placed shall be submitted to the engineer.

**401.5.2.2 Application of Prime or Tack.** Application of prime or tack shall be in accordance with [Sec 403.11.2](http://sharepoint/systemdelivery/CM/FieldOffice/Shared%20Documents/Text/Sec403.xhtml" \l "S403_12).

**401.5.3 Spreading.** The base course, tacked or primed surface, or preceding course or layer shall be cleaned of all dirt, packed soil or any other foreign matter prior to spreading the bituminous mixture. The mixture shall be spread in the number of layers and in the quantity required to obtain the compacted thickness and cross section shown on the plans. When placing multiple layers with varying thicknesses, the thicker layer shall be placed first. The compacted thickness of a single layer of bituminous pavement mixture shall be no more than 2 inches for the surface course and 4 inches for the leveling course.

**401.5.3.1 Segregation.** No segregation will be permitted in handling the mixture at the plant, from the truck or during spreading operations on the roadbed. Mixture production shall immediately cease if either criteria of MoDOT Test Method TM 75 fail. Segregated mixture shall be removed and replaced to the limits determined by the engineer.

**401.5.3.2 Leveling Course.** If required by the contract, a leveling course consisting of a layer of variable thickness shall be spread to the desired grade and cross section to eliminate irregularities in the existing surface.

**401.5.3.3 Base Widening.** The specified total thickness of base widening shall be completed to the adjacent traveled way elevation as shown on the plans. Additional thickness of base widening may be placed as required prior to coldmilling, at the contractor's expense, and shall subsequently be coldmilled to the same elevation as the traveled way, if conducive to expedite operations. On base-widening work, a succeeding layer of bituminous mixture may be placed the same day as the previous layer, if it can be shown that the desired results are being obtained. On small areas, and on areas that are inaccessible to mechanical spreading and finishing equipment, the mixture may be spread and finished by hand methods if permitted by the engineer. At least one lane of the existing pavement and the adjacent shoulder shall be kept open to traffic at all times during construction, except for short intervals when the movement of the contractor's equipment will seriously hinder the flow of traffic. Intervals during which the contractor will be allowed to halt traffic shall be as designated by the engineer. The contractor shall not open more trenches ahead of the first layer of the base widening than is necessary for placing that layer in one half a day's operations. The first layer of the base widening shall not be placed for a greater distance ahead of the second layer than is necessary for placing the second layer in one half a day's operations. The second layer shall not be placed for a greater distance ahead of the final layer than is necessary for placing the final layer in one day's operation. Any changes in these lengths shall be made only with written permission from the engineer.

**401.5.4 Defective Mixture.** Any mixture showing an excess of bituminous material or that becomes loose and broken, mixed with dirt, or is in any way defective, shall be removed and replaced with a satisfactory mixture, which shall be immediately compacted to conform to the surrounding area.

**401.5.5 Longitudinal Joints.**

**401.5.6 Transverse Joints.**

**401.5.7 Surfaced Approaches.** At locations designated in the contract or as specified by the engineer, approaches shall be primed or tacked in accordance with [Sec 408](http://sharepoint/systemdelivery/CM/FieldOffice/Shared%20Documents/Text/Sec408.xhtml#S408) and surfaced with a plant mix bituminous mixture. The bituminous surface shall be placed as shown on the plans or as directed by the engineer. Approaches shall not be surfaced before the surface course adjacent to the entrance is completed. No direct payment will be made for any work required to condition and prepare the subgrade on the approaches.

**401.5.8 Other Compaction.**  In lieu of density requirements, mixtures used for wedging, transitions, shoulders, temporary bypasses to be maintained at the expense of the contractor, and areas where a commercial mixture is used shall be thoroughly compacted by at least three complete coverage's over the entire area with either a pneumatic tire roller weighing no less than 10 tons, a tandem-type steel wheel roller weighing no less than 10 tons or an approved vibratory roller. Rolling shall be performed at proper time intervals on each layer and shall be continued until there is no visible evidence of further consolidation.

**5.9**

**401.5.10 Surface Smoothness.** The finish of the pavement surface shall be substantially free from waves or irregularities and shall be true to the established crown and grade. The pavement shall be thoroughly tested for smoothness by profiling or straightedging in accordance with [Sec 610](http://sharepoint/systemdelivery/CM/FieldOffice/Shared Documents/Text/Sec610.xhtml" \l "S610).

**401.5.11 Pavement Edge Treatment.**  For roadways constructed under traffic, pavement edge treatments as described in Standard Plan 619.10 shall be required. No pavement edge treatments shall be left in place for more than seven days, unless approved by the engineer.

**401.5.12 Coring.** The contractor shall restore the surface from which samples have been taken immediately with the mixture under production or with a cold patch mixture acceptable to the engineer.

**401.6 Quality Control.** The contractor shall control and monitor the quality of the work. Mixture suppliers shall have either a standard quality control plan on file with the Construction & Materials division for the applicable plant or be included in the contractor’s quality control plan.

**401.6.1 Retained Samples.** One half of the contractor’s sample for mixture gradation, aggregate deleterious content, and mixture asphalt content as well as all cores shall be retained for the engineer.  The contractor shall retain the samples for 7 days after testing has been completed and the results accepted by the engineer.

**401.6.2 Temperature of Air and Base.**  The contractor shall monitor the environmental conditions that affect asphalt production and laydown operations. Temperatures shall be obtained in accordance with MoDOT Test Method TM 20.

**401.6.3 Mixture Temperature.**  The contractor shall periodically record temperature of mix before it leaves the plant.

**6.4Mixture .**The gradations of the total aggregate will be determined from samples taken from the hot bins on batch-type plants or continuous mixing plants or from the composite cold feed belt on drum mix plants. Mixtures as produced shall be subject to the maximum variations from the approved JMF in the table below. If a gradation test falls between the Tolerance and Action Limits, mixture adjustments per Sec 401.2.1.2 shall be made and another gradation shall be taken immediately. Plant production for the following day shall not resume until the gradation tolerances are met or the mixture adjustment is successfully verified. If a gradation test falls outside the Action Limit, production shall cease until the mixture is brought back into specification.

|  |  |  |  |
| --- | --- | --- | --- |
| **Mix Type** |  |  | |
|  |  |
| BP-1, BP-2 |  |  |  |
| BP-3 | No 16 |
| All |  |  |  |

**401.6.5 Mixture Asphalt Content.** Samples for asphalt content determination may be taken at the plant. The quantity of asphalt binder determined by tests on the final mixture shall not vary by more than − 0.3 to + 0.5 percent from the job-mix formula. If an asphalt content test result falls outside of the specification tolerances, a review or mixture adjustment per Sec 401.2.1.2 shall be made and another sample shall be immediately taken. If the second test falls outside of the specification tolerances, production shall be immediately ceased until the mixture can be brought back into specification.

**401.6.6 Mixture Moisture Content.** The bituminous mixture, when sampled and tested in accordance with AASHTO T 329, shall contain no more than 0.5 percent moisture by weight of the mixture

**401.6.7 Moisture Susceptibility.**  TSR results shall be 70 percent or above. QC TSR testing shall be waived when independent QA deleterious and plasticity index tests compare favorably.

**401.6.8 RAP Gradation.**  The contractor shall test the residual aggregate from the RAP asphalt content testing to determine its gradation.

**401.6.9 RAP Asphalt Content.**  RAP shall be sampled from the RAP feeding system on the asphalt plant. Solvent extraction or binder ignition methods shall be used to determine RAP asphalt contents. If AASHTO T 308 is used to determine the asphalt content, the binder ignition oven shall be calibrated in accordance with MoDOT Test Method TM 77.

**401.6.10 RAP Durability.** All RAP material not from a MoDOT roadway shall be tested in accordance with AASHTO T 327, Method of Resistance of Coarse Aggregate Degradation by Abrasion in the Micro-Deval Apparatus. Samples of RAP for this test shall have the asphalt coating removed either by extraction or binder ignition. The percent loss of RAP shall not exceed the loss of the combined loss of the virgin material by more than five percent.

**401.6.11 Aggregate Deleterious.** The deleterious content of the total aggregate shall be determined from samples taken per Sec 401.6.3. The deleterious content of the material retained on the No. 4 sieve for the combined virgin aggregates shall not exceed the limits specified in [Sec 1004.2](http://sharepoint/systemdelivery/CM/FieldOffice/Shared Documents/Text/Sec1004.xhtml" \l "S1004_2). QC deleterious testing shall be waived when independent QA deleterious and plasticity index tests compare favorably.

**401.6.12 Aggregate Plasticity Index.**  All individual aggregate fractions shall be tested for plasticity. Samples for plasticity index shall be taken from the stockpile. The plasticity index shall be within two of the Job Mix Formula. QC plasticity index testing shall be waived when independent QA deleterious and plasticity index tests compare favorably.

**401.6.13 Surface Smoothness.** See Sec 610 for additional details.

**401.6.14 Lift Thickness.**  The thickness of the layer to be tested shall be measured on all density and joint cores.

**401.6.15 Pavement Density.**  The compacted mixture shall have a minimum density of 92 percent of the theoretical maximum specific gravity shown on the JMF. Density will be determined by the direct transmission nuclear method in accordance with MoDOT TM 41 or by a specific gravity method. Density of the pavement shall be determined by one core obtained by the contractor at each random location selected by the engineer.   Minimum 4-inch diameter cores, shall be taken the full depth of the layer to be tested.  Cores tested by AASHTO T 166 shall be in accordance with Sec 490.8.   When the contractor elects to place a lift of mixture greater than six times the nominal maximum aggregate size, cores shall be cut in half and the density of each half determined separately.

**401.6.16 Longitudinal Joint Density.**  Core sampling and testing shall be in accordance Sec 401.6.15 unless modified herein. The minimum density of all traveled way pavement within 8 inches of a longitudinal joint, shall be no less than 90%. One longitudinal joint density core shall be taken from the same transverse cross section as each pavement density core. The longitudinal joint density core shall alternate sides of the paved layer. The cores shall be centered 6 inches from the longitudinal joint.



**401.6.17 Segregation Limits.** Areas in question will be tested in accordance with MoDOT Test Method TM 75. QC shall ensure MoDOT has the opportunity to witness TM 75 being performed.

**401.6.18 Binder Quality.** The contractor shall ensure the binder is handled and stored in a manner that does not affect its quality. When the contractor is modifying the binder after delivery, additional quality control requirements apply. QC shall either assist QA in taking samples or obtain the QA sample directly in the inspector’s absence.

**401.7 Quality Assurance.**  The engineer or designated representative will be responsible for monitoring the work and quality control efforts of the contractor.

**401.7.1 Independent QA Samples.**  Unless otherwise stated, a favorable comparison shall be obtained when independent QA samples meet the same specification requirements as QC. A QA test for plasticity index will be performed by the engineer on an independent sample during the first day’s production and results furnished to the contractor within 24 hours of obtaining the sample. When the plasticity index on aggregate passing the No. 30 sieve exceeds 3, moisture susceptibility QA test will be required. The engineer may waive independent QA pavement density samples and instead utilize a existing QC core as a QA split sample.

**401.7.2 Split QA Samples.**  A favorable mixture gradation comparison shall be obtained when QA is within 5% of QC on all sieves and within 2% of QC on the #200 sieve. A favorable mixture asphalt content comparison shall be obtained when QA is within 0.5% of QC. A favorable comparison for deleterious content shall be obtained when QA is within one half of the requirements found in Sec 1004.2 of the QC results. If the results of a split sample do not compare, another split sample will be taken jointly and tested by both QC and QA.  If the second test results do not compare, production shall cease until the testing discrepancy is resolved.

**401.8 QC/QA Frequency Table.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tested Property** | **QC Frequency** | **QA Frequency** | | **QC Small Quantity Frequency** |
| **Independent Samples** | **Split Samples** |
| Temperature of Base and Air | As Needed | As Needed | - | As Needed |
| Mixture Temperature | 4 per Day | 1 per Project | 4 per Day |
| Mixture Gradation | 1 per 1000 Tons, Min of 1 per Day | 1 per 4 QC, Min 1 per Week | 1 per 5 Days | 1 per Project |
| Mixture Asphalt Content |
| Mixture Moisture | 1 per Week | 1 per Project | - | - |
| Moisture Susceptibility\* | 1 per Mix |
| RAP Gradation | 1 per 10000 Tons |
| RAP Asphalt Content |
| RAP Durability\* | 1 per 1500 Tons | - |
| Aggregate Deleterious | 1 per 5000 Tons | 1 per 4 QC | 1 per 5 Days |
| Aggregate Plasticity Index | 1 per Mix | 1 per Mix | - |
| Surface Smoothness | Per Section 610 | | | |
| Lift Thickness | 1 per 500 Tons | 1 per Week | - | - |
| Pavement Density |
| Longitudinal Joint Density\* | - |
| Segregation Limits | As Needed | As Needed | As Needed |
| Binder Quality | - | 1 per Day | - |

\* Testing of this property is conditional based on other specification requirements.

**401.9 Method of Measurement.** Measurement will be in accordance with [Sec 403](http://sharepoint/systemdelivery/CM/FieldOffice/Shared%20Documents/Text/Sec403.xhtml#S403).

**401.10 Basis of Payment.** The accepted quantities of plant mix bituminous pavement and base course will be paid for at the contract unit price for each of the pay items included in the contract. Payment for obtaining and delivering samples of compacted mixture from the base and replacement of the surface will be made per sample at the fixed contract unit price specified in [Sec 109](http://sharepoint/systemdelivery/CM/FieldOffice/Shared%20Documents/Text/Sec109.xhtml#S109). No direct payment will be made for QC testing, excavating the trench for base widening, or for hauling and disposing of excess excavation material.

**401.10.1 Density Adjustment.**  The contract unit price shall be adjusted by whichever is lower of the pavement density pay factor or the longitudinal joint density pay factor. Pay adjustments due to longitudinal joint density pay factor shall apply to the full width of the lane paved. When a core is cut in half due to lift thickness, the lower of the two densities results will be used to determine the pay factor. Pay factors in the table below shall be applied to material represented by each density sample.

|  |  |  |
| --- | --- | --- |
| **Pavement Density** | **Longitudinal Joint Density Pay Factor** | **Percent of Contract**  **Unit Price Pay Factor** |
| 91.5 or above | 89.5 or above | 100% |
| 91.0 to 91.4 | 89.0 to 89.4 | 97% |
| 90.5 to 90.9 | 88.5 to 88.9 | 94% |
| 90.0 to 90.4 | 88.0 to 88.4 | 90% |
| 89.5 to 89.9 | 87.5 to 87.9 | 80% |
| Below 89.5 | Below 87.5 | Remove and Replace |

**401.10.2 Surface Smoothness Adjustment.** Payment for mixture placed shall be adjusted per Sec 610 when applicable.