

SECTION 401**PLANTMIX BITUMINOUS PAVEMENTS – GENERAL**

DESCRIPTION

401.01.01 GENERAL

- A. These specifications include general requirements that are applicable to all types of bituminous pavements of the plantmix type irrespective of gradation of aggregate, kind, and amount of bituminous material, or pavement use. Deviations from these general requirements will be indicated in the specific requirements for each type.
- B. This work shall consist of one 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 conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.
- C. The testing and inspection of the asphalt concrete shall comply with this specification. In Clark County unincorporated areas and if required by other Contracting Agencies, all field and laboratory sampling and testing for project control shall be performed by NAQTC certified technicians in an AASHTO Materials Reference Laboratory (AMRL) or Construction Materials Engineering Council (CMEC) R-18 AASHTO accredited laboratory. The accreditation shall extend to the test method used on the particular project. The accreditation shall include ASTM D3666.

401.01.02 PAVEMENT STRUCTURAL DESIGN

- A. All public pavement sections shall be designed in accordance with the 1993 AASHTO Guide for Design of Pavement Structures. The following parameters, based upon the AASHTO Guide and the 1996 Nevada Department of Transportation Pavement Structural Design and Policy Manual, shall be used in the design calculations. Parameters which are specific to a road classification are identified by the right-of-way dimension. The design shall be stamped and signed by a professional engineer registered in the state of Nevada.
 - 1. The reliability factor will be a minimum of 80 percent with a standard normal deviate (ZR) of -0.841 for 51-foot, 60-foot, and 80-foot rights-of-way, and a minimum 90 percent with a standard normal deviate (ZR) of -1.282 for 100-foot rights-of-way.
 - 2. The standard deviation will be 0.45 for all classifications.
 - 3. The initial service index will be 4.2 and the final service index 2.5 for all classifications.
 - 4. Drainage coefficients shall not exceed 1.0.
 - 5. The structural coefficient for asphalt will be 0.35.
 - 6. For materials meeting **Subsection 704.03.04, "Type II Aggregate Base,"** the elastic modulus shall be 25,000 psi and the structural coefficient shall be 0.12.
 - 7. For materials meeting **Subsection 704.03.03, "Type I Aggregate Base,"** the elastic modulus shall be 15,000 psi and the structural coefficient shall be 0.11.
 - 8. Prior to design, soil testing will be performed in accordance with ASTM D2844 or AASHTO T190 to determine a representative Resistance (R) value for the prepared subgrade. The subgrade shall be prepared in accordance with the Geotechnical Soils Investigation Report, and soil sampling performed subsequent to rough

grading to confirm the original results. An average of the R-values may be used if the soil classification results are consistent, or if the values do not differ by more than 10. The minimum testing requirements are 1 right-of-way R-value test and post grading soil classifications every 1,000 linear feet of roadway, with a minimum of 2 classifications per project.

9. The subgrade R-value (psi) shall be converted to a Resilient Modulus (MR, psi) using the following correlation: $MR=145*(10^{(0.0147*R)+1.23})$.
 10. The minimum AC sections are 2.0 inches for a residential street, 3.0 inches for a minor collector, 4.0 inches for a major collector, and 4.0 inches for an arterial street.
 11. All designs require a minimum of 4 inches Type II aggregate base material.
 12. The subgrade shall be scarified and recompacted to a minimum of 95 percent, to minimum depth of 8 inches.
 13. Expansive soils may require additional design compensation. If native soils classify as either an AASHTO A-6 or A-7 (more than 36 percent passing the #200 sieve and a PI equal to or greater than 11), the design may include stabilization, over-excavation, or utilization of a geomembrane, as recommended by the geotechnical engineer.
 14. Hydro-collapsible soils, or the presence of soluble materials, may require additional design compensation, as recommended by the geotechnical engineer.
- B. The minimum design equivalent axial loads (EAL) based on a 20-year design are 7.2E+3 for a residential street, 3.3E+4 for a minor collector, 3.7E+5 for a major collector, and 1.0E+6 for an arterial street. Locations with heavier than normal traffic shall be designed accordingly. A traffic study may be required for roads with a projected TI greater than 9.5. If required by the Contracting Agency, actual vehicle count data and assigned axle factors shall be used in the design of the pavement section. Definition of the roadway classifications, for design purposes, are listed below:
1. Residential roadways are those that provide access for residential areas only: Most 51-foot right-of-way roads are residential. The normal design TI is 5.0. A Residential road is considered to have heavy traffic, and a TI of 5.5, if minor amounts of thru-traffic use the road or bus traffic is encountered due to an adjacent school. Category II mix designs shall be used on residential streets.
 2. Minor Collector roadways are those that collect residential traffic or service limited commercial facilities: Most 60-foot and some 51-foot right-of-way roads fit this classification. The normal design TI is 6.0. A Minor Collector is assumed to have heavy traffic and a TI of 6.5 if there is substantial commercial truck traffic or bus traffic due to an adjacent school.
 3. Major Collector roadways are those that serve as destination roadways or service normal commercial or light industrial facilities: Most 80-foot, and some 60-foot, right-of-way roads fit this classification. The normal design TI is 8.0. A Major Collector is assumed to have heavy traffic, and a TI of 8.5, if there is substantial commercial or industrial truck traffic.
 4. Arterial roadways are those that provide primary traffic routes or service heavy industrial facilities: All 100-foot, and some 80-foot and 60-foot, right-of-way roads fit this classification. The normal design TI is 9.5. An arterial may have light traffic, if there is a disruption or decrease in the road capacity, in which case the design TI is 9.0. An Arterial is assumed to have heavy traffic if it is at full capacity with substantial truck traffic, or if there is heavy industrial traffic. A traffic study is recommended in those situations.

MATERIALS

401.02.01 COMPOSITION OF MIXTURES

- A. The bituminous plantmix shall be composed of a mixture of aggregate, mineral filler if required, and bituminous material. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that the resulting mixture meets the grading requirements of the job-mix formula.
- B. Before starting work, the Contractor shall submit a proposed job-mix formula in writing, for use by the Engineer in setting the job-mix formula to be used.
 - 1. The proposed job-mix formula shall be determined by a testing laboratory under the direction and control of a registered professional engineer, based on tests performed in accordance with the "Marshall Method of Mix Design" as described in the Asphalt Institute Manual Series No. 2 (MS-2), latest edition.
 - 2. The number of compaction blows to be applied to the specimens will be based on the appropriate traffic category.
 - 3. Traffic Category I will use a 75-blow design and will apply to all arterial streets and wherever "heavy" traffic is expected.
 - 4. Traffic Category II will use a 50-blow design and will apply to collector and local streets.
 - 5. Unless otherwise specified, voids determinations and effective asphalt contents will be determined and reported in accordance with procedures described herein.
- C. The job-mix formula shall be selected in accordance with the following procedures:
 - 1. Determine asphalt content required for 4 percent air voids, and
 - 2. Determine the average asphalt content for:
 - a. Maximum density.
 - b. Maximum stability.
 - c. 4 percent air voids.
 - 3. The lower of the asphalt contents obtained for a. or b. above will be used as the design asphalt content for the job-mix formula.
- D. The job-mix formula asphalt content shall satisfy all Marshall design criteria as shown in the following table:

MARSHALL DESIGN CRITERIA

TRAFFIC CATEGORY*	I TRAFFIC INDEX (TI) ≥ 7.0		II TRAFFIC INDEX (TI) < 7.0	
	75		50	
Compaction Blows Each End of Specimen	75		50	
Test Property	Min.	Max.	Min.	Max.
Stability, Lb.	1800	--	1500	--
Flow, 0.01 In.	8	14	8	16
Percent Total Air Voids	3	5	3	5

MARSHALL DESIGN CRITERIA

TRAFFIC CATEGORY*	I TRAFFIC INDEX (TI) ≥ 7.0		II TRAFFIC INDEX (TI) < 7.0	
	Compaction Blows Each End of Specimen	75		50
Test Property	Min.	Max.	Min.	Max.
Percent Voids Filled With Asphalt	65	75	65	78
Minimum Voids In Mineral Aggregate - Percent	See Table In Asphalt Institute MS-2 Manual			
* Traffic Category I - Applies to arterials and major collectors. See roadway classification in Subsection 401.01.02, "Pavement Structural Design." Traffic Category II - Applies to minor collectors and residential streets. See roadway classification in Subsection 401.01.02, "Pavement Structural Design."				

- E. In addition to the Marshall Design Criteria set forth herein, the job-mix formula shall also meet the following tensile strength requirements for all traffic categories:

TEST PROPERTY	TEST METHOD	REQUIREMENTS
Indirect Tensile Strength (Unconditioned)	AASHTO T283	65 psi minimum (50 psi minimum with AC-10 asphalt)
Indirect Tensile Strength (Retained Strength)	AASHTO T283	70 percent minimum

- F. Should the job-mix formula fail to meet the tensile strength requirements, the Contractor shall add hydrated lime (hereinafter referred to as mineral filler) to the plantmix bituminous aggregates as specified in **Subsection 401.03.08, "Preparation of Aggregates."** If the addition of mineral filler fails to achieve the minimum tensile strengths, the Contractor will be required to change sources of material, and submit a new job-mix formula that will satisfy all design criteria.
- G. The test report shall show the curves and data tabulations used to determine the following characteristics:
1. Unit weight per cubic foot.
 2. Percentage of air voids.
 3. Percent voids filled with asphalt.
 4. Marshall stability.
 5. Percent voids in mineral aggregate (VMA).
 6. Marshall flow.
 7. Indirect tensile strength (Unconditioned and Retained strength).
- H. Data tabulations shall include indications of the water absorption, aggregate bulk specific gravities for both coarse (retained on No. 8 sieve) and fine (passing No. 8 sieve) aggregate, theoretical specific gravity of bituminous mixture, absorbed asphalt, and effective asphalt content as determined in accordance with referenced Asphalt Institute procedures. ASTM D2041 will be used for determination of theoretical maximum specific gravity of bituminous paving mixtures.
- I. The test report shall give the recommended asphalt content and the values for:
1. Unit weight per cubic foot (bulk density).

2. Stability.
 3. Flow.
 4. Air voids.
 5. Voids filled with asphalt.
 6. Voids in mineral aggregate (VMA).
 7. Indirect tensile strength (Unconditioned and Retained strength).
- J. The formula submitted shall propose definite single values for:
1. The percentage of aggregate passing each specified sieve.
 2. The percentage of bitumen to be added (to 0.1 percent) based on weight of total mix.
 3. The percentage of mineral filler to be added to the aggregate.
 4. The temperature of the mixture leaving the mixer.
 5. The temperature of the mixture in the hopper of the paving machine.
- K. The job-mix formula aggregate with the allowable tolerances herein shall conform to **Section 705, "Aggregates for Bituminous Courses,"** for plantmix bituminous base aggregates, plantmix bituminous surface aggregate, or plantmix bituminous open-graded aggregate, as applicable.
- L. The Engineer will determine a job-mix formula with single values for **Subsection 401.02.01.J, "Composition of Mixtures,"** paragraphs 1 through 5 above, and so notify the Contractor in writing. This job-mix formula shall not be modified except with the written approval of the Engineer. The mix furnished shall conform to this job-mix formula, within the following range of tolerances:
1. Aggregate passing the No. 4 and larger sieves: ± 7 percent
 2. Aggregate passing the No. 8 to No. 100 sieves: ± 4 percent
 3. Aggregate passing the No. 200 sieve: ± 2 percent, but not to exceed upper limit of specification. Mineral filler is not considered as part of the aggregate.
 4. Bitumen content: ± 0.3 percent
 5. Temperature leaving the mixer: ± 20 degrees F
 6. Temperature in hopper of paving machine: ± 20 degrees F
- M. Should there be a change in sources of materials, a new job-mix formula shall be established before the new material is used. Check tests of properties of the plantmix bituminous materials shall be made on the first day of production and as requested by the Engineer during period of construction to confirm that all properties are in compliance with Marshall Design Criteria and tensile strength requirements. Adjustments in gradation, mineral filler content, and asphalt content shall be made as necessary to meet design criteria.
- N. The temperature of the bituminous material just prior to mixing and of the completed mixture in the hauling vehicle just prior to leaving the plant shall conform to the following table:

PLANTMIX BITUMINOUS MIXTURE WITH ASPHALT CEMENT

Grade of Asphalt Cement	Bituminous Material		Plantmix Bituminous Base of Surface Mixtures		Plantmix Bituminous Open-Graded Mixtures	
	Min.	Max.	Min.	Max.	Min.	Max.
PG76-22CC, PG70-22CC, PG64-34CC	275°F	350°F	275°F	350°F	--	--
AC-40	275°F	350°F	255°F	350°F	245°F	275°F
AC-20, AC-30	265°F	330°F	245°F	325°F	245°F	275°F
AC-10	255°F	325°F	235°F	325°F	--	--
AC-20P	280°F	350°F	300°F	350°F	300°F	350°F

401.02.02 AGGREGATES

- A. Aggregates shall comply with **Section 705, "Aggregates for Bituminous Courses."**

401.02.03 COMMERCIAL MINERAL FILLER

- A. Commercial mineral filler shall comply with **Subsection 705.03.04, "Commercial Mineral Filler."**

401.02.04 BITUMINOUS MATERIALS

- A. The bituminous material shall comply with **Section 703, "Bituminous Materials."** Bituminous material may be conditionally accepted at the source.
- B. Unless otherwise specified in the Special Provisions for Category I pavements, the grade of bituminous material for dense-graded mixes shall be PG70-22 asphalt cement, except in the City of Las Vegas, City of Henderson, and the Clark County unincorporated areas, where PG76-22CC and PG64-34CC materials shall be used according to Table 1 of **Section 703 "Bituminous Materials."** PG70-10 may be used in Laughlin. The grade may be changed one step by the Engineer.
- C. Unless otherwise specified in the Special Provisions, for Category II pavements the grade of bituminous material for dense-graded mixes shall be PG70-22 asphalt cement, except in the Clark County unincorporated areas, where PG76-22CC and PG64-34CC materials shall be used according to Table 1 of **Section 703, "Bituminous Materials."** PG70-10 may be used in Laughlin. The grade may be changed one step by the Engineer.
- D. Certificates of Compliance for the asphalt, showing test values necessary for specification compliance, shall be made available upon request by the Engineer.

401.02.05 FIELD COMPACTION AND MIX DESIGN CORRELATION

- A. Type 2 coarse mix design annual submittals only.
- B. In an effort to establish the "point of refusal," if it has been determined that the in-place air voids are less than 6 percent or more than 8 percent, the mix design bitumen content shall be adjusted. This procedure will be required as a part of all new mix designs, and any field adjustment shall be noted.
- C. The field compaction shall be as required in **Section 401.03.11, "Rolling and Compaction."**

1. The in-place air voids, as based on the Maximum Theoretical Specific Gravity and 10 correlated nuclear tests or 5 cores, shall then be calculated.
 2. If the mean percent air voids is outside the limits noted above, the bitumen content shall be mathematically increased or reduced and noted on the mix design submittal. If adjustment is made, then a new control strip is required.
 3. Once the control strip meets the above requirements, it becomes the control strip for subsequent mix placements.
- D. Subsequent compaction testing lots shall be tested in accordance with **Section [401.03.12](#), "Acceptance Sampling and Testing of Bituminous Mixture."** If the compaction cannot be maintained between the above limits, a new control strip shall be implemented to re-establish the mean density for testing.

CONSTRUCTION

401.03.01 BITUMINOUS MIXING PLANT

- A. Sufficient storage space shall be provided for the aggregate, or for each size aggregate when required. The storage yard shall be maintained neat and orderly and the stockpile, or separate stockpiles when required, shall be readily accessible for sampling.
- B. Mixing plants shall be of sufficient capacity and coordinated to adequately handle the proposed bituminous construction.
- C. **Mixing Plants.** Plants used for the preparation of bituminous mixtures shall conform to the following requirements:
 1. Equipment for Preparation of Bituminous Material:
 - a. Tanks for the storage of bituminous material shall be equipped to heat and hold the material at the required temperatures.
 - b. The heating shall be accomplished by steam coils, electricity, or other approved means so that no flame shall be in contact with the tank or contents.
 - c. The circulating system for the bituminous material shall be designed to ensure proper and continuous circulation during the operating period.
 - d. Provisions shall be made for measuring and sampling storage tanks.
 2. Drier: The plant shall include a drier or driers which continuously agitate the aggregate during the heating and drying process.
 3. Thermometric Equipment:
 - a. An armored thermometer of adequate range in temperature reading shall be fixed in the bituminous feed line at a suitable location near the charging valve at the mixer unit.
 - b. The plant shall be equipped with either an approved dial-scale, mercury-actuated thermometer, an electric pyrometer, or other approved thermometric instrument so placed at the discharge chute of the drier as to register automatically or indicate the temperature of the heated aggregate.
 - c. The Engineer may require replacement of any thermometer by an approved temperature-recording apparatus for better regulation of the temperature of aggregates.

4. Smoke and Dust Control: The Contractor will be required to install satisfactory precipitation devices, or use other methods which will meet local conditions, city and county regulations as set forth by the Clark County Air Pollution Control Officer, and state laws pertinent to air pollution.
 5. Truck Scales:
 - a. Except as allowed in **Subsection 401.04.01, "Measurement,"** bituminous mixture shall be weighed on approved scales furnished by the Contractor or on public scales at no cost to the Contracting Agency.
 - b. Such scales shall be platform scales and conform to the provisions of **Subsection 109.01, "Measurement of Quantities."**
 6. Safety Requirements:
 - a. Adequate and safe stairways to the mixer platform and sampling points shall be provided and guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required.
 - b. Accessibility to the top of truck bodies shall be provided by a platform or other suitable device to enable the Engineer to obtain sampling and mixture temperature data.
 - c. A hoist or pulley system shall be provided to raise scale calibration equipment, sampling equipment, and other similar equipment from the ground to the mixer platform and return.
 - d. All gates, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly guarded and protected.
 - e. Ample and unobstructed passage shall be maintained at all times in and around the truck loading area.
 - f. This area shall be kept from drippings from the mixing platform.
- D. **Batching Plants.** Batch mixing plants shall conform to the following requirements:
1. Plant Scales:
 - a. Scales shall be accurate to 0.5 percent of the minimum load that may be required. Poises shall be designed to be locked in any position to prevent unauthorized change of position.
 - b. Scales shall be as described in **Subsection 109.01, "Measurement of Quantities."** In lieu of truck scales, the Contractor may provide an approved automatic printer system which will print the weights of the material delivered, provided the system is used in conjunction with an approved automatic batching control system. Such weights shall be evidenced by a weight ticket for each load.
 - c. The amount of filler material shall be determined by weighing on springless dial scales separate from the plant weigh hopper or by some method that uniformly feeds the mixer within 10 percent of the required amount.
 2. Feeder for Drier: The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the drier so that uniform production and uniform temperature will be obtained.

3. Screens: Plant screens capable of screening the aggregate to the specified sizes will be required.
4. Bins:
 - a. The plant shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity.
 - b. Bins shall be arranged to ensure separate and adequate storage of appropriate fractions of the mineral aggregates.
 - c. Separate dry storage shall be provided for mineral filler when used and the plant shall be equipped to feed such material into the mixer.
 - d. Each bin shall be provided with overflow pipes, of such size and at such locations as to prevent backing up of material into other compartments or bins.
 - 1) Each compartment shall be provided with its individual outlet gate constructed so that when closed there shall be no leakage.
 - 2) The gates shall cut off quickly and completely.
 - 3) Bins shall be so constructed that samples representative of the entire material in the bin can be readily obtained.
5. Weigh Box or Hopper:
 - a. All materials shall be proportioned by weight.
 - b. Aggregate scales shall be one of the following:
 - 1) Multiple beam scale.
 - 2) Springless dial type scale.
 - 3) Fully automatic solid-state digital strain gauge transducer measuring device.
 - c. Aggregate scales shall have a capacity exceeding 1-1/4 times the total amount of materials to be weighed in one operation. Each scale gradation shall be approximately 1/1000 of the total capacity of the scale.
 - d. All scales used for proportioning materials shall be accurate to within 1 percent.
 - 1) The scales shall be sealed and certified by the State Sealer of Weights and Measures.
 - 2) Certifications shall be dated within the past 12 months and shall be renewed whenever required by the Engineer.
 - 3) If the plant is moved, a new certificate will be required.
 - e. All scales shall be of such size and so arranged that they may be read easily from the operator's platform.
 - 1) The scales shall indicate the true net weight without the application of any factor.
 - 2) The dials of scales shall not be less than 12 inches in diameter.
 - 3) The figures on the scale dials shall be clearly legible.

- f. Weighing equipment shall be so insulated against the vibration or movement of other operating equipment in the plant that the error in weighing with the entire plant running will not exceed 1-1/2 percent for any batch.
6. Bituminous Control Unit: Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of bituminous material in the mix within the tolerance specified. Means shall be provided for checking the quantity or rate of flow of bituminous material into the mixer.
 7. Bituminous Control:
 - a. The equipment used to measure the bituminous material shall be accurate to plus or minus 0.5 percent.
 - 1) The bituminous material bucket shall be a non-tilting type with a loose sheet metal cover.
 - 2) The length of the discharge opening or spray bar shall be not less than three-fourths the length of the mixer and it shall discharge directly into the mixer.
 - 3) The bituminous material bucket, its discharge valve or valves, and spray bar shall be adequately heated.
 - 4) Steam jackets, if used, shall be efficiently drained and all connections shall be so constructed that they will not interfere with the efficient operation of the bituminous scales.
 - 5) The capacity of the bituminous material bucket shall be at least 15 percent in excess of the weight of bituminous material required in any batch.
 - 6) The plant shall have an adequately heated quick-acting, non-drip, charging valve located directly over the bituminous material bucket.
 - b. Bituminous material shall be measured by means of springless dial scales or metering devices. Springless dial scales shall have a capacity of not more than 1,000 pounds in 2-pound gradations.
 - 1) The indicator dial shall have a capacity of at least 15 percent in excess of the quantity of bituminous material used in a batch.
 - 2) The controls shall be constructed so that they may be locked at any dial setting and will automatically reset to that reading after the addition of bituminous material to each batch.
 - 3) The dial shall be in full view of the mixer operator.
 - c. The flow of bituminous material shall be automatically controlled so that it will begin when the dry mixing period is over.
 - 1) All of the bituminous material required for one batch shall be discharged in not more than 15 seconds after the flow has started.
 - 2) The size and spacing of the spray bar openings shall provide a uniform application of bituminous material the full length of the mixer.
 - 3) The section of the bituminous line between the charging valve and the spray bar shall be provided with a valve and outlet for checking the

accuracy of the meter when a metering device is substituted for a bituminous material bucket.

8. Mixer:
 - a. The batch mixer shall be of a twin pugmill type, steam jacketed, or heated by other approved means and capable of producing uniform mixtures within the specified tolerances.
 - b. It shall be equipped with a sufficient number of paddles or blades set in proper order and operated at such speed as to produce a properly and uniformly mixed batch.
 - c. At the beginning of the mixing operation, the clearance between paddle tips and liner shall not exceed half the maximum aggregate diameter for the specified job mix.
 - d. The clearance of the paddles or blades from all fixed and moving parts shall not exceed 1 inch.
 - e. Badly worn or defective paddles or blades shall not be used in mixing operations.
 9. Control of Mixing Time:
 - a. The mixer shall be equipped with an accurate time lock to control the operations of a complete mixing cycle.
 - 1) It shall lock the weigh box gate after the charging of the mixer until the closing of the mixer gate at the completion of the cycle.
 - 2) It shall lock the mixer gates throughout the dry and wet mixing periods.
 - 3) The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the start of introduction of bituminous material.
 - 4) The wet mixing period is the interval of time between the start of introduction of bituminous material and the opening of the mixer gate.
 - b. The mixer shall be equipped with a timing device which will indicate by a definite audible or visual signal the expiration of the mixing period.
 - 1) The device shall measure the time of mixing within an accuracy of 2 seconds.
 - 2) A suitable automatic device for counting the number of completely mixed batches shall be provided and maintained in proper working condition.
 - c. When the aggregate and the bituminous material have been combined, the entire mass shall be mixed in an approved mixer.
 - 1) The mixing shall continue until homogeneity and a uniform coating are achieved.
 - 2) The output rate shall not exceed the manufacturer's capacity rating.
- E. **Drier Drum Mixing Plants.** Drier drum mixing plants shall conform to the following requirements:

1. Aggregate Stockpiles: Comply with **Subsection [401.03.08](#)**, “**Preparation of Aggregates**” paragraphs A through C.
2. Aggregate Proportioning:
 - a. The plant shall include a means for accurately proportioning each bin size of aggregate prior to the drying operation.
 - b. The plant shall have a mechanical feeder mounted under each compartment bin.
 - 1) Each compartment bin shall have an accurately controlled individual gate for volumetrically measuring the material drawn from each compartment.
 - 2) The feeding orifice shall be rectangular with one dimension adjustable by positive means.
 - 3) Indicators shall be provided for each gate to show the respective gate opening in inches.
 - c. A meter for determining the rate of each feeder, or a revolution counter, shall be provided. Commercial filler material introduced into the mixer shall be drawn from storage bins by a continuous mechanical feeder which will uniformly feed the mixer within 10 percent of the required amount.
3. Weight Calibration of Aggregate: The plant shall include a means for calibration for each aggregate feeder by weighing test samples.
4. Bituminous Metering Device: The bituminous material shall be introduced into the mixer through a gallonage meter by a positive displacement metering device, equipped with a ready means of varying the bituminous material delivery rate.
5. Synchronization of Aggregate Feed and Bituminous Material Feed:
 - a. Satisfactory means shall be provided to afford a positive interlocking control between the flow of aggregate from each feeder and the flow of bituminous material.
 - b. The interlocking control shall indicate a visible or audible signal when the level of material in any one feeder approaches the strike off capacity of the feed gate, or shut the plant down.
6. Mixer:
 - a. The plant shall include a mixing device which will obtain homogeneity and a uniform coating.
 - b. The mixing output shall not exceed the manufacturer's capacity rating.
 - c. The moisture content of the bituminous mixture shall not exceed 3 percent at the discharge end of the dryer.
7. Surge Bins: The plant will be equipped with an approved surge bin at the discharge. This surge bin will be in excess of 20 tons, and shall be equipped with an approved surge batcher or other approved method satisfactory to the Engineer that will prevent segregation of the bituminous mixture as it is being discharged into the hauling vehicle.

401.03.02 HAULING EQUIPMENT

- A. Trucks used for hauling bituminous mixtures shall have tight, clean, smooth beds which have been thinly coated with a minimum amount of paraffin oil, lime solution, or other approved material to prevent the mixture from adhering to the beds.

401.03.03 PAVERS

- A. Bituminous pavers shall be self-contained, self-propelled units provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading the finishing courses of bituminous plantmix material in lane widths applicable to the specified typical section and thicknesses shown on the plans.
- B. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of bituminous plantmix material in widths shown on the plans.
- C. The asphalt paver shall operate independently of the vehicle being unloaded and shall be capable of propelling the vehicle being unloaded in a satisfactory manner.
 - 1. If necessary, the load of the haul vehicle shall be limited to that which will ensure satisfactory spreading.
 - 2. While being unloaded, the haul vehicle shall be in contact with the machine at all times, and the brakes on the haul vehicle shall not be depended upon to maintain contact between the vehicle and the machine.
- D. Pavers shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed.
- E. The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.
- F. Pavers shall be capable of placing the bituminous mixture to meet the surface tolerances specified under the respective sections of bituminous pavement.

401.03.04 ROLLERS

- A. Rollers shall be vibratory, steel-wheeled or pneumatic-tired type, in good condition.
 - 1. Rollers shall be capable of reversing without backlash and operating at slow speeds to avoid displacement of the bituminous mixture.
 - 2. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density without detrimentally affecting the completed material as determined by the Engineer.
 - 3. Comply with **Subsection [401.03.11](#), "Rolling and Compaction."**
- B. Rollers for the test strip shall meet the following requirements:
 - 1. Breakdown rollers shall be either a 3-wheeled steel roller or a 2-axle tandem or a 3-axle tandem weighing not less than 10 tons.
 - 2. Except as hereinafter permitted, pneumatic-tired rollers shall comply with the following:
 - a. Rollers shall consist of not less than 9 wheels equipped with pneumatic tires of equal size and diameter.

- b. Tires shall be mounted on 2 axles attached to a rigid frame, equipped with a loading platform or body suitable for ballast loading, so that the total weight of the roller can be varied to produce an operating weight per tire of between 1,000 and 2,000 pounds.
 - c. The tires shall have treads satisfactory to the Engineer.
 - d. The tires on the rear axle shall be so spaced that the entire gap between adjacent tires on the front axle will be covered by 1 tread of the following tires.
 - e. The tires shall be uniformly inflated so that the air pressure in the several tires will not vary more than 5 pounds per square inch. Inflation pressure in pounds per square inch shall be the tire manufacturer's recommendation.
 - f. Minimum tire size shall be 7.50 x 15 inches, 4 ply.
3. The use of pneumatic-tired rollers with fewer wheels and a greater maximum operating weight per tire than that specified herein will be permitted subject to the following requirements:
 - a. The minimum width between the outer edge of the outside tires on a given axle shall be 60 inches.
 - b. The weight of the roller and the tire pressure can be varied to produce a ground contact pressure between 50 and 70 psi.
 4. The finish roller shall be a 2-axle tandem weighing not less than 8 tons.

401.03.05 WEATHER LIMITATIONS

- A. The bituminous mixture shall not be placed upon any wet surface or when the surface temperatures of the underlying course is less than specified in Table 1. The temperature requirements may be modified, but only when so directed by the Engineer.

TABLE 1 - BASE TEMPERATURE LIMITATIONS

Mat Thickness	Base Temperature (Minimum °F)
3 Inches or Greater	40
Greater than 1 Inch but Less than 3 Inches	45
1 Inch or Less	50

401.03.06 PREPARATION OF EXISTING SURFACE

- A. When the surface of the existing pavement or old base is irregular, it shall be brought to a uniform grade and cross section as shown on the plans.
- B. The subgrade to receive asphalt concrete, or asphalt concrete base immediately prior to applying prime coat, shall conform to the compaction and elevation tolerance specified for the material involved and shall be free of loose or extraneous material.
- C. If the plantmix bituminous surface is being constructed directly upon an existing hard-surfaced pavement, a tack coat emulsified asphalt, diluted 50/50 at an approximate rate of 0.05 to 0.10 gallons per square yard, shall be uniformly applied upon the existing pavement preceding the placement of the asphalt concrete. Comply with **Section 405, "Tack Coat."**

1. The surface shall be free of water, foreign material, or dust when the tack coat is applied.
 2. To minimize public inconvenience, no greater area shall be treated in any one day than is planned to be covered by plantmix during the same day, unless otherwise authorized by the Engineer.
- D. A similar tack coat shall be applied to the surface of any previous course even if the course is placed the same day. Also, if as determined by the Engineer, the surface is such that a satisfactory bond cannot be obtained between it and a succeeding course.
- E. The contact surfaces of all cold pavement joints, curbs, gutters, manholes, and similar structures shall be painted with emulsified asphalt immediately before the new asphalt concrete is placed. Comply with **Section 405, "Tack Coat."**
- F. When specified in the contract, longitudinal and transverse joints and cracks shall be sealed by the application of an approved joint sealing compound before spreading the mixture upon a Portland cement concrete surface. Excess bituminous material shall be removed from joints and cracks prior to spreading the mixture.

401.03.07 PREPARATION OF BITUMINOUS MATERIALS

- A. The bituminous material shall be heated to the specified temperature in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature at all times.

401.03.08 PREPARATION OF AGGREGATES

- A. Aggregates proportioned prior to the heating and drying process shall be separated into at least two general sizes:
1. That portion of the material having a minimum of 80 percent passing No. 4 sieve.
 2. That portion of the material having a minimum of 80 percent retained on a No. 4 sieve.
- B. The material shall be maintained within the limits above with a uniformity of plus or minus 5 percent. Each portion of the material shall be stored separately.
- C. When moving the aggregate from storage to compartment bins, any method may be used which will not cause segregation, degradation, or combinations of aggregate which fail to meet the specified gradation requirement. Plantmix operations shall not commence until sufficient aggregate material is stockpiled to ensure one day's run.
- D. Aggregate proportioned immediately after the heating and drying process shall be screened into a minimum of 2 fractions when minus 1/2-inch aggregate is used, and into a minimum of 3 fractions when larger sized aggregate is used. The screened material shall be conveyed to separate compartments ready for proportioning and mixing with bituminous material.
- E. If the Contractor elects to introduce baghouse fines into the mix, the material shall be drawn from a storage facility in which the material is kept in a uniform free flowing condition.
1. The baghouse fines for delivery to the plant shall be from a vane type metering device which is interlocked (electrical driven feeders shall be activated from the same circuit) to the flow of each aggregate feeder.
 2. The drive shaft on the baghouse fines vane feeder shall be equipped with a revolution counter accurate to 1/10 of a revolution, and a means for varying the rate.

3. In a continuous mix and/or dryer drum plant, the baghouse fines shall be added at the asphalt feed line to ensure a uniform mix.
 4. In batch plants, the baghouse fines shall be added by the use of a separate bin.
 5. The baghouse fines shall be introduced at a point as approved by the Engineer at a percentage determined by the Engineer, not to exceed 2 percent by dry weight of the aggregate.
 6. Baghouse fines shall be considered as part of the aggregate, and not as a mineral filler.
- F. If mineral filler is required to meet the tensile strength requirements of the job-mix formula, it shall be added by one of the following methods:
1. Cold Feed Method:
 - a. Hydrated lime (hereinafter referred to as mineral filler) shall be added to all plantmix bituminous aggregates at the rate of not less than 1 percent nor more than 2-1/2 percent of the weight of the dry aggregate. The exact rate of application shall be as determined by the job mix formula.
 - b. Mineral filler shall be drawn from a storage facility in which the mineral filler is agitated by air or other means to keep it in a uniform free flowing condition.
 - 1) The mineral filler for delivery to the mixer shall be from a vane type metering device which is interlocked, (electrical driven feeders shall be actuated from the same circuit) to the flow of each aggregate feeder.
 - 2) The drive shaft on the mineral filler vane feeder shall be equipped with a revolution counter reading to 1/10 of a revolution, and a means for varying the rate.
 - c. In continuous mix and/or drum dryer plants, the mineral filler shall be added to the aggregate after the aggregate is proportioned.
 - d. In batch plants, the mineral filler shall be added to the aggregate prior to drying.
 - e. Regardless of which type of plant is used, the following methods shall be utilized:
 - 1) Prior to the introduction of the mineral filler, sufficient moisture shall be added using spray bars at the aggregate bins to bring the aggregate to a moisture content where enough free surface moisture is available to thoroughly wet the aggregate and wet the lime.
 - a) This content shall be a minimum of 4 percent.
 - b) The actual amount of moisture required will be determined by the Engineer.
 - c) After the addition of water and mineral filler, the aggregate shall be mixed using a horizontal twin-shaft pugmill.
 - d) The mixing paddles shall be adjustable for angular position on the shaft to permit altering of the mixing pattern or retarding the flow to ensure that the aggregate is thoroughly coated with mineral filler.

- e) The volume of material in the pugmill shall not extend above the vertical position of the blade tips.
 - f) The completed mixture shall be directly introduced into the hot plant.
 - g) Stockpiling of the completed mixture is strictly prohibited.
- 2) The moisture control valve shall be interlocked with the hot plant control room so the moisture control valve is automatically turned off when the cold feed belts are shut off. The control valve shall also turn on automatically when the cold feed belts are activated.
2. Marination Method:
- a. Hydrated lime (hereinafter referred to as mineral filler) shall be added to all fractions of the plantmix bituminous aggregates.
 - 1) The coarse aggregates shall be wet cured with mineral filler at a rate of 1 percent of the weight of dry aggregate.
 - 2) The fine aggregates shall be wet cured with mineral filler at a minimum rate of 2 percent of the weight of the dry aggregate.
 - b. The aggregates shall be marinated (wet cured) in the stockpiles for a minimum of 48 hours.
 - c. The wet cured aggregate in the stockpile shall be used within 45 calendar days. Material marinated in stockpile in excess of 45 calendar days shall not be used for the production of plantmix bituminous aggregates unless otherwise approved by the Engineer.
 - d. Prior to the introduction of the mineral filler, sufficient moisture shall be added using spray bars at the aggregate bins to bring the aggregates to a moisture content where enough free surface moisture is available to thoroughly wet the aggregate and activate the lime.
 - 1) This content is recommended to be a minimum of 3 percent for coarse aggregates and 6 percent for the fine aggregates.
 - 2) The actual amount of moisture required will be determined by the Engineer.
 - 3) After the addition of water and mineral filler, the aggregate shall be mixed using a horizontal twin-shaft pugmill.
 - 4) The mixing paddles shall be adjustable for angular position on the shaft to permit altering of the mixing pattern or retarding the flow to ensure that the aggregate is thoroughly coated with mineral filler.
 - 5) The volume of material in the pugmill shall not extend above the vertical position of the blade tips.
 - e. Mineral filler shall be drawn from a storage facility in which the mineral filler is agitated by air or other means to keep it in a uniform free flowing condition.
 - 1) The mineral filler for delivery to the mixer shall be from a vane type metering device which is interlocked (electrical driven feeders shall be actuated from the same circuit) to the flow of each aggregate feeder.

- 2) The drive shaft on the mineral filler vane feeder shall be equipped with a revolution counter reading to 1/10 of a revolution, and a means for varying the rate.
3. Slurry Method:
- a. Hydrated lime or slaked quicklime (hereinafter referred to as mineral filler) shall be added to all plantmix bituminous aggregates in slurry form.
 - 1) Add at a rate of not less than 1 percent nor more than 2-1/2 percent of dry mineral filler based on the weight of the dry aggregate.
 - 2) The exact rate of application shall be as determined by the job-mix formula.
 - b. A slurry containing 1 part mineral filler and 2 parts water by weight is recommended.
 - 1) The actual amount of water required in the production of the slurry will be determined by the Engineer after a visual inspection to ensure that the aggregate is thoroughly and uniformly coated with the mineral filler.
 - 2) The addition of moisture to the aggregate prior to mixing of the mineral filler and aggregate will not normally be required.
 - c. The slurry shall be prepared in a central mixing tank provided with agitation for keeping the mineral filler in suspension until applied to the aggregate.
 - 1) The slurry mixing tanks shall be capable of producing sufficient slurry for the hot mix asphalt manufacturing facility production rate, and shall produce a uniform slurry consistency.
 - 2) The plant shall be equipped with suitable pumps and meters for introducing the required amount of slurry to the aggregate. A suitable device shall be provided to the Engineer for determining the weight of mineral filler per gallon of slurry.
 - d. If quicklime is used as the mineral filler, it shall be converted to hydrated lime by using one or more slaking tanks. The slaking unit shall be capable of:
 - 1) Complete slaking or hydration of the quicklime.
 - 2) Providing agitation for mixing and keeping the mineral filler in suspension until use.
 - e. After the addition of the mineral filler slurry, the aggregate shall be mixed using a horizontal twin-shaft pugmill.
 - 1) The mixing paddles shall be adjustable for angular position of the shaft to permit altering of the mixing pattern or retarding the flow to ensure that the aggregate is thoroughly coated with mineral filler.
 - 2) The volume of material in the pugmill shall not extend above the vertical position of the blade tips.
 - 3) The completed mixture shall be directly introduced into the hot plant.
 - 4) Stockpiling of the completed mixture is strictly prohibited.

401.03.09 MIXING

- A. The permissible moisture content of the bituminous mixture just behind the paver shall not exceed 1-1/2 percent as determined by test method ASTM D1461 or equivalent.
 - 1. Should the aggregate contain excessive moisture when heated within the temperature limits, the Contractor will be required to take satisfactory corrective action before resuming plantmix operations.
 - 2. When an approved dryer drum mixing process is used, the moisture content of the bituminous mixture at discharge from the mixer shall not exceed 3 percent, and the resulting product at the discharge end of the drier shall be a homogenous mixture of uniformly distributed and properly coated aggregates of unchanging appearance.
- B. The drier aggregate shall be combined in the mixer in the amount of each fraction of aggregates required to meet the job-mix formula. The bituminous material shall be measured or gauged and introduced into the mixer in the amount specified by the job-mix formula.
- C. Commercial filler material, when required, shall be added to the mixer separately and shall be thoroughly dry. If the materials are mixed in a batching plant, the filler material shall be fed directly into the mixer as near the center as possible.
- D. The time of mixing a batch shall begin on the charging stroke of the weight hopper dumping mechanism and shall end when discharge is started.
 - 1. Mixing shall continue until a homogenous mixture of uniformly distributed and properly coated aggregates of unchanging appearance is produced.
 - 2. In general, the time of mixing shall not be less than 30 seconds, except that the time may be reduced when, in the opinion of the Engineer, the sizes of aggregates are uniformly distributed and all particles are thoroughly and uniformly coated with asphalt binder.
 - 3. The output rate shall not exceed the manufacturer's capacity rating.
- E. Should the mixture, at the plant or in place, show an excess or deficiency of bitumen, show injury or damage due to burning or overheating, or show an improper combination of aggregates, due to the Contractor's failure to conform to the specified requirements, it shall be rejected and if still in the truck shall be disposed of as required. If an unsatisfactory mix, as referred to above, has been placed, it shall be disposed of and replaced as directed. No compensation will be allowed for rejected material.

401.03.10 SPREADING AND FINISHING

- A. The mixture shall be laid upon an approved surface, and shall be spread and struck off to the grade and elevation established. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable.
- B. The forward rate of travel of the paving machine(s) shall be regulated to a speed dependent upon the capacity of the mixing plant to furnish the mixture and the rate at which the rollers can obtain the required compaction. The machine shall be operated so that material does not accumulate and remain along the sides of the receiving hopper.
- C. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked, and compacted by hand tools. For such areas, the mixture shall be dumped, spread, and screeded to give the required compacted thickness, correct grade, and cross section.

- D. The Contractor may windrow plantmixed bituminous base or surface material in front of the spreading and finishing machine, provided that the following conditions and requirements are strictly adhered to:
1. The windrow is properly sized, thereby ensuring the delivery of the correct amount of material to the spreading and finishing machine at all times.
 2. The bituminous mixture shall be transferred from the windrow to the spreading and finishing machine in such a manner that the materials in the spreading machine will be a uniform mixture. The base upon which the windrow was formed shall not be disturbed, and there shall be no paving material remaining on this base between the pickup device and the spreading and finishing machine.
 3. The temperature requirements for the material in the hopper of the spreading and finishing machine are complied with. Plantmix bituminous mixture that does not meet the minimum temperatures specified shall not be incorporated in the work, but shall be wasted in a manner satisfactory to the Engineer.
- E. Should any course of bituminous mixture placed by utilizing a windrow be inferior, as determined by the Engineer, to that placed by transferring the bituminous mixture directly from the hauling vehicle to the spreading machine, the use of a windrow shall be discontinued.
- F. The bituminous mixture spread through the paving machine during one day's operation shall come from a single plant manufacturer. Intermixing from more than one source shall not be allowed.

401.03.11 ROLLING AND COMPACTION

- A. The initial or breakdown rolling shall consist of one complete coverage of the bituminous mixture with a steel-wheeled roller.
1. Initial rolling shall commence at the lower edge and shall progress toward the highest portion of the roadbed.
 2. Under no circumstances shall the center be rolled first.
- B. The initial or breakdown rolling shall be followed by rolling such that uniform density is obtained throughout the depth of the layer of the material being compacted.
1. At least two rollers, one steel-wheeled, the other pneumatic-tired, shall be used.
 2. The total number of rollers used shall be sufficient to obtain the required compaction while the mixture is in a workable condition.
- C. The final rolling of the bituminous mixture shall be performed with the same type of roller used for breakdown rolling.
- D. Rolling shall be performed in such a manner that cracking, shoving, or displacement will be avoided.
1. All rollers shall be in good condition and the reversing mechanism maintained so that the roller is capable of changing directions smoothly.
 2. The roller shall be kept in continuous motion while rolling so that all parts of the pavement receive equal compression.
 3. The motion of the roller shall be slow enough at all times to avoid displacement of the pavement.

4. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected immediately by the use of rakes and fresh mixture when required.
- E. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly maintained.
1. The use of diesel oil on pneumatic-tired rollers shall be kept to a minimum as determined by the Engineer.
 2. Preferably, a water soluble oil or an asphalt release agent shall be used.

401.03.12 ACCEPTANCE SAMPLING AND TESTING OF BITUMINOUS MIXTURE

- A. At no cost to the Contracting Agency, field thickness and density determinations of the bituminous mixture shall be made in lots, each lot representing one day's placement.
1. A lot shall be divided into 5 equal sublots, and 1 test shall be made for each sublot.
 2. The location of the field tests may be chosen on a random basis using ASTM D3665, Section 4.3, except that any random location given shall be set back 2 feet from a curb or 3 feet from an edge, joint, or seam.
 3. A summary of the random number chart used and the lot description shall be completed and approved by the Engineer prior to sampling and shall be included in the finished test results.
- B. Determination of the field thickness of the compacted bituminous mixture, as required by the Engineer, shall be accomplished by ASTM D3549, "Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens."
- C. Determination of the field density of the compacted bituminous mixture shall be accomplished by either of the methods listed below. In case of dispute, ASTM D1188 as modified shall govern.
1. ASTM D2950, "Density of Bituminous Concrete in Place by Nuclear Method." When this method is used, the nuclear device shall first be correlated with the density of core samples.
 2. ASTM D1188, "Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens." When this method is used, the procedure shall be modified to require the use of "Coated Specimens" (Parafilm or Paraffin) only. The use of Bulk Specific Gravity determinations by SSD (surface saturated dry) method are prohibited.
- D. The use of ASTM D2950 shall include correlation of test results to drilled cores.
1. A minimum of 1 lot (one full day's production), and not less than 5 sublots, shall be used for this correlation.
 2. Should any nuclear test density in the first lot differ from its corresponding drilled core density by more than 3.00 percent relative compaction, a second lot shall be correlated and the average of all sublots in the first and second lots, but not less than 10 sublots, shall be used for the correlation. The 4-inch cores shall be transferred to the Engineer along with the random number generator listing station/offset locations.
- E. The theoretical maximum density of the bituminous mixture shall be determined by taking random samples of the mixture delivered to the job site and testing in accordance with ASTM D2041, "Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures."

1. At least 2 theoretical maximum density determinations shall be made for each day's production of bituminous mixture used in the work.
 2. If the day's production is less than 500 tons, then only 1 theoretical maximum density determination is required.
- F. As a quality control measure, the Contractor shall, at no cost to the Contracting Agency, make periodic checks of the field density of the compacted bituminous mixture at any time during paving operations. The testing performed by the Contractor may be used by the Engineer in part or in whole as the basis of acceptance in addition to the Quality Assurance testing to be done by the Engineer.
- G. The pavement thickness acceptance criteria are as listed below:
1. If the average of all measurements meets or exceeds the design thickness, with no core more than 10 percent less than the design thickness, the placement is acceptable.
 2. If there is only an isolated thin area, the limits of the area should be identified to determine if a construction resolution is necessary.
 3. If the core results indicate a consistently thin section, with no core more than 15 percent less than the design thickness and with the approval of the Engineer, the Contractor has the option of proposing a construction resolution or contributing an amount equivalent to the reduction in the asset value. Calculation of the lost asset value is accomplished with the following steps:
 - a. Determine the annual numbers of 18-kip equivalent single axle loads (ESAL), based upon the design traffic index (TI), a 20-year design life and an assumed traffic growth rate.
 - b. Calculate the composite structural number of the designed road section (i.e., the AC and aggregate base sections).
 - c. Using the average AC thickness, calculate the structural number of the constructed road section.
 - d. Determine the ESAL value that correlates with the reduced structural number.
 - e. Based upon the annual ESAL counts, determine the corresponding design life of the reduced section.
 - f. Using a 3 percent inflation factor and the unit cost of the AC (on a \$/square yard basis) determine the equivalent uniform annual cost (EUAC) of each section.
 - g. Multiply the reduction in design life by the EUAC to determine the reduced value of the pavement, on a unit cost basis.
 - h. Multiply the unit cost by the pavement area.
 - i. As an alternative, use the following unit cost values for the 4 road classifications (dollars per square yard per inch deviation from design thickness): Residential = \$6.97, Minor Collector = \$7.10, Major Collector = \$6.14, and Arterial = \$7.20.
 4. If the core results yield an average thickness greater than the design thickness, but are alternately very high and very low (more than 10 percent out), the Engineer may reject the placement.

- H. The pavement density acceptance criteria for production placements shall be as listed below, otherwise specified in the project plans or contract documents:
1. The average density for Residential roadway pavement shall be 92 percent \pm 2.0 percent (90.0 percent - 94.0 percent), with no single density deviating more than 4 percentage points (all measurements between 88 percent - 96 percent). If the average is between 2.0 percent - 4.0 percent out (88 percent - 90.0 percent or 94.0 percent - 96 percent), with no density more than 5.0 percent out (all measurements between 87 percent - 97 percent), the Contractor has the option of contributing the lost asset value of \$1.22 per square yard per percentage point deviation from the acceptance range.
 2. The average density for Minor Collector roadway pavement shall be 93.0 percent \pm 2.0 percent (91.0 percent - 95.0 percent), with no single density deviating more than 4 percentage points (all measurements between 89 percent - 97 percent). If the average is between 2.0 percent - 4.0 percent out (89 percent - 91.0 percent or 95 percent - 97 percent), with no density more than 5.0 percent out (all measurements between 88 percent - 98 percent), the Contractor has the option of contributing the lost asset value of \$1.22 per square yard per percentage point deviation from the acceptance range.
 3. The average density for Major Collector roadway pavement shall be 93.0 percent \pm 1.5 percent (91.5 percent - 94.5 percent), with no single density deviating more than 4 percentage points (all measurements between 89 percent - 97 percent). If the average is between 1.5 percent - 4.0 percent out (89 percent - 91.5 percent or 94.5 percent - 97 percent), with no density more than 5.0 percent out (all measurements between 88 percent - 98 percent), the Contractor has the option of contributing the lost asset value of \$0.81 per square yard per percentage point deviation from the acceptance range.
 4. The average density for Arterial roadway pavement shall be 93.0 percent \pm 1.5 percent (91.5 percent - 94.5 percent), with no single density deviating more than 4 percentage points (all measurements between 89 percent - 97 percent). If the average is between 1.5 percent - 4.0 percent out (89 percent - 91.5 percent or 94.5 percent - 97 percent), with no density more than 5.0 percent out (all measurements between 88 percent - 98 percent), the Contractor has the option of contributing the lost asset value of \$0.81 per square yard per percentage point deviation from the acceptance range.

401.03.13 MAINTAINING TRAFFIC

- A. Traffic shall not be allowed on newly placed pavement for at least 24 hours or until the bituminous paving mix in-place temperature has dropped below 104 degrees F.
- B. Exceptions shall be made at the discretion of the Engineer. Artificial means to reduce the pavement temperature may be used as approved by the Engineer.

401.03.14 JOINTS

- A. Placing of the bituminous paving shall be as continuous as possible.
 1. Rollers shall not pass over the unprotected end of the freshly laid mixture unless authorized by the Engineer.
 2. Transverse joints shall be conformed by cutting back on the previous run to expose the full depth of the course.

3. A brush coat of asphalt emulsion shall be used on contact surface of transverse joints just before additional mixture is placed against the previously rolled material.
- B. Longitudinal joints shall be spaced so that joints in succeeding courses will be at least 6 inches horizontally from joints in any preceding course. Lanes will be evened up each day to eliminate cold longitudinal joints insofar as practicable.
- C. Transverse joints shall be spaced so that joints in succeeding courses will be a minimum of 5 feet horizontally from joints in any adjacent course. Lanes shall be evened up each day to eliminate cold transverse joints insofar as practicable.
- D. Comply with **Subsection [401.03.10](#), "Spreading and Finishing."**

401.03.15 SURFACE TOLERANCES

- A. Surface tolerances will be specified under the respective sections of bituminous pavement.

401.03.16 SURFACING MISCELLANEOUS AREAS

- A. Surfacing of road approaches and connections, street intersection areas, frontage roads, island areas, sidewalks, dikes, curbs, gutters, gutter flares, ditches, downdrains, spillways, aprons at the ends of drainage structures, and other designated areas outside the travelled way shall conform to the provisions specified in these specifications.
- B. The combined aggregate grading for bituminous mixtures placed on miscellaneous areas shall conform to that specified for the bituminous mixture placed on the travelled way, except the aggregates used in the construction of island areas and dikes shall be constructed of aggregate conforming to the requirements of Plantmix Surface Aggregate, Type 3.
 1. The amount of bituminous material used in the bituminous mixture placed in dikes, gutters, gutter flares, downdrains, spillways, aprons at the end of drainage structures, and other designated areas outside the travelled ways shall be increased not less than 1 percent by weight of the aggregate over the amount of bituminous material used in the bituminous mixture placed on the travelled way.
 2. Submittal of a revised job-mix formula will not be necessary.
- C. The bituminous mixture placed in island areas, sidewalks, dikes, gutters, gutter flares, ditches, downdrains, spillways, aprons at the end of drainage structures, and other designated areas outside the travelled way may be spread in 1 layer. The material shall be compacted to the required lines, grades, cross section, and density requirements for Category II pavements in accordance with **Subsection [401.03.12](#), "Acceptance Sampling and Testing of Bituminous Material."**
- D. Dikes shall be shaped and compacted with an extrusion machine or other equipment capable of shaping and compacting the material to the required correct grade and cross section.

METHOD OF MEASUREMENT

401.04.01 MEASUREMENT

- A. The quantity of bituminous plantmix to be measured for payment shall be the number of tons used in the accepted work, and will be determined by weighing the completed mixture of aggregate, mineral filler if required, and bituminous material.

- B. The quantity of shoulder dikes constructed of bituminous plantmix to be measured for payment shall be the number of linear feet and will be determined from measurement taken along the top of the completed dikes to the nearest 1-foot length.
- C. All measurements will be made in accordance with **Subsection 109.01, "Measurement of Quantities."** Batch weights will not be permitted as a method of measurement unless the alternate provisions of **Subsection 401.03.01.D.1, "Plant Scales,"** are met, in which case the cumulative weight of all the acceptable batches will be used for payment.
- D. Due to possible variations in the specific gravity and voids of the payment, the tonnage used may vary from the proposal quantities and no adjustment in contract unit price will be made because of such variation.

BASIS OF PAYMENT

401.05.01 PAYMENT

- A. All accepted work and materials measured as prescribed above will be paid for as provided in the representative sections for each type specified.
- B. Full compensation for furnishing and applying bituminous material or asphaltic emulsion as provided for in **Subsection 401.03.06, "Preparation of Existing Surface,"** including tack coat, and **Subsection 401.03.14, "Joints,"** shall be considered as included in the contract price paid for the principal items involved and no further compensation will be allowed.
- C. When bituminous plantmix, Type III, is used in the construction of island areas or dikes, and there is no separate payment for said mixture, this bituminous plantmix shall be included in the payment for plantmix bituminous surface of the major type shown in the list of bid items and the proposal.