

SECTION 300
BASE COURSES

SECTION 301 – SAND SUBBASE

301-1 DESCRIPTION

This item shall consist of sand subbase course constructed on a prepared subgrade or underlying course in accordance with these specifications and in conformity with the dimensions and typical cross section shown on the plans and with the lines and grades established by the ENGINEER.

301-2 MATERIALS

The sand to be furnished under this item shall conform to the Subsection 501-2.5 of these specifications.

301-3 CONSTRUCTION REQUIREMENTS

Sand subbase shall be placed, spread, shaped, and compacted prior to the placement of the pavement, sidewalk, curb, and gutter, etc. The sand subbase shall be compacted by at least two complete passes over the entire width of the forms by a vibratory compactor. Immediately prior to concrete placement, the sand subbase shall be regraded and watered thoroughly to produce a uniform wet appearance.

301-4 MEASUREMENT AND PAYMENT

Sand subbase shall be measured by the ton and paid for at the unit price bid for "Sand Subbase." Water used as specified above shall be considered incidental to the "Sand Subbase" item and separate payment shall not be made for watering.

SECTION 302 – STABILIZED GRAVEL BASE

302-1 DESCRIPTION

This item shall consist of a base course composed of crushed, partially crushed, or uncrushed coarse aggregate bonded with either soil or fine aggregate or both. It shall be constructed on a prepared underlying course in accordance with these specifications and shall conform to the dimensions and typical cross section shown on the plans and with the lines and grades established by the ENGINEER.

302-2 MATERIALS

It shall be the responsibility of the CONTRACTOR to furnish material which, when compacted, will support the construction equipment without showing signs of displacement.

302-2.1 GRADATION. The gradation of the stabilized gravel base material shall meet the requirements of one of the gradations given in the following table when tested in accordance with ASTM C136.

Square Mesh Sieve Size	Percent By Weight Passing	Class 5 Subbase	Percent By Weight Passing	NDDOT Aggregate Surface Class
	-A-		-B-	
1"	100	-	100	-
3/4"	70-100	90-100	70-100	-
No. 4	38-85	35-70	38-75	-
No. 10	20-70	-	20-60	22-62
No. 30	-	16-40	-	12-45
No. 40	14-45	-	10-35	-
No. 200	0-20	4-10	0-12	7-15
P.I.	6.0 (Max.)	-	6.0 (Max.)	-
L.L.	25.0 (Max.)	-	25.0 (Max.)	-
% Shale & Rock in total sample	20.0 (Max.)	12	15.0 (Max.)	12%
% L.A. Abrasion Loss	50 (Max.)	-	50 (Max.)	-

The maximum allowable P.I. shall be 6.0 except in the cases where the P.I. computed by the formula $10 - (\% \text{ of material passing the No. 40 sieve} \div 10)$ results in a higher P.I. then the higher P.I. shall be the maximum allowable. The P.I. and L.L. shall be reported to the nearest whole number. When a P.I. greater than 6.0 is permitted, the maximum liquid limit shall be increased by the amount the computed P.I. exceeds 6.0.

The gradations in the table represent the limits which shall determine suitability of aggregate for use from the sources of supply. The final gradations decided on within the limits designated in the table shall be well graded from coarse to fine and shall not

vary from the low limit on one sieve to the high limit on the adjacent sieves, or vice versa.

All natural material passing an 8-inch ring and retained on the 1-inch sieve shall be crushed and uniformly mixed with the uncrushed material unless otherwise specified.

The amount of the fraction of material passing the No. 200 mesh sieve shall not exceed one-half the fraction passing the No. 40 mesh sieve.

The selection of any of the gradations shown in the table shall be such that the maximum size aggregate used in any course shall not be more than two-thirds the thickness of the layer of the course being constructed.

If filler in addition to that naturally present in the base course material is necessary for satisfactory bonding of the material for changing the soil constants of the material passing the No. 40 mesh sieve or for correcting the gradation to the limitations of the specified gradation, it shall be uniformly blended with the base material at the crushing and/or mixing plant. The material for such purpose shall be obtained from sources approved by the ENGINEER. The addition of filler may be composed of sand, but the amount of sand shall not exceed 20 percent by weight of the total combined base aggregate. The sand shall pass a No. 4 mesh sieve and not more than 5 percent by weight shall pass a No. 200 mesh sieve.

Gravel pits from which the CONTRACTOR proposes to furnish this base material shall be approved prior to hauling to the project.

Sampling of the final stabilized gravel base material shall be performed by an independent testing laboratory approved by the ENGINEER to test the composition of the mixtures, the mineral aggregates, and the in-place density of the mixture. Approval or disapproval of the material and reasons therefore will be by written order to the CONTRACTOR over the signature of the CITY ENGINEER.

302-3 CONSTRUCTION REQUIREMENTS

302-3.1 OPERATIONS IN PITS AND QUARRIES. All work involved in clearing and stripping pits and quarries, including handling of unsuitable material, shall be performed by the CONTRACTOR. All material shall be handled in a manner that shall secure a uniform and satisfactory base product. The base course material shall be obtained from sources that have been approved.

302-3.2 EQUIPMENT. All equipment necessary for the proper construction of this work shall be on the project in first-class working condition and approved by the ENGINEER before construction is permitted to start.

302-3.3 PREPARING UNDERLYING COURSE. The underlying course shall be checked and accepted by the ENGINEER before placing and spreading operations are started. Any ruts or soft, yielding places due to improper drainage conditions, hauling,

or any other cause, shall be corrected and rolled to the required density before the base course is placed thereon.

Grade control between the edges of the pavement shall be accomplished by grade stakes, steel pins, or forms placed in lanes parallel to the centerline of the pavement at intervals sufficiently close that string lines or check boards may be placed between stakes, pins, or forms.

To protect the underlying course and to insure proper drainage, the spreading of the base shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope.

302-3.4 METHODS OF PRODUCTION.

(a) Plant Mix. When provided in the proposal, or when selected by the CONTRACTOR and approved by the ENGINEER, the base material shall be uniformly blended or mixed in an approved plant. The mixing plant shall include bins for storing and batching of the aggregate, pump and tanks for water, and batch mixers of either the pugmill or drum type. All mineral aggregates shall be batched into a mixer by weight. The agitation shall be such that a thorough dispersion of moisture is obtained. The size of the batch and the time of mixing shall be fixed by the ENGINEER and shall produce the results and requirements specified. The base course material produced by combining two or more materials from different sources shall be mixed in a mixing plant described herein. The mixture material shall be at a satisfactory moisture content to obtain maximum density.

(b) Travel Plant. When the use of a traveling plant is allowed, the plant shall blend and mix the materials to meet these specifications. It shall accomplish a thorough mixing in one trip. The agitation shall be such that the dispersion of the moisture is complete. The machine shall move at a uniform rate of speed and this speed shall be regulated to fix the mixing time. If a windrow-type of travel plant is employed for mixing, the aggregate shall be placed in windrows parallel to the pavement centerline. The windrow volume shall be sufficient to cover exact areas planned. The windrow contents shall produce a mixture of the required gradation and bonding qualities. If a travel plant is used which is of the type that mixes previously spread aggregates in place, the material shall have been spread in such thickness and proportions as may be handled by the machine to develop a base course of the thickness of each layer and of the gradation required. With either type of equipment, the mixed material shall be at satisfactory moisture content to obtain the maximum density.

(c) Proportioning or Blending In-Place. When the base materials are to be proportioned and mixed or blended in-place, the different layers shall be placed and spread with the relative proportions of the components of the mixture being designated by the ENGINEER. The base aggregate shall be deposited and spread evenly to a uniform thickness and width. Then the binder or filler shall be deposited and spread evenly over the first layer. There shall be as many layers of materials added as the ENGINEER may direct to obtain required gradation and layer thickness. When the

required amount of materials have been placed, they shall be thoroughly mixed and blended by means of approved graders, discs, harrows, rotary tillers, or a machine capable of combining these operations, supplemented by other suitable equipment if necessary. The mixing shall continue until the mixture is uniform throughout and accepted by the ENGINEER. Areas of segregated material shall be corrected by the addition of needed material and by remixing. Water shall be uniformly applied, prior and during the mixing operation if necessary, to maintain the material at the proper moisture content. When the mixing and blending have been completed, the material shall be bladed and dragged, if necessary, until a smooth uniform surface is obtained, true to line and grade.

(d) Materials of Proper Gradation. When the entire base course material from coarse to fine is secured in a uniform and well graded condition and contains approximately the proper moisture, such approved material may be handled directly to the spreading equipment. The material may be obtained from gravel pits, stockpiles, or produced from a crushing and screening plant with the proper blending. The materials from these sources shall meet the requirements for gradation, quality, and consistency. The intent of this section of these specifications is to secure materials that will not require further mixing. The base material shall be at satisfactory moisture content to obtain maximum density. Any minor deficiency or excess of moisture may be corrected by surface sprinkling or by aeration. In such instances some mixing or manipulation may be required immediately preceding the rolling to obtain the required moisture content. The final operation shall be blading or dragging, if necessary, to obtain a smooth uniform surface true to line and grade.

302-3.5 METHODS OF SPREADING.

(a) The aggregate base material that is correctly proportioned or has been processed in a plant shall be placed on the prepared underlying course and compacted in layers of the thickness shown on the plans. The depositing and spreading of the material shall commence where designated and shall progress continuously without breaks. The material shall be deposited and spread in lanes in a uniform layer and without segregation of size to such loose depth that when compacted, the layer shall have the required thickness. The base aggregate shall be spread by spreader boxes or other approved devices having positive thickness controls that shall spread the aggregate in the required amount to avoid or minimize the need for hand manipulation. Dumping from vehicles in piles which require rehandling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

(b) The aggregate base material that has been processed in a traveling plant or mixed and blended in place, shall be spread in a uniform layer of required depth and width and to the typical cross section. The spreading shall be by a self-powered blade grader, mechanical spreader, or other approved method. In spreading, care shall be taken to prevent cutting into the underlying layer. The material shall be bladed until a smooth, uniform surface is obtained, true to line and grade.

(c) The base course shall be constructed in a layer not less than 3 inches nor more than 4 inches of compacted thickness. The aggregate as spread shall be of uniform grading with no pockets of fine or coarse materials. The aggregate, unless otherwise permitted by the ENGINEER, shall not be spread more than 2,000 square yards in advance of the rolling. Any necessary sprinkling shall be kept within these limits. No material shall be placed in snow or on a soft, muddy, or frozen course.

When more than one layer is required, the construction procedure described herein shall apply similarly to each layer.

The ENGINEER shall make tests to determine the maximum density and the proper moisture content of the base material, and this information will be available to the CONTRACTOR. The base material shall be at a satisfactory moisture content when rolling is started, and any minor variation prior to or during rolling shall be corrected by sprinkling or by aeration if necessary.

During the mixing and spreading, sufficient caution shall be exercised to prevent the incorporation of subgrade, subbase, or shoulder material in the base course mixture.

302-3.6 FINISHING AND COMPACTING. While spreading, the aggregate shall be thoroughly compacted by rolling. The rolling shall progress gradually from the sides to the center of the lane under construction, or from one side toward previously placed material by lapping uniformly each preceding rear wheel track by one-half the width of such track. Rolling shall continue until the entire area of the course has been rolled by the rear wheels. The rolling shall continue until the aggregate is thoroughly set, the interstices of the material reduced to a minimum, and until creeping of the material ahead of the roller is no longer visible. Rolling shall continue until the base material has been compacted to not less than 95 percent of the maximum dry density at optimum moisture as determined by the compaction control tests specified in ASTM D1557. Blading and rolling shall be done alternately as required or directed to obtain a smooth, even, and uniformly compacted base.

The course shall not be rolled when the underlying course is soft or yielding or when the rolling causes undulation in the base course. When the rolling develops irregularities that exceed 1/2 inch when tested with a 16-foot straightedge, the irregular surface shall be loosened, refilled with the same kind of material as that used in constructing the course, and rolled again as required.

In areas inaccessible to rollers, the base course material shall be tamped thoroughly with approved mechanical tampers.

The sprinkling during rolling, if necessary, shall be in the amount and by equipment approved by the ENGINEER.

302-3.7 SURFACE TEST. After the course has been completely compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be

scarified, reshaped, recompact, and otherwise manipulated as the ENGINEER may direct until the required smoothness and accuracy are obtained. The finished surface shall not vary more than 1/2 inch from a 16-foot straightedge when applied to the surface parallel with and at right angles to the centerline.

302-3.8 THICKNESS. The thickness of the base course shall be determined by depth tests or cores taken at intervals in such manner that each test shall represent no more than 300 square yards. When the base deficiency is more than 1/2 inch, the CONTRACTOR shall correct such areas by scarifying, adding satisfactory base mixture, rolling, sprinkling, reshaping, and finishing in accordance with these specifications. The CONTRACTOR shall replace at its expense the base material where borings have been taken for test purposes.

302-3.9 PROTECTION. Work on the base course shall not be accomplished during freezing temperatures nor when the subgrade is wet. When the aggregates contain frozen materials or when the underlying course is frozen, the construction shall be stopped.

Hauling equipment may be routed over completed portions of the base course, provided no damage results and provided that such equipment is routed over the full width of the base course to avoid rutting or uneven compaction. However, the ENGINEER in charge shall have full and specific authority to stop all hauling over completed or partially completed base course when in his opinion such hauling is causing damage. Any damage resulting to the base course from routing equipment over the base course shall be repaired by the CONTRACTOR at its own expense.

302-3.10 MAINTENANCE. Following the completion of the base course, the CONTRACTOR shall perform all maintenance work necessary to keep the base course in a condition satisfactory for priming. After priming, the surface shall be kept clean and free from foreign material. The base course shall be properly drained at all times. If cleaning is necessary, or if the prime coat becomes disturbed, any work or restitution necessary shall be performed at the expense of the CONTRACTOR.

Before preparations begin for application of a surface treatment or for a surface course, the base course shall be allowed to partially dry until the average moisture content of the full depth of base is less than 80 percent of the optimum moisture of the base mixture. The drying shall not continue to the extent that the surface of the base becomes dusty with consequent loss of binder. If during the curing period the surface of the base dries too fast, it shall be kept moist by sprinkling until such time as the prime coat is applied as directed.

302-3.11 TRUCK SCALES. The stabilized gravel base shall be weighed on approved scales furnished by the CONTRACTOR or on public scales at the CONTRACTOR's expense. Scales shall be inspected for accuracy and sealed as often as the ENGINEER deems necessary.

302-4 MEASUREMENT AND PAYMENT

302-4.1 STABILIZED GRAVEL BASE. Stabilized Gravel Base shall be measured by the ton in place and paid for at the unit price bid for "Stabilized Gravel Base." This price shall be full compensation for furnishing all materials and for all operations, hauling, and placing of these materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

302-4.2 WATERING. Water used under this item shall be in accordance with and paid for under Section 203.

SECTION 304 – AC STABILIZED BASE

304-1 DESCRIPTION

This item shall consist of a base course composed of mineral aggregate and bituminous material, mixed in a central mixing plant and placed on a prepared subgrade in accordance with these specifications and in conformity with the dimensions and typical cross sections shown on the plans and with lines and grades established by the ENGINEER.

The base course shall be constructed as shown on the plans in lifts not to exceed 3 1/2 inches in thickness. 3 1/2 inch maximum lift thickness will be waived if the CONTRACTOR is able to demonstrate by means of a test section that compaction, texture, and surface tolerance can be obtained for a thicker lift. If the result of the test is satisfactory, the ENGINEER will authorize the CONTRACTOR in writing to construct the thicker lift.

304-2 MATERIALS

304-2.1 AGGREGATE. The aggregate shall consist of crushed stone, crushed gravel, gravel, sand gravel, sand or other natural granular, and approved material which have essentially the same qualities and meet all requirements when combined within the limits for gradation.

The aggregate shall be tough, durable, and sound and shall consist of angular fragments reasonable uniform in density and quality. It shall be free of soil, roots, and other organic matter. The physical characteristics and quality of the materials shall be conditionally approved by the ENGINEER, in stockpile, at the plant site.

Aggregate (fine and coarse) shall be sampled in accordance with ASTM Standard D75 for aggregate sampling.

Aggregate for all gradation shall not contain more than 5 percent (maximum allowable percentage) by weight of lightweight particles in accordance with ASTM Standard C123 for lightweight pieces in aggregate.

The coarse aggregate (that portion retained on the No. 8 sieve) for all gradations shall not show more than 40 percent wear when abraded in accordance with ASTM Standard C131 for Resistance to Degradation by the Los Angeles Abrasion Method. In addition, the coarse aggregate when subjected to five (5) cycles of the soundness test (ASTM Standard C88) shall have a weighted loss not greater than 12 percent when sodium sulfate is used or 18 percent when magnesium sulfate is utilized.

The minimum weight percentage allowable for that portion of the aggregate retained on the No. 4 sieve shall have at least one fractured face for all classes.

304-2.2 FILLER. Filler, if required, shall consist of finely divided mineral matter such as rock dust, slag dust, hydrated lime, hydraulic cement, fly ash, loess, or other suitable material matter and shall conform to ASTM Standard Specification D242 for mineral fillers.

304-2.3 BITUMINOUS MATERIAL. The bitumen shall be 58-28 performance-graded asphalt cement or as approved by the ENGINEER. A certificate of asphalt cement material shall be submitted for each mixture supplied, for each load of asphalt cement delivered to the hot mix plant.

The asphalt cement shall conform to ASTM D946 and shall be mixed at a temperature falling within the range of 250°F to 325°F.

304-2.4 JOB MIX FORMULA. The CONTRACTOR shall submit for the ENGINEER's written approval a job mix formula for the mixture to be supplied for the project. The job mix formula with the allowable tolerances shall be within the master range specified for the particular type of bituminous material. The job mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size and a single percentage of bituminous material to be added to the aggregate.

The mineral aggregate for the base course shall be of such size that the percentage composition by weight as determined by laboratory sieves shall conform to the gradations specified. The final gradations shall be within the designated limits shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on adjacent sieves or vice versa. The bituminous content of the mixture shall be calculated on a percentage basis by weight of the total mix.

The tabulated composition limits shall govern, but a closer control appropriate to the job materials will be required for the specific project in accordance with the established job mix formula. The following job mix tolerances shall be applied to the job mix formula to establish a job control grading band. The full range of tolerances will still apply if application of the job mix tolerances results in a job control grading band outside the master grading band.

<u>Material</u>	<u>Tolerance</u>
Aggregate passing No. 50 or larger sieves	+ or – 6%
Aggregate passing No. 200 sieves	+ or – 2%
Bitumen Content	+ or - 0.4%
Mixing Temp.	+ or - 20°F

Should a change be made in sources of materials, a new job mix formula shall be established prior to any new materials being used. Should unsatisfactory results or unforeseen conditions make it necessary, a new job mix formula may be established at the discretion of the ENGINEER.

The job mix formula for each mixture shall be in effect until modified in writing by the ENGINEER.

The aggregate shall be accepted in stockpile at the plant site. The bituminous material shall be conditionally accepted at the source. The plant mixed material shall be accepted after blending and mixing at the plant.

304-3 COMPOSITION OF MIXTURE

The mineral aggregate for the base course shall be of such size that the percentage composition by weight as determined by laboratory sieves will conform to the gradation specified. The percent by weight for the bituminous material shall be within the limits given. The bituminous content of the mixture shall be calculated on a percentage basis by weight of the total mix.

The composition limits tabulated shall govern, but a closer control appropriate to the job materials will be required for the specific project in accordance with the job mix formula. The final gradation decided on within the limits designated in the table shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieves or vice versa.

A sample of the coarse and fine aggregate shall be washed to determine the percentage of the total material passing the No. 200 mesh sieve; of the amount of the material passing the No. 200 mesh sieve, at least one-half shall pass the No. 200 mesh sieve by dry sieving.

The percentage of bituminous material by weight to be added to the aggregate shall be specified by the ENGINEER on the basis of preliminary laboratory tests and field sieve analysis.

For each appropriate job mix, the mixture shall meet the following requirements according to ASTM Standard D1559 for Marshall Stability plus the stated limitations of voids filled and flow.

	MIX CLASSES		
	Class C	Class B	Class A
No. of Blows (per side)	50	50	50
Stability	750	1200	1650
Flow (hundredth of an inch)	8-18	8-18	8-16
Percent Air Voids			
Base Course	3-8	3-8	3-8
Surface Course	3-5	3-5	3-5
Percent Voids Mineral Aggregate	13 Min	13 Min	13 Min

Determine the maximum theoretical density of each sample taken which shall be used to calculate air voids.

The aggregate shall conform to the following gradations as specified and all requirements contained therein:

AGGREGATE GRADATION

Square Mesh Sieve Size	Percent by Weight Passing		
	Class C	<u>Mix Classes</u> <u>Class B</u>	Class A
5/8"	100	100	100
1/2"	70-100	70-100	70-100
No. 4	40-70	40-70	40-70
No. 8	33-55	33-55	33-55
No. 16	25-45	25-45	25-45
No. 30	15-35	15-35	15-35
No. 50	10-30	10-30	10-30
No. 200	2-9	2-9	2-9
Shale	5%	5%	5%
LA Abrasion (max)	40%	40%	40%
Plasticity Index (max)	3	3	Non Plastic per AASHTO T-90
Fractured Faces (+No.4)	min. 55%	min. 65%	min. 95%
Crushed Fines (-No.4)	min. 10%	min. 40%	min. 60%

304-4 EQUIPMENT

304-4.1 EQUIPMENT AND ORGANIZATION. All methods and equipments, tools, plants, and machinery used for handling materials and executing any part of the work shall be subject to the approval of the ENGINEER before the work is started. If unsatisfactory, they shall be changed and improved as required.

304-4.2 BITUMINOUS MIXING PLANT. General. Adequate storage space shall be provided to prevent intermingling of stockpiles containing separated aggregate sizes until the aggregates are delivered into the plant. The various units of the plant shall be designed and coordinated to permit uniform, uninterrupted production under the normal operating conditions. The plant shall be provided with means for readily obtaining representative samples and for calibrating and checking the proportions of each ingredient used in the mixture.

(a) Requirement for all Plants. Mixing plants shall be of sufficient capacity and coordinated to adequately handle the proposed bituminous construction.

(1) Plant Scales. Scales shall be accurate to within 0.5 percent of the required maximum load. Poles shall be designed to be locked in any position to prevent

unauthorized change of position. In lieu of plant and truck scales, the CONTRACTOR may provide an approved automatic printer system to print the weights of the material delivered, provided the system is used in conjunction with an approved automatic batching and mixing control system. Such weights shall be evidenced by a weigh ticket for each load. Scales shall be inspected and sealed as often as the ENGINEER may deem necessary to assure their continued accuracy. The CONTRACTOR shall have on hand not less than ten 50-pound weights for testing the scales.

(2) Equipment for Preparation of Bituminous Material. Tanks for the storage of bituminous material shall be equipped to heat and hold the material at the required temperatures. Heating shall be accomplished by steam coils, electricity, or other approved means so that flame(s) will not contact the tank. The circulating system for the bituminous material shall be designed to assure proper and continuous circulation during the operating period. Provisions shall be made for measuring and sampling storage tanks.

(3) Feeder for Drier. The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the drier to obtain uniform production and temperature.

(4) Drier. The plant shall include a drier(s) which continuously agitates the aggregate during the heating and drying process.

(5) Screens. Plant screens capable of screening all aggregate to the specified sizes and proportion and having normal capacities in excess of the full capacity of the mixer shall be provided.

(6) Bins. The plant shall include storage bins of sufficient capacity to supply a mixer operation at full capacity. Bins shall be arranged to assure separate and adequate storage of appropriate fractions of the mineral aggregates. When used, separate dry storage shall be provided for filler or hydrated lime, and the plant shall be equipped to feed such material into the mixer. Each bin shall be provided with overflow pipes of such size and at such location to prevent backup of material into other compartments or bins. Each compartment shall be provided with its own individual outlet gate constructed so as to prevent leakage. The gates shall cut off quickly and completely. Bins shall be so constructed that samples may be obtained readily. Bins shall be equipped with adequate telltale devices which indicate the position of the aggregates in the bins at the lower quarter points.

(7) Bituminous Control Unit. Satisfactory means, either by weighing or metering, shall be provided to obtain the specific amount of bituminous material in the mix. Means shall be provided for checking the quantity or rate of flow of bituminous material into the mixer.

(8) Thermometric Equipment. Dual armored thermometer of adequate range shall be fixed in the bituminous feed line at a suitable location near the charging valve of the mixer unit.

The plant shall also be equipped with an approved thermometric instrument placed at the discharge chute of the drier to indicate the temperature of the heated aggregates. The ENGINEER may require replacement of any thermometer by an approved temperature recording apparatus for better regulation of the temperature of aggregates.

(9) Dust Collector. The plant shall be equipped with a dust collector to waste or return uniformly to the hot elevator all or any part of the material collected.

(10) Truck Scales. The bituminous mixture shall be weighed on an approved scale furnished by the CONTRACTOR or on public scales at the CONTRACTOR's expense. Scales shall be inspected and sealed as often as the ENGINEER deems necessary to assure their accuracy.

(11) Safety Requirements. 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. Accessibility to the top of truck bodies shall be provided by a suitable device to enable the ENGINEER to obtain samples and mixture temperature data. Means shall be provided to raise and lower scale calibration equipment, sampling equipment, and other similar equipment between the ground and the mixer platform. All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly guarded. Ample and unobstructed passage shall be maintained at all times in and around the truck loading area. This area shall be kept free of drippings from the mixing platform.

(b) Cold Feed Control. The CONTRACTOR may elect to operate the hot plant without plant screens. The basic requirements of this method of operation are to remove all plant screens with the exception of the scalping screen. Permission to continue under this option may be rescinded upon failure to maintain production within the specified gradation limits.

The volume or tonnage placed in each of the two or more stockpiles shall be such a significant portion of the whole tonnage produced as to enable adequate control of the gradation within the job mix formula.

Each individual aggregate shall be fed through a separate feeder that has a positive feed and that can be easily and accurately calibrated. The feed shall be quick adjusting and shall maintain a constant and uniform flow throughout the range of its calibration.

(1) Batch Plants and Continuous Mix Plants. The point of acceptance for the physical properties of the aggregates will be in the stockpiles at the plant site. Acceptance testing for aggregate gradation will be performed just prior to the addition of bituminous material to the mixture.

In batch plants, a surge bin shall be provided between the drier and the batch plant; the discharge into the weigh hopper shall be from one bin only which shall discharge into the center of the weigh hopper. The amount of aggregate in the bin at any one time

shall not exceed one batch in weight and shall be fed into the bin in a manner that will prevent sluffing and segregation.

In continuous mix plants, a surge bin and mechanical feeder shall be provided. The storage in each bin used shall be limited in amount so that sluffing and segregation will not occur. If more than one bin is used, separation shall be accomplished in such a manner as to insure uniform flow to each bin and preclude segregation of the total material as obtained from the individual bins.

(c) Dryer Drum Plants. An approved dryer drum mixing process will be permitted in lieu of pugmill mixing. The system shall provide positive weight control of the cold aggregate feed by use of a belt scale or other device which will automatically regulate the feed gate and permit instant correction of variations in load. The cold feed flow shall be automatically coupled with the bitumen flow to maintain the required proportions. Proportioning shall be within the tolerances specified in the job mix formula. The system shall be equipped with automatic burner controls and shall provide for temperature sensing of the bituminous mixture at discharge.

The moisture contents of the bituminous mixture at discharge from the mixer shall not exceed 3 percent. The temperature of the bituminous mixture at discharge from the mixer shall not exceed 300°F. The temperature of the mix at laydown shall be not less than 180°F. The actual mixing temperature shall be adjusted as directed by the ENGINEER within the allowable limitations to best suit construction conditions.

304-4.3 HAULING EQUIPMENT. Trucks used for hauling bituminous mixtures shall have tight, clean, smooth metal beds which have been lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material to prevent the mixture from adhering to the beds. In adverse weather, each truck shall have a suitable cover to protect the mixture.

304-4.4 BITUMINOUS PAVERS. Bituminous Pavers shall be self-contained, power-propelled units, provided with an activated screen or strike-off assembly, heated if necessary. It shall be capable of spreading and finishing courses of bituminous plant mix material which will meet the specified thickness, smoothness, and grade. The paver shall be capable of spreading and finishing courses of bituminous plant mix material in lanes not less than 10 feet in width and shall be capable of operating at forward speeds consistent with satisfactory laying of the mixture.

The paver shall have a receiving hopper of 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.

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.

304-4.5 ROLLERS. Rollers shall be in good condition, capable of reversing without backlash, and shall operate at slow speeds to avoid displacement of the bituminous

mixture. The number, type and weight of rollers used shall be sufficient to compact the mixture to the required density while the mixture is still in a workable condition. The use of equipment which results in excessive crushing of the aggregate will not be permitted.

304-5 CONSTRUCTION REQUIREMENTS

304-5.1 WEATHER LIMITATIONS. The base course shall be constructed only when the surface is dry, the subgrade is not frozen, the atmospheric temperature is above 30°F, and the weather is not foggy or rainy. The temperature requirement may be waived, but only when so directed by the ENGINEER.

304-5.2 PREPARATION OF BITUMINOUS MATERIAL. The bituminous material shall be heated to the mixing temperature specified in Subsection 304-2.3 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.

304-5.3 PREPARATION OF MINERAL AGGREGATE. The aggregate for the mixture shall be dried and heated at the paving plant before entering the mixer. When introduced into the mixer, the combined aggregate shall not contain more than 0.5 percent moisture. Water in the aggregate shall be removed by heating to the extent that there is no subsequent foaming in the mixture prior to the placing of the material. The aggregate shall be heated to temperature as designated by the job formula within the job tolerance specified. The maximum temperature and rate of heating shall be such that no permanent damage occurs to the aggregates. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by heating. The aggregate shall be screened to specified sizes and conveyed into separate bins ready for mixing with bituminous material.

304-5.4 PREPARATION OF BITUMINOUS MIXTURE. Before delivery, the aggregate shall be mixed with the bituminous material at a central mixing plant. The mixture shall be prepared at a temperature as shown in Subsection 304-2.3.

The dry aggregates, prepared as specified in Subsection 304-5.3 shall be combined in the plant in the proportionate amounts of each fraction of aggregate required to meet the specified gradation. The quantity of aggregate for each batch shall be determined, measured, and conveyed into the mixer. In case of volumetric proportioning, the size of the grate openings shall be determined and the gates locked in position.

The quantity of the bituminous material for each batch of calibrated amount shall be determined by the ENGINEER. The bituminous material shall be measured by weight or volume and introduced into the mixer at the specified temperature, using the lowest range possible for adequate mixing and spreading. For batch mixtures, all mineral aggregates shall be in the mixer before the bituminous material is added. The exact temperature within the specified range shall be fixed by the ENGINEER. As determined by the ENGINEER, the mixing shall continue for the time necessary to coat all particles uniformly. This time is dependent upon the mix designs and the type of mixing equipment used.

304-5.5 TRANSPORTATION AND DELIVERY OF THE MIXTURE. The mixture shall be transported from the mixing plant to the point of use in vehicles such as described in Subsection 304-4.3. The mixture shall be placed at a minimum temperature of 225°F. When mixture is being placed during warm weather and the ENGINEER has determined that satisfactory results can be obtained at lower temperatures, he may direct that the mixture be mixed and delivered at the lower temperatures.

Loads shall not be sent out so late as to interfere with spreading and compacting the mixture during daylight unless artificial light, satisfactory to the ENGINEER, is provided. The mixture shall be delivered at a temperature within the tolerance specified in the approved job formula.

304-5.6 SPREADING AND LAYING.

(a) Preparation for Placing. Immediately before placing the bituminous mixture, the existing underlying course shall be cleaned of loose or deleterious materials.

The mixture shall be laid only upon an approved underlying course which is dry and only when weather conditions are suitable. No mixture shall be placed when the air temperature away from the artificial heat is 30°F or lower, unless so directed by the ENGINEER. The ENGINEER may, however, permit work of his character to continue when overtaken by sudden rains, up to the amount which may be in transit from the plant at the time, provided the mixture is within the temperature limits specified.

Placing shall commence at the point(s) farthest from the mixing plant and progress continuously toward the plant, unless otherwise ordered by the ENGINEER. Hauling over material already placed shall not be permitted until the material has been thoroughly compacted as specified and allowed to cool to atmospheric temperature.

(b) Machine Spreading. Upon arrival, the mixture shall be dumped into an approved bituminous paver and immediately spread to the full width required. It shall be struck off in a uniform layer of such depth that, when the work is completed, it will have the required thickness and will conform to the grade and surface contour required. The speed of the paver shall be regulated to eliminate the pulling and tearing of the bituminous mat.

The mixer shall be placed in strips of a minimum width of 10 feet. To insure proper drainage, the spreading shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope. After the first strip or width has been compacted, the second width shall be placed, finished, and compacted in the same manner as the first width. After the second strip has been placed and rolled, a 10-foot straightedge shall be placed across the longitudinal joint to determine if the surface conforms to grade and contour requirements.

Exposed vertical edges of paved strips shall be free of all accumulations of dirt or other foreign material before any mixture is spread in an adjacent lane. If joint faces become

dry or dusty, the contract surfaces shall be given a brush coat of asphalt. In lieu of painting the contract surfaces, the CONTRACTOR may use a joint heater approved by the ENGINEER. If the spreading machine should drift from an adjacent lane during construction, the unfilled space shall be carefully filled with fresh hot mixture obtained from truck or the hopper of the spreading machine. Stealing mixture from that already spread to fill up these areas shall not be permitted.

In limited areas where due to irregularities or unavoidable obstacles the use of mechanical spreading and finishing equipment is not practical, the mixture may be hand spread.

When hand spreading is permitted, the mixture shall be dumped on approved dump sheets outside the area upon which it is to be spread, and then distributed into place immediately using hot shovels. It shall be spread with hot rakes in a uniformly loose layer to the full width required and of such depth that, when the work is completed, it will have the required thickness and will conform to the grade and surface contour shown on the plans.

304-5.7 COMPACTION OF MIXTURE. After spreading, the mixture shall be thoroughly and uniformly compacted with power rollers as directed by the ENGINEER. Rolling of the mixture shall begin as soon after spreading as it will bear the roller without undue displacement or hair checking. On the first strip spread, rolling shall start in the center and continue toward either edge. On subsequent strips laid, rolling shall start on the edge adjacent to previously laid material and continue toward the opposite edge.

Initial rolling shall be done longitudinally. The rollers shall overlap on successive trips. Alternate trips of the roller shall be of slightly different lengths, and cross rolling shall not exceed more than one-half the width of the pavement or crowned sections. The speed of the roller shall at all times be slow to avoid displacement of the hot mixture. Any displacement occurring as a result of reversing the direction of the roller or from any other cause shall be corrected at once by rakes and fresh mixture.

Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until all roller marks are eliminated, the surface is of uniform texture and true to grade and cross section, and a density of at least 92 percent of the laboratory density specified in the job mix formula per Subsection 304-4 is obtained.

To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened, but excessive water will not be permitted.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with hot hand tampers.

Any mixtures which become loose and broken, mixed with dirt, or in any way defective prior to the application of the finish coat, shall be removed and replaced with fresh hot mixture and immediately compacted to conform with the surrounding area. This shall be done at the CONTRACTOR's expense.

304-5.8 JOINTS

(a) General. The mixture at the joints shall comply with the surface requirements and present the same uniformity of texture, density, smoothness, etc., as other sections of the course. In the formation of all joints, provision shall be made for proper bond with the adjacent course for the specified depth on the course. Joints shall be formed by cutting back on the previous day's run to expose the full depth of the course. The exposed edge shall then be given a light paint coat of asphalt as required by the ENGINEER and the fresh mixture raked against the joint, thoroughly tamped with tampers and rolled.

(b) Transverse. The placing of the course shall be continuous as possible. The roller shall pass over the unprotected end of the freshly laid mixture only when discontinuing the laying of the course.

(c) Longitudinal. The placing of the course shall be as specified and in such a manner that the joint is exposed for the shortest period possible.

304-5.9 SHAPING EDGES. While the surface is being compacted and finished, the CONTRACTOR shall carefully trim the outside edges of the pavement to the proper alignment. The edge so formed shall be beveled while still hot with the back of the rake or a smoothing iron and thoroughly compacted by tampers or by other satisfactory methods.

304-5.10 SURFACE TESTS. Tests for conformity with the specified crown and grade shall be made by the CONTRACTOR immediately after initial compression. Any variation shall be corrected by the removal or addition of materials and by continuous rolling.

The finished surface shall not vary more than 3/8 inch when tested with a 10-foot straightedge applied parallel with or at right angles to the centerline.

After the completion of final rolling, the smoothness of the course shall again be tested; the humps or depressions exceeding the specified tolerances or that retain water on the surface shall be corrected immediately as directed by the ENGINEER. This shall be done at the CONTRACTOR's expense.

304-5.11 DENSITY AND TESTING REQUIREMENTS FOR BITUMINOUS PAVEMENTS. The CONTRACTOR shall engage an independent testing laboratory, approved by the ENGINEER, to test the composition of the mixtures, the mineral aggregates, and the in-place density of the mixture.

(a) Density. AC Base Course shall be compacted to 92 percent of Marshall Density. The density of the compacted bituminous pavement shall be determined in sub lots of 1,500 square yards per each lift.

Each day's haul will be considered a "lot" and each "lot" shall be divided into acceptance sub lots not to exceed 1,500 square yards, unless the control strip method outlined below is used. Densities per sub lot will be taken at random with a minimum of one (1) nuclear density per sub lot, and the mean density in each sub lot shall equal or exceed the specified density. A minimum of 10 percent of the sub lots shall be cored.

Densities shall be taken by a Nuclear Gauge Tester in accordance with ASTM D2950 or by the Coring Method.

Compaction methods and equipment used shall be approved by the ENGINEER.

During the course of bituminous pavement construction, it may be deemed necessary by the ENGINEER to verify pavement composition and/or the results obtained by the Nuclear Density Tester. This will be accomplished by removing suitable sized samples of the completed pavement. The CONTRACTOR shall remove the samples and replace the pavement at no extra charge. If the pavement is deficient in composition, compaction, or thickness, satisfactory correction shall be made immediately.

Should the CONTRACTOR require any of the above verification sampling, he may do so provided he agrees to assume all costs incurred including the testing of the sample.

(b) Control Strip Method. If the ENGINEER determines that through the CONTRACTOR's efforts and the test results the specified percent (%) of Marshall Density cannot be obtained, a control strip shall be used to establish the density criteria for the particular pavement area involved.

The subbase on which the control strip is to be constructed shall be approved by the ENGINEER prior to the construction of said strip. The ENGINEER may abandon the control strip criteria or require a new control strip when a change in materials or a change in construction methods is observed.

The control strip shall be constructed with blended materials meeting specifications and approved by the ENGINEER. The control strip shall cover not less than 300 square yards at the specified pavement depth, and shall remain in place as part of the completed work.

Compaction of the control strip shall begin as soon as possible after the mixture is placed. Compaction shall be uniform over the entire surface. During compaction, pavement densities will be determined by the CONTRACTOR with a portable nuclear device. When the ENGINEER determines density increases less than 1 lb. per cubic foot per roller pass, the rolling shall cease provided a minimum of three (3) roller coverages have been completed. Roller or rollers shall be approved by the ENGINEER. The mean density shall be determined by ten (10) random density tests within the control strip. The control strip density determination shall be the responsibility of the CONTRACTOR.

The remainder of the work in which the control strip is to govern shall be divided into acceptance strips containing no more than 1,500 square yards. The density of each acceptance strip shall be obtained by the results of five (5) nuclear densities, the mean density of which shall not be less than 98 percent of the control strip density accepted by the ENGINEER. No individual test shall be less than 95 percent of the control strip density.

If the mean density of the acceptance strip does not conform to the requirements stated herein, or if an individual test value does not meet the requirements stated herein, the CONTRACTOR shall continue its compactive effort until the required density is obtained.

It is intended that acceptance density testing will be accomplished while the bituminous mixture is hot enough to permit further densification if such is shown to be necessary.

After the required density has been attained in the acceptance strips, further finish rolling may be necessary to remove roller marks or other surface irregularities.

The ENGINEER reserves the right to require testing of individual areas which are apparently defective based upon visual examination and to reject any area that does not have at least 95 percent of the mean density of the control strip.

(c) Testing of Aggregate and Bituminous Mixture. One (1) dry belt sample shall be taken in accordance with ASTM D75 for each increment of 1,000 tons of bituminous pavement produced with a minimum of one (1) dry belt sample taken and tested per day. The dry sample shall be tested for gradation in accordance with Section 304-3 or the Standard Specifications.

One (1) bituminous mixture sample shall be taken per day in accordance with ASTM D979 for each increment of 1,000 tons of bituminous pavement produced. The bituminous mixture shall be tested in accordance with ASTM D1559 for marshall properties of unit weight, stability, flow, voids - total mix and voids filled. The bituminous mixture shall also be tested to determine the bitumen content by an extraction in accordance with ASTM D2172. The gradation of the mineral aggregate shall also be determined after the extraction is made.

The CONTRACTOR must keep track of daily tonnages of each material produced and a total tonnage to date quantity. This tonnage information along with the asphalt cement (cutoff) percentage must be completed on a form which can be acquired at the City of Mandan Engineering Department, and sent to the testing laboratory before 9:00 a.m. the next day. The testing laboratory SHALL then test the material properties, fill out the remainder of the form, then forward it back to the CONTRACTOR and then to the CITY OF MANDAN. Communication between the CONTRACTOR, testing laboratory, and the CITY is essential. The testing laboratory must be notified at least one (1) hour prior to any paving activities. If the CONTRACTOR's paving activities exceed beyond 5:00 p.m. or on weekends, the CITY and the testing laboratory shall be notified prior to 4:00 p.m. that day.

Test for percent of fractured faces will be determined by the percentage of fractured faces for each dry belt sample taken.

(d) Payment and Reports. The cost of all said testing shall be considered incidental to Subsection 304-6.1 AC Stabilized Base.

The time, locations, depths, and frequency of testing shall be at the discretion of the ENGINEER during construction. Should it become necessary to require an additional number of initial tests over and above the frequency specified herein, the CITY OF MANDAN will assume the responsibility to perform said additional testing, except as outlined herein under "Compaction."

The CONTRACTOR, however, will be required to assume the cost of all testing to determine the limits of an area not meeting specifications and subsequent retesting of said area after corrections have been completed.

Written reports of all test results shall be supplied to the ENGINEER and the CONTRACTOR by the testing laboratory as soon as possible. To expedite construction progress, it is necessary that the CONTRACTOR and ENGINEER be furnished with the results of all tests as soon as testing is completed.

The availability of the independent testing laboratory when needed and speed of testing and reporting are to be considered the responsibility of the CONTRACTOR.

304-5.12 BITUMINOUS AND AGGREGATE MATERIAL CONTRACTOR'S RESPONSIBILITY. Samples of the bituminous and aggregate materials that the CONTRACTOR proposes to use, together with a statement of their source and character, shall be submitted to the ENGINEER; approval must be obtained before the use of such material begins. The CONTRACTOR shall require the manufacturer or producer of the bituminous and aggregate materials to furnish material subject to this and all other pertinent requirements of the contract. Only those materials that have demonstrated performance under the proposed design requirements will be accepted.

The ENGINEER or his authorized representative shall have access at all times to all parts of the paving plant for the purpose of inspecting equipment, conditions operation of the plant, for verification of weights or proportions and character of materials, and to determine temperatures maintained in the preparation of the mixtures.

The CONTRACTOR shall furnish vendor's certified test reports for each tanker, carload, or equivalent of bitumen shipped to the project. The report shall be delivered to the ENGINEER before permission is granted for use of the material. The furnishing of the vendor's certified test report for the bituminous material shall not be interpreted as a basis for final acceptance. All such test reports shall be subject to verifications by testing samples of materials received for use on the project.

304-6 MEASUREMENT AND PAYMENT

304-6.1 AC STABILIZED BASE (CLASS). The AC Stabilized Base Material shall be measured by the ton of bituminous mixture and paid for at the unit price bid for "AC Stabilized Base (Class)" complete in place and accepted by the ENGINEER. No deduction will be made for the weight of the asphalt cement in the mixture. Batch weights will not be permitted for method of measurement. Asphalt cement shall be paid per 401-6.4 Asphalt Cement pay item.

SECTION 305 – MIXED IN-PLACE BASE COURSE

305-1 DESCRIPTION

This item shall consist of a base course composed of existing stabilized gravel base with several seal coats referred to in the CITY OF MANDAN as "Hard-surfacing," windrowed, mixed in a traveling pugmill type plant where bituminous material shall be added and reconstructed on the prepared underlying course in accordance with these specifications and shall conform to the dimensions and typical cross sections shown on the plans and the lines and grades established by the ENGINEER. After a 4-inch depth has been windrowed, the street shall be shaped to section under Section 202 to correct existing crown and make provision for the wearing course material.

305-2 MATERIAL

305-2.1 AGGREGATE. The aggregate material to be added, if any, shall conform to Subsections 304-2.1 and 304-2.2.

305-2.2 BITUMINOUS MATERIAL. The bituminous material shall be SM-K Emulsified Cationic Asphalt. The mixing temperature shall range from 75°F to 130°F. The bitumen content shall be 6 percent of the total weight of the mixed material.

305-3 COMPOSITION OF MIXTURE

The base aggregate shall consist of existing seal coat material and existing stabilized gravel base which shall be sufficiently dried by aerating with motor graders prior to mixing and laydown. Additional stabilized gravel base required for subcut and/or build-up of crown shall conform to Subsection 304-3.

305-4 CONSTRUCTION REQUIREMENTS

305-4.1 WEATHER LIMITATIONS. The base course shall be constructed only when the surface is dry, the atmospheric temperature is above 45°F, and the weather is not foggy or rainy. The temperature requirement may be waived, but only when so directed by the ENGINEER.

305-4.2 EQUIPMENT

(a) General. All methods and equipment, tools, and other plants or machinery used for handling materials and executing any part of the work shall be subject to the approval of the ENGINEER before the work is started. If unsatisfactory, they shall be changed and improved as required.

(b) Traveling Plant Mixer. The traveling pugmill plant shall be self-propelled or tractor-drawn and capable of maintaining a uniform rate of travel while mixing. It shall be mounted on wheels or tread equipment of such type that when loaded to capacity, it will not rut or damage the subgrade or subbase course. The device for picking up the

aggregates from the window shall take up the loose material and leave the underlying course clean without damage. Plants equipped for drying the aggregates before adding the bituminous material shall be constructed to allow for no loss of mineral filler or segregation of the aggregate. The equipment for proportioning the aggregate and bituminous material shall accurately measure the specified amounts of material for the mix while the machine is in operation. The plant shall be capable of thoroughly combining the aggregates and bituminous material into a mixture of uniform color with all the particles completely coated, and it shall also be capable of depositing the processed mixture on the subgrade or subbase.

Other machines capable of accomplishing the required results, both in regard to uniform and depth in one pass, will be acceptable under this specification.

Approved methods shall be provided for accurately controlling the correct amount of filler, portland cement, or lime, and for their induction into the mixture at the specified time.

(c) Spreading Equipment. Blade graders for windrowing aggregate and for spreading processed material shall be self-powered.

(d) Rolling Equipment. The rollers shall be an approved type and in good condition as determined by the ENGINEER.

305-4.3 PREPARATION OF UNDERLYING COURSE. Prior to mixing and laydown, a 4-inch depth of existing material shall be windrowed to facilitate excavating and shaping the subgrade to proper section in accordance with Section 202.

305-4.4 MIXING. The aggregate, windrowed and prepared as specified, shall then be mixed with the bituminous material in the traveling mixing plant and then deposited for spreading.

The quantity of bituminous material calibrated for continuous mix shall be determined by the ENGINEER and introduced into the mixer. The mixing shall continue until all particles have been coated and a homogeneous mixture obtained.

Before spreading, the mixture shall be examined by the ENGINEER who shall determine that the mixing is complete and satisfactory. Should the mixture show an excess, deficiency, or uneven distribution of bituminous material, the unsatisfactory condition shall be corrected by the addition of the required aggregate or bituminous material and by remixing. Mixing or spreading shall be done only when authorized by the ENGINEER.

305-4.5 SPREADING AND FINISHING.

(a) General. Spreading shall not be started until the subgrade or subbase has been properly prepared, compacted, and approved by the ENGINEER.

Grade control between the edges of the pavement shall be accomplished by grade stakes or steel grade pins placed in lanes parallel to the centerline of the pavement and at intervals sufficiently close that string lines may be stretched between the stakes or pins.

When practicable, to protect the subgrade and to insure proper drainage, the mixing and spreading shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope.

(b) Spreading and Blade Finishing. The mixture shall be placed in lanes parallel to the centerline of the pavement and ending each day's run for the full width of the lane.

After the mixing has been completed, the mixed material shall be spread to the required width and depth by a self-powered blade grader, mechanical spreader, or other approved method. In spreading from a windrow, care shall be taken to prevent cutting into the underlying course. If necessary, to prevent such cutting, a layer of the mixture approximately 1/2-inch thick shall be left at the bottom of the windrow. The mixture shall be spread and cured in thin layers. If necessary, the surface shall be continually bladed until a smooth uniform surface, true to line, grade and cross section has been developed. Should the mixture show an excess, deficiency, or uneven distribution of bituminous material, corrective action shall be taken to alleviate these conditions.

After the base course material has been mixed, spreading shall not be started if threatening weather is apparent. The ENGINEER shall have control of the spreading, aeration, and rolling procedure. The CONTRACTOR shall regulate its operations in a scheduled manner by mixing only such amounts that can be spread, aerated, and compacted within relatively short periods. Those areas which become wet shall be dried and remixed with bituminous material. The remixing including applications of the bituminous material shall be handled to insure a thorough and uniform coating of the aggregate. Any wet mixture that remains unsatisfactory after remixing shall be removed.

305-4.6 COMPACTION OF MIXTURE. Aeration after mixing and prior to rolling shall be continued until the mixture is in suitable condition for proper compaction. After each layer has been placed and cured, it shall be thoroughly and uniformly compacted by rollers, as specified. Blading shall continue during the rolling only if so ordered by the ENGINEER.

Initial rolling shall be done longitudinally, overlapping at least 12 inches on successive trips. Alternate trips of power rollers shall be of slightly different lengths. Rolling shall continue until all roller marks are eliminated and until no deflection, rutting, and shoving is noticeable under pneumatic tired rollers.

The speed of the rollers shall at all times be slow to avoid displacement of the mixture. Any displacement occurring as a result of reversing the direction or the roller or from any other cause shall be corrected at once using rakes and fresh mixture. Sufficient rollers shall be furnished to handle the spreading output and aeration of the mixture.

Places not accessible to the roller shall be thoroughly compacted with tampers. The surface of the mixture after compaction shall be smooth and true to the established crown and grade.

Any mixture which becomes loose and broken, mixed with dirt, or defective in any way prior to acceptance, shall be removed and replaced at the CONTRACTOR's expense with fresh mixture which shall be compacted to conform with the surrounding area. Skin patching shall not be allowed. Any mixture remaining unbonded after rolling shall be removed and replaced.

305-4.7 SURFACE TESTS. The finished surface shall conform to the requirements of Subsection 401-4.13.

305-4.8 THICKNESS. The CONTRACTOR shall remove suitable size samples of the of the completed base course from locations designated by the ENGINEER to enable him to determine the thickness. When the base deficiency exceeds 1/2 inch, the CONTRACTOR shall correct such areas by scarifying, adding satisfactory base mixture, rolling, reshaping, and finishing in accordance with these specifications. The CONTRACTOR shall replace the base material where borings have been taken for test purposes.

305-4.9 MAINTENANCE. The surface of the base course shall be maintained in its finished condition until any surface course or surface treatment provided in the contract is placed thereon and until the contract is completed and accepted.

305-4.10 BITUMINOUS AND AGGREGATE MATERIAL CONTRACTOR'S RESPONSIBILITY. Samples of the bituminous and aggregate materials that the CONTRACTOR proposes to furnish, together with a statement of their source and character, shall be submitted to the ENGINEER; approval must be obtained before the use of such material begins. The CONTRACTOR shall require the manufacturer or producer of the bituminous and aggregate materials to furnish material subject to this and all other pertinent requirements of the contract. Only those materials that have demonstrated performance under the proposed design requirements will be accepted.

The CONTRACTOR shall furnish vendor's certificate test reports for each tanker, carload, or equivalent of bitumen shipped to the project. The report shall be delivered to the ENGINEER before permission is granted for use of the material. The furnishing of the vendor's certificate test report for the bituminous material shall not be interpreted as a basis for final acceptance. All such test reports shall be subject to verifications by testing samples of materials received for use on the project.

305-5 MEASUREMENT AND PAYMENT

305-5.1 MIXED IN-PLACE BASE COURSE. The Mixed In-Place Base Course shall be measured by the square yard (SY) and paid for at the unit price bid for "Mixed In-Place Base Course" complete in place and accepted by the ENGINEER.

305-5.2 BITUMINOUS MATERIAL. The Bituminous Material shall be measured by weighing and this weight converted to gallons at 60°F based on the unit weight shown on the certified analysis report on each car. Payment shall be made at the unit price bid per gallon (GAL) for "Bituminous Material."