

SPECIAL SPECIFICATION

ITEM 3028

Hot Mix Asphaltic Concrete Pavement Containing
Reclaimed Roofing Shingles

1. Description. This Item shall govern for the construction of a base course, a level-up course, a surface course or any combination of these courses as shown on the plans, each course being composed of a compacted mixture of aggregate, asphalt cement, and reclaimed asphalt shingles (RAS) mixed hot in a mixing plant, in accordance with the details shown on the plans and the requirements herein.
2. Materials. The Contractor shall furnish materials to the project meeting the following requirements prior to mixing. Additional test requirements affecting the quality of individual materials or the paving mixture shall be required when shown on the plans.
 - (1) Aggregate. The aggregate shall be composed of a coarse aggregate, a fine aggregate, and if required or allowed, a mineral filler and shall include RAS. Samples of each aggregate shall be submitted for approval in accordance with Item 6, "Control of Materials".

Aggregate from each stockpile shall meet the quality requirements of Table 1 and other requirements as specified herein. The aggregate contained in RAS will not be required to meet Table 1 requirements except as shown on the plans.

- (a) Coarse Aggregate. Coarse aggregate is defined as that part of the aggregate retained on a 2.00 millimeter sieve. The aggregate shall be natural, and be of uniform quality throughout. When shown on the plans, certain coarse aggregate material may be allowed, required or prohibited.

Gravel from each source shall be so crushed as to have a minimum of 85 percent of the particles retained on the 4.75 millimeter sieve with two or more mechanically induced crushed faces, as determined by Test Method Tex-460-A (Part I). The material passing the 4.75 millimeter sieve and retained on the 2.00 millimeter sieve must be the product of crushing aggregate that was originally retained on the 4.75 millimeter sieve.

The polish value of the virgin (not previously used in construction) coarse aggregate used in the surface or finish course shall not be less than the value shown on the plans, when tested in accordance with Test Method Tex-438-A.

Unless otherwise shown on the plans, the polish value requirement will apply only to aggregate used on travel lanes. For rated sources, the Materials and Tests Division's Rated Source Polish Value (RSPV) catalog will be used to determine polish value compliance.

- (b) Reclaimed Asphalt Shingles (RAS). RAS may consist of either manufacturing waste or consumer waste. In no instance shall the blending or mixing of manufacturing and consumer waste be allowed.

Manufacturing waste (MW) shingles are defined as new material that is obtained from a roofing shingle production plant. The shingles used in a particular mixture shall be from only one factory source, and shingles from more than one factory source shall not be mixed together. In addition, manufacturing waste shingles used in a particular mixture shall have a consistent binder content and aggregate gradation. Manufacturing waste shingles containing different aggregate types and gradations and different binder contents and viscosities shall not be mixed together.

Consumer waste (CW) shingles are those obtained during the removal of existing roofs (tearoffs).

The source of the RAS shall be preapproved before they may be used in HMA. The RAS supplier shall certify that the shingles contain no harmful quantities of asbestos in accordance with the guidelines provided by the Environmental Protection Agency.

The addition of RAS to HMA is very similar to the addition of reclaimed asphalt pavement (RAP) to the same mixture.

RAS shall have an asphalt content of 15 to 25 % by mass of shingle. The gradation of the aggregate in the RAS shall be such that 100% passes the 4.75 mm sieve and a maximum of 40% passes the 75 um sieve. The RAS shall be preprocessed by the Contractor so that 100% of the shingle particles pass the 19 mm sieve and 95% of the shingle particles pass the 12.5 mm sieve.

RAS can be stockpiled in one of two forms: (1) whole and/or partial shingles which have not yet been reduced in size or (2) shingles which have been shredded to meet the maximum size requirements stated above. Stockpiled RAS shall not be contaminated by dirt or other objectionable materials. Blending with aggregate may be necessary when it is desirable to stockpile shredded manufacturing waste to avoid conglomeration of the sticky shingle particles. Manufacturing waste shingles and consumer waste shingles shall be kept in separate stockpiles.

The polish value of the aggregate in the RAS will not be used in any determination of polish value specification compliance.

Any Contractor-owned RAS that is to be used on the project shall remain the property of the Contractor, while stockpiled. Any unused Contractor-owned RAS shall be removed from the project site upon completion of the project.

- (c) Fine Aggregate. The fine aggregate is defined as that part of the aggregate passing the 2.00 millimeter sieve and shall be of uniform quality throughout. When shown on the plans, certain fine aggregate material may be allowed, required or

prohibited. However, a maximum of 15 percent of the total virgin aggregate may be field sand or other uncrushed fine aggregate.

Screenings shall be supplied from sources whose coarse aggregate meets the Los Angeles abrasion and magnesium sulfate soundness loss requirements shown in Table 1, unless otherwise shown on the plans.

1. Unless otherwise shown on the plans, stone screenings are required and shall be the result of a rock crushing operation and meet the following gradation requirements, when tested in accordance with Test Method Tex-200-F, Part I.

Percent by Mass

Passing the 9.5 mm sieve	100
Passing the 2.00 mm sieve	70-100
Passing the 75 um sieve	0-15

2. Crushed gravel screenings may be used with, or in lieu of, stone screenings when shown on the plans. Crushed gravel screenings must be the product of crushing aggregate that was originally retained on the 4.75 millimeter sieve and meet the gradation for stone screenings shown above.

- (d) Mineral Filler. Mineral filler shall consist of thoroughly dried stone dust, portland cement, lime, fly ash, or other mineral dust approved by the Engineer. The mineral filler shall be free from foreign matter.

When a specific type of mineral filler is shown on the plans, fines collected by the baghouse or other air cleaning or dust collecting equipment shall not be used to meet this requirement. When mineral filler is not specifically required, the addition of baghouse or other collected fines will be permitted if the mixture quality is not adversely affected in the opinion of the Engineer. In no case shall the amount of material passing the 75 micrometer sieve exceed the tolerances of the job-mix formula or the master gradation limits.

When mineral filler is specified or allowed by the Engineer, or baghouse fines are permitted to be added to the mixture, it shall be proportioned into the mix by a vane meter or an equivalent measuring device acceptable to the Engineer. A hopper or other acceptable storage system shall be required to maintain a constant supply of mineral filler to the measuring device.

The measuring device for adding mineral filler shall be electronically coordinated with the automatic plant controls so that the supply of mineral filler will be automatically adjusted to plant production and provide a consistent percentage to the mixture. When shown on the plans, the measuring device for adding baghouse fines shall have controls in the plant control room which will allow manual adjustments of feed rates to match plant production rate adjustments.

When tested in accordance with Test Method Tex-200-F (Part I or Part III, as applicable), the mineral filler shall meet the following gradation requirements, unless otherwise shown on the plans. Baghouse fines are not required to meet the gradation requirements.

	Percent by Mass or Volume
Passing the 600 um sieve	95 - 100
Passing the 180 um sieve, not less than	75
Passing the 75 um sieve, not less than	55

Table 1
Aggregate
Quality Requirements *

Requirement	Test Method	Manufactured or Natural Aggregate	Lightweight Aggregate
COARSE AGGREGATE			
Dry Loose Unit Weight, kg/m ³ , minimum	Tex-404-A	-	560
Pressure Slaking Value, maximum	Tex-431-A	-	4.0
Freeze Thaw Loss, percent, maximum	Tex-432-A	-	7.0
24 Hour Water Absorption, percent, maximum	Tex-433-A	-	12.0
Deleterious Material, percent, maximum	Tex-217-F Part I	1.5	1.5
Decantation, percent, maximum	Tex-217-F Part II	1.5	1.5
Los Angeles Abrasion, percent, maximum	Tex-410-A	40	35
Magnesium Sulfate Soundness Loss, 5 cycle, percent, maximum	Tex-411-A	30**	-
FINE AGGREGATE			
Linear Shrinkage, maximum	Tex-107-E Part II	3	3
COMBINED AGGREGATES ***			
Sand Equivalent Value, minimum	Tex-203-F	45	45

* Sampled during delivery to the plant or from the stockpile, unless otherwise shown on the plans.

** Unless otherwise shown on the plans.

*** Aggregates, without added mineral filler, RAP, or additives, combined as used in the job-mix formula.

(2) Asphaltic Material.

(a) Paving Mixture. Asphalt cement for the paving mixture shall be of the grade shown on the plans or designated by the Engineer and shall meet the requirements of Item 300,

"Asphalts, Oils and Emulsions". The Contractor shall notify the Engineer of the source of the asphaltic material prior to design of the asphaltic mixture. This source shall not be changed during the course of the project without the authorization of the Engineer. Should the source of asphaltic material be changed, the moisture resistance of the new material combination will be evaluated to verify that the requirements of Section 3(1) are met.

(b) Tack Coat. Asphaltic materials, shown on the plans or approved by the Engineer, shall meet the requirements of Item 300, "Asphalts, Oils and Emulsions".

(3) Additives. Additives to facilitate mixing and/or improve the quality of the asphaltic mixture or tack coat shall be used when noted on the plans or may be used with the authorization of the Engineer.

Unless otherwise shown on the plans, the Contractor may choose to use either lime or a liquid antistripping agent to reduce the moisture susceptibility of the aggregate. The evaluation and addition of antistripping agents will be in accordance with Item 301 "Asphalt Antistripping Agents".

3. Paving Mixtures. The paving mixtures shall consist of a uniform mixture of aggregate, hot asphalt cement, and additives if allowed or required.

An asphalt mixture design is a laboratory process which includes the determination of the quality of the asphalt and the individual aggregates, the development of the job-mix formula, and the testing of the combined mixture.

The job-mix formula lists the quantity of each component to be used in the mix and the combined gradation of the aggregates used.

(1) Mixture Design. The Contractor shall furnish the Engineer with representative samples of the materials to be used in production. Using these materials, the mix will be designed in accordance with Test Method Tex-204-F to conform with the requirements herein. Unless otherwise shown on the plans, the Engineer will furnish the mixture design for mixtures when using 5 % RAS. The Engineer may accept a design from the Contractor which was derived using these design procedures.

The second and subsequent mixture designs, or partial designs, for each type of paving mixture which are necessitated by changes in the material or at the request of the Contractor will be charged to the Contractor when a rate is shown on the plans.

The bulk specific gravity will be determined for each aggregate to be used in the design mixture. If the determined values vary by 0.300 or more, the Volumetric Method, Test Method Tex-204-F, Part II, will be used. The bulk specific gravity of aggregates in RAP will be determined on extracted aggregates.

When properly proportioned, for the type specified, the blend of aggregates shall produce an aggregate gradation which will conform to the limits of the master grading shown in Table 2. Unless otherwise shown on the plans, the gradation of the aggregate will be determined in accordance with Test Method

Tex-200-F, Part I (Dry Sieve Analysis), to develop the job-mix formula.

The master grading limits for the appropriate type and the proposed job-mix formula will be plotted on a gradation chart with sieve sizes raised to the 0.45 power. This plot must show that the proposed job-mix formula is within the limits of the master grading. Gaps in gradation shown by this plot should be avoided.

The voids in the mineral aggregate (VMA) will be determined as a mixture design requirement only, in accordance with Test Method Tex-200-F, and shall not be less than the value indicated in Table 2.

Unless otherwise shown on the plans, the mixture of aggregate, asphalt and additives proposed for use will be evaluated in the design stage for moisture susceptibility in accordance with Item 301, "Asphalt Antistripping Agents ". The Engineer may waive this test if a similar design, using the same ingredients (excepting the use of RAS), has proven satisfactory.

To substantiate the design, trial mixtures shall be produced and tested using all of the proposed project materials and equipment prior to any placement. The Engineer may waive trial mixtures if similar designs not using RAS have proven satisfactory.

- (2) Density. The mixture shall be designed to produce an acceptable mixture at an optimum density of 96.0 percent, when tested in accordance with Test Method Tex-207-F and Test Method Tex-227-F. The operating range for control of laboratory density during production shall be optimum density plus or minus 1.5 percent.

Laboratory density is a mixture design and process control parameter. If the laboratory density of the mixture produced has a value outside the range specified above, the Contractor shall investigate the cause and take corrective action. If three (3) consecutive test results fall outside the specified range, production shall cease unless test results or other information indicate, to the satisfaction of the Engineer, that the next mixture to be produced will be within the specified range.

- (3) Stability. The materials used in the mixture design shall produce a mixture with a stability value of at least 35, unless otherwise shown on the plans, when tested in accordance with Test Method Tex-208-F.

If, during production, the stability value falls below the specified minimum, the Engineer and the Contractor shall closely evaluate other test result values for specification compliance such as gradation, asphalt content, moisture content, crushed faces, etc., to determine the cause and take corrective action. If three (3) consecutive test results fall below the minimum value specified, production shall cease unless test results or other information indicate, to the satisfaction of the Engineer, that the next material to be produced will meet the minimum value specified.

- (4) Job-Mix Formula Field Adjustments. The Contractor shall produce a mixture of uniform composition closely conforming to the approved job-mix formula.

If, during initial days of production, it is determined that adjustments to the mixture design job-mix formula are necessary to achieve the specified requirements, or to more nearly match the aggregate production, the Engineer may allow adjustment of the mixture design job-mix formula within the following limits without a laboratory redesign of the mixture. The adjusted job-mix formula shall not exceed the limits of the master grading for the type of mixture specified nor shall the adjustments exceed five (5) percent on any one sieve, 12.5 millimeter size and larger, or three (3) percent on the sieve sizes below the 12.5 millimeter sieve.

When the considered adjustments exceed either the five (5) or three (3) percent limits, and the Engineer determines that the impact of these changes may adversely affect pavement performance, a new laboratory mixture design will be required.

The asphalt content will be adjusted as deemed necessary by the Engineer to maintain desirable laboratory density near the optimum value while achieving other mix requirements.

- (5) Types. The aggregate gradation of the job-mix formula shall conform to the master grading limits shown in Table 2 for the type mix shown on the plans.

TABLE 2
Master Grading
Percent Passing by Mass or Volume

Sieve Size	Type				
	A	B	C	D	F
	Coarse Base	Fine Base	Coarse Surface	Fine Surface	Fine Mixture
37.5 mm	100				
31.5 mm	95-100				
25.0 mm		100			
22.4 mm	70-90	95-100	100		
16.0 mm		75-95	95-100		
12.5 mm	50-70			100	
9.5 mm		60-80	70-85	85-100	100
6.3 mm					95-100
4.75 mm	30-50	40-60	43-63	50-70	
2.0 mm	20-34	27-40	30-40	32-42	32-42
425 um	5-20	10-25	10-25	11-26	9-24
180 um	2-12	3-13	3-13	4-14	3-13
75 um	1-6 *	1-6 *	1-6 *	1-6 *	1-6 *
VMA % minimum	11	12	13	14	15

* 2-8 when Test Method Tex-200-F, Part II
(Washed Sieve Analysis) is used.

(6) Tolerances. The gradation of the aggregate and the asphalt cement content of the produced mixture shall not vary from the job-mix formula by more than the tolerances allowed herein. When within applied tolerances, the gradation of the produced mixture may fall outside the master grading limits for any of the sieve sizes from the largest sieve size on which aggregate may be retained down through the 180 micrometer sieve. Only the quantity of aggregate passing the 75 micrometer sieve is further restricted to conform to the master grading limitations shown in

Table 2 or as modified in Test Method Tex-229-F. A tolerance of two (2) percent is allowed on the sieve size for each mixture type which shows 100 percent passing in Table 2.

Tolerance,
Percent by Mass
or
Volume as Applicable

Passing the 31.5 mm to 2.00 mm sieve...	Plus or Minus 5
Passing the 425 um to 75 um sieve.....	Plus or Minus 3
Asphalt, mass	Plus or Minus 0.5
Asphalt, volume	Plus or Minus 1.2

The mixture will be tested in accordance with Test Method Tex-210-F, or Test Method Tex-228-F will be used in conjunction with combined cold feed belt samples tested in accordance with Test Method Tex-229-F. Other methods of proven accuracy may be used. The methods of test will be determined by the Engineer. However, mixtures produced by weigh-batch plants and all mixtures containing RAS will be tested for gradation in accordance with Test Method Tex-210-F. If three (3) consecutive tests indicate that the material produced exceeds the above tolerances on any individual sieve, or if two (2) consecutive tests indicate that the asphalt content tolerance is exceeded, production shall stop and not resume until test results or other information indicate, to the satisfaction of the Engineer, that the next mixture to be produced will be within the above tolerances.

When disagreements concerning determination of specification compliance occur between allowed sampling and testing procedures, extracted aggregate testing shall take precedence over cold feed belt testing.

When cold feed belt samples are used for job control, the Engineer will select the sieve analysis method that corresponds with the one used to determine the mixture design gradation. The tolerances will be adjusted as outlined in Test Method Tex-229-F.

4. Equipment.

- (1) General. All equipment for the handling of all materials, mixing, placing and compacting of the mixture shall be maintained in good repair and operating condition and subject to the approval of the Engineer. Any equipment found to be defective and potentially having a negative effect on the quality of the paving mixture or ride quality will not be allowed.
- (2) Mixing Plants. Mixing plants may be the weigh-batch type, the modified weigh-batch type, the drum-mix type, or the specialized recycling type. All plants shall be equipped with satisfactory conveyors, power units, mixing equipment, aggregate handling equipment, bins and dust collectors.

Automatic proportioning devices are required for all plants and shall be in accordance with Item 520, "Weighing and Measuring Equipment".

It shall be the Contractor's responsibility to provide safe and accurate means to enable inspection forces to take all required samples, to provide permanent means for checking the output of any specified metering device, and to perform calibration and

mass checks as required by the Engineer. When cold feed belt sampling is to be used for gradation testing, occasional stoppage of the belt may be necessary unless other means of sampling are approved by the Engineer.

When using fuel oil heavier than Grade No. 2, or waste oil, the Contractor shall insure that the fuel delivered to the burner is at a viscosity of 100 SSU or less, when tested in accordance with Test Method Tex-534-C, to insure complete burning of the fuel. Higher viscosities will be allowed if recommended by the burner manufacturer. If necessary, the Contractor shall preheat the oil to maintain the required viscosity.

The Contractor shall provide means for obtaining a sample of the fuel, just prior to entry into the burner, in order to perform the viscosity test. The Contractor shall perform this test or provide a laboratory test report that will establish the temperature of the fuel necessary to meet the viscosity requirements. There shall be an in-line thermometer to check the temperature of the fuel delivered to the burner.

Regardless of the burner fuel used, the burner or combination of burners and types of fuel used shall provide a complete burn of the fuel and not leave any fuel residue that will adhere to the heated aggregate or become mixed with the asphalt.

(a) Weigh-Batch Type.

Cold Aggregate Bin Unit and Proportioning Device. The cold aggregate bin unit shall have at least four bins of sufficient size to store the amount of aggregate required to keep the plant in continuous operation and of proper design to prevent overflow of material from one bin to another. There shall be vertical partitions between each bin and on each end of the bins of sufficient height so that any overflow will be to the front and back, and not allow overflow to the sides or between bins. Overflow that might occur shall not fall onto any feeder belt. The proportioning device shall provide a uniform and continuous flow of aggregate in the desired proportion to the dryer. Each aggregate shall be proportioned from a separate bin.

A separate cold bin shall be required for RAS. The RAS feed system shall be equipped with a scalping screen to remove particles over 19 millimeters in size. The cold bin system shall supply the proper amount of RAS to the weigh box. RAS will not be allowed in the hot bins.

When mineral filler is used, as specified in Section 2.(1)(d), an additional bin shall be provided.

Dryer. The dryer shall continually agitate the aggregate during heating. The temperature shall be controlled so that the aggregate will not be damaged in the drying and heating operations. The dryer shall be of sufficient size to keep the plant in continuous operation.

Screening and Proportioning. The screening capacity and size of the hot aggregate bins shall be sufficient to screen and store the amount of aggregate required to properly operate the plant and keep the plant in continuous operation

at full capacity. The hot bins shall be constructed so that oversize and overloaded material will be discarded through overflow chutes. Provisions shall be made to enable inspection forces to have easy and safe access to the proper location on the mixing plant where representative samples may be taken from the hot bins for testing. The aggregate shall be separated into at least four bins when producing Type "A", Type "B" or Type "C" mixtures, at least three bins when producing Type "D" mixture and at least two bins when producing Type "F" mixture. These bins shall contain the following sizes of aggregates, in percentages by mass or by volume, as applicable.

Type "A" (Coarse-Graded Base Course):

- Bin No. 1 - Shall contain aggregates of which 85 to 100 percent will pass the 2.00 mm sieve.
- Bin No. 2 - Shall contain aggregates of which at least 85 percent will be of such size as to pass the 12.5 mm sieve and be retained on the 2.00 mm sieve.
- Bin No. 3 - Shall contain aggregates of which at least 85 percent will be of such size as to pass the 22.4 mm sieve and be retained on the 9.5 mm sieve.
- Bin No. 4 - Shall contain aggregates of which at least 85 percent will be of such size as to pass the 37.5 mm sieve and be retained on the 22.4 mm sieve.

Type "B" (Fine-Graded Base Course):

- Bin No. 1 - Shall contain aggregates of which 85 to 100 percent will pass the 2.00 mm sieve.
- Bin No. 2 - Shall contain aggregates of which at least 70 percent will be of such size as to pass the 4.75 mm sieve and be retained on the 2.00 mm sieve.
- Bin No. 3 - Shall contain aggregates of which at least 75 percent will be of such size as to pass the 9.5 mm sieve and be retained on the 4.75 mm sieve.
- Bin No. 4 - Shall contain aggregates of which at least 75 percent will be of such size as to pass the 25.0 mm sieve and be retained on the 9.5 mm sieve.

Type "C" (Coarse-Graded Surface Course):

- Bin No. 1 - Shall contain aggregates of which 85 to 100 percent will pass the 2.00 mm sieve.
- Bin No. 2 - Shall contain aggregates of which at least 70 percent will be of such size as to pass the 4.75 mm sieve and be retained on the 2.00 mm sieve.
- Bin No. 3 - Shall contain aggregates of which at least 75 percent will be of such size as to pass the 9.5 mm sieve and be retained on the 4.75 mm sieve.

Bin No. 4 - Shall contain aggregates of which at least 75 percent will be of such size as to pass the 22.4 mm sieve and be retained on the 9.5 mm sieve.

Type "D" (Fine-Graded Surface Course):

Bin No. 1 - Shall contain aggregates of which 85 to 100 percent will pass the 2.00 mm sieve.

Bin No. 2 - Shall contain aggregates of which at least 70 percent will be of such size as to pass the 4.75 mm sieve and be retained on the 2.00 mm sieve.

Bin No. 3 - Shall contain aggregates of which at least 75 percent will be of such size as to pass the 12.5 mm sieve and be retained on the 4.75 mm sieve.

Type "F" (Fine-Graded Mixture):

Bin No. 1 - Shall contain aggregates of which 85 to 100 percent will pass the 2.00 mm sieve.

Bin No. 2 - Shall contain aggregates of which at least 75 percent will be of such size as to pass the 9.5 mm sieve and be retained on the 2.00 mm sieve.

Aggregate Weigh Box and Batching Scale. The aggregate weigh box and batching scales shall be of sufficient capacity to hold and weigh a complete batch of aggregate. The weigh box and scales shall conform to the requirements of Item 520, "Weighing and Measuring Equipment".

Asphaltic Material Measuring System. If an asphaltic material bucket and scales are used, they shall be of sufficient capacity to hold and weigh the necessary asphaltic material for one batch. The bucket and scales shall conform to the requirements of Item 520, "Weighing and Measuring Equipment".

If a pressure type flow meter is used to measure the asphaltic material, the requirements of Item 520, "Weighing and Measuring Equipment", shall apply. This system shall include an automatic temperature compensation device to insure a constant percent by mass of asphaltic material in the mixture.

Provisions of a permanent nature shall be made for checking the accuracy of the asphaltic material measuring device. The asphalt line to the measuring device shall be protected with a jacket of hot oil or other approved means to maintain the temperature of the line near the temperature specified for the asphaltic material.

Mixer. The mixer shall be of the pugmill type and shall have a capacity of not less than 1350 kilograms (of natural-aggregate mixture) in a single batch, unless otherwise shown on the plans. Any mixer that has a tendency to segregate the aggregate or fails to secure a thorough and uniform mixture with the asphaltic material shall not be used. All mixers shall be provided with an automatic timer that will lock the discharge doors of the mixer for the required

mixing period. The dump door or doors and the shaft seals of the mixer shall be tight enough to prevent spilling of aggregate or mixture from the pugmill.

Surge-Storage System and Scales. A surge-storage system may be used to minimize the production interruptions during the normal day's operations. A device such as a gob hopper or other device approved by the Engineer to prevent segregation in the surge-storage bin shall be used. The mixture shall be weighed upon discharge from the surge-storage system.

When a surge-storage system is used, scales shall be standard platform truck scales or other equipment such as weigh hopper (suspended) scales and shall conform to Item 520, "Weighing and Measuring Equipment". If truck scales are used, they shall be placed at a location approved by the Engineer. If other weighing equipment is used, the Engineer may require mass checks by truck scales for the basis of approval of the equipment.

Recording Device and Record Printer. The mixture shall be weighed for payment. If a surge-storage system is used, an automatic recording device and a digital record printer shall be provided to indicate the date, project identification number, vehicle identification, total mass of the load, tare mass of the vehicle, the mass of asphaltic mixture in each load and the number of loads for the day, unless otherwise shown on the plans. When surge-storage is not used, batch mass will be used as the basis for payment and automatic recording devices and automatic digital record printers in accordance with Item 520, "Weighing and Measuring Equipment", shall be required.

(b) Modified Weigh-Batch Type.

General. This plant is similar to the weigh-batch type plant. The hot bin screens shall be removed and the aggregate control is placed at the cold feeds. The cold feed bins will be the same as those required for the drum-mix type plant.

Cold-Aggregate Bin Unit and Feed System. The number of bins in the cold-aggregate bin unit shall be equal to or greater than the number of stockpiles of individual materials to be used.

The bins shall be of sufficient size to store the amount of aggregate required to keep the plant in continuous operation and of proper design to prevent overflow of material from one bin to another. There shall be vertical partitions between each bin and on each end of the bins of sufficient heights so that any overflow will be to the front and back and not allow overflow to the sides or between bins. Overflow that might occur shall not fall onto any feeder belt. When required by the Engineer, an approved stationary scalping screen shall be placed on top of the field sand bin to eliminate roots and other objectionable material. The feed system shall provide a uniform and continuous flow of

aggregate in the desired proportion to the dryer. The Contractor shall furnish a chart indicating the calibration of each cold bin in accordance with the manufacturer's recommendations or in a method acceptable to the Engineer.

When mineral filler is used, as specified in Section 2.(1)(d), an additional bin shall be provided.

A separate cold bin shall be required for RAS. The RAS feed system shall be equipped with a scalping screen to remove particles over 19 millimeters in size. The cold bin system shall supply a uniform and proper amount of RAS to the mixture. RAS may be added at the weigh box. If not added at the weigh box, the system shall include means acceptable to the Engineer to verify that the correct amount of RAS is continuously being fed.

Scalping Screen. A scalping screen shall be required after the cold feeds and ahead of the hot aggregate surge bins.

Dryer. The dryer shall continually agitate the aggregate during heating. The temperature shall be controlled so that the aggregate will not be damaged in the drying and heating operations. The dryer shall be of sufficient size to keep the plant in continuous operation.

Screening and Proportioning. The hot aggregate shall not be separated into sizes after being dried. There shall be one or more surge bins provided between the dryer and the weigh hopper. Surge bins shall be of sufficient size to hold enough combined aggregate for one complete batch of mixture.

Aggregate Weigh Box and Batching Scale. The aggregate weigh box and batching scales shall be of sufficient capacity to hold and weigh a complete batch of aggregate. The weigh box and scales shall conform to the requirements of Item 520, "Weighing and Measuring Equipment".

Asphaltic Material Measuring System. If an asphaltic material bucket and scales are used, they shall be of sufficient capacity to hold and weigh the necessary asphaltic material for one batch. The bucket and scales shall conform to the requirements of Item 520, "Weighing and Measuring Equipment".

If a pressure type flow meter is used to measure the asphaltic material, the requirements of Item 520, "Weighing and Measuring Equipment", shall apply. This system shall include an automatic temperature compensation device to insure a constant percent by mass of asphaltic material in the mixture.

Provisions of a permanent nature shall be made for checking the accuracy of the asphaltic material measuring device. The asphalt line to the measuring device shall be protected with a jacket of hot oil or other approved means to maintain the temperature of the line near the temperature specified for the asphaltic material.

Mixer. The mixer shall be of the pugmill type and shall have a capacity of not less than 1350 kilograms (of natural-aggregate mixture) in a single batch, unless otherwise shown on the plans. Any mixer that has a tendency to segregate the aggregate or fails to secure a thorough and uniform mixture with the asphaltic material shall not be used. All mixers shall be provided with an automatic timer that will lock the discharge doors of the mixer for the required mixing period. The dump door or doors and the shaft seals of the mixer shall be tight enough to prevent spilling of aggregate or mixture from the pugmill.

Surge-Storage System and Scales. A surge-storage system may be used to minimize the production interruptions during the normal day's operations. A device such as a gob hopper or other device approved by the Engineer to prevent segregation in the surge-storage bin shall be used. The mixture shall be weighed upon discharge from the surge-storage system.

When a surge-storage system is used, scales shall be standard platform truck scales or other equipment such as weigh hopper (suspended) scales and shall conform to Item 520, "Weighing and Measuring Equipment". If truck scales are used, they shall be placed at a location approved by the Engineer. If other weighing equipment is used, the Engineer may require mass checks by truck scales for the basis of approval of the equipment.

Recording Device and Record Printer. The mixture shall be weighed for payment. If a surge-storage system is used, an automatic recording device and a digital record printer shall be provided to indicate the date, project identification number, vehicle identification, total mass of the load, tare mass of the vehicle, the mass of asphaltic mixture in each load and the number of loads for the day, unless otherwise indicated on the plans. When surge-storage is not used, batch mass will be used as the basis for payment and automatic recording devices and automatic digital record printers in accordance with Item 520, "Weighing and Measuring Equipment", shall be required.

(c) Drum-Mix Type.

General. The plant shall be adequately designed and constructed for the process of mixing aggregates and asphalt. The plant shall be equipped with satisfactory conveyors, power units, aggregate-handling equipment and feed controls.

Cold-Aggregate Bin Unit and Feed System. The number of bins in the cold-aggregate bin unit shall be equal to or greater than the number of stockpiles of individual materials to be used.

The bins shall be of sufficient size to store the amount of aggregate required to keep the plant in continuous operation and of proper design to prevent overflow of material from one bin to another. There shall be vertical partitions between each bin and on each end of the bins of sufficient height so that any overflow will be to the front and back and not allow overflow to the sides or between bins.

Overflow that might occur shall not fall onto any feeder belt. When required by the Engineer, an approved stationary scalping screen shall be placed on top of the field sand bin to eliminate roots and other objectionable material. The feed system shall provide a uniform and continuous flow of aggregate in the desired proportion to the mixer. The Contractor shall furnish a chart indicating the calibration of each cold bin in accordance with the manufacturer's recommendations or in a method acceptable to the Engineer.

The system shall provide positive mass measurement of the combined cold-aggregate feed by use of belt scales or other approved devices. Provisions of a permanent nature shall be made for checking the accuracy of the measuring device as required by Item 520, "Weighing and Measuring Equipment". When a belt scale is used, mixture production shall be maintained so that the scale normally operates between 50 percent and 100 percent of its rated capacity. Belt scale operation below 50 percent of the rated capacity may be allowed by the Engineer if accuracy checks show the scale to meet the requirements of Item 520, "Weighing and Measuring Equipment", at the selected rate. It shall be satisfactorily demonstrated to the Engineer that mixture uniformity and quality have not been adversely affected.

A separate cold bin shall be required for RAS. The RAS feed system shall be equipped with a scalping screen to remove particles over 19 millimeters in size prior to the weighing device. There shall be adequate cold bin controls to provide a uniform amount of RAS to the mixture.

When RAS is used, positive mass measurement of this material shall be provided by the use of belt scales or other approved devices.

Scalping Screen. A scalping screen shall be required after the cold feeds and ahead of the combined aggregate belt scales.

Asphaltic Material Measuring System. An asphaltic material measuring device meeting the requirements of Item 520, "Weighing and Measuring Equipment", shall be placed in the asphalt line leading to the mixer so that the cumulative amount of asphalt used can be accurately determined. Provisions of a permanent nature shall be made for checking the accuracy of the measuring device output. The asphalt line to the measuring device shall be protected with a jacket of hot oil or other approved means to maintain the temperature of the line near the temperature specified for the asphaltic material. The measuring system shall include an automatic temperature compensation device to maintain a constant percent by mass of asphaltic material in the mixture.

Synchronization Equipment for Feed-Control System. The asphaltic material feed-control shall be coupled with the total aggregate mass measuring device to automatically vary the asphalt-feed rate in order to maintain the required proportion.

Mixing System. The mixing system shall control the temperature so that the aggregate and asphalt will not be damaged in the drying, heating and mixing operations. A continuously recording thermometer shall be provided which will indicate the temperature of the mixture as it leaves the mixer.

Surge-Storage System and Scales. A surge-storage system shall be used to minimize the production interruptions during the normal day's operations. A device such as a gob hopper or other device approved by the Engineer to prevent segregation in the surge-storage bin shall be used. The mixture shall be weighed upon discharge from the surge-storage system.

Scales shall be standard platform truck scales or other equipment such as weigh hopper (suspended) scales and shall conform to Item 520, "Weighing and Measuring Equipment". If truck scales are used, they shall be placed at a location approved by the Engineer. If other weighing equipment is used, the Engineer may require mass checks by truck scales for the basis of approval of the equipment.

Recording Device and Record Printer. Automatic recording devices and automatic digital record printers shall be provided to indicate the date, project identification number, vehicle identification, total mass of the load, tare mass of the vehicle, the mass of asphaltic mixture in each load and the number of loads for the day in accordance with Item 520, "Weighing and Measuring Equipment", unless otherwise shown on the plans.

(d) Specialized Recycling Type.

General. Alternate methods of heating may be used which will not abnormally age the asphalt cement. This type of plant shall be capable of continually producing a minimum of 136 megagrams per hour of completed asphalt mixture that will meet all the requirements of this specification.

Cold-Aggregate Bin Unit and Feed System. The cold-aggregate feed system and controls shall meet all the requirements as listed under the drum-mix type plant.

Scalping Screen. A scalping screen shall be required after the cold feeds and ahead of the combined aggregate belt scales.

Dryer. The dryer shall continually agitate the RAS and aggregate during heating. The temperature shall be controlled so that the aggregate and asphalt will not be damaged in the drying and heating operations. The dryer shall be of sufficient size to keep the plant in continuous operation.

Asphalt Material Measuring System. An asphaltic material measuring device meeting the requirements of Item 520, "Weighing and Measuring Equipment", shall be placed in the asphalt line leading to the mixer so that the cumulative amount of asphalt used can be accurately determined. Provisions of a permanent nature shall be made for checking

the accuracy of the measuring device output. The asphalt line to the measuring device shall be protected with a jacket of hot oil or other approved means to maintain the temperature of the line near the temperature specified for the asphaltic material. The measuring system shall include an automatic temperature compensation device to maintain a constant percent by mass of asphaltic material in the mixture.

Synchronization Equipment for Feed-Control Systems. The asphaltic material feed-control shall be coupled with the total aggregate mass measuring device to automatically vary the asphalt-feed rate in order to maintain the required proportion.

Mixer. The mixer shall be of the continuous mechanical mixing type. Any mixer that has a tendency to segregate the mixture or fails to secure a thorough and uniform mixture shall not be used. A continuously recording thermometer shall be provided which will indicate the temperature of the mixture as it leaves the mixer.

Surge-Storage System and Scales. A surge-storage system shall be used to minimize the production interruptions during the normal day's operations. A device such as a gob hopper or other device approved by the Engineer to prevent segregation in the surge-storage bin shall be used. The mixture shall be weighed upon discharge from the surge-storage system.

Scales shall be standard platform truck scales or other equipment such as weigh hopper (suspended) scales and shall conform to Item 520, "Weighing and Measuring Equipment". If truck scales are used, they shall be placed at a location approved by the Engineer. If other weighing equipment is used, the Engineer may require mass checks by truck scales for the basis of approval of the equipment.

Recording Device and Record Printer. Automatic recording devices and automatic digital record printers shall be provided to indicate the date, project identification number, vehicle identification, total mass of the load, tare mass of the vehicle, the mass of asphaltic mixture in each load and the number of loads for the day in accordance with Item 520, "Weighing and Measuring Equipment", unless otherwise shown on the plans.

- (3) Asphaltic Material Heating Equipment. Asphaltic material heating equipment shall be adequate to heat the required amount of asphaltic material to the desired temperature. The heating apparatus shall be equipped with a continuously recording thermometer with a 24-hour chart that will record the temperature of the asphaltic material at the location of highest temperature.
- (4) Spreading and Finishing Machine. The spreading and finishing machine shall be approved by the Engineer and shall meet the requirements indicated below.

- (a) Screed Unit. The spreading and finishing machine shall be equipped with a heated compacting screed. It shall produce a finished surface meeting the requirements of the typical cross sections and the surface tests.

Extensions added to the screed shall be provided with the same compacting action and heating capability as the main screed unit, except for use on variable depth tapered areas and/or as approved by the Engineer.

The spreading and finishing machine shall be equipped with an approved automatic dual longitudinal screed control system and automatic transverse screed control system. The longitudinal controls shall be capable of operating from any longitudinal grade reference including a stringline, ski, mobile stringline, or matching shoe.

The Contractor shall furnish all equipment required for grade reference. It shall be maintained in good operating condition by personnel trained in the use of this type of equipment.

The grade reference used by the Contractor may be of any type approved by the Engineer. Control points, if required by the plans, shall be established for the finished profile in accordance with Item 5, "Control of the Work". These points shall be set at intervals not to exceed 15 meters. The Contractor shall set the grade reference from the control points. The grade reference shall have sufficient support so that the maximum deflection shall not exceed two (2) millimeters between supports.

- (b) Tractor Unit. The tractor unit shall be equipped with a hydraulic hitch sufficient in design and capacity to maintain contact between the rear wheels of the hauling equipment and the pusher rollers of the finishing machine while the mixture is being unloaded.

No portion of the mass of hauling equipment, other than the connection, shall be supported by the asphalt paver. No vibrations or other motions of the loading equipment, which could have a detrimental effect on the riding quality of the completed pavement, shall be transmitted to the paver.

The use of any vehicle which requires dumping directly into the finishing machine and which the finishing machine cannot push or propel to obtain the desired lines and grades without resorting to hand finishing will not be allowed.

- (5) Material Transfer Equipment. Equipment to transfer mixture from the hauling units or the roadbed to the spreading and finishing machine will be allowed unless otherwise shown on the plans. A specific type of material transfer equipment shall be required when shown on the plans.

- (a) Windrow Pick-Up Equipment. Windrow pick-up equipment shall be constructed in such a manner that substantially all the mixture deposited on the roadbed is picked up and loaded into the spreading and finishing machine. The mixture shall not be contaminated with foreign material. The loading equipment shall be designed so that it does not interfere

with the spreading and finishing machine in obtaining the required line, grade and surface without resorting to hand finishing.

- (b) Material Feeding System. Material feeding systems shall be designed to provide a continuous flow of uniform mixture to the spreading and finishing machine. When use of a material feeding system is required on the plans, it shall meet the storage capacity, remixing capability, or other requirements shown on the plans.
- (6) Motor Grader. The motor grader, when used, shall be a self-propelled power motor grader and shall be equipped with smooth tread pneumatic tired wheels unless otherwise directed. It shall have a blade length of not less than 3.6 meters and a wheelbase of not less than 4.8 meters.
- (7) Rollers. Rollers provided shall meet the requirements for their type as follows:
 - (a) Pneumatic-Tire Roller. The roller shall be an acceptable medium pneumatic tire roller conforming to the requirements of Item 213, "Rolling (Pneumatic Tire)", Type A, unless otherwise specified on the plans. Pneumatic-tire rollers used for compaction shall provide a minimum 550 kilopascals ground contact pressure. When used for kneading and sealing the surface only, they shall provide a minimum of 380 kilopascals ground contact pressure.
 - (b) Two-Axle Tandem Roller. This roller shall be an acceptable self-propelled tandem roller weighing not less than 7.2 megagrams.
 - (c) Three-Wheel Roller. This roller shall be an acceptable self-propelled three wheel roller weighing not less than 9.1 megagrams.
 - (d) Three-Axle Tandem Roller. This roller shall be an acceptable self-propelled three axle roller weighing not less than 9.1 megagrams.
 - (e) Trench Roller. This roller shall be an acceptable self-propelled trench roller equipped with a sprinkler for keeping the wheels wet and an adjustable road wheel so that the roller may be kept level during rolling. The drive wheel shall be not less than 500 millimeters wide. The roller under working conditions shall produce not less than 5800 kilograms per meter of roller width and be so geared that a speed of approximately three (3) kilometers per hour is obtained in low gear.
 - (f) Vibratory Steel-Wheel Roller. This roller shall have a minimum mass of 5.4 megagrams. The compactor shall be equipped with amplitude and frequency controls and shall be specifically designed to compact the material on which it is used.
- (8) Straightedges and Templates. When directed by the Engineer, the Contractor shall provide acceptable 3-meter straightedges for surface testing. Satisfactory templates shall be provided as required by the Engineer.

- (9) Alternate Equipment. When permitted by the Engineer, equipment other than that specified herein which will consistently produce satisfactory results may be used.

5. Stockpiling, Storage and Mixing.

(1) Stockpiling of Aggregates.

- (a) Weigh-Batch Plant. Prior to stockpiling of aggregates, the area shall be cleaned of trash, weeds, grass and shall be relatively smooth and well drained. The stockpiling shall be done in a manner that will minimize aggregate degradation, segregation, mixing of one stockpile with another, and will not allow contamination with foreign material.

The plant shall have at least a two-day supply of aggregates on hand before production can begin and at least a two-day supply shall be maintained through the course of the project, unless otherwise directed by the Engineer.

No stockpile shall contain aggregate from more than one source.

Coarse aggregates for mixture Types "A", "B" and "C" shall be separated into at least two stockpiles of different gradation, such as a large-coarse-aggregate and a small-coarse-aggregate stockpile, except when the use of large percentages of RAP preclude the need for two virgin coarse aggregate stockpiles.

When shown on the plans, coarse aggregates for Type "D" mixtures shall also be separated into at least two stockpiles.

No coarse-aggregate stockpile shall contain more than 15 percent by mass of material that will pass a 2.00 millimeter sieve.

Fine-aggregate stockpiles may contain coarse aggregate in amounts up to 20 percent by mass. This requirement does not apply to stone screenings stockpiles, which must meet the gradation requirements shown in Section 2.(1)(c), unless otherwise shown on the plans.

Prior to starting RAS stockpiling operations, the Contractor shall develop and submit in writing to the Engineer an acceptable stockpile production procedure and management plan which will ensure that homogeneous stockpiles of RAS are available. Stockpiles of Contractor-owned RAS material shall be completely established at the plant site or another approved location prior to submission of mixture design samples and shall be of sufficient quantity to meet the material requirements of the project for which they are prepared.

When required by the Engineer, additional material shall not be added to stockpiles that have previously been sampled for approval.

Equipment of an acceptable size and type shall be furnished to work the stockpiles and prevent segregation and degradation of the aggregates.

- (b) Modified Weigh-Batch Plant. The stockpiling requirements for aggregate shall be the same as required for a drum-mix type plant.
- (c) Drum-Mix Plant. When a drum-mix plant is used, the following stockpiling requirements for coarse aggregates shall apply in addition to the aggregate stockpiling requirements listed under Section 5.(1)(a).

Once a job-mix formula has been established in accordance with Article 3, the virgin coarse aggregates delivered to the stockpiles shall not vary on any grading size fraction by more than plus or minus eight (8) percentage points from the percentage found in the samples submitted by the Contractor and upon which the job-mix formula was based. Should the gradation of virgin coarse aggregates in the stockpiles vary by more than the allowed tolerance, the Engineer may stop production. If production is stopped, new aggregates shall be furnished that meet the gradations of the aggregates submitted for the job-mix formula, or a new mix design shall be formulated in accordance with Article 3.

When the volume of production from a commercial plant makes sampling of all coarse aggregate delivered to the stockpiles impractical, cold feeds will be sampled to determine stockpile uniformity. Should this sampling prove the stockpiles non-uniform beyond the acceptable tolerance, separate stockpiles which meet these specifications may be required.

- (d) Specialized Recycling Plant. The stockpiling requirements for aggregate shall be the same as required for drum-mix type plant.
- (2) Storage and Heating of Asphaltic Materials. The asphaltic material storage capacity shall be ample to meet the requirements of the plant. Asphalt shall not be heated to a temperature in excess of that specified in Item 300, "Asphalts, Oils and Emulsions". All equipment used in the storage and handling of asphaltic material shall be kept in a clean condition at all times and shall be operated in such a manner that there will be no contamination with foreign matter.
 - (3) Feeding and Drying of Aggregate. The feeding of various sizes of aggregate and RAS, if applicable, to the dryer shall be done through the cold aggregate bins and the proportioning device in such a manner that a uniform and constant flow of materials in the required proportions will be maintained. The aggregate shall be dried and heated to the temperature necessary to produce a mixture having the specified temperature.
 - (4) Mixing and Storage.
 - (a) Weigh-Batch Plant. In introducing the batch into the mixer, all aggregate shall be introduced first and shall be mixed thoroughly for a minimum period of 5 seconds to uniformly distribute the various sizes throughout the batch before the

asphaltic material is added. The asphaltic material shall then be added and the mixing continued for a wet mixing period of not less than 15 seconds. The mixing period shall be increased if, in the opinion of the Engineer, the mixture is not uniform or the aggregates are not properly coated.

Temporary storing or holding of the asphaltic mixture by the surge-storage system will be permitted during the normal day's operation. Overnight storage will not be permitted unless authorized in the plans or by the Engineer. The mixture coming out of the surge-storage bin shall be of equal quality to that coming out of the mixer.

- (b) Modified Weigh-Batch Plant. The mixing and storage requirements shall be the same as is required for a standard weigh-batch plant.
- (c) Drum-Mix Plant. The amount of aggregate and asphaltic material entering the mixer and the rate of travel through the mixing unit shall be so coordinated that a uniform mixture of the specified grading and asphalt content will be produced.

Temporary storing or holding of the asphaltic mixture by the surge-storage system will be required during the normal day's operation. Overnight storage will not be permitted unless authorized in the plans or by the Engineer. The mixture coming out of the surge-storage bin shall be of equal quality to that coming out of the mixer.

- (d) Specialized Recycling Plant. The mixing and storage requirements shall be the same as that stated for the drum-mix plant.
- (e) Discharge Temperature. The Engineer will select the target discharge temperature of the mixture between 120 C and 175 C. The mixture, when discharged from the mixer, shall not vary from this selected temperature more than 15 C, but in no case shall the temperature exceed 180 C.
- (f) Moisture Content. The mixture produced from each type of mixer shall have a moisture content not greater than one (1) percent by weight when discharged from the mixer, unless otherwise shown on the plans and/or approved by the Engineer. The moisture content shall be determined in accordance with Test Method Tex-212-F.

6. Construction Methods.

- (1) General. It shall be the responsibility of the Contractor to produce, transport, place and compact the specified paving mixture in accordance with the requirements herein.

The asphaltic mixture, when placed with a spreading and finishing machine, or the tack coat shall not be placed when the air temperature is below 10 C and is falling, but it may be placed when the air temperature is above 5° C and is rising.

The asphaltic mixture, when placed with a motor grader, shall not be placed when the air temperature is below 15° C and is falling, but may be placed when the air temperature is above 10° C and is rising.

The air temperature shall be taken in the shade away from artificial heat.

Mat thicknesses of 40 millimeters and less shall not be placed when the temperature of the surface on which the mat is to be placed is below 10 C.

Mixtures with lightweight coarse aggregate shall not be placed when the temperature of the surface on which the mat is to be placed is below 10 C.

Additional surface temperature requirements may be shown on the plans.

It is further provided that the tack coat or asphaltic mixture shall be placed only when the humidity, general weather conditions and temperature and moisture condition of the base, in the opinion of the Engineer, are suitable.

If, after being discharged from the mixer and prior to placing, the temperature of the asphaltic mixture is 10 C or more below the selected discharge temperature established by the Engineer, all or any part of the load may be rejected and payment will not be made for the rejected material.

- (2) Tack Coat. The surface upon which the tack coat is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer. The surface shall be given a uniform application of tack coat using asphaltic materials of this specification. This tack coat shall be applied, as directed by the Engineer, with an approved sprayer at a rate not to exceed 0.2 liter residual asphalt per square meter of surface. Where the mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated by the Engineer. All contact surfaces of curbs and structures and all joints shall be painted with a thin uniform application of tack coat. During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutter and structures. The tack coat shall be rolled with a pneumatic tire roller when directed by the Engineer.
- (3) Transporting Asphaltic Concrete. The asphaltic mixture shall be hauled to the work site in tight vehicles previously cleaned of all foreign material. The dispatching of the vehicles shall be arranged so that all material delivered is placed and all rolling completed during daylight hours unless otherwise shown on the plans. In cool weather or for long hauls, covering and insulating of the truck bodies may be required. If necessary, to prevent the mixture from adhering to the body, the inside of the truck may be given a light coating of release agent satisfactory to the Engineer.

(4) Placing.

- (a) The asphaltic mixture shall be dumped and spread on the approved prepared surface with the spreading and finishing machine. When properly compacted, the finished pavement shall be smooth, of uniform texture and density and shall meet the requirements of the typical cross sections and the surface tests. In addition, the placing of the asphaltic mixture shall be done without tearing, shoving, gouging or segregating the mixture and without producing streaks in the mat.

Unloading into the finishing machine shall be controlled so that bouncing or jarring the spreading and finishing machine shall not occur and the required lines and grades shall be obtained without resorting to hand finishing, except as shown under Section 6.(4)(d).

Unless otherwise shown on the plans, dumping of the asphaltic mixture in a windrow and then placing the mixture in the finishing machine with windrow pick-up equipment will be permitted. The windrow pick-up equipment shall be operated in such a manner that substantially all the mixture deposited on the roadbed is picked up and loaded into the finishing machine without contamination by foreign material. The windrow pick-up equipment will be so operated that the finishing machine will obtain the required line, grade and surface without resorting to hand finishing. Any operation of the windrow pick-up equipment resulting in the accumulation and subsequent shedding of accumulated material into the asphaltic mixture will not be permitted.

- (b) When approved by the Engineer, level-up courses may be spread with a motor grader.
- (c) The spreading and finishing machine shall be operated at a uniform forward speed consistent with the plant production rate, hauling capability, and roller train capacity to result in a continuous operation. The speed shall be slow enough that stopping between trucks is not ordinarily required. If, in the opinion of the Engineer, sporadic delivery of material is adversely affecting the mat, the Engineer may require paving operations to cease until acceptable methods are provided to minimize starting and stopping of the paver.

The hopper flow gates of the spreading and finishing machine shall be adjusted to provide an adequate and consistent flow of material. These shall result in enough material being delivered to the augers so that they are operating approximately 85 percent of the time or more. The augers shall provide means to supply adequate flow of material to the center of the paver. Augers shall supply an adequate flow of material for the full width of the mat, as approved by the Engineer. Augers should be kept approximately one-half to three-quarters full of mixture at all times during the paving operation.

- (d) When the asphaltic mixture is placed in a narrow strip along the edge of an existing pavement, or used to level up small areas of an existing pavement, or placed in small irregular

areas where the use of a finishing machine is not practical, the finishing machine may be eliminated when authorized by the Engineer.

- (e) Adjacent to flush curbs, gutters and structures, the surface shall be finished uniformly high so that when compacted it will be slightly above the edge of the curb or structure.
- (f) Construction joints of successive courses of asphaltic material shall be offset at least 150 millimeters. Construction joints on surface courses shall coincide with lane lines, or as directed by the Engineer.
- (g) If a pattern of surface irregularities or segregation is detected, the Contractor shall make an investigation into the causes and immediately take the necessary corrective action. With the approval of the Engineer, placement may continue for no more than one full production day from the time the Contractor is first notified and while corrective actions are being taken. If the problem still exists after that time, paving shall cease until the Contractor further investigates the causes and the Engineer approves further corrective action to be taken.

(5) Compacting.

- (a) The pavement shall be compacted thoroughly and uniformly with the necessary rollers to obtain the compaction and cross section of the finished paving mixture meeting the requirements of the plans and specifications.
- (b) When rolling with the three-wheel, tandem or vibratory rollers, rolling shall start by first rolling the joint with the adjacent pavement and then continue by rolling longitudinally at the sides and proceed toward the center of the pavement, overlapping on successive trips by at least 300 millimeters, unless otherwise directed by the Engineer. Alternate trips of the roller shall be slightly different in length. On super-elevated curves, rolling shall begin at the low side and progress toward the high side, unless otherwise directed by the Engineer.

When rolling with vibratory steel-wheel rollers, equipment operation shall be in accordance with Item 217, "Rolling (Vibratory)," and manufacturer's recommendations, unless otherwise directed by the Engineer. In addition they shall be operated at a speed and frequency to provide at least ten impacts of vibration per foot of travel when operated in the vibrating mode. Vibratory rollers shall not be left vibrating while not rolling or when changing directions. Unless otherwise shown on the plans or approved by the Engineer, vibratory rollers shall not be allowed in the vibrating mode on mats with a plan depth of less than 40 millimeters.

The motion of the rollers shall be slow enough to avoid other than usual initial displacement of the mixture. If any displacement occurs, it shall be corrected to the satisfaction of the Engineer. The roller shall not be allowed to stand on pavement which has not been fully compacted. To prevent adhesion of the surface mixture to

the steel-wheel rollers, the wheels shall be kept thoroughly moistened with water, but an excess of water will not be permitted. Necessary precautions shall be taken to prevent the dropping of diesel, gasoline, oil, grease or other foreign matter on the pavement, either when the rollers are in operation or when standing.

- (c) The edges of the pavement along curbs, headers and similar structures, and all places not accessible to the roller, or in such positions as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.
 - (d) Rolling with a trench roller will be required on widened areas, in trenches and other limited areas where satisfactory compaction cannot be obtained with the approved rollers.
- (6) In-Place Compaction Control. In-place compaction control is required for all mixtures. Unless otherwise shown on the plans, air void control shall be required.
- (a) Air Void Control. The Contractor shall be responsible for determining the number and type of rollers to be used to obtain compaction to within the air void range required herein. The rollers shall be operated in accordance with the requirements of this specification and as approved by the Engineer.

Unless otherwise shown on the plans, rolling with a pneumatic-tire roller to seal the surface shall be provided. Rolling with a tandem or other steel-wheel roller shall be provided if required to iron out any roller marks.

Asphaltic concrete shall be placed and compacted to contain from five (5) to nine (9) percent air voids. The percent air voids will be calculated using the maximum theoretical specific gravity of the mixture determined according to Test Method Tex-227-F. Roadway specimens, which shall be either cores or sections of asphaltic pavement, will be tested according to Test Method Tex-207-F. The nuclear-density gauge or other methods which correlate satisfactorily with results obtained from project roadway specimens may be used when approved by the Engineer. Unless otherwise shown on the plans, the Contractor shall be responsible for obtaining the required roadway specimens at his expense and in a manner and at locations selected by the Engineer.

If the percent air voids in the compacted placement is greater than nine (9) percent but is 10 percent or less, production may proceed with subsequent changes in the construction operations and/or mixture. If the air void content is not reduced to between five (5) and nine (9) percent within one production day from the time the Contractor is notified, production shall cease. At that point, a test section as described below shall be required.

If the percent air voids is more than 10 percent, production shall cease immediately and a test section shall be required as described below.

In either case, the Contractor shall only be allowed to place a test section of one lane width, not to exceed 300 meters in length, to demonstrate that compaction to between five (5) and nine (9) percent air voids can be obtained. This procedure will continue until a test section with five (5) to nine (9) percent air voids can be produced. Only two (2) test sections per day will be allowed. When a test section producing satisfactory air void content is placed, full production may then resume.

Increasing the asphalt content of the mixture in order to reduce pavement air voids will not be allowed. If the percent air voids is determined to be less than five (5) percent, immediate adjustments shall be made to the plant production by the Contractor, as approved by the Engineer, within the tolerances as outlined in Subarticle 3.(4), so that an adequate air void level results.

The Contractor is encouraged to perform supplemental compaction testing for his own information.

- (b) Ordinary Compaction Control. When the requirement of air void control has been removed by plans note, one (1) three-wheel roller, one (1) pneumatic-tire roller, and one (1) tandem roller shall be furnished for each compaction operation except as provided below or approved by the

Engineer. The use of a tandem roller may be waived by the Engineer when the surface is already adequately smooth and further steel-wheel rolling is shown to be ineffective. With approval of the Engineer, the Contractor may substitute a vibratory roller for the three-wheel roller and/or the tandem roller. Use of at least one (1) pneumatic-tire roller is required. Additional or heavier rollers shall be furnished if required by the Engineer.

- (c) Compaction Cessation Temperature. Regardless of the method required for in-place compaction control, all rolling for compaction shall be completed before the mixture temperature drops below 80 C.

- (7) Ride Quality. Unless otherwise shown on the plans, ride quality will be required in accordance with Special Specification 5000, "Ride Quality for Pavement Surfaces".
- (8) Opening to Traffic. The pavement shall be opened to traffic when directed by the Engineer. The Contractor's attention is directed to the fact that all construction traffic allowed on the pavement open to the public will be subject to the State laws governing traffic on highways.

If the surface ravels, flushes, ruts or deteriorates in any manner prior to final acceptance of the work, it will be the Contractor's responsibility to correct this condition at his expense, to the satisfaction of the Engineer and in conformance with the requirements of this specification.

7. Measurement. The quantity of asphaltic concrete will be measured by the composite mass or composite volumetric method.

- (1) Composite Mass Method. Asphaltic concrete will be measured by the megagram of the composite "Asphaltic Concrete" of the type actually used in the completed and accepted work in accordance with the plans and specifications for the project. The composite asphaltic concrete mixture is hereby defined as the asphalt, aggregate, RAS and additives as noted in the plans and/or approved by the Engineer.

If mixing is done by a drum-mix plant or specialized recycling plant, measurement will be made on scales as specified herein.

If mixing is done by a weigh-batch plant or modified weigh-batch plant, measurement will be determined on the batch scales unless surge-storage is used. Records of the number of batches, batch design and the mass of the composite "Asphaltic Concrete" shall be kept. Where surge-storage is used, measurement of the material taken from the surge-storage bin will be made on truck scales or suspended hopper scales.

- (2) Composite Volumetric Method. The asphaltic concrete will be measured by the cubic meter of compacted "Asphaltic Concrete" of the type actually used in the completed and accepted work in accordance with the plans and specifications for the project. The composite asphaltic concrete mixture is hereby defined as the asphalt, aggregate, RAS and additives as noted in the plans and/or approved by the Engineer. The volume of the composite asphaltic concrete mixture shall be calculated by the following formula:

$$V = \frac{W}{1000 G_a}$$

V = Cubic meters of compacted "Asphaltic Concrete"

W = Total mass of asphaltic concrete in kilograms

G_a = Average actual specific gravity of three (3) molded specimens as prepared by Test Method Tex-206-F and determined in accordance with Test Method Tex-207-F.

If mixing is done by a drum-mix plant or a specialized recycling plant, the mass "W" will be determined by scales as specified herein.

If mixing is done by a weigh-batch plant or modified weight-batch plant and surge-storage is not used, mass will be determined by batch scales and records of the number of batches, batch designs and mass of asphalt and aggregate shall be kept. Where surge-storage is used, measurement of the material taken from the surge-storage bin will be made on truck scales or suspended hopper scales.

8. Payment.

- (1) The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for the "Asphaltic Concrete" of the type specified.

Measurement Method	Bid Item	Unit of Measure
Composite Mass	Asphaltic Concrete	Megagram
Composite Volumetric	Asphaltic Concrete	Cubic Meter

The payment based on the unit bid price shall be full compensation for quarrying, furnishing all materials, additives, freight involved, for all heating, mixing, hauling, cleaning the existing base course or pavement, tack coat, placing, rolling and finishing asphaltic concrete mixture, transporting RAP and RAS from designated sources, transporting any excess RAP and RAS to locations shown on the plans, and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

- (2) All templates, straightedges, core drilling equipment, scales and other weighing and measuring devices necessary for the proper construction, measuring and checking of the work shall be furnished, operated and maintained by the Contractor at his expense