

CITY OF ABILENE**ITEM 330****LIMESTONE ROCK ASPHALT PAVEMENT****330.1. DESCRIPTION.**

This Item shall govern the construction of a base course, a surface course, a level-up course, or any combination of these courses of the types and grades shown on the plans using a cold mixed material consisting of native limestone rock asphalt (LRA) aggregate, fluxing material, water, and when specified, additives and virgin aggregates.

330.2. MATERIALS.

Type I LRA mixture consists entirely of native LRA aggregate, flux material, water, and additives. Type II LRA mixture consists of a blend of native LRA aggregate, virgin aggregates, fluxing material, additives, and water. Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all materials sources. Notify the Engineer before changing any material source or formulation. When making a source or formulation change, the Engineer will verify that the specification requirements are met and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time throughout the duration of the project to assure specification compliance.

(1) Aggregate. Furnish aggregates from sources that conform to the requirements shown in Table 1, and as specified in this Section, unless otherwise shown on the plans. Provide aggregate stockpiles that meet the definition in this Section for either a coarse aggregate or fine aggregate. Supply mechanically crushed gravel or stone aggregates that meet the definitions in Tex-100-E. The Engineer will designate the plant or the quarry as the sampling location. Samples must be from materials produced for the project. The Engineer will establish the surface aggregate classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in Table 1. Document all test results. The Engineer may run tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately.

- (a) Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 10 sieve. Provide aggregates from sources listed in the TxDOT's *Bituminous Rated Source Quality Catalog* (BRSQC). Provide nonlisted sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for nonlisted sources.

Provide coarse aggregate with a minimum SAC as shown on the plans. SAC requirements apply only to aggregates used on the surface of travel lanes, unless otherwise shown on the plans. The SAC for sources on the TxDOT's Aggregate Quality Monitoring Program (AQMP) is listed in the BRSQC.

When a Type II LRA mixture is specified, Class B aggregate may be blended with Class A aggregate in order to meet requirements for Class A materials. When blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. Blend virgin aggregate with native LRA aggregate in the percentages shown in Table 4. When blending, do not use Class C aggregates.

- (i) **LRA Aggregate.** Native LRA aggregate consists of limestone impregnated with naturally occurring asphalt. LRA aggregates that contain less than 1% of naturally occurring asphalt are defined as white rock. Each aggregate source proposed for use will be sampled and tested to determine compliance with Table 1 requirements before the addition of fluxing material, additives, and water.
- (ii) **Virgin Aggregate.** Provide virgin aggregates that meet the requirements of Table 1. Each aggregate source proposed for use will be sampled and tested to determine compliance with Table 1 requirements before the addition of fluxing material, additives, and water.
- (b) **Fine Aggregate.** Fine aggregate stockpiles must have no more than 30% material retained on the No. 10 sieve. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify that the material is free from organic impurities. Use only fine aggregates generated by the production and handling of LRA or the virgin coarse aggregate. Use LRA fine aggregate that has a naturally impregnated bitumen content of 5.0 to 8.5% when tested in accordance with Tex-236-F.

If 10% or more of the stockpile is retained on the No. 4 sieve, test the stockpile and verify that it meets the requirements in Table 1 for Coarse Aggregate Angularity (Tex-460-A) and Flat and Elongated Particles (Tex-280-F)

Table 1
Aggregate Quality Requirements

| Property | Test Method | Requirement | |
|---|--------------------|-----------------------------|------------------|
| | | Native LRA Aggregate | Virgin Aggregate |
| Coarse Aggregate | | | |
| SAC | AQMP | B or C as sown on the plans | A |
| Deleterious material, %, Max | Tex-217-F, Part I | 1.5 | 1.5 |
| Decantation, %, Max | Tex-217-F, Part II | N/A | 1.5 |
| Micro-Deval abrasion, %, Max | Tex-461-A | Note 1 | Note 1 |
| Los Angeles abrasion, %, Max | Tex-410-A | 40 | 25 |
| Magnesium sulfate soundness, 5 cycles, %, Max | Tex-411-A | 30 | 25 |
| Coarse aggregate angularity, 2 crushed faces, %, Min | Tex-460-A, Part I | N/A | 85 ² |
| Flat and elongated particles @ 5:1, %, Max | Tex-280-F | N/A | 10 |
| Combined Aggregate³ | | | |
| Naturally impregnated bitumen content, total combined gradation, % by wt. | Tex-236-F | 5.0 to 8.5 | N/A |

1. Not used for acceptance purposes. Used by the Engineer as an indicator of the need for further investigation.
2. Unless otherwise shown on the plans. Only applies to crushed gravel.
3. Aggregates, without added mineral filler or additives, combined as used in the job mix formula (JMF).

(2) Asphalt Material.

- (a) **Fluxing Material.** Provide fluxing material, composed of flux oil (a blend of asphalt and oil) or a blend of flux oil and aromatic oil meeting the requirements of Table 2. When required by the Engineer, provide a test report showing that the fluxing material meets the requirements of Table 2. Use fluxing material in the paving mixture to meet the workability requirements of Section 330.4 (5), “Mixing”.

**Table 2
Fluxing Material Properties**

| Property | Material | Flux Oil | | Aromatic Oil | |
|---------------------------------|----------------|----------|-----|--------------|-----|
| | Test Procedure | Min | Max | Min | Max |
| Kinematic viscosity, 140°F, cSt | T 201 | 60 | 200 | — | 150 |
| Loss on heating, % by wt. | T 47 | — | 10 | — | 12 |
| Water, % | T 55 | — | 0.2 | — | 0.2 |
| Flash point, C.O.C., °F | T 48 | 200 | — | 135 | — |

- (b) **Water.** Provide water that meets the requirements of Item 204, “Sprinkling”.
- (c) **Tack Coat.** Unless otherwise shown on the plans or approved, furnish CSS-1H, SS-1H, or a performance-graded (PG) binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, “Asphalts, Oils, and Emulsions”. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use. If required, verify that emulsified asphalt proposed for use meets the minimum residual asphalt percentage specified in Item 300.

The Engineer will obtain at least 1 sample of the tack coat per project and test the sample for specification compliance. The Engineer will obtain the sample from the asphalt distributor, immediately before use.

- (3) **Additives.** When shown on the plans, use the type and rate of additive specified. Other additives that facilitate mixing or improve the quality of the mixture may be allowed when approved. Approved additives must be listed in the Quality Control Plan (QCP) as specified in Article 330.4, “Construction”.

If lime is specified or selected for use as an antistripping agent, add only to the virgin aggregate in accordance with Item 301, “Asphalt Antistripping Agents”. If a liquid antistripping agent is used, add in accordance with Item 301. Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream, unless the plant has a baghouse or dust collection system that reintroduces the lime back into the drum.

330.3. EQUIPMENT.

Provide required or necessary equipment in accordance with Item 320, “Equipment for Asphalt Concrete Pavement”. Use either weigh-batch or continuous mixing plants. The following requirements are modifications or additions to those in Item 320.

(1) Weigh-Batch Plants.

- (a) Screening and Proportioning.** Provide a sufficient number of bins as specified in Article 330.4, "Construction".
- (b) Fluxing Material Measuring System.** Provide a fluxing material measuring device in the fluxing material line leading to the mixer to accurately determine the accumulated amount of fluxing material. Make permanent provisions for checking the accuracy of the meter output. Provide scales to hold and weigh flux for (one) 1 batch.
- (c) Mixer.** Equip the mixer with a spray bar that will distribute the fluxing material quickly and uniformly throughout the mixer.

(2) Continuous Mixing Plants.

- (a) Screening and Proportioning.** Meet the requirements of Section 330.3(1)(a)(i), "Screening and Proportioning". These requirements also apply to stockpiled material proposed for direct use by a continuous mixing plant without the use of plant bins.
- (b) Fluxing Material Measuring System.** Place a fluxing material measuring device in the fluxing material line leading to the mixer to accurately determine the accumulated amount of fluxing material. Make permanent provisions for checking the accuracy of the meter output.
- (c) Mixer.** Provide a continuous type mixer large enough to produce not less than 40 tons of mixture per hour. Equip the mixer with a spray bar that will distribute the fluxing material quickly and uniformly throughout the mixer.

330.4. CONSTRUCTION.

Provide quality control (QC) and quality assurance (QA) testing as needed to meet the requirements of this Item.

- (1) QCP.** Develop and follow the QCP in detail. Obtain approval from the Engineer for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP to the Engineer. Receive the Engineer's approval of the QCP before beginning production. Include the following items in the QCP.

(a) Project Personnel. For project personnel, include:

- a list of individuals responsible for quality control with authority to take corrective action and
- contact information for each individual listed.

(b) Material Delivery and Storage. For material delivery and storage, include:

- the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
- aggregate stockpiling procedures to avoid contamination and segregation;
- frequency, type, and timing of LRA and aggregate stockpile testing to assure conformance of material requirements before mixture production;
- flux oil for use in the LRA mixture; and
- aromatic oil for use in the LRA mixture.

(c) **Production.** For production, include:

- loader operation procedures to avoid contamination in cold bins;
- the number of bins and the aggregate size to be placed in each bin for each type of LRA mixture produced;
- procedures for calibrating and controlling cold feeds;
- procedures to eliminate debris and oversized material;
- procedures for adding and verifying rates of each applicable mixture component (i.e., LRA, white rock, aggregates, flux oil) to minimize the formation of flux balls;
- procedures for LRA mixture testing to assure conformance of material requirements during production;
- procedures for reporting job control test results; and
- procedures to avoid segregation in the silo.

(d) **Loading and Transporting.** For loading and transporting, include:

- type and application method for release agents and
- truck and rail car loading procedures to avoid segregation.

(e) **Placement and Compaction.** For placement and compaction, include:

- proposed arrangements for any required prepaving meetings, including dates and locations;
- type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
- procedures for the transfer of mixture into the paver while avoiding segregation and preventing material spillage;
- process to balance production, delivery, paving, and compaction to achieve continuous placement operations;
- paver operations (e.g., operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
- procedures to construct quality longitudinal and transverse joints.

(2) **Stockpiling of Aggregates and LRA.** Provide a smooth and well-drained area, cleared of trash, weeds, and grass. Build stockpiles in a manner that will minimize aggregate degradation and segregation. Avoid contamination and mixing of stockpiles.

Provide LRA or aggregate stockpiles for a minimum of 2 days' production before beginning plant operations. Maintain at least a 2-day aggregate supply through the course of the project unless otherwise directed.

Stockpile aggregates for each source and type separately. Do not add material to an approved stockpile unless otherwise approved. Handle and load the LRA in a manner that prevents segregation. The Engineer may reject stockpiled materials that come in contact with the earth or other objectionable material.

In addition to the requirements listed above, the material storage and stockpile requirements must be included in the approved QCP.

(3) **Storage and Heating of Fluxing Material.** Do not heat fluxing material to a temperature more than that specified by the manufacturer. Ensure that the flux material storage capacity meets the requirements of the plant.

(4) **Job-Mix Formula.** Provide a job-mix formula (JMF) design report for a paving mixture that meets the requirements of Tables 3, 4, and 5. Identify in the report the combined aggregate gradation,

the percentage of each material component used in the mixture, and results of all applicable tests. Obtain approval of the JMF before starting production. With approval, the JMF target values may be adjusted as needed within the percentage point tolerances of Table 6 without a laboratory redesign of the mixture. If the adjustments exceed the tolerances shown in Table 6, the Engineer may require a new mixture design. Adjustments must not exceed the master gradation for the type of mixture specified on the plans.

Determine the aggregate and asphalt correction factors from the ignition oven using Tex-236-F. Provide the Engineer with split samples of the mixtures and blank samples used to determine the correction factors. The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven in accordance with Tex-236-F.

If the aggregate mineralogy is such that Tex-236-F does not yield reliable results, the Engineer may allow alternate methods for determining the asphalt content and aggregate gradation. Unless otherwise allowed, the Engineer will require the Contractor to provide evidence that results from Tex-236-F are not reliable before permitting an alternate method. If an alternate test method is allowed, use the applicable test procedure as directed.

Table 3
Master Grading per Tex-200-F, Part I, % Retained by Weight

| Sieve Size | Type I | | | | | | Type II | | | |
|------------|-------------|-------------|-----------|----------------|----------------|--------------|---------|----------------|--------------|--------------|
| | Grade | | | | | | Grade | | | |
| | AA | A | B | C | CC | D | BS | CS | DS | FS |
| | Coarse Base | Medium Base | Fine Base | Course Surface | Medium Surface | Fine Surface | Base | Medium Surface | Fine Surface | Thin Surface |
| 1-1/2" | 0 | — | — | — | — | — | — | — | — | — |
| 1-1/4" | 0-10 | — | — | — | — | — | — | — | — | — |
| 1" | — | 0 | — | — | — | — | — | — | — | — |
| 7/8" | 15-30 | 0-2 | — | — | — | — | — | — | — | — |
| 3/4" | — | — | — | — | — | — | 0 | — | — | — |
| 5/8" | — | 5-15 | 0 | — | — | — | 0-2 | 0 | — | — |
| 1/2" | — | — | 0-2 | 0 | 0 | — | 0-10 | 0-2 | 0 | — |
| 3/8" | 25-45 | 25-35 | 5-15 | 0-2 | 0-2 | 0 | 10-25 | 0-10 | 0-2 | 0 |
| 1/4" | — | — | — | — | — | 0-2 | — | — | — | — |
| #4 | 45-60 | 50-60 | 45-60 | 35-50 | 35-50 | 10-25 | 40-55 | 35-55 | 10-25 | 0-15 |
| #10 | 60-75 | 65-75 | 60-75 | 65-80 | 50-65 | 50-65 | 60-75 | 60-75 | 50-65 | 35-60 |

Table 4
Mixture Components % by Weight

| Mixture Component | Type I Grade | | | | | | Type II Grade | | | |
|-------------------|-------------------------|---------------|-------------|------------------|-------------------|----------------|---------------|-------------------|-----------------|-----------------|
| | AA Coarse Base | A Medium Base | B Fine Base | C Course Surface | CC Medium Surface | D Fine Surface | BS Surface | CS Medium Surface | DS Fine Surface | FS Thin Surface |
| | White rock ¹ | N/A | 15-35 | 15-35 | 15-35 | 15-35 | 15-35 | 15-35 | 15-35 | 15-35 |
| LRA | 96-98 | 96-98 | 96-98 | 96-98 | 96-98 | 96-98 | 72-80.5 | 72-80.5 | 72-80.5 | 36.5-63.5 |
| Virgin aggregate | N/A | N/A | N/A | N/A | N/A | N/A | 18-25 | 18-25 | 18-25 | 35-60 |
| Flux material | 2.0-4.0 | 2.0-4.0 | 2.0-4.0 | 2.0-4.0 | 2.0-4.0 | 2.0-4.0 | 1.5-3.0 | 1.5-3.0 | 1.5-3.0 | 1.5-3.5 |

1. White rock values are given as a percentage of total LRA aggregate.

Table 5
Mixture Properties

| Property | Test Method | Requirement |
|---|--------------------|-----------------|
| Hveem stability, min | Tex-208-F | 35 ¹ |
| Laboratory-molded density, % | Tex-207-F | 89.0 ±2 |
| Theoretical maximum specific gravity of bituminous mixtures | Tex-227-F | N/A |
| Bitumen content, % by wt. | Tex-236-F | 6.5 to 11.0 |
| Water and light hydrocarbon volatiles, %, max | Tex-212-F, Part II | 5.5 |
| Boil test, % | Tex-530-C | 10 ² |

1. Cease operations if 2 consecutive tests fail. The Engineer may waive this requirement if other information indicates that the next material to be produced will meet the minimum value specified.

2. May be increased or eliminated when directed by the Engineer.

Table 6
Deviations from Current JMF Target Values

| Material | Test Method | Tolerance |
|--|-------------------------------|-----------|
| Individual % retained for #10 sieves and larger | Tex-200-F | ±5.0 |
| Individual % retained for sieves smaller than #10 and larger than #200 | | ±3.0 |
| % passing the #200 sieve | | ±2.0 |
| Fluxing material, % | Determined from quantity used | ±0.2 |

(5) Mixing. Produce all LRA mixtures in the same mixing plant, unless otherwise approved. When needed, mix aromatic oil into the mixing chamber independently of the fluxing material. The aromatic oil may not exceed 35% of the total weight of the combined fluxing material and aromatic oil used in the paving mixture.

The Engineer will not accept mixtures produced when the LRA aggregate or virgin aggregate contains moisture above the saturated surface dry condition. Inspect for visual surface moisture on the aggregates or any unusual quantities of fines clinging to the coarse aggregate.

Mix the materials at a central mixing plant and ship ready to use. Add water when necessary to improve workability of the mixture. Ensure that the mixture leaves the plant in a workable condition. The Engineer may reject mixtures that do not remain workable for a period that is sufficient to permit loading, unloading, hauling, placing, and compacting. Provide materials that remain workable in a stockpile for at least 6 months.

(6) Hauling Operations. Transport the LRA mixture to the project or delivery point in trucks or rail cars as needed. Before use, clean all truck beds or rail cars to ensure mixture is not contaminated. When a release agent is necessary, use a release agent on the approved list maintained by the Construction Division to coat truck beds and inside rail cars. Waterproof tarpaulins are not required to cover loads.

(7) Placement Operations. Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of mixture by at least 6 in. Place mixture so longitudinal joints on the surface course coincide with lane lines, or as directed. Ensure that all finished surfaces will drain properly.

Unless otherwise shown on the plans, the asphalt mixture may be dumped in a windrow and then placed in the finishing machine with windrow pickup equipment. Prevent the windrow pickup equipment from contaminating the mixture.

After placing the paving mixture, defer compaction, as directed by the Engineer, to allow for volatilization. When placing more than 1 pavement course, allow the previous course to dry and cure before placing the next course. Unless otherwise directed, the course will be considered cured if the hydrocarbon volatile content of the mixture is 0.4% or less by weight of the mixture when tested according to Tex-213-F.

When shown on the plans or as approved, a motor grader may be used to spread the mixture. Thoroughly aerate the mixture and spread into place with a power motor grader in a uniform layer. Placement in narrow strips or small irregular areas may require hand spreading.

(a) Weather Conditions. Place the mixture when the roadway surface temperature is 60°F or higher unless otherwise approved. Place the mixture only when the weather conditions and moisture conditions of the roadway surface are suitable in the opinion of the Engineer.

(b) Tack Coat. Clean the surface before placing the tack coat. Unless otherwise approved, apply tack coat uniformly at the rate directed by the Engineer. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply a thin, uniform tack coat to all contact surfaces of curbs, structures, and joints. Prevent splattering of the tack coat when placed adjacent to curb, gutter, and structures. Roll the tack coat with a pneumatic-tire roller when directed. The Engineer may use Tex-243-F to verify that the tack coat has adequate adhesive properties. The Engineer may suspend paving operations until there is adequate adhesion.

(8) Compaction. Furnish the type, size, and number of rollers required for compaction, as approved. Furnish at least 1 medium pneumatic-tire roller (minimum 12-ton weight). Use Tex-207-F, Part IV, to establish rolling patterns that achieve maximum compaction. Follow the selected rolling pattern unless changes that affect compaction occur in the mixture or placement conditions. When such changes occur, establish a new rolling pattern. Compact the pavement to the cross section of the finished paving mixture meeting the requirements of the plans and specifications. Unless otherwise directed, operate vibratory rollers in static mode when: not compacting, changing directions, or the plan depth of the pavement mat is less than 1-1/2 in.

When rolling with the 3-wheel, tandem, or vibratory rollers, start by first rolling the joint with the adjacent pavement and then continue by rolling longitudinally at the sides. Proceed toward the center of the pavement, overlapping on successive trips by at least 1 ft., unless otherwise directed. Make alternate trips of the roller slightly different in length. On superelevated curves, begin rolling at the low side and progress toward the high side, unless otherwise directed.

Avoid displacement of the mixture. If any displacement occurs, correct to the satisfaction of the Engineer. Ensure pavement is fully compacted before allowing rollers to stand on the pavement.

Unless otherwise directed, use only water or an approved release agent on rollers, tamps, and other compaction equipment. Keep diesel, gasoline, oil, grease, and other foreign matter off the mixture.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with the rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

(9) Irregularities. Immediately take corrective actions if surface irregularities, including but not limited to segregation, rutting, raveling, flushing, fat spots, mat slippage, color, texture, roller marks, tears, gouges, streaks, or uncoated aggregate particles, are detected. The Engineer may allow placement to continue for at most 1 day of production while the Contractor takes appropriate action. If the problem still exists after that day, suspend paving until the problem is corrected to the satisfaction of the Engineer.

At the expense of the Contractor and to the satisfaction of the Engineer, remove and replace any mixture that does not bond to the existing pavement or that has other surface irregularities identified above.

(10) Ride Quality. Use Surface Test Type A to evaluate ride quality in accordance with TxDOT Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

330.5. MEASUREMENT.

LRA pavement will be measured by the ton of composite LRA pavement of the type actually used in the completed and accepted work in accordance with the plans and specifications for the project. Measure on scales in accordance with TxDOT Item 520, "Weighing and Measuring Equipment." Keep records on tare weight, gross weight, and net weight of the LRA paving mixture for each load of the same type of mixture. All water and light hydrocarbon volatiles in the mixture, in excess of 5.5% by weight at the time of weighing, will be deducted from the net weight to determine the quantity for payment.

330.6. PAYMENT.

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 "Limestone Rock Asphalt Pavement" of the type, grade and surface aggregate classification specified.

These prices are full compensation for surface preparation, materials including tack coat, placement, equipment, labor, tools, and incidentals.

Pay adjustment for ride quality, when required, will be determined in accordance with TxDOT Item 585, "Ride Quality for Pavement Surfaces."