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**DMS - 9210**  
**LIMESTONE ROCK ASPHALT (LRA)**

**EFFECTIVE DATE: MARCH 2010**

**9210.1. Description.** This specification governs the production, quality control, and quality assurance of native limestone rock asphalt (LRA) aggregate used for surface treatments and of cold mixed material consisting of native LRA aggregate, fluxing material, water, and when specified, additives and virgin aggregates.

Perform the quality control of LRA according to the production testing frequency established in this specification. The Department will perform quality assurance.

**9210.2. Units of Measurements.** The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

**9210.3. Equipment.**

**A. Field Office and Inspection Laboratory.** Field office and inspection laboratory furnishings and equipment will be subject to approval. As directed, maintain, repair, or replace the building and equipment immediately, if either the building or equipment becomes inadequate for its intended use. Provide a field office and inspection laboratory with the following:

- controlled access with security measures controlled by CST/M&P,
- unrestricted internet access,
- ceilings at least 8-ft. high,
- square footage as approved by CST/M&P,
- adequate heating, ventilation, and air conditioning system,
- adequate electrical outlets,
- a sink with hot and cold running water,
- windows,
- impervious floor covering,
- sufficient ventilation for testing equipment, and
- restroom facilities that include:
  - a flush toilet,
  - a sink with hot and cold running water,
  - a sewer or septic tank with connections, and
  - adequate rest room supplies.

**B. Mixing Equipment.** Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement." Use either weigh-batch or continuous mixing plants to produce pre-coated LRA aggregates, Type I LRA mixture, or Type II LRA mixture. 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 and screens to adequately proportion the materials.
- 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 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.** Provide a sufficient number of bins and screens to adequately proportion the materials. 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.

**9210.4. Materials.**

- A. LRA Aggregates for Surface Treatments.** Provide LRA aggregates for surface treatments of the type, grade, and surface aggregate classification (SAC) shown on the plans or purchase order in accordance with the material requirements of Item 302, "Aggregates for Surface Treatments."
- B. Type I LRA and Type II LRA Mixtures.** 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. Provide LRA mixtures of the type, grade, and SAC shown on the plans or purchase order and in accordance with the following requirements.

## 1. Component Material Properties.

**a. 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. CST/M&P 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 SAC and CST/M&P will perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in Table 1 and document all test results. CST/M&P may run tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately.

**(1) Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 10 sieve. Provide aggregates from sources listed in the Department's [Bituminous Rated Source Quality Catalog \(BRSQC\)](#). Provide non-listed sources only when tested by CST/M&P and approved before use. Allow 30 calendar days for CST/M&P to sample, test, and report results for non-listed 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 Department'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 or volume 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.

**(a) 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.

**(b) 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.

**(2) 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. CST/M&P 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 1a.**

**Aggregate Quality Requirements for LRA used in Surface Treatments (Item 302)**

Property	Test Method	Native LRA Aggregate Requirement
SAC	AQMP	As shown on the plans
Deleterious material <sup>1</sup> , %, Max	Tex-217-F, Part I	2.0 <sup>1</sup>
Decantation, %, Max	Tex-406-A	1.5
Flakiness Index, Max	Tex-224-F	17 <sup>2</sup>
Los Angeles abrasion, %, Max	Tex-410-A	40 <sup>2</sup>
Magnesium sulfate soundness, 5 cycles, %, Max	Tex-411-A	25
Micro-Deval abrasion <sup>3</sup> , %, Max	Tex-461-A	Note 3
Naturally impregnated bitumen content, total combined gradation, % by wt.	Tex-236-F	4.0 to 7.0
White Rock Count <sup>4</sup> , % by Wt.	Tex-220-F	15–35

1. Deleterious material includes iron pyrites.
2. Unless otherwise shown on plans.
3. Not used for acceptance purposes. Used by CST/M&P as an indicator of the need for further investigation.
4. White rock count applies to aggregate retained on the #4 sieve.

**Table 1b.**  
**Aggregate Quality Requirements for LRA used in Mixtures (Item 330)**

Property	Test Method	Requirement	
		Native LRA Aggregate	Virgin Aggregate
<b>Coarse Aggregate</b>			
SAC	AQMP	As shown on the plans	A
Deleterious material, %, Max	Tex-217-F, Part I	1.5	1.5
Decantation, %, Max	Tex-406-A	N/A	1.5
Micro-Deval abrasion, %, Max	Tex-461-A	Note 1	Note 1
Los Angeles abrasion, %, Max	Tex-410-A	40 <sup>2</sup>	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 <sup>3</sup>
Flat and elongated particles @ 5:1, %, Max	Tex-280-F	N/A	10
<b>Combined Aggregate<sup>4</sup></b>			
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 CST/M&P as an indicator of the need for further investigation.
2. Unless otherwise shown on the plans.
3. Unless otherwise shown on the plans. Only applies to crushed gravel.
4. Aggregates, without added mineral filler or additives, combined as used in the job mix formula (JMF).

**b. 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 CST/M&P, provide a test report showing that the fluxing material meets the requirements of Table 2. Use fluxing material in the paving mixture to provide materials that remain workable in a stockpile for at least 6 months.

**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	–

- c. Water.** Provide water that meets the requirements of Item 204, “Sprinkling.”
- d. 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 9210.5.A.

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 re-introduces the lime back into the drum.

- C. Precoating.** When shown on the plans, precoat aggregate uniformly and adequately with asphalt material to the satisfaction of the Engineer. When shown on the plans, specific aggregates may be prohibited from being precoated. Do not precoat LRA aggregate that contains visual surface moisture or excessive quantities of fines. Meet the requirements of Tables 2 and 3 before precoating. Furnish precoated aggregate that spreads uniformly using approved mechanical spreading equipment.

The Engineer will reject precoated aggregate that contains more than 0.5% passing the No. 40 sieve as determined by Tex-200-F, Part I.

- 1. Asphalt Material.** Precoat the aggregates with asphalt material that meets the requirements of Item 300, “Asphalts, Oils, and Emulsions.” Precoat the LRA with flux oil meeting the requirements of Item 330, “Limestone Rock Asphalt Pavement.” Unless a specific precoat material is specified on the plans, use any asphalt material that meets the requirements of Item 300.

- D. Completed Mixture Properties.** Provide completed LRA mixtures meeting the requirements of Tables 3, 4, and 5 for the Type, Grade, and SAC shown on the plans or purchase order.

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

Sieve Size	Type I						Type II			
	Grade						Grade			
	AA Coarse Base	A Medium Base	B Fine Base	C Coarse Surface	CC Medium Surface	D Fine Surface	BS Surface	CS Medium Surface	DS Fine Surface	FS Thin Surface
1-1/2"	0	–	–	–	–	–	–	–	–	–
1-1/4"	0–10	–	–	–	–	–	–	–	–	–
1"	–	0	–	–	–	–	–	–	–	–
7/8"	15–30	0–10	–	–	–	–	–	–	–	–
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"	–	–	–	–	–	0–5	–	–	–	–
#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						Type II			
	Grade						Grade			
	AA Coarse Base	A Medium Base	B Fine Base	C Coarse Surface	CC Medium Surface	D Fine Surface	BS Surface	CS Medium Surface	DS Fine Surface	FS Thin Surface
White rock <sup>1</sup>	N/A	15–35	15–35	15–35	15–35	15–35	15–35	15–35	15–35	N/A
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 <sup>1</sup>
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	6.0
Boil test, %	Tex-530-C	10 <sup>2</sup>

1. Cease operations if two consecutive tests fail. CST/M&P 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 CST/M&P.

**9210.5. Production Operations.** All plant facilities and materials used are subject to inspection or testing by CST/M&P at any time during production or use. Provide safe access for Department personnel to perform inspection and sampling. Quality control is solely the responsibility of the Producer, and the Department will not perform quality control for the Producer.

- A. QCP.** Develop a QCP and submit a written QCP to CST/M&P for approval prior to the beginning of production. Follow the QCP in detail. Obtain approval from CST/M&P for changes to the QCP made during production. CST/M&P may suspend operations if the Contractor fails to provide or comply with the QCP.

Include the following items in the QCP for LRA surface treatment aggregate and LRA mixtures as appropriate.

**1. 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.

**2. 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;



- aromatic oil for use in the LRA mixture; and
- additive for use in the LRA mixture.

**3. 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, additives) 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.

**B. Stockpiling of LRA.** Provide a smooth and well-drained area, cleared of trash, weeds, and grass. Stockpile, handle, and load LRA in a manner that will minimize aggregate degradation and segregation. Avoid contamination and mixing of stockpiles. CST/M&P may reject stockpiled materials that come in contact with the earth or other objectionable material.

**C. Job-Mix Formula for LRA Mixtures.** 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, CST/M&P may require a new mixture design. Adjustments must not exceed the master gradation for the type of mixture specified on the plans.

**Table 6**  
**Deviations from Current JMF Target Values**

Material	Test Method	Tolerance
Individual % retained for #10 sieves and larger	Tex-200-F, Part I	±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

**D. Production Sampling.** Obtain LRA samples at the plant in accordance with Tex-222-F. The sampler will split each sample into two equal portions in accordance with Tex-200-F and label these portions as “Producer” and “CST/M&P.” Deliver the samples to the appropriate party’s laboratory. Discard unused samples after acceptance of CST/M&P test results.

**E. Production Testing.** The Producer and CST/M&P must perform production tests in accordance with Tables 7 and 8. Perform production testing in accordance with Table 7 for LRA used for surface treatments. Perform production testing in accordance with Table 8 for LRA mixtures. The Producer has the option to verify CST/M&P’s test results on split samples provided by the Producer or CST/M&P.

Unless otherwise directed, CST/M&P will suspend production and cease shipping of materials if the Producer fails to comply with the production testing frequency listed in Tables 7 and 8. Immediately take corrective action if any test result fails to meet the material requirements of Item 302 and this DMS. CST/M&P may suspend production, cease shipping of materials, and require removal of any material transported to a railcar if test results from any two consecutive tests of the same property listed in Tables 7 and 8 fail to meet the material requirements.

**1. Certification.** Provide a Level IA certified specialist by the Department-approved hot-mix asphalt certification program at the plant during production operations to conduct all sampling and testing.

**Table 7**  
**Production Testing Frequency for LRA used for Surface Treatments (Item 302)**

Description	Test Method	Minimum Producer Testing Frequency	Minimum CST/M&P Testing Frequency <sup>1</sup>
Gradation Cumulative % Retained	Tex-200-F, Part I	Combined Aggregate Sample <sup>2</sup>	
		1 per 300 tons	1 per 3,000 tons
		Precoated Aggregate	
		1 per 1,200 tons	1 per 10,000 tons
Deleterious Material	Tex-217-F, Part I	1 per month, per aggregate (per grade)	1 per month, per aggregate (per grade)
Decantation	Tex-406-A	1 per month, per aggregate (per grade)	1 per month, per aggregate (per grade)
White rock count	Tex-220-F	1 per 600 tons, per aggregate (per grade)	1 per 6,000 tons, per aggregate (per grade)
Flakiness index	Tex-224-F	1 per month, per aggregate (per grade)	1 per month, per aggregate (per grade)
Naturally impregnated bitumen content, % by wt. for combined aggregate	Tex-236-F	1 per 600 tons	1 per 5,000 tons
Micro-Deval abrasion	Tex-461-A	1 per week, per aggregate (per grade)	1 per month
Unit weight	Tex-404-A	1 per 20,000	1 per 20,000

1. CST/M&P may reduce or waive the sampling and testing requirements based on a satisfactory test history.

2. Combined aggregate sample may contain LRA, white rock, and/or virgin aggregate depending on the grade type.

**Table 8**  
**Production Testing Frequency for LRA used in Mixtures (Item 330)**

Description	Test Method	Minimum Producer Testing Frequency	Minimum CST/M&P Testing Frequency <sup>1</sup>
Cumulative % Retained (Combined Aggregate Sample <sup>2</sup> )	Tex-200-F, Part I	1 per 300 tons	1 per 3,000 tons
Laboratory-molded density	Tex-207-F	1 per week, per mix type <sup>3</sup>	1 per week, per randomly selected mix type <sup>4</sup>
Hveem Stability	Tex-208-F	1 per week, per mix type <sup>3, 5</sup>	1 per week, per randomly selected mix type <sup>4</sup>
Moisture content	Tex-212-F, Part II	1 per week, per mix type	1 per week, per selected mix type <sup>4</sup>
Deleterious material	Tex-217-F, Part I	1 per month, per aggregate (per grade)	1 per month, per aggregate (per grade)
Decantation	Tex-406-A	1 per month, per aggregate <sup>6</sup> (per grade)	1 per month, per aggregate <sup>6</sup> (per grade)
White rock count	Tex-220-F	1 per day, per mix type	1 per week, per mix type
Flakiness index	Tex-224-F	1 per month, per aggregate (per grade)	1 per month, per aggregate (per grade)
Theoretical maximum specific (Rice) gravity	Tex-227-F	1 per week, per mix type <sup>3</sup>	1 per week, per randomly selected mix type <sup>4</sup>
Naturally impregnated bitumen content, % by wt. for LRA material passing the #10 sieve	Tex-236-F	1 per day	1 per week
Naturally impregnated bitumen content, % by wt. for LRA combined aggregate	Tex-236-F	1 per 600 tons	1 per 5,000 tons
Micro-Deval abrasion	Tex-461-A	1 per week, per mix type <sup>3</sup>	1 per month
Unit weight	Tex-404-A	1 per 20,000	1 per 20,000
Kinematic viscosity, 1400F, cSt	T 201	1 per month	1 per month
Heat Loss Test	T 47	1 per month	1 per month

1. CST/M&P may reduce or waive the sampling and testing requirements based on a satisfactory test history.
2. Combined aggregate sample may contain LRA, white rock, and/or virgin aggregate depending on the mixture type.
3. Minimum production of 100 tons required prior to performing test.
4. Mix type randomly selected by CST/M&P at the plant.
5. Deliver molds used to determine laboratory-molded density to CST/M&P for Hveem Stability testing.
6. Decantation is performed on virgin aggregate only that is added to LRA mixtures.

**F. Weather Conditions.** Produce LRA mixture for Item 330 when the air temperature is 40°F or higher, unless otherwise approved. Precoat aggregate for Item 302 when the air temperature is 50°F and rising, unless otherwise approved.

**G. Reporting.** Use Department-provided software to record and calculate all test data.

- 1. Production Testing.** CST/M&P and the Producer will provide test results to the other party within 2 working days of performing all required testing. CST/M&P and the Producer will immediately report to the other party any test result that requires production to be suspended or that fails to meet the specification requirements of Item 302 or Item 330. Use the approved communication method (e.g., email, paper copy) to submit test results to CST/M&P. CST/M&P may suspend production if test results are not received within 2 working days of performing all required testing. The Producer may, at their own risk, ship material prior to completing and reporting all required testing and information to CST/M&P. Notify CST/M&P each time this occurs and immediately provide shipment information specified in 9210.5.G.2. Replace material that does not meet the requirements listed in Tables 1b, 2, 3, 4, 5, and 6 shipped at own risk.

Use the procedures described in Tex-233-F to plot the results of all quality control and quality assurance testing. Update the control charts as soon as test results become available. Make the control charts readily accessible at the field laboratory. CST/M&P may suspend production for failure to update control charts.

- 2. Shipment Information.** Use Department-provided software to report shipment information to include the following:

- Shipment date,
- Control-Section-Job (CSJ) number,
- Project number,
- Requisition/Purchase Order & Item numbers,
- Maintenance contract numbers,
- District,
- County,
- Highway,
- Contractor,
- Delivery destination,
- Material type,
- Material quantity, and
- Railcar numbers, if shipped by rail.

The Producer will provide this information within 1 working day of shipment. CST/M&P may suspend production for failure to report shipment information.