



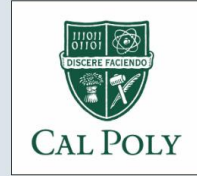
City and County
Pavement Improvement Center

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HOT MIX ASPHALT - LOCAL GOVERNMENT (HMA-LG) MODEL SPECIFICATION APRIL 6, 2021

Intent

The following model specification is based on the Superpave mix design method and is intended for use on City and County roadways. It is not for use on the State Highway System nor has it been approved for use on National Highway System (NHS) routes. Pilot projects using this specification have not been constructed. Agencies interested in use of this specification are encouraged to contact the CCPIC.

139 HOT MIX ASPHALT (HMA) – LOCAL GOVERNMENT (LG)

139-1 General

139-1.1 Description

The specifications in Section 139 are written to the Bidder before award and the Contractor after. Before award, interpret sentences written in the imperative mood as starting with “The Bidder must” and interpret you as the Bidder and “your” as the Bidder's. After award, interpret sentences written in the imperative mood as starting with “The Contractor must” and interpret “you” as the Contractor and “your” as the Contractor's.

Section 139 includes specifications for producing and placing HMA-LG. You may produce HMA-LG using an authorized WMA technology.

HMA-LG is specified by Level and nominal maximum aggregate size, e.g., HMA-LG (Level 1, 1/2”). The Agency specifies the Level to be used.

HMA-LG is not for HMA to be used in miscellaneous areas and dikes.

You may not use Section 139 for HMA to be produced and placed on a State (Caltrans) Highway. HMA for production and placement on a State Highway must conform to Section 39 of the Caltrans Standard Specifications, and corresponding Revised Standard Specifications and Special Provisions, as specified and required by Caltrans.

References to the Caltrans Standard Specifications are to the 2018 edition, and the Revised Standard Specifications dated November 19, 2020.

139-1.2 Abbreviations

Abbreviations used in Section 139 are those listed in 1-1.06 of the Caltrans Standard Specifications.

139-1.3 Definitions

The following terms as used in Section 139 are defined as follows:

binder replacement: Binder from RAP expressed as a percent of the total binder in the mix.

coarse aggregate: Aggregate retained on a No. 4 sieve.

fine aggregate: Aggregate passing a No. 4 sieve.

manufactured sand: Fine aggregate produced by crushing rock or gravel.

non-manufactured sand: Fine aggregate not produced by crushing gravel or rock.

Reclaimed Asphalt Pavement (RAP): Removed and/or reprocessed pavement materials containing asphalt and aggregates

processed RAP: RAP that has been fractionated.

supplemental fine aggregate: Mineral filler consisting of rock dust, slag dust, hydrated lime, hydraulic cement, or any combination of these and complying with AASHTO M 17.

Warm Mix Asphalt (WMA): HMA produced using a warm mix asphalt technology.

Additional terms are as defined in Section 1-1.07 of the Caltrans Standard Specifications.

139-1.4 Submittals

Submittals are required in various sections of Section 139. Submit the required submittals on or prior to the time specified.

139-2 Quality Assurance

139-2.1 General

Quality Assurance as used in Section 139 is composed of Contractor Quality Control, Independent Assurance, Dispute Resolution, Personnel Qualification, and Laboratory Qualification.

139-2.2 Laboratories

Laboratories testing aggregate and HMA-LG qualities used to prepare the mix design and JMF, and Independent Third Party laboratories performing dispute resolution testing, must be qualified under the AASHTO re:source program and the Caltrans Independent Assurance Program. A list of qualified laboratories are shown in the Caltrans Statewide Independent Assurance Database:

<https://sia.dot.ca.gov/index.php>

139-2.3 Hot Mix Asphalt Plants

Before production, the HMA-LG plant must have a current qualification under the Caltrans' Material Plant Quality Program, or utilize weighing and metering devices that comply with California Test 109 as certified by a State of California Department of Food

and Agriculture, Division of Measurement Standards, Registered Service Agency. A listing of registered service agencies is available at the following:

<https://www.cdfa.ca.gov/dms/programs/rsa/rsalistings/rsaListings.html>

139-2.4 Test Methods

Wherever reference is made to the following test methods, the year of publication for these test methods is as shown in the following table:

Test method	Year of publication
AASHTO M 17	2019
AASHTO M 323	2013
AASHTO R 30	2019
AASHTO R 59	2019
AASHTO T 27	2020
AASHTO T 49	2019
AASHTO T 59	2013
AASHTO T 96	2019
AASHTO T 164	2018
AASHTO T 176	2008
AASHTO T 209	2020
AASHTO T 269	2018
AASHTO T 275	2007 (2012)
AASHTO T 304	2020
AASHTO T 305	2018
AASHTO T 308	2010
AASHTO T 312	2014
AASHTO T 313	2012 (2016)
AASHTO T 315	2012 (2016)
AASHTO T 329	2019
AASHTO T 335	2020
ASTM D36/D36M	2020
ASTM D92	2012b
ASTM D217	2010
ASTM D297	2019
ASTM D445	2014
ASTM D1856	2009 (Reapproved 2015)
ASTM D2007	2011
ASTM D2074	2007 (Reapproved 2013)
ASTM D2995	1999 (Reapproved 2009)
ASTM D4791	2010
ASTM D5095	2013
ASTM D5329	2009
ASTM D7741/D7741M	2011
Asphalt Institute MS-2	7th edition (2015)
California Test 125	December 2, 2019
California Test 204	June 1, 2010
California Test 375	February 1, 2012
California Test 384	June 1, 2015
California Test 389	2020

Take samples in accordance with California Test 125.

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139-2.5 Quality Control

139-2.5.1 General

The Contractor is responsible for Quality Control. Quality Control activities are required in various sections of Section 139.

139-2.5.2 Quality Control Plan

At least 5 business days prior to the pre-paving meeting, submit a QC plan for HMA-LG. The QC plan must describe the organization and procedures for:

1. Controlling HMA-LG quality characteristics
2. Taking samples, including sampling locations
3. Establishing, implementing, and maintaining QC
4. Determining when corrective actions are needed
5. Implementing corrective actions
6. Using methods and materials for backfilling core locations

The QC plan must address the elements affecting HMA-LG quality, including:

1. Aggregates
2. Asphalt binder
3. Additives
4. Production
5. Paving

The QC plan must include aggregate QC sampling and testing during lime treatment.

Allow 5 business days for review of the QC plan.

If you change QC procedures, personnel, or sample testing locations, submit a QC plan supplement before implementing the proposed change. Allow 3 business days for review of the QC plan supplement.

139-2.6 Dispute Resolution

You and the Engineer must work together to avoid potential conflicts and to resolve disputes regarding test result discrepancies. You and the Engineer may request witness testing and sharing of test data worksheets. Notify the Engineer within 3 business days of receiving a test result if you dispute the test result.

An independent third party performs referee testing. The independent third party must have no prior direct involvement with this Contract. By mutual agreement, the independent third party is chosen from among laboratories not currently employed by you or your HMA-LG producer.

The Agency is responsible for securing and maintaining split samples. If the Agency's portion of the split acceptance samples are not available, the independent third-party samples and uses any available material agreed on by you and the Engineer as

representing the disputed HMA for evaluation. When addressing disputes related to density, use cores or density gauges correlated to cores from the work.

The results of the tests performed by the independent third party shall prevail. If the independent third party determines the Engineer’s test results are valid, the Engineer deducts the independent third party's testing costs from payments. If the independent third party determines your test results are valid, the Engineer pays the independent third party's testing costs.

139-3 MATERIALS

139-3.1 Aggregates

139-3.1.1 General

Aggregates must be clean and free from deleterious substances.

139-3.1.2 Quality

Before the addition of asphalt binder and lime treatment (if required), the aggregates must comply with the requirements shown in the following tables:

Aggregate Quality – Level 1 (Traffic Index 5.0 to 7.5)

Quality Characteristic	Test Method	Requirement
Percent of crushed particles: Coarse aggregate (min, %) One-fractured face Two-fractured faces Fine aggregate (min, %) (Passing No. 4 sieve and retained on No. 8 sieve.) One-fractured face	AASHTO T 335	75 70 70
Los Angeles Rattler (max, %) Loss at 100 Rev. Loss at 500 Rev.	AASHTO T 96	15 52
Sand equivalent (min) ^a	AASHTO T 176	45
Flat and elongated particles (max, % by weight at 5:1)	ASTM D4791	10
Fine aggregate angularity (min, %) ^b	AASHTO T 304, Method A	45

^aThe reported value must be the average of 3 tests from a single sample. Use of a sand reading indicator is required as shown in AASHTO T 176, Figure 1. Sections 4.7, "Manual Shaker," 7.1.2, "Alternate Method No. 2," and 8.4.3, "Hand Method," do not apply. Prepare the stock solution as specified in section 4.8.1, "Stock solution with formaldehyde," except omit the addition of formaldehyde.

^bThe Engineer waives this specification if the Type A HMA contains 10 percent or less of non-manufactured sand by weight of total aggregate, except if your JMF fails verification.

Aggregate Quality – Level 2 (Traffic Index 8.0 to 10.0)

Quality Characteristic	Test Method	Requirement
Percent of crushed particles: Coarse aggregate (min, %) One-fractured face Two-fractured faces Fine aggregate (min, %) (Passing No. 4 sieve and retained on No. 8 sieve.) One-fractured face	AASHTO T 335	85 80 70
Los Angeles Rattler (max, %) Loss at 100 Rev. Loss at 500 Rev.	AASHTO T 96	15 52
Sand equivalent (min) ^a	AASHTO T 176	45
Flat and elongated particles (max, % by weight at 5:1)	ASTM D4791	10
Fine aggregate angularity (min, %) ^b	AASHTO T 304, Method A	45

^aThe reported value must be the average of 3 tests from a single sample. Use of a sand reading indicator is required as shown in AASHTO T 176, Figure 1. Sections 4.7, "Manual Shaker," 7.1.2, "Alternate Method No. 2," and 8.4.3, "Hand Method," do not apply. Prepare the stock solution as specified in section 4.8.1, "Stock solution with formaldehyde," except omit the addition of formaldehyde.

^bThe Engineer waives this specification if the Type A HMA contains 10 percent or less of non-manufactured sand by weight of total aggregate, except if your JMF fails verification.

Aggregate Quality - Level 3 (Traffic Index 10.5 to 13.5)

Quality Characteristic	Test Method	Requirement
Percent of crushed particles: Coarse aggregate (min, %) One-fractured face Two-fractured faces Fine aggregate (min, %) (Passing No. 4 sieve and retained on No. 8 sieve.) One-fractured face	AASHTO T 335	95 90 70
Los Angeles Rattler (max, %) Loss at 100 Rev. Loss at 500 Rev.	AASHTO T 96	12 40
Sand equivalent (min) ^a	AASHTO T 176	47
Flat and elongated particles (max, % by weight at 5:1)	ASTM D4791	10
Fine aggregate angularity (min, %) ^b	AASHTO T 304, Method A	45

^aThe reported value must be the average of 3 tests from a single sample. Use of a sand reading indicator is required as shown in AASHTO T 176, Figure 1. Sections 4.7, "Manual Shaker," 7.1.2, "Alternate Method No. 2," and 8.4.3, "Hand Method," do not apply. Prepare the stock solution as specified in section 4.8.1, "Stock solution with formaldehyde," except omit the addition of formaldehyde.

^bThe Engineer waives this specification if the Type A HMA contains 10 percent or less of non-manufactured sand by weight of total aggregate, except if your JMF fails verification.

139-3.1.3 Gradations

The aggregate gradations HMA-LG must comply with the requirements shown in the following table:

Aggregate Gradation Requirements

HMA-LG pavement thickness shown	Gradation
0.10 foot to less than 0.125 foot	3/8 inch
0.125 to less than 0.20 foot	1/2 inch
0.20 foot and greater	3/4 inch

Aggregate gradation must be within the Target Value (TV) limits for the specified sieve size shown in the following tables:

Aggregate Gradations for HMA-LG**3/4 inch**

Sieve size	Target value limit	Allowable tolerance
1"	100	--
3/4"	90-100	TV \pm 5
1/2"	<90	TV \pm 6
No. 8	23-49	TV \pm 5
No. 30	10-24	TV \pm 4
No. 200	2.0-8.0	TV \pm 2.0

1/2 inch

Sieve size	Target value limit	Allowable tolerance
3/4"	100	--
1/2"	90-100	TV \pm 5
3/8"	<90	TV \pm 5
No. 8	28-58	TV \pm 5
No. 30	13-30	TV \pm 4
No. 200	2.0-10.0	TV \pm 2.0

3/8 inch

Sieve size	Target value limit	Allowable tolerance
1/2"	100	--
3/8"	90-100	TV \pm 5
No. 4	<90	TV \pm 5
No. 8	32-67	TV \pm 5
No. 30	15-35	TV \pm 5
No. 200	2.0-10.0	TV \pm 2.0

139-3.1.4 Lime Treatments

If aggregate lime treatment is required as specified in Section 139-4.2.3, the virgin aggregate must comply with the aggregate quality specifications specified in Section 139-3.1.2.

Lime for treating aggregate must comply with section 24-2.02 of the Caltrans Standard Specifications.

Water for lime treatment of aggregate with lime slurry must comply with section 24-1.02B of the Caltrans Standard Specifications.

139-3.2 Reclaimed Asphalt Pavement

Provide enough space at your plant for complying with all RAP handling requirements. Provide a clean, graded base, well drained area for stockpiles.

If RAP is from multiple sources, blend the RAP thoroughly and completely before fractionating.

For RAP substitution of 15 percent of the aggregate blend or less, fractionation is not required.

For RAP substitution greater than 15 percent of the aggregate blend, fractionate RAP stockpiles into 2 sizes, a coarse fraction RAP retained on 3/8-inch sieve and a fine fraction RAP passing 3/8-inch sieve.

The RAP fractionation must comply with the requirements shown in the following table:

RAP Stockpile Fractionation Gradation Requirements

Size	Test method	Requirement
Coarse (% passing the 1-inch sieve)	California Test 202 ^a	100
Fine (% passing the 3/8-inch sieve)	California Test 202 ^a	98–100

^aMaximum mechanical shaking time is 10 minutes.

You may use the coarse fractionated stockpile, the fine fractionated stockpile, or a combination of the coarse and fine fractionated stockpiles.

Isolate the processed RAP stockpiles from other materials. Store processed RAP in conical or longitudinal stockpiles. Processed RAP must not be agglomerated or be allowed to congeal in large stockpiles.

139-3.3 Asphalt Binder

Asphalt binder must comply with section 92 of the Caltrans Standard Specifications.

The grade of asphalt binder for HMA-LG must be **[Specify]**.

139-3.4 Liquid Antistrip

Liquid antistrip total amine value must be a minimum of 325 when tested in accordance with ASTM D2074.

Non-volatile content of organosaline-based liquid antistrip must be 40 percent minimum when tested under ASTM D5095. Dosage for organosaline-based liquid antistrip must be from 0.05 to 0.15 percent by weight of asphalt.

Use only 1 liquid antistrip type or brand at a time. Do not mix liquid antistrip types or brands.

Store and mix liquid antistrip under the manufacturer's instructions.

139-3.5 Tack Coat

Tack coat must comply with the specifications for asphaltic emulsion or asphalt binder in the Caltrans Standard Specifications. Choose the type and grade of emulsion or binder.

139-4 MIX DESIGNS

139-4.1 General

The HMA mix design must comply with the Superpave HMA mix design as described in *Asphalt Institute publication MS-2, "Asphalt Mix Design Methods", 7th Edition*.

The Contractor Hot Mix Asphalt Design Data form must show documentation on aggregate quality.

The HMA mix design must comply with AASHTO R 35 except:

1. Notes 3 and 10 do not apply

139-4.2 Requirements

139-4.2.1 General

The mix design for HMA-LG must comply with the requirements shown in the following tables for the specified Level:

Level 1 (Traffic Index 5.0 to 7.5)

Quality Characteristic	Test Method	Requirement
Air voids content (%)	AASHTO T 269 ^a	N _{initial} > 8.0 N _{design} = 3.5 N _{max} > 2.0
Gyrations compaction (no. of gyrations)	AASHTO T 312	N _{initial} = 6 N _{design} = 50.0 N _{max} = 75
Voids in mineral aggregate (min, %) ^b Gradation: 3/8-inch 1/2-inch 3/4-inch	MS-2 Asphalt Mixture Volumetrics	14.5–17.5 13.5–16.5 12.5–15.5
Dust proportion	MS-2 Asphalt Mixture Volumetrics	0.4-1.4
Hamburg wheel track (min number of passes at 0.5-inch rut depth) Binder grade: PG 58 PG 64 PG 70 PG 76 or higher	California Test 389 ^c	5,000 7,500 15,000 20,000

^aCalculate the air voids content of each specimen using AASHTO T 275, Method A, to determine bulk specific gravity. Use AASHTO T 209, Method A, to determine theoretical maximum specific gravity. Use a digital manometer and pycnometer when performing AASHTO T 209.

^bMeasure bulk specific gravity using AASHTO T 275, Method A.

^cTest plant-produced HMA-LG.

Level 2 (Traffic Index 8.0 to 10.0)

Quality Characteristic	Test Method	Requirement
Air voids content (%)	AASHTO T 269 ^a	N _{initial} > 8.0 N _{design} = 4.0 N _{max} > 2.0
Gyrations compaction (no. of gyrations)	AASHTO T 312	N _{initial} = 7 N _{design} = 65.0 N _{max} = 115
Voids in mineral aggregate (min, %) ^b Gradation: 3/8-inch 1/2-inch 3/4-inch	MS-2 Asphalt Mixture Volumetrics	15.0–18.0 14.0–17.0 13.0–16.0
Dust proportion	MS-2 Asphalt Mixture Volumetrics	0.5-1.3
Hamburg wheel track (min number of passes at 0.5-inch rut depth) Binder grade: PG 58 PG 64 PG 70 PG 76 or higher	California Test 389 ^c	10,000 15,000 20,000 25,000

^aCalculate the air voids content of each specimen using AASHTO T 275, Method A, to determine bulk specific gravity. Use AASHTO T 209, Method A, to determine theoretical maximum specific gravity. Use a digital manometer and pycnometer when performing AASHTO T 209.

^bMeasure bulk specific gravity using AASHTO T 275, Method A.

^cTest plant-produced HMA-LG.

Level 3 (Traffic Index 10.5 to 13.5)

Quality Characteristic	Test Method	Requirement
Air voids content (%)	AASHTO T 269 ^a	N _{initial} > 8.0 N _{design} = 4.0 N _{max} > 2.0
Gyrations compaction (no. of gyrations)	AASHTO T 312	N _{initial} = 8 N _{design} = 85.0 N _{max} = 130
Voids in mineral aggregate (min, %) ^b		
Gradation:	MS-2 Asphalt Mixture Volumetrics	
3/8-inch		15.5–18.5
1/2-inch		14.5–17.5
3/4-inch		13.5–16.5
Dust proportion	MS-2 Asphalt Mixture Volumetrics	0.6–1.3
Hamburg wheel track (min number of passes at 0.5-inch rut depth)	California Test 389 ^c	
Binder grade:		
PG 58		10,000
PG 64		15,000
PG 70		20,000
PG 76 or higher		25,000

^aCalculate the air voids content of each specimen using AASHTO T 275, Method A, to determine bulk specific gravity. Use AASHTO T 209, Method A, to determine theoretical maximum specific gravity. Use a digital manometer and pycnometer when performing AASHTO T 209.

^bMeasure bulk specific gravity using AASHTO T 275, Method A.

^cTest plant-produced HMA-LG.

139-4.2.2 Reclaimed Asphalt Pavement

For HMA-LG mixtures using RAP, the maximum allowed binder replacement is 25.0 percent. The binder replacement is calculated as a percentage of the approved JMF target asphalt binder content.

For RAP substitution of 15 percent or less, the grade of the virgin binder must be the specified grade of asphalt binder for HMA-LG.

For RAP substitution greater than 15 percent and not exceeding 25 percent use one of the following criteria:

- The grade of the virgin binder must be the specified grade of asphalt binder for HMA-LG with the upper and lower temperature classification reduced by 6 degrees C.
- The grade of the virgin binder as identified using a blending chart.

Hamburg wheel track requirements are based on the grade of asphalt binder specified for HMA-LG.

139-4.2.3 Treatments

If the proposed JMF indicates that the aggregate is being treated with dry lime or lime slurry with marination, or the HMA-LG with liquid antistrip, then testing the mix with untreated aggregate in accordance with California Test 389 is not required.

If HMA-LG treatment is required or being used by the Contractor, determine the plasticity index of the aggregate blend in accordance with California Test 204.

Do not use an aggregate blend with a plasticity index greater than 10.

If the plasticity index is from 4 to 10, treat the aggregate blend with dry lime with marination or lime slurry with marination.

If the plasticity index is less than 4, treat the aggregate blend with dry lime or lime slurry with marination, or treat the HMA-LG with liquid antistrip.

Liquid antistrip must be from 0.25 to 1.0 percent by weight of asphalt binder. Do not use liquid antistrip as a substitute for asphalt binder.

139-4.2.4 Warm Mix Asphalt Technology

For HMA-LG with WMA additive technology, produce HMA mix samples for your mix design using your methodology for inclusion of WMA admixture in laboratory-produced HMA. Cure the mix samples in a forced-air draft oven at 275 degrees F for 4 hours \pm 10 minutes.

For WMA water injection foam technology, the use of foamed asphalt for mix design is not required

139-4.3 Job Mix Formulas

139-4.3.1 General

The JMF must be based on the Superpave HMA mix design as described in *Asphalt Institute publication MS-2, "Asphalt Mix Design Methods", 7th Edition* as modified herein.

139-4.3.2 Submittals

139-4.3.2.1 General

Submit your proposed JMF for each Level of HMA-LG to be used. The JMF must be submitted on Pages 1 and 2 of Caltrans form CEM-3511, Contractor Job Mix Formula Proposal.

<https://dot.ca.gov/programs/construction/forms>

If requested, submit the following additional information:

1. Mix design documentation on Caltrans form CEM-3512, Contractor Hot Mix Asphalt Design Data, dated within 24 months of the submittal date.
2. JMF verification on Caltrans form CEM-3513, Contractor Hot Mix Asphalt Verification, and the Contractor Hot Mix Asphalt Design Data form that was submitted for the JMF verification, if applicable.

The Caltrans Contractor Hot Mix Asphalt Design Data form must identify the AASHTO re:source accredited lab responsible for the mix design and show documentation on aggregate quality.

Submit a new JMF if you change any of the following:

1. Target asphalt binder percentage greater than ± 0.2 percent
2. Asphalt binder supplier
3. Combined aggregate gradation
4. Aggregate sources
5. Liquid antistriper producer or dosage
6. Average binder content in a new processed RAP stockpile by more than ± 2.00 percent from the average RAP binder content reported on page 4 of your Contractor Hot Mix Asphalt Design Data form
7. Any material in the JMF, except lime supplier and source

Allow the Engineer 5 business days from a complete JMF submittal for document review of the design data (if submitted) and the JMF. The Engineer notifies you if the proposed JMF submittal is accepted.

139-4.3.2.2 Liquid Antistriper Treatment

If liquid antistriper treatment is used, submit the following with your proposed JMF submittal:

1. Certificate of Compliance for each liquid antistriper shipment. On each Certificate of Compliance, include:
 - 1.1. Your signature and printed name
 - 1.2. Shipment number
 - 1.3. Material type
 - 1.4. Material specific gravity
 - 1.5. Manufacturer
 - 1.6. Consignee
 - 1.7. Destination
 - 1.8. Quantity
 - 1.9. Contact or purchase order number
 - 1.10. Shipment date

2. Proposed proportions for the liquid antistrip

139-4.3.2.3 Lime Treatment

If aggregate lime treatment is used, submit the following with your proposed JMF submittal and each time you produce lime treated aggregate:

1. Exact lime proportions for fine and coarse virgin aggregates
2. If marination is required, the averaged aggregate quality test results within 24 hours of sampling
3. For dry lime aggregate treatment, a treatment data log from the dry lime and aggregate proportioning device in the following order:
 - 3.1. Treatment date
 - 3.2. Time of day the data is captured
 - 3.3. Aggregate size being treated
 - 3.4. HMA type and mix aggregate size
 - 3.5. Wet aggregate flow rate collected directly from the aggregate weigh belt
 - 3.6. Aggregate moisture content, expressed as a percentage of the dry aggregate weight
 - 3.7. Flow rate of dry aggregate calculated from the flow rate of wet aggregate
 - 3.8. Dry lime flow rate
 - 3.9. Lime ratio from the authorized JMF for each aggregate size being treated
 - 3.10. Lime ratio from the authorized JMF for the combined aggregates
 - 3.11. Actual lime ratio calculated from the aggregate weigh belt output, aggregate moisture input, and dry lime meter output, expressed as a percentage of the dry aggregate weight
 - 3.12. Calculated difference between the authorized lime ratio and the actual lime ratio
4. For lime slurry aggregate treatment, a treatment data log from the slurry proportioning device in the following order:
 - 4.1. Treatment date
 - 4.2. Time of day the data is captured
 - 4.3. Aggregate size being treated
 - 4.4. Wet aggregate flow rate collected directly from the aggregate weigh belt
 - 4.5. Moisture content of the aggregate just before treatment, expressed as a percentage of the dry aggregate weight
 - 4.6. Dry aggregate flow rate calculated from the wet aggregate flow rate
 - 4.7. Lime slurry flow rate measured by the slurry meter
 - 4.8. Dry lime flow rate calculated from the slurry meter output
 - 4.9. Authorized lime ratio for each aggregate size being treated
 - 4.10. Actual lime ratio calculated from the aggregate weigh belt and slurry meter output, expressed as a percentage of the dry aggregate weight
 - 4.11. Calculated difference between the authorized lime ratio and actual lime ratio
 - 4.12. Dry lime and water proportions at the slurry treatment time

139-4.3.2.4 Warm Mix Asphalt Technology

If a WMA technology is used, submit the following with your proposed JMF submittal:

1. SDS for the WMA technology
2. For water injection foam technology:
 - 2.1. Name of technology
 - 2.2. Proposed foaming water content
 - 2.3. Proposed HMA-LG production temperature range
 - 2.4. Certification from binder supplier stating no antifoaming agent is used
3. For additive technology:
 - 3.1. Name of technology
 - 3.2. Percent admixture by weight of binder and percent admixture by total weight of HMA-LG as recommended by the manufacturer
 - 3.3. Methodology for inclusion of admixture in laboratory-produced HMA-LG
 - 3.4. Proposed HMA-LG production temperature range

139-4.3.3 Verification

The Agency may verify the JMF. Verification will be performed by the Agency or the Agency will retain a laboratory qualified under the AASHTO re:source program and the Caltrans Independent Assurance Program to perform the verification. Either of the aforementioned are hereinafter referred to as "Agency Lab." The cost of verification is paid by the Agency. You perform the sampling at your own expense as follows:

The production set point at the plant must be within ± 0.2 from the asphalt binder percentage TV shown in your Contractor Job Mix Formula Proposal form. Notify the Engineer at least 2 business days before sampling materials. Samples may be taken from a different project including a non-Agency project if you make arrangements for the Engineer to be present during sampling.

In the Engineer's and Agency Lab's presence and from the same production run, take samples of:

1. Aggregates. Coarse, fine, and supplemental fine aggregates must be taken from the combined cold-feed belt or the hot bins. If lime treatment is required, samples must be taken from individual stockpiles before lime treatment. Samples must be at least 120 pounds for each coarse aggregate, 80 pounds for each fine aggregate, and 10 pounds for each type of supplemental fine aggregate. For hot-bin samples, the Department combines these aggregate samples to verify the TV submitted on a Contractor Job Mix Formula Proposal form.
2. Asphalt binder. Take at least two 1-quart samples. Each sample must be in a cylindrical-shaped can with an open top and friction lid. If the asphalt binder is modified or rubberized, the asphalt binder must be sampled with the components blended in the proportions to be used.
3. RAP. Samples must be at least 50 pounds from each fractionated stockpile used or 100 pounds from the belt.

4. Plant-produced HMA-LG. The HMA-LG samples must be at least 250 pounds.

For aggregate, RAP, and HMA-LG, split the samples into at least 4 parts and label their containers. Submit 3 parts and keep 1 part.

After acceptance of the JMF submittal, the Agency verifies each proposed JMF within 20 days of receiving all verification samples.

For JMF verification, the Agency Lab tests the following for compliance with the specifications:

1. Aggregate quality
2. Aggregate gradation
3. HMA quality characteristics for Agency acceptance

To verify the HMA-LG for air voids, voids in mineral aggregate, and dust proportion, the Agency Lab uses an average of 3 briquettes. The Agency Lab tests plant-produced material.

If the Agency Lab verifies the JMF, the Engineer furnishes you a Hot Mix Asphalt Verification form.

You may submit an adjusted aggregate gradation TV on a Contractor Job Mix Formula Proposal form before verification testing. Aggregate gradation TV must be within the TV limits specified.

If the Agency Lab test results on plant-produced samples do not show compliance with the specifications, the Engineer notifies you. Submit a JMF adjusted after verification failure based on your testing unless the Engineer authorizes reverification without adjustments. The adjusted JMF must include a new Contractor Job Mix Formula Proposal form, Contractor Hot Mix Asphalt Design Data form, and the results of the failed verification testing. Engineer-authorized reverification without adjustment is not JMF adjusted after verification failure. A JMF adjusted after verification failure may include a change in:

1. Asphalt binder content TV up to ± 0.20 percent from the OBC value submitted on the Contractor Hot Mix Asphalt Design Data form
2. Aggregate gradation TV within the TV limits specified in the aggregate gradation table

You may adjust the JMF only once due to a failed verification test.

For each HMA-LG level and aggregate size specified, the Agency Lab verifies up to 2 proposed JMF submittals including a JMF adjusted after verification failure. Do not resubmit any of the 2 proposed submittals including a JMF adjusted after verification failure that failed verification on any other Agency projects.

A verified JMF is valid for 24 months.

In lieu of Agency-performed verification testing, the Agency may accept the results of verification testing performed by another City or County within 24 months for the same HMA-LG Level, aggregate size and source, and asphalt binder.

139-4.3.4 Authorization

You may start HMA production if:

1. The Engineer's review of the JMF shows compliance with the specifications.
2. Verification is required, the JMF has been verified within 24 months before HMA-LG production.
3. The Agency performs verification testing; the Engineer authorizes the verified JMF.
4. The Contractor QC plan has been reviewed and approved.

139-4.3.5 Renewal

The JMF must be verified for renewal from samples taken from the plant to be used. The laboratory who performs the verification must be qualified under the AASHTO re:source program and the Caltrans Independent Assurance Program. You pay the cost of the JMF renewal.

You may request a JMF renewal by submitting:

1. Proposed JMF on a Contractor Job Mix Formula Proposal form
2. Previously verified JMF documented on a Caltrans Hot Mix Asphalt Verification form dated within 24 months
3. Mix design documentation on a Contractor Hot Mix Asphalt Design Data form used for the previously verified JMF

For a JMF renewal and upon request, in the Engineer's presence and from the same production run, take samples of:

1. Aggregates. Coarse, fine, and supplemental fine aggregates must be taken from the combined cold-feed belt or the hot bins. If lime treatment is required, samples must be taken from individual stockpiles before lime treatment. Samples must be at least 120 pounds for each coarse aggregate, 80 pounds for each fine aggregate, and 10 pounds for each type of supplemental fines. For hot-bin samples, the Agency combines these aggregate samples to verify the TV submitted on a Contractor Job Mix Formula Proposal form.
2. Asphalt binder. Take at least two 1-quart samples. Each sample must be in a cylindrical-shaped can with an open top and friction lid. If the asphalt binder is modified or rubberized, the asphalt binder must be sampled with the components blended in the proportions to be used.
3. RAP. Samples must be at least 50 pounds from each fractionated stockpile.
4. Plant-produced HMA-LG. The HMA-LG samples must be at least 250 pounds.

Notify the Engineer at least 2 business days before sampling materials. For aggregate, RAP, and HMA-LG, split samples into at least 4 parts. Submit 3 parts and use 1 part for your testing.

Allow the Agency 5 business days from a complete JMF reverification submittal for document review of the aggregate qualities, mix design, and JMF.

The most recent aggregate quality test results within the past 12 months may be used for verification of JMF renewal.

The Agency may verify the JMF for renewal, at its own expense, in accordance with Section 139-4.3.3 except:

1. The Engineer keeps the samples until you provide test results for your part on a Contractor Job Mix Formula Renewal form.
2. The Agency Lab tests samples of materials obtained from the HMA-LG production until after you submit test results that comply with the mix design specifications.
3. After completion of the JMF verification renewal document review, the Agency Lab verifies each proposed JMF within 20 days of receiving the verification renewal samples and the complete Contractor Job Mix Formula Renewal form.
4. You may not adjust the JMF due to a failed verification.

The Engineer furnishes you an HMA-LG Verification form.

The HMA-LG Verification form is valid for 24 months.

139-4.3.6 Modification

For an authorized JMF, submit a modified JMF if you change any of the following:

1. Asphalt binder supplier
2. Liquid antistrip producer
3. Liquid antistrip dosage

You may change any of the above items only once during the Contract.

The Agency may authorize a JMF modification based upon review or require verification. The laboratory who prepares the JMF modification and, if requested, verification, must be qualified under the AASHTO re:source program and the Caltrans Independent Assurance Program. You pay the cost of the modified JMF verification.

Submit your modified JMF request at least 15 days before production. Each modified JMF submittal must include:

1. Proposed modified JMF on Contractor Job Mix Formula Proposal form, marked *Modified*.
2. Mix design records on Contractor Hot Mix Asphalt Design Data form for the authorized JMF to be modified.
3. JMF verification on Hot Mix Asphalt Verification form for the authorized JMF to be modified.

4. Test results for the modified JMF in compliance with the mix design specifications. Perform tests at the mix design OBC as shown on the Contractor Asphalt Mix Design Data form.

With an accepted modified JMF submittal, the Agency Lab verifies each modified JMF within 10 days of receiving all verification samples.

The Agency Lab verifies the modified JMF after the modified JMF HMA-LG is placed and verification samples are taken within the first 750 tons. The ITP tests verification samples for compliance with:

1. Hamburg wheel track mix design specifications
2. Air void content
3. Voids in mineral aggregate on plant-produced HMA mix design specifications
4. Dust proportion mix design specifications

The Agency Lab may test for moisture susceptibility for compliance with the mix design specifications.

If the modified JMF is verified, the Engineer revises your Hot Mix Asphalt Verification form to include the new asphalt binder source, new liquid antistriper producer, or new liquid antistriper dosage. Your revised form will have the same expiration date as the original form.

139-5 Production

139-5.1 General

Do not start HMA-LG production before authorization of the JMF.

Weighing and metering devices used for the production of HMA-LG modified with additives must comply with the Caltrans Material Plant Quality Program (MPQP):

<https://dot.ca.gov/programs/construction/material-plant-quality-program>

or

comply with California Test 109 as certified by a State of California Department of Food and Agriculture, Division of Measurement Standards, Registered Service Agency. A listing of registered service agencies is available at the following:

<https://www.cdfa.ca.gov/dms/programs/rsa/rsalistings/rsaListings.html>

If a loss-in-weight meter is used for dry HMA-LG additive, the meter must have an automatic and integral material delivery control system for the refill cycle.

Calibrate the loss-in-weight meter by:

1. Including at least 1 complete system refill cycle during each calibration test run
2. Operating the device in a normal run mode for 10 minutes immediately before starting the calibration process
3. Isolating the scale system within the loss-in-weight feeder from surrounding vibration
4. Checking the scale system within the loss-in-weight feeder for accuracy before and after the calibration process and daily during mix production
5. Using a minimum 15 minute or minimum 250-pound test run size for a dry ingredient delivery rate of less than 1 ton per hour.
6. Complying with the limits of Table B, "Conveyor Scale Testing Extremes," in the Caltrans' MPQP.

Proportion aggregate by hot or cold-feed control.

Asphalt binder temperature must be from 275 to 375 degrees F when mixed with aggregate.

Mix HMA-LG ingredients into a homogeneous mixture of coated aggregates.

HMA-LG must be produced at the temperatures shown in the following table:

HMA-LG Production Temperatures	
HMA compaction	Temperature (°F)
HMA-LG	
Density based	≤ 325
HMA-LG with WMA technology	
Density based	240–325

If RAP is used, the asphalt plant must automatically adjust the virgin asphalt binder to account for RAP percentage and RAP binder.

During production, you may adjust hot- or cold-feed proportion controls for virgin aggregate and RAP. For RAP substitution of 15 percent or less, RAP must be within ± 5 of RAP percentage shown in your Contractor Job Mix Formula Proposal form without exceeding 15 percent. For RAP substitution of greater than 15 percent, RAP must be within ± 5 of RAP percentage shown in your Contractor Job Mix Formula Proposal form without exceeding 25 percent.

139-5.2 Aggregate Lime Treatments

139-5.2.1 General

Notify the Engineer at least 24 hours before the start of aggregate treatment.

Do not treat RAP.

The lime ratio is the pounds of dry lime per 100 pounds of dry virgin aggregate expressed as a percentage. Water content of slurry or untreated aggregate must not affect the lime ratio.

Coarse and fine aggregate fractions must have the lime ratio ranges shown in the following table:

Aggregate fractions	Lime ratio percent
Coarse	0.4–1.0
Fine	1.5–2.0
Combined	0.8–1.5

The lime ratio for fine and coarse aggregate must be within ± 0.2 percent of the lime ratio in the accepted JMF. The lime ratio must be within ± 0.2 percent of the authorized lime ratio when you combine the individual aggregate sizes in the JMF proportions. The lime ratio must be determined before the addition of RAP.

If marination is required, marinate treated aggregate in stockpiles from 24 hours to 60 days before using in HMA. Do not use aggregate marinated longer than 60 days. Treated aggregate must not have lime balls or clods.

139-5.2.2 Dry Lime

If marination is required:

1. Treat and marinate coarse and fine aggregates separately
2. Treat the aggregate and stockpile for marination only once
3. Treat the aggregate separately from HMA-LG production

Proportion dry lime by weight with an automatic continuous proportioning system.

If you use a batch-type proportioning system for HMA-LG production, control proportioning in compliance with the specifications for continuous mixing plants. Use a separate dry lime aggregate treatment system for HMA-LG batch mixing including:

1. Pugmill mixer
2. Controller
3. Weigh belt for the lime
4. Weigh belt for the aggregate

If a continuous mixing plant for HMA-LG production without lime-marinated aggregates is used, use a controller that measures the blended aggregate weight after any additional water is added to the mixture. The controller must determine the quantity of lime added to the aggregate from the aggregate weigh belt input in connection with the manually input total aggregate moisture, the manually input target lime content, and the lime proportioning system output. Use a continuous aggregate weigh belt and pugmill mixer for lime treatment in addition to the weigh belt for the aggregate proportioning to asphalt

binder in the HMA plant. If you use a water meter for moisture control for lime treatment, the meter must comply with Caltrans' MPQP manual.

When mixing dry lime with aggregate, the aggregate moisture content must ensure complete lime coating. The aggregate moisture content must not cause aggregate to be lost between the point of weighing the combined aggregate continuous stream and the dryer. Add water to the aggregate for mixing and coating before dry lime addition. Immediately before mixing lime with aggregate, water must not visibly separate from the aggregate.

Mix aggregate, water, and dry lime with a continuous pugmill mixer with twin shafts. Immediately before mixing lime with aggregate, water must not visibly separate from the aggregate. Store dry lime in a uniform and free-flowing condition. Introduce dry lime to the pugmill in a continuous process. The introduction must occur after the aggregate cold feed and before the point of proportioning across a weigh belt and the aggregate dryer. Prevent loss of dry lime.

The pugmill must be equipped with paddles arranged to provide sufficient mixing action and mixture movement. The pugmill must produce a homogeneous mixture of uniformly coated aggregates at mixer discharge.

If the aggregate treatment process is stopped longer than 1 hour, clean the equipment of partially treated aggregate and lime.

Aggregate must be completely treated before introduction into the mixing drum.

139-5.2.3 Lime Slurry

For lime slurry aggregate treatment, treat aggregate separate from HMA-LG production. Stockpile and marinate the aggregate.

Proportion lime and water with a continuous or batch mixing system.

Add lime to the aggregate as slurry consisting of mixed dry lime and water at a ratio of 1-part lime to from 2 to 3 parts water by weight. The slurry must completely coat the aggregate.

Immediately before mixing lime slurry with the aggregate, water must not visibly separate from the aggregate.

Proportion lime slurry and aggregate by weight in a continuous process.

139-5.3 Warm Mix Asphalt Technology

Proportion all ingredients by weight. The HMA-LG plant process controller must be the sole source of ingredient proportioning control and be fully interfaced with all scales and

meters used in the production process. The addition of the HMA additive must be controlled by the plant process controller.

Liquid ingredient additive, including a normally dry ingredient made liquid, must be proportioned with a mass flow meter at continuous mixing plants. Use a mass flow meter or a container scale to proportion liquid additives at batch mixing plants.

Continuous mixing plants using HMA-LG additives must comply with the following:

1. Dry ingredient additives for continuous production must be proportioned with a conveyor scale or a loss-in-weight meter.
2. HMA-LG plant process controller and ingredient measuring systems must be capable of varying all ingredient-feed rates proportionate with the dry aggregate delivery at all production rates and rate changes.
3. Liquid HMA-LG additive must enter the production stream with the binder. Dry HMA-LG additive must enter the production stream at or before the mixing area.
4. If dry HMA-LG additives are used at continuous mixing HMA-LG plants, bag-house dust systems must return all captured material to the mix. This requirement is waived for lime-treated aggregates.
5. HMA-LG additive must be proportioned to within ± 0.3 percent of the target additive rate.

Batch mixing plants using HMA-LG additives must comply with the following:

1. If a container scale is used, weigh additive before combining with asphalt binder. Keep the container scale separate from other ingredient proportioning. The container scale capacity must be no more than twice the volume of the maximum additive batch size. The container scale's graduations must be smaller than the proportioning tolerance or 0.001 times the container scale capacity.
2. Dry HMA-LG additive proportioning devices must be separate from metering devices for the aggregates and asphalt binder. Proportion dry HMA-LG additive directly into the pugmill, or place in an intermediate holding vessel to be added to the pugmill at the appropriate time in the batch cycle. Dry ingredients for batch production must be proportioned with a hopper scale.
3. Zero tolerance for the HMA-LG additive batch scale is ± 0.5 percent of the target additive weight. The indicated HMA-LG additive batch scale weight may vary from the preselected weight setting by up to ± 1.0 percent of the target additive weight.

139-5.4 Production Start-Up Evaluation

Evaluation of HMA-LG production and placement at production start-up is not required if the total tonnage for the work for the Level and aggregate size is less than 2,000 tons. You and the Engineer evaluate HMA-LG production and placement at production start-up if the total tonnage for the work for the Level and aggregate size is:

1. Greater than 4,000 tons

2. Between 2,000 and 4,000 tons and the JMF has not been verified by testing performed by the Agency lab or the Agency did not accept verification testing performed by another City or County as specified in Section 139-4.3.3.

Within the first 750 tons produced on the 1st day of HMA-LG production, in the Engineer's presence, and from the same production run, take samples of:

1. Aggregates
2. Asphalt binder
3. RAP
4. HMA-LG

Sample aggregates from the combined cold-feed belt or hot bin. Take RAP samples from the RAP system.

For aggregates, RAP, and HMA-LG, split the samples into at least 4 parts and label their containers. Submit 3 parts to the Engineer and keep 1 part. The Engineer must retain 2 parts in the event of dispute resolution.

You and the Engineer must test the samples and report test results, except for California Test 389. If you proceed with paving before receipt of the test results, the Engineer may consider the HMA placed to be represented by these test results.

California Test 389 is not required.

If production stops for more than 60 days, perform a production start-up evaluation. If production stops for more than 30 days but less 60 days, perform a reduced production start-up evaluation. Reduced production start-up evaluation is production start-up evaluation without California Test 389.

If production start-up evaluation fails, do not begin production.

The test strip construction, cores, and correlation of the nuclear gauge specified in Section 139-6.8.1 may be performed concurrently with production start-up evaluation.

139-5.5 Quality Control

139-5.5.1 General

QC test results must comply with the specifications for Agency acceptance.

Condition each at-the-plant sample of HMA-LG mixture when composite aggregate absorption factor is greater than 2.0 percent as indicated by the JMF in compliance with sections 7.1.2, 7.1.3, and 7.1.4 of AASHTO R 30.

Prepare 3 briquettes for air voids content and voids in mineral aggregate determination. Report the average of 3 tests. If 2 consecutive material QC test results or any 3 material QC test results for 1 day's production do not comply with the specifications:

1. Stop HMA-LG production
2. Notify the Engineer
3. Take corrective action
4. Demonstrate compliance with the specifications before resuming production and placement

For QC tests performed under AASHTO T 27, results are considered 1 QC test regardless of number of sieves out of compliance.

Do not resume production and placement until the Engineer authorizes your corrective action proposal.

139-5.5.2 Aggregate

139-5.5.2.1 General

Test the quality characteristics of aggregates under the test methods and frequencies shown in the following table:

Aggregate Testing Frequencies

Quality characteristic	Test method	Minimum testing frequency
Gradation ^a	AASHTO T 27	1 per 750 tons and any remaining part
Sand equivalent ^{b, c}	AASHTO T 176	
Moisture content ^d	AASHTO T 255	
Crushed particles	AASHTO T 335	Levels 1: 1 per 10,000 tons or 1 per project whichever is greater
Los Angeles Rattler	AASHTO T 96	
Flat and elongated particles	ASTM D4791	
Fine aggregate angularity ^e	AASHTO T 304 Method A	Levels 2 and 3: 1 per 10,000 tons or 2 per project whichever is greater

^aIf RAP is used, test the combined aggregate gradation under California Test 384.

^bReported value must be the average of 3 tests from a single sample.

^cUse of a sand reading indicator is required as shown in AASHTO T 176, Figure 1. Sections 4.7, "Manual Shaker," 7.1.2, "Alternate Method No. 2," and 8.4.3, "Hand Method," do not apply. Prepare the stock solution as specified in section 4.8.1, "Stock solution with formaldehyde," except omit the addition of formaldehyde.

^dTest at continuous mixing plants only. If RAP is used, test the RAP moisture content at continuous mixing plant and batch mixing plant.

^eWaived if 10% or less non-manufactured sand.

For lime treated aggregate, test aggregate before treatment and test for gradation and moisture content during HMA-LG production.

139-5.5.2.2 Gradations

Aggregate gradation must be determined before the addition of asphalt binder and must include supplemental fine aggregates. Test for aggregate gradation under AASHTO T 27. Do not wash the coarse aggregate. Wash the fine aggregate only. Use a mechanical sieve shaker. Aggregate shaking time must not exceed 10 minutes for each coarse and fine aggregate portion.

Choose a TV within the TV limits shown in the tables titled "Aggregate Gradations."

Gradations are based on nominal maximum aggregate size.

139-5.5.2.3 Lime Treatments

If aggregate lime treatment is used, submit the following with your proposed JMF submittal and each time you produce lime-treated aggregate:

1. Exact lime proportions for fine and coarse virgin aggregates
2. If marination is required, the averaged aggregate quality test results within 24 hours of sampling
3. For dry lime aggregate treatment, a treatment data log from the dry lime and aggregate proportioning device in the following order:
 - 3.1. Treatment date
 - 3.2. Time of day the data is captured
 - 3.3. Aggregate size being treated
 - 3.4. HMA type and mix aggregate size
 - 3.5. Wet aggregate flow rate collected directly from the aggregate weigh belt
 - 3.6. Aggregate moisture content, expressed as a percentage of the dry aggregate weight
 - 3.7. Flow rate of dry aggregate calculated from the flow rate of wet aggregate
 - 3.8. Dry lime flow rate
 - 3.9. Lime ratio from the authorized JMF for each aggregate size being treated
 - 3.10. Lime ratio from the authorized JMF for the combined aggregates
 - 3.11. Actual lime ratio calculated from the aggregate weigh belt output, aggregate moisture input, and dry lime meter output, expressed as a percentage of the dry aggregate weight
 - 3.12. Calculated difference between the authorized lime ratio and the actual lime ratio
4. For lime slurry aggregate treatment, a treatment data log from the slurry proportioning device in the following order:
 - 4.1. Treatment date
 - 4.2. Time of day the data is captured
 - 4.3. Aggregate size being treated
 - 4.4. Wet aggregate flow rate collected directly from the aggregate weigh belt
 - 4.5. Moisture content of the aggregate just before treatment, expressed as a percentage of the dry aggregate weight
 - 4.6. Dry aggregate flow rate calculated from the wet aggregate flow rate
 - 4.7. Lime slurry flow rate measured by the slurry meter
 - 4.8. Dry lime flow rate calculated from the slurry meter output
 - 4.9. Authorized lime ratio for each aggregate size being treated
 - 4.10. Actual lime ratio calculated from the aggregate weigh belt and slurry meter output, expressed as a percentage of the dry aggregate weight

- 4.11. Calculated difference between the authorized lime ratio and actual lime ratio
- 4.12. Dry lime and water proportions at the slurry treatment time

Each day during lime treatment, submit the treatment data log on electronic media in tab delimited format on a removable CD-ROM storage disk. Each continuous treatment data set must be a separate record using a line feed carriage return to present the specified data on 1 line. The reported data must include data titles at least once per report.

If lime treatment is required, sample coarse and fine aggregates from individual stockpiles before lime treatment. Combine aggregate in the JMF proportions. Test the aggregates under the test methods and frequencies shown in the following table:

Aggregate Quality Control During Lime Treatment

Quality characteristic	Test method	Minimum sampling and testing frequency
Sand equivalent ^{a, b}	AASHTO T 176	1 per 750 tons of untreated aggregate
Percent of crushed particles	AASHTO T 335	Levels 1: 1 per 10,000 tons or 1 per project whichever is greater
Los Angeles Rattler	AASHTO T 96	
Fine aggregate angularity	AASHTO T 304, Method A	Levels 2 and 3: 1 per 10,000 tons or 2 per project whichever is greater
Flat and elongated particles	ASTM D4791	

^aReport test results as the average of 3 tests from a single sample.

^bUse of a sand reading indicator is required as shown in AASHTO T 176, Figure 1. Sections 4.7, "Manual Shaker," 7.1.2, "Alternate Method No. 2," and 8.4.3, "Hand Method," do not apply. Prepare the stock solution as specified in section 4.8.1, "Stock solution with formaldehyde," except omit the addition of formaldehyde.

For lime slurry aggregate treatment, determine the aggregate moisture content at least once every 2 hours of treatment. Calculate moisture content under AASHTO T 255 and report it as a percent of dry aggregate weight. Use the moisture content calculations as a set point for the proportioning process controller.

The device controlling lime and aggregate proportioning must produce a treatment data log. The log must consist of a series of data sets captured at 10-minute intervals throughout daily treatment. The data must be a treatment activity register and not a summation. The material represented by a data set is the quantity produced 5 minutes before and 5 minutes after the capture time. Collected data must be stored by the controller for the duration of the Contract.

If 3 consecutive sets of recorded treatment data indicate a deviation of more than 0.2 percent above or below the lime ratio in the authorized JMF, stop treatment and take corrective action.

If a set of recorded treatment data indicates a deviation of more than 0.4 percent above or below the lime ratio in the authorized JMF, stop treatment and do not use the material represented by that set of data in HMA-LG.

If 20 percent or more of the total daily treatment indicates a deviation of more than 0.2 percent above or below the lime ratio in the authorized JMF, stop treatment and do not use that day's treated aggregate in HMA-LG.

The Engineer may order you to stop aggregate treatment activities for any of following:

1. You fail to submit treatment data log.
2. You fail to submit aggregate QC data for marinated aggregate.
3. You submit incomplete, untimely, or incorrectly formatted data.
4. You do not take corrective actions.
5. You take late or unsuccessful corrective actions.
6. You do not stop treatment when proportioning tolerances are exceeded.
7. You use malfunctioning or failed proportioning devices.

If you stop treatment for noncompliance, notify the Engineer of any corrective actions taken and conduct a successful 20-minute test run before resuming treatment.

139-5.5.3 Reclaimed Asphalt Pavement

During RAP production sample RAP at a minimum frequency of 1 sample per 1,000 tons with a minimum of 6 samples per stockpile and test for the following:

1. Binder content under AASHTO T308 and T164
2. Aggregate gradation under California Test 384

Sample and test processed RAP at a minimum frequency of 1 sample per 1,000 tons with a minimum of 6 samples per fractionated stockpile. If the fractionated stockpile has not been augmented, the 3 RAP samples taken and tested for mix design can be part of this minimum sample requirement. If a processed RAP stockpile is augmented, sample and test processed RAP quality characteristics at a minimum frequency of 1 sample per 500 tons of augmented RAP.

When tested under AASHTO T 308, the uncorrected binder content of the combined RAP sample must be within ± 2.00 percent of the average uncorrected asphalt binder content reported on page 4 of your Contractor Hot Mix Asphalt Design Data form. If a new processed RAP stockpile is required, the average uncorrected binder content of the new processed RAP stockpile tested under AASHTO T 308 must be within ± 2.00 percent of the average uncorrected binder content reported on page 4 of your Contractor Hot Mix Asphalt Design Data form. You must use the same ignition oven (or an oven correlated to the oven) used to determine the uncorrected asphalt binder content reported on page 4 of your Contractor Hot Mix Asphalt Design Data form.

The combined RAP sample when tested under AASHTO T 209 must be within ± 0.06 of the average maximum specific gravity reported on page 4 of your Caltrans Contractor Hot Mix Asphalt Design Data form.

During HMA-LG production, sample RAP twice daily and perform QC testing for:

1. Aggregate gradation at least once a day under California Test 384
2. Moisture content at least once a day

Submit QC test results for gradation with the combined aggregate gradation within 2 business days of taking RAP samples during HMA-LG production.

139-5.5.4 Liquid Antistrip Treatment

For each delivery of liquid antistrip to the HMA-LG production plant, submit a 1-pint sample to the Engineer. Submit shipping documents. Label each liquid antistrip sampling container with:

1. Liquid antistrip type
2. Application rate
3. Sample date
4. Contract number

At the end of each day's production shift, submit production data in electronic and printed media. Present data on electronic media in a tab delimited format. Use line feed carriage return with 1 separate record per line for each production data set. Allow enough fields for the specified data. Include data titles at least once per report. For each HMA-LG mixing plant type, submit the following information in the order specified:

1. For batch plant mixing:
 - 1.1. Production date
 - 1.2. Time of batch completion
 - 1.3. Mix size and type
 - 1.4. Each ingredient's weight
 - 1.5. Asphalt binder content as a percentage of the total weight of mix
 - 1.6. Liquid antistrip content as a percentage of the asphalt binder weight
2. For continuous mixing plant:
 - 2.1. Production date
 - 2.2. Data capture time
 - 2.3. Mix size and type
 - 2.4. Flow rate of wet aggregate collected directly from the aggregate weigh belt
 - 2.5. Aggregate moisture content as a percentage of the dry aggregate weight
 - 2.6. Flow rate of asphalt binder collected from the asphalt binder meter
 - 2.7. Flow rate of liquid antistrip collected from the liquid antistrip meter
 - 2.8. Asphalt binder content as a percentage of the total weight of mix calculated from:
 - 2.8.1. Aggregate weigh belt output
 - 2.8.2. Aggregate moisture input
 - 2.8.3. Asphalt binder meter output

- 2.9. Liquid antistrip content as a percentage of the asphalt binder weight calculated from:
 - 2.9.1. Asphalt binder meter output
 - 2.9.2. Liquid antistrip meter output

For continuous mixing or batch-plant mixing, sample asphalt binder before adding liquid antistrip. For continuous mixing, sample the combined asphalt binder and liquid antistrip after the static mixer.

If 3 consecutive sets of recorded production data show that the actual delivered liquid antistrip weight is more than ± 1 percent of the authorized mix design liquid antistrip weight, stop production and take corrective action.

If a set of recorded production data shows that the actual delivered liquid antistrip weight is more than ± 2 percent of the authorized mix design liquid antistrip weight, stop production. If the liquid antistrip weight exceeds 1.2 percent of the asphalt binder weight, do not use the HMA-LG represented by that data.

The continuous mixing plant controller proportioning the HMA-LG must produce a production data log. The log must consist of a series of data sets captured at 10-minute intervals throughout daily production. The data must be a production activity register and not a summation. The material represented by the data is the quantity produced 5 minutes before and 5 minutes after the capture time. For the duration of the Contract, the collected data must be stored by the plant controller or a computer's memory at the plant.

The Engineer orders proportioning activities stopped for any of the following reasons:

1. You fail to submit data
2. You submit incomplete, untimely, or incorrectly formatted data
3. You fail to take corrective actions
4. You take late or unsuccessful corrective actions
5. You fail to stop production when proportioning tolerances are exceeded
6. You use malfunctioning or failed proportioning devices

If you stop production, notify the Engineer of any corrective actions taken before resuming.

139-5.5.5 Warm Mix Asphalt Technology

Collect and hold data for the duration of the Contract and submit the electronic media daily. The snapshot of production data must include the following:

1. Production date
2. Production location
3. Time of day the data is captured
4. HMA-LG mix type being produced and target binder rate

5. HMA-LG additive type, brand, and target rate
6. Temperature of the binder and HMA-LG mixture
7. For a continuous mixing plant, the rate of flow of the dry aggregate calculated from the wet aggregate flow rate as determined by the conveyor scale
8. For a continuous mixing plant, the rate of flow of the asphalt meter
9. For a continuous mixing plant, the rate of flow of HMA-LG additive meter
10. For batch plant mixing, actual batch weights of all ingredients
11. Dry aggregate to binder ratio calculated from metered ingredient output
12. Dry aggregate to HMA-LG additive ratio calculated from metered output

At the end of each day's production shift, submit electronic and printed media from the HMA-LG plant process controller. Present data on electronic media in comma-separated values or tab-separated values format. The captured data for the ingredients represented by the production snapshot must have allowances for sufficient fields to satisfy the amount of data required by these specifications and include data titles at least once per report.

139-5.5.6 Hot Mix Asphalt Mixtures

Test the quality characteristics of HMA-LG under the test methods and frequencies shown in the following table:

HMA-LG Production Testing Frequencies

Quality characteristic	Test method	Minimum testing frequency
Asphalt binder content	AASHTO T 308, Method A	1 per 750 tons and any remaining part
HMA moisture content	AASHTO T 329	1 per 2,500 tons but not less than 1 per paving day
Air voids content	AASHTO T 269	1 per 4,000 tons or 2 every 5 paving days, whichever is greater
Voids in mineral aggregate	MS-2 Asphalt Mixture Volumetrics	1 per 10,000 tons or 2 per project whichever is greater
Dust proportion	MS-2 Asphalt Mixture Volumetrics	

Submit QC test results within 3 business days of a request.

If a tapered notched wedge is used, submit compaction test result values within 24 hours of testing.

139-6 Construction

139-6.1 General

If a WMA technology is used, a technical representative for the WMA technology must attend the preconstruction meeting.

Do not place HMA-LG on wet pavement or frozen surface.

HMA-LG must be free of:

1. Segregation
2. Coarse or fine aggregate pockets
3. Hardened lumps
4. Marks
5. Tearing
6. Irregular texture

If widening existing pavement, construct new pavement structure to match the elevation of the existing pavement's edge before placing HMA-LG over the existing pavement.

Until the adjoining through lane's top layer has been paved, do not pave the top layer of:

1. Shoulders
2. Tapers
3. Transitions
4. Road connections
5. Driveways
6. Curve widenings
7. Chain control lanes
8. Turnouts
9. Turn pockets

If the number of lanes changes, pave each through lane's top layer before paving a tapering lane's top layer. Simultaneous to paving a through lane's top layer, you may pave an adjoining area's top layer, including shoulders. Do not operate spreading equipment on any area's top layer until completing final compaction.

If shoulders or median borders are shown, pave shoulders and median borders adjacent to the lane before opening a lane to traffic.

If shoulder conform tapers are shown, place conform tapers concurrently with the adjacent lane's paving.

If a driveway or a road connection is shown, place additional HMA-LG along the pavement's edge to conform to road connections and driveways. Hand rake, if necessary, and compact the additional HMA to form a smooth conform taper.

139-6.2 Equipment

139-6.2.1 Spreading Equipment

Paving equipment for spreading must be:

1. Self-propelled
2. Mechanical
3. Equipped with a screed or strike-off assembly that can distribute HMA-LG the full width of a traffic lane

4. Equipped with a full-width compacting device
5. Equipped with automatic screed controls and sensing devices that control the thickness, longitudinal grade, and transverse screed slope

Install and maintain grade and slope references.

The screed must be heated and produce a uniform HMA-LG surface texture without tearing, shoving, or gouging.

The paver must not leave marks such as ridges and indentations unless you can eliminate them by rolling.

Rollers must be equipped with a system that prevents HMA-LG from sticking to the wheels. You may use a parting agent that does not damage the HMA or impede the bonding of layers.

139-6.2.2 Material Transfer Vehicle

If a material transfer vehicle is specified, the material transfer vehicle must have sufficient capacity to prevent stopping the paver and must be capable of:

1. Either receiving HMA-LG directly from trucks or using a windrow pickup head to load it from a windrow deposited on the roadway surface
2. Remixing the HMA-LG with augers before transferring into the paver's receiving hopper or feed system
3. Transferring HMA-LG directly into the paver's receiving hopper or feed system

139-6.3 Surface Preparation

Prepare subgrade to receive HMA-LG under the sections for the material involved. Subgrade must be free of loose and extraneous material.

Before placing HMA-LG, remove loose paving particles, dirt, and other extraneous material by any means.

The full-width of a surface to which tack coat is to be applied shall be cleaned with a self-propelled, truck-mounted sweeper equipped with both power brooms and a vacuum system to remove loose dirt, sand, dust and other objectionable material. The surface to which tack coat is to be applied shall be dry prior to application.

139-6.4 Tack Coat

Prior to applying tack coat, submit calculations for the minimum spray rate required to achieve the minimum residual rate.

Apply a tack coat:

1. To existing pavement including planed surfaces
2. Between HMA layers
3. To vertical surfaces of:
 - 3.1. Curbs
 - 3.2. Gutters
 - 3.3. Construction joints

The surfaces of structures and trees adjacent to the areas being treated shall be protected to prevent their being splashed or damaged.

Equipment for the application of tack coat must comply with section 37-1.03B of the Caltrans Standard Specifications.

For gore points and other areas not accessible to a truck distributor bar apply by hand spraying.

Close areas receiving tack coat to traffic. Do not allow the tracking of tack coat onto pavement surfaces beyond the job site.

If you use an asphalt binder for tack coat, the asphalt binder temperature must be from 285 to 350 degrees F when applied.

A certificate of compliance for each truckload of emulsion or asphalt binder shall be provided to the Engineer before the application of tack coat starts. The Engineer may obtain and retain samples for testing.

Immediately after cleaning the surface, except if water was used, apply a tack coat in one application at the minimum residual rate shown in the table. If water was used, do not apply a tack coat until immediately after the surface is dry. The distributor truck spray bar shall be pressurized during application and discharge tack coat material in a fan shape (spray cone) from each nozzle. The spray bar shall be set at a height above the existing pavement which results in each interior spray cone overlapping a minimum of twice before coming into contact with the underlying pavement. Streaking or streaked applications will not be accepted.

Tack Coat Application Rates for HMA-LG

HMA over:	Minimum residual rates ¹ (gallons/square yard)		
	CSS-1/CSS-1h, SS-1/SS-1h and QS-1h/CQS-1h asphaltic emulsion	CRS-1/CRS-2, RS-1/RS-2 and QS-1/CQS-1 asphaltic emulsion	Asphalt binder and PMRS-2/PMCRS-2 and PMRS-2h/PMCRS-2h asphaltic emulsion
New HMA (between layers)	0.02	0.03	0.02
Concrete pavement and existing asphalt concrete surfacing	0.03	0.04	0.03
Cold Milled/Micro-Milled/Cold Planed Pavement	0.05	0.06	0.04

¹The residual application rate will be verified in accordance with ASTM D2995.

Following the application of tack coat, the surface shall be allowed to cure without being disturbed for period of time necessary to permit setting of the tack coat. Tack coat shall be applied only as far in advance of the placing of the overlying layer as required for that day's operation. Treated surface shall be protected from damage until the succeeding course of pavement is placed.

Apply a tack coat to vertical surfaces with a residual rate that will thoroughly coat the vertical face without running off.

Notify the Engineer if you dilute asphaltic emulsion with water. The weight ratio of added water to asphaltic emulsion must not exceed 1 to 1.

Measure added water either by weight or volume under section 9-1.02 of the Caltrans Standard Specifications or use water meters from water agencies. If you measure water by volume, apply a conversion factor to determine the correct weight.

With each dilution, submit:

1. Weight ratio of water to bituminous material in the original asphaltic emulsion
2. Weight of asphaltic emulsion before diluting
3. Weight of added water
4. Final dilution weight ratio of water to asphaltic emulsion

If authorized, you may change tack coat rates.

Immediately in advance of placing HMA-LG, apply additional tack coat to damaged areas or where loose or extraneous material is removed.

139-6.5 Placement

139-6.5.1 General

The Engineer will meet daily with the Contractor on days when paving occurs to ensure the Contractor's operations are continuous and non-stop.

Deliver HMA-LG to the site in a thoroughly mixed condition and spread by a self-propelled asphalt paving machine.

HMA-LG shall not be placed when the air temperature is below 50°F unless using an approved WMA technology.

HMA-LG with WMA water injection technology shall be spread at a mix temperature of not less than 260°F, or not less than 250°F if a WMA additive technology is used.

No placement will be allowed when the roadway is moist, damp or when it is raining. For the purpose of this provision, "raining" means any weather condition that causes the roadway to become moist or damp. In the case of sudden precipitation, all paving work

must stop immediately, all HMA-LG on site not yet placed and all HMA-LG in transit from the plant will be rejected and no payment will be allowed.

You may deposit HMA-LG in a windrow and load it in the paver if:

1. Paver is equipped with a hopper that automatically feeds the screed
2. Loading equipment can pick up the windrowed material and deposit it in the paver hopper without damaging base material
3. Activities for depositing, pickup, loading, and paving are continuous

Do not use petroleum products such as kerosene or diesel fuel to release HMA-LG from trucks, spreaders, or compactors.

Where the pavement thickness shown is 0.30 foot or greater, you may place HMA-LG in multiple lifts not less than 0.15 foot each. If placing HMA-LG in multiple lifts:

1. Table in Section 139.3.1.3 does not apply
2. Aggregate gradation must comply with the requirements shown in the following table:

Aggregate Gradation Requirements

HMA-LG lift thickness	Gradation
0.15 to less than 0.20 foot	1/2 inch
0.20 foot to less than 0.25 foot	3/4 inch
0.25 foot or greater	3/4 inch

3. Apply a tack coat before placing a subsequent lift
4. The Engineer evaluates each HMA-LG lift individually for compliance

If the ambient air temperature is below 60 degrees F, cover the loads in trucks with tarpaulins. If the time for HMA-LG discharge to truck at the HMA-LG plant until transfer to paver's hopper is 90 minutes or greater and if the ambient air temperature is below 70 degrees F, cover the loads in trucks with tarpaulins, unless the time from discharging to the truck until transfer to the paver's hopper or the pavement surface is less than 30 minutes. The tarpaulins must completely cover the exposed load until you transfer the mixture to the paver's hopper or the pavement surface.

Spread HMA-LG with WMA at the ambient air and surface temperatures shown in the following table:

Minimum Ambient Air and Surface Temperatures

Lift thickness (feet)	Ambient air (°F)		Surface (°F)	
	Unmodified asphalt binder	Modified asphalt binder	Unmodified asphalt binder	Modified asphalt binder
<i>HMA-LG produced with WMA water injection technology</i>				
<0.15	55	50	60	55
≥0.15	45	45	50	50
<i>HMA-LG produced with WMA additive technology</i>				
<0.15	45	45	50	45
≥0.15	40	40	40	40

139-6.5.2 Longitudinal Joints

Longitudinal joints in the top layer must match lane lines. Alternate the longitudinal joint offsets in the lower layers at least 0.5 foot from each side of the lane line. Other longitudinal joint placement patterns are allowed if authorized.

A vertical longitudinal joint of more than 0.15 foot is not allowed at any time between adjacent lanes open to traffic.

For an HMA-LG thickness of 0.15 foot or less, the distance between the ends of the adjacent surfaced lanes at the end of each day's work must not be greater than can be completed in the following day of normal paving.

For an HMA-LG thickness greater than 0.15 foot, you must place HMA-LG on adjacent traveled way lanes or shoulder such that at the end of each work shift the distance between the ends of HMA-LG layers on adjacent lanes is from 5 to 10 feet. Place additional HMA-LG along the transverse edge at each lane's end and along the exposed longitudinal edges between adjacent lanes. Hand rake and compact the additional HMA-LG to form temporary conforms. You may place kraft paper or other authorized release agent under the conform tapers to facilitate the taper removal when paving activities resume.

If placing HMA-LG against the edge of existing pavement, saw cut or grind the pavement straight and vertical along the joint and remove extraneous material.

139-6.6 Compaction

Start rolling at the lower edge and progress toward the highest part except when compacting layers which exceed 4 inches in compacted thickness. For layers which exceed 4 inches in compacted thickness, start rolling in the middle of the mat, and advance gradually to both edges. Roll supported edges (edges along concrete curbs and gutters, or headers) before unsupported edges. If approved, you may delay rolling of an unsupported edge if the required density is achieved on the remainder of the mat after the completion of finish rolling.

Complete finish rolling activities before the pavement surface temperature is:

1. Below 150 degrees F for HMA-LG with unmodified binder
2. Below 140 degrees F for HMA-LG with modified binder

Rolling must leave the completed surface compacted and smooth without tearing, cracking, or shoving.

If a vibratory roller is used as a finish roller, turn the vibrator off.

HMA-LG, after the completion of rolling, shall be compacted to not less than 92 percent and not more than 97 percent of the maximum theoretical density (MTD) as determined in accordance with AASHTO T 209.

Do not open new HMA-LG pavement to traffic until its mid depth temperature is below 160 degrees F.

If the surface to be paved is both in sunlight and shade, pavement surface temperatures are taken in the shade.

139-6.7 Smoothness

The HMA-LG pavement top layer must not vary from the lower edge of a 12-foot-long straightedge:

1. More than 0.01 foot when the straight edge is laid parallel with the centerline
2. More than 0.02 foot when the straightedge is laid perpendicular to the centerline and extends from edge to edge of a traffic lane
3. More than 0.02 foot when the straightedge is laid within 24 feet of a pavement conform

139-6.8 Quality Control

139-6.8.1 HMA-LG Density

The Contractor shall demonstrate that their equipment and operation can achieve the required density on a test strip not less than 200 feet long and 12 feet wide in accordance with California Test 375. The Contractor is responsible for the quality control process necessary to achieve the required density.

[Note to Specifier: Choose one of the following two paragraphs.]

The test strip construction shall be on the same day as production verification testing. The Agency will issue the notice to proceed for paving within 2 business days after completion of the test strip.

or

The test strip construction may be on the same day as production testing or the first day of paving. If on the first day of paving, the Engineer will issue a notice to proceed for paving after the completion of the test strip. You are fully responsible for achieving the required in-place density both prior to, and after, determination of the theoretical maximum density.

139-6.8.2 In-Place Density

The Engineer determines the percent of theoretical maximum density by determining the in-place density by nuclear gauge and dividing by the theoretical maximum density.

The Engineer will determine the field density by a nuclear gauge calibrated from cores taken from the test strip in accordance with California Test 375. Nuclear gauge asphalt testing devices will be re-correlated whenever there is a change in lift thickness of 1/2 inch or greater, underlying material, materials source, or mix design.

139-7 Acceptance

139-7.1.1 General

The Agency tests treated aggregate for acceptance before lime treatment except for gradation.

The Engineer takes HMA-LG samples from any of the following locations:

1. Plant
2. Truck
3. Windrow
4. Mat behind the paver

You must assist in collecting Engineer acceptance samples. Sample in the presence of the Engineer. Split the Engineer acceptance samples into at least 4 parts. Engineer retains 3 parts and you keep 1 part.

To obtain workability of the HMA-LG sample for splitting, the Engineer reheats each sample of HMA-LG mixture not more than 2 cycles. Each reheat cycle is performed by placing the loose mixture in a mechanical forced-draft oven for 2 hours or less after the sample reaches 140 degrees F.

The Engineer conditions each at-the-plant sample of HMA-LG mixture when composite aggregate absorption factor is greater than 2.0 percent as indicated by the JMF in compliance with sections 7.1.2, 7.1.3, and 7.1.4 of AASHTO R 30.

No single aggregate or HMA-LG test result may represent more than 750 tons or one day's production, whichever is less.

For Agency acceptance tests performed under AASHTO T 27, results are considered 1 Agency acceptance test regardless of the number of sieves out of compliance.

The Engineer accepts HMA-LG based on:

1. Authorized JMF
2. Authorized QC plan
3. Asphalt binder compliance
4. Asphalt emulsion compliance
5. Visual inspection
6. Pavement smoothness

The Agency accepts HMA-LG based on compliance with:

1. Aggregate quality requirements shown in the following table:

Aggregate Quality

Quality Characteristic	Test Method	Requirement
Aggregate gradation ^a	AASHTO T 27	JMF ± Tolerance
Percent of crushed particles Coarse aggregate (min, %) One-fractured face Two-fractured faces Fine aggregate (min, %) (Passing No. 4 sieve and retained on No. 8 sieve.) One-fractured face	AASHTO T 335	As specified for each Level in Section 139-3.1.2 70
Los Angeles Rattler (max, %) Loss at 100 Rev. Loss at 500 Rev.	AASHTO T 96	As specified for each Level in Section 139-3.1.2
Sand equivalent (min.) ^{b, c}	AASHTO T 176	45 (Levels 1 and 2); 47 (Level 3)
Flat and elongated particles (max, % by weight at 5:1)	ASTM D4791	10
Fine aggregate angularity (min, %) ^d	AASHTO T 304, Method A	45

^aThe Engineer determines combined aggregate gradations containing RAP under California Test 384. The Engineer uses the correlation factor from Contractor Hot Mix Data Form and mathematically combines the virgin and corrected RAP aggregate gradations at the correct proportions to obtain the combined gradation.

^bReported value must be the average of 3 tests from a single sample.

^cUse of a sand reading indicator is required as shown in AASHTO T 176, Figure 1. Sections 4.7, "Manual Shaker," 7.1.2, "Alternate Method No. 2," and 8.4.3, "Hand Method," do not apply. Prepare the stock solution as specified in section 4.8.1, "Stock solution with formaldehyde," except omit the addition of formaldehyde.

^dThe Engineer waives this specification if HMA-LG contains 10 percent or less of non-manufactured sand by weight of total aggregate.

2. If RAP is used, RAP quality requirements shown in the following table:

Reclaimed Asphalt Pavement Quality

Quality Characteristic	Test Method	Requirement
Uncorrected binder content (% within the average value reported ^a)	AASHTO T 308	± 2.00
Specific gravity (within the average value reported ^b)	AASHTO T 209	± 0.06

^aAverage uncorrected binder content of three ignition oven tests performed at JMF verification. Engineer must use the same ignition oven used to determine the average uncorrected binder content at JMF verification.

^bAverage maximum specific gravity reported on page 4 of Contractor Hot Mix Asphalt Design Data form.

3. In-place HMA-LG quality requirements shown in the following table:

HMA-LG Acceptance In Place

Quality Characteristic	Test Method	Requirement
Asphalt binder content (%)	AASHTO T 308 Method A	JMF -0.40, +0.60
HMA-LG moisture content (max, %)	AASHTO T 329	1.00
Air voids content at N_{design} (%) ^{a, b}	AASHTO T 269	3.5 ± 1.5: Level 1 4.0 ± 1.5: Levels 2 & 3
Voids in mineral aggregate on laboratory-produced HMA-LG (min, %) ^d Gradation: No. 4 3/8-inch 1/2-inch 3/4-inch 1-inch with NMAS = 1-inch with NMAS = 3/4-inch	MS-2 Asphalt Mixture Volumetrics	As specified for each Level in Section 139-4.2.1
Voids in mineral aggregate on plant-produced HMA-LG (min, %) ^a Gradation: No. 4 3/8-inch 1/2-inch 3/4-inch 1-inch with NMAS = 1-inch with NMAS = 3/4-inch	MS-2 Asphalt Mixture Volumetrics ^c	As specified for each Level in Section 139-4.2.1
Dust proportion	MS-2 Asphalt Mixture Volumetrics	0.6–1.3 ^g
Density (% of max theoretical density) ^{e, f}	California Test 375	92.0–97.0

^aPrepare 3 briquettes. Report the average of 3 tests.

^bThe Engineer determines the bulk specific gravity of each lab-compacted briquette under AASHTO T 275, Method A, and theoretical maximum specific gravity under AASHTO T 209, Method A.

^cDetermine bulk specific gravity under AASHTO T 275, Method A.

^dThe Engineer determines the laboratory-prepared HMA-LG value for only mix design verification.

^eThe Engineer determines percent of theoretical maximum density under California Test 375 except the Engineer uses:

1. AASHTO T 275 to determine in-place density of each density core for dispute resolution.
2. AASHTO T 209, Method A to determine theoretical maximum density instead of calculating test maximum density.

^fThe Engineer determines theoretical maximum density under AASHTO T 209, Method A, at the frequency specified in California Test 375, part 5, section D.

^gFor lime-treated aggregates, the dust proportion requirement is 0.6–1.5.

139-7.1.2 HMA-LG Density

The project will be divided into lots of 1500 tons. If one day's production is less than 1500 tons that day's production will be a lot. If one day's production is one lot plus an additional amount, the additional work will be included in the last lot of 1500 tons. The Engineer will sample and test each lot prior to acceptance. Testing of lots will be at the Engineer's discretion. If the Engineer does not test the lot it will be accepted.

The Engineer will calculate the percent of MTD for each lot to the nearest 0.1 percent for each calibrated nuclear gauge density reading or each core by dividing the in-place density by the MTD and multiplying by 100 percent. The mean percent of MTD will be used by the Engineer to determine compliance with the specification for each lot.

If the percent of theoretical maximum density does not comply with the specifications, the Engineer must accept the HMA-LG lot and take a payment deduction as shown in the following table:

Reduced Payment Factors for Percent of Maximum Theoretical Density

HMA-LG percent of maximum theoretical density	Reduced payment factor	HMA-LG percent of maximum theoretical density	Reduced payment factor
92.0	0.0000	97.0	0.0000
91.9	0.0125	97.1	0.0125
91.8	0.0250	97.2	0.0250
91.7	0.0375	97.3	0.0375
91.6	0.0500	97.4	0.0500
91.5	0.0625	97.5	0.0625
91.4	0.0750	97.6	0.0750
91.3	0.0875	97.7	0.0875
91.2	0.1000	97.8	0.1000
91.1	0.1125	97.9	0.1125
91.0	0.1250	98.0	0.1250
90.9	0.1375	98.1	0.1375
90.8	0.1500	98.2	0.1500
90.7	0.1625	98.3	0.1625
90.6	0.1750	98.4	0.1750
90.5	0.1875	98.5	0.1875
90.4	0.2000	98.6	0.2000
90.3	0.2125	98.7	0.2125
90.2	0.2250	98.8	0.2250
90.1	0.2375	98.9	0.2375
90.0	0.2500	99.0	0.2500
<90.0	Remove and replace	>99.0	Remove and replace

139-8 Measurement

139-8.1 Tack Coat

The weight of asphalt binder used for tack coat will be calculated in accordance with Section 92-1.04 of the Caltrans Standard Specifications. The weight of asphalt emulsion will be calculated in accordance with Section 94-1.04 of the Caltrans Standard Specifications.

139-8.2 HMA-LG

The payment quantity for HMA-LG of the Level shown on the Bid Item List is measured based on the combined mixture weight. If recorded batch weights are printed automatically, the bid item for HMA-LG is measured by using the printed batch weights, provided:

1. Total aggregate and supplemental fine aggregate weight per batch is printed. If supplemental fine aggregate is weighed cumulatively with the aggregate, the total aggregate batch weight must include the supplemental fine aggregate weight.
2. Total virgin asphalt binder weight per batch is printed.
3. Each truckload's zero tolerance weight is printed before weighing the first batch and after weighing the last batch.
4. Time, date, mix number, load number and truck identification is correlated with a load slip.
5. Copy of the recorded batch weights is certified by a licensed weigh master and submitted.

139-9 Payment

Payment for tack coat is not included in the payment for HMA-LG.

The Agency does not adjust the unit price for an increase or decrease in the tack coat quantity.

Payment for HMA-LG placed in the test strip is made under the item in the Bid Item List for HMA-LG (Test Strip).