Section 39-2.14. Use for RHMA-G with 10 percent RAP option.

Use with NSSP 39-2.01A(1).

Use only for projects with rubberized hot mix asphalt less than 10,000 tons.

Use with non-standard bid item 013430, RUBBERIZED HOT MIS ASHPHALT (GAP GRADED) WITH 10 percent RAP.

Replace section 39-2.14 with:

39-2.14 RUBBERIZED HOT MIX ASPHALT–GAP GRADED WITH 10 percent RAP

39-2.14A General

39-2.14A(1) Summary

Section 39-2.14 includes specifications for designing, producing and placing RHMA-G with 10 percent RAP.

RHMA-G with 10 percent RAP must comply with section 39-2.03 unless specified in this section 39-2.14.

You may produce RHMA-G without RAP. You must comply with section 39-2.03 only with no payment adjustment if you choose to produce RHMA-G without RAP.

39-2.14A(2) Definitions

total binder content, BC: percent of asphalt rubber binder and RAP binder by total weight of mix. BC is the reported test result from running AASHTO T 308, Method A on plant produced 10 percent RAP in RHMA-G mix.

RAP binder content, BCRAP: percent of RAP binder by total weight of RAP mix. BC_{RAP} is reported in page 5 of CEM 3512 *Contractor Hot Mix Asphalt Design Data*.

asphalt rubber binder content, BCARB: percent of asphalt rubber binder by total weight of mix. BCARB is calculated by mathematically deducting RAP binder content from total binder content using the equation below:

$$BC_{ARB} = 100\left(\frac{\left(\frac{BC}{1-0.01BC}\right)-\left(\frac{0.1BC_{RAP}}{1-0.01BC_{RAP}}\right)}{100+\frac{BC}{1-0.01BC}}\right)$$

39-2.14A(3) Submittals

39-2.14A(3)(a) General

Not Used

39-2.14A(3)(b) Reclaimed Asphalt Pavement

Submit QC test results for RAP gradation with the combined aggregate gradation within 2 business days of taking RAP samples during RHMA-G With 10 percent RAP production.

39-2.14A(4) Quality Assurance

39-2.14A(4)(a) General

If you choose to produce RHMA-G with 10 percent RAP, all QC and Engineer test results must be recorded in Data Interchange for Materials Engineering (DIME) at https://dime.dot.ca.gov/.

39-2.14A(4)(b) Quality Control

39-2.14A(4)(b)(i) General

Enter all QC test results into DIME at https://dime.dot.ca.gov/.

39-2.14A(4)(b)(ii) Aggregates

The first paragraph of 39-2.03A(4)(c)(iii) does not apply.

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	AASHTO T 30	1 per 750 tons and any remaining part
Sand equivalent[a, b]	AASHTO T 176	
Moisture content[c]	AASHTO T 255	
Crushed particles	AASHTO T 335	1 per 10,000 tons or 2 per project, whichever is greater
Los Angeles Rattler	AASHTO T 96	
Flat and elongated particles	ASTM D4791	
Fine aggregate angularity	AASHTO T 304, Method A	

[a]Reported value must be the average of 3 tests from a single sample.

[b]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.

[c]Test at continuous mixing plants only.

39-2.14A(4)(b)(iii) Reclaimed Asphalt Pavement

Sample and test mix design RAP stockpile under California Test 384. Report the average AASHTO T 308 (Modified) uncorrected binder content on page 45 of your Contractor Hot Mix Asphalt Design Data form. When the mix design RAP stockpile is augmented, sample RAP used to augment the stockpile at a minimum frequency of 1 sample per 1,000 tons under California Test 384 before augmenting the stockpile. Test each sample to determine the uncorrected binder content under AASHTO T 308 (Modified). Average the results of the 3 tests. When tested under AASHTO T 308 (Modified), the uncorrected binder content of each augmented RAP sample must be within ±2.00 percent of the average uncorrected asphalt binder content reported on page 45 of your Contractor Hot Mix Asphalt Design Data form. You must use the same ignition oven used to determine the uncorrected asphalt binder content reported on page 5 of your Contractor Hot Mix Asphalt Design Data form.

The augmented RAP sample when tested under AASHTO T 209 must be within ±0.06 of the average maximum specific gravity reported on page 45 of your Contractor Hot Mix Asphalt Design Data form.

During RHMA-G with 10 percent RAP production, sample RAP twice daily and perform QC testing for moisture content at least once a day.

39-2.14A(4)(b)(iv) Rubberized Hot Mix Asphalt–Gap Graded With 10 percent RAP Production

The first paragraph of 39-2.03A(4)(c)(ix) does not apply.

Test the quality characteristics of RHMA-G with 10 percent RAP under the test methods and frequencies shown in the following table:

RHMA-G With 10% RAP Production Testing Frequencies

Quality characteristic	Test method	Minimum testing frequency
Asphalt rubber binder content[a]	AASHTO T 308 (Modified), 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[b]	MS-2 Asphalt Mixture Volumetrics	1 per 10,000 tons or 2 per project whichever is greater
Dust proportion	MS-2 Asphalt Mixture Volumetrics	
Density of core	California Test 375	2 per paving day
Nuclear gauge density	California Test 375	3 per 250 tons or 3 per paving day, whichever is greater
Hamburg wheel track	CT 389	1 per 10,000 tons or 1 per project, whichever is greater
Moisture susceptibility	AASHTO T 283	

[a]Determine the total binder content and mathematically deduct the RAP binder content. Asphalt rubber binder content calculation spreadsheet is available at Department Construction Web site.
[b]Use total binder content in VMA calculation.

39-2.14A(4)(c) Department Acceptance

39-2.14A(4)(c)(i) General

Section 39-2.03A(4)(e)(i) does not apply.

Engineer must enter all Engineer test results into DIME at https://dime.dot.ca.gov/.

The Department accepts RHMA-G with 10 percent RAP based on compliance with:

1. Aggregate quality requirements shown in the following table:

Aggregate Quality

Quality characteristic	Test method	Requirement
Aggregate gradation	AASHTO T30	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	 -- 90 70
Los Angeles Rattler (max, %) Loss at 100 Rev. Loss at 500 Rev.	AASHTO T 96	 12 40
Sand equivalent (min)[a, b]	AASHTO T 176	47
Flat and elongated particles (max, % by weight at 5:1)	ASTM D4791	Report only
Fine aggregate angularity (min, %)[c]	AASHTO T 304, Method A	45

[a]Reported value must be the average of 3 tests from a single sample.
[b]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.
[c]The Engineer waives this specification if RHMA-G contains 10 percent or less of nonmanufactured sand by weight of total aggregate. Manufactured sand is fine aggregate produced by crushing rock or gravel.

2. In-place RHMA-G with 10% RAP quality requirements shown in the following table:

RHMA-G with 10% RAP Acceptance In Place

Quality characteristic	Test method	Requirement
Asphalt rubber binder content (%)[h]	AASHTO T 308 (Modified) Method A	JMF -0.40, +0.50
HMA moisture content (max, %)	AASHTO T 329	1.00
Air voids content @ N_{design} (%)[a, b]	AASHTO T 269	Minimum 2.0, TV 1.5
Voids in mineral aggregate on laboratory-produced HMA[d] (min, %) Gradation: 1/2-inch and 3/4-inch	MS-2 Asphalt Mixture Volumetrics[c]	 18.0–23.0
Voids in mineral aggregate on plant-produced HMA (min, %)[a] Gradation: 1/2-inch and 3/4-inch	MS-2 Asphalt Mixture Volumetrics[c]	 18.0–23.0
Dust proportion[a]	MS-2 Asphalt Mixture Volumetrics	Report only
Density of core (% of max theoretical density)[e, f]	California Test 375	91.0–97.0
Hamburg wheel track (min number of passes at 0.5-inch rut depth) Base binder grade: PG 64 or lower PG 70	California Test 389	 15,000 20,000
Hamburg wheel track (number of passes at inflection point)	California Test 389	Report only
Moisture susceptibility (min, psi, dry strength)	AASHTO T 283	100
Moisture susceptibility (min, psi, wet strength)	AASHTO T 283[g]	70

[a]Prepare 3 briquettes. Report the average of 3 tests.

[b]The 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.

[c]Determine bulk specific gravity under AASHTO T 275, Method A. Use total binder content in VMA calculation.

[d]The Engineer determines the laboratory-prepared RHMA-G value for only mix design verification.

[e]The Engineer determines percent of theoretical maximum density under California Test 375 except the Engineer uses:

1. AASHTO T 275, Method A, to determine in-place density of each density core instead of using the nuclear gauge
2. AASHTO T 209, Method A to determine theoretical maximum density instead of calculating test maximum density

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

[g]Freeze thaw required.

[h]Determine the total binder content and mathematically deduct the RAP binder content. Asphalt rubber binder content calculation spreadsheet is available at Department Construction Web site.

3. RAP must meet the RAP quality requirement 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

[a]Average uncorrected binder content of three ignition oven tests performed at JMF verification. The Engineer must use the same ignition oven used to determine the average uncorrected binder content at JMF verification.

[b]Average maximum specific gravity reported on page 5 of Contractor Hot Mix Asphalt Design Data form.

39-2.14B Materials

39-2.14B(1) General

Not used

39-2.14B(2) Rubberized Hot Mix Asphalt–Gap Graded With 10 percent RAP Mix Design

Section 39-2.03B(2) does not apply.

For RHMA-G with 10 percent RAP, the mix design must comply with the requirements shown in the following table:

RHMA-G Mix Design Requirements

Quality characteristic	Test method	Requirement
Air voids content (%)	AASHTO T 269[a]	N_{design} = 3.0 – 4.0
Gyration compaction (no. of gyrations)	AASHTO T 312	N_{design} = 50–150[b]
Voids in mineral aggregate (min, %)	SP-2 Asphalt Mixture Volumetrics[c]	18.0–23.0
Dust proportion	SP-2 Asphalt Mixture Volumetrics	Report only
Hamburg wheel track (min number of passes at 0.5-inch rut depth) Base binder grade: PG 64 or lower PG 70	California Test 389[d]	 15,000 20,000
Hamburg wheel track (number of passes at inflection point)	California Test 389[d]	Report only
Moisture susceptibility, dry strength (min, psi)	AASHTO T 283[d]	100
Moisture susceptibility, wet strength (min, psi)	AASHTO T 283[d, e]	70

[a]Calculate the air voids content of each specimen using AASHTO T 275, Method A, to determine bulk specific gravity and AASHTO T 209, Method A, to determine theoretical maximum specific gravity. Under AASHTO T 209, use a digital manometer and pycnometer when performing AASHTO T 209.

[b]Superpave gyratory compactor ram pressure may be increased to a maximum of 825kPa, and specimens may be held at a constant height for a maximum of 90 minutes.

[c]Measure bulk specific gravity using AASHTO T 275, Method A. Use total binder content in VMA calculation.

[d]Test plant produced RHMA.

[e]Freeze thaw required.

Determine the quantity of asphalt rubber binder to be mixed with the aggregate for RHMA-G as follows:

1. Base the calculations on the average of 3 briquettes produced at each asphalt rubber binder content.
2. Plot asphalt rubber binder content versus average air voids content for each set of 3 specimens and connect adjacent points with a best-fit curve.

3. Calculate voids in mineral aggregate for each specimen, average each set, and plot the average versus asphalt rubber binder content.
4. Calculate the dust proportion and plot versus asphalt rubber binder content.
5. From the curve plotted, select the theoretical asphalt rubber binder content at air voids target value.
6. At the selected asphalt rubber binder content, calculate dust proportion.
7. Record the asphalt rubber binder content in the Contractor Hot Mix Asphalt Design Data Form as the asphalt rubber OBC.

The asphalt rubber OBC must not fall below 7.5 percent by total weight of the mix.

Laboratory mixing and compaction must comply with superpave HMA mix design as described in *MS-2 Asphalt Mix Design Methods* by the Asphalt Institute, except the mixing temperature of the aggregate must be from 300 to 325 degrees F. The mixing temperature of the asphalt rubber binder must be from 375 to 425 degrees F. The compaction temperature of the combined mixture must be from 290 to 320 degrees F.

39-2.14B(3) Reclaimed Asphalt Pavement

Substitute 10 percent of the aggregate blend with RAP.

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

Isolate the 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.

39-2.14C Construction

Not Used

39-2.14D Payment

Not Used