Graniterock

# Specification:
# 30-6 Cold-in-Place Recycling (CIR) Using Foamed Asphalt

Caltrans

FMG™

A Graniterock Division

**Replace section 30-6 with:**

## 30-6 COLD IN-PLACE RECYCLING USING FOAMED ASPHALT

### 30-6.01 GENERAL

#### 30-6.01A Summary

Section 30-6 includes specifications for constructing the pavement using cold in-place recycling (CIR) using foamed asphalt.

CIR consists of:

1. Cold planing the existing asphalt concrete pavement to the depth shown
2. Mixing the cold-planed material with foamed asphalt, cement and water
3. Spreading and compacting the mixture
4. Applying asphaltic emulsion and sand cover

#### 30-6.01B Definitions

**action limit:** Test results at which corrective actions must be made while production continues.

**lot:** 2,640 feet or fraction thereof of CIR pavement constructed in the same day.

**sub-lot:** 528 feet

**suspension limit:** Test results at which production must be suspended while corrections are made.

#### 30-6.01C Submittals

#### 30-6.01C(1) General

For tests where the requirement shown is “report only” submit the test result information to the Engineer and e-mail the results to:

CIR@dot.ca.gov

At least 20 days before starting CIR work, submit the following:

1. QC Plan
2. Mix Design
3. Contingency Plan

#### 30-6.01C(2) Quality Control Plan

The Engineer reviews the QC plan within 5 business days from the submittal. Do not start CIR production until the Engineer authorizes the QC plan.

If QC procedures, personnel, tester qualifications, or lab accreditation status change, submit a QC plan supplement at least 3 business days before implementing proposed changes.

If a change is needed in your QC plan, do not implement the change without authorization.

#### 30-6.01C(3) Mix Design

Submit separate mix designs based on RAP material qualities for each location shown on the following table:

| Mix Design | |
|---|---|
| Location No. | Post mile to post mile |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

For each CIR mix design, submit:

1. Mix design documentation on the Contractor Cold in Place Recycling Mix Design form, including all raw test data and calculations. The mix design submittal must be signed and sealed by an Engineer who is registered as a civil engineer in the State of California.
2. JMF on the Contractor Cold in Place Recycling Job Mix Formula form
3. SDS for:
    3.1. Asphalt
    3.2. Cement
4. Process for incorporating cement to be used into the CIR mixture.

**30-6.01C(5) Contingency Plan**

Contingency plan must include actions you will take to ensure the roadway will be open to traffic at the end of each work shift. The contingency plan must include provisions for constructing a temporary structural section and reopening the roadway to traffic.

**30-6.01C(6) Quality Control Reporting**

For each lot, submit a report daily that includes the following items:

1. General Information:
    1.1. Lot number
    1.2. Location description
    1.3. Beginning and ending station
    1.4. Lane number and offset from centerline
    1.5. Temperature:
        1.5.1. Ambient air temperature before beginning daily CIR activities including time of temperature reading
        1.5.2. Road surface temperatures before beginning daily CIR activities including time of temperature reading
2. For asphalt:
    2.1. Weight in tons
    2.2. Percentage by weight of dry RAP
3. For cement:
    3.1. Application rate by lb/sqyd, if you spread cement directly to the existing pavement, take surface area measurements to calculate applied spread rate and submit with the quantity of cement used, area covered, and certified weight tickets.
    3.2. Total weight in tons
    3.3. Percentage by weight of dry RAP
4. Water application rate by theoretical percent dry weight of CIR:
    4.1. Used for foaming asphalt
    4.2. Added during mixing for compaction
5. For CIR processing:
    5.1. Length, width, depth of cut at each end of the cold planing drum at least every 300 feet along the cut length
    5.2. Average forward speed
    5.3. Calculated weight in tons of material processed
    5.4. Maximum wet density using California Test 216
6. Straightedge measurement locations and the following:
    6.1. Variance measured from the lower edge of a 12-foot straightedge placed parallel with the centerline
    6.2. Variance measured from the lower edge of a 12-foot straightedge placed transverse
7. CIR quality control test results for:
    7.1. Wet field gradation for material passing the 1.25-inch, 1-inch, 3/4-inch, and No. 4 sieves
    7.2. Moisture content under California Test 226
    7.3. In-place wet density under California Test 231
    7.4. Relative compaction under California Test 216
    7.5. Indirect tensile strength of three dry briquettes, three soaked briquettes and the tensile strength ratio under modified California Test 371 section J. Fabricate specimens under AASHTO T 245.
    7.6. Air voids under California Test 308

7.7 Maximum theoretical specific gravity under California Test 309
7.8 Relative compaction under California Test 375

8. For asphaltic emulsion used on finished CIR surface:
   8.1. Emulsion type
   8.2. Emulsion application rate in gal/sqyd
   8.3. Emulsion dilution as the weight ratio of added water to asphaltic emulsion
9. Rate of sand cover application
10. Note on the daily report postmile or station limits of any:
    10.1. Changes to foamed asphalt application rate, including application rate change and reasons for change
    10.2. Changes to water application rate, including application rate change and reasons for change for:
        10.2.1. Water for foaming
        10.2.2. Water added for compaction
    10.3. Unsuitable materials locations and when the Engineer was notified

Update each day's submitted report within 24 hours of obtaining test results. Consolidate all of the lots completed in a day into one report with each lot reported separately.

During CIR activities, submit the following items daily

1. Square yards recycled.
2. Tons of asphalt used.
3. Tons of asphalt to be carried over to next production day.
4. Tons cement utilized and spread rate.
5. Tons cement to be carried over to next production day.

**30-6.01C(7) Certificates**

Submit certificates of compliance for the cement, asphalt and asphaltic emulsion with each delivery.

Submit a certified copy of each delivery's weight for cement, asphalt, asphaltic emulsion, and sand.

**30-6.01C(8) Asphalt Binder**

Submit samples of asphalt in quart cans to the Engineer.

Within 3 days after taking asphalt quality control samples, submit the authorized laboratory's test results for asphalt quality characteristics.

**30-6.01C(9) Asphaltic Emulsion**

Submit samples of asphaltic emulsion in 1/2-gallon plastic containers to the Engineer.

Within 3 days after taking asphaltic emulsion quality control samples, submit the authorized laboratory's test results for asphaltic emulsion.

Each time you dilute the asphaltic emulsion, submit:

1. Weight ratio of water to residual asphalt 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

**30-6.01C(9) Cold In-Place Recycling**

Submit quality control test results for the quality characteristics within the reporting times allowance after sampling shown in the following tables:

**CIR Quality Control Test Result Reporting**

| Quality Characteristic | Maximum reporting time allowance |
|---|---|
| Water sulfates (ppm, max) | Before work starts |
| Water chlorides (ppm, max) | |
| Asphalt expansion (volume, min) | 24 hours |
| Asphalt half-life (seconds, min) | |
| Moisture Content (%) | 24 hours |
| Wet gradation (% passing)<br>Sieve Size<br>1.25 inch | 24 hours |
| Wet field gradation (% passing)<br>Sieve size<br>1.25- inch<br>1-inch<br>3/4-inch<br>No. 4 | 5 business days |
| Dry gradation (% passing)<br>Sieve size<br>1.25-inch<br>1-inch<br>3/4-inch<br>No. 4<br>No. 30<br>No. 200 | 5 business days |
| In-place wet density (lb/cu ft) | 24 hours |
| Relative compaction California Test 231 (%, min) | 24 hours |
| Air voids (%) | 5 business days |
| Theoretical maximum density | 5 business days |
| Relative compaction California Test 275 (%, min) | 5 business days |
| Thickness (inch)<br>Each Core<br>Average thickness of cores | 24 hours |

**30-6.01C(10) Cold In-Place Recycling Surface Smoothness**

Submit the CIR surface data information shown in Section 36-3.01C for both the initial CIR surface and corrected CIR surface.

**30-6.01D Quality Assurance**

**30-6.01D(1) General**

Not used

**30-6.01D(2) Quality Control**

**30-6.01D(2)(a) General**

The laboratory for preparing the mix design and JMF must be accredited under AASHTO re:source program and the Department's Independent Assurance Program.

Quality control laboratories and personnel performing sampling and testing must be in compliance with the Department Independent Assurance Program. For asphalt binder, the quality control laboratory must be accredited under AASHTO re:source program. For asphaltic emulsion, the quality control laboratory must participate in the AASHTO re:source proficiency samples program.

If you adjust the application rate of CIR components, record the adjustments and document the reasons for the adjustments in your daily report submittal to the Engineer.

### 30-6.01D(2)(b) Quality Control Plan

The QC plan must describe the organization, responsible parties, and procedures you will use to perform the following:

1. Control the production process
2. Determine whether a change to the production process is needed
3. Obtain samples, including determining sampling locations
4. Control quality, including sampling, testing and reporting
5. Determine action limits when corrective actions are needed
6. Implement corrective actions
7. Ensure CIR cold planing, mixing, spreading, compacting and finishing activities are coordinated

The QC plan must include action and suspension limits and the details of the corrective action to be taken if any process is outside of those limits. The suspension limits must not exceed the specified acceptance criteria.

The QC plan must address the elements affecting CIR quality including:

1. RAP
2. Asphalt
3. Cement
4. Production
5. Paving
6. Compaction
7. Smoothness

The QC plan must contain copies of the forms that will be used to provide the required inspection records and sampling and testing results.

The QC plan must include the name of your authorized laboratory.

### 30-6.01D(2)(c) Prepaving Conference

At least 10 days before starting CIR activities, meet with the Engineer at a prepaving conference at a mutually agreed time and place. Discuss the QC plan and the methods of performing production and placement.

The following personnel must attend the prepaving conference:

1. Project manager
2. Project superintendent
3. QC manager
4. Workers and your subcontractor's workers, including:
    4.1. Foremen
    4.2. Ground supervisors
    4.3. Representative from quality control testing lab

### 30-6.01D(2)(d) Quality Control

#### 30-6.01D(2)(d)(i) General

Take samples under California Test 125.

During CIR activities, take two quart samples of asphalt from each load delivered to the job site in the presence of the Engineer. Use 1 sample for QC testing and submit 1 sample to the Engineer.

#### 30-6.01D(2)(d)(ii) Test Strip

On the 1st day of CIR activities and within the pavement area to receive CIR, construct a test strip. The test strip must be a single lane width and at least 1,056 feet (2 sub-lots) in length. The test strip must show:

1. How the equipment, materials, and processes proposed can produce and place the CIR mixture
2. How varying the forward speed and drum rotation rate of the cold planing machine affect the consistency of the mixture

3. Application rates for asphalt, cement, and optimum water content
4. Rolling pattern needed to reach 98 percent relative compaction
5. Application rates of asphaltic emulsion and sand cover

The Engineer evaluates the test strip under section 30-6.01D(3). For smoothness, only the straightedge requirements apply for test strip authorization. Retest the test strip smoothness under section 30-6.01D(4)(d). Rework and recompact or remove and replace test strip if it does not comply with the specifications. Do not proceed with CIR activities until the Engineer notifies you that the test strip is authorized.

**30-6.01D(2)(d)(iii) Quality Control Testing**

**30-6.01D(2)(d)(iii)(a) General**

For any lot including the test strip, stop CIR activities and immediately notify the Engineer whenever any test result does not comply with the quality characteristic requirements or your quality control plan suspension limits. If CIR activities are stopped for noncompliance, before resuming activities:

1. Notify the Engineer of the adjustments you will make
2. Reprocess, remedy, or replace the noncompliant lot

**30-6.01D(2)(d)(iii)(b) Asphalt Binder**

Perform sampling and testing of asphalt binder for compliance with the quality characteristics requirements in Section 92 table “PG Asphalt Binder” for the performance grade of asphalt used.

Test the first three asphalt samples and then every third sample taken.

**30-6.01D(2)(d)(iii)(c) Asphaltic Emulsion**

Circulate asphaltic emulsion in the distributor truck before sampling. Take samples from the distributor truck at mid load or from a sampling tap or thief. Before taking samples, draw and dispose of 1 gallon. In the presence of the Engineer take two 1/2-gallon samples. Sample must be submitted in insulated shipping container.

For asphaltic emulsion, the Authorized Laboratory must perform quality control sampling and testing at the specified frequency and location for the following quality characteristics:

**Asphaltic Emulsion Quality Testing Frequencies**

| Quality characteristic | Test method | Minimum sampling and testing frequency | Location of sampling |
|---|---|---|---|
| Saybolt Furol Viscosity, @ 25 °C (SFS)[a] | AASHTO T 59 | 1 per truck tank minimum 1 per day | Distributor truck |
| Saybolt Furol Viscosity, @ 50 °C (SFS)[a] | | | |
| Settlement, 5 days (max, %)[b] | | | |
| Storage stability test, 1 day (max, %) | | | |
| Demulsibility, 35 ml, 0.02 *N* $CaCl_2$ (min, %) | | | |
| Particle charge test | | | |
| Sieve test (max, %) | | | |
| Residue by distillation (min, %) | | | |
| Tests on residue from distillation test: | | | |
| Penetration, 25 °C | | | |
| Ductility, 25 °C, 50 mm/minute (min, mm) | | | |
| Solubility in trichloroethylene (min, %) | | | |

[a]SFS means Saybolt Furol Seconds.
[b]Settlement tests not required when the asphaltic emulsion is used in less than 5 days.

**30-6.01D(2)(c)(iii)(d) Cold In-Place Recycling**

Perform sampling and testing at the specified frequency and location for the following quality characteristics:

**CIR Quality Testing Frequencies**

| Quality Characteristic | Test method | Minimum sampling and testing frequency | Location of sampling |
|---|---|---|---|
| Water sulfates[a] (ppm, max) | California Test 417 | 1 per source | Source |
| Water chlorides [a] (ppm, max) | California Test 422 | 1 per source | Source |
| Asphalt expansion (volume, min) | California Test 213 | Each Tanker Truck | Recycling Equipment |
| Asphalt half-life (seconds, min) | California Test 213 | Each Tanker Truck | Recycling Equipment |
| Moisture Content (%) | California Test 226 | Test strip and 1 per lot | Recycled mat |
| Wet gradation (% passing) Sieve Size 1.25-inch | California Test 202 | Test strip and 1 per lot | |
| Wet gradation[b,c] (% passing) Sieve size 1.25-inch 1-inch 3/4-inch No. 4 | California Test 202 | Test strip and every 3rd lot | |
| Dry gradation[c] (% passing) Sieve size 1.25-inch 1-inch 3/4-inch No. 4 No. 30 No. 200 | California Test 202 | Test strip and 1 per day | |
| Indirect dry tensile strength[d] (psi) | California Test 371 Section J | 1 per lot | Recycled mat |
| Indirect wet tensile strength[d] (psi, min) | California Test 371 Section J | 1 per lot | |
| Tensile strength ratio (%) | California Test 371 | 1 per lot | |

[a]Only required for non-potable water sources.
[b]Test results are report only.
[c]Split with the moisture content sample and weigh immediately. Use the moisture content to calculate the dry mass for testing under California Test 202.
[d]Fabricate 6 indirect tensile strength specimens under AASHTO T 245. Fabrication of indirect tensile strength specimens must be completed within 2 hours after materials have been mixed. Cure the specimens at 100 degrees F for 72 hours and allow the specimens to cool to room temperature. Test 3 specimens for dry tensile strength under California 371. Test 3 specimens for wet tensile strength under California test 371 after moisture conditioning.

**30-6.01D(2)(c)(iii)(e) Density**

For density, perform sampling and testing at the specified frequency and location for the following quality characteristics:

**Density Quality Testing Frequencies**

| Quality Characteristic | Test method | Minimum sampling and testing | Location of |
|---|---|---|---|

| | | frequency | sampling |
|---|---|---|---|
| In-place wet density (lb/cu ft) | California Test 216 | Test strip and 1 per lot | Recycled mat |
| Relative compaction[a] (%, min) | California Test 231 | Test strip and 1 per lot | Compacted mix |
| Air voids[b] (%) | California Test 308 | Test strip and 2 per day | Recycled mat |
| Theoretical maximum density[b] | California Test 309 | Test strip and 2 per day | Recycled mat |
| Relative compaction[b] (%) | California Test 375 | Test strip and 2 per day | Compacted mix |

[a]Average of lot test locations 98 percent with no individual test less than 95 percent.
[b]Take and split a sample of the loose CIR mixture daily at a location determined by the Engineer. Split the CIR samples into 2 parts and label the containers with location and station. Submit 1 split part and use 1 part for your testing. Determine maximum theoretical density of the CIR sample under California Test 309. Use the maximum theoretical density and calculate air voids under California Test 308 for each compaction test site and the average of the lot. Report air voids ratio on daily quality control inspection records. The Department does not use your California Test 309 test results and air voids to determine specification compliance.

**30-6.01D(2)(c)(iii)(f) Smoothness**

Straightedge and record surface smoothness at least once every 1000 feet along the cut length.

Stop cold planing activities and immediately inform the Engineer whenever:

1. Variance of more than 0.03 foot measured from the lower edge of a 12-foot straightedge placed parallel with the centerline
2. Transverse slope variance of more than 0.02 foot measured from the lower edge of a 12-foot straightedge
3. Visual inspection shows evidence of
   3.1. Raveling
   3.2. Loose material
   3.3. Non-uniform surface texture

After completing CIR activities, prior to HMA overlay, determine CIR surface smoothness under section 36-3.

Correct CIR surface with MRI greater than 90 in/mi for each 0.1-mile section and areas of localized roughness greater than 240 in/mi. For areas corrected by grinding reapply asphalt emulsion and sand.

**30-6.01D(3) Department Acceptance**

The Engineer samples materials for testing under California Test 125

Asphalt acceptance is based on the Department's sampling and testing for compliance with the requirements for the quality characteristic requirements in Section 92 table "PG Asphalt Binder" for the performance grade of asphalt used.

Asphaltic emulsion acceptance is based on the Department's sampling and testing for compliance with the requirements for the quality characteristic requirements in Section 94 table "Slow-Setting Anionic Asphaltic Emulsion Requirements" or "Slow-Setting Cationic Asphaltic Emulsion Requirements" for grade of asphaltic emulsion used.

CIR acceptance is based on:

1. Visual inspection for the following:
   1.1. Segregation, raveling, rutting, humps, depressions, roller marks, and loose material.
   1.2. Uniform surface texture throughout the work limits.
2. Compliance with smoothness requirements on the CIR surface of MRI of 90 in/mi or less for each 0.1-mile section and no areas of localized roughness greater than 240 in/mi.

3. Compliance with quality characteristic requirements in the following table:

**CIR Quality**

| Quality Characteristic | Test method | Requirement |
|---|---|---|
| Wet gradation<br>(% passing)<br>Sieve Size<br>1.25-inch | California Test 202 | 100 |
| Wet gradation<br>(% passing)<br>Sieve size<br>1.25-inch<br>1-inch<br>3/4-inch<br>No. 4 | California Test 202 | Report only |
| Dry gradation<br>(% passing)<br>Sieve size<br>1.25-inch<br>1-inch<br>3/4-inch<br>No. 4<br>No. 30<br>No. 200 | California Test 202 | Report only |
| Indirect tensile strength wet[a,b]<br>(psi, min) | California Test<br>371<br>Section J | 35 |
| Relative compaction<br>(%, min) [c] | California Test 231 | 98 |
| Thickness (inch) [d]<br>Each Core<br>Average thickness of cores | Core measurements | ±0.75 inch of the thickness shown<br>≥ thickness shown |

[a]Fabricate 3 indirect tensile strength specimens under AASHTO T 245. Fabrication of indirect tensile strength specimens must be completed within 2 hours after materials have been mixed.
[b]Cure the specimens at 100 degrees F for 72 hours and allow the specimens to cool to room temperature. Test 3 specimens for wet tensile strength under California Test 371 after moisture conditioning.
[c]Average density per lot with no individual test below 95 percent.
[d]Take 4- or 6-inch core from three random locations per lot as determined by the Engineer. Coring at more than 3 locations per lot is change order work. Perform coring and measure core depth in the presence of the Engineer.

If the Engineer orders you to stop CIR activities for noncompliance, before resuming activities:

1. Notify the Engineer of the adjustments you will make
2. Reprocess, remedy, or replace the noncompliant lot
4. Obtain the Engineer's authorization

**30-6.01D(4) Dispute Resolution**

You and the Engineer must work together to avoid potential conflicts and to resolve disputes regarding test result and visual inspection discrepancies. Notify the Engineer within 5 business days of receiving a test result if you dispute the test result.

If you or the Engineer dispute each other's test results, submit quality control test results and copies of paperwork including worksheets used to determine the disputed test results. An independent third party (ITP) performs referee testing. Before the ITP participates in a dispute resolution, the ITP must be accredited under AASHTO re:source program, and the Department's Independent Assurance Program. The ITP must be independent of the project. By mutual agreement, the ITP for referee testing is chosen from:

1. A Department laboratory
2. A Department laboratory in a district or region not in the district or region the project is located
3. The Transportation Laboratory
4. A laboratory not currently employed by you or your CIR producer

If split QC or acceptance samples are not available, the ITP uses any available material representing the disputed CIR for evaluation.

If you or the Engineer dispute each other's visual inspection findings, submit copies of your visual inspection findings. An independent third party (ITP) consisting of a Department expert and a CIR industry or Academia expert will perform a joint visual inspection. The ITP must be independent of the project. The ITP is chosen by mutual agreement.

**30-6.02 MATERIALS**

**30-6.02A General**

A summary of existing material investigations is available in the *Information Handout* as supplemental project information.

**30-6.02B Water**

If a water source other than potable water is used, test water for sulfates and chlorides.

**Water Requirements**

| Quality Characteristic | Test method | Requirement |
|---|---|---|
| Water sulfates[a] (ppm, max) | California Test 417 | 1,300 |
| Water chlorides [a] (ppm, max) | California Test 422 | 650 |

[a]Only required for non-potable water sources.

**30-6.02C Cement**

Cement must comply with section 90-1.02B(2).

**30-6.02D Reclaimed Asphalt Pavement**

Cold plane existing asphalt pavement and process to produce RAP. RAP must be processed by mechanical means to pass the 1.25-inch sieve.

Reclaimed asphalt pavement must meet the following requirements:

**CIR Requirements**

| Quality Characteristic | Test method | Requirement |
|---|---|---|
| Indirect dry tensile strength[a] (psi) | California Test 371 Section J | Report only |
| Indirect wet tensile strength[a] (psi). | California Test 371 Section J | 35 |
| Tensile strength ratio (%) | California Test 371 | Report only |

[a]Fabricate 6 indirect tensile strength specimens under AASHTO T 245. Fabrication of indirect tensile strength specimens must be completed within 2 hours after materials have been mixed. Cure the specimens at 100 degrees F for 72 hours and allow the specimens to cool to room temperature. Test 3 specimens for dry tensile strength under California 371. Test 3 specimens for wet tensile strength under California test 371 after moisture conditioning

**30-6.02E Asphalt**

Use PG ____ for foamed asphalt.

### 30-6.02F CIR Mix Design

The mix design must include RAP from the job site, asphalt, cement, and water.

The mix design must comply with Lab Procedure LP-8-FA and the requirements shown in the following table:

**Mix Design Requirements**

| Quality Characteristic | Test Method | Requirement |
|---|---|---|
| RAP asphalt content (%) | ASTM D 2172, Method B | Report only |
| Bulk specific gravity of compacted samples[a, b] | AASHTO T 275 | Report only |
| Maximum theoretical specific gravity[b] | AASHTO T 209 | Report only |
| Air voids of compacted and cured specimens[b], % | AASHTO T 269 | Report only |
| Marshall Stability, cured specimen[b] at 104 °F (lbs, min) | AASHTO T 245 | Report Only |
| Marshall retained stability[b, c] at 104 °F based on moisture conditioning on cured specimen (%, min) | AASHTO T 245 | Report Only |
| Indirect dry tensile strength[d] (psi) | California Test 371 Section J | Report only |
| Indirect wet tensile strength[d] (psi) | California Test 371 Section J | 35 |
| Tensile strength ratio (%) | California Test 371 | Report only |
| Maximum density (lb/cu ft) | California Test 216 | Report only |

[a]4-inch diameter mold compaction based on gyratory compactor at 30 gyrations.
[b]Test specimens after 104 degrees F curing to constant weight between 16 hours and 48 hours.
[c]Vacuum saturation from 55 percent to 75 percent. Water bath at 77 degrees F for 23 hours, with the last 30 minutes to 40 minutes in 104 degrees F water bath.
[d]Fabricate 6 indirect tensile strength specimens under AASHTO T 245. Fabrication of indirect tensile strength specimens must be completed within 30 minutes after materials have been mixed. Cure the specimens at 100 degrees F for 72 hours and allow the specimens to cool to room temperature. Test 3 specimens for dry tensile strength under California Test 371. Test 3 specimens for wet tensile strength under California Test 371 after moisture conditioning.

Cement must be at least 0.25 but not more than 1.0 percent of the dry weight of RAP.

If additional mix designs are required, this work is change order work.

### 30-6.02G Temporary Structural Section

Use minor HMA or commercial quality bituminous material to construct a temporary structural section.

The minor HMA for the temporary structural section must include:

1. 1/2-inch HMA Type A aggregate gradation
2. Asphalt binder grade PG 64-10, PG 64-16, or the binder grade specified for the HMA layer on the CIR surface

The commercial quality bituminous material for the temporary structural section must contain aggregate that complies with 1/2-inch HMA Type A aggregate gradation.

### 30-6.02H Asphaltic Emulsion

Asphaltic emulsion must be Grade SS1h or Grade CSS1h.

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

Measure added water weight.

### 30-6.02I Sand Cover

Sand used for sand cover must comply with the material specifications for fine aggregate in section 90-1.02C. Sand must not contain more than 2 percent moisture by dry weight of sand.

## 30-6.03 CONSTRUCTION

### 30-6.03A General

Do not disturb or damage the underlying materials during pavement cold planing activities. Do not use a heating device to soften the pavement.

Before starting CIR activities, provide 100 tons of commercial quality bituminous surfacing material onsite for maintenance and protection of the completed CIR surface.

Use the same equipment, materials, rolling pattern and construction methods that were used for the authorized test strip for the remainder of the CIR work. Any adjustments must be authorized.

If the equipment or process fail to meet the specifications, stop CIR activities and notify the Engineer.

### 30-6.03B Surface Preparation

Before starting CIR activities, prepare the existing roadway by:

1. Removing loose material from the roadway width including:
   1.1. Dirt
   1.2. Vegetation
   1.3. Standing water
   1.4. Combustible materials
   1.5. Oils
   1.6 Pavement markers and underlying adhesive
2. Accurately referencing the existing pavement's profile and cross slope.
3. Accurately marking the proposed longitudinal cut lines on the existing roadway surface.

### 30-6.03C Cold In-Place Recycling Equipment

#### 30-6.03C(1) General

The equipment for CIR must consist of:

1. Cold planing
2. Mixing and proportioning
3. Water storage and supply
4 Cement storage and supply
5. Cement mixing and spreading
6. CIR mixture spreading
7. Compacting
8 Applying asphaltic emulsion to the surface
9. Spreading sand cover

Use equipment that:

1. Cold planes, pulverizes, crushes, and sizes the existing asphalt pavement
2. Mixes the RAP with the foamed asphalt and cement into a homogeneous mixture
3. Places the CIR mixture to the lines, grades, and specifications

#### 30-6.03C(2) Cold-Planing Equipment

The cold-planing machine must:

1. Be self-propelled
2. Have a 12-foot minimum wide cutter that can remove the existing pavement to the specified depths

3. Be equipped with automatic depth and cross slope controls capable of maintaining the cutting depth to within 0.25 inch of the shown depth.

A cold-planing machine with a cutter narrower than 12 feet wide may be used for shoulders and miscellaneous areas.

**30-6.03C(3) Mixing Chamber or Pugmill**

Provide a continuous mixing chamber or pugmill mixing machine as part of the recycle train with either a belt scale or an integrated microprocessor control system to control:

1. RAP delivered to the mixing chamber or pugmill
2. Amount of foamed asphalt being delivered

The mixing chamber or pugmill must be arranged to mix the RAP, foamed asphalt, and cement to produce the specified CIR mixture. The mixing chamber may be equipped with paddles or other suitable mixing devices. If paddles or other suitable mixing devices are used the RAP must be fed from the pulverizing, crushing, or sizing equipment to the mixer at a uniform and controlled rate.

The CIR machine must rear load directly into the paver's receiving hopper or the paver's loading equipment must pick up the CIR mixture and deposit it in the paving machine without waste. If the paving screed is directly attached to the CIR equipment, feed the CIR mixture directly to the paving screed.

**30-6.03C(4) Mixing and Proportioning Equipment**

**30-6.03C(4)(a) General**

Use a mass flow, Coriolis Effect type meter with a visible readout display and printing capabilities.

The weighing and measuring devices for the asphalt and cement must comply with the requirements of the MPQP. You may use equipment that has successfully passed the calibration requirements of MPQP within the past 6 months.

**30-6.03C(4)(b) Cement Continuous Mixing Equipment**

For continuous mixing of cement slurry, the proportioning device must be capable of determining the exact ratio of water to dry cement at each production rate.

Rate-of-flow indicators and totalizers for similar materials must be accurate within 0.5 percent of each other.

The cement continuous mixing equipment must include:

1. Belt scale for weighing cement. The belt scale must operate between 30 to 100 percent of production capacity. The average difference between the indicated and actual material weight must not exceed 0.5 percent of the actual material weight for 3 individual runs. For each run, the indicated weight must not vary from the actual material weight by more than 1 percent of the actual weight. Test for belt scale accuracy must be for at least 0.5 tons of cement. Actual material weight must be verified on a certified scale.
2. Water meter for measuring water used in cement slurry. The meter must operate between 50 to 100 percent of production capacity. The average difference between the indicated and actual water weight must not exceed 1 percent of the actual weight for 3 individual runs. Test for water meter accuracy must be for at least 300 gallons of water.

Meters and scales must be equipped with:

1. Rate-of-flow indicators that show the delivery rates of cement and water
2. Resettable totalizers that indicate the total amount of cement and water introduced into the slurry storage tank

Feeds for water and cement must be equipped with no-flow devices that stop slurry production when the individual ingredients are not being delivered to the cement slurry storage tank.

**30-6.03C(4)(c) Cement Batch Mixing Equipment**

For batch-type mixing of cement slurry, the proportioning equipment must include:

1. Certified weight scale.
2. Water meter equipped with a resettable totalizer. Test for water meter accuracy must be for at least 300 gallons of water.

If an automatic controller is used to batch the cement, the controller must also control the water proportioning.

If an automatic controller is used to proportion the water, the indicated draft of the water must be within 1 percent of its total draft weight.

The meter must operate between 50 to 100 percent of production capacity. The average difference between the indicated and actual water weight must not exceed 1 percent of the actual weight for 3 individual runs.

**30-6.03C(5) Water Storage and Supply Equipment**

As part of the recycle train, provide an independent supplemental water source separate from the water added to the mill to cool the teeth. Interlock the supplemental water with the RAP weighing device or microprocessor to properly disperse the foamed asphalt.

**30-6.03C(6) Cement Storage and Supply Equipment**

Provide cement slurry storage and supply equipment with agitators or similar equipment to keep the cement slurry in suspension while held in the slurry feed tank.

If cement is spread dry to the existing pavement, use a spreader capable of spreading the cement at the required weight per unit area. The spreader must have working scales and distance measuring devices to control the spread rate.

**30-6. 03C(7) Spreading Equipment**

Spreading equipment must comply with section 39-2.01C(2).

Spreading equipment must be equipped with ski devices for longitudinal profile. The ski devises maybe a conventional contact ski or noncontact laser or sonar devise.

**30-6.03C(8) Compacting Equipment**

Compacting equipment must comply with sections 39-2.01C(2). Provide a minimum of 1 pneumatic-tired roller weighing at least 25 tons and 1 double drum vibratory steel-wheeled roller weighing at least 10 tons. Rollers must be at least 5.5 foot wide. Each roller must have a working water spray system.

**30-6.03D Cold In-Place Recycling**

**30-6.03D(1) General**

Do not perform CIR activities under the following conditions:

1. Pavement surface is wet due to rain.
2. Rain is forecasted within 24 hours of the scheduled work.

Use the existing pavement profile and cross slope to establish the CIR finished profile and cross slope. You may adjust the recycling depth by ± 0.75 inch from the depth shown to achieve uniform pavement profile, cross slope, and surface smoothness. The average recycled depth determined by cores must be equal to or greater than the depth shown.

**30-6.03D(2) Cold Planing**

Do not leave gaps of unrecycled material between successive cuts along the same longitudinal cut line. Do not leave untreated wedges created by the entry of the milling drum into the existing pavement. Longitudinal joints between successive cuts must overlap by 4 inches minimum.

**30-6.03D(3) Unsuitable Conditions**

If you encounter unsuitable subgrade material:

1. Notify and meet with the Engineer immediately.
2. Clearly define the unsuitable material areas and depth.
3. Excavate and dispose of any unsuitable subgrade material encountered.

4. Unless otherwise ordered, backfill the excavated area with Class 2 AB as specified in section 26.
5. Submit within 24 hours of defining unsuitable material the following:
    5.1. Unsuitable areas including station or postmile, length, width, depth and centerline offset.
    5.2. Remediation taken, including quantities of materials used.

Top the Class 2 AB with HMA Type A or a premixed bituminous material equivalent in thickness to the existing asphalt concrete layer adjacent to the excavation. If premixed bituminous material is used, remove and replace it with HMA Type A prior to placing final surfacing. Place HMA in layers and compact until the level of the CIR surface is reached.

Excavating and disposing of unsuitable material and replacing with AB and surfacing material is change order work.

**30-6.03D(4) Asphalt Binder**

Test asphalt foaming half-life and expansion ratio for each tanker load of asphalt. Verify the half-life and expansion ratio, if the supplied asphalt changes more than 10 degrees F from the temperature at which the tests were conducted.

**30-6.03D(5) Cement**

Add the cement into the recycling process by one of the following methods:

1. Add at the mill head as a slurry
2. Add directly in the pugmill or mixing chamber as a slurry
3. Spread on the existing pavement surface ahead of the recycling train in a dry form

If you spread the cement directly to the existing pavement, do not spread more than 100 feet ahead of the recycling train. Do not spread under windy conditions and employ dust control measures to minimize fugitive dust.

Do not allow spread cement to remain exposed at the end of the work shift. Do not allow traffic other than the recycling equipment to pass over the spread cement.

**30-6.03D(5) Water**

Determine percentage of water for foaming based on expansion and half-life testing for each truck load of asphalt. For additional water added for compaction, water should be added by the recycling unit so that material being placed is within ± 2 percent of the optimum moisture content determined under California Test 216.

**30-6.03D(6) Proportioning**

Using the mass flow, Coriolis Effect type meter, measure the cement slurry and foamed asphalt before adding them into the RAP. The amount of cement slurry and foamed asphalt must match the amount reported in the JMF or the amount as adjusted and authorized.

Keep cement slurry in suspension during transport using agitator equipment. Keep dry cement in dry cement spreader trucks, pneumatic trailers, or silos.

**30-6.03D(7) Spreading and Compacting**

When placing the initial mat of CIR, the end of the screed nearest the centerline must be controlled by a sensor activated by a ski device not less than 20 feet long. The end of the screed farthest from centerline must be controlled by:

1. A sensor activated by a similar ski device if adjacent to a lane or paved shoulder.
2. An automatic transverse slope device set to reproduce the existing pavement cross slope if adjacent to an unpaved shoulder or no shoulder.

When paving contiguously with previously placed CIR, the end of the screed adjacent to the previously placed CIR must be controlled by a sensor that responds to the grade of the previously placed CIR surface and will reproduce the grade in the new CIR within a 0.01-foot tolerance. The end of the screed farthest from centerline must be controlled by:

1. A sensor activated by a ski device if adjacent to a lane or paved shoulder.

2. An automatic transverse slope device set to reproduce the existing pavement cross slope if adjacent to an unpaved shoulder or no shoulder

You may vary the depth of the CIR to achieve uniform CIR pavement profile, cross slope, and surface smoothness.

Do not allow segregation, tearing, or scarring of the compacted surface.

Compact the CIR mixture by implementing the same compaction rolling pattern established in the authorized test strip. For a lot, compact the CIR mixture to achieve a minimum average of 98 percent relative compaction of the density determined under California Test 216.

Establish a new rolling pattern if any of the following occur:

1. Relative compaction of any of the 10 individual locations is less than 95 percent of the density determined under California Test 216
2. Average relative compaction of the lot is less than 98 percent of the density determined under California Test 216
3. Changes in RAP or proportions
4. Changes in equipment or procedures
5. Change in temperature or weather conditions affecting mixing and compaction temperatures of the placed mixture
6. Visible displacement or cracking occurs

Perform final rolling with a double-drum vibratory steel-wheel roller operating in static or vibratory mode.

The compacted CIR surface must be free from raveling, segregation, rutting, humps, depressions, roller marks, or irregularities. Rework, recompact, or remove and replace CIR that shows raveling, segregation, rutting, humps, depressions, roller marks, or irregularities.

For CIR smoothness, the completed CIR surface must have an MRI of 90 in/mi or less for a 0.1-mile section and no areas of localized roughness greater than 240 in/mi.

For areas that require CIR surface smoothness determined using a 12-foot straightedge, the CIR surface must not vary from the lower edge of the straightedge by more than:

1. 0.02 foot when the straightedge is laid parallel with the centerline
2. 0.03 foot when the straightedge is laid perpendicular to the centerline and extends from edge to edge of a traffic lane

**30-6.03E Asphaltic Emulsion and Sand Cover**

After initial compaction and before opening the CIR surface to traffic, apply a coat of asphaltic emulsion followed by sand cover to the CIR surface. Apply asphaltic emulsion and sand cover under section 37-2.04.

Remove excess sand from the pavement surface by sweeping before opening to traffic.

**30-6.03F Temporary Structural Section**

Place a temporary structural section to the level of the CIR surface if:

1. You are unable to complete the CIR before opening to roadway to traffic
2. CIR fails during the maintaining period by raveling or rutting

For minor HMA or commercial quality bituminous material, place in layers and compact until the level of the CIR surface is reached. Compact the minor HMA or commercial quality bituminous material using method compaction process as specified in section 39-2.01D(5).

If commercial quality bituminous material or minor HMA is used, remove and replace it with HMA Type A under an authorized JMF meeting all of the requirements for HMA Type A before placing overlay.

**30-6.03G Maintain, Cure and Protect Surface**

Do not place the HMA layer over CIR surface until either of the following conditions is met:

1. 3 days and moisture measured at mid-depth of the CIR pavement is 2.0 percent or less
2. 10 days without rainfall

HMA layer must be placed within 15 days of completion of the CIR layer.

Immediately repair any damage or defects by:

1. Reworking and re-compacting the CIR surface
2. Replacing any damaged area with the same depth of cold bituminous surfacing material or HMA

**30-6.04 PAYMENT**

Test strips are paid for as CIR.

The Department does not adjust the unit price for an increase or decrease in the quantity for:

1. Cement (cold in-place recycling)
2. Asphalt (cold in-place recycling)
3. Asphaltic emulsion (cold in-place recycling)
4. Sand cover (cold in-place recycling)