

Use section 30-5 to construct pavement using Partial Depth Recycling.

Only Partial Depth Recycling using foamed asphalt technology can be used at night.

Design in accordance with the Highway Design Manual (HDM) Chapter 634.

The PDR thickness should be at least 3",

For estimating purposes, recycling agent is 2.75% and cement is 1% of the weight of PDR. Assume an in-place recycled pavement material density of 135 lb/ft³.

Include Section 39-2.01A(4)(i)(iii) smoothness of HMA on PDR NSSP.

Intelligent compaction is optional. If used contact.IC@dot.ca.gov for Intelligent Compaction NSSP for PDR and HMA.

For Design Guidance-- Use the following Bid Items:

304101A	Partial Depth Recycling	SQYD
304201A	Cement (Partial Depth Recycling)	TON
304302A	Recycling Agent (Partial Depth Recycling)	TON
304401A	Asphaltic Emulsion (Partial Depth Recycling)	TON
304500A	Sand Cover (Partial Depth Recycling)	TON

Replace section 30-5 with:

30-5 PARTIAL DEPTH RECYCLING

30-5.01 GENERAL

30-5.01A Summary

1

Section 30-5 includes specifications for constructing the pavement using partial depth recycling (PDR).

2

PDR consists of:

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

30-5.01B Definitions

3

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

break-over point: Maximum density of the PDR section achieved when nuclear density tests do not show an increase in density after additional compaction passes.

CIR: cold in place recycling is a general term for in-place recycling of asphalt pavement without application of heat.

In-place recycled pavement material: the combination of processed in-place asphalt pavement material with recycling agent.

PDR: partial depth recycling is a type of CIR where only the HMA layers are recycled and no underlying layer material is incorporated.

PDR-EA: partial depth recycling using emulsified asphalt.

PDR-FA: partial depth recycling using foamed asphalt.

Recycling Agent: Cationic emulsified asphalt or foamed asphalt used in the recycling process.

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

sub-lot: 528 feet or fraction thereof of PDR pavement constructed in the same day.

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

30-5.01C Submittals

30-5.01C(1) General

4

Submit all the test results, including "report only", to the Engineer and e-mail to:

PDR@dot.ca.gov

5

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

1. Quality Control (QC) Plan
2. Mix Design
3. Contingency Plan

30-5.01C(2) Quality Control Plan

6

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

7

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.

8

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

30-5.01C(3) Mix Design

9. Insert each location by starting and ending post mile. Delete or add rows to table as required.

Submit separate mix designs based on in-place recycled pavement 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 PDR mix design, submit:

1. Mix design documentation on the Contractor PDR using recycling agent Mix Design form per CTM 315, 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. SDS for:
 - 2.1. Recycling Agent
 - 2.2. Cement
 - 2.3. Other additives
3. Manufacture's Certificate of Compliance (COC) for:
 - 3.1. Recycling agent
 - 3.2. Cement
 - 3.3. Other additives

10

30-5.01C(4) 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.

30-5.01C(5) Quality Control Reporting

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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 PDR activities including time of temperature reading
 - 1.5.2. Road surface temperatures before beginning daily PDR activities including time of temperature reading
2. For emulsified asphalt or foamed asphalt recycling agent:
 - 2.1. Weight in tons
 - 2.2. Percentage by weight of dry in-place recycled pavement material
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 in-place recycled pavement material
4. Water application rate:
 - 4.1. Used for foaming asphalt by weight of asphalt for PDR-FA
 - 4.2. Added during mixing for compaction by theoretical percent dry weight of PDR
5. For PDR processing:
 - 5.1. Length, width, depth of cut at each end of the milling 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. Break-over point used for relative compaction calculation
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. PDR quality control test results for:
 - 7.1. Wet field gradation for material passing the 1-inch, 3/4-inch, and No. 4 sieves under AASHTO T 27
 - 7.2. Relative compaction under California Test 231 for lifts greater than 4-inches and relative compaction under California Test 375 for lifts less than or equal to 4-inches
 - 7.3. For PDR-EA test for Marshall stability under California Test 315 and for PDR-FA test for ITS under California Test 315.
 - 7.4. Air voids under AASHTO T 269
 - 7.5. Maximum theoretical specific gravity under AASHTO T 209
8. For asphaltic emulsion used on finished PDR 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 recycling agent 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 (only for PDR-FA)
 - 10.2.2. Water added for compaction
 - 10.3. Unsuitable materials locations and when the Engineer was notified

12

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.

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During PDR activities, submit the following items daily

1. Square yards recycled.
2. Tons recycling agent utilized.
3. Tons recycling agent 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.

30-5.01C(6) Certificates

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Submit certificates of compliance for the cement, recycling agent and asphaltic emulsion with each delivery. Include the manufacturer's test results for recycling agent and asphaltic emulsion with your certificate of compliance. The test results must be from material tested within 30 days prior to delivery.

15

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

30-5.01C(7) Recycling Agent

16

Submit samples of asphalt in 1-quart cans to the Engineer.

17

Within 10 business days after taking asphalt quality control samples, submit the test results for asphalt quality characteristics.

30-5.01C(8) Asphaltic Emulsion

17

Submit two samples of asphaltic emulsion in 1-quart plastic containers to the Engineer.

18

Within 10 business days after taking asphaltic emulsion quality control samples, submit the test results for asphaltic emulsion.

19

Each time you dilute the asphaltic emulsion, submit data according to Section 30-1.01C(2).

30-5.01C(9) Partial Depth Recycling

20

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

PDR Quality Control Test Result Reporting

Quality Characteristic	Test Method	Maximum reporting time allowance
Water sulfates (max, ppm)	California Test 417	Before work starts
Water chlorides (max, ppm)	California Test 422	
Asphalt expansion (for PDR-FA) (min, volume)	Visual Inspection	24 hours
Asphalt half-life (for PDR-FA) (min, seconds)	Visual Inspection	
Maximum wet gradation (% passing) Sieve Size 1.25-inch	AASHTO T 27	24 hours
Wet field gradation (% passing) Sieve size 1.25-inch 1-inch 3/4-inch No. 4	AASHTO T 27	24 hours
Dry gradation (% passing) Sieve size 1.25-inch 1-inch 3/4-inch No. 4 No. 30 No. 200	AASHTO T 27	10 business days
Bulk specific gravity of compacted samples	AASHTO T 269	10 business days
Maximum theoretical specific gravity	AASHTO T 209	10 business days
Air voids (%)	AASHTO T 269	10 business days
Relative compaction (min, %)	California Test 231	24 hours
In-place wet density (g/cc)	California Test 375, Part 4 or California Test 231	24 hours
Relative compaction (%)	California Test 375 or California Test 231	24 hours
Thickness (inch) Each Core Average thickness of cores	Core measurements	24 hours
Marshall stability (min, lbs)	AASHTO T 245	10 business days

Marshall retained stability (min, %)	AASHTO T 245	10 business days
Indirect dry tensile strength (psi)	AASHTO T 283	10 business days
Indirect wet tensile strength (min, psi)	AASHTO T 283	10 business days
Tensile strength ratio (%)	AASHTO T 283	10 business days

30-5.01C(10) Partial Depth Recycling Surface Smoothness

21

Submit the PPF files for the initial PDR surface and the corrected PDR surface as shown in Section 36-3.01C. Use the required naming convention, except for where

X = *PDRPAVE* for the initial PDR surface, and *PDRCORR* for the corrected PDR surface.

Include both PDR profiles in the ProVAL project (PVP) file and payment adjustment spreadsheet required for the smoothness payment adjustment request for the hot mix asphalt pavement placed over the PDR surface.

30-5.01D Quality Assurance

30-5.01D(1) General

22

Not used

30-5.01D(2) Quality Control

30-5.01D(2)(a) General

23

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

24

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

25

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

30-5.01D(2)(b) Quality Control Plan

26

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 PDR cold planing, mixing, spreading, compacting and finishing activities are coordinated

27

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.

28

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

1. In-place recycled pavement material
2. Recycling Agent
3. Cement
4. Production
5. Paving
6. Compaction
7. Smoothness

29

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

30

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

30-5.01D(2)(c) PDR Preconstruction Meeting

31

At least 10 days before starting PDR activities, meet with the Engineer for a PDR preconstruction meeting at a mutually agreed time and place. Discuss the QC plan and the methods of performing PDR production and placement. This meeting will also include just in time training provided by the contractor to Caltrans personnel working on the project.

32

The following personnel must attend the preconstruction meeting:

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

30-5.01D(2)(d) Test Strip

33

On the 1st day of PDR activities and within the pavement area to receive PDR, 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 PDR 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 water
4. Rolling pattern needed to reach break-over point.
5. Application rates of asphaltic emulsion and sand cover

34

Document the established rolling pattern and submit to the Engineer

35

The Engineer evaluates the test strip for authorization 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. Wet gradation
3. Smoothness
4. Relative compaction

36

For smoothness, only the straightedge requirements apply for test strip authorization.

37

Retest the test strip smoothness under section 30-5.01D(2)(d)(ii)(G). Rework and recompact or remove and replace test strip if it does not comply with the specifications. Do not proceed with PDR activities until the Engineer notifies you that the test strip is authorized.

30-5.01D(2)(d)(i) Quality Control Testing

30-5.01D(2)(d)(i)(A) General

38

Take samples under California Test 125.

39

For any lot including the test strip, stop PDR 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 PDR 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

30-5.01D(2)(d)(i)(B) Recycling Agent

40

During PDR activities, take four 1-quart samples of recycling agent from each load delivered to the job site in the presence of the Engineer. Use 2 samples for QC testing and submit 2 samples to the Engineer.

41

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.

42

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

43

Store recycling agent samples in clean, dry, and sealed 1 quart plastic containers at a temperature between 40 to 100 degrees F.

44

For emulsified asphalt, the authorized laboratory must perform sampling and testing every second tanker load according to Section 94-1.02E.

30-5.01D(2)(d)(i)(C) Asphaltic Emulsion

45

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 gal. In the presence of the Engineer take four 1-quart samples of asphalt emulsion in plastic containers with lined sealed lid for testing. Use 2 quart samples for QC testing and submit 2 quart samples to the Engineer for acceptance testing. Sample must be submitted in insulated shipping container.

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For asphaltic emulsion, the Authorized Laboratory must perform quality control sampling and testing at each tanker load according to Section 94-1.02C or Section 94-1.02E.

30-5.01D(2)(d)(i)(D) Partial Depth Recycling

47

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

PDR Quality Testing Frequencies

Quality Characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Water sulfates ^a (max, ppm)	California Test 417	1 per source	Source
Water chlorides ^a (max, ppm)	California Test 422	1 per source	Source
Asphalt expansion and half-life (for PDR-FA)	Visual Inspection	Each Tanker Truck	Recycling Equipment
Maximum wet gradation (% passing) Sieve Size 1.25-inch	AASHTO T 27	Test strip and 2 per lot	Recycled Mat
Wet gradation (% passing) Sieve size 1.25-inch 1-inch 3/4-inch No. 4	AASHTO T 27	Test strip and every 3 rd lot	
Dry gradation ^b (% passing) Sieve size 1.25-inch 1-inch 3/4-inch No. 4 No. 30 No. 200	AASHTO T 27	1 per day and prior to the introduction of recycling agent	
Marshall stability (min, lbs)	California Test 315	Every other lot	
Marshall retained stability (min, %) ^c	California Test 315	Every other lot	
Indirect dry tensile strength (psi)	California Test 315	Every other lot	
Indirect wet tensile strength (min, psi) ^c	California Test 315	Every other lot	
Tensile strength ratio (%)	California Test 315	Every other lot	

^aOnly required for non-potable water sources.

^bSampling must be conducted prior to mixing the RAP with recycling agent and cement so as to obtain accurate gradations on dry gradations.

^cContractor shall fabricate companion samples for department testing.

30-5.01D(2)(d)(i)(E) Density

48

Take and split a sample of the loose PDR mixture daily at a location determined by the Engineer. Split the PDR samples into 2 parts and label the containers with location and station. Submit 1 split part and use 1 part for your testing. 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 frequency	Location of sampling
Maximum theoretical specific gravity ^{a, b, c}	AASHTO T 209	Test strip and 2 per day	Recycled mat
Air voids of compacted and cured specimens ^{a, b, c} (%)	AASHTO T 269	Test strip and 2 per day	Recycled mat
In-place wet density (g/cc) ^d	California Test 375 Part 4, or California Test 231	Test strip and 1 per day	Compacted mix
Relative compaction ^{d, e} (min, %)	California Test 375 or California Test 231	Test strip and 2 test sites per subplot	Compacted mix

^aTake and split a sample of the loose PDR mixture daily at a location determined by the Engineer. Split the PDR 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 gravity of the PDR sample under AASHTO 209. Use the maximum theoretical gravity and calculate air voids under AASHTO T 269 for each compaction test site and the average of the lot. Report air voids ratio at end of project. The Department does not use your maximum theoretical specific gravity test results and air voids to determine specification compliance.

^bFabricate 3 4-inch diameter specimens compacted under AASHTO T 245 at 75 blows per side or under AASHTO T 312 at 30 gyrations. Fabrication of specimens must be completed within 2 hours after materials have been mixed.

^cTest specimens after 104 degrees F curing to constant weight for 72 hours and allow the specimens to cool to room temperature.

^dUse California Test 375 for 4 inches or less and California Test 231 for greater than 4 inches. The relative compaction is based on the break-over point. Verify break-over point once per day of production and when significant changes in material are observed.

^eTesting frequency two test sites per sub-lot and no lot shall be represented by fewer than five test sites.

30-5.01D(2)(d)(i)(F) Smoothness

49

Straightedge and record surface smoothness at least once every 1,000 feet along the cut length.

50

Stop cold planing activities and immediately inform the Engineer whenever:

1. Variance of more than 0.02 foot measured from the lower edge of a 12-foot straightedge placed parallel with the centerline
2. Transverse slope variance of more than 0.03 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

51

After completing PDR activities, prior to HMA overlay, determine PDR surface smoothness under section 36-3. Smoothness is measured after supplemental compaction for PDR-EA. Smoothness is measured after final compaction for PDR-FA.

52

Correct PDR surface with MRI greater than 90 in/mi for each 0.1-mile section and areas of localized roughness greater than 240 in/mi. Measure smoothness after corrections have been made under section 30-5.01C(10). For areas corrected by grinding or micro milling reapply asphaltic emulsion and sand.

53

Smoothness corrections must leave at least 90 percent of the specified PDR thickness. If ordered, core the pavement at the locations selected by the Engineer. Coring, including traffic control, is change order work. Remove and replace deficient pavement areas where the overlay thickness is less than 75 percent of the thickness specified.

30-5.01D(3) Department Acceptance

54

The Engineer samples materials for testing under California Test 125

55

PDR 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 PDR surface of:
 - 2.1 MRI of 90 in/mi or less for each 0.1-mile section
 - 2.2 No areas of localized roughness greater than 240 in/mi.
 - 2.3 For areas that require PDR surface smoothness determined using a 12-foot straightedge, the PDR surface must not vary from the lower edge of the straightedge by more than:
 - 2.3.1 0.02 foot when the straightedge is laid parallel with the centerline
 - 2.3.2 0.03 foot when the straight edge is laid perpendicular to the centerline and extends from edge to edge of a traffic lane
3. 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.
4. Asphaltic emulsion acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

Asphaltic Emulsion Requirements

Quality characteristic	Test method	Requirements	
		Minimum	Maximum
Test on emulsion:			
Sieve test (max, %)	AASHTO T 59	--	0.1
Residue by evaporation (min, %)	AASHTO T 59	28.5 ^a	--
Test on residue by evaporation:			
Penetration, @ 25 °C (mm)	AASHTO T 49	40	90

^aResidue requirement is based on 1:1 dilution ratio of asphaltic emulsion and water.

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

PDR Quality

Quality Characteristic	Test method	Requirement
Maximum wet gradation (% passing) Sieve Size 1.25-inch	AASHTO T 27	100
Wet gradation (% passing) Sieve size 1.25-inch 1-inch 3/4-inch No. 4	AASHTO T 27	100 98 report only report only
Dry gradation (% passing) Sieve size 1.25-inch 1-inch 3/4-inch No. 4 No. 30 No. 200	AASHTO T 27	report only
Indirect wet tensile strength ^{a,b} (min, psi)	AASHTO T 283	report only
Relative compaction (min, %) ^c	California Test 231 or California Test 375	98-102
Thickness (inch) ^d Each Core Average thickness of cores	Core measurements	±0.75 inch of the thickness shown ≥ thickness shown

^aFabricate 3 indirect tensile strength specimens under AASHTO T 245 or AASHTO T 312. Fabrication of indirect tensile strength specimens must be completed within 2 hours after materials have been mixed. Indirect tensile strength testing is only required for acceptance of PDR-FA. No indirect tensile strength testing is required for PDR-EA.

^bCure 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 AASHTO T 283 after moisture conditioning.

^cAverage of lot test locations 98 to 102 percent with no individual test less than 95 to 105 percent. Use California Test 375 for 4 inches or less and California Test 231 for greater than 4 inches.

^dTake 4- or 6-inch core from two random location per lot as determined by the Engineer. Coring at more than 2 location per lot is change order work. Perform coring and measure core depth in the presence of the Engineer or submit depth measurements, taken in the presence of the engineer, if core retrieval is not achieved. This process will be done after supplemental compaction for PDR-EA. Coring must be done after any milling.

If the Engineer orders you to stop PDR 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

30-5.01D(4) Dispute Resolution

57

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.

58

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

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

60

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 PDR 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.

30-5.02 MATERIALS

30-5.02A General

61 List available existing pavement information in SSP 2-1.06B and include the information in the Information Handout.

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

30-5.02B Material Quality Characteristics During Production

PDR Quality Characteristic Requirements

Quality characteristic	Test method	Requirement
Asphalt expansion and half-life (for PDR-FA)	Visual Inspection	Foaming
Maximum wet gradation (% passing) Sieve size 1.25-inch	AASHTO T 27	100
Wet gradation (% passing) Sieve size 1.25-inch 1-inch 3/4-inch No. 4	AASHTO T 27	100 98 report only report only
Dry gradation (% passing) Sieve size 1.25-inch 1-inch 3/4-inch No. 4 No. 30 No. 200	AASHTO T 27	report only
Bulk specific gravity of compacted samples	AASHTO T 269	report only
Maximum theoretical specific gravity	AASHTO T 209	report only
Air voids (%)	AASHTO T 269	report only
Relative compaction (min, %) ^a	California Test 231 or California Test 375	98-102
In-place wet density (g/cc)	California Test 375, Part 4	report only
Thickness (inch) ^b Each Core Average thickness of cores	Core measurements	±0.75 inch of the thickness shown ≥ thickness shown
Marshall stability (min, lbs) ^c	AASHTO T 245	report only
Marshall retained stability (min, %) ^c	AASHTO T 245	report only
Indirect dry tensile strength (psi) ^c	AASHTO T 283	report only
Indirect wet tensile strength (min, psi) ^c	AASHTO T 283	report only
Tensile strength ratio (%) ^c	AASHTO T 283	report only

^aAverage of lot test locations 98 to 102 percent with no individual test less than 95 to 105 percent. Use California Test 375 for 4 inches or less and California Test 231 for greater than 4 inches.

^bTake 4- or 6-inch core from two random location per lot as determined by the Engineer. Coring at more than 2 location per lot is change order work. Perform coring and measure core depth in the presence of the Engineer or submit depth measurements, taken in the presence of the engineer, if core retrieval is not achieved. This process will be done after supplemental compaction for PDR-EA.

^cTesting is report only during production, alternating between ITS and Marshall stability per lot.

30-5.02C 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 (max, ppm)	California Test 417	1,300
Water chlorides (max, ppm)	California Test 422	650

30-5.02D Cement

63

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

30-5.02E Recycling Agent

64

Use PG 64-10 unmodified binder for PDR-FA or as approved by the Engineer.

65

Use PG 64-22 as the asphalt binder for PDR-EA.

66

Cationic emulsified recycling agent must comply with the requirements in Section 94-1.02E.

30-5.02F PDR Mix Design

67

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

68

The mix design must comply with California Test 315 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 269	report only
Maximum theoretical specific gravity ^b	AASHTO T 209	report only
Air voids of compacted and cured specimens ^{b, c} , (%)	AASHTO T 269	report only
Marshall Stability, cured specimen ^{b, e} at 104 °F with cement (min, lbs)	AASHTO T 245	1500
Marshall retained stability ^{b, c, d, e} based on moisture conditioning on cured specimen at 104 °F with cement (min, %)	AASHTO T 245	70
Indirect dry tensile strength (psi)	AASHTO T 283	report only
Indirect wet tensile strength (min, psi)	AASHTO T 283	35
Tensile strength ratio (min, %)	AASHTO T 283	70
Maximum density (lb/cu ft)	California Test 216	report only
Ratio of asphalt binder to cement (min, %)	--	2.5:1
Raveling test at 50 °F (max, %) ^e	ASTM D7196	7
RAP coating Test for PDR EA (%)	AASHTO T 59	95

^a4-inch diameter mold compaction based on gyratory compactor at 30 gyrations.

^bTest specimens after 140 degrees F curing to constant weight between 16 hours and 48 hours.

^cVacuum 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.

^dIf the saturated Marshall Stability is at least 1500 lbs, the Marshall Retained Stability ratio may be reduced to 60 percent

^eRequirements are only applicable to PDR-EA and for PDR-FA will be report only.

69

Cement must be at least 0.50 but not more than 1.0 percent of the dry weight of in-place recycled pavement material.

70

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

30-5.02G Temporary Structural Section

71

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

72

The minor HMA for the temporary structural section must comply with Section 39-2.07.

30-5.02H Asphaltic Emulsion

73

Asphaltic emulsion must be Grade SS1h or Grade CSS1h or cationic emulsified recycling agent according to section 94-1.02.

74

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.

75

Measure added water weight.

30-5.02I Sand Cover

76

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.

30-5.03 CONSTRUCTION

30-5.03A General

77

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

78

Before starting PDR activities, provide 20 tons of commercial quality bituminous surfacing material onsite for maintenance and protection of the completed PDR surface.

79

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

80

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

30-5.03B Surface Preparation

81

Before starting PDR 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.

30-5.03C Partial Depth Recycling Equipment

30-5.03C(1) General

82

The equipment for PDR must consist of:

1. Cold planing
2. Pulverizing, crushing, or sizing of in-place recycled pavement material
3. Recycling agent storage, supply and foaming for PDR-FA.
4. Mixing and proportioning
5. Water storage and supply
6. Cement storage, supply and spreading
7. PDR mixture spreading

8. Compacting
9. Applying asphaltic emulsion to the surface
10. Spreading sand cover

83

Use equipment that:

1. Cold planes, pulverizes, crushes, and sizes the existing asphalt pavement
2. Mixes the in-place recycled pavement material with the recycling agent and cement into a homogeneous mixture
3. Places the PDR mixture to the lines, grades, and specifications

84

Pulverizing, crushing, or sizing equipment must produce uniform material to the specified size before mixing the in-place recycling pavement material with recycling agent.

30-5.03C(2) Cold-Planing Equipment

85

The cold-planing machine must:

1. Be self-propelled
2. Have a 12-foot minimum wide cutter that can recycle 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.

The cold-planing machine may be equipped with ski devices for longitudinal profile. The ski devices may be conventional contact ski or noncontact laser or sonar device.

86

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

30-5.03C(3) Mixing Chamber or Pugmill

87

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. In-place recycled pavement material delivered to the mixing chamber or pugmill
2. Amount of recycling agent being delivered

88

The mixing chamber or pugmill must be arranged to mix the in-place recycled pavement material, recycling agent, and cement to produce the specified PDR mixture. The mixing chamber may be equipped with paddles or other suitable mixing devices. If paddles or other suitable mixing devices are used the in-place recycled pavement material must be fed from the pulverizing, crushing, or sizing equipment to the mixer at a uniform and controlled rate.

89

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

30-5.03C(4) Mixing and Proportioning Equipment

30-5.03C(4)(a) General

90

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

91

The weighing and measuring devices for the recycling agent 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.

30-5.03C(5) Water Storage and Supply Equipment

92

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 in-place recycled pavement material weighing device or microprocessor to properly disperse the recycling agent.

30-5.03C(6) Cement Storage and Supply Equipment

93

Keep cement in dry cement spreader trucks, pneumatic trailers, or silos. Use an automated spreader capable of spreading the cement at the required weight per unit area. The spreader must have working scales and distance measuring devices to verify the spread rate.

30-5.03C(7) Spreading Equipment

94

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

95

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

30-5.03C(8) Compacting Equipment

96

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.

30-5.03D Partial Depth Recycling

30-5.03D(1) General

97

Do not perform PDR activities under the following conditions:

1. Pavement surface is wet due to rain.
2. Rain is forecasted within 24 hours of the scheduled work.
3. Pavement temperature is less than 60 degrees F.
4. Ambient temperature is less than 50 degrees F.
5. Between 30 minutes before sunset and 30 minutes after sunrise for PDR-EA.
6. No freezing forecast temperatures in 48 hours.

98

Use the existing pavement profile and cross slope to establish the PDR 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.

99

To achieve PDR surface smoothness requirements, you may use a cold planer with automatic controls and sensors for profile control or perform smoothness correction on the existing pavement prior to performing PDR, or use both methods, in addition to the spreading and compacting requirements required for PDR paving.

30-5.03D(2) Cold Planing

100

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.

101

During cold planing of existing pavement use automatic controls for profile and cross slope

102

If cold planer automatic controls for profile and cross slope are used for achieving smoothness, use ski devices for longitudinal profile. The ski devices maybe conventional contact ski or noncontact laser or sonar device. The cutting head nearest the centerline must be controlled by a sensor activated by a ski device not less than 20 feet long. The end of the cutting head 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.

103

When cold planing adjacent to previously completed PDR lanes use automatic controls for profile and cross slope. The end of the cutting head adjacent to the PDR lane must be controlled by a sensor that responds to the grade of the previously completed PDR surface and will reproduce the grade within a 0.01-foot tolerance. The end of the cutting head farthest from the previously completed PDR surface must be controlled in the same way it was controlled during initial cold planing.

30-5.03D(3) Unsuitable Conditions

104

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.

105

Place HMA Type A or a premixed bituminous material equivalent in thickness to the existing asphalt concrete layer adjacent to the excavation on top of class 2 AB. 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 PDR surface is reached.

106

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

30-5.03D(4) Recycling Agent for PDR-FA

107

Inspect recycling agent foaming half-life and expansion ratio for each tanker load of asphalt. Verify the half-life and expansion ratio by visual inspection and confirm that the foaming action of the recycling agent is taking place through the test port.

30-5.03D(5) Cement

108

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

1. Add directly in the pugmill
2. Spread on the existing pavement surface ahead of the recycling train in a dry form

109

If you spread cement directly onto the existing pavement, do not spread more than 50 feet ahead of the recycling train. Do not spread under windy conditions and employ dust control measures to minimize fugitive dust.

110

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.

30-5.03D(6) Water

111

Determine percentage of water for foaming based on expansion and half-life testing for each truck load of asphalt for PDR-FA.

For additional water added for compaction, water should be added by the recycling unit so that material being placed is consistent with the established break-over point.

30-5.03D(7) Proportioning

112

The amount of recycling agent must match the amount reported in the JMF or the amount as adjusted and authorized.

30-5.03D(8) Spreading and Compacting

113

Remove any visible oversized crack treatment material or paving fabric larger than 1 inch measured at any dimension in the in-place recycled pavement material or in the PDR mixture before placement and compaction.

114

When placing the initial mat of PDR, 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.

115

When paving contiguously with previously placed PDR, the end of the screed adjacent to the previously placed PDR must be controlled by a sensor that responds to the grade of the previously placed PDR surface and will reproduce the grade in the new PDR 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

116

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

117

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

118

For PDR-EA, determine the time interval between spreading and start of compacting PDR mixture. Establish the time interval based on ambient temperatures, weather, and type of emulsified asphalt. Record the time intervals in the daily quality control records. Avoid starting or stopping rolling on uncompacted material.

119

Compact the PDR mixture by implementing the same compaction rolling pattern established in the authorized test strip.

120

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 or greater than 105 percent of the break-over point
2. Average relative compaction of the lot is less than 97 percent or greater than 103 percent of the break-over point
3. Changes in the in-place recycled pavement material 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

121

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

122

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

123

For PDR smoothness, the completed PDR 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.

124

For areas that require PDR surface smoothness determined using a 12-foot straightedge, the PDR 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

30-5.03E Asphaltic Emulsion and Sand Cover

125

After final compaction and before opening the PDR surface to traffic, apply a coat of asphaltic emulsion followed by sand cover to the PDR surface and place temporary painted traffic stripes and painted pavement markings used for temporary delineation. Apply asphaltic emulsion and sand cover under section 37-4.03. Apply temporary pavement delineation under section 12-6 of the Standard Specifications.

126

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

30-5.03F Temporary Structural Section

127

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

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

128

For minor HMA or commercial quality bituminous material, place in layers and compact until the level of the PDR surface is reached. Compact the minor HMA or commercial quality bituminous material using method compaction process as specified in section 39-2.01C(15)(b).

129

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

30-5.03G Maintain, Cure and Protect Surface

130

Do not recompact the PDR for PDR-FA.

131

Do not place the HMA layer over PDR surface until one of the following conditions is met:

1. 3 days and moisture measured at mid-depth of the PDR pavement is 2.0 percent or less
2. 10 days without rainfall
3. 4 days without rainfall and no change in measured moisture content of the PDR pavement within a 24 hour period.

132

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

133

Immediately repair any damage or defects by:

1. Reworking and recompacting the PDR surface
2. Replacing any damaged area with the same depth of cold bituminous surfacing material or HMA

30-5.03H Supplemental Compaction for PDR-EA

134

Recompact the PDR surface:

1. After curing is completed per section 30-5.03G
2. When surface temperature is at least 80°F
3. Before smoothness testing

4. Before placing the HMA surfacing

135

Use the same equipment to establish the rolling pattern and break over curve for recompacting the PDR surface. Adjustments must be authorized.

30-5.04 PAYMENT

136

Test strips are paid for as PDR.

137

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

1. Cement (Partial Depth recycling)
2. Recycling agent (Partial Depth recycling)
3. Asphaltic emulsion (Partial Depth recycling)
4. Sand cover (Partial Depth recycling)