

Pavement Preservation  
Checklist Series

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Cold In-Place

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Asphalt Recycling

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Application  
Checklist

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# CIR Application Checklist

This checklist is one of a series created to guide State and local highway maintenance and inspection staff in the use of innovative pavement preservation processes. The series is provided through the joint efforts of the Pavement Preservation Program of the Federal Highway Administration (FHWA), the Foundation for Pavement Preservation (FP<sup>2</sup>) and the Asphalt Recycling & Reclaiming Association (ARRA).

FHWA uses its partnerships with FP<sup>2</sup>, ARRA, the American Association of State Highway and Transportation Officials, and State and local transportation agencies to promote pavement preservation.

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# Preliminary Responsibilities

This section includes documents and information that should be available prior to any construction activities.

## Document Review

- Project Specifications
- Mix Design
- Structural Pavement Design
- Construction Manual
- Traffic Control Plan
- Owner/Agency Requirements
- Additive Manufacturers' Instructions
- Safety Data Sheets (SDSs)
- Health and Safety Plan and Job Hazard Analysis

## Project Review

- Note the types and causes of existing pavement distresses.
- Identify if there are any weak or unstable mixes in the existing cross section or weak subgrades.
- Verify that previous testing has not detected the presence of weak areas underlying the pavement, confirming that pavement failures do not result from base or subgrade failure.

- Visually examine the current surface and subsurface drainage conditions and confirm they are sufficient to prevent surface deterioration and softening of the subgrade and will enable long-term performance of the pavement after cold in-place recycling (CIR) treatment.
- Verify that both center and edge pavement cores have been obtained at various locations along the length of the project and use cores to confirm the thickness of the asphalt layer.
- Verify from the cores that there is sufficient thickness of asphalt material in place to perform the CIR process.
- Verify that existing structures, e.g., guardrails, curbs, and bridge clearances, do not impose limitations on potential variations of the existing pavement geometry.
- Determine whether paving fabric is present within any of the layers to be recycled and if it could affect construction operations.
- Determine if excessive crack sealant is present in the pavement to be recycled and if it could affect construction operations.
- Note the presence, frequency and elevation of utility covers (manholes and valves) and

develop a plan to address affected areas without disturbing utilities.

- Verify that the project is a good candidate for CIR based on the project review.

## **Materials Checks**

- A sufficient number of cores/samples are obtained for mix design.
- Samples are evaluated for consistency over the length of the project.
- The recycling agent is compatible with the materials and processes. The recycling agent may be:
  - Emulsified asphalt
  - Foamed (expanded) asphalt
- Recycling additives can be added in small amounts to improve mix properties, if indicated by the mix design. Recycling additives may be lime, hydraulic cement or new aggregates.

# Preconstruction Inspection Responsibilities

This section identifies activities that should be performed before proceeding with construction activities.

## Preconstruction Meeting

- Ensure that all necessary contractor and agency personnel attend the preconstruction meeting.

## Surface Preparation

- Ensure that structural pavement distresses have been addressed.
- Identify and correct any subsurface drainage problems.
- Ensure that pre-milling, if required, was performed satisfactorily.

## Equipment Inspections

This section identifies equipment inspections. For CIR processing either a multi-unit train or a single unit train can be used.

### *Multi-Unit Trains*

#### **Milling Machine**

- Verify that the milling drum is the correct width.
- Verify that the milling machine has sufficient weight and horsepower to cut to

the depth and tolerances specified in the contract documents.

- Verify that the cutting teeth are all in place and in adequate condition.
- Verify that the spray bar and nozzles are working properly and not clogged.

### **Screening and Crushing Units**

- Verify that the opening size of the screen deck meets the specifications/contract documents and is in good working condition.
- Verify that all oversize material will be routed through the crusher and re-screened.
- Verify that the crushing unit is working properly.

### **Pugmill**

- Verify that all paddles within the pugmill are present and in good condition.
- Verify that the clearance between the paddles and the wall of the pugmill does not exceed that specified in the contract documents.
- Verify that the pugmill wall is not greatly worn and does not have holes.
- Verify that the spray bars and recycling agent supply lines are not clogged.

## **Recycling Agent and Additive Systems (Water, Foamed Asphalt/Emulsified Asphalt, Other)**

- ❑ Verify that the mixing unit is properly calibrated and is capable of accurately dispensing the required quantity of recycling agent and additives, if required.
- ❑ Verify that the on-board recycling agent/additive system is equipped with a meter capable of recording the rate of flow and total amount of each liquid being added to the recycled material.
- ❑ Verify that the on-board foam generating system includes a foamed asphalt sampling valve when foamed asphalt is being used as the recycling agent.
- ❑ Verify that the on-board recycling agent system has a positive interlock system linked to the forward speed of the train so that the amount of liquid recycling agent being added will change according to the operational speed of the train.
- ❑ Verify that the correct amount of water is being added to achieve a homogenous mixture and achieve specified percent compaction.
- ❑ Verify that the bulk spreader is properly calibrated and is capable of accurately dispensing the required quantity of additive such as cement or aggregate.

### ***Single-Unit Trains***

- ❑ Verify that the cutting drum is the correct width.
- ❑ Verify that the single-unit train has sufficient weight and horsepower to cut to the depth and tolerances specified within the contract documents.
- ❑ Verify that the cutting teeth are all in place and in adequate condition.
- ❑ Verify that the spray bar and nozzles are working properly and not clogged.
- ❑ Verify that the on-board recycling agent system is equipped with a meter capable of recording the rate of flow and total amount of each liquid being added to the recycled material.
- ❑ Verify that the single-unit train is equipped with an on-board foam generating system that includes a foamed asphalt sampling valve when foamed asphalt is being used as the recycling agent.
- ❑ Verify that the on-board recycling agent system has a positive interlock system linked to the forward speed of the single-unit train so that the amount of liquid recycling agent being added will change according to the operational speed of the train.
- ❑ Verify that the correct amount of water is being added to achieve a homogenous

mixture and achieve specified percent compaction.

### ***All Trains***

#### **Nurse Trucks**

- ❑ Verify that the interior of the nurse tank is not contaminated and that the trailer is dedicated to transporting only the specific material used.
- ❑ Verify that the flexible hose used to convey material from the nurse trailer to the pugmill/recycling unit is clean and not contaminated.

#### **Paver and Pickup Machine**

- ❑ Verify that the paver and pickup machine, if required, have adequate horsepower.
- ❑ Verify that the paver hopper is adequately sized for the project to prevent material spillover.
- ❑ Verify that the automatic grade and cross-slope controls are functioning properly.

#### **Compaction Rollers**

- ❑ Verify that the rollers proposed for use by the contractor are in accordance with those specified in the contract documents. Typically, at least one pneumatic-tired roller (22 to 25 tons) and one vibratory, double-steel drum roller (10 to 12 tons) are required.

- Verify that the number of rollers used is consistent with the rate of material being processed and placed.
- Verify that the tire pressures on pneumatic-tired rollers are consistent with the tire pressures specified in the contract documents.
- Verify that working water systems are installed on all rollers as required by the contract documents.
- Verify that working scrapers are in place on all rollers as required by the contract documents.

## **Weather Requirements**

- Verify that the RAP temperature meets contract specification requirements, typically a minimum of 50 °F (10 °C).
- Verify that overnight ambient low temperatures do not drop below 35 °F (2 °C) during construction operations.
- Consider that variations in temperature, humidity, and wind conditions will all affect breaking and curing times.
- Verify that no significant precipitation is predicted during construction operations, in accordance with contract specifications.

## **Mix Design**

- ❑ Verify that a mix design has been performed and that the resulting mixture meets the specifications in the contract documents.
- ❑ Verify that any special instructions included with the mix design are incorporated into the contractor's preparations for construction operations.
- ❑ Verify that the contractor has submitted the final mix design for review and acceptance prior to initiation of construction operations.

## **Traffic Control**

- ❑ Verify that the traffic control plan complies with the contract documents and the Manual on Uniform Traffic Control Devices (Federal Highway Administration, 2009).
- ❑ Verify that signs and devices erected on the roadway match the traffic control plan contained in the contract documents.
- ❑ Ensure that flaggers do not hold traffic for extended periods of time.
- ❑ Ensure that flaggers do not hold traffic stopped on freshly treated material.
- ❑ Ensure that signs are removed or covered when they no longer apply.
- ❑ Ensure that an appropriate action plan is developed and implemented for emergency vehicles passing through the project.

- Ensure that any unsafe conditions are reported to a supervisor or the appropriate law enforcement officials.

## **Project Inspection Responsibilities**

This section identifies activities that should be performed during the construction process.

### **Milling, Crushing, and Mixing**

- Ensure that all grass and soil are removed from the pavement surface, especially along the edges of the pavement, prior to recycling.
- Ensure that the depth and width being milled are in accordance with contract documents.
- Verify that the width of milling overlaps with the previous pass by at least 4 inches (100 mm).
- Verify that the maximum size of the RAP is less than or equal to the maximum permitted by the mix design, typically, 1.0 to 1.5 inches (25 to 38 mm).
- Verify that paving fabric incorporated into the recycled mix has a maximum dimension as per contract documents. Typically, the maximum dimension is not greater than 2 inches (50 mm). Obvious

oversized material should be removed from the recycled mixture.

- Ensure the asphalt cement for foamed CIR is sufficient to exceed minimum expansion ratio and half-life requirements. Typical minimum asphalt temperatures of 320°F (160° C) are required for foam CIR.
- Ensure the asphalt cement temperature for foam CIR is not greater than 375° F (190° C).

### **Pickup Machine and Paver**

- When processed material is being windrowed, ensure that the pickup machine is the correct distance behind the pugmill. (Note: Contract documents may specify a maximum separation, either in units of distance or time.)
- Ensure the screed on the paver is not heated.
- Ensure that the paving machine places processed material to grade and slope or crown in accordance with contract documents.
- Ensure that both the transverse and longitudinal joints are constructed in accordance with contract documents.
- Ensure that a continuous flow of material is deposited into the paver hopper. Material should not overflow the hopper and spill over

the sidewalls, nor should the hopper be under filled such that the drag slats in the bottom of the hopper are exposed.

## **Rolling Procedure**

- ❑ Develop a rolling pattern at the beginning of construction so that the number of passes required using the specified rollers will result in the maximum achievable density (using a nuclear density gauge) in accordance with contract documents.
- ❑ Ensure that there is no damage from potential over rolling.
- ❑ Communicate daily with the roller operators to review the developed rolling pattern.
- ❑ Ensure that compaction tests are performed as required by the contract documents and that the test results meet the specification requirements.
- ❑ Ensure that stops, starts, and turns are gradual.
- ❑ Ensure that finish rolling is completed within the time frame specified in the contract documents.
- ❑ Ensure that water is lightly sprayed onto the roller drums and tires to prevent pickup. Under no circumstances should diesel or other solvents be used to prevent pickup.

- ❑ If a wetting agent is utilized, verify compatibility with the recycling agent.

## **Acceptance**

- ❑ Verify that recycling agent, water, and additives are added at the rates specified by the mix design in accordance with contract documents.
- ❑ Visually inspect the mixture for uniformity and homogeneity as it is discharged, whether onto the pavement and windrowed or directly into the paver hopper.
- ❑ Obtain samples of the mixture and component recycling agents and additives in accordance with the acceptance requirements of the contract documents.
- ❑ Verify that the mixture and component recycling agents and additives comply with the requirements of the contract documents.

## **Opening to Traffic**

- ❑ Ensure that the material in the recently completed mat meets the requirements for compaction density and length of initial cure time as presented in the contract documents.
- ❑ As required by the contract documents, or to minimize raveling, apply fog seal, typically 0.05 to 0.15 gal. /yd<sup>2</sup>, (0.2 to 0.7

l/m<sup>2</sup>) prior to opening to traffic. If necessary to absorb excess fog seal and to prevent pick-up by traffic, apply blotter sand, typically at a rate of 1 to 2 lbs. /yd<sup>2</sup> (0.5 to 1.0 kg /m<sup>2</sup>). Take extra care to not over sand the pavement surface.

- Ensure that temporary pavement markings required by the contract documents are in place prior to opening the surface to traffic.

## Curing

- Allow the completed CIR to cure in accordance with contract documents.
- When required by the contract documents, perform secondary compaction to remove minor consolidation in the wheel paths at the end of the curing period and prior to placing the surface course. (for emulsified asphalt CIR mixes only)

## Surface Course

- After curing, and secondary compaction when required, apply a surface course (seal coat or HMA overlay) as specified by the contract documents.
- Apply a tack coat for an HMA overlay in accordance with the contract requirements to

promote a good bond between the CIR layer and the surface course.

- If necessary, sweep excess blotter sand prior to tack coat application.

## Common Problems and Solutions

### **(Problem: Solution)**

- **Base Layer Aggregate or Subgrade Soils in the CIR:**
  1. Inspect milling depth.
  2. Ensure sufficient asphalt pavement thickness.
- **Oversize material or chunks in the recycled mat:**
  1. Check the screen deck for correct size or holes (multi-unit train).
  2. Check for chunks in the pugmill: ensure paddle clearance; remove chunks before compaction.
  3. Check forward speed of the CIR machine and breaker bar (single-unit train)

- **Nonhomogeneous mixture:**

1. Check for sufficient moisture content.
2. Check for sufficient recycling agent.
3. Check recycling agent temperature for extremes.
4. Check correct operation of the pugmill/mixing chamber.

- **Segregation:**

1. Inspect the top size versus the depth being placed.
2. If the wings of the hopper are being used, make sure segregated material is not being introduced.
3. Identify systematic segregation areas and make corrections, such as around a gear box.
4. If the screed is extended, look for segregation in the extensions.

- **Drag marks in uncompacted mixture:**

1. Ensure that the screed is clean.
2. Ensure that the screed is not heated.

- **Insufficient compaction:**

1. Ensure rolling is started at the correct time.
2. Ensure the proper rates of recycling agents, water and additives are being introduced to the mix.
2. Ensure roller patterns have been adequately established, are understood, and are being followed.
3. Ensure the correct type, number, and size of rollers are being used.
4. Ensure rollers are not operating too fast.
5. Re-establish the rolling pattern as necessary.

- **Raveling:**

1. Ensure the water system is working on the rollers.
2. Check if traffic may be on the compacted CIR too soon.
3. Check for sufficient recycling agent content.
4. Ensure ambient conditions are not too cool.

- **Flushing:**

1. Ensure there is not too much pre-wet water or recycling agent being added (total fluids).

## Acknowledgements

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## Sources

Information in this checklist is based on or refers to the following sources:

- *Basic Asphalt Recycling Manual, Second Edition, 2013.* Annapolis, MD: Asphalt Recycling & Reclaiming Association. Available at [www.arra.org](http://www.arra.org).
- *Manual on Uniform Traffic Control Devices.* 2009. Washington, DC: Federal Highway Administration. Available at <http://mutcd.fhwa.dot.gov>.

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