Section 2318. Cold In-Place Recycled Asphalt Pavement

2318.01 DESCRIPTION.

Cold in-place recycling (CIR) consists of:

- Milling existing asphalt pavement,
- Processing and mixing RAP with an asphalt stabilizing agent and water (if required), and
- Placing and compacting the mixture.

2318.02 MATERIALS.

A. Asphalt Stabilizing Agent.

Use one of the following asphalt stabilizing agents, as specified in the contract documents:

1. Standard Asphalt Emulsion (HFMS-2s) meeting the requirements of Section 4140 shall be used on Primary and Interstate projects. CSS-1 emulsion meeting the requirements of Section 4140 may be used in place of HFMS-2s on other projects.

2. Foamed Asphalt using PG 52-34 or PG 46-34 asphalt binder meeting the requirements of Section 4137 may be used on Interstate, Primary, Secondary, and local projects.

B. Recycled Asphalt Pavement.

The processed RAP is intended to comply with the following gradation. The gradation may be revised with the approval of the Engineer. Ensure the top size of the material does not exceed 50% of the depth of the compacted recycled mat.

Sieve Size	% Passing
1 1/2 inch (37.5 mm)	98 to 100
1 inch (25 mm)	90 to 100

C. Mix Design.

1. Unless stated otherwise in the contract documents, do not perform a mix design process for standard asphalt emulsion or foamed asphalt. Use the following application rates per square yard per inch (per square meter per mm) of compacted thickness when no mix design is performed.

Asphalt Stabilizing Agent	Application Rate (/yd^2/in)	(/m^2/25 mm)
Standard Asphalt Emulsion	0.30 gallons (emulsion)	1.325 L
Foamed Asphalt	0.0011 tons (asphalt binder)	1.175 kg

2. When a mix design is required by the contract documents, apply the following provisions:

Provide the Engineer a representative 150 pound (22 kg) bulk sample of the existing pavement surface as directed by the Engineer following the sampling options in Materials I.M. 504, and 10 gallons (38 L) of the intended asphalt stabilizing agent. The Engineer will provide the details of the mix design no later than 6 weeks after receiving the samples. The Central Materials Laboratory will perform the mix design and will establish the amount of asphalt binder to incorporate into the RAP. The mix design shall determine the target asphalt temperature and percent of water injected into the asphalt to achieve optimum foaming.

2318.03 CONSTRUCTION.

Except in specific cases when permitted by the Engineer, CIR will only be allowed between May 1 and October 1. Do not perform recycling operations when:

- The ambient temperature is below 60°F (15°C),
- The weather is foggy or rainy, or
- Weather conditions are such that proper mixing, placing, and compacting of the recycled material cannot be accomplished.

A. Equipment.

1. Furnish a self-propelled machine equipped with automatic depth control. Ensure it is capable of:
   - Milling the existing asphalt pavement to the depth shown in the contract documents in one pass.
   - Maintaining a constant cutting depth and width, uniform grade, and uniform slope.
   - Producing the properly sized RAP or additional screening.
   - Crushing the RAP.

2. Furnish equipment capable of mixing the RAP and asphalt stabilizing agent into a homogeneous CIR mixture. Ensure the equipment meets the requirements of Article 2001.22, F. Ensure it also provides a positive means, including visual display, for accurately controlling the rate of flow and total delivery of the asphalt stabilizing agent into the mixture in relation to the quantity of RAP being recycled. Ensure the asphalt stabilizer application system is capable of adjusting for the width of recycling so that overlapped CIR mixture maintains the designed asphalt stabilization content.

3. When foamed asphalt stabilizing agent is used, ensure the asphalt foaming system accurately and uniformly injects the specified percent of water into the hot asphalt binder. Fit the equipment with a test nozzle to provide field samples of foamed asphalt. Equip tankers supplying hot asphalt binder with a thermometer to continuously measure temperature of the asphalt in the bottom third of the tank.

4. Place CIR material using a bituminous paver meeting the requirements of Article 2001.19 (heating the screed will not be permitted).

5. Compact CIR material using rollers meeting the requirements of Article 2001.05. As a minimum, have the following available for use:
   - A self-propelled double drum vibratory steel roller (may be used in either the static or vibratory mode).
   - A self-propelled 25 ton (25 Mg) or greater pneumatic tire roller.

B. Preparation.

Prior to initiating the recycling operation, clear all vegetation and debris within the width of pavement to be recycled according to Article 2212.03, B, 1.

C. Milling the Existing Pavement.

1. Mill the existing pavement to the specified constant depth and width in one pass. Process RAP to the required gradation. When specified in the contract documents or if the Engineer approves, the pavement surface may be pre-milled to the slope specified in the contract documents. Remove pre-milling RAP from the project.

2. When the plans note that the milling operation will encounter a paving fabric, make necessary adjustments in equipment or operations so no fabric piece has any dimension exceeding a length of 4 inches (100 mm). Remove RAP containing over-sized pieces of paving fabric.

D. Mixing the Recycled Material.

1. During recycling operations, apply asphalt stabilizing agent to the RAP at the specified application rate. The Engineer may vary the application rate of the asphalt stabilizing agent as required by existing pavement conditions.

2. Determine the amount of additional water needed to facilitate uniform mixing with the asphalt stabilizing agent and to achieve a stable pavement layer above the minimum specified density. The water may be added prior to or concurrently with the asphalt stabilizing agent. Ensure adding water, to facilitate uniform mixing, does not adversely affect the asphalt stabilizing agent.

E. Placement of the Recycled Material.

1. Deposit CIR mixture in a windrow, into a spreader or paver (as required by Article 2318.03, A), or load into trucks, without segregation.
2. Place and finish CIR mixture in one continuous pass, without segregation. Ensure the surface of the CIR lift has a uniform cross-slope as specified in the contract documents. Ensure lift thickness is a minimum of 2 inches (50 mm). If using a pick-up machine to feed the windrow into the paver hopper, ensure it is capable of picking up the entire windrow to the underlying material.

F. Compaction and Density.

1. Comply with the following minimum field densities:
   - Interstate and Primary Roads: 94% of laboratory density based on the dry weight of compacted material according to Materials I.M. 504.
   - All other roads: 92%.

2. Perform initial rolling with a pneumatic tired roller. Perform final rolling using steel wheel rollers, either in static or vibratory mode, to eliminate pneumatic tire marks.

3. If rolling results in cracking, movement, or other types of pavement distress, discontinue until such time that the problem can be resolved.

4. If there is a significant change in mix proportions, weather conditions, or other controlling factors, the Engineer may require construction of test strips to check target density.

G. Opening CIR Layer to Traffic.

1. After compaction is complete, determine when CIR layer is stable enough to open to traffic.

2. The Contractor has 14 calendar days after the CIR layer is complete and initially achieves allowable moisture content to place the first lift of HMA overlay or specified surface treatment. If the first lift is placed after the 14 calendar day period and CIR layer shows damage, correct the damage, at no additional cost to the Contracting Authority, before placing the lift.

H. Placement of Surface Course.

Subsequent HMA overlay or surface treatment will not be allowed until moisture content of the CIR layer is no more than 0.3% above the residual moisture content or 2.0%, which ever is greater. The Engineer may adjust this drying period depending on field conditions. The CIR shall be retested until the moisture content is at or below the limits stated above.

I. Quality Control.

1. The Contractor is responsible for quality control of the materials and CIR process. Perform testing according to Materials I.M. 204. Take samples and deliver them to the District Materials Laboratory according to Materials I.M. 504. A lot, for quality control sampling and testing, is defined as each day of CIR operation.

2. Sample and test the asphalt stabilizing agent according to Materials I.M. 204.

3. Apply asphalt stabilization agent at the target application rate within ± 0.06 gallon per square yard per inch (0.25 L/m^2/25 mm) for standard emulsion and within ± 0.000165 tons per square yard per inch (0.175 kg/m^2/25 mm) for foamed asphalt.

4. When foamed asphalt is used, maintain asphalt binder at a temperature within ± 20°F (10°C) of 310°F (155°C) or the optimum temperature established by the mix design. Maintain the injection water at the target ± 0.5%. Foaming characteristics of each new tanker load will be verified by measuring a sample from the equipment's test nozzle.

5. If required by the Engineer, measure the profile of the center of each lane of the compacted CIR mat with a profilograph. Correct, at no additional cost to the Contracting Authority, bumps and dips in the profile greater than 1 inch (25 mm) in 25 feet (7.6 m). Ensure the cross-slope of the compacted CIR mat is within 0.4% of the desired slope. Payment will be $400 per lane-mile ($250/lane-km) for profiling the length directed by the Engineer.

6. Perform nuclear gauge moisture and density tests according to Materials I.M. 504 within 24 hours of completing each lot at locations determined by the Engineer. During each lot of CIR production, furnish a 40 pound (18 kg) sample of loose CIR mixture, sealed in plastic, from a location the Engineer determines. Each day, deliver the sample as soon as possible after sampling to the District Materials Laboratory for density determination. The Quality Index for density does not apply. Recompact sublots that do not achieve the minimum required density. Recompact them within 2 calendar days after the CIR layer was placed to meet the target density.

J. Limitations.

When HMA resurfacing is part of the contract, cover cold in-place recycled surfaces with at least one full lift of HMA prior to winter shutdown.

2318.04 METHOD OF MEASUREMENT.

Measurement will be as follows:

A. Cold In-Place Recycled Asphalt Pavement.

Square yards (square meters) computed from the measured longitudinal length of pavement and the width of pavement specified in the contract documents.

B. Asphalt Stabilizing Agent.

Gallons (liters) at 60°F (15°C) for standard emulsion, or tons (megagrams) for asphalt binder, through a calibrated pump used for metering the total delivery of the agent or through delivery ticket quantity.

2318.05 BASIS OF PAYMENT.

Payment will be the contract unit price as follows:

A. Cold In-Place Recycled Asphalt Pavement.

1. Per square yard (square meter) for Cold In-Place Recycled Asphalt Pavement.

2. Payment is full compensation for all labor, material (including mixing water), and equipment necessary for:
   - Obtaining and delivering bulk sample for mix design,
   - Quality control, and
   - Milling, mixing, spreading, placing, shaping, and compaction of the completed Cold In-Place Recycled Asphalt Pavement.

B. Asphalt Stabilizing Agent.

1. Per gallon (liter) or ton (megagram) for Asphalt Stabilizing Agent.

2. Payment is full compensation for all labor, materials, and equipment necessary for furnishing the stabilizing agent.