

SPECIAL SPECIFICATION

3178

Hot In-Place Recycling of Asphalt Concrete Surfaces (HIR)

- 1. Description.** Use the hot in-place process to recycle the existing pavement in one of the following sub-categories described below.

Recycling. Recycling is the process in which the existing asphalt pavement is heated, softened and then milled. A recycling agent is added and the material is thoroughly mixed and placed with a standard paving screed.

Remixing. Remixing is similar to recycling with the addition of virgin aggregate or new hot mix asphalt added to the recycled material. The materials are then thoroughly mixed and placed with a standard paving screed.

Repaving. Repaving combines either recycling or remixing with an overlay of new hot-mix asphalt placed immediately after the recycled mixture. The new hot mix asphalt layer is placed directly on the recycled layer, and both are compacted simultaneously.

The Department will provide in the plans all typical sections and any grade change requirements; the depth and width of recycling required; core information from the existing roadway to include pavement layers, lift thicknesses; the AC content and penetration value of the existing asphalt to be recycled plus any other data collected from the pavement evaluation.

- 2. Materials.**

A. Recycling Agent. Furnish a recycling agent in accordance with Section 4.A, "Mixture Design," and meeting the requirements of Section 300.2.F, "Recycling Agent."

B. Hot Mix Asphalt. If the process requires additional hot-mix asphalt, furnish new hot-mix asphalt that meet the requirements of Section 4.A. Use materials meeting the requirements of Article 340.2, "Materials," to produce the new hot-mix asphalt.

C. Aggregate. If the process requires additional aggregate, furnish aggregates to meet the requirements shown in Section 4.A, "Mixture Design." Use aggregates meeting the requirements of Article 340.2, "Materials."

- 3. Equipment.**

A. Processing Equipment. Provide equipment that is capable of a continuous single pass, multi-step operation, including heating; milling; introducing recycling agent, virgin materials, and/or hot mix asphalt (if determined necessary;) mixing the reclaimed material; redistributing the recycled material; placing the mix and leveling it with an asphalt paver or paving screed; and compacting the mixture, that meets the following requirements.

1. **Pavement Pre-Heaters.** Supply pavement pre-heaters capable of uniformly heating the existing pavement to a temperature high enough to remove excess moisture and allow dislodging of the material to the specified depth, while minimizing the fracturing of aggregate particles. Equip heaters with an enclosed or shielded hood to prevent damage to adjacent property or vegetation. Ensure that the heaters overlap the completed adjacent lane by a minimum of 6 in. to create a hot bond at the longitudinal joint.
2. **Pavement Milling Heads.** Provide milling heads for pavement recycling capable of uniformly loosening the entire pavement lane width to the depth specified in the plans. Accomplish the recycling by using milling heads that have a grade control system for each head. Ensure that the tooth spacing of the milling heads is sufficient to allow material to pass without excessive retention. Utilize equipment that is capable of raising and lowering the milling heads in order to recycle the material around manholes and other obstacles.

Equip the milling heads such that they are capable of gathering the heated and loosened asphalt concrete pavement. Operate the milling heads in such a manner to minimize aggregate degradation. Utilize milling heads that are capable of creating a windrow of the milled material ahead of the mixing chamber or subsequent milling units.

3. **Recycling Agent Application System.** Provide a system for adding and uniformly applying a recycling agent at the specified rate with the hot, loosened material. Control the system to within 5.0% of the target application rate. Equip the recycling agent system with positive on/off capabilities to prevent any dripping. Add the recycling agent during or after milling has taken place to provide uniform application of the recycling agent and adequate mixing with the recycled material during the mixing cycle.
 4. **Mixing Unit.** Provide equipment with an on-board mixing chamber that is capable of thoroughly mixing the heated, reworked material with new materials. Enclose and configure the mixing chamber such that no milled material escapes or bypasses the mixer chamber. Ensure that the rotation of the mixer apparatus does not cause segregation during the mixing process.
 5. **Paving Unit.** Furnish a paver or paver screed meeting the requirements Section 320.2.C.1, "Equipment."
- B. **Rollers.** Provide rollers meeting the requirements of Article 210.2, "Equipment."
 - C. **Broom.** Furnish rotary self-propelled power brooms. The broom should have positive control on the downward pressure applied to the surface.
 - D. **Mobile Testing Laboratory.** Unless otherwise shown on the plans, furnish a mobile testing laboratory meeting the requirements of Tex-237-F and a Level 1A certified laboratory technician qualified under the Department's approved program. If fresh hot mix asphalt is added, perform the tests necessary to control plant production.

4. **Construction.** Rehabilitate existing asphalt concrete pavement to meet the typical sections shown on the plans and the lines and grades established by the Engineer. The existing pavement should be heated and milled to the required depth of treatment as shown on the plans.
 - A. **Mixture Design.** Provide a mix design and job mix formula that meets the criteria of Table 1. Specimens will be compacted using the Superpave Gyratory Compactor in accordance with Tex-241-F at 50 gyrations. The target number of gyrations may be adjusted if allowed by the Engineer. Submit the completed mix design to the Engineer for approval prior to the start of the project. Perform additional mix designs based on road variability, as directed by the Engineer.
 1. **Sampling.** Obtain cores at intervals throughout the project to determine the existing condition of the roadway and account for variability within the project limits. Obtain an adequate quantity of material to perform the mixture design. Evaluate cores and note any evidence of material (rubber seal, fabric underseal, etc.) that could be detrimental to the process. A minimum of 2 in. of the existing pavement structure must remain in place following milling. Note any base or uncoated material that falls within the layer to be recycled. Notify the Engineer of any of these conditions before proceeding with the mix design.
 2. **Job-Mix Formula Approval.** The job-mix formula (JMF) is the combined aggregate gradation and target asphalt recycling agent percentage established from the laboratory mixture design used for hot in-place production.
 3. **Hot Mix Asphalt.** If the process requires new hot-mix asphalt, use materials meeting the requirements of Section 340.4.A, "Mixture Design," to produce the new hot-mix asphalt. Document in the JMF the percentage of new hot-mix used in the laboratory mix design submitted to the Engineer.
 4. **Aggregates.** If necessary, use aggregates meeting the requirements in Table 1 of Article 340.2, "Materials."
 5. **Other Additives.** If necessary, use additives to meet the requirements in Table 1. In the case that an additive is used, describe the type and allowable usage percentage in the submitted design recommendation.

**Table 1
Laboratory Mix Design Requirements**

Mixture Property	Test Method	Min	Max
Target laboratory molded density, %	Tex-207-F	96.0	
Theoretical Maximum Spec. (Rice) Gravity ¹	Tex-227-F	NA	
Tensile strength, lbs./in. ²	Tex-226-F	75	
Hamburg Wheel-tracking Test , 50°C, 10,000 cycles, mm	Tex-242-F		12.5
Overlay Test	Tex-248-F	Report Only	
Boil Test ²	Tex-530-C	-	
Combined Asphalt Property	Test Method	Min	Max
Penetration, 77°F, 100 g, 5 sec.	T49	40	80

1. Used to determine lab molded density.

2. Used to establish baseline for comparison to production results.

B. Pavement Heating. Heat the existing pavement without charring the existing asphalt and without producing undesirable pollutants. The temperature of the material immediately behind the heater should maintain a minimum of 200°F. Uniformly heat the pavement surface across its full lane width such that cold milling of the pavement surface does not occur.

C. Pavement Milling. Mill the existing pavement to the required depth and width as indicated on the plans. Do not disturb the underlying material in the existing roadway when recycling. Remove grass and other vegetation from the edge of the existing pavement to prevent contamination of the recycled bituminous material during this operation.

Utilize the milling heads to remove a minimum of 3 in. laterally of the completed adjacent pass and make a square vertical cut in the heated material such that a hot bonded longitudinal joint is achieved. Ensure that all material across the full lane-width is processed between consecutive lane passes to assure that any wedges (slivers) of unprocessed materials are not left untouched by the milling heads and covered by the recycled material, unless otherwise approved by the Engineer.

Ensure that the temperature of the milled surface directly behind the milling heads is greater than 160°F so that cold milling does not occur. All loosened asphalt material must be cleaned away by the milling heads, and a milling tooth pattern must be clearly visible after milling.

Remove all material around manholes and utility structures prior to paving the recycled mixture to allow for the plan depth of the pavement around these structures.

Cold mill and sweep clean any areas that cannot be heated and milled by the recycling equipment. Properly tack and pave these areas of cold milling in advance of the recycling process.

D. Addition of Recycling Agent. Incorporate the asphalt recycling agent into the hot recycled bituminous material at the rate determined by the approved mix design(s).

Sampling and testing during mixture production may result in varying quantities of recycling agent at different portions of the project in order to meet the requirements in Table 1. Change the recycling agent content only with approval of the Engineer.

- E. Placement of Recycled Material.** Spread the material using a paver and screed attached to the mixing/milling unit or a traditional paver in a separate and continuous operation meeting the requirements of Section 320.2.C.1, "Equipment." Spread the recycled material to the lines and grades established by the Engineer. Ensure the temperature of the recycled material behind paver is greater than 200°F.
- F. Compaction.** Compact the recycled mix using rollers meeting the requirements of Section 3.B, "Rollers." Establish rolling patterns to achieve the target air voids in accordance with Tex-207-F. Only operate rollers in vibratory mode when doing so does not damage the pavement. Compact the recycled mix to in-place air voids between 4% and 9%, unless otherwise shown on the plans. Follow the selected rolling pattern unless changes occur in the recycled mix or placement conditions, at which time establish a new rolling pattern. Adjust or cease compaction when cracking or displacement occurs. Ensure that pavement is fully compacted before allowing rollers to park on the pavement.
- G. Traffic.** After the completion of compaction of the recycled material, permit no traffic, including that of the contractor, on the completed recycled material until the material has cooled to 160°F or less. After opening to traffic, maintain the surface of the recycled pavement in a condition suitable for the safe movement of traffic. Remove all loose particles that may develop on the pavement surface by power brooming.
- H. Irregularities.** Immediately take corrective action if surface irregularities, including but not limited to segregation, rutting, raveling, flushing, fat spots, mat slippage, color, texture, roller marks, tears, gouges, streaks, or uncoated aggregate particles, are detected. The Engineer may allow placement to continue for at most 1 day of production while taking appropriate action. If the problem still exists after that day, suspend paving until the problem is corrected to the satisfaction of the Engineer.

At the expense of the Contractor and to the satisfaction of the Engineer, repair any areas with surface irregularities as identified above prior to the placement of any hot mix asphalt surface course or other applicable surface treatment.
- I. Curing.** A surface treatment may be allowed as the final riding surface when shown on the plans. If hot-mix asphalt concrete or another applicable surface treatment is placed as a surface course, allow the hot in-place recycled bituminous material to cure for a minimum of 7 days, or as directed by the Engineer.
- J. Weather Limitations.** Unless otherwise approved, perform hot in-place recycling operations when the existing pavement surface temperature is 60°F or higher and when weather conditions and moisture conditions of the roadway surface are suitable, in the opinion of the Engineer.

5. **Quality Control.** Perform the quality control tests listed in Table 2. If operational tolerances in Table 2 are exceeded, adjust processes or cease production when directed by the Engineer. The Engineer may perform independent tests to confirm contractor compliance and may require testing differences or failing results to be resolved before resuming production. The Engineer will determine resolution for failures which may include requiring removal and replacement of failing material with new asphalt concrete pavement mixture.

Table 2
Operational Tolerance & Minimum Testing Frequency

Description	Test Method	Allowable Difference from JMF Target	Minimum Testing Frequency
Asphalt Content, %	Tex-236-F	± 0.5	1 per day
Theoretical Maximum Spec. (Rice) Gravity	Tex-227-F	N/A	1 per day
Laboratory-Molded Density, %	Tex-207-F	± 1.0	1 per day
Hamburg Wheel-tracking Test , 50°C, 10,000 cycles, mm	Tex-242-F	N/A ¹	1 per week
Boil Test	Tex-530-C	N/A ²	1 per day
Air Voids (4% to 9%)	Tex-207-F	N/A ³	1 per day

1. Hamburg values must not exceed 12.5 mm in 10,000 passes, unless otherwise directed.

2. Compare with sample from mix design to determine amount of stripping.

3. In-Place Air voids should be between 4% and 9%.

- A. Mixture Testing.** Sample the recycled mixture for testing in accordance with Tex-222-F. For Hamburg Wheel-tracking test, sample prior to compaction.
- B. Asphalt Recycling Agent.** Meet the requirements of Item 300, “Asphalt, Oils, and Emulsions,” Table 12, “Recycling Agent and Emulsified Recycling Agent.” Unless otherwise directed, obtain a sample from each transport in accordance with Tex-500-C prior to unloading into the contractor’s storage units. Deliver the samples to the Engineer for testing. The Engineer will test at least one sample per project for specification compliance.
- C. Total Asphalt Binder Content.** Make asphalt recycling content changes based upon mix design recommendations for varying roadway conditions in order to meet the requirements in Table 2.
- D. New Hot Mix Asphalt.** Control the quantity of new hot-mix asphalt added to the recycled mix from haul tickets to within 5.0% of the target JMF.
- E. Depth of Recycled Material.** Maintain the required nominal depth on both outside vertical faces and in the center of the recycled area. Manually measure and report to the Engineer recorded depths each 1/4 mile, measured from the bottom of the mill pass to the top of the surface placed.
- F. In-Place Air Voids.** The Engineer will select and provide the Contractor random numbers for all placement tests. Unless otherwise shown on the plans, obtain two roadway specimens at each random location determined in accordance with Tex-225-F for in-place air void determination. The Engineer will measure air voids in accordance with Tex-207-F and Tex-227-F. Before drying to a constant weight, cores may be pre-dried using a Corelok or similar vacuum device to remove excess moisture. The Engineer will use the average air void content of the two cores to calculate the in-place air voids at the selected location.

G. Ride Quality. Use Surface Test Type A to evaluate ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

- 6. Measurement.** Hot in-place recycling of asphalt concrete surface will be measured by the square yard. The dimensions for determining the surface areas are established by the depths and widths shown on the plans and the lengths measured at placement.

Recycling agent will be measured at the applied temperature by the gallon from strap depths measured from the calibrated strap stick for each load or other automated means approved by the Engineer.

New hot-mix asphalt concrete will be measured by the ton of composite mix, which includes asphalt, aggregate, and additives. Measure the new hot-mix on scales in accordance with Item 520, "Weighing and Measuring Equipment."

- 7. Payment.** Hot in-place recycling of asphalt concrete surfaces will be paid for at the unit price bid for "Hot In-Place Recycling of Asphalt Concrete (Surface)" of the depth specified.

Asphalt recycling agent will be paid for separately at the unit price bid for "Hot In-Place Recycling of Asphalt Concrete (Recycling Agent)."

New hot-mix asphalt concrete will be paid for at the unit price bid for "Hot In-Place Recycling of Asphalt Concrete (Mix)."

This price is full compensation for the removal and processing of the existing pavement; for preparing, hauling, and placing materials; for all freight involved; for all manipulations, including rolling and brooming; and for all labor, tools, equipment, and incidentals necessary to complete the work. This price also includes any surface treatment that is allowed in the plans but not required to complete the above work.