Hot In-place Recycling

Technical Guideline
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1. Description

- This shall be part of a multi-stage process of asphalt surface rehabilitation as well as a variable depth leveling course. This process consists of softening the existing flexible pavement with heat and thoroughly stirring, and/or tumbling the mixture, applying asphalt rejuvenator and re-compacting the Hot In-place recycled surface. Installing a durable surface treatment or HMA overlay is a separate and/or concurrent function of this work done by others.

2. Materials

- Rejuvenating agent shall be applied at an approximate rate of 0.1 gallons per square yard per 1.5”
- Rejuvenating agent shall be an approved oil or emulsion capable of increasing the existing penetration to a value of ten (10) or above
- Rejuvenating agent must be environmentally-friendly and non-hazardous.
- Rejuvenating agent may be a water-based emulsion or oil designed to rejuvenate aged asphalt pavements
- The rejuvenating agent shall contain special oils to restore and improve the chemistry of oxidized asphalt surfaces and may reverse the effects of aging due to environmental damage from sunlight and water intrusion
- Rejuvenating agent may increase the durability of asphalt surfaces, prolonging pavement life by slowing oxidation, preventing raveling and protecting the pavement

3. Equipment Requirements

- The total equipment length of the pre-heater, Heater-Scarifier, and roller shall not exceed 119 feet, unless an additional preheater is required

- 3.1 Preheater
  - The preheating machine shall be a self-contained unit capable of operating at speeds from ten (10’) feet to twenty five (25’) feet per minute while uniformly heating the existing surface of the asphalt
  - The entire burner assembly shall contain the ability to be hydraulically raised or lowered
  - Hand hoses will be placed on unit to allow for pre-wetting of specific plants or objects
  - The burner assembly shall be adjustable in width from eight (8’) feet to fourteen (14’) feet

- 3.2 Heater-Scarifier & Spraying Unit
  - The Heater-Scarifier machine shall be one self-contained machine specifically designed to reprocess surface layers of existing asphalt pavements. The Heater-Scarifier machine shall be a self-propelled and completely self-contained unit capable of operating at speeds of ten (10’) feet to twenty five (25’) feet per minute
The entire burner assembly shall contain the ability to be hydraulically raised or lowered. The burner assembly shall be adjustable in width from either eight (8’) feet to fourteen (14’) feet. The scarifying unit consists of no less than two rows of spring loaded, carbon steel capped bolts. Immediately in front of the tines of the scarifying unit, the prescribed application of rejuvenating agent shall be applied. Rejuvenating agent must be administered by the means of either a spray bar or spinner system. The spraying unit on the machine must be equipped with an electronic digital measuring system to constantly monitor the quantity of rejuvenated agent being applied. This device must be calibrated to show gallons used to the nearest tenth.

- In cases of electronic difficulties, a stick measurement will be acceptable in the presence of the agency.

Unit shall be equipped with spring-loaded tines in order to not damage existing castings or structures. Immediately after the scarifying operation, the treated material shall be mixed by the continuously rotating augers. The material shall then be leveled by the screed, evenly distributing the heater scarified, treated material over the width of the area being processed. The screed must be capable of recycling in widths of eight (8’) feet to sixteen (14’) feet.

3.3 Compaction Unit

- Immediate compaction shall take place with rolling equipment of sufficient type and size.
- Compaction will be completed with a Steel Drum or Combination roller, capable of vibratory and static mode.
- Roller shall be equipped with a water system, which will keep all drums uniformly wet to prevent material pickup when required.
- Density may be determined by the establishment of a growth curve, done by others as follows:
  - The nuclear gauge shall be placed near the center of the hot mat and the position marked for future reference. With the bottom of the nuclear gauge and source rod clean, a 1-minute nuclear reading (without mineral filler) shall be taken after each pass of the roller. Rolling shall continue until a growth curve can be plotted, the maximum density determined, and three consecutive passes show no appreciable increase in density nor evident destruction of the mat.
4. Construction Requirements

- **4.1 Unexpected Construction Findings**
  - If unforeseen circumstances are encountered once heater scarification begins, including but not limited to road fabric, dirt between layers, excessive chip seal etc., The HIR contractor reserves the right to adjust the HIR process accordingly while conferring with the Owner.

- **4.2 General Construction Requirements**
  - Heater scarification will be performed at a one and one half inch (1.5”) nominal* depth, OR the depth of the surface lift up to 1.5” as measured by the poker.
  - The entire surface shall be cleared of all foreign material which may disturb the HIR process.
  - Base failures that require patching shall be completed before HIR and performed by others.
  - Average mix temperature of pavement shall not exceed three hundred and twenty five (325) degrees Fahrenheit as measured behind the screed.
  - The heating process shall not exceed twenty five (25) feet per minute.

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*Number of passes shown above is atypical for HIR. Typical for HIR is 4-6 passes maximum.

Corresponding image can be seen below in Figure 3-1.
o A minimum of a two inch (2”) overlap is required when Heater Scarifying adjacent to a previously performed pass
o Rehabilitation work shall be performed only when the air temperature is at forty five (45) degrees Fahrenheit and rising
o All raised reflective pavement markers or thermoplastic pavement markings shall be removed prior to the recycling operation by others
o The owner shall be responsible for the removal of excess joint filler material both asphaltic and rubberized as recommended by the contractors’ representative
o The owner shall be responsible for edge milling along the curb flange for receipt of surface treatment

*Nominal is defined as the required scarification depth +/- three eighths (3/8”) of an inch

5. Traffic Control
- All of the project locations can remain open to traffic during the construction operations under this process unless otherwise directed by the owner
- The owner shall be responsible for all traffic control, including but not limited to, warning signs, barricades, and arrow boards.
- Traffic cannot be allowed on the pavement until it is fully compacted and the Heater-Scarification train has passed
- Others shall be responsible for posting and notifying residents and businesses in the construction area at least 2 days (48 hrs) in advance of planned work (“No Parking” signs)

6. Material Testing
- All material testing of existing asphalt surfaces will be paid for by the owner
  - 6.1 Pre-Job Testing
    o The agency shall provide cores to the HIR contractor according to the Core Standards found in Figure 6-1

<table>
<thead>
<tr>
<th>Size of Cores</th>
<th>Number of Cores per pave</th>
</tr>
</thead>
<tbody>
<tr>
<td>4”</td>
<td>Ten cores</td>
</tr>
<tr>
<td>6”</td>
<td>Seven cores</td>
</tr>
</tbody>
</table>

“Per Pave” Explanation
Main St. is composed of 50% of mix “A”, and 50% of mix “B”. Either seven 6” cores, or ten 4” cores, need to be taken from both mix “A” and mix “B”. For 6” cores, this calls for a total of fourteen cores. For 4” cores, this calls for a total of twenty cores
- Observe cores for depth, surface treatments, presence of road fabric etc.
- Test untreated cores for penetration, Dust to AC Ratio, and AC Content
  - AC Content levels must be normal
  - See correlating AASHTO / ASTM tests in Figure 6-3
- Test treated (.1 gal/SY/ 1.5”) cores for penetration, Dust to AC Ratio, and AC Content
  - See post-treated standards in Figure 6-2
  - AC Content levels must remain normal
- Compare the untreated and treated results

![Recommended HIR Testing Matrix](image)

**Figure 6-2**

<table>
<thead>
<tr>
<th>Test Name</th>
<th>AASHTO METHOD</th>
<th>ASTM METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extraction Analysis</td>
<td>T164</td>
<td>D2172</td>
</tr>
<tr>
<td>Penetration</td>
<td>T49</td>
<td>D5</td>
</tr>
<tr>
<td>Abson Recovery</td>
<td>R59</td>
<td>D1856</td>
</tr>
<tr>
<td>Mechanical Analysis*</td>
<td>T30</td>
<td>D5444</td>
</tr>
</tbody>
</table>

- From this, calculate the total percent passing the #200 sieve/total extracted AC (dust/ ac ratio)

**Figure 6-3**

- 6.2 Mid-Job Testing
  - Ring tests
    - Will be completed by scraping out and weighing the heated and scarified material from a one square foot area. This weight shall be no
less than 75% of the theoretical weight of one square foot by the proposed bituminous recycled surface course
  - Ring tests will be performed daily or at the request of the RE
    - Depth Check
      - The poker is set for the specified depth. The poker is inserted into the mat just behind the screed to ensure and check scarification depth.
      - Depth will be determined by the average depth of three measurements taken across the mat behind the screed and before compaction
      - Depth checks will be performed periodically immediately behind the screed to verify the achievement of the agreed upon depth
        - Example of Depth check can be found in Figure 6-4

*The figure above depicts a bolt penetration of nominal 1.5". Depth of scarification in the field varies due to various road conditions

**Figure 6-4**

- The “Depth Check Form” shall be signed by the agency and/or owner at the end of production each day. This form affirms the achieved average depth, and achieved ring test weights each day.
  - A copy of this form can be seen below, in Figure 6-5
7. Basis of Payment

- Method of Measurement
  - The HIR process will be measured in place and the area computed in square yards
  - The Rejuvenating Agent will be measured in gallons
  - Lump sum for mobilization

- Basis of Payment
  - The HIR process will be paid for at the contract unit price per square yard as Hot-In-place Recycling
  - The rejuvenating agent will be paid for at the contract unit price per gallon as Asphalt Modifier
  - Mobilization will be paid at the lump sum price for mobilization
TYPICAL ASPHALT COMPACTION GROWTH CURVE

Figure 3-1
Recommended HIR Testing Matrix

Suitability Testing

- Perform core sample testing
  - Gradation
  - Penetration

- Test preferred rejuvenator at 0.1
  - Penetration

- Proceed with HIR

- Pen < 1.0

- Pen > 1.2

- Test other rejuvenator options or higher application rates

- Proced with HIR

- Not acceptable for HIR

Figure 6-2
Figure 6-4
<table>
<thead>
<tr>
<th>Miscellaneous Information</th>
<th>Recorded Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Goal Depth</td>
</tr>
<tr>
<td>Job #</td>
<td>Time</td>
</tr>
<tr>
<td>Job Name</td>
<td>Location</td>
</tr>
<tr>
<td>Weather</td>
<td>Ring Test Weight</td>
</tr>
<tr>
<td></td>
<td>Average Poker Depth</td>
</tr>
<tr>
<td>Street Name</td>
<td>Time</td>
</tr>
<tr>
<td>Location From</td>
<td>Location</td>
</tr>
<tr>
<td></td>
<td>Ring Test Weight</td>
</tr>
<tr>
<td></td>
<td>Average Poker Depth</td>
</tr>
<tr>
<td>To</td>
<td></td>
</tr>
<tr>
<td>Square Yards</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time</td>
</tr>
<tr>
<td></td>
<td>Location</td>
</tr>
<tr>
<td></td>
<td>Ring Test Weight</td>
</tr>
<tr>
<td></td>
<td>Average Poker Depth</td>
</tr>
<tr>
<td>HIR Contractor Representative</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time</td>
</tr>
<tr>
<td></td>
<td>Location</td>
</tr>
<tr>
<td></td>
<td>Ring Test Weight</td>
</tr>
<tr>
<td></td>
<td>Average Poker Depth</td>
</tr>
<tr>
<td>Owners Representative</td>
<td></td>
</tr>
</tbody>
</table>

*Depth will be determined by the average depth of three measurements taken across the mat behind the screed and before compaction.
*Will be completed by scraping out and weighing the heated and scarified material from a one square foot area. This weight shall be no less than 75% of the theoretical weight of one square foot by the recycled bituminous surface course.

**Figure 6-5**