

## **Hot In-Place (HIR) Production Checklist**

Below is a checklist covering the full production process, along with compacting and finishing of HIR. Acceptance, measurement, and payment for a finished HIR project are also covered.

Note that some specifications described in the following content may not be the same as the specifications followed by your agency. Always check with your State agency's standards and specifications when using these guidelines.

### **Sections**

- **Treatment Depth**
- **Precision Level Surveys**
- **Probe Measurements**
- **Check Pavement Temperatures**
- **Rejuvenating Agents**
- **Additive (HIR Remix)**
- **Mixing and Spreading**
- **HIR Compaction**
- **Weather Limitations**
- **Smoothness**
- **Acceptance**
- **Rejuvenating Agents and Additives**
- **HIR Mix Design**
- **Treatment Depth, Spreading Depth, and Cross-slope**
- **Measurement and Payment**

### Treatment Depth

- Control of treatment depth is critical to the consistency of the HIR process
- Methods for controlling HIR treatment depth include:
  - Precision level surveys
  - Measurements at the outside edges
  - Compacted unit weight conversion of removed scarified material
  - Uncompacted mixture probing behind the paver screed
- Tines must scarify, or the milling drum must remove the existing pavement surface to the specified treatment depth

### Precision Level Surveys

- Remove treated material
- Shoot elevations on top and bottom of mat
- Calculate thickness
  - Typical tolerance  $\pm 5\%$  of depth or  $\frac{1}{4}$  inch

### Probe Measurements

- To determine depth, measure across the full width of the pavement from the back of the screed
- Measure every 100 feet and report every fifth measurement
- The depth equals the average measured depth across the full width of the pavement
- Typical tolerance  $\pm 5\%$  of depth or  $\frac{1}{4}$  inch

### Check Pavement Temperatures

- Temperatures should be checked continually at a number of different locations in the HIR process
- Timing and locations vary depending on the HIR equipment but should include:
  - After each pre-heating unit
  - Prior to final heating
  - Prior to final mixing
  - Immediately behind the screed
- Verify that an adequate temperature is achieved for mixing the rejuvenating agent and admixture, and for facilitating scarification
- Broken aggregate and/or pavement chunks are indications of insufficient heating
- Typically, a pavement surface temperature of 230 to 320 °F is required
- Ensure that the pavement surface is not being burned or charred, which typically occurs at temperatures of 330 °F and above
- Ensure that under no circumstances does the temperature of the pavement surface exceed 375 °F

### Rejuvenating Agents

- Rejuvenating agents are generally hydrocarbons and are added to HIR mixtures as:
  - Rejuvenating oil
  - Rejuvenating emulsion
  - Soft binder

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- Rejuvenating agent application rate should be linked to the forward operating speed of the unit and based on a consistent treatment depth
- A 5% tolerance rate is typically specified
- Calibrate rejuvenating agent rate to required treatment depth
- Adjust for changes in treatment depth
- Rejuvenating agent consumption is recorded on a totalizer
- Monitor rejuvenating agent rate by checking the amount used over a given distance and calculating the yield of liquid placed

### Additive (HIR Remix)

- Verify that the application rate of additive (admixture or new aggregate) is consistent with the mix design and the contract documents
  - Application rate is checked volumetrically using distance spread and mass applied
  - Typical tolerance  $\pm 5\%$  of mix design rate

### Mixing and Spreading

- Verify by visual observation that a uniform product is being produced
- Method – Joints
  - Longitudinal Joints
    - Verify adjacent pass extends at least 2 inches into previously placed mat
  - Transverse Joints
    - Same as asphalt paving

## HIR Compaction

- HIR mixes are typically placed and compacted using the same requirements as HMA or WMA
- Compacted density is specified as a percent of the maximum specific gravity of the HIR mixture
- Without additives, laboratory compacted air voids will be lower than that of HMA mixtures
- Verify the temperature is adequate for compaction
- Ensure a rolling pattern is developed at the beginning of construction
- Ensure there is no damage from potential over-rolling
- Ensure finish rolling is completed at or above the minimum required temperature
- Accomplished with conventional pneumatic and vibratory steel-wheeled rollers
- Compactor**
  - Self-propelled
  - Width  $\geq$  65 inches
  - Have properly operating scrapers and spray bars
- Control Strip**
  - 500 to 1,000 feet long
  - Determines rolling pattern necessary to obtain specified percent compaction
  - Demonstrates equipment, materials, and process produce a mix that meets specification
  - Verifies optimal rejuvenating agent and admixture rates

❑ **Compacted Density**

- HMA compaction requirements typically used for HIR
- In-place density determined using cores and AASHTO T 166
- Determined in-place density using an electromagnetic or thin-lift asphalt gauge
- Test in accordance with agency methods and requirements

❑ **Percent Compaction**

- Compaction requirements for HMA are typically used for HIR
- Percent compaction is reported as a percent of maximum specific gravity determined using AASHTO T 209
- $G_{mm}$  should be determined regularly along the pavement or when a change in materials is suspected

❑ **Compacted Density**

- Frequency of testing varies by agency
  - 1 per 1,000 yd<sup>2</sup> or m<sup>2</sup>
  - 10 tests per day
  - 1 test per ¼ lane mile
- Gauge used to develop target density in control strip should be used to verify compacted density

❑ **Compaction Method**

- Pay attention to longitudinal joint
- Roll longitudinal joint first then roll from low side to high side
- Roller should not be started or stopped on uncompacted material

❑ **Finish Rolling**

- Finish rolling completed with vibratory steel-wheel roller
- Roller should be operated in static mode

### Weather Limitations

- Additional energy is required to remove excess moisture after rainfall
- Ambient temperature in shade should be  $> 45^{\circ}\text{F}$
- Significant precipitation should be avoided during construction operations

### Smoothness

- HIR Surface Recycle**
  - Without the placement of an asphalt overlay, an HIR Surface Recycle mixture may not achieve optimum smoothness
  - With an overlay, improvement in existing smoothness of 50% is often achievable
- HIR Remix**
  - With the addition of admixture to HIR remix in order to accommodate surface deficiencies, a greater percent of improvement may be achieved
- HIR Repave**
  - The HIR repave process should be able to achieve the same improvement in smoothness as an equivalent thickness of plant-mixed asphalt

### Acceptance

- Visual Inspection**
  - Based on visual inspection of work
    - Compliance with contract

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- Compliance with industry standards
- Certification of Compliance**
  - Based on signed statement that material meets requirements
- Measured and Tested for Conformance**
  - Material sampled and tested
  - Contract specifies frequency or rate of sampling
  - Contract specifies tolerances or limits
- Qualified Product List (QPL)**
  - Based on sourcing of material from QPL
  - Periodic review or verification of suppliers required
- Acceptance Evaluation Items**
  - Rejuvenating agents and additives
  - HIR mix design approval
  - HIR mix in the field
  - Surface tolerance
  - Depth and width of scarification/milling
  - Line, grade, and elevation HIR mat
  - Smoothness
  - Integral HMA overlay mix properties for repave

### Rejuvenating Agents and Additives

- Rejuvenating agents accepted based on conformance to ASTM D4552, or equivalent
- Recycling additives, as needed for remix only, should meet owner agency specified materials
- Integral HMA overlay, for repave only, should be designed and inspected to meet owner agency standard specified materials



## HIR Mix Design

### Agency provided mix design

- No acceptance is needed
- Collection of samples may be required

### Contractor provided mix design

- Use certified technicians and lab
- Agency evaluates design prior to use

### Application Rates

- Precise testing methods do not exist
- Compliance relies upon manual equipment metering checks
- Addition of rejuvenating agent linked to forward speed and depth
- Application system should be calibrated to depth
- Application of rejuvenating agent monitored through yield rate calculations

### Density

- Rolling pattern established to meet specified percent compaction
- Periodic density checks should be taken
- Correct compaction is determined by comparing field compaction to  $G_{mm}$
- Excessive compaction will reduce the air voids below the desired level

### Lab Molded Mix Properties

- Applying or adapting conventional asphalt mix tolerances for HIR mixture properties, such as asphalt binder content, gradation, voids, etc.
- Will be difficult due to the inherent variability associated with all in-place recycling techniques

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- Unless new aggregates or admixture is added to correct mix properties, lab molded HIR specimens will have lower void properties than conventional HMA mixtures
- A HIR repave mix can be tested using conventional HMA procedures

### Treatment Depth, Spreading Depth, and Cross-slope

#### Treatment depth

- Control critical to consistency
- Control methods include precession level surveys, measurement of outside edges, removal and weighing of material, and probing uncompacted material

#### Spreading depth

- Remixing and repaving depth checked by probing uncompacted material
- Periodic excavation of compacted material to verify roll down
- Tolerance for spread depth is  $\pm 1/8$  inch (3 mm) or 10% of the lift thickness

#### Cross-slope

- Checked by precision survey, string line, or straightedge level
- Tolerance usually  $\pm 0.2\%$

### Measurement and Payment

#### Construction of HIR layer

- Measurement:
  - Measured by square yard, station, or other linear distance
  - Longitudinal and transverse measurements should be calculated horizontally

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- Payment:
  - Purchased by contract quantity
  - Lump sum

### Rejuvenating Agent and Additives

- Measured and purchased by ton
  - Commercial weighing system
  - Supplier invoice with net weight
  - Project weighing system
- Measured and purchased by gallon
  - Container volume
  - Metered volume