

**STATE**

**OF**

**TENNESSEE**

(Rev. 6/27/2016)  
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January 1, 2021

**SPECIAL PROVISION**

**REGARDING**

**FULL DEPTH RECLAMATION (FDR) OF FLEXIBLE PAVEMENT**

**Description**

This work consists of the Full Depth Reclamation (FDR) process to reclaim existing flexible pavement by pulverizing the bituminous asphalt layers, mixing the pulverized material with the existing base and subgrade layers, and adding a specified amount of cement and water to achieve a homogeneous mixture of reclaimed material. The reclaimed material shall be constructed to the lines and grades as specified in the plans and/or as directed by the Engineer.

**Materials**

Provide materials as specified in:

Portland Cement, Type I.....	<b>901.01</b>
Portland-Pozzolan Cement, Type IP.....	<b>901.01</b>
Portland-Limestone Cement, Type IL.....	<b>901.01</b>
Bituminous Curing Seal, Emulsified Asphalt, Types allowed for Tack Coat in 403.....	<b>904.03</b>
Water.....	<b>302.03.B</b>

Provide and place emulsified asphalt, of a type allowed for Tack Coat in **section 403**, or as specified in the plans, meeting the test requirements specified in Table **904.03-1**.

**Mix Design Submittal**

Perform all preliminary investigations necessary in order to develop a mix design for the project. Submit the mix design to the Engineer for approval. The mix design submittal shall include, at a minimum, the following information:

1. Percent by weight of stabilizing agent to be added to the reclaimed material to achieve a minimum Unconfined Compressive Strength (UCS) of 300-500psi at 7 days as determined by ASTM D1633, Method A.
2. Maximum dry density (MDD) as determined in accordance with AASHTO T 134
3. Optimum Moisture Content (OMC) as determined in accordance with AASHTO T 134.
4. UCS of Soil-Cement Cylinders as determined by ASTM D1633.

The mix design to be used on the project shall be submitted to the Engineer for approval no less than 30 days prior to the planned start date of work. If at any time during production the material changes and changes to the mix design are required, cease work and resubmit design for approval

prior to production.

### **Quality Control**

Submit a Quality Control Plan to the Engineer prior to work beginning. The plan shall ensure a consistent and continuous FDR process and at a minimum include the following:

1. An organizational list of the personnel responsible for Quality Control for the duration of the project along with applicable certifications/qualifications.
2. A process control plan which outlines the procedures for the sampling, testing, and analysis to be performed for Quality Control.
3. An outline of the procedures taken to meet contract requirements for corrective actions when Quality Control criteria and/or Acceptance criteria are not met.
4. A description of how all Quality Control information will be documented.
5. A Contingency Plan which addresses, at a minimum, the following:
  - a) Inclement weather
  - b) Mechanical breakdowns
  - c) Material shortages
  - d) Insufficient density
  - e) Material doesn't cure in a timely manner
  - f) Gradations do not meet tolerance(s)

Prior to the beginning of each day's work, provide scales capable of measuring the required quantity of cement per square yard and square canvas tarps measuring 1.0 square yard. The scales shall have been calibrated by a qualifying agency within the last six months. Keep equipment on hand to verify the reclaimed material particle size after pulverizing, to calibrate the water meter of the mechanical mixer, and to verify the spread rates of cement and bituminous curing materials.

### **Test Strip**

In the presence of the Engineer, construct a test strip with one cement spreader load of cement during initial reclamation to assure the process and equipment will produce the desired outcome. Demonstrate the full FDR process including pulverization, application of cement and water, final compaction, and shaping. Once the test strip has been completed, cease work for 10 days to allow all verification test results to be determined prior to resuming work. In the event that the test strip does not demonstrate that the full FDR process will produce acceptable results, complete additional test strips on the project site to demonstrate that the process will produce acceptable results. No more than 3 test strips shall be placed at the project site. If the 3 test strips do not demonstrate an acceptable process, work shall cease until all issues producing unacceptable results have been proven to be resolved in the presence of the Engineer. If a new mix design is required then the test strip process will be done with the new mix design.

Perform compaction in a continuous and uniform manner over the entire test strip. Compact the reclaimed material until the sheepsfoot roller produces no additional indentions into the compacted material. The sheepsfoot roller shall compact the material until the pad marks left by the sheepsfoot are less than one-half inch deep. After clipping and upon completion of final compaction, the Department will take a minimum of 5 tests at random locations to determine the average in-place density of the test strip. Use the process, means, and methods established in the successful test strip for the remainder of the project.

Establish the target speed and/or RPMs of the mixing and spreading equipment to assure that the moisture content and cement spread rates will be acceptable. Verify time constraints can be achieved.

Identify and adjust any processes of the work not conforming to the intent of the contract requirements before proceeding with full production work. If processes of the work are not found to be adequately controlled to produce the desired reclaimed material, construct additional test sections until the necessary control is established.

### **Equipment**

All equipment necessary for the satisfactory performance of this work shall be fully operational and approved before work will be permitted to begin.

### **Cement Spreader**

Provide a self-propelled mechanical cement spreader that has an adjustable/metered rate of flow and will uniformly distribute the cement at the required rate. Cement spreader must be equipped with a digitally controlled rate which adjusts for RPM.

### **Mechanical Reclaimer**

Provide a self-propelled mechanical reclaimer capable of pulverizing and mixing the existing pavement, base, sub-grade, and cement uniformly. The reclaimer shall be equipped with a reclaiming drum. A soil stabilization drum is unacceptable. Provide a reclaimer that is equipped with a metered water additive system which uniformly adds water in the mixing chamber. Equipment that requires the application of water separate of the mixing operation is not acceptable.

If the depth of reclamation specified in the contract plans exceed the ability to provide a consistent pulverized material, then a milling machine may be used to mill off a portion of the existing asphalt pavement leaving the gates open so the asphalt material is left in place, as approved in writing by the Engineer.

### **Rollers**

Provide a minimum of three rollers having a capacity to compact the reclaimed material to 100% MDD as determined in accordance with AASHTO T 134. Provide suitable compaction equipment as follows:

- Perform initial compaction of the reclaimed material using a sheepfoot roller.
- Perform intermediate compaction using a pneumatic tire roller.
- Perform finish compaction using a single or tandem steel drum roller operated in static mode. At no time shall the finish roller be operated in a vibratory mode.

### **Motor Grader**

Provide a motor grader with an electronic grade/slope control system or provide other means to control the roadway profile and slope. Alternate methods shall be approved in writing by the Engineer.

## **Construction Requirements**

### **Limitations**

Only apply cement to reclaimed material that is not frozen, between April 1 through October 31, and when the air temperature in the shade is 35°F and rising. Construction of reclaimed material shall not proceed during periods of high wind, in the rain, when the forecasted chance for rain exceeds 50%, or if the weather forecast predicts freezing temperatures within 7 days of the planned date of application, unless approved by the Engineer.

Limit the application of cement to an area that will allow for continuous completion of the FDR process, clipping, finishing, and final compaction, within 3 hours from the time the cement is applied. Do not leave any uncompacted reclaimed material undisturbed for more than 30 minutes.

If the uncompacted reclaimed material is wetted by rain and exceeds the average moisture content above the specified tolerance, reconstruct the entire section.

### **Pulverizing**

Pulverize the existing pavement structure and uniformly mix with existing base, and/or subgrade to the depth and width specified in the plans such that 100% passes a 3 inch sieve and 95% passes a 2 inch sieve prior to the application of cement. Verify particle size in the presence of the Engineer initially and periodically during the process of work.

### **Cement Application, Spreading and Mixing**

Uniformly spread the required quantity of cement on the pulverized material and immediately blend the cement until evenly distributed. Thoroughly mix water, cement, and the pulverized materials until the water and cement are uniformly distributed throughout the reclaimed material. Maintain moisture content in the range of  $\pm 2.0\%$  of OMC during final mixing. Measure the moisture content after final mixing and prior to initial compaction using a nuclear gauge by direct transmission method in accordance with AASHTO T 310.

### **Initial Compaction**

Begin compaction immediately after cement and water has been incorporated and thoroughly blended with the reclaimed material. Compact the reclaimed materials using approved sheepsfoot roller(s) to 100% of MDD specified in the mix design. Maintain the moisture content prior to breakdown rolling in the range of  $\pm 2\%$  OMC. If the reclaimed mixture becomes too wet for initial compaction, adjust moisture content as directed by the Engineer. Compact the entire area using uniform passes of compaction equipment as determined from the test strip, ensuring that uniform density is achieved.

## Shaping

After mixing and initial compaction, shape the surface of the reclaimed material to the required lines, grades, and cross-sections using an approved motor grader. If no lines or grades are provided, maintain the existing profile and provide correction to noticeable imperfections and cross slopes as instructed by the Engineer. Sprinkle the surface until it is damp, but not wet, and clip with a motor grader as directed by the Engineer. Dispose of the material removed by clipping.

## Intermediate and Final Compaction

Following shaping, perform intermediate compaction using a pneumatic tire roller and then seal the surface with a self-propelled steel wheel roller in static mode. At no time shall the finish roller be operated in vibratory mode.

## Construction Joints

At the beginning of each day's construction, form a straight transverse construction joint by cutting back into the previously completed work a minimum of 5 feet to form a true vertical face, free of loose or shattered material. Straightedge the transverse joints using a 12-foot straightedge during final grading.

If longitudinal joints between adjacent stabilization passes are necessary, the joints shall be overlapped 2 to 4 inches in a neat straight line. Pre-determined cut lines shall be marked in a manner visible to the operator. The overlap cut width should be confirmed before starting a new cut sequence.

The longitudinal joint shall be offset at least 6 inches with the succeeding layer of HMA or surface treatment.

## Surface Tolerances

After finishing and final compaction of the reclaimed material, test the entire reclaimed surface with a 12 foot straightedge applied parallel to the centerline of the pavement. The deviation of the surface from the testing edge of the straightedge shall not exceed 1/2 inch. Any areas failing to meet the surface tolerances shall be corrected at no additional expense to the Department.

## Curing

Unless otherwise noted in the plans, protect the reclaimed material from drying by applying the bituminous curing materials. Apply the curing material in accordance with all applicable Standard Specifications for the type of bituminous curing material to be used. The bituminous curing material shall be placed at the rate shown on the Plans, or as directed by the Engineer. Perform this work as soon as possible after completing the base construction, but in no case later than 24 hours after completing finishing operations. Maintain the finished reclaimed material in a continuously moist condition until the curing material is placed.

If construction equipment or other local traffic must use the bituminous-covered surface before it has dried sufficiently, apply sufficient granular cover consisting of clean sand, meeting the requirements of **Table 903.01-2**, or provide other approved material to prevent pickup.

Maintain the bituminous curing material for 7 days to ensure that all of the reclaimed material remains effectively sealed and covered. Protect finished portions of reclaimed material from equipment utilized in constructing adjoining sections to prevent equipment from marring or damaging the completed surface.

Subsequent asphalt-based layers or surface treatment identified in the plans can be used as a curing material and can be placed any time after finishing, as long as the reclaimed material is sufficiently able to support the required construction equipment without marring or damaging the completed surface. Do not operate construction equipment on the new reclaimed material except as necessary to discharge into the asphalt spreader during pavement operations.

Sufficiently protect the reclaimed material from freezing for 7 days after its construction unless otherwise approved by the Engineer.

### **Traffic**

Completed sections of the reclaimed material may be opened to traffic when necessary, provided the reclaimed material has received a bituminous coating, and has hardened sufficiently to prevent marring or damaging the completed surface, and provided the curing is not impaired. Appropriate traffic signs must be posted to prevent heavy traffic on the constructed base. Finished sections can be opened, with Departmental approval, to all traffic after the reclaimed material has received subsequent asphalt-based layers or surface treatment identified in the plans and is sufficiently able to withstand marring or damaging the completed surface. Ingress and egress shall be provided for property owners, public entrances, and side roads during the curing period.

### **Acceptance Testing**

The Department will divide the project into lots for density and moisture testing purposes and will perform five tests on each lot. One lot shall be defined as one day's production. Density tests shall be performed as soon as practical after final compaction. The average dry density of each lot shall not be less than 100% of MDD as determined in accordance to AASHTO T 134, and no individual test shall be less than 95%. The average moisture content for each lot shall be within the range of  $\pm 2$  of the OMC specified by the mix design.

### **Verification Testing**

During the construction of the test strip, the Department will collect material samples after mixing and prior to initial compaction to verify the mix design. The Department, at a minimum, will verify the following:

1. OMC and MDD of the reclaimed material in accordance with AASHTO T 134.
2. The 7-day UCS of the reclaimed material meets the required strengths in accordance with ASTM D1633, Method A.
3. Particle size of the reclaimed material.
4. Depth of mixing and pulverization.

### **Reconstruction and Replacement**

If a lot, or any portion of reclaimed material, fails to meet acceptance criteria, repeat all construction procedures and adhere to the time limitations specified. Construction procedures shall be repeated at no additional cost to the Department.

Replace work for the full depth of treatment if required. Correct low areas by replacing the material for the full depth of treatment rather than by adding a thin layer of reclaimed material to the completed work.

### **Maintenance**

Maintain the reclaimed material in good condition until all work has been completed and accepted. Immediately repair defects that may occur at no additional cost to the Department.

### **Method of Measurement**

The Department will measure:

1. Processing by the square yards of completed reclaimed material, as determined using the actual length measured along the center-line of the roadbed and the width shown on the plans or designated by the Engineer.
2. Cement incorporated in the work by the ton in accordance with **section 109**.
3. Bituminous Material used for a curing seal by the ton in accordance with **section 109**.
4. Water used in mixing and finishing operations by the MG (1,000 gallons) using calibrated tanks or distributors, or accurate meters.

The Department will not measure or pay for water added to emulsified asphalt or aggregate cover material used during the curing process.

### **Basis of Payment**

The Department will pay for accepted quantities at the contract process as follows:

<i>Item</i>	<i>Description</i>	<i>Pay Unit</i>
304-01.04	Processing (reclaimed material)	Square Yard
304-01.08	Portland Cement (reclaimed material)	Ton
309-10.02	Bituminous Material	Ton
203-06	Water	MG

The Department will not pay for reconstructive work, including additional cement and processing.

The Department will not pay for the furnishing and spreading of granular cover used for protection, in accordance with the curing requirements for areas opened to equipment and other traffic before the curing material has sufficiently dried.