

FULL DEPTH RECLAMATION

(REV 4-9-24)

The following new Section is added:

SECTION 332

FULL DEPTH RECLAMATION

332-1 Description.

This work in this Section consists of the preparation of a base course constructed by in-place pulverizing and blending of the existing bituminous pavement and a predetermined portion of the underlying materials, and the introduction of asphalt emulsion, cement, and other additives. Pulverize existing asphalt pavement and underlying base material by a method that does not damage the material below the design depth as shown in the Plans. Refer to the Plans for site specific restrictions.

332-2 Materials.

332-2.1 Base Material: If field conditions necessitate the use of additional base material, use a base material meeting the requirements of Section 285.

332-2.2 Asphalt Emulsion: Use CSS-1h meeting the requirements of Section 916, AASHTO M 208, and approved by the State Materials Office (SMO) prior to use.

Use prime and tack coats meeting the requirements of Section 300.

332-2.3 Portland Cement: Add Type I or II Portland cement meeting the requirements of Section 921, in either a dry or slurry form, to the reclaimed mixture. Slurry made from Portland cement must contain a minimum of 30% dry solids content.

332-2.4 Water: Use water meeting the requirements of Section 923 for the base course compaction.

332-2.5 Documents: Submit copies of all material delivery tickets to the Engineer upon delivery to the project site.

332-3 Qualifications.

The Contractor performing the work must submit a list of at least three projects, successfully completed within the last three years, where work included a minimum of 7,000 square yards of full depth reclamation using emulsion and cement blend stabilization. For each project listed, provide the project location, the project owner's name and the name, title, and current phone number of a project owner representative. Include documentation that verifies that the Specification criteria for each project was met.

332-4 Mix Design.

Prior to construction, obtain an adequate number of core samples from each type of material to develop the mix designs. Representative samples of the asphalt pavement material, underlying base material, and virgin materials, where applicable, must be supplied to a nationally accredited laboratory for testing to determine the proportions of asphalt emulsion, cement, and other additives, if necessary, needed to produce a mix design meeting the requirements of Table 332-1. Use cement at a minimum dosage rate of 1.0 percent and a maximum dosage rate of 1.5 percent based upon the maximum unit weight determined by the

bulk specific gravity of Marshall specimens or the modified Proctor unit weight of the reclaimed material. Cement amounts greater than 1.5 percent will only be allowed if approved by the Engineer. The ratio of residual emulsified asphalt to cement shall be a minimum of 1.5:1.0. The optimum binder content will be the binder content that results in the highest wet Marshall stability while also having 70% retained Marshall stability compared to the dry Marshall stability and additionally the dry Marshall stability shall be a minimum of 3,500 pounds and not to exceed 6,000 pounds. The mix design must be signed and sealed by a Professional Engineer, registered in the State of Florida and submitted to the Engineer prior to use for approval.

Table 332-1 Mix Design Criteria		
Test	Test Method Number	Criteria
Gradation of reclaimed material	AASHTO T 27 and FM 1-T 011	Report
Determination of optimum binder content		
Compaction effort at optimum fluids content. Marshall Compactor; 50 blows/side or Superpave Gyratory Compactor, 100 mm diameter specimens, 30 gyrations. Density determination.	Asphalt Institute MS14, Appendix F ASTM D6926 AASHTO T 312 FM 1-T 166	Report
Marshall stability Cure at 60°C to constant weight. Test at 40°C at 48 +/-8 hours.	ASTM D6927	3,500 lb minimum stability; not to exceed 6,000 lb
Resistance of compacted bituminous mixture to moisture induced damage. 55 to 75% vacuum saturation, water bath at 25°C for 23 hours, last hour in water bath at 40°C.	AASHTO T 283 with modification of Marshall stability instead of tensile strength	70% minimum retained Marshall stability
Compressive Strength of Molded Soil-Cement Cylinders	ASTM D1633, FM 5-520	Minimum compressive strength multiplied by 0.85 $\geq$ 90 psi; 7- day maximum compressive strength $\leq$ 300 psi

332-5 Equipment.

332-5.1 Road Reclaimer: Use a road reclaimer specifically designed for pavement reclaiming and capable of pulverizing and mixing pavement, base materials, and subgrade soil to a depth of 16 inches. It must have the capability of introducing and metering additives uniformly and accurately and have positive displacement pumps which can accurately meter the planned amount of asphalt emulsion into the mixture. The reclaiming machine must be capable of mixing the emulsified asphalt additive thoroughly with the RAP and soil materials. The pump must be interlocked with the ground speed of the machine. The asphalt metering system and water metering system must be capable of continuously monitoring flow and totaling the quantity of water and asphalt applied into the mixing chamber.

Additives, if specified, must be uniformly distributed and mixed with the pulverized material and any existing underlying material.

332-5.2 Cement Spreader: Uniformly spread the cement using a cement spreader equipped with a bag house and curtains. Other types of spreader equipment may be approved by the Engineer. Minimize the amount of airborne cement dust. Air pressure shall only be used to transfer the cement from the tanker into a holding bin or spreader truck. An integrated cement spreader system shall be required in urban and other sensitive areas.

332-5.3 Motor Grader: Use a motor grader of sufficient size and horsepower to adequately rough grade the pulverized base and rough and finish grade the mixed and compacted base. The equipment must be in good working order free from leaks and capable of maintaining an accurate grade and cross-slope.

332-5.4 Rollers: Use rollers in good working order free from leaks and capable of compacting the mix to the requirements of this Section.

332-5.5 Additional equipment: Use additional equipment as needed to complete the work in this Section.

332-6 Construction.

332-6.1 Layout: The Contractor is responsible for the string lining and layout of the roadway prior to reclaiming. Elevations of the existing roadway must be referenced at 100-foot intervals to ensure the roadway elevation is constructed in accordance with the Contract Documents. Existing structures shall be protected in accordance with Section 108.

332-6.2 Weather and Seasonal Limitations: Do not mix or place the base while the air temperature is below 40°F or when conditions indicate that the temperature may fall below 40°F within 24 hours. Do not mix or place the base when the weather is foggy or rainy or when the soil or subgrade is frozen.

332-6.3 Widening Existing Shoulder Base: Prior to pulverization, excavate the existing embankment as shown in the plans from the edge of the existing pavement to at least six inches beyond the planned new width of the base. Keep the bottom of the trench free of loose soil and vegetation.

If needed to increase material volume, place approved base material on the existing pavement so it can be mixed in with the existing pavement and base material during the pulverization operation to make a homogeneous base course across the entire width of the paved shoulder. Correct all areas of irregular grade or deficient thickness and remove and replace material contaminated with soil, organic material, or debris.

332-6.4 Additional Material: When additional material is to be added to correct cross slope deficiencies or change elevation as directed by the Engineer, use approved base material placed on the roadway prior to the final pass for pulverization and mix uniformly with the existing material.

332-6.5 Pulverization: Pulverize and blend the existing pavement and base material to the depth required so that all material is uniformly graded in accordance with AASHTO T 27 and FM 1-T 011 and meet the requirements of Table 332-2.

Table 332-2 Gradation Requirements for Pulverized Material	
Sieve Size	Percent Passing
3 inches	= 100
2 inches	≥ 95
No. 200	0 to 20

Material gradation may vary due to local aggregates and conditions. A minimum of two passes of the reclaimer is required. If approved by the Engineer, thick hot mix asphalt sections may be pre-cut with a milling machine. Perform as many passes necessary to achieve the required gradation requirements in accordance with Table 332-2.

Remove pulverized material to the depth shown in the Plans.

Incorporate the asphalt emulsion into the mix through the reclaimer uniformly and accurately metered so that all areas are of equal consistency and moisture content. Control the moisture of the material to be compacted, as required. During wetting or drying operations, manipulate, as a unit, the entire width and depth of the course that is being compacted. Combine the reclaimed material and additives in place to meet the requirements specified in such proportions that the reclaimed mixture is of acceptable composition and stability. Before the start and at the end of each day's work and at any time requested, permit the Engineer access to the mixing equipment in order to read the meter to verify the quantity of asphalt emulsion and cement applied during the day's work. Make field adjustments, as necessary, to the mix design to obtain a satisfactory reclaimed mixture of consistent composition and stability throughout the project. Submit daily printouts of cement spread rate and emulsion spread rate meeting the requirements of the mix design.

332-6.6 Laboratory Testing: Reclaimed base testing shall be performed as quickly as possible and completed after the material is pulverized and blended, prior to curing, in accordance with Table 332-3.

332-6.7 Compaction: After the material has been processed, compact the completed base course to conform with the finished lines, grades, and cross-section as required in the Plans. Apply water as necessary to ensure adequate moisture content at the time of mixing and compaction.

Determine the modified Proctor maximum density and optimum moisture content in accordance with FM 1-T 180. Construct a control strip of not less than 1,000 feet to develop proper rolling/compaction patterns and methods to obtain a minimum QC density of 96% of the modified Proctor maximum density by nuclear density testing in accordance with FM 1-T 310. Whenever there is a change in the reclaimed material, compaction method, equipment, mix design, or when unacceptable results occur, construct a new control strip of the same length. Control strips failing to meet Specification criteria may be required to be reworked, as determined by the Engineer. Acceptance of the control strips must be obtained prior to continuance with production. Furnish the proper number, weight, and type of rollers to obtain the required compaction of the reclaimed material. Begin rolling at the low side of the course, except leave three to six inches from any unsupported edge or edges unrolled initially to prevent distortion.

Correct any pavement shoving or other unacceptable displacement. Take care in rolling the edges of the reclaimed mixture so the line and grade of the edges are maintained.

At the end of each day's production, construct a transverse joint formed by a header or by cutting back into the compacted material to form a vertical face free of loose material. Protect construction joints so that the placing, spreading, and compacting of base material will not damage previous work. Where it is necessary to operate or turn any equipment on the completed base course, protect and cover the finished surface using mats or wood planks to prevent damage.

332-6.8 Thickness: Report depth requirements in the Earthwork Records System (ERS) section of the Department's database measured to the nearest 0.25 inch. The difference between the individual measured depth thickness on the roadway and the plan target thickness must not exceed 3/4 inches. The difference between the LOT average (average of the three individual measured depth thickness) and the plan target thickness must not exceed 1/2 inch. Meet the frequency requirements for reclaimed base thickness of 332-7.7.

Measure the thickness while being witnessed by the Engineer. Meet the required plan mixing depths by ensuring the bottom of the base is at plan elevation during mixing and the top of the base is at plan elevation after final grading. When the thickness is not within the tolerances given, the Engineer will evaluate the area and determine if it must be reconstructed at the Contractor's expense or the deficiency deducted from the total material in place. With the approval of the Engineer, for areas of deficient thickness, an asphalt leveling course or overbuild may be used to correct deficiencies.

Determine test locations, including stations and offsets, using the Random Number generator approved by the Engineer. Notify the Engineer a minimum of 24 hours before checking mixing depths. Record the results as approved by the Engineer.

332-6.9 Finishing: After completing all base course operations, ensure the base course conforms to the required lines, grades, and cross section. The cured reclaimed base may be milled to achieve the desired lines, grades, and cross slope.

If the Engineer identifies an objectionable surface irregularity, straightedge and correct all deficiencies, 50 feet on both sides (where possible), that are in excess of 3/8 inch over 15 feet in length within 72 hours of placement to the full depth of the reclaimed base, or as determined by the Engineer.

332-6.10 Protection and Curing: Protect and cure the completed base course by applying a prime coat at a rate of 0.10 to 0.15 gallons per square yard. Apply the prime coat after the completion of finishing operations and prior to opening to traffic. Keep the finished base course continuously moist until the prime coat is placed. At the time the prime coat is applied, ensure the surface is dense, free of all loose and extraneous material, and contains sufficient moisture to promote proper penetration of the bituminous material. Apply water in sufficient quantity to fill the surface voids immediately before the bituminous curing material is applied.

For base courses that have been milled, apply tack coat at a rate of 0.09 gallons per square yard prior to paving.

To prevent equipment from marring or damaging the completed work, protect finished portions of base used by equipment.

Do not allow traffic on the reclaimed base until it is assured the reclaimed base surface will not distort, shove, or ravel under the anticipated vehicular loading. Apply sand to primed surface as necessary to prevent tracking and broom off excess when installing

temporary striping prior to opening to traffic. The Contractor shall be responsible for any damage caused to the base.

332-7 Quality Control Testing.

Collect the required amounts of reclaimed base material to conduct QC lab testing at a minimum frequency referenced in 332-7.7 (Table 332-3). For construction of mainline, shoulder, turn lanes, and ramps, a LOT is defined as a single lift of finished base not to exceed 500 feet. Isolated compaction operations will be considered as separate LOTs. For multiple phase construction, a LOT shall not extend beyond the limits of the phase. Determine test locations, including stations and offsets, using the Random Number generator approved by the Engineer.

Record QC test results in the ERS section of the Department's data base.

332-7.1 Reclaimed Material Gradation Analysis: Perform gradation analysis on the sample collected in 332-7 in accordance with AASHTO T 27 and FM 1-T 041. The sample must not include any additives. Meet the requirements of Table 332-2. If the requirements of Table 332-2 are not met, adjust the pulverization operation so that the resultant material will meet Specification requirements, or to the satisfaction of the Engineer.

332-7.2 Modified Proctor Maximum Density Determination: Determine modified Proctor maximum density and optimum moisture content by sampling and testing the material collected in 332-7 in accordance with FM 1-T 180.

332-7.3 Density Testing Requirements: Obtain a minimum QC density of 96% of the modified Proctor maximum density by nuclear density testing the full reclaimed base depth in accordance with FM 1-T 310. If one density test is below 96% of the modified Proctor maximum density, cease production and resolve the issue to the satisfaction of the Engineer before resuming production. Determine the in-place moisture content for each density test in accordance with FM 5-507 (Determination of Moisture Content by Means of a Calcium Carbide Gas Pressure Moisture Tester), or ASTM D4643 (Determination of Water Content of Soil and Rock by Microwave Oven Heating) for moisture determination.

The test depth for density shall not be greater than 12 inches.

332-7.4 Marshall Stability and Retained Marshall Stability: Perform both Marshall stability and retained Marshall stability to the frequency referenced in 332-7.7 (Table 332-3). Meet the requirements of Table 332-1. If the Marshall stability or the retained Marshall stability does not meet the requirements of Table 332-1, cease production and resolve the issue to the satisfaction of the Engineer before resuming production.

332-7.5 Surface Testing Requirements: Test the finished surface of the base course with a 15-foot straightedge laid parallel to the centerline of the road. Correct all irregularities greater than 1/4 inch to the satisfaction of the Engineer. For high straightedge deficiencies only, the reclaimed base may be milled for the full lane width to a depth and length adequate to remove the deficiency. With the approval of the Engineer, an asphalt leveling course or overbuild may be used to correct low straightedge deficiencies.

Meet the requirements for cross slope measurement in accordance with Section 330, Table 330-3. Meet the frequency requirements for reclaimed base surface of 332-7.7.

332-7.6 Additional Testing: Additional sampling and testing may be required if significant changes in the characteristics of the reclaimed material are observed, such as a much coarser or finer gradation or a noticeable difference in asphalt content, or when there is considerable variability in the field test results.

332-7.7 Frequency: Conduct QC sampling and testing at a minimum frequency listed in the table below. The Engineer will perform Verification testing at a minimum frequency listed in the table below.

Table 332-3 Sampling and Testing Frequency		
Test Name/Method	Quality Control	Verification
Modified Proctor Maximum Density (FM 1-T 180)	One per four consecutive LOTs	Witness QC
Gradation (AASHTO T 27/ FM 1-T 011)		
Marshall Stability (ASTM D6927)	One per four consecutive LOTs Break at 48+/- 8 hours	
Density (FM 1-T 310)	One per LOT	
Reclaimed Base Surface	Ten per LOT	
Reclaimed Base Thickness	Three per LOT	

332-8 Acceptance.

The Engineer may inspect and test any material, at points of production, distribution and use. The Engineer will base acceptance of the work on determining that the material requirements and the testing requirements of this Section and the placement requirements of the Plans have been met.

332-9 Method of Measurement.

The quantity to be paid for will be the area, in square yards, of base course constructed, completed, and accepted, including the areas of widened base.

332-10 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including furnishing all labor, materials, tools, equipment, testing, and incidentals necessary to complete the work.

Payment will be made under:

Item No. 915-332- Full Depth Reclamation, per square yard