S T A T E **O F** **T E N N E S S E E**

October 15, 2020 January 1, 2021

SPECIAL PROVISION

REGARDING

COLD CENTRAL PLANT RECYCLED BITUMINOUS PAVEMENT

Description

This work shall consist of the Cold Central Plant Recycled Bituminous Pavement (CCPR) process and shall include furnishing all labor, materials, equipment and transportation for the placement of a CCPR bituminous pavement. Recycling of the bituminous pavement will be accomplished by a cold central plant (CCP).

CCPR Bituminous Pavement shall not be used as a finished riding surface. Protect and maintain the finished surface until it is covered with a surface course.

Materials

Provide Materials as specified in:

Asphalt Cement, PG64-22…….**904.01**
Portland Cement……**901.01**
Water…….**921.01**
Aggregate (if needed) ……...**903.07**

Recycled Asphalt Pavement (RAP): provide processed RAP meeting **307.03.B.1**.

Provide certifications for Portland Cement and Asphalt Cement to the Department.

Equipment

A. Cold Central Plant

Provide a CCP capable of proportioning the ingredients of the mix design per the job mix formula (JMF) and mixing the materials to produce a homogenous product.

The CCP shall have means of controlling the proportioning of all added ingredients to within 0.2% of the required amount; except for water in which case the capability of adding up to 5% by weight of the RAP is required. Proportioning systems shall be automated and set to

automatically adjust to the mass of material being processed. Introduction of asphalt cement shall be accomplished by an asphalt foaming system. The CCP shall have a test nozzle to test the foamed asphalt.

The CCP shall have a means for the operator to verify the proportions of the ingredients.

The CCP shall record the quantities and proportions of all materials used during production and be capable of producing a ticket or electronic report of the quantities consumed and produced.

The CCP shall have a scalping screen deck set to prevent particles larger than the maximum aggregate size of the approved JMF gradation from being incorporated into the mixture.

B. Hauling

Trucks used for hauling shall meet the requirements of **407.05**, except tie down straps and the thermometer insertion holes are not required.

C. Paver and Material Transfer Device

After mixing, the CCPR material shall be placed and spread by means of a bituminous paver per **407.06.A.** The screed and screed extension heaters shall not be used.

Do not use a Material Transfer Device.

D. Rollers

Provide a minimum of 2 rollers meeting **407.07.** The breakdown roller shall be a vibratory double drum steel roller weighing a minimum of 12 tons. The second roller shall be a pneumatic tire roller weighing a minimum of 20 tons. Additional rollers may be necessary to obtain the required density.

E. Small Tools

Provide all necessary small tools per **407.08**.

F. Density Gauge

Provide a density gauge (nuclear or electromagnetic) and a technician qualified to operate the instrument for the purposes of quality control.

Design

A. Mix Design

Sample RAP from a stockpile that has been processed to produce a gradation meeting one of the gradations listed in AASHTO MP38-18. Include any virgin aggregate, if needed, to meet the required gradation. Virgin Aggregate shall not make up more than 50% of the combined dry gradation. If virgin aggregate is used in the combined gradation, it will be included as RAP for simplicity of terminology.

Determine the optimum water content of the RAP per AASHTO PP94-18. Conduct the remainder of the design at optimum moisture content.

Determine the required asphalt content using the materials listed below per AASHTO PP94-18. The mixture shall be combined utilizing a laboratory pug mixer capable of producing foamed asphalt.

1. RAP
2. Water to bring the RAP to optimum moisture content
3. Portland Cement, 1% by weight of RAP
4. Foamed asphalt cement (PG 64-22), minimum 2% by weight of RAP

The resultant CCPR material shall meet the dry indirect tensile strength (ITS) and indirect tensile strength ratio (TSR) per AASHTO MP38-18.

B. Expansion Ratio and Foam Half-Life

Calculate the Expansion Ratio and Foamed Asphalt Half-Life of the asphalt cement per the Wirtgen 2012 Cold Recycling Manual. Ensure that both meet the requirements listed in Table 1.

Table 1: Foamed Asphalt Requirements

Aggregate Temperature	Test	Requirement
Equal or greater than 25°C	• Expansion Ratio • Foam Half-Life	• 10 times • Minimum 8 seconds
Less than 25°C	• Expansion Ratio • Foam Half-Life	• 8 times • Minimum 6 seconds

C. Target Density

Produce compacted specimens of CCPR material using the selected mix design to determine bulk specific gravity. Specimens are to be 4 inches in diameter and compacted with 75 blows per side with a Marshall hammer. Calculate bulk specific gravity of each specimen directly by geometric volume and average the results. Determine the density in pounds per cubic foot from the average bulk specific gravity to be used as the Target Density for the mix.

D. Mix Design Submittal

A minimum of two weeks prior to production work, provide the Department with test results of the CCPR material using a minimum of 3 AC contents from a qualified lab and the identify the proposed JMF for the following criteria for the Department's approval:

1. Gradation of the combined unbound CCPR Materials (RAP, virgin aggregate (if used), and Portland cement) for the 1.25", 1", 3/4", No. 4, No. 30, and No. 200 sieves. RAP used in determining the gradation of the unbound CCPR Materials shall be taken directly from the stockpile. Do not recover RAP aggregate by extraction or ignition prior to determining gradation.
2. Optimum Water Content of the RAP.
3. Proportion of each RAP or virgin aggregate stockpile by weight of total RAP.
4. Portland Cement, percent by weight of RAP.
5. Asphalt Binder temperature and foaming water content.
6. Unconditioned (dry) ITS at 3 asphalt contents, psi.
7. Conditioned (wet) ITS at 3 asphalt contents, psi.
8. TSR at 3 asphalt contents.
9. Optimum foamed asphalt content by weight of the RAP.
10. Supplier and point of origin of all mixture ingredients.
11. Expansion Ratio and Half-Life characteristics of foamed asphalt.
12. Asphalt Content of original RAP.
13. Target Density, pcf.

Construction Requirements

A. Weather Limitations

Place CCPR bituminous pavement only when the atmospheric and material temperature (measured in the shade, if exist) is a minimum of 50°F and rising. Do not proceed with the work if the National Weather Service predicts freezing within 48 hours.

Do not work during precipitation events. Do no work if there is standing water on the existing pavement surface that the CCPR material will be placed.

B. Conditioning the Existing Surface

Meet requirements per **407.10.**

C. Preparing the RAP

Crush, screen or otherwise process the RAP to meet the gradation requirements of the JMF. The addition of virgin aggregate shall be allowed provided it does not exceed 50% by weight of the combined dry CCPR material. If virgin aggregate is used, it shall be mixed into the processed RAP to form a homogenous stockpile; with the exception if the virgin aggregate proportion is less than 20% of the combined dry CCPR material, then it may be blended during production at the CCP.

D. Mixing

Combine the RAP, cement, water, and foamed asphalt in the CCP to the proportions in the approved JMF.

E. Spreading and Finishing

Place the mixture upon the approved surface per **407.14,** except there is no requirement for temperature at the time of deposit into the paver.

F. Compaction

After spreading and striking off the mixture, compact the mixture utilizing the required rollers. Establish a uniform roller pattern to achieve consistent and acceptable densities throughout the project.

Operate rollers in a slow uniform speed, with the drive wheel nearest the paver. Keep rollers in continuous operation if at all possible. If rollers must stop, do not park or allow rollers to idle on uncompacted mixture. If rollers must stop on the compacted mat, rollers shall not stop with the drum perpendicular to the centerline of the mat.

Do not refuel rollers on the CCPR bituminous pavement.

G. Density

Compact the mixture to a minimum of 98% of the target density identified on the JMF.

H. Trial Batch

At least 5 days prior to planned start of production, mix a trial batch of the CCPR Material per the JMF for the purpose of verifying the mixture performance. Sample, prepare, condition, and test the CCPR material per AASHTO PP94-18 to verify that the Dry ITS and

TSR meet the required specification in accordance with AASHTO MP38-18 for a cement treated CCPR. Sampling and Testing shall be done under the Engineer's observation. The Department may choose to split and verify the sample at a Regional Materials Laboratory.

The trial batch may be done in conjunction with the Test Strip, but full production may not start until satisfactory Dry ITS and TSR results have been obtained.

I. Test Strip

Before planned start of full production, place a CCPR test strip no more than a 500 foot long and one-lane width wide at the designed thickness utilizing the approved JMF. Construct the test strip at a location approved by the Engineer inside the project limits using the same equipment and procedure intended for the remainder of the project. The test strip is to remain in place as part of the completed work.

Compact the test strip in a continuous and uniform manner over the entire test strip. After each pass of the roller take a reading with a density gauge. Compaction is to continue until the density indicated by the density gauge shows no appreciable increase in density with additional passes (<1 pound per cubic foot). Stop work after construction of the test strip when maximum density has been achieved and notify the Engineer. No work is to continue until the test strip is evaluated and accepted.

Once the test strip has reached final compaction the Engineer shall take five density readings using the direct transmission method to determine the dry density and compute the average.

Resume CCPR production work only when the test strip has been accepted by the Department. Acceptance of the test strip will be constituted by achievement of a minimum average of 98% of the target density.

If 98% of the target density is not achieved, adjust the roller pattern until the requirement is met.

Construct a new test strip if there is a change in the JMF, compaction equipment, or consecutive lots fail to meet density requirements. Notify the Engineer prior to construction of a new test strip.

Quality Control

Monitor the results of the following tests at a minimum frequency specified. If any of the quality control tests show failing results take immediate corrective action. Record all test results both passing and failing and provide copies to the Engineer upon request.

A. Gradation

At least once per 1000 tons, verify that gradation of the dry blended CCPR material meets the gradation of the JMF. If possible, sample from a dry belt feed after the addition of cement. If not possible, discharge suitable material for sampling from the plant with the asphalt foamer turned off.

The gradation may vary from the JMF within the tolerance listed in Table 2. In the event that the gradation is outside the allowable tolerance, stop production until adjustments to the process are made to resolve the failed result.

Table 2: RAP Gradation Tolerances

Sieve Size	Tolerance from JMF value
1.25", 1" and 3/4"	±10%
No. 4	±8%
No. 30	±5%
No. 200	+2% from JMF value[1]

[1] In no case shall the gradation be less than 1 percent passing the #200 sieve.

B. Moisture Content of the Mixture

Check the moisture content of the mixture daily and after any work stoppages due to precipitation. Take samples from loaded trucks at the plant and determine moisture content by drying to constant mass as soon as practical. If samples must be stored for greater than an hour, place sample in a sealed plastic bag. Adjust the water being metered into the mixture as necessary to stay at or within 0.2% under the moisture content listed on the JMF. Control the mixture to maintain the optimum moisture content.

C. Conformance to Job Mix Formula

Provide printed or electronic tickets and a summary at the end of each day's CCPR production to the Engineer. The ticket shall show the yield in tons of RAP processed, the dosage rates of water, Portland cement and asphalt cement. Monitor the readouts throughout production. Stop CCPR production at any time that the dosage rate of any ingredient of the mix is more than 0.2% from the stated dosage on the job mix formula. Make the necessary corrections to meet the Job Mix Formula.

D. Half-Life and Expansion Ratio

Once per day verify the Half-Life and Expansion Ratio of the foamed asphalt at the CCP. If either verification does not meet the requirements in Table 1, stop production. Make the necessary corrections to the process to meet the requirements specified.

E. Density

Routinely perform density checks throughout the project with a densitometer. If indicated results are less than 98% of the Target Maximum Density, perform additional compaction work to the section until the density increases to at least 98% of the Target Maximum Density. If the problem persists stop CCPR production and construct a new test strip to adjust the roller pattern.

The Department will not take quality control density readings.

Method of Acceptance

The Department shall accept the mixture based on the results of acceptance tests for In-place Density and Laboratory Testing. The Department will perform all acceptance testing.

A. In-Place Density

In-place density shall be tested by direct transmission with a nuclear density gauge per SOP 7-1. In-Place Density Testing shall be done on a lot basis. The standard lot shall be a day's production.

Provide an estimate of the day's production rate to the Engineer for estimating the approximate length of the lot. Notify the Engineer if any changes due to unforeseen circumstances or weather.

The Department will subdivide the lot into 5 equal sized sublots. One nuclear gauge test will be taken per sublot and the results of all 5 sublots averaged to represent the lot. Testing locations shall be determined by random number for both the transverse and longitudinal directions. Test results are final, no additional test will be considered prior to computing payment.

B. Laboratory Testing

1. Indirect Tensile Strength Test

ITS shall be tested daily per the procedure in AASHTO PP94. Samples are to be taken from loaded trucks prior to leaving for the job site and chosen by random number. The Department will fabricate test specimens and initiate conditioning immediately after sampling. If immediate testing is not possible, the sample will be stored in sealed plastic bag to prevent moisture loss.

2. Virgin Asphalt Content of the Mixture

The Department will sample the RAP stockpile and complete CCPR Mixture daily. The Department will determine the asphalt content of each sample, dried to constant mass, per

AASHTO T308 and compute the arithmetic difference to determine the virgin asphalt content.

Samples of the mixture are to be determined by random number and taken from a loaded truck at the plant. Samples of the RAP are to be taken from the stockpile at the same time. Assist the Engineer in this sampling by building a sampling pad with a loader out of the RAP stockpile per ASTM D75.

Method of Measurement

The Department will measure CCPR Bituminous Pavement by the ton.

The Department will measure Asphalt Cement and Portland Cement separately from the CCPR Bituminous Pavement. Measurement is to be based on certified weigh tickets. The entire quantity accepted of the Asphalt Cement and Portland Cement must be accounted for by materials certification by the ton in accordance with **109**.

Basis of Measurement and Payment

The Department will pay for accepted quantities, complete in place, at the contract prices as follows:

Item No.	Description	Unit
308-02.10	Cold Central Plant Recycled Bituminous Pavement	Ton
308-02.12	Asphalt Cement (PG 64-22) CCPR	Ton
309-10.01	Portland Cement	Ton

Such payment shall be full compensation for any additional materials, labor, equipment, and incidentals necessary for the proper performance of the work for Cold Central Plant Recycled Bituminous Pavement.

Such payment shall be full compensation for any additional material, labor, equipment and incidentals necessary for the Asphalt Cement, and Portland Cement in the CCPR Bituminous Pavement process.

Acceptance and Adjustments

The Department shall apply deduction in payment for of CCPR Bituminous Pavement, not as a penalty but as liquidated damages, for failure to meet requirements. The payment factors shall be applied to each lot of CCPR pavement for the following:

1. Density as shown in Table 3,
2. ITS as shown in Table 4
3. Virgin Asphalt Content as shown in Table 5.

For each CCPR pavement lot, the 3 payment factors are to be averaged into a single QA Pay Factor using simple average. The CCPR pavement deduction will be calculated by the following:

CCPR Pavement Deduction = Lot (Tons) x Bid Price x QA Factor

Table 3: Density Pay Factors

Percentage of Target Maximum Density	Pay Factor for Density
98.0-100%	1.00
97.0-97.9%	0.95
96.0-96.9%	0.90
<96.0%	0.80[1]

[1]At the Engineer's discretion the completed work may be left in place at the indicated pay factor or removed and replaced at no additional cost to the Department, if removed and replaced the new construction will be tested for acceptance as stated above.

Table 4: Indirect Tensile Strength

Indirect Tensile Strength (psi)	Pay Factor for Indirect Tensile Strength
≥ 45 psi	1.00
<45 psi and ≥ 42.5 psi	0.95
<42.5 psi and ≥ 40 psi	0.90
<40 psi	0.80[1]

[1]At the Engineer's discretion the completed work may be left in place at the indicated pay factor or removed and replaced at no additional cost to the Department, if removed and replaced the new construction will be tested for acceptance as stated above.

Table 5: Virgin Asphalt Content

Variation from JMF	Pay Factor for Indirect Tensile Strength
0.00 – 0.30	1.00
0.31 - 0.35	0.95
0.36 – 0.40	0.90
>0.40	0.80[1]

[1]At the Engineer's discretion the completed work may be left in place at the indicated pay factor or removed and replaced at no additional cost to the Department, if removed and replaced the new construction will be tested for acceptance as stated above.