

COLD MIXED RECYCLED BITUMINOUS PAVEMENT, PORTLAND CEMENT

**\*\*From Berlin STP 2935(1)  
Berlin NH STP 2938(1)  
Berlin NH STP 2947(1)**

- xx. DESCRIPTION. This work shall consist of cold planing and crushing and/or screening the existing bituminous pavement, adding additional asphalt emulsion and virgin aggregate, and mixing and repaving of the material to the depths, lines, and grades shown on the Plans.

Recycling of the existing pavement shall be performed in a manner that does not disturb the underlying materials.

- xx. MATERIALS. The emulsified asphalt for Cold Mixed Recycled Bituminous Pavement shall meet the requirements of Section 404 and/or be as recommended by the Contractor as a result of CONTROL SECTION of this specification and as approved by the Engineer. Portland cement shall meet the requirements of PORTLAND CEMENT FOR COLD MIXED RECYCLING of Section 900. Materials for any Fog Seal Surface Treatment shall meet the requirements of FOG SEAL SURFACE TREATMENT of Section 900.

The grade and initial application rate of emulsion, and rate of Portland cement additive, based on emulsion and Portland cement rate-density curves (AASHTO T 245 - Mod., 50 blows, Asphalt Institutes MS-14, Cold Mix Design Guide) developed from test section material, shall be recommended by the Contractor and accepted by the Engineer. The value for the emulsion and Portland cement rates shall be based on the optimum for achieving maximum density. The exact application rate may be varied by the Contractor as required by existing pavement conditions and approved by the Engineer.

- (a) Gradation. The Cold Mixed Recycled Bituminous Pavement shall meet the following gradation requirements for extracted aggregate (AASHTO T-30) taken from the pulverized material:

<u>Sieve Size</u>	<u>Percent Passing</u>
37.5 mm (1½ inches)	100
25.0 mm (1 inch)	90-100
4.75 mm (No. 4)	30- 70
75 µm (No. 200)	0- 12

If the processed existing bituminous material does not meet the gradation requirements as specified, additional virgin aggregate shall be added at a rate and gradation sufficient such that the blended mixture conforms to those requirements.

- (b) Design Criteria. The Cold Mixed Recycled Bituminous Pavement shall meet the following design criteria requirements:

Cement Content	1.0% min.
Emulsion Content	2.5% min.
Stability Value	6675 Newtons (1500 lbf) min.

Emulsion, water, processed bituminous pavement, virgin aggregate, and Portland cement shall be added in the proportions necessary to meet mix design requirements and verified by tank checks performed in accordance with the minimum quality control frequencies. Cement additive may be introduced in dry form or as a cement slurry.

- xx. EQUIPMENT. The Contractor may furnish a self-propelled machine capable of planing the existing bituminous pavement to the depth shown on the Plans in one pass. The machine shall be equipped with standard automatic depth controls and must maintain a constant cutting depth and width. The machine shall be capable of producing the proper size material required through additional crushing or screening, or allow the addition of virgin aggregate to meet the gradation requirements. Oversized RAP particles shall be reduced to proper size by crushing prior to any extraction process.

Alternately, portable mixing equipment may be provided which is capable of mixing, crushing, and/or screening the processed bituminous and any virgin material, liquid binder, and Portland cement into a homogeneous mixture. Oversized RAP particles shall be reduced to proper size by crushing prior to any extraction process for the purpose of mix design and production operations. The mixing equipment shall be equipped with belt scales to accurately proportion the additives, adjusted by moisture content of the processed recycled asphalt pavement as specified in MOISTURE of this specification. The belt scale will be verified for accuracy at each new location prior to mix production, and shall be checked for accuracy weekly. The belt scale operation shall be verified daily prior to mixing. The method of depositing the mixed material shall be such that segregation does not occur.

Placing of the Cold Mixed Recycled Bituminous Pavement shall be accomplished with a self-propelled bituminous paver. The Cold Mixed Recycled Bituminous material shall be spread without segregation to the lines and grades shown on the Plans or as directed by the Engineer. If a pick-up machine is used to feed a windrow of the bituminous material into the paver hopper, the pick-up machine shall be capable of picking up the entire windrow down to the underlying materials.

The number, mass, and type of rollers shall be sufficient to obtain the required uniform density, full depth, while the mixture is in a workable condition. A rubber tire roller shall perform the initial rolling after the emulsion initially "breaks" (indicated by color change from brown to black).

- xx. WEATHER AND SEASONAL LIMITATIONS. Recycling operations shall not be performed when the ambient air temperature is below 10°C (50°F), when the overnight temperatures are expected to be below 10°C (50°F), when the surface temperature of the pavement to be recycled is below 10°C (50°F), when the weather is foggy or rainy, or when weather conditions or predicted weather conditions are such that proper mixing, spreading, and compacting of the recycled material cannot be accomplished.

The placement of Cold Mixed Recycled Pavement shall not be performed prior to May 1st or after September 15th.

When it is in the public interest for servicing traffic, the Construction Engineer may adjust the ambient air and/or pavement temperature requirements or extend the dates of the recycling season.

- xx. MOISTURE. The moisture content of the stockpiled recycled material shall be checked using AASHTO T-217 prior to mixing each day to determine if increased or decreased water percentages are required. The Contractor may add, under positive control, a small amount of water to the processed material to facilitate uniform mixing with the emulsion and cement. The water may be added prior to the mixing phase of the operation. The water shall be added carefully so as not to cause any adverse affect.

- xx. COMPACTION. Compaction shall be performed while the emulsion is in a workable state. The Cold Mixed Recycled Bituminous Pavement material shall be finished within a grade tolerance of  $\pm 12\text{mm}$  ( $\frac{1}{2}$  inch), provided that this deviation is not maintained for a distance longer than 15 meters (50 feet), and provided that the required crown or superelevation is maintained.

The Cold Mixed Recycled Bituminous Pavement shall be compacted to meet a minimum of 96.0% of the lab established maximum density as approved by the Engineer in accordance with MATERIALS and CONTROL SECTION of this specification.

- xx. CURING AND STABILITY. The Cold Mixed Recycled Bituminous Pavement may be opened to traffic as approved by the Engineer.

Hot mixed bituminous concrete pavements shall not be placed until the Cold Mixed Recycled Bituminous Pavement material has been allowed to cure and the free moisture content is reduced according to AASHTO T-217 to a maximum of one and one-half percent (1½%) every 1000 ft per lane or as directed by the Engineer.

The Engineer may waive the 1½% free moisture content in such cases that the Cold Mixed Recycled Bituminous Pavement has been open to a cure period of 14 calendar days or more.

The required density shall be achieved and maintained until a hot mixed bituminous concrete pavement has been placed. Any additional compactive effort or repair of imperfections in the Cold Mixed Recycled Bituminous material shall be performed as directed by the Engineer at no additional compensation to the Contractor. As an alternate for the purpose of protecting the Cold Mixed Recycled Bituminous Pavement from damage due to traffic, the Engineer may approve the use of a Fog Seal surface treatment subsequent to the placement of the Cold Mix and prior to the placement of any hot mix bituminous pavement.

- xx. CONTROL SECTION. The Contractor shall be responsible for performing all Process Control and Quality Control sampling and testing.

Process Control sampling and testing shall involve taking a set of four representative samples from the test section. The samples may be taken either before or after the cold recycling process. The four samples shall be combined to represent a uniform sample for determining maximum density. The material used, including that used for the Marshall series to determine the optimum emulsion and Portland cement rates, shall be in a processed pulverized state replicating the state which the material will be in immediately prior to the point when the emulsified asphalt and Portland cement is introduced during the recycling process.

The Contractor shall perform the Marshall Design series tests to determine the maximum density. A maximum density shall be obtained by performing a series of tests using the 50 blow Marshall Design method (AASHTO T 245 - Mod.) as stated in the Asphalt Institutes MS-14, Cold Mix Design Guide. The series of Marshall tests shall be prepared using a minimum of five different percentages of emulsion, and a minimum of five different percentages of emulsion and Portland cement combined. The maximum density obtained from these tests shall be used as the recommended target density to be approved by the Engineer.

The Contractor shall perform all tests necessary to verify that the target density is achieved and maintained prior to placement of a hot bituminous overlay. The necessity for additional testing will be determined by the Engineer. The Contractor shall provide the Engineer with the original copies of all Marshall Design series, Process Control, and Quality Control test results.

The Contractor shall demonstrate to the Engineer, on the first day of Cold Mix production and placement, that the Contractor's equipment and procedure are suitable for the work specified and are capable in achieving the density specified. If the control section does not meet the requirements of this specification, or the density achieved does not appear suitable, the Contractor shall modify the procedure and either construct another control section or reconstruct the original until acceptable results are obtained. The suitability of results will be determined by the Engineer.

- xx. QUALITY CONTROL PLAN. The Contractor shall operate in accordance with an approved Quality Control Plan (QCP) to assure a final product meeting the Contract requirements. The QCP shall meet the requirements of this Subsection. The Contractor shall not begin cold mix production until the QCP is submitted for approval.

Prior to performing any cold mix production, the Engineer and/or the Contractor may request a Pre-recycle conference to discuss the recycling schedule.

The QCP shall address any items that affect the quality of the recycling process including, but not limited to, the following:

- a. Methods to adhere JMF(s).
- b. Mixing details, pugmill type, production rates, and material processing.
- c. Make and type of paver(s).
- d. Make and type of rollers.
- e. Transportation, including process for ensuring that truck bodies are clean and free of debris or contamination that could adversely affect the finished product, and type of release agent used (if required).
- f. Laydown operations, including procedures for mix design modification, avoiding recycling and curing in inclement weather, material yield monitoring, methods to ensure that segregation is minimized, longitudinal joint construction, procedures to determine the maximum rolling and placing speeds based on field quality control, and achieving the best possible smoothness.
- g. Methods for Quality Control testing to assure the material is meeting the mix design.
- h. Methods for protecting the finished product from damage and procedures for any necessary corrective action.
- i. Examples of QCP and logbook forms.
- j. Name, responsibilities, and qualifications of the responsible onsite Recycling Supervisor experienced and knowledgeable with the process.
- k. Method for calibration/verification of density gauge.
- l. Stockpile management procedures.

The Project Superintendent shall be named in the QCP, and the responsibilities for successful implementation of the QCP shall be outlined.

The Contractor shall sample, test, and evaluate the Cold Mix Recycled Bituminous Pavement process in accordance with the following procedures and minimum frequencies:

MINIMUM QUALITY CONTROL FREQUENCIES

Test or Action	Frequency	Test Method
Density	1 per 300 m (1000 ft)/lane	AASHTO T-310
Air Temperature	4 per day at even intervals	
Surface Temperature	At the beginning and end of each days operation	
Gradation and AC Content of Final Product	1 per day	AASHTO T-30

The Contractor shall submit QCP reports and summaries in writing, signed by the appropriate technician, and present them to the Agency's onsite representative by the completion of the project, except when otherwise noted in the QCP due to local restrictions. The Contractor shall make all test results, including randomly sampled densities, available to the Engineer onsite.

xx. FIELD OPERATIONS. The Contractor shall cease recycling operations whenever one of the following occurs:

- (1) The computed yield of each additive differs from the approved Job Mix Formula by 10% or more.
- (2) The Contractor fails to follow the approved QCP.
- (3) The Contractor fails to achieve 96% of the established field density after corrective action has been taken.
- (4) The finished product is visually segregated, unstable, or otherwise defective, as determined by the Engineer.

Recycling operations shall not resume until the Contractor and the Agency agree on the corrective action to be taken.

xx. METHOD OF MEASUREMENT. The quantity of Special Provision (Emulsified Asphalt, Cold Mix with Cement) to be measured for payment will be the number of kilograms [hundredweight (CWT)] used in the complete and accepted work.

The quantity of Special Provision (Cold Mixed Recycled Bituminous Pavement, Portland Cement) to be measured for payment will be the number of square meters (square yards) of existing pavement which has been recycled in an acceptable manner as determined by actual surface measurements of the lengths and widths of the recycled area as shown on the Plans or as directed by the Engineer. No additional compensation will be made for overlapping areas.

The quantity of Special Provision (Aggregate to Meet Cold Mixed Gradation) to be measured for payment will be the number of metric tons (tons) used in the complete and accepted work.

xx. BASIS OF PAYMENT. The accepted quantity of Special Provision (Emulsified Asphalt, Cold Mix with Cement) will be paid for at the Contract unit price per kilogram [hundredweight (CWT)] for the specified material applied. Payment will be full compensation for furnishing, transporting, and placing the material and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

The accepted quantity of Special Provision (Cold Mixed Recycled Bituminous Pavement, Portland Cement) will be paid for at the Contract unit price per square meter (square yard). Payment will be full compensation for performing the work specified and for furnishing all labor, materials, tools, equipment, and incidentals necessary to complete the work. Any additional RAP material, not generated from the project, required to meet the project volume of Special Provision (Cold Mixed Recycled Bituminous Pavement, Portland Cement) will not be paid for separately but will be considered incidental to Special Provision (Cold Mixed Recycled Bituminous Pavement, Portland Cement).

The accepted quantity of Special Provision (Aggregate to Meet Cold Mixed Gradation) will be paid for at the Contract unit price per metric ton (ton). Payment will be full compensation for furnishing and placing the material specified and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

Payment for the furnishing of Portland cement will be made under the Special Provision (Portland Cement for Cold Mixed Recycling) item in the Contract.

Payment for the furnishing of any Fog Seal Surface Treatment will be made under the Special Provision (Fog Seal Surface Treatment) item in the Contract.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.675 Special Provision (Cold Mixed Recycled Bituminous Pavement, Portland Cement)	Square Meter (Square Yard)
900.680 Special Provision (Aggregate to Meet Cold Mixed Gradation)	Metric Ton (Ton)
900.683 Special Provision (Emulsified Asphalt, Cold Mix with Cement)	CWT (Kilogram)