

## **ITEM 405.0201--07 - COLD RECYCLING ASPHALT CONCRETE**

### **DESCRIPTION**

This specification covers the requirements for cold recycling asphalt concrete. This work shall consist of coring the existing pavement, preparing a mix design and recycling the existing asphalt concrete pavement. The recycling shall be a continuous process of milling the existing pavement, remixing with bituminous material (unmodified or modified) and aggregate, reshaping, and compacting the asphalt mixture. Pavement locations that are milled shall have material replaced on the same day. All work under this item shall be in accordance with these specifications and in reasonably close conformity with the limits established by the Engineer.

### **MATERIAL REQUIREMENTS**

**Bituminous Material.** Liquid bituminous material shall be obtained from a Department approved facility. All bituminous material proposed for use on Department projects shall be approved by the Director, Materials Bureau. The engineer shall take one sample from each tank truck of bituminous material arriving on the project in accordance with Materials Method - NY 8.2. The sample shall be sent to the Materials Bureau with a completed BR170d attached.

**Additives.** Additives may be used to improve the quality of the resulting recycled pavement. Additives may be combined with the bituminous material prior to construction or may be added to the mix during construction. The proportion and amounts of additive shall be determined by the Contractor and approved by the Director, Materials Bureau.

**Aggregates.** Additional aggregates for cold recycling of pavements shall conform to the requirements of Section 703-02, Coarse Aggregate, of the Standard Specifications. The gradation and source of the aggregates shall be specified by the Contractor and included in the proposed mix design.

**Reclaimed Material.** Asphalt pavement and any milled material which has been removed and/or processed from the pavement will be referred to as reclaimed material. The reclaimed material shall pass the 50 mm sieve size.

### **DESIGN GUIDELINES**

The recycled mixture consists of reclaimed material, additional aggregate, liquid bituminous material, additives and water.

The minimum design liquid bituminous material content is 3% for asphalt emulsions and 2% for performance-graded binders. The liquid bituminous material is calculated as a percentage of the dry mass of millings:

$$[\text{mass of liquid bituminous material}/\text{mass of millings}] \times 100 = \% \text{ liquid bituminous material}$$

Recycled mixtures may be designed with or without additional aggregate, depending on the existing pavement's gradation. When additional aggregate is used, the minimum content is 5.0% and the maximum content is 20.0%, regardless of the recycled mixture's design gradation. The percentage of additional aggregate is calculated as a percentage of the dry mass of millings:

$$[\text{mass of additional aggregate}/\text{mass of millings}] \times 100 = \% \text{ additional aggregate}$$

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Design the recycled mixture to conform to the following gradation:

Sieve Size	Percent Passing By Weight	
	Minimum	Maximum
37.5 mm	100	
25.0 mm	95	100
12.5 mm	70	85
6.3 mm	48	68
3.2 mm	32	54
850 µm	15	30
425 µm	8	22
180 µm	4	14
75 µm	2	8

The Department shall supply the core results to the Contractor for the determination, by the Contractor, of the amount and type of bituminous material to properly recycle the pavement.

### **EQUIPMENT**

Use equipment capable of:

- Milling the existing pavement to the appropriate depth.
- Processing the reclaimed material to pass a 50 mm sieve.
- Mixing the reclaimed material with bituminous material.
- Paving the reclaimed material to the correct grade.

**Calibration.** Calibrate the mixing equipment prior to the start of work, in accordance with established calibration procedures as detailed in the Procedural Directives of the Director, Materials Bureau. Submit the calibration results for approval to the Director, Materials Bureau at least 7 days prior to the start of work. The first calibration of each calendar year must be witnessed by Department personnel. Submit subsequent calibrations with written certification that proper procedures were followed and that all measurements and calculations are accurate. If the results submitted in subsequent calibrations are more than 5.0% different from the first calibration of the season, the equipment must be calibrated in the presence of Department personnel. Calibration approval is valid for 90 days from the date of calibration. Provide a copy of the calibration approval letter to the Engineer before the start of work. No cold recycling will be allowed under this contract until the calibration has been completed and approved. No payment will be made for material recycled by equipment without a valid calibration.

### **CONSTRUCTION**

**Weather Limitations.** This work will not be permitted when the existing pavement contains frost, or when the air surface temperature is below 7°C or expected to drop below 7°C within 24 hours. No material shall be placed from the last Saturday in September to May 1.

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**Testing.** Prior to starting recycling operations, test two aggregate samples to verify the gradation. Supply the test results to the Engineer before the start of work.

Once continuous production has been achieved, test four samples of the recycled mixture for gradation and total asphalt content. Submit the test results to the Engineer and Regional Materials Engineer before the end of the next workday. For each subsequent day of production, take a minimum of one sample of the recycled mixture from each kilometer, or fraction thereof, of pavement recycled. Test each sample for gradation and total asphalt content. Submit the test results from the mix samples taken from each kilometer of pavement within two workdays. Make adjustments to the mix proportions or additional aggregate gradation based on the test results to comply with the approved mix design and construct a stable pavement layer.

Should it be necessary to bring a second recycling train to the project, four samples should again be taken and tested following the frequencies detailed above.

**Spreading.** The mixture shall be deposited in a windrow or directly into an approved bituminous paver equipped with a 9.1 meter moving reference and mechanically spread in a uniform layer so as to produce the specified thickness and surface tolerance after compaction. Excessive amounts of non-coated reclaimed material which spill onto the milled surface shall be removed, as ordered by the Engineer, prior to placing the mixture.

**Compaction.** After the bituminous mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving. All courses shall be initially rolled with the roller traveling parallel to the centerline of the pavement beginning at each edge and working toward the center. Banked curves shall be rolled starting at the low side edge and working toward the super-elevated edge. The roller drive roll or wheel shall be nearest the paver.

A pneumatic tire roller with a minimum ground contact pressure (GCP) of 550 kPa will be supplied by the Contractor for compacting the cold recycled mix. The Contractor may choose to use vibratory compaction equipment for initial or intermediate rolling. The vibratory roller shall appear on the Department's current Materials and Equipment Approved List.

Initial and intermediate rollers shall operate at a uniform speed not to exceed 4 kilometers per hour (67 meters per minute). All turning of the compaction equipment shall be completed on material which has had a minimum of one roller pass. The Contractor will note that if vibratory compaction equipment is used, they assume full responsibility for the cost of repairing all damages which may occur to highway components and adjacent property.

The pavement course shall be finish rolled with a steel wheel tandem roller having a minimum weight of 7.2 metric tons. This finish roller shall add a minimum of two passes. Dual vibrating drum rollers meeting the requirements of a tandem roller and operating in the static mode may be used for the finished roller. This vibratory roller may be used as the initial or intermediate roller and the finish roller.

On the first day of production, establish a roller pattern consistent with §402-3.07.C. 70 Series Compaction Method. Proposed changes to the roller pattern shall be approved by the Engineer. Material that cannot be properly and adequately compacted to a stable condition shall be removed and replaced, as ordered by the Engineer, at the Contractor's expense.

Along forms, curbs, headers, walls and other areas not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers as directed by the Engineer. On depressed areas, a trench roller or a small vibratory roller approved by the Engineer may be used.

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Any displacement occurring as a result of reversing the direction of the roller, or from other causes shall be corrected at once by the use of rakes and addition of fresh mixture as required. Care shall be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture. To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with small quantities of detergent or other approved material, but in no case shall a solvent having an adverse affect upon the bituminous pavement be used.

**Longitudinal Joints.** A longitudinal joint shall be located at the centerline. All other longitudinal joints should coincide with pavement lane lines whenever possible. If the Contractor proposes longitudinal joint locations that do not coincide with pavement lane lines, the following procedure shall be used:

- Pave the recycled mat.
- Compact using an established roller pattern.
- Upon next milling pass, reclaim a minimum of 150 mm of the adjoining, compacted recycled mat.

Paving operations shall match multiple lanes at the completion of the work day to minimize the exposure of longitudinal joints to traffic overnight.

When the Contractor is unable to match multiple lanes at the completion of the work day, place UNEVEN LANES (W8-11) signs at a maximum spacing of 300 m to alert the drivers to the uneven edge. Any length of longitudinal joint left exposed at the completion of the work day must be constructed using a pneumatic tire roller to form the joint into a wedge shape and provide a smooth transition for traffic. Construct the wedge at a slope of 1 on 8 or flatter to meet the existing pavement elevation using recycled material. Do not overlap recycled material onto the existing pavement.

**Brooming.** The pavement and shoulders shall be broomed by the Contractor, as ordered by the Engineer, to remove loose stone or reclaimed material resulting from the recycling process.

**Tolerance.** The recycled surface shall be constructed to a 10 mm tolerance. The elevation difference at the longitudinal joint shall be constructed to a 5 mm tolerance. If, in the opinion of the Engineer, the pavement has not been constructed to these tolerances based upon visual observation or upon riding quality he/she may test the surface with a 5 meter straight edge or string line placed parallel to the center line of the pavement. He/she may also test with a 3 meter straight edge or string line placed transversely to the center line of the pavement on any portion of the pavement. Variations exceeding 10 mm shall be satisfactorily corrected or the pavement re-laid at no additional cost to the Department as ordered by the Engineer.

**Existing Pavement Cross Slopes.** If the existing pavement's cross slopes meet appropriate standards, then the cross slopes of the finished cold recycling shall match the existing. If the existing pavement's cross slopes are not in accordance with the appropriate standards, then the Contractor shall present a plan to the Engineer that attempts to bring the cross slopes of the finished cold recycling into conformance with the appropriate standards. The Contractor will not be responsible for corrections to the cross slopes where sufficient material does not exist in the pavement to make such corrections.

**Curing.** Allow the recycled material to cure for a minimum of 10 days before placing the next paving course. The provisions of the paragraphs above, Brooming and Tolerance, apply from the time of recycling until the recycled material is overlaid, not to exceed 30 days.

**Fog Seal.** If the Contractor determines that the recycled pavement surface requires a fog seal to correct an overly dry surface or to reduce the quantity of dry stone or reclaimed material pulled out by traffic and the Engineer agrees, fog seal may be applied. Fog seal will be paid for, under 407.10---07, only when the total originally estimated amount of liquid bituminous material has not been utilized. The amount of bituminous material paid for as part of the fog sealing and recycling operations is limited to an amount equal to 110% of the amount of liquid bituminous material originally estimated.

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The liquid bituminous material and rate of application for the fog seal shall be chosen by the Contractor. The Contractor shall also be responsible for all work zone traffic control for the fog seal operation. A work zone traffic control plan for the fog seal operation must be developed by the Contractor and submitted to the Engineer for approval. No extra payment will be made for the fog seal application or for all work zone traffic control measures.

**Damaged or Deficient Areas.** Any mixture that ravel, becomes loose or broken, mixed with dirt, or is in any way defective shall be reworked or removed and replaced with fresh recycled mix or fresh hot mixture and shall be compacted to conform with the surrounding area.

Any area showing an excess or deficiency of bituminous material shall be corrected to the satisfaction of the Engineer.

Ruts 10 mm or greater in depth which occur in the recycled mixture which cannot be corrected by rolling shall be corrected by a method approved by the Engineer.

**Repairs.** Immediately after becoming aware of damage or deficiencies in the recycled mix the Engineer will notify the Contractor or the Contractor's designated representative. The Contractor shall make arrangements to repair the damaged or deficient areas to the satisfaction of the Engineer.

All repairs or remedial actions necessary to correct damaged or deficient areas of recycled pavement shall be carried out at the Contractor's expense. The Contractor shall not be responsible for damage to the recycled mix as a result of other work performed on the pavement or shoulders.

### **METHOD OF MEASUREMENT**

**Cold Recycling Asphalt Concrete.** Measurement will be the number of square meters of pavement surface recycled in accordance with the specifications and contract documents.

**Bituminous Material.** Measurement will be the number of liters, measured at 16°C, incorporated into the work in accordance with the specifications.

**Aggregate.** Measurement will be the number of metric tons incorporated into the work in accordance with the specifications.

### **BASIS OF PAYMENT**

**Cold Recycling Asphalt Concrete.** Payment will be made at the unit price per square meter for the quantities measured. The unit price bid shall include the cost of all labor, materials, equipment and incidentals necessary to complete the work except that Bituminous Material and Aggregate will be paid for under their appropriate pay items. No separate payment will be made for the use of water in the mixing process. Any work required for the maintenance, replacement, or repair of the cold recycled pavement prior to the acceptance of the contract, shall be done at no additional cost to the State.

**Bituminous Material.** Payment will be made at the unit price per liter for the quantities measured. The unit price shall include the cost of furnishing all labor, materials and equipment necessary to incorporate the bituminous materials into the work.

**Aggregate.** Payment will be made in accordance with Standard Specification Item No. 623. The unit price shall include the cost of furnishing all labor, materials and equipment necessary to properly incorporate the aggregate into the work.

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Payment will be made under:

<b>Item No.</b>	<b>Description</b>	<b>Pay Unit</b>
405.0201—07 M	Cold Recycling Asphalt Concrete	Square Meter
407.10----07	Cold Recycling Emulsion	Liter
623.0X M	Aggregate	Metric Ton