DESCRIPTION:

This specification covers the requirements for hot in-place recycling of asphalt concrete (Option A) and cold milling and placing an inlay of hot mix asphalt concrete (Option B). The Contractor must choose only one of the options contained in this specification unless otherwise indicated on the plans.

**Option A.**

This work shall consist of recycling in-place the existing asphaltic pavement in a simultaneous multi-step process of heating, scarifying, remixing with a virgin asphalt concrete, reshaping and compacting the asphalt surface. All work under this item shall be in accordance with these specifications and in substantial conformance with the limits shown on the plans or established by the Engineer.

**Option B.**

This work shall consist of cold milling, applying a tack coat and placing an inlay of hot mix asphalt concrete to a depth and of a mix type specified in the contract document.

**MATERIALS:**

**Option A.**

The Contractor shall provide an approved mix design and work plan to the Engineer a minimum of ten work days prior to the planned start of work. The mix design shall include the results of tests performed on 150 mm diameter cores taken by the Contractor. One core will be taken for each two lane kilometers of pavement, with a minimum of six cores taken for each mix design. As a minimum the following information shall be provided with each mix design.

1. Pavement type.
2. Core location.
3. Total core depth and depth to be recycled.
4. The aggregate gradation from the extracted cores for the depth to be recycled.
5. Recovered asphalt content for each core, penetration at 25°C of the recovered asphalt from every third core (minimum of three penetration results for each mix design) and the average value for each test requirement.
6. Amount of virgin asphalt concrete admixture to be added by percentage and by kilograms per square meter.
7. Asphalt content of virgin asphalt concrete admixture.
8. The combined gradation of the average core gradation and virgin asphalt concrete admixture.
9. Plots of the original and combined gradations on form BR81 for top course and form BR82 for binder course.

The virgin asphalt concrete admixture shall meet the requirements as specified in the approved mix design provided by the Contractor. The mix design shall meet the material requirements for Rut Avoidance Asphalt Concrete, Type 3 RA or Rut Avoidance Asphalt Concrete, Type 6F RA. The grade and content of asphalt cement used shall be determined by the Contractor. The use of recycled material will not be allowed.

The mix design shall include the results of tests run on 150 mm diameter cores taken by the Contractor. No 100 mm diameter cores will be allowed. One core will be taken for each two lane kilometers of pavement with a minimum of six cores taken for each mix design. Cores must be uniformly spaced along the length of the project and taken in alternating lanes. If the pavement material changes at some point within the project limits a separate mix design for that section will be required. Coring of the pavement will be allowed before the project is awarded. Prior to coring the Contractor must apply for a highway work permit from the Resident Maintenance Engineer.

**Option B.**
Materials removed during the cold milling process shall be disposed of in accordance with Section 490, Cold Milling. The cold milling material from this contract may be used as RAP (Reclaimed Asphalt Pavement) in the top course asphalt concrete in-lay. Up to 20% RAP will be allowed to be recycled into the top course asphalt concrete in-lay. The mix type(s) for the asphalt concrete in-lay shall meet the material requirements for Rut Avoidance Asphalt Concrete, Type 3 RA or Rut Avoidance Asphalt Concrete, Type 6F RA.

Tack Coat shall meet the requirements of Section 407, Tack Coat.

**Equipment**

**Option A.**

A minimum of two machines shall be used: a preheater and a recycling machine. The Contractor shall use hot in-place asphalt concrete recycling equipment appearing on the current Materials Bureau Approved List. Detailed requirements and procedures for approval are available from the Materials Bureau.

**Option B.**

The requirements of Section 400, Bituminous Pavement shall apply. Equipment requirements for cold milling shall meet the requirements of Section 490, Cold Milling.

**CONSTRUCTION DETAILS:**

**Option A.**

Weather and seasonal limitations for the entire in-place recycling operation shall conform to the general requirements outlined in Subsection 401-3.01, Weather and Seasonal Limitations for top course asphalt concrete.

Prior to beginning pavement recycling operations the pavement surface to be rehabilitated shall be cleaned of all dirt and other objectionable materials by blading, brooming or other methods approved by the Engineer.

The existing asphalt pavement surface shall be evenly heated, scarified and reworked to the widths and depths shown on the plans. Immediately following the scarifying process the virgin asphalt concrete admixture shall be added in the amounts specified or as directed by the Engineer. The virgin asphalt concrete shall be mixed with the scarified material and the resultant mixture shall be homogenous. The heated oscillating screed shall then pass over the material, leaving the resultant pavement course to the specified line and grade.

**Option B.**

The requirements of section 400, Bituminous Pavement shall apply. Cold Milling shall be in accordance with Section 490, Cold Milling. Tack Coat shall be applied to milled surfaces in accordance with Section 407, Tack Coat.

**Compaction.**

The requirements of Subsection 401-3.06, Rollers apply. The operation of the rollers during the placement of this item including the speed, the amplitude settings, the vibration frequency, and the weight of the rollers will be controlled by the Contractor.

Subsection 401-3.12, Compaction shall be deleted and replaced with the following:
Immediately after the asphaltic mixture has been spread, struck off and surface irregularities adjusted, thoroughly and uniformly compact by rolling. Roll the surface when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving. Initially roll the pavement with the roller traveling parallel to the centerline of the pavement beginning at each edge and working toward the super-elevated edge. The types of rollers used, the number of rollers used, and the number of roller passes made will be controlled by the Contractor.

Compact the pavement sufficiently to achieve a minimum of 96% of the Project Target Density (PTD) in a single test and 98% of the PTD calculated as a moving average of the last 10 test as determined by a nuclear density gauge. Take a gauge reading at a site, randomly selected by the Engineer, approximately every 153 m along the length of the pavement for each pass of the paver. On every fifth day of production take 5 nuclear gauge readings, loose mix samples, and cores as described below in "Test Section" to assure that adequate density is being achieved and to recalibrate the nuclear gauge. Deliver the pavement core samples and the loose mix samples to the appropriate Department Regional Laboratory no later than the day following placement for analysis. If insufficient density is being achieved in the pavement cores, paving operations will be stopped and a new Test Section will be required.

If the moving average of the last 10 test falls below 98% of the PTD, paving operations will be stopped and a new Test Section will be required. Paving operations for this item will not be permitted until a new test section has been placed and a new PTD established.

When the rolling operation is complete there should be no visible shallow ruts, ridges, other irregularities, or roller marks in the pavement. If these imperfections are present, correct the imperfections or relay the pavement at no additional cost to the Department as ordered by the Engineer.

Correct at once any displacement occurring as a result of reversing the direction of the roller, or from other causes, by the use of rakes and addition of fresh mixture as required. Exercise care in rolling not to displace the line and grade of the edges of the bituminous mixture. To prevent adhesion of the mixture to the drum(s) of the roller, properly moisten the drums with water, or water mixed with small quantities of detergent or other Department approved materials. If a pneumatic tire roller is used, the pneumatic drive wheels may be coated with a fine mist spray of fuel oil or other similar materials to prevent pneumatic tire pickup. In all instances, protect the surface of the pavement from drippings of fuel oil or any other solvents used in paving, compaction or cleaning operations.

Unless otherwise directed by the Engineer, vibratory rollers have pneumatic drive wheels shall compact the longitudinal joint by using one of the pneumatic drive wheels to overlap the joint in two (2) passes with the drum operating static. Unless otherwise directed by the Engineer, dual vibrating drum rollers shall compact the joint by overlapping the joints in two (2) passes with both drums operating static.

Along forms, curbs, headers, walls and other areas not accessible to the roller, compact the mix thoroughly with mechanical tampers as directed by the Engineer. On depressed areas, a trench roller or small vibratory roller approved by the Engineer may be used. Cleated compression strips also may be used under the roller to transmit compression to the depressed area.

Remove any mixture that becomes loose and broken, mixed with dirt, or is in any way defective and replace with fresh hot mixture and compact to conform with the surrounding area. Correct any area showing an excess or deficiency of asphaltic material to the satisfaction of the Engineer.

The Contractor should note that if he elects to use vibratory compaction equipment, he assumes full responsibility for the cost of repairing all damage which may occur to highway components and adjacent property.

Add the following to the end of Subsection 401-3:

Test Section.
Prior to paving operations for this item, construct a test section on the project site at a location approved by the Engineer, at least 30 m long and a maximum of 460 m long, one full lane width, and of the same depth specified for the construction of the course which it represents. The test section is for the sole purpose of calibrating the nuclear density gauge which will be used on this project. Construct the test section using the same equipment and procedures to be used in the construction of the remainder of the course being laid. Construct the test section the following manner:

1. Determine limits of test section. If multiple rollers are to be tested, each rolling train must be evaluated in a separate test section.

2. Compaction equipment must meet the requirements of Subsection 401-03.06 rollers. If vibratory compaction equipment is used, the roller settings must be in accordance with the Department's approved list for Bituminous Concrete Vibratory Compaction Equipment.

3. Density testing should be accomplished using a nuclear density gauge. This gauge should consist of a radioactive source combined with moisture detector, scaler and other basic components housed in a single backscatter unit. This gauge should be operated by personnel trained in the principles of nuclear testing and safety practices.

4. During the construction of the test section obtain two loose mix samples in accordance with ASTM D979, Standard Test Method for Sampling Bituminous Paving Mixtures. The samples should be taken periodically throughout the placement of the test section so as to represent production during the construction of the test section.

5. Once an appropriate amount of material has been placed, compact the pavement with 2 vibratory passes of the breakdown roller. Perform density tests at three sites randomly selected by the Engineer, at least 0.6 m from the edge of the pavement, to determine the level of compaction. These sites will be selected in accordance with Department written instructions, available from the Regional Materials Engineer or the Director, Materials Bureau. Mark the sites so that subsequent tests can be performed at the same locations. After every two subsequent passes of the compaction equipment, density measurements shall be performed at the three selected sites. The Engineer will visually inspect the course being compacted after each pass of the compaction equipment for obvious signs of distress. If distress occurs, different compaction methods must be used until satisfactory results are achieved. Rolling and testing shall continue until no further increase (less than 8 kg/m³) in density is obtained, or until the Engineer directs compaction efforts to stop because the pavement shows signs of distress.

If the average of the 3 density measurements shows a significant loss of density (greater than 8 kg/m³), the control strip will be considered invalid because of over rolling and probable distress in the pavement, and placing of a new test strip shall begin immediately. The original control strip will be permitted to remain in place unless significant damage is visually apparent.

6. After the test strip has been compacted perform 5 additional density tests at sites in the test strip randomly selected by the Engineer, and extract a core. The density of each core will be determined by the Engineer. If the density of each core is between 91% to 97% of the mixture's maximum theoretical density, as determined from the pavement core, compaction will be deemed to be acceptable. If this requirement is not met the test section is not acceptable and another test section will have to be placed. After the Contractor has exhausted all reasonable efforts to reach the 91% to 97% level, the Engineer has the option of establishing a lesser density to prevent excessive damage to the mat or underlying layer.

Determine the average difference between the 5 core densities and the 5 nuclear gauge densities. This difference will be used to adjust the average of the 5 nuclear gauge densities to establish a PROJECT TARGET DENSITY (PTD). Once a PTD has been established full scale paving operations may begin.
Option A

The Contractor shall sample, test and supply test results to the Engineer on recycled loose mix samples taken from the project. The testing shall be performed by properly trained personnel in a laboratory approved by the Regional Materials Engineer. The following tests shall be performed on representative recycled loose mix samples.

<table>
<thead>
<tr>
<th>Test</th>
<th>Reference Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stability</td>
<td>ASTM D1559/AASHTO T245</td>
</tr>
<tr>
<td>Flow</td>
<td>ASTM D1559/AASHTO T245</td>
</tr>
<tr>
<td>Air Voids</td>
<td>ASTM D2726 &amp; D2041/AASHTO T209</td>
</tr>
<tr>
<td>Penetration</td>
<td>ASTM D5-86/AASHTO T209</td>
</tr>
<tr>
<td>Aggregate Gradation</td>
<td>NYSDOT Materials Bureau MM5</td>
</tr>
<tr>
<td>Asphalt Content</td>
<td>NYSDOT Materials Bureau MM5</td>
</tr>
</tbody>
</table>

**Testing Frequency.** A minimum of three samples shall be tested at the start of the project. Any time there is a change to the virgin asphalt concrete or the rate of usage, two samples of the recycled loose mix samples shall be tested. Each day, during routine production, one sample shall be taken from each kilometer recycled or fraction thereof. One of these daily samples shall be tested and the remaining samples shall be retained until the acceptance of the project. If, in the opinion of the Engineer, the existing pavement condition changes or the recycled pavement is not satisfactory, additional tests shall be performed as ordered by the Engineer at no cost to the State.

Test results shall be made available to the Engineer in a timely manner. If conditions warrant, the Engineer may stop work until the required test results become available.

**Option B.**

If the Contractor chooses to use RAP in the top course asphalt concrete in-lay, the testing shall conform to the testing procedure outlined in Option A. If no RAP is used in the top course asphalt concrete in-lay, the requirements of Section 401, Plant Mix Pavements-General shall apply.

**METHOD OF MEASUREMENT:**

**Option A.**

Hot In-Place Recycling Asphalt Concrete shall be measured by the number of square meters of pavement surface to be recycled as described in this specification.

Virgin asphalt concrete admixture when required shall be measured by the number of metric tons placed in accordance with this specification.

**Option B.**

Cold milling shall be measured by the square meter in accordance with Subsection 490-4, Method of Measurements. Asphalt concrete shall be measured by the number of metric tons placed in accordance with this specification.

The quantity of tack coat incorporated into the work will be the number of liters of asphalt emulsion measured at 16°C.

**BASIS OF PAYMENT:**

**Option A.**
ITEM 01403.5096 M - HOT IN-PLACE RECYCLING ASPHALT CONCRETE
ITEM 01403.5196 M - VIRGIN ASPHALT CONCRETE ADMIXTURE - TOP COURSE
ITEM 01403.5396 M - VIRGIN ASPHALT CONCRETE ADMIXTURE - BINDER COURSE
ITEM 01490.0196 M - COLD MILLING ASPHALT CONCRETE
ITEM 01407.0196 M - TACK COAT
ITEM 01403.0196 M - ASPHALT CONCRETE - TOP COURSE (IN-LAY)
ITEM 01403.0296 M - ASPHALT CONCRETE - BINDER COURSE (IN-LAY)

Hot In-Place Recycling Asphalt Concrete. The unit price bid per square meter for this item shall include the cost of furnishing all labor, materials, tools, equipment and incidentals necessary to complete the work including cleaning the existing pavement, all heating and scarifying, mixing, repaving, and compaction of the recycled material. The virgin asphalt concrete admixture will be paid separately as outlined below.

Virgin Asphalt Concrete Admixture. The unit price bid per metric ton for this item shall include the cost of furnishing the mix design and all materials including asphalt cement and all equipment and labor necessary to complete the work.

Option B.

Cold Milling. Payment for this item shall be in accordance with Subsection 490-5, Basis of Payment.

Asphalt Concrete. The unit price for this item shall include the cost of furnishing all materials, equipment and labor necessary to complete the work.

Tack Coat. The unit price for this item shall include the cost of furnishing all materials, equipment and labor necessary to complete the work.

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>ITEM DESCRIPTION</th>
<th>PAY UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>01403.5096 M</td>
<td>Hot In-Place Recycling Asphalt Concrete</td>
<td>Square Meter</td>
</tr>
<tr>
<td>01403.5196 M</td>
<td>Virgin Asphalt Concrete Admixture-Top Course</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>01403.5396 M</td>
<td>Virgin Asphalt Concrete Admixture-Binder Course</td>
<td>Metric Ton</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>ITEM DESCRIPTION</th>
<th>PAY UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>01490.0196 M</td>
<td>Cold Milling Asphalt Concrete</td>
<td>Square Meter</td>
</tr>
<tr>
<td>01407.0196 M</td>
<td>Tack Coat</td>
<td>Liter</td>
</tr>
<tr>
<td>01403.0196 M</td>
<td>Asphalt Concrete-Top Course (In-lay)</td>
<td>Metric Ton</td>
</tr>
<tr>
<td>01403.0296 M</td>
<td>Asphalt Concrete-Binder Course (In-lay)</td>
<td>Metric Ton</td>
</tr>
</tbody>
</table>