**Delete Section 405 of the Standard Specifications for this project and replace with the following:**

# Description

**405.01** This work consists of softening the existing asphalt pavement with heat, loosening the top ♦ inches, adding the furnished hot mix asphalt (HMA), and thoroughly remixing and leveling the blended material. It shall be accomplished by a single multi‑step process of cleaning, heating, milling, applying a rejuvenating or recycling agent, pugmill mixing, re-leveling, and screeding in a single pass of the equipment, and compacting the remixed HMApavement. The rehabilitated layer shall conform to the lines, grades, thicknesses and typical cross section shown on the plans or established.

# Materials

**405.02** The new HMA to be added shall meet the requirements of Section 403 for the grading specified in the Contract and as modified herein. The finished HMA pavement shall be a homogeneous layer composed of in-place HMA pavement, rejuvenating or recycling agent, and new hot mix asphalt.

Rejuvenating or recycling agent shall meet one of the following requirements:

1. Rejuvenating agent shall meet the requirements of subsection 702.02(f).
2. Recycling agent shall either meet the requirements of Table 702-6 except that the residual penetration shall be greater than 300 dmm or shall meet the requirements of subsection 702.02 (e).

# Construction Requirements

**405.03** Weather limitation shall be per subsection 401.07 (Layers below Top Layer criteria).

**405.04** **Equipment.** Heating and remixing treatment shall be accomplished using the following equipment:

1. Preheating mechanisms consisting of clusters of heaters, which radiate thermal energy into the existing asphalt pavement to the required penetration depth without breaking aggregate particles, charring the existing asphalt pavement, or producing undesirable pollutants. The heating mechanism shall be so equipped that the heat application shall be under totally insulated enclosed hoods.
2. A self-propelled processing unit containing the following:
3. A recycling machine equipped with additional heaters conforming to the same requirements as the pre‑heaters.
4. A unit capable of uniformly loosening the existing asphalt pavement to the depth specified without degrading the aggregates. If the recycled product fails to meet the requirements of Table 405-1 at any time during the operation, the Engineer may compare gradations before milling and after milling to assure that aggregates are not being degraded by the milling process.
5. A controlled system for adding and uniformly blending a rejuvenating or recycling agent at a predetermined rate with the reclaimed mix during the remixing and leveling operation. The application rate for the added material shall be synchronized with the machine speed to provide uniform application. The actual rate used may be adjusted as determined by the Engineer.
6. A blending unit consisting of a twin shafted pugmill capable of thoroughly mixing the loosened HMA pavement, furnished HMA, and rejuvenating or recycling agent at the pugmill so as to produce a uniform mixture.
7. A unit capable of augering the heated and loosened material into a windrow at the center of the machine before intake into the blending unit.
8. A leveling unit which shall redistribute the remixed material over the width being processed and finished so as to produce a uniform cross section and surface, as shown on the plans and per subsection 401.10.
9. Rollers capable of achieving the specified density requirements.

**405.05 Construction Methods.** Heating and remixing shall proceed as follows:

Before commencing heater remixing operations, the pavement shall be cleaned of all loose material. Power brooms shall be used, supplemented when necessary by hand brooming andsuch other tools as required to bring the surface to a clean, suitable condition, free of deleterious material.

The pavement surface shall be evenly heated, milled, and remixed to the widths and depths shown on the plans. Heating shall be controlled to assure uniform heat penetration without overheating, coking, or sooting of the asphalt and aggregate. The rejuvenating or recycling agent shall be applied uniformly to the mixed material before remixing with the furnished HMA in the pugmill. The rate of application will be approved by the Engineer based upon the Contractor's proposed mix design.

The heating operation shall extend at least 4 inches beyond the width of remixing on both sides. When a pass is made adjacent to a previously placed mat, the longitudinal seam shall extend at least 2 inches into the previously placed mat. The temperature of the milled material shall not exceed 300 °F when measured immediately behind the milling machine. The milled material shall be picked up and mixed in a blending unit and then distributed and leveled by an activated screed assembly. The temperature of the remixed material shall not be less than 235 °F directly behind the screed or as directed.

A Compaction Test Section (CTS) shall be constructed and documented for the heating and remixing treatment in conformance to subsection 401.17. If the CTS fails to meet the requirements of subsection 401.17, the Contractor may elect to rework the CTS in lieu of price reductions. Reworked sections will not be measured and paid for separately.

The remixed HMA pavement shall be compacted immediately after it has been distributed and leveled. The temperature of the pavement during compaction shall be at least 185 °F unless otherwise approved.

Pavement shall be compacted to a density of 92 to 96 percent of the maximum theoretical density, determined according to CP 51 for each density test. Longitudinal joint density reports for heating and remixing shall be submitted for information only. A minimum of 48 hours shall elapse before any overlay is applied.

The Contractor shall protect the area adjacent to the work from heat damage. All damages to this area resulting from heat damage shall be repaired or replaced as directed by the Engineer and shall be at the Contractor's expense. The Engineer may require the Contractor to furnish firefighting equipment at the Contractor’s expense.

The Contractor shall meet all local, county, state, and federal air pollution regulations. All costs and extra work necessary to comply with air pollution regulations shall be at the Contractor’s expense.

Areas that flush, rut, ravel, or pothole shall be repaired or patched at the Contractor's expense.

**405.06 Mix Design.** The Department will have sampled and tested the existing in-place pavement to be recycled to establish the mix design requirements set forth in Table 405-1 before start of work. Test results will be available for Contractor’s review at the Region Materials Lab. Before starting hot recycling operations, the Contractor shall furnish the Engineer with a proposed mix design following the procedures of CP-L 5140. The proposed mix design conforming to CDOT Procedures shall be submitted to the Engineer for approval within 14 working days before starting of the recycling operation. The mix design shall be based on samples obtained by the Contractor in the presence of the Engineer, and shall include the following elements:

1. The asphalt content of the pavement to be recycled.
2. The penetration at 77 °F and viscosity at 140 °F of the asphalt cement contained in the pavement to be recycled.
3. Gradation of the pavement to be recycled.
4. Type and amount of rejuvenating or recycling agent recommended.
5. Penetration at 77 °F and viscosity at 140 °F of the recycled mixture (includes asphalt from the pavement to be recycled, new asphalt cement, and rejuvenating or recycling agent).
6. Aggregate gradation of the recycled mixture (includes aggregates in the pavement to be remixed combined with the added new aggregates).
7. Hveem Stability, effective voids in the mineral aggregate (effective VMA), air voids, voids filled with asphalt (VFA), maximum specific gravity, bulk specific gravity, and Lottman test results on the proposed combined mix.

**Table 405-1**

**Mix Design and Field Production Requirements**

|  |  |  |  |
| --- | --- | --- | --- |
| **Test** | **Test Procedure** | **Mix Design**  **Requirements** | **Field Production**  **Requirements** |
| Asphalt Content | CP-L 5120 | Report in Job Mix Formula (JMF) | Report in production |
| Sieve Analysis | CP 31 | Report in JMF |  |
| Lab Compaction N(des), Mixing Temp. 154 °C (310 °F), Compaction Temp 138 °C (280 °F) | CP-L 5115 | ▲ Gyrations |  |
| Abson Recovery | AASHTO T‑170 | Report in JMF |  |
| Penetration @ 25 °C (77 °F) | AASHTO T‑49 | Report in JMF |  |
| \*Viscosity @ 60 °C (140 °F) (combined) | AASHTO T‑202 | Report in JMF |  |
| Max. Sp. Gr. of Mix | CP 51 | Report in JMF |  |
| Hveem Stability | CP-L 5106 | 28 min. | 28 min. |
| VMA eff. (Effective Voids in Mineral Aggregate) | CP 48 | Report in JMF | Report in production |
| Air Voids | CP-L 5115 | 2.5 - 4.5 | Form 43 Target Voids Tolerance +/- 1.2% |
| Voids Filled with Asphalt | Asphalt Institute Manual Series 2 | Report in production | Report in production |
| Bulk Specific Gravity | CP 44 or CP 81 |  | 92%-96% of Gmm |
| Lottman Test | CP-L 5109 | 70% min. | Report in production |

When Laboratory tests indicate that the proposed job-mix formula complies with the specifications as revised for the project, a Form 43 shall be executed between the Engineer and the Contractor to establish the job-mix formula for the field production of remixed HMA.

1. *Acceptance Testing*. The Contractor shall obtain and submit samples of the combined mixture to the Engineer daily for testing and review. Samples shall be taken by the contractor per CP 41, or as approved by the Engineer, and the Mix Design for Heater Remixing will be verified per subsection 106.05(e) Mix Verification Testing, using the element for Air Voids only. Production may continue if the Quality Level for Air Voids is 70 or greater when evaluated per subsection 106.05(e). If the mixture properties do not correlate with the plan mix design, work may be suspended until proper corrective actions or adjustments can be made. This may include but not be limited to modifying the Furnish HMA material or changing amount and type of rejuvenating or recycling agent added to the combined mixture.

Before starting Heating and Remixing Treatment the Contractor shall select the method of Density Acceptance Testing to be determined by either CP 44 or CP 81. If CP 44 is selected as the testing method for determining density, the Contractor shall submit core samples based on a stratified random schedule. Coring will not be measured and paid for separately but shall be included in the work. If CP 81 is selected as the testing method for determining density, the Contractor shall accept the variability in thickness of recycled mat as part of the variability in the testing procedure. Pavement shall be compacted to a density of 92 to 96 percent of the maximum theoretical density, determined according to CP 51 for each density test. Acceptance Samples for Density will be evaluated per subsection 105.03. The Factor “F” for compaction shall be 7.

1. *Process Control Testing*. The Contractor shall perform Process Control Testing for density of the remixed HMA pavement. This testing shall be performed at the minimum rate of one density test per 5000 square yards of compacted remixed pavement or fraction thereof. For each density test, The Contractor shall determine the Maximum Specific Gravity for that material, per CP 51. The Contractor may elect to perform PC Density Testing by CP 44 or CP 81. This testing shall be independent of the Acceptance Testing performed on the project. In addition to density testing, the Contractor shall document daily roller patterns and production rates for the heating and remixing treatment. All work associated with this quality control shall be documented in the Contractor’s quality control plan, which shall be submitted for approval before starting the heating and remixing treatment.

**405.07** Milling will be deemed to be acceptable when the average measured depth for the full width of the milling is a minimum of ♦ inches or as approved by the Engineer. The Engineer will randomly verify thickness of milling throughout the day’s production. If the Engineer determines that the minimum depth has not been achieved, the work will be suspended, and the Contractor shall prepare a written correction plan including a method statement that defines how the minimum depth shall be achieved. Work shall resume upon receipt and approval of the correction plan. After this plan has been accepted, further random thickness verification that determines the milled thickness is less than the minimum of ♦ minus 0.25 inches will result in the Contractor being assessed a price reduction of $0.25 per square yard for that entire day’s heating and remixing production. The Engineer may suspend work at any time if the equipment provided is not capable of heating and remixing the minimum thickness as specified in the plans.

**405.08 Smoothness Testing.** The longitudinal surface smoothness of the pavement surface before and after heating and remixing shall be tested per subsection 105.07.

# Method of Measurement

**405.09** Heating and Remixing Treatment will be measured by the actual number of square yards that are completed and accepted.

# Basis of Payment

**405.10** The accepted quantities of Heating and Remixing Treatment will be paid for at the contract unit price per square yard.

Payment will be made under:

**Pay Item Pay Unit**

Heating and Remixing Treatment Square Yard

Payment will be full compensation for all materials, labor and equipment required to complete the work including cleaning, heating, milling, adding rejuvenating agent, remixing, redistributing, re-leveling, compacting, and sampling and testing the existing and remixed pavement surface.

The rejuvenating or recycling agent will be measured and paid for under the Pay Item 411, Asphalt Rejuvenating Agent per Section 411.

The new HMA plant mix material added during the process will be measured and paid for per Section 403, under Pay Item 403, Furnish Hot Mix Asphalt. Acceptance of Pay Item 403 Furnish Hot Mix Asphalt will be per subsection 105.05, Conformity to the Contract of Hot Mix Asphalt. The Pay Factor for the Density Element of Pay Item 403 Furnish Hot Mix Asphalt shall be PF = 1.

The Contractor's mix design and production sampling will not be measured and paid for separately but shall be included in the work.

Smoothness testing of the roadway surface according to subsection 405.08 will not be measured and paid for separately but shall be included in the work.

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**Instructions** **to** **Designers** (delete instructions and symbols from final draft):

▲ Should be the same gyrations used in the Project Special Provision, Revision of Section 403 - Hot Mix Asphalt.

♦Insert the thickness of the existing HMA pavement to be heated and remixed.