

**REVISION OF SECTION 405
HEATING AND REMIXING TREATMENT**

Section 405 of the Standard Specifications is hereby deleted for this project and replaced 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 HMA pavement. 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:

- (a) Rejuvenating agent shall meet the requirements of subsection 702.04.
- (b) Recycling agent shall either meet the requirements of Table 702-4 except that the residual penetration shall be greater than 300 dmm, or shall meet the requirements of subsection 702.03(c).

CONSTRUCTION REQUIREMENTS

405.03 Weather limitation shall be in accordance with subsection 401.07 (Layers below Top Layer criteria).

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

- (a) 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.
- (b) A self-propelled processing unit containing the following:
 - (1) A recycling machine equipped with additional heaters conforming to the same requirements as the pre-heaters.
 - (2) 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 prior to milling and after milling to assure that aggregates are not being degraded by the milling process.
 - (3) 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.
 - (4) A blending unit consisting of a twin shafted pugmill capable of thoroughly mixing the loosened HMA pavement, added virgin HMA, and rejuvenating or recycling agent at the pugmill so as to produce a uniform mixture.

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- (5) A unit capable of augering the heated and loosened material into a windrow at the center of the machine prior to intake into the blending unit.
 - (6) A leveling unit to redistribute the remixed material over the width being processed and finished, so as to produce a uniform cross section and surface.
- (c) Rollers capable of achieving the specified density requirements.

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

Prior to commencing heater remixing operations, the pavement shall be cleaned of all loose material. Power brooms shall be used, supplemented when necessary by hand brooming and such 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 prior to 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.

The leveling machine must be capable of screeding the full width of remixed material. Leveling shall be accomplished to produce a uniform cross section as shown on the plans.

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 not less than 185 °F unless otherwise approved.

Density shall be 92 to 96 percent of maximum theoretical density as determined by CP 51 and in accordance with subsection 401.17. Longitudinal joint density will be evaluated in accordance with subsection 401.17 and subsection 401.22. The longitudinal joint density for heating and remixing shall be submitted for information only and will not be evaluated. 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 at the Contractor's expense. The Engineer may require the Contractor to furnish fire fighting 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.

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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 prior to start of work. Test results will be available for Contractor’s review at the Region Materials Lab. Prior to starting hot recycling operations, the Contractor shall furnish the Engineer with a proposed mix design following the procedures of CPL 5140. The proposed mix design conforming to CDOT Procedures shall be submitted to the Engineer for approval within 14 working days prior to 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

TEST	TEST PROCEDURE	MIX DESIGN REQUIREMENTS	FIELD PRODUCTION REQUIREMENTS
Asphalt Content	CPL 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)	CPL 5115	♥ Gyration	
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	CPL 5106	28 min.	28 Min.
VMA eff. (Effective Voids in Mineral Aggregate)	CP 48	Report in JMF	Report in production
Air Voids	CPL 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	CPL 5109	70% min.	Report in production

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- (a) **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 in accordance with CP 41, or as approved by the Engineer and the Mix Design for Heater Remixing will be verified as per Revision of Sections 106 Hot Mix Asphalt - Verification Testing, 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 in accordance with 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.

Prior to 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 Quality Assurance random schedule. 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. Acceptance Samples for Density will be evaluated as per subsection 105.03. The Factor "F" for compaction shall be 7.

- (b) **Quality Control Testing.** The Contractor shall perform Quality Control Testing for density of the remixed HMA pavement. This testing shall be performed at the minimum rate of 1 density test per 5000 square yards of compacted remixed pavement. For each density test, The Contractor shall determine the Maximum Specific Gravity for that material, in accordance with CP 51. The Contractor may elect to perform QC Density Testing by Colorado Procedures 44 or 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 prior to 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 of 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 shall be tested in accordance with 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. Furnish Hot Mix Asphalt will be measured by the ton.

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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
Furnish Hot Mix Asphalt	Ton

Payment will be full compensation for all materials, labor and equipment required to complete the work including cleaning, heating, milling, adding rejuvenating agent, remixing, adding new HMA, 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 in accordance with Section 411.

The new HMA plant mix material added during the process will be measured and paid for under the Pay Item 403 Furnish Hot Mix Asphalt. Asphalt Cement (PG ●) for this item will not be measured and paid for separately, but shall be included in the work. Acceptance of Pay Item 403 Furnish Hot Mix Asphalt will be in accordance with the standard special provision, Revision of Sections 105 and 106, Quality 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 section 405.08 will not be measured and paid for separately, but shall be included in the work.

INSTRUCTIONS TO DESIGNERS (delete instructions and symbols from final draft):

This Project Special Provision is designed for Voids Acceptance only

- Insert the thickness of the existing HMA pavement to be heated and remixed.
- ♥ Should be the same gyrations used in the Project Special Provision Revision of Section 403 Hot Mix Asphalt.
- Should be the same PG grade of asphalt cement used in the Project Special Provision Revision of Section 403 Hot Mix Asphalt.