Designer Note: This special should be inserted into contracts using Cold-in-Place Recycling (CIR) with Emulsified Asphalt (CBM).

COLD-IN-PLACE RECYCLING (CIR) WITH EMULSIFIED ASPHALT (CBM)

Effective: December 1, 2025
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State of Illinois
Department of Transportation
Special Provision
for
COLD IN-PLACE RECYCLING (CIR) WITH EMULSIFIED ASPHALT (CBM)

Description. This work shall consist of cold milling and pulverizing existing bituminous layers to a specified depth and maximum size; mixing emulsified asphalt, water and additives with the recycled material; and spreading and compacting the mixture.

Materials. Materials shall be according to the following Articles of Division 1000 – Materials.

Item	Article/Section
(a) Portland Cement (Note 1)	1001
(b) Water	1002
(c) Fine Aggregate (Note 2)	1003
(d) Coarse Aggregate (Note 2)	1004
(e) Reclaimed Asphalt Pavement (Note 3)	1031
(f) Emulsified Asphalt (Note 4)	1031.06
(g) Cold Pulverized Material (Note 5)	

Note 1. If necessary, the mix design may require additional additives to increase fines in the mix. The type and allowable percentage will be described in the mix design.

Note 2. The mix design will specify gradation and quality of any additional aggregate.

Note 3. The Engineer may allow reclaimed asphalt pavement (RAP) from Fractionated RAP, Homogeneous, or Conglomerate RAP stock piles as specified in Article 1031.02 or from other millings of the existing pavement, “B” quality or better. The RAP material shall not exceed the maximum size requirement of the cold pulverized material, and when blended with the cold pulverized material shall produce a product which meets the specifications of AASHTO MP 31-17.

Note 4. The emulsified asphalt shall be selected for the project by the emulsified asphalt supplier based on the Contractor’s mix design. The penetration of the supplied emulsified asphalt shall be within ±25 dmm of the penetration

of the design emulsified asphalt but cannot exceed the values listed in the table below. A representative from the emulsified asphalt supplier shall be on the job site at the beginning of the project to monitor the characteristics and the performance of the emulsified asphalt. Throughout the job, the representative shall be available to check on the project and make adjustments to the emulsified asphalt formulation as required. The emulsified asphalt shall be received on site at a temperature no greater than 120°F (49°C).

The emulsified asphalt shall meet the following requirements:

CIR EMULSIFIED APSHALT MATERIAL SPECIFICATION			
Test	Procedure	Minimum	Maximum
Viscosity, Saybolt Furol, at 77°F (25°C), SFS	AASHTO T 72	20	100
Sieve Test, No. 20 (850 μm), retained on sieve, %	AASHTO T 59		0.10
Storage Stability Test, 24 hr., %	AASHTO T 59		1.0
Distillation Test, Residue from distillation to 347 ±9°F (175 ±5°C), %	AASHTO T 59 [1]	64.0	
Oil distillate by volume, %	AASHTO T 59		1.0
Penetration, 77°F (25°C), 100 g, 5 s, dmm	AASHTO T 49	75	200

Note: 1. Modified AASHTO T 59 procedure – distillation temperature listed above with a 20-minute hold.

Note 5. Prior to the addition of emulsified asphalt, the gradation of the cold pulverized material shall be 100% passing the 1 1/2 in. (37.5 mm).

Equipment. Equipment shall be according to the following.

Item	Article/Section
(a) Self-propelled Pneumatic-Tired Rollers (Note 1)	1101.01(c)
(b) Steel Wheel Tandem Rollers	1101.01(e)(1)
(c) Vibratory Roller (Note 2)	1101.01(g)
(d) Mechanical Sweeper	1101.03
(e) Self-propelled Milling Machine	1101.16(a)
(f) Spreading and Finishing Machine	1102.03
(g) Aggregate Spreaders	1102.04
(h) Dry Cement Spreader (Note 3)	
(i) Multi-unit Recycling Train (Note 4, 6, 8)	
(j) Single-unit Recycler (Note 5, 6, 8)	
(k) Pickup Machine (Note 7)	

Note 1. The self-propelled pneumatic-tired roller shall have a gross weight (mass of not less than 25 Tons (23 Metric Tons).

Note 2. The double drum vibratory rollers shall have a gross operating weight (mass) of not less than 10 Tons (9 Metric Tons) and a width of 78 in. (1950 mm).

Note 3. Spreaders used to apply dry cement recycling additives shall be non-pressurized mechanical vane-feed, cyclone or screw type capable of providing a consistent, accurate and uniform distribution of material while minimalizing dust during construction. The spreader shall have the ability to control the cement content to within ±0.5 lb./sq. yd. (0.27 kg/ sq. m) of the design target.

Note 4. The multi-unit recycling train shall contain the following.

a. A self-propelled cold milling machine that is capable of pulverizing the existing bituminous material in a single pass to the depth shown on the plans and to a minimum width of not less than 12.5 ft. (3.8 m). The machine shall have automatic depth controls to maintain the cutting depth to within 0.25 in. (6 mm) of that shown on the plans and shall have a positive means for controlling cross slope elevations. The use of a heating device to soften the pavement will not be permitted.

b. A material sizing unit having screening and crushing capabilities to reduce the cold pulverized material to the appropriate size. The screening and crushing unit shall have a closed-circuit system capable of continuously returning oversized material to the crusher. All of the pulverized material (100 percent) shall be processed to the maximum size requirements as specified.

c. A mixing unit equipped with a belt scale for the continuous weighing of the pulverized and sized bituminous material and a coupled/interlocked computer controlled liquid metering device. The mixing unit shall be an on-board completely self-contained pugmill. The liquid metering device shall be capable of automatically adjusting the flow of emulsified asphalt to compensate for any variation in the weight of pulverized material coming into the mixer. The metering device shall deliver the amount of emulsified asphalt to within ± 0.2 percent of the required amount by weight of pulverized bituminous material (for example, if the design requires 3.0 percent, the metering device shall maintain between 2.8 percent to 3.2 percent). The emulsified asphalt pump should be of sufficient capacity to allow emulsion contents up to 4.0 percent by weight of pulverized bituminous material. Also, automatic digital readings will be displayed for both the flow rate and total amount of pulverized bituminous material and emulsified asphalt in appropriate units of weight and time.

Note 5. The single-unit recycler shall be a self-propelled cold milling machine/cold recycling machine with a down cutting cutter head capable of pulverizing and recycling the existing hot-mix asphalt pavement to a maximum depth of 5 in. (125 mm), incorporate the emulsified asphalt and water, and mix the materials to produce a homogeneous material. The minimum power of this machine is 900 hp (670 kW). The machine shall be capable of pulverizing and recycling not less than 12.5 ft. (3.8 m) wide in each pass.

The machine shall have two systems for adding emulsified asphalt and water, with each system having a full-width spray bar with a positive displacement pump interlocked to the machine's ground speed to insure that the amount of emulsified asphalt and water being added is automatically adjusted with changes to the machine's ground speed.

Each additive system shall have its own spray bar equipped with 2 nozzles per ft (6 nozzles per m) of spray bar and be capable of incorporating up to 7 gal./sq. yd. (31.7 L/sq. m) of emulsified asphalt and/or water. Individual valves on the spray bar shall be capable of being turned off as necessary to minimize emulsified asphalt and water overlap on subsequent passes.

Note 6. Any additives such as water added by the recycling equipment at the mill head or mixing unit shall be controlled through liquid metering devices capable of automatically adjusting for the variation in the weight of the pulverized material going into the mixing unit. The metering devices shall be capable of delivering the amount of additive to within ±0.2 percent of the required amount by weight of the pulverized bituminous material. A capability of adding up to 5% water by weight of the pulverized bituminous material, if necessary, based on environmental and material requirements, is mandatory. It will not be required to meter the water added at the milling machine to control dust in the screens, belts, or crusher/material sizing unit.

Note 7. The pick-up machine shall be capable of removing the entire windrow down to the remaining underlying material.

Note 8. The recycling units, single-unit and multi-unit shall be calibrated annually. Copies of the calibration charts shall be submitted to the Engineer prior to production.

CONSTRUCTION REQUIREMENTS

Weather Limitations. Unless otherwise authorized by the Engineer, recycling operations shall be done between May 15th and September 15th for Districts 1 through 6, and between May 1st and September 15th for Districts 7 through 9. The air temperature at time of construction shall be a minimum 60°F (15°C) and the forecast for the next 48 hours shall be above 45°F (7°C) with no fog or rain. Air temperature shall be measured in the shade. The Engineer may restrict work when the heat index is greater than 100°F (38°C).

Authorized Project Delay. For working day contracts, the Contractor may request to delay the start of work for a period of up to 40 consecutive calendar days after the execution of the contract for the processing of the CIR mix design. The delay shall be requested by the Contractor at or prior to the time of the preconstruction meeting.

When approved, the charging of working days will begin at the termination of the delay.

Mix Design. CIR mix designs shall be in accordance with Illinois Modified AASHTO PP 86 and comprised of existing RAP, asphalt emulsion, and additives, if necessary. The mix design and all associated testing shall be performed using samples of each proposed material. RAP samples shall be either collected from the existing pavement at the project site representing the milling

depth. The mix design shall be completed by a design laboratory that is AASHTO accredited in Hot-Mix Asphalt.

Test Method	Criteria	Property
Indirect Tensile Strength, dry subset, Illinois Modified T 283	Minimum 45 psi (310kPa)	Cured Strength
Tensile strength ratio, Illinois Modified T 283	Minimum 0.70	Resistance to Moisture Induced Damage
Marshall Stability, dry subset, T 245	Minimum 1250 lbs. (5560 N)	Cured Stability
Retained Marshall Stability[1], T 245	Minimum 0.70	Resistance to Moisture Induced Damage
Raveling Test of Cold Mixed Bituminous Mixtures, ASTM D7196	Maximum 2.0% loss	Resistance to Raveling
Ratio of Asphalt Emulsion to Cement	Minimum 3.0:1.0	Prevent Rigid Behavior

[1] Retained Marshall stability = average of conditioned Marshall stability/average of dry Marshall stability

Preparation of Existing Pavement. Grass and other vegetation shall be removed from the edge of the existing pavement to prevent contamination of the pulverized bituminous material during the milling operation.

The existing pavement shall be milled to the required depth and width as indicated on the plans. Recycling shall be in a manner that does not disturb the underlying material in the existing roadway. The milling operation shall be conducted so that the amount of fines occurring along the vertical faces of the cut will not prevent bonding of the cold recycled materials. The pulverized bituminous material shall be processed to the required gradation specified, if the max gradation is exceeded, operations will be stopped until adequate adjustments are made. When a paving fabric is encountered during the CIR operation, the Contractor shall make the necessary adjustments in equipment or operations so that at least 90 percent of the shredded fabric in the recycled material is no more than 5 sq. in. (3200 sq. mm). Additionally, no fabric piece shall have any dimension exceeding a length of 4 in. (100 mm). These changes may include, but not be limited to, adjusting the milling rate or screens in order to obtain a recycled material meeting specification requirements. The Contractor shall be required to waste material containing over-sized pieces of paving fabric as directed by the Engineer. When the Contractor is aware that paving fabric exists, such as indicated on the plans, the Contractor will not receive additional payment. However, if the Contractor is not made aware of the paving fabric, then the Contractor shall receive additional payment for any necessary adjustments in equipment and operations.

Spreading Cement. If cement is required in the mix design, cement shall be spread over the existing pavement prior to the mixing operation. The spreading shall be done in a manner to minimize dusting. The mixing operation shall start within a half an hour of the dry cement being spread.

Mixing Operation. The pulverized material shall be processed through a mixing unit capable of combining the pulverized material, emulsified asphalt, water, and any additives to produce a homogeneous recycled mixture. The emulsified asphalt shall be incorporated into the pulverized bituminous material at the initial rate determined by the mix design(s) and approved by the Engineer. Sampling and mix design may determine different levels of emulsified asphalt at various portions of the project.

Spreading and Finishing. The recycled material shall be spread using a self-propelled paver. The material shall be transferred to the self-propelled paver via integral conveyor, or a pick-up machine shall be used to transfer the windrowed recycled material into the paver. The pick-up machine must be within 150 ft. (45 m) of the mixing unit. The recycled material shall be spread by a spreading and finishing machine in one continuous pass, without segregation, and to the lines and grades established by the Engineer.

Compaction. The compacted recycled material shall be at a thickness of 2.5 in. to 5.0 in. (63 mm to 125 mm). The recycled material shall be compacted according to the following.

(a) The effective rolling distance behind the spreading and finishing machine shall not exceed 150 feet. Rolling shall start no more than 30 minutes behind the paver. When possible, rolling shall not be started or stopped on uncompacted materials but with rolling patterns established so that they begin or end on previously compacted material.

(b) The breakdown roller shall be a steel wheel tandem or vibratory roller in either static or dynamic mode. Dynamic mode shall only be used if it is shown to not damage the mixture.

(c) Growth Curve. Rolling patterns shall be developed using growth curves. The Contractor shall perform a growth curve within the first 500 ft of mixture placed each day. The Contractor shall perform additional growth curves during the day if placement begins on a different lift or if mixture emulsion content changes by 0.5% or more. A new growth curve shall be performed if breakdown roller equipment changes.

The growth curve, consisting of a plot of lb./cu. ft. (kg/cu. m) versus the number of passes with the project breakdown roller, shall be developed. Roller speed during the growth curve development shall be the same as the normal compaction operation. The curve shall be established by using a nuclear gage in backscatter mode according to ASTM D 2950. Tests shall be taken after each pass until the highest lb./cu. ft. (kg/ cu. m) is obtained. This value shall be the target density.

(d) Quality Control by the Contractor. The Contractor shall control the compaction process by testing the mix density at random locations as determined according to the QC/QA document, "Determination of Random Density Test Site Locations", and recording the results on forms approved by the Engineer. Testing shall be performed according to ASTM D 2950 in backscatter mode with the same nuclear gage used for growth curve development. Longitudinal joint testing shall be located at each random density location at a distance equal to the lift thickness or a minimum of 2 inches (50 mm) from each pavement edge.

Density shall be between 95.0% and 102.0% of the target density. Unconfined edge density shall be a minimum of 93.0% of the target density. All density test results shall be reported to the Engineer prior to the start of the next day’s production. The Engineer shall be immediately notified of any failing tests and subsequent remedial action.

(e) Quality Assurance by the Engineer. The Engineer will conduct independent assurance density testing with a nuclear gage utilized in conjunction with daily growth curve development.

If the Contractor is not controlling the compaction process and is making no effort to take corrective action, the operation shall stop as directed by the Engineer.

Opening to Traffic. After the completion of compaction of the recycled material, no traffic, including that of the Contractor, shall be permitted on the completed recycled material for at least two hours. After two hours, rolling traffic may be permitted on the recycled material. This time may be adjusted by the Engineer to allow establishment of sufficient cure so traffic will not initiate raveling or permanent deformation. All loose particles that may develop on the pavement surface shall be removed by power brooming.

After opening to traffic, the surface of the recycled pavement shall be maintained in a condition suitable for the safe movement of traffic.

Maintenance. The Contractor shall maintain the recycled pavement in a manner satisfactory to the Engineer until the wearing course has been constructed. Maintenance related to Contractor construction procedures or quality of work, shall not be paid for separately.

Curing. Before placing the specified wearing course, the recycled pavement shall be allowed to cure until the moisture of the material is reduced to 2.5 percent or less. If a rain event occurs between the final cure and wearing course paving operations, additional moisture content testing shall be conducted to verify the moisture content does not exceed 2.5 percent prior to placing the wearing course. Moisture content testing shall be observed by the Engineer and the test samples shall be taken as a representative sample form the entire thickness of the CIR Unless otherwise directed by the Engineer, the specified wearing course shall be placed within two weeks of the recycled pavement final cure.

Quality Control / Quality Assurance.

QC/QA TESTING FREQUENCY		
Test	QC Frequency[1]	QA Frequency[1]
Pulverized Material Sizing and Gradation	1 per 0.5 day of production	1 per day of production
Optimum Field Density	1 per day of production	1 per day of production
Pulverized Moisture Content	1 per 0.5 day of production	1 per day of production
Compacted Density	1 per 0.5 mile (0.4 km)	1 per mile (1.6 km)
Field Moisture Content for Curing	1 per each day of production	1 per each day of production
Emulsion Content	1 per day of production	1 per day of production

Note: 1. The Contractor shall perform all quality control tests within the first 500 ft. (150 m) after startup or any change in the mix. The Department will also run the split samples at these locations.

(a) Quality Control by the Contractor. The Contractor shall perform or have performed the inspection and tests required to assure conformance to the contract requirements. Control includes the recognition of obvious defects and their immediate correction. This may require increased testing, communication of test results to the job site, modification of operations, suspension of work, or other actions as appropriate.

The Engineer shall be immediately notified of any failing tests and subsequent remedial action. Passing tests shall be reported to the Engineer no later than the start of the next work day.

(b) Quality Assurance by the Engineer. The Engineer will conduct independent assurance tests on split samples taken by the Contractor for quality control testing. In addition, the Engineer will witness the sampling and splitting of these samples and will immediately retain witnessed samples for quality assurance testing. The Engineer will check the yield daily.

(c) Test Methods:

(1) Pulverized Material Sizing and Gradation. A sample shall be obtained after the milling operation is complete and screened using a 1.5 in. (37.5 mm) sieve to determine if meeting the maximum particle size requirement. The mixing operations shall be turned off and samples collected to check the gradation. Gradations shall be performed each day on the millings at field moisture content using the following sieves: 1.5 in. (37.5 mm), 1.0 in. (25 mm), 3/4 in. (19 mm), 1/2 in. (12.5 mm), 3/8 in. (9.5 mm), No. 4 (4.75 mm), No. 8 (2.36 mm), No. 16 (1.18 mm), and No. 30 (600 µm). The resulting gradation shall be compared to the mix design gradations to determine any necessary changes to emulsion content. The recycling train shall be move back to the beginning of the sample milling section and all processes turned on to complete the recycling process of the material.

Sampling procedures shall generally be in accordance with ASTM D 979 or AASHTO T 168.

(2) Compacted Density. A wet density shall be determined using a nuclear moisture density gauge following the procedures for ASTM D 2950, backscatter measurement. The measurement shall be compared to the target density obtained by the growth curve.

(3) Emulsion Content. Total weight of material used against the total area of CIR constructed. It would require any nurse tanks to be weighed at the beginning of the project and at the end of each day of production.

(4) Field Moisture Content for Curing. The moisture content of the in-place material shall be tested as specified in Illinois Test Procedure 255.

Surface Tests. If the completed recycled pavement will be overlaid with hot-mix asphalt, then the completed recycled pavement will be tested for smoothness according to 407.09.

If the recycled pavement has a surface treatment as the final surface then the completed recycled pavement will be tested for smoothness in the wheel paths with a 16 ft (5 m) straightedge.

For each variation in the recycled pavement that exceeds 3/8 in. (10 mm), the entire area affected shall be corrected by a self-propelled milling machine. After the completion of the Cold In-Place Recycling operation, the Contractor shall survey the pavement surface at the centerline, middle of each lane and each edge of pavement at every 500 ft. station or as directed by the Engineer. After the survey is completed, the Contractor shall verify the cross slope meets the slopes defined in the plans. If the slope does not meet that which is defined in the plans, corrective milling action

will be taken by the Contractor. The Contractor shall propose a milling plan to be approved by the Resident Engineer. The Contractor shall be allowed a maximum of 0.75 inches milling at the centerline to create the required cross slope. If needed, additional Hot-Mix Asphalt required to correct the cross slope will not be paid for beyond the maximum allowed per Article 406.13 (b) of the Standard Specifications.

If milling for surface variations or cross slope correction are required, the milling machine shall be operated at a maximum speed of 50 feet per minute. The milled material will be disposed of as per Article 202.03 of the Standard Specifications at the contractor's expense. The recycled pavement shall be swept by a mechanical broom to remove all loose material from the recycled pavement before opening to traffic.

The Contractor shall furnish a 16 ft. (5 m) straightedge and shall provide for its jobsite transportation at no additional cost to the Department.

Method of Measurement. Bituminous materials will be measured for payment as specified in Section 1032 of the Standard Specifications.

Coarse aggregate will be measured in Tons (Metric Tons).

Reclaimed asphalt pavement from existing stockpiles will be measured in Tons (Metric Tons).

Corrective milling will be measured in Square Yards (Square Meters) of the corrected pavement.

The cold in-place recycling will be measured in Square Yards (Square Meters) of the recycled pavement. The width and depth will be as shown on the plans or as directed by the Engineer.

Basis of Payment. The bituminous material will be paid for at the contract unit price per Ton (Metric Ton) for CIR-FDR EMULSIFIED ASPHALT. Payment will be made for the bituminous material in accordance with the approved job mix formula (± 0.2 percent) and any agreed adjustments.

The coarse aggregate will be paid for at the contract unit price per Ton (Metric Ton) for ADD ROCK.

The reclaimed asphalt pavement from existing stockpiles will be paid for at the contract unit price per Ton (Metric Ton) for RECLAIMED ASPHALT PAVEMENT.

Correcting milling will be paid for at the contract unit price per Square Yard (Square Meter) for HMA SURFACE REMOVAL, VARIABLE DEPTH.

The cold in-place recycling will be paid for at the contract unit price per Square Yard (Square Meter) for COLD IN-PLACE RECYCLING, of the thickness specified.

If provided as a payment item, the additional cement required by the mix design will be measure and paid as specified in Section 302 of the Standard Specifications. If not provided as a payment item, the cost of additional cement required by the mix design will be paid for according to Article 109.04 of the Standard Specifications.