Recommended Construction Guidelines
For
Micro Milling (MM)
CP102

Revised 10/03/2022

NOTICE

It is not intended or recommended that these guidelines be used verbatim within a specification. Owner Agencies should use them to help establish their particular project specification. Owner Agencies should understand that all geographical areas and pavement rehabilitation/preservation projects are unique and the availability of materials and equipment may vary as well. ARRAassumes no liability for utilization of these guidelines by any individual or entity. Contact ARRA for answers to questions and for a list of ARRA member Contractors and Suppliers.

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1. General

Micro Milling (MM) consists of removing a portion of the existing asphalt or concrete pavement to the length, depth, and width shown on the plans to remove limited surface irregularities, remove existing pavement surface, restore proper grade and/or transverse slope of pavement as indicated in the plans and specifications.

The milled surface shall provide a texture suitable for use as the final riding surface, a temporary riding surface or for an immediate overlay. When the milled pavement is used as a temporary or permanent ridingsurface, the roadway shall be left in a usable condition at the end of each work day. The Contractor shalltake appropriate measures to ensure that the milled surface does not trap or hold water. All required pavement markings removed by planing shall be restored before the roadway is opened to traffic.

2. Micro Milling Depth

The depth of Micro Milling shall be as indicated on the plans and specifications but no greater than 2 inches (25 mm).

User Note: Micro milling depths greater than 2 inches (50 mm) are not recommended. Depths greater than 2 inches should be performed by milling with a traditional milling drum. The traditional milling process may be followed up with a shallow micro milling process to achieve the desired surface texture.

3. Materials

Reclaimed Asphalt Pavement (RAP) shall consist of asphalt coated material only. The RAP shall be clean, free of contamination of dirt, base, concrete or other deleterious materials such as silt and clay. The Contractor shall use trucks that are covered or tarped so as to not spill the material on the roadway. When the milled material becomes the property of the Contractor, it shall be removed from the project by the Contractor. If the milled materials or a specified portion of the material becomes the property of the Owner Agency, it shall be transported from the project by the Contractor to the location specified in the contract documents. RAP shall be neatly dumped in stockpile(s) in the areas defined by the contract documents.

When specified, stockpile the milled material at locations shown on the plans.

A. Uniformly stockpile the materials to a height of no more than 10 feet (3 m).
B. Maintain the existing drainage pattern of water from the RAP stockpile storage area.
C. Dress the RAP storage area to drain rainwater away from the material.
D. Manage stockpiles to prevent milled material degradation, segregation, and reconsolidation.

4. Recommended Preconstruction Plan – Optional

Prior to beginning MM operations, the Contractor shall submit a MM plan and a Quality Control Plan (QCP) for review by the Engineer.

The MM Plan shall include at a minimum:

A. The number, types and sizes of cold planers (milling machines) to be used.
B. The width and location of each planing pass.
C. The number and types of brooms to be used and their locations with respect to planers.
D. The proposed method for planing and wedging around existing structures such as manholes,

value boxes, and inlets.

E. The longitudinal and transverse typical sections for tie-ins at the end of the day.
F. If required by the Owner Agency, a plan sheet showing the milling passes.

The Quality Control Plan (QCP) shall include at a minimum:

A. The schedule for replacing cutting teeth.
B. The daily preventive maintenance schedule and checklist.
C. The proposed use of grade controls. (Longitudinal and Transverse)
D. The frequency of smoothness testing. Finish surface shall not exceed 1/4 in. (6 mm) longitudinal measured by a 10 ft. (3 m) straightedge or equal.
E. Frequency of macrotexture testing shall be no less than once per day.
F. The process for filling distressed areas.
G. Corrective procedures if the MM surface does not meet the minimum texture requirements of the plans and specifications.
H. Corrective procedures if the MM surface does not meet the specified minimum transverse or longitudinal surface finish when measured with a 10 foot (3 m) straightedge.

The Contractor shall not start the planing operation until a MM Plan and Quality Control Plan have been submitted, reviewed and accepted in writing by the Owner Agency.

5. Equipment

The CP (Cold Planing) equipment shall be capable of micro milling the existing roadway to meet the requirements asindicated in the project plans and specifications and as follows:

5.1 Cold Planing Machine

The cold planing machine shall be self-propelled and have sufficient horsepower, traction and stability to maintain an accurate depth of cut. The primary milling equipment shall have a minimum _____ feet _____ (m) cutter capable of removing the existing pavement to the depths shown in the plans.

The CP machine shall be equipped with depth controls capable of maintaining the cutting depth to within 1/4 inch (6 mm) of the desired depth, and shall have an effective means for controlling cross-slope. The milling operation shall not disturb or damage the underlying material.

The CP machine shall be capable of picking up the removed material in a single operation. A self-loading conveyor is recommended to be an integral part of the cold planer. The conveyor shall be capable of side or front loading to transfer the milled material from the roadway to a haul truck.

The CP machine shall be equipped with a cutting drum with carbide or equivalent tipped cutting teeth designed for milling asphalt pavement to the specified tolerances. Replace missing, worn, or damaged teeth as necessary throughout the operation to provide a consistent pattern behind the milling machine.

The CP machine shall be equipped with a dust suppression device(s) so as to ensure the machine complies with all relevant dust suppression guidelines as set forth by OSHA or other relevant local enforcement agencies.

The CP machine shall be furnished with a lighting system for night work, as necessary.

A smaller CP machine may be used to mill shoulders and miscellaneous areas.

5.2 Cleanup

Provide mechanical power brooms, vacuum sweepers, power blowers, or other means to remove loose debris or dust from the roadway. Do not allow dust or milling debris to restrict visibility of passing traffic or to disrupt adjacent property owners.

6. Macrotexture Testing

Macrotexture testing shall be performed in accordance with with the plans and specifications.

User Note: Sample specifications from Indiana DOT Test Method ITM No. 812-13T are included in the Appendix.

User Note: Typical macrotexture ratio, measured in accordance with ITM No. 812-13T, is equal or greater than 5.0.

7. Control Strip

During the first day of production, a control strip shall be constructed to demonstrate to the Owner Agency that the construction will meet specification requirements. The control strip shall be at least 1,000 feet (300 meters) in length that has uniform textured surface and cross-section for the Contractor to show that the construction operations meet the specification requirements including:

A. Perform macrotexture testing in accordance with ITM No. 812-13T (Appendix) at two random locations but not closer than 500 feet (150 m) apart.
B. The finished longitudinal profile shall meet the appropriate smoothness specification of the Owner Agency.

MM operations may continue through the first day unless the Contractor's equipment and process fail to meet the requirements for successful completion of MM operations.

MM operations shall not continue beyond the first day unless a control strip has been approved by the Owner Agency. The Contractor shall submit a written plan of action detailing what steps will be taken to improve operations if any of these requirements are exceeded in the test strip. If the control strip fails to meet the specification requirements the Contractor will construct another 1,000 foot (300 m) test section using the approved corrective action plan. This designated section shall be milled to conform to the same requirements as those in the initial test section. The Contractor shall not be allowed to start continual MM until an acceptable test section is obtained. Control strips that do not meet the requirements shall be reworked at the Contractor's expense.

In lieu of a control strip, the Owner Agency may allow the Contractor to provide proof, based on previous experience with the same equipment, personnel, and materials that the work will conform to the specification requirements.

7.1 Micro Milled Surface Used as a Riding Surface

The control strip shall have a uniform textured surface and cross-section. The final pavement surface shall have a transverse pattern of 0.2 inch (5 mm) center to center of each strike area. The target difference between the ridge and valley (RVD) measurement ofthe mat surface shall not exceed 1/16 inch (1.6 mm). The finished longitudinal profile shall meet the appropriate smoothness specification of the Owner Agency.

8. Micro Milling Operation

Follow the plans and specifications to mill the designated areas to the indicated depths including bridge decks, approaches and ramps, as required. Ensure the following requirements are met:

A. The cold planing operation shall use micro milling methods that will produce a uniform finished surface and maintain a constant cross-slope between extremities in each lane.

B. The existing pavement shall be milled to the cross-slope shown on the plans and shall have a surface finish that does not vary longitudinally or transversely more than 3/8 inch (9 mm) as indicated by the use of a 10 foot (3 m) straightedge.

C. Provide positive drainage to prevent water accumulation on the milled pavement, as shown on the plans and specifications.

D. Remove dust, residue, and loose milled material from the milled surface in accordance with the requirements of the plans and specifications prior to opening milled surface to traffic.

E. Distressed or irregular areas not meeting project plans and specification requirements, and identified in the planed surface by Owner Agency, shall be repaired in accordance with the plans andspecifications.

F. If scabbing occurs, the Owner Agency shall be notified. Remove scabbing by milling to a depth as directed.

User note: Scabbing is defined as the raveling of asphalt material from the milled surface which is typically caused by the condition of the existing underlying layers of asphalt. Additional milling to remove scabbing should be paid by force account.

G. Bevel longitudinal vertical edges greater than 1 inch (25 mm) that are produced by the removal process and left exposed to traffic. Bevel the edge at no less than a 3:1 slope.

H. Prior to opening the milled surface to traffic, transverse joints and other exposed vertical edges greater than 1 inch (12.5mm) depth shall be tapered to no less than a 10:1 slope. Transverse tapered joints may be tapered with the cold planer, a temporary asphalt ramp, or other methods as approved by the Engineer.

I. If transverse joints are tapered with a temporary asphalt mixture ramp, the milled surface at the joint shall be constructed as a butt joint for the full depth of the lift of the asphalt mixture placed onthe milled surface. The Contractor shall be responsible for maintaining these asphalt ramps until all required asphalt lifts are placed on the project.

J. If the transverse joint is tapered with a CP machine, a butt joint shall be cut into the taper for the fulldepth of the lift of the asphalt mixture to be placed on the milled surface prior to commencement ofresurfacing.

User note: The Owner Agency may adjust this taper length based on speed limit of the road. A minimum taper distance of 15 feet (5 m) is recommended for higher volume roadways.

K. The roadway shall be left in a condition suitable for the movement of traffic at the end of each workday. The Contractor shall take appropriate measures to ensure that milled surfaces do not trap or hold water. All required pavement markings removed by the planing operation shall be restored before the roadway is opened to traffic. The use of the milled pavement as a temporary riding surface shall be allowed for a maximum of___calendar days.

User note: Traffic operations on the milled surface, if not intended as the final riding surface, shouldnot exceed 14 days.

8.1 Maintenance

If temporary traffic is allowed, the surface of the milled pavement shall be maintained in a condition suitable for the safe movement of traffic. Maintenance of the temporary surface is the responsibility of the Contractor.

9. Measurement and Payment

Micro milling asphalt pavement shall be paid for at the Contract Unit Price bid per square yard (meter), asspecified. Specialty areas, such as in approaches or transitions, shall be paid for at the bid per square yard (meter), when specified.

Payment of the specified micro milling represents full compensation for milling operations, macrotexture testing, furnishing equipment, labor, milling, hauling, stockpiling milled material, protection and maintenance of exposed surfaces prior to resurfacing in accordance the requirements of the plans and specifications.

User Note: The price bid for this item may include the credit value of all Reclaimed Asphalt Pavement (RAP) recovered and no adjustment in the unit price for this item or other items will be considered for variations in the amount of RAP actually recovered.

Payment for poor subgrade areas or scabbed area repairs not caused by Contractor operations shall be paid by force account.

APPENDIX

INDIANA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS MANAGEMENT

MACROTEXTURE OF MILLED PAVEMENT ITM No. 812-13T

(Revised 7/11/13)

(Used by permission IDOT)

INDIANA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS MANAGEMENT

MACROTEXTURE OF MILLED PAVEMENT
ITM No. 812-13T
(Revised 7/11/2013)

1.0 SCOPE.

1.1 This test method covers the procedure to evaluate the macrotexture of a milled pavement surface.

1.2 This ITM may involve hazardous materials, operations, and equipment and may not address all of the safety problems associated with the use of the test method. The user of the ITM is responsible for establishing appropriate safety and health practices and determining the applicability of regulatory limitations prior to use.

2.0 REFERENCE.

2.1 AASHTO Standards.

M 247 Glass Beads Used In Traffic Paints

2.2 ASTM Standards.

E 1272 Standard Specification for Laboratory Glass Graduated Cylinders

2.3 ITM Standards.

802 Random Sampling

3.0 TERMINOLOGY. Terms and abbreviations shall be in accordance with the Department's Standard Specifications, Section 101.

4.0 SIGNIFICANCE AND USE. This ITM is used to determine the macrotexture of a pavement surface to meet the requirements of the texture of a milled surface prior to an overlay.

5.0 APPARATUS.

5.1 Filler. Type 1 glass beads in accordance with AASHTO M 247

5.2 Spreader. A flat, stiff hard disk made from methyl methacrylate (Plexiglas) with a thickness of 0.5 ± 0.1 in., diameter of 8 ± 2 in. and a round handle affixed in the center used to spread the filler.

5.3 Graduated Cylinder. A class B or better, style III, 250 mL capacity graduated cylinder in accordance with ASTM E 1272, used to measure the volume of filler for the test

5.4 Brushes. A stiff wire brush and a soft bristle brush used to clean the pavement

5.5 Container. A small container with a secure and easily removable cover used to store 200 ml of filler

5.6 Screen. A shield used to protect the test area from air turbulence by the wind or traffic

6.0 LABORATORY PREPARATION.

6.1 Prepare one container with 200 ml of filler for each sample location

6.2 Fill the graduated cylinder to the specified volume

6.3 Gently tap the side of the graduated cylinder to level the surface of the filler

6.4 Place the measured volume of filler in the container

6.5 Label the container with the type and quantity of filler

7.0 PROCEDURE.

7.1 Randomly determine a sample location on the milled pavement surface in accordance with ITM 802

7.2 Inspect the sample location and ensure the location is a dry, homogeneous site, free of unique or localized features such as cracks, joints, stripping and patching

7.3 If localized features are present, move up-station at the same transverse offset until a suitable site is located

7.4 Clean the sample location using the brushes to remove any residue, debris or loosely bonded material

7.5 Place the screen on the milled pavement surface to protect the sample location from air turbulence

7.6 Hold the container with filler above the pavement at the sample location at a height not greater than 4 in.

7.7 Pour the measured volume of filler from the container onto the milled pavement

surface into a conical pile

7.8 Place the spreader lightly on top of the conical pile of filler being careful not to compact the filler

7.9 Move the spreader in a slow, circular motion to disperse the filler in a circular area and to create a defined crest around the perimeter

7.10 Continue spreading the filler until the filler is well dispersed and the spreader rides on top of the high points of the milled pavement surface

7.11 Measure and record the diameter of the circular area four times, at intervals of 45º and to the nearest 5 mm, as shown in Figure 1

7.12 Measure the diameter of the circular area from the crest of the slope on one side, through the center, and to the crest of the slope on the other side of the circular area

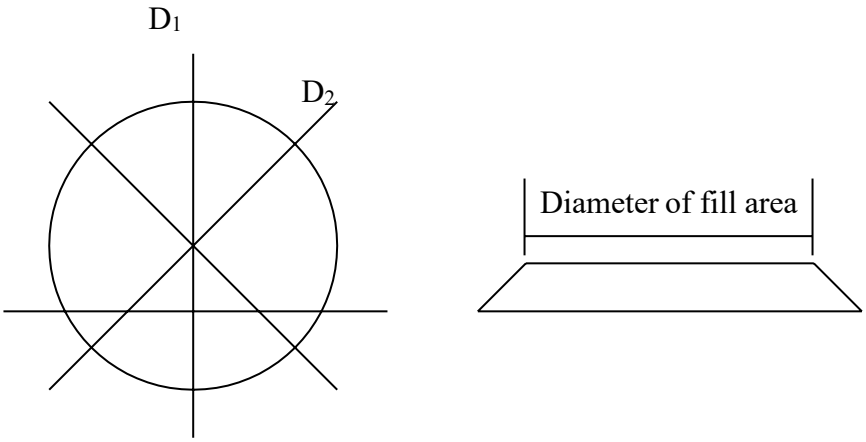

Figure 1

8.0 CALCULATIONS.

8.1 Calculate the average diameter of the circular area covered by the filler as follows:

$D_a = (D_1 + D_2 + D_3 + D_4) / 4$

where:

Da = average diameter of the filler area, mm

D_1, D_2, D_3, D_4 = diameters of the filler area, mm

8.2 Calculate the Macrotexture Ratio from the following table using the average diameter of the area covered by the filler.

MACROTEXTURE RATIO based on 200 ML

of GLASS BEADS and AVERAGE DIAMETER

Average Diameter	Macrotexture Ratio	Average Diameter	Macrotexture Ratio	Average Diameter	Macrotexture Ratio
190	1.42	260	2.65	340	4.54
195	1.49	265	2.76	345	4.67
200	1.57	270	2.86	350	4.81
205	1.65	275	2.97	355	4.95
210	1.73	280	3.08	357	5.00
214	1.80	285	3.19	360	5.09
215	1.81	290	3.30	365	5.23
220	1.90	295	3.42	370	5.38
225	1.99	300	3.53	375	5.52
230	2.08	305	3.65	380	5.67
235	2.17	310	3.77	385	5.82
237	2.20	315	3.90	390	5.97
240	2.26	320	4.02	395	6.13
245	2.36	325	4.15	400	6.28
250	2.45	330	4.28	405	6.44
255	2.55	335	4.41	410	6.60

9.0 REPORT. The following information is reported on the form in Appendix A.

9.1 Date of test

9.2 Contract number

9.3 Station of sample location

9.4 Offset of sample location

9.5 Name of Milling Contractor and representative

9.6 Name of Prime Contractor and representative

9.7 Diameter measurements of filler area, D_1, D_2, D_3, D_4

9.8 Average diameter of filler area, mm

9.9 Macrotexture ratio

MACROTEXTURE REPORT

Contract No.:_____ Road:_____

Milling Contractor: _____

Milling Representative: _____

Prime Contractor: _____

Prime Representative: _____

Station	Offset	D_1 (mm)	D_2 (mm)	D_3 (mm)	D_4 (mm)	D_a mm	Macrotexture Ratio

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