Preparing Activity: USACE

Superseding
UFGS-32 01 16.17 (February 2017)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION 32 01 16.71

COLD MILLING ASPHALT PAVING
11/22

NOTE: This guide specification covers the requirements for cold milling of bituminous pavement for airfields, roads, streets, parking areas, and other general applications.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

NOTE: This guide specification can be used to specify cold milling alone on structurally sound pavements for surface texturing to increase skid resistance of a worn pavement, or for pavement removal to restore roadway and airfield geometry. Cold milling can also be used in conjunction with mill and overlay operations.

Consider the overall weight of the milling equipment to ensure there is not damage to the existing pavements and pavement remaining after milling.

Consider limits of milling to ensure sufficient material is left to minimize the potential for delamination or the entire layer may require removal. In certain cases, full depth reclamation may be more valuable than cold milling.

Evaluate the existing pavement section by taking pavement cores to determine appropriate milling depth. Delamination potential exists anytime cold milling depth is approximately equal to the layer placed. If base course is not to be disturbed, leave a layer of bituminous pavement, 25 mm 1-inch thick, over the undisturbed base course.

On the project drawings, show:

1. Location and extent of milling operation.

2. Required elevation of finish surface of new pavement. Provide spot elevations on a maximum 7.5 meter 25 foot by 7.5 meter 25 foot grid.

3. Section indicating in mm inches the depth that existing pavement has to be removed.

4. Location, size and elevation of existing manholes, valve boxes, utility lines or other structures penetrating the pavement..

****

1.1 Payment

****

NOTE: For unit-price Contracts, include first bracketed statements and delete the second set. For lump sum Contracts, delete the first bracketed statements and include the second set. Additional CLIN is required on the bid schedule if unit price is utilized.

It is recommended on lump sum Contracts to include additional unit price CLINs to address scabbing/delamination of asphalt pavements. In this scenario, use an appropriate quantity for the size of the project, additional depth of milling (minimum of 25.4 mm 1 inch), and and square meter yard as the unit.

****

1.1.1 Measurement

[The quantity of milled pavement measured will be paid for at the contract unit price when completed and accepted by the Contracting Officer. Payment will be made at the contract unit price for the nearest square meter yard for the scheduled item at the proposed depth displayed in the Contract. Measure the width of the area to the closest mm inch and measure the length of the area to the closest meter foot. Payment will constitute full compensation for providing all equipment, labor, tools, and other incidentals necessary to complete the milling operation. Unless

otherwise stated, unit price will also include cost for clean-up and disposal operations as per paragraph REMOVAL OF MILLED MATERIAL. No payment will be made for milling outside the specified area of work.][The measured quantity of asphalt milling, including cost for clean-up and disposal, will be paid for and included in the lump sum Contract price.]

1.2 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 247	(2013) Standard Specification for Glass Beads Used in Pavement Markings

ASTM INTERNATIONAL (ASTM)

ASTM E965	(2015; R 2019) Standard Test Method for Measuring Pavement Macrotexture Depth Using a Volumetric Technique

1.3 DEFINITIONS

1.3.1 Scabbing/Delamination

Scabbing or delamination is defined as the debonding or raveling of material which may be caused by either the condition of the existing underlying layers of asphalt mixture or the milling operation.

1.3.2 Milling Machine

Milling machines may also be known as pavement cold planers. Throughout this specification, any references to milling machines will also apply to pavement cold planers.

1.3.3 Milling Drum

Milling drums are upward-rotating drums or rotors which are outfitted with toolholders and teeth (picks). Milling drums perform different tasks dependent on the structure and design. The main tasks are cutting particles from the composite pavement, conveying removed material to the ejector, and ejecting removed material. Any reference to milling drum also applies to milling rotors.

1.4 TRAFFIC CONTROL

Provide all necessary traffic control during milling operations.

1.5 SCHEDULING

After completion of the preconstruction submittals, provide notice to the Contracting Officer a minimum of seven days prior to starting milling operations.

1.6 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S"

classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only.] When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Equipment; G[, [____]]

Proposed Techniques; G[, [____]]

Quality Control Plan; G[, [____]]

Qualifications; G[, [____]]

SD-06 Test Reports

QC Monitoring

Grade-Conformance Tests; G[, [____]]

Test Section Results; G[, [____]]

Macrosurface Texture Acceptance; G[, [____]]

1.7 QUALITY CONTROL

1.7.1 Qualifications

****
NOTE: Use below paragraph when profile milling (e.g. milling to specified plan grade) or performance milling (e.g. using fine or mirco-milling drum) is being specified. Otherwise, delete this paragraph.
****

Provide documentation of at least five successful projects utilzing [profile] [and] [performance] milling. Documentation will include project references, equipment used (including scanning/sensing equipment), and company personnel associated with the project. Project documentation will also include if any equipment was owned or rented in the execution of the project.

1.8 PROJECT/SITE CONDITIONS

1.8.1 Environmental Requirements

Do not perform milling when there is accumulation of snow or ice on the pavement surface.

PART 2 PRODUCTS

2.1 EQUIPMENT

Maintain in a satisfactory working condition equipment, tools, and machines used in the performance of this work.

2.1.1 Cold Milling Machine

****

NOTE: Analyze the project layout and constraints. Specify the appropriate cutting width for the project.

Milling machines range from cutting widths less than 61 cm 2 feet up-to 4.4 meters 14.5 feet. Typical milling machines have cutting widths around 2 meters 6.5 feet. When specifying milling machine cutting widths, ensure milling drums are manufactured in the specified width for the intended purpose.

****

Use a self-propelled unit capable of removing the existing asphalt pavement to the depths and widths shown in the Contract. Milling machines will have a minimum cutting width of [2 meters][6.5 feet]. Use milling machines designed and built exclusively for pavement milling operations and with sufficient power, traction and stability to accurately maintain depth of cut and slope. The equipment will be capable of operating the machine speed independently from the cutting equipment speed. Use milling machines capable of being equipped with dual longitudinal controls (operated from both sides of the machine). Use electronic control systems that will automatically control the longitudinal profile and cross slope of the milled surface. Accomplish this through the use of a mobile grade reference, an erected string line, joint matching shoe, slope control systems, or a combination of approved methods. When using a mobile grade reference, use systems capable of averaging the existing grade or pavement profile over at least 9 meters 30 foot. Use a machine capable of leaving a uniform surface suitable for handling traffic without damage to the underlying pavement structure. Provide additional equipment necessary to satisfactorily remove the pavement in the area of manholes, water valves, curb, gutter and other obstructions. Provide milling machines with a means of effectively limiting the amount of dust escaping from the removal operations. If milling operations result in excessive fugitive dust, a silica dust suppressant is required at no additional cost to the Government. Milling equipment is not allowed to damage any part of the pavement structure that is not to be removed. Equip the milling machine with a lighting system for night work as required by the Contract. Smaller width milling machines may be necessary for use around structures or other penetrations. Produce the same surface texture with small milling machines as with the large milling machines.

2.1.2 Milling Drums

****

NOTE: Select the appropriate milling drum for the intended use. Delete the others.

The texture of the milled surface is impacted by the bit spacing, which is the distance between one cutting bit to the next. If unsure, select the standard milling drum.

For rigid pavement milling, complete removal of flexible pavement, or removing surface and binder courses, select the "Rough/Coarse" or "Standard" milling drum.

Where correction of an existing surface is required, or when milling for replacement with a thin lift (e.g. bonded wearing course), a fine or micro milling drum offers a smoother milled surface by reducing the line spacing and making it easier to produce shallower peak-to-valley depths. Fine or micro-milling is sometimes required by surface treatment manufacturers. Typically fine and micro milling drums are utilized only for partial or full wearing/surface courses of asphalt. Fine and micro-milling drums are limited in milling depth and should be only selected when appropriate. Select the fine or micro-milling tailoring option as appropriate and edit the desired drum based upon the tool spacing.

****

[2.1.2.1 Rough/Coarse Milling Drum

Provide a Rough/Coarse milling drum having a tool spacing between 18 mm - 25 mm 11/16 inch - 1 inch.]

[2.1.2.2 Standard Milling Drum

Provide a standard milling drum having a tool spacing between 12 - 18 mm 1/2 - 3/4 inch.]

[2.1.2.3 Fine Milling Drum

Provide a fine milling drum having a tool spacing between 8 - 10 mm 5/16 - 3/8 inch.]

[2.1.2.4 Micro Milling Drum

Provide a micro milling drum having a tool spacing between 3 - 6 mm 1/8 - 1/4 inch.]

2.1.3 Sensors and Scanning Components

****

NOTE: Available sensors and scanning components consist of sonic, laser and 3-D systems.

It is recommended for projects with asphalt pavement grade or smoothness requirements to utilize a laser or 3-D sensor. When new surface grades or contours are required, laser or 3-D sensors will most likely be used. It is recommended that a 3-D model be available to supply to the Contractor to adjust and input into the milling machine interface. Additional text may be added for when 3-D or laser sensors are required. Excercise caution on the verbiage added as intent is to keep specification performance driven.

****

Provide sensors and scanners as necessary to produce the grade and smoothness as specified. Submit all sensors and scanning components for Government approval. [_____]

2.1.4 Cleaning Equipment

Provide cleaning equipment suitable for removing and cleaning loose material from the pavement surface. If using street sweeper type equipment, equip the street sweeper with a water tank, dust control spray assembly, both a pick-up and gutter broom, and a debris hopper.

2.1.5 Straightedge

Furnish and maintain at the site, in good condition, at least one 4 meter 12 foot straightedge for each milling machine, for testing the finished surface. Make the straightedge available for Government use. Use straightedges constructed of aluminum or other lightweight metal, with blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Use straightedges with handles to facilitate movement on the milled surface.

PART 3 EXECUTION

3.1 CONTRACTOR QUALITY CONTROL

3.1.1 General Quality Control Requirements

****

NOTE: Based upon anticipated project duration, edit the text within brackets with an appropriate timeline for adequate review prior to milling operations.

****

Submit the Quality Control Plan a minimum of [30] days in advance of starting milling operations. The Quality Control Plan is specific to this specification and supplements the overall Quality Control Plan required by the project. Do not start milling operations until the Quality Control Plan has been approved. In the Quality Control Plan, address all elements which affect the quality of the milling operation including, but not limited to:

a. Type of cutting teeth and schedule for replacement.

b. The daily preventative maintenance schedule and checklist.

c. The proposed use of grade and slope controls (longitudinal and transverse).

d. The frequency of smoothness testing.

e. The process for milling distressed areas (scabbing/delamination).

f. Corrective procedures if the milling operation does not meet the specified texture or grade requirements.

g. Corrective procedures if the milled surface does not meet the specified minimum transverse or longitudinal smoothness when measured with a 4 meter 12 foot straightedge.

h. The frequency of macrotexture testing.

3.2 PROPOSED TECHNIQUES

Submit the proposed techniques a minimum of [30] days in advance of starting milling operations. The proposed techniques will be project specific and address the following items:

a. The number, type(s) and size(s) of milling machines to be used.

b. The width and location of each cutting pass.

c. The number and types of brooms to be used with their location with respect to milling machines.

d. The proposed method for milling around existing structures such as manholes, valve boxes, and inlets.

e. The longitudinal and transverse typical sections for tie-ins at the end of the work day.

3.3 MILLING OPERATION

****

When the milled material (millings) is to be cold recycled, the maximum size of the millings should be equal to or less than one-half of the recycled pavement thickness. Generally, the maximum size for a single 100 mm 4 inch lift of pavement will be 50 mm 2 inches or less. For central-plant hot recycling the recommended maximum size of the milled material is 50 mm 2 inches.

****

Make sufficient passes so that the designated area is milled to the profile, cross-slope, grade and elevations as indicated. Mill the pavement in depth increments that will not damage the pavement below the designated finished grade. If scabbing or delamination occurs, the milled surface is unlikely to meet smoothness requirements. Notify the Contracting Officer for further direction when delamination or scabbing occurs. Repair or replace items damaged during milling operations such as manholes, valve boxes, utility lines, pavement that is torn, cracked, gouged, broken, or undercut, at no additional cost to the Government. [Windrow the milled material.] Remove the milled material from the pavement and load into trucks.

3.3.1 Milling Machine and Drum Speed

Operate the milling machine and drum speed at appropriate speeds required to produce a uniform and acceptable surface texture per paragraph ACCEPTABLE SURFACE TEXTURE.

3.4 TEST SECTION

****

NOTE: For length of test section, analyze project limits and make adjustments as necessary in the empty bracketed text. Otherwise use default length. When milling on active roadways, select one milling lane wide. When the entire roadway is closed or on

airfields, select two milling lanes wide.

Only include item d. when plan grade spot elevations are provided in design.

Ensure list of alpha-characters are in sequencial order after editing bracketed text.

****

The test section will be considered the first half-day of milling production. The test section will be a minimum of [300] meters [1,000] feet [_____] long and [one][two] milling lanes wide. Evaluate the milled surface texture[, grade,] and smoothness as part of the test section. Make any changes necessary, including the speed of the milling machine, to produce the desired milled surface texture and smoothness. Any adjustments in grade should be approved by the Contracting Officer. Perform macrosurface texture acceptance testing at two random locations no closer than 150 m 500 feet. At a minimum, provide the following in the Test Section Results:

a. Overall visual appearance of the milled surface texture noting any scabbing or delamination concerns. Provide five or more photos of the cleaned surface texture with a scale showing the line spacing.

b. Speed of milling machine and drum (rpm).

c. Approximate station and offset of straightedge testing and measurements.

[d. Interpolated grade of milled surface reported as a comparison from the spot elevations provided in the Contract.]

e. Macrosurface mean texture depth results.

[3.5 MILLING TO PLAN GRADE

****

NOTE: Delete paragraphs relating to Grade when Contractor is not required to mill to grade. Select 15 m 50 feet for roadway and 7.5 m 25 feet for airfields.

****

3.5.1 Grade Reference

If string-line is utilized as a grade reference, place grade reference points at maximum intervals of [7.5] m [25] feet. Use reliable control points to set the grade reference. Support the grade reference so the maximum deflection does not exceed 1.5 mm 1/16 inch between supports. If utilzing a surface model, ensure the model is reviewed and accepted by the Government prior to execution of the work.

3.5.2 Grade

Mill pavement such that the finished milled surface conforms to the lines, grades, and cross sections indicated in the contract. The maximum allowable deviation of the finished milled pavement surfaces from the established plan grade line and elevation is plus 0 mm inch minus 6 mm 1/4 inch.

3.5.3 Grade-Conformance Tests

****

NOTE: For airfield pavements, lines of levels are required to determine elevation of the milled pavement. Lines of levels will be run longitudinally and transversely at intervals not exceeding 7.5 meters 25 feet.

For all other pavements, select appropriate interval for grade conformance verification.

****

After clean-up, test the finished milled surface of the pavement for conformance with the plan-grade requirements and for acceptance by the Contracting Officer by running lines of levels at maximum intervals of [7.5] m [25] feet longitudinally and [7.5] m [25] feet transversely to determine the elevation of the completed milled surface. Correct variations from the designated grade line and elevation in excess of the plan-grade requirements as directed. Skin patching for correcting low areas will not be permitted. If it is determined that Contractor operations resulted in deficient low areas, remove and replace area with a minimum 25 mm 1 inch of asphalt leveling course as approved by the Government.]

3.6 SURFACE SMOOTHNESS

3.6.1 Straightedge Testing

After completion of the final milling and clean-up, test the finished milled surface with the straightedge. Correct surface irregularities that depart from the testing edge by more than 6 mm 1/4 inch. Straightedge testing will be performed continuously throughout production as a Quality Control check for the milled surface on a frequency longitudinally and transversely as approved in the Quality Control Plan. Skin patching for correcting low areas will not be permitted. If it is determined that Contractor operations resulted in deficient low areas, remove and replace area with a minimum 25 mm 1 inch of asphalt leveling course as approved by the Government. Report approximate station and individual measurements taken and submit QC Monitoring to the Contracting Officer on a daily basis.

3.7 ACCEPTABLE SURFACE TEXTURE

Produce a milled surface texture with continuous, longitudinal milling striations with no gaps in the longitudinal striations. Gaps in the milling striations and cases where gaps create a diagonal pattern or chevron appearance are required to be milled again such that continuous, longitudinal striations are achieved.

3.7.1 Macrosurface Texture Acceptance

****

NOTE: Edit the bracketed text that corresponds with the milling surface intended. The below acceptance test will determine the macrotexture of the pavement surface prior to an overlay or surface treatment.

Use below information to fill in bracketed text or

research any state DOT standard for acceptable alternatives.

Fine Milling: 228 mm 9 inch
Micro Milling: 300 mm 12 inch

****

Conduct macrosurface texture acceptance testing in accordance with ASTM E965 to determine the average macrotexture circular diameter for the day's production. Provide four randomly selected locations from each day's production which are randomly selected using ASTM D3995. Change location of test area by moving upstation 3 m 10 feet if any test area has unique, localized features such as cracks or joints. Provide a minimum circle diameter of [_____] when tested in accordance with ASTM E965 with the following revisions:

a. Use 200 ml12 inch^3 of material (glass spheres) meeting AASHTO M 247.

b. Use a flat, stiff hard disk made from methyl methacrylate (plexiglass) with a thickness of 12 mm plus or minus 2.5 mm 0.5 inch plus or minus 0.1 inch, diameter of 203 mm plus or minus 50 mm 8 inches plus or mins 2 inches.

c. Measure and record the diameter of the circular area four times, at intervals of 45 degrees and to the nearest 5 mm 0.25 inch. Measure the diameter of the circular area from the extent of the glass beads on one side, through the center, and to the extent of the glass beads on the other side of the circular area. Report the average diameter of the circle for acceptance using the following equation:

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

If surface texture does not meet the minimum circle diameter specified, evaluate the cause and provide adjustment procedures detailing methods to the Government to meet specified macrosurface texture.

3.8 TRAFFIC ON MILLED SURFACE

****

NOTE: Delete this paragraph and subparagraph when traffic is not expected to be allowed on the milled surface. If milled surface is anticipated to be exposed to traffic, review the state DOT or agency requirements for longitudinal and transverse joints. At a minimum analyze project geometrics and speed limit and fill in bracketed text for taper distance. If unknown, use 5 m 15 feet.

****

Mill the entire pavement width to a flush surface at the end of each work day when the pavement is open to traffic. If uncompleted operations result in a vertical or near vertical longitudinal face, re-slope the longitudinal face to provide a taper, construct a temporary bituminous taper or provide protective measures, as approved by the Contracting Officer. Taper transverse cutting faces at the end of each work day where pavement is open to traffic. Taper transverse edges to a minimum 10:1 taper. Provide taper over a distance of [_____]metersfeet. Construct temporary bituminous tapers (paper joint) at intersecting streets, around utility appurtenances, and drainage structures during the milling

operation. Maintain adequate drainage on the milled surface.

3.8.1 Taper Material

Use the same quality of asphalt mixture used elsewhere on the project or as detailed in the Contract.

3.9 CLEAN-UP OPERATIONS

After milling to the depth shown in the Contract, sweep or vacuum clean the milled area with the approved equipment.

3.10 REMOVAL OF MILLED MATERIAL

****

NOTE: Select the appropriate bracketed text below and delete others. If using Cold In-Place Recycling (CIR) techniques coordinate this section with Section 32 01 16.70 Cold-Mix Reused Asphalt Paving.

****

[Place material that is removed [in the disposal area as specified] [into traveling mixing plant for cold-mix recycling].] [Transport material that is removed to central plant for hot-mix or cold-mix recycling.] [Stockpile material that is removed as specified and in such a manner to prevent segregation or contamination. Dress the reclaimed asphalt area to drain rainwater from the material.] [Material that is removed will become the property of the Contractor and removed from the site.]

-- End of Section --