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USACE / NAVFAC / AFCEC / NASA **UFGS-32 12 36.26 (November 2020)**

Preparing Activity: USACE **Superseding without Revision**
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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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SECTION 32 12 36.26

POLYMER CONCRETE MICRO-OVERLAY (PCMO) FOR FUEL AND ABRASION RESISTANT WEARING SURFACES

11/20

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NOTE: This guide specification covers the requirements for Polymer Concrete Micro-Overlay (PCMO) for fuel and abrasion resistant wearing surfaces.

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).

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PART 1 GENERAL

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NOTE: PCMO can be used as an alternative to coal-tar seal coats placed over asphalt surfaces to provide fuel resistance. PCMO also has application as a seal coat over asphalt surfaces not requiring fuel resistance. PCMO can be applied to concrete surfaces to bridge cracks, repair spalled areas and provide increased friction characteristics while improving aesthetics. For airfields, PCMO may be used on taxiways and parking aprons, it is not recommended for runway use. If PCMO is applied to grooved surfaces, take care to restore the friction characteristics of the surface by patterning the PCMO. Colored PCMO may be used for taxiway markings,

stop bars and/or directional designations on both asphalt or concrete. PCMO may also be used on roads and parking lots for friction enhancement or for delineation of crosswalks, bus areas or pedestrian areas as well as a fuel and abrasion resistant wearing surface.

This guide specification only pertains to the polymer concrete micro-overlay aspects of the project and not to any surface preparation requirements. Surface preparation requirements should be covered by either including them in this guide specification or by adding pertinent sections to the project documents.

This specification utilizes a Quality Assurance and Quality Control (QA/QC) construction management philosophy. Quality Assurance refers to the actions performed by the Government to assure the final product meets the job requirements. Results of QA testing are the basis for pay. Quality Control refers to the actions of the Contractor to monitor the construction and production processes and to correct these processes when out of control. Results of QC testing are reported daily on the process control charts maintained by the Contractor. Quality Control is covered in paragraph CONTRACTOR QUALITY CONTROL.

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1.1 UNIT PRICES

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NOTE: Delete this paragraph when lump sum payment is desired.

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1.1.1 Measurement

Measure the quantity of PCMO, per square meter square yard placed and accepted, for the purposes of assessing payment.

1.1.2 Payment

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NOTE: Delete this paragraph when lump sum payment is desired.

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Quantities of PCMO mixture, determined as specified above will be paid for at respective contract unit prices. Payment will constitute full compensation for furnishing all materials, equipment, plant, surface preparation, and tools; and for all labor and other incidentals necessary to complete the required work.

1.2 REFERENCES

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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.

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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 CONCRETE INSTITUTE (ACI)

ACI 201.1R	(2008) Guide for Conducting a Visual Inspection of Concrete in Service

ASTM INTERNATIONAL (ASTM)

ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C67/C67M	(2020) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C117	(2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C150/C150M	(2020) Standard Specification for Portland Cement
ASTM C1077	(2017) Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1583/C1583M	(2013) Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
ASTM D242/D242M	(2009; R 2014) Mineral Filler for Bituminous Paving Mixtures

ASTM D3699	(2019) Standard Specification for Kerosene
ASTM E274/E274M	(2015) Standard Test Method for Skid Resistance of Paved Surfaces Using a Full-Scale Tire

1.3 SUBMITTALS

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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.

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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-03 Product Data

Material Safety Data Sheets (MSDS)

COA/QCC Documentation

SD-05 Design Data

Mix Design; G[, [_____]]

Service Record; G[, [_____]]

Quality Control Plan; G[, [_____]]

SD-06 Test Reports

Aggregate Test Results

SD-07 Certificates

Portland Cement

Testing Laboratory

SD-08 Manufacturer's Instructions

Manufacturer Representative Resume

SD-09 Manufacturer's Field Reports

QC Test Results

1.4 QUALITY CONTROL

1.4.1 Qualifications

Perform sampling and testing using an approved commercial testing laboratory or on-site facility that is accredited in accordance with ASTM C1077. Do not start work requiring testing until the facilities have been inspected and approved. The Government will inspect all laboratories requiring validation for equipment and test procedures prior to the start of any concreting operations for conformance to ASTM C1077. Schedule and provide payment for laboratory inspections. Additional payment or a time extension due to failure to acquire the required laboratory validation is not allowed. Maintain this certification for the duration of the project.

1.4.2 Quality Control Plan

Develop and submit a Quality Control Plan. Do not produce PCMO for payment until the quality control plan has been approved. Address all elements that affect the quality of the PCMO including, but not limited to:

a. Mix Design.
b. Aggregate Grading.
c. Quality of Materials.
d. Fuel Resistance Testing.
e. Preparation of Existing Pavement Surface

1.4.3 Manufacturer Representative

At the beginning of job site operations, provide an independent technical consultant with a minimum of 3 years experience in the use of PCMO and knowledge of the materials, procedures, and equipment described in this specification. The consultant will assist in the proper mixing of the

component materials and application of the PCMO. Submit manufacturer representative resume documenting this experience prior to the start of operations.

1.5 Project/Site Conditions

1.5.1 Environmental Requirements

Do not apply PCMO when the surface is wet unless permitted by the manufacturer or when the humidity or impending weather conditions will not allow proper curing. Apply PCMO only when the atmospheric or pavement temperature is 7.5 degrees C 45 degrees F and rising and is expected to remain above 7.5 degrees C 45 degrees F for 24 hours, unless otherwise directed. Pavement temperatures exceeding 50 degrees C 130 degrees F are not recommended for PCMO application. Ideal conditions for placement are air temperatures between 15 and 32 degrees C 60 and 90 degrees F and humidity levels between 50 and 60 percent.

1.6 ACCEPTANCE

1.6.1 Tolerances

Acceptance of PCMO mixture is based on compliance with the tolerances presented in Table 1. Remove and replace PCMO represented by the failing tests or submit repair plan for approval.

TABLE 1

Attribute	Tolerance
Color	Uniform throughout
Appearance	Free of excessive pinholes, air bubbles, lumps, or other visible defects
Thickness	No lumps or thin spots
Fuel Resistance	Passes
Skid Resistance	SN(65)RSN40R greater than 35
Bond to Substrate	Failure in substrate

1.6.2 Test Section

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NOTE: The test section is used to determine the exact application rate, quality of the mixture in place, and the performance of the equipment.

The application rate depends on the pavement surface texture, desired PCMO thickness, PCMO aggregate size, and equipment used during PCMO placement. If operational conditions preclude placement of a test section on the pavement to be seal coated, apply on a pavement with similar surface texture.

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Prior to full production, prepare a quantity of mixture in the proportions shown in the approved mix design and in sufficient amount to place a test section a minimum of 37 square m 400 square feet at the rate specified in the job mix formula. Locate the proposed test section on a representative section of the pavement. The test application rate depends on the condition of the pavement surface. Use the test section to verify the adequacy of the mix design and to determine the actual application rate for the project. Use the same equipment and method of operations on the test section as will be used on the remainder of the work. Acceptance of the test section is based on compliance with the Tolerances listed in Table 1. If the test section should prove to be unsatisfactory, make the necessary adjustments to the mix composition, application rate, placement operations, and equipment. Place additional test sections and evaluate. Do not begin full production without approval. Schedule a minimum of 1 day following the placement of the test section prior to job mix approval to allow for proper curing, and an overall assessment of the PCMO test section.

1.6.2.1 Fuel Resistance

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NOTE: Select first bracketed option for laboratory fuel resistance testing (Appendix A) and coordinate with paragraph: MIX DESIGN. Select second bracketed option for test section fuel resistance testing (Appendix B).

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[Submit test results, performed in accordance with the test method given in Appendix A, showing that the PCMO mixture meets the tolerances of Table 1.] [Conduct fuel resistance testing on the test section in accordance with Appendix B. If the fuel resistance test results meet the tolerances of Table 1, the test section may remain as part of the project pavement. If the test section fails the tolerances, remove the test section, construct another test section, and retest.]

1.6.2.2 Skid Resistance

Evaluate the skid resistance of the test section using a ribbed tire (R), traveling at 65 kilometers per hour 40 miles per hour over a wetted PCMO in accordance with ASTM E274/E274M. Report the result as SN(65)R SN40R and meet the tolerances of Table 1.

1.6.2.3 Bond To Substrate

Evaluate the bond strength of the PCMO to the prepared pavement substrate in accordance with ASTM C1583/C1583M. Report the failure mode and meet the tolerances of Table 1.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

The work consists of placing one or more applications of a polymer concrete micro overlay, with mineral or synthetic aggregate, applied on an existing, previously prepared bituminous or concrete surface. Requirements for the mixing and placement equipment are specific to the manufacturer's

product and are not specified herein.

2.2 CEMENT

Provide cement for PCMO conforming to ASTM C150/C150M for Type I, II, I/II or III Portland Cement. Submit copies of certified test data.

2.3 WATER

Provide potable water free from harmful soluble salts. Control the temperature of the water added during mixing to a minimum of 10 degrees C 50 degrees F and not above 32 degrees C 90 degrees F. Control the pH of the water added during mixing to the requirements of the manufacturer.

2.4 AGGREGATES

Provide aggregate which is either a natural or manufactured aggregate composed of clean, hard, durable, uncoated particles, free from lumps of clay and all organic matter, meeting the quality requirements of ASTM C33/C33M or ASTM D242/D242M. Submit all aggregate test results and samples at least 14 days prior to start of construction.

2.5 MIX DESIGN

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NOTE: For laboratory fuel resistance testing, include the bracketed item specifying Appendix A.

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Submit proposed JMF [including fuel resistance test results in accordance with Appendix A]. Develop the mix design and submit the recommended formulation of water, polymer, and cement/aggregate blend and estimated application rate proposed for use at least 14 days prior to the start of operations. Submit a service record of five years successful performance for a similar JMF on comparable substrate equal to or exceeding the proposed exposure and traffic conditions for the related use. Include photographs and written report addressing pinholes, air bubbles, lumps or other visible defects in accordance with ACI 201.1R. Submit service record performed by a third party engineer, petrographer, or concrete materials engineer. Exact application rates cannot be determined until the test section is placed due to the variability in surface textures of asphalt pavement. The specific JMF selected will be submitted in writing and approved prior to the start of the project.

2.5.1 Composition

Provide PCMO consisting of a polymer, water, cement, additives, and aggregate [and/or fibers] in the specified proportions and according to the specific manufacturer's requirements. Develop a job mix formula (JMF) suitable to the range of different PCMO products available, the local climatic zone, local temperature during application, and pavement surface conditions.

2.5.2 Mix Design Report

Perform trial design batches, mixture proportioning studies, testing, and submit test results demonstrating that the proposed mixture proportions produce PCMO of the qualities indicated. Submit test results in a mix design report to include:

a. Coarse and fine aggregate gradations and plots.
b. Coarse aggregate quality test results, include deleterious materials.
c. Fine aggregate quality test results.
d. Mill certificates for cement.
e. Recommended proportions and volumes for proposed mixture.
f. Narrative discussing methodology on how the mix design was developed.

2.5.3 Adjustments to JMF

Maintain the JMF in effect until a new formula is approved in writing. Should a change in sources of any materials be made, do not use new material until a new mix design has been performed and approved.

2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

2.6.1 Certifications

Submit Material Safety Data Sheets (MSDS) and certificate of analyses (COA) or quality control certificates (QCC) verifying the composition of each separate material employed in the PCMO without revealing proprietary information. Submit COA/QCC documentation traceable to the batch/lot of materials received from the supplier of each proposed component of the PCMO. Clearly mark batch/lot identification on all packaging to be traceable to a specific COA/QCC for that particular batch.

PART 3 EXECUTION

3.1 PREPARATION OF THE UNDERLYING SURFACE

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NOTE: In order to ensure adequate adhesion and minimize cracking and curling, allow the pavement surface to cure prior to application of the seal coat. Experience has shown that a minimum of 30 days and an average of approximately 90 days of hot weather (daytime temperatures of 21 degrees C 70 degrees F) are needed for adequate curing of a HMA surface prior to application of a PCMO.

This guide specification only pertains to the polymer concrete micro-overlay aspects of the project and not to any surface preparation requirements. Address surface preparation requirements by either including them in this guide specification or by adding pertinent sections to the project documents..

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Prior to placing PCMO, clean the surface of the pavement to remove dust, dirt, other loose foreign matter, grease, oil, any type of objectionable surface film, or thermoplastic or painted pavement markings, using a vacuum sweeper or a combination of wire brushes and a power blower. Where vegetation exists in cracks, remove the vegetation and clean the cracks to a depth of 50 mm 2 inches where practical. Treat those cracks with a concentrated solution of an approved herbicide. [Clean, rout, and repair cracks in accordance with Section 32 01 17.61 SEALING OF CRACKS IN ASPHALT PAVING.] Remove bituminous pavement surfaces softened by petroleum derivatives, or that have failed due to any other cause, to the full depth

of the damage and replace with new bituminous concrete similar to that of the existing pavement. Maintain areas of the pavement surface to be sealed with PCMO in a firm consolidated condition, and sufficiently cured so that there is no concentration of oils on the surface. Allow a period of a minimum of 30 days to elapse between the placement of a bituminous surface course and the application of the seal coat unless detergent washing is chosen as an alternative to the time requirement. After the 30 day curing period or detergent washing, verify the surface is suitable by pouring a cup of water on the pavement surface (on a warm day) and observing if any oils appear in the standing water. If oils appear, the surface is not sufficiently cured to accept a seal coat.

3.2 APPLICATION

Continuously agitate the mixture from the initial mixing until its application on the pavement surface. Maintain the distributor or applicator, pumps, and all tools in a satisfactory working condition. Apply a primer prior to placement of PCMO, if recommended by the manufacturer. Apply the PCMO seal coat at the application rate determined from the test section. When an area will be subjected to significant fuel spillage, place a double coat of PCMO in the appropriate area at an approved application rate. The application rate for the second coat of PCMO can vary significantly from the underlying PCMO coat due to changes in the surface texture of the surface after PCMO application.

3.2.1 Calibration

Furnish all equipment, materials, and labor necessary to calibrate the equipment so that it will produce and apply a mix that conforms to the job mix design. Make all calibrations with the approved job materials prior to applying the PCMO to the pavement as part of the test section. Submit a copy of the calibration test results.

3.2.2 Curing

Permit the mixture to cure for a minimum of 24 hours, after the final application, before opening to traffic. Repair any damage to the uncured mixture due to early traffic.

3.3 JOINTS

Overlap all joints with the adjacent PCMO section and maintain a similar texture as other sections of the PCMO.

3.4 FIELD QUALITY CONTROL

3.4.1 QC Monitoring

Document each batch of material prepared for placement, and keep written records of the weights of cement, aggregate, polymer emulsion, and water used for each batch. In addition, keep records of air temperature, pavement temperature), wind velocity (speed and direction), and humidity. Submit all QC test results on a daily basis, as the tests are performed.

3.4.2 Sampling

Perform sieve analyses on aggregates a minimum of once for each half-days's production. Conduct tests in accordance with ASTM C117 and ASTM C136/C136M.

3.5 APPENDICES

APPENDIX A

LABORATORY FUEL RESISTANCE TEST

1. Scope. This method determines the resistance of the PCMO to kerosene.

2. Apparatus.
   a. Two 150 X 150 mm 6 X 6 inch square 16 gauge sheet metal masks with a 100 by 100 mm 4 by 4 inch square center removed.

   b. One 150 X 150 mm 6 X 6 inch unglazed white ceramic tile with an absorption rate of 10-18 percent (according to ASTM C67/C67M).

   c. Brass ring, 50 mm 2 inch diameter and 50 mm 2 inch high.

   d. Kerosene meeting requirements of ASTM D3699.

   e. Silicone rubber sealant or fast-setting epoxy.

3. Procedure
   a. Immerse the ceramic tile in distilled water for a minimum of ten minutes.

   b. Remove excess water from the tile to produce a damp surface before applying the seal coat.

   c. Using the mask described in 2.a apply one layer of the PCMO blend (mixed as specified). Spread even with the top of the mask using a spatula or other straight edge.

   d. Allow the sample to cure for 24 hours at 24 degrees C + 1 77 + 2 degrees and 50 + 10 percent relative humidity.

   e. If a two-layer application is specified, position a second mask on top of the first mask. Apply a second coat of PCMO emulsion mixture. Spread even with the top of the second mask.

   f. Cure as in step 3.d.

   g. After curing, affix the brass ring to the seal coat on the tile with silicone rubber or epoxy. Epoxy often adheres better to the PCMO than silicone.

   h. Fill the brass ring with kerosene. Add a small amount of coloring to the kerosene, asphalt works well for this. The coloring may be necessary to determine if the kerosene breached the PCMO surface.

   i. After 24 hours, remove the kerosene from the brass ring, blot dry and immediately examine the film for softness and loss of adhesion. Immediately after the film is examined, break the tile in half, exposing that part of the tile whose film was subjected to the kerosene.

   j. Evaluate for penetration of kerosene through the sealer and loss of adhesion.

4. Report. Report the results as pass or fail. Visible evidence of

APPENDIX A

LABORATORY FUEL RESISTANCE TEST

leakage through or discoloration in the tile constitutes failure of the test.

5. Criterion. A "pass" rating in the fuel resistance test is required.

APPENDIX B

FIELD FUEL RESISTANCE TEST

1. Scope. This field method is recommended to verify the resistance of the PCMO to aviation fuel. This procedure is adapted from a field test proposed for use with coal-tar materials. Some slight modifications to the method have been made to accommodate PCMO. This test is best conducted in conditions of little wind and moderate temperatures (around 21-24 degrees C 70-75 degrees F).

2. Apparatus

a. A 150 mm 6-inch diameter metal, glass, or PVC pipe at least 76 mm 3 inches long.

b. A lid for the pipe.

c. RTV silicone rubber sealant or fast-setting epoxy for affixing the pipe to the pavement surface.

e. A ruler.

3. Procedure

a. Locate a clean, flat surface on the pavement to be tested.

b. Place the pipe on the pavement surface and seal the edge with silicone or epoxy. Firmly mold the adhesive between the pipe and the surface of the pavement to prevent leakage.

c. Allow the sealant/adhesive to cure for 24 hours.

d. Pour approximately one inch of aviation fuel or kerosene inside the pipe. Determine baseline of fluid by placing the ruler inside the pipe and measuring the distance from the surface of the fluid to the top of the pipe. Record this distance. Place the lid on the top of the pipe.

e. After 30 minutes remove the lid and measure the distance from the top of the fluid to the top of the pipe. Record this distance. Any discoloration of the fuel or softening of the PCMO surface should be recorded.

f. If seepage occurs between the bottom of the pipe and the pavement surface through the adhesive, the test is invalid. Retest in a different location.

4. Report. Report the distance from the surface of the fluid to the top of the pipe immediately after placing the fluid and after 30 minutes. Determine the difference between the two readings. If less than 5 mm 0.2 inches of fluid has penetrated the surface, a 'Pass' rating is given. If more than 5 mm 0.2 inches of fluid penetrates the surface, the pavement surface is deemed 'Failed' and may be unacceptable for fuel resistance. If any discoloration of the fuel or softening of the PCMO surface is evident, the PCMO surface is deemed 'Failed' and may be unacceptable for fuel resistance.

5. Criterion: A "pass" rating in the fuel resistance test.

-- End of Section --