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TRI-SERVICE PAVEMENTS WORKING GROUP (TSPWG) MANUAL

DETERMINING THE NEED FOR RUNWAY RUBBER REMOVAL

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TRI-SERVICE PAVEMENTS WORKING GROUP MANUAL (TSPWG M)

DETERMINING THE NEED FOR RUNWAY RUBBER REMOVAL

Indicate the preparing activity beside the Service responsible for preparing the document.

U.S. ARMY CORPS OF ENGINEERS

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This TSPWG M supersedes Air Force ETL 04-10, *Determining the Need for Runway Rubber Removal*, dated 12 May 2004.

FOREWORD

This Tri-Service Pavements Working Group Manual supplements guidance found in other Unified Facilities Criteria, Unified Facility Guide Specifications, Defense Logistics Agency Specifications, and Service-specific publications. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and, in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the TSPWG Manual, the SOFA, the HNFA, and the BIA, as applicable. This manual provides optional guidance for using continuous friction measuring equipment (CFME) to determine the need for rubber removal on runways. The information in this TSPWG Manual is referenced in technical publications found on the Whole Building Design Guide. It is not intended to take the place of Service-specific doctrine, technical orders (T.O.s), field manuals, technical manuals, handbooks, Tactics, Techniques, and Procedures (TTPs), or contract specifications, but should be used along with these to help ensure pavements meet mission requirements.

TSPWG Manuals are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction, maintenance, repair, or operations. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and the Air Force Civil Engineer Center (AFCEC) are responsible for administration of this document. Technical content of this TSPWG Manual is the responsibility of the Tri-Service Pavements Working Group (TSPWG). Defense agencies should contact the preparing activity for document interpretation. Send recommended changes with supporting rationale to the respective Service TSPWG member.

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TRI-SERVICE PAVEMENTS WORKING GROUP MANUAL (TSPWG M) NEW SUMMARY SHEET

Document: TSPWG Manual 3-270-01.04-10, *Determining the Need for Runway Rubber Removal*

Superseding: ETL 07-10, *Determining the Need for Runway Rubber Removal*, dated 12 May 2004

Description: This Tri-Service Pavements Working Group Manual (TSPWG M) provides optional guidance for using continuous friction measuring equipment (CFME) to determine the need for rubber removal on runways.

Reasons for Document: This TSPWG M provides an objective, alternate method for determining when rubber should be removed from runways.

Impact: There are no cost impacts.

Unification Issues: There are no unification issues.

Note: The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this TSPWG M does not imply endorsement by the Department of Defense (DOD).

CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

Over time, the skid resistance of runway pavement deteriorates due to a number of factors. The primary factors are: 1) mechanical wear and polishing action from aircraft tires rolling or braking on the pavement; and 2) the accumulation of contaminants, chiefly rubber, on the pavement surface. The effect of these two factors is directly dependent upon the volume and type of aircraft traffic.

The most persistent contaminant problem is the deposition of rubber from tires of landing jet aircraft. Rubber deposits principally occur on the touchdown areas of runways and can be quite extensive. Heavy rubber deposits can completely cover the pavement surface texture, causing the loss of aircraft braking capability and directional control, particularly when runways are wet. It should be noted that even if the data indicate that friction values are acceptable, rubber deposits might still need to be removed. An example is when rubber deposits obscure markings and/or numerals.

1-2 PURPOSE AND SCOPE.

This TSPWG M supersedes ETL 04-10, *Determining the Need for Runway Rubber Removal.* This TSPWG M provides optional guidance for using continuous friction measuring equipment (CFME) to determine the need for rubber removal on runways. Currently, the airfield manager visually inspects the runway surface to determine when rubber removal is required. This procedure is subjective and can result in removing rubber too often (friction characteristics are good and markings are visible) or, in some cases, not removing rubber at the proper time. The procedure outlined in this TSPWG M provides an objective basis for determining when rubber needs to be removed. It is based on procedures currently used by the Federal Aviation Administration (FAA). Use this procedure <u>only</u> to determine rubber removal requirements; the airfield evaluation teams will continue to conduct routine baseline friction characteristics tests.

1-2.1 Some bases have CFME available to determine runway condition rating (RCR) values. Other bases may want to obtain CFME to perform friction testing or they can contract for these services. Adding friction testing to existing indefinite delivery indefinite quantity (IDIQ) contracts appears to be the most economical approach.

1-2.2 This TSPWG M provides the minimum requirements for rubber removal. Note that factors other than friction may drive the need for rubber removal, such as the obscuring of airfield markings by excess rubber buildup or the need for a clean surface before applying markings.

1-3 APPLICABILITY.

The guidance in this TSPWG M is optional. The bases should determine if this guidance should be implemented. Additional recommendations are available from the Pavements Discipline Working Group (DWG) or their designated representative. Operational risk management (ORM) procedures as outlined by the Services should be considered in determining use of this TSPWG M.

1-4 REFERENCES.

Appendix C contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

1-5 GLOSSARY.

Appendix B contains acronyms, abbreviations, and terms.

CHAPTER 2 EVALUATION CRITERIA

2-1 MINIMUM FRICTION SURVEY FREQUENCY.

Table 2-1 provides criteria for scheduling runway friction testing for rubber removal. This table is based on an average mix of turbojet aircraft operating on any runway. When any runway end has 20 percent or more wide-body aircraft (e.g., C-5, C-17, C-141, C-130, KC-10, KC-135) in the total aircraft mix, a higher frequency of testing is required; therefore, the next-higher level of aircraft operations in Table 2-1 should be used to determine the minimum testing frequency. As data are accumulated on the rate of change of runway friction under various traffic conditions, adjust the scheduling of friction surveys to ensure evaluators detect and predict degraded friction conditions in time to take corrective actions.

Table 2-1 Friction Testing Frequency

Number of Daily Minimum Aircraft Landings Per Runway End	Minimum Friction Testing Frequency
Less than 15	1 year
16 to 30	6 months
31 to 90	3 months
91 to 150	1 month
151 to 210	2 weeks
Greater than 210	1 week

Note: Each runway end should be evaluated separately (e.g., Runway 18 and Runway 36).

2-2 CFME – GENERAL.

2-2.1 Performance Standards.

Appendix A contains the performance specifications for CFME.

2-2.2 Qualified Product List.

FAA-approved CFME can be found in Appendix A-4 of FAA AC 150/5320-12C, *Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces*. For future updates to this listing, check the FAA website at: https://www.faa.gov/documentLibrary/media/advisory_circular/150-5320-12C/150_5320_12c.PDF

2-2.3 Training.

The success of friction measurement in delivering reliable friction data depends heavily on the personnel responsible for operating the equipment. Provide adequate professional training on the operation, maintenance, and procedures for conducting friction measurement, either as part of the procurement package or as a separate contract with the manufacturer. Also, recurrent training is necessary for review and update to ensure the operators maintain a high level of proficiency. Experience has shown that unless this is done, personnel will lose touch with new developments on equipment calibration, maintenance, and operating techniques. A suggested training outline for CFME operators is provided in Appendix A. Testing personnel should be trained not only on the operation and maintenance of CFME but also on the procedures for conducting friction surveys. These procedures are provided in paragraph 2-3.

2-2.4 Calibration.

Before conducting friction surveys, check all CFME for calibration within tolerances provided by the equipment manufacturer. Periodically calibrate the CFME self-wetting system to ensure the water flow rate is correct and the amount of water produced for the required water depth is consistent and applied evenly in front of the friction measuring wheel(s) for all test speeds.

2-3 CONDUCTING FRICTION EVALUATIONS WITH CFME.

2-3.1 Preliminary Steps.

Precede friction measurement operations by a thorough visual inspection of the pavement to identify inadequacies such as drainage problems, including ponding and groove deterioration, and structural deficiencies. Take careful and complete notes, not only of the CFME data but of the visual inspection as well. Provide appropriate communications equipment and frequencies on all vehicles used in conducting friction surveys and ensure all personnel are fully cognizant of airfield safety procedures. Also ensure personnel operating equipment are fully trained and current in all procedures. Check the CFME for accurate calibration and have the vehicle checked for adequate braking ability.

2-3.2 Location of Friction Surveys on Runway.

2-3.2.1 When conducting friction surveys on a runway at 65 kilometers per hour (km/h) (40 miles per hour [mph]), begin recording data at the threshold when an adequate overrun with in-ground lighting is present. If the overrun will not allow the operator to accelerate to speed before crossing the threshold, collect data as soon as the vehicle reaches 65 km/h (40 mph). Terminate the friction survey approximately 152 meters (500 feet) from the opposite end of the runway if the overrun will not allow the operator to use it for deceleration; otherwise, terminate the survey at the threshold. When conducting friction surveys on a runway at 95 km/h (60 mph), begin recording data at the threshold when an adequate overrun with in-ground lighting is present. If the overrun will not allow the operator to accelerate to speed before crossing the threshold, collect data as soon as the vehicle reaches 95 km/h (60 mph). Terminate the friction survey approximately 305 meters (1000 feet) from the opposite end of the runway if the overrun will not allow the operator to use it for deceleration; otherwise, terminate the survey at the threshold. Whatever the test speed, where travel beyond the end of the runway or overrun could result in equipment damage or personal injury, allow additional runway length for stopping.

2-3.2.2 Ensure the lateral location on the runway for performing the test is 3 and 6 meters (10 and 20 feet) from the centerline. Unless surface conditions are noticeably different on either side of the runway centerline, a test on one side of the centerline, in the same direction that aircraft primarily land, is sufficient. When both ends of the runway are to be evaluated, make vehicle runs to record data on the return trip (both ways).

2-3.3 Vehicle Speed for Conducting Surveys.

All of the approved CFME referenced in paragraph 2-2.2 can be used at either 65 or 95 km/h (40 or 60 mph). The lower speed test determines the overall macrotexture, contaminant, and drainage condition of the pavement surface. The higher test speed provides an indication of the condition of the surface’s microtexture. A complete survey includes tests at both speeds.

2-3.4 Use of CFME Self-Wetting System.

Since wet pavement always yields the lowest friction measurements, ensure testing mirrors such “worst case” conditions. Conduct testing with CFME equipped with a self-wetting system to simulate wet pavement surface conditions and that provides the operator with a continuous record of friction values along the length of the runway. In these systems, the attached nozzle(s) are designed to provide a uniform water depth of 1 millimeter (0.04 inch) in front of the friction-measuring tire(s). The wetted test surface produces friction values that are most meaningful in determining whether or not corrective action is required.

2-3.5 Friction Level Classification.

Mu numbers (friction values) measured by CFME are used as guidelines for evaluating the surface friction deterioration of runway pavements and identifying appropriate corrective actions required for safe aircraft operations. Table 2-2 depicts the friction values for two classification levels for qualified CFME operated at test speeds of 65 and 95 km/h (40 and 60 mph). This table was developed from qualification and correlation tests conducted at the National Aeronautics and Space Administration’s (NASA) Wallops Flight Facility in 1989. Contact information for various test devices is referenced in paragraph 2-2.2.

Table 2-2 Friction Level Classifications for Runway Pavement Surfaces Using CFME with Self-Wetting Systems

Test Device	65 km/h (40 mph)		95 km/h (60 mph)	
	Action Level	Planning Level	Action Level	Planning Level
Airport Surface Friction Tester	0.50	0.60	0.34	0.47
BV-11 Skiddometer	0.50	0.60	0.34	0.47
GripTester Friction Tester	0.43	0.53	0.24	0.36
Mu Meter	0.42	0.52	0.26	0.38
RUNAR (operated at fixed 16% slip)	0.45	0.52	0.32	0.42
Runway Friction Tester (M 6800)	0.50	0.60	0.41	0.54
Safegate Friction Tester	0.50	0.60	0.34	0.47
Tatra Friction Tester	0.48	0.57	0.42	0.52

2-3.6 Evaluation and Maintenance Guidelines.

The following evaluation and maintenance guidelines are recommended based on the friction levels classified in Table 2-2. These guidelines take into account that poor friction conditions for short distances on the runway do not pose a safety problem to aircraft but long stretches of slippery pavement are of serious concern and require prompt remedial action.

2-3.6.1 Friction Deterioration Below the Planning Level (152-Meter [500-Foot] Segment).

When the average Mu value on the wet runway pavement surface at both 65 and 95 km/h (40 and 60 mph) is less than the planning level but above the action level in Table 2-2 for a distance of 152 meters (500 feet) and both of the adjacent 152-meter (500-foot) segments are at or above the planning level, no corrective action is required. These readings indicate that the pavement friction is deteriorating but the situation is still within an acceptable overall condition.

2-3.6.2 Friction Deterioration Below the Planning Level (305-Meter [1000-Foot] Segment).

When the average Mu value on the wet runway pavement surface in a rubber deposit area at both 65 and 95 km/h (40 and 60 mph) is less than the planning level in Table 2-2 for a distance of 305 meters (1000 feet) or more, initiate a project to have rubber removed from the affected areas of the runway before the next friction test is scheduled. If low friction is due to factors other than rubber accumulation (e.g., aggregate polishing), initiate a project to take appropriate corrective measures.

2-3.6.3 Friction Deterioration Below Action Level.

When the average Mu value on the wet pavement surface in a rubber deposit area at both 65 and 95 km/h (40 and 60 mph) is below the action level in Table 2-2 for a distance of 152 meters (500 feet) and both of the adjacent 152-meter (500-foot) segments are below the planning level, take action immediately to remove rubber from the affected areas of the runway and a Notice to Airmen (NOTAM) should be issued, warning pilots of the loss in friction. If low friction is due to factors other than rubber accumulation (e.g., aggregate polishing), initiate a project to take appropriate corrective measures.

2-3.7 Computer Evaluation of Friction Test Data.

As required by the criteria in paragraph 2-3.6, a manual evaluation of friction test data can be tedious and prone to human error. The FAA's Runway Friction Data Evaluation Program software that performs this evaluation is available free of charge and may be downloaded from the FAA website at https://www.faa.gov/airports/engineering/design_software/. Computer programs to evaluate data can also be obtained from some CFME manufacturers.

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APPENDIX A BEST PRACTICES

The Best Practices Appendix is considered to be guidance and not requirements. Its main purpose is to communicate proven facility solutions, systems, and lessons learned, but may not be the only solution to meet the requirement.

A-1 PERFORMANCE SPECIFICATIONS FOR CFME

A-1.1 Friction Equipment Performance Standard.

The CFME may be self-contained or towed. If towed, the tow vehicle is considered an integral part of the device. Ensure the vehicles or trailers meet all applicable federal and state laws and regulations for vehicles or trailers for use on public highways. Ensure the side force friction-measuring device, the Mu Meter, meets the standard test method given in American Society for Testing and Materials (ASTM) E670, *Standard Test Method for Testing Side Force Friction on Paved Surfaces Using the Mu-Meter*. For standard test method for fixed slip devices follow ASTM E2340, *Standard Test Method for Measuring the Skid Resistance of Pavements and Other Trafficked Surfaces Using a Continuous Reading, Fixed-Slip Technique.*

A-1.2 Friction Measuring Equipment.

Ensure the friction measuring equipment:

A-1.2.1 Provides fast, continuous, accurate, and reliable friction measurements for the entire length of the runway, less the differences required for accelerating and decelerating the vehicle at the runway ends.

A-1.2.2 Is designed to sustain rough usage and still function properly and provides efficient and reliable methods of equipment calibration.

A-1.2.3 Is capable of automatically providing the operator with a selection of average friction values for both a 152-meter (500-foot) segment and a one-third segment of runway length. In addition, it is capable of providing data with which the average friction value for any length of runway can be manually calculated.

A-1.2.4 Is capable of producing a permanent trace of friction measurements versus pavement length at a minimum scale of 25 millimeters (1 inch) equals 90 meters (300 feet).

A-1.2.5 Is capable of consistently repeating friction averages throughout the friction range on all types of pavement surfaces. Ensure friction averages for each 152-meter (500-foot) segment located on the pavement surface are within a confidence level of 95.5 percent or two standard deviations of ±0.06 Mu numbers.

A-1.2.6 Contains a self-wetting system that distributes water in front of the friction-measuring wheel(s) at a uniform depth of 1 millimeter (0.04 inch). Ensure the manufacturer provides documentation to show that the flow rate is within a tolerance of ±10 percent for both standard test speeds (i.e., 65 and 95 km/h [40 and 60 mph]).

A-1.2.7 Is able to conduct friction surveys at speeds of 65 and 95 km/h (40 and 60 mph) within a tolerance of ±5 km/h (±3 mph).

A-1.2.8 Includes a complete set of the latest operation and maintenance manuals, including guidelines for training airfield personnel. Ensure the training manuals include a copy of this TSPWG M.

A-1.2.9 Has electronic instrumentation (solid-state electronics), including a keyboard for data entry, that enhances the information-gathering and analysis capability of the equipment and provides the operator more convenience in equipment operation and performance. Store the information gathered during a friction survey in an internal microprocessor memory that is readily visible to the vehicle operator. This will allow for the examination of data, printouts, and calculation of average friction values over all or any portion of the test run. Ensure each printout of the chart produced by the microprocessor unit includes the following recorded information: runway designation and date; time of friction survey; a continuous trace of the friction values obtained for the entire runway length minus the acceleration and deceleration distances; printed marks depicting each 30-meter (100-foot) increment of the runway length so the operator can easily identify specific areas on the runway pavement surface; average friction value for 152-meter (500-foot) segments and one-third segments of the runway length, as pre-selected by the operator; and average vehicle speed for each segment.

A-1.3 Vehicle Requirements.

Ensure the vehicle:

A-1.3.1 Is able to conduct friction surveys at speeds of 65 and 95 km/h (40 and 60 mph) within a tolerance of ±5 km/h (±3 mph). The vehicle, when fully loaded with water, is capable of accelerating to these speeds within 152 and 305 meters (500 and 1000 feet) from the starting position, respectively.

A-1.3.2 Is equipped with electronic speed control.

A-1.3.3 Conforms to the requirements of FAA Advisory Circular (AC) 150/5210-5D, *Painting, Marking, and Lighting of Vehicles Used on an Airport,* for airfield service vehicles.

A-1.3.4 Is equipped with one or more transceivers necessary for communication with airfield operations and air traffic control.

A-1.3.5 Is equipped with a water tank constructed of strong, lightweight material, that has sufficient capacity to complete a friction survey on a 4,267-meter (14,000-foot) runway in one direction, and has all necessary appurtenances to deliver the required water flow rate to the friction measuring wheel(s).

A-1.3.6 Is equipped with appropriate heavy-duty suspension to adequately handle imposed loads.

A-1.3.7 Is equipped with a device that regulates water flow. Unless flow regulation is automatic, locate the device within the confines of the vehicle, near the driver's position. If flow regulation is automatic, no device is required in the vehicle.

A-1.4 Tire Performance Standard.

Furnish the CFME with measuring tires designed for use in conducting friction surveys and that meet ASTM standard E670, E1551*, Standard Specification for a Size 4.00-8 Smooth-Tread Friction Test Tire*, or E1844, *Standard Specification for a Size 10 x 4-5 Smooth-Tread Friction Test Tire*, as appropriate. Use non-ribbed (blank) tires to eliminate the effect of tread wear and provide greater sensitivity to variations in pavement surface texture. Furnish tires with split rims and tubes with curved stems. In addition, ensure the manufacturer provides the airfield user with a calibrated pressure dial gauge.

A-2 TRAINING REQUIREMENTS OUTLINE FOR CFME

A-2.1 Introduction.

Paragraph A-2.2 lists the major items considered in developing a training program for personnel responsible for operating and maintaining CFME. Whenever a major change in equipment design occurs, revise the training and instruction manuals. Ensure the manufacturer always provides personnel with a current training and instruction manual.

A-2.2 Training Requirements Outline.

A-2.2.1 Classroom Instruction.

- Purpose of training program
- General discussion on pertinent Air Force regulations
- General discussion on pertinent FAA ACs
- General discussion on pertinent ASTM standards
- General overview of program
- Review of requirements in this TSPWG M and discussion of related topics
    - Coefficient of friction definition
    - Factors affecting friction conditions
    - ASTM standards for CFME
    - ASTM standards for friction-measuring tires
    - Programming the computer for Air Force and International Civil Aviation Organization (ICAO) formats
    - Procedures for reporting numbers
    - Preparation and dissemination of NOTAMs
- Orientation on the calibration, operation, and maintenance of CFME

A-2.2.2 Field Experience.

Operation and maintenance of CFME.

A-2.2.3 Testing.

Solo test and written examination on all items covered in the course.

A-2.2.4 Award of Training Certificate.

Provide signed and dated training certificates with equivalent continuing education units (CEU).

APPENDIX B GLOSSARY

B-1 ACRONYMS

ASTM	American Society for Testing and Materials
CFME	Continuous Friction Measuring Equipment
ETL	Engineering Technical Letter
FAA	Federal Aviation Administration
FAA AC	Federal Aviation Administration Advisory Circular
km/h	Kilometers per Hour
mph	Miles Per Hour
Mu	Friction Coefficient
NOTAM	Notice To Airmen
UFC	Unified Facilities Criteria

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APPENDIX C REFERENCES

FEDERAL AVIATION ADMINISTRATION

https://www.faa.gov/regulations_policies/advisory_circulars/

FAA AC 150/5210-5D, *Painting, Marking, and Lighting of Vehicles Used on an Airport*

FAA AC 150/5320-12C, *Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces*

ASTM INTERNATIONAL

https://www.astm.org/index.html

ASTM E670, *Standard Test Method for Testing Side Force Friction on Paved Surfaces Using the Mu-Meter*

ASTM E1551, *Standard Specification for a Size 4.00-8 Smooth-Tread Friction Test Tire*

ASTM E1844, *Standard Specification for a Size 10 x 4-5 Smooth-Tread Friction Test Tire*

ASTM E2340, *Standard Test Method for Measuring the Skid Resistance of Pavements and Other Trafficked Surfaces Using a Continuous Reading, Fixed-Slip Technique*