TSPWG M 3-260-02.24-01
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# TRI-SERVICE PAVEMENT WORKING GROUP (TSPWG) MANUAL

# TRAPEZOIDAL GROOVING FOR RIGID AND FLEXIBLE AIRFIELD PAVEMENTS

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# TRI-SERVICE PAVEMENTS WORKING GROUP MANUAL (TSPWG M): TRAPEZOIDAL GROOVING FOR RIGID AND FLEXIBLE AIRFIELD PAVEMENTS



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

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# 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 guidance on trapezoidal grooving for military airfields. 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.), field manuals, technical manuals, handbooks, Tactics, Techniques and Procedures (TTP) 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 Systems 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 PAVEMENT WORKING GROUP (TSPWG)**
**NEW SUMMARY SHEET**

**Document:** TSPWG M 3-260-02.24-01, *Trapezoidal Grooving for Rigid and Flexible Airfield Pavements*

**Superseding:** None

**Description:** This TSPWG Manual provides guidance on selecting trapezoidal-shaped grooving for military airfield pavements.

**Reasons for Document:**

- Provide personnel in engineering design, planning, or construction roles with the latest guidance regarding trapezoidal-shaped grooving and relevant Department of Defense (DOD) criteria.

**Impact:** There is most likely a cost impact to selecting trapezoidal-shaped grooving as opposed to standard grooving. However, the following benefits should be realized: reduced rubber buildup, higher groove stability, and improved water dispersion.

- Supplemental information on the operation, maintenance, and repair of pavements as well as airfield damage repair will be available to all Services.
- Maintenance and/or upgrading of this supplemental information will include inputs from all Services.

**Note:** The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by DOD.

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# CHAPTER 1 INTRODUCTION

## 1-1 PURPOSE AND SCOPE.

This TSPWG M provides guidance to specifiers, designers, planning personnel, and construction-executing agents for trapezoidal grooving on military rigid and flexible airfield pavements. The latest Unified Facilities Guide Specification (UFGS) 32 01 18.71, *Grooving of Airfield Paving* (dated November 2023) and Unified Facilities Criteria (UFC) 3-260-02, *Pavement Design for Airfields*, (dated June 2001) contain minor discrepancies. This TSPWG M provides unifying content in the interim, pending resolution of the discrepancies. Following the guidance within this TSPWG M during design and/or construction adheres to best practices for airfield grooving and produces a finished product that further contributes to pavement durability.

## 1-2 BACKGROUND.

The implementation of transverse grooves on airfields began in the mid-1960s to minimize aircraft tire hydroplaning incidents in adverse weather conditions (Horne & Brooks, 1967). Standard (square-shaped) grooves in runways (as well as high-speed taxiways) reduce the amount of rubber buildup and improve water dispersion, contributing to pavement durability and overall service life.

The Federal Aviation Administration (FAA) studied and reviewed the performance of trapezoidal-shaped transverse grooves in contrast to standard grooves. (Patterson, 2012). This study, along with recent field experiences, concludes that while trapezoidal grooving may be more costly than standard grooves, users can expect improved performance with trapezoidal-shaped grooves.

UFGS 32 01 18.71 includes an option for specifiers to choose trapezoidal grooves in lieu of standard grooves. Additionally, attachments in UFGS 32 01 18.71 serve as guides for quality control testing and inspection of grooved pavements.

## 1-3 APPLICABILITY.

Use this TSPWG M together with UFGS 32 01 18.71, UFC 3-260-01, *Airfield and Heliport Planning and Design*, UFC 3-260-02, and UFGS documents related to joint sealing. Negligently planned or constructed pavement grooving can structurally damage pavement, produce surface defects, and damage joint material. Refer to this TSPWG M during the design and construction of airfield projects that include grooving.

## 1-4 GLOSSARY.

Appendix B contains acronyms, abbreviations, and terms.

## 1-5 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.

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# CHAPTER 2 SELECTING TRAPEZOIDAL GROOVING

## 2-1 CONSIDERATIONS FOR TRAPEZOIDAL GROOVING.

UFGS 32 01 18.71 includes added considerations not addressed in previous DOD documents. When considering and overseeing operations related to trapezoidal grooving, users, owners, designers, and construction executing agents are advised to account for the topics outlined in this chapter.

### 2-1.1 Impacts of Trapezoidal Grooving.

Due to increased blade wear, installing trapezoidal-shaped grooves is likely more expensive versus standard grooves. The configuration of the blade tips that cut a trapezoidal groove shape may require more frequent halts in operation to swap out worn diamond saw cutting blades. The increased surface area per groove requires additional energy that can reduce production rates, although the change in productivity is often negligible.

Benefits of trapezoidal-shaped grooves include improved resistance to rubber contamination, improved performance with regards to heavy aircraft tire loading, water dispersion, and resistance to chipping and closure. Trapezoidal grooves can improve pavement durability and resiliency.

### 2-1.2 Candidates for Trapezoidal Grooving.

Airfields with the following circumstances are candidates for trapezoidal grooving:

- Historical record of groove closure in standard-shaped grooves
- Frequent groove chipping or presence of unstable grooves
- Desire to reduce operations and maintenance (O&M) related to rubber contamination removal
- Location that receives large amounts of rainfall and risks of hydroplaning and flooded pavements are elevated
- Location that receives large amounts of aircraft traffic

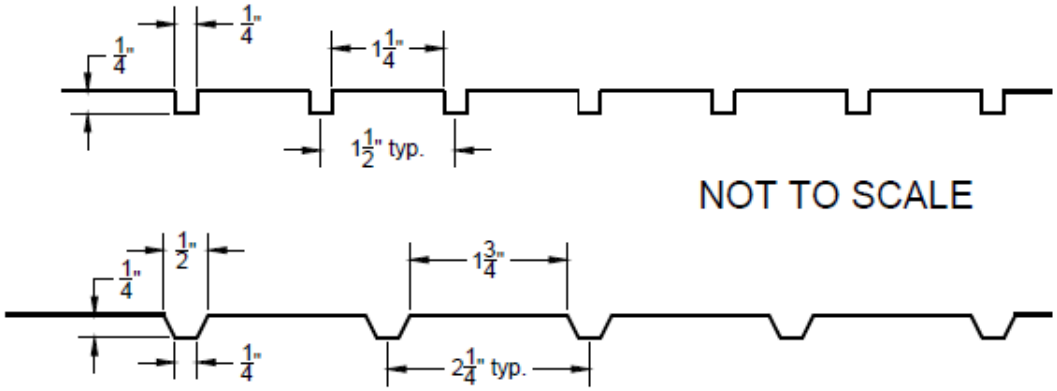
Trapezoidal-shaped grooves provide better performance with respect to groove stability, rubber contamination, water dispersion, and overall pavement durability and resilience. Users and owners are recommended to consult with their project designers and the Tri-Service Pavement Working Group (TSPWG) representative when considering the use of trapezoidal-shaped grooves on airfield projects. See Appendix A for known airfields with trapezoidal-shaped grooves.

### 2-1.3 Planning and Design.

During the planning and engineering design of airfield pavement projects that include trapezoidal grooving in the scope, individuals engaged in design need to consider the altered geometry that comes with trapezoidal grooves. This includes a wider center-to-center spacing and top-of-groove opening (see Figure 2-1). The equipment, other than

a new blade configuration and added spacers between blades, is not expected to change when transitioning from standard grooves to trapezoidal grooves.

**Figure 2-1 Standard and Trapezoidal-Shaped Groove Configurations**




UFGS 32 01 18.71 outlines items/notes for the designer when considering existing pavements, sealed joints, and other factors not previously covered. See UFGS 32 01 18.71 and paragraph 2-2 and Table 2-1 of this TSPWG M for items to address during design of all grooving projects (trapezoidal or standard shapes). Consult the latest UFGS 32 01 18.71 and consider project-specific constraints when preparing individual details of trapezoidal grooves.

Based on field experience and recent publications, expect trapezoidal grooving to wear saw blades at a faster pace when compared to standard grooving. To accommodate this, individuals engaged in planning and engineering design for grooving-related projects are encouraged to discuss expected delays and coordinate with airfield management regarding operations conducted in any active areas. See Designer Note in UFGS 32 01 18.71, paragraph 1.5, “Anticipated Delays Due to Mission Requirements,” when creating contract documents.

The use of both groove types (standard and trapezoidal) along the same cross-section of pavement is discouraged when the two groove types directly abut each other (e.g., when there is no clearance from a longitudinal joint). Groove dimensions will differ at these locations (e.g., groove opening width, center-to-center spacing) and inadvertent constructability constraints may arise. When wishing to interchange groove types along the same cross-section of pavement, include the option within UFGS 32 01 18.71, paragraph 3.3.2, “Procedures,” that prescribes a groove clearance from each longitudinal joint. Caution is advised when selecting this clearance, as areas that are un-grooved may not fully disperse water and are potentially hazardous in freezing climates. Consult with the user/owner and the TSPWG representative on the risks involved when choosing to make this selection. Interchanging groove types longitudinally down the pavement may be permitted where increased braking and rubber contamination are expected.

When previously grooved pavement is considered as part of the scope to receive trapezoidal grooving, two options are recommended to address the grooved pavement (regardless of existing groove condition): (1) pavement reconstruction or (2) overlay.

Assess the overall pavement condition as part of this decision-making process, review airfield pavement evaluation reports, perform visual assessments, and consult with the TSPWG representative.

### 2-1.4 Construction.

Due to an expected increase in blade wear for trapezoidal grooves, inspectors and personnel related to construction operations should be cognizant of blade condition by performing routine checkups on groove shape. A mold of a trapezoidal groove shape may be recommended for use to compare to freshly cut grooves. Additionally, the use of a laser texture scanner may be beneficial to scan several grooves in a single pass and precisely assess the groove shape. Note that laser texture scanners may be outside the budget for government quality assurance (QA) programs and grooving contractors are encouraged to procure these scanners for future work. A tire tread depth gauge may also evaluate the grooving depth, but does not provide an assessment of the groove shape.

If the dimensions of the groove are showing a shallower depth, narrower groove widths, or any other deviance from specification requirements, the grooving operator should be informed and the equipment/procedures modified. It is not expected that a single saw blade may wear while the rest of the blades on the cutting head are relatively unaffected (see Figure 2-2); however, in such case for trapezoidal grooves, halt work to repair the defective blade and resume operations.

Inspectors and construction-related personnel are encouraged to actively engage in the preparation, planning, and execution of grooving work for their respective project. Such activities include reviewing contract documents and grooving-related submittals, attending preparatory meetings with the grooving contractor, attending the grooving test section, routinely inspecting freshly cut grooves to evaluate their geometry/spacing, and noting any deficiencies to be addressed in conjunction with the review of daily inspection reports. UFGS 32 01 18.71 contains two attachments: a Grooving Test Section/Inspection Diagram and a Grooving Depth Measurement Spreadsheet. These attachments are intended to assist in the inspection of airfield grooving (both trapezoidal and standard grooves).

**Figure 2-2 Cutting Head of Grooving Machine**

## 2-2 OUTSTANDING CONFLICTS WITH OTHER DOD CRITERIA.

During the development of the latest UFGS 32 01 18.71 and the accommodation of trapezoidal grooves, outstanding conflicts were identified with other active DOD documents that pertain to design and construction. Table 2-1 addresses these conflicts and is intended to guide designers and engineers preparing contract documents. For specific questions related to current conflicts, consult the TSPWG representative.

**Table 2-1 Conflicts Between UFGS 32 01 18.71 and Other DOD Criteria**

| DOD Document | Outstanding Conflict | Recommended Action |
|---|---|---|
| UFC 3-260-01 | Paragraph 3-17.2.2, “Runway Pavement,” limits the groove-free zone on either side of the arresting barrier cable which requires hook engagement for operation to 10 feet. New UFGS 32 01 18.71 requirements update that zone to 20 feet on either side to accommodate requests by the F-35 community. | Revise groove-free zone on either side of the arresting barrier cable which requires hook engagement for operation to 20 feet. |
| UFC 3-260-02 | Depth of groove is 1/4 in. ± 1/16 in.<br>UFC 3-260-02, Figure 12-31, Sheet 1 and 2 of 3, Note: “Top of sealant shall be 1/4-in. to 1/16 in. below pavement surface. In areas to be grooved, the joint seal shall be recessed below the depth of the grooves.” Although reference for grooves is made, no dimension is specified for recession of joint sealant. | Specify recession of joint sealant to a minimum of 3/8 in. below pavement surface for non-beveled joints, and 1/8-in. below bottom of bevel for beveled joints. |
| UFC 3-260-02 | Depth of groove is 1/4 in. ± 1/16 in.<br>UFC 3-260-02, Figure 12-31, Sheet 3 of 3, Note: “Top of preformed seal shall be 1/8 to 1/4 inch below the pavement surface. In areas to be grooved, the joint seal shall be recessed below the depth of the grooves.” Although reference for grooves is made, no dimension is specified for recession of joint sealant. | Specify recession of preformed compression seal to a minimum of 3/8 in. below pavement surface for non-beveled joints, and 1/8 in. below bottom of bevel for beveled joints. |
| UFC 3-260-02 | No reference made to trapezoidal-shaped grooves in airfield pavements in Chapter 21, “Improving Skid Resistance/Reducing Hydroplaning Potential of Runways.” | Include text to permit trapezoidal-shaped grooves, as well as an additional figure in the chapter that details trapezoidal-shaped grooves conforming to the dimensions shown in Table 1 of UFGS 32 01 18.71. |
| UFC 3-260-02 | Chapter 21 does not include any references to high-speed taxiways. UFC 3-260-01 does address their need to be grooved. | Include high-speed taxiways in appropriate sentences within Chapter 21. |
| UFC 3-260-02 | Chapter 21 limits the groove-free zone on either side of the arresting barrier cable which requires hook engagement for operation to 10 feet. New UFGS 32 01 18.71 requirements update that zone to 20 feet on either side to accommodate requests by the F-35 community. | Revise groove-free zone on either side of the arresting barrier cable which requires hook engagement for operation to 20 feet. |

| | | |
|---|---|---|
| UFGS 32 01 19.61 | Paragraph 3.5.2, “Sealing Joints”: “For airfield pavements, the sealant should be recessed 1/8 in below the pavement surface….” This statement conflicts with grooving requirements and will ensure joint material is damaged if performed before grooving operations. | Include text to recess joint sealant a minimum of 3/8 in. below pavement surface when the pavement is to be grooved, and include text for recessing sealant 1/8 in. below joint bevel, if joint bevels will be included. |
| UFGS 32 13 73.19 | Paragraph 3.3, “Sealing of Joints”: “Place the compression joint seal to a depth of 1/4 in, plus or minus 1/8 in, below the pavement surface except when the joint is beveled or has a radius at the surface, or unless otherwise directed.” For grooved runways, damage to the preformed compression seal can be expected due to variations in grooving depth. | Include text to recess compression joint seal a minimum of 3/8 in. below pavement surface when the pavement is to be grooved. |

# APPENDIX A KNOWN AIRFIELDS WITH IN-PLACE TRAPEZOIDAL GROOVES

## A-1 LIST OF AIRFIELDS (AS OF DECEMBER 2023)

FAA Technical Center William F. Hughes Test Facility (Atlantic City, NJ)

5,000 SY – Asphalt

Completed October 2005

Runway 2-20, Quantico MCAF (Quantico, VA)

41,022 SY – Asphalt

Completed July 2007

Runway 9R-27L, Chicago O'Hare International Airport (Chicago, IL)

41,557 SY – Asphalt

Completed November 2007

Runway 15-33, Fort Collins-Loveland Airport (Loveland, CO)

75,378 SY – Asphalt

Completed October 2011

Runway 10-28, Centennial Airport (Centennial, CO)

29,333 SY – Asphalt

Completed August 2014

Runway 12-30, Glacier Park International Airport (Kalispell, MT)

16,150 SY – Asphalt

Completed October 2015

Runway 1, Changi Airport (Singapore)

267,904 SY – Asphalt

Completed December 2016

Runway 5-23, Queenstown Airport (Frankton Otago, New Zealand)

87,980 SY – Asphalt

Completed April 2017

Runway 16-34, Great Falls International Airport (Great Falls, MT)

87,100 SY – Asphalt

Completed April 2017

Runway 3, Changi Airport (Singapore)

276,778 SY – Asphalt

Completed March 2018

Runway 13-31, Ayers Rock (Australia)

84,269 SY – Asphalt

Completed June 2019

Runway Grooving, Seletar Airport (Singapore)

87,834 SY – Asphalt

Completed October 2019

Runway 12-30, Alice Springs Airport (Australia)

120,011 SY – Asphalt

Completed May 2020

Runway 18R-36L, Dallas - Fort Worth International Airport (Dallas, TX)

27,248 SY – Concrete

198,986 SY – Asphalt

Completed April 2021

Runway 1-19, Key Field (Meridian, MS)

115,498 SY – Asphalt

Completed October 2021

Runway 1-19, Jackson Hole Airport (Jackson, WY)

104,260 SY – Asphalt

Completed August 2022

2022 Airfield Improvements, Centennial Airport (Centennial, CO)

69,950 SY – Asphalt

Completed October 2022

Runway 5R-23L, Indianapolis International Airport (Indianapolis, IN)

123,600 SY – Concrete

Completed December 2022

Runway 2, Changi Airport (Singapore)

312,542 SY – Asphalt

Completed June 2023

Runway 5R-23L, Indianapolis International Airport (Indianapolis, IN)

32,866 SY – Concrete

Completed August 2023

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# APPENDIX B GLOSSARY

## B-1 ACRONYMS

| | |
|---|---|
| DoD | Department of Defense |
| FAA | Federal Aviation Administration |
| MCAF | Marine Corps Air Facility |
| SY | Square Yard |
| TSPWG | Tri-Service Pavement Working Group |
| U.S. | United States |
| UFC | Unified Facilities Criteria |
| UFGS | Unified Facilities Guide Specifications |

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# APPENDIX C REFERENCES

**FEDERAL AVIATION ADMINISTRATION**

Patterson, James W. Jr. (May 2012). *DOT/FAA/TC-TN12/7*, *Evaluation of Trapezoidal-Shaped Runway Grooves*

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

Horne, Walter B.; Brooks, George W. (December 1967). *Runway Grooving for Increasing Tire Traction – The Current Program and an Assessment of Available Results*

**TRI-SERVICE PAVEMENT WORKING GROUP**

https://www.wbdg.org/ffc/dod/supplemental-technical-documents

TSPWG 1-200-01, *DoD Building Code*

**UNIFIED FACILITIES CRITERIA**

https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

UFC 3-260-01, *Airfield and Heliport Planning and Design*

UFC 3-260-02, *Pavement Design for Airfields*

**UNIFIED FACILITIES GUIDE SPECIFICATIONS**

https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs

UFGS 31 01 18.71, *Grooving of Airfield Paving*

UFGS 32 01 19.61, *Sealing of Joints in Rigid Pavement*

UFGS 32 13 73.19, *Compression Concrete Paving Joint Sealant*