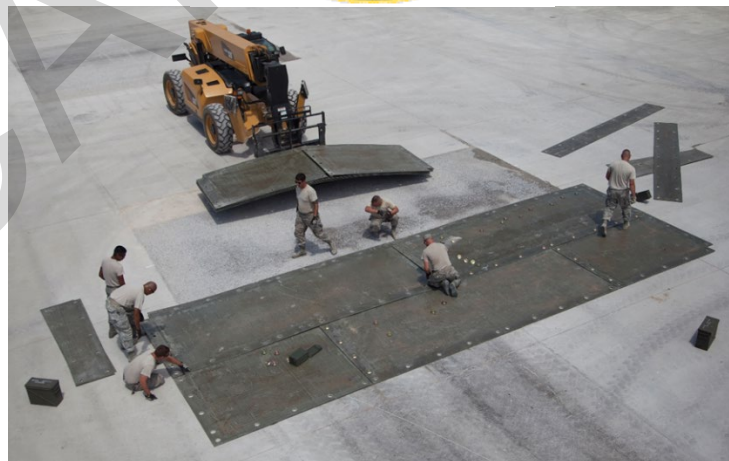


# **TRI-SERVICE PAVEMENTS WORKING GROUP MANUAL (TSPWG M)**

---

## **AIRCRAFT COMPATIBILITY WITH FIBER-REINFORCED POLYMER (FRP) MATTING SYSTEMS FOR AIRFIELD DAMAGE REPAIR**



**APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED**

CANCELLED

*This Page Intentionally Left Blank*

**TRI-SERVICE PAVEMENTS WORKING GROUP MANUAL (TSPWG M)**  
**AIRCRAFT COMPATIBILITY WITH FIBER-REINFORCED POLYMER (FRP)**  
**MATTING SYSTEMS FOR AIRFIELD DAMAGE REPAIR**

Any copyrighted material included in this TSPWG Manual is identified at its point of use. Use of the copyrighted material apart from this TSPWG M must have the permission of the copyright holder.

Indicate the Military Department Preparing Activity responsible for the document.

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND

AIR FORCE CIVIL ENGINEER CENTER (Preparing Activity)

Record of Changes (changes are indicated by \1\ ... /1/)

<b>Change No.</b>	<b>Date</b>	<b>Location</b>

CANCELLED

*This Page Intentionally Left Blank*

## 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 aircraft compatibility with the Fiber-Reinforced Polymer matting system for airfield damage repair. The information in this TSPWG Manual may be 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 (TOs), field manuals, technical manuals, handbooks, Tactic Techniques or 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 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.

TSPWG Manuals are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site <http://dod.wbdg.org/>.

Hard copies of TSPWG Manuals printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

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

**Document:** TSPWG M 3-270-01.24-02, *Aircraft Compatibility with Fiber-Reinforced Polymer (FRP) Matting System for Airfield Damage Repair.*

**Superseding:** No other documents

**Application:** This document is authoritative but not directive and serves as a starting point for making decisions in a contingency environment. The information in this publication takes precedence over conflicting information found in other nondirective publications and is applicable to the modern Fiber-Reinforced Polymer Matting System for Airfield Damage Repair manufactured on or after the year 2018 when installed, inspected, and maintained as per the most recent version of USAF AFCEC TTP Document *Interim Process for Fiber Reinforced Polymer (FRP) Matting Installation and Maintenance Actions.*

**Description:** This publication provides guidance for aircraft compatibility with the Fiber-Reinforced Polymer Matting for Airfield Damage Repair. This guidance has been validated during live flight test events (F-15E, C-17, F-35I, and A400M), full-scale simulated traffic testing, and engineering analysis of aircraft gear configurations and loads.

**Reasons for Document:** This document provides aircraft compatibility information to engineers for rapid airfield damage recovery (RADR) during contingency operations for employment of the Fiber-Reinforced Polymer Matting System for Airfield Damage Repair.

**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 the Department of Defense (DOD).

## TABLE OF CONTENTS

<b>CHAPTER 1 INTRODUCTION .....</b>	<b>1</b>
<b>1-1 BACKGROUND. ....</b>	<b>1</b>
<b>1-2 FRP SYSTEM DESCRIPTION. ....</b>	<b>1</b>
1-2.1 Panels.....	1
1-2.2 Connections.....	2
1-2.3 System.....	2
<b>1-3 PURPOSE AND SCOPE.....</b>	<b>2</b>
<b>1-4 APPLICABILITY.....</b>	<b>3</b>
<b>1-5 GENERAL BUILDING REQUIREMENTS. ....</b>	<b>3</b>
<b>1-6 GLOSSARY.....</b>	<b>3</b>
<b>1-7 REFERENCES. ....</b>	<b>3</b>
<b>CHAPTER 2 MISSION AIRCRAFT COMPATIBILITY GUIDANCE.....</b>	<b>2</b>
<b>2-1 FRP REPAIRS ON APRONS AND TAXIWAYS. ....</b>	<b>2</b>
<b>2-2 FRP REPAIRS ON RUNWAYS.....</b>	<b>2</b>
<b>2-3 OTHER CONSIDERATIONS.....</b>	<b>2</b>
2-3.1 Crushed Stone Repairs Without FRP. ....	3
2-3.2 Geocellular (Sand Grid) Without FRP.....	3
2-3.1 Mat Removal for Large Aircraft Operations.....	3
2-3.1 Repair Quality Criteria. ....	3
2-3.2 Repair near Aircraft Arresting Systems.....	3
2-3.1 FRP Connections.....	3
2-3.1 FRP Anchoring. ....	4
2-3.1 Maintenance and Inspection.....	4
<b>APPENDIX A GLOSSARY .....</b>	<b>6</b>
<b>A-1 ACRONYMS.....</b>	<b>6</b>
<b>A-2 DEFINITION OF TERMS.....</b>	<b>7</b>
<b>APPENDIX B REFERENCES.....</b>	<b>8</b>

CANCELLED

*This Page Intentionally Left Blank*

## CHAPTER 1 INTRODUCTION

### 1-1 BACKGROUND.

The modern Fiber-Reinforced Polymer (FRP) matting system for Airfield Damage Repair (ADR) was developed and live flight tested during the Critical Runway Assessment and Repair (CRATR) Joint Capabilities Technology Demonstration (JCTD) in 2008-2009 after a determination was made by the US Air Force Air Mobility Command that the Folded Fiberglass Mat (FFM) was incapable of supporting operations of the C-17. The modern FRP for ADR (henceforth FRP) is generally based on the legacy Army fiberglass-reinforced polyester matting system. The legacy Army fiberglass-reinforced polyester matting system is the system called out in Table 2-1 of TSPWG 3-270-01.3-270-07 (21 May 2020) and is not the system that is covered in this TSPWG M. This TSPWG M covers only the modern FRP for ADR (NSN 5680-01-701-5374)

### 1-2 FRP SYSTEM DESCRIPTION.

FRP functions as a modular foreign object debris (FOD) cover for ADR and consists of four panel types: full-size panels, half-size panels, full-size anchor panels, and half-size anchor panels.

#### 1-2.1 Panels.

In 2018 prior to the first large-scale USAF procurement of FRP, a joint advisory panel made recommendations for a slight refinement of the detailed specification for FRP which included minor modifications to the panel dimensions to support multi-modal transport, improved UV resistance for long-term storage, and updated non-skid surfacing requirements to standardize manufacturing methods. The standard FRP panel dimensions based on the minor modifications from the advisory panel in 2018 are:

- Full-size panel (208 in. x 78 in.), NSN 5680-01-701-5375,
- Half-size panel (108 in. x 78 in.), NSN 5680-01-700-9352,
- Full-size anchor panel (200 in. x 24 in.), NSN 5680-01-701-5376, and
- Half-size anchor panel (100 in. x 24 in.), NSN 5680-01-700-9359.

FRP panels are fabricated using a closed molding process from fiberglass reinforcement, high-strength aramid fibers, and thermosetting polyester resin. Panels are nominally 0.4 in. thick with an approximate unit weight of 3.6 lbf/ft<sup>2</sup>. Full- and half-size FRP panels have two adjacent edges recessed at the panel bottom and two remaining edges recessed at the panel top, yielding two “overlap edges” and two “underlap edges.” The full- and half-size anchor panels are recessed at the bottom of one of the panel’s long edges, yielding a single overlapping edge on each anchor panel. All overlaps and underlaps in the FRP system are 8 in. in depth.

### **1-2.2 Connections.**

Connection of FRP panels to one another is accomplished with specially designed upper joining bushings (NSN 5306-01-701-5398) that are received by threaded lower joining bushings that are pre-installed in the underlapping portions of full- and half-size FRP panels. Additionally, assembled FRP covers are anchored to the existing pavement surface on the leading and trailing edges (with respect to the primary direction of flight). Anchoring is accomplished by securing the mat to the pavement surface with an approved anchoring system and an FRP anchor bushing. Anchor bushings (NSN 5365-01-700-9608) are received in the open holes along a cover's overlapping edge or the open holes along the full-thickness edge of an FRP anchor panel. Anchor panels are necessary to facilitate the transition from full- and half-size panel underlap edges to open-holed edges for anchoring and are intended for placement on the leading edge of the repair when conditions allow.

### **1-2.3 System.**

The full-thickness FRP cross-section consists of a robust laminate structure capable of withstanding main gear loading from a variety of mission aircraft. Since the FRP system is compatible with a wide range of crater fill materials, rutting performance (or resistance to the vertical component of load imparted by the aircraft gear) is dictated by fill material quality. In other words, stiffer crater fill material placed at adequate thickness generates more resistance to rutting than less stiff, shallow fill materials. One added benefit of the FRP system is that it can be removed from the repaired crater so that the backfill material can be reconstituted. Afterwards, the FRP cover can be re-anchored atop the same crater repair. FRP system resistance to the horizontal loading component imparted by the aircraft gear is related to a variety of factors including existing rut depth, surface friction, repair length, aircraft gear type, aircraft load, aircraft speed, braking force, and others. System degradation due to horizontal forces imparted by the aircraft gear is often observed in the form of tearing or discoloration around anchoring locations indicating delamination of the fiberglass layers. Prior experience during live flight-testing events indicates that horizontal loading from the main gear of cargo aircraft tends to be more damaging than that of fighter aircraft.

### **1-3 PURPOSE AND SCOPE.**

This publication provides guidance on mission aircraft compatibility with FRP. The guidance for mission aircraft compatibility of the FRP FOD cover provided in this document supplements the guidance given in TSPWG Manual 3-270-01.3-270-07, *O&M: Airfield Damage Repair, Interim Process for Rapid Airfield Damage Recovery (RADR)*, and USAF AFCEC TTP Document *Interim Process for Fiber Reinforced Polymer (FRP) Matting Installation and Maintenance Actions*.

#### **1-4 APPLICABILITY.**

The information in this publication takes precedence over conflicting information in other nondirective publications. Use this manual when no other guidance is available or when other guidance does not meet mission needs.

This TSPWG Manual is applicable to all DoD units that provision, train, apply, or operate on FRP repairs on airfield pavements

#### **1-5 GENERAL BUILDING REQUIREMENTS.**

Comply with UFC 1-200-01, DoD Building Code, outlining applicability of model building codes and government-unique criteria. Use this publication in addition to UFC 1-200-01.

#### **1-6 GLOSSARY.**

Appendix A contains acronyms, abbreviations, and terms.

#### **1-7 REFERENCES.**

Appendix B 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.

CANCELLED

*This Page Intentionally Left Blank*

## CHAPTER 2 MISSION AIRCRAFT COMPATIBILITY GUIDANCE

### 2-1 FRP REPAIRS ON APRONS AND TAXIWAYS.

Operations of all aircraft in the current DOD inventory are permitted on the FRP for any repair size on aprons and taxiways unless otherwise prohibited by the aircraft System Program Office. Differential braking during turning is not permitted directly atop the FRP matting. Vertical takeoff or vertical landing of AV-8, V-22, and F-35B aircraft is not permitted on FRP matting.

### 2-2 FRP REPAIRS ON RUNWAYS.

All variants of the following aircraft are permitted on FRP repairs of any size on the runway unless otherwise prohibited by the aircraft System Program Office. FRP is not compatible with AV-8 or F-35B short take off, vertical takeoff, or vertical landing operations; FRP is compatible with the F-35B for all other aircraft maneuver operations.

Aircraft listing: C-12, C-21, C-23, C-38A, C-41A, RC-26, RQ-4-Bk 10, A-10, AT-38, F-15, F-16, F-22, F-35, F-117, AV-8, RQ-4-Bk 20+, CV-580, C-130, C-27J, C-295, CN-235, C-20, C-37, B-717, C-9, DC-9, A-319, A-320, A-321, B-727, B-737, C-22, C-40, MD-81, MD-82, MD-83, MD-87, MD-90, P-3, and P-8A.

All variants of the following aircraft are permitted on FRP repair lengths of up to 50 ft on the runway unless otherwise prohibited by the aircraft System Program Office.

Aircraft listing: A300, A310, B-2A, B-707, B-720, B-757, C-32A, DC-8, E-3, E-8C, KC-135, RC-135, VC-137, A330, B-767, B-787, DC-10-10, KC-46A, L-1011, MD-10, B-767-400ER, C-17, IL-76, and A400M.

All variants of the following aircraft are currently not permitted on FRP repairs on runways.

Aircraft listing: B-1, C-5, A340, A350, B-777, DC-10-30, DC-10-40, KC-10, MD-11, A380, AN-124, B-747, B-747-8, E-4, VC-25, B-747-400, and B-52.

### 2-3 OTHER CONSIDERATIONS.

In an emergency aircraft evacuation (takeoff only) event where there is immediate threat to aircraft on the ground, prohibited aircraft may depart via the runway, even if FRP repairs are present.

Backfill quality dictates FRP repair performance in most situations. A minimum of 25 CBR is required for fighter aircraft operations. A minimum 25 CBR is required for C-17 operations. A minimum 15 CBR is required for C-130 operations. Every attempt should be made to employ high quality backfill material of adequate stiffness placed at adequate thickness. A total of 18 in. of backfill material is recommended for most aircraft operations. For heavy single-drum vibratory roller compactors, target lift thicknesses of

6 in. are possible. For lightweight plate or tamping style compactors, target lift thicknesses should not exceed 4 in.

### **2-3.1 Crushed Stone Repairs Without FRP.**

Unless otherwise prohibited by the aircraft System Program Office, operations on crushed stone repairs without FOD covers are approved for C-17, C-5, C-130, KC-10, and KC-135 operations provided that the following conditions are met:

- Backfill must meet or exceed minimum CBR requirement, and
- For jet aircraft, repair backfill must not exceed  $\frac{3}{4}$  in. maximum particle size in the top 6 in. of the repair.

### **2-3.2 Geocellular (Sand Grid) Without FRP.**

Unless otherwise prohibited by the aircraft System Program Office, operations on geocellular confinement materials (sand grid) without FOD covers are approved for C-17, C-5, C-130, KC-10, and KC-135 operations provided that the following conditions are met:

- Backfill must meet or exceed minimum CBR requirement, and
- For jet aircraft, repair backfill must not exceed  $\frac{3}{4}$  in. maximum particle size in the top layer of the repair.

### **2-3.1 Mat Removal for Large Aircraft Operations.**

If operational conditions allow and maximum particle size restrictions are met, then consider removing the FRP matting system prior to C-17 operations to prevent damage to FRP matting inventory at an operating location with mixed aircraft traffic. Anchor bolts should be reinstalled to prevent debris from entering bolt holes.

### **2-3.1 Repair Quality Criteria.**

It is imperative that FRP repairs meet repair quality criteria (RQC) requirements for mission aircraft which will operate on the repair or series of repairs as per the USAF document Air Force Tactics, Techniques, and Procedures 3-32.12, *Minimum Airfield Operating Surface (MAOS) Selection and Repair Quality Criteria (RQC)*. All reasonable attempts to achieve a "flush" repair, with a surface profile of  $\pm \frac{3}{4}$  in. of the existing surface elevation profile, should be made.

### **2-3.2 Repair near Aircraft Arresting Systems.**

FRP repairs are not allowed in the center 75 ft of pavement within 200 ft of either the approach or departure end of an aircraft arresting system as per FC 3-260-18F. Tailhook impacts on FRP surfaces should be avoided.

### **2-3.1 FRP Connections.**

Proper assembly and connection of FRP panels is critical. FRP should be assembled and connected as per the guidance provided in USAF AFCEC TTP Document *Interim*

*Process for Fiber Reinforced Polymer (FRP) Matting Installation and Maintenance Actions.*

**2-3.1 FRP Anchoring.**

Proper anchoring of FRP covers to the existing pavement is critical. FRP should be anchored as per USAF AFCEC TTP Document *Interim Process for Fiber Reinforced Polymer (FRP) Matting Installation and Maintenance Actions.*

**2-3.1 Maintenance and Inspection.**

Proper maintenance and inspection of FRP panels, connectors, and anchors is critical. FRP repairs should be maintained and inspected as per USAF AFCEC TTP Document *Interim Process for Fiber Reinforced Polymer (FRP) Matting Installation and Maintenance Actions.*

CANCELLED

CANCELLED

*This Page Intentionally Left Blank*

## APPENDIX A GLOSSARY

### A-1 ACRONYMS.

ADR	Airfield Damage Repair
AFCEC	Air Force Civil Engineer Center
BIA	Bilateral Infrastructure Agreement
CBR	California Bearing Ratio
CRATR	Critical Runway Assessment and Repair
DoD	Department of Defense
ERDC	U.S. Army Engineer Research and Development Center
FC	Facilities Criteria
FFM	Folded Fiberglass Mat
FOD	Foreign Object Damage/Debris
FRP	Fiber-Reinforced Polymer
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
JCTD	Joint Capabilities Technical Demonstration
NAVFAC	Naval Facilities Engineering Systems Command
RADR	Rapid Airfield Damage Recovery
RQC	Repair Quality Criteria
SOFA	Status of Forces Agreements
TTP	Tactics, Techniques, and Procedures
TSPWG M	Tri-Service Pavements-Transportation Working Group Manual
UFC	Unified Facilities Criteria
U.S.	United States

**A-2            DEFINITION OF TERMS.**

**Reserved for future use**

CANCELLED

## APPENDIX B REFERENCES

### DEPARTMENT OF DEFENSE

TSPWG Manual 3-270-01.3-270-07, *O&M: Airfield Damage Repair*,  
[https://www.wbdg.org/FFC/DOD/STC/TSPWG\\_M\\_3\\_270\\_01\\_3\\_270\\_07.pdf](https://www.wbdg.org/FFC/DOD/STC/TSPWG_M_3_270_01_3_270_07.pdf)

FC 3-260-18F, *Air Force Aircraft Arresting Systems (AAS) Installation, Operation, and Maintenance (IO&M)*,  
[https://www.wbdg.org/FFC/DOD/UFC/fc\\_3\\_260\\_18f\\_2015\\_c1.pdf](https://www.wbdg.org/FFC/DOD/UFC/fc_3_260_18f_2015_c1.pdf)

### AIR FORCE

AFTTP 3-32.12, *Minimum Airfield Operating Surface (MAOS) Selection and Repair Quality Criteria (RQC)*

Interim AFTTP, *Interim Process for Fiber Reinforced Polymer (FRP) Matting Installation and Maintenance Actions*

Interim Process for Rapid Airfield Damage Recovery (RADR)