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TRI-SERVICE PAVEMENTS WORKING GROUP MANUAL (TSPWG M)

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

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

Indicate the Military Department Preparing Activity responsible for the document.

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NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND

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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 aircraft combability with the fiber-reinforced polymer (FRP) matting system for airfield damage repair (ADR). The information in this 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 (TO), 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.

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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 (FRP) matting system for airfield damage repair (ADR) manufactured on or after the year 2018 when installed, inspected, and maintained as per the most recent version of AFCEC Interim RADR TTP *Interim Process for Fiber Reinforced Polymer (FRP) Matting Installation and Maintenance Actions*.

Description: This document provides guidance for aircraft compatibility with the FRP matting system for ADR. 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 FRP matting system for ADR.

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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 the US Air Force Air Mobility Command determined that folded fiberglass mat (FFM) was incapable of supporting C-17 operations. 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 (see TSPWG M 3-270-01.3-270-07, *O&M: Airfield Damage Repair*, Table 2-1) is not covered in this manual. This manual covers only the modern FRP (NSN 5680-01-701-5374).

1-2 PURPOSE AND SCOPE.

This manual provides guidance on mission aircraft compatibility with FRP. The guidance for mission aircraft compatibility of the FRP FOD cover provided in this manual supplements the guidance in TSPWG M 3-270-01.3-270-07, AFCEC RDR AFTTP *Interim Process for Rapid Airfield Damage Recovery (RADR),* and AFCEC Interim RADR TTP *Interim Process for Fiber Reinforced Polymer (FRP) Matting Installation and Maintenance Actions*.

1-3 APPLICABILITY.

The information in this manual 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 manual is applicable to all DOD units that provision, train, apply, or operate on FRP repairs on airfield pavements

1-4 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.

1-4.1 Panels.

In 2018, before the first large-scale Air Force 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 ultraviolet (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 as follows:

- 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
- 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. (10 mm) thick, with an approximate unit weight of 3.6 lbm/ft^2 (17.6 kg/m^2). 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. (203 mm) in depth.

1-4.2 Connections.

Connecting 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 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.

1-4.3 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 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.

1-5 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.

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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 takeoff, vertical takeoff, or vertical landing operations; FRP is compatible with the F-35B for all other aircraft maneuver operations.

- 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
- P-8A

All variants of the following aircraft are permitted on FRP repair lengths of up to 50 ft (15.2 m) on the runway unless otherwise prohibited by the aircraft System Program Office.

- 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
- A400M

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

- 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
- B-52

2-3 OTHER CONSIDERATIONS.

In an emergency aircraft evacuation (takeoff only) event where there is an 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 25 CBR (California Bearing Ratio) 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. (450 mm) of backfill material is recommended for most aircraft operations. For heavy single-drum vibratory roller compactors, target lift thicknesses of 6 in. (150 mm) are possible. For lightweight plate or tamping style compactors, target lift thicknesses should not exceed 4 in. (100 mm).

2-3.1 Crushed Stone Repairs Without FRP.

1\ 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, and KC-10 operations, provided the following conditions are met: /**1**/

- Backfill must meet or exceed minimum CBR requirement; and
- For jet aircraft, repair backfill must not exceed 0.75 in. (19 mm) maximum particle size in the top 6 in. (150 mm) of the repair.

2-3.2 Geocellular (Sand Grid) Without FRP.

\1\ 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, and KC-10 operations, provided the following conditions are met: /1/

- Backfill must meet or exceed minimum CBR requirement; and
- For jet aircraft, repair backfill must not exceed 0.75 in. (19 mm) maximum particle size in the top layer of the repair.

2-3.3 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.

2-3.4 Repair Quality Criteria.

It is imperative that FRP repairs meet repair quality criteria (RQC) requirements for mission aircraft that will operate on the repair or series of repairs as per Air Force TTP 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 ± 0.75 in. (19 mm) of the existing surface elevation profile, should be made.

2-3.5 Repair Near Aircraft Arresting Systems.

FRP repairs are not allowed in the center 75 ft (23 m) of pavement within 200 ft (61 m) of either the approach or departure end of an aircraft arresting system per FC 3-260-18F, *Air Force Aircraft Arresting Systems (AAS) Installation, Operation, and Maintenance (IO&M)*. Tailhook impacts on FRP surfaces should be avoided.

2-3.6 FRP Connections.

Proper assembly and connection of FRP panels is critical. FRP should be assembled and connected per AFCEC Interim RADR TTP *Interim Process for Fiber Reinforced Polymer (FRP) Matting Installation and Maintenance Actions*.

2-3.7 FRP Anchoring.

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

2-3.8 Maintenance and Inspection.

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

APPENDIX A GLOSSARY

A-1 ACRONYMS.

ADR	Airfield Damage Repair
AFCEC	Air Force Civil Engineer Center
CBR	California Bearing Ratio
FC	Facilities Criteria
FFM	Folded Fiberglass Mat
FOD	Foreign Object Damage/Debris
FRP	Fiber-Reinforced Polymer
ft	Foot
in.	Inch
kg/m^2	Kilogram per Square Meter
lbm/ft^2	Pound Mass per Square Foot
m	Meter
mm	Millimeter
NSN	National Stock Number
RADR	Rapid Airfield Damage Recovery
RDR	Rapid Damage Repair
RQC	Repair Quality Criteria
TTP	Tactics, Techniques, and Procedures

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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

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

AIR FORCE

AFTTP 3-32.12, *Minimum Airfield Operating Surface (MAOS) Selection and Repair Quality Criteria (RQC)*, https://static.e-publishing.af.mil/production/1/af_a4/publication/afttp3-32.12/afttp3-32.12.pdf

Interim RADR TTP, *Interim Process for Fiber Reinforced Polymer (FRP) Matting Installation and Maintenance Actions*, https://www.wbdg.org/FFC/DOD/STC/interim_af_radr_ttp_rev2.1_Oct_19.pdf

Interim RDR TTP, *Interim Process for Rapid Damage Repair*, https://www.wbdg.org/FFC/DOD/STC/interim_af_rdr_ttp_rev17.0_Aug_23.pdf