Interim RADR TTP
8 October 2019
Revision 2.1

INTERIM TACTICS, TECHNIQUES, AND PROCEDURES (TTP)

INTERIM PROCESS FOR FIBER REINFORCED POLYMER (FRP) MATTING INSTALLATION AND MAINTENANCE ACTIONS

RELEASABILITY: There are no releasability restrictions on this publication.

SUPERSEDES: *Interim FRP TTP*, 6 August 2019

INQUIRIES REGARDING THIS DOCUMENT MAY BE DIRECTED TO:

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PURPOSE: To provide **interim** tactics, techniques and procedures (TTP) for expeditious airfield recovery after a major attack using Fiber Reinforced Polymer (FRP) matting to cap crater repairs. These TTPs are unofficial guidance until officially codified in official Departmental Publications (AFTTPs) and posted on e-Pubs as are the AFTTP 3-32.11, *Airfield Damage Assessment after Major Attack*, AFTTP 3-32.12, *Minimum Airfield Operating Surface (MAOS) Selection and Repair Quality Criteria (RQC)*, AFTTP 3-32.13, *Airfield Marking and Striping after Major Attack*, AFTTP 3-32.14, *Alternate Installation Sequence for Emergency Airfield Lighting System after Major Attack*, and AFTTP 3-32.15, *Rapid Setback Installation of Mobile Arresting Gear System*. It supports Air Force Instruction (AFI) 10-209, *RED HORSE Program*; AFI 10-210, *Prime Base Engineer Emergency Force (BEEF) Program*, Air Force Pamphlet (AFPAM) 10-219, Volume 4, *Airfield Damage Repair Operations*, and Air Force Doctrine Annex 3-34, *Engineer Operations*. Ensure all records created as a result of processes prescribed in this publication are maintained in accordance with (IAW) Air Force Manual (AFMAN) 33-363, *Management of Records*, and disposed of IAW Air Force Records Information Management System (AFRIMS) Records Disposition Schedule (RDS). Refer recommended changes and questions about this publication to the Office of Primary Responsibility (OPR) using the AF Form 847, *Recommendation for Change of Publication*; route AF Forms 847 from the field through the appropriate functional chain of command.

SUMMARY OF CHANGES: A bar (┃) in the margin indicates a change: Chapter 3, paragraph 3.1, Overview, added references (UFC 3-270-07, *O&M: Airfield Damage Repair*, T.O. 35E2-5-1, *Crushed Stone Crater Repair and Line-of-Sight Profile Measurement for Rapid Runway Repair, and* Interim RADR TTPs v13.3, *Rapid Airfield Damage Recovery*) for crushed stone crater repair at the end of sentence 1. References were also added in Attachment 1, *Glossary of References and Supporting Information*.

APPLICATION: This publication applies to all Regular Air Force, Air National Guard (ANG), and Air Force Reserve Command (AFRC) Civil Engineer personnel performing airfield recovery after a major attack. This document is authoritative but not directive. The TTPs found in this publication take precedence over those found in other nondirective publications. Applicable AFIs take precedence when this publication and AFIs conflict.

SCOPE: This publication describes the TTPs to expeditiously cap crater repairs using FRP during airfield recovery after an attack. This publication does not replace mandatory compliance instructions found in directive publications. It describes required resources, planning factors and expeditious airfield repairs supporting emergency launch and recovery of mission aircraft.

Contents

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 Air Force.

Chapter 1
INTRODUCTION

1.1. Overview. The Air Force Civil Engineer Center (AFCEC) has developed an updated Airfield Damage Repair (ADR) concept of operations (CONOPS) under the ADR Modernization Program that provides updated capabilities to rapidly repair damaged airfield pavements using FRP panels, known as FRP matting when assembled. The FRP matting is utilized as foreign object debris (FOD) covers over crushed-stone or debris backfilled craters.

1.1.1. The FRP matting system consists of bolt together fiber reinforced polymer panels made from layers of glass fiber and polymer resin impregnated aramid fabric. Panels are connected with metal bushings enabling FOD covers of various sizes. The panels are anchored on concrete surfaces using expansion bolts and asphalt surfaces using tri-talon anchors.

1.1.2. Repairs capped with FRP matting are expedient temporary repairs expected to support up to 100 passes of most aircraft (US Army Corps of Engineers Engineer Research and Development Center (ERDC)/Geotechnical and Structures Laboratory (GSL) Technical Reference (TR) 16-22, *Validation of FRP Matting Requirements*). These repairs are susceptible to erosion, vibration from the aircraft, and point loading from the aircraft landing gear requiring frequent maintenance to provide suitable surfaces for aircraft operations.

1.2. Background. For decades, folded fiberglass mat (FFM) has been the U.S. Air Force solution as a foreign object debris cover for repairs over crushed stone backfilled craters. Its design provided adequate support for airframes operating during that time. In 2005, a test conducted at the U.S. Air Force (USAF) Plant 42 Facility in Palmdale, California, revealed that FFM matting was not strong enough to withstand traffic from C-17 aircraft. These aircraft had not been used for testing with FFM since their incorporation into the USAF fleet in the 1990s. An alternative FOD cover matting solution, FRP, was identified as a potential replacement as the USAF ADR matting solution. During the same experiment, the legacy FRP matting system was also incapable of supporting traffic loads induced by modern cargo and fighter aircraft. Failures in the legacy FRP occurred solely in the connecting and anchor bushings themselves. However, the FRP mat panels remained undamaged. A new modified FRP system with redesigned connector and anchor bushings was then developed. This new system was live-flight certified in 2009 for fighter and cargo aircraft.

1.3 Purpose and Scope. This publication provides interim TTPs for civil engineers during airfield recovery. FRP matting is typically used as a supplement or backup crater repair capping solution. When semi-permanent crater and spall repair material are exhausted, or unavailable, FRP may be used to cap crater repairs.

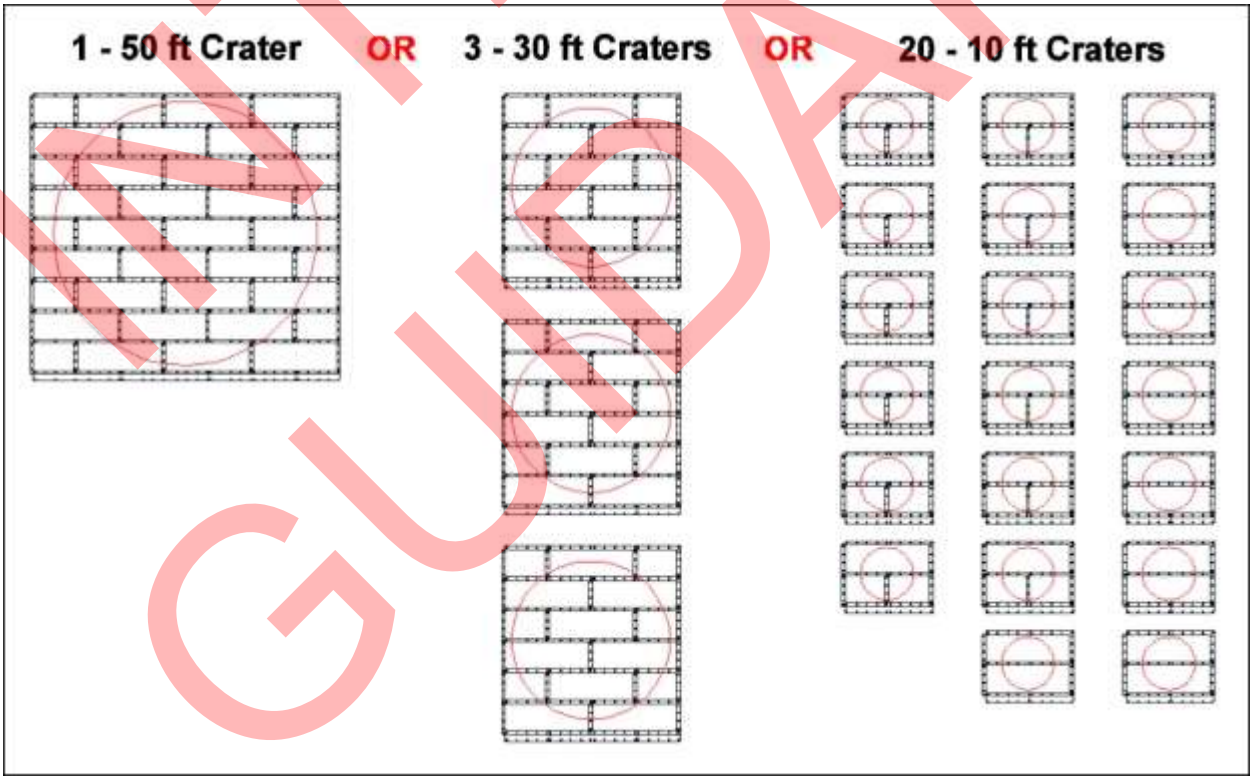
Chapter 2

CAPABILITIES AND CONFIGURATON

2.1. Overview. The FRP matting (**Figure 2.1**) capability is postured as the 4FWFR unit type code (UTC), containing five distinct increments. The first two increments are pallets of mat, increment three (3) is the tool kit, increment four (4) is the anchor kit, and increment five (5) is the mortar mix kit. Each UTC is capable of covering one (1) 50-ft crater, three (3) 30-ft craters, or twenty (20) 10-ft craters (**Figure 2.2**).

Figure 2.1. Matting Configurations.

Figure 2.2. Matting Configuration Example.



2.2 Increments 1 & 2, FRP Panel Kit. These increments contain 2 bundles of FRP matting. Each bundle contains seven (7) full-sized panels, six (6) half-sized panels, three (3) full sized anchor panels, and four (4) half-sized anchor panels. A complete increment contains 28 full-sized panels, 24 half-sized panels, 12 full-sized anchor panels, and 16 half-sized anchor panels. See **Table 2.1** for bundle stacking sequence. The FRP panels are transported on a 463L pallet train. The pallet train is created by joining two 46L pallets along the 88-inch edge using certified 463L pallet couplers. Panels in outside storage should be covered by a tarp to provide protection from ultraviolet rays. See **Attachment 2** for a detailed inventory of the FRP UTC.

Table 2.1. Bundle Stacking Sequence.

Layer	Panel Type
Top	1 Full Panel
2	2 Half Panels
3	4 Half Anchor Panels
4	3 Full Anchor Panels
5	1 Full Panel
6	1 Full Panel
7	2 Half Panels
8	1 Full Panel
9	1 Full Panel
10	2 Half Panels
11	1 Full Panel
12	1 Full Panel

2.2.1. FRP Panels are nominally 0.4 inches thick. See **Figure 2.3** for panel dimensions. The panels have two adjacent edges recessed at the panel bottom and the two remaining panel edges recessed at the panel top, yielding two “overlap edges” and two “underlap edges” (**Figure 2.4**). FRP panels are joined with bushings to form a cover to be placed over a back-filled crater and anchored to the existing pavement by the approved anchoring systems (**Figure 2.5**). Lower joining bushings are pre-attached to receiving holes located on the underlap edges of the panels.

2.2.2. Anchor panels are used to facilitate the transition from panel underlap edges to open holed edges for anchoring and are intended to be placed on the leading edge with respect to the primary direction of travel over FRP matting (**Figure 2.6**).

2.2.3. FRP matting is designed to endure up to 100 combined passes of fighter and cargo aircraft except the B-1, C-5, or P-8 aircraft (US Army Corps of Engineers Engineer Research and Development Center (ERDC)/Geotechnical and Structures Laboratory (GSL) Technical Reference (TR) 16-22, *Validation of FRP Matting Requirements*).

2.2.4. FRP matting does not support vertical and/or short take-off and landing (VTOL/STOVL).

2.2.5. All FRP tools and panels are delivered together and can easily be transported to the repair site. A crew of eight (8); crew lead, equipment operator, (2) alignment crew, (4) helpers are recommended to rapidly deploy and assemble these kits.

Figure 2.3. FRP Panel Dimensions.

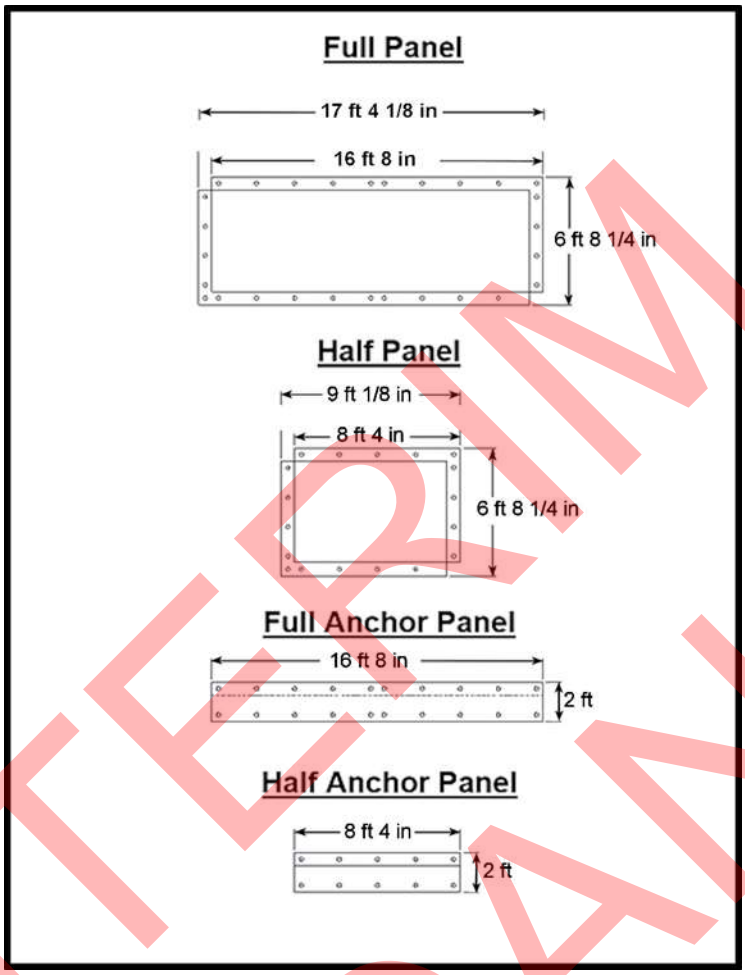


Figure 2.4. FRP Panel Overlap/Underlap Edges.

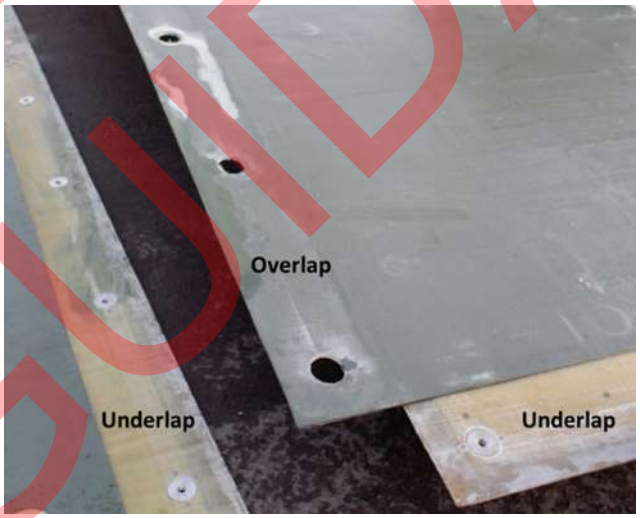
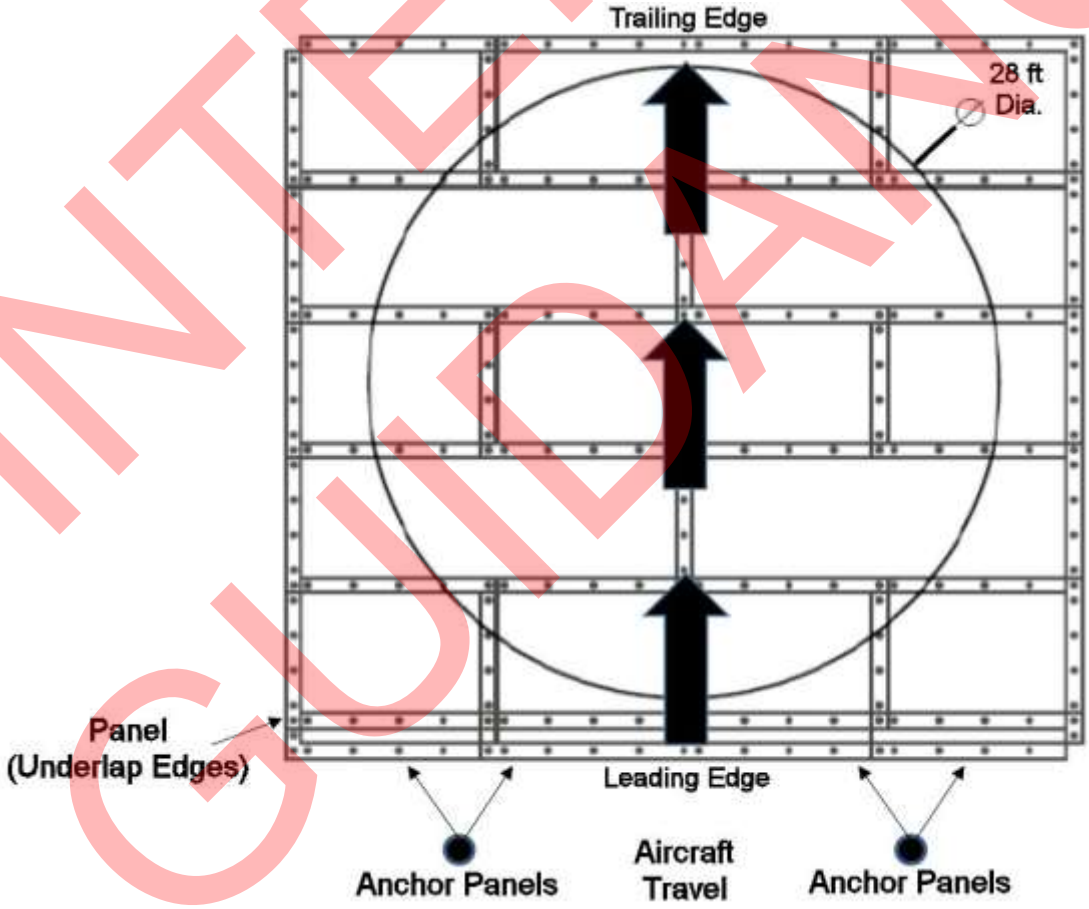


Figure 2.5. FRP Anchor Panel.

Figure 2.6. FRP Layout.



2.3. Increment 3, Tool Kit. The tools are packaged in a customized 8-ft International Standards Organization (ISO) container. The tools, a mix of hand, electric, hydraulic, and pneumatic, were selected to support installation and maintenance of the FRP matting system. See Table A2.2 for a detailed inventory.

2.4. Increment 4, Anchor Kit. The anchor kit contains the upper connector and anchor bushings, set tool, concrete expansion anchors, and tri-talon anchors. The upper bushing is threaded and comes with a bolt preinstalled with Loc-tite. See **Table A2.3** for a detailed inventory.

2.5. Increment 5, Mortar Mix Kit. The mortar mix kit is for setting the tri-talon anchors. See **Table A2.4** for a detailed inventory.

Chapter 3
INSTALLATION

3.1. Overview. An FRP FOD cover is installed over a crushed stone crater repair (UFC 3-270-07, *O&M: Airfield Damage Repair*, T.O. 35E2-5-1, *Crushed Stone Crater Repair and Line-of-Sight Profile Measurement for Rapid Runway Repair, and* Interim RADR TTPs v13.3, *Rapid Airfield Damage Recovery*). The Rapid Airfield Damage Repair (RADR) Capping Crew, using equipment from UTC 4FWCR, perform FRP FOD cover installation when concrete or asphalt semi-permanent cap materials are exhausted or not available.

3.2. Manpower Requirements. The FRP mat assembly and installation requires a minimum of eight (8) personnel. It is recommended the crew lead be a Structural Specialist (3E3X1).

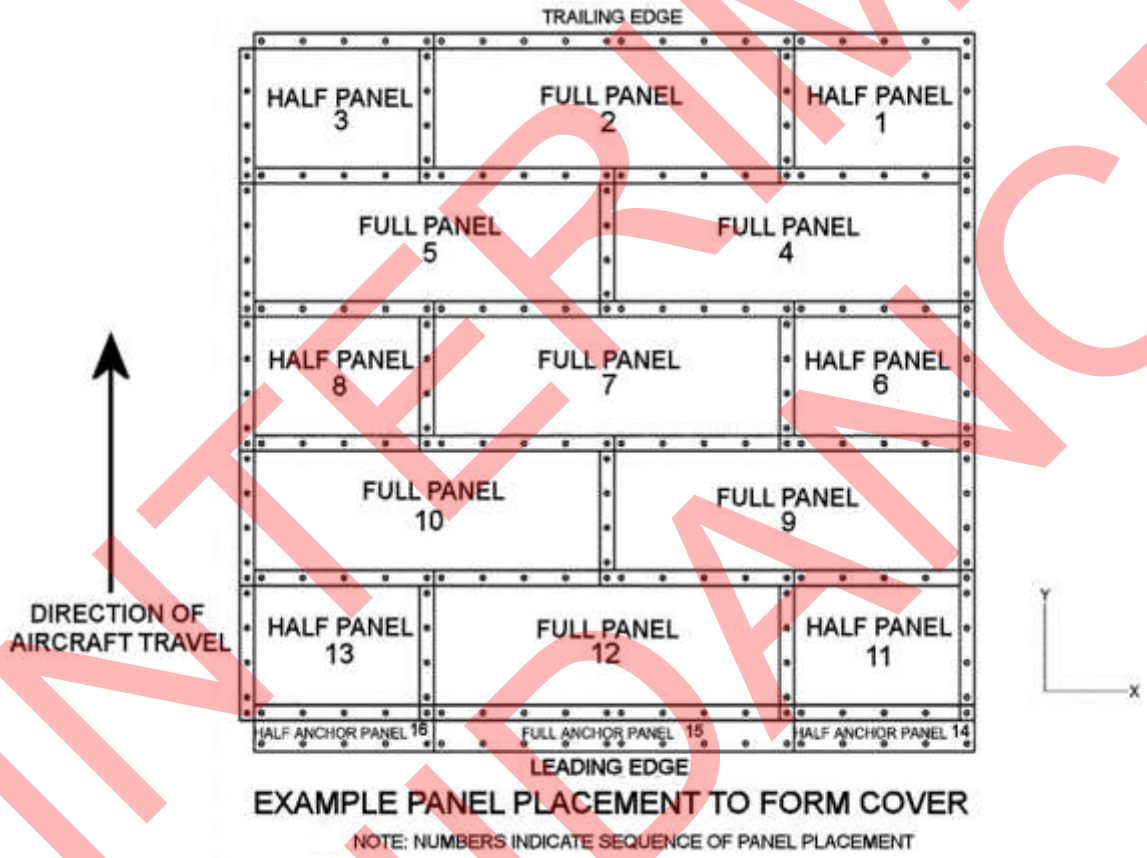
3.3. Unpacking. The panel bundles are marked with "*Fork Entry This Side*" to ensure the overlap side of the mat is away from the forks and the mat can easily be placed on the underlap of the proceeding row (**Figure 3.1**). A full panel weighs 440 lbs and should be lifted with a forklift or telehandler. The half panels weigh 220 lbs. While lifting half panels with four personnel is manageable, it is recommended to use a forklift or telehandler to conserve energy. Movement of the panels on the ground is facilitated with shovels, crow bar, and wonder bar from the tool kit. There are nylon tow straps with loops in the tool kit for moving entire mat assemblies.

Figure 3.1. FRP Panel Bundle.

3.4. FOD Cover Placement. Following crater backfill, compaction, and final grading, the FRP FOD cover is assembled atop the backfilled crater or assembled adjacent to the repair and dragged into place atop the crater following assembly. The cover requires a minimum of a 1-ft overlap onto sound pavement around the repaired crater in order to perform adequately under aircraft traffic loads. The FRP cover should be assembled or placed such that the anchor panels are located on the leading edge of the cover with respect to the primary direction of flight and anchored only on the leading and trailing edges. Anchoring only on the leading and trailing edges allows for expansion and contraction of the system under aircraft loading as well as thermal loading; it is

imperative the cover be able to displace under load to effectively dissipate stress concentrations around connections and anchor locations. Assembly of the FRP FOD cover should begin with a half panel on the right side of the trailing edge of the cover (determine left and right side of FOD cover when facing in the direction of aircraft travel) (**Figure 3.2**). Once this first panel is in place, assembly should be completed row-by-row in a brickwork fashion, i.e., no vertical joints fall in a line, until a cover of the desired size is assembled. Panels are attached to one another with upper joining bushings. The upper joining bushings and anchor bolts are torqued to 110-ft/lbs following assembly.

Figure 3.2. Example Panel Placement.



3.4.1. Place the first panel in position as described above.

3.4.2. The second panel is placed to the left of the first panel. The two panels are connected with the upper bushings (if the upper bushing and bolt are not preassembled, bolts should be placed in the upper bushing pre-attack) and should only be hand-tight. Continue this process until the entire first row is placed (and aligned if being constructed on the repair).

3.4.3. When placing the second row, start aligning the upper bushings from right to left; again only hand tighten. Once the three panels in row one and the first panel in row two are in place, upper bushings may then be fully torqued as described in the next paragraph.

3.4.4. Upper bushings are first tightened with the 1/2-in electric impact wrench with the 110-ft/lb torque limiter attached. A generator is provided to power the electric impact wrench.

Count to seven once the torque limiter stops turning, which should be close to the final torque (**Figure 3.3**).

Figure 3.3. Torqueing.

3.4.5. Perform final torque of upper bushings with the torque wrench set to **110-ft/lbs.** A slow steady pull on the wrench is best since there is only a small click at the appropriate torque. After all upper bushings have been torqued, the wrench should be reset to 0-ft/lbs to relieve spring compression.

3.5. Towing Mat. If mat is assembled adjacent to the repair, the mat will need to be towed over the repair using the following procedures:

3.5.1. Place the two nylon straps through the anchor holes closest to the repaired crater to be covered, any two holes may be used. Connect chains to the nylon straps, one chain per nylon strap (**Figure 3.4**)

3.5.2. Attach chains to a front end-loader or similar vehicle.

3.5.3. Drag the mat over the repaired crater. Use shovels to raise the entire leading edge of the mat to prevent loosening stones as it is towed over the repaired crater.

3.5.4. Once the mat is in place, inspect the pavement area where anchors will be installed.

3.5.4.1. Ensure at least 1-ft of overlap exists on sound pavement.

3.5.4.2. Anchors must be at least 6 inches from transverse joints or pavement cracks; move mat assembly if either condition occurs. If joints and cracks cannot be avoided by moving the mat, utilize the 2.5-in hole saw with mandrel and the static drive drill to cut new anchor holes at least 6 inches from joints/cracks.

Figure 3.4. FRP Matting Tow Example.

3.6. Asphalt Anchoring. Tri-talon anchors are utilized in asphalt surfaces at least 4 inches thick, and concrete less than 9 inches thick (**Figure 3.5**). Safety is paramount when working with these anchors, the all-thread shaft may have burrs and oil, and the talons are very sharp. The sequence for installing tri-talon anchors in asphalt pavement is as follows:

3.6.1. Anchors are installed on the leading and trailing edges of the mat. The mat anchor holes, open holes on the leading and trailing edges of the assembled cover, are utilized as drilling guides during the installation process. Special attention must be given to prevent damaging the mat and allowing material to build up under the mat.

3.6.2. Attach the 2-in diameter drill bit to the hammer drill (both items are in the FRP Tool Kit) and drill through the complete thickness of the pavement surface.

3.6.2.1. If using the hydraulic hammer drill the following steps should be taken, some steps should be accomplished during pre-attack preparations.

3.6.2.2. If not already accomplished during pre-attack actions, connect the batteries of the Hydraulic Power Units (HPU).

3.6.2.3. Connect the hydraulic hoses to the HPU and hydraulic hammer drill.

3.6.2.4. Start the HPU by turning and holding the *Off-Run-Start* switch in the run position. Release the switch once engine starts and the switch will automatically return to the run position.

3.6.2.5. Move the *Tool Off/On* lever to the Tool On position long enough to circulate hydraulic fluid through the hammer drill and return to the Tool Off position.

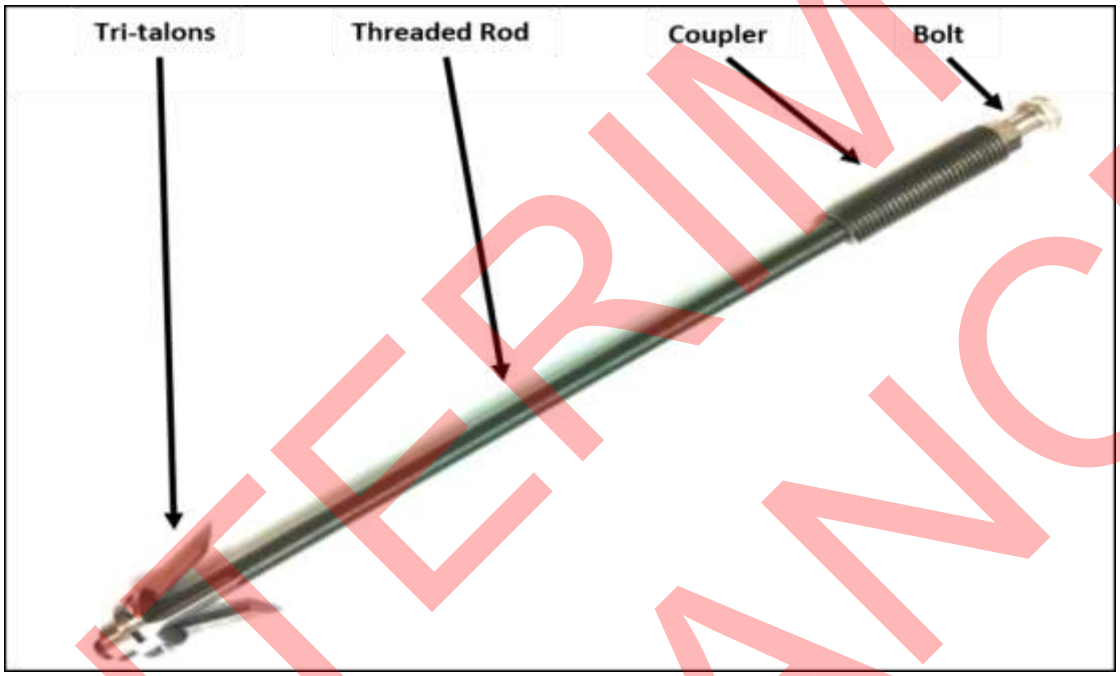
3.6.2.6. Shut down the HPU by pulling the *Pull to Stop* handle.

3.6.2.7. Turn *Off-Run-Start* switch to the off position. Ensure the switch is turned to "off" after each use to prevent draining the battery.

3.6.2.8. Check hydraulic fluid level and add fluid as necessary.

3.6.2.9. Restart the HPU and start the fluid flow again following steps in paragraphs **3.6.2.4** and **3.6.2.5**.

Figure 3.5. Tri-Talon Anchor.



3.6.3. Utilize the auger and 2-in auger bit to continue drilling to a depth of approximately 22.5 inches (**Figure 3.6**). Ensure the torque tube is connected to both the auger and a vehicle via the 2-in hitch receiver (**Figures 3.7** and **3.8**). Use spotters to ensure auger remains plumb throughout this step to prevent problems when inserting and securing the tri-talon anchors.

Figure 3.6. 2-in Hydraulic Auger.

Figure 3.7. Torque Converter.

Figure 3.8. Torque Converter Connection.

3.6.4. Utilize the set tool (solid end) (**Figure 3.9**) to firmly tamp the loose material at the bottom of the hole. Care must be given to not over tamp and make the hole too deep. Loose or soft material can cause the anchor to accidentally be driven too deeply when setting the talons. If the anchor is driven too deep, steps to secure the mat to the anchor become impossible and a new anchor hole will likely be required.

Figure 3.9. Set Tool Tamping.

3.6.5. Remove the coupler and bolt from the top of the tri-talon and the rubber band from the talons. Insert the threaded rod, talon end first, into the anchor hole (**Figure 3.10**).

Figure 3.10. Tri-Talon Setting.

3.6.6. Place the tri-talon set tool over the threaded rod and deploy the talons by striking the set tool sharply with a sledge hammer (**Figure 3.11**). This will cause the talons to embed into the walls of the anchor hole.

Note: Care should be taken to not drive the anchor assembly deeper while deploying the talons. Two or three medium strikes with a sledge hammer should be sufficient.

Figure 3.11. Tri-Talon Anchor Deployment.

3.6.7. Reconnect the coupler to the top of the tri-talon and tighten the coupler with the impact wrench until the top of the coupler is slightly lower than the pavement surface. Reattach the bolt and adjust the height to make the top of the bolt flush with the pavement surface. When tightening, ensure the socket is on both the coupler and the bolt.

3.6.8. Prepare the rapid-setting mortar mix according to manufacturer's instructions and then use the transmission funnel to fill the anchor hole around the threaded rod with rapid-setting mortar mix until **flush** with the pavement surface. The funnel discharge tube may have to be cut off some to make the hole a little larger to allow better mix flow. Using a dowel, or piece of wire, coax the material thru the funnel and tamp the material down in the hole (**Figure 3.12**). The bolt area should be wiped clean of mortar mix to facilitate removing the bolt later.

Figure 3.12. Mortar mix.

3.6.9. Once mortar mix has set, remove the anchor bolt from the coupler and install the anchor bushing. Replace the anchor bolt and tighten to secure the FRP cover. The anchor bolt is torqued to 110-ft/lbs (**Figure 3.13**).

3.6.10. If the mat is damaged, or the anchor does not set (can't achieve the proper torque) the bushing is removed and the anchor is abandoned (it may need to be cut or ground below the pavement surface with the angle grinder. A new hole is drilled through the mat and another anchor is set. Holes should not be closer than 3 inches edge to edge.

3.7. Concrete Anchoring. Expansion anchors are utilized in concrete surfaces (**Figure 3.14**). Anchors are installed on the leading and trailing edges of the mat. The mat anchor holes, open holes on the leading and trailing edges of the assembled cover, are utilized as drilling guides during the installation process. If anchor holes are within 6 inches of concrete joints or pavement cracks, new holes are made in the mat using the 2 1/2–in hole saw. Ensure new holes are not within 3 inches edge to edge of any existing holes. Pay special attention not to damage the mat and not allowing material to build up under the mat. The installation sequence for installing expansion bolts is as follows:

3.7.1. Attach the 3/4-in diameter bit to the electric or hydraulic hammer drill.

3.7.1.1. If using the hydraulic hammer drill the following steps should be taken, some steps should be accomplished during pre-attack preparations.

Figure 3.13. Installed Tri-Talon Anchor.

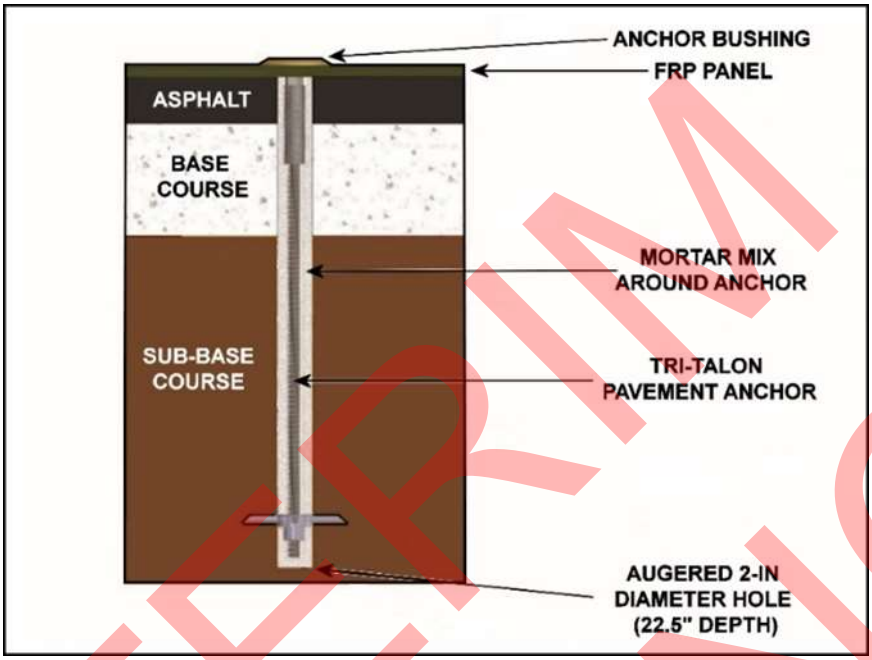


Figure 3.14. Heavy Duty Sleeve Anchor.

3.7.1.2. If not already accomplished during pre-attack actions, connect the batteries of the Hydraulic Power Units (HPU).

3.7.1.3. Connect the hydraulic hoses to the HPU and hydraulic hammer drill.

3.7.1.4. Start the HPU by turning and holding the *Off-Run-Start* switch in the run position. Release the switch once engine starts and the switch will automatically return to the run position.

3.7.1.5. Move the *Tool Off/On* lever to the Tool On position long enough to circulate hydraulic fluid through the hammer drill and return to the Tool Off position.

3.7.1.6. Shut down the HPU by pulling the *Pull to Stop* handle.

3.7.1.7. Turn *Off-Run-Start* switch to the off position. Ensure the switch is turned to "off" after each use to prevent draining the battery.

3.7.1.8. Check hydraulic fluid level and add fluid as necessary.

3.7.1.9. Restart the HPU and start the fluid flow again following steps in paragraphs **3.7.1.4** and **3.7.1.5**.

3.7.1.10. Using the 3/4-in diameter drill bit attached to the hammer drill, drill through the mat anchoring hole to a depth of at least 9 inches.

Note: If concrete thickness is less than 9 inches, use tri-talon anchors and follow installation procedures starting in **paragraph 3.6.**

3.7.2 Using compressed air and other hand tools, clear all debris from the anchor hole.

3.7.3. Remove the anchor/expanding attachment sleeve and slide the expansion bolt into anchor bushing, then reattach sleeve to bolt. If the expansion bolt washer will not sit within the bushing, the washer should be removed.

3.7.4. Carefully insert the bolt into the anchor hole to avoid deployment of the expanding attachment on the base of the bolt. Use a hammer if necessary (**Figure 3.15**).

Figure 3.15. Heavy Duty Sleeve Anchor Placement.

3.7.5. Tighten the bolt using the electric impact wrench with torque limiter. Final torqueing is performed with the torque wrench, to set the bushings at 110-ft/lbs.

3.7.6. If the mat is damaged, or the anchor does not set (can't achieve the proper torque) a new hole is drilled thru the mat and another is anchor is set. Holes should not be any closer than 3 inches edge to edge.

Chapter 4

MAINTENANCE ACTIONS

4.1. Maintenance Requirements. Due to the stress of aircraft taxiing, landing, and launching, installed FRP will require frequent checks to ensure the mat assembly remains securely anchored and damage free. Maintenance actions are based on the number of aircraft passes regardless of aircraft size; fighter or heavy. A pass is anytime an aircraft traffics over the mat surface.

4.1.1. After initial installation, and before aircraft operations, check all bolts and bushing assemblies to ensure they are properly torqued.

4.1.2. Visually inspect the matting surface for any tire or FOD hazard at every opportunity, but not to exceed ten (10) passes between inspections. If a tear occurs in an anchor hole the panel must be scheduled for replacement, if two (2) tears are found, the panel requires immediate replacement.

4.1.3. After each ten (10) pass interval, check all anchor bolts and approximately twenty-five (25) percent of the upper bushing bolts for security ensuring 110-ft/lbs of torque is maintained. If any bolt or bushing is loose, all bolts and bushings must be inspected and tightened.

4.1.4. At twenty (20) passes, perform visual and security inspections as described in paragraph 4.1.3 and also check for sag and/or rutting of both the mat and subsurface by performing a RQC check.

4.1.4.1. The rigidness of FRP may obscure surface rutting below the mat, thus making subsurface rutting more difficult to detect. Therefore, when performing RQC checks, weight must be applied by placing a vehicle, or similarly weighted object, on trafficked areas of the mat.

4.1.4.2. Perform at least three (3) profiles using the same stanchions, sight, and personnel for each.

4.1.4.3. Any sag exceeding 3/4-in requires FRP removal to correct the deficiency.

4.1.5. Between 100 and 150 passes, the anchors' bolt and coupling along with the leading and trailing edge panels must be replaced (US Army Corps of Engineers Engineer Research and Development Center (ERDC)/Geotechnical and Structures Laboratory (GSL) Technical Reference (TR) 16-22, *Validation of FRP Matting Requirements*).

Note: When re-anchoring the new panels, utilize the existing anchors if possible by removing the tri-talon or expansion sleeve from a new anchor and retreading them into the existing, imbedded tri-talon or expansion sleeve.

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

AFD Annex 3-34, *Engineer Operations*, 17 Dec 2018

UFC 3-270-07, *O&M: Airfield Damage Repair*, 12 Aug 02

AFI 10-209, *RED HORSE Program*, 28 Aug 2017

AFI 10-210, *Prime Base Engineer Emergency Force (BEEF) Program*, 21 Jan 2015

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AFTTP 3-32.13, *Airfield Marking and Striping after Major Attack*, 14 Mar 2016

AFTTP 3-32.14, *Alternate Installation Sequence for Emergency Airfield Lighting System after Major Attack*, 1 Apr 2016

AFTTP 3-32.15, *Rapid Setback Installation of Mobile Arresting Gear System*, 21 Jun 2016

ERDC/GSL TR-16-22, *Validation of FRP Matting Requirements*, August 2016

T.O. 35E2-5-1, *Crushed Stone Crater Repair and Line-of-Sight Profile Measurement for Rapid Runway Repair*, 27 Aug 07

Interim RADR TTPs v13.3, *Rapid Airfield Damage Recovery*, 20 Sep 19

ERDC/GSL TR-16-22, *Validation of FRP Matting Requirements*, August 2016

Adopted Forms

AF Form 847, *Recommendation for Change of Publication*

Abbreviations and Acronyms

ADR—Airfield Damage Repair

AFCEC—Air Force Civil Engineer Center

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFPAM—Air Force Pamphlet

AFRC—Air Force Reserve Command

AFRIMS—Air Force Records Management System

AFTTP—Air Force Tactics, Techniques, and Procedures

ANG—Air National Guard

BEEF—Base Engineer Emergency Force

CONOPS—Concept of Operations

FFM—Folded Fiberglass Mat

FOD—Foreign Object Debris

FRP—Fiber Reinforced Polymer

HPU—Hydraulic Power Units

IAW—In Accordance With

ISO—International Standards Organization

MAOS—Minimum Airfield Operating Surface

OPR—Office of Primary Responsibility

RADR—Rapid Airfield Damage Repair

RED HORSE—Rapid Engineer Deployable Heavy Operational Repair Squadron Engineers

RDS—Records Disposition Schedule

RQC—Repair Quality Criteria

STOVL—Short Take-Off and Vertical Landing

TTP—Tactics, Techniques and Procedures

USAF—United States Air Force

UTC—Unit Type Code

VTOL—Vertical Take-Off and Landing

Terms

Airfield—An area prepared for the accommodation (including any buildings, installations, and equipment), landing, and takeoff of aircraft.

Crater—The pit, depression, or cavity formed in the surface of the earth by an explosion. It may range from saucer-shaped to conical, depending largely on the depth of burst.

Techniques—Non-prescriptive ways or methods use to perform missions, functions, or tasks.

Fiber Reinforced Polymer Panels—Panels made from layers of glass fiber and polymer resin impregnated aramid fabric.

Pass—Anytime an aircraft traffics over the FRP matting.

FOD Cover—FRP matting placed on top of crushed stone backfilled craters.

Spotter—An observer stationed for the purpose of observing.

Attachment 2

FRP KIT INCREMENT INVENTORIES

Table A2.1. Increment 1 and 2 – FRP Matting.

Part No	Qty	Description	NSN
	28	FULL MAT PANEL W/LOWER BUSHINGS	N/A
	24	HALF PANEL W/LOWER BUSHINGS	N/A
	12	FULL ANCHOR PANEL	N/A
	16	HALF ANCHOR PANEL	N/A
	4	463L PALLET	
	2	463L SQUARE PALLET COUPLER	
	2	UV RESISTANT TARP	

Table A2.2. Increment 3 – FRP Tool Kit.

Part No	Qty	Description	NSN
	1	TRICON	8145-01-509-3531
T9A237797WH	8	5 GALLON BUCKET	7240-01-094-4305
T9A237798WH	8	BUCKET LID	7240-01-094-4305
937	8	2 QUART MEASURING CUP	7330-00-205-3096
7920-TDG-2	6	SHOP TOWELS, 200 SHEETS, 10-IN x 12-IN	7920-01-370-1365
P736.200024	10	2-IN DIA X 24-IN LG, SHAFT-FLIGHTED, ROCK BIT	N/A
P736.75024	10	¾-IN DIA X 24-IN LG, SHAFT-FLIGHTED HYDRAULIC HAMMER DRILL BIT	N/A
9023-C2H	24	CARBIDE CHISEL POINTS FOR EARTH AUGER	N/A
9061-H	3	1.5-IN AND 2-IN HEX TO SQUARE AUGER ADAPTER.	N/A
2688	4	EXTENSION CORDS, 50 FT LG, 15-AMP, 120-VAC	6150-01-503-2025
DW311K	1	ELECTRIC RECIPROCATING SAW	5130-00-819-7767
48-00-5185	20	RECIPROCATING SAW BLADES, 4-IN	5130-01-053-8733
48-00-5785	20	RECIPROCATING SAW BLADES, 6-IN	5130-00-275-1203

Part No	Qty	Description	NSN
DW292	4	ELECTRIC IMPACT WRENCH - ½-IN DRIVE - HEAVY DUTY	5130-00-940-7065
D25763K	2	ELECTRIC HAMMER DRILL	5130-01-365-6507
DW5812	10	DRILL BITS, ¾-IN DIA X 16-IN LG	N/A
DW5831	10	DRILL BITS, CONCRETE, 2-IN DIA X 18-IN, 22.5-IN LG	N/A
X0 4HF	1	HANDHELD ELECTRIC CONCRETE PADDLE MIXER	N/A
WK140HF	2	CONCRETE MIXING PADDLE	N/A
D28402	1	ELECTRIC ANGLE GRINDER - 4-1/2-IN	5130-01-499-0442
75150	2	TORQUE WRENCH, ½-IN DRIVE	5120-01-374-1936
5090	1	FUEL CAN, 5-GALLON	7240-00-240-6958
0455DD	2	2-7/8-IN DEEP DRAWER FOR PELICAN 0450 TOOL CASE	N/A
001-026	2	2-IN THICK X 2-FT WIDE X 2-FT LONG FOAM, TOOL CUT-OUT	N/A
001-027	2	1-IN THICK X 2-FT WIDE X 2-IN LONG FOAM, TOOL CUT-OUT	N/A
56-204	2	3-LB ENGINEERS HAMMER W/FIBERGLASS HANDLE	5120-00-900-6103
55-515K	1	WONDER BAR	5120-00-293-0665
9-34951	1	COMBINATION WRENCH SET, 1/4-IN THRU 1-1/16-IN AND 7-32-MM	
9-44704	4	COMBINATION WRENCH, 15/16-IN	5120-00-228-9513
9-47136	1	COMBINATION SCREWDRIVER SET, FLAT AND PHILLIPS, 8 PC	5120-00-103-9743
45411	1	FOUR PIECE PLIER SET	5110-00-222-2708
J223G	1	PLIERS, LONG NEEDLE NOSE, 7-IN	5120-00-293-0032
9-44809	4	SOCKET RATCHET, 9.5-IN LG, ½-IN DRIVE	5120-00-230-6385
J7180P	2	½-IN DRIVE, IMPACT EXTENSION, 1.5-2-IN LG	5120-00-227-8074
20-030	12	SOCKET, 15/16-IN, ½-IN DRIVE, IMPACT	5120-01-430-2974
066 or 066F	2	FOLDING RULER	5210-00-293-3511

Part No	Qty	Description	NSN
DW1803	2	HOLE SAW MANDREL	N/A
D180040	6	2.5-IN HOLE SAW	N/A
DW8062	20	ANGLE GRINDER METAL CUT-OFF WHEELS, 4-1/2-IN	5345-01-496-7235
33-725	2	HEAVY DUTY TAPE MEASURE, 25-FT, METAL	5210-01-428-5502
34-130	2	TAPE MEASURE, 100-FT, METAL	5210-00-527-9429
5034	8	PLASTIC TRANSMISSION FUNNEL	N/A
424RM-16	2	WISK BROOM	7920-00-178-8315
DW130V	1	½-IN DRILL, ELECTRIC	5130-00-901-7585
61205Q	2	MORTAR MIX MIXING PADDLE COMPATIBLE W/1/2-IN DRILL	N/A
28120	2	TORQUE LIMITER FOR IMPACT DRILL (110-120 FT/LBS)	N/A
2837803	4	TOW STRAPS WITH LOOPS, 2-IN WIDE, 3-FT LG	N/A
803082	2	TOW CHAIN, 5/16-IN, 20 FT LG, GRADE 70	N/A
NTH 90519	1	TIRE FILLER ADAPTOR - STANDARD AND LARGE BORE	N/A
MIP-2100	1	BANDING CUTTERS	N/A
10P20FH	4	RATCHET STRAPS - 20 FT LG	N/A
63869788	4	ORANGE TRAFFIC CONES - SMALL RUBBER TYPE	N/A
101-017-178	112	STUD, WELDED, 3/8-16UNC-2A, 1 LG	5307-01-293-1818
FE12687C240	26	TIE DOWN, CARGO, AIRCRAFT	1670-00-725-1437
91831A127	112	NUT, HEX, 3/8-16UNC-2B	N/A
92141A031	146	WASHER, FLAT, 3/8 NOM, .875-IN OD	N/A
210636	2	RAMP HANGER, M/F PLATE 3/16 THK	N/A
CW-T4RR20	4	CABLE WRAP, LARGE	N/A
CW-T3R	1	CABLE WRAP, MEDIUM	N/A
CW-T3RR25	4	CABLE WRAP, SMALL	N/A

Part No	Qty	Description	NSN
9041-2	18	PIN, LOCKING, 1-1/2-IN – 2-IN HEX AUGERS	N/A
97252A415	2	RIVET, BLIND, 1/8 DIA	N/A
5012WH	3	RATCHET STRAPS - 12 FT LG	N/A
370	2	BUNGIE CORD, 15 LG	N/A
	1	TAMPER, VIBRATING, W/MAINTENANCE KIT	3895-00-NSL-0003
	1	COMPACTOR, IMPACT, PORT, HAND	3895-01-012-3450
	1	SAW, CIRCULAR, GASOLINE, PORTABLE, K-12	5130-01-NSL-0019
K-100A	1	DYNAMIC CONE PENETROMETER SET	6635-00-NSL-0012
	1	PUMP, CENTRIFUGAL, DIESEL, 2-IN	4320-00-NSL-0003
HP18289M	2	HYDRAULIC POWER PACK, DIESEL POWERED	2815-01-533-2471
HD45110B	2	HYDRAULIC HAMMER DRILL	5130-01-178-6338
HYD-2MH150	2	HYDRAULIC EARTH AUGER	3820-01-486-4918
UTB-9092-M		AUGER TORQUE TUBE	N/A
2x36-H.S.L	6	2-IN DIA X 36-IN LG, SHAFT-FLIGHTED EARTH AUGER W/PINNED CONNECTIONS	N/A
31972	3	HYDRAULIC HOSE SET W/COUPLERS, 25-FT LG	4720-01-361-3662
62-GENSET6KW	2	GENERATOR, DIESEL, 6-KW W/WHEEL KIT	8340-01-533-7678
11308	2	8-LB SLEDGE HAMMER W/FIBERGLASS HANDLE	5120-00-251-4489
0450WD	1	TOOL BOX	N/A
55-136	1	CROW BAR - STANDARD 3-FT	N/A
EM 810-4M	1	AIR COMPRESSOR	N/A
5205004910JP	2	AIR HOSES (must be compatible with compressor)	N/A
U8OLJ036AA2	2	AIR BLOW GUN, 3-FT LG	N/A

Part No	Qty	Description	NSN
2594400	2	SHOVELS - LONG HANDLE ROUND POINT SHOVELS	N/A
2187T33	1	RAMP, 36-IN WIDE X 18-IN LONG	N/A
3750A805	2	PIN, QUICK RELEASE, T-HANDLE ALUMINUM, WITH LANYARD	N/A
5205004910JP	2	AIR HOSES (must be compatible with compressor)	N/A

Table A2.3. Increment 4 – FRP Anchor Kit.

Part No	Qty	Description	NSN
BXQFSGDLCVS003	1	QUADCON	8150-01-533-8677
	500	ANCHOR BUSHING	N/A
	600	UPPER CONNECTOR BUSHING W/BOLT	N/A
7553296	48	M2A1 AMMO BOX	8140-00-960-1699
	480	TRI-TALON ANCHOR ASSEMBLY	N/A
	10	TRI-TALON SET STEEL	N/A
6957SD	480	EXPANSION BOLTS, ¾-IN DIA X 8-1/4-IN LG, 10 CT BOX	5340-01-603-0399

Table A2.4. Increment 5 – FRP Mortar Mix Kit.

Part No	Qty	Description	NSN
BXQFSGDLCVS003	1	QUADCON	8150-01-533-8677
433RSMM55	140	RAPID SET MORTAR MIX, 5-GL BUCKET	N/A