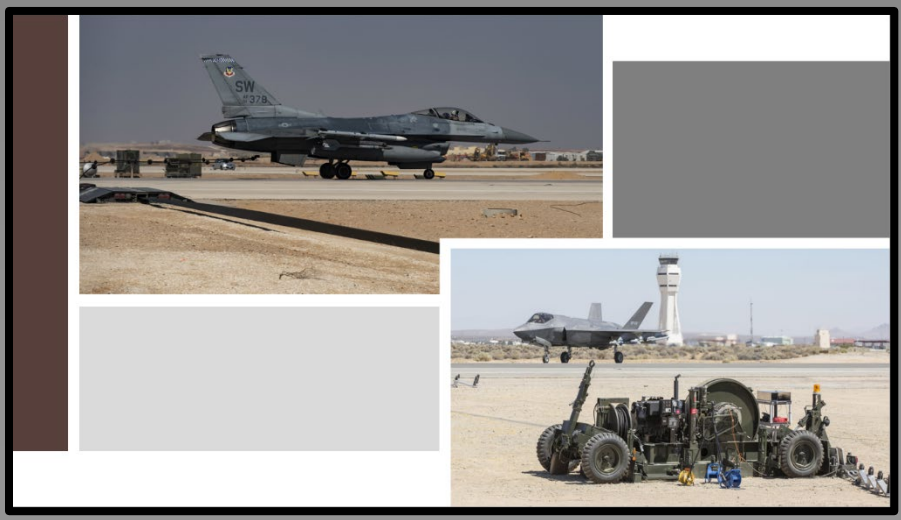
AIR FORCE TACTICS, TECHNIQUES, AND PROCEDURES 3-32.15

10 JULY 2024

RAPID SETBACK INSTALLATION OF MOBILE ARRESTING GEAR SYSTEM



DEPARTMENT OF THE AIR FORCE

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BY ORDER OF THE SECRETARY OF THE AIR FORCE

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Tactical Doctrine

RAPID SETBACK INSTALLATION OF MOBILE ARRESTING GEARS SYSTEM

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This publication supports Air Force Instruction (AFI) 10-209, *RED HORSE Program*, AFI 10-210, *Prime Base Engineer Emergency Force (BEEF) Program*, and Air Force Pamphlet (AFPAM) 10-219, Volume 4, *Airfield Damage Repair Operations*. This publication applies to the Regular Air Force, the Air Force Reserve, and the Air National Guard. This publication does not apply to the United States Space Force. It covers current tactics, techniques, procedures and accepted best practices to accurately and rapidly install a mobile arresting gear system after attack. Ensure all records generated as a result of processes prescribed in this publication adhere to AFI 33-322, *Records Management and Information Governance Program*, and are disposed in accordance with the Air Force Records Disposition Schedule, which is located in the Air Force Records Information Management System. Refer recommended changes and questions about this publication to the office of primary responsibility using the DAF Form 847, *Recommendation for Change of Publication*; route DAF Forms 847 from the field through the appropriate functional chain of command. 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 the Air Force.

SUMMARY OF CHANGES: This document has been substantially revised and must be completely reviewed. Major changes include Unit Type Code (UTC) and various equipment updates, gauge readings and measurements changes, and the addition of Rapid Airfield Damage Recovery (RADR) respiratory protection guidance.

Chapter 1

INTRODUCTION

1.1. Overview. Current contingency airfield operations will most likely require a mobile arresting gear system setback installation during airfield recovery. In these instances, the Mobile Runway Edge Sheave (MRES) will be installed in combination with the Mobile Aircraft Arresting System (MAAS).

1.1.1. Although not designed to be expeditious, a setback installation must still meet stringent recovery timelines. This necessitates specific pre-attack actions and potential sequence changes to normal installation procedures to avoid conflicts with other rapid airfield damage repair teams and their large amounts of equipment and vehicles throughout the minimum airfield operating surface (MAOS).

1.1.2. The expeditious procedures described herein are emergency recovery actions to supplement Technical Orders (T.O.) 35E8-2-10-1, *Mobile Aircraft Arresting Systems* and 35E8-2-3-1, *Operations Manual for Mobile Runway Edge Sheave*. These procedures will assist the aircraft arresting system (AAS) installation team with reaching airfield recovery timelines when installing a setback AAS. This publication does not replace mandatory compliance instructions, but augments those found in the T.O. and the T.O. will still take precedence if contradictions are found. This publication describes required resources, planning factors, expeditious installation of contingency aircraft arresting systems supporting emergency launch and recovery of fighter aircraft.

Note: Expeditionary installations may not remain in service longer than one year without a waiver; request waivers as described in FC 3-260-18F *Air Force Aircraft Arresting Systems (AAS) Installation, Operation, and Maintenance (IO&M)*, paragraph 5.8.3. Expeditionary soil installation should not be used if the anticipated period of service is longer than one year.

1.2. Description. The mobile arresting gear system consists of the MAAS and the MRES. In most instance, contingency airfields support multiple airframes and

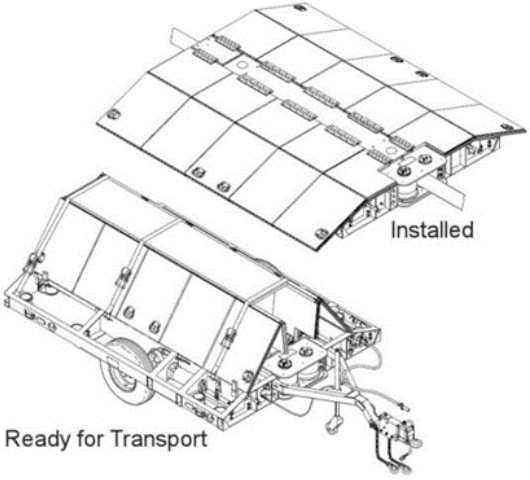
consequently require additional wing clearance for wide-bodied aircraft. The MRES allows the MAAS to be setback from the minimum operating strip's (MOS) edge, providing the additional wing clearance, as well as placing the absorbers outside the frangibility zone to reduce the need to reposition later. A setback installation may take additional two and one-half plus hours compared to a MAAS-only installation. **Note:** This additional time is with an experienced team and under ideal conditions. When a contingency airfield supports fighter aircraft only, or when a Wing Commander determines a setback installation will cause unacceptable delays to initial sorties, the MAAS may be installed temporarily at the edge of the MOS without a runway edge sheave system. Once normal operations return it must be relocated outside the frangibility zone.

1.2.1. The MAAS is a rotary friction-type energy absorber consisting of two identical units installed on each side of the runway (**Figure 1.1**). It is designed around special nylon tape used as the purchase or drive member. Arrestment of landing aircraft is accomplished by engagement of the aircraft's arresting hook with a pendant cable assembly stretched across the runway. The pendant cable is fastened to the nylon tape with a mechanical connection known as the tape connector. Energy of the arrested aircraft is absorbed in the rotary friction brakes during the tape payout. The MAAS can arrest specified aircraft within a nominal 1,200 feet runout. The system is capable of being installed in soil, asphalt, or concrete, but is most likely installed in soil for setback installations. The MAAS is towable by any vehicle capable of towing 18,000 pounds (36,000 pounds if towed in tandem) and equipped with a standard pintle-hook.

Figure 1.1. MAAS Trailer Views.

1.2.2. The MRES system (**Figure 1.2**) is designed to enhance capabilities of the MAAS by providing a low-profile runway edge sheave allowing the MAAS to be setback from the runway, removing high profile equipment from edges of the runway. One mobile runway edge sheave trailer is called an MRES assembly. Two mobile runway edge sheave assemblies make up a mobile runway edge sheave system, or MRES system. Any installation combining the MRES system and the MAAS is referred to as a mobile arresting gear system.

Figure 1.2. MRES Assembly Views.



1.2.2.1. The MRES is designed for contingency situations to support the setback configuration of unit-/or bi-directional installed arresting gear. It should not be used as a permanent component of a real property installed mobile arresting gear system. As with the Lightweight Fairlead Beams and standard fairlead beam, it reduces potential hazards to incoming and outgoing aircraft by significantly reducing the arresting system profile at the edge of the MOS. The MRES is the preferred contingency runway edge sheave as it has a cleaner and safer installation footprint and does not require additional vehicles for transporting, unloading, and installing the system. After airfield recovery, and when time permits, increase the rollover ramp on the sides of the MRES to a 1V:30H slope in accordance with Facilities Criteria (FC) 3-260-18F, *Air Force Aircraft Arresting Systems (AAS) Installation, Operation, and Maintenance (IO&M)*, paragraph 3-4 to allow an aircraft to roll over them smoothly.

1.2.2.2. The system may be anchored in soil or on concrete and is suitable for all arrestments and aborted take-offs. The MRES is towable by any vehicle capable of towing 5,200 pounds and equipped with a standard pintle-hook. The MRES assembly may be attached to the rear of a MAAS trailer for tandem towing with

a suitable vehicle capable of towing 23,200 pounds and equipped with a standard pintle-hook.

1.3. General Safety Considerations. In standard and nonstandard construction practices, there are multiple known risk factors in performing RADR duties. It is vital to protect workers from hazards such as high-pressure subsystems and components, harmful solvents and adhesives, and silica dust. The risks and safety factors involved with materials and operations should be identified prior and briefed to all personnel that could be involved. A key responsibility of supervisors is to ensure personnel have and wear the necessary personal protective equipment (PPE) and individual protective equipment (IPE) for the working environment. Unsafe field operations while conducting RADR could cause long and short-term injuries, health issues, disable equipment, and negatively affect the mission.

1.3.1. Published Guidance. Review applicable safety standards and technical manuals for additional safety requirements before performing RADR operations. Guidance can be found in the following subparagraphs. Compliance with technical order warnings and cautions is essential.

1.3.2. AFI 91-203, *Air Force Consolidated Occupational Safety Instruction*, lists PPE for selected CE activities. Although T.O. and other job-related publications address proper wear and use of PPE and IPE, workers ultimately have the responsibility to properly use, inspect, and care for protective equipment assigned.

1.3.3. Consult AFI 48-137, *Respiratory Protection Program* for training documentation procedures and inhalation guidance. Refer to 29 CFR 1910.133, *Eye and Face Protection,* and AFI 48-127, *Occupational Noise and Hearing Conservation Program,* for additional guidance and information. For end users consult 29 CFR 1910.134, *Respiratory Protection.*

1.3.4. Handlers and users of any polymeric repair material should ensure a manufacturer's Safety Data Sheet always accompanies the material. Before use, review and follow the Safety Data Sheet guidance for personal protective equipment and other safety precautions.

1.3.5. In accordance with Air Force Medical Readiness Agency Bioenvironmental Engineering (AFMRA/SG3PB) Memorandum, *Joint Service General Purpose Mask M50 Use During Rapid Airfield Damage Recovery Training Events*, dated 30 September 2020, "Commanders have the discretion to elect the use of the Joint Service General Purpose Mask M50 series protective mask as approved by Bio-environmental Engineering or a National Institute for Occupational Safety and Health certified respirator for "Training events Only". PPE is identified in **Table 1.1.**

1.4. Personal Protective Equipment. Supervisors should coordinate with the Bioenvironmental Engineering and the Wing Safety office on the PPE needed to perform RADR operations. Brief safety procedures and appropriate PPE before operations and verify that all PPE has been approved for the work to be performed. See **Table 1.1** for a list of PPE for typical RADR operations. **Note:** Breathing crystalline silica dust is a serious health hazard. Those performing duties where they may be exposed to silica dust should wear appropriate PPE (including respiratory and eye protection) according to Commander's guidance.

Table 1.1. Listing of Typical PPE by Operation.

Operation or Equipment	Typical PPE Required
Dump Truck	Safety-toe boots Gloves
Loader, Grader, Sweeper, Backhoe, Bulldozer, Roller, Paver	Safety-toe boots Gloves Eye protection (dust and bright sun) Hearing protection Respiratory protection (if dusty) *
Jackhammer, Pneumatic Drill	Respiratory protection* Safety-toe boots Eye protection Hearing protection Gloves

Concrete Saw	Safety-toe boots Eye protection Hearing protection Respiratory protection (if dusty) * Gloves
Concrete Mixer	Safety-toe boots Eye protection Respiratory protection* Hearing protection
Portable Power Tools	Eye protection Hearing protection Respiratory protection (if dusty) *
Paint Striping	Eye protection Respiratory protection* Gloves Coveralls
MAAS Installation	Eye protection Hearing Protection Gloves Coveralls
*-N-95, P-95, and R-95 respirator or M50 JSGPM, as directed by Commander.	

1.5. Safety Summary. Training, practice, and safety are essential to minimize installation time. The following paragraphs describe general safety precautions that personnel should understand and apply during all phases of operation and maintenance.

1.5.1. Winch Operation.

Note: To prevent serious injury to personnel, ensure the MAAS winch operator protective shield is properly installed during winching operation.

1.5.1.1. When loading onto an aircraft or other transport vehicle using the on-board MAAS winch, do not winch the trailer up an incline exceeding 15 degrees.

1.5.1.2. Do not overlap winch cable during rewind. Overlap may result in cable failure, injury to personnel, or damage to equipment.

1.5.2. Towing. The following steps are required to ensure the safety of the equipment and personnel prior to towing the MAAS.

1.5.2.1. Physically inspect the trailer for any loose hardware or equipment.

1.5.2.2. Check the hook cable to ensure that it is properly stored on its storage reel and the free end of the cable is properly secured.

1.5.2.3. Check the tape connector for proper storage and security.

1.5.2.4. Inspect the front and rear sheave guards to ensure they are properly installed, and fasteners are tight.

1.5.2.5. Inspect the hydraulic power units and storage brackets to ensure they are properly secured.

1.5.2.6. Inspect all installation hardware and storage brackets for security and tightness of straps.

1.5.2.7. Inspect splash guards for damage and ensure that they are secure.

1.5.2.8. Check front storage box to ensure lid is properly installed and latches are secure.

1.5.2.9. Ensure the retaining bolts and pins are properly installed and secure in the front and rear axle support frames.

1.5.2.10. If the trailer is being towed with its protective cover installed, check for security of lanyard and hooks.

1.5.2.11. Anytime the MAAS or MRES is being connected or disconnected from the “Prime Mover” (tow vehicle) chock one wheel and set the parking handbrake. This also applies when the trailer is not being transported or is not connected to its tow vehicle. Failure to comply may result in serious injury to personnel and/or equipment.

1.5.2.12. Always use a signalman to direct the driver of the tow vehicle. Failure to comply may result in injury to personnel or equipment.

1.5.2.13. Towing speed limit is reduced when towing two trailers in tandem to 20 mph over improved roads. Failure to comply may result in injury to personnel or equipment.

1.5.3. Raising/Lowering.

1.5.3.1. Hydraulic systems will be operated by qualified personnel only.

1.5.3.2. Prior to operating the MAAS hydraulic raise/lower system, chock one rear wheel and apply the parking brake. Failure to comply may result in serious injury to personnel and equipment. A runaway vehicle may be the result of non-compliance.

1.5.3.3. Ensure the area under the trailer is clear and instruct personnel to remain clear of the trailer during the raise or lower operation.

1.5.3.4. Keep feet and hands away from axle frames and trailer bottom during raising or lowering trailer to prevent injury to personnel.

1.5.3.5. If the axle support frames hit any object in its path when raising the MAAS trailer, stop until the object is removed to prevent injury to personnel or equipment.

1.5.3.6. When raising or lowering the trailer, ensure the front toolbox lid is either properly latched and secured or completely removed. Failure to comply may result in the lid binding into the hydraulic elbow on the front axle cylinder actuator and broken elbow, which eliminates the ability to raise or lower trailer.

1.5.4. Installation.

1.5.4.1. Wear adequate eye protection while driving stakes. Propelled rocks, metal fragments, and soil particles can damage unprotected eyes.

1.5.4.2. Do not position hands near the stake driving head/stake interface when driving stakes. The stake driving head occasionally bounces off the stake. Insertion of fingers between driving head and stake can result in severe injury to personnel.

1.5.4.3. Due to certain soil conditions or terrain, it may be necessary to provide a person to help stabilize the work stand when in use to avoid injury to personnel.

1.5.4.4. Wear protective clothing when operating hydraulic tools. Hydraulic fluid can pose serious health hazards.

1.5.4.5. Wear gloves and hearing protection during MAAS and MRES assembly anchoring. The hydraulic breaker poses injury hazards to unprotected hands and ears.

1.5.4.6. Wear gloves and other protective equipment when handling the breaker and MRES drive gad assembly. The breaker and the drive pieces of the drive gad assembly can become hot enough during installation to cause burns.

1.5.4.7. The MAAS Tire and wheel assembly weight is approximately 410 lbs. Ensure there is adequate lifting capability available.

1.5.4.8. Do not place fingers between the latch and installation tools when closing the latch on the breaker. Doing so can result in personal injury.

1.5.5. Operation, Rewind and Engagement.

1.5.5.1. Before stretching tapes, ensure the area between the tow vehicle and lead-off sheave is clear of all personnel and equipment. Failure to comply may result in serious injury to personnel and equipment.

1.5.5.2. During rewind and tensioning, it is recommended to maintain a minimum safe distance of 30 feet from the pendant/hook cable since it will swing back through the bight. The bight is defined as the cable line between the runway edge sheaves. Serious injury could otherwise result.

1.5.5.3. Do not add fuel, fluid, or oil when the engine is running. A fire could result causing serious injury to personnel or equipment.

1.5.5.4. Do not attempt to remove hook cable while the system is pre-tensioned. Injury to personnel or equipment may result.

1.5.5.5. Do not attempt to remove MAAS chain guards while the engine is running. Do not run engine with chain guard removed except when performing synchronization or hydraulic system proof testing.

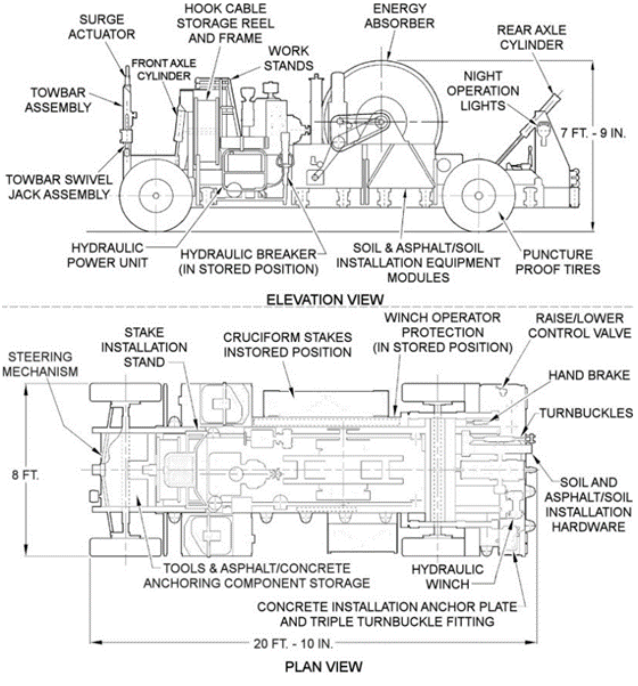
1.5.5.6. Before rewind, clear personnel from the tape sweep and cable travel area (**Attachment 2**).

Chapter 2

RESOURCES

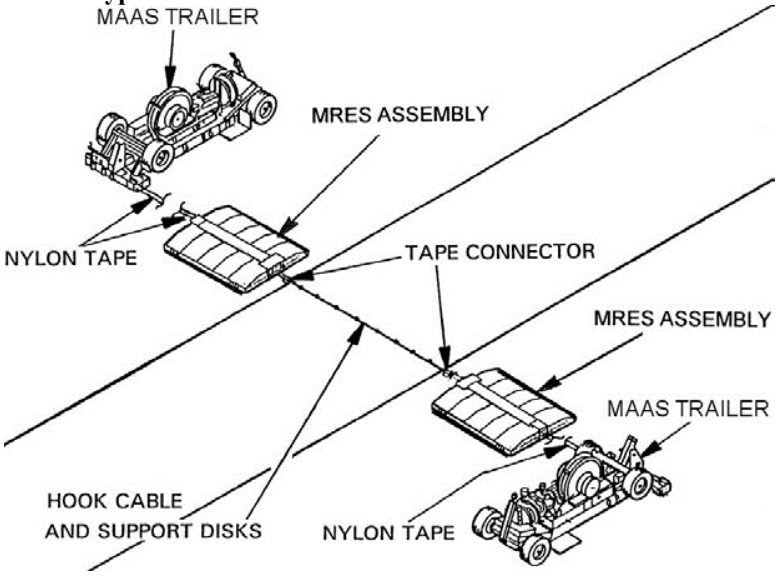
2.1. MAAS Equipment. The MAAS consists of two identical mobile units with the exception that one trailer is supplied with a 153-ft pendant cable and the other a 90-ft pendant cable (**Figure 2.1**). Each unit houses a BAK-12 rotary friction energy absorber; contains all basic components of a fixed-base arresting system, and all the tools and hardware necessary for installation and removal (except for installation on soils with a low bearing pressure, which requires a deadman anchoring system). The MAAS equipment and tools also support the MRES installation and removal.

Figure 2.1. MAAS Elevation and Plan Views.



2.2. MRES Equipment. The MRES system consists of two identical assemblies and installation hardware to anchor the assemblies on each side of the MOS (**Figure 2.2**). The assemblies route the tapes from the MAAS through their center-mounted sheave assemblies. The sheave assemblies properly orient the tapes to allow smooth payout/pay-in without hang-up or tangling.

Figure 2.2. Typical MRES Installation.



2.2.1. The anchoring equipment supplied with the MRES system, together with the installation equipment and tools supplied as part of the MAAS, provide all parts necessary to install and operate the mobile arresting gear system.

2.2.2. The body of the MRES assembly is also the body of an integral trailer. The MRES body is fitted with take-up assemblies that function not only as wheels, but as entire suspension systems to provide smooth transport over most surfaces. The MRES assembly has lights integrated into the body of the trailer.

2.2.3. Regardless of the type of anchors used, the power for the installation tools is provided by the hydraulic power unit (HPU) of the MAAS. For additional information on the HPU, refer to T.O. 35E8-2-10-1.

2.3. Installation Team. An installation team of 12 individuals is recommended to help ensure the rapid mobile arresting gear system installation meets recovery timelines. This includes one barrier crew chief, three barrier crew (3E0X2), and 8 equipment operators/augmentative personnel. The other eight members may be from any specialty; however, the more experienced 3E0X2 technicians on the team, the greater likelihood the installation will be accelerated. **Table 2.1** describes the 12-member team distribution and their responsibilities. **Note:** An engineering technician (3E5X1) is not required for system alignment but may help expedite the installation by using survey equipment in place of the manual alignment method identified in T.O. 35E8-2-10-1.

Table 2.1. AAS Team Assignments.

Position	AFSC	Component	Vehicle
AAS Crew 1 Team Lead	3E072	All	
AAS Crew Member	3E0X2	All	
Augmentee	Any	All	
Augmentee	Any	All	
Crew 2 Lead	3E052	MAAS-B1 Location*	
Augmentee	Any	MAAS-B1 Location*	Vehicle-A
Augmentee	Any	MAAS-B1 Location*	
Crew 3 Lead	3E052	MAAS-C1 Location*	

Augmentee	Any	MAAS-C1 Location*	Vehicle-B
Augmentee	Any	MAAS-C1 Location*	
Crew 4 Lead	3E052	MRES-C&B Locations*	
Augmentee	Any	MRES-C&B Locations*	

*See **Figure 4.1** for installation locations.
Note: An engineering technician (3E5X1) may perform as an augmentee to help expedite system alignment when survey equipment is available.

2.4. Tools and Spares. The mobile units (trailers) contain all tools and hardware necessary for installation and removal. Special service tools required for BAK-12 absorber maintenance are not provided with the MAAS, but the most common tools are included in the Mobility Readiness Spare Packages support kit within the War Reserve Materiel/Basic Expeditionary Airfield Resources AAS UTC-XFWR4. Consumables are also included in the Mobility Readiness Spare Packages kit.

2.4.1. The only consumable hardware designed into the MAAS and MRES is the anchor nut, used with the bolt in the concrete anchor system. Twenty-four nuts are consumed on each MAAS concrete setback installation. An additional box of 20 is supplied on each MAAS trailer providing 40 spares per system. Twenty-eight anchor nuts are consumed on each MRES concrete installation. Two additional anchor nuts and bolts are stored on each MRES assembly.

Note: The system provides 12 hard soil and 12 medium soil manta ray anchors. Large soft soil manta ray anchors (12 each) must be procured through supply system by the unit if they are identified as a need.

2.4.2. The War Reserve Materiel/Basic Expeditionary Airfield Resources Barrier Maintenance UTC-XFWCL includes an AAS shop facility, rubber support disc

loading machine, and battery maintenance equipment to help expedite AAS installation.

2.4.3. See T.O. 35E8-2-10-1 for a comprehensive list of installation/removal equipment, tools, and spares.

Chapter 3

PRE-ATTACK ACTIONS

3.1. Introduction. This chapter identifies actions taken when intelligence personnel report an enemy air attack is probable; waiting until the attack is imminent may not provide time necessary for completion. The pre-attack actions within this chapter will help expedite the mobile arresting gear system setback installation during airfield recovery.

3.1.1. Major air attacks can result in craters throughout the airfield. The crater repairs during rapid recovery operations are suitable for all airframes; therefore, installations supporting wide-body (cargo, transport, refuelers) aircraft require a mobile arresting gear system setback configuration to provide necessary wing tip clearance. The setback configuration is accomplished by utilizing the MRES system.

3.1.2. Installing the MRES system, especially in soil, is a time-consuming process and involves detailed planning to ensure the installation is completed within the 8-hour airfield recovery window.

Note: An exception is when installation site pavement is asphalt over soil, 20-feet by 15-feet of asphalt will have to be removed in the installation clear zone and the resulting depression backfilled and compacted to match the surrounding pavement height. Attempt to achieve a California Bearing Ratio (CBR) of 25 or greater to allow use of small manta-ray anchors. A soil installation will then be performed on this compacted soil patch. Otherwise, the MOS width will be the full runway width and both MRES assemblies installed on soil at the runway's edge.

3.1.3. A MAAS-only installation immediately adjacent to the MOS during rapid airfield recovery is suitable for airfields supporting fighter aircraft only but must be reinstalled in the setback configuration as soon as time permits.

3.2. Preparing for Mobile Arresting Gear System Setback Installation. Perform the following pre-attack actions to accelerate the mobile arresting gear system installation in accordance with T.O. 35E8-2-10-1, paragraph 3.1.1.1.1 (see checklist in Attachment 3).

3.2.1. Guidance applicable to all airfields is **paragraphs 3.2.1.1** through **3.2.1.5**.

3.2.1.1. If not already available, conduct a runway profile identifying longitudinal and transverse slopes and CBR readings along the runway shoulders to determine suitable AAS installation sites. If runway and shoulders are constructed of asphalt over soil, determine asphalt thicknesses.

3.2.1.2. Adjust MAAS turnbuckles to 39 inches and MRES turnbuckles to 30 inches.

3.2.1.3. Accomplish all required maintenance and inspections in accordance with T.O. 35E8.2.5.1 (including synchronization and hydraulic system proof test) on mobile arresting gear system during pre-attack phases to expedite installation during airfield recovery following an attack.

3.2.1.4. Ensure correct cam and cam sprocket are installed according to system configuration as indicated in T.O. 35E8-2-5-1.

3.2.1.5. When the MAAS has new tapes installed that have not been previously stretched, recommend temporarily anchoring each trailer in a suitable location and stretching the tapes as described in T.O. 35E8-2-5-1. Tapes not stretched may lead to longer runouts, especially during high-energy arrestments. Some energy may remain in tapes and cause aircraft walk-back. Tapes not stretched will also grow in length during the first couple of arrestments. This requires cropping excess tape to accommodate cable length. In a multi-arrestment scenario, technicians may not have time to do so.

3.2.2. For airfields supporting fighter aircraft only, the runway profile (**see paragraph 3.2.1.1**) should extend at least 25 feet from runway's edge.

3.2.3. Guidance for airfields Supporting Bomber/Tankers/Mobility and Fighter Aircraft, see **paragraphs 3.2.3.1** through **3.2.3.7**.

3.2.3.1. In preparation for a possible off-center MOS with a setback mobile arresting gear system installation, the runway profile (see **paragraph 3.2.1.1**) should extend at least 275 feet from both sides of the runway centerline.

3.2.3.2. From the runway profile, determine which manta-ray anchors provided with the MRES is required for the soil conditions adjacent to the runway (for hard soil with CBR over 25 or for medium soil with CBR 25 or less). Soil that does not support a 10,000-lb proof load may require the use of the manta ray for soft soil (P/N 9D00204-3). These are included with the BEAR UTC XFWR4. Other non-BEAR UTC will be required to order 12 manta ray anchors (6 required per MRES trailer).

3.2.3.3. On one MRES trailer remove all soil installation tools and hardware, install concrete installation brackets, and reconfigure anchor weldments to the installation position (as described in T.O. 35E8-2-10-1) unless runway surface is asphalt. If both MRES assemblies are to be installed on concrete and sufficient notice is provided after attack, perform these actions on both trailers.

3.2.3.4. Remove bushings from both MAAS trailer stake pockets and store them in an appropriate location on each trailer.

3.2.3.5. Pull enough tape from both MAAS tape reels to reach approximately 10 feet beyond the distance between the MAAS exit sheave and MRES exit sheave (at least 285 feet) and remove the tape connectors if already installed. This will be the tape reeved through the MRES. Doing this during pre-attack actions prevents having to pull tape from the reels during installation. Roll up tape pulled from the reel and secure on the MAAS trailer for transport.

3.2.3.6. Obtain a small, stranded wire rope at least 120 foot long (for siting component locations), or equivalent, and place in MRES storage compartment.

3.2.3.7. Adjust load-locker pressure relief to 10.5K pounds according to the gauge. **Note:** The MRES Load-Locker is a 3,000 PSI gauge with a sticker that correlates to pounds of force at an approximate 1/10 ratio. This means at 10.5K pounds on the gauge, actual pressure would be around 1,050.

3.3. Expected Installation Times. Installation times in **Table 3.1** were accomplished during a mobile arresting gear system installation demonstration. The times included positioning trailers, connecting hook cable to tape connectors, tensioning the hook cable, anchoring components, and synchronizing both absorbers.

Table 3.1. AAS Installation Completion Baselines.

System Configuration			Installation Times
Unidirectional	Concrete	Concrete	1 hour*
Unidirectional	Soil	Concrete	1 hour*
Bidirectional	Concrete	Concrete	1 hour*
Bidirectional	Soil	Concrete	1 hour*
Setback with MRES	Concrete	Concrete	2 hours
Setback with MRES	Soil**	Concrete	3.5 hours

***Note:** When not in the setback configuration, MAAS installation was complete prior to finishing the synchronization (approximately 1 hour).
**CBR for the MRES soil installation: 00” - 12” = 31.5 CBR, 13” - 24” = 20.0 CBR, 25” - 36” = 08.5 CBR, with Average CBR = 20
Note: Times in **Table 3.1** may be used for planning purposes; however, local results may be considerably different due to soil conditions, team experience, and/or equipment condition.

Chapter 4

INSTALLATION

4.1. Introduction. Procedures provided in this chapter assume pre-attack actions described in **Chapter 3** have been accomplished. Perform setback installation as described in T.O. 35E8-2-10-1 while incorporating rapid installation procedures within this chapter. See **Attachment 4** for installation checklist.

4.2. Setback Configuration. The MAAS must be setback from the MOS centerline a minimum of 275 feet if both fighter and wide-bodied aircraft will use the same MOS. This setback provides necessary wingtip clearance when wide-bodied aircraft utilize the MOS while also placing the absorbers outside the frangibility zone. If conditions during rapid recovery do not allow a setback of the full 275-foot setback, the system will have to be reinstalled at the earliest opportunity after normal operations return.

Note: Installations of the MAAS on commercial airfields should comply with the most current version of the US Department of Transportation Federal Aviation Administration Advisory Circular 150/5220-9B, *Aircraft Arresting Systems on Civil Airports*.

4.2.1. General Information. The setback installation detailed here is suitable for all arrestments, including bi-directional landings and aborted take-offs. No reduction in installation hardware is authorized for unidirectional installations.

4.2.1.1. The MAAS HPU provides power for MAAS and MRES installation tools regardless of anchor types used.

4.2.1.2. If a runway profile was not conducted during pre-attack actions, an engineering technician (3E5X1) with proper surveying equipment should verify the selected installation site meets slope requirements before installation begins (an engineering technician from each crater repair team should be available after all upheaval on the MAOS has been marked). This technician may also assist with siting components through use of surveying equipment to help expedite the installation.

4.2.2. Manpower Requirements. The T.O. recommends a 7-person work force to install the MRES; however, the MRES was not designed for rapid installation during airfield recovery operations. Legacy concept of operations were to install the MAAS only during airfield recovery and, if necessary, a setback installation would be installed as time permitted after returning to normal operations. Current concept of operations calls for a setback installation during initial recovery at airfields supporting multiple airframes to enable all aircraft types to generate sorties as soon as the MAOS opens.

4.2.2.1. The 12-person team identified in **Table 2.1** should be assembled to rapidly perform a setback installation. Divide the team into four crews as follows:

4.2.2.1.1. Crew 1 (four-person AAS Crew). Responsibilities include:

- Siting and positions components
- Lowering MAAS trailers
- Reeves tape through MRES
- Installing tape connectors
- Connecting hook cable to tape connectors
- Performing preliminary alignment
- Directing pull-out alignment while operating rewind engines
- Performing synchronization, if not accomplished during pre-attack actions; otherwise, bleeds absorbers' hydraulic system.
- Performing final inspection of system.
- Crew Lead certifies the system installation

4.2.2.1.2. Crew 2 (three-person anchoring crew). Responsibilities include:

- Install MAAS soil anchors at B1 location
- When finished anchoring MAAS, transport HPU to MRES B location if required
- Assist Crew 4 with MRES installation

4.2.2.1.3. Crew 3 (three-person anchoring crew). Responsibilities include:

- Installing MAAS soil anchors at C1 location

- When finished anchoring MAAS, transporting HPU to MRES C location if required
- Assisting Crew 4 with MRES installation

4.2.2.1.4. Crew 4 (two-person MRES crew). Responsibilities include:

- Unloading tools and hardware from MRES trailers
- Installing concrete installation brackets and anchor weldments when applicable if not done during pre-attack actions
- Lowering MRES trailers
- Installing alignment anchors
- Adjusting turnbuckles during pullout alignment
- Installing MRES anchors

4.2.2.2. The mobile arresting gear system AAS Crew Chief has overall responsibility for the installation and must utilize all personnel effectively to minimize installation time. Many installation steps are performed simultaneously by different team members as directed by the Team Lead.

4.2.3. Installation Site Selection. The MAOS Selection Team will determine the mobile arresting gear system installation site depending on the operational need and airfield layout. A portion of the runway should be selected that allows for a touchdown zone, a tape sweep area, and an aircraft clear zone beyond the 1,200-foot maximum rollout. Allow approximately 100 additional feet for clearing the aircraft after an arrestment. For bi-directional installations, these distances must be considered in both directions. If a runway profile was not accomplished during pre-attack actions, the AAS Crew Chief must ensure appropriate surveying equipment and personnel are available to verify slope requirements.

Note: For additional information on MAOS siting and selection see AFTTP 3-32.12, *Minimum Airfield Operating Surface Selection and Repair Quality Criteria* as MAAS installation may be affected by preceding and trailing surface repair locations.

4.2.3.1. MRES Site Requirements. The most advantageous installation site will locate both, or at least one, MRES trailer on concrete as this configuration can be installed faster than the soil installation. The anticipated site should be checked by the mobile arresting gear system Team Lead to verify positioning requirements

are met before beginning installation. See MRES complete site requirements in T.O. 35E8-2-3-1.

4.2.3.2. MAAS Site Requirements. The setback distance should be at least 275 feet. Setback distance is defined as the total distance from the MOS centerline to the exit point of the MAAS edge sheaves. Shorter setback installations are only acceptable to take advantage of existing site conditions. See MAAS complete site requirements in T.O. 35E8-2-10-1.

Note: Under no circumstances should the setback distance be shortened based upon available tape length. If necessary, acquire new 1500-foot tapes (part number 68C37215-13) for the setback installation.

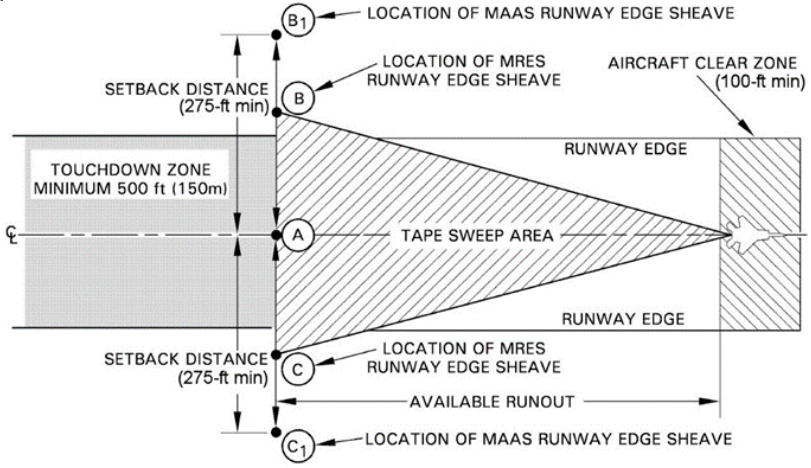
Note: Tape stack height dimension is a function of tape length (allowable aircraft runout) and tape reel diameter. Following the installation of the MAAS and the MRES, the tape edge distance must not exceed the limits given in T.O. 35E8-2-5-1, *Operation and Maintenance Instructions, Aircraft Arresting Systems, Model BAK-12/E32A*, Table 5-5, Control Cam and Tape Stack Height Data. Failure to adhere to these limits will result in reduced allowable runout and may result in aircraft damage, serious injury, or even loss of life.

4.2.4. Marking Component Locations. After selecting a site based upon the requirements given above, the exact locations of the system components must be determined and marked prior to installation. Mark the component locations as described in T.O. 35E8-2-10-1. When available, an engineering technician (3E5X1) may use surveying equipment to expedite marking component locations.

4.2.5. Positioning Components. Each tow vehicle should have a MAAS trailer connected to its pintle-hook and an MRES trailer connected to the MAAS trailer for tandem towing.

4.2.5.1. The tow vehicle approaches the MOS perpendicular to the centerline with the center of the MRES trailer centered on Points B and B1 (**Figure 4.1**).

Figure 4.1. Typical Positioning, Setback Trailer System.



4.2.5.2. As MRES trailer approaches Point B, the Team Lead signals tow vehicle operator to stop when front tape sheaves are centered on Point B. Set both trailer hand brakes and disconnect from tow vehicle. Crew 4 performs MRES trailer unloading and installation preparation steps (if not accomplished during pre-attack actions) identified in T.O. 35E8-2-10-1.

4.2.5.3. Position one HPU from the MAAS trailer next to the MRES trailer location.

4.2.5.4. The tow vehicle then swings around to the right and approaches Point B1 while parallel to the MOS.

4.2.5.5. As the MAAS trailer approaches Point B1, the Team Lead directs the tow vehicle operator when to stop so that the center of the tape exit sheaves have traveled approximately 6-inches beyond Point B1. The trailer will move backwards approximately 6-inches as it lowers to the ground.

4.2.5.6. When lowering, ensure cross-runway alignment of the trailer sheave exit points are within plus or minus 1 foot of the line perpendicular to the runway centerline.

4.2.5.7. Perform same procedure on opposite side of runway for Points C and C1.

4.2.6. Preliminary Alignment. Perform preliminary alignment as directed in T.O. 35E8-2-10-1. Pay particular attention to the following points:

4.2.6.1. Verify that 90-degree tape twist on each side of runway between each MAAS exit sheaves and each MRES assembly's rear sheave is in the same direction relative to the runway.

4.2.6.2. The tensioned tape and pendant cable should form a straight line from the exit sheave of the MAAS, through the MRES trailer, across the runway, through the opposite MRES trailer, and into the opposite MAAS sheave.

4.2.6.3. Reposition MRES assemblies as required to remove any bow from tape while keeping front sheaves at Marks B and C.

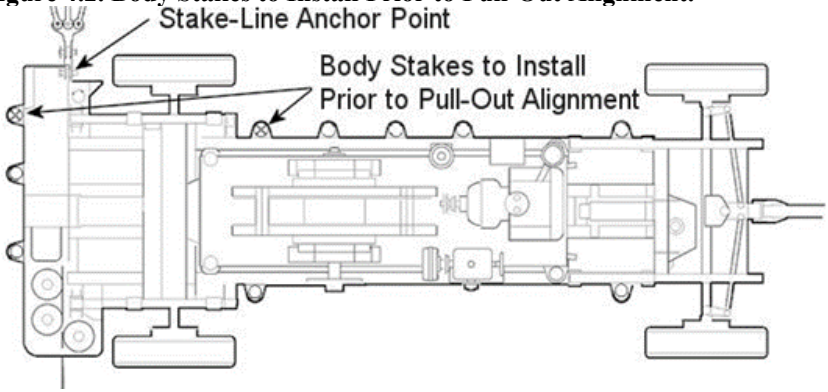
4.2.7. Install MRES Alignment Anchors. Install applicable alignment anchors (concrete, soil) as described in T.O. 35E8-2-3-1.

4.2.8. Pull-out Alignment. Perform pull-out alignment following T.O. 35E8-2-3-1 procedures.

4.2.8.1. It is recommended that at least two MAAS body stakes be installed on either side of the stake-line anchor point prior to performing the pullout alignment (**Figure 4.2**). This will ensure the trailer does not move during pull-out alignment.

4.2.8.2. Perform pull-out alignment on both sides simultaneously by hooking pull vehicle to the pendent.

Figure 4.2. Body Stakes to Install Prior to Pull-Out Alignment.



4.2.8.3. Adjust the MRES trailer alignment by loosening one turnbuckle first and tightening the opposite alignment turnbuckle to pull the assembly into alignment.

4.2.8.4. Tighten MRES alignment turnbuckles, without moving the trailer, to hold it in position during anchoring.

4.2.9. MRES Installation Procedures.

4.2.9.1. Concrete Installation. Perform installation as directed in T.O. 35E8-2- 3-1.

4.2.9.1.1. It is imperative a spotter ensure holes being drilled are as vertical as possible; otherwise, taper bolts may be difficult or impossible to install completely.

4.2.9.1.2. All 14 taper bolts are required and must be installed to provide the proper safety margin.

4.2.9.2. Soil Installation. Perform installation as directed in T.O. 35E8-2-3-1.

Note: Because the mobile arresting gear system must be relocated if any of the six manta-ray load tests fail on either MRES assembly, recommend installing stakes only in the four corners of each MRES assembly prior to installing the manta-rays and load testing them.

4.2.9.2.1. Install a body stake in the three corners that do not have a stake driven already (the alignment pivot-point stake was previously driven in one corner for the pull-out alignment). Do not drive body stakes below the top rim of the stake pockets.

4.2.9.2.2. Install the appropriate manta-ray anchors, according to the CBR of the installation site (see **paragraph 3.2.3.2**) before installing the remaining body stakes.

4.2.9.2.2.1. Ensure the load locker base frame is securely tightened to the trailer frame before driving the manta-ray anchors or when setting the anchors with the load-locker. Periodically check tightness of the load-locker base frame to prevent misalignment.

4.2.9.2.2.2. If relief valve on the load-locker cannot be set to open at 10,500 pounds of force, use the operating lever to keep the pressure at 10,000 pounds of force as indicated by the load-locker gauge. Setting and proof- testing the anchors using pressure above 10,500 pounds of force may cause the pulling bar to move more than 0.5 inch during the one-minute test period. **Note:** The MRES Load-Locker is a 3,000 PSI gauge with a sticker that correlates to pounds of force at an approximate 1/10 ratio. This means at 10.5K pounds on the gauge, actual pressure would be around 1,050.

4.2.9.2.2.3. If the manta-ray anchors selected will not set and hold during proof loading with the load-locker, the system must be moved to another area with a higher CBR reading. If soil conditions are similar, larger manta-ray anchors may be required in the new location.

4.2.9.2.3. Drive the remaining body stakes. The 24 body stakes in the center sections of the MRES should be driven into the ground until 8 to 10 inches of the stake remains exposed above ground level. The 8 stakes in the sloped sections should be driven until approximately 6.5 inches of the stake remains exposed above ground level. Make certain stakes are driven deep enough to allow covers to sit flush.

4.2.10. MAAS Setback Installation Procedures. Divide personnel into 4 crews as described in **Table 2.1** and perform installation IAW TO 35E8-2-10-1.

4.2.10.1. Concrete Installation. The MAAS trailer exit sheaves are setback 275 feet from the MOS centerline. This distance will almost assuredly require a soil installation. If the installation site is concrete, perform a setback concrete installation as described in T.O. 35E8-2-10-1.

4.2.10.2. Soil Installation. Pay particular attention to the following points:

4.2.10.2.1. Install 10 MAAS trailer body stakes first; drive stakes until only 18 inches are exposed above ground. When finished, count the body stakes to ensure all 10 were installed.

4.2.10.2.2. The KM anchoring system should be installed on level ground to keep proper alignment (remove soil on high spots and add soil to low spots).

4.2.11. Preparation for Use. Prepare the system for use following procedures in T.O. 35E8-2-10-1. Pay particular attention to the following points:

4.2.11.1. Place a storage bag over each MRES brake drum and hub for protection.

4.2.11.2. Proof loading is not mandatory under combat or emergency conditions; however, proof load the mobile arresting gear system as prescribed in T.O. 35E8-2-5-1 following the conclusion of the emergency. This testing of the MAAS anchoring system is always preferred after installation because it imposes a load on the nylon tape similar to the loading experienced during an actual aircraft engagement. One of the purposes of proof loading is to find problems with the anchoring. It should highlight loose components, which may cause the system to shift during use. Proof loading does not replace the tape stretch procedure.

4.2.11.3. Perform tape stack height measurement; replace tapes if out of tolerance.

4.2.11.4. Pendant cable should be supported above the runway surface by pendant cable support discs. Space the disks 6 to 10 feet apart to support the bottom of the pendant/hook cable is a minimum of 2 inches above the runway surface to facilitate positive engagement by the aircraft tail hook. Avoid placing a support disc on the centerline of the landing zone. Should pendant cable tend to sag due to extreme runway crown, spacing distance may be slightly reduced to maintain 2-inch clearance. If effective pendant cable height is less than 1.5 inches, schedule corrective action as soon as possible.

4.2.11.5. Two hundred feet of pavement on both the approach and departure sides of the pendant/cable are deemed as critical areas. The maximum permissible longitudinal surface deviation in this area is ±0.125 inches within a length of 12 feet. Saw-cut grooves in runway pavement designed to improve surface drainage and surface friction characteristics using Unified Facilities Criteria (UFC) 3-260-02, *Pavement Design for Airfields*, are not considered protruding objects or undulations. Changes in pavement type or an interface between rigid and flexible pavements are not permitted within the center 75-foot of the MOS in critical areas of pavement. The prohibition on changes in surface pavement type is not applicable to emergency aircraft arresting systems located in overruns. Protruding objects and undulating surfaces are detrimental to successful tail-hook engagement and are not allowable.

4.3. MAAS-Only Installation. Follow T.O. 35E8-2-10-1 procedures for MAAS-only installation configurations.

4.4 After combat or emergency conditions have ended. All installation requirements and inspections should be completed following the procedures prescribed in T.O. 35E8-2-5-1 and T.O. 35E8-2-10-1 including synchronization, proof load, and certification engagement.

TOM D. MILLER
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Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

AFI 10-209, *RED HORSE Program*, 11 June 2019

AFI 10-210, *Prime Base Engineer Emergency Force (BEEF) Program*, 25 October 2023

AFI 33-322, *Records Management and Information Governance Program*, 23 March 2020

AFI 48-127, *Occupational Noise and Hearing Conservation Program*, 26 February 2016

AFMAN 91-203, *Air Force Consolidated Occupational Safety Standard*, 10 December 2018

AFPAM 10-219, Volume 4, *Airfield Damage Repair Operations*, 28 May 2008

AFTTP 3-32.12, *Minimum Airfield Operating Surface Selection and Repair Quality Criteria,* 28 March 2016

T.O. 35E8-2-3-1, *Operations Manual for the Mobile Runway Edge Sheave,* 1 July 2012

T.O. 35E8-2-5-1, *Aircraft Arresting Systems, Model BAK-12/E32A,* 29 March 2021

T.O. 35E8-2-10-1, *Mobile Aircraft Arresting Systems*, 24 July 2022

FC 3-260-18F, *Air Force Aircraft Arresting Systems (AAS) Installation, Operation, and Maintenance (IO&M)*, 28 October 2015

UFC 3-260-02, *Pavement Design for Airfields*, 30 June 2001

Prescribed Forms

None

Adopted Forms

DAF Form 847, *Recommendation for Change of Publication*

Abbreviations and Acronyms
AAS—Aircraft Arresting System
AFI—Air Force Instruction
CBR—California Bearing Ratio
FC—Facilities Criteria
HPU—Hydraulic Power Unit
MAAS—Mobile Aircraft Arresting System
MAOS—Minimum Airfield Operating Surface
MOS—Minimum Operating Strip
MRES—Mobile Runway Edge Sheave
RADR—Rapid Airfield Damage Recovery
T.O.—Technical Order
UFC—Unified Facilities Criteria

Office Symbols
AF/A4C—Director of Civil Engineers
AFMRA/SG3PB—Air Force Medical Readiness Agency, Bioenvironmental Engineering

Terms
Aircraft Arresting System (AAS)—A series of components used to engage and absorb the forward momentum of a routine or emergency landing or an aborted takeoff.

Bidirectional arresting gear—An arresting system that can support aircraft operations in both directions.

Cable harmonics—The resulting cable rebound and flex when an aircraft's landing gear impacts the hook cable.

California Bearing Ratio (CBR)—A test for estimating the bearing value of subbases and sub-grades.

Energy absorber—The component of the arresting system that dissipates the kinetic energy of the arrested aircraft.

Lightweight Fairlead Beam—A configuration set designed to enhance the capabilities of the MAAS by presenting a significantly decreased arresting gear profile at the edge of the runway, thus reducing potential hazards to incoming and outgoing aircraft.

Mobile Aircraft Arresting System (MAAS)—A self-contained, trailer mounted BAK-12 aircraft arresting system that accommodates rapid installation during contingencies.

Mobile Arresting Gear System—Any installation combining the MRES system and any aircraft arresting gear.

Mobile Runway Edge Sheave (MRES)—A system on mobile trailers that provides a low-profile runway edge sheave. The system allows the aircraft arresting gear to be set back from the runway, removing the equipment from the edges of the runway or overrun.

Overrun—An area beyond the take-off runway designated by the airport authorities as able to support an airplane during an aborted take-off. The FAA/ICAO term for this is “stopway.” UFC 3-260-01 identifies this area as one that prevents serious damage to aircraft that overrun or undershoot the runway.

Pendant—The part of an aircraft arresting system that spans the runway surface of flight deck landing area and is engaged by the aircraft arresting hook.

Setback distance—The total distance from the MOS centerline to the exit point of the MAAS edge sheaves.

Stopway—An area beyond the take-off runway designated by the airport authorities as able to support an airplane during an aborted take-off. The USAF term for this is “overrun.”

Tape stack height—The height of the fully rewound stacked tape on the tape reel, as measured from the outer wrap to the outer diameter of the reel plate.

Unidirectional—An arresting system that can support aircraft operations in one direction.

Attachment 2

TAPE SWEEP ZONES

A2.1. Minimum tape sweep area is determined by sighting a straight line from the position of the runway edge sheave to a point of maximum tape payout (990- or 1200-ft) down the centerline in direction of arrestment. Remove lights and cable within this area on both sides of the runway. Repeat process in opposite direction for a bidirectional installation. **Table A2.1** shows approximate light free zone distances for a 990-ft tape payout, with 90/153-ft pendant cables, and edge lights offset at 0, 5, and 10 ft.

Table A2.1. Light Free Zone Distances.

MOS WIDTH **(Feet)**	***PENDANT CABLE LENGTH*** **(Feet)**	***EDGE LIGHT OFFSET***		
		0-FEET	**5-FEET**	**10-FEET**
50	90	550*	450*	350*
50	153	700	650	600
90	90	150	50	0
90	153	450	400	350
150	153	50	0	0
* Distance from AAS to far edge of tape sweep area (in feet). Round up to nearest 50-ft; interpolate this data for other conditions.				

Attachment 3

PRE-ATTACK CHECKLIST

Table A3.1. Pre-Attack Checklist.

Pre-Attack Actions Checklist for Mobile Arresting Gear System Setback Installa-	
All airfields:	
___ 1.	Obtain/conduct runway profile to determine suitable installation sites: ___ a. Longitudinal and transverse slopes ___ b. CBR readings along runway shoulders ___ c. Determine asphalt thickness on runway & shoulders
___ 2.	Adjust turnbuckles to their appropriate lengths: ___ a. MAAS: 39 inches ___ b. MRES: 30 inches (if setback is required)
___ 3.	Accomplish all required maintenance and inspections (including synchronization and hydraulic system proof test)
___ 4.	Ensure correct cam and cam sprocket is installed as indicated in T.O. 35E8-2-5-1 according to system configuration.
___	Stretch tapes if new tapes are installed and not previously stretched.
___	Inspect installation tools and hardware.
___	Inspect purchase tape and measure stack height.
___	Inspect tape connector, reeving and cover or casing integrity
___	Inspect/operate rewind and HPU engines
Airfields Supporting Fighters Only:	
___	Ensure runway profile extends at least 25 feet from the runway's edges.
___ 2.	Prepare tapes for pendant installation. ___ a. Pull approx. 15 to 20 ft of tape to facilitate pendant attachment
Airfields Supporting Fighters and Transport/Cargo Aircraft:	
___ 1.	Ensure runway profile extends at least 275 feet from both sides of runway's centerline.

___ 2.	Determine which of the two MRES manta-ray anchors is required. ___ a. Hard soil w/CBR over 25 (PN 9D00204-1: small anchors). ___ b. Medium soil w/CBR 25 or less (PN 9D00204-2: medium anchors). ___ c. Soft soil that does not support a 10K-lb proof load of medium anchors (P/N 9D00204-3: large anchors).
___ 3.	Reconfigure one MRES trailer when runway surface is **concrete**: ___ a. Remove soil installation tools and hardware. ___ b. Install concrete installation brackets. **Note:** If both assemblies are to be installed on concrete and sufficient notice is provided after attack, perform these actions on both trailers.
___	Reconfigure anchor weldments to installation position.
___ 5.	Remove bushings from stake pockets on both MAAS trailers and properly store them.
___ 6.	Prepare tapes for reeving through MRES: ___ a. Pull tapes to reach 10 ft beyond distance between MAAS exit sheave and MRES exit sheave (at least 285 feet) ___ b. Remove both tape connectors if already installed. ___ c. Roll tape pulled from reels and secure on MAAS trailers.
___ 7.	Obtain small, stranded wire rope, or equivalent, at least 120 foot long and place in MRES storage compartment (used for siting component locations).
___	Adjust load-locker pressure relief valve to 10,500 PSI.

Attachment 4

INSTALLATION CHECKLIST

Table A4.1. Installation Checklist.

Mobile Arresting Gear System Setback Installation Checklist	
Site Requirements, Mark Installation locations, & Position Components:	
___ 1.	Ensure installation location meets component siting requirements: ___ a. Area provides sufficient installation clear zone for MRES and MAAS trailers. ___ b. Slope of MRES assembly location (0% to -3% above runway surface) ___ c. Runway edge clearance (tape is at least of equal height with edge of runway) ___ d. Slope between MRES rear roller assembly and MAAS (0% to -8%)
___ 2.	Mark installation locations for component positioning: ___ a. Centerline - Point A ___ b. MRES - Point B ___ c. MRES - Point C ___ d. MAAS - Point B1 ___ e. MAAS - Point C1
___ 3.	Position components: ___ a. MRES Point B ___ b. MAAS Point B1 ___ c. MRES Point C ___ d. MAAS Point C1
Ensure appropriate PPE is worn while installing components	
MAAS Setback Installation	
___ 1.	Chock one rear wheel, apply parking brake and lower trailers with exit sheaves aligned on marks B1 and C1.
___	Install trailer adapter fitting to trailer.
Concrete Installation	

___ 3a.	Ensure turnbuckles lengths are adjusted to 39 inches and attach locknut end of 2 turnbuckles to outer holes of turnbuckle fitting
___ 4a.	Attach an anchor plate to end of each turnbuckle and position for anchoring.
___ 5a.	Drill 12 holes and secure anchor plates to concrete with 12 anchor bolts.
___ 6a.	Tighten turnbuckles to remove slack, but do not overtighten causing the trailer to move.
___	Tighten locknuts on turnbuckles.
Soil Installation	
___	Install 10 trailer body stakes.
___	Install a triple turnbuckle fitting onto trailer adapter fitting.
___ 5b.	Ensure turnbuckle lengths are adjusted to 39 inches and attach locknut ends to triple turnbuckle fittings.
___ 6b.	Attach to triplet turnbuckle fitting and install setback KM anchoring system.
MRES Installation:	
___	Remove tools and hardware from MRES storage compartment.
___ 2.	Remove anchor weldments from transport position and install in installation position if not done during pre-attack actions.
___ 3.	*CONCRETE INSTALLATION ONLY*: Install the 2 installation brackets onto opposite sides of the MRES trailer if not done during pre-attack actions.
___ 4.	Disconnect brake quick-disconnect plug and electrical cable from MRES trailer.
___	Lower MRES assembly to the ground with ratchets and tow-bar jack.
___	Remove towbar from MRES assembly.
___	Remove wheel and tire assemblies and set aside.
___	Reeve tape through MRES assemblies.
___	Install tape connectors.
___	Install pendant cable assembly.
___	Perform preliminary alignment.

___	Install MRES alignment anchors.
___ 13.	Perform pull-out alignment, when complete tighten turnbuckles enough to hold MRES assembly in place while installing anchors.
___ 14.	*CONCRETE INSTALLATION ONLY*: Install 14 anchor bolts per assembly.
___ 15.	*SOIL INSTALLATION ONLY*: ___ a. Initially, only drive an anchor stake in each corner, 4 stakes per assembly. ___ b. Install 6 appropriately sized manta-ray anchors. ___ c. Load test manta-ray anchors
___ 16.	If all manta-ray anchors pass load tests, connect chains to MRES assembly and tighten.
___	Drive remaining 28 body stakes per MRES assembly.
___	Remove alignment hardware and properly store.
___	Repair alignment anchor holes in concrete.
Preparation for Use:	
___ 1.	Store MRES wheels flat on ground under cover support tube weldments in rear corner of MRES assemblies.
___ 2.	Place storage bag over each MRES assembly brake drum and hub assembly for protection.
___ 3.	Lower take-up assemblies to allow covers to close without contacting brake drums.
___	Lower covers.
___	Perform rewind operations to pretension tapes.
___	Properly store all unused tools, installation equipment, and hardware.
___ 8.	Perform proof loading unless under emergency conditions. Otherwise, complete afterwards.
___ 9.	Perform initial installation synchronization if not in emergency conditions. Otherwise, complete afterwards.

___ 10.	Perform tape stack measurement. **WARNING:** Tape stack height dimension is a function of tape length (allowable aircraft runout) and tape reel diameter. Following the installation of the MAAS and the MRES, the tape edge distance must not exceed the limits given in T.O. 35E8-2-5-1. Failure to adhere to these limits will result in reduced allowable runout and may result in aircraft damage, serious injury or loss of life.
___ 11.	Aircraft certification. Initial aircraft certification is not mandatory under combat or emergency conditions. Certification engagement is required if system remains installed after the emergency.