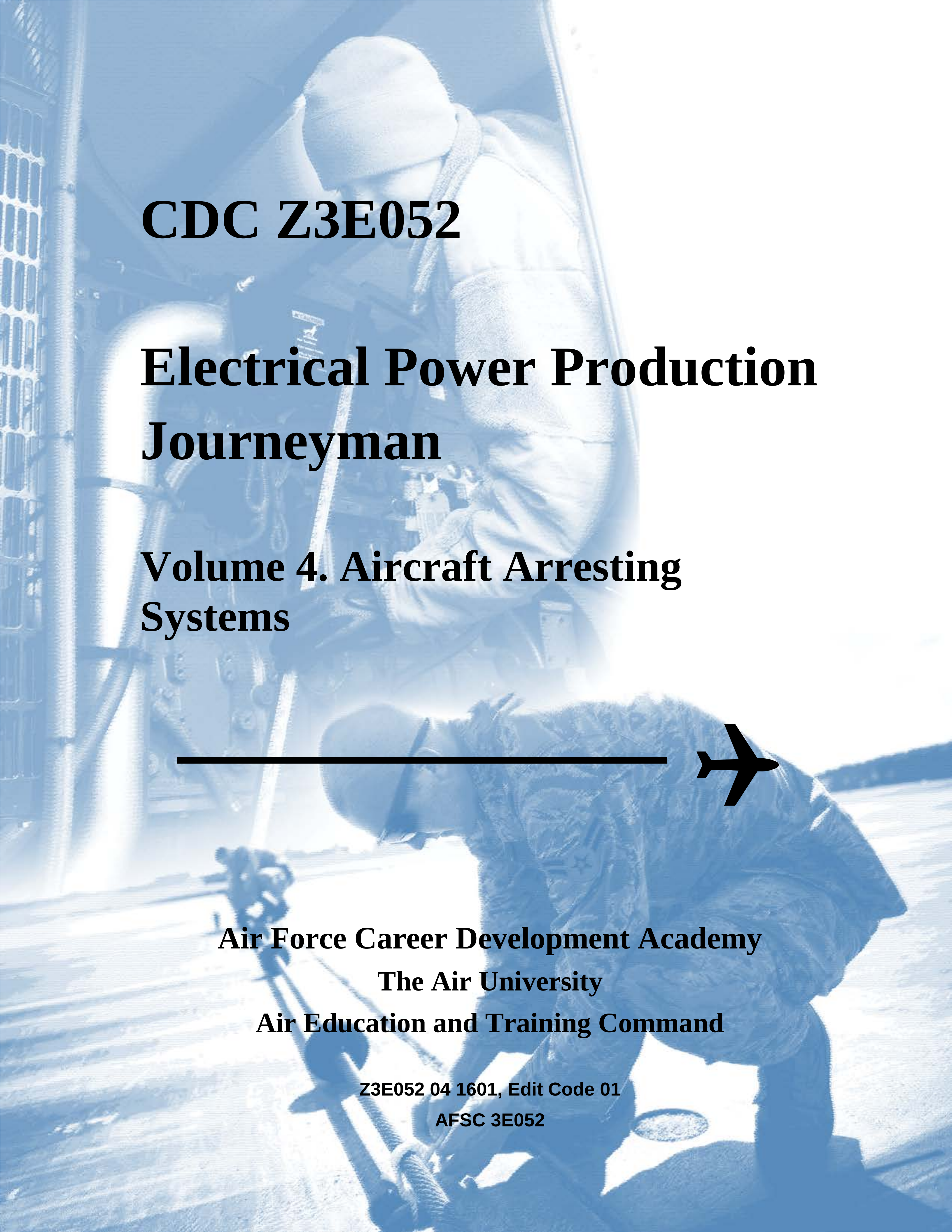

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Electrical Power Production Journeyman

Volume 4. Aircraft Arresting Systems

Air Force Career Development Academy

The Air University

Air Education and Training Command

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Material in this volume is reviewed annually for technical accuracy, adequacy, and currency. For SKT purposes the examinee should check the *Weighted Airman Promotion System Catalog* to determine the correct references to study.

THIS FORTH VOLUME of CDC 3E052, *Electrical Power Production Journeyman*, introduces you to Aircraft Arresting Systems.

Unit 1 covers the MA–1A, BAK–14 support systems and the aircraft arresting system setback kits.

Unit 2 covers the BAK–12, the mobile aircraft arresting system (MAAS) and it closes out with the inspections, maintenance, and troubleshooting.

As an electrical power production journeyman, you have stepped into one of the most important career fields in the Air Force and we depend on you to uphold the long standing excellence that has come before you.

A glossary is included for your use.

Code numbers on figures are for preparing agency identification only.

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This volume is valued at 15 hours and 5 points.

NOTE:
In this volume, the subject matter is divided into self-contained units. A unit menu begins each unit, identifying the lesson headings and numbers. After reading the unit menu page and unit introduction, study the section, answer the self-test questions, and compare your answers with those given at the end of the unit. Then complete the unit review exercises.

Page

Unit 1. Emergency and Support Systems

IN AN EMERGENCY, an aircraft arresting system safely stops an aircraft from overrunning the runway and injuring the pilots. In the Air Force, an aircraft arresting system most commonly stops aircraft with brake failure and other emergency conditions. An arresting system is designed to use the energy of friction to apply predictable deceleration forces on the aircraft structure to safely stop the aircraft and minimize the potential for structural damage.

Aircraft arresting systems consist of engaging devices, energy absorbers, and rewind systems. Engaging devices are net barriers, disc supported pendants (hook cables), and cable support systems that allow the pendant to be raised to the battery position or retracted below the runway surface. Energy absorbing devices are ships' anchor chains and rotary friction brakes, such as the BAK–12. The systems designated as a Barrier Arresting Kit (BAK) use a numbering sequence based on when the Air Force began using the system design. There is no connection between the Air Force designations of these systems and their function.

In addition there are setback kits to move arresting systems away from the edge of the runway. The Lightweight fairlead beam and the mobile runway edge sheave allow for this function. These sits are generally used when installing a mobile aircraft arresting system which is a mobile operational system.

The information in this volume should not replace the technical orders published for the various arresting systems. However, the information presented should give you enough detail so that you can understand the basic principles of arresting systems. Your supplemental study should include the applicable technical orders associated with the particular arresting system. You will find aircraft arresting systems listed in 35E8–2 series technical orders.

In this unit you will learn some general characteristics of the arresting mechanisms we classify as *emergency* aircraft arresting systems. *Operational* aircraft arresting systems will be discussed in the next unit.

1–1. Emergency Aircraft Arresting Systems

Though the airfield manager and pilots consider all aircraft arresting systems emergency systems, we define emergency systems more narrowly. An emergency system, based on our view, is a system that stops an aircraft and then requires an extended amount of time before it is ready for the next aircraft. An emergency system can also require extensive time on the runway to remove all of the system components and material. We will look at the MA–1A, E–5, BAK–15, and textile brake systems.

601. MA–1A and E–5 aircraft arresting system

Manufacturers usually design an aircraft arresting system to arrest a specific type of aircraft. Some systems can arrest only aircraft equipped with hooks; others arrest those not equipped with hooks. Some arresting systems may arrest both types of aircraft. The MA–1A arresting system can arrest both types of aircraft, while the E–5 arresting system, a modification of the MA–1A, can arrest only aircraft equipped with tail hooks.

Components and operating principles of the MA–1A

The MA–1A is the simplest type of arresting system (barrier) used in the Air Force. This system is compatible with jet fighter and trainer aircraft. It is not compatible with propeller-driven aircraft, jet bombers, and cargo aircraft. Since the energy absorber for this barrier is a chain, we commonly refer to it as a chain-arresting barrier. To help you better understand the MA–1A; refer to figure 1–1 throughout this discussion. The illustration will help you understand the information presented in the text.

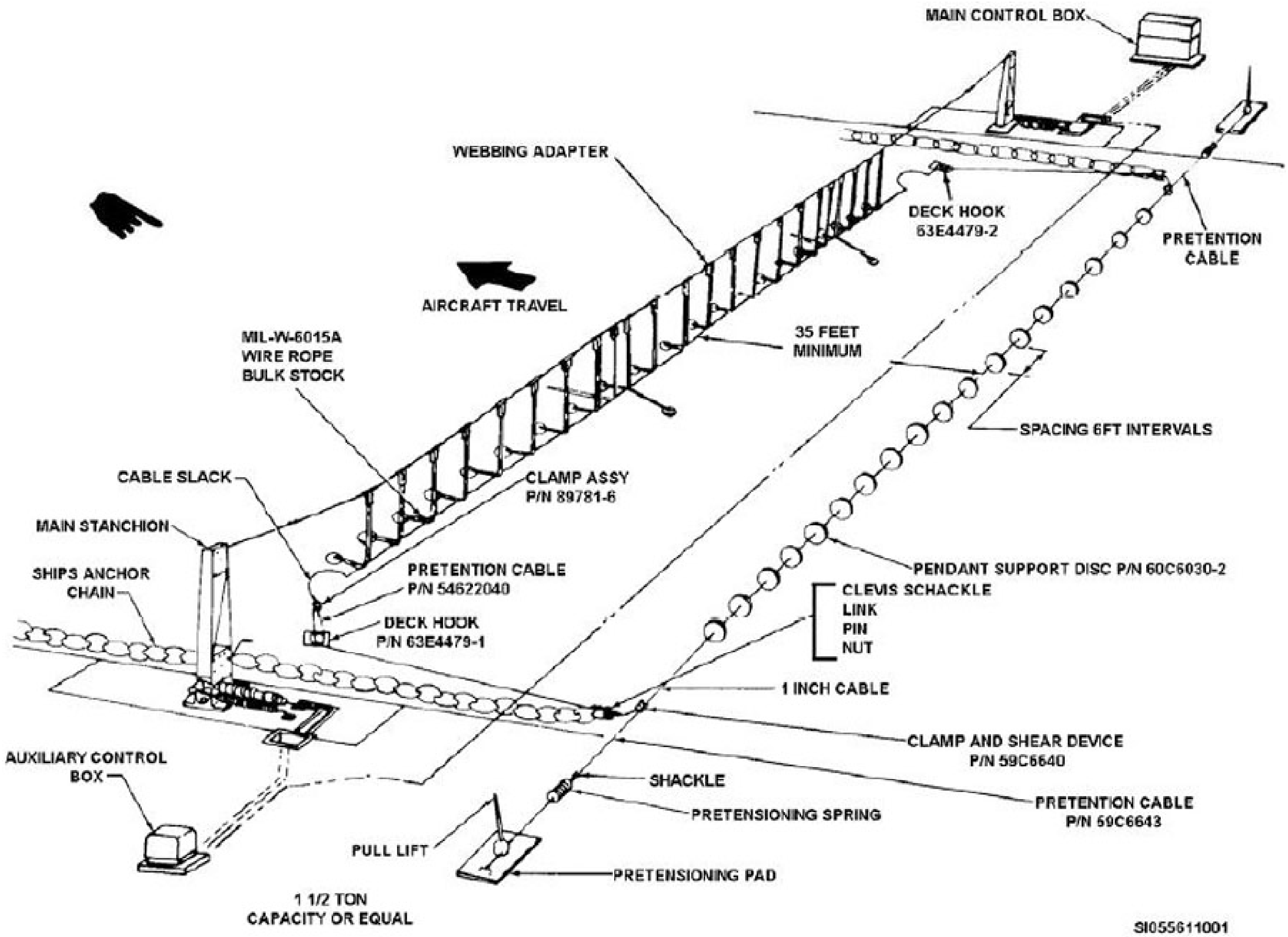


Figure 1–1. MA–1A barrier.

System components

The MA–1A barrier consists of two steel stanchions that support the webbing assembly spanning the runway, intermediate stanchions for the webbing assembly and arresting cable, as well as two arresting chains. The following paragraphs discuss some of the most important components of a chain-type aircraft-arresting barrier.

If needed, we can install the MA–1A barrier with component variations at different bases. To eliminate confusion, you will learn about components associated with the most common type of installation.

Webbing assembly

The webbing assembly, which stretches across the runway to contact the aircraft, contains two horizontal actuator straps with a number of vertical lifter straps attached, shown in figure 1–2. Each lifter strap is rigged to the arresting cable by special fasteners. An extension of the vertical lifter strap attaches to an anchor plate embedded in the runway.

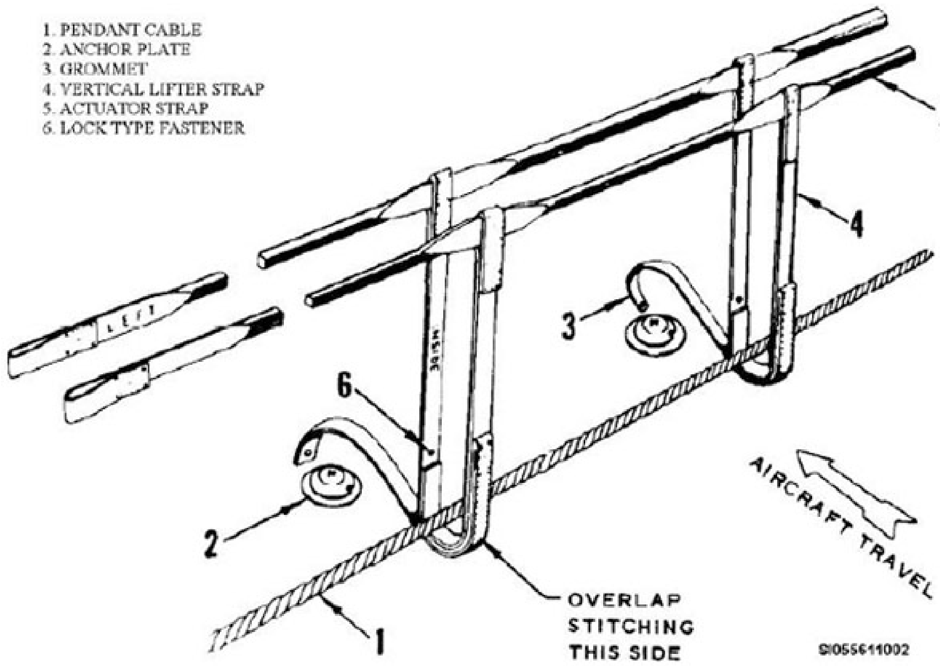


Figure 1–2. Webbing assembly.

Deck hooks

Deck hooks on each end of the webbing assembly arresting cable provide a certain amount of slack for the cable. The hooks lie flat on the overrun surface, fastened with anchor bolts. The hook's purpose is to release the pendant at the appropriate time during an arrestment.

Arresting chains

The energy absorber for the MA–1A barrier consists of two ship's anchor chains, with each link in the chain weighing 45 to 55 pounds per foot. The chain lays out on each edge of the runway in the direction of aircraft arrestment. It consists of a single chain for the first 90 feet. The remaining chain (approximately 360 feet) is doubled, with two rows lying next to each other. The barrier's design allows for a 1,000-foot runout. If necessary, an additional chain weighing no more than 500 lbs. per foot may be added to increase absorber energy. Always refer to the specific technical order for details on the amount of chain to use.

Main stanchions

The main stanchions, mounted at the edge of the runway, support the webbing assembly. Each stanchion incorporates a hand-operated winch for positioning and tensioning the webbing. The stanchions also pivot at their bases and are equipped with pneumatic cylinders and springs. The cylinders raise the stanchions to the operating position. The springs tend to dampen the stanchion motion after the aircraft engages the barrier.

Intermediate stanchions

Intermediate stanchions are a tubular design and support the webbing assembly at the center of the runway. Intermediate stanchions disassemble upon impact. For this reason, we replace them frequently.

Main control box

The main control box, shown in figure 1–3, contains most of the automatic controls and some of the equipment for the barrier. Some control box equipment can include air compressors, air accumulators, power units, storage batteries, valves, relays, circuit breakers, switches, and associated components.

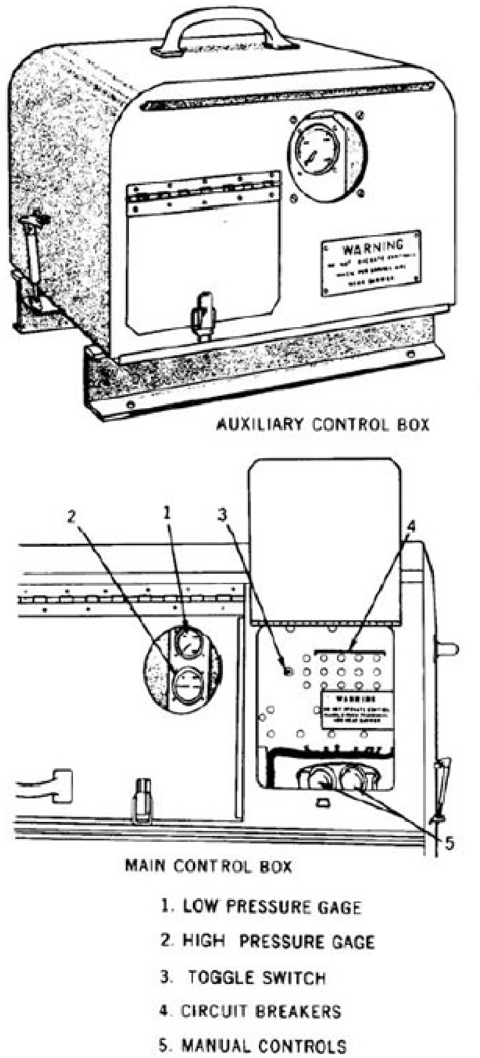


Figure 1–3. Main and auxiliary control boxes.

Auxiliary control box

The auxiliary control box (fig. 1–3), located on the opposite side of the runway from the main control box, contains additional components: valves, one air accumulator, four-way solenoid valve, pressure gauge, and a high pressure accumulator.

Electrical system

The control box normally uses alternating current (AC) from the base power supply. The AC power also charges the emergency backup batteries. Power from the batteries operates the air compressors. If the AC power fails, the batteries can operate the system for several hours.

Compressed air system

The compressed air system includes two high-pressure air compressors. Each compressor has its own accumulators, valves, gauges, switches, relays, and related air pressure-regulating valves and components to maintain the system. The system is entirely automatic and requires no attendance by the operator. The air compressor system components are located in the control boxes.

Pendant assembly

When necessary to arrest aircraft equipped with a tail hook, an additional pendant—connected to the chains and supported by rubber discs—stretches across the runway (refer back to figure 1–1). The pendant is usually 1 inch in diameter, with each end attached to a pre-tensioning pad through pre-tensioning cables, springs, and a pull lift. The pull lift is operated manually and is used to pre-tension the cable; the springs allow the cable to yield as the aircraft runs over it.

Operation

As seen in figure 1–1 above, a nylon webbing assembly stretches across the runway. When an aircraft nose wheel engages the webbing, the action triggers a steel cable to engage the main landing gear struts on the aircraft. Once the main gear engages the cable, the cable pulls out two heavy anchor chains resting in place parallel to the runway, thus absorbing the kinetic energy of the aircraft. The drag force applied to the main landing gear struts (due to the dragging chains) reduces the speed and finally stops the aircraft. An additional cable stretched across the runway in advance of the webbing assembly uses rubber support discs to hold the cable above the runway. This cable also connects to the anchor chains. This cable can engage the arresting hook of the aircraft, but only if the aircraft is equipped with a hook.

System safety for the MA–1A

There are many hazardous conditions associated with operating and maintaining aircraft arresting barriers. The MA–1A barrier has a high and low air pressure system.

> **WARNING:** For safety reasons, never stand near the main stanchions when they are operating. They operate pneumatically in the UP and DOWN position and can deliver a fatal blow.

Be very careful when you are servicing the air compressor. The air pressure developed and stored in the accumulators is approximately 1,500 pounds per square inch (psi).

> **WARNING:** Due to high pressure, never stand within 25 feet of the main stanchions when an aircraft engages the barrier. The actuator pendant can whip around when the shear pin releases with sufficient force to cause a fatal injury.

Always be familiar with the system’s operation before doing maintenance.

Components and operating principles of the E–5

The E–5 aircraft arresting system is a modification of the MA–1A. The E–5 is an MA–1A without the net. It is capable of engaging only aircraft with a tail hook. The E–5 is a unidirectional barrier, typically installed on the runway’s overrun.

This system consists of anchor chains, a pendant, support disks, pre-tensioning pad, cables, springs and a pull lift. The pendant can connect to the anchor chain with two different configurations. Figure 1–4 shows connection without a cable connection and figure 1–5 shows with a cable connector. The pendant also connects to the pre-tensioning cables using connectors and shear pins. One end of the pre-tensioning cable attaches to an anchor cemented into the runway edge. The other end of the pre-tensioning cable has a spring connected to the pull lift. The spring absorbs shock loads in the system. The pull lift tensions the pendant until the spring reaches a measurement of 21 inches. On the pendant, the space the support disks are at six foot intervals. The system is then ready for an engagement.

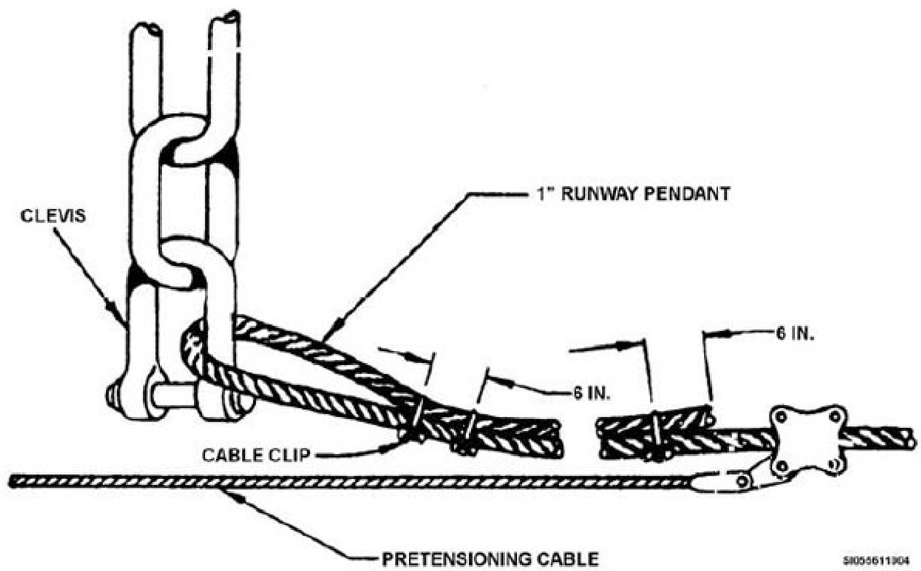


Figure 1–4. Pendant connection *without* cable connector.

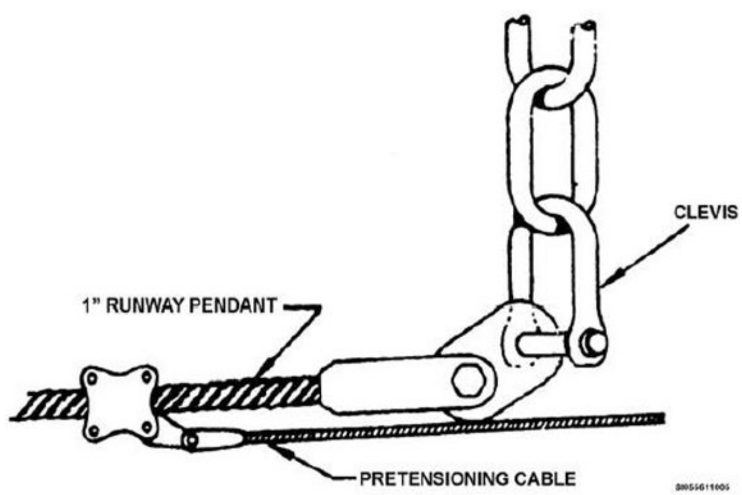


Figure 1–5. Pendant connection *with* cable connector.

The first thing to happen when an aircraft engages the pendant is that tension on the pendant increases rapidly, breaking the shear pins. After the aircraft hooks the pendant, the pendant follows the aircraft down the overrun, pulling the beginning of the anchor chain with it.

There are many E–5 aircraft arresting systems. The newer BAK–15 has made the MA–1A obsolete. The Air Force uses the E–5, on the other hand, because of its relatively low maintenance requirements and minimal repair costs.

602. BAK–15 aircraft arresting system

The basic objective of the arresting system is to remove the kinetic energy of the moving aircraft and halt its forward motion in a controlled manner to save the pilot and crew. To accomplish this objective, the arresting system must engage the aircraft, control and distribute the forces during the arrestment, and stop the aircraft within the available runout distance. The BAK–15 is a web barrier arresting system designed for wing engagements. The barrier is erected between stanchions attached to an energy absorption system such as a rotary friction or chain. The energy absorption unit will provide the braking power needed to stop the aircraft. This system also provides the means to lower the net to avoid obstruction and raise the net in about three seconds.

System components

Many components make up the BAK–15 aircraft arresting system, shown in figure 1–6. Components such as the net assembly, suspension system, mechanical system, raise/lower hydraulic system, accumulator recharge system, electrical system, and controls and indicators are all vital to the BAK–15 system.

Figure 1–6. BAK–15 aircraft arresting system.

Net assembly

The net has several sections that perform the engaging action. The parts of the net assembly are the elementary net, shock absorbers, and test strap assembly.

Elementary net

The net assembly, shown in figure 1–7, consists of 15 superimposed dual elementary nets (nets that are laid or placed on each other). Each elementary net consists of a single upper horizontal strap and two independent lower horizontal straps, shown in figure 1–8. Uniformly spaced vertical straps connect the horizontal straps to one another. Each vertical strap connects to one of the lower horizontal straps. The spacing of the verticals is staggered from net element to net element to assure the maximum number of verticals engage the aircraft during the arrestment.

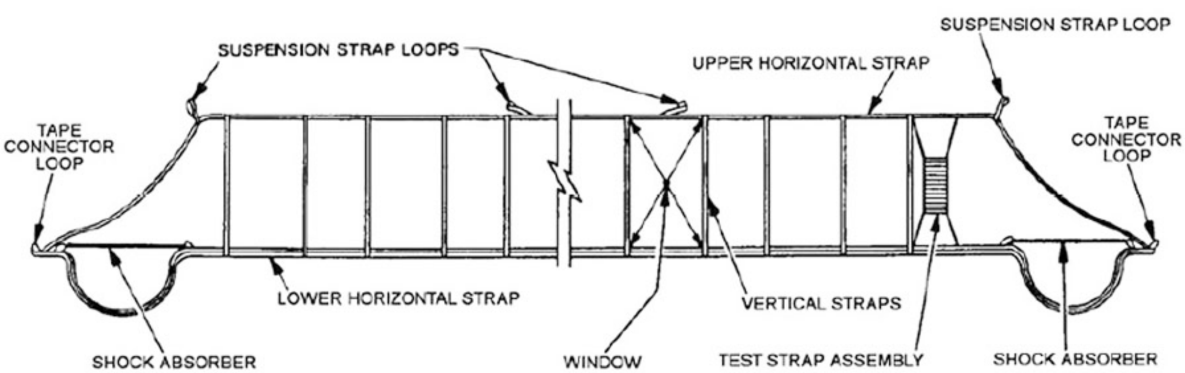


Figure 1–7. BAK–15 net assembly.

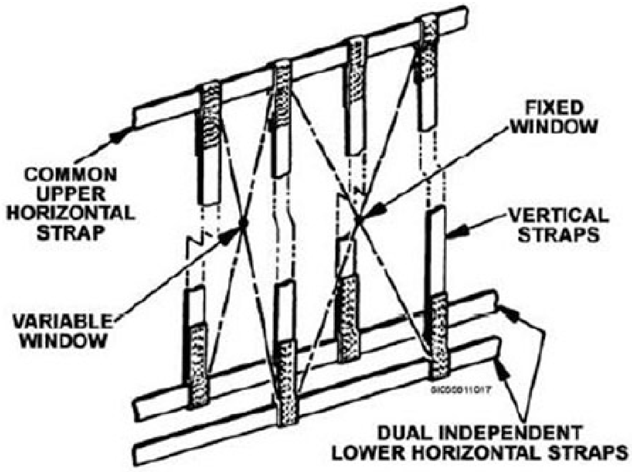


Figure 1–8. Section of one element (net assembly).

The upper horizontal strap of each net element is fitted with sewn loops for attaching the net to the suspension system. These loops are located at the side of each net element and along the top of the net.

The lower horizontal straps of each net element are fitted with sewn loops to allow for connection of the net shock absorbers.

The 15 elementary nets form three groups of five elementary nets each, shown in figure 1–9. To help in setting up the net, we use a stenciled reference letter and number at each end of each horizontal strap to identify each of the elementary nets.

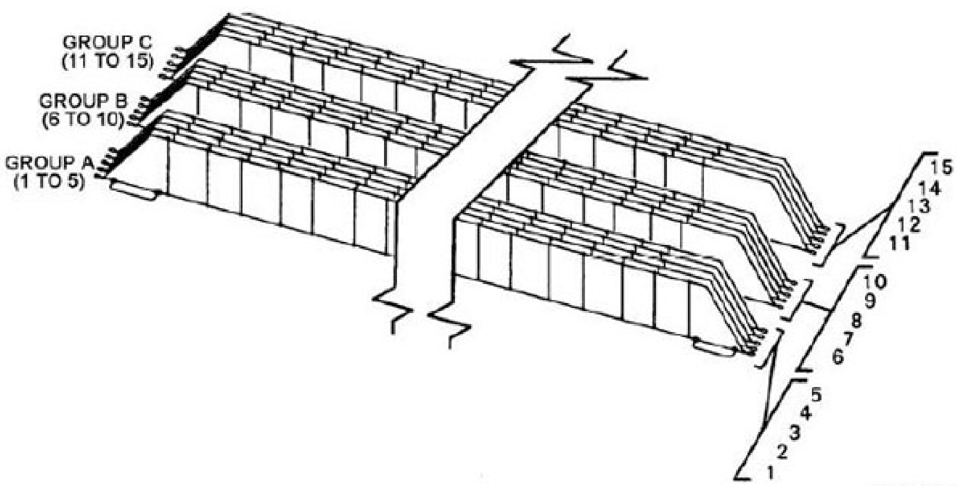


Figure 1–9. Net elements grouped.

At both ends of each elementary net, the upper horizontal strap connects with the two lower horizontal straps to form a loop. The loops of all the net elements in a group are bound together to form a single loop for each net group. The loop at the end of each net group connects the net group to the energy absorber.

Manufacturers assemble the three net groups (A, B, and C) to form a 15-element dual element net. A tack stitch sewn through the upper and lower horizontals of all of the net elements approximately every 9 feet maintains the integrity of the net and facilitates handling. During an arrestment, these tack stitches break, allowing each elementary net to act independently.

Shock absorbers

An elastic nylon shock absorber attaches to the three sewn loops at the lower edges of each net element using “quick-eye” splices, shown in figure 1–10. Protective covers wrap the shock absorbers to prevent runway abrasion and ultraviolet degradation. During an arrestment, the shock absorbers stretch, allowing the arrestment load to be equally distributed among the elementary nets.

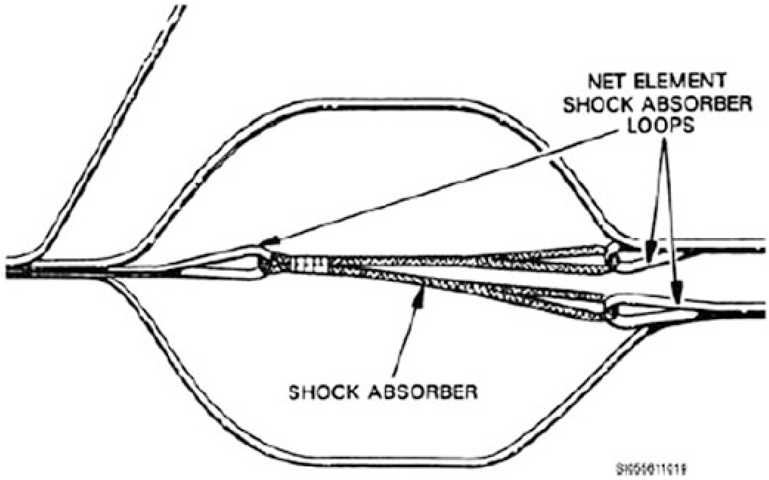


Figure 1–10. Shock absorber for one element.

Test strap assembly

A test strap assembly is located on the right side of the net element (as in fig. 1–11). We can remove individual test straps periodically and test them to determine the strength of the net.

Suspension system

The suspension system holds the net upright and centered on the runway in its arrestment position. Shown in figure 1–11, the suspension system consists of suspension straps, anchor straps, and anchor disks.

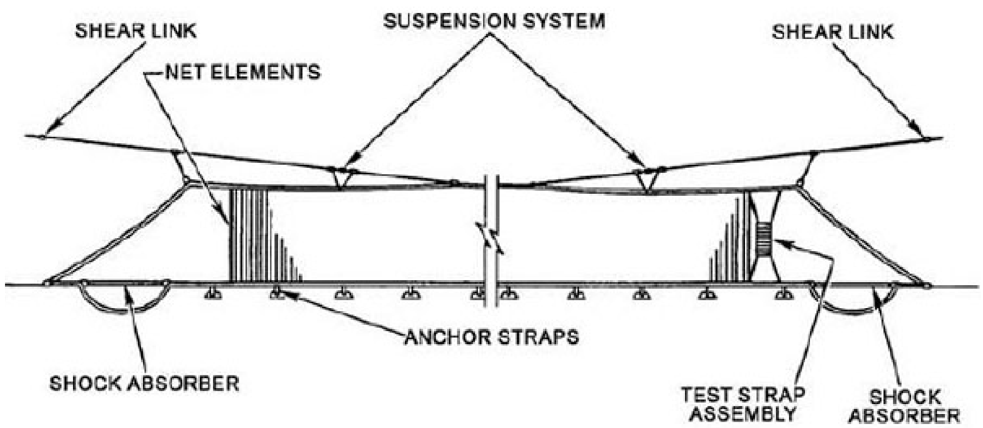


Figure 1–11. Suspension system.

Suspension straps

The suspension straps are arranged symmetrically to the centerline of the net assembly and are comprised of the following:

- Six inner suspension straps, one for each group (three on each side of the net), shown in figure 1–12.
- Two middle suspension straps (one on each side of the net assembly) designed to hold the outer portions of the net at the proper installation height, shown in figure 1–12.
- Two external suspension straps (one on each side of the net assembly), adjustable in length, designed to raise the net at its ends, shown in figure 1–13.
- Two net-to-stanchion connecting straps, shown in figure 1–13, which connect to the shear links (one on each side of the net). The straps connect to the three inner suspension straps at each side of net and provide length adjustment loops.

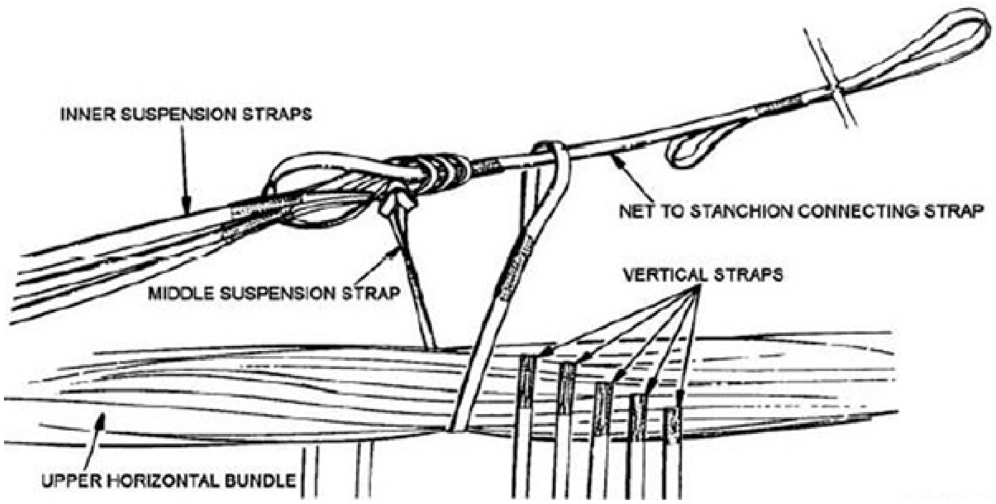


Figure 1–12. Suspension straps.

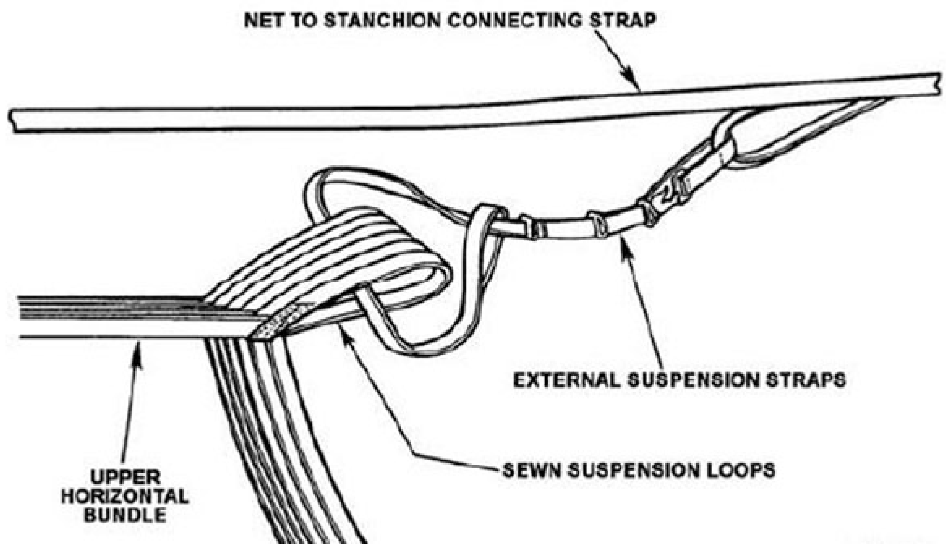


Figure 1–13. External suspension straps.

Anchor straps

The anchor straps are short (approximately 15 inches long), continuously sewn loops with a D-ring at one end, as shown in figure 1–14.The lower horizontal net straps tie to the anchor straps with anchor cord lacing. The D-ring of each anchor strap is inserted into an anchor disk and held with a pin. The anchor straps hold the bottom of the net in place on the runway. During an arrestment, the anchor cord lacing breaks, allowing the net to envelop the aircraft while the anchor straps remain attached to the anchor disks.

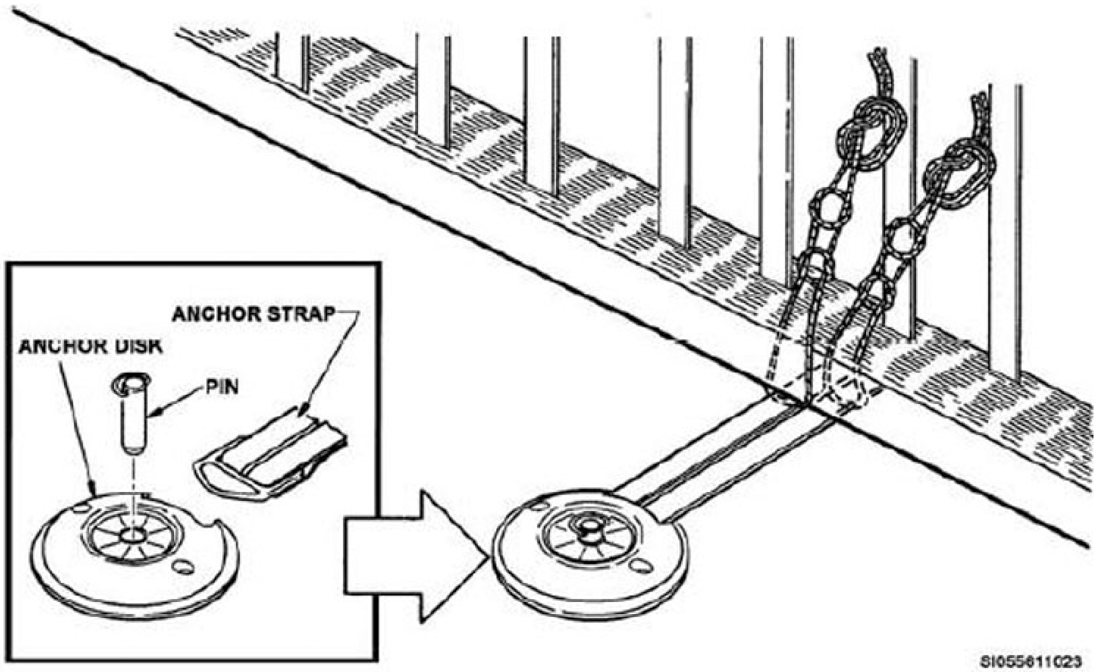


Figure 1–14. Net anchoring arrangement.

Anchor disks

The anchor disks (fig. 1–14) are small, flat devices that are fastened to the runway surface. The disks provide a mounting point for the anchor straps.

Mechanical system

The mechanical system consists of those components that act together to hold and tension the net for an arrestment. The mechanical system, shown in figure 1–15, consists of the mast assembly, masthead assembly, and the mast stabilizing components.

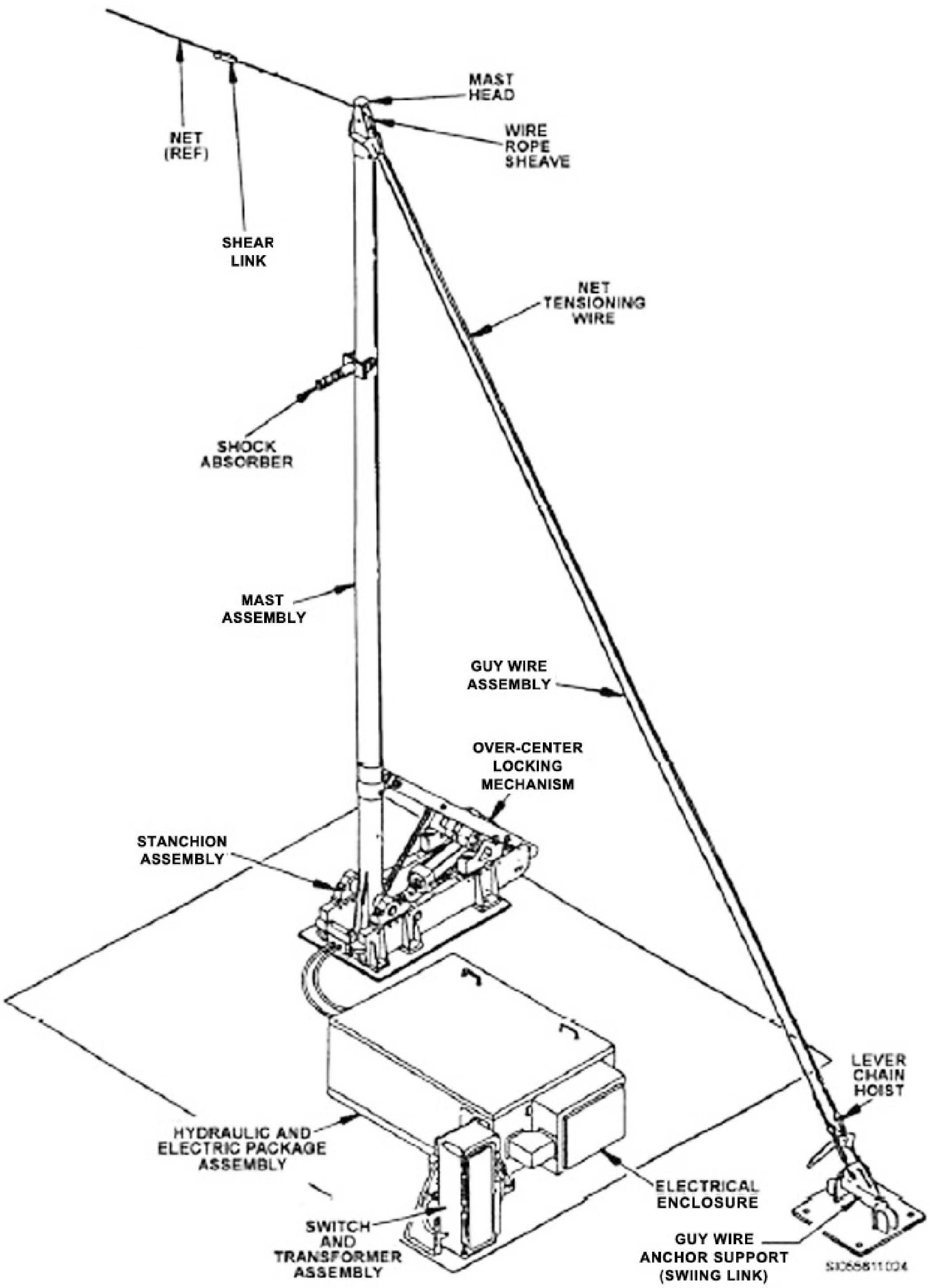


Figure 1–15. Mechanical system.

Mast assembly

The *mast assembly* is the 23-foot post that holds the net in position in order to perform the arrestment. The mast assembly consists of three fitted, steel tube sections, which bolt together and attach to the stanchion assembly. A masthead assembly is located at the top of the upper mast.

The *shock absorber* is a hydraulic tube and plunger assembly installed on the mast to absorb the impact when the mast assembly is in the lowered position on the runway.

Masthead assembly

The *masthead assembly* consists of the masthead, a net tensioning wire, a wire rope sheave to hold the net tensioning wire in place, and a lever chain hoist, which adjusts tension on the net tensioning wire. The masthead assembly also includes the shear link.

The *masthead*, located at the extreme top of the upper mast, provides an attaching point for the guy wire. The masthead contains the *wire rope sheave* for the net tensioning wire.

The *shear link* is a mechanical device designed to release the net upon impact by the engaging aircraft. One end of the shear link assembly connects to the net by a pinned spool yoke arrangement. The other end of the shear link assembly connects to the net tensioning wire. When an aircraft engages the net, the shear link breaks and release the net from the stanchions, thereby allowing the net to envelop the aircraft.

The *lever chain hoist* tightens and loosens the net tensioning wire, which in turn determines the height of the net.

Mast stabilizing components

The mast stabilizing components of the stanchion stabilize the mast assembly in the raised position. These components include the guy wire assembly, guy wire anchor support, and over-center locking mechanism.

A *guy wire assembly* attaches to a lug at the base of the masthead and to the swing link of the guy wire anchor support assembly. It provides structural rigidity to the mast assembly and engaging system. The guy wire is fitted with a turnbuckle to adjust guy wire tension.

The *guy wire anchor support* provides an anchoring point for the guy wire and net tensioning wire. The swing link allows the guy wire and net tensioning wire to rotate up or down as the stanchion rises or lowers.

When the stanchions are elevated, an *over-center locking arm mechanism* securely holds them in the upright position. As the mast reaches its upright position, the locking arms drop down into place, effectively locking the mast into position.

When the actuating cylinder activates to lower the mast, the unlocking hydraulic cylinder pushes the locking arm and moves it out of the over-center position. This allows the action of the actuating cylinder to lower the mast.

Both the hydraulic cylinders operate simultaneously. When the mast rises, the unlocking cylinder moves into its locked position, and the actuating cylinder raises the mast. When the mast lowers, the unlocking cylinder moves into its unlocked position, and the actuating cylinder lowers the mast.

Raise/lower hydraulic system

The raise/lower hydraulic system, shown in figure 1–16, contains all the components and hydraulic force required to raise or lower the stanchion. High-pressure hydraulic fluid provides the force required to perform the raise/lower operation.

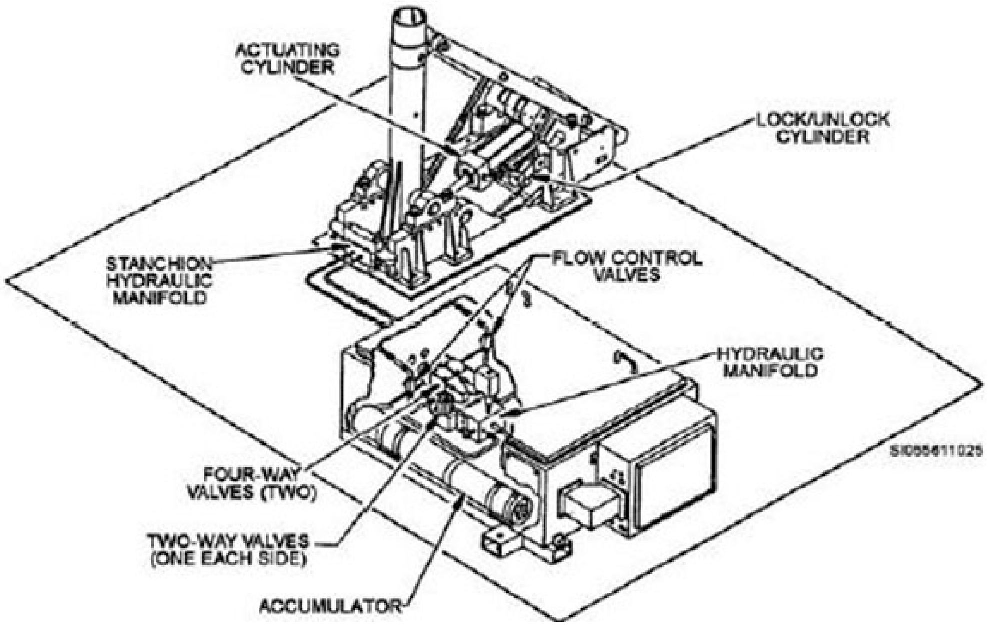


Figure 1–16. Raise/lower hydraulic system.

Hydraulic actuating cylinder

The stanchions raise and lower the mast by rotating the lower portion of the mast about a pivot point. A hydraulic cylinder connects to the lower mast section to provide the force needed to rotate the mast.

Flow control valves

The system is equipped with flow control valves, which control the UP and DOWN cycle times of the stanchion mast. These valves, located in the hydraulic and electric package assembly, regulate the rate of flow from the hydraulic actuating cylinder during UP and DOWN cycles.

Hydraulic manifold

A hydraulic manifold (mounted within the hydraulic and electric package assembly) directs hydraulic fluid at high pressure to operate the stanchion and provides a return path to the reservoir for the low-pressure fluid returning from the cylinders.

Accumulator

An accumulator is a pressure vessel which stores fluid. Typically, an accumulator contains a compressible gas, a separator (i.e., piston, bladder diaphragm, etc.), and an incompressible hydraulic fluid. The compressible gas behaves much like a spring that allows energy to be stored and dissipated, while the separator transfers these changes in energy and volume to the hydraulic fluid. On the BAK–15, the hydraulic accumulator is a two-chamber cylinder used to operate the hydraulic cylinders.

Accumulator recharge system

The accumulator recharge system recharges the hydraulic accumulator when system pressure falls below the preset value. The system consists of a hydraulic fluid reservoir, a fluid filter, an electrically driven hydraulic pump, an automatic relief valve, a dump (manually operated relief) valve, and a pressure switch, shown in figure 1–17.

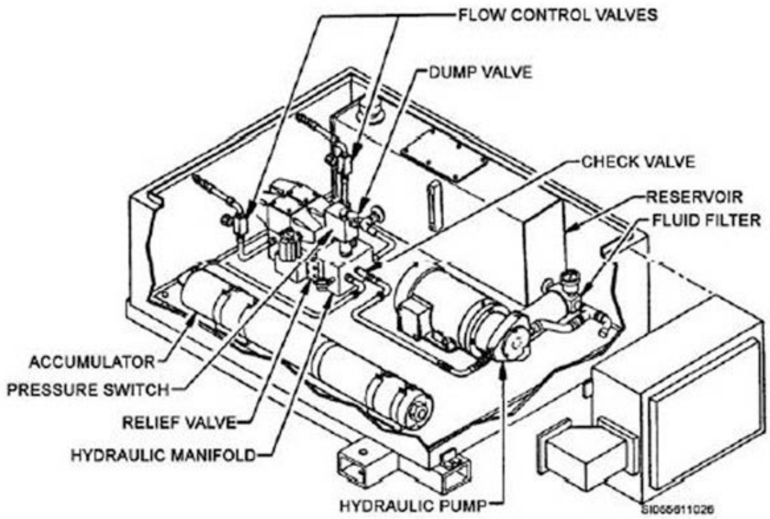


Figure 1–17. Accumulator recharge system.

Electrical system

The electrical system, shown in figure 1–18, contains all electrical components required to operate the stanchion system. The controls are located on a mounting plate within the near side electrical enclosure. These controls provide for arming and securing the system, deactivating the hydraulic pump, raising or lowering the stanchion, and enabling control of the system from a remote location.

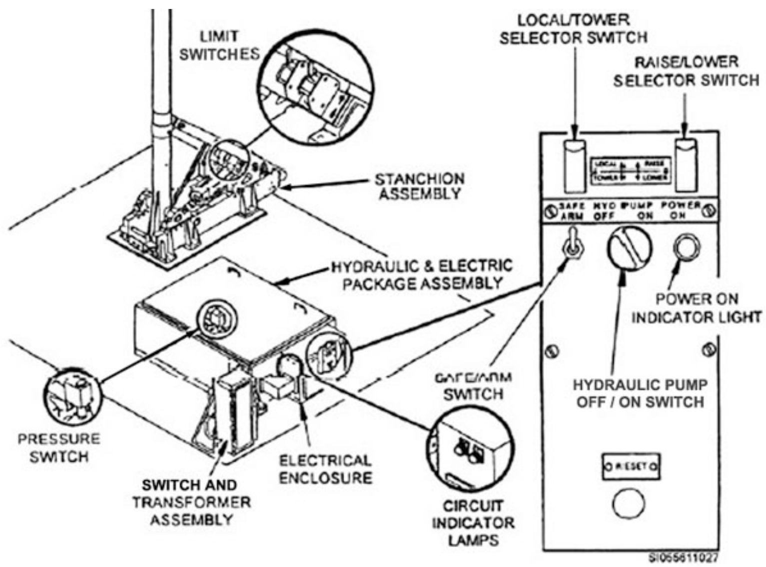


Figure 1–18. Electrical system.

Switch and transformer assembly

When components require servicing, we use an ON/OFF switch to interrupt incoming power.

Stanchion electrical enclosure

The near side enclosure is equipped with the switches and relays, which control both the near side and far side stanchion systems.

Limit switches

To prevent damage to the equipment, the stanchion system is fitted with limit switches in the fully raised and fully lowered positions. When the stanchion has completed its travel, either up or down, the appropriate limit switch interrupts the signals to the hydraulic system, and the system shuts down.

Up and down circuit indicators

The electrical circuits are fitted with circuit indicator lamps, located on the outside of the near side electrical enclosure.

Pressure switch

The accumulator recharge circuit is fitted with a pressure switch. When hydraulic system pressure in the accumulator circuit falls below the preset value, the switch activates the hydraulic pump circuit to recharge the accumulator to the proper pressure.

Controls and indicators

The BAK–15 arresting system is an important safety device for pilots and must be available for operation at a moment's notice. We can control the system from the tower, as shown in figures 1–19 and 1–20, or from the runway edge, shown in figure 1–21. Refer to the tables below when looking at figures 1–19 and 1–20.

The following tables describe one type of radio control system used with the BAK–15. We can also utilize other radio control systems with the BAK–15, such as systems that use touch screen technology.

Index No.	*Name*
1	System "ARMED" indicator light
2	"NET UP" indicator light
3	"RAISE/LOWER" toggle switch
4	"NET DOWN" indicator light
5	"CHARGED" indicator light
6	Press-to-test button

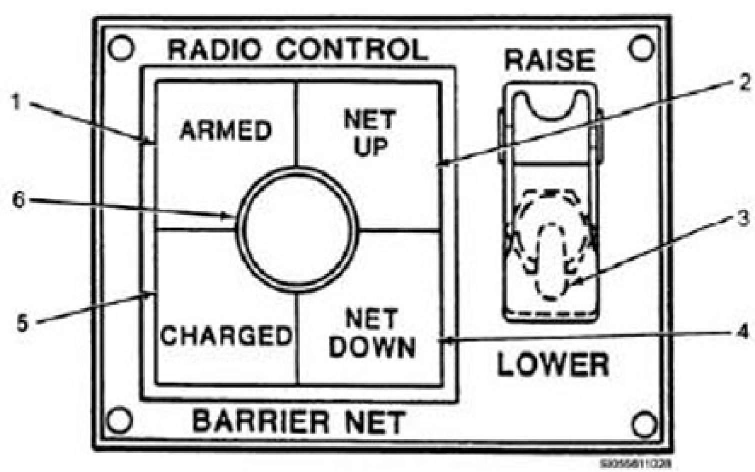


Figure 1–19. Controls and indicators in tower (1).

Item No.	*Name*
7	Alarm test pushbutton
8	Alarm reset pushbutton
9	Audible alarm
10	Visual alarm indicators

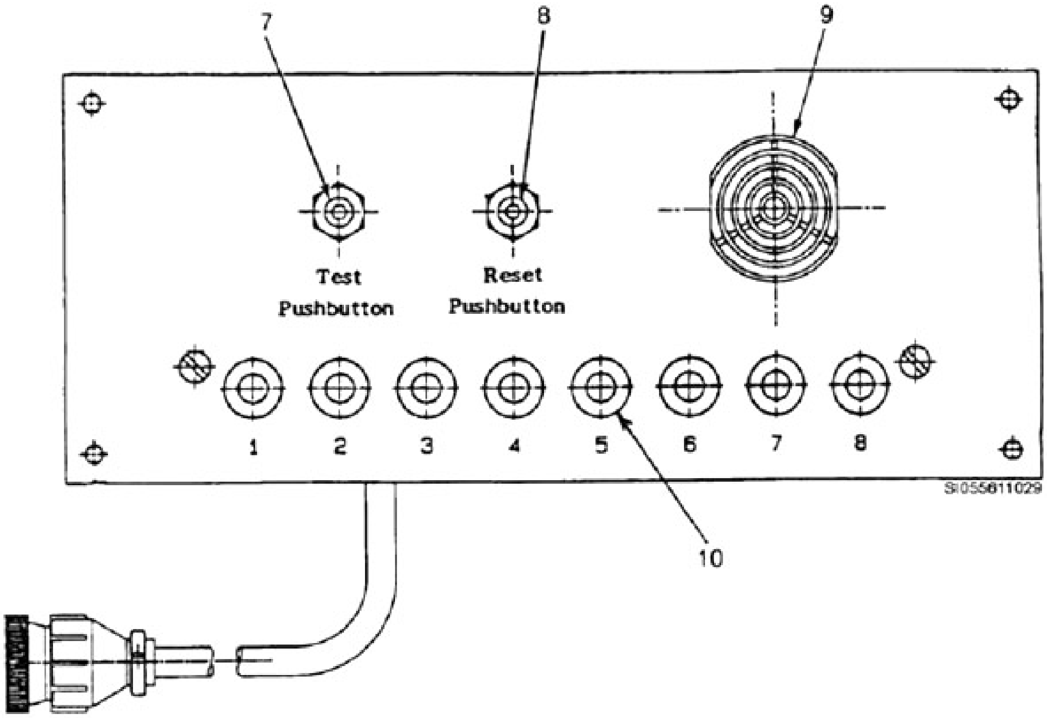


Figure 1–20. Controls and indicators in tower (2).

Item No.	Name
11	LOCAL/TOWER selector switch (located in near side enclosure only)
12	RAISE/LOWER selector switch (located in near side enclosure only)
13	POWER ON indicator light
14	Hydraulic pump ON/OFF switch (located in both near and far side enclosures)
15	Pump motor starter reset button
16	SAFE/ARM switch (near side enclosure only)
17	Up and down circuit indicator lamps
18	Transformer and ON/OFF switch assembly

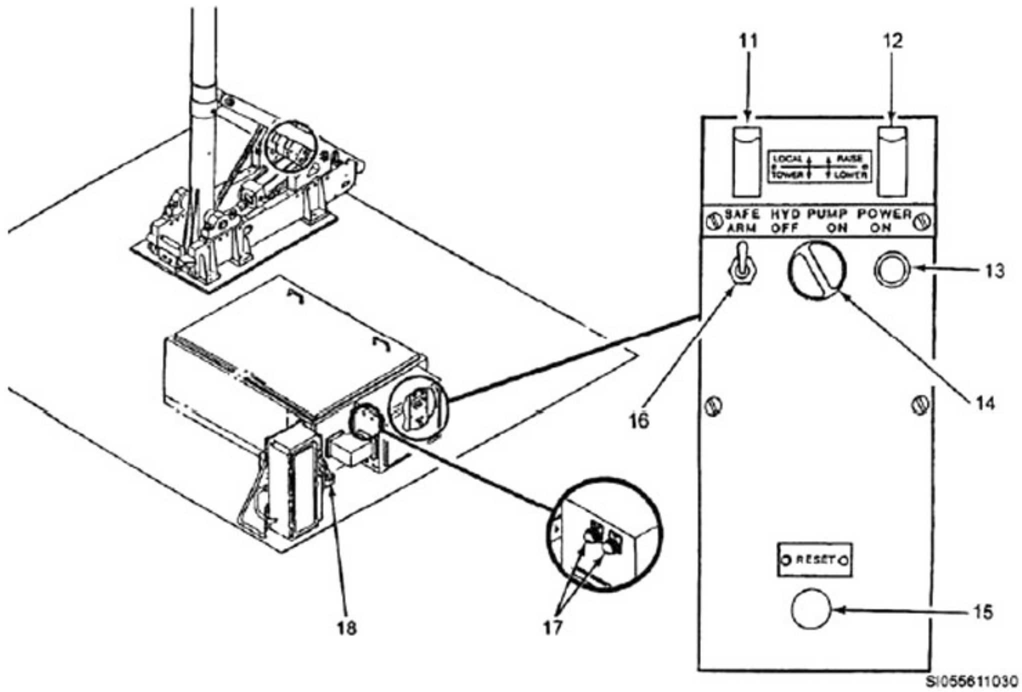


Figure 1–21. Controls and indicators from runway edge.

Configuration

We find the BAK–15 installed at the ends of the runway, used with various energy absorbers. It can accommodate a 150-foot wide runway.

The BAK–15 can also include a pendant placed in front of the net for hook-equipped aircraft. It uses a similar concept as the MA–1A interconnected by use of a “J” hook assembly.

Operation

Normally, the BAK–15 masts and net assembly lie horizontal on the overrun/runway and are in the standby position. An electrical control panel, located in the airfield control tower, energizes the BAK–15 and converts the signal to hydraulic pressure to activate the stanchions within seconds when an emergency arises. When activated, the stanchions rise and lock, suspending the net assembly across the overrun/runway. Refer to figure 1–22 and the following paragraph to better understand the hydraulic process that raises and lowers the net assembly.

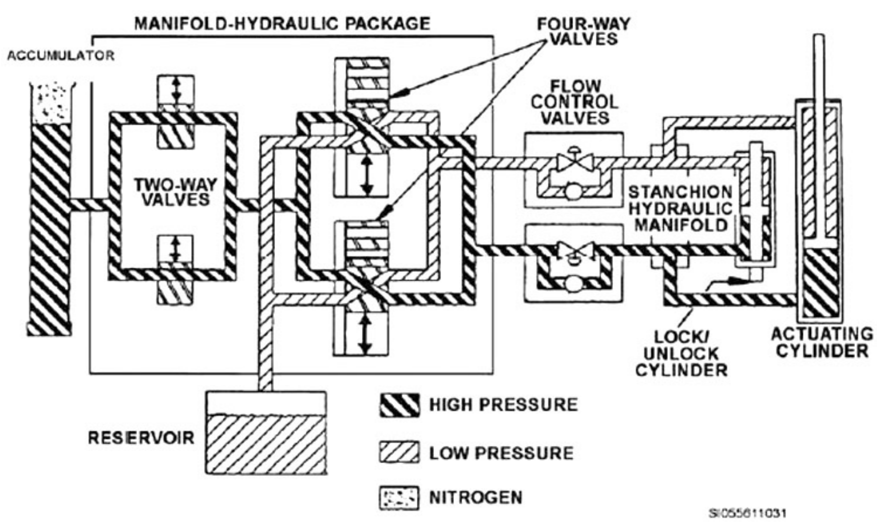


Figure 1–22. Stanchion raise/lower hydraulic system.

Dry nitrogen pre-charges the accumulator, and then hydraulic oil is pumped in under high pressure. This high-pressure oil powers the stanchion raise/lower mechanism. When the RAISE/LOWER switch moves from LOWER to RAISE, two-way valves in the accumulator open and both four-way valves move to the RAISE position. This opens a path for high-pressure hydraulic oil from the accumulator to flow through the hydraulic manifold to the RAISE flow control valve. This also opens a path for low-pressure hydraulic oil, being displaced from the cylinders, to flow back to the reservoir. The low-pressure oil must flow through a restrictive device, which slows the movement of the mast to reduce stress on the mechanism. The high-pressure oil flows unrestricted through the flow control valve and energizes the internal check/bypass to both the lock/unlock cylinder and the actuating cylinder. The lock/unlock cylinder retracts to the LOCK position, putting it out of the way of the over-center locking mechanism. As the actuating cylinder extends, it causes the mast to rise and the over-center locking mechanism to move to the locked position. When the mast reaches its fully raised position, an electrical limit switch actuates, causing the signal to the solenoid valves to interrupt. This causes the two-way valves to close, locking the mechanism in position.

Battery position

When the engaging system is ready to make an arrestment, it is in the BATTERY position. The pendant (cable) is under tension across the runway and elevated off the surface by use of pendant support discs (rubber donuts on BAK–12) or rubber elevation arms (BAK–14 mod). Once we place the system in battery position, no external power sources or manpower is required for the arrestment.

Engagement

The aircraft activates the system when the net begins to envelop the wings and main landing gear of the aircraft. The impact of the aircraft causes the net to release from the stanchions by means of the shear link devices. The net envelops the wings and main landing gear of the aircraft as the arrestment progresses. This generates some aerodynamic braking due to the area of the net webbing being dragged through the air. The net attaches to energy absorber units mounted on each side of the runway. As the aircraft and net proceed down the runway, they engage the energy absorbers. The absorbers' braking system slows and stops the aircraft in a safe, controlled manner. Energy absorbers can be, but are not limited to, anchor chains, BAK–12, or the textile modular brake.

Return to standby

Once the aircraft stops, the net disconnects from the energy-absorbing system. The net is removed from the aircraft, inspected, repaired (if necessary), and returned to service or placed in storage. Lower the stanchions to the standby position and attach a net. Once the net has been placed, raise the assembly and place it in the battery position, then check it for security. Inspect the assembly for proper net center height, and then lower the assembly to the standby position. The following paragraph will explain the workings of the hydraulic system when lowering the net.

When the RAISE/LOWER switch moves to the LOWER position, the four-way valves move to the LOWER position and the two-way valves open. This action causes high pressure oil from the accumulator to flow through the hydraulic manifold and move the LOWER flow control valve to the lock/unlock cylinder and the actuating cylinder. When the lock/unlock cylinder extends, it pushes the over-center locking mechanism back out over center. This allows the actuating cylinder to lower the mast. When the four-way valves move to the LOWER position, they also open a path for low-pressure oil being displaced from the cylinders to flow back to the reservoir. This low-pressure oil must flow through the restricting orifice of the LOWER flow control valve. This restriction of flow causes the masts to lower slowly to reduce stress on mechanical components.

The system uses dual two-way valves and dual four-way valves connected in parallel circuits as a safety precaution. This is to ensure the system will operate in the event of a malfunction in one of the valves.

Accumulator recharge system

Each time the stanchions are lowered, the pressure in the accumulator decreases slightly. After several up/down cycles, pressure must be restored in the accumulator by recharging the accumulator with hydraulic fluid from the reservoir.

The accumulator recharge system, shown in figure 1–23, is fitted with a pressure-sensing switch, which starts the electrically driven hydraulic pump when the pressure in the accumulator system falls below the preset value. The same switch deactivates the pump when the accumulator pressure reaches the desired value. The electrically driven hydraulic pump draws oil from the reservoir through a filter and discharges it through a check valve into the accumulator. The recharge system has a relief valve to allow excess hydraulic pressure to automatically be released back to the reservoir. There is also a dump (manual relief) valve to permit high-pressure oil to be released back to the reservoir when servicing of the system is necessary. The check valve prevents bleed-off of system pressure due to a faulty pump.

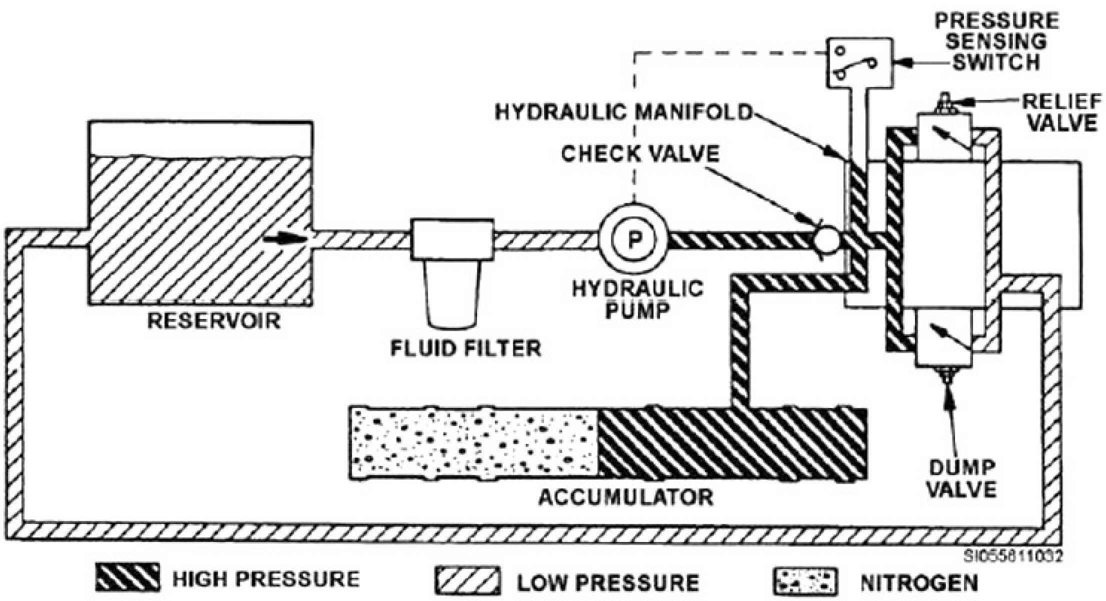


Figure 1–23. Accumulator recharge system.

The BAK–15 is a relatively new system installed throughout the Air Force. This system is capable of arresting many types of aircraft, providing the means to stop before damage occurs. You will likely see this system sometime soon.

603. Textile brake arresting system

Many companies are designing aircraft arresting systems and selling them to the military. One new concept based on textile tearing straps is the textile brake and pendant aircraft arresting system. The energy absorber in the textile brake system consists of many portable modules that we can arrange parallel and in series to match the requested energy absorbing capacity. The Air Force has bought and installed many of these systems as emergency barriers. The textile brake system, shown in figure 1–24, offers many advantages such as performance flexibility, quick installation, easy transportation, and cost effectiveness. It is virtually maintenance free. Its design allows us to use it as a replacement for older systems on airfields with low rates of engagement. The textile brake system provides an increased energy absorption alternative to the MA–1A chain barrier.

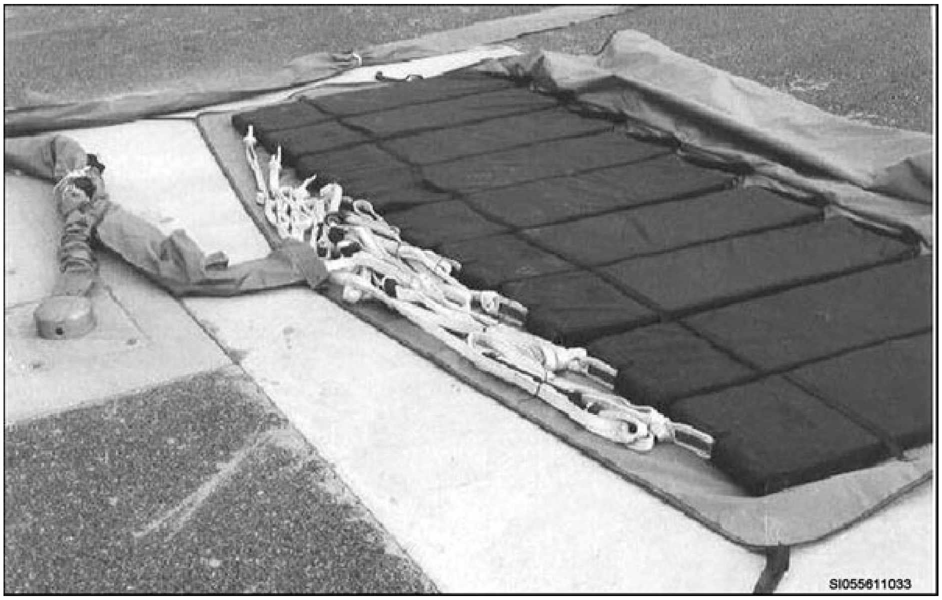


Figure 1–24. Textile brake arresting system.

System components

The key components of the textile brake arresting system are the pendant, the brake assembly, and connecting straps.

Pendant

The pendant is a 1¼-inches diameter wire rope assembly fitted with rubber support discs to increase the probability of a successful aircraft engagement. The support discs keep the pendant at a nominal height of 3.15 inches above the runway surface. The pendant tensioning assembly consists of two Tirfor winches. Each winch is equipped with 16.4 feet of steel cable and a hook. A concrete foundation anchors the winch by means of a swiveling hook engaged in an eye loop.

Brake assembly

The brake assembly has two shear link units. The units consist of two breakable shunts and a tear strap that keeps the pendant tensioned without tension being applied on the short connecting straps. The shear link units, shown in figure 1–25, are the link between the strap and the Tirfor winch. Each of the straps is a textile link composed of three straps stitched together and two reinforced eyes to receive the yoke pins. The two yokes are metal assemblies that link the pendant to the strap (similar to the purpose of a tape connector). The yoke includes a cable pin and two pins for the strap. Each pin comes with a retainer nut and setscrew. A neoprene cover protects the yoke.

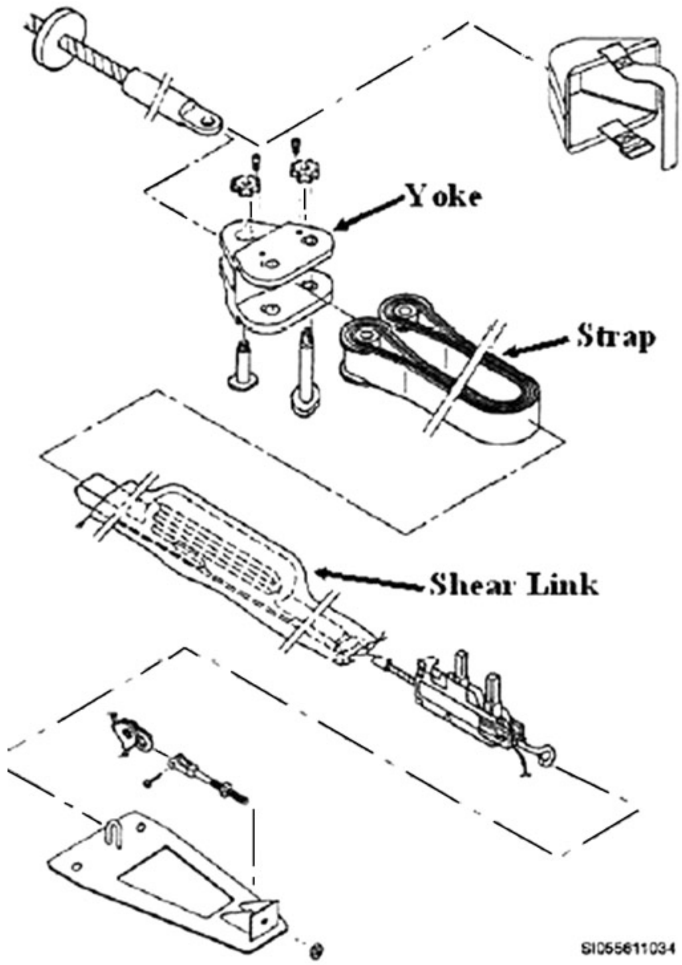


Figure 1–25. Shear link.

The braking assembly also consists of either single or multiple braking stages, connecting straps, directional modules (unidirectional only), and shackle assemblies (unidirectional only). For unidirectional operation, each braking stage consists of two units. Each unit consists of an environmental cover that can accommodate nine braking modules. The braking requirements determine the number of modules of the system. For single stage systems, each unit can accommodate ten braking units. The braking modules are the basic energy-absorbing elements of the system. Each consists of two tearing straps stitched together. One strap attaches to the connecting strap and pendant, and the second strap attaches to an anchor in a concrete foundation. The tearing action absorbs the kinetic energy of the aircraft when the two straps separate.

Connecting straps connect the various components of a two-stage system. There are two types of connecting straps: 1) Short connecting straps link from the tearing strap of the braking module to the strop. 2) Long connecting straps attach to the short directional module, the long directional module, and to the anchor line of stage two. The long connecting straps connect brake stage one and brake stage two together.

Included in this system you will find short and long directional modules. These guide the long connecting straps during operation of stage one. These modules also keep the cable tensioned at the end of stage one/beginning of stage two operation (in the event of an engagement activating both stages).

Located on the environmental cover of each braking unit are tear strap test samples. These test straps are of the same manufacturing lot as the braking modules. We can use these samples to check the aging characteristics of the tear straps.

Configuration

When configuring the textile brake system, shown in figure 1–26, consider the user's requirements and the available space. We can configure the textile brake for either unidirectional engagement or bidirectional engagement. With unidirectional configuration, there are two braking stages. Each braking stage unit has nine braking modules on each side of the runway. Stage one connects to the strop by the short connecting straps and the long connecting straps connect short directional modules, long directional modules, and stage two braking units to the pendant. With bidirectional configuration, we can only use one breaking stage. Each braking stage unit has 10 braking modules on each side. All the system components anchor to a concrete foundation.

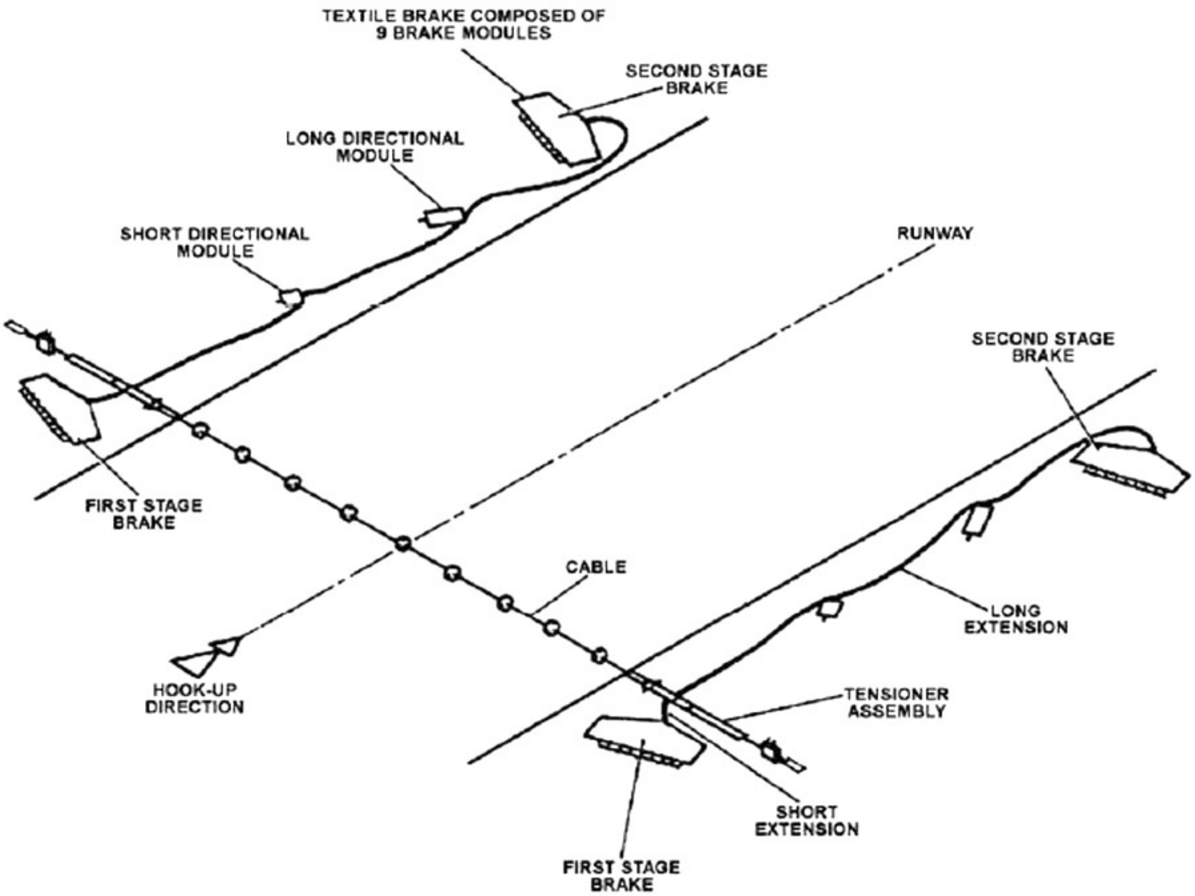


Figure 1–26. Textile brake configuration.

Operation

The textile brake arresting system operates automatically. When an aircraft engages the pendant, the load transmits to the shunts of the two shear links, which "break" at a strain of 8992 pounds of force. The incorporated tear straps maintain tension on the pendant until the textile brakes activate through the short connecting straps. Thereafter, the continuous tearing force provided by the 18 braking modules of stage one slows the aircraft down. If stage one does not entirely absorb the aircraft's kinetic energy, stage two comes into action. At the end of stage one and the beginning of stage two, the long directional modules and the swivel shear links maintain the tension of the pendant. During braking, the protective cover of the modules remains attached to its anchors, and the tear straps pay out as the aircraft moves forward, as shown in figure 1–27.

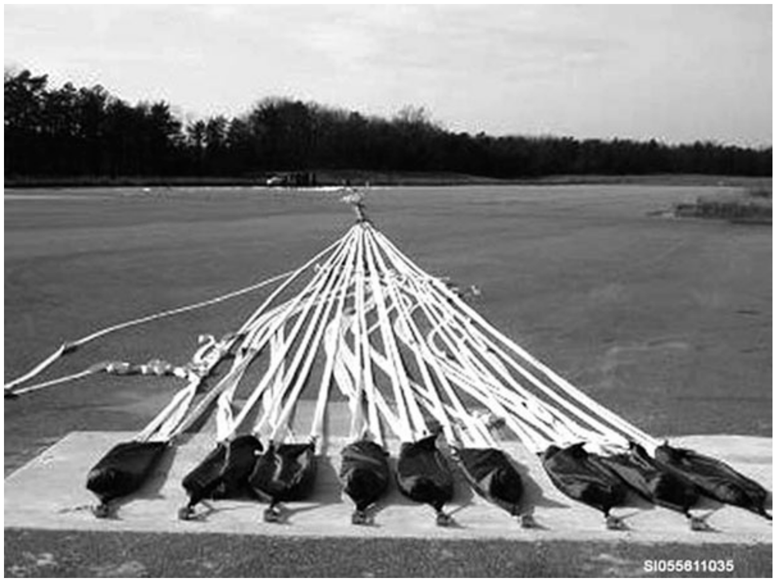


Figure 1–27. Textile brake after engagement.

You will see the textile brake arresting system in various places. Some commands see these systems as replacements for some of the old, expensive systems. Since the maintenance is virtually non-existent, the cost after installation is minimal. You will also see these systems on deployments as temporary systems until the mobile aircraft arresting systems (MAAS) and set back kits make it to the site.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

601. MA–1A and E–5 aircraft arresting systems

1. List the components of an MA–1A arresting barrier.

2. On the MA–1A arresting system, what is the purpose of the springs on the pendant assembly?

3. What absorbs the kinetic energy of an aircraft as it engages an MA–1A chain arresting barrier?

4. What is the safest *minimum* distance to stand away from an MA–1A during an engagement?

602. BAK–15 aircraft arresting system

1. What is the basic objective of the BAK–15 arresting system?

2. What does each elementary net on the BAK–15 consist of?

3. What are anchor disks?

4. What is the mast assembly?

5. What does the guy wire anchor support provide?

6. On the BAK–15, what does the hydraulic manifold do?

7. What happens when the stanchion has completed its travel, either up or down?

8. What can the BAK–15 use as energy absorbers?

603. Textile brake arresting system

1. What advantages can the textile brake system offer over other systems?

2. What tensions the pendant?

3. What does the braking module consist of?

4. How many braking modules are in each single stage brake assembly?

1–2. Aircraft Arresting Support Systems

Aircraft arresting systems stop aircraft that have no other way to stop. They are very effective at what they do. The problem is, sometimes they get in the way of aircraft that need no cable on the runway. Aircraft arresting support systems can overcome this problem. They allow the cable to rest lower than the runway surface unless an aircraft needs to use it. There are several systems that do this effectively. We will look at the BAK–14 and the Type-H support systems.

604. BAK–14 support system

The BAK–14 is a pendant support system used in conjunction with the BAK–12 arresting system (discussed in the following unit) or other comparable system to safely stop a hook-equipped aircraft that for any reason would otherwise overrun the limits of the runway. The support system allows aircraft not needing an arresting system to use the runway without having to run over the cable. Running over the cable can damage some aircraft; therefore, the cable must be removed from the runway anytime these type of aircraft land or take off. The BAK–14 provides the means of raising the pendant up so that the bottom of the cable is a minimum of 2 inches above the runway surface for engagement of the aircraft hook. The retractable feature allows the cable to lie beneath the runway surface to avoid interference with traffic not requiring or incapable of using the pendant, as shown in figure 1–28.

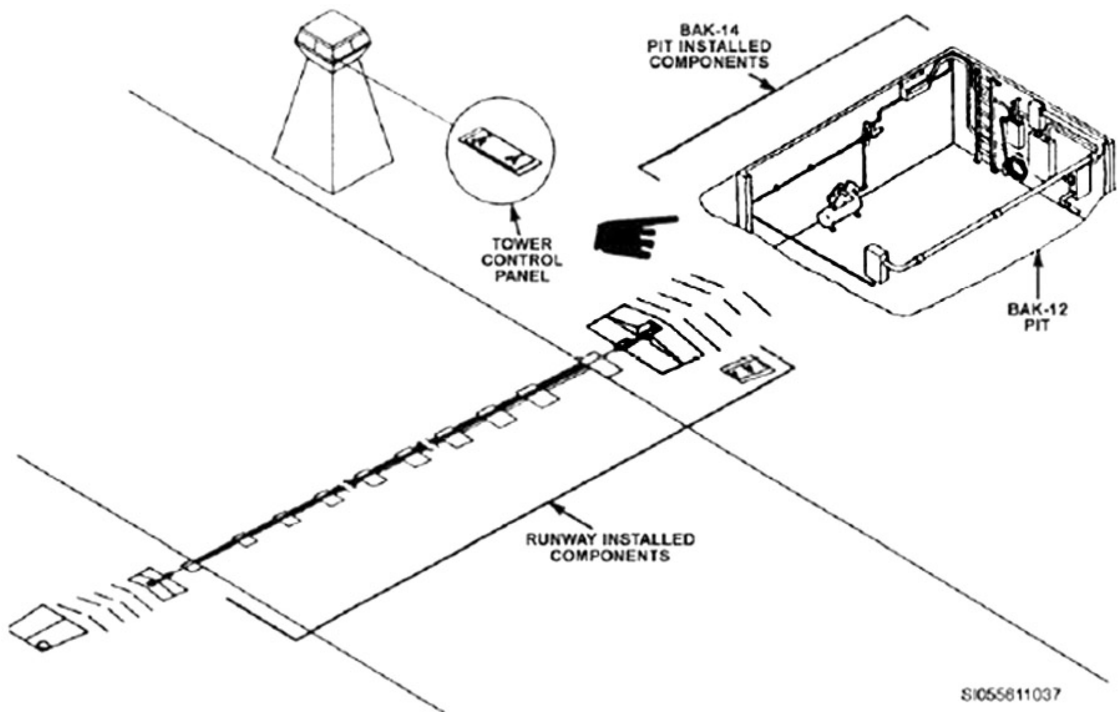


Figure 1–28. BAK–14 hook cable support system.

System components

The system consists of either 14 or 20 rubber support blocks, shown in figure 1–29, that support the pendant 2 inches above the runway surface. These support blocks are an elastomeric material and contain diagonal slots in the top for insertion of the cable into the support hole provided to accommodate the pendant. Each support block mounts on a support arm contained in a metal box inserted into the runway. Retraction of the support arm (lowering) moves the support block down and with it the pendant. A steel trough accommodates the pendant between the boxes.

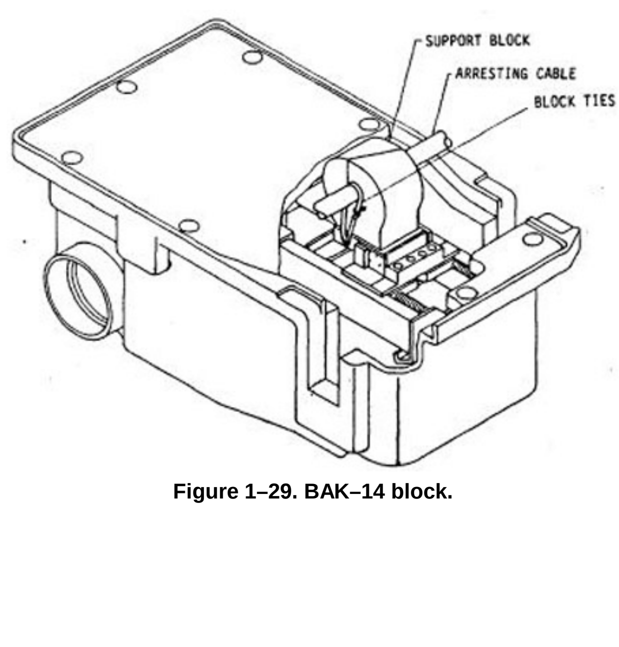


Figure 1–29. BAK–14 block.

In the fully lowered position, the pendant presents a flush runway surface. The pendant retracts into the trough by a pneumatic system and is raised above the runway by torsion springs. A heating system permits cold weather operation when needed. Indicating lights and appropriate switching circuits allow the tower to control the position of the pendant in either the raised or retracted position.

Support block

The support block is an elastomeric material that is specially compounded for the physical conditions encountered during an aircraft engagement. Manufacturers mold it with a hole that provides space to accept the pendant and a diagonal slot in the top that permits entry and exit of the pendant during an engagement. A metal frame molded in the base of the support block has attaching means to secure the support block to the support arm, as shown in figure 1–30.

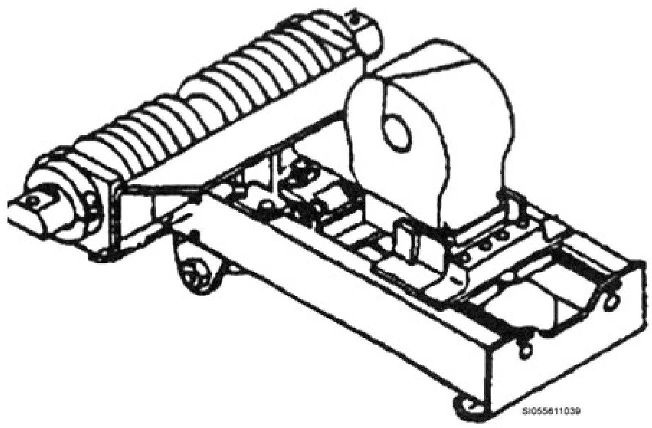


Figure 1–30. Support block and arm.

Support box

The support box contains the operating means to raise and retract the support block. The support arm pivots on a mandrel and swings the support block in an arc. Cam action rotates the block away from the frame to provide a 3-inch separation between the cable and trough. The block latches in this position.

In the FULL UP position, the support block is above the runway surface at the required distance to provide the nominal cable height.

In the RETRACT position, the blocks are lowered into the trough so a flush runway surface is presented. To lower the block, an air cylinder is pressurized actuating a piston which overcomes the torsion spring tension allowing the cable to enter the trough as the support arm descends. Release of the air pressure permits the support arm to rotate up against the cover to again place the support block in the raised position.

Also contained in the support box is an electrical box with a watertight gasket. The electrical box contains the up/down indicating switches, heater elements, and thermostats required for operation. A drain provided in the bottom of the box helps avoid accumulation of water. The drain uses heaters in areas that are subject to freezing.

The cover of the support box is in two pieces and made from 1-inch steel plates. Considerable force is stored in the support arm torsional spring and these covers retain the arm in its correct upper position. An up bumper minimizes the shock from oscillations of the support arm caused by wheel rollover of the raised pendant during an arrestment.

Trough sections

Trough sections provide a protected recess in the runway surface so the pendant can rest beneath the runway surface in the retracted position. A series arrangement of similar sections creates the end trough sections that continue to the sides of the runway.

Pneumatic system

The pneumatic system uses a 1½ HP air compressor, located in the engine pit area on one side of the runway. Maximum air pressure supplied to the system is 125 psi. A three-way solenoid valve charges the system when the valve actuates. Introduction of air pressure lowers the cable into the trough. Thus, an electric power failure allows the cable to rise above the runway surface as the solenoid valve releases and vents the system. A ⅝-inch supply line lies in the trough sections to supply air to each support box. A quick-exhaust valve aids in venting the system.

Manual operation of the system can be done by using the manual override feature of the solenoid valve. Use the manual override on the three-way valve in conjunction with the removal of pit power only during maintenance of the support boxes.

Control system

Primary control of the BAK–14 comes from a control panel that is located in the tower. The tower panel contains a switch to permit pit control of the system. Control can be passed to the pit. However, should the tower need to operate the system, any command at the pit can be overcome by actuation of a tower function as long as the manual override feature is in the released position and power is present to the three-way solenoid valve. The electrically shielded control cable prevents stray current malfunctions and eliminates interference fields.

Controls and indicators located in the tower include a main switch to raise or retract the arresting cable, lights to indicate the UP or DOWN position of the arresting cable, a control switch to pass control to the runway edge and a light to indicate control of the system is at the runway edge.

The runway edge control station is portable and permits the operator to leave the pit and stand at the edge of the runway. This control contains a duplicate set of switches and lights similar to those in the tower with the exception of the TOWER/RUNWAY selection switch and the runway permissive light.

Mercury-type limit switches located on each support box arm indicate whether the arm is up or down and monitor the raise/retract function of the control. These switches are in a series with the light circuit so that failure in any support box prevents the light from illuminating and informs the operator there is a malfunction. Such a failure can be mechanical failure, electrical failure, or a switch malfunction. To avoid checking a multitude of possibilities on the runway, use the check circuit feature in the pit. This circuit permits location of the particular switch/support box where the fault lies.

Heater system

The BAK–14 is equipped with a heater system for cold weather locations. The heaters serve two purposes. The first purpose is to keep the air in the pneumatic tube and the operating cylinders from freezing moisture trapped in the pneumatic system. The second purpose is to keep the trough sections and drains free from ice. A check circuit is located in the pit so you can check heater continuity for the trough and box heaters without going on the runway. The heaters are in four groups.

Box heaters

The box heaters are located in the support boxes and surround the air cylinder. These heaters also provide integral protection for the drain and keep the air cylinder from freezing. Once you remove the support arm, you can then remove the heater without removing the air cylinder or breaking the air-lines. The heaters are mineral- insulated, metallic sheathed-type units, with potted leads, attached to a nonresistive section that will not overheat. The heater is capable of either wet or dry service. One thermostat, located in the support box nearest the arresting system pit, controls the heat for all of the support box heaters.

Trough heaters

Each heater takes care of one trough section between the support boxes. The leads from the heaters pass through the electrical box, which is in the support box adjacent to the trough. One thermostat is located in the trough next to the support box nearest the arresting system pit. It controls the heat for all the trough heaters.

End trough heaters

The end trough heaters are paired for the 150- and 200-foot runways. One connection is in the last support box located on either side of the runway; a second connection is in the junction box in the hand holes located on either side of the runway. The 300-foot runway has three sets of heaters. One thermostat located in the end trough at the runway edge nearest the arresting system pit controls the heat for both end troughs.

Heaters can be monitored from the pit and have variable power control to provide adjustable heating controls.

Cross-runway drain heaters

The drain heaters are the last group of heaters. A manual ON/OFF switch controls them rather than a thermostat. The switch provides low wattage per foot for a wider opportunity for heating control.

Operation

The electrical control panel for the BAK–14 is located in the control tower. The tower can pass control to the runway pit, if needed to perform maintenance. With the arresting system in the BATTERY position, the tail hook of the aircraft engages the supported runway pendant. The pendant releases through the slots in the top of the support blocks and the arrestment proceeds without further contribution by the BAK–14 system. Once the aircraft disengaged from the pendant, rewind the arresting system and return the pendant through the slot in each support block.

The BAK–14 is used in different applications throughout the world. Most of them are where a multitude of aircraft are stationed.

605. Type-H support system

The Type-H support system, shown in figure 1–31, is a newer system. It performs the same function as a BAK–14, but does it in an entirely different way.

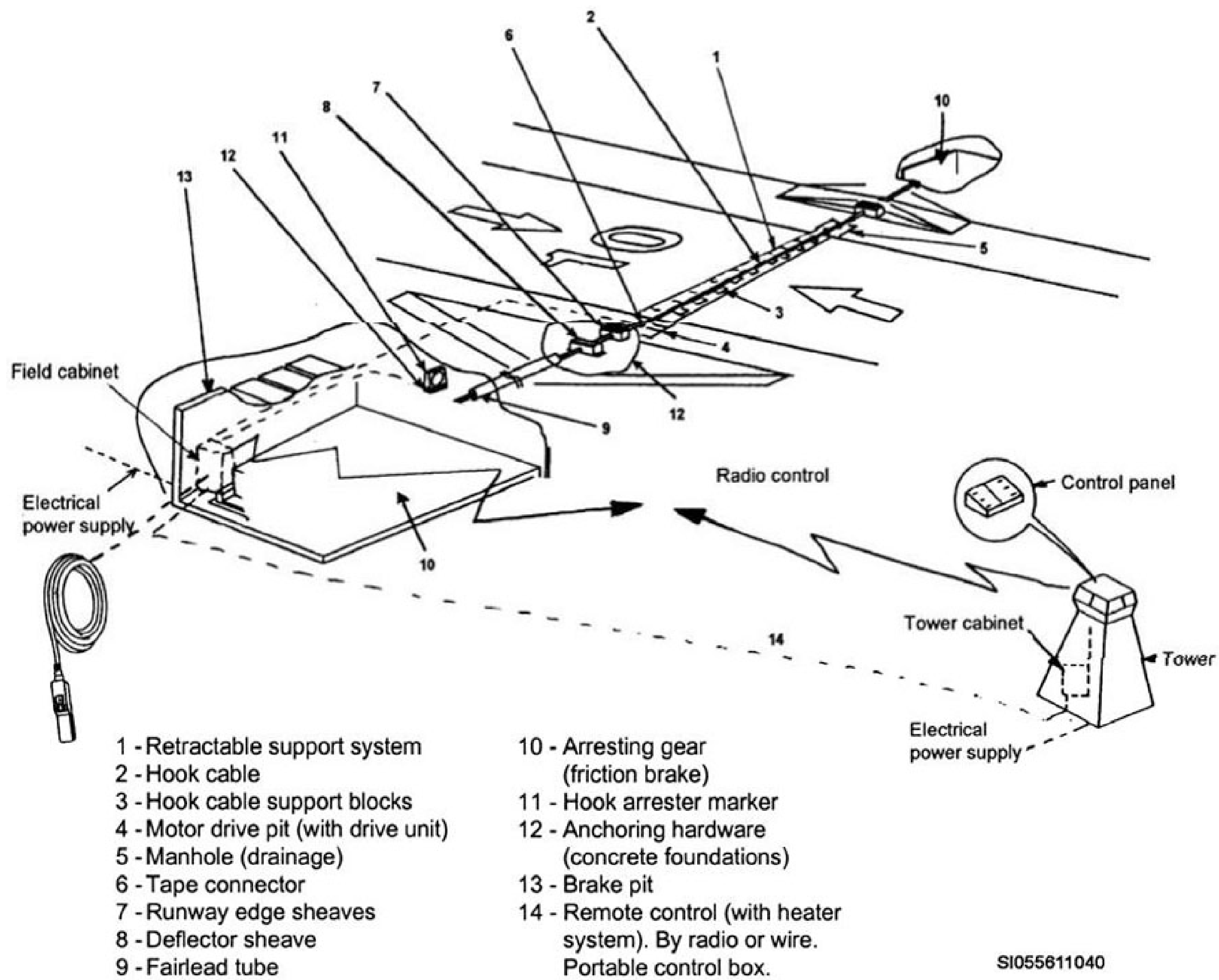


Figure 1–31. Type-H support system.

System components

The Type-H has three groups. They are the infrastructure; this is what is needed to support the system, the motor drive unit, retraction module, mechanical and the electrical assembly.

Infrastructure

The infrastructure, shown in figure 1–32, includes 8 precast concrete blocks without recess and 14 concrete blocks with recess for the installation of the retraction modules. We position these concrete blocks inside a steel reinforced trench cut into the runway. Each of the blocks has a cover plate laid over it. This provides the support to sustain the weight of the aircraft during rollover. A set of neoprene protectant sheets lies between the concrete blocks and the cover plates to keep the system clean and protect the mechanical assembly.

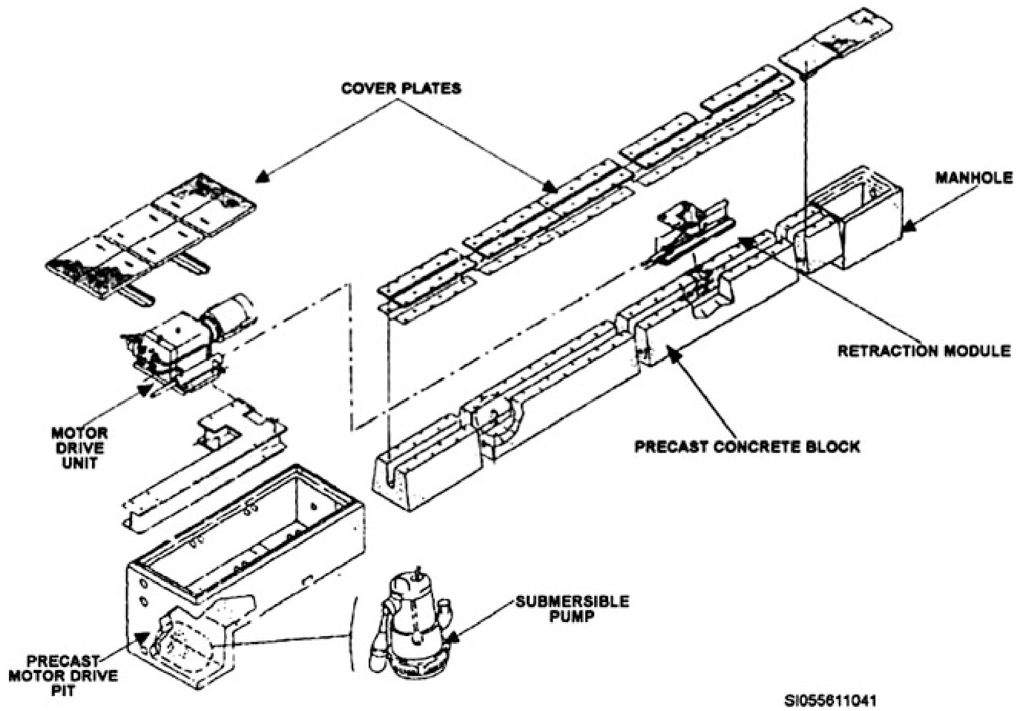


Figure 1–32. Type-H system infrastructure.

The edge of the runway has a precast manhole to house the fixed pulley of the transmission, a sump pump, wiring, and heating resistors. The other side of the runway contains the motor driver pit that houses the hydraulic power unit, a sump pump, an electrical panel, and heating resistors. Each of the pits has a cover panel to close it with a retractable latch and handle to open it. A low area built into each of the pits collects any water entering the system. Sump pumps drain whatever water collects into the low parts of the pits.

4-inch diameter ducts located in the trench hold the electrical cable for the heater elements in the heating resistors.

Motor drive unit

The motor drive unit, shown in figure 1–33, consists of a watertight reservoir to hold the hydraulic fluid, a hydraulic jack and an electric motor. The motor operates to drive the hydraulic fluid to the jack. The direction the motor turns determines which way the jack moves. The jack connects to the transmission of the mechanical assembly.

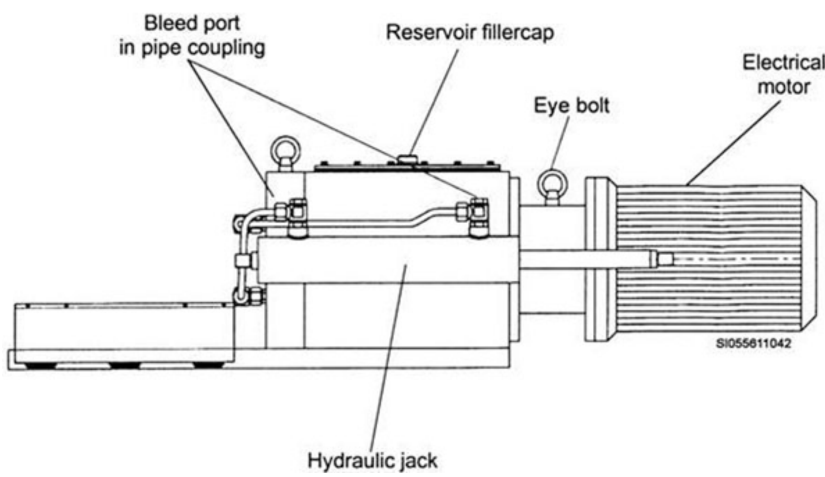


Figure 1–33. Motor drive unit.

The motor drive unit also has a manual directional valve for maintenance and manual stand-by control. The manual control uses a three-way valve labeled Hook Cable UP, Neutral, and Hook Cable DOWN.

Retraction module

The retraction module, shown in figure 1–34, consists of the components that move the pendant up and down. All components must do their job for the system to function properly. These components include the ramps, support blocks, support arms, and drawback cable.

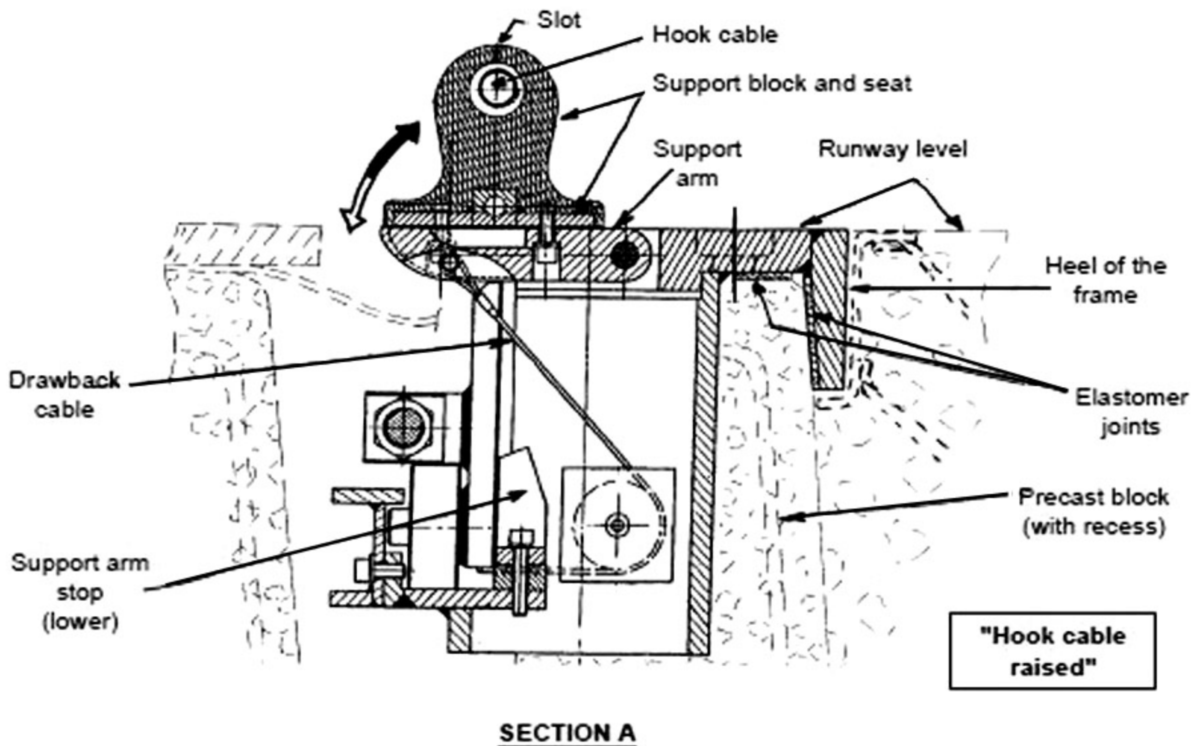


Figure 1–34. Retraction module.

Ramps

The ramp, shown in figure 1–35, is a wedge-shaped device that moves back and forth, causing the pendant to be raised and lowered. The support arm rests on the top of the ramp regardless if the pendant is raised or lowered. Each support block has a ramp to rest on.

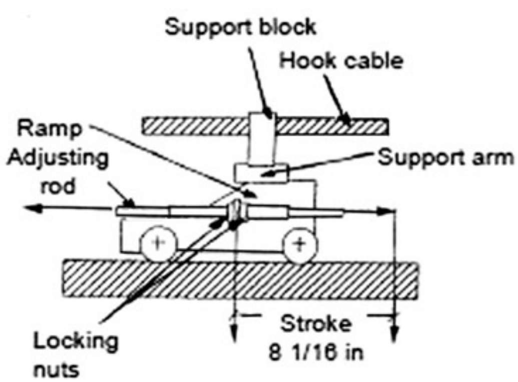


Figure 1–35. Ramp.

Support arm

The support arm pivots at one end with the other riding on the ramp. The arm is made of steel to support the extreme stresses of an engagement.

Support block

The support block, made of elastomer, mounts to the support arm. The block is 2 inches wide with a slit cut at an angle to ease the insertion of the pendant. The slit also allows the pendant to release freely during an engagement. The support block holds the pendant 3 inches above the runway surface.

Drawback cable

The drawback cable, also shown in figure 1–34, pulls the support arm and support block back into the lowered position when the ramp moves to the low spot. It connects to the support arm on one end and the frame of the ramp on the other end. This causes it to follow the motion of the ramp, pulling the arm down as the ramp moves.

Mechanical assembly

The mechanical assembly provides two-way movement for the ramps. The back and forth movement of the ramps causes the up and down movement by the retraction modules.

Driving rod and return cable

The driving rod connects each of the ramps together to cause the pendant to rise and lower simultaneously throughout the entire system. This rod has adjustments to raise and lower the pendant evenly as the ramps move.

The return cable is the bottom cable in the continuous loop that moves the ramps. One end of the return cable connects to the hydraulic actuator that moves the ramps.

Adjustable pulley

The adjustable pulley fits on the motor unit fixed chassis to provide for tensioning of the transmission loop. It allows us to make minor adjustments to the tension of the loop as the cable stretches.

Electrical system

The electrical system has three components: the connections, heater systems, and drainage pumps. The electrical system uses three-phase 120/208 volts, alternating current (VAC). It draws 23 kilovolt-amps (kVA) during operation when heaters are in use.

Connections

The power enters the system through the remote control field cabinet, from which it is distributed to several places. There are four junction boxes in the system: one on each of the two sump pumps, and one in each pit on the side of the runway. The sump pump junction boxes operate the sump pump they are with. The junction boxes in the runway pits operate the heaters in the pits and the trough heaters. The electrical drive motor operates directly from the remote control field cabinet.

Heater system

Heater units allow the Type-H support system to operate in severely cold climates. Each of the sump pumps, as well as the electric drive motor, has heaters. The trough also has heaters installed. These heaters have thermostats that automatically control the heating based on the temperature.

Drainage pumps

The pit at each end of the runway has a low point where a submersible pump, referred to as a sump pump, mounts. A float switch automatically turns on the pump when the water level gets high, which moves the water outside the pit area. Always be sure the output of the sump pump directs the water to a place where it moves away from the pit and not back toward it.

Configuration

The Type-H support system has 14 blocks for runways up to 150 feet wide and 18 blocks for runways from 150 feet wide to 300 feet wide. This means support blocks are approximately 8 feet apart, depending on the specific configuration of the runway. The rubber support blocks are 2 inches wide. The support blocks hold the pendant 3 inches above the runway in the raised position. They also completely conceal the pendant below the runway surface while in the lowered position.

The maximum aircraft engaging speed for the Type-H support system is 190 knots. The Type-H system is compatible with any pendant diameter and adaptable to any runway width. This means it will support any type of aircraft arresting system. Aircraft can engage a pendant held in this system in either direction.

The operating temperatures range from –40º F to 158º F. This means we can install the system on whatever runway we need, whether it is in Alaska or the desert in Saudi Arabia.

The Type-H support system retracts or raises the pendant in 1.5 seconds. It also requires no waiting time between operations. This allows us to immediately raise or lower the system at any point in time without waiting for a system to recharge.

Operation

The operation of the Type-H support system begins with the control tower operating the remote control to move the pendant either up or down. This sets a series of events in motion to make the pendant move. Figure 1–36 shows the moving components of the Type-H support system. Refer to this figure as you read about what takes place to move the pendant.

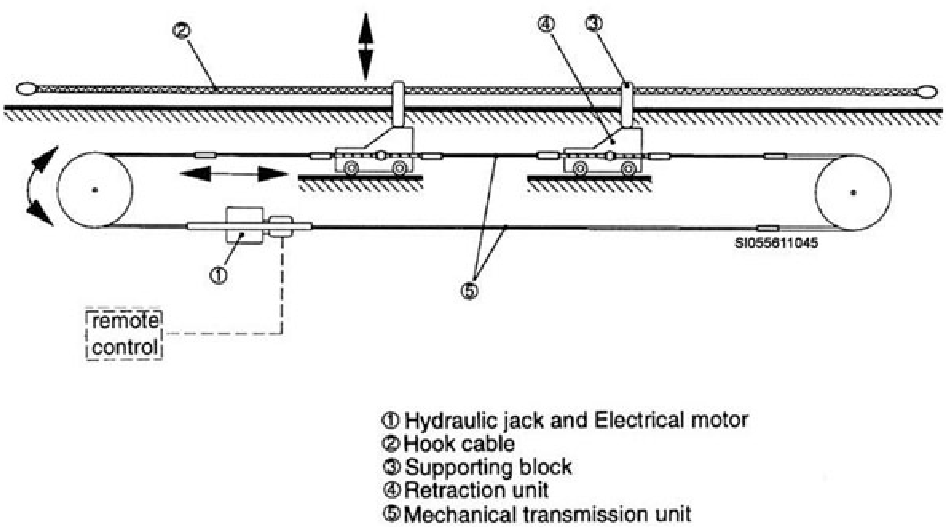


Figure 1–36. Type-H support system moving parts.

With the pendant in the up position, as shown in figure 1–37, the control tower signals the system to lower the pendant. This starts the electric motor. The operation of the motor turns a hydraulic pump, moving fluid into the hydraulic jack. The jack then begins to move. This causes the mechanical transmission system to move, causing the ramps to move. As the ramp moves, the support arm begins to follow the wedge part of the ramp in the downward direction. The drawback cable also pulls the support arm tight to the ramp. As the ramp continues to move, the pendant begins to lower. Once the ramp has moved all the way and the pendant is completely below the runway, a limit switch actuates, stopping the motor. The drawback cable holds the pendant in the lowered position.

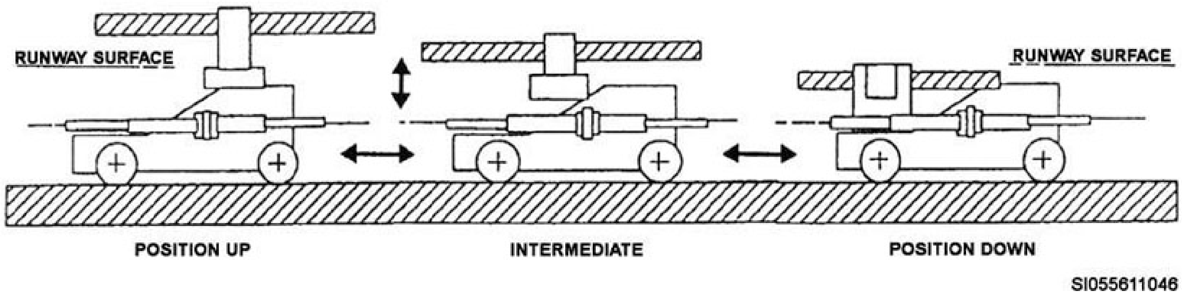


Figure 1–37. Ramp-support arm movement.

With the pendant in the lowered position, the control tower signals the system to raise the pendant. The electric motor rotates in the opposite direction it did to lower the pendant. This causes the ramps to move to the up position. This movement causes the support arms to follow the wedge in the up direction, as shown in figure 1–37. This causes the pendant to move upward. Once the ramps have moved all the way to the left and the pendant is in the fully raised position, limit switches stop the operation of the electric motor, stopping the movement of the system.

There is an option to manually operate the system should the power go out. This uses a standard hydraulic pump. We would manually operate the pump to move the pendant either up or down. It takes approximately 10 seconds for the manual operation to raise or lower the pendant.

The Type-H support system is one a newer system. This system allows for a more reliable means of raising and lowering pendants on very busy runways.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

604. BAK–14 support system

1. How is the pendant of the BAK–14 support system raised?

2. What material is used in the construction of the BAK–14 support block?

3. What is provided to minimize the shock from oscillation of the support arm on the BAK–14 support system?

4. What is used to charge the pneumatic system when the valve is actuated on the BAK–14 system?

5. Where is the *primary* control of the BAK–14 support system?

6. What type of switch is used to monitor the raise/retract function on the BAK–14?

7. What is provided to avoid checking a multitude of possibilities on the runway if a malfunction is indicated on the BAK–14 system?

8. What are the two purposes of the BAK–14 heaters?

9. List the four groups of heaters on the BAK–14.

605. Type-H support system

1. What is the function of the drawback cable?

2. How many blocks does the Type-H support system have?

3. How fast does the Type-H support system retract or raise the pendant?

1–3. Aircraft Arresting System Setback Kits

Generally a MAAS is designed to operate during contingency operations to support fighter aircraft operation. During flying operations, a MAAS is essential to the safe recovery of equipment and the pilot's well-being during an emergency condition. The MAAS can become a danger to larger aircraft, to alleviate this, the arresting system needs to be moved further away from the runway. To accomplish this there are two options currently available, the lightweight fairlead beam (LWFB) or the mobile runway edge sheave (MRES).

606. Lightweight fairlead beam

The LWFB permits MAAS trailer units to be set further back from the runway edge without lessening the operability of the system. With the fairlead installed, wide-body aircraft can safely use the runway without concern over wing clearances. Figure 1–38 shows the LWFB and the stakes securing the beam.

The LWFB consists of three main components; a beam and two sheaves. The beam is a long tube that protects the tape, provides mounting points for the cruciform stakes, and connects the rear and main sheave assemblies. The sheave assemblies act as a tape guide system providing a smooth tape payout. The primary difference between the two sheaves is their orientation. The rear sheaves lie horizontally where the main or front sheaves lie vertically.

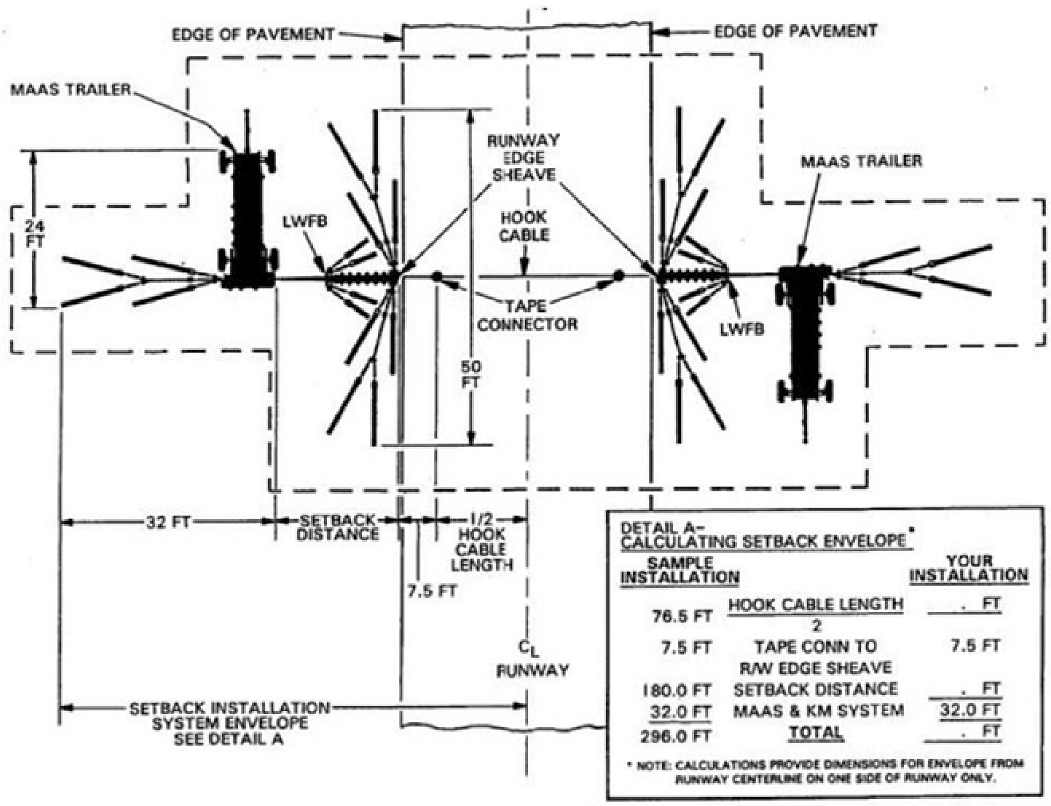


Figure 1–38. LWFB.

LWFB installation

The LWFB is installed on the edge of the runway. The installation must hold the LWFB in place during an engagement. The installation hardware must be able to maintain the intense force associated with stopping the aircraft. If we use the LWFB, the stress on the MAAS is different; therefore, we install the MAAS differently.

Installation hardware

Figure 1–39 shows a complete listing of all the hardware required to install a single LWFB.

(Each Side of Runway).

Description	Part Number	Quantity
Stake	52C7755-1	52
Tie Stake Spacer	52C8174-1	28
Stake Spacer	52B10763-1	28
Stake Guide	52C8173-1	12
Triple Turnbuckle Fitting, Including	52C8194-1	6
Clevis Pin	G-4065-1½	6
Hitch Pin Clip	52D7800-20	6
Turnbuckle Assembly, Including	HG228-1½x12	14
RH Threaded Lock Nut	G-4060-1½	14
Hitch Pin Clip	52D7800-20	28
Master Link	52B10726-3	12
Anchor Fitting	52D10062-1	2
Shoulder Screw	22846-016	4
Hex Nut	01857-010	4
Chain Sling	52D10726-3	2

Figure 1–39. LWFB installation kit.

LWFB site selection

The particular operational need and airfield layout will dictate the location of the LWFB configuration set. The site should be relatively flat and should extend evenly on both sides of the runway for the required setback distance. Personnel familiar with operational requirements must select the system arrangement.

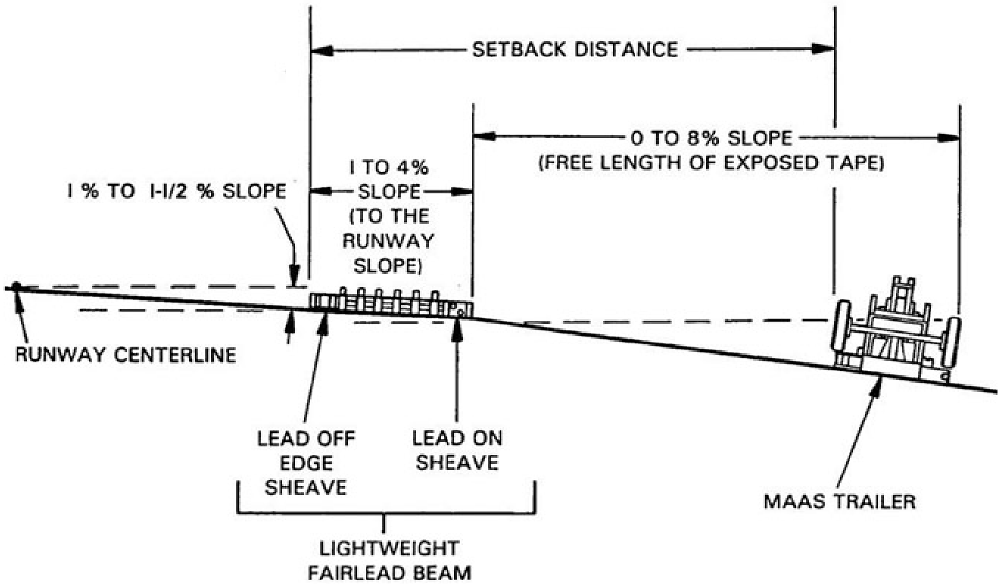


Figure 1–40. LWFB and runway slope.

It is desirable that the centerline of the LWFB sheaves project through the landing zone centerline plane 1 to 4 feet above the runway surface. Under no condition should the LWFB be angled so the projected tape path interferes with the runway surface, shown in figure 1–40.

To make sure we meet the minimum and maximum slope requirements, the supervisor (crew chief) must make sure appropriate surveying equipment and personnel are available.

The LWFB can be installed in soil using the K/M anchoring system. The loads experienced during aircraft arrestments affect the soil where we place the K/M anchoring system. For this reason, the identification of the type of soil and its suitability for the installation is most important. A soil with a minimum California bearing ratio (CBR) of 7 is acceptable for an installation.

The CBR is a test to determine the strength and load absorption capability of the soil in a selected area. Do not reinstall the LWFB configuration set at a site previously used. Removal of the K/M anchoring system will greatly reduce the CBR rating of the old site. Perform a CBR test prior to installation at a new site, or have the old site excavated compacted to a CBR of 15 or better.

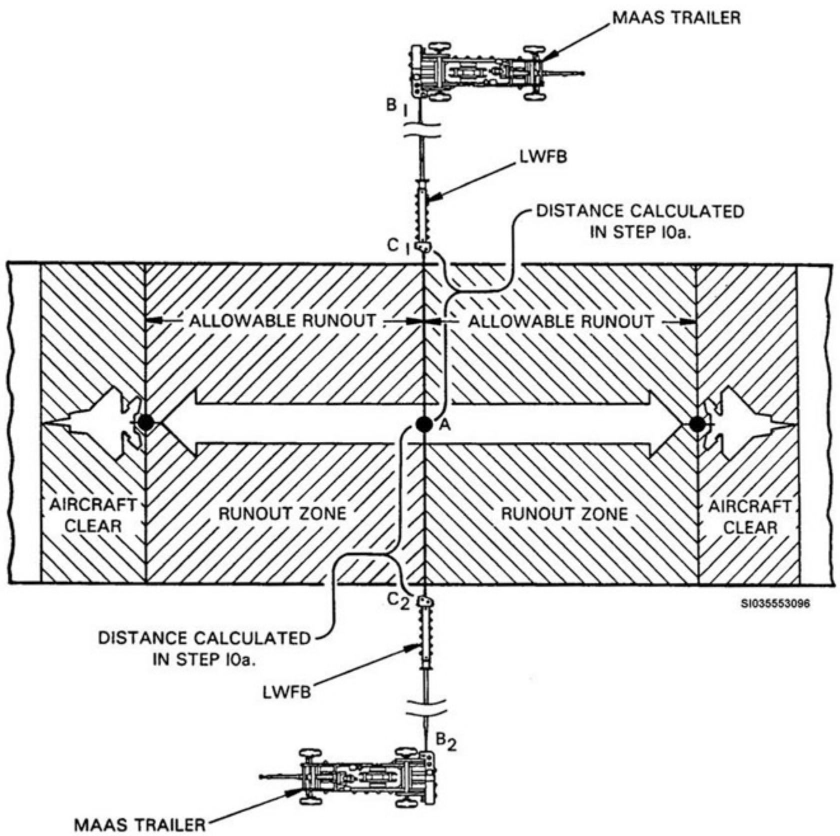
LWFB positioning

The following procedures are required to position the MAAS trailer on a suitable installation site. Using survey equipment, an engineering assistant must verify that the installation site conforms to the slope requirements. Refer to the appropriate TO to verify configuration of MAAS installation. Then proceed with positioning and installation of the LWFB.

Refer to figure 1–41 when reading about LWFB installation. First calculate the distance from point "A" to runway edge sheave on LWFB using the formula listed below.

$$\frac{Pendant\ length + 15\ feet}{2}$$

Tie a lacing cord or string of sufficient length between the two MAAS trailers and align with the center of the tape exit point on each trailer. Make sure the string or lacing cord is taunt and straight (even light wind will cause a sufficient bow in the string between the two trailers) and mark a new point “A” where the cord crosses the runway centerline. Measure the distance that we calculated from the center point of the runway (point A) on both sides and mark them. Position a LWFB on each side of the runway at the marks. Make sure the beams and sheaves are aligned with the string or lacing cord. Using a suitable sling routed through the hand-holes in the LWFB will allow us to position the fairlead beam with less effort.



1. CALCULATE DISTANCE FROM POINT A TO RUNWAY EDGE SHEAVE OF LWFB.
2. USE LACING CORD TO FIND NEW POINT A.
3. MEASURE DISTANCE FROM POINT A TO LWFB RUNWAY EDGE SHEAVE, MARK AS POINT C_1.
4. ON OPPOSITE SIDE OF RUNWAY, MEASURE DISTANCE FROM POINT A TO LWFB RUNWAY EDGE SHEAVE, MARK AS POINT C_2.
5. LOCATE LWFB PERPENDICULAR TO RUNWAY, RUNWAY EDGE SHEAVES AT POINTS C_1 AND C_2.

Figure 1–41. LWFB positioning.

Tape reeving procedures for the LWFB

Once we have the LWFB and MAAS in position, your next step is to reeve the tape through the beams and connect it to the tape connectors. This is a fairly simple operation if we follow the TO guidance. Note that we reeve the tape thru the LWFB before installing the outboard anchoring system. Make sure we wear leather gloves when reeving the LWFB.

First pull out a sufficient amount of tape to extend through the fairlead beam. Make sure the shuttle valve is in the OFF position. Make sure we have not damaged the tape during the reaving operation. As a reminder, do not crop the tapes until we have completed the proof loading operations.

To insert the tapes into the rear sheaves, rotate the tapes 90 degrees clockwise and insert through the front sheave. Rotate the tape back 90 degrees counterclockwise and pull thru the front sheave, as shown in figure 1–42. Make sure that the same edge of the tape is up on both sides of the LWFB.

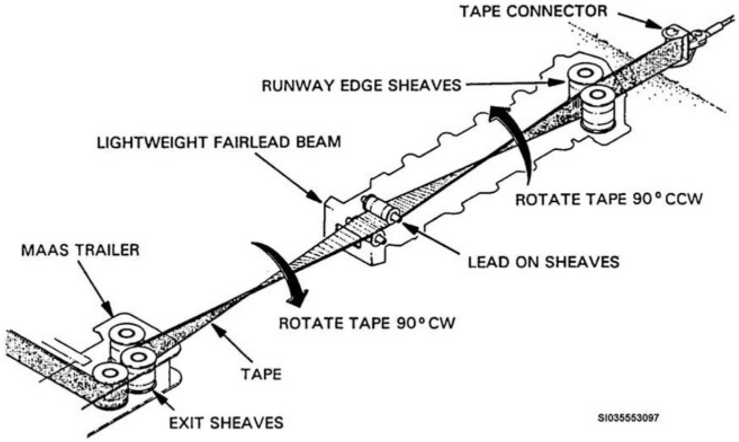


Figure 1–42. Tape reaving.

Final alignment

Once we have reeved the tapes, we must confirm the alignment is correct. Connect the tape connector, pendant and tension the cable with the tape connectors positioned correctly. Do this carefully because the LWFB does not have any anchors. This makes it possible to damage the tapes. Once we have tension on the cable, look at the tape and cable. It should form a straight line between the MAAS trailers. If not, adjust the position of the LWFB to get a straight line. Once a straight line exists, begin the installation of the anchoring system.

LWFB Anchoring

The procedures that follow describe how to install the LWFB for bidirectional arrestments in a soil environment. Refer to figure 1–43 and figure 1–44 for this installation

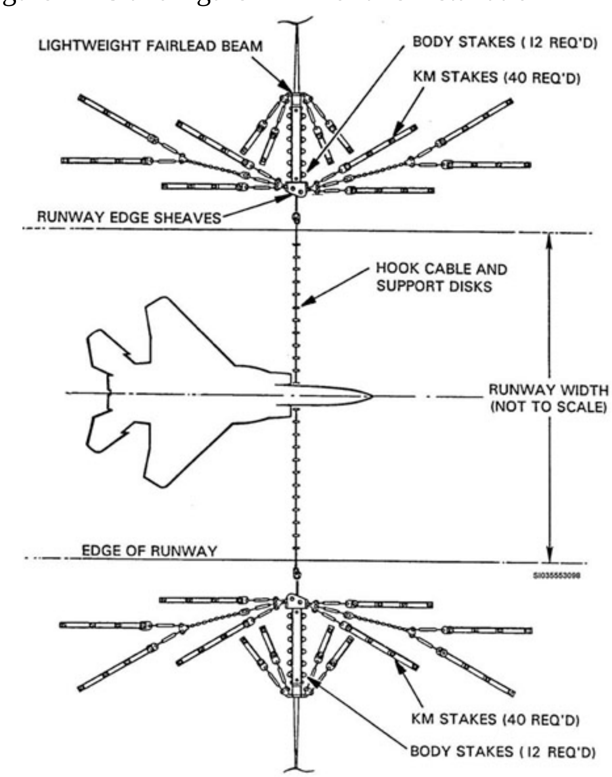


Figure 1–43. LWFB outrigger installation.

The tools required for this installation are stored on each MAAS trailer. Refer to figures 1–43 and 1–44 for the outrigger installation and a complete listing of tools required to install the LWFB.

Install the K/M anchoring system onto each of the front sheave housing of the LWFB. Refer to figures 1–43 and 1–44 for proper orientation of the stake lines. Each primary K/M stake line consists of one turnbuckle, one master link, one stake guide, four stakes, three spacers, and three tie stake spacers. Each LWFB will require 52 stakes for proper installation.

When installing the LWFB ensure to install the body stakes only after final alignment is completed. If it is done prior it will not be possible to adjust the tracking and or alignment of the LWFB.

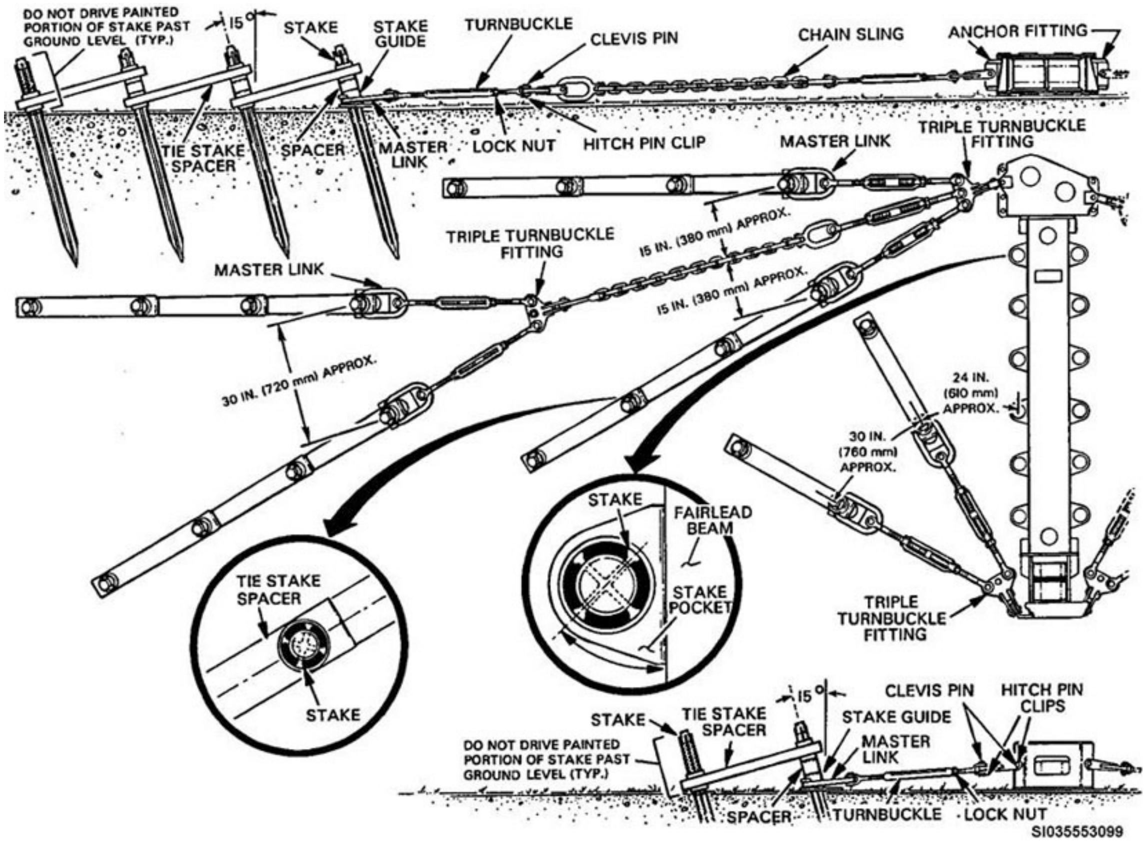


Figure 1–44. LWFB outrigger installation.

Description	Part Number	Quantity
Stake	52C7755-1	52
Tie Stake Spacer	52C8174-1	28
Stake Spacer	52B10763-1	28
Stake Guide	52C8173-1	12
Triple Turnbuckle Fitting, Including	52C8194-1	6
Clevis Pin	G-4065-1½	6
Hitch Pin Clip	52D7800-20	6
Turnbuckle Assembly, Including	HG228-1½x12	14
RH Threaded Lock Nut	G-4060-1½	14
Hitch Pin Clip	52D7800-20	28
Master Link	52B10726-3	12
Anchor Fitting	52D10062-1	2
Shoulder Screw	22846-016	4
Hex Nut	01857-010	4
Chain Sling	52D10726-3	2

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Figure 1–45. LWFB installation tools.

Perform a proof load and functional checkout of the MAAS system as described in the proper TO. Crop any excess tape. Finally perform a tape stack height measurement.

Daily inspections

As with all arresting system ensure that daily inspections are through and are done in accordance with the applicable TO and Air Force Instructions. Inspect the front and rear sheave housings for security of attachment and inspect the nylon tapes condition. Conduct these inspections in conjunction with the daily requirements for the MAAS.

Monthly inspections

Inspect fairlead beams for burrs and sharp edges at the tape entry/exit points. Inspect fairlead beams and sheaves for nicks, scratches, and corrosion. Inspect sheaves for cracks and any other damage. Rotate sheaves and listen for unusual sound, which may indicate internal damage. Inspect all tape guides for security and wear. Verify that the tape is tracking evenly across all sheaves. This can best be observed during the monthly functional checkout. We perform all these inspection items in conjunction with the monthly requirements for the MAAS.

For further information and clarification on performing the LWFB inspection, refer to TO 35E8–3–11–2.

This lesson discussed the LWFB. The site selection criteria, installation and maintenance actions needed to keep the LWFB in operational status were all covered. The LWFB is the first of two setback kits commonly used throughout the Air Force. The MRES allows for more options for installation and a lower profile at the edge of the runway surface. This next lesson will contain information about the MRES.

607. Mobile runway edge system

The MRES system consists of two identical MRES assemblies and installation hardware to anchor the MRES assemblies at the installation site. The MRES system provides a low profile runway edge sheave. This independent runway edge sheave allows us to set the aircraft arresting gear back from the runway, removing the equipment from the edges of the runway or overrun.

In a typical installation, shown in figure 1–46, one MRES assembly is positioned on each side of the runway, and the aircraft arresting gear at a safe distance away from each side of the runway. The tapes from each MAAS aircraft arresting gear connect to a hook cable/pendant which crosses the runway.

Figure 1–46. Typical MRES installation.

MRES installation

The MRES offers some distinct advantages over the LWFB when it comes to installation choices and procedures. The MRES can be installed on concrete or soil and the LWFB can only be installed in soil. Another benefit of the MRES is the integrated trailer. Instead of using a forklift to position the beam you can pull the trailer into position with a tow vehicle.

MRES site selection

The particular operational need and airfield layout will dictate the location of anticipated sites. Selection of the particular system arrangement must be accomplished by personnel familiar with operational requirements. Concrete installations may be performed on the runway itself, or on concrete pads. Installation may also be performed on a concrete surface with an asphalt overlay of one inch (25.4 mm) or less in thickness. In any case, the anticipated site should be checked to verify that all positioning requirements are met before the installation is attempted. Soil installations are performed in undisturbed soil, immediately adjacent to the sides of the runway or overrun. The selection of a runway site must consider three sets of requirements:

- On-runway (or overrun) requirements – providing enough room for the aircraft to land and be safely arrested.
- MRES requirements – the MRES assembly must meet footprint and alignment requirements at the side or edge of the runway or overrun.
- MAAS setback requirements – the MAAS trailer must meet footprint and alignment requirements when setting the MAAS trailers back from the sides of the runway (or overrun).

Touchdown zone

The selected site must provide for a touchdown zone for the landing aircraft. The minimum touchdown zone should be 500 feet (150 m).

Tape sweep area

Site selection must ensure there will be no tape interference with obstructions during arrestment and rewind. In addition, the surface of the runway in the tape sweep area must be in a condition that will not cause damage to the aircraft during landing. The tape sweep area is determined as follows.

1. From the center of the proposed hook cable, measure a distance equal to the length of the arresting tape in the direction of arrestment. For bi-directional installations, the tape sweep area in both directions must be accounted for.
2. The triangle enclosed by Marks B and C (see fig. 1–47), as well as the point determined in Step A is the tape sweep area.

MAAS site requirements

It is necessary that a suitable site be chosen to permit installation of the MAAS trailers. The selected site should be relatively flat and should be clear of obstructions both above and below ground. When selecting a site, take into account the footprint for the MAAS in the intended installation configuration, the alignment of the MAAS and MRES trailers, and achievement of the desired setback.

Alignment

The installation site should be relatively level in the area selected for arresting gear installation. This eliminates the need for grading of the site. Refer to figure 1–47 for alignment requirements between the MRES and the MAAS. The slope and alignment requirements must be taken into account for the entire length of the setback. Where backfill is necessary to meet the slope requirements, earth shall be placed in layers and tamped to obtain 95 percent compaction at optimum moisture content.

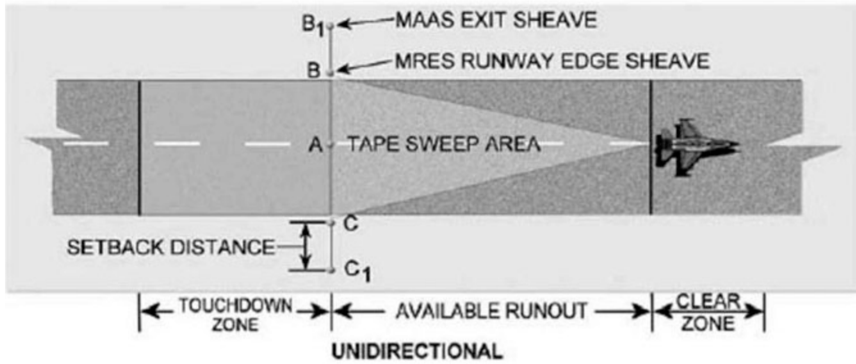

Figure 1–47. MRES siting requirements.

MRES positioning

Now that we have determined where on the runway we can safely place the MRES we need to find the exact position for each piece of the assembly. In this lesson section, we will determine the MAAS trailer locations along with the MRES. In order to do this, we must know the cable length and have a determined setback distance from the runway edge for the MAAS trailers.

Mark MRES Positions

1. Calculate the position for each MRES lead-off sheave as follows.
   a. Determine the length of the pendant/hook cable.
   b. Add 15 feet (4.5m) to the length of the pendant/hook cable. Divide the sum in half. This number is the distance from point A to point B on figure 1–48.
2. Starting at point A, measure the distance determined in step A along the perpendicular line marked on the runway. Mark point B.
3. Starting at point A, measure the distance determined in step A along the perpendicular line, in the opposite direction. Mark point C.

Mark MAAS positions

Measure the setback distance from Marks B and C, along the perpendicular lines. These are Marks B_1 and C_1, respectively.

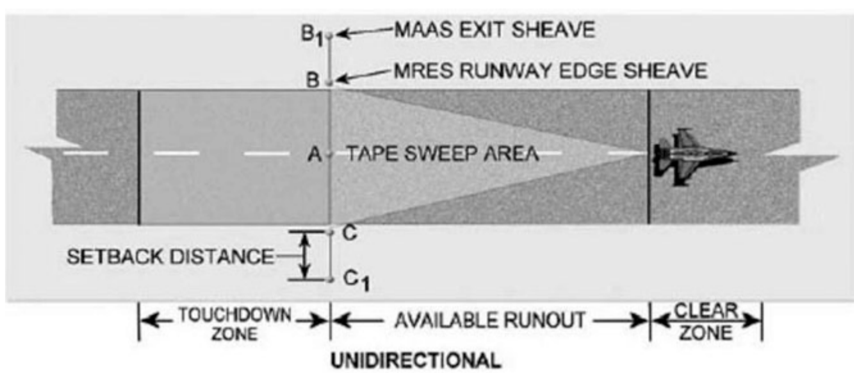

Figure 1–48. MRES positioning.

Position MAAS trailers

Locate one MAAS trailer on each side of the runway, parallel with the runway centerline, with the tape exit sheaves at points B_1 and C_1. Lower the MAAS trailers to the ground, in their anticipated positions. When lowering, maintain cross runway alignment of the trailer sheave exit points to within plus or minus 1 foot of the line perpendicular to the runway centerline.

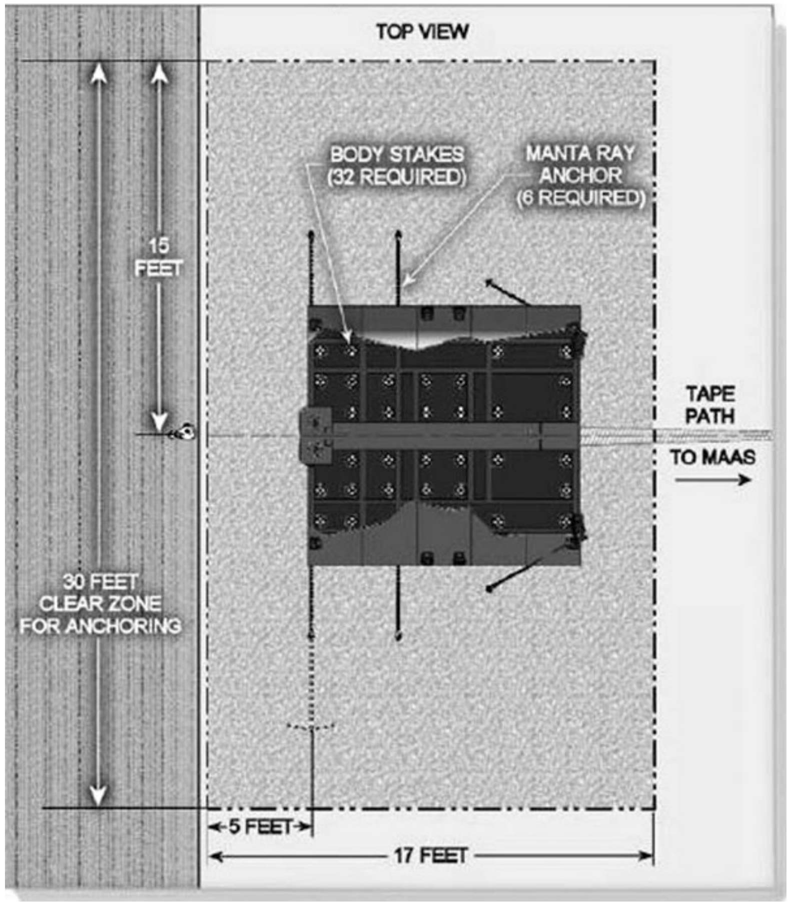

Figure 1–49. MRES alignment requirements.

Position MRES trailers

Locate one MRES trailer on each side of the runway, perpendicular to the runway centerline, with the front tape sheaves at points B and C. Verify that the alignment requirements are met (fig.1–49).

1. Remove ratchet straps stakes, tools and all other hardware, three stake retainer plates, and load locker tool box from the MRES.
2. Remove anchor weldments (9D00283–1 and 9D00283–2) from transport positions shown in figure 1–50. Retain stake pockets and all hardware for re-use.
3. Install anchor weldments (9D00283–1 and 9D00283–2) in the installation positions shown in figure 1–50. Re-install the stake pockets, and secure all in place using the hardware removed in step e. above.
4. FOR CONCRETE INSTALLATIONS ONLY: Install installation brackets 9D00336–1 and 9D00336–2 onto the MRES as shown in figure 1–51. Installation bracket 9D00336–2 is shown in the figure, installation bracket 9D00336–1 is on the opposite side of the MRES.
5. Verify both tires and tow bar jack are the MRES assembly's only three points of contact with the ground.
6. At the front of the MRES, disconnect the brake quick disconnect plug from the quick disconnect socket. Cap the socket and plug to prevent line fouling. Disconnect the electrical cable from the MRES trailer.

7. Using the ratchets in the front corners of the MRES assembly, lower the rear of the MRES assembly to the ground. To make each ratchet lower the MRES, engage its lower catch in the ratchet sprocket, then stroke down. Using the tow bar jack, lower the front end of the MRES assembly. Attempt to keep the trailer level as the ratchets and tow bar jack lower the trailer. Crank the tow bar jack as far as it will go.
8. Remove tow bar.
9. Use ratchets in front corners of each MRES assembly to raise wheel and tire assemblies to their maximum heights.
10. Remove lug nuts and washers to free wheels from hubs. Remove wheels from hubs. Set wheels aside. Install lug nuts and washers onto studs. Finger tighten only.

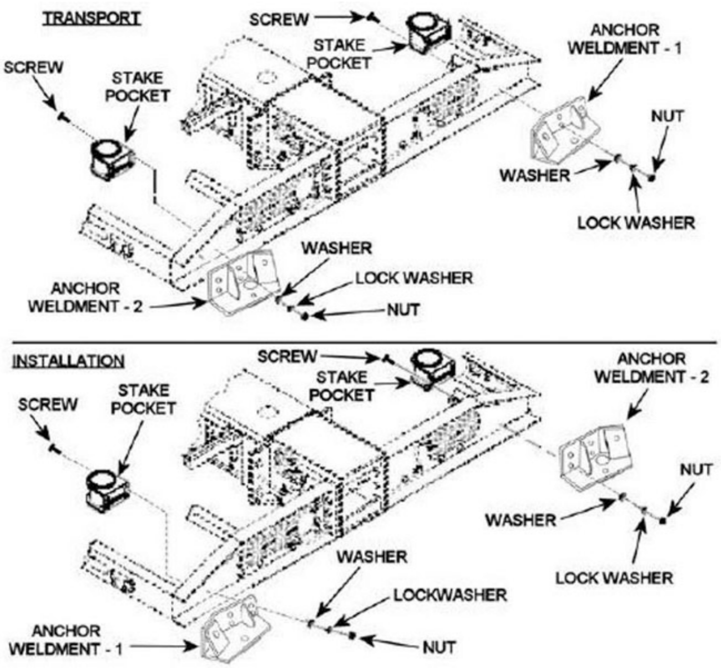

Figure 1–50. Anchor weldment positioning.

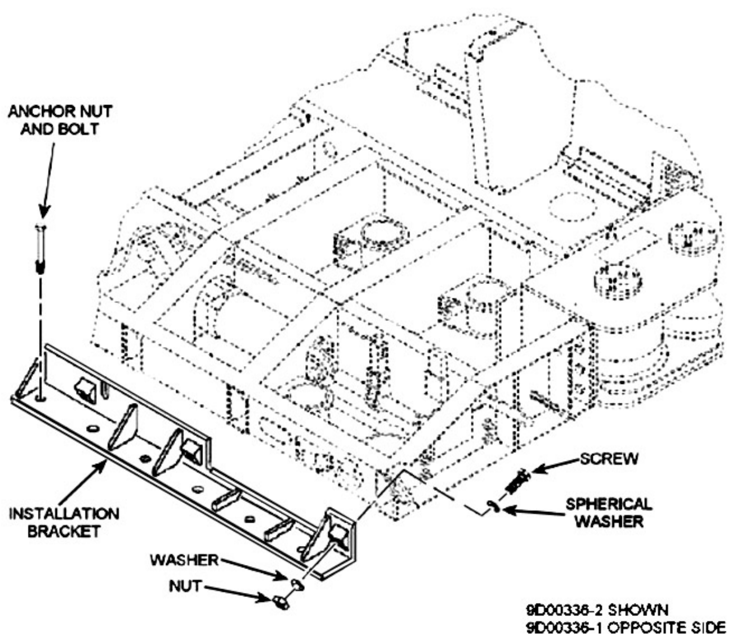

Figure 1–51. Concrete installation brackets.

Before the MRES can be aligned, the tape must be reeved. Follow the steps below to reeve the tape.

1. Pull a sufficient length of tape from each MAAS trailer to reach the edge of the runway.
2. If installed, remove the tape connector in accordance with T.O. 35E8–2–10–1.
3. Reeve the tape through the MRES as follows (see figure 1–52).
   a. Rotate tape 90 degrees clockwise (CW) to the horizontal and insert tape between the sheaves of the MRES rear sheave assembly.
   b. Remove inspection hole plugs from frame weldment's center tube portion of MRES assembly.
   c. Rotate tape 90 degrees counter-clockwise (CCW) to the vertical and insert tape between the sheaves of the MRES front sheave assembly.
   d. Reinstall inspection hole plugs.
4. Reinstall tape connectors onto tapes per TO 35E8–2–10–1.
5. Repeat steps (1) through (4) for the opposite side of the runway. Rotate the tape counterclockwise and clockwise, respectively.

CAUTION: Verify that 90 degrees tape twist on each side of runway between each aircraft arresting gear's exit sheaves and each MRES assembly's rear sheave is in the same direction, relative to the runway. Repeat steps (1) through (4) for the opposite side of the runway. Rotate the tape counterclockwise and clockwise, respectively.

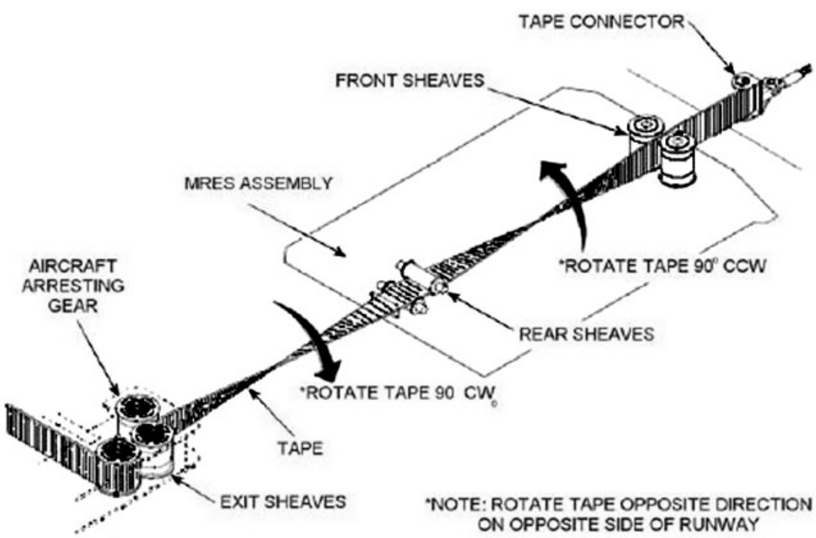

Figure 1–52. MRES tape reaving.

Aligning the system

Prior to installing the equipment, the two MAAS trailers and the two MRES trailers must be aligned. Follow the steps below to align the systems.

1. Install the pendant/hook cable assembly per TO 35E8–2–10–1.
2. Perform rewind and pretension tapes per TO 35E8–2–10–1.
3. The tensioned tape 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. Reposition MRES assemblies as required to remove all bow from tape, while keeping front sheaves at Marks B and C.

MRES soil installation

These instructions are for installation of the MRES on soil only.

Installation hardware

NOTE: Items and quantities shown are for the installation of one MRES trailer, and are supplied with the MRES. The installation items listed in figure 1–53 are required for installation of the MRES on soil.

Installation procedures

1. Verify that alignment anchors have been installed, and the pull-out alignment has been performed.
2. Verify that the alignment anchor turnbuckles are tight enough to hold the MRES in position.

Description	*Quantity*
Stake driving head	1
Drive shank, 1-1/4 inch hex	1
Load locker base frame	1
Reversible wrench	1
Wrench	1
Shovel	1
Extension piece	3
Coupler	4
Drive tip	1
T-handle pin	1
Anchor setting bar	1
Load locker assembly	1
Jaw set	1

Description	*Quantity*
Stake	32
Anchor weldment	1
Anchor weldment	1
Turnbuckle eye	6
Extension nut	6
Spherical washer	6
Double clevis link	6
Storage bag	3
Manta ray anchor for hard soil	6
Manta ray anchor for medium soil	6
Manta ray anchor for soft soil	6
Cap screw	1
Flat washer	1

Figure 1–53. MRES soil installation items.

Staking of MRES assembly

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

WARNING: When driving stakes, do not position hands near the stake driving head/stake interface. The stake driving head occasionally bounces off the stake. Insertion of fingers between driving head and stake can result in severe injury to personnel.

CAUTION: Place the MRES stake driver over each stake before driving the stake into the ground, and make certain the driving head stays square to the stake during driving. Failure to use the stake driver or to keep it square may result in deformation of the stake head which makes removal difficult.

NOTE: Do not install the body stakes in the MRES stake pockets until a tape pull-out has been performed approximately 300 feet in each direction, and you have verified the tape will track properly. Refer to figure 1–54. To stake each MRES assembly to the ground, drive all 32 stakes through the frame weldment's 32 stake pockets. Move covers as needed to gain access to stake pockets. The 24 body stakes in the center sections of the MRES should be driven to a depth which allows 8-10 inches of the stake to remain exposed. The 8 stakes in the sloped sections of the MRES should be driven to a depth which allows approximately 6.5 inches of the stake to remain exposed above ground. Make certain the stakes are driven deep enough to allow the covers to sit flush.

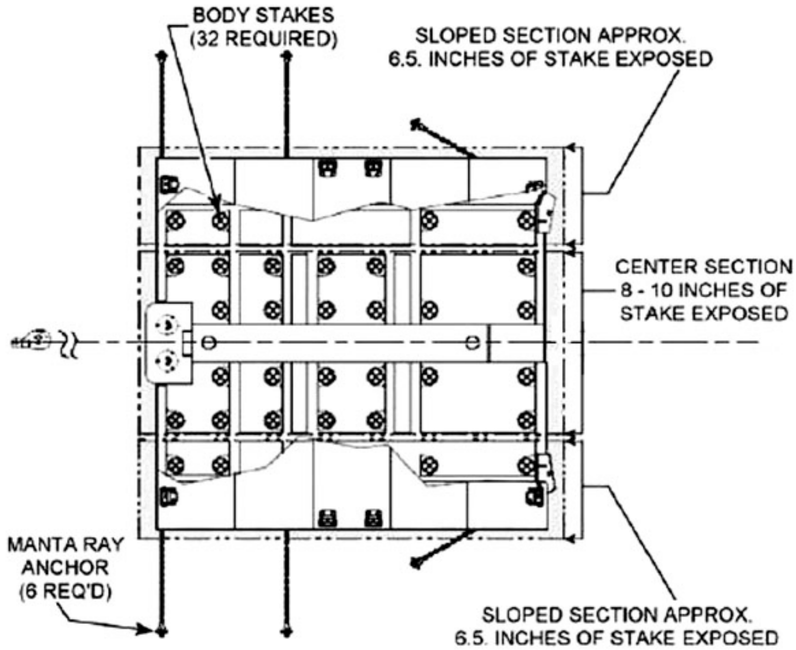

Figure 1–54. MRES stake body pocket locations.

Manta ray anchoring of MRES Assembly

Install Manta ray anchors as follows. Refer to figure 1–55.

1. Place the load locker base frame over the anchoring point on the frame (or anchor weldment) so its feet point away from the frame (or anchor weldment) and its “chute” hangs over the frame (or anchor weldment). Fasten the load locker base frame to the frame
2. About a foot away from the load locker base frame, dig a small hole with the shovel.
3. Place the Manta ray anchor assembly into the hole previously dug. Position the anchor at approximately a 30-degree angle to the ground, pointing away from the MRES assembly. Position anchor so that the double clevis link and the chain are on the top surface of the anchor. Lay out the chain so it can follow the anchor into the ground without catching or binding.
4. Connect the radiused drive tip to the 1¼-inch drive shank with a coupler.
5. Prepare a hydraulic breaker for operation. Use the HPU from the MAAS for hydraulic power.
6. Insert the 1¼-inch drive shank in the hydraulic breaker.
7. Using the load locker base frame as a guide, route the radiused drive tip into the driving socket of the Manta ray anchor.

WARNING: It is permissible to have an assistant stabilize the anchor with his foot to help drive it into the ground.

NOTE: If an object is encountered and no progress is made for two minutes or more, relocate the anchoring point. It may be possible to get the anchor out of the ground by keeping the drive gad assembly in the anchor and pulling gently with the chain.

8. Use the hydraulic breaker to drive the Manta ray anchor assembly into the ground. Stop when the first coupler penetrates the ground.

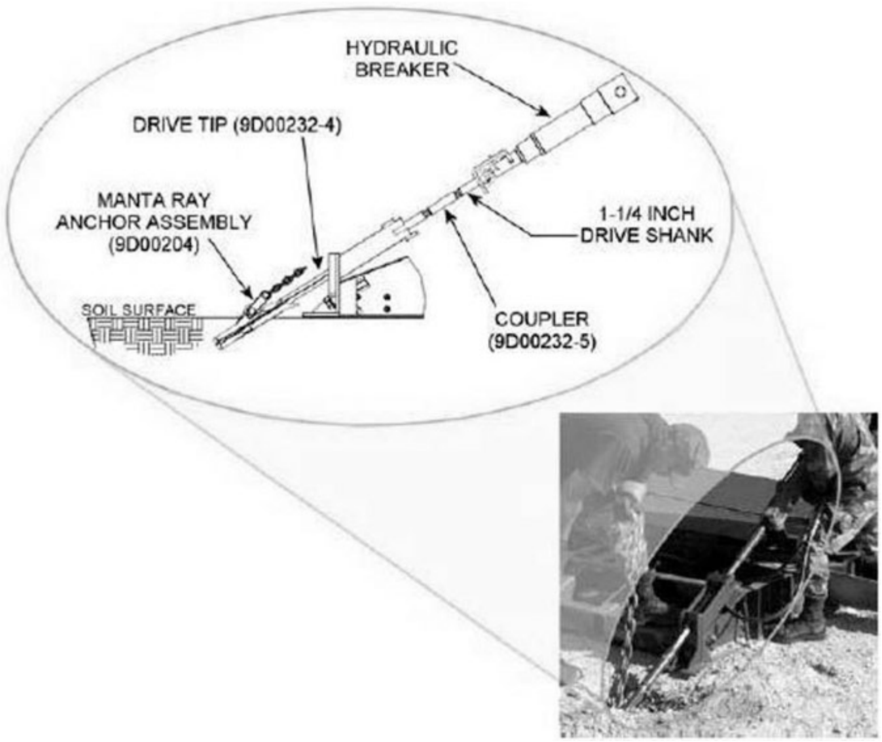

Figure 1–55. Manta ray installation.

NOTE: Do not remove the stinger drive gad assembly from the Manta ray anchor assembly. The drive gad assembly pieces are threaded, and should be removed by unscrewing (reverse thread is used). The drive gad assembly is NOT fastened to the Manta ray anchor, and will be pulled out of the anchor if the drive gad assembly pieces are pulled on. Do not remove the drive gad assembly from the Manta ray anchor until the anchor has been fully driven to the desired depth.

9. Separate the hydraulic breaker from the 1¼-inch drive shank (Do not remove the stinger drive gad assembly parts from the Manta ray anchor assembly). Then attach another coupler and repeat until only 6 chain links are above ground

CAUTION: Wear gloves and other protective equipment when handling the breaker and drive gad assembly. During installation the breaker and the drive pieces of the drive gad assembly can become hot and cause burns.

NOTE: If the drive gad assembly does not break free (such as when rocks lodge against the drive gad assembly in dry soil or if soft soil and mud sag around the drive gad assembly), remove hydraulic breaker from the 1¼-inch drive shank. Separate the drive gad at the third coupler. Install gad extractor bar in third coupler, then use the load locker assembly to pull the drive gad assembly free.

10. Pull upward on the hydraulic breaker to remove the drive gad assembly parts from the Manta ray anchor assembly. If the drive gad assembly does not break free immediately, pull up on the hammer while engaging the trigger to “creep” the drive gad assembly up and out of the anchor. Refer to figure 1–56, Manta Ray Load Locker.

11. Remove the T-handle pin from the anchor setting bar and then insert the anchor setting bar through the “chute” in the load locker base.
12. Attach the anchor setting bar to the end of the chain by using the T-handle pin.
13. Slide the load locker assembly down over the anchor setting bar until the “ears” on the load locker rest in the matching slots in the load locker base.
14. While pulling upward on the end of the anchor setting bar until the anchor chain is tight, place the jaw set in position around the anchor setting bar and push downward until the jaws are firmly in position on the top of the load locker.
15. Disconnect HPU hydraulic lines from the hydraulic breaker. Connect them to the fittings on the load locker assembly.
16. Move the valve handle on the load locker assembly to the up position. The load locker pulls up on the chain once and then stops.

NOTE: The relief valve on the load locker can be set to open at 10,500 psi, which will “automatically” hold constant pressure. Refer to the manufacturer’s manual for instructions on setting the relief valve pressure.

17. Check the gauge reading on the Manta ray load locker assembly. The desired reading on the gauge is 10,000 pounds. A gauge reading at or above the minimum must be held for one minute to assure that the anchor has pivoted enough to anchor firmly enough in the ground to meet specifications. During the one minute test period, the anchor setting bar shall not move more than 0.5 inches. If the anchor setting bar moves more than 0.5 inches, reposition the installation to an undisturbed location, and use a larger anchor.

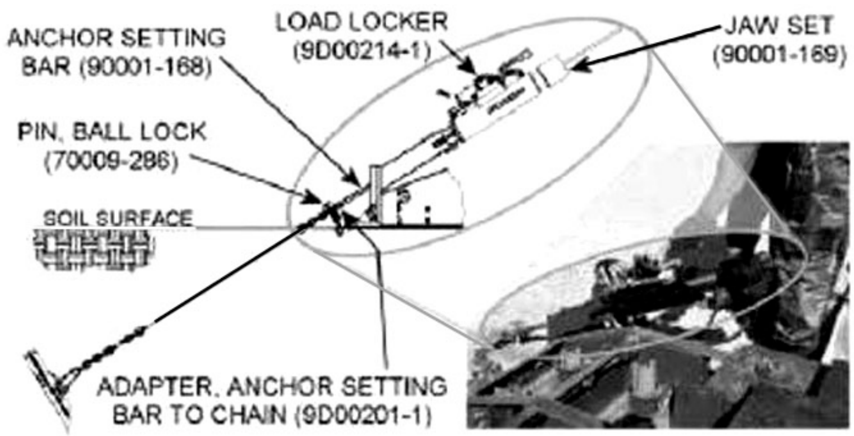

Figure 1–56. Manta ray load locker.

18. Install a turnbuckle eye, a spherical washer, and an extension hex nut. If working at a frame hole, place the turnbuckle eye so the eye points out and the extension hex nut and washer are inside the frame. If working at an anchor weldment hole, place the turnbuckle eye so the eye points out and forward, and the extension hex nut and washer are in and rearward.
19. Connect the appropriate link in the chain to turnbuckle eye with a double clevis link.
20. Turn turnbuckle eye so the eye opening faces the ground. Hold turnbuckle eye in this position with wrench.
21. Tighten the extension hex nut.
22. Remove the alignment turnbuckles from the MRES and from the stakes.
23. Remove the stakes from the ground.
24. Store alignment anchoring hardware.

MRES concrete installation

In some cases the MRES will be installed on concrete. This generally will be on a prepared concrete pad. However, this configuration can be done as part of a minimum operating strip installation.

Installation hardware

NOTE: Items and quantities shown are for the installation of one MRES trailer, and are supplied with the MRES. The installation items listed in figure 1–57 are required for installation of the MRES on concrete.

Description	*Quantity*
Installation bracket	1
Installation bracket	1
Anchor weldment	1
Anchor weldment	1
Screw, hex head	6
Nut	6
Washer	6
Washer, spherical	6
Taper bolt	14
Storage bag	3

Description	*Quantity*
Ratchet, ¾" drive	1
Extension, 4"	1
Socket, 1-1/2" x 3/4" drive	1
Tape Measure, 100'	1
Adjustable wrench, 20"	1
Hammer, 4 lb	1
Taper bolt gauge	1
Hydraulic hammer drill	1
Helical bit	1
Tubing, round, 1-1/2"x24" long	1

Figure 1–57. MRES concrete installation items.

Installation procedures

1. Verify that the alignment anchors have been installed, and the pull-out alignment has been performed.
2. Verify that the alignment anchor turnbuckles are tight enough to hold the MRES in position.
3. Using a 1-inch bit, operate the hydraulic hammer drill from the MAAS.
4. Using each installation bracket as a template (fig. 1–58), drill 1-inch diameter holes in the concrete to a depth of 7 inches. To maintain bracket position, after each hole is drilled, insert a taper bolt, nut, and washer into each hole to a depth of one-half the bolt length. Adjust the taper nut such that inserting requires tapping with a 4-pound hammer. Six holes each are required in installation brackets 9D00336–1 and 9D00336–2. One hole each is required for anchor weldments 9D00283–1 and 9D00283–2. If an asphalt overlay of 1 inch or less is present, drill through the asphalt and into the concrete to a depth of 6 inches.
5. Remove the alignment turnbuckles from the MRES and from the turnbuckle eyes.
6. Remove the turnbuckle eyes from the holes in the concrete.
7. Store alignment anchoring hardware.
8. Repair (plug) the holes in the concrete.

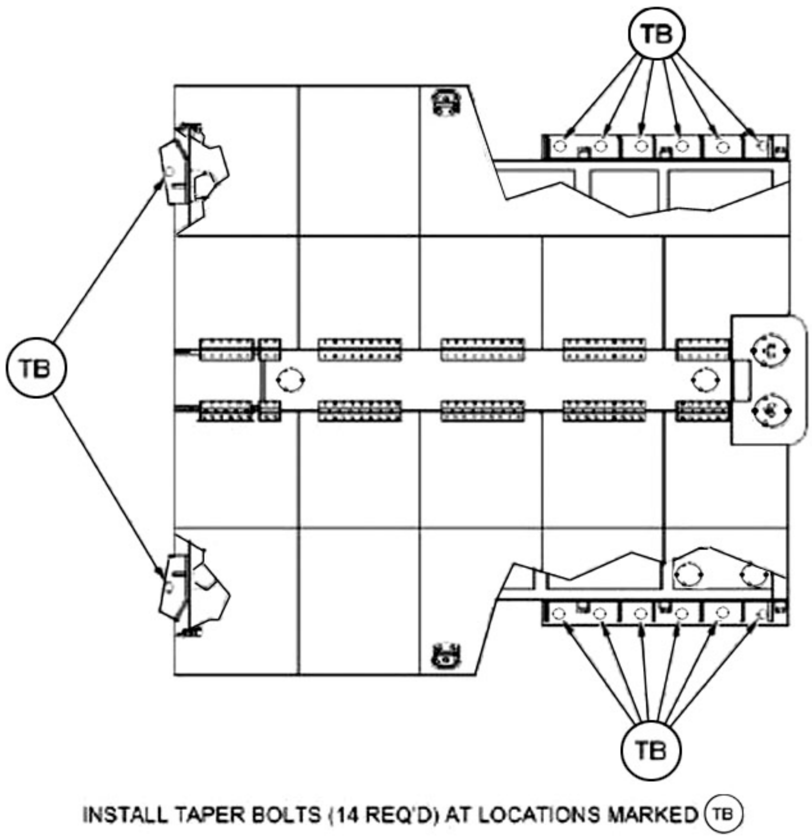

Figure 1–58. MRES concrete anchoring.

Final alignment

The final alignment of the MRES is accomplished by performing an alignment pullout of the system to confirm the tapes are tracking evenly. The task should be accomplished in accordance with the following steps extracted from the technical data:

NOTE: Tapes should be pulled from the reel with the minimum brake pressure possible (shuttle valve OFF) to avoid moving the trailers. Before adjusting a turnbuckle when aligning the MRES during pullout, loosen the turnbuckle on the opposite side of the MRES.

1. Using a truck, or similar tow vehicle, slowly pull the tapes down the runway approximately 300 feet.
2. Observe tape tracking at each MRES rear sheave assembly during the pullout.
3. Adjust turnbuckles on MRES alignment anchors to center tape on rear tape sheaves during pullout.
4. Rewind tape per T.O.35E8–2–10–1.
5. Repeat steps to pull tape out in the opposite direction.
6. When tape is centered, make certain that both turnbuckles are tight enough to prevent movement of the MRES.
7. Repeat steps 1–6 for the MRES on the opposite side of the runway.

When you have completed the final alignment procedures it is time to perform proof loading and the functional checkout of the entire (MAAS and MRES) assembly.

Daily inspections

Once installed the MRES and prepped for use the MRES is considered an operational aircraft arresting system. With this in mind, we will follow the same maintenance regiment that we utilize on all other systems.

Front tape sheave assembly

Visually inspect each sheave for damage, cracks, and other faults. Rotate each sheave and listen for unusual sounds which may indicate internal damage.

Rear tape sheave assembly

Visually inspect each sheave for damage, cracks, and other faults. Rotate each sheave and listen for unusual sounds which may indicate internal damage.

Tape guides

Inspect all tape guides for wear. Verify no tape guide is excessively worn. Inspect attaching screws to verify that tape guides are attached securely. If any portion of the guide is worn in excess of one-third of the original thickness of the guide, replace the tape guide.

Weldment

Inspect front sheave weldment for burrs and sharp edges at the tape entry and exit points.

Monthly inspections

The monthly inspection criteria for the MRES includes lubrication of the deck sheave components and inspection, and maintenance, of the trailer assembly. Individual inspection items includes the following.

Brake lines

Inspect the brake lines and fittings for leaks.

Surge brake actuator

Check brake fluid. If it is dirty, cloudy, or watery, drain and replace the fluid. Check that the actuator is filled to the indicator below the filler opening. Add fluid as required.

Parking brake cable assembly

The MRES manual includes instructions to adjust the parking brake assembly. Parking brakes may seem minor in importance most of the time, but if they do not work when you need them problems will arise, not to mention some explaining to do. The following steps highlight the maintenance needed to keep the parking brakes in operational status and you out of trouble for a MRES that rolls into the side of the building.

1. Using ratchets in front corners of MRES assembly, and using the tow bar jack, lower the MRES assembly until it is flat on the ground.
2. Continue turning ratchets until wheels are at their maximum heights.
3. With the parking brake disengaged, the wheel should turn freely. With the parking brake engaged, the wheel should not turn. If required, adjust the parking brake in accordance with MRES technical order instructions.
4. Repeat steps 1 through 3 for the other parking brake and wheel.

Take-up assembly

Inspect the suspension arm, clevis, spring rod, spring, spring sleeve, and sleeve end plate for damage (disassembly is not required unless damage is evident). Also check ratchet assembly, particularly the ratchet teeth and catch and the eye bolt threads, for damage. Repair or replace any damaged parts.

Verify all attaching hardware is present and serviceable; replace any missing or damaged attaching hardware.

Tow bar assembly

Inspect tow bar components for damage. Verify the wheel is serviceable and the jack can move tow bar end of MRES assembly up and down. Verify all attaching hardware is present and serviceable. Replace any broken or missing attaching hardware.

In this lesson, we have covered the setback kits used throughout the USAF contingency environment. With the use of these systems, we enhance our operational capabilities and make your job as a technician a little easier. The capabilities are enhanced by allowing the MAAS to be safely used for bi-directional engagements. Your job is easier because the MAAS does not have to be right on the side of the runway where time is limited for performing maintenance. Yes you will still have your hands full but at least you will not have the wing of a heavy aircraft traveling right over your MAAS each time one lands.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

606. Lightweight fairlead beam

1. What are the three main components that make up a LWFB?

2. How many stakes are required for a soil installation of a lightweight fairlead beam?

3. When can tape tracking be best observed?

607. Mobile runway edge system

1. What advantages does the MRES offer over the LWFB?

2. How many stake pockets does each MRES assembly have?

Answers to Self-Test Questions

601

1. Webbing assembly, deck hooks, arresting chains, main stanchions, intermediate stanchions, main control box, auxiliary control box, electrical system, compressed air system, and pendant assembly.
2. The springs allow the cable to yield as the aircraft runs over it.
3. Anchor chains resting in place parallel to the runway.
4. 25 feet.

602

1. To remove the kinetic energy of the moving aircraft and to halt its forward motion in a controlled manner to save the pilot and crew.
2. A single upper horizontal strap and two independent lower horizontal straps.
3. Small, flat devices that are fastened to the runway surface.
4. The mast assembly is the 23-foot post that holds the net in position in order to perform the arrestment.
5. An anchoring point for the guy wire and net tensioning wire.
6. Directs hydraulic fluid, at high pressure, to operate the stanchion and provides a return path to the reservoir for the low-pressure fluid returning from the cylinders.
7. The appropriate limit switch interrupts the signals to the hydraulics, and the system shuts down.
8. Anchor chains, BAK–12, or the textile modular brake.

603

1. Maintenance free, performance flexibility, easy transportation, quick installation, and cost effectiveness.
2. Two Tirfor winches.
3. Two tearing straps stitched together.
4. Each braking stage unit has 10 braking modules on each side of the runway.

604

1. By torsion springs.
2. An elastomeric material.
3. An up bumper.
4. A three-way solenoid valve.
5. The control tower.
6. A mercury-type limit switch.
7. A check circuit in the pit.
8. To keep the run of pneumatic tube and the operating cylinders from freezing if moisture is trapped in the pneumatic system; to keep the trough sections and drains free from ice.
9. (1) Box heaters.
   (2) Trough heaters.
   (3) End trough heaters.
   (4) Cross-runway drain heaters.

605

1. It pulls the support arm and support block back into the lowered position when the ramp moves to the low spot.
2. 14 blocks for runways up to 150 feet wide and 18 blocks for runways from 150 feet wide to 300 feet wide.
3. 1.5 seconds.

606

1. A beam and two sheaves.
2. 52 stakes per beam.
3. During the monthly functional pullout.

607

1. It can be installed on soil or concrete; it has an integrated trailer so it can be installed without the need of a forklift.
2. 32.

Do the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

Do not return your answer sheet to the Air Force Career Development Academy (AFCDA).

1. (601) Which components of the MA–1A arresting barrier provide a certain amount of slack for the arresting cable?
   a. Deck hooks.
   b. Arresting chains.
   c. Webbing assemblies.
   d. Intermediate stanchions.

2. (601) On an MA–1A arresting barrier, the arresting chain is doubled after the first
   a. 30 feet.
   b. 60 feet.
   c. 90 feet.
   d. 120 feet.

3. (601) Which component of the MA–1A arresting system is used to pre-tension the hook cable?
   a. Winch.
   b. Pull lift.
   c. Tension springs.
   d. Pre-tensioning pad.

4. (601) When an aircraft nose wheel engages the webbing on an MA–1A arresting barrier, this action triggers a steel cable to engage the aircraft's
   a. tail hook.
   b. nose gear.
   c. wing frame.
   d. main landing gear.

5. (601) On the MA–1A arresting barrier compressor, what is the normal air pressure stored in the accumulators?
   a. 1,200 per square inch (psi).
   b. 1,500 psi.
   c. 1,800 psi.
   d. 2,100 psi.

6. (601) Where is the E–5 unidirectional barrier typically installed on the runway?
   a. On the overrun.
   b. At midfield.
   c. At the 1200 foot mark.
   d. At the 5000 foot mark.

7. (601) When an aircraft engages the pendant on an E–5 arresting system, tension increases rapidly and causes the
   a. webbing to break.
   b. shear pins to break.
   c. anchor chains to break.
   d. arresting cable to engage the main gear of the aircraft.

8. (602) To avoid obstructing landing aircraft, the BAK–15 arresting system can lower the net in about
   a. one second.
   b. three seconds.
   c. five seconds.
   d. fifteen seconds.

9. (602) On a BAK–15 arresting system, what holds the net upright and centered on the runway in its arrestment position?
   a. Anchor plates.
   b. Anchor straps.
   c. Shock absorbers.
   d. Suspension system.

10. (602) What component of a BAK–15 arresting system holds the bottom of the net in place on the runway?
    a. Anchor plates.
    b. Anchor straps.
    c. Shock absorbers.
    d. Suspension system.

11. (602) What is the 23-foot post that holds the net in position in order to perform the arrestment on a BAK–15?
    a. Anchor plates.
    b. Anchor straps.
    c. Mast assembly.
    d. Suspension straps.

12. (602) On a BAK–15, what is used to tighten or loosen the net tensioning wire, thus determining the height of the net during an arrestment?
    a. Backstop clutch.
    b. Lever chain hoist.
    c. Tensioning spring.
    d. Elementary net.

13. (602) When the BAK–15 stanchions are elevated, they are held securely in the upright position by the
    a. limit switch disconnect system.
    b. cable support centering system.
    c. guy wire anchor support system.
    d. over-center locking arm mechanism.

14. (602) To prevent damage to the equipment when it is in the fully raised and fully lowered positions, the BAK–15 stanchion system is fitted with
    a. limit switches.
    b. circuit breakers.
    c. locking mechanisms.
    d. rubber support disks.

15. (602) When an aircraft engages the BAK–15 arresting system, what causes the net to release from the stanchions?
    a. Tear away straps.
    b. Shear link devices.
    c. Photo electric sensors.
    d. Laser disconnect system.

16. (603) What is one of the many advantages the textile brake system offers?
    a. Less energy absorption than other systems.
    b. Detailed hydraulic system.
    c. Heavy anchoring system.
    d. Easy transportation.

17. (603) What size is the pendant on a textile brake system?
    a. ¾ inch.
    b. 1 inch.
    c. 1¼ inches.
    d. 1½ inches.

18. (603) What protects the yoke on a textile brake system?
    a. Shear links.
    b. Retainer nut.
    c. Neoprene cover.
    d. Short connecting straps.

19. (603) When an aircraft engages the textile brake arresting system, the kinetic energy of the aircraft is absorbed when the
    a. stanchions are activated.
    b. two tearing straps separate.
    c. arresting chain is laid out on the runway.
    d. steel cable engages the main landing gear.

20. (603) In a bidirectional configuration of the textile brake arresting system, how many braking modules are on each side of the braking stage unit?
    a. 2.
    b. 5.
    c. 7.
    d. 10.

21. (604) How many rubber support blocks does the BAK–14 system have for supporting the pendant two inches above the runway surface?
    a. Either 3 or 9.
    b. Either 7 or 10.
    c. Either 14 or 20.
    d. Either 20 or 32.

22. (604) How does the BAK–14 support system pendant retract into the runway trough?
    a. Pneumatic system.
    b. Hydraulic control.
    c. Torsion springs.
    d. Manual control.

23. (604) Which component of the BAK–14 support system aids in venting the pneumatic system?
    a. Control switch.
    b. Quick-exhaust valve.
    c. Manual override valve.
    d. Three-way solenoid switch.

24. (604) What is the purpose of the box heater in a BAK–14 support system?
    a. Keep the arresting support system at a constant temperature of 50º.
    b. Protect the trough sections from freezing moisture.
    c. Protect the air cylinder from freezing moisture.
    d. Defrost the support box system if it freezes.

25. (605) What houses the hydraulic power unit, sump pump, electrical panel, and heating resistors on a Type-H support system?
    a. Retraction module.
    b. Motor drive pit.
    c. Precast manhole.
    d. Trough assembly.

26. (605) What is the function of the electric motor in the Type-H support system's motor drive unit?
    a. Move the pendant up and down.
    b. Operate the heaters in the pit and trough.
    c. Create the back-and-forth movement of the ramps.
    d. Drive the hydraulic fluid from the reservoir to the jack.

27. (605) In a Type-H support system, which component pulls the support arm and support block back into the lowered position when the ramp moves to the low spot?
    a. Torsion spring.
    b. Air compressor.
    c. Drawback cable.
    d. Mechanical lever.

28. (605) What controls the heaters in a Type-H support system?
    a. Thermostats.
    b. Field cabinet.
    c. Limit switches.
    d. Remote sensors.

29. (605) If a Type-H support system is installed correctly, the support blocks will be approximately how many feet apart?
    a. Two.
    b. Five.
    c. Eight.
    d. Twelve.

30. (605) How fast does the Type-H support system retract or raise the pendant?
    a. .75 second.
    b. 1.5 seconds.
    c. 2.5 seconds.
    d. 5 seconds.

31. (606) How far are purchase tapes rotated in the clockwise (CW) direction before the tape is inserted into the rear sheaves of the lightweight fairlead beam (LWFB)?
    a. 45 degrees.
    b. 90 degrees.
    c. 120 degrees.
    d. 180 degrees.

32. (606) What is the total number of stakes needed to install the lightweight fairlead beam (LFWB) in soil?
    a. 26.
    b. 32.
    c. 42.
    d. 52.

33. (607) What is the desired reading on the manta ray load locker assembly when testing for security?
    a. 9,000 pounds.
    b. 10,000 pounds.
    c. 11,000 pounds.
    d. 12,000 pounds.

Please read the unit menu for unit 2 and continue ➔

Student Notes

Unit 2. Operational Systems

ALL AIRCRAFT ARRESTING systems are emergency systems. Also there are times when more than one aircraft needs the system to get on the ground safely. The next aircraft cannot wait for a lengthy amount of time for us to reset the system. This is why the Air Force has operational aircraft arresting systems. These systems can be reset quickly to catch multiple aircraft. The system of choice is the BAK–12 and in expeditionary environments or where an arresting system is only needed temporarily the mobile aircraft arresting system is used.

2–1. BAK–2 Aircraft Arresting System

The BAK–12 is the standard USAF operational aircraft arresting system. This bi-directional system employs two energy absorbers, each equipped with two multi-disc rotary friction brakes mounted on either side of the purchase tape reel on a common shaft. The barrier has a quick recycle capability that allows engagements at only 5-minute intervals.

608. System components and theory of operation

The following paragraphs describe the features associated with the BAK–12 system using a Wisconsin model engine (fig. 2–1). In order to understand how to maintain the BAK–12 you must know the components, where they are located, and understand how it functions.

Figure 2–1. BAK–12.

Energy-absorbing capacity

The energy-absorbing capacity is specified as 65,000,000 (65×10^6) foot-pounds, which is determined by the aircraft weight, maximum engaging velocity, and run out.

Rewind system

The retraction system used to rewind the tape on the storage reel consists of an engine, a fluid coupling, a gear reducer, and the rewind clutch.

The rewind engine supplies power for the retraction system through a sheave and shaft assembly bolted to its flywheel. The output shaft of the fluid coupling attaches to the input shaft of a 15–to–1 gear reducer. The gear reducer output shaft connects to the reel shaft rewind sprocket by a chain drive arrangement. The rewind clutch connects the rewind sprocket to the reel assembly shaft.

The tape stops reel rotation when the rewind cycle is completed. The fluid coupling continues to transmit the rewind engine torque to the rewind drive system, pre-tensioning the tapes. Accumulator pressure maintains the pre-tension. Actuating the shuttle valve applies this pressure to the brakes. The rewind system pre-tensions the pendant to 1,500 to 2,000 pounds.

A telltale tachometer records maximum tape reel revolutions per minute (rpm) during an arrestment. The cam gearbox drive chain drives the tachometer. During an arrestment, the telltale needle stops at the maximum rpm encountered during the operation.

If the tachometer malfunctions, a hydraulic pressure gage connected to the brake pressure line can correlate pressure to aircraft engaging speed. The pressure gage is for synchronization and hydrostatic testing.

Reel assembly

The reel assembly consists of a tape storage reel mounted on a common shaft with a multiple-disc brake on each side of the reel. As the aircraft engages the pendant, the tape storage reel begins to turn and pay out the tape. The tape reel drives the hydraulic system pump. This causes fluid to flow through a cam-actuated control valve and onto the brakes. The brake pressure is in relation to the speed of the reel, creating friction that slows and stops the aircraft.

The shaft rotates on self-aligning bearings positioned in pillow blocks located at each end of the assembly. The stationary portion of the brake bolts to the pillow blocks. The braking unit can be water-cooled to prevent overheating caused by successive arrestments.

Reel motion during an arrestment drives two sprocket assemblies, which mount on the hydraulic system end of the reel shaft. One sprocket drives the main hydraulic pump, and the other drives the cam control valve through a gear reducer. The pump drive sprocket incorporates a clutch that automatically disengages the sprocket during the rewinding of the tapes to the BATTERY position following an arrestment. The entire reel assembly mounts on a steel base, which supports the hydraulic retraction, brake cooling, and synchronizing systems, as well as the tape leadoff sheave.

Hydraulic system

The hydraulic system is a “closed” recirculating system and requires approximately 4½ gallons of hydraulic fluid per unit. Three hydraulic subsystems make up the complete hydraulic system of the unit. The subsystems are the static system, the main or braking system, and the rewind clutch system.

A reservoir, which is common to these three subsystems, supplies hydraulic fluid. The reservoir has a sight gauge for maintaining the proper fluid level. Figure 2–2 shows a schematic of the hydraulic system.

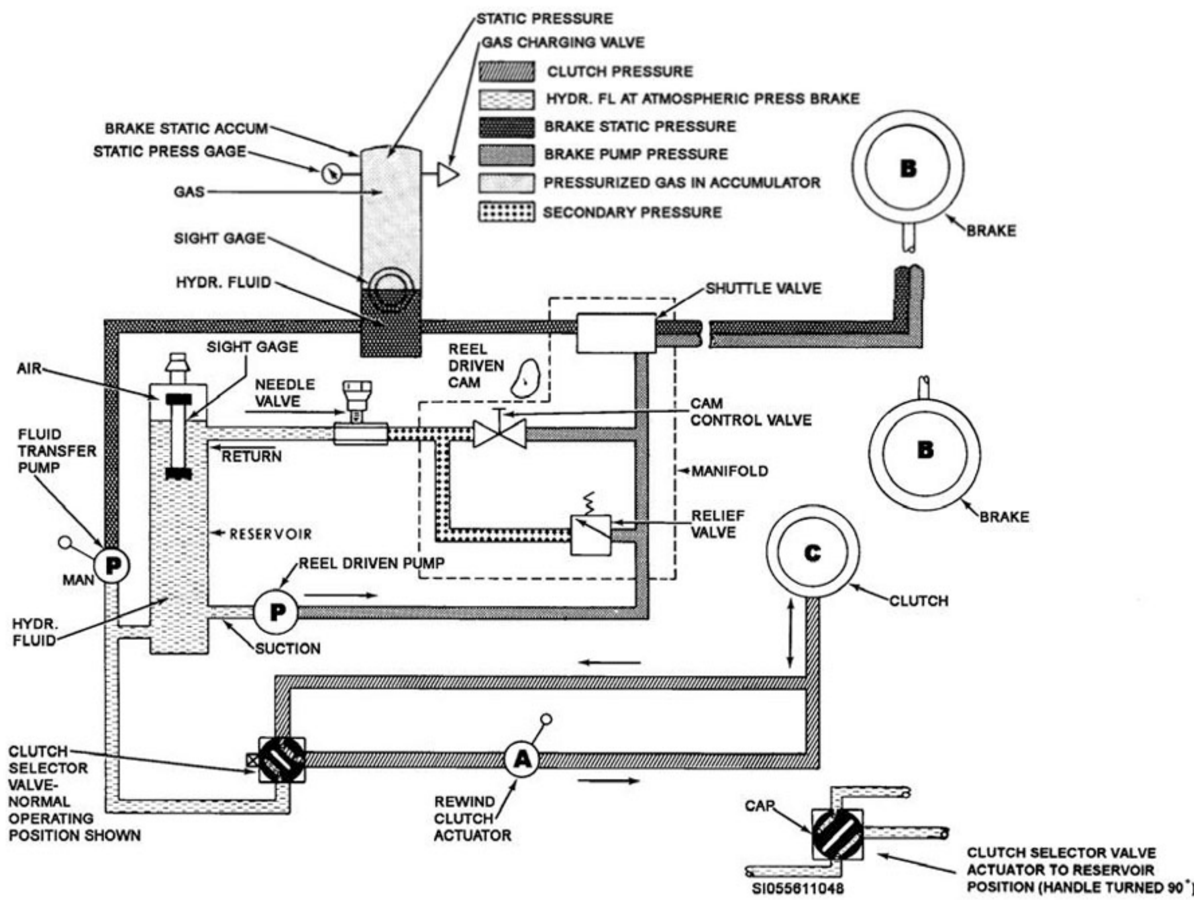

Figure 2–2. BAK–12 hydraulic system schematic.

Static system

The static system contains an accumulator, a fluid replenishing hand pump, and a shuttle valve. The static system connects to the main system by this shuttle valve, which locks out the static pressure once the main hydraulic system pressure assumes control of the arrestment. The static pressure system applies a light pressure to the brakes so it can maintain the proper tension on the tapes and pendant while they are in the BATTERY position.

The accumulator maintains the static pressure of 175 pounds per minute (psi) of dry nitrogen. To transfer hydraulic fluid from the reservoir to the accumulator, you must use the hand pump. To help the technician or operator determine the fluid level, the accumulator is equipped with a sight glass at the bottom. It is also fitted with a pressure gauge to show the static pressure, and a valve for admitting the charging gas. Always keep the fluid level in the accumulator at the halfway point to prevent the nitrogen gas from entering the brake lines.

The pressure in the accumulator applies the fluid to the brakes through the shuttle valve. When the valve is in the ON position, fluid from the accumulator is applied to the brakes through this shuttle valve, thus applying a light brake pressure to maintain the pendant tension. As pressure from the reel-driven pump, which the cam control valve controls, exceeds the static pressure, the valve spool shifts to block the static pressure. A reset latch holds the valve spool in this new position until the operator manually releases it. This mechanical latch stops the shuttle valve from reapplying static pressure to the brakes and permits the rewinding of the tape with the brakes disengaged.

NOTE: Certain slow-speed arrestments may not permit the reel-driven pump to generate enough pressure to shift the shuttle valve. In this condition, the accumulator pressure of 175 psi applied to the brakes is enough to stop the aircraft, but the operator must shift the shuttle valve manually to release the brakes and to rewind the tape.

Once the tapes are rewound and pendant pre-tensioned, press down on the reset lever of the shuttle valve. When the reset lever changes, the accumulator pressure shifts the shuttle valve to the ON position and allows static pressure to be applied to the brakes.

Main or braking system

To stop the aircraft, the braking or main hydraulic system provides the required pressure to the brakes. The action of a cam controls the hydraulic pump, a pressure relief valve, and a control valve. The cam control valve controls the output pressure of the hydraulic pump. The hydraulic pump is chain-driven from the tape reel shaft. The cam for the control valve is chain-driven from the tape reel shaft through a gear reducer.

When an arrestment takes place and the tape reel starts turning, the hydraulic pump starts pumping fluid through the cam control valve back to the reservoir. As more nylon tape pays out, the cam starts closing the control valve, which restricts the bypass line to the reservoir. This restriction causes an ever-increasing output pressure from the pump to the shuttle valve. When the pump pressure exceeds the static pressure, the shuttle valve shifts and allows this pump pressure to be applied to the brakes. As the aircraft continues to pay out the tapes the pressure continues to increase until the aircraft comes to a complete stop. A relief valve in the hydraulic manifold prevents the pressure in the hydraulic system from exceeding system limitations.

The purchase tape is a woven nylon belt specially treated with a chemical solution to increase its strength. This treatment increases the tape's resistance to wear and dimensional stability. The inside of the tape contains bundles of longitudinal nylon fibers. These fibers are the primary load-bearing members. The edge of the tape has reinforcement to protect the fibers from wear.

The tape connector, shown in figure 2–3, connects the purchase tape to the pendant. The pendant end attaches with a pinned tongue and jaw arrangement. The tape attaches to the connector with a mechanical clamping arrangement with the tension of the tape providing the clamping force, shown in figure 2–4. This figure also shows the correct reeving of the tape on the tape connector. Notice that proper reeving has the tape and metal alternating with the bitter end toward the top. This is a very important arrangement; be sure you follow the TO to perform this procedure.

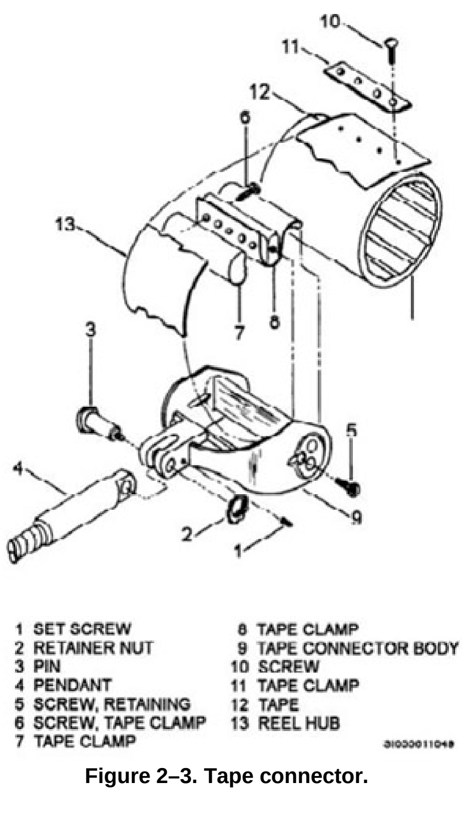

Figure 2–3. Tape connector.

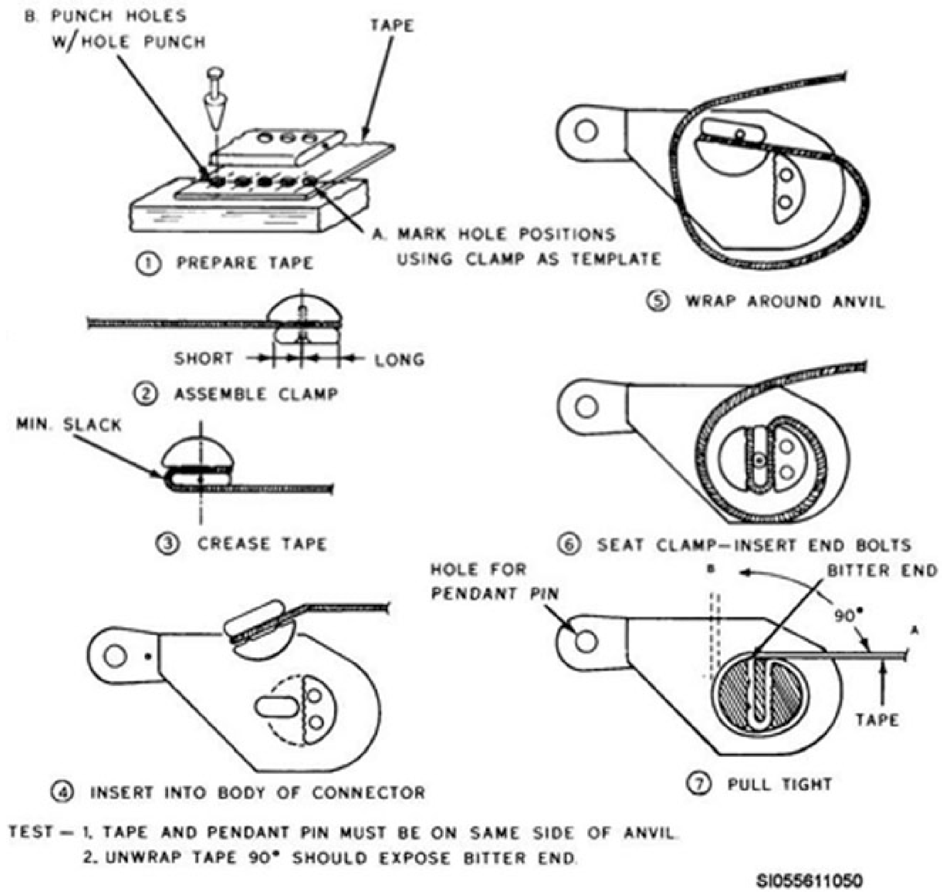

Figure 2–4. Assembling tape in tape connector.

A tape connector tire casing eliminates tape twist caused by the rolling action of the pendant supports. The tires also minimize wear on the tape connectors without compromising the performance of the arresting barrier.

Rewind clutch system

The rewind clutch system contains an actuating pump, a hose assembly, a swivel joint, a selector valve, and a friction clutch. The friction clutch connects a rewind sprocket to the reel assembly shaft to rewind the tape on the storage reel after an arrestment.

The pump selector valve connects the pump inlet to the hydraulic fluid from the reservoir. When the position of the selector valve is changed, the fluid flows from the pump to the rewind clutch. Only use the selector valve when replenishing the fluid supply in the pump or do work on the clutch hydraulic system.

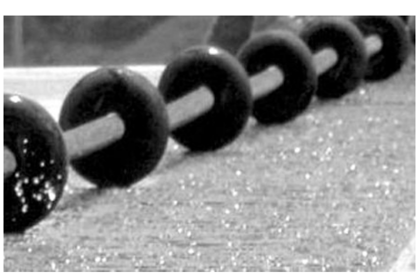

Figure 2–5. Pendant and support discs.

Applying manual pressure to the pump handle causes the clutch to engage. Releasing the pressure on the pump handle allows the return springs in the clutch to return the fluid to the pump for storage in the pump cylinder bore.

Pendants

The pendant is a 1- or 1¼-inch diameter wire rope of 18 by 7 strand, non-rotating cable construction. Synthetic rubber discs (donuts) support the pendant above the runway surface. Figure 2–5 shows the pendant supports and cable. Typically a 1¼-inch pendant is used on operational installations of the BAK–12.

Fairlead tube

The fairlead tube is used between the BAK–12 and the fairlead beam. This tubing protects the tape as it travels between the fairlead beam and the arresting engine. Without the tubing, the tape would be subject to deterioration by sunlight and abrasion by wind flapping, and vehicle damage could result. The tubing also protects against mud, snow, and wet sand.

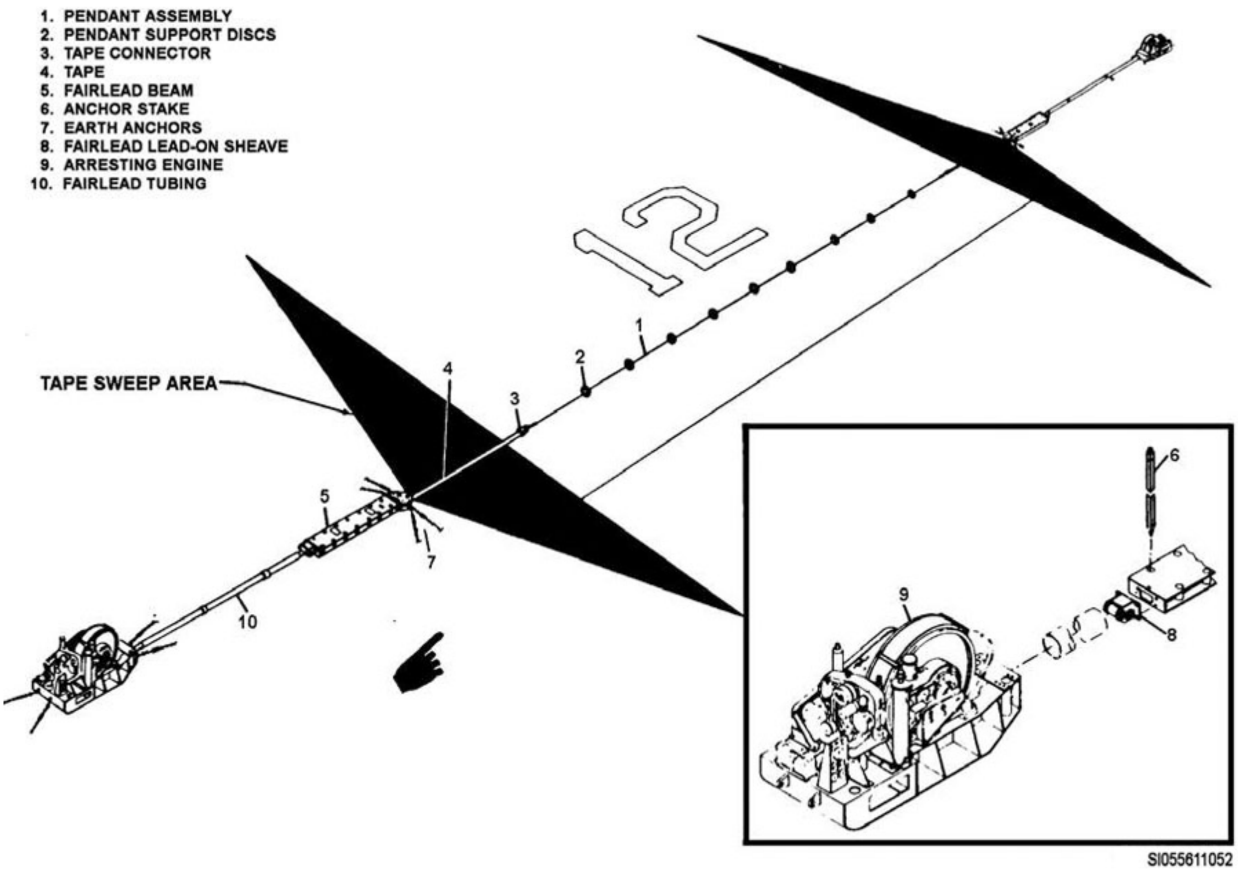

Figure 2–6. BAK–12 standard expeditionary installation.

Configurations

Figure 2–6 (above) shows a standard expeditionary BAK–12 installation and figure 2–7 shows a bolted-up expeditionary installation. Figure 2–8 shows a semi-permanent system installation. Figure 2–9 shows a pit installation.

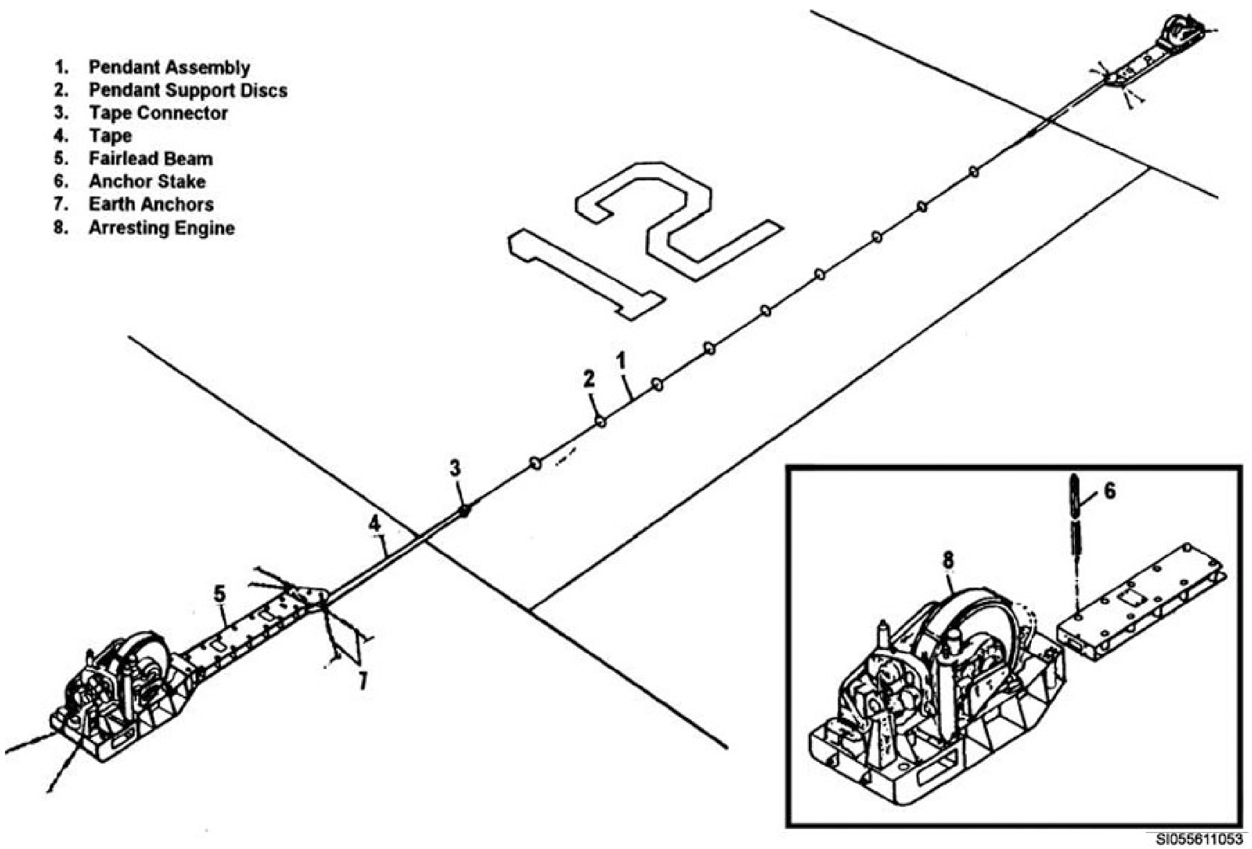

Figure 2–7. BAK–12 bolted-up expeditionary installation.

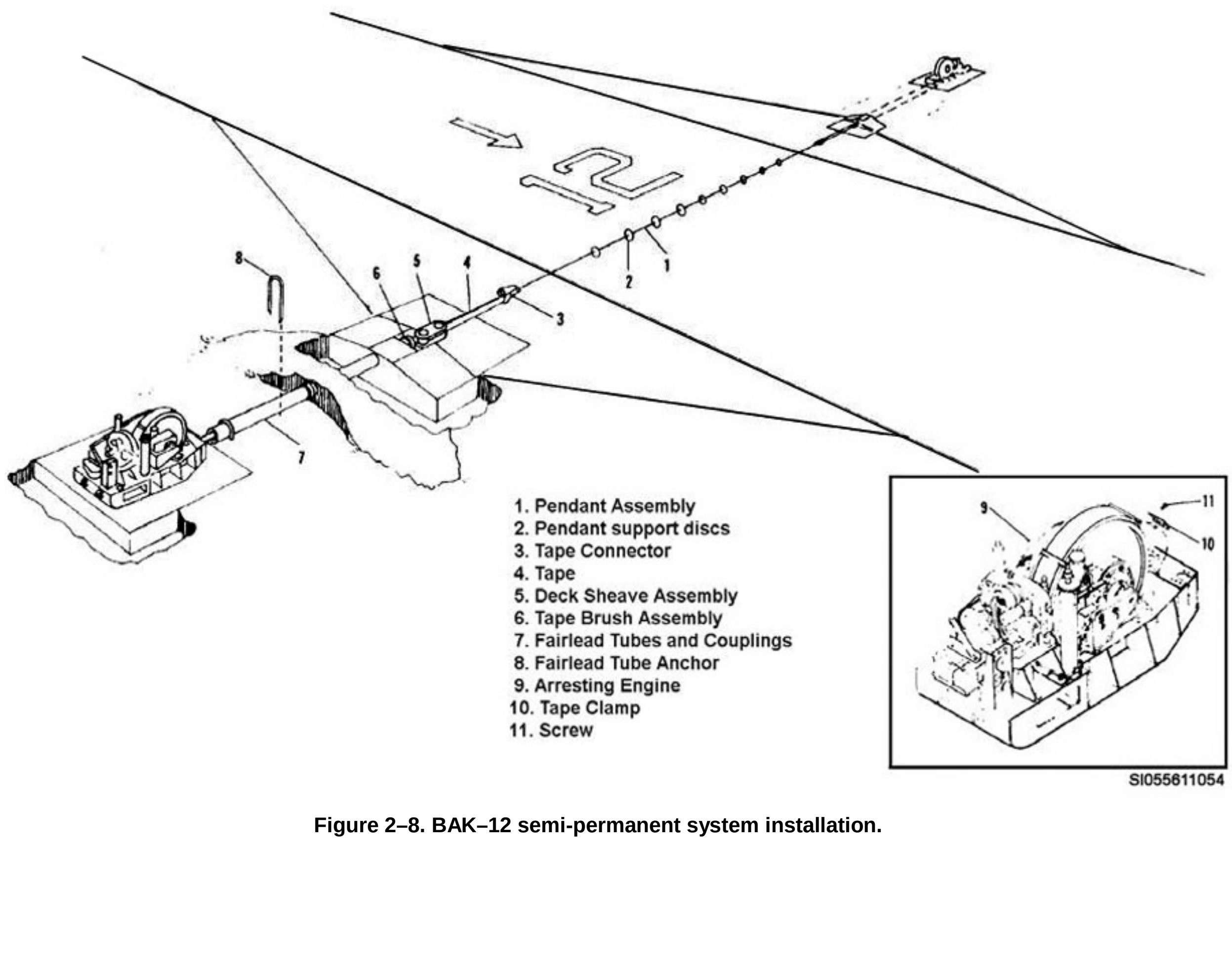

Figure 2–8. BAK–12 semi-permanent system installation.

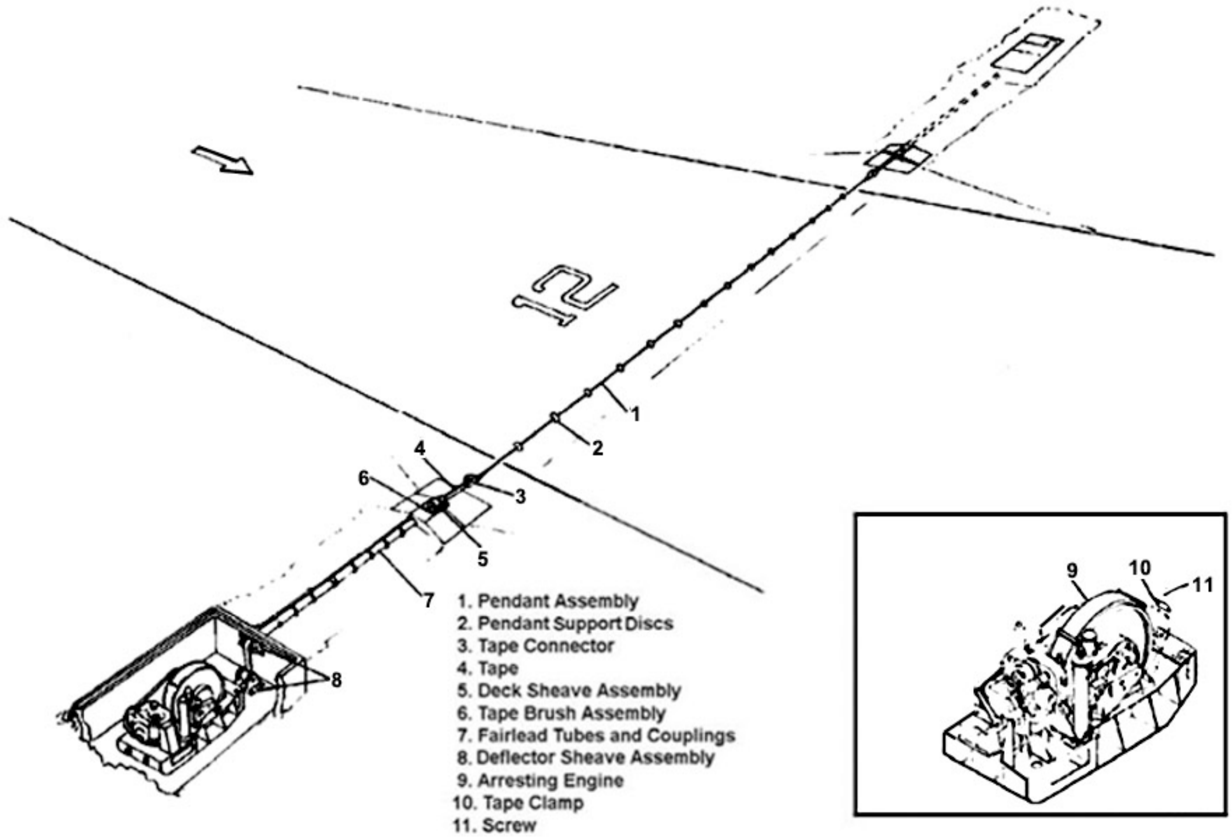

Figure 2–9. BAK–12 permanent system installation.

Since the BAK–12 is the Air Force choice for an operational aircraft arresting system, you will see plenty of them. Understanding the operation is key to recovering aircraft and getting the system ready to catch another. Just like any piece of equipment maintenance required to keep the BAK–12 in peak operating condition.

609. Inspections and maintenance planning

For a successful inspection and maintenance program to exist, strict administrative requirements must be followed. This includes making sure that our arresting systems are in top operational condition at all times. This lesson looks at the information required to comply with applicable publications and directives, how to document maintenance, setting up schedules, system reports, and training of personnel.

Publications and directives

Correct publications and directives must be followed to insure the correct maintenance is conducted. These publications as part of the work center's publications library so they are available to all work center personnel.

AFI 32–1043, Managing, Operating, and Maintaining Aircraft Arresting Systems

AFI 32–1043, complete with all MAJCOM and local supplements, is the primary guidance in managing the inspection and maintenance program.

Local procedures and instructions

The work center supervisor develops and implements local procedures and instructions to direct the work center personnel in their day-to-day operations. These clearly define responsibilities of personnel engaged in AAS activities, both during and after normal duty hours. The Base Civil

Engineer must first approve any operating instructions prior to implementation. Once approved, provide a signed copy to the MAJCOM barrier representative and maintain a copy in the work center.

Applicable technical orders

All arresting systems require use of 35E8–2- series technical order (TO) to accomplish installation and maintenance.

Documentation requirements

AFI 32–1043 directs the work center to maintain documentation of all inspections, maintenance, certifications, and effective pendant height measurements. The following paragraphs will explain each of the documentation requirements.

Maintenance records

We must keep records of the maintenance and inspections we complete. An AFTO Form 244, *Industrial/Support Equipment Record,* is used to document the inspections, lubrication, and maintenance conducted on the arresting system.

Historical logs

The AFTO Form 95, *Significant Historical Data*, is used to record historical maintenance actions.

Status boards

The status board is an optional item that is used in shop area to provide an instant overview of the various arresting systems in use at our base.

Record of certification

Use the record of certification to document the results of certification engagements and certification inspections.

Record of effective pendant height

The record of effective pendant height (EPH) is a sketch that identifies the exact location of the various measurements taken and allows us to determine when pavement requires repair.

Scheduling inspection and maintenance requirements

Use TOs and other directives to schedule inspection and maintenance actions to provide the most effective and efficient use of people, facilities, and equipment while reducing the likelihood of unscheduled maintenance requirements.

Routine inspection and maintenance requirement

The inspection and maintenance program directs specific timelines that we can project days, or even weeks, in advance.

Certification by engagement requirements

AFI 32–1043 requires a certification engagement on the arresting system after the initial installation or whenever the arresting system has not had an engagement at a speed sufficient to exercise the hydraulic system within the preceding twelve months.

Certification by inspection requirements

If circumstances prevent certification by engagement, a MAJCOM barrier representative must accomplish a certification by inspection. Remove the system from service if certification by engagement or certification by inspection cannot be conducted.

Reporting

Arresting system reporting provides outside agencies important information concerning the status and availability of the system. Always keep agencies such as base operations, air traffic control (ATC), MAJCOM, and the Air Force Civil Engineer Center (AFCEC) informed of changes affecting system readiness.

Daily status report

Report the arresting system daily status to base operations and ATC personnel upon completion of the daily inspections. Relay any discrepancies affecting the operational capability of the arresting system or anchoring hardware to base operations and ATC personnel.

Engagement reports

Submit an engagement report to the MAJCOM representative as soon as possible following each arrestment or attempted arrestment.

Training plans

The Base Civil Engineer has the ultimate responsibility to make sure that only qualified personnel operate, maintain, and certify the AAS under their control. This means someone must develop local training plans to maintain compliance.

The section supervisor develops these local training plans to make sure power production and fire department personnel receive standardized training and certification in operating and maintaining the arresting system. AFI 32–1043 authorizes specific tasks that each skill level can accomplish without supervision.

In conclusion, your understanding of AAS publications, proper documentation and maintenance procedures, scheduling and training of personnel is essential for the safe operations. The job of managing these systems is very challenging and will provide valuable organizational skills. Planning and developing a training and maintenance plan is key in having a reliable arresting system.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

608. System components and theory of operation

1. What is the energy-absorbing capacity of the BAK–12?

2. List the three subsystems of the BAK–12's hydraulic system.

3. What is the static pressure of the BAK–12?

4. How is pre-tension maintained on the pendant of the BAK–12 arresting system?

5. What provides the clamping force between the tape and tape connector of a BAK–12 arresting system?

6. List the components of the BAK–12 rewind clutch system.

609. Inspections and maintenance planning

1. What AFI is our primary source for guidance in the managing aircraft arresting systems?

2. When must a certification engagement be conducted?

2–2. Mobile Aircraft Arresting System

The MAAS engages hook-equipped aircraft and absorb the forward momentum of a routine or emergency landing or aborted takeoff. The compact size of the system makes it completely air transportable in any number of cargo aircraft. The primary purpose of the MAAS, shown in figure 2–10, is to provide an arresting system that is capable of rapid deployment in support of combat air operations from bomb-damaged runways, alternate bases, or forward operating areas in a post-attack environment.

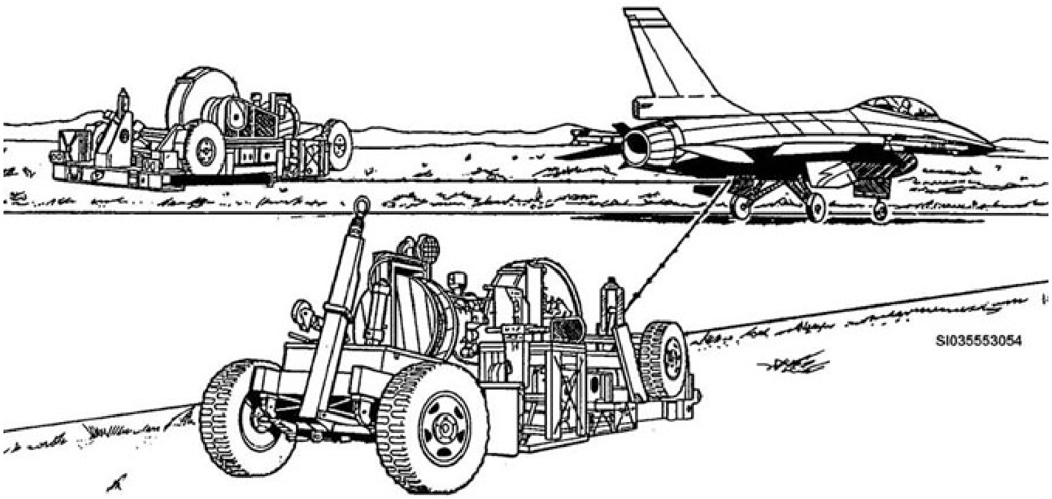

Figure 2–10. MAAS.

610. Construction features and operation

When the BAK–12 arresting gear mounts on a mobile trailer, it is called the MAAS. The MAAS can be secured, into concrete pads, or staked into soil or asphalt. Installation usually takes six people, two hours to complete. The MAAS has an on-board winch that allows loading onto transport aircraft without a tow vehicle as well as controlled off-loading.

MAASs used in the US Air Force are equipped with the standard BAK–12 energy absorber and fitted with an upgrade kit allowing bi-directional operation. The complete system consists of a MAAS positioned on either side of the operational runway and connected by the cable assembly. The system has demonstrated a rapid-cycle arrestment capability, providing for up to 20 arrestments an hour.

Energy absorber

As mentioned earlier, the energy absorber is a BAK–12 aircraft arresting system (AAS) with a friction brake absorber. The energy-absorbing capacity for this system is 40,000,000 (40 X 10^6) foot-pounds. This capacity relates to, and is determined with, the aircraft weight, maximum engaging velocity, and runout.

Hydraulic power unit

There are two hydraulic power units (HPU) located on every MAAS trailer. The HPU is used to both raise and lower the trailer and to provide hydraulic power to the tools used to install and remove the MAAS. Each HPU is equipped with 50 foot hydraulic hoses with quick disconnect ends. There are both gasoline and diesel HPU’s, so ensure you know which one you are using. Refer to the appropriate TO for specifics of your HPU.

Trailer

For over-the-road travel, the MAAS trailer is equipped with a hydraulic brake and a full complement of brake and running lights. A pintle hook, located on the rear of each trailer, provides a tandem tow capability.

Hydraulic cylinders support the axles of the trailer. The pressurized cylinders raise and lower the trailer. Once the trailer is in the raised position, insert the pins into the frame to take the pressure off of the hydraulic cylinders.

Hydraulic cylinders

The raise/lower circuit of the trailer is comprised of a front jack, a rear jack, and two manual four-way valves. The front and rear jacks are heavy-duty cylinders rated for a nominal pressure of 3,000 psi and a non-shock capacity of 5,000 psi.

Sheaves

The sheaves are located within the trailer body so that the purchase tape achieves a positive wrap. This creates a reliable tracking system for the tape during payout.

Coolant reservoir

Each trailer is equipped with a coolant reservoir located in the left tunnel of the trailer body. The reservoir is manufactured from rubber and treated for resistance to ozone and hydraulic fluid. The reservoir has molded fittings and discharge ports. Each reservoir holds approximately 65 gallons of brake coolant.

Brakes

The trailer is equipped with service brakes that decelerate the tow vehicle. A master cylinder and built-in reservoir develop pressure and apply it to a preloaded coil spring inside the housing. When stopping or slowing the pressure overcome the spring and send fluid to the wheel brakes.

The trailer has all the cables and fasteners needed for attachment to the towing vehicle. The trailer also comes with an emergency breakaway lever. In the event of accidental vehicle separation, the cable pulls the breakaway lever forward causing the hydraulic brakes to apply pressure, stopping the MAAS trailer. The MAAS has a parking brake on the rear wheel brakes that we actuated using a single lever via a steel cable.

Pendant cable

The MAAS comes preconfigured with two pendant cables. One cable can be found on each of the two trailers. The cables are 90 feet and 153 feet in length. Along with the cables, you will find the pendant supports (donuts).

The MAAS provides the AF with the mobile capabilities vital in the air expeditionary force environment. It is very likely that at sometime in your career you will be tasked to install and operate the MAAS. In the next section, the different methods used to install the MAAS will be covered.

611. Mobile aircraft arresting system installations

To accommodate the need and expeditious installation of an AAS after an airfield attack, a MAAS can be fastened to concrete, soil, asphalt. The following section will give information these MAAS installation methods.

Site selection

One of the most likely targets on our base during an attack is the runway. This may force rapid runway repair (RRR) teams to change the runway length and width due to bomb damage.

If the attack requires us to reconfigure the runway, then we may have to install a MAAS, or if one is already in place, repositioned. MAAS position plays a crucial role for runway usability.

The engineer assistant

The engineer assistant (EA) takes a lead role in selecting the MAAS site. The first task for an EA is to determine a new minimum operating strip (MOS) based on bomb damage to the runway. The MOS is the smallest runway required in order for planes to take off and land successfully. Once the EA has decided on the new runway, they will mark the runway edge, centerline, and MAAS position. The EA follows strict site selection criteria when selecting the MAAS position.

The site must be level and free of obstructions. Large cracks, rocks, or other obstructions will damage the purchase tape and could cause a possible missed engagement. After the EA identifies the MAAS position, they mark a spot that allows for the minimum runout distance plus aircraft length shown in figure 2–11 Last, the MAAS edge sheave must be equal to or higher than the runway surface. If the edge sheave is lower than the runway surface, significant damage could occur to the purchase tape upon aircraft arrestment, shown in figure 2–12.

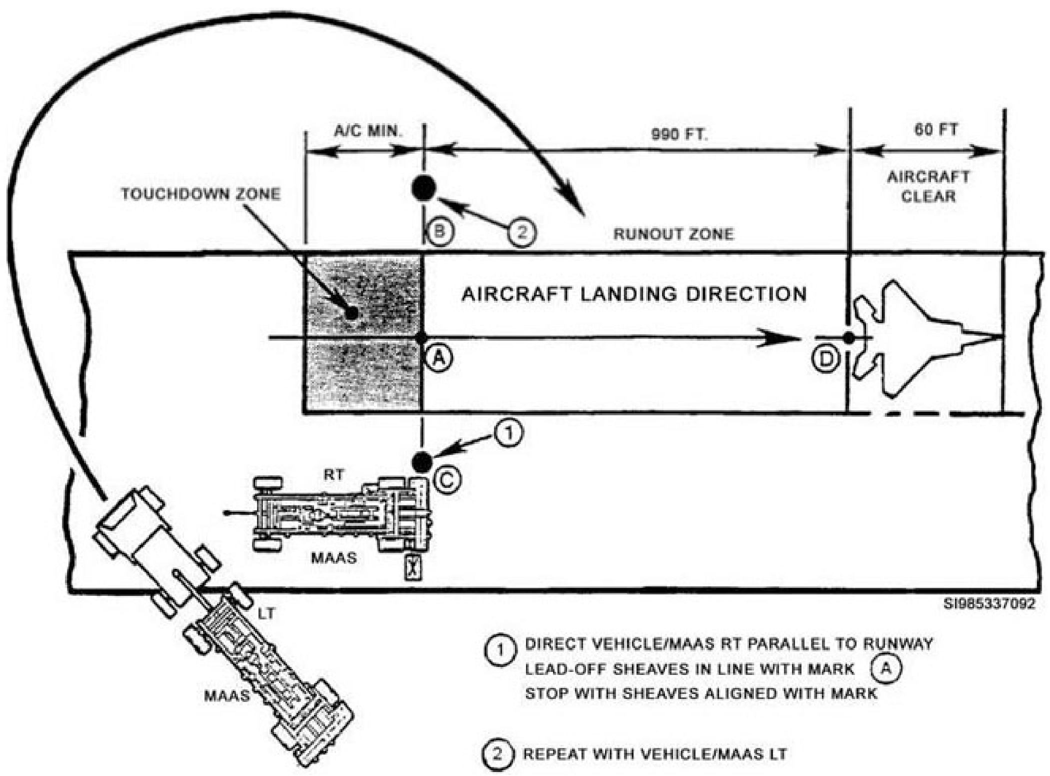

Figure 2–11. MAAS placements.

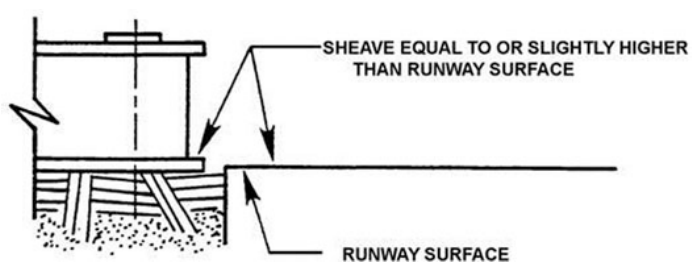

Figure 2–12. Edge sheave placements.

Positioning the MAAS

Once the site is established, position the MAAS units for installation. MAAS installation is critical; correct alignment and distance from the runway edge is essential to safe and effective aircraft engagements. Verify the landing direction of the aircraft, this will ensure correct installation of the MAAS.

Safety

Safety is the highest priority when installing and operating the MAAS. Always use the TO, and always follow basic risk management (RM) principles. Follow all applicable safety rules while positioning the MAAS. Remove all rings, watches, and any jewelry. Wear leather gloves and steel-toe boots. Be alert at all time for any vehicles operating in your general area.

Trailer positioning

The following procedures are required to position the MAAS on a suitable site on the runway edge, shown in figure 2–11. Determine the direction the aircraft will land. Locate a point on the runway centerline allowing MAAS runout plus aircraft length for the distance needed to stop the aircraft. Use this formula to determine where to position the MAAS:

$$\frac{Pendant\ length + 15'}{2}$$

It is now time to position the trailer, start on the centerline of the runway and measure the distance calculated for the sheave of the first trailer, and mark the position. Go back to the centerline and measure the same distance to the sheave of the second trailer. When pulling the MAAS units into place, make sure that they are parallel to the runway centerline with the sheave toward the runway. Line the sheave up so that the tape will be in line with the mark on the center of the runway.

Once the trailers have been positioned, clear the tape sweep area and installation area of any obstructions such as lights, stones, or any other sharp objects. The minimum tape sweep area is defined as, lines extending out MAAS runout distance from landing zone centerline in the direction of runout. Lower the tow bar swivel jack. Set the trailer parking brake, and disconnect the trailer from the prime mover (tow vehicle). Remove the trailer cover and store the cover when time permits. Remove the runway edge sheave guard and store the guard when time permits. Always follow TO procedures when installing the MAAS unit.

Unidirectional concrete installation

Once the MAAS unit is positioned, it is time to complete the installation process. For unidirectional arrestment capability install two anchor plates to the runway and connect the unit to these plates with turnbuckles.

Safety

Follow these safety rules while installing the MAAS. Remove all rings, watches, and jewelry. Wear the provided leather gloves, hearing protection, and steel-toe boots. Wear goggles during drilling operation, when driving stakes, or whenever we strike metal against metal (hammer). Keep fingers away from drill bit, avoid touching hot components, and be aware of moving machinery. Always use your legs, not your back, to lift heavy or awkward items. Be alert for any vehicles operating in the area. Make sure the area under the trailer is clear, and instruct personnel to remain clear of the trailer during raise or lower operations. Never attempt to raise or lower the trailer on a steep incline.

Concrete installation hardware

Figure 2–13 shows all the hardware we need to install the MAAS on a concrete surface. The hardware is located in the storage compartment on the trailer. Notice the figure also shows the quantities for each component. Remove this hardware prior to lowering trailers. When it comes time to remove the unit, all hardware is recoverable with the exception of the expansion nuts.

INSTALLATION KIT (52-D-7800-107)

Item	Quantity	Part Number	Description
1	2	52-C-8265-101	Anchor Plate
2	12	3461	Taper Bolt
3	12	13393-012	Washer, Flat
4	4	8	Hitch Pin Clip
5	2	HG-228-1-1/2 X 12	Turnbuckle
6	20	3460-2	Nut

SI035553057

NOTE

Items and quantities shown are for installation of one MAAS trailer unit, and are supplied with each unit.

Figure 2–13. Concrete installation hardware.

Concrete installation tools

The installation tools are listed in TO 35E8–2–10–1. An example is shown in figure 2–14. All installation tools come with the trailer so there is no need to acquire additional tools. We should remember to remove these tools prior to lowering trailers. Figure 2–15 shows a MAAS unit configuration associated with concrete installation.

INSTALLATION TOOL KIT (52-D-7821-102)
BASIC TOOL KIT (52-D-7818-101)

Item	Quantity	Part Number	Description
1	Ref	52-D-7821-102	Installation Tool Kit
2	2	52-D-7821-3	3/4 Drive Ratchet
3	2	52-D-7821-4	Extension 4 in. Long
4	2	52-D-7821-6	Socket 1-1/2 x 3/4 Drive
5	4	52-D-7821-7	Drill Bit, TE-60
6	2	52-D-7821-8	Hydraulic Hammer Drill
7	2	52-B-10780-1	Gauge — Taper Bolt
8	Ref	52-D-7818-101	Basic Tool Kit
9	1	52-D-7818-7	Tape Measure — 100 ft
10	1	52-D-7818-13	Adjustable Wrench — 20 in.
11	1	52-D-7818-10	Hammer, 4 lb
12	1	52-D-7818-9	Round Tube, 1-1/2 OD x 24 in.

Figure 2–14. Concrete installation tools.

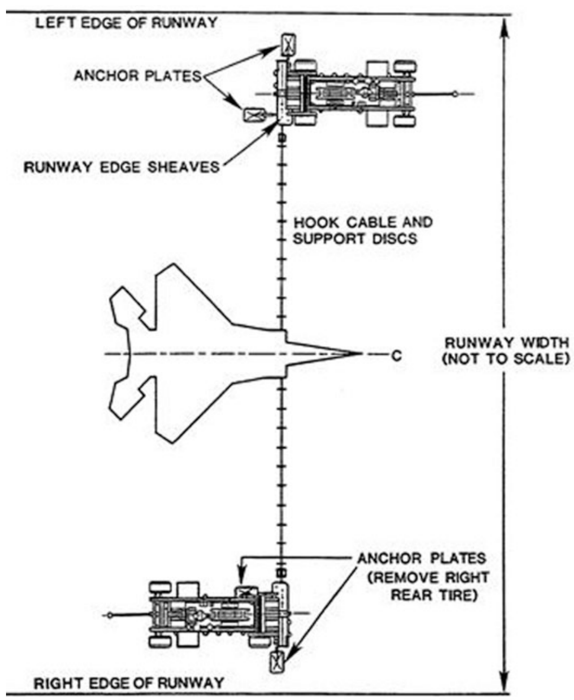

Figure 2–15. Unidirectional concrete installation.

Lowering the MAAS

Once the HPU is started, ensure the hydraulic lines are connected to the trailer. Next place the control valves in the “raise trailer” position and remove the pins. This will remove the pressure on the retaining pins. Once there is no more pressure, remove the four-axle retaining pins, and store them in the front storage box. Place the control valves in the “lower trailer” position being careful to keep the trailer level as it lowers. When the axles are in a full RAISE position (trailer body down) put valves back in their NEUTRAL position.

Tire removal

Remove the right rear tire from the MAAS unit on the pilot’s right. Store the lug nuts back on the wheel studs to prevent loss. Store the tire out of the way on far side of installation. The tire and wheel assembly weighs approximately 410 pounds; make sure that there is adequate lifting capability and personnel to handle this weight.

Installing the mounting hardware

All mounting hardware comes with the MAAS trailer for maintainers to use to operate and secure the MAAS unit. This portion of the lesson describes the procedures for connecting the hammer drill, installing the turnbuckle and anchor plates, and pendant connection.

Hydraulic hammer drill

Install the drill bit and connect the hydraulic hose between the drill and HPU. Always keep hose fittings clean to prevent seal damage. Do not allow free ends of hoses to drop in the dirt. Wipe the quick disconnect ends prior to connecting.

Turnbuckle and anchor plates

Set the length of the turnbuckles to 39 inches from the center of one clevis pin to the center of the other pin. Attach the turnbuckle to the appropriate connection points on trailer body, as shown in figure 2–16. Make sure to install the turnbuckle with the locknut towards the trailer body to prevent loosening during an engagement. Attach the other end of the turnbuckle to the anchor plate. The connection point on the anchor plate is off center. The short side should be toward the trailers, as shown in figure 2–16.

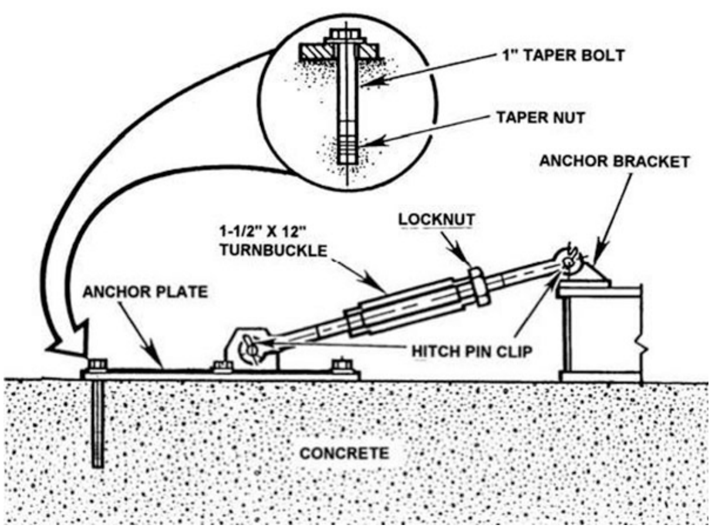

Figure 2–16. Concrete anchor plate layout.

Drill holes and taper bolts installation

Using the drill bits provided in the hardware package, using the anchor plate as a template, drill 1-inch diameter holes in the concrete to the depth of 6½-inches. Hold the drill bit as straight as possible to ease in later removal of taper bolts. After each hole is drilled, insert a taper bolt so the anchor pad does not shift. Seat all taper bolts using hammer and taper bolt gauge. The taper bolt gauge will give a $^3/_8$-inch clearance between the bolt head and anchor plate. Once all bolts are inserted tighten them this causes the expansion nut to expand and lock the taper bolt into the concrete.

Tightening the turnbuckles

Tighten the turnbuckle to remove any slack. Do not over tighten; this can cause the trailer to shift, resulting in alignment issues. Once the turnbuckles are snug, tighten the locknut on the turnbuckle.

Pendant connection

Proper connection of the tape connector to the pendant cable is a simple but important task. The MAAS tape connector is a standard BAK–12 tape connector that connects the purchase tape to the pendant. The pendant end attaches using a pinned tongue and jaw arrangement.

The first step to connecting the cable is to make sure there is enough slack in the tape. If the tape is taut, we need to set the shuttle valve on the hydraulic system to the OFF position. Use two or three personnel to pull a small amount of tape off the reel. This should give enough slack to remove the tape connector pin.

Now, remove the set screw and retaining nut and then pull out the pin. The setscrew is small, so don’t lose it; it is best to screw it all the way in, if possible. Slide the end of the pendant into the slot of the tape connector, and make sure to line up the holes, as shown in figure 2–17. Do not try to pull the cable towards the tape; if more slack is needed, pull some tape off the trailer. Never use fingers to align the two holes. This could result in a finger being severed. Slide the pin back through the tape connector with the end of the pendant in place. Make sure the flat edge of the pin is against the flat mark on the tape connector. Most barrier shops have a special tool called a “bullet” that quickly screws on and off the end of the pin. This tool is a wedge-shaped device that aligns the cable end with the tape connector. Use this tool if available.

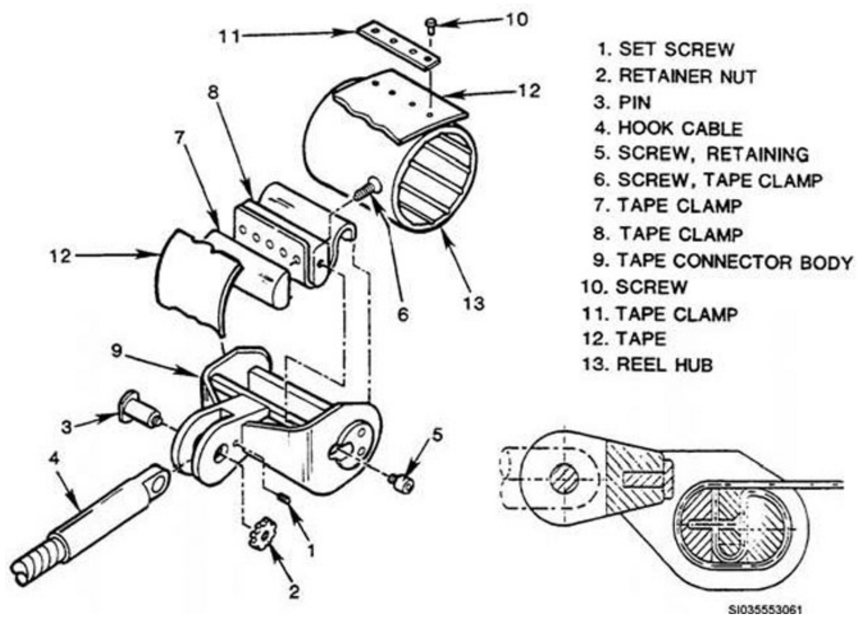

Figure 2–17. Tape connector and reel hub.

Place the retaining nut on the threaded end of the screw and tighten it. Always do this by hand; do not use tools. Make sure that the retaining screw hole can be seen through one of the openings in the retaining nut. If it cannot be seen, simply back the screw off enough to give access to this hole.

Turn the retaining screw in to prevent the nut from possibly slipping off. Only insert the retaining screw halfway; do not tighten it all the way to the tape connector, shown in figure 2–17.

Repeat this process on the other end of the pendant. Make sure there is no more than a ¼ twist in the tape for each side.

Tension the pendant

With the rewind engine is at operating temperature, prepare the system for rewind. Make sure that the brakes are not applied. It may be necessary to push the manual shuttle lever to the OFF position, as shown in figure 2–18; pushing the manual shuttle lever to the OFF position will disengage the brakes. With the engine at idle speed, engage the over center clutch. Make sure that the clutch selector valve, shown in figure 2–19, is in the operating position. Signal the point person that you are ready and waiting for further instructions. The point person will signal operator number to slowly rewind the tapes until the tape connector is approximately 7½ feet from the deck sheave. The rewind will stop and the brakes will be set. Be sure to make any adjustments to the accumulator fluid level after the brakes are set. The point person will have the second operator rewind at full speed to tension the pendant. Set the brakes and allow them to seat before disengaging the clutch. The point person will then check the tension on the pendant to determine if it is satisfactory.

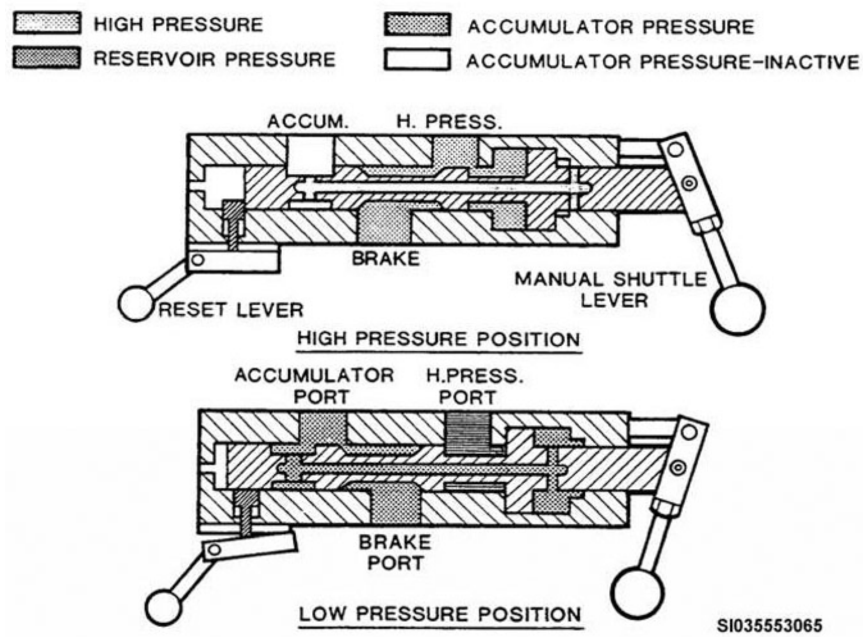

Figure 2–18. Shuttle valve.

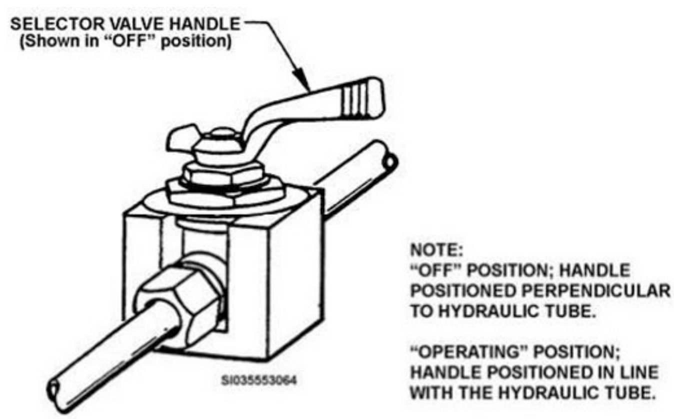

Figure 2–19. Selector valve.

Bi-directional concrete installation

The bi-directional installation will require the addition of one anchor plate, six additional taper bolts and washers, and one additional turnbuckle.

The tools required for the bi-directional concrete installation are the same as the unidirectional installation. To upgrade a concrete installation to a bi-directional configuration install an additional anchor pad, turnbuckle and taper bolts, as shown in figure 2–20.

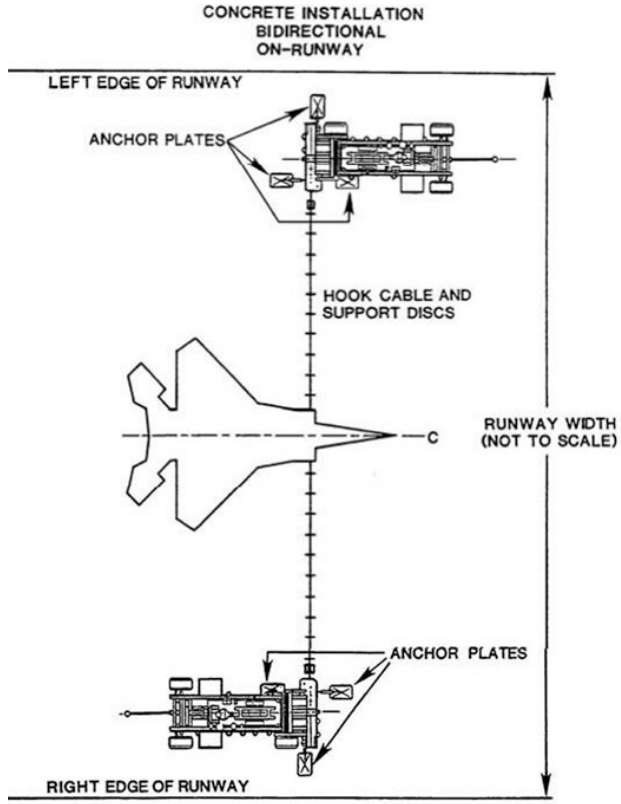

Figure 2–20. Bi-directional installation.

Unidirectional soil installation

Most MAAS are installed in some type of soil configuration. The MAAS can be directly anchored to the soil alongside a runway or secondary landing site. Each unit stores all of the tools and anchoring hardware needed for soil installation. This system incorporates 19, 5 ½ foot long aluminum stakes. 10 of these are installed through stake pockets located around the perimeter of the trailer while the remaining 9 are put into K/M stake lines. Figures 2–21 and 2–22 show a complete listing of all hardware and tools required for a unidirectional soil installation.

Installation Kit (52-D-7800-107)

Item	Quantity	Part Number	Description
1	19	52-C-7755-1	Stake
2	6	52-B-10763-1	Spacer, Stake
3	3	52-C-8173-1	Guide, Stake
4	6	52-C-8174-1	Spacer
5	7	8	Hitch Pin Clip
6	3	A-342-1 1/2	Master Link
7	3	HG-228-1-1/2 X 12	Turnbuckle
8	5	52-D-8172-1 *	Stake Pocket
9	6	52-D-8172-2 *	Stake Pocket
10	1	52-C-8194-1	Triple Turnbuckle Fitting
11	1	G4065-1 1/2	Clevis Pin

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NOTE

Items and quantities shown are for installation of one MAAS unit, and are supplied with each unit.

Figure 2–21. Soil installation kit.

Installation Tool Kit (52-D-7821-102)
Basic Tool Kit (52-D-7818-101)

Item	Quantity	Part Number	Description
1	Ref	52-D-7821-102	Installation Tool Kit
2	2	52-C-7235-1	Stake Driver 3-1/2
3	2	52-B-9496-7	Driver Shank 1-1/4 Hex
4	Ref	52-D-7818-101	Basic Tool Kit
5	1	52-D-7818-7	Tape Measure -- 100 ft
6	1	52-D-7818-13	Adjustable Wrench 10 in.
7	2	PD45142	Stake Driver
8	2	PP10100A	Stake Puller

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NOTE

Item No. 7 may be used as an alternative in lieu of Items No. 2 and 3 provided they are used with the Stanley HPU No. HP-1 Compact Model 350447.

Figure 2–22. Soil installation tools.

Position the MAAS and lower it into place. Remember to remove all of the installation hardware and set it to the side.

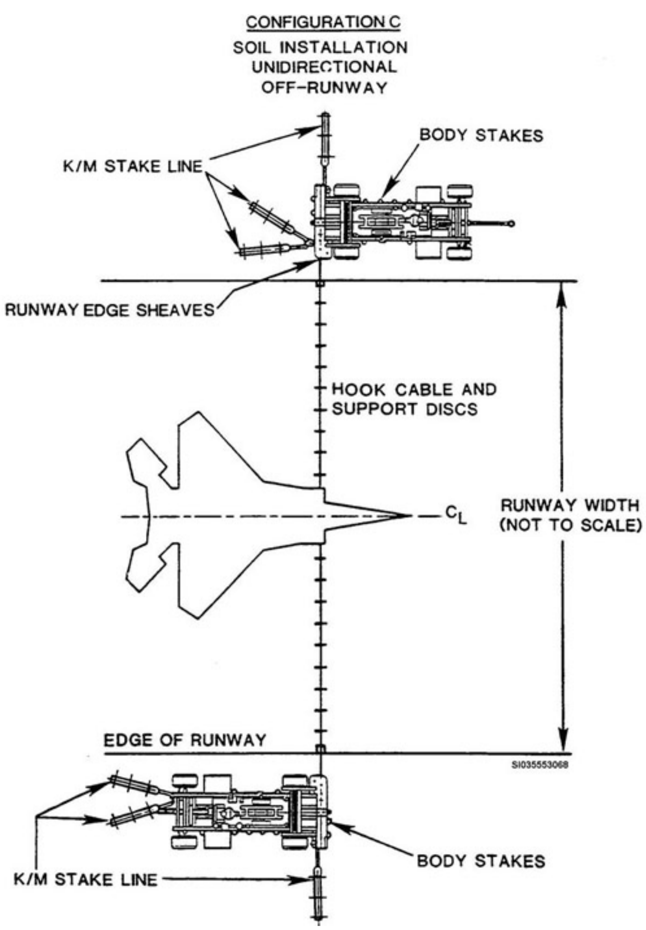

Figure 2–23. Soil installation configuration.

Connect the stake drivers or the hydraulic breakers and connect the hydraulic hoses. Adjust the length of the three turnbuckles to 36 inches measured from the centers of the clevis pins. Attach the triple turnbuckle fitting to the appropriate trailer body anchor point, as shown in figure 2–22. Now attach the turnbuckles. Two turnbuckles will attach to the triple turnbuckle fitting and one turnbuckle will attach to the MAAS trailer, as shown in figure 2–23.

Make sure that the locking nut is toward the trailer. Install the stakes through the 10 stake pockets located on the perimeter of the trailer. Position the stakes in the pockets to create an “+” pattern on the stake. Placing the stakes in the “+” position will ease stake removal.

The top 18 inches of each stake are painted green to indicate the recommended depth to drive each stake. Drive stake until painted portion reaches ground level. The minimum acceptable depth a stake can be driven is 36 inches. Continue installation by positioning the remaining nine stakes in the K/M anchoring configuration shown in figure 2–24.

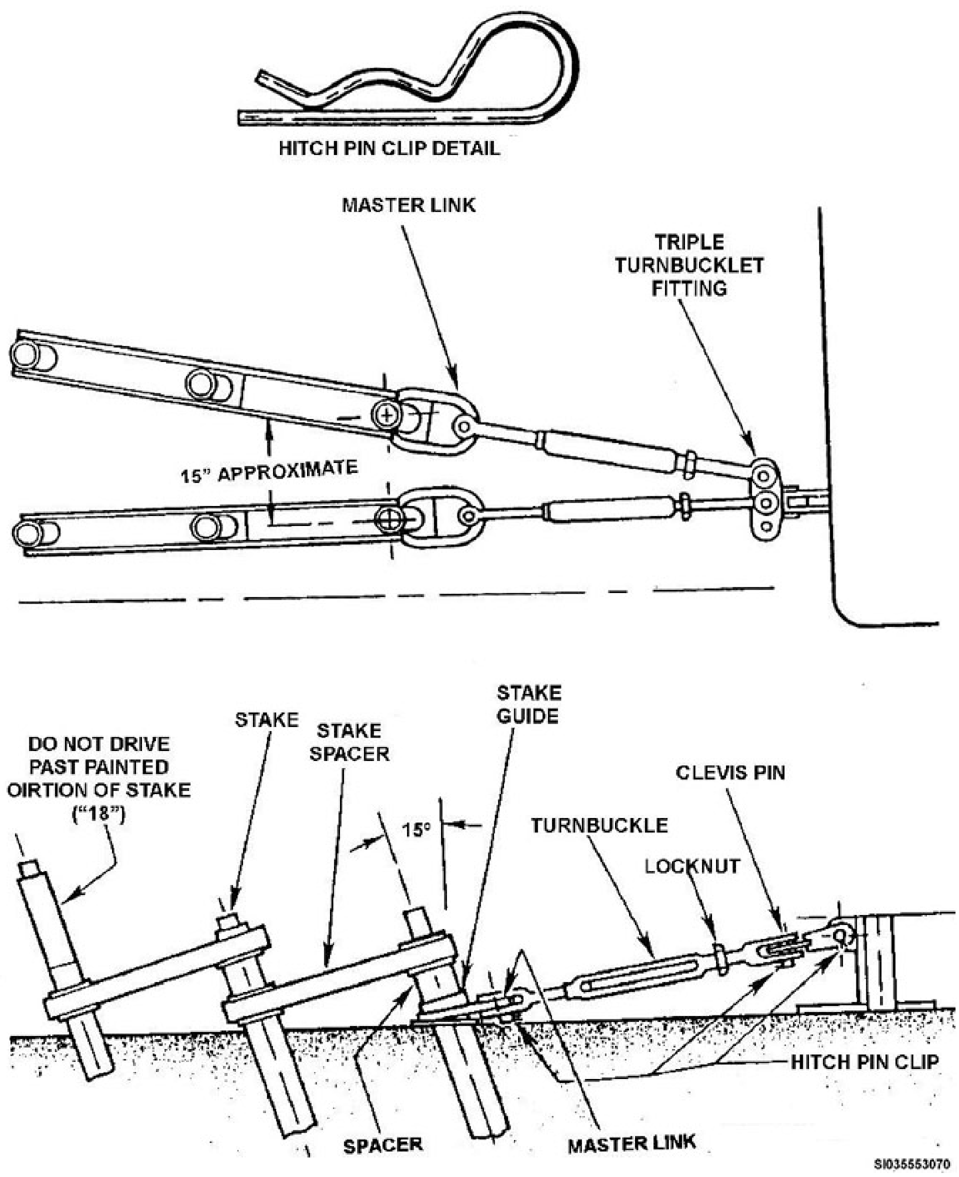

Figure 2–24. K/M stake line layout.

The K/M unidirectional anchoring system consists of three stake lines. Each K/M stake line consists of one turnbuckle, one master link, one stake guide, three stakes, two spacers, and two stake spacers. Install the master link through the turnbuckle and placed around the stake guide ensuring that the master link is under the retaining plate of the stake guide (fig. 2–23). Pull the stake guide and turnbuckle tight to locate the first stake. Install a stake through the stake guide driving until painted portion reaches ground level. The stake guide will provide the 15-degrees angle that is required for the stake. Install a spacer over the stake and rest it on the stake guide. Install a stake spacer over the stake and rest it on the spacer. Tighten the turnbuckle to remove any slack in the outrigger; then tighten the locknut on turnbuckle. Install and pre tension pendant.

Bi-directional soil installation

The MAAS is originally installed in the standard unidirectional configuration. The bi-directional soil installation requires the addition of extra K/M stake lines. The bi-directional installation requires 25 stakes, shown in figure 2–25. To increase arresting capacity 6 more stakes can be added as shown in figure 2–26.

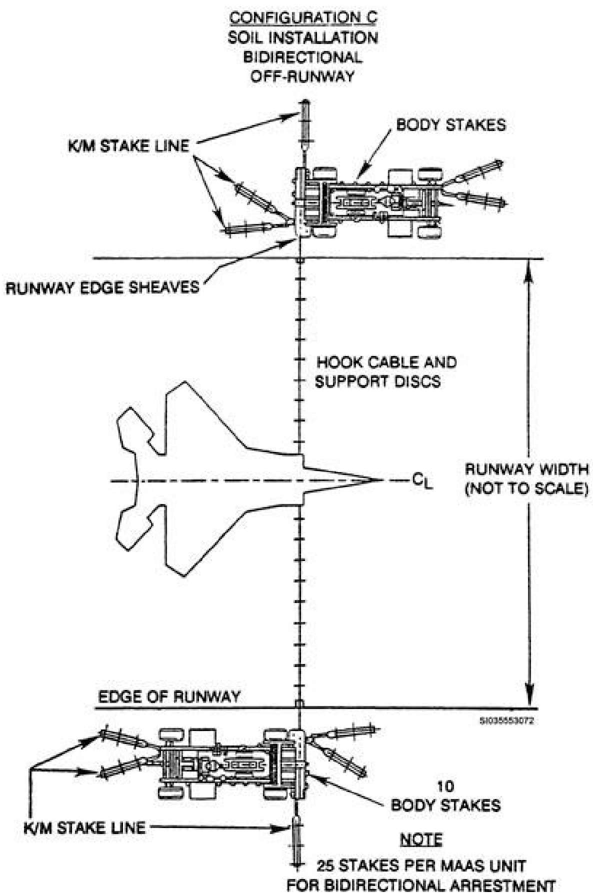

Figure 2–25. Bi-directional soil installation (25 stakes).

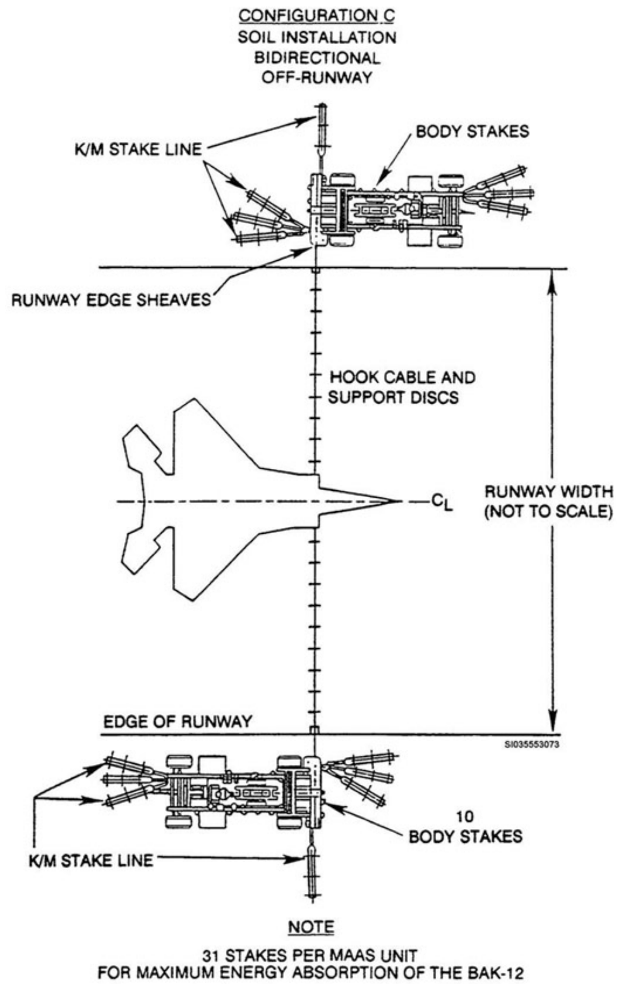

Figure 2–26 Bi-directional soil installation (31 stakes).

Asphalt over concrete installation

If asphalt is laid over concrete and the asphalt is less than 1 inch thick, then installation of a MAAS is the same as the standard concrete installation, except that the asphalt needs to be shipped away first. If we are installing the MAAS when the asphalt is over 1 inch in thickness, the process is different. This portion of the lesson will describe the procedures for asphalt over concrete installation.

Asphalt over concrete installation hardware

Refer to figure 2–27 for a complete listing of the hardware required for the asphalt over concrete installation. Notice the table also shows quantities for each component.

Item	Quantity	Part Number	Description
1	10	52-C-7800-4	Moil Point
2	10	52-C-8403-1	Bushing, Stake Pocket
3	5	52-C-8172-1	Stake Pocket
4	5	52-C-8172-2	Stake Pocket

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NOTE

Items and quantities shown are for installation of one MAAS unit, and are supplied with each unit.

Figure 2–27. Asphalt over concrete hardware.

Installing the anchoring system for asphalt over concrete

Start by positioning the MAAS as described earlier. Remove the required installation tools and hardware and lower the MAAS. Connect the hydraulic breakers to the hose assemblies attached to the HPUs and then start the HPU. Insert a moil point into the hydraulic breaker and lock the moil in place using the retaining spring. Insert the moil point through the bushing in the stake pocket, and drive the moil point through the asphalt and into the concrete, as shown in figure 2–28. Stop driving when the bottom of the tool retaining spring is just above the MAAS trailer body frame. Unlock the moil point from the breaker and repeat for the other nine moil points. Install the pendant and pre-tension it using the same procedures for concrete installation.

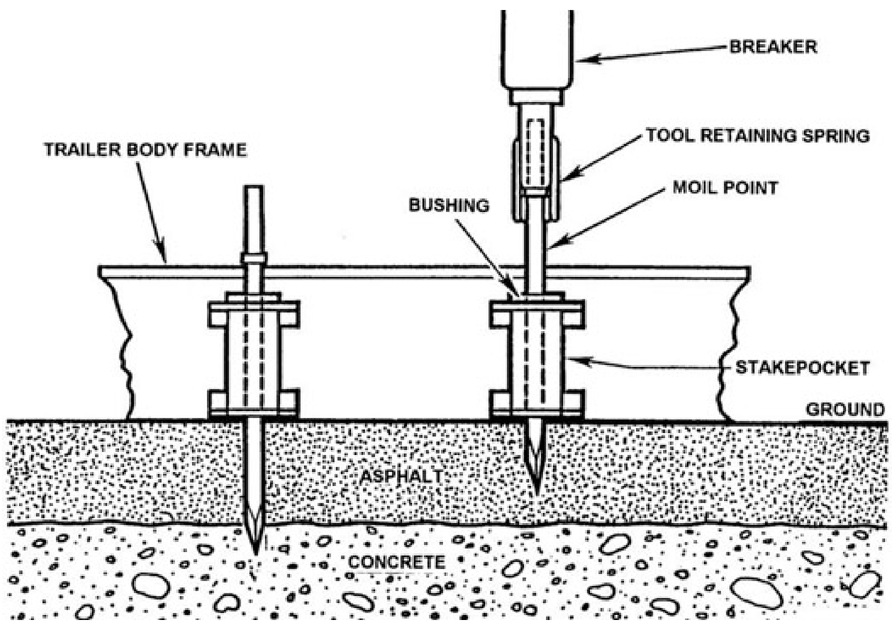

Figure 2–28. Moil point installation.

Asphalt over soil installation

When encountering asphalt over soil condition drive stakes through asphalt unto soil to fasten equipment to the ground just as we use anchors to secure equipment to concrete pads. Essentially this is done in the same manner as a soil installation with the addition of not putting in body stakes.

Asphalt over soil installation hardware

Refer to figure 2–29 for a complete listing of the hardware required for the asphalt over soil installation. Notice the table also shows quantities for each component.

Installation Kit (52-D-7800-107)

Item	Quantity	Part Number	Description
1	9	52-C-7755-1	Stake
2	6	52-B-10763-1	Spacer, Stake
3	3	52-C-8173-1	Guide, Stake
4	6	52-C-8174-1	Spacer
5	7	8	Hitch Pin Clip
6	3	A-342-1 1/2	Master Link
7	3	HG-228-1-1/2 X 12	Turnbuckle
8	1	52-C-8194-1	Triple Turnbuckle Fitting
9	1	G4065-1 1/2	Clevis Pin

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NOTE

Items and quantities shown are for installation of one MAAS trailer, and are su pplied with each unit.

Figure 2–29. Asphalt/soil installation kit.

Fastening the system to asphalt over soil

Position the MAAS in accordance with previously described procedures. Remove the required installation tools and hardware and lower the MAAS. For an installation of a MAAS on an asphalt surface with a soil base, refer to figures 2–30 and 2–31. Using the HPU associated with each MAAS, install the hardware, and anchor the equipment located on different sides of the runway. Installation of this kind is performed the same as a soil installation with the exception of not installing body stakes and chipping up asphalt in order to access the soil sub base.

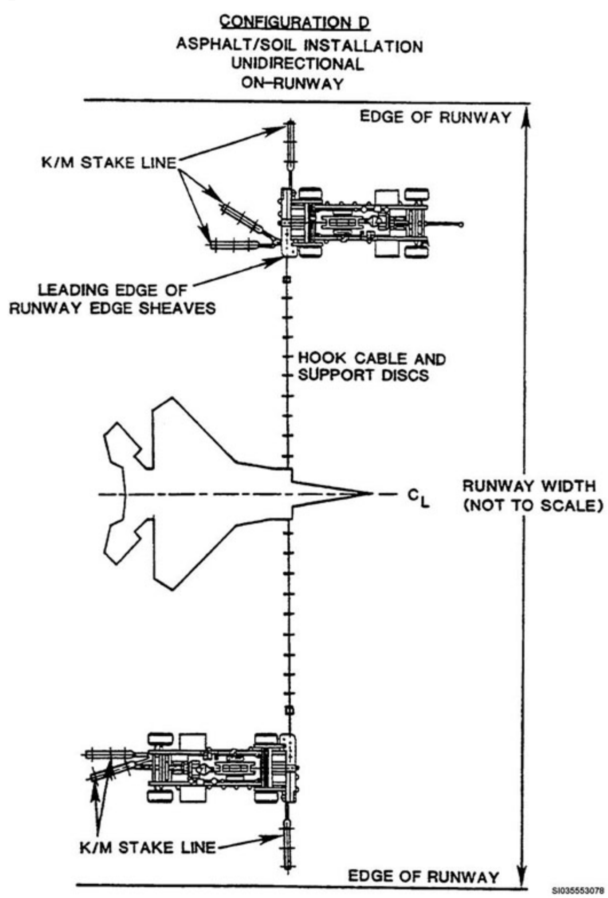

Figure 2–30. Asphalt/soil installation layout.

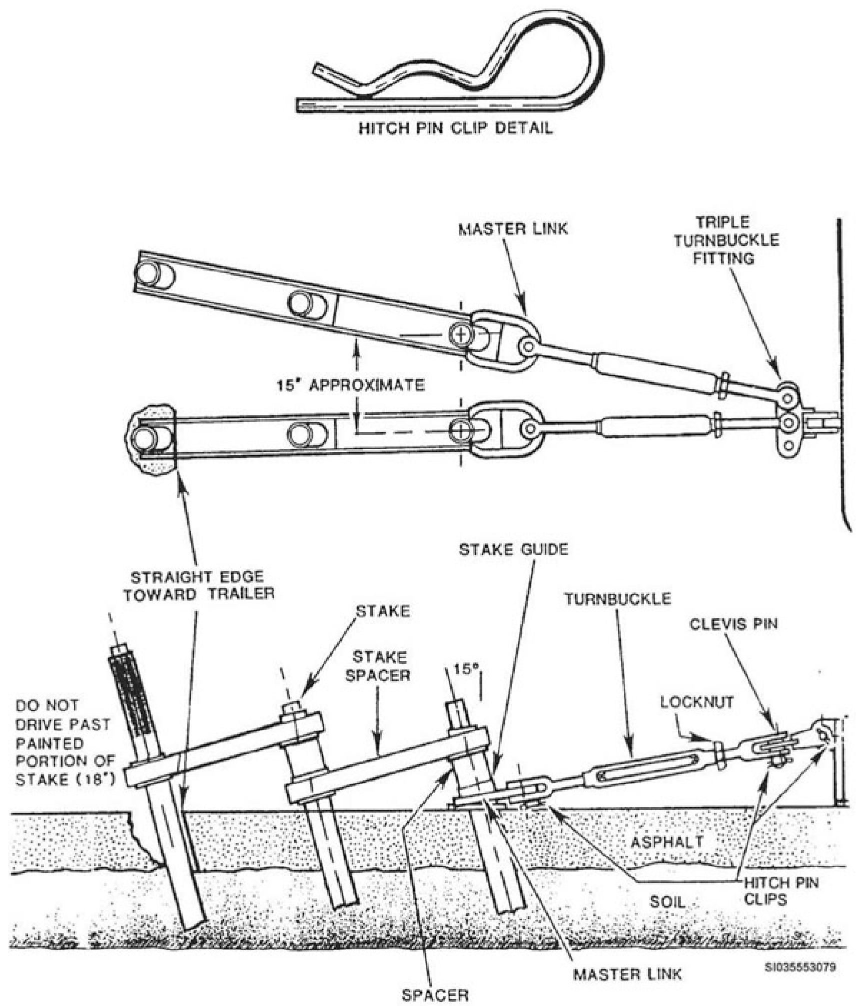

Figure 2–31. Asphalt/soil K/M stake line.

Proof loading the MAAS

It is always preferred to test the MAAS anchoring system after installation (proof loading). One purpose of proof loading is to find problems with the anchoring hardware. Proof loading will highlight loose components and will determine whether the system will shift during use. If the anchoring system fails during an arrestment, numerous problems can occur such as MAAS dislodgment and aircraft damage. To proof an installation follow these steps, as always this is only reference, use the proper TO when performing any maintenance on arresting systems.

1. Move the shuttle valve lever to the “off” position.
2. Disconnect the hydraulic line to the brake on the hydraulic side of the energy absorber at the tee connection to the shuttle valve and cap the tee. Use the cap from the end of the utility pump hose.
3. Connect a utility pump and hose assembly to the brake hydraulic line.
4. Attach the tape connector to a vehicle tow point having a minimum pull of 18,000 pounds. Pull the tape from the storage reel slowly until the tape connector is approximately 450 feet down the runway.
5. Stop the vehicle.
6. Apply 1,800 psig to the brake with the utility pump and move the vehicle forward until tape is taut but not actually loaded. Mark the location of the tape connector on the runway and mark a second point 23 feet further in the direction of tow.

7. Operate the tow vehicle to stretch the tape until the tape connector is in line with the second mark. Check the arresting system for any movement. Relax the load on the tape and tighten components as required. Turnbuckles should be adjusted to maintain alignment and to minimize equipment movement under load. Repeat this step three times.
8. Disconnect the utility pump and hose assembly and reconnect the hydraulic line to the tee fitting. Replace cap on utility pump hose.
9. Rewind tapes and bleed brakes.

Reconstitute the MAAS

When the MAAS is no longer needed it must be reconstituted for storage orshipment. All MAAS installation hardware is retrievable, with the exception of the expansion nuts for the concrete installation. After removal of the installation hardware, take care to properly store and secure equipment in the proper storage compartments. The following paragraphs describe the simple process for removing anchoring hardware.

Concrete removal

First, remove the turnbuckles that attach the anchor pads to the MAAS and store them in the proper location. Next remove the six taper bolts used to fasten each anchor pad to the runway and store these items. This will leave a flush surface with the runway taper bolt nuts still embedded in the concrete. During removal of installation hardware inspect all items for damage and replace as necessary.

Soil removal

All installation hardware used for the soil installation is retrievable. Remove these cruciform stakes from the body with a stake puller kit then move to the KM stake lines. Take the time to remove excess soil clinging to the stakes and clean all installation hardware then store in the appropriate box. The next step in reconstitution is raising the trailer. Remove the axle support frame retaining pins stored in the front storage box. Connect the transmission hoses from the HPU to the quick disconnect block located directly behind the HPU. Always use the same HPU to lower and then raise the trailer in order to prevent transfer of hydraulic fluid between HPU reservoirs. If it becomes necessary to replace this unit or use the other side HPU for this operation, check the fluid level and adjust as necessary. Clear the area of unnecessary personnel and start the HPU. Remove any foreign material or tools left in this area. Stop if the axle support frames hit any object in its path during this operation. Place the control valves in the “raise trailer” position, and make sure the trailer raises at a level attitude. When the trailer reaches its fully raised position install the four retaining pins. Make sure that the toggle mechanism is in the locked position on each pin. Return the control valve to the neutral position and shut down the HPU. Finally chock the wheels and check that the parking brake is set.

Pendant removal

Remove the cable ends from the tape connectors. Then push the cable support disk (donuts) to the far side of the cable and carefully roll the pendant cable back on the storage reel. The cable will be awkward and heavy to roll back on reel. This procedure requires multiple personnel and use of deliberate, steady motions to prevent injury.

This lesson discussed the different types of installations for the MAAS and how to safely remove the units when no longer needed. Strict adherence to the TO is needed to ensure the MAAS is ready to complete the job of stopping a damaged aircraft. The job of installing the MAAS is not simple but the satisfaction that comes from knowing you may someday be responsible for saving a pilot’s life, not to mention the valuable aircraft, makes the task worth the effort. Installation is only part of the job. Once in service many maintenance tasks must be conducted to keep the unit in safe operating condition.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

610. Construction features and operation

1. How many HPUs are included on each MAAS trailer?

2. The front and rear jacks are heavy-duty cylinders rated for what pressures?

3. MAAS cables come in what two lengths?

611. Mobile aircraft arresting system installations

1. What is the minimum runout distance needed when determining the site for MAAS installation?

2. What is the required length of the turnbuckles for concrete installation?

3. What tool will give a $^{3}/_{8}$-inch clearance between the bolt head and anchor plate

4. What does each K/M stake line consists?

5. When proof loading the MASS, what step is required after the hydraulic line is reattached?

2–3. AAS Inspections, Maintenance and Troubleshooting

The last two lessons covers the two primary operational arresting systems. This lesson will cover the maintenance and other tasks associated with the BAK–12 and MAAS. As covered before, the MAAS has the same energy absorber as the BAK–12 so most of the inspections, maintenance, and troubleshooting overlap. The MAAS has a few extra components that we will cover as well.

612. AAS inspections

Regular inspections and preventive maintenance actions are described in the TO. In addition to periodic inspection and preventive maintenance, the energy absorber should be overhauled every ten years or 500 arrestments whichever occurs first.

In order to keep the arresting system in peak operating condition, operation personnel must inspect the complete system after each arrestment and during rewind. This inspection will detect any possible malfunctions and afford maintenance personnel time to correct the problem. Proper periodic inspections are critical to make sure a successful aircraft engagement. This section will cover the TO requirements to perform daily, weekly, monthly, after arrestment, quarterly and semi-annual inspections.

Operation				
System	**D**	**Each Arrestment**	**W**	**M**
1. Inspect system for loose or worn parts and anchor assemblies for security.		X	X	
2. Inspect all fittings and lines for leaks.		X	X	
3. Inspect runway edge sheave and tape sweep area for debris and obstructions.	X	X		
4. Inspect all tape sheaves for freedom of rotation.		X		X
5. Inspect system for corrosion.				X
6. Check sump pump, exhaust fan, and all lights for operation.	X			
7. Check alignment (expeditionary only).		Each regime IV or after 10 Regime I, II, & III 3 Mo Max		
Pendant/hook cable and support disks				
1. Inspect the pendant/hook cable for kinking, broken wires, excessive wear and tension (see figure 2-32).	X	X		
2. Inspect the pendant/hook cable support disks for spacing and wear.	X	X		
Tape				
1. Inspect the nylon tape for wear or damage, and time in service.		X	X	
2. Inspect tape within fairlead beam housing to ensure one 90 degree twist from a vertical to horizontal plane between the tape cleaning brushes and the lead-on sheave assembly exists.		X		X
Fairlead beam assembly				
1. Inspect sheaves for damage and proper operation.	X			
2. Inspect tape guides for wear.				X
3. Inspect and adjust tape brush.				X
4. Overhaul fairlead beam.		Every 10 years		
Runway edge sheave assembly				
1. Inspect sheaves for damage and proper operation.		X		
2. Inspect tape guides for wear.				X

Operation				
System	D	Each Arrestment	W	M
3. Overhaul runway edge sheave.		Every 10 years		
Tape brush assembly				
1. Inspect tape brushes for wear or damage.				X
Fairlead Tube				
1. Inspect fairlead tubes for debris.	X			
Deflector sheave assembly				
1. Inspect sheaves for damage and proper operation.		X		
2. Inspect tape guides for wear.				X

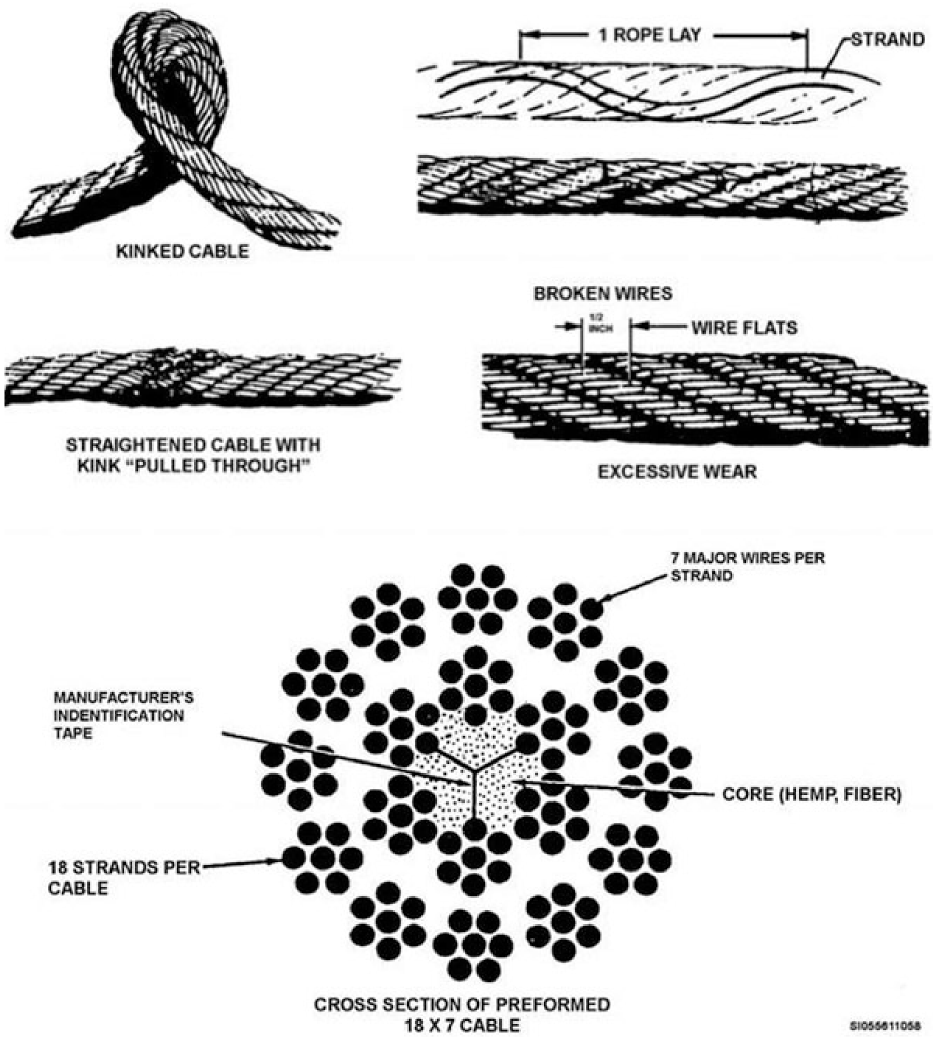

Figure 2–32. Pendant wear and damage

Preventative maintenance

The following chart shows other preventative maintenance that must be performed on the BAK–12.

Operation	Interval
1. Replace pendant/hook cable.	Every 36 Months
2. Crop end of tape.	Every 6 Months
3. Turn tape and for end.	Every 24 Months
4. Synchronize units and proof test hydraulic system.	Every 3 Months
5. Perform functional check-out.	Monthly
6. Clean entire equipment.	As needed
7. Replace tape.	Maximum 48 Months
8. Change rewind engine oil filter.	6 Months or 50 arrestments
9. Clean rewind engine air filter.	6 Months
10. Replace rewind engine oil.	6 Months or 50 arrestments
11. Bleed brakes.	Weekly
12. Bleed clutch.	Weekly
13. Bleed maximum brake pressure gauge.	Weekly
14. Drain rewind engine exhaust moister trap.	Weekly
15. Anchor inspection.	Every 10 years
See AFI 32–1043 for more maintenance requirements	

Additional MAAS requirements

Because the MAAS is a mobile BAK–12 all the inspection requirements for the absorber and rewind systems are the same. There are a few other requirements that are listed below.

MAAS anchoring system

Check all anchor assemblies for security of components and loose or worn parts. Make sure that the turnbuckles are secure and the locknuts are tight. If the installation is in concrete, make sure the tapered bolts are tight and the anchor plate is flat on the ground. If the installation is in soil, make sure that the stake spacers are in good condition.

MAAS trailer

Check the MAAS trailer alignment and earth anchors for security of attachment.

Determining engagement regime

After every arrestment, it is required to determine the regime level of the engagement. This is used to charge the appropriate amount of arrestments against the tapes. Additionally all engagements in excess of 165 knots require pendant replacement. The regime level is determined by analyzing the aircraft's weight and speed. A Regime Chart, shown in figure 2–33, is located in the applicable TO and used to determine purchase tape replacement. Looking at the chart, select an aircraft (A/C) gross weight; by moving your eyes right, the aircraft's engaging speed (knots) increases. Once the aircraft weight and speed are determine, the associated REGIME area (I, II, III, or IV) will dictate tape replacement.

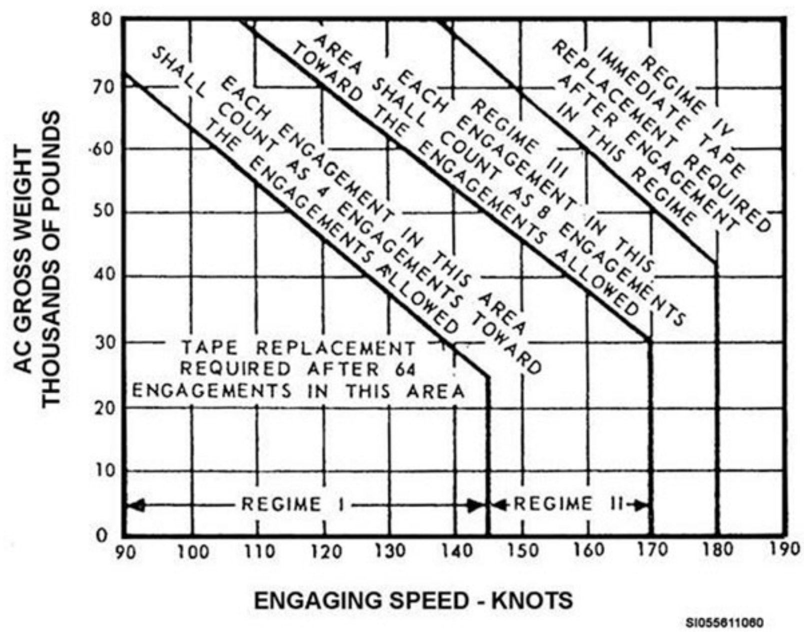

Figure 2–33. Purchase tape replacement criteria (Regime Chart).

For example if an aircraft weighing 40,000 pounds engages a barrier at 150 knots, that would put the engagement in the area labeled REGIME II. The instructions for that area say “Each engagement in this area shall count as four engagements toward the engagements allowed.” Notice that tape replacement is required when the total regime count reaches 64 or any time an engagement is REGIME IV.

The weight of the aircraft is needed to use the Regime Chart. The pilot, the chief of fire protection, or base operations usually provides the weight to us. Sometimes in extreme emergencies the pilot is unable to determine the aircraft speed. It will then become your responsibility to determine the aircrafts velocity based upon your telltale gauge readings.

The TO provides figures 2–34 and 2–35 to assist in determining velocity of the aircraft. Use figure 2–34 to determine the aircraft’s speed by utilizing the telltale tachometer. The tachometer is accurate within ± 5 percent. Use the chart in figure 2–34 to determine aircraft speed by utilizing the telltale hydraulic pressure gauge. The maximum hydraulic pressure gauge is accurate within ± 15 percent.

Each full tape pullout and rewind cycle made to comply with the requirements of the third monthly inspection, shall count as one half of an engagement.

To determine the aircraft’s speed, start by reading and recording the telltale tachometer. Let’s say your reading on the telltale tachometer is 600 RPM. Using figure 2–33, follow the line from the tachometer reading, 600 RPM, to the right until it crosses the line labeled “Mean Engaging Velocity.” Now stop at the mean engaging velocity line and move straight down. At the bottom of this chart, 600 RPM will correlate to 111 knots. Now take the value of 111 knots to the Regime Chart and determine the level of the engagement.

Now take the time to determine the regime for an engagement with a tachometer reading of 600 RPM and a weight of 26,000 pounds using figure 2–35. The regime that we should have found is a REGIME I.

NOTE: At speeds above 140 knots or when aircraft runout is less than 350 feet, the tachometer is not accurate. In these cases, we use the pilots estimated speed.

Aircraft speed can also be determined using a known aircraft weight and telltale pressure reading. Read and record the telltale hydraulic pressure gauge. If the pressure gauge is reading 600 psi, use the known weight of the aircraft. After the engagement, call base operations and request this information. For example, if base operations comes back with an aircraft weight of 20,000 pounds. Locate 600 psi on the left side of the chart in figure 2–35. Move to the right until it crosses the line that correlates with the aircraft weight—20,000 pounds. When this intersects with the line that indicates the aircraft weight, stop and move straight down. The numbers at the bottom of the chart indicate the aircraft's engaging speed in knots. In this example, 600 psi with an aircraft weighing 20,000 pounds will correlate to 133 knots. Now take the time to apply this information to the Regime Chart in figure 2–33. This engagement is a REGIME 1 and counts for one engagement towards the tapes.

Once we determine the regime of the engagement, add the number of points associated with the engagement to the total already accumulated on the tape and determine if the tape requires replacement.

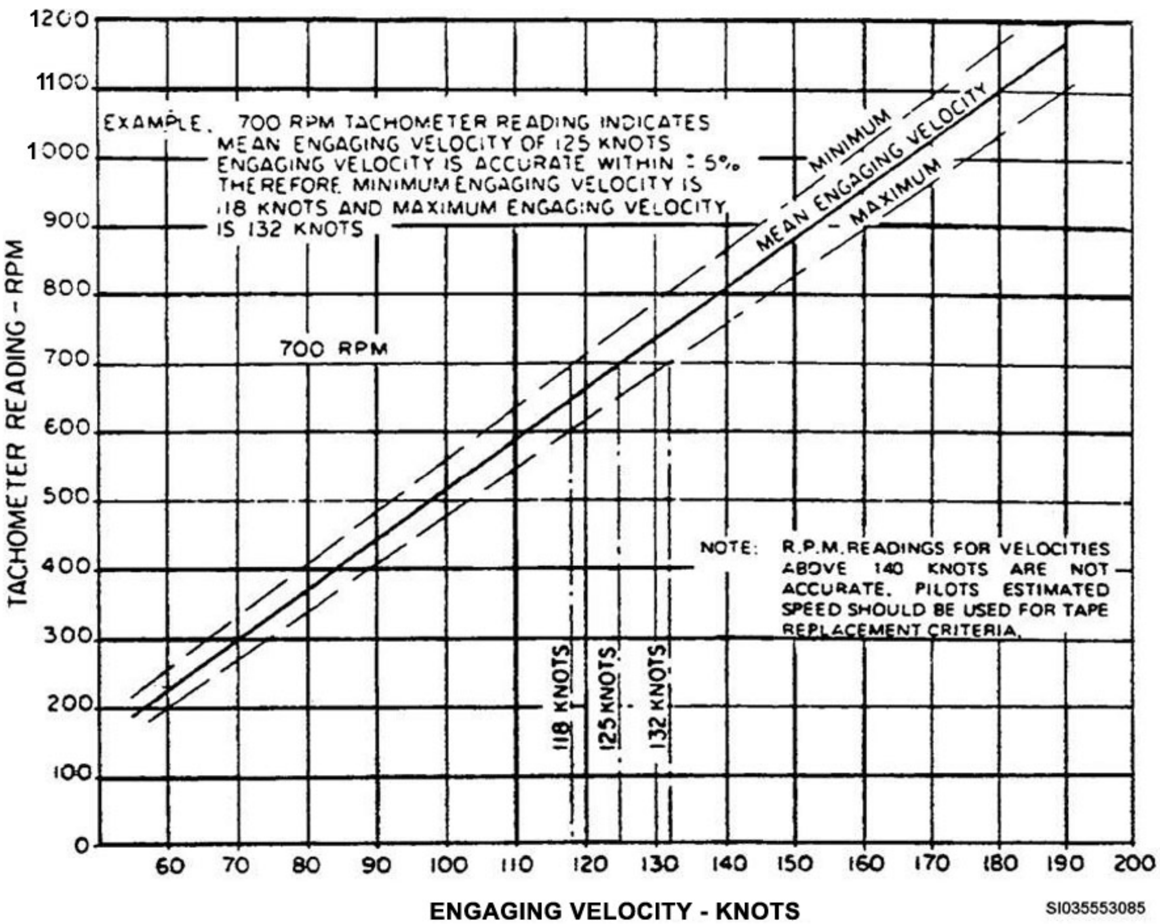

Figure 2–34. Tachometer reading vs. engaging velocity.

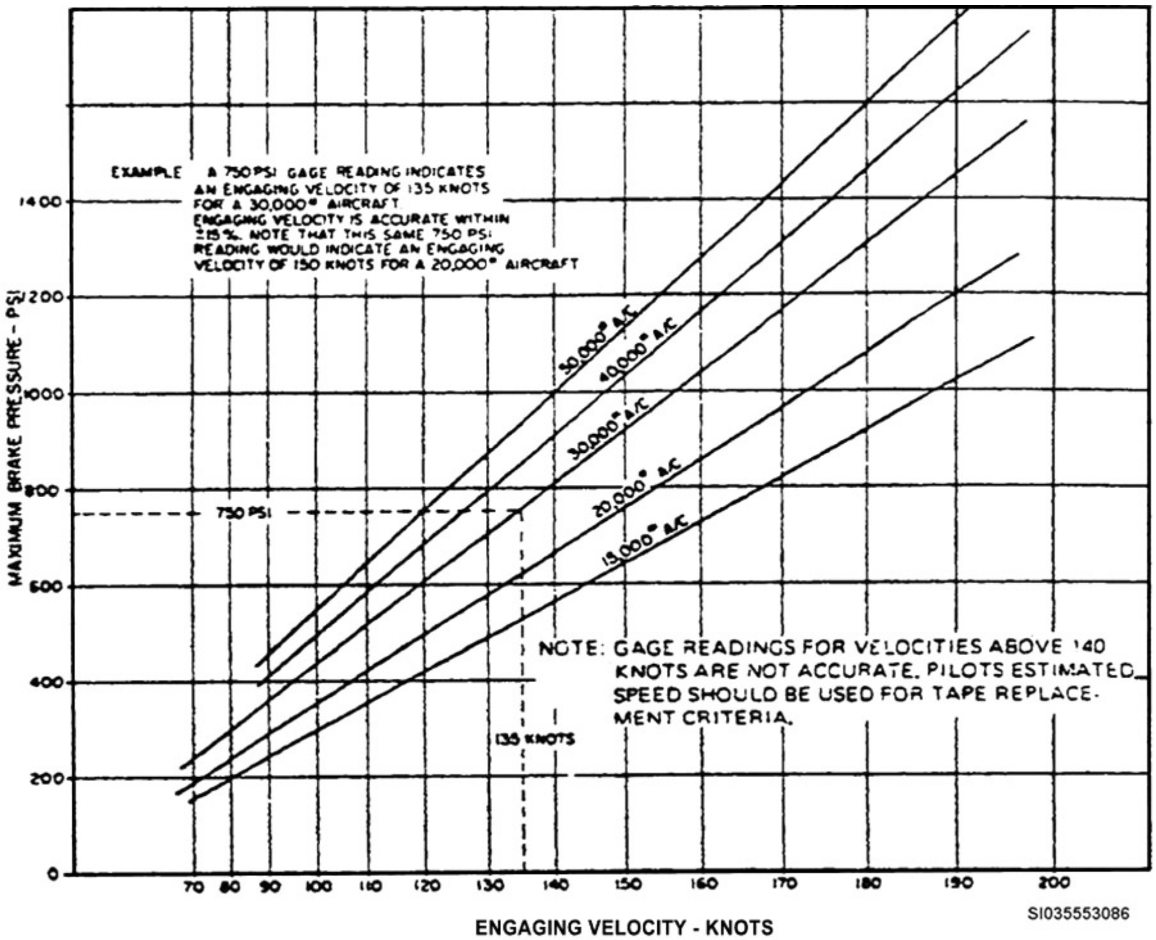

Figure 2–35. Hydraulic pressure gauge chart.

613. AAS repair and troubleshooting

Even with the best periodic maintenance from time to time components on arresting systems will go bad. This lesson will cover replacing some of these components and troubleshooting these arresting systems in order to better diagnose problems.

Replacing components

We must understand the way the MAAS functions to be able to maintain it. This includes the rewind system, hydraulic system, and trailer system. This section looks at replacing components in each of the systems. Remember always use the TO when performing any maintenance.

Rewind system component replacement

The rewind system consists of the rewind engine, power take-off unit, fluid coupling, gear reducer, clutch, and chains. Each of these components is vital to retracting the tapes after they are on the runway. The applicable TO will describe the specific steps that we must follow to replace each of these items. When replacing components, make sure you torque the mounting bolts to the proper specification. Also keep in mind that accurate component alignment is essential to the system working properly. If aligned improperly the gears, the drive chains could jump track and fall off or wear rapidly causing failure.

When refilling the fluid coupling and gear reducer, make sure we use the proper grade of oil and fill to the correct level. The improper grade of fluid or improper level will affect the operation. If we use too heavy of a grade of oil or overfill the coupling, system components will not slip at the proper level. This could cause damage to the power take-off, gear reducer, or chains. Insufficient oil level in the coupling could cause a reduced pre-tension pressure to the tapes and pendant.

MAAS Trailer hydraulic system replacement

When replacing components on the trailer hydraulic system, be sure to use the correct replacement parts. Just because it psychically fits does not mean it will do the job. These systems must be able to maintain the pressures the systems operate at.

Hydraulic cylinder replacement

As always, refer to the proper TO for the correct procedures before any maintenance is performed. Follow the steps below when replacing the hydraulic cylinder.

1. Remove hydraulic hoses.
2. Plug hose end with suitable fitting to minimize fluid loss.
3. Remove retaining rings.
4. Reassemble in reverse order and bleed the hydraulic system.

Troubleshooting AAS

When an arresting system is not operating correctly it in imperative that is gets repaired as soon as possible. Knowing the troubleshooting charts will help you resolve most problems quickly and the arresting system back in service.

Troubleshooting the hydraulic system

When troubleshooting the BAK–12 hydraulic system always refer to the proper TO. Below is a troubleshooting chart that shows typical problems and causes.

Trouble	Probable Cause	Remedy
1. Excessively long runout.	Valve cam clearance incorrect.	Set valve cam clearance.
	Air in hydraulic system.	Bleed system.
	Air leak in reel driven pump suction.	Secure fittings. If leak still exists, remove tube between pump and reservoir, examine and replace if cracked. Replace O-rings and reattach.
	Low relief valve setting.	Check setting and reset valve if necessary.
	Incorrect weight setting.	Synchronize absorbers.
	Cam out of index.	15-degree cam advancement.
	Faulty control valve or linkage.	Inspect and repair linkage or control valve.
	Brakes worn.	Check brake wear.
2. Short runout or excessive rollback.	Cam out of index.	15-degree cam advancement.
	Incorrect weight setting.	Synchronize energy absorbers.
	Incorrect control valve clearance.	Check control valve clearance.
3. Inability to obtain sufficient tension on pendant/hook cable.	Brake dragging.	Cycle manual shuttle lever two or three times and leave in off position.
	Excessive friction between support ring and reel plates.	Lubricate phenolics and/or widen spacing of support ring assemblies.
	Oil in fluid coupling low.	Fill with oil.
4. Loss of tape tension.	Leak in static pressure system.	Find leak and repair.
	Internal leak in shuttle valve.	Replace valve.
	Leak at Schrader charging fitting.	Tighten or replace charging fitting as required.

Trouble	Probable Cause	Remedy
	Leak in check valve in hand pump.	Repair or replace hand pump.
5. Loss of fluid through breather of reservoir.	Binding, damaged, or stiff valve levers.	Check shuttle valve levers.
	Faulty hand transfer pump.	Check pump (reservoir to accumulator).
6. Tapes extend unevenly during an on-center arrestment.	Air in hydraulic system or long tape.	Bleed system.
	Cam out of index.	15-degree cam advancement.
	Engine not synchronized.	Synchronize energy absorber.
	Faulty control valve or linkage.	Inspect and repair linkage or control valve.
7. Pendant/hook cable excessive sag (less than 2 inches from the bottom of the cable to the surface of the runway).	Not properly pretensioned.	Pretension tapes.
	Brakes not holding.	Refer to item 4 above – Loss of tape tension.
	Pendant/hook cable disks worn.	Replace disks.

Troubleshooting the rewind system

When troubleshooting the BAK–12 rewind system always refer to the proper TO. Below is a troubleshooting chart that shows typical problems and causes.

Trouble	Probable Cause	Remedy
1. Tape will not rewind.	Oil in fluid coupling is low.	Fill with oil.
	Overcenter clutch not engaged.	Engage overcenter clutch.
	Brakes on.	Set shuttle valve levers to off.
	Faulty selector valve.	Replace valve.
	Clutch not activated.	Low fluid in system - replenish through selector valve.
	Air in clutch system.	Bleed clutch.
2. Tape sheave(s) binds or does not rotate freely.	Damaged bearing or shaft.	Repair

Troubleshooting the MAAS trailer hydraulic system

When troubleshooting the MAAS trailer hydraulic system always refer to the proper TO. Below is a troubleshooting chart that shows typical problems and causes.

Trouble	Probable Cause	Remedy
1. Erratic action.	Air in system.	Bleed air and check for leaks.
	Viscosity of hydraulic fluid too high.	Change to lower viscosity fluid.
	Internal leakage in cylinder.	Replace worn packing, check for excessive contamination or wear.
	Cylinder sticking or binding.	Check for dirt, gummy deposits or leaks. Check for misalignment, worn parts or defective packing.
2. Cylinder does not move.	Improper valve position.	Select proper position.
	Low or no fluid in HPU.	Fill with fluid and bleed the system.
	Air locked in pump.	Bleed the system.
	Couplers not fastened.	Fasten couplers and bleed.
	Plugged hydraulic line.	Flush and clean system.
	Pump not operating.	Check HPU operating instructions.

Trouble	Probable Cause	Remedy
3. Cylinder moves only partially.	Pump reservoir is low on fluid.	Fill and bleed.
	Cylinder piston rod binding.	Check for dirt, gummy deposits or leaks. Check for misalignment, worn parts or defective packing.
4. Cylinder moves slower than normal or does not move.	Loose connection.	Tighten and bleed.
	Leaky connection.	Clean connection and use a non-hardening pipe thread compound or Teflon tape as needed.
	Pump HPU not working correctly.	Check HPU operating instructions.
	Leaking seals.	Replace seals.
	Loose couplers.	Tighten couplers.
	Blocked hydraulic lines.	Clean and flush.
	Cylinder damage internally.	Send to service center.
5. Cylinder moves but does not maintain pressure.	Leaky connection.	Clean connection and use a non-hardening pipe thread compound or Teflon tape as needed.
	Cylinder seals leaking.	Replace seals.
	Pump valve malfunctioning.	Check HPU operating instructions.
6. Cylinder leaks hydraulic fluid.	Worn or damaged seals.	Replace seals.
	Loose connections.	Tighten fittings.
7. Trailer does not lower	HPU not connected.	Check connection and fasten.
	Retaining pins not removed.	Remove pins.
	Foreign object beneath trailer.	Raise and remove blockage.
	Damaged hydraulic cylinder.	See 1 through 6.
8. Trailer does not raise	HPU not connected.	Check connection and fasten.
	Hydraulic fluid leak.	Check lines and fittings.
	Foreign object in axle frame path.	Remove blockage.
	Insufficient fluid.	Check reservoir and service.
9. Winch does not operate properly	Dog clutch disengaged.	Engage.
	HPU not connected.	Check connection and fasten.
	Hydraulic fluid leak.	Check lines and fittings.
	Insufficient hydraulic fluid.	Check reservoir and service.
	Winch low on gear case oil.	Check oil level and service.

In this lesson, we have discussed the MAAS contruction features, theory of operation, installation, inspections, maintenance and maintenance planning. Your understanding of this vital piece of equipment may someday save a pilot’s life.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

612. AAS inspections

1. When should the MAAS/BAK–12 be overhauled?

2. How often are purchase tapes replaced?

3. What is used to determine an engagements regime?

613. AAS maintenance and troubleshooting

1. What can be read to better understand troubleshooting the MAAS?

2. What could cause erratic action on the MAAS trailer hydraulic system?

3. What could cause the trailer not to raise?

Answers to Self-Test Questions

608

1. 65,000,000 foot-pounds.
2. The static system, the main or braking system, and the rewind clutch system.
3. 175 psi.
4. Actuating the shuttle valve applies accumulator pressure to the brakes.
5. The tape attaches to the connector with a mechanical clamping arrangement with the tension of the tape.
6. The rewind clutch system contains an actuating pump, a hose assembly, a swivel joint, a selector valve, and a friction clutch.

609

1. AFI 32–1043.
2. Certification engagements are required after initial installation or whenever the arresting system has not had an engagement at a speed sufficient to exercise the hydraulic system within the preceding 12 months.

610

1. 2.
2. 3,000 psi.
3. 90 and 153 feet.

611

1. 990 feet plus aircraft length.
2. 39 inches.
3. The taper bolt gauge.
4. One turnbuckle, one master link, one stake guide, three stakes, two spacers, and two stake spacers.
5. Rewind tapes and bleed brakes.

612

1. 10 years or 500 arrestments, whichever occurs first.
2. Maximum for 48 months.
3. Regime charts.

613

1. The troubleshooting charts.
2. Air in system, viscosity of hydraulic fluid too high, internal leakage in cylinder, cylinder sticking or binding.
3. HPU not connected, hydraulic fluid leak, foreign object in axle frame path, and insufficient fluid.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

Do not return your answer sheet to the Air Force Career Development Academy (AFCDA).

34. (608) In the BAK–12 arresting system, the hydraulic pressure gauge is used for
    a. controlling the flow of fluid from the pump to the clutch.
    b. measuring the energy-absorbing capacity of the system.
    c. hydrostatic testing and synchronization.
    d. maintaining tape tension.

35. (608) On the BAK–12 hydraulic system, what is used to maintain a light pressure on the brakes to keep the proper tension on the pendant while in the BATTERY position?
    a. Brake pressure.
    b. Rewind system.
    c. Static pressure.
    d. Control system.

36. (608) On the BAK–12 arresting system, what eliminates tape twist caused by the rolling action of the pendant supports?
    a. Deck sheaves.
    b. Tape guide.
    c. Tire casing.
    d. Brushes.

37. (608) For rewind operation, which component of the BAK–12 rewind clutch system connects the rewind sprocket to the reel assembly shaft?
    a. Swivel joint.
    b. Actuating pump.
    c. Selector valve.
    d. Friction clutch.

38. (608) What size pendant is typically used on operational installations of the BAK–12 arresting system?
    a. ½ inch.
    b. ¾ inch.
    c. 1¼-inch.
    d. 1½ inch.

39. (609) What is the primary guidance in managing the inspection and maintenance program?
    a. AFI 32–1043, complete with all MAJCOM and local supplements.
    b. AFI 32–1043 only.
    c. AFI 32–1062.
    d. ETL 13–4.

40. (609) Which form is used to record historical maintenance data?
    a. Effective Pendant Height.
    b. AFTO Form 244.
    c. AFTO Form 95.
    d. Record of certification.

41. (610) Which type of energy absorber is used on the mobile aircraft arresting system (MAAS)?
    a. Barrier arresting kit (BAK)–15.
    b. BAK–12.
    c. BAK–13.
    d. BAK–14.

42. (610) What type of engine(s) are used on the hydraulic power units (HPU) located on the mobile aircraft arresting system (MAAS)?
    a. Gasoline only
    b. Diesel only.
    c. Propane.
    d. Gasoline and diesel.

43. (611) Who has the lead role in selecting a site for the mobile aircraft arresting system (MAAS)?
    a. Airfield manager.
    b. Engineer assistant.
    c. Electrical superintendent.
    d. Power production NCOIC.

44. (611) What *minimum* run out distance must be provided for installation of the mobile aircraft arresting system (MAAS)?
    a. 990 feet.
    b. 990 feet, plus aircraft length.
    c. 1,200 feet.
    d. 1,200 feet, plus aircraft length.

45. (611) Which formula is used to determine where to position the mobile aircraft arresting system (MAAS) on the runway edge?
    a. *Pendant length.*
    b. $\frac{Pendnt\ length}{2}$.
    c. *Pendant length* + 15 feet.
    d. $\frac{Pendant\ length + 15\ feet}{2}$.

46. (611) What is used to secure the mobile aircraft arresting system (MAAS) on a concrete runway for unidirectional arrestment capability?
    a. Moil points.
    b. Stake pockets.
    c. Anchor plates.
    d. KM stake lines.

47. (611) Where should the four-axle trailer retaining pins on a mobile aircraft arresting system (MAAS) be stored once they have been removed?
    a. In your pocket.
    b. In the stake pockets.
    c. In the front storage box.
    d. In the pin storage compartment.

48. (611) On the mobile aircraft arresting system (MAAS), what is used to ensure a $^{3}/_{8}$ –inch clearance gap between the bolt head and anchor plate?
    a. Ruler.
    b. Flat washer.
    c. Taper bolt gauge.
    d. Long nosed pliers.

49. (611) For soil installation of a unidirectional mobile aircraft arresting system (MAAS), 19 aluminum stakes are used to anchor the unit alongside a runway. Around the perimeter of the MAAS trailer, what are 10 of the stakes installed through?
    a. Stake guide.
    b. Anchor plate.
    c. Stake spacers.
    d. Stake pockets.

50. (611) If you have an asphalt over concrete runway and want to use standard concrete installation procedures, how much asphalt are you allowed to chip away before installing a mobile aircraft arresting system (MAAS)?
    a. Less than ½ inch.
    b. More than ½ inch.
    c. Less than 1 inch.
    d. More than 1 inch.

51. (612) How many months can the BAK–12 arresting system pendant be in service before replacement is required?
    a. 20.
    b. 36.
    c. 40.
    d. 48.

52. (612) When do you turn the purchase tapes end for end on the BAK–12 arresting system?
    a. Every 6 months.
    b. Every 12 months.
    c. Every 24 months.
    d. Every 36 months.

53. (612) Synchronize both of the hydraulic systems on a BAK–12 arresting system
    a. weekly.
    b. monthly.
    c. every 3 months.
    d. every 2 months.

54. (613) What can be used to better understand diagnosing problems with the MAAS?
    a. Diagnostics charts.
    b. HPU manual.
    c. Lubrication chart.
    d. Troubleshooting charts.

55. (613) Which of the following malfunctions would be noted by excessive aircraft rollback following a BAK–12 engagement?
   a. Cam out of index.
   b. Insufficient cable pre-tension.
   c. Low fluid coupling oil level.
   d. Uneven tape stack height.

Glossary of Abbreviations and Acronyms

A/C	aircraft
AAS	aircraft arresting system
AC	alternating current
AFCEC	Air Force Civil Engineer Center
ATC	air traffic controller
BAK	Barrier Arresting Kit
CBR	California bearing ratio
CCW	counter-clockwise
CW	clockwise
EA	engineering assistant
EPH	effective pendant height
HPU	hydraulic power unit
kVA	kilo-volt amps
LWFB	lightweight fairlead beam
MAAS	mobile aircraft arresting system
MOS	minimum operating strip
MRES	mobile runway edge sheave
psi	pounds per square inch
RM	risk management
rpm	revolutions per minute
RRR	rapid runway repair
TO	technical order
VAC	volts, alternating current

Student Notes

Student Notes

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