BY ORDER OF THE
SECRETARY OF THE AIR FORCE

AIR FORCE INSTRUCTION 32-1043

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Civil Engineering

MANAGING AIRCRAFT ARRESTING SYSTEMS

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

OPR: HQ AFCESA/CESC
(Mr. Michael Ates)
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This instruction implements AFPD 32-10, *Installations and Facilities.* It gives procedures for managing, installing, maintaining, and using USAF aircraft arresting systems. **Attachment 1** lists references, abbreviations, acronyms, and terms used in this instruction.

SUMMARY OF REVISIONS

This revision of AFI 32-1043, revises the requirements for qualification of aircraft arresting system maintainers contained within paragraph **1.2.3.**, and documenting equivalent training for civilians in paragraph **1.3.8.** This revision also highlights in paragraph **1.3.7.** the requirement to report missed engagements, and adds the definition of a missed engagement within **Attachment 1**, *Glossary of References, Abbreviations, Acronyms, and Terms.* Paragraph **3.2.3.** is updated to include references to the appropriate pavement design manual for pavement repair beneath arresting system cables, and paragraph **3.3.6.** is corrected to provide the correct reference for marking aircraft arresting system locations on runways. This revision also updates the definitions of terms to agree with the latest changes in Joint Pub 1-02. A indicates revisions from the previous edition.

Supersession history: AFR 55-42, 30 June 1986..

1. Responsibilities:

1.1. Headquarters USAF and Field Operating Agencies:

1.1.1. The Civil Engineer, Headquarters USAF (HQ USAF/CE), develops maintenance policy and oversees execution. See AFPD 32-10 and the 35E8-series technical orders (TO).

1.1.2. The Air Force Civil Engineer Support Agency, Directorate of Technical Support (HQ AFCESA/CES), provides technical guidance for all phases of aircraft arresting system programs.

It also validates requirements for new systems and helps resolve technical difficulties between the major commands (MAJCOM) and the San Antonio Air Logistics Center.

1.1.3. The Deputy Chief of Staff for Plans and Operations (HQ USAF/XO), develops operational policy and oversees execution.

1.1.4. The Air Force Flight Standards Agency provides technical support to the Air Staff on operational issues relating to installation, maintenance, and use of these systems. It also helps to plan, develop, review, and recommend standards for siting, installing, operating, and maintaining aircraft arresting systems.

1.2. Major Commands (MAJCOM). The MAJCOM civil engineer representative manages arresting system programs and enforces Air Force policy. The representative must also perform the following tasks.

1.2.1. Submit an *Aircraft Arresting Systems Report* (RCS: HAF-CE [AR] 7150) to:

AFFSA/XOI

1535 Command Drive, Suite D309

Andrews AFB MD 20331-2007

These reports are accurate inventories of the arresting systems assigned to each base.

1.2.1.1. Submit the report any time you plan changes in an arresting system complex, and update it at least every 5 years. See **Attachment 4**.

1.2.2. Submit (or ensure that each base submits) an *Aircraft Arrestment Report* (RCS: HAF-CE [M&AR] 8403) to:

SA-ALC/LDEA

303 Wilson Blvd, Suite 2

Kelly AFB TX 78241-5442

NOTE:

Do not submit the report during periods of inactivity or emergency.

1.2.2.1. In the report, include:

- Base name.
- Arresting system type.
- Aircraft type.
- Reason for engagement.
- Approximate speed and weight of aircraft.
- Damage to aircraft or equipment (if any).
- Problems (if any) and the suspected cause.
- A focal point and phone number at the base.
- Details of each engagement or attempted engagement.
- Any other pertinent information.

NOTE:

Do not submit classified information. Discontinue reporting during emergency conditions.

1.2.3. Ensure personnel engaged in aircraft arresting system activities meet the following minimum requirements for the associated tasks:

- To certify an aircraft arresting system back in service after arrestment, personnel must be task qualified 3E052 technicians.
- To perform maintenance on an aircraft arresting system, personnel must be task qualified 3E032 technicians.
- To perform daily inspections on an aircraft arresting system, personnel must be designated by the base civil engineer and be certified annually by the designated Power Production technician on an AF Form 483, **Certificate of Competency**.

1.2.4. Request waivers to the 35E8-series TOs from San Antonio Air Logistics Center when a base requires it.

1.2.5. Establish a record of dates when all arresting systems under the command's authority last underwent an overhaul that included a brake change.

1.2.6. Develop an overhaul plan and schedule that prevents unnecessary runway closures and waiver requests. Include all systems, even ones designated war reserve materiel, such as the Mobile Aircraft Arresting System.

1.2.6.1. If the plan requires the San Antonio Air Logistics Center depot to do overhauls, send them a copy of the schedule 1 calendar year before the earliest requirement on the schedule. Provide them with updates at least once a year, but not more often than once every 6 months.

1.2.7. Review all new aircraft arresting system project installation drawings for functional and technical correctness before awarding a contract. All projects must comply with siting criteria (see paragraph 3), the applicable TO, and typical installation drawings.

1.2.8. Process AF Forms 601, **Equipment Action Request**, authorizing new systems with the directorate of operations.

1.2.9. Communicate with all other MAJCOMs that have a flying mission before you decommission any arresting system. MAJCOMs with flying missions include activities that use the base in question as a possible divert facility.

1.2.9.1. If you decommission and remove an arresting system and no longer need it within the command, return it to the San Antonio Air Logistics Center. Send an information copy of the shipping document to the Air Force Civil Engineer Support Agency, Director of Technical Support, for tracking purposes.

1.3. Base Civil Engineers. Base civil engineers approve AF Forms 601 and work with representatives from operations and safety to:

- Recommend that additional systems be installed to meet new or revised mission requirements.
- Recommend (to the MAJCOM) decommissioning of systems no longer needed to support the mission.

- Review and update the Department of Defense (DoD) flight information publication before removing any system from service.
- Determine siting requirements for new systems and obtain MAJCOM coordination for non-standard and midfield installations.
- Determine annually if nonstandard arresting system installations can continue in use without compromising operational efficiency and safety.
- Comply with the provisions of this instruction.

1.3.1. The base civil engineer's representative must also:

1.3.2. Obtain waivers from the San Antonio Air Logistics Center through the MAJCOM if you need to modify these systems.

1.3.3. Submit AF Form 601 through appropriate channels to obtain authorization for arresting systems.

1.3.4. Make sure that installation, operation, and maintenance actions comply with all criteria listed in this instruction. Conduct inspections according to 35E8-series work cards.

1.3.5. Develop local procedures to clear aircraft from the runway and inspect and reset the system immediately after each engagement.

1.3.6. Submit all requested information to the MAJCOM for inclusion in the aircraft arresting system report as described in paragraph **1.2.1.**

1.3.7. Submit aircraft engagement information according to paragraph **1.2.2.** and MAJCOM direction. Include all missed engagement attempts. (See **Attachment 1** for the definition of a missed engagement.)

1.3.8. Develop local procedures to thoroughly train each person who uses, operates, or maintains an arresting system. Document training and certification of civilian employees to a level equivalent to that required for award of a Special Experience Identifier on AF Form 971, **Supervisor's Record of Employee**. See AFMAN 36-2108, *Airman Classification*, for the specific aircraft arresting system Special Experience Identifiers and the requirements for assigning these identifiers.

1.3.9. Establish procedures to ensure coordination among the activities engaged during emergencies and operations such as snow and ice removal. These procedures must clearly delineate the different responsibilities of power production and fire protection personnel involved in rewind operations.

1.3.10. Report all deficiencies discovered with arresting systems and components to supply according to TO 00-35D-54, *USAF Material Deficiency Reporting and Investigating System.*

1.3.11. Keep a record of the effective pendant height according to **Attachment 6** for each arresting system installed.

1.4. HQ Air Force Materiel Command:

1.4.1. The Aeronautical Systems Center manages engineering development of new requirements and oversees initial production. Once the initial quantity production is complete, responsibility for item management, engineering, and procurement support transfers to San Antonio Air Logistics Center.

1.4.2. San Antonio Air Logistics Center provides logistic and engineering support and item management for these systems and components. It:

- Procures systems and spare parts.
- Provides technical assistance and consultation on maintenance, product improvement, modifications, inspections, and installation of all arresting systems in the USAF inventory.
- Compiles, analyzes, and documents information for the monthly aircraft arrestment report.

2. Standard Operational Configuration of Aircraft Arresting Systems:

2.1. Disconnect and remove unidirectional barrier nets and cables on the approach end of the runway. Full-size net systems such as the BAK-15 may remain in place in the down position; however, the base civil engineer's designated representative must inform the airfield manager and the director of safety when the net is in place.

Do this to publicize the hazard to aircrews.

2.2. Maintain operational arresting systems in the ready position on the approach and departure ends of the runway unless the installation commander directs otherwise.

2.3. You may remove barriers and hook cables from the runway during snow and ice removal operations, but return them to operational status quickly. Clear enough space to allow unobstructed runout of the system plus the length of the aircraft.

3. Siting:

3.1. Siting Criteria. Criteria for siting aircraft arresting systems vary according to the type of system and operational requirement:

3.1.1. The large rectangular pavement markings located 1,000 feet from the threshold represent the ideal aim point for pilots on approach to landing.

3.1.2. Other visual landing aids such as the visual glide slope indicator cue the pilot to touch down at approximately 1,000 feet from the threshold, thus ensuring a minimum threshold crossing height.

3.1.3. Since stabilizing the tailhook after touchdown requires a distance of 500 to 800 feet, the best location for an arresting system that accommodates approach end engagements is 1,500 to 1,800 feet from the threshold.

3.1.4. The best location for runways used extensively during instrument meteorological conditions is 2,200 to 2,500 feet from the threshold. However, if aircraft that are not compatible with trampling of the pendant must operate on the same runway, the installation commander may shift the installation site as close to the threshold as possible. The critical factor in this case is assurance that the runout area for an aircraft engaging the system in an aborted takeoff scenario is large enough to safely accommodate other arresting systems or equipment such as light fixtures.

3.1.5. Other operating scenarios may dictate that you place an additional system at the midpoint of the runway. The installation commander must approve this configuration. Coordinate plans for these type installations with the host MAJCOM.

3.2. System Standards. Comply with the following standards when locating, configuring, installing, or repairing an arresting system. Base civil engineers must get the installation commander's approval and coordinate with major command operations and civil engineer organizations before deviating from these standards.

NOTE:

You don't have to relocate systems that don't conform to standards. Each year, however, the civil engineer's designated representative must review such systems with flight safety and operations to determine whether they can serve without compromising operational efficiency or safety.

3.2.1. The base civil engineer's designated representative determines the configuration and location of arresting systems. Design must conform with the criteria in section 3 of the appropriate 35E8-series TO and the typical installation drawings. Both are available from San Antonio Air Logistics Center, office symbol "LDEA."

3.2.2. The Base Civil Engineer's aircraft arresting system representative approves the construction drawings and contract specifications at the 90 percent design completion phase and ensures that installation contracts stipulate that:

- The construction superintendent, project engineer, or other authority experienced in installing arresting systems be on site during construction and installation of each system.
- The contractor corrects any deficiencies in the installation until at least two pull-outs of the purchase tape are accomplished in each direction of intended operation and the contracting officer officially accepts the system.

3.2.3. The 200 feet of pavement on both the approach and departure sides of the arresting system pendant are critical areas. Eliminate protruding objects and undulating surfaces that could cause tailhook skip and result in a missed engagement. The maximum permissible longitudinal surface deviation in this area is plus or minus 0.125 inch in 12 feet. Do not change pavement type in this area except to repair damage beneath the pendant. See AFJMAN 32-1028, *Standard Practice for Rigid Pavements*, and AFJMAN 32-1029, *Standard Practice for Flexible Pavements*.

3.2.4. Do not use Portland cement concrete as a repair material beneath the cable in a flexible runway system. This type of repair increases the likelihood of hook skip when the flexible pavement consolidates, exposing the leading edge of the rigid pavement.

3.3. Locating Systems:

3.3.1. Locate unidirectional arresting systems and barriers (nets) in the overrun area of the runway. The energy-absorbing device dictates the distance from threshold because of the need to accommodate full system runout.

3.3.2. Do not locate a unidirectional system or net closer than 35 feet from the threshold of the runway. ***Note: Runway threshold markings begin 20 feet inboard of the full strength pavement; therefore, do not install a unidirectional system within 55 feet of the threshold markings.)***

3.3.3. Locate all energy absorbers except BAK-13 and ships' anchor chains below grade or at least 200 feet from the edge of the runway pavement. Locate semipermanent BAK-13 installations as close as 150 feet.

3.3.4. Provide paved transitions and buried crushed stone ramps around the arresting system components located on the runway shoulders. (See AFI 32-1024, *Standard Facility Requirements.*)

3.3.5. Where deck sheaves, fairlead beams, or tape tubes project above the grade of the existing runway shoulders, provide suitable fill materials and compaction next to or over these components to a finished grade of 1V:30H or flatter.

3.3.6. Provide obstruction marking and lighting and arresting system location marking and lighting according to the provisions of AFI 32-1042, *Standards for Marking Airfields,* and AFI 32-1044, *Visual Air Navigation Facilities.*

3.3.7. Use frameless protective shelters for above-grade systems to comply with the frangibility requirement in AFJMAN 32-1013, *Airfield and Heliport Planning and Design Criteria* (use AFI 32-1026, *Planning Criteria for Airfield Support Facilities* [formerly AFRs 86-5 and 86-14], pending publication of this document). Also provide a removable roof or end to facilitate major maintenance or replacement.

4. Obtaining New Systems:

4.1. San Antonio Air Logistics Center centrally procures arresting systems.

4.2. Identify requirements at least 24 months in advance to allow lead time for budgeting and manufacturing.

4.3. The base civil engineer's representative submits requirements on AF Form 601 through logistics support channels to the Command Equipment Management Office.

4.4. The Command Equipment Management Office coordinates the AF Form 601 with the director of flight operations and the civil engineer. When coordination is complete, the office sends a copy of the form to the Air Force Civil Engineer Support Agency, Directorate of Technical Support.

4.5. The Air Force Civil Engineer Support Agency validates the new requirements with San Antonio Air Logistics Center for budgeting and procurement. It then returns the AF Form 601 to the base through the appropriate table of allowance manager.

4.6. Upon approval of AF Form 601, base-level personnel should order the system and other components not included in the Government-furnished equipment package (such as the pendant).

5. Jointly Used Civil Airports. The Federal Aviation Administration (FAA) acts for and on behalf of the DoD Service component in operating arresting systems installed at jointly used civil airports for the primary use of US military aircraft.

5.1. Site arresting systems on civil airports jointly used by civil and military aircraft according to Federal Aviation Administration Advisory Circular 150/5220-9, *Aircraft Arresting Systems for Joint Civil/Military Airports.* Order this Advisory Circular from:

US Department of Transportation

General Services Section

M-443.2

Washington DC 20590

5.2. To install an arresting system at a jointly used civil airport, the installation commander must first notify the airport manager (or authority) of the need. If the airport manager agrees, the installation commander submits the plan with sketches or drawings to the USAF liaison officer at the FAA regional office. Refer any disagreement between the responsible officials to the next higher level.

5.3. If construction involves a lease agreement that does not allow placement of additional structures on the leased premises, contact the MAJCOM.

5.4. Third-party claims presented for damage, injury, or death resulting from the FAA operation of the system for military aircraft or from the Air Force or Air National Guard maintenance of the system may be the responsibility of the Air Force. Process such claims under the appropriate USAF regulatory guidance (AFI 51-502, *Personnel and Government Recovery Claims*).

5.5. The FAA is responsible for claims presented for damage resulting from FAA operation of the system for civil aircraft. Therefore, separate agreements between the DoD and the FAA concerning liability for such damage are not necessary.

5.6. The MAJCOM negotiates the operational agreement with FAA for a jointly used civil airport. The major command may delegate this authority to the installation commander. The agreement describes FAA functions and responsibilities concerning the remote control operation of arresting systems by FAA air traffic controllers. See **Attachment 5** for a sample letter of agreement.

6. Military Rights Agreements for Non-Continental US Locations and Use by Non-US Government Aircraft. Install these systems under the military rights agreement with the host government. The installation commander coordinates any separate agreements required with the local US diplomatic representative and negotiates the agreement with the host nation. If the parties are unable to agree, refer the issue to the MAJCOM.

6.1. In an emergency, the pilot of a non-US Government aircraft may request and use arresting systems at Air Force bases and jointly used airports within the continental US and overseas.

EUGENE A. LUPIA, Maj General, USAF
The Civil Engineer

Attachment 1

GLOSSARY OF REFERENCES, ABBREVIATIONS, ACRONYMS, AND TERMS

References

AFPD 10-6, *Mission Needs and Operational Requirements*

AFPD 32-10, *Installations and Facilities*

AFI 10-601, *Mission Needs and Operational Requirements Guidance and Procedures*

AFI 11-218, *Aircraft Operations and Movement on the Ground*

AFI 13-203, *Air Traffic Control*

AFI 32-1024, *Standard Facility Requirements*

AFI 32-1026, *Planning and Design of Airfields*

AFI 32-1042, *Standards for Marking Airfields*

AFI 32-1044, *Visual Air Navigation Systems*

AFI 36-2108, *Airman Classification*

AFI 51-502, *Personnel and Government Recovery Claims*

AFJMAN 32-1013, *Airfield and Heliport Planning and Design Criteria*

Abbreviations and Acronyms

AFI—Air Force Instruction

AFPD—Air Force Policy Directive

AFR—Air Force Regulation

AR—As Required (used in report control symbols)

DoD—Department of Defense

EPH—Effective Pendant Height

MAAS—Mobile Aircraft Arresting System

MAJCOM—Major Command

M & AR—Monthly and As Required (used in report control symbols)

RCS HAF-CE—Report Control Symbol - Headquarters Air Force - Civil Engineer

SEI—Special Experience Identifier

TO—Technical Order

Terms

Aircraft Arresting Barrier—A device, not dependent on an aircraft arresting hook, used to stop an aircraft by absorbing its forward momentum in an emergency landing or aborted takeoff. (Joint Pub 1-02)

Aircraft Arresting Cable—The part of an aircraft arresting system that spans the runway surface or flight deck landing area and is engaged by the aircraft arresting hook. (Joint Pub 1-02)

Aircraft Arresting Complex—An airfield layout comprising one or more arresting systems.

Aircraft Arresting System—A series of devices used to stop an aircraft by absorbing its momentum in a routine or emergency landing or aborted takeoff. (Joint Pub 1-02)

Arrestment Capable Aircraft—An aircraft whose flight manual specifies arrestment procedures.

Cycle Time—A measure of time between engagement of an aircraft and the point when the arresting system is certified fully operational and ready for another engagement.

Effective Pendant Height—The vertical distance in inches from the underside of the pendant cable to a projected surface representing undamaged runway surface.

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

Location Identification—A description identifying the location of arresting systems by the approach or departure end, runway designation, and position in hundreds of feet from the threshold. For example, the location identification *extended runout BAK-12 at +1,500 on approach runway 36* indicates a 1,200 foot runout BAK-12 located 1,500 feet beyond the threshold of runway 36.

Missed Engagement—Any unsuccessful attempt to engage an aircraft arresting system hook cable with a successfully deployed aircraft tailhook.

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

Reset Time—The time required to ready the arresting system for another engagement after aircraft release. (This does not include time to disengage the aircraft from the arresting system but does include the time required to inspect and certify the system fully operational.)

Attachment 2

TYPES OF AIRCRAFT ARRESTING SYSTEMS

A2.1. Types of Aircraft Arresting Systems. Aircraft arresting systems consist of engaging devices and energy absorbers:

- Engaging devices are net barriers, disc-supported pendants (hook cables), and cable support systems that raise the pendant to the battery position or retract it below the runway surface.
- Energy absorbing devices are ships' anchor chains, rotary friction brakes (such as the BAK-9 and BAK-12), or rotary hydraulic systems (such as the BAK-13 and E-28).

Table A2.1 shows the leading particulars for USAF systems.

A2.2. Aircraft Arresting System Designations. The numbering of systems designated "Barrier, Arresting Kit" (BAK) corresponds to the sequence of procurement of the system design. Designations such as E-5, E-28, and M-21 are US Navy designations.

A2.3. Types of USAF Systems:

A2.3.1. MA-1A. This emergency arresting system consists of a net barrier and cable system designed to engage the main landing gear of an aircraft. Because it is a unidirectional system, it must always be installed in the overrun area.

A2.3.1.1. These systems require a runout area of at least 850 feet plus the length of the aircraft. Aircraft engaging this system above the speed and weight limits provided in HChart 1-1 of TO 35E8-2-2-1 will cause either a runout greater than 1,000 feet or cable failure.

A2.3.1.2. Most MA-1A systems employ ships' anchor chains as the energy absorber. The chains lie on either side of the runway overrun, beginning at the barrier location and running in the direction of aircraft travel. However, some MA-1A nets use a BAK-9 as the energy absorbing device. This configuration is an MA-1A/BAK-9.

A2.3.1.3. You can equip either configuration with a disc-supported pendant (hook engaging cable), interconnected with the net system and energy absorbing device. Position this cable on the runway side of the net to allow tailhook engagements. This configuration is an MA-1A Modified.

A2.3.1.4. The MA-1A is not currently in production as a system. Do not consider it for new installations unless you can salvage the necessary equipment from another facility. Obtain further technical information on this system from USAF TO 35E8-2-2-1, *USAF Types MA-1 and MA-1A Runway Overrun Barrier.*

A2.3.2. E-5. This unidirectional emergency arresting system is a US Navy design and designation. Much like the MA-1A, this system uses several shots of ships' anchor chain as the energy absorber. These systems can have from one to four disc-supported hook cables, with designations of E-5 and E-5 Mod 1 through E-5 Mod 3. However, these systems never use a barrier (net) of any type. Obtain further technical information on this system from US Navy publication NAVAIR 51-5-28.

A2.3.3. BAK-9. The BAK-9 is a bidirectional emergency arresting system. It consists of one energy absorber that employs two rotary friction brakes and purchase-tape reels mounted on a common shaft. The reels are mechanically connected at the midpoint by a third brake that acts as a clutch. This

allows each reel to turn at different speeds during off-center engagements and helps steer the aircraft toward the center of the runway.

A2.3.3.1. Install the energy absorber below grade on one side of the runway. Route one purchase tape to the opposite side of the runway through deflector sheaves and duct. Route the other purchase tape to a turnaround sheave located in a pit sited to allow both purchase tapes to be of equal length.

A2.3.3.2. The BAK-9 is not currently in production as a system. Do not consider it for new installations unless you can salvage the necessary equipment from another facility. Obtain further technical information on this system from TO 35E8-2-4-1, *Aircraft Arresting Gear, Model BAK-9.*

A2.3.4. BAK-12. The BAK-12 is the standard USAF operational aircraft arresting system. This bidirectional system employs two energy absorbers. Each absorber consists of two multidisc rotary friction brakes mounted on either side of the purchase-tape reel on a common shaft.

A2.3.4.1. Install the energy absorbers on opposite sides of the runway and connect them by the purchase tape to a 1.25-inch disc-supported pendant. The installation should be in a below-grade pit with a minimum split distance of 50 feet. Split distance is a measurement taken between the lead-on sheave of the fairlead beam or deck sheave, and the energy absorber. Split distances of up to 300 feet are acceptable for all BAK-12 installations.

A2.3.4.2. You may also install BAK-12 systems above grade in one of two configurations, the selection depending upon site conditions and operational requirements. These are the expeditionary installation and the semipermanent installation.

A2.3.4.3. Siting and grading requirements are in section 3 of USAF TO 35E8-2-5-1. Drawings for pit-type installations (drawing number 67F2012) and semipermanent installations (drawing number 67F2011) are available from San Antonio Air Logistics Center.

A2.3.4.4. An expeditionary installation requires 100 work hours under normal circumstances. However, this type of installation may not continue in service for more than 1 year unless you excavate and inspect the anchors. It will accommodate construction and temporary requirements such as exercises. Siting requirements and installation instructions are in section 3 of USAF TO 35E8-2-5-1. Instructions for requesting an expeditionary system are at attachment 7.

A2.3.4.5. Construct semipermanent installations where pit installations are not economically feasible. In these instances, protect the energy absorber from the elements with a frameless metal structure. Construct it with a removable roof or end and provide fairlead tubing to protect the purchase tape. Site the energy absorber foundations at least 200 feet from the runway edge.

A2.3.4.6. Originally, BAK-12 energy absorbers were fitted with a 60-inch purchase-tape storage reel. This design allowed the maximum energy expected to be imparted during an aircraft engagement to dissipate within a runout of 950 feet plus the length of the aircraft.

A2.3.4.7. Designers have since improved the BAK-12 to meet increased demands of heavier and faster aircraft. They retrofitted the energy absorbers with larger 66-inch or 72-inch tape storage reels to accommodate increased runout, thus increasing the total energy capacity of the system. Although some BAK-12 systems have 60-inch tape storage reels, new and upgraded BAK-12 systems (part numbers 52-W-2291-801, 52-W-2291-801A, 52-W-2291-901, and 52-W-2291-901A) have 66-inch reels. These systems require 1,200 feet plus the length of the aircraft for maximum runout. The 72-inch reel systems are special purpose systems configured for 2,000 feet runout.

A2.3.4.8. The standard BAK-12 is configured for cross-runway separations of up to 200 feet (distance between fairlead beams or deck sheaves). For installations with cross-runway spans exceeding 200 feet, replace the BAK-12 control valve cam to accommodate full runout of the system. Refer to TOs 35E8-2-5-1 and 35E8-2-5-4 to identify the part number for the correct replacement cam and installation procedures.

A2.3.4.9. Dual BAK-12 systems are special-purpose installations configured to accommodate high-energy engagements of aircraft ranging from 60,000 to 140,000 pounds. These configurations consist of four BAK-12 energy absorbers arranged in pairs on either side of the runway. The energy absorbers may be standard BAK-12s or be equipped with 72-inch diameter tape storage reels to accommodate 2,000 feet of runout. You need special tape connectors and edge sheaves for these installations. For details of these components and other special considerations, see section 8 of TO 35E8-2-5-1.

A2.3.5. BAK-13. The BAK-13 is a bidirectional aircraft arresting system. It employs two velocity-sensitive energy absorbers installed on opposite sides of the runway, interconnected by nylon purchase tapes and a 1.25-inch disc-supported pendant.

A2.3.5.1. The energy absorbers contain:

- A steel weldment base that incorporates a tape-storage reel mounted on a vertical shaft.
- A vaned rotor assembly enclosed within a vaned stator assembly (also called a tub), which contains a water and glycol mixture.
- An operator control panel.
- A rewind engine.
- A transmission assembly.
- Hydraulic system components.

A2.3.5.2. The energy imparted during an aircraft arrestment converts to heat through the turbulence developed by rotation of the vaned rotor within the vaned stator. An external cooling reservoir permits rapid cycle of this system.

A2.3.5.3. Install BAK-13 systems on grade in one of two configurations, the choice depending upon site conditions and operational requirements. These are the expeditionary installation and the semipermanent installation.

A2.3.5.4. For siting and grading requirements, see section 3 of TO 35E8-2-7-11. The site requirements are essentially the same as for the BAK-12. However, the low-profile units are located as close as 150 feet from the runway edge if installed in a semipermanent configuration. These systems require 950 feet plus the length of the aircraft for maximum runout.

A2.3.6. BAK-14. This system is a bidirectional hook cable (pendant) support system used in conjunction with the BAK-12, BAK-13, or a comparable arresting system to engage and safely stop a hook-equipped aircraft. It provides the means to support the pendant at least 2 inches above the runway surface while giving air traffic control the means to lower the pendant below the surface of the runway to prevent damage to low-undercarriage aircraft, the pendant, and the pavement below the pendant during trampling. These systems can accommodate runways 150, 200, and 300 feet wide, but you order them to suit the specific application.

A2.3.6.1. The system consists of:

- Individual pendant support arms and their housings (support boxes).
- Cross-runway cable trough.
- The pneumatic line.
- Heaters and controls.
- A compressed air system.

You must expand the BAK-12 pit or protective shelter to house the compressed air and control systems.

A2.3.6.2. The site and utility considerations for installation are in TO 35E8-2-8-1, *Operation, Maintenance, and Installation Instructions With Illustrated Parts Breakdown, Hook Cable Support System, Model BAK-14.*

A2.3.6.3. Consider installation of pendant restraints with a donut supported pendant system to reduce the potential for cable slap to aircraft during trampling in lieu of BAK-14. See the appropriate 35E8 Series TO for standard detail drawings of these anchors, their recommended locations, and specifications for the materials and procedures.

A2.3.7. BAK-15 (61QSII). The BAK-15 aircraft arresting system consists of a pair of electrohydraulically powered steel masts that provide support and remote-controlled movement for a unidirectional nylon net barrier. Install the masts on opposite sides of the runway overrun on concrete foundations. The air traffic control tower contains a remote-control panel, which can be either hard-wired or radio controlled.

A2.3.7.1. Augment this system with an energy-absorbing device such as a ship's anchor chain, BAK-9, BAK-12, BAK-13, or other comparable equipment connected by the purchase tape to the ends of the lower net straps. During an aircraft engagement, shear links in the net suspension straps separate by the force of the aircraft engaging the net. The net then envelops the aircraft and seats on the leading edge of the wings, transferring the forward momentum of the aircraft to the energy-absorbing device. You can complement the system with a standard disc-supported pendant to accommodate tailhook engagements through interconnect configuration hardware similar to that used for the MA-1A Modified.

A2.3.7.2. The hook cable interconnect kit is the 62 NI (net interconnect). System operation and maintenance instructions are in TO 35E8-2-9-2. Obtain installation drawings through the procuring activity at the time of procurement.

A2.3.8. Mobile Aircraft Arresting System (MAAS). The MAAS is essentially a BAK-12 aircraft arresting system mobilized through installation on a specially developed trailer. It is configured for a maximum aircraft runout of 990 feet. This system was initially developed and tested to accommodate recovery of fighter aircraft returning to a battle damaged airfield. Such cases require rapid deployment and installation, and may require that only the minimum essential anchoring hardware be installed to accommodate the above scenario. When installed for this purpose, the MAAS is installed using a 19-stake anchoring scheme. This configuration is limited to unidirectional engagement capability with a maximum aircraft weight and speed of 40,000 pounds at 150 knots (energy absorbing capacity of 40 X 10^6 foot-pounds). For detailed instructions on this system, refer to USAF TO 35E8-2-10-1, *Operation and Maintenance Instructions, Arresting Systems, Aircraft, Mobile.*

A2.3.8.1. The MAAS can be upgraded to accommodate bi-directional engagements with the full capacity of a standard USAF BAK-12 aircraft arresting system (energy absorbing capacity of 85 x 10^6 foot-pounds). This is accomplished by increasing the total number of cruciform stakes used to anchor the system from 19 to 31, extending the runout to 1,200 feet, and synchronizing the system for higher brake pressure. The system may also be installed in a set-back configuration to accommodate wide body aircraft operations through use of a fairlead beam. For detailed information, see USAF TO 35E8-2-10-1, Section VIII, *Difference Data Sheets*.

Table A2.1. USAF Aircraft Arresting System Leading Particulars.

System Type	**BAK-9**	**BAK-12 60" Reel**	**BAK-12 66" Reel**	**Dual BAK-12 66" Reel**	**BAK-13**	**BAK-14**	**BAK-15**	**MAAS (990 feet Runout)****
Energy Capacity	55 X 10^6	65 X 10^6	85 X 10^6	170 X 10^6	85 X 10^6	N/A	N/A	40 X 10^6
Nominal Runout	950’	950’	1,200’	1,200’	950’	N/A	N/A	990’
Tape Strength	65,000 lbs	105,000 lbs	105,000 lbs	105,000 lbs	130,000 lbs	N/A	N/A	105,000 lbs
Cable Strength	84,000 lbs	130,000 lbs	130,000 lbs	130,000 lbs	129,000 lbs	N/A	N/A	130,000 lbs
Maximum Speed*	180 knots	180 knots	180 knots	180 knots	180 knots	N/A	N/A	150 knots
Nominal Aircraft Weight	40,000 lbs	40,000 lbs	50,000 lbs	100,000 lbs	50,000 lbs	N/A	N/A	40,000 lbs

* 190 knots is the dynamic limit for steel cables used in aircraft arresting systems. Random failures will occur at 190 knots and above. Therefore, 180 knots is established as the working limit for cable-engagement systems.

** MAAS configured for 1,200 feet runout have the same technical characteristics as a 66" BAK-12.

Attachment 3

STANDARD CONFIGURATIONS, AUTHORIZATIONS, AND DECOMMISSIONING

A3.1. Configurations. The primary mission aircraft dictates the total number, type, and location of aircraft arresting systems required. Use the following examples for guidance:

A3.1.1. A runway intended primarily for operating tactical or training tailhook-equipped aircraft should have a system in each overrun and two systems at each end of the runway for a redundant operational capability.

A3.1.2. Runways that are prime divert facilities for bases operating tactical or training tailhook-equipped aircraft should have a system in each overrun and a system on each end of the primary runway.

A3.1.3. Bases that are occasional hosts to arrestment-capable transient aircraft should have a system installed in each overrun of the primary runway or a system on each end of the primary runway.

A3.2. Decommissioning. If the mission aircraft assigned to an installation does not require an arresting system complex and removal will not have an impact on other USAF activities, consider decommissioning.

Attachment 4

SAMPLE FORMAT FOR AIRCRAFT ARRESTING SYSTEMS REPORT

A4.1. Reporting Guidelines. The DoD needs an accurate accounting of all aircraft arresting systems to determine worldwide operational capabilities. Base civil engineer representatives must ensure that the status and locations of their arresting systems are correct in the Worldwide Aircraft Arresting System Summary and in the DoD Flight Information Publication. Report changes in the arresting system array promptly, so that others can validate and publish the correction before DoD activates or deactivates the system.

A4.1.1. Submit arresting system information to the Air Force Flight Standards Agency at the address provided in paragraph **1.2.1.**

A4.2. Report Contents. Submit the following information, along with a diagram similar to that shown in figure A4.1:

- Base name.
- MAJCOM or sponsor.
- Runway designation
- System type (see **Attachment 2**).
- Length of runway to the nearest 100 feet (threshold to threshold).
- Width of runway, in feet.
- Length of overrun, in feet (threshold to end of overrun).
- Longitudinal location of the arresting system with respect to the threshold, in feet (for example, "plus (+) 950" indicates that the system is 950 feet from the threshold on the runway; "minus (-) 35" indicates that the system is 35 feet from the threshold into the overrun).

A4.2.1. Describe the arresting system installation characteristics for each system indicated on the air-field scheme, using these notations:

AG--above ground.

BG--below ground.

P--portable system.

I--barrier interconnected with a hook cable.

R--remote controlled from the tower or runway supervisory unit.

M--manually raised and lowered.

D--dual installation (for example, dual BAK-12).

Q1--equipped with BAK-11 engaging device.

Q2--equipped with BAK-14 engaging device.

Z--owned by another Service, country, or agency.

O--inoperative.

Y--programmed for installation (show fiscal year).

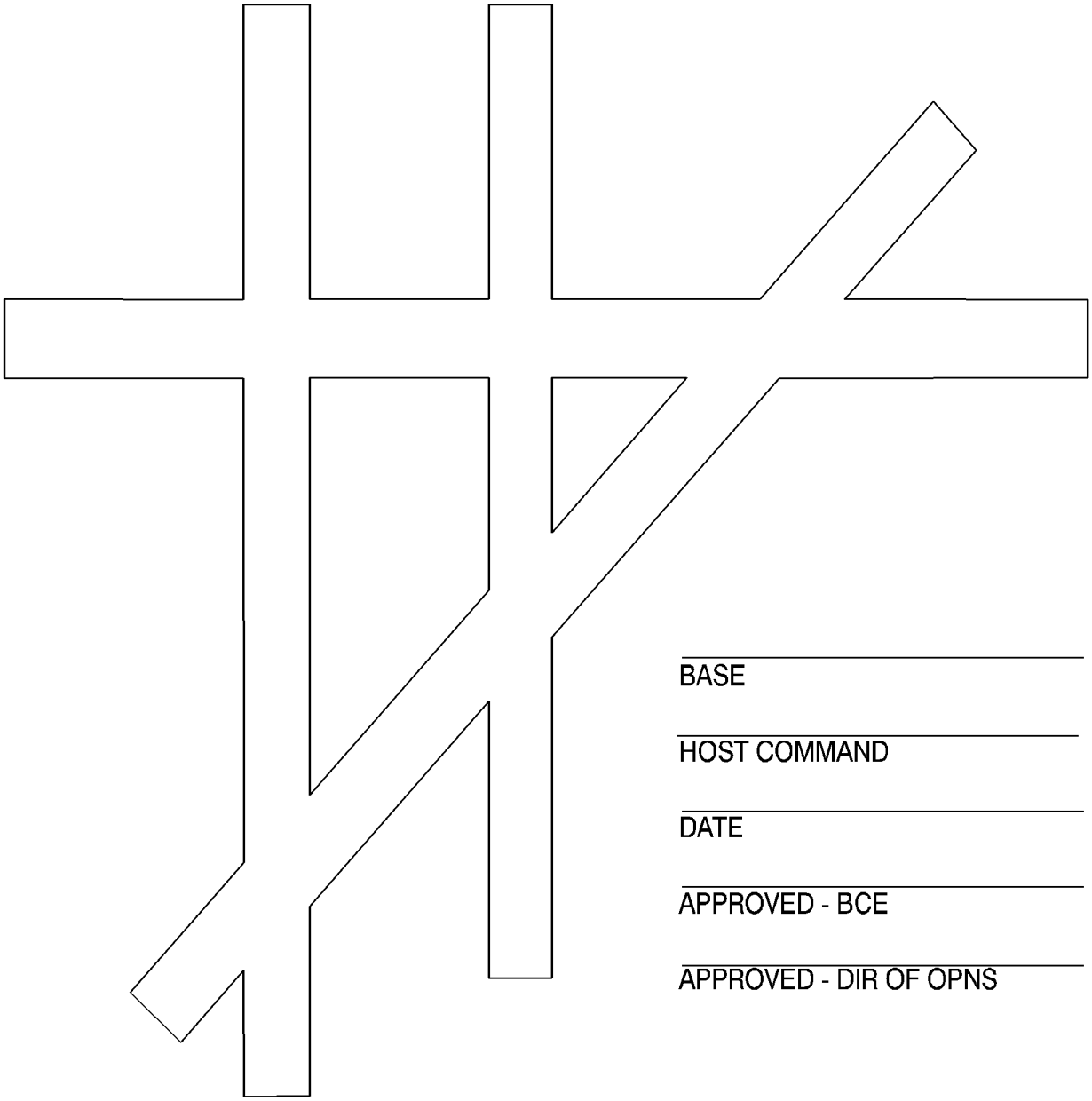
T--950 feet runout.

T1--1,200 feet runout.

T2--2,000 feet runout.

T3--nonstandard runout.

Figure A4.1. Sample Airfield Layout.



SYSTEM TYPE	R/W	LENGTH	WIDTH	OVERRUN	LOCATION	REMARKS

Attachment 5

SAMPLE LETTER OF AGREEMENT WITH THE FEDERAL AVIATION ADMINISTRATION (FAA)

The (FAA office and address) and (designated command) agree to the following provisions for the operation and use of aircraft arresting equipment installed on (designated runway, airport name, and address).

A5.1. General Provisions:

A5.1.1. This agreement governs the use of the arresting barrier and hook cable arresting systems for military aircraft and, in an emergency, for civil aircraft at pilot request.

A5.1.2. This agreement becomes effective when the tower chief receives written notice from the base commander that one of these situations applies:

A5.1.2.1. The arresting system has been accepted from the contractor and is commissioned and fully operational.

A5.1.2.2. The arresting system is available for emergency use only. If the arresting system has not been accepted from the contractor, this notification must come with a written statement from the contractor authorizing emergency use of the system and waiving any claim against the FAA for damage to the system as the result of such use.

A5.1.2.3. A NOTAM has been issued specifying one of the above conditions. Before receiving the letter from the installation commander, the military crew deenergizes the tower arresting system controls and the chief controller labels them "Inoperative." Tower personnel may not energize the controls under any circumstances.

A5.1.3. Automatic arresting systems may be installed on the runway or in the overrun. Control tower personnel raise or lower the barrier or hook cable through a remote-control panel in the control tower.

A5.1.4. Controllers operate the tower arresting system controls at the request of:

- The pilot of any military aircraft (regardless of the service concerned, type of aircraft, or nature of the operation).
- The pilot of a civil aircraft in an emergency, when in commission or emergency use status as described above.
- A mobile control unit, the base operations officer, or a designated representative.

A5.1.5. The military crew originates NOTAMs covering operational or outage status of a barrier or hook cable. During a NOTAM outage for repair or maintenance, tower personnel operate the controls, provided that the outage NOTAM contains the statement "available for emergency use" and the tower possesses a copy. Otherwise, the military crew deenergizes tower controls and the chief controller labels them "Inoperative." In this event, tower personnel may not energize the controls under any circumstances.

A5.1.6. During the NOTAM outages due to failure of controls or when tower personnel advise of malfunction of the system (see **A5.2.8.**paragraph A5.2.8 for notice), the military crew at the system site has full and final responsibility for operating the arresting device. The arresting system crew maintains a listening watch on air and ground frequencies and has transmitting and receiving capabil-

ity with the tower on the ground control frequency keeping personnel informed of the position of the system.

A5.2. Operations:

A5.2.1. Normally, all military aircraft take off and land toward an operational arresting system in the "ready" configuration. The pilot asks the control tower operator to raise or lower the barrier or hook cable. For example, the pilot says "Duluth Tower, Joy 32 on base, gear down and locked, raise cable."

A5.2.1.1. For normal landings, the request involves the approach-end cable.

A5.2.1.2. For normal takeoffs, the request involves the departure-end barrier and cable.

A5.2.2. When tower personnel receive a request to raise or lower the barrier or cable, they must inform the pilot of the intended barrier or cable position as part of takeoff or landing information. For example, they say "Joy 32 cleared for takeoff, barrier indicates up."

A5.2.3. The pilot may request barrier or cable operating status at any time.

A5.2.4. The barrier and cable controls are in the down position except when pilots or other authorized personnel request that either or both be raised.

A5.2.5. Tower personnel raise the departure-end barrier and both approach and departure-end cables for known or suspected radio failure landing by any military arrestment-capable aircraft. Activate the arresting system even if you doubt the aircraft’s ability to engage the system.

A5.2.6. The standard phraseology for emergency requests to raise the barrier is "barrier, barrier, barrier." The standard phraseology for emergency requests to raise the cable is "cable, cable, cable."

A5.2.7. Tower personnel start normal crash procedures when an aircraft engages the barrier or cable if these procedures are not in progress.

A5.2.8. When there is a malfunction of the barrier, hook cable mechanism, or remote control system, the tower personnel notify base operations immediately.

A5.3.

Executed at _____ Dated _____

For the FAA	For the Air Force
_____	_____
(Signed)	(Signed)
_____	_____
(Title)	(Title)

Attachment 6

EFFECTIVE PENDANT HEIGHT (EPH) CRITERIA

A6.1. General. Pendant discs must have proper pavement support if you are to ensure adequate clearance between the underside of the pendant cable and the runway surface. Adequate clearance increases the probability that the aircraft tailhook will successfully engage with the arresting system pendant cable.

A6.1.1. The term for this clearance is the effective pendant height. The effective pendant height is the vertical distance (in inches) from the underside of the pendant to a projected surface representing the original runway surface. The effective pendant height for an undamaged or ungrooved runway surface is approximately 2.38 inches for a 1.25-inch pendant cable and 2.5 inches for a 1.0-inch cable.

A6.2. Effective Pendant Height Measurements. Measure the effective pendant height along the center third of the runway width at 10-foot intervals or less using an effective pendant height measuring tool (see figure A6.1). Manufacture the tool locally for use by the power production shop.

A6.2.1. Start measuring when you notice pavement erosion or grooving, and repeat measurements at least monthly. As the effective pendant height approaches 1.5 inches, take and record measurements daily.

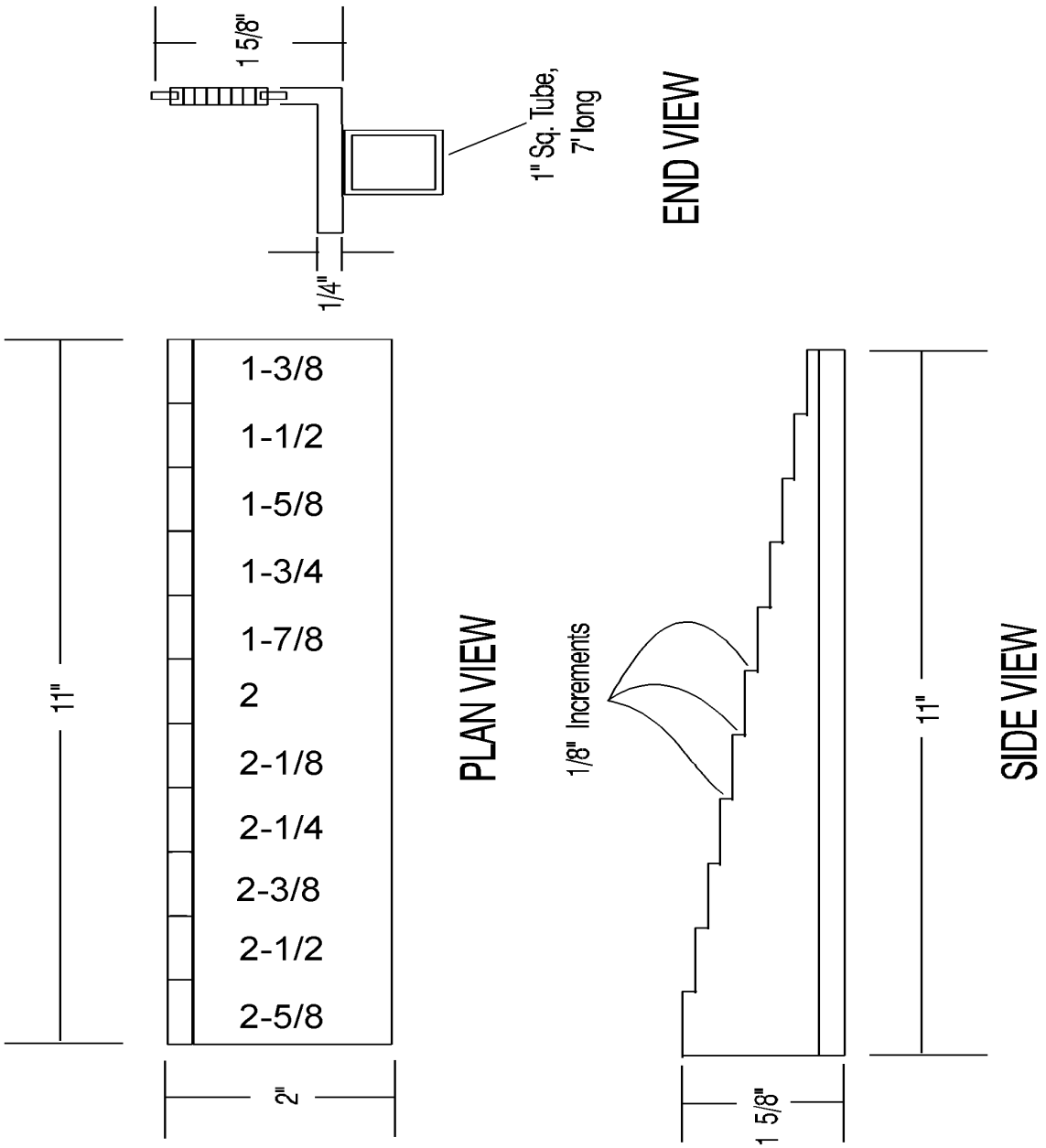
A6.2.2. Record effective pendant height measurements in the arresting system maintenance log, using a sketch to demonstrate the effective pendant height values and the distance to the location where the measurement was taken. Indicate the distance in feet and inches to the left or right of the runway centerline facing the runway approach.

A6.2.3. Arresting system maintenance personnel must notify the commander's designated representative when effective pendant height measurements become necessary. Provide status reports as changes to the effective pendant height occur.

A6.3. Pavement Repairs. Arrange for pavement repairs when any effective pendant height measurement drops to 1.75 inches or less. Make the repair before the lowest effective pendant height drops below 1.5 inches. Perform emergency repairs (permanent or temporary) when any effective pendant height measurement is less than 1.5 inches.

A6.4. Notification of Reduced Engagement Reliability. When the effective pendant height falls to less than 1.5 inches, ask the airfield manager to issue an airfield advisory notifying pilots of the reduced arresting system reliability.

Figure A6.1. EPH Measuring Tool.



EPH Measuring Tool Constructed From 2" Angle Stock
(Not to Scale)

Figure A6.1. EPH Measuring Tool.

Attachment 7

OBTAINING A TEMPORARY ARRESTING SYSTEM

A7.1. Submit requests for temporary use of expeditionary aircraft arresting systems to Headquarters Air Combat Command (HQ ACC) at least 2 months before the system must be in place and operational. Typically, HQ ACC only considers requests to support continental US locations. Coordinate overseas requirements through the appropriate MAJCOM. Give the following information in all requests.

- Number of systems you need.
- Reason you need the systems (including type of aircraft).
- Geographic location of the requirement.
- Date you need the systems to be operational.
- Date the systems can be removed.
- Point of contact and telephone number.

A7.1.1. In the request, specify the intended source and the number of Special Experience Identifier 331 personnel who will operate and maintain the expeditionary system at the site. Qualified personnel must attend the systems during all hours of intended operation.

A7.1.2. The requesting activity must provide a fund citation to cover all costs associated with supporting the expeditionary installation. Include costs for:

- Shipment of the equipment.
- Temporary duty.
- Expendable materials.
- Repair or replacement of damaged items.
- Installation equipment.

A7.1.3. Send the information to:

ACC CES/ESO

11817 Canon Blvd

Crestar Bank Bldg, Suite 208

Newport News VA 23606-2558

A7.2. HQ ACC evaluates each request on the basis of availability of personnel, equipment, and priority. It approves or disapproves requests within 10 working days.