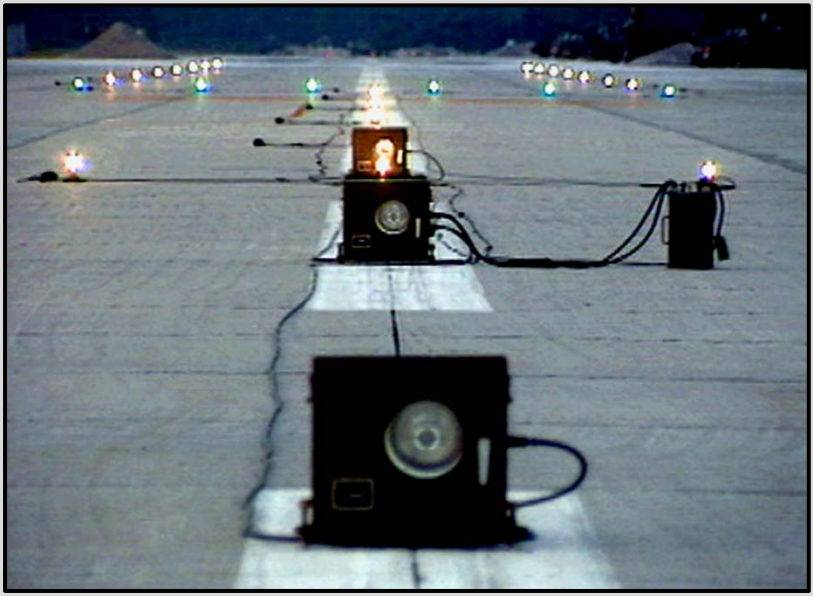
AIR FORCE TACTICS, TECHNIQUES, AND PROCEDURES 3-32.14

1 APRIL 2016

ALTERNATE INSTALLATION SEQUENCE FOR EMERGENCY AIRFIELD LIGHTING SYSTEM AFTER MAJOR ATTACK



DEPARTMENT OF THE AIR FORCE

This page intentionally left blank.

BY ORDER OF THE SECRETARY OF THE AIR FORCE

AIR FORCE TACTICS, TECHNIQUES AND PROCEDURES 3-32.14

1 APRIL 2016

Tactical Doctrine

ALTERNATE INSTALLATION SEQUENCE FOR EMERGENCY AIRFIELD LIGHTING SYSTEM AFTER MAJOR ATTACK

OPR: AFCEC/CXX

Certified By: AF/A4C
(Maj Gen Timothy S. Green)

Pages: 33

PURPOSE: To provide an alternate installation sequence for Emergency Airfield Lighting System (EALS) to meet the Air Component Commander's Air Tasking Order (ATO) after a major enemy attack. It supports Air Force Instruction (AFI) 10-209, *RED HORSE Program*; AFI 10-210, *Prime Base Engineer Emergency Force (BEEF) Program*, AFPAM 10-219, Volume 4, *Airfield Damage Repair Operations*, and Air Force Doctrine Annex 3-34, *Engineer Operations*. Ensure all records created as a result of processes prescribed in this publication are maintained IAW Air Force Manual (AFMAN) 33-363, *Management of Records*, and disposed of IAW the Air Force Records Disposition Schedule (RDS) in the Air Force Records Information Management System (AFRIMS). Refer recommended changes and questions about this publication to the Office of Primary Responsibility (OPR) using the AF Form 847, *Recommendation for Change of Publication*; route AF Forms 847 from the field through the appropriate functional chain of command.

APPLICATION: This publication applies to all Air Force active duty, Air National Guard (ANG), and Air Force Reserve Command (AFRC) Civil Engineer personnel performing contingency airfield lighting installation after a major attack. This document is authoritative but not directive. The contingency airfield lighting TTPs found in this publication take precedence over those found

in other nondirective publications. Applicable AFIs take precedence when this publication and AFIs conflict.

SCOPE: This publication does not replace Emergency Airfield Lighting System component installation instructions found in Technical Order (T.O.) 35F5-3-17-1, *Emergency Airfield Lighting System*; however, it provides an alternate sequence to install system components when necessary to meet the Air Component Commander's Air Tasking Order (ATO) after a major enemy attack. Specifically, it describes required resources, planning factors, and an alternate installation sequence of contingency airfield lighting systems.

Chapter 1

INTRODUCTION

1.1. Overview. This publication provides an alternate sequence to install Emergency Airfield Lighting System (EALS) components when necessary to meet the Air Component Commander's Air Tasking Order (ATO) after a major enemy attack. However, it does not replace component installation instructions found in Technical Order (T.O.) 35F5-3-17-1, *Emergency Airfield Lighting System*. Specifically, it describes required resources, planning factors, and an alternate installation sequence of contingency airfield lighting systems.

1.2. Variation of Procedures. It is unlikely the contingency lighting system can be installed without disruptions after a major attack. Legacy procedures direct MOS marking precede lighting installation, and then lighting installed in a specific sequence while pavement repairs are in progress. Final connections and system checkout finishes after pavement repairs are complete. However, the time allotted to repair the amount of expected damage and numbers of recovery equipment, personnel, and vehicles throughout the minimum airfield operating surface (MAOS) during the recovery process will likely dictate changes to the lighting installation sequence from those described in T.O. 35F5-3-17-1.

1.2.1. Legacy marking procedures used "T" clear zones to mark crater repair areas that should not be entered by support teams until the crater has been repaired. With today's threat it is unlikely "T" clear zones will be used to mark repair areas; doing so would likely produce "T" clear zones throughout the entire MOS leaving little to no real estate for support teams (i.e., Aircraft Arresting System [AAS] Installation Team, MAOS Marking Team, Contingency Airfield Lighting Installation Team, and Water and Fuel Expeditionary Repair System [WaFERS] Team) to begin their recovery efforts.

1.2.2. Contingency lighting installation will most likely begin with tasks on the MAOS periphery after a major attack. As pavement repairs are completed and relieve congestion on parts of the MAOS, teams may begin installing MOS edge lighting and finish just before pavement repair final curing. Follow T.O. 35F5-3-17-1 instructions and task sequencing to the greatest extent possible; however, when contingency lighting installation processes conflict with other recovery operations, perform installation as described in **Chapter 4** of this publication to expedite the process.

1.3. Description. The current Base Expeditionary Airfield Resources (BEAR) contingency airfield lighting system is the EALS. The EALS is designed to be rapidly installed at contingency airfields or at other locations that need temporary airfield lighting. When installed, it provides runway edge lighting, approach lighting, threshold/end lighting, taxiway lighting, visual glide slope indication, runway distance marker (RDM) lighting, and obstruction lighting. The system is suitable for Visual Flight Rules during contingency operations at night and during periods of reduced visibility but do not qualify the airfield for instrument operations of any kind. The standards in this publication do not apply to forward tactical airfields or landing zones requirements. See AFI 13-217, *Assault Zone Procedures*, for guidance on those requirements.

Note: RDMs are described as distance-to-go (DTG) markers in T.O. 35F5-3-17-1; however, they will be referred to as RDM within this publication to be consistent with other DOD publications.

1.3.1. The EALS can be installed and secured on all types of surfaces (e.g., sand, frozen earth, mud, ice, asphalt, and concrete). The EALS can light a Minimum Operating Strip (MOS) up to 150 ft. by 10,000 ft. Installation of a 50 ft. by 5,000 ft. MOS can be accomplished within 2.5 hours by a six person crew using two general purpose vehicles (e.g., 0.75 ton pick-up, 1 ton, 1.5 ton trucks, etc.) under ideal conditions. The EALS can be installed by personnel wearing chemical defense gear and/or arctic weather clothing, including arctic mittens.

1.3.2. The EALS also contains taxiway lighting and reflectors, approach lighting equipment, RDM lights, obstruction lights, and Precision Approach Path Indicators (PAPIs).

1.3.3. The EALS is designed for use as a unidirectional or bidirectional contingency lighting system. It is not designed for permanent use, to support instrument flight rules (IFR) operations, or use when meteorological visibility is less than four statute miles.

1.4. Safety Summary. The following paragraphs describe general safety precautions not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions personnel should understand and apply during all phases of operation and maintenance.

1.4.1. **Keep Away From Live Circuits.** Personnel should at all times observe all safety regulations. Do not replace components or make adjustments inside equipment with the voltage supply energized. Under certain conditions,

dangerous potentials may exist when the system is de-energized due to charges retained by capacitors. To avoid casualties, always remove power and ground a circuit before touching it. Adhere to all lockout/tag-out requirements.

1.4.2. **Do Not Service or Adjust Alone.** Under no circumstances should any person reach into or enter energized enclosures for the purpose of servicing or adjusting equipment except in justified circumstances and approved by the Base Civil Engineer, or equivalent, and in the presence of someone capable of rendering aid IAW AFI 32-1064, *Electrical Safe Practices.*

1.4.3. **Do Not Drive over Exposed Cables.** The EALS has cable protection strips which protect runway cable at points where it crosses active taxiways or at other points where runway cable crossing by planes or vehicles is required. Only drive over these protection strips. Driving over live/active power cables is an unsafe practice. Loose cables could create a spark resulting in fire, and/or injury to ground support personnel.

1.4.4. **Resuscitation.** Personnel working on or near high voltages should be trained in modern methods of resuscitation.

Chapter 2

RESOURCES

2.1. EALS Equipment. The EALS is packed on six trailers (**Figure 2.1**) that fit within three 463L aluminum aircraft pallet positions. The equipment needed to install a 50 ft. by 5,000 ft. MOS is packed on four trailers (trailers #2, 3, 4, and 5) which fit on two pallet positions. **Table 2.1** lists the stored location of equipment/components. See T.O. 35F5-3-17-1, Table 1-1 for a complete list of trailer contents.

Figure 2.1. EALS Trailers.

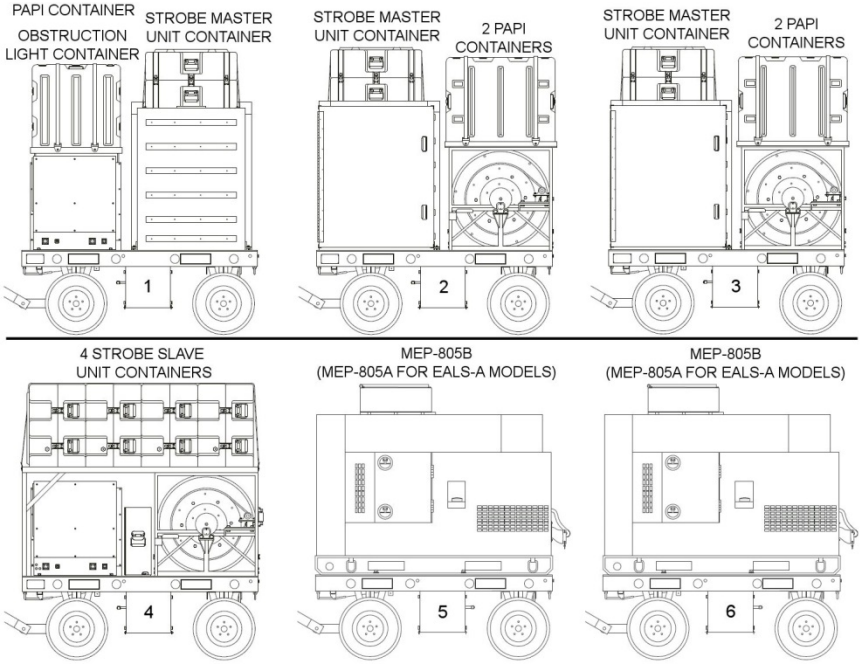


Table 2.1. Use of EALS Trailers.

Trailer	*Primary Use*
# 1	Contains primary control panel & regulator with 2 generator connections. Contains taxiway lights & reflectors, obstruction

Trailer	*Primary Use*
	lights, a spare PAPI & strobe master unit.
# 2	Contains fixtures & cables for lighting one end & one edge of a runway; and cables and light fixtures for approach lighting.
# 3	Contains fixtures & cables for lighting opposite end & edge of runway; and cables and light fixtures for approach lighting.
# 4	Contains backup control panel & regulator with connection for one generator. Also contains strobe slave units & extra cables for edge & end lighting plus generator power & control cables & ground cables.
# 5	Generator; serves as primary or backup power source.
# 6	Generator; serves as primary or backup power source.

2.2. Installation Team. Six people organized into four crews, with two general-purpose vehicles, can set-up the EALS. Both TEAM A and TEAM B have two members and one truck each. TAG A and TAG B are each a one-person crew traveling on foot for majority of the installation. The two-person teams lay the series circuit cable and place equipment on the ground, while TAGs follow on foot, approximately 800-feet behind the trailer, connecting components to the primary series circuit. **Table 2.2** identifies personnel and vehicle assignments.

Table 2.2. Personnel and Vehicle Assignments.

Position	AFSC	Vehicle
Lead, Crew A	3E0X1	Truck A
Operator, Vehicle A	3EXXX	Truck A
TAG A	3E0X1	Truck A
Lead, Crew B	3E0X1	Truck B
Operator, Vehicle B	3EXXX	Truck B
TAG B	3E0X1	Truck B

2.3. Tools and Spares. All tools required for installation and organization level maintenance are provided with the EALS. Also, spares for 30 days of operation are provided.

2.4. Consumable Materials. Lubricants are the only consumable materials required for the operation and/or maintenance of the EALS, but are not part of the system. These consumable materials are listed in **Table 2.3**.

Table 2.3. Consumable Materials List.

Nomenclature	Specification/Standard	Part No./NSN
Grease, lubricating, auto and industrial	VV-G-632 or equiv.	N/A
Grease, lubricating, auto and artillery	MIL-G-10924 or equiv.	N/A
Transformer Oil	N/A	DIALA (Shell)
Silicone Gasket	N/A	#77C Ultra-Blue Permatex
Thread Sealant	N/A	AV (Loctite)
Cloth, Cleaning, Low-Lint	MIL-C-85043 or equiv.	NSN 7920-00-044-9281
Cleaning Compound, Optical Lens	MIL-C-43454 or equiv.	NSN 6850-00-592-3283
Spray White Lithium Grease	N/A	N/A
Non-detergent Motor Oil (SAE 50W)	MIL –PRF-2104 or equiv.	OE/HDO 50
Threadlocker, Loctite #242	N/A	242-21
Adhesive	N/A	CA40H
Lubricant, polywater	N/A	G-128

Chapter 3

PREINSTALLATION ACTIONS

3.1. Required Information. Before beginning the EALS installation, the team will receive information on the MOS location, taxiway locations, direction of aircraft takeoffs and landings, approach slope/PAPI aiming angle, arresting system location, and lighting subsystems to be installed from the Support Chief (see AFPAM 10-219V4 for airfield recovery command and control hierarchy). **Table A2.1** in **Attachment 2** lists the required information needed before the installation begins.

3.2. Pre-Employment Checks. Observe safety precautions in **Table A2.2** before inspecting and/or servicing equipment. Perform equipment checks outlined in **Table A2.3** before operating the system to ensure equipment is ready for installation and operation.

3.3. Pre-Marking of Light Locations. Typically, a marking crew will mark the location of the runway, taxiways, approach lights, strobes, PAPI, RDMs, and the aircraft arresting systems prior to the EALS installation. Verify marked locations are in compliance with criteria in T.O. 35F5-3-17-1. See UFC 3-535-01, *Visual Air Navigation Facilities*, to determine proper PAPI system siting requirements.

3.3.1. The PAPI system should be securely installed on stabilized surfaces to keep proper alignment and angle setting. If soil is used to elevate PAPI units, soil should be placed within a form and compacted to prevent soil from shifting/settling due to environmental conditions (e.g., wind and rain), jet blasts, engine vibrations, etc. Forms should be left in place after installation to maintain compaction.

3.3.2. If time permits, a concrete foundation may be poured with rapid-setting crater repair material for mounting PAPI units using concrete anchors if available.

3.3.3. Additionally, a wooden mounting deck may be constructed during pre-attack actions. The deck legs should be long enough so when the PAPI unit is at the proper elevation the top of the unit is not more than 6 feet above ground level and the legs are buried at least one foot for stability. If the proper mounting height is below the six foot maximum the legs may be cut, but keep the legs

long enough so they may be buried at least one foot while still maintaining the proper PAPI unit height.

3.4. Tape Sweep Area. Minimum tape sweep area is determined by sighting a straight line from the position of the runway edge sheave to a point of maximum tape payout (990- or 1200-ft) down the centerline in direction of arrestment. Remove lights and cable within this area on both sides of the runway. Repeat process in opposite direction for a bidirectional installation. **Table A2.4** shows approximate light free zone distances for a 990-ft tape payout, with 90/153-ft pendants, and edge lights offset at 0, 5, and 10 ft.

Chapter 4

INSTALLATION SEQUENCE

4.1. Introduction. This chapter provides an alternate EALS layout and installation sequence after a major attack as a result of extensive damage from the attack and may vary from sequences found in T.O. 35F5-3-17-1. The sequences provided in this chapter are recommended to reduce layout and installation time to the greatest extent possible. The EALS Team Lead determines if the ground truth dictates varying from T.O. sequencing.

4.2. Modified EALS Layout and Installation Sequence. The following paragraphs show the preferred routes by the four EALS installation teams when the airfield is saturated by bomb damage, repair crews, and their vehicles and equipment. They also outline the corresponding sequence of tasks performed when unable to follow the T.O. sequence.

4.2.1. **Team-A Installation Sequence.** **Figure A3.1** illustrates the route taken and outlines the basic tasks performed by Team-A during EALS installation. Ensure UXO are cleared in work areas prior to beginning work. Team-A installation procedures are as follows:

4.2.1.1. Latch the RAC door open and connect trailer #2 to the vehicle. Make sure all straps are secured to prevent interference with cable reel operation.

4.2.1.2. With TAG-A aboard, drive to End-A threshold and payout 200-ft runway cable segments from the threshold to the strobe master unit location (1,200-ft from threshold).

4.2.1.3. At the strobe master unit location (center strobe location) begin installing End-A strobe segment as described in T.O. 35E5-3-17-1, *TEAM A MOS Installation Procedure* paragraph.

4.2.1.4. After strobe segment is installed, drop off TAG-A and three approach lights, three 45W isolation transformers, three stakes or ballast rings, and two 10-ft runway cables near the strobe slave unit nearest the threshold for the 1,000-ft crossbar. This crossbar should be installed 3 to 5 feet in front of the strobe slave nearest the threshold.

4.2.1.5. Place approach lights, 45W isolation transformers, stakes or ballast rings, and 200-ft runway cable from the strobe slave unit location nearest the threshold to the center of the threshold. Procedures for light fixture and

transformer placement are provided in T.O. 35F5-3-17-1, *Light Fixture, DTG Marker Light, and Transformer Placement* paragraph.

4.2.1.6. At threshold, place and install End-A threshold/end lights, 100W isolation transformers, 10-ft runway cable and two ballast rings per fixture. If threshold/end lights are to be installed on soil, place one stake per fixture vice ballast rings. Place 10-ft cable segments so male ends of connectors point in a clockwise direction around the runway. Install fixtures 10-ft from threshold with light fixture cord oriented away from the MOS to prevent jet blasts from launching transformers towards light fixtures and causing possible damage. Space fixtures 10-ft apart and ensure outside threshold/end lights are lined up with edge lights. Cable between light fixture and transformer should be pulled taught so jet blasts do not displace transformers and cause movement of light fixtures. Place two ballast rings on each threshold/end light or stake fixtures down if possible.

4.2.1.7. Begin installing End-A approach lights and 45W transformers along the MOS centerline from the center of the threshold towards the strobes. The light fixture cord should be oriented perpendicular to the centerline. Continue installing approach lights until meeting TAG-A. If TAG-A has not completed assigned tasks on End-A, assist TAG-A until all End-A tasks are complete.

4.2.1.8. Pick up TAG-A and drive to Edge-A PAPI location, place and install PAPIs using procedures provided in T.O. 35F5-3-17-1, paragraph 3-48.

4.2.1.9. If applicable, drive to Edge-B PAPI location, place and install PAPIs.

4.2.1.10. Drop TAG-A at End-A and proceed towards End-B placing edge lights, RDM lights, 45W transformers (for both edge lights and RDM lights), stakes, and 200-ft runway cable along Edge-A. In areas that have not been cleared of repair vehicles and debris, place items far enough from MOS edge where they will not be damaged.

4.2.1.11. When reaching End-B, travel back along Edge-A from End-B threshold toward End-A installing edge lights (and staking), RDM lights, transformers previously placed on the ground until meeting up with TAG-A.

4.2.1.12. Pick up TAG-A and drive to regulator/control panel location and check with Team B to see if they need assistance.

4.2.2. **TAG-A Installation Sequence.** **Figure A3.2** displays the route taken and outlines the basic tasks performed by TAG-A during EALS installation. Ensure

UXO are cleared in work areas prior to beginning work. TAG-A installation procedures are as follows:

4.2.2.1. Carry out steps in paragraphs 4.2.2.2 and 4.2.2.3 with Team-A.

4.2.2.2. Payout 200-foot runway cable segments form End-A threshold to strobe master unit location.

4.2.2.3. Install End-A strobe segment with Team-A as described in T.O. 35E5-3-17-1, paragraph 3-23.d thru l.

4.2.2.4. Travel on foot to inboard strobe slave and install three End-A crossbar approach lights and 45W transformers. The center crossbar approach light should be placed on the approach side of the near strobe slave unit. The right crossbar approach light should be installed even with the center approach light and 10-ft to the right of the MOS centerline (use 10-ft cable as a measuring device). The left crossbar approach light should be installed even with the center approach light and 10-ft to the left of the MOS centerline.

4.2.2.5. Install End-A approach lights and 45W transformers from the crossbar to the center of the End-A threshold. The approach lights should be installed along the centerline with the light fixture cord oriented perpendicular to the centerline.

4.2.2.6. When meeting Team-A while installing End-A approach lights, join Team-A and assist with installing Edge-A PAPIs IAW T.O. 35F5-3-17-1, *PAPI Subsystem Installation* paragraph.

4.2.2.7. Travel with Team-A to Edge-B PAPIs and assist with PAPI installation.

4.2.2.8. Travel with Team-A to End-A. Dismount and travel on foot installing Edge-A light fixtures, RDM lights, and transformers toward End-B. Stake the fixtures as needed. At the arresting barrier, ensure the runway cable is clear of the arresting gear and tape sweep area (Team-A will be installing light fixtures and transformers along Edge-A from End-B toward End A simultaneously).

4.2.2.9. Upon meeting Team-A and edge light installation is complete, join Team-A and proceed to regulator/control panel location and assist Team-B if necessary.

4.2.3. **Team-B Installation Sequence.** **Figure A3.3** shows the route taken and outlines the basic tasks performed by Team-B during EALS installation. If the MOS is unidirectional, disregard paragraphs 4.2.3.1. thru 4.2.3.14 and 4.2.3.16.

Ensure UXO are cleared in work areas prior to beginning work. Team-B installation procedures are as follows:

4.2.3.1. Latch the RAC door open and connect trailer #3 to vehicle. Make sure all straps are secured so they will not interfere with the operation of the cable reels.

4.2.3.2. If the MOS is bidirectional, drive to End-B threshold, with TAG-B aboard, and payout 200-ft runway cable segments from the threshold to the strobe master unit location (1,200-ft from threshold). If not bidirectional, skip to paragraph 4.2.3.6.

4.2.3.3. At the strobe master unit location (center strobe location) begin installing End-B strobe segment as described in T.O. 35E5-3-17-1, *TEAM B MOS Installation Procedure* paragraph.

4.2.3.4. After strobe segment is installed, drop off three approach lights, three 45W isolation transformers, three stakes or ballast rings, and two 10-ft runway cables for the 1,000-ft crossbar. This crossbar should be installed 3 to 5 feet in front of the strobe slave nearest the threshold.

4.2.3.5. Place approach lights, 45W isolation transformers, stakes or ballast rings, and 200-ft runway cable from inboard strobe slave unit to the center of the threshold. Ensure proper alignment with the MOS centerline. Procedures for light fixture and transformer placement are provided in T.O. 35F5-3-17-1, *Light Fixture, DTG Marker Light, and Transformer Placement* paragraph.

4.2.3.6. At the threshold, place and install End-B threshold/end lights, 100W isolation transformers, 10-ft runway cable and two ballast rings per fixture. If the threshold/end lights are to be installed on a soil surface, place one stake per light fixture instead of ballast rings. Place the 10-ft cable segments so that the male ends of the connectors point in a clockwise direction around the runway. Install fixtures 10-ft from the threshold with the light fixture cord oriented away from the MOS to prevent jet blasts from launching the transformers towards the light fixtures and causing possible damage. Space the fixtures 10-ft apart and ensure the outside threshold/end lights are lined up with the edge lights. The cable between the light fixture and transformer should be pulled taught so that jet blasts do not displace the transformers and cause movement of the light fixtures. Place two ballast rings on each threshold/end light or stake the fixtures down if possible.

4.2.3.7. Begin installing End-B approach lights and 45W transformers along the MOS centerline from the center of the threshold towards the strobes. The light fixture cord should be oriented perpendicular to the centerline. Continue installing approach lights until meeting TAG-B. If TAG-B has not completed their tasks on End-B, assist TAG-B until all End-B tasks are complete.

4.2.3.8. Pick-up TAG-B and drive to the regulator/control panel location and place 200-ft runway cable from the regulator location to the edge of the MOS (to be connected to the nearest edge light cable connector on the MOS edge). Place 200-ft runway cable segments back to the regulator.

4.2.3.9. Install generators using procedures provided in T.O. 35F5-3-17-1, *TEAM B MOS Installation Procedures* paragraph.

4.2.3.10. Drop TAG-B at End-B and place Edge-B lights, RDM lights (if applicable), 45 watt transformers (for both edge lights and RDM lights), and 200-ft runway cable segments from End-B threshold to End-A threshold. If light fixtures will be staked down during this installation, place one stake with each light fixture.

Note: If the MOS is greater than 9,000-ft, disconnect trailer #3 and connect trailer #4 to have sufficient amount of cable for the installation.

4.2.3.11. Begin installing Edge-B lights and RDM lights (if applicable) starting at End-A working towards End- B until meeting up with TAG-B. If the MOS is bidirectional, connect End-B PAPIs to the Edge-B lighting circuit if arriving to the PAPI location before TAG-B.

4.2.3.12. Pick up TAG-B and drive to regulator and control panel location.

4.2.4. **TAG-B Installation Sequence.** **Figure A3.4** displays the route taken and outlines the basic tasks performed by TAG-B during EALS installation. Ensure UXO are cleared in work areas prior to beginning work. TAG-B installation procedures are as follows:

4.2.4.1. TAG-B installation procedure begins with Team-B. Carry out steps in paragraphs 4.2.4.2 and 4.2.4.3 with Team-B if the MOS is bidirectional; otherwise, begin at paragraph 4.2.4.6.

4.2.4.2. Payout 200-foot runway cable segments from End-B threshold to strobe master unit location.

4.2.4.3. Install End-B strobe segment with Team-B as described in T.O. 35E5-3-17-1, *TAG B MOS Installation Procedure* paragraph.

4.2.4.4. Travel on foot to inboard strobe slave and install the three End-B crossbar approach lights and 45W transformers. The center crossbar approach light should be placed on the approach side of the near strobe slave unit. The right crossbar approach light should be installed even with the center approach light and 10-ft to the right of the MOS centerline (use 10-ft cable as a measuring device). The left crossbar approach light should be installed even with the center approach light and 10-ft to the left of the MOS centerline.

4.2.4.5. Install End-B approach lights and 45W transformers from the crossbar to the center of the End-B threshold. The approach lights should be installed along the centerline with the light fixture cord oriented perpendicular to the centerline.

4.2.4.6. When meeting Team-B while installing End-B approach lights, join Team-B and travel to the regulator and control panel location.

4.2.4.7. Ground generators, regulator, and control panel. If a ground is not present, establish a ground by installing three 3-ft ground rods supplied. Connect a separate ground cable from the ground rod to each generator and regulator.

4.2.4.8. Make power and control connections IAW T.O. 35F5-3-17-1, *Power and Control Electrical Connections* paragraph.

4.2.4.9. Travel with Team-B to End-B and install edge light fixtures, RDM lights, and transformers toward End-A. Stake the fixtures down as needed. At the arresting barrier, ensure the runway cable is clear of the arresting gear. Team-B will be installing light fixtures and transformers along Edge-B from End-A toward End-B. If the MOS is bidirectional, connect End-B PAPIs to the Edge-B lighting circuit.

4.2.4.10. Upon meeting Team-B, proceed with Team-B to the regulator and control panel location and assist Team-A as necessary.

4.3. Taxiway Installation Procedure. If damage, UXO, equipment, vehicles, and/or repair personnel prevent MOS installation as described above and results in work stoppage, the six-man team may begin taxiway installation where available as shown in T.O. 35F5-3-17-1, *Taxiway Lighting, Layout* Figure. Otherwise, perform taxiway installation after MOS lighting has been installed.

JOHN B. COOPER, Major General, USAF
DCS/Logistics, Engineering & Force Protection

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

Air Force Doctrine Annex 3-34, *Engineer Operations*, 30 December 2014

AFI 10-209, *RED HORSE Program*, 8 May 2012

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

AFI 13-217, *Assault Zone Procedures*, 10 May 2007

AFI 32-1064, *Electrical Safe Practices*, 7 January 2015

AFMAN 33-363, *Management of Records*, 1 March 2008

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

T.O. 35F5-3-17-1, *Lighting System, Airfield, Emergency*, 6 June 2014

UFC 3-535-01, *Visual Air Navigation Facilities*, 17 November 2005

Adopted Forms

AF Form 847, *Recommendation for Change of Publication*, 22 September 2009

Abbreviations and Acronyms

AAS—aircraft arresting system

AFCEC—Air Force Civil Engineer Center

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFPAM—Air Force Pamphlet

AFRC—Air Force Reserve Command

AFRIMS—Air Force Records Information Management System

ANG—Air National Guard

BEAR—Base Expeditionary Airfield Resources

BEEF—Base Engineer Emergency Force

DTG—distance to go

EALS—Emergency Airfield Lighting System

FOD—foreign object debris

IAW—in accordance with

IFR—instrument flight rules

MAAS—Mobile Aircraft Arresting System

MAOS—minimum airfield operating surface

MOS—Minimum Operating Strip

OPR—office of primary responsibility

PAPI—precision approach path indicator

RAC—random access container

RDM—Runway distance marker

RDS—Records Disposition Schedule

SCA—series circuit adapter

T.O.—technical order

TTP—tactics, techniques, and procedures

UTS—under trailer storage

UXO—unexploded explosive ordnance

Terms

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

Contingency—A situation requiring military operations in response to natural disasters, terrorists, subversives, or as otherwise directed by appropriate authority to protect US interests. (JP 5-0)

Contingency Operation—A military operation that is either designated by the Secretary of Defense as a contingency operation or becomes a contingency operation as a matter of law (Title 10, United States Code, Section 101[a][13]). (JP 1)

Debris—Material ejected from the crater including broken pavement and soil. Debris is some-times usable as backfill material particularly for large crater repair, but for small crater or spall repair it is generally not advisable.

Mobile Aircraft Arresting System (MAAS)—An aircraft arresting system mounted on two identical, four-wheeled towable trailers, one on each side of the runway. Each trailer serves as a storage and ground transportation and as a platform for securing the basic arresting gear components: BAK-12 energy absorber, pendent tape, tape connector, hook cable, rewind system, and cooling system. The MAAS can be anchored in concrete, asphalt, or soil in less than 1 hour and is capable of 20 arrested landings per hour. The MAAS is capable of bidirectional arrestment, but if configured for airfield survivability application (aborted takeoff and landing aircraft), is unidirectional.

Minimum Airfield Operating Surface (MAOS)—The combined requirement for airfield surfaces for both runway and access routes. The MOS is part of the MAOS.

Minimum Operating Strip (MOS)—1. A runway which meets the minimum requirements for operating assigned and/or allocated aircraft types on a particular airfield at maximum or combat gross weight. 2. The MOS is the smallest area to be repaired to launch and/or recover aircraft after an attack. Selection depends upon mission requirements, taxi access, resources available, and estimated time to repair. For fighter aircraft, the typically accepted dimensions are 5,000 feet long by 50 feet wide.

Mission—1. The task, together with the purpose, that clearly indicates the action to be taken and the reason therefore. 2. In common usage, especially when applied to lower military units, a duty assigned to an individual or unit; a task. 3. The dispatching of one or more aircraft to accomplish one particular task. (JP 1-02)

Personnel—Those individuals required in either a military or civilian capacity to accomplish the assigned mission.

Procedures—Standard, detailed steps that prescribe how to perform specific tasks.

Recovery operations—Operations conducted to search for, locate, identify, recover, and return isolated personnel, human remains, sensitive equipment, or items critical to national security. (JP 3-50)

RED HORSE—Air Force units wartime-structured to provide a heavy engineer capability that are mobile, rapidly deployable, and largely self-sufficient for limited periods of time.

Runway—A defined rectangular area of an airfield, prepared for the landing and takeoff of aircraft along its length. A runway is measured from the outer edge of the thresholds from one end of the runway to the others. The width of the runway is typically measured from the outer edge of the load-bearing pavement on one side to the outer edge of the load-bearing pavement on the other side. In some cases the runway may be measured from the outside edge of the runway marking line on one side to the outside edge of the marking line on the other side and any remaining load bearing pavement is considered shoulder.

Runway edge—One of the long sides of the runway/MOS. EDGE A is the side in the clockwise (left) direction from end A. EDGE B is the other side (right).

Runway Threshold/End—The threshold is the beginning portion of the usable pavement as viewed by the approaching pilot. The runway end is the last portion of the usable runway/MOS available to a pilot. Green lights mark the threshold end, and red lights mark the runway end. When the threshold of a runway is co-located with the end of the opposite runway, the threshold/end lights have a split lens with green on one side and red on the other.

Support—1. The action of a force that aids, protects, complements, or sustains another force in accordance with a directive requiring such action. 2. A unit that helps another unit in battle. 3. An element of a command that assists, protects, or supplies other forces in combat. (JP 1-02)

Tactics—1. The employment of units in combat. 2. The ordered arrangement and maneuver of units in relation to each other and/or to the enemy in order to use their full potentialities. (JP 1-02)

TAG—1-person installation team.

Taxiway—A specially-prepared or designated path on an airfield or heliport, other than apron areas, on which aircraft move under their own power to and from landing, takeoff, service, and parking areas.

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

Unexploded Explosive Ordnance (UXO)—Explosive ordnance which has been primed, fuzed, armed, or otherwise prepared for action, and which has been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material, and remains unexploded either by malfunction or design. (JP 3-15, JP 1-02)

Unidirectional Runway—A condition where, for whatever reason, aircraft takeoff and land on the runway in only one direction.

Attachment 2

PREINSTALLATION CHECKLISTS

Table A2.1. Required Information Checklist for System Installation.

__	Determine MOS location and size of runway.		
	Coordinates: Threshold _____ Departure _____		
	Length: ____ ft Width: ____ ft Centerline offset: __ ft __ L or __ R		
__	Determine subsystems to install:		
	__ Edge lights		
	__ Threshold/end lights	Threshold: ___	Departure: ___
	__ Approach lighting		
	__ Approach strobes	Threshold: ___	Departure: ___
	__ Approach lights	Threshold: ___	Departure: ___
	__ Taxiway lighting—Taxiways: _____ / _____ / _____ / _____ / _____		
	__ RDM lighting __ Aircraft arresting system marker lights		
	__ PAPI lights		
	Approach slope angle/ PAPI aiming angle:	Threshold: ___°	Departure: ___°
	Distance from threshold:	Threshold: ___ ft	Departure: ___ ft
	__ Obstruction lights—Locations: ____ / ____ / ____ / ____ / ____ / ____		
__	Coordinate with marking team to determine how when they plan to mark the location of the runway/MOS threshold, edges, centerline, approach-zone centerline, aircraft arresting systems, taxiways, RDMs, PAPI lights, and obstruction lights.		
__	Coordinate EALS setup with MAAS team. Determine if aircraft arresting system is ___ unidirectional / ___ bidirectional. Determine tape sweep area (light free zone): ____ft (see **Table A3.2**).		

__	Coordinate with marking team to determine approximate set up location for EALS regulator and generators. Preferred location is midway of MOS and at least 200 feet from the MOS edge.
__	Determine grounding schemes for power/control equipment and strobe segments.
__	Coordinate EALS installation and timing with crater repair operations. Do not install EALS components in locations that conflict with repair operations, including debris removal and paint striping.

Table A2.2. Safety Checklist.

1. __	Remove all rings, bracelets, watches, and metal-framed glasses.
2. __	Wear safety-toed boots, gloves, and earplugs as necessary.
3. __	Use only general-purpose vehicles to tow trailers and always use spotters when connecting trailers. Pintle-hook height should not exceed 18” from ground (additional height can cause tow bar to bend or snap when making turns). Raise tailgate on tow vehicle before moving.
4. __	Trailers are top heavy—do not exceed 25 mph on paved surfaces or 5 mph on curves and unpaved surfaces. Stay on paved surfaces when possible. When towing more than one trailer, reduce speed and allow extra stopping distance when braking. Do not tow more than three trailers at a time.
5. __	Engage trailer parking-brake before performing any operation on or around the trailer. Always disengage brake before moving a trailer.
6. __	Wear proper PPE for potential arc flash hazards IAW AFI 32-1064.
7. __	Ensure people are clear of lighting components and cables before energizing a circuit and during operation of the EALS.
8. __	Do not work on an energized circuit. Shut off generators before working on a circuit and disconnect runway cables from regulator output terminals.
9. __	Do not attempt to lift or carry a loaded removable container or SCA alone. Do not attempt to open or close the under trailer storage (UTS) drawer alone.
10. __	Discharge both capacitors before working inside a strobe unit.
11. __	Do not dispense cable from reel too quickly. Cable ends can fly off reel. Reel operator should wear gloves. Ensure all bungee cords are tight.
12. __	Install PAPI approach lights in correct locations & properly set angles and elevations.
13. __	View as-built drawings to ensure utility lines are not present before driving ground rods (if areas where ground rods will be driven are known in advance, submit an AF Form 103, *Clearance Work Request*, during pre-attack measures).
14. __	Ground generators, regulators, control panels, strobe masters, and SCAs

	before energizing the system.
15. __	Do not look directly into an operating strobe.
16. __	Use 100W isolation transformers with threshold/end lights.
17. __	Connect generator power & control cables to proper terminals on control panel.
18. __	Pick up any debris in work areas to eliminate foreign object damage (FOD) potential.
19. __	Do not attempt to back trailers with tow vehicle, swivel tongues cause the trailer to jackknife.
19. __	Latch random access container (RAC) doors open or close them before towing trailers.

Table A2.3. Pre-employment Equipment Checklist.

1. __	Inspect and service generators IAW applicable T.O.			Trlr #5	Trlr #6
	Visual inspection for leaks, loose cables, and damage			____	____
	Fuel level			____	____
	Oil level			____	____
	Engine coolant level			____	____
	Battery water level, charge, and terminal corrossion			____	____
	Belts			____	____
	Tire pressure (65 PSI)			____	____
	Hand brake			____	____
2. __	Check trailers #1 - #4	# 1	# 2	# 3	# 4
	Tire pressure (65 PSI)	____	____	____	____
	Hand brake	____	____	____	____
	Inspect for damage	____	____	____	____
	Mounted equipment secured	____	____	____	____
	Inventory trailers (T.O. 35F5-3-17-1)	____	____	____	____
3. __	Check cable reels for proper operations		#2	#3	#4
	Rewind		____	____	____
	Brake		____	____	____
	Freewheel		____	____	____
	Cable secured on reel		____	____	____

Table A2.4. Light Free Zone Distances.

MOS WIDTH (Feet)	*PENDANT LENGTH* (Feet)	*EDGE LIGHT OFFSET*		
		0-FEET	5-FEET	10-FEET
50	90	550*	450*	350*
50	153	700	650	600
90	90	150	50	0
90	153	450	400	350
150	153**	50	0	0

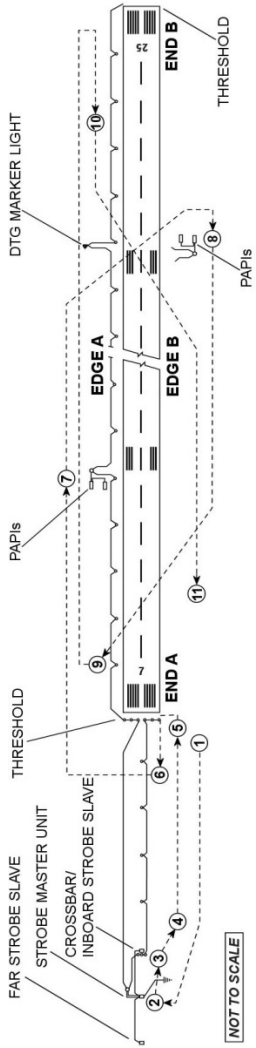
* Distance from AAS to far edge of tape sweep area (in feet). Round up to nearest 50-ft; interpolate this data for other conditions.

** No numbers are provided for a 90-ft pendant on a 150-ft wide runway; the 90-ft pendant effectively reduces runway width to 90 ft.

Attachment 3

ALTERNATE TEAM INSTALLATION SEQUENCES

Figure A3.1. Team-A MOS Installation Sequence.



(1) Pay out 200-ft runway cable segments from End-A threshold to strobe master unit location
(2) Place and install End-A strobe segment
(3) Place 3 approach lights, transformers, 3 stakes/ballast rings, and two 10' runway cables for 1,000-ft crossbar
(4) Place approach lights, transformers, stakes/ballast rings, & 200' runway cable between inboard slave strobe & threshold
(5) Place and install End-A threshold/end lights, transformers, and 200-ft runway cable segments
(6) Install approach lights towards strobes until meeting TAG-A
(7) Pick up TAG-A and place and install Edge-A PAPIs
(8) Place and install Edge-B PAPIs
(9) Drop TAG-A at End-A and proceed towards End-B placing edge lights, DTG marker lights, transformers, and runway cable segments along Edge-A
(10) Install Edge B lights and DTG marker lights starting at End-B until meeting TAG-A along Edge-A
(11) Pick up TAG-A and drive to regulator and control panel location

NOTE: *UXO must be mitigated in work areas prior to beginning work.*

Figure A3.2. TAG-A Installation Sequence.

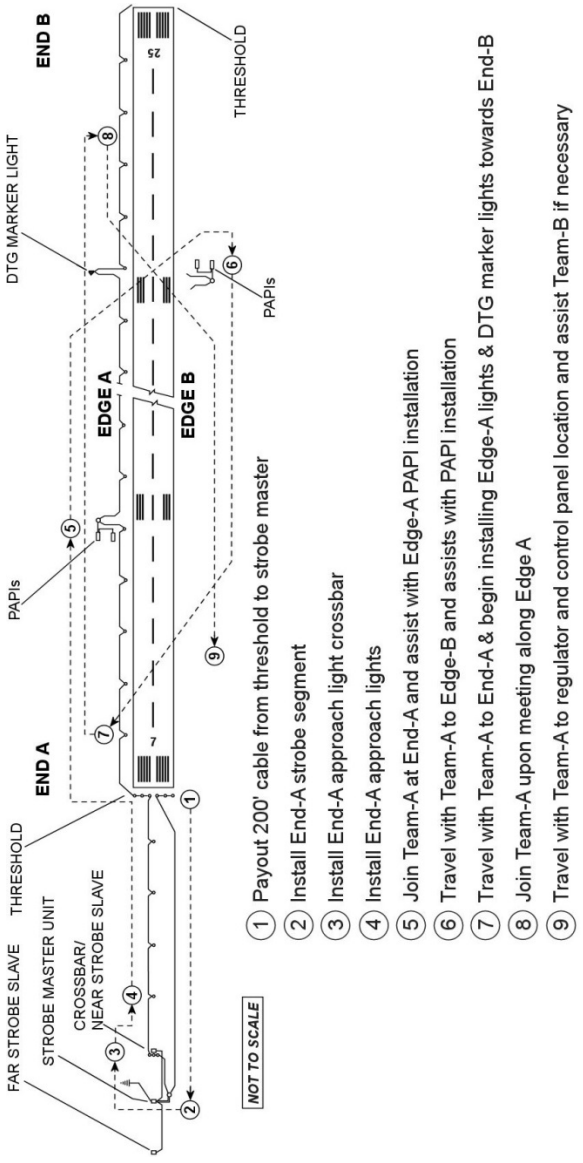


Figure A3.3. Team-B Installation Sequence.

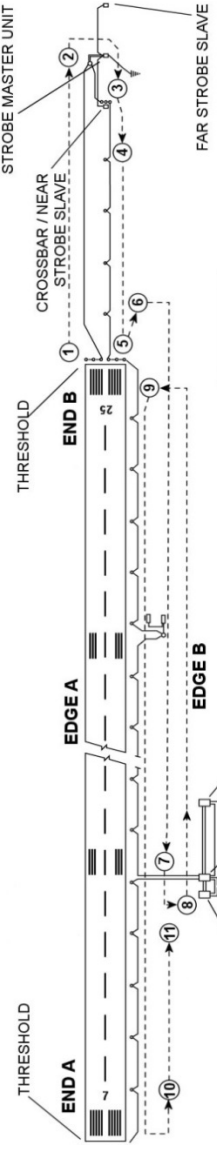


Figure A3.4. TAG-B Installation Sequence.