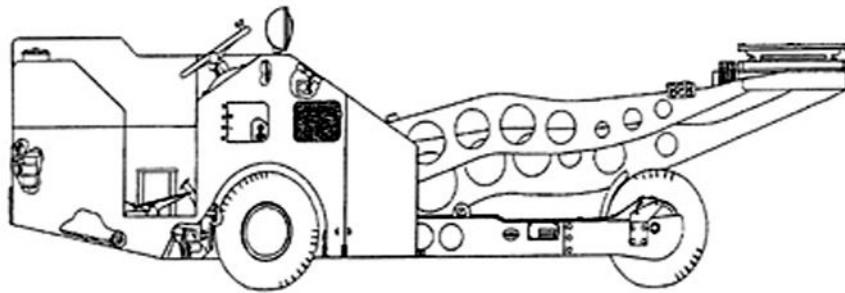


# **CDC 2W151B**

## **Aircraft Armament Systems Journeyman**

### **Volume 1. Aerospace Ground Equipment**



**Air Force Career Development Academy  
Air University  
Air Education and Training Command**

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THIS CAREER development course (CDC) consists of three volumes. When you have completed this course, you'll have covered aerospace ground equipment (AGE) in volume 1, air munitions in volume 2, and general aircraft fundamentals in volume 3. In this first volume, you'll study aerospace ground equipment (AGE) as it applies to your career field; it is divided into two units. In unit 1, we will begin with munitions handling and loading equipment. In unit 2, we will cover flight-line support equipment.

A glossary is included for your use.

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



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# Unit 1. Munitions Handling and Loading Equipment

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**T**HE ULTIMATE SUCCESS or failure of a combat mission depends on your ability to load/unload munitions quickly and efficiently. To do this, you must know what handling and loading equipment to use. You are, to a degree, familiar with the various types of handling and loading equipment used in the loading section of your own organization. However, as you progress in the Aircraft Armament Systems career field, you must know not only the equipment used in your organization, but also the equipment used in other Air Force organizations.

In this unit, we provide a description of the handling and loading equipment used to load/unload munitions. In this first section, we'll cover what munition lift trucks are used for transporting, loading, and unloading conventional munitions and nuclear weapons.

## 1-1. Lift Trucks

The various handling and loading lift trucks are the primary vehicles used by armament personnel for the installation of suspension equipment and munitions loading on aircraft. These lift trucks make it relatively easy to transport heavy stores and related suspension equipment from one location to another. The most commonly used bomb lift trucks (also known as jammers) are the MJ-1B, the munitions handling unit (MHU)-83, and the MJ-40.

### 001. MJ-1B bomb lift truck

The MJ-1B bomb lift truck (fig. 1-1) is a self-propelled, hydraulically operated lift truck. Its purpose is to transport (short distances), lift, and attach bombs, fuel tanks, pylons, and aerial stores weighing up to 3,000 pounds to wing or fuselage stations.

#### General overview

The MJ-1B is mounted on a low-slung, heavy-duty frame supported by four high-capacity wheels. The rear wheels are driven by a hydrostatic drive system connected between the 25.2-horsepower diesel engine and a conventional differential gear. The rear wheels are steered by a hydraulically operated and controlled steering cylinder.

The MJ-1B has a two-cylinder, air-cooled, diesel engine used to provide power to operate the hydrostatic drive system. A hand throttle located to the left of the steering wheel controls the engine speed. It is adjusted and manually locked at the desired setting usually 2,400 revolutions per minute (rpm).

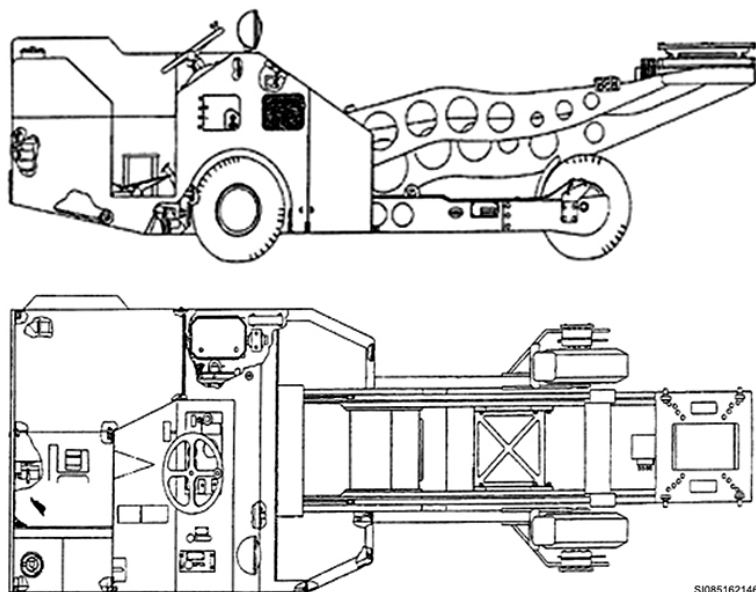


Figure 1-1. MJ-1B.

### Hydrostatic drive

Power from the engine is used to operate a hydraulic pump in the hydrostatic drive system. The hydrostatic drive system consists of a fluid coupling between the engine and the differential, a variable displacement hydraulic pump connected to the engine, and a fixed displacement hydraulic motor connected to the differential. The amount of hydraulic fluid delivered from the pump to the motor determines the speed of the truck. Changing the position of the accelerator pedal varies the flow rate of the pump in the hydrostatic drive. The accelerator pedal increases the flow rate by changing the stroke of the piston within the hydraulic pump.

During normal operation, the engine speed is adjusted to 2,400 rpm with the throttle control, and the truck speed is controlled with the accelerator pedal. Forward and reverse direction is selected with a directional control lever located on the instrument panel. By depressing the accelerator pedal on the floorboard, you engage the hydrostatic drive. Dependent upon the hand throttle setting, you can drive the lift truck at speeds up to 10-15 miles per hour (mph). For safety reasons a governor is used to control top speed.

The fuel tank is located to the right of the driver. Since there is no fuel gauge, the filler cap must be removed to check the fuel level. The MJ-1B has a 6-gallon fuel tank. A floodlight and a backup light are provided for night operations and are controlled by a switch located on the control panel. The floodlight can be adjusted manually to provide better lighting during loading operations.

Cantilever lift arms are raised and lowered by hydraulic cylinders operated by a control located either at the driver's position or directly behind the cradle.

The cradle assembly is supported by the lift arms and is used to hold the munition or store to be loaded. The driver positions the lift truck as close and accurately as possible. The final adjustments are made by another crew member using the hydraulic cradle (table) controls (fig. 1-2).

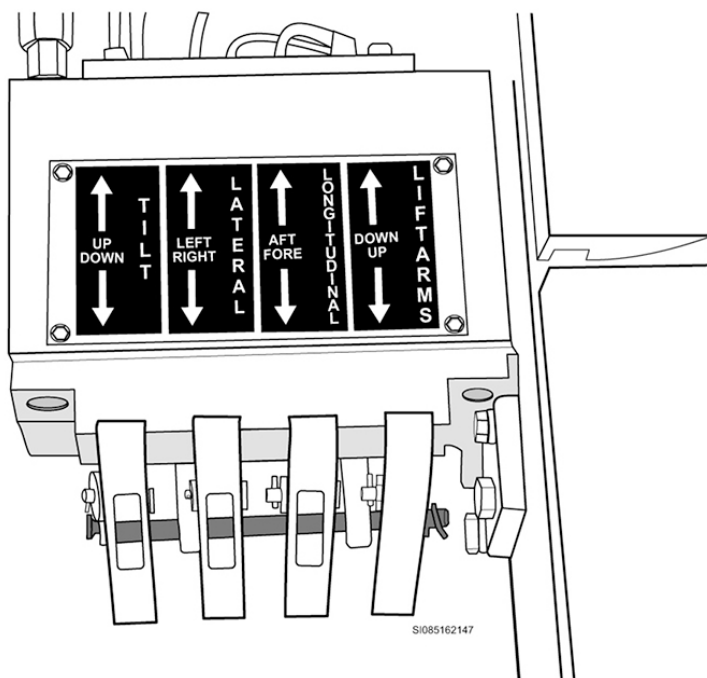


Figure 1-2. Forward controls.

## 002. MJ-40 lift truck

The MJ-40 lift truck (fig. 1-3) is a 10,000-pound capacity, self-propelled, hydraulically operated lifting and positioning device used to lift and attach aerial stores. It consists of a main structural frame, a cantilever lift boom, extendable outriggers, and auxiliary frames for the sheet-metal body.

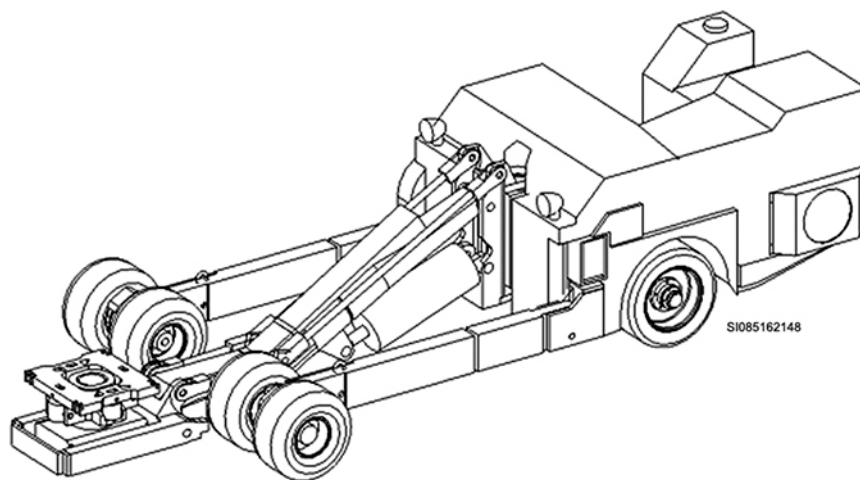


Figure 1-3. MJ-40 lift truck.

### General overview

The MJ-40 lift truck is powered by a 25.2-horsepower, two-cylinder, diesel engine. The engine drives several pumps to provide the hydraulic power for all functions. The rear wheel steering is power assisted. The unit's operator/driver position contains easily reachable controls for all functions. The drive system is a hydrostatic system just like the MJ-1/B and provides variable forward and reverse speeds. The unit design also includes a remote control unit (RCU) for all positioning functions. The MJ-40 is presently only being used with the B-1B and B-2 aircraft.

### Lift truck functions

The lift boom is a cantilever-type structure affixed to the frame at one end. Lifting is done by a double-acting hydraulic cylinder attached between the frame and the approximate center of the lift boom. The lift cylinder is equipped with a hydraulic locking valve to ensure the boom cannot fall if a hydraulic line ruptures.

All functions of the lift truck have controls located in the operator's compartment and/or the RCU shown in (fig. 1-4 and fig. 1-5). Functions controlled at the operator's compartment are boom lift and azimuth table movements include roll, tilt, and yaw plus left and right outrigger extensions. The RCU contains controls for boom lift and azimuth plus table controls for longitude, roll, tilt, yaw, and ram up/down. The RCU is hand held and is connected to the lift truck by a flexible electrical cord allowing full freedom around the vehicle.

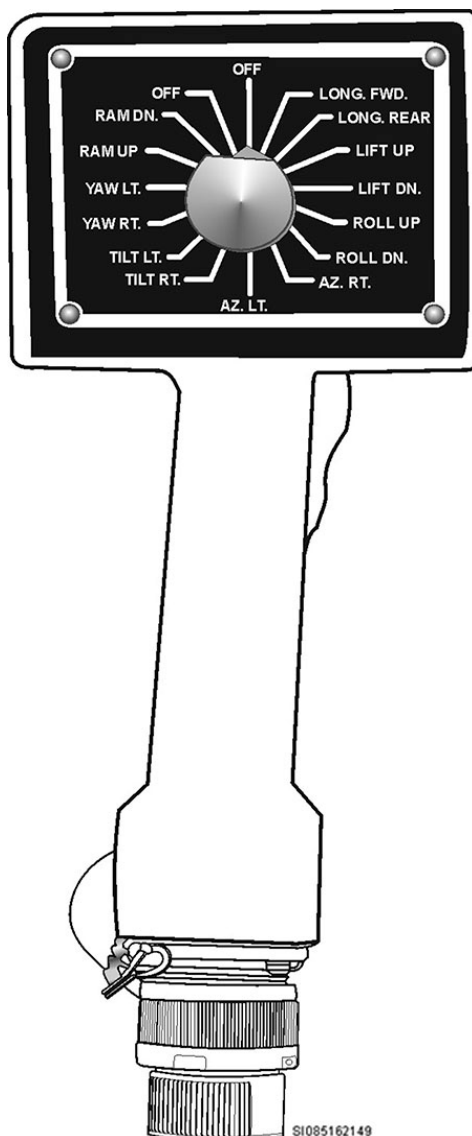
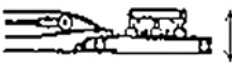
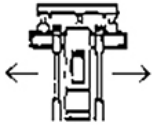



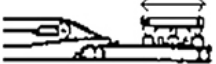
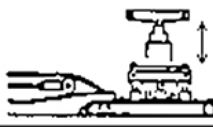
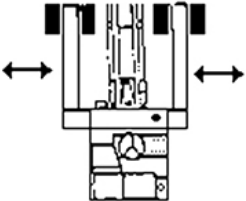


Figure 1-4. MJ-40 remote control unit.

OPERATOR'S POSITION	REMOTE CONTROL UNIT	VIEW	ACTION
BOOM (UP/DOWN)	BOOM (UP/DOWN)	SIDE VIEW	
AZIMUTH (LEFT/RIGHT)	AZIMUTH (LEFT/RIGHT)	DRIVER'S VIEW	
ROLL (UP/DOWN)	ROLL (UP/DOWN)	SIDE VIEW	
TILT (LEFT/RIGHT)	TILT (LEFT/RIGHT)	DRIVER'S VIEW	
YAW (LEFT/RIGHT)	YAW (LEFT/RIGHT)	BIRD'S EYE (TOP) VIEW	
NOT AVAILABLE	LONGITUDINAL (FWD/REAR)	SIDE VIEW	
NOT AVAILABLE	RAM UP/DOWN	SIDE VIEW	
OUTRIGGERS (IN/OUT)	NOT AVAILABLE	BIRD'S EYE VIEW	

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Figure 1-5. MJ-40 control overview.

### 003. MHU-83 lift trucks

The MHU-83 series munitions handling and loading lift trucks are designed to lift, transport, and load/unload munitions and stores weighing up to 7,000 pounds (fig. 1-6). In addition, the MHU-83 series can handle munitions preloaded on triple ejector racks (TER), preloaded missiles, gun systems, and aircraft pylons.

#### General overview

The MHU-83 lift truck's engine is an air-cooled, 25.2-horsepower, two-cylinder diesel engine used to operate the lift truck and provide power for the hydraulic system. It has the capability of running on diesel fuel at all temperatures or JP-8 jet fuel at temperatures greater than 0°F. A hand throttle controls the engine speed and can be locked at the desired engine rpm. Operator controls and indicators are mounted on the instrument panel and control panel in the operator's compartment (fig. 1-7). A three-position, spring-centered, and spool-type control valve located on the control panel in front of the operator is used for the major portion of the lifting cycle. A similar control valve is located on the forward end of the lift boom. The second control valve offers more precise control of

the lifting and azimuth actions. A duplicate control valve system also provides tilt, roll, and yaw motion. Controls for adjusting the side frame width are located at the operator's position only.

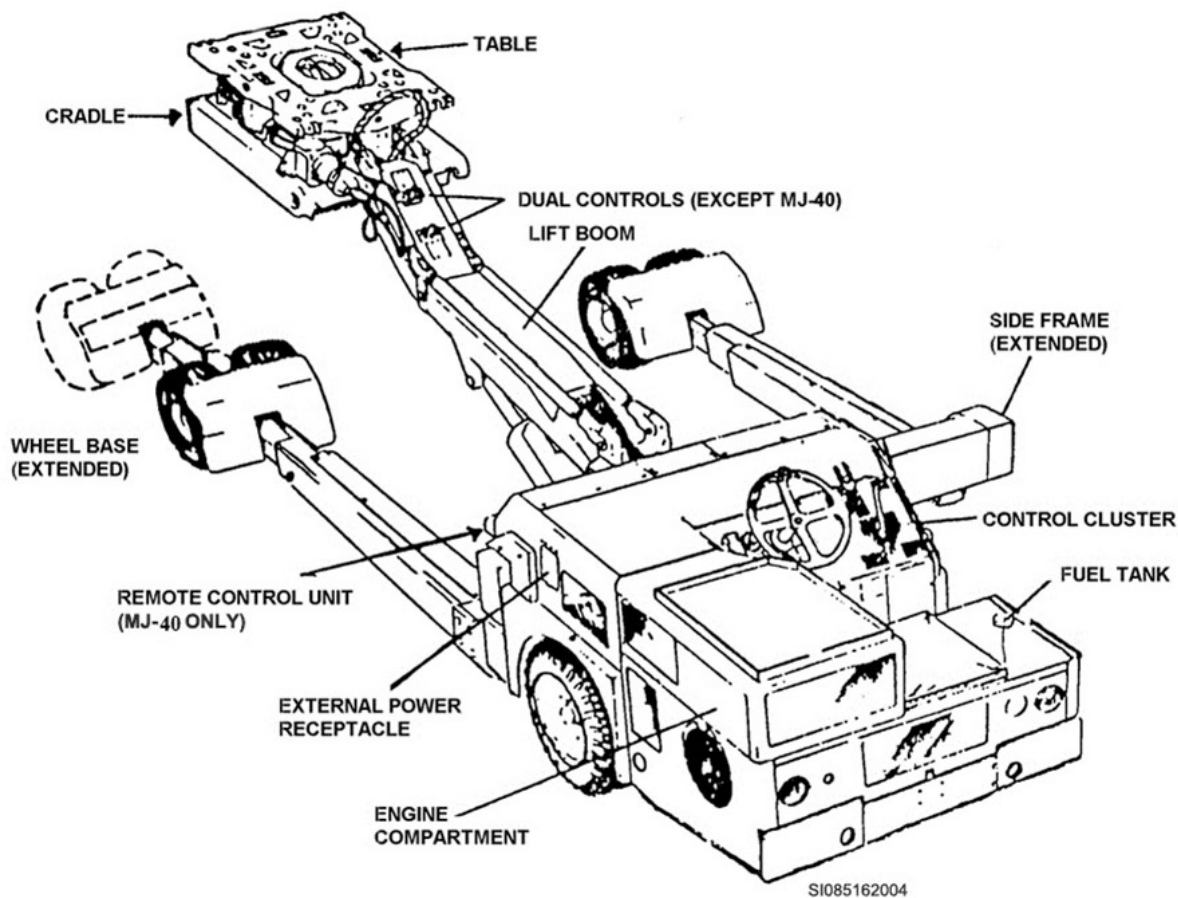


Figure 1-6. MHU-83.

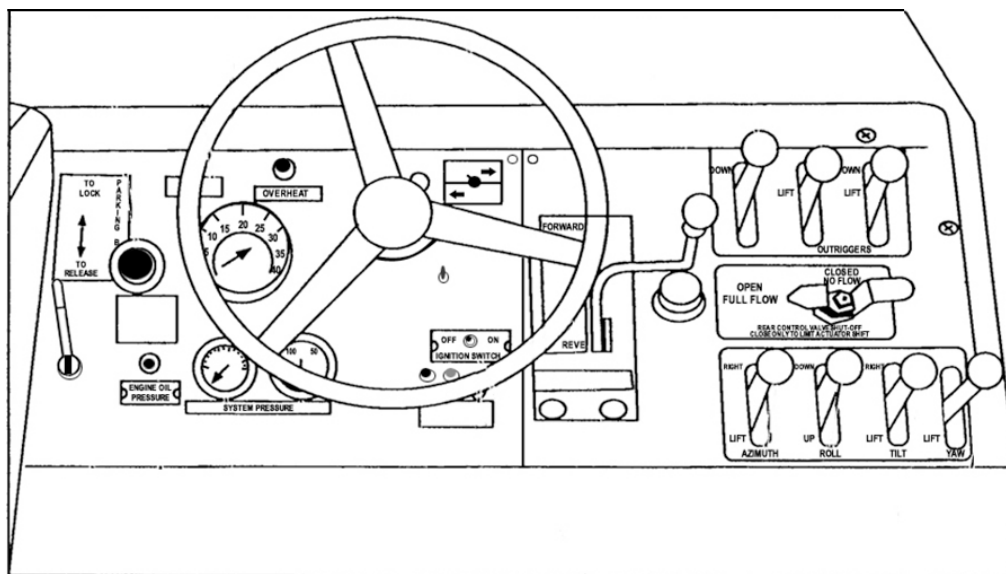


Figure 1-7. MHU-83 drivers controls.



A hydrostatic drive system, just like the MJ-1, is used to supply power to drive the lift truck and to operate the hydraulic system. The hydraulic fluid tank holds six gallons of hydraulic fluid and is located in the right forward part of the lift truck body. The cradle movements, cantilever lift boom, power steering, power brakes, and side-frame width adjustments are operated by the hydraulic system. The lift truck has power steering and steers from the rear wheels like the other lift trucks.

The lift boom is a tubular cast steel cantilever-type structure fixed to the frame at the rear end and free at the front end which supports the cradle. The lift cylinder is equipped with a counterbalance valve that ensures the boom cannot fall in the event hydraulic power is lost because a component fails or a line breaks.

The lift boom is also used to lift the front wheels off the ground to allow side frame width adjustment by spreading the front wheels apart for increased lift truck stability or to increase the clearance for munitions items attached to the table or forks. The wheels themselves may be extended forward to increase clearance or wheelbase as required. The forward wheels are mounted on an extendable beam that can slide forward out from the tubular frames up to 24 inches.

The lift truck brakes, which are mounted on the two inside front wheels, are conventional caliper-type operated by the foot brake valve located next to the motion pedal on the floorboard at the operator's position. The parking brakes are controlled by a locking valve located to the left of the steering wheel on the instrument panel. With the locking valve in the closed position, the parking brakes are set by depressing the service brake pedal in the normal manner. To release the parking brakes simply disengage the locking valve.

Of special note is the newer MHU-83 D/E variant of this lift truck. This model incorporates many of the features from the MJ-40 lift truck into the much more common MHU-83 platform increasing its capabilities to support a wider variety of missions. By incorporating an RCU and hydraulic servicing lines/connectors, this variant of the MHU-83 can now perform tasks once necessitated by the use of the MJ-40. The following table lists the MHU-83 lift truck characteristics.

MHU-83 Lift Truck Characteristics	
Speed (flight line)	10.6 mph
Brakes	Power assisted
Steering	Power assisted rear wheel
Maximum lift capacity	7,000 pounds
Side frame adjustments (hydraulic)	70–140 inches
Wheel base adjustments (manually)	89–113 inches

### **Cradle maneuverability**

The cradle assembly is supported by the lift boom and is used to support the munitions or accessories during transport and/or loading operations. The cradle has a series of holes used for support rollers for supporting items being transported on the cradle assembly. A hand pump is located on the right-hand side of the lift truck. It is used to operate the hydraulic system should the engine quit during loading operations. The cradle assembly capabilities are listed in the following table.

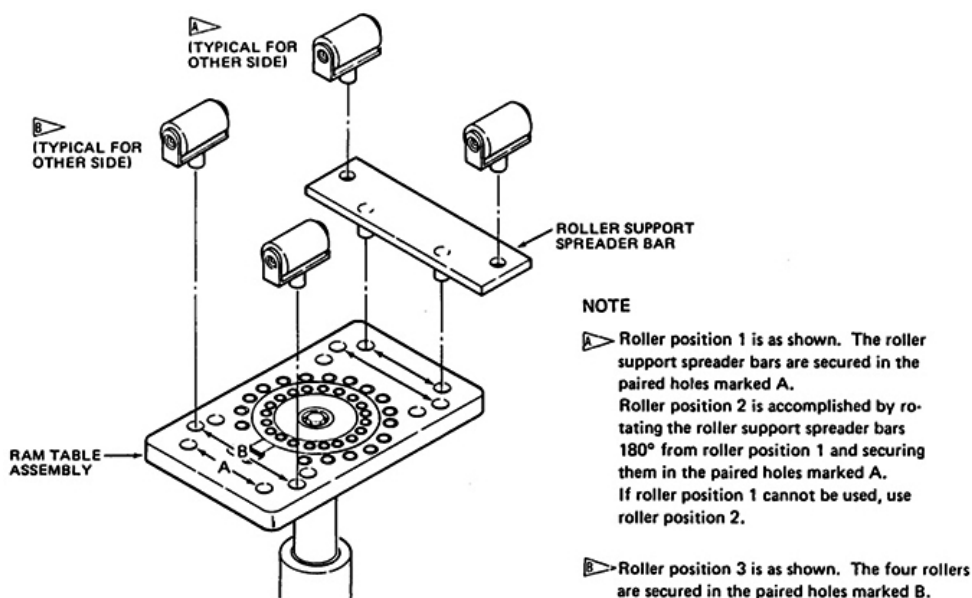
Cradle Assembly Capabilities	
Tilt (tilt left or tilt right)	5°
Yaw (rotate left or rotate right)	104°
Longitudinal (forward or aft)	4 inches
Roll (roll up or roll down)	7°
Lift (load table only)	12 to 96 inches
Lift (forks standard position)	2 to 86 inches
Lift (forks inverted position)	18 to 108 inches

## 004. Lift truck accessories

We use many added accessories to load, handle, or position munition items. The proper accessories can greatly help the operation you are performing. Within this lesson, we will discuss several accessories you will use to assist you in your duties.

### Rollers

Bomb support rollers can be used with all bomb lift trucks. They may be installed on the lift truck tables, ram assemblies, and various other adapters. Rollers provide rotation of stores (i.e., munitions) during loading. Rollers differ, not by their purpose, but by design and individual uses. Figure 1-8 shows where the different types of rollers may be installed on bomb lift truck tables. Rollers are used in sets of four, and their weight capacities vary with their construction and the lift truck they're installed on. Aluminum rollers installed on the MJ-1A/1B or MHU-83 have a capacity of 3,000 and 7,000 pounds, respectively. Roller extensions may be used with all rollers. The MJ-40 uses a modified version of the rubber rollers to meet the 10,000-pound lifting capacity. The extenders provide additional height above the lift table cradle for the bomb support rollers to give added clearance between the store and bomb lift truck table when loading smaller-diameter stores.



STORE	HYDRAULIC LIFT TRUCK (RAM) TYPE HLU-264/E ROLLER POSITION
MK 20 ROCKEYE	3
MK 36 DESTRUCTOR	3
MK 82 GENERAL PURPOSE	3
MK 83 LOW DRAG	1
MK 82 SNAKEYE	3
MK 82 AIR	3
M117 GENERAL PURPOSE	2
M117 DESTRUCTOR	2
M117 RETARDED	2
M129E2 LEAFLET	2
CBU DISPENSERS	2
DST 40 MINE	1
MK 52 MINE	1
MJU1/B COUNTERMEASURE	2
MC-1	2

Figure 1-8. Rollers.

## Straps

Load binder assemblies (i.e., tie-down straps) are used to secure a single munition to the lift table or loading adapters of bomb lift trucks during transport, loading, or unloading (fig. 1-9). Only one tie-down strap is required per munition when using the MJ-1A/1B, but you need two per munition when you're using the MHU-83-series bomb lift trucks.

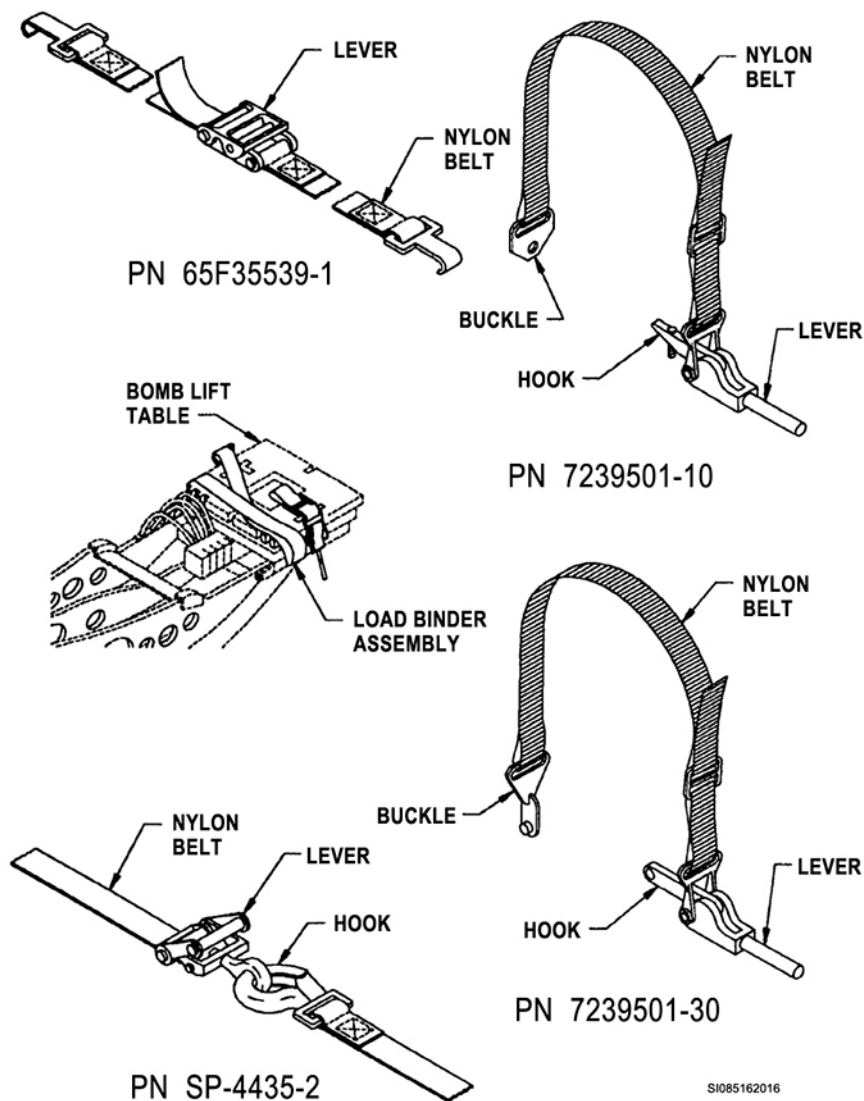
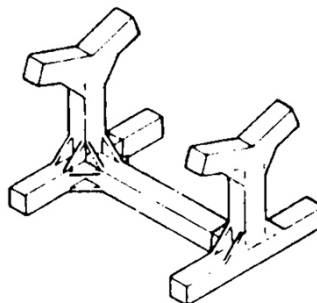


Figure 1-9. Load binders (tie-down straps).

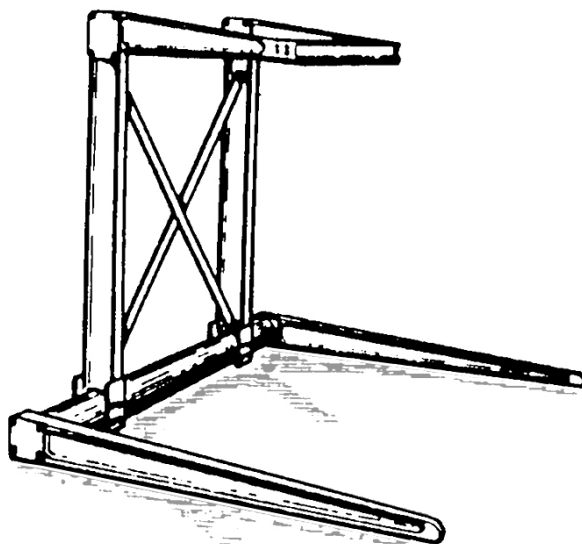
## Stands

Bomb stands, or “Y” stands support munitions temporarily (fig. 1-10, A). The main factor to consider when using these stands is their structural strength; they must be strong enough to support the munition being placed on them. Another thing to remember is they may be found in aircraft loading or munitions storage areas. These stands can save considerable loading time by supporting munitions once they are removed from handling trailers. If you stop and think about the time required to remove a munition from a trailer and then load an aircraft as compared to picking up a munition from a stand and then loading it to an aircraft, the time saving is considerable. Never rule out the use of these types of stands.

Another type of stand you may encounter is a gantry stand, or preload stand (fig 1-10, B). This type of stand is used to support TERs when loading them and storing them for future use. Once the TER is loaded and stored, it becomes what is known as preloaded. These preloads may be picked up with lift trucks at any time and loaded directly on an aircraft.



A.



B.

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Figure 1-10. "Y" and gantry stands.

### Beams

These pieces of equipment, regardless of what they are called, are all classed together and serve the same basic purpose: to support or lift some type of munition. They were designed for use with bombs, missiles, dispensers, or anything with suspension lugs. They will also accommodate items equipped with suspension, bail, or T-lugs spaced 14 or 30 inches apart. The beams vary in their individual design depending on the munition or dispenser they are used with. Figures 1-11 through 1-13 show some of the more typical beams you'll be using as a 2W1. Each individual beam has a particular capacity rating to match the store it was designed to support. The only sure way to know the right beam to use in a particular situation is to check your technical order (TO).

The lug and bomb support beams shown in figure 1-11 are used with the MJ-1-series lift trucks. They are also shown in their normal configurations. Note the bomb lug beam comes equipped with a nylon load binder attached to it for securing munitions to be transported over long distances. Figure 1-12 shows the beams (MK 4 MOD 0, MK-55, and H1004) used to hoist and transfer naval mines and the air-to-ground missile (AGM)-84, Harpoon missile, from their cases or flatbed trucks to the MHU-83-series lift trucks.

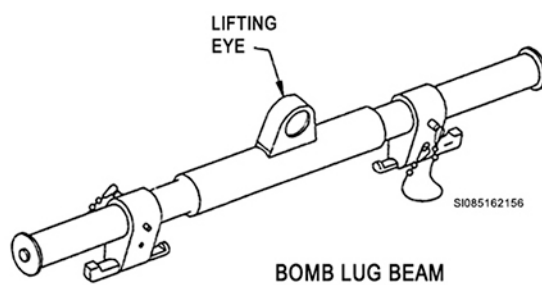
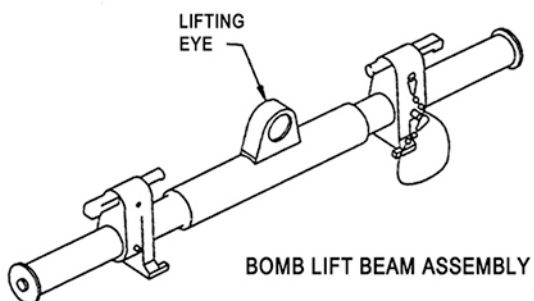
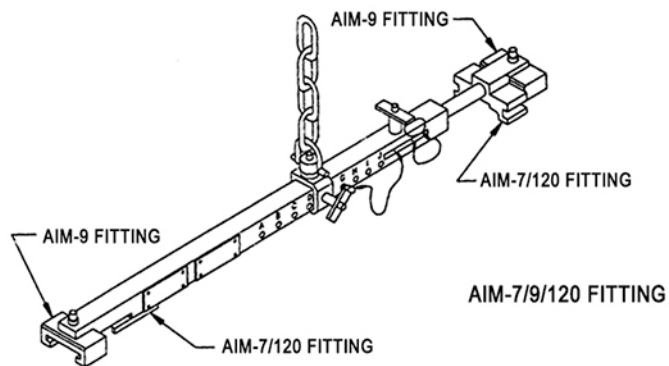


Figure 1-11. Bomb and missile lift beams.

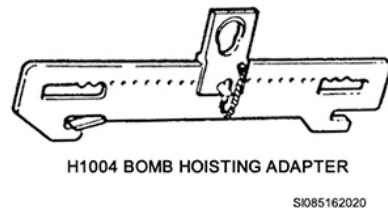
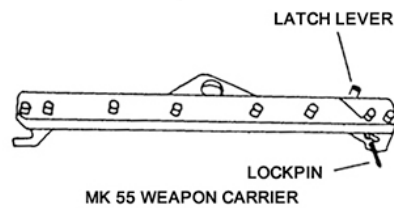
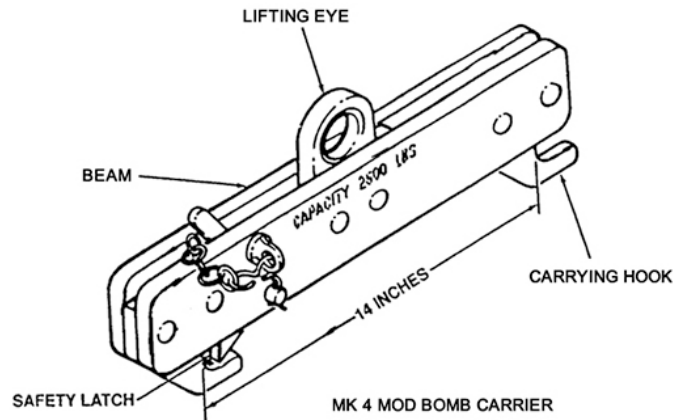


Figure 1-12. Bomb/weapon carriers and hoisting adapters.

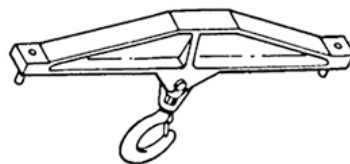
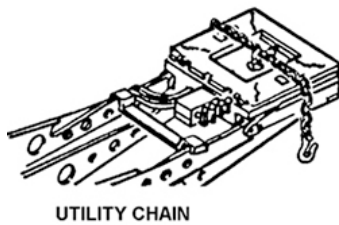
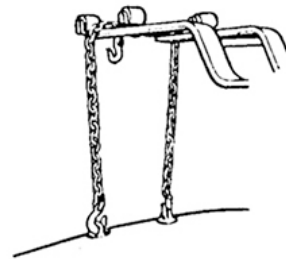
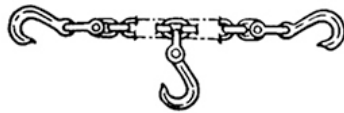


Figure 1-13. Utility chains and adapters.

### Chains and slings

Chains and slings (fig. 1-13) may be used in conjunction or separately, depending on the task. They may be attached to the cradle or table assembly of bomb lift trucks, forklift adapters, or lift arm extensions to get the configuration needed for a particular task. These pieces of equipment are used for lifting bombs or other munitions from the ground, bomb stands, crates, trailers, and so forth. The lifting capacity of the chains we use ranges from 2,000 to 7,000 pounds. The sling assembly has a lifting capacity of 4,600 pounds.

### Adapters

Adapters used with bomb lift trucks come in many different sizes, shapes, and configurations. In this lesson, we cover some of the more common adapters used to move, load, or unload munitions and to install or remove suspension equipment.

### Extension lift arm

The extension lift arms are used only with the MJ-1B lift trucks (fig. 1-14). They lift single munitions from the ground, trailers, dollies, and so forth, and position them onto bomb stands. They can also be used to position munitions onto a lift truck table immediately before transportation or aircraft loading. This accessory limits the lifting capacity of the MJ-1B to a maximum of 2,200 pounds.

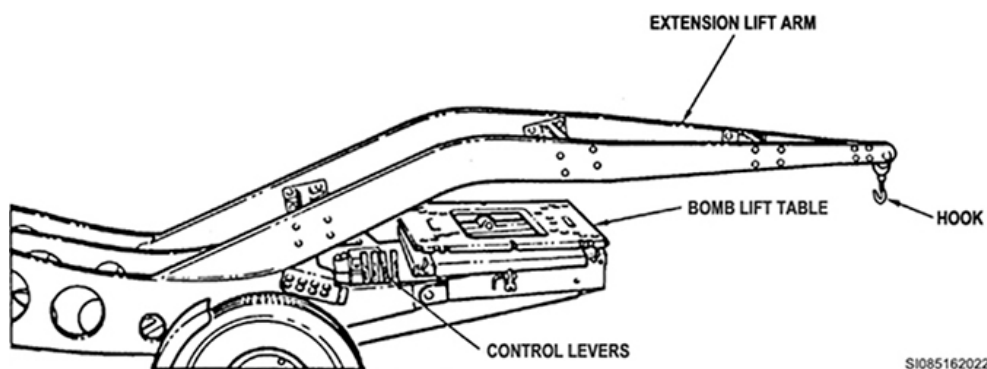


Figure 1-14. Extension lift arms.

Other accessories such as the utility chain, cargo hook sling, and lug beam are used in conjunction with the extension lift arms by attaching them to the hook located on the end of the arms. The extension lift arms are installed on the MJ-1B by inserting the end of the arms into slots on the inside of the MJ-1B lift arms. Make sure the extension lift arms are fully seated in the slots to prevent equipment damage and possible personnel injury.

### Forklift adapters assemblies

Forklift adapter assemblies for the MJ-1- and MHU-83-series bomb lift trucks are quite different in design, but they serve the same purposes. The MJ-1B forklift adapter is used for loading where there's not enough clearance between components to use the bomb lift truck table. Load binder adapters must also be used when forklift adapters are installed on the lift trucks.

### Fork adapter assembly

The fork adapter assembly (fig. 1-15) is used with the MHU-83- and MJ-40-series bomb lift trucks, but it limits the lift truck's weight capacity to 6,000 pounds. Fork adapter assembly's wide variety of uses include loading, unloading, and handling external heavy stores on B-52s; loading single munitions onto or around aircraft and munitions handling trailers; loading all naval mines; and loading the AGM-65, 84, 88, and 130 missiles.

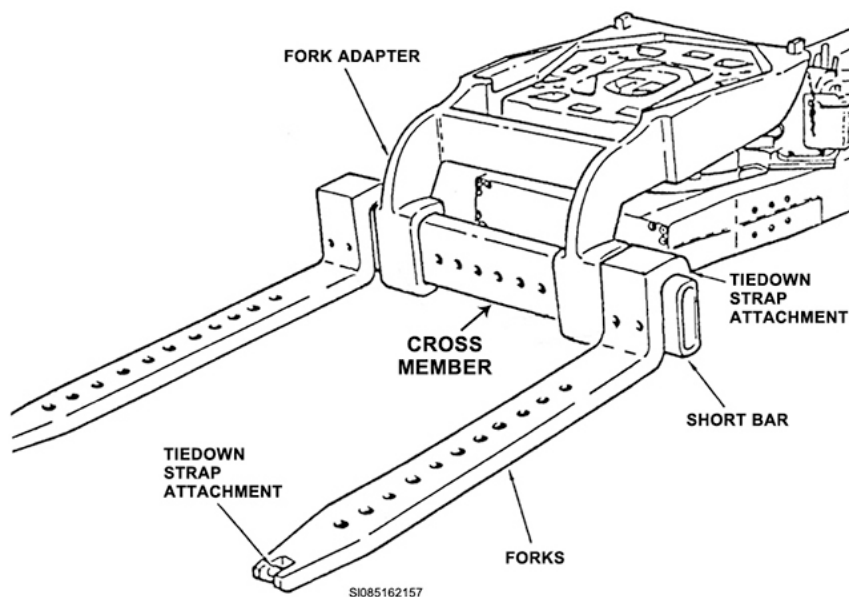


Figure 1-15. Fork adapters.

The adapter assembly consists of the fork adapter, which is attached to the lift truck cradle by two quick-release pins, a short or long bar, and a set of forks. The short bar facilitates one set of forks and provides fork centerline spacing from 4 to 32 inches in 2-inch increments (fig. 1-16). The long bar facilitates two sets of forks and provides centerline spacing from 4 to 124 inches in 2-inch increments (fig. 1-17). The forks are attached to the bars by quick-release pins with each fork having 11 holes for bomb rollers to facilitate handling munitions of various sizes. Since the standard forks sometimes aren't long enough, fork extensions provide extra length for unusual situations. For maximum lifting height (107.5 inches), the complete adapter assembly may be installed in the inverted position. You normally find this configuration used in loading the B-52.

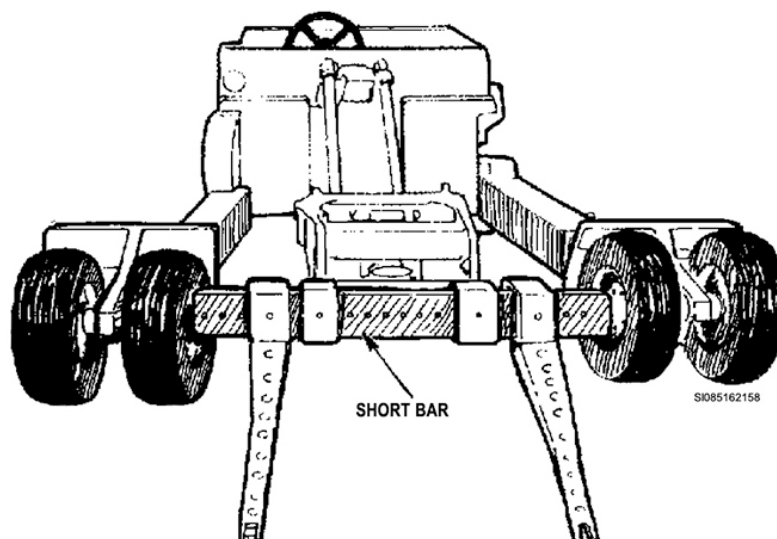


Figure 1-16. Short bar.



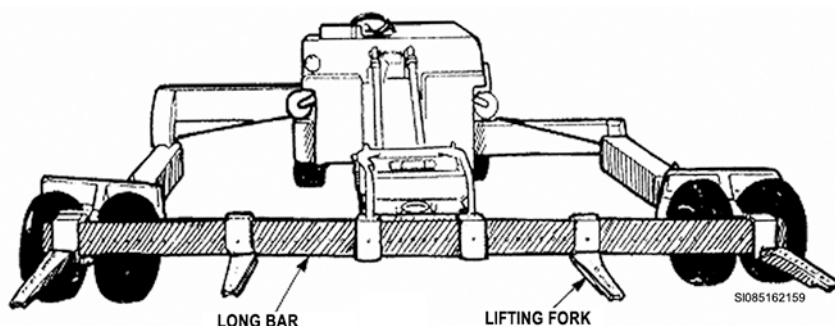


Figure 1-17. Long bar.

### *Suspension handling/loading adapters*

These adapters are used for everything from facilitating storage, transporting, loading, and unloading aircraft suspension equipment. At this time, we should probably define suspension equipment to eliminate any confusion. Suspension equipment is any component, excluding munitions, attached to an aircraft. Examples of suspension equipment are pylons, launchers and pods (e.g., missiles, rockets, and flare), TERs, bomb racks, and so forth. The adapters used with this equipment have either multiple or limited uses. By this, we mean an adapter may be used with more than one piece of equipment or more than one aircraft, or it may be used with only one piece of equipment and only one aircraft. Figures 1-18 through 1-21 identify some of the more commonly used equipment of this type.

Figures 1-18 and 1-19 show the different pylon handling adapters in use today. These adapters are used while installing and removing aircraft pylons. They provide a secure way to fasten, support, and steady the pylon during removal, installation, and handling. Before we had these adapters, pylons were removed or installed by positioning them on the table of a bomb lift truck and used a normal tie-down strap to keep them steady. These adapters have produced a safer and more efficient way to handle pylons.

The pylon handling adapters have suspension lugs spaced either 14 or 30 inches apart to match the bomb racks in the pylons. This allows the bomb racks hooks to be latched to the adapter's suspension lugs to serve as mounting points. The pylons all have sway pads or points for positioning the bomb rack sway braces to steady the pylon during all operations.

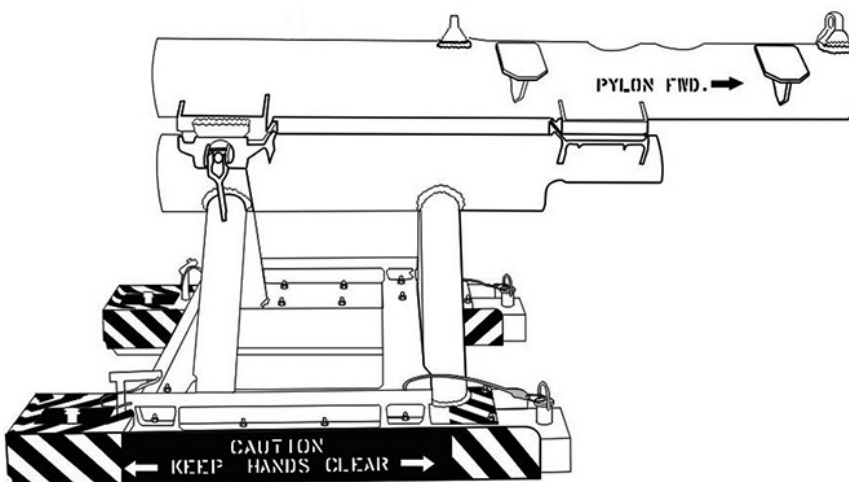


Figure 1-18. F-15 pylon handling adapter.

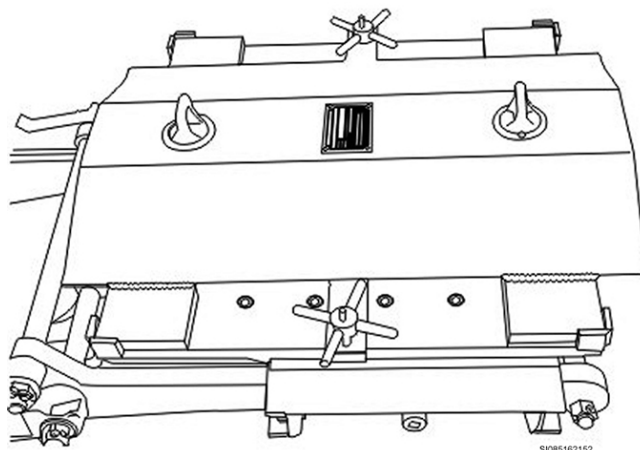


Figure 1-19. F-16 pylon handling adapter.

### *Bomb loading adapters*

Normally, you'll load single bombs with a lift truck and roller assemblies alone or in conjunction with a pan-type adapter. There are times, though, when different loading configurations dictate the need for different loading support equipment.

The F310707-500 (27-inch) bomb loading adapter is mated to a modified 9-inch loading adapter to form what is called the 36-inch adapter. The 36-inch adapter (fig. 1-20) loads internal and external stores on the B-52. It's used in conjunction with the MJ-1-series lift truck to load internal and external stores onto the B-52 aircraft. It can also be installed on the MHU-83 to load cluster racks.

The 6.5-inch height adapter (fig. 1-21) mounts onto the MJ-1 table giving an added 6.5 inch reach for loading into the F-22 bomb bay. The adapter allows mounting of MJ-1 rollers in holes on the face of the adapter just like the table of the MJ-1. The pyramid shaped cut outs in the base of the adapter allow attachment of the MJ-1 strap to the MJ-1 table. The adapter has a 3,000 pound weight capacity.

Figure 1-22 shows the pan-type adapters used to support and load rocket and flare pod dispensers or thin-skinned munitions. Their design differs with their individual uses. They normally are found in sizes adequate to support pods from 20 inch diameters up to 34 inches. Most of them are padded on the inside with a rubber material to protect the pod from damage while it's being loaded, unloaded, or transported. They may be used in conjunction with either the MJ-1- or MHU-83-series bomb lift trucks and are supported by roller assemblies positioned on the lift truck tables.

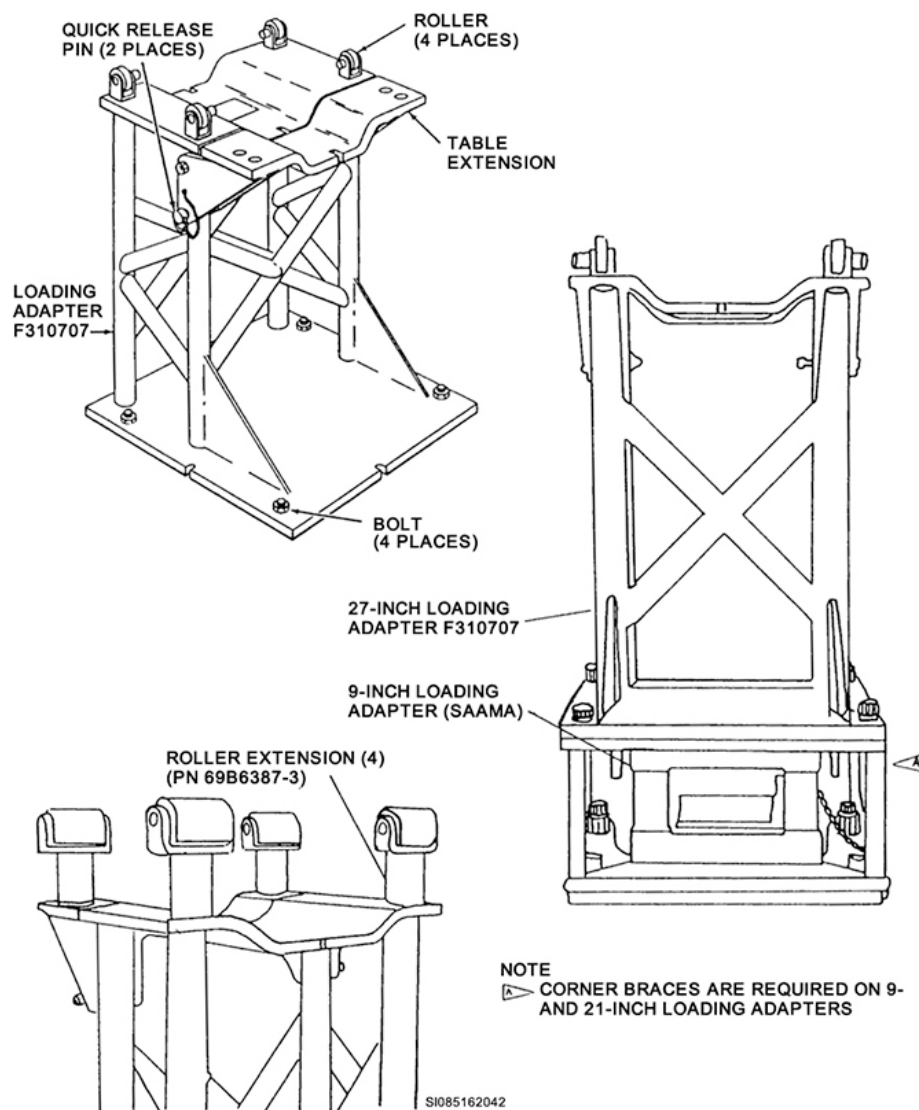


Figure 1-20. The 36-inch adapter.

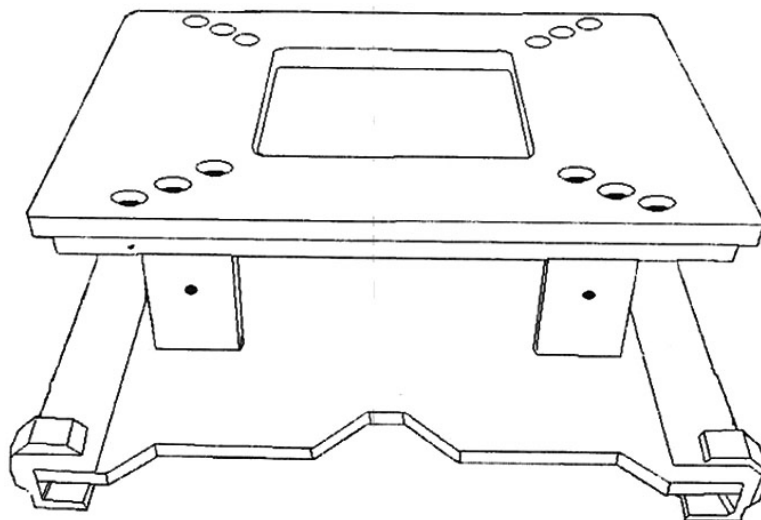


Figure 1-21. 6.5-inch height adapter.

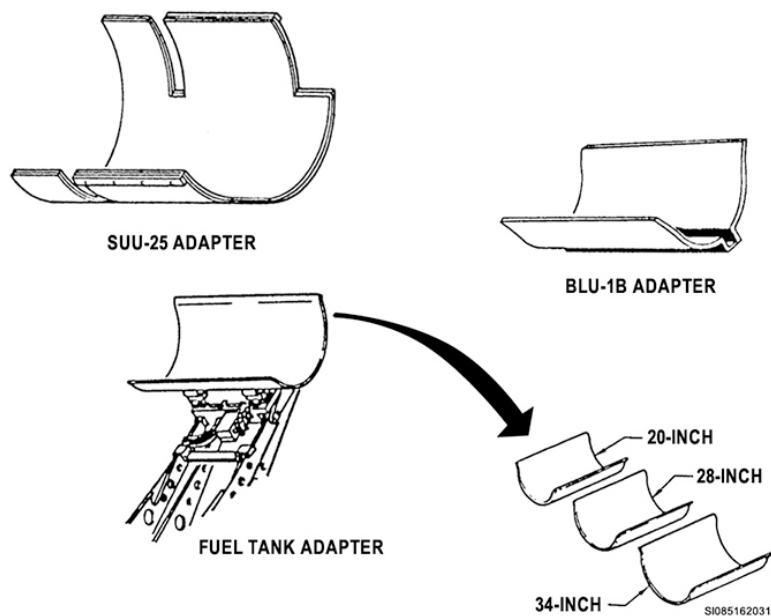


Figure 1-22. Pan/tank adapters.

### *Missile loading/handling adapters*

These adapters are used for loading and unloading missiles from aircraft, transporting missiles from place to place, transferring missiles to other equipment, and removing them from or placing them into their storage containers (figs. 1-23 through 1-25). Most of the adapters have a particular application in terms of the lift truck they're used with and the missile they support.

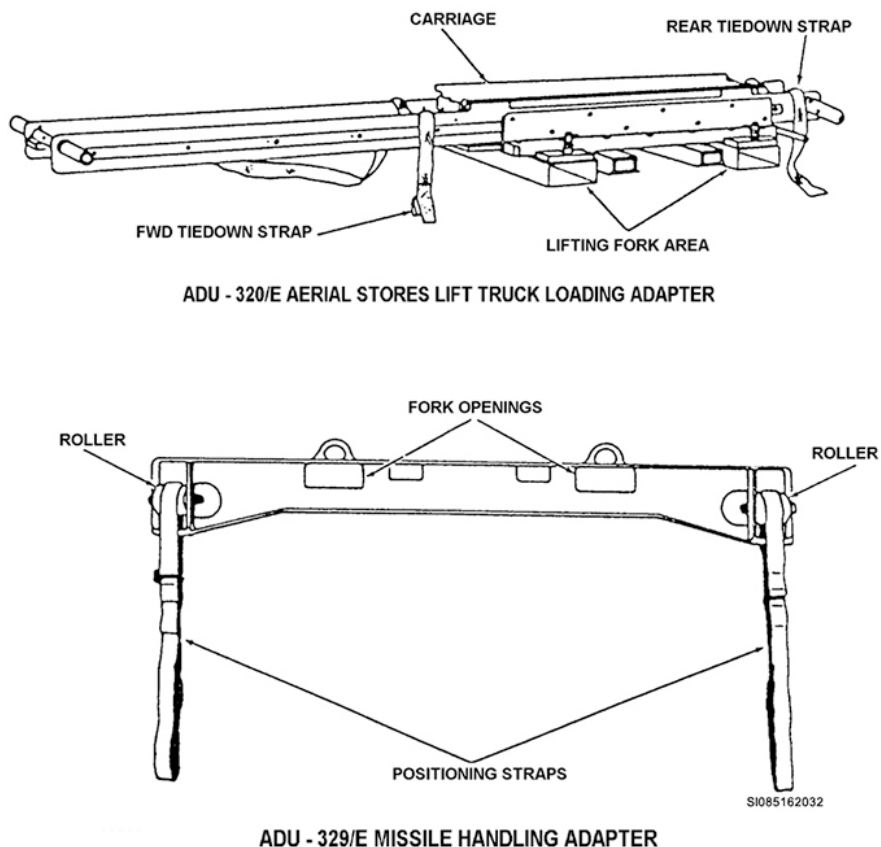


Figure 1-23. Missile handling/loading adapters.

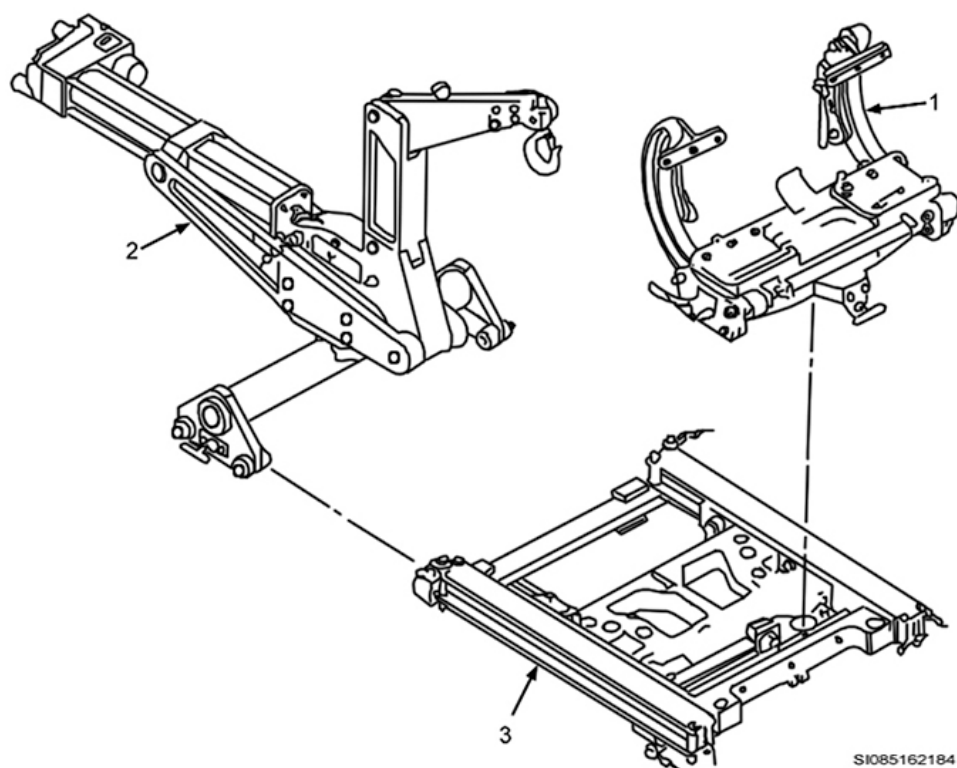


Figure 1-24. ADU-537A/E Missile-Munitions Loading Adapter (MMLA) with hoist.

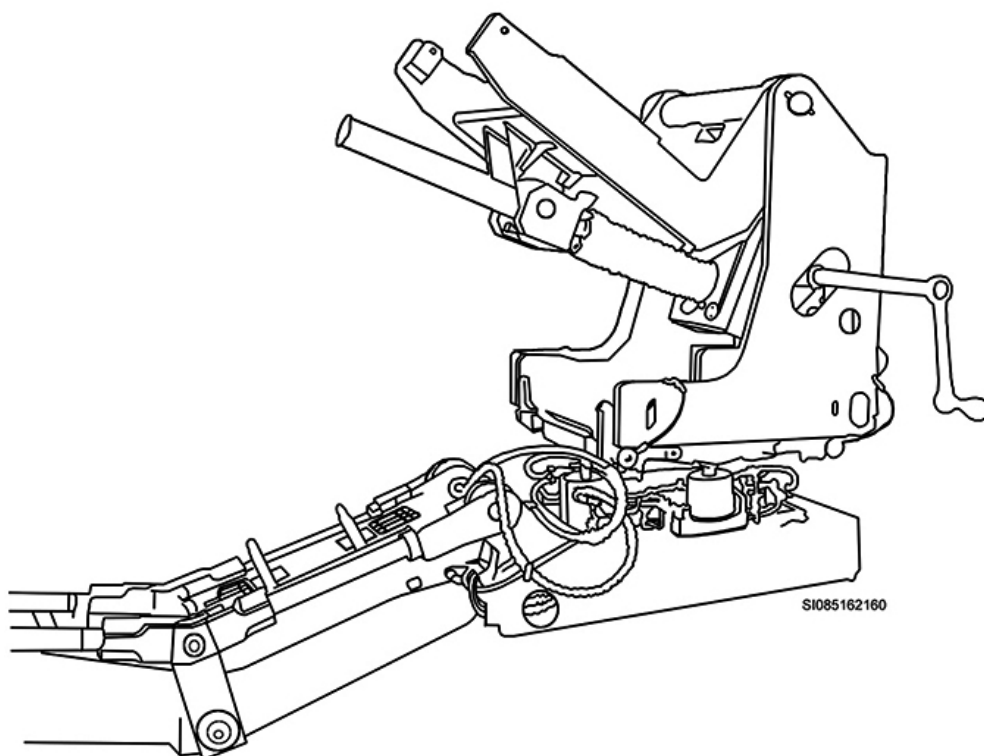


Figure 1-25. ADU-468/E missile positioning/handling unit adapter.

### **Ram assembly**

The mechanical ram assembly (MRA) is a multiple sleeve, hydro-mechanical lifting device mounted to the MJ-40 or MHU-83 D/E table assembly (figs. 1-26 and 1-27). It receives its power from the lift truck through two hydraulic servicing lines attached to the boom assembly, and it is primarily controlled/operated by the lift truck's remote control unit. The primary purpose of the MRA is to increase the lift height capability of the MJ-40 and MHU-83D/E bomb lift trucks to load single stores into the weapons bay(s) of the B-1B/B-2 aircraft. When fully collapsed, the MRA is 37 inches tall, and when fully extended its height is 83 inches. The MRA itself weighs 500 pounds; for safety reason, this prevents personnel from installing it by hand. The MRA itself has a lift capacity of 5,000 pounds.

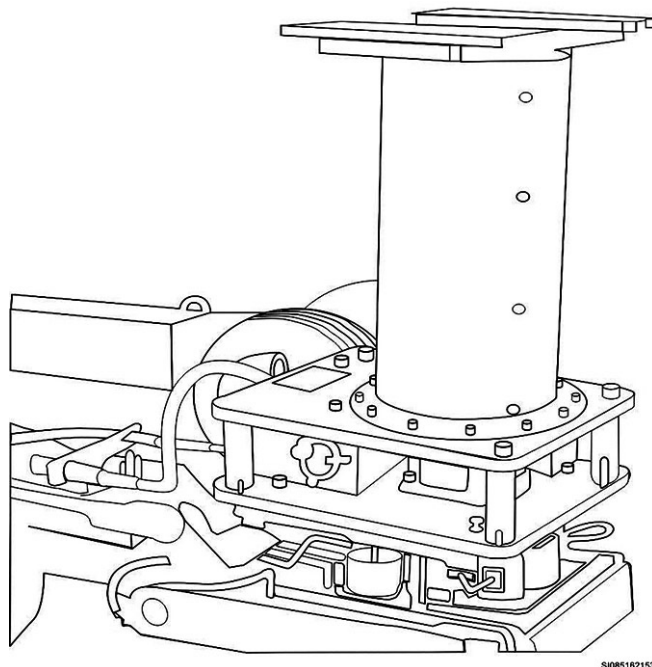


Figure 1-26. Mechanical ram assembly.

### **Launcher/module handling adapter**

The launcher/module handling adapter (LMHA) (fig. 1-28) is used to upload and download unloaded rotary launchers and bomb modules on the B-1 aircraft. It is primarily used in situations where the use of the MHU-196 heavy lift trailer is impractical. The LMHA is a much smaller and easier to use piece of equipment when compared to the MHU-196. The LMHA is usually the only method of uploading and downloading launchers or modules at deployed locations because of the large logistical footprint of the MHU-196.

The LMHA is mounted directly to the table of the MJ-40 lift truck by four quick release pins in a similar fashion to the way the fork adapter is mounted. Two hydraulic motor driven screw jack assemblies mounted under the yolk assemblies on either end of the adapter lift the launcher or bomb module during loading operations. Hydraulic power is supplied to the LMHA by the jammer through two hydraulic hoses, much like the MRA. The lift action is controlled by the "RAM Up/Down" controls found on the RCU of the lift truck.

The LMHA includes four sets of tandem pivoting wheels and a tow bar. These allow maintenance personnel to transport both the LMHA and loaded launcher or bomb modules with any appropriate pintle hook equipped vehicle, reducing our dependence on lift trucks. The wheels and the tow bar must be removed after mounting to the lift truck prior to transporting or performing any loading operation with the LMHA.

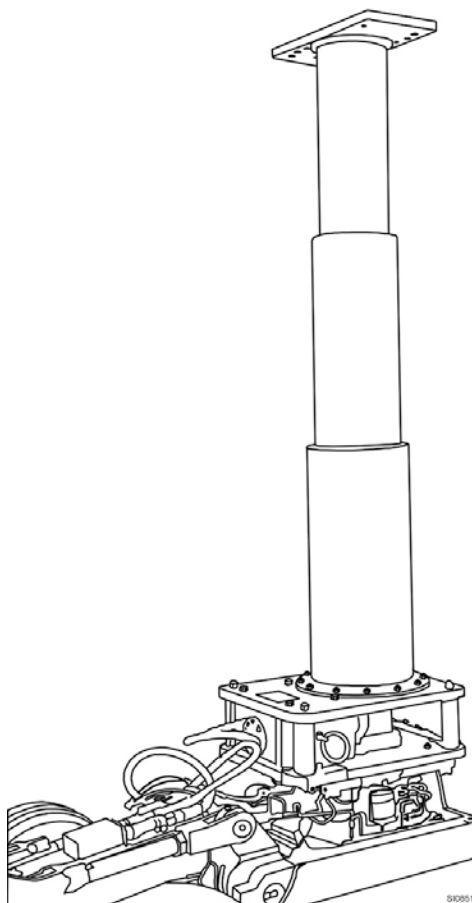


Figure 1-27. Mechanical ram assembly extendedly collapsed.

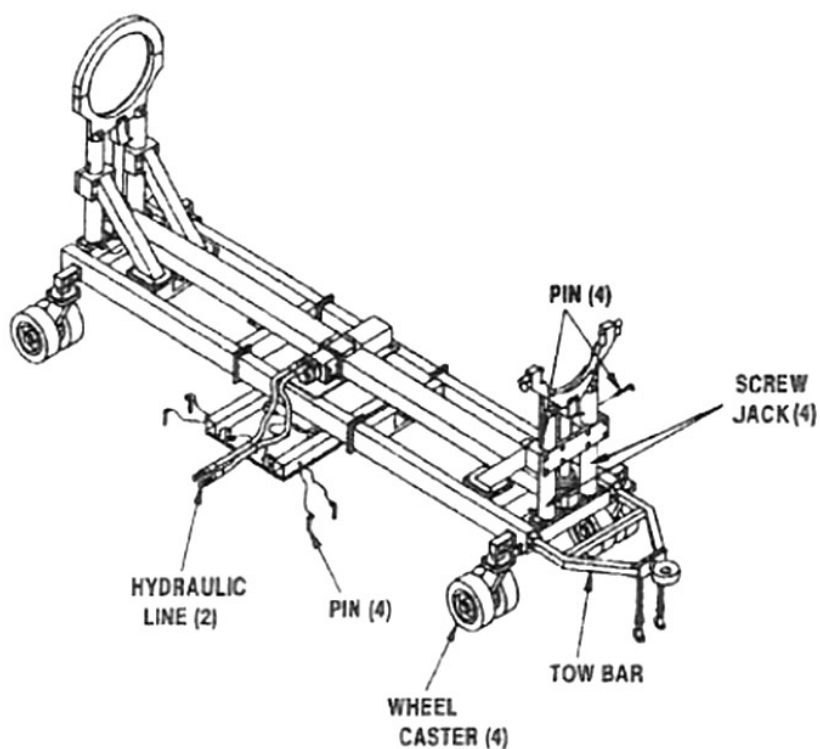


Figure 1-28. LMHA.

### B-52/B-2 rotary launcher adapter

The B-52/B-2 rotary launcher adapter (fig. 1-29) is used to load a rotary launcher into the B-52 and B-2 aircraft in circumstances where the use of a heavy lift trailer is impractical. This adapter is usually the only method of uploading and downloading launchers or modules at deployed locations because of the large logistical footprint of heavy lift trailers.

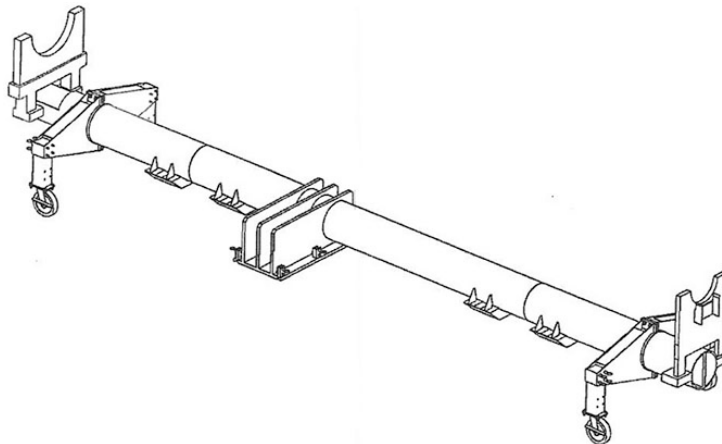


Figure 1-29. B-52/B-2 rotary launcher adapter.

The adapter consists of a heavy tube frame, two mounts on either end for supporting the rotary launcher, castor wheels, and a mounting plate for attaching it to a lift truck. The adapter mounts to the table of a lift truck using four quick release pins (QRP) in the similar fashion to the way the fork adapter is mounted (fig. 1-30). While the adapter is equipped with wheels, these are insufficient for transporting the adapter significant distances. If the adapter needs to be transported, it is placed on a MHU-110 trailer (fig. 1-31).

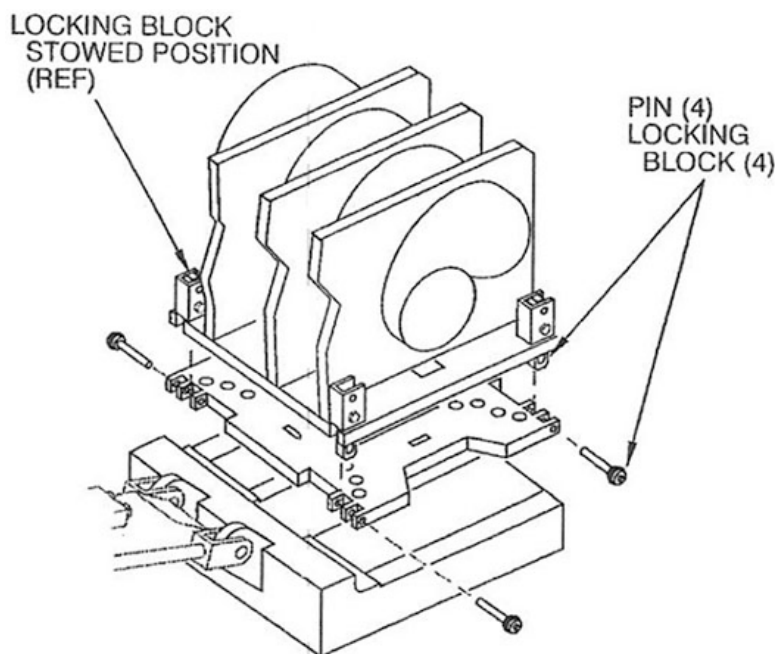


Figure 1-30. B-52/B-2 rotary launcher adapter mount.



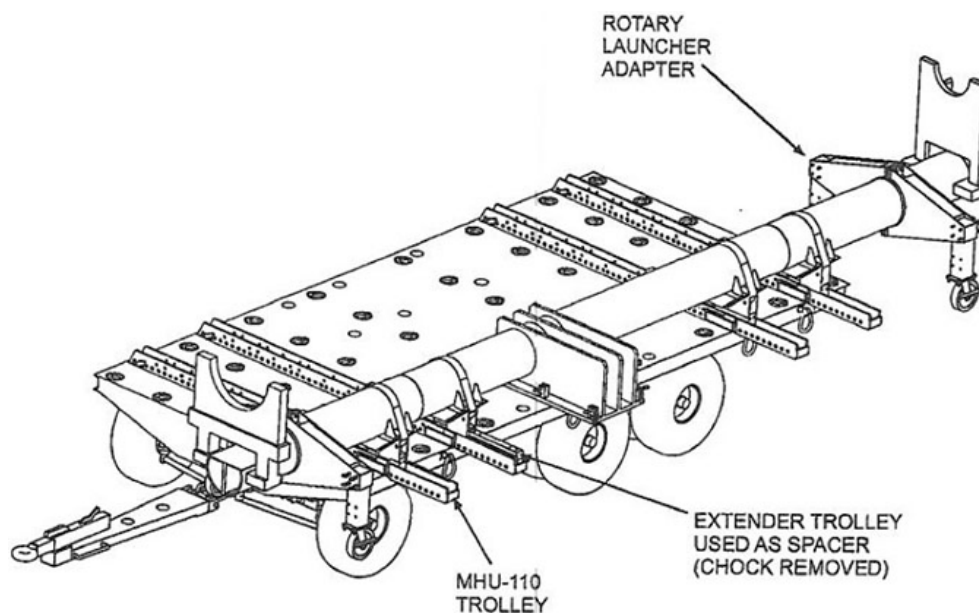


Figure 1-31. B-52/B-2 rotary launcher adapter mounted on MHU-110 trailer.

## Self-Test Questions

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

### 001. MJ-1B bomb lift truck

1. What is the lifting capacity of the MJ-1B?
2. What drives the rear wheels on the MJ-1B?
3. What type of engine is used in the MJ-1B?
4. Name the three components of the hydrostatic drive system.
5. How does the accelerator pedal change the speed of the MJ-1B lift truck?
6. How are the cantilever lift arms operated on the MJ-1B?

### 002. MJ-40 lift truck

1. What is the lift capacity of the MJ-40 lift truck?

2. What device ensures the lift boom cannot fall if a hydraulic line were to rupture?
3. What functions can the remote control unit control?
4. How is the remote control attached to the lift truck?

### **003. MHU-83 lift trucks**

1. What are the MHU-83-series munitions handling/loading lift truck designed to do?
2. Describe the engine of the MHU-83 series lift trucks.
3. What is used to lift the front wheels off the ground to adjust the width of the side frames?
4. Describe how the parking brake is set on the MHU-83?
5. Which variant of the MHU-83 incorporates features of the MJ-40 to increase its capabilities allowing it to support a wider variety of missions?
6. What is the purpose of the hand pump located on the right-hand side of the MHU-83?

### **004. Lift truck accessories**

1. Which lift truck or trucks use bomb rollers?
2. What is the lift capacity of aluminum rollers when installed on the MJ-1?
3. Explain the usage of load binders.
4. Explain the usage of “Y” stands.

5. Explain the usage of a gantry stand.
6. What beams are used to transfer naval mines from their cases to the MHU-83 lift truck?
7. What is the lifting capacity of the sling assembly?
8. What is the lifting capacity of the MHU-83 when the fork adapter assemblies are installed?
9. What is the maximum lifting height on the MHU-83 when the fork adapter assembly is installed in the inverted position?
10. What are suspension handling/loading adapters used for?
11. Explain the usage of the 36-inch adapter.
12. What lift truck(s) use the MRA?

## **1-2. Handling and Lift Trailers**

The Air Force uses a wide variety of equipment to help move munitions efficiently and easily from one point to another and to load or unload aircraft. The types, models, and sizes of these trailers are so varied we won't attempt a full presentation on them here. You will have to rely on your on-the-job trainer for the proper operating and maintenance procedures for the equipment assigned to your base. Here, we'll discuss just a few handling and lift trailers.

### **005. Munitions handling trailers**

We just covered lift trucks and the accessories used with them. Now, we have the items that help in the transportation of a large quantity of items at one time. Their use is critical to all loading operations. Now in this lesson, we will go over handling trailers.

#### **Handling trailers**

The handling trailers we use on a daily basis are the MHU-141/M, MHU-110/M, and the MHU-226/M, shown in figures 1-32 through 1-34. These trailers are essentially flat-decked units equipped with running gears, brakes, and an electrical and steering system.

**MHU-141/M**

This munitions trailer is a four-wheeled, automotive steering vehicle capable of transporting loads of up to 5,500 pounds. Panel or stake racks, chocks, and tie-down equipment are all supplied with the trailer. The chocks are used to transport weapons or stores. These chocks are secured to the chock rails with quick-release pins. The chock rails are welded to the underside of the hinged deck panels and are exposed when the panels are opened (fig. 1-35). The tie-down equipment consists of four cables and 16 tie-down straps used to secure any type of item in place during transportation. The trailer's inter-vehicular harness is an electrical cable interconnecting the towing vehicle and the trailer (or trailers in tandem towing). The harness carries electrical power for the trailer lights.

Accessories such as the M-9 missile adapter may be used with the MHU-141/M handling trailer in order to carrying air-to-air-missiles (fig. 1-36). You will normally see additional accessories such as the M-9 missile adapter used with mixed munitions loads of missiles on the same trailer (fig. 1-37).

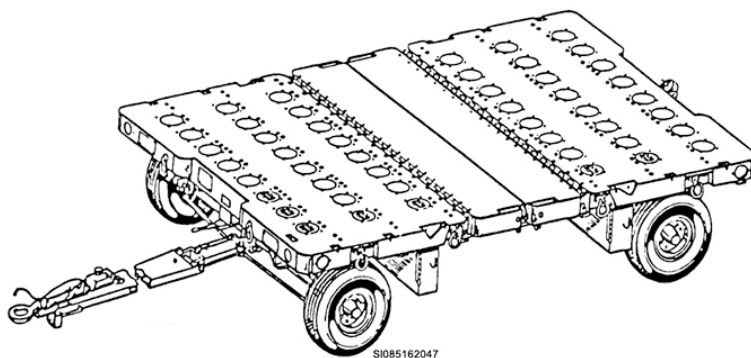


Figure 1-32. MHU-141/M munitions trailer.

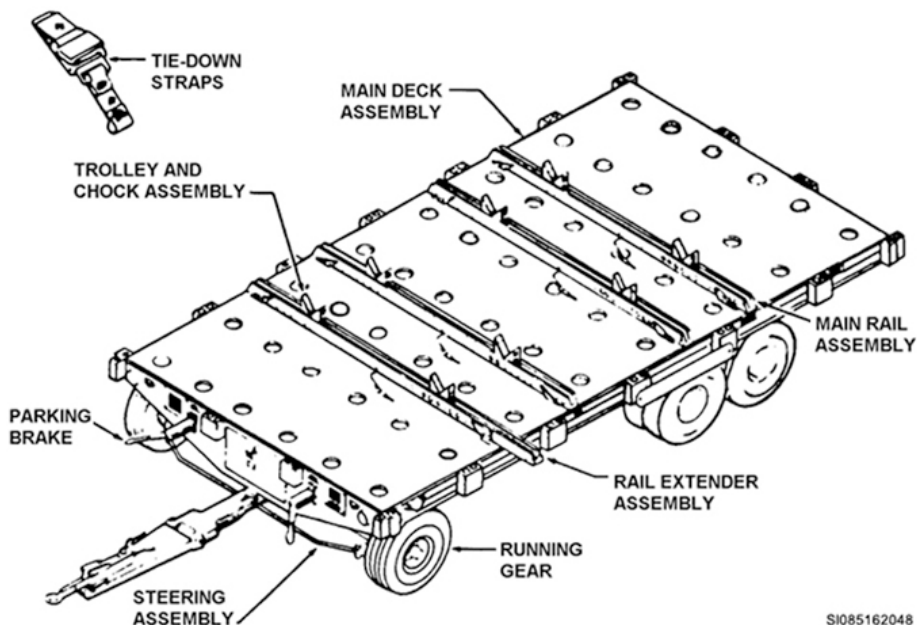


Figure 1-33. MHU-110/M munitions trailer.

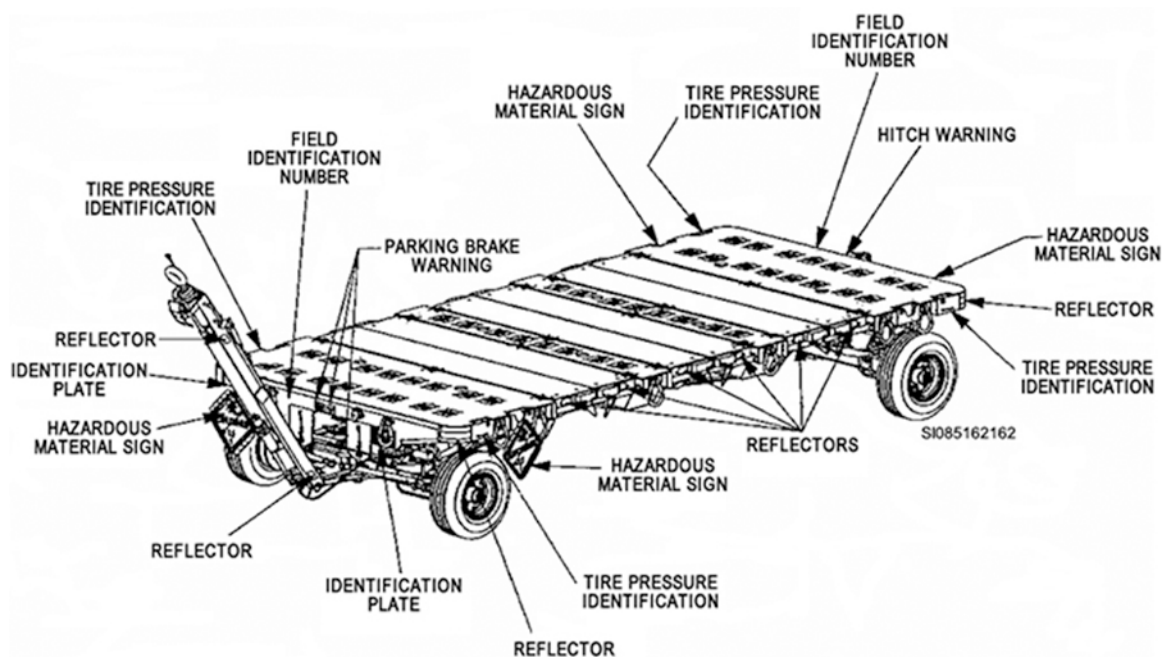


Figure 1-34. MHU-226/M munitions trailer.

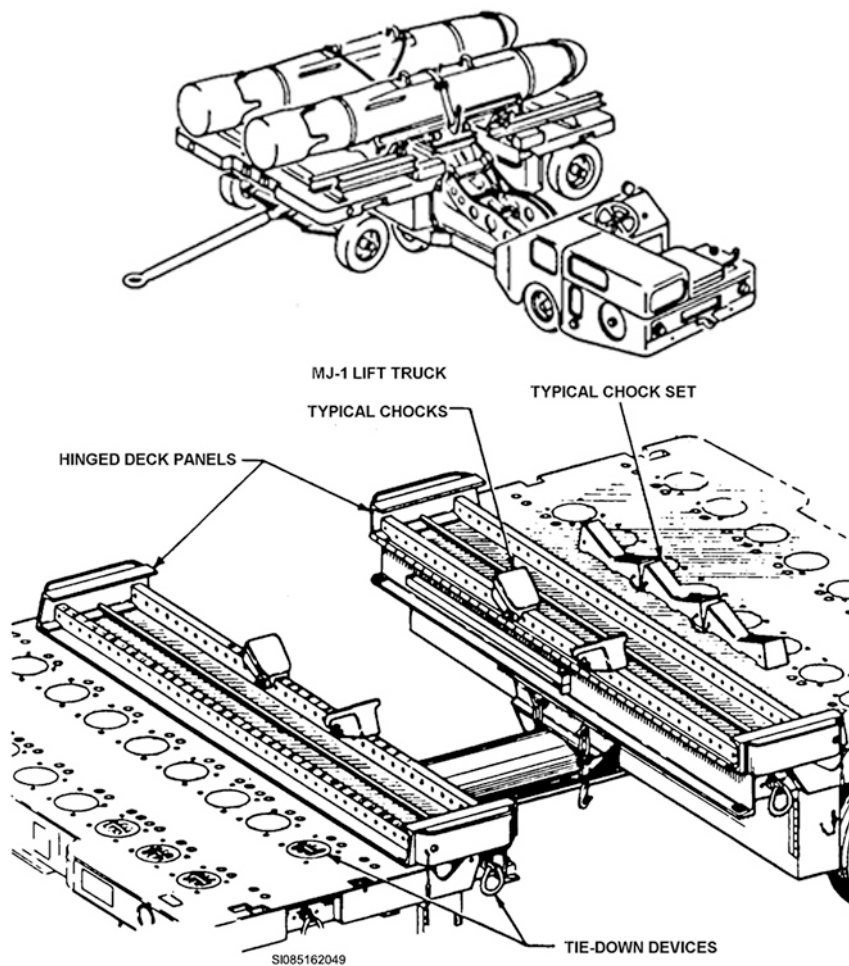


Figure 1-35. Opened MHU-141 hinged deck.

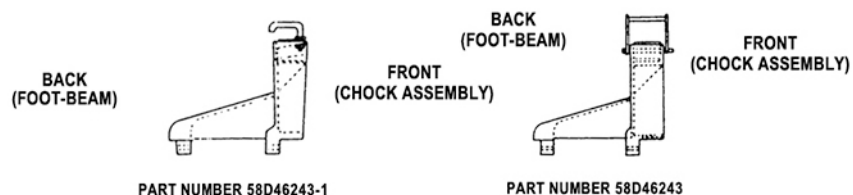
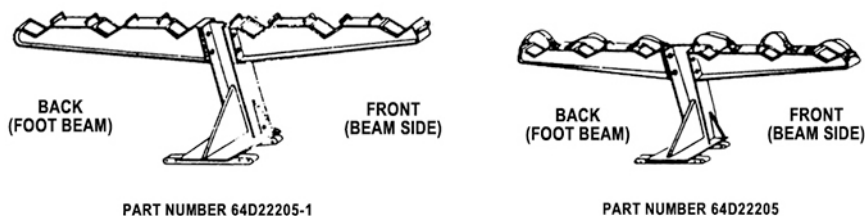
**MHU-25 SUPPORT****M-9 ADAPTER**

Figure 1-36. Missile adapters.

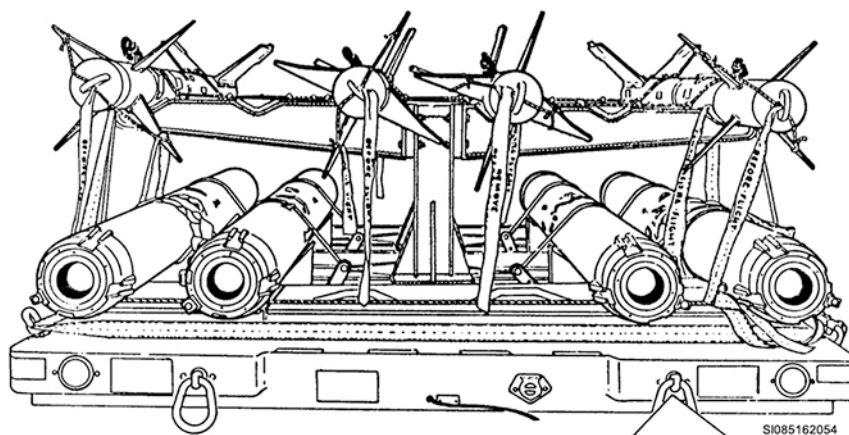


Figure 1-37. Mixed missile load.

**MHU-110/M**

The MHU-110/M trailer is a 10-wheeled, three-axle, flatbed carrier with a capacity of 15,000 pounds. The trailer usually comes equipped with an inter-vehicular harness, main rail assembly, rail extender assembly, and chock assembly. Six main rail assemblies can be installed on the deck of the trailer. At each side of the trailer, there are seven QRPs. By inserting a QRP through the deck wall and rail support tube, the main rail can be locked to the main deck. The four rail extender assemblies can be installed on the ends of the main rail assembly for loading and unloading munitions (fig. 1-38). Maximum weight capacity per rail extender is 1,500 pounds or a total of 3,000 pounds maximum per pair.

The trailer can be configured with up to 24 trolleys and 48 chocks (with tie-down straps) for round-shaped stores (fig. 1-39). Two chocks are installed on each trolley by means of spring-loaded stop pins, and they can be adjusted in three different positions to accommodate a variety of munitions with different diameters. You'll also need extra tie-down straps (not furnished with the trailer) to secure preloaded bomb release units.

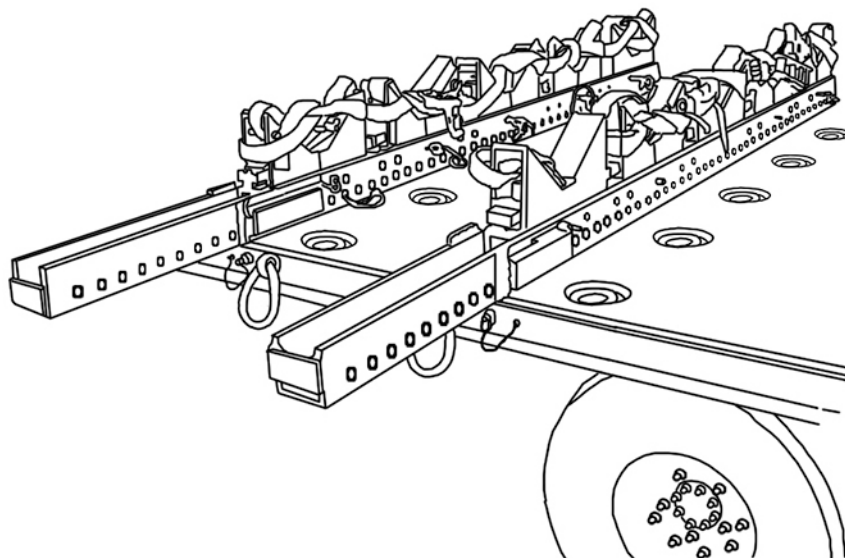


Figure 1-38. Rail extenders.

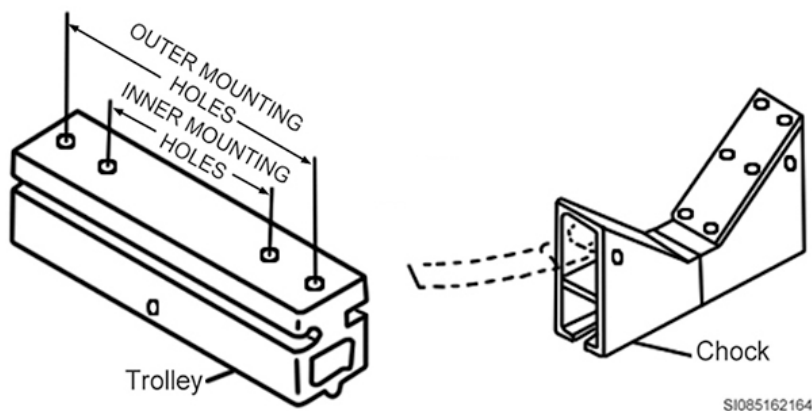


Figure 1-39. Chocks and trolleys.

### **MHU-226/M**

The MHU-226/M is four-wheeled munitions trailer with double-Ackerman steering (four wheel steering), is air transportable, and capable of transporting loads up to 12,000 pounds of conventional munitions. The deck has three openings, each with hinged panels. With the center panels open, long munitions can be carried. With the center panels closed and the fore and aft panels open, smaller munitions can be carried. The trailer can function as a flat bed with all panels closed. A stowage container is provided to stow the wheel chocks. Two storage boxes at the front and three at the rear of the trailer provide for storage of accessories.

### **Trailer decks**

The MHU-141/M, MHU-110/M, and MHU-226/M trailers have deck assemblies equipped with tie-down devices to secure a load to the trailer. The decks on these trailers differ because the MHU-141/M and the MHU-226/M incorporate hinged deck panel (hatchway) and the MHU-110/M strictly a flat deck. On the MHU-141/M, the single hinged deck panel can be lifted and opened to provide an opening across the full width of the trailer. The MHU-226/M incorporates three hinged deck access points used either alone or in conjunction with each other depending on the munitions being transported. These hatchways allow a lift truck to be driven directly under the trailer and pick up a munition positioned toward the center of the trailer.



## Brakes

The following information is the same for the MHU-141/M, MHU-110/M, and MHU-226/M munitions trailers brake systems, except as noted. The hydraulic braking system (fig. 1-40) is activated by the automatic surge brake. Hydraulic fluid for operation of the brake cylinders is contained within a master cylinder called a surge brake reservoir. Components of the brake system are interconnected by associated fittings, tubing, and hose assemblies.

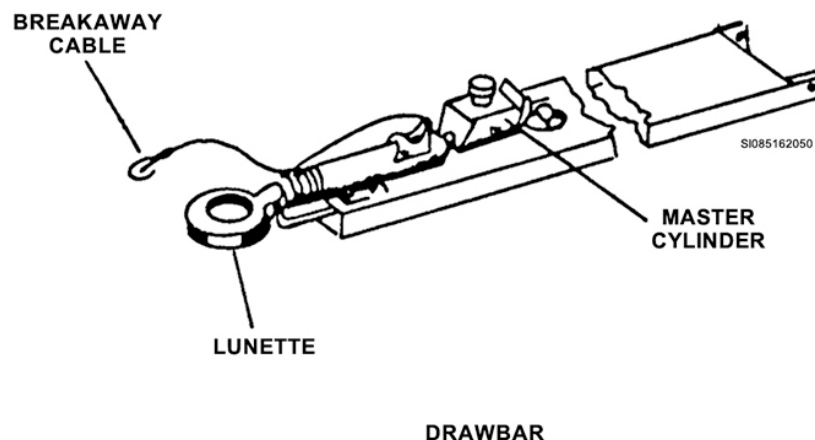


Figure 1-40. Tow bar breaking system.

### Surge brake

The surge brake is mounted on the forward end of the trailer drawbar and consists of a lunette and a hydraulic master cylinder. When the towing vehicle decelerates, the forward pressure of inertia from the trailer pushes against the lunette. This pressure compresses the lunette and actuates the hydraulic master cylinder. A hydraulic line, connecting the master cylinder to the trailer hydraulic system, automatically transfers the correct amount of braking pressure to the wheel brake cylinders to slow down or stop the trailer. Activation of the surge brake initiates brakes in all four wheels on the MHU-141/M and MHU-226/M, and on each of the six wheel cylinders on the MHU-110/M.

### Breakaway cable

The breakaway cable is connected between the surge brake lever and the towing vehicle. If the trailer becomes disengaged from the tow vehicle, the breakaway cable will pull a lever in the surge brake forward, which applies the trailer brakes.

### Parking brake

The parking brakes are standard automotive mechanical type and consist of several linkages, flexible cables, and connecting points. The MHU-141/M has one hand brake lever located on the front center of the trailer; the MHU-110/M and MHU-226/M have two hand brake levers located on the front of the trailer to either side. The hand brake lever of the MHU-141/M operates the brakes in the two rear wheels, the hand brake levers of the MHU-110/M operate the brakes in the four inboard rear wheels, and the hand brake for the MHU-226/M operates the brakes on all four wheels.

## 006. Lift trailers

Like lift trucks, the lift trailer is critical to successful loading operations. Your knowledge of these items is essential. Within this lesson, we will briefly discuss the MHU-204/M and MHU-196/M lift trailers.

### MHU-204/M and MHU-196/M

The MHU-204/M and MHU-196/M trailers are the most commonly used munitions lift trailers in the Air Force inventory (figs. 1-41 and 1-42). They were designed for transporting various types of



weapons, launchers, pylons, and so forth, to and from storage sites and loading areas and for loading and unloading bomber-type aircraft, specifically the B-52, B-1B, and B-2.

These trailers, the MHU-204/M and MHU-196/M, are some of the best pieces of equipment ever devised to make your job easier. With their heavy-duty, U-type frames and integral power units, they can easily lift or transport stores weighing up to 40,000 pounds. They can be towed behind a suitable tow vehicle and are approved for handling nuclear and conventional munitions. The MHU-204/M and MHU-196/M munitions lift trailers are 40,000-pound-capacity trailers. We use the MHU-204/M and MHU-196/M to lift, load, unload, and transport different assemblies and munitions items when working on the B-52, B-1B, and B-2 aircraft.

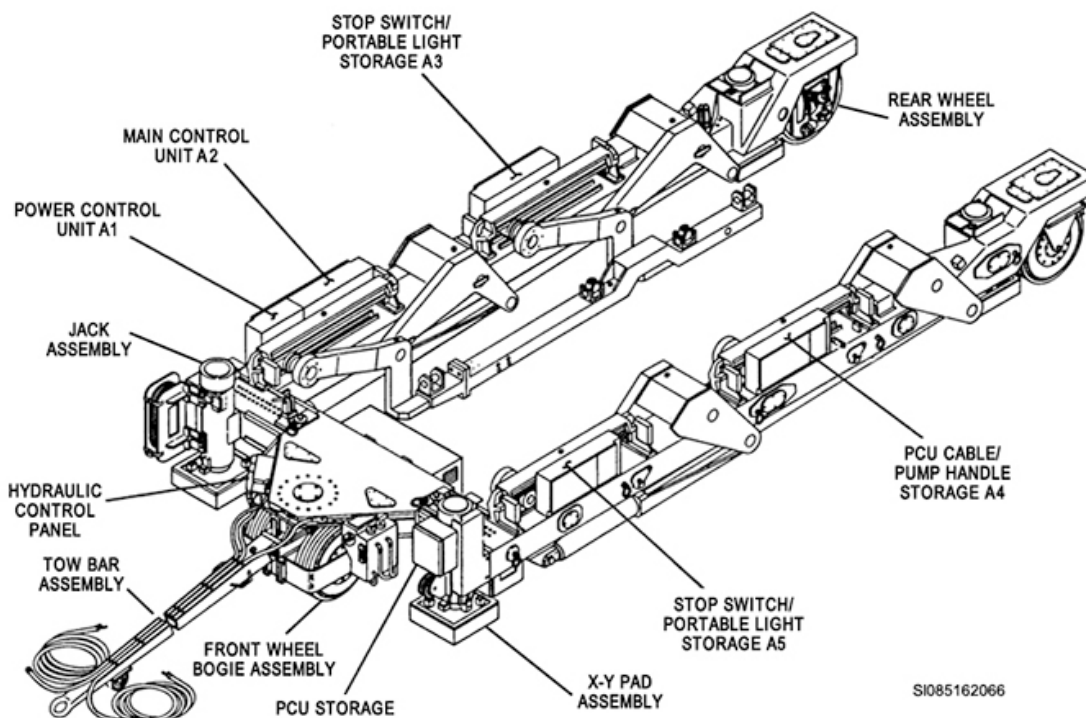


Figure 1-41. MHU-196 lift trailer.

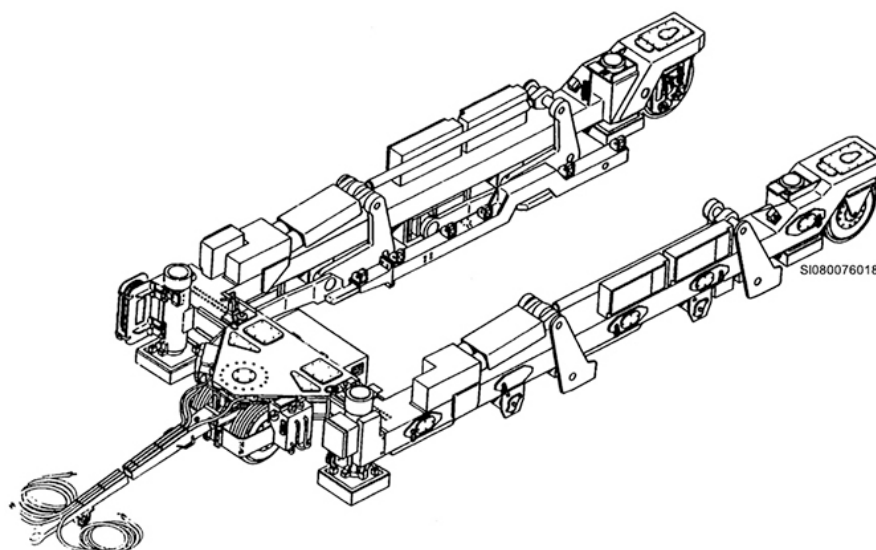


Figure 1-42. MHU-204 lift trailer.

### MHU-204/M and MHU-196/M description

These trailers can be attached to a towing vehicle that has a towing pintle and safety pin, air connections for brakes, and electrical connections for running lights. They both use 120/208 volts, alternating current (VAC), 400-hertz (Hz), three-phase power for all electrical and hydraulic functions. Loading and positioning operations are precise with the use of the handheld portable control unit (PCU). The PCU provides 15 different operational modes for controlling wheel steering, drive, and load positioning (fig. 1-43). To prevent personnel injury or equipment damage, each mode automatically shuts off when either one of two team members press a remote stop switch or when the “dead man” switch is released on the PCU.

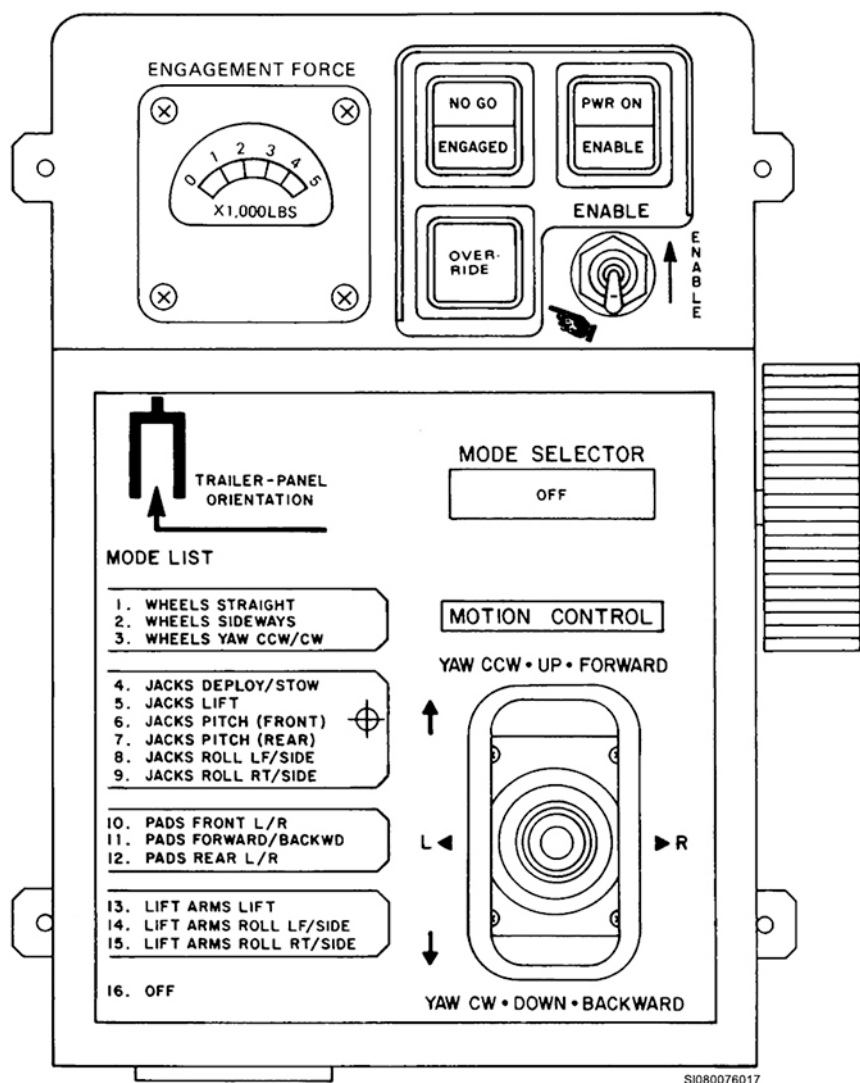


Figure 1-43. Portable control unit.

Each frame has three major structural assemblies connected to form a U-type trailer: the forward connector assembly and the left and right chassis beams. The width of the frames can be adjusted for various load widths by extending or retracting the left and right chassis beams. The frame width adjustments are hydraulically powered and are controlled by width adjustment switches on the left and right sides of the frames. Twenty-one alphabetically coded adjustment pin locator holes on each chassis beam aid in these adjustments.

The forward connector assembly is connected to the left and right chassis beams by a hydraulic frame expansion cylinder and mechanical frame width adjustment locks. The forward connecting assembly

is also the connecting point for the front wheel bogie, and it houses the electrical, hydraulic, mechanical, and pneumatic components that operate the lift trailers. The left and right chassis beams are longitudinal assemblies forming the sides of the lift trailers. The chassis beams form the support structure for the electromechanical components and serve as housing for electrical cables and hydraulic fluid lines.

The front wheel bogie assembly is a dual-wheel assembly mounted to the forward connector assembly containing hydraulic drive motors and brake cylinders. When the lift trailers are towed, the bogie is steered by the tow vehicle.

The tow bar is an assembly used to tow and steer the lift trailers during towing. The tow bar is connected to the tow vehicle pintle hook. On the lift trailers, it's connected to the towing and pivot adapter on the front wheel bogie assembly. The tow bar assembly is 10 feet 4½ inches long and weighs 170 pounds. For safety reasons, you'll need at least two people to remove the tow bar because of its weight. During towing, a fixed mechanical stop limits turns to 45 degrees counterclockwise and a retractable stop limits turns to 45 degrees clockwise. You must be very careful not to exceed these limits or you can cause significant damage to the trailers. The left and right rear wheel assemblies are single-wheel units. Each unit has a hydraulic drive motor and brake cylinder. During towing, spring-loaded lockpins mechanically lock the rear wheel assemblies in the straight position.

Four jack assemblies are mounted onto the lift trailer's frame. The jacks are used to lift the trailer and to adjust to variables in the terrain. Independent or paired motion of the jacks translates to attitude changes to the lift trailers and load in pitch and roll. An X-Y pad is attached to the base of each jack assembly. During loading, the jacks are deployed to place the X-Y pads on the ground. Hydraulic cylinders within each X-Y pad provide precise lateral (X) and longitudinal (Y) positioning corrections to the lift trailers and load during lifting operations.

The air compressor supplies pneumatic pressure to all brake chambers to release the brakes whenever the trailer is in self-propelled operation. A loaded trailer is capable of holding on an 11.5° slope. It is also capable of stopping within 40 feet at a speed of 20 mph.

### **MHU-204/M and MHU-196/M differences**

So far, we've seen very little difference between the MHU-204/M and the MHU-196/M lift trailers. The lifting mechanisms are where the major differences start. The lifting systems of the MHU-204/M and MHU-196/M lift trailers are one of the major differences between the two trailers. The MHU-204/M can lift a 40,000-pound payload to a maximum height of 8 feet 4 inches. The MHU-196/M can lift a 40,000-pound payload to a maximum height of 12 feet. Both lifting systems consist of two mirror-image lifting mechanisms mounted on the chassis assemblies. The lifting mechanism assemblies are responsible for raising or lowering the load. The lifting mechanism assemblies contain two lift arms per assembly. The lift cylinders of the MHU-204/M are located on the top of the left and right chassis assemblies, and the MHU-196/M has the lift cylinders located on the bottom of the chassis assembly. These cylinders raise and lower the lifting mechanism.

The operation of the lift arms can be simultaneous or independent. Simultaneous operation of both lift arms raises or lowers the load evenly; independent operation of either lift arm mechanism makes the load roll. Retractable travel locks on the chassis assemblies support the lift arms under transport conditions. There are four fixed attaching fittings on one lift beam and four pendulum attaching fittings on the other, but only two per lift beam are used at any time. The forward part of each lift beam has a removable lift beam extension to accommodate various load adapter configurations.

Both the MHU-204/M and MHU-196/M have hydraulic control panels with the gauges, manual valves, and manual pumps (fig. 1-44) to monitor and control the hydraulic system to meet operational requirements. The main control unit on the MHU-204/M and the main control unit on the MHU-196/M have the same functions. Both house electronic printed circuit modules that control the lift trailer's operation. They're both on the top of the right chassis assembly beside the main cabinet and

main control unit. The MHU-204/M power cabinet houses the controls for alternating-current (AC)/direct-current (DC) power distribution and a 28 volts, direct current (VDC) power supply. The MHU-196/M power control unit houses five different DC power supplies and the controls for AC/DC power distribution. Both trailers' air compressors supply air pressure to all brake cylinders. The air pressure releases the wheel drive motor brakes whenever the lift trailers are disconnected from a tow vehicle. The compressor is controlled at the power cabinet on the MHU-204/M and at the power control unit on the MHU-196/M. There must be 105 pounds per square inch (psi) in the air tank before loading with the MHU-204/M and a minimum of 90 psi in the tank before loading with the MHU-196/M.

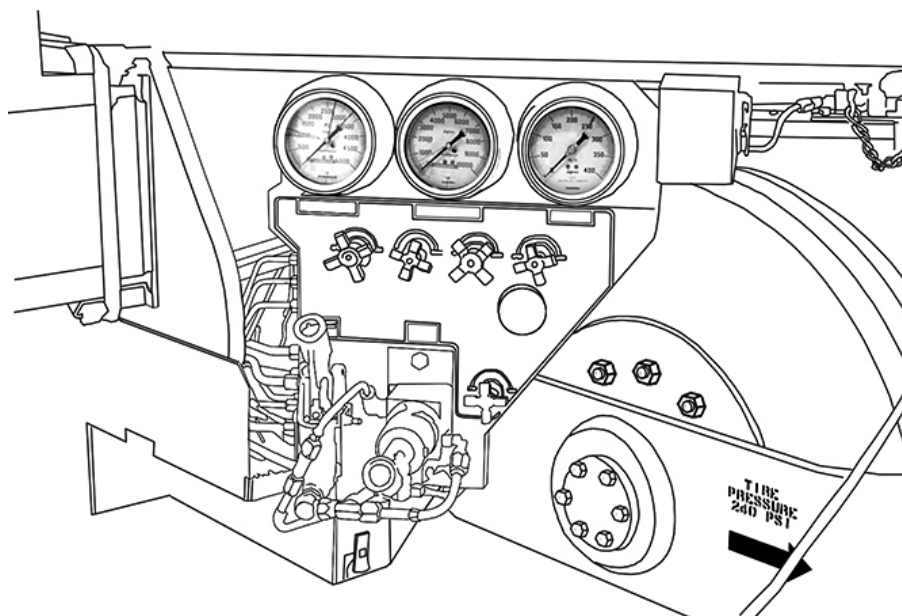


Figure 1-44. Hydraulic control panel.

The light switch cabinet and the stop switch cabinet on the MHU-204/M are next to each other on the right chassis beam. The light cabinet of the MHU-204/M provides a storage area strictly for portable work lights and cables. The stop switch cabinet provides the connection for one remote stop switch and a storage area for two. The second remote stop switch connection is in the PCU cabinet. The remote stop switches are two handheld, cable-mounted switches which provide a safety feature to inhibit all lift trailer operation in an emergency. If an emergency situation arises, you can use either stop switch to inhibit lift trailer operation. The MHU-196/M has a stop switch/portable light storage cabinet on each chassis beam. Each cabinet provides the storage area for one stop switch and one floodlight. They serve the same function as do the ones for the MHU-204/M.

The MHU-204/M PCU is on the left chassis beam, and it has the connections for the PCU and one remote stop switch. The PCU itself is considered the main operating component of the lift trailers. It lets you select the trailer operating mode with the PCU handle or joystick. The cabinet stores the PCU and its umbilical cable. The PCU also has other controls and indicators that help control the lift trailers. The MHU-196/M also has a PCU that serves the same purposes. It has two storage cabinets, one for the PCU cable and a hand pump and another for the PCU itself.

## Self-Test Questions

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

### 005. Munitions handling trailers

1. From where do these trailers get electrical power to illuminate their brake lights?
2. What accessory on the MHU-110 trailer may be installed on the main rail assembly to facilitate loading and unloading munitions?
3. What is the maximum weight supported by a pair of rail extenders?
4. How many trolleys and chocks can be installed on the deck of the MHU-110 trailer and what is their purpose?
5. What is the purpose of the hinged deck sections found on the MHU-141/M and the MHU-226/M?
6. What is the purpose of the breakaway cable?

### 006. Lift trailers

1. What ~~aircrafts~~ were the powered lift trailers specifically designed to support?
2. Which of the powered lift trailers are approved for handling nuclear weapons?
3. What is the lift capacity of the MHU-204/M and MHU-196/M lift trailers?
4. Why is the frame width adjustable on the MHU-204/M and MHU-196/M lift trailers?
5. What is the purpose of the jacks and X-Y pads on the MHU-204/M and MHU-196/M lift trailers?

6. What is the maximum lifting height of the MHU-196 and the MHU-204 respectively?
7. How much air pressure must be maintained in the air tank before loading with the MHU-204/M and MHU-196/M lift trailers?

### **1-3. Ammunition Loading Systems**

Redesign and repositioning aircraft gun systems in aircraft such as the F-15, F-16, and A-10 brought a need to deviate from the original gun system loading techniques. These techniques normally included such things as carrying ammunition cans to the aircraft and hand-feeding ammunition into the systems. These techniques were extremely slow and not at all acceptable during extreme emergencies or have-to situations. Ammunition loading systems (ALS) were designed to make the job easier and faster. Originally, they could only be used on a particular aircraft, but recent developments have somewhat remedied this situation. In this section, we cover the various ALSs in use today and follow their evolution into the universal ammunition loading systems (UALS).

#### **007. Ammunition and loading systems models and uses**

The 20-/30-millimeter (mm) ALSs transfer linkless ammunition into an aircraft gun system. While they're doing this, they simultaneously download unfired rounds and spent cases from the gun system and carries ammunition from the storage areas to aircraft loading sites.

#### **20-millimeter systems**

At the time of this volume's publication, we have two models of 20 mm loading systems in use—the linkless ammunition loading system (LALS) (fig. 1-45) and the UALS (fig. 1-46). Both systems function in a similar fashion and use many similar components.

#### **Linkless ammunition loading system**

The United States Navy initially developed and used the LALS to load their aircraft with 20 mm ammunition. Because their LALS program was a success, the Air Force decided to use common assemblies and parts from their system and combine them with commonalities of the UALS hardware to produce a USAF LALS.

The LALS is a four-wheel trailer used to transport pre-inspected ammunition to and from the aircraft. The LALS may be delivered to the aircraft fully loaded with 2,100 rounds of 20 mm ammunition. During the loading function, the LALS will simultaneously download spent cases/live rounds from the gun system as rounds are loaded. Power to drive the system may be supplied by the aircraft's hydraulic system, a self-contained pneumatic system incorporated into the LALS, a separate external air compressor, or manually by rotation of a hand crank (½ inch drive speed handle).

The LALS consists of five major subassemblies called weapons replaceable assemblies (WRA) (fig. 1-47). The purpose for these assemblies is to remove and replace entire modules versus repairing single defective components; this process expedites the repair process for the system as a whole. In the event of a failure of an individual part, the entire WRA can be replaced returning the system to service.

The WRA can then be held in the backshop and extensively troubleshot without keeping the entire system out of service. The five major WRAs are as follows:

<b>Weapons Replaceable Assembly</b>	<b>Description</b>
Trailer assembly	The trailer assembly is a four-wheeled trailer used to transport the loader, behind a tow vehicle, to an aircraft or to an appropriate location for replenishing operations.
Support frame assembly	The support frame assembly is mounted to the trailer chassis as a device to support the storage container.
Storage container assembly	The storage container assembly is housed within the support frame assembly. The container structure is a box-like housing that has no moving parts and is constructed of lightweight aluminum honeycomb panels. The storage container assembly can store 2,100 rounds of 20 mm ammunition in three bays. Within the storage container, the ammunition is positively controlled by a permanently lubricated chain ladder assembly, which travels through the multiple levels using idler sprockets, end turns, and integral chain guides. The storage container has lifting points to provide attachment of the lifting beam to facilitate removal and handling of the storage container assembly for maintenance.
Conveyor assembly	<p>The conveyor assembly consists of the universal aircraft interface unit (UAIU), interchange unit assembly, flexible drive shaft assembly, conveyor belt assembly, and conveyor chute assembly. The purpose of the conveyor assembly is to accept rounds from the transfer unit assembly and transport them, by way of the conveyor belt elements with the conveyor chute assembly, to the UAIU.</p> <p>The interface unit transfers the rounds into the gun systems loading adapter while simultaneously downloading spent cases and unfired rounds. The spent cases and unfired rounds are transported, by way of the conveyor belt assembly, back to the transfer unit assembly to be placed into the three bays of the storage container.</p>
Transfer unit assembly	The transfer unit assembly interfaces with and is mounted on the top of the storage container assembly. Once spent cases and unfired rounds enter the transfer unit assembly, the transfer unit assembly will then transfer the stream of unfired rounds and spent cases into the three bays of the storage container assembly.

### ***Linkless ammunition loading system theory of operation***

Operation of the LALS is divided into four modes: replenishment mode, aircraft servicing mode, transport mode, and stowage mode. The mode you will be most familiar with is the aircraft servicing mode.

### ***Aircraft servicing mode***

When the LALS interface unit is initially mated to the aircraft, the interface unit (fig. 1-48) shift lever handle on the LALS is set to the BYPASS mode. In this mode, neither loading nor downloading can occur. Therefore, in order to transfer rounds into the gun system, you will need to shift the interface unit shift lever to the LOAD/DOWNLOAD mode. After a few short turns with a ½ inch drive speed handle, the interface unit will shift to the LOAD/DOWNLOAD mode. Once the interface unit has shifted to the LOAD/DOWNLOAD mode, cycling of the system will transfer live rounds from the interface unit to the aircraft loader adapter unit and into the gun system as shown in (fig. 1-49). Simultaneously, spent cases or unfired rounds from the gun system will be transferred from the loader adapter unit to the interface unit and back into the container assembly of the LALS. Continue cycling the system until it is fully loaded with live rounds and all spent cases or unfired rounds are downloaded from the gun system. This operation may be done by using the ½ inch drive speed handle or the pneumatic wrench assembly located on the LALS. Once the system is loaded, the interface unit

is then set back to BYPASS mode, rotated a few turns using a hand crank, and removed from the loader adapter unit.

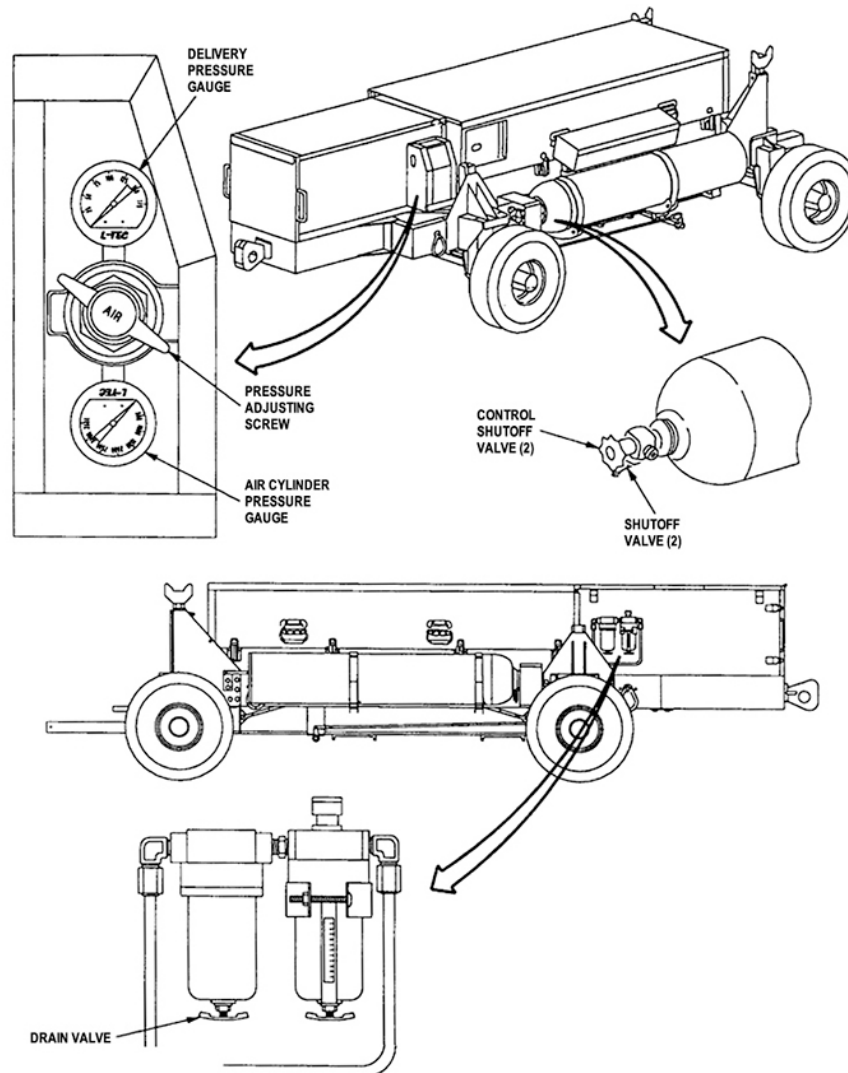


Figure 1-45. LALS.



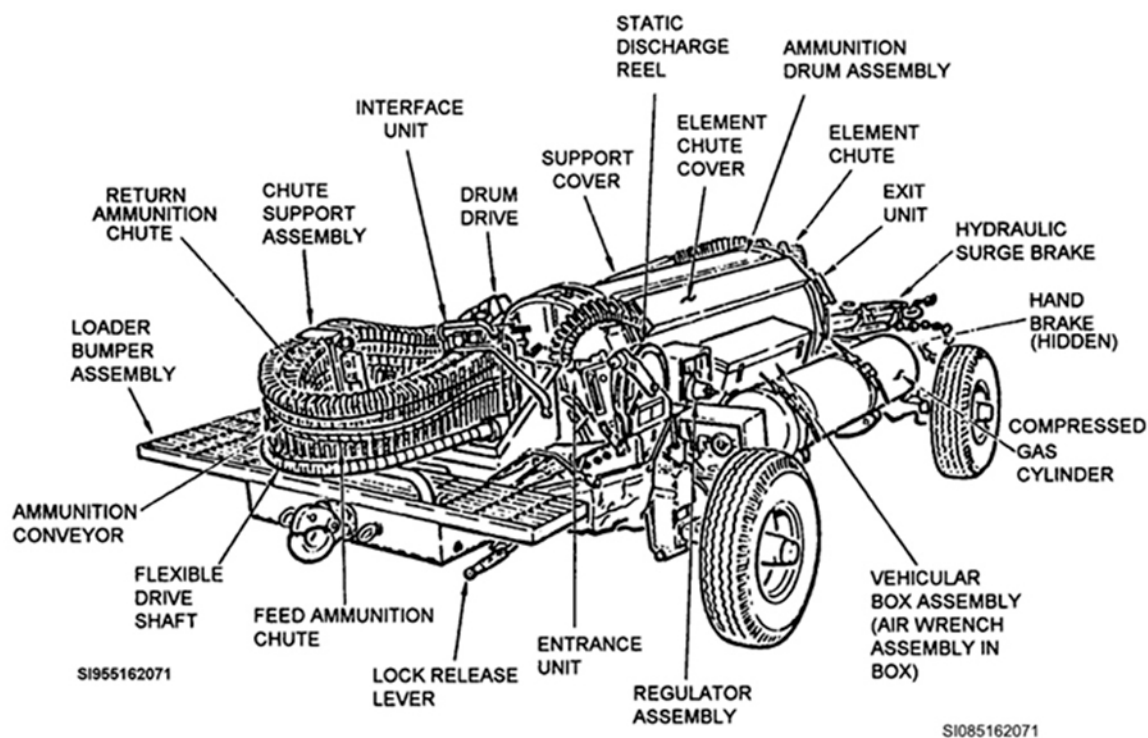


Figure 1-46. UALS.

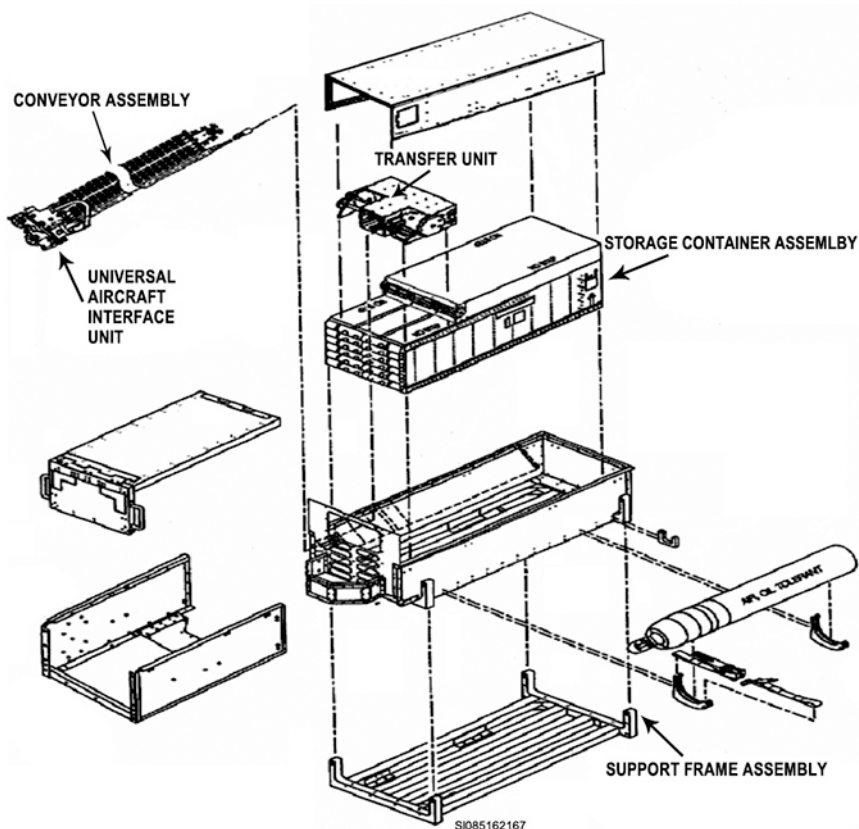


Figure 1-47. LALS exploded view.

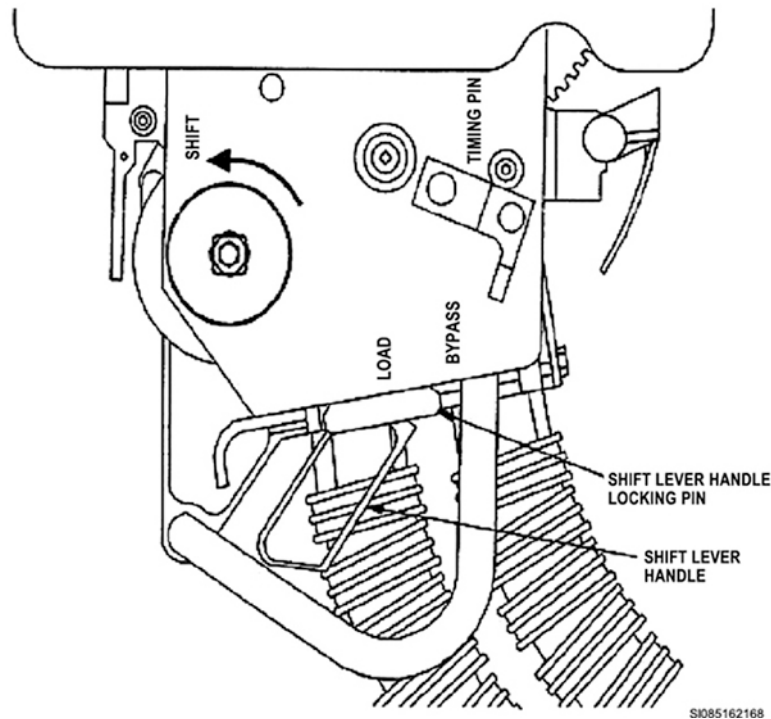


Figure 1-48. LALS interface unit.

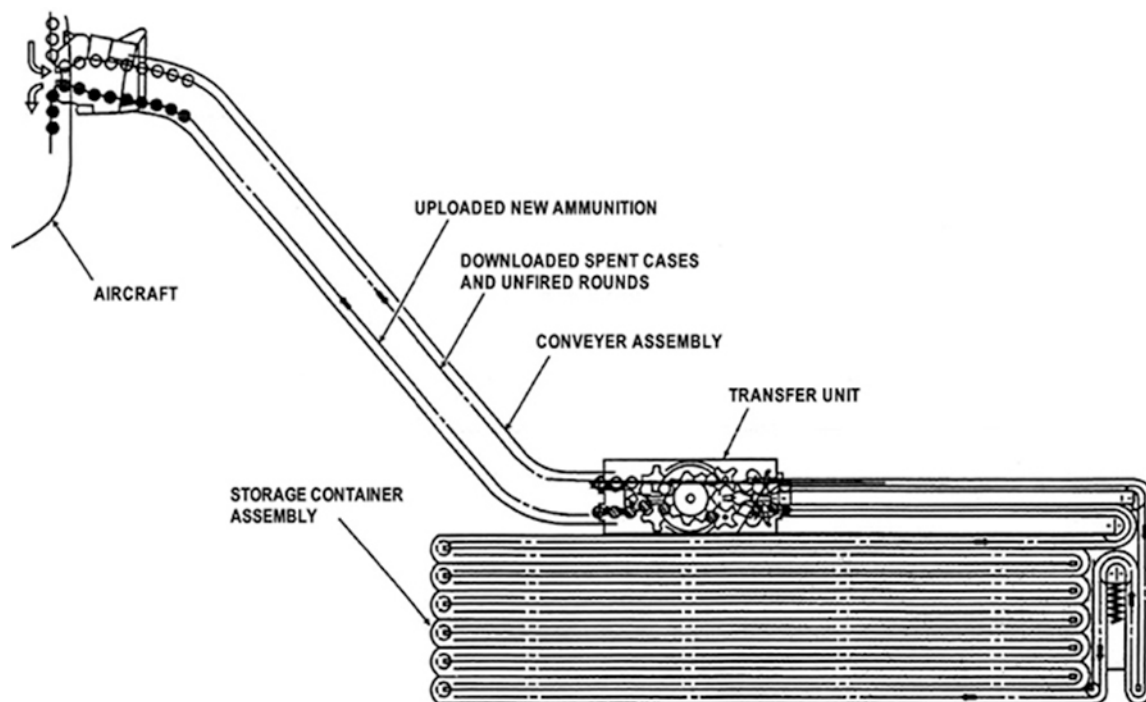


Figure 1-49. LALS ammunition flow.

### Universal ammunition loading system

The UALS shown in figure 1-46 can be used on all tactical aircraft equipped with 20 mm gun systems and has an ammunition drum holding 2,100 rounds. It operates in much the same manner as the LALS in respect to its loading and unloading capabilities and modes. The main differences between the systems are in the manner in which the rounds are stored and the way the rounds are

transferred to the aircraft they are servicing. The loader assembly consists of eight major subassemblies and units:

Subassembly/Unit	Description
Ammunition drum assembly	The drum assembly consists of an outer and inner drum, entrance and exit scoop disc assemblies and two drum cover assemblies. The outer drum provides the attachment point for the drum partitions and the entrance and exit covers. The inner drum (helix), in connection with the drum partitions, controls and moves the rounds and/or spent cases by the corkscrew action of the helix.
Ammunition conveyor and chuting	The ammunition conveyor consists of 220 conveyor elements assembled to form an endless conveyor for live rounds and spent cases. The conveyor elements travel through flexible chutes from the exit unit to the interface unit then to the entrance unit.
Interface unit	The interface unit is driven by a gear on the loader adapter unit of the aircraft or replenisher. It drives a flexible drive shaft coupled to the drum assembly and loads live rounds into the aircraft gun system and removes spent cases or unfired rounds. The interface unit is the "interface" between the UALS and the aircraft or replenisher.
Entrance unit	During a replenishing operation, the entrance unit will transfer live rounds from the ammunition conveyor elements moving through the entrance unit to the entrance drum cover assembly. During an aircraft loading operation, the entrance unit will transfer downloaded spent cases and unfired rounds from conveyor elements to the entrance drum cover assembly.
Exit unit	During a replenishing operation, the exit unit will transfer spent cases and unfired rounds (previously downloaded from an aircraft) from the exit drum cover to the conveyor elements. During aircraft loading operations, the exit unit will transfer live rounds from the exit drum cover to the ammunition conveyor elements moving through the exit unit.
Flexible drive shaft	To ensure synchronization between the interface unit and the drum assembly, a flexible drive shaft is installed between the entrance drum cover assembly drive coupling and the interface unit.
Chute support assembly	In preparing to load/download an aircraft, the interface unit must be lifted to the required height for mating with the loader adapter unit. The chute support assembly reduces the weight that must be lifted by the load crew to approximately 70 pounds maximum during this operation
Trailer chassis	The trailer chassis is used to transport the loader behind a tow vehicle.

### *Universal ammunition loading system theory of operation*

Generally, as an armament system technician, your interaction with the UALS will be in its capacity to service aircraft. We will focus on this mode of its operation.

When the UALS is initially mated to the aircraft, the interface unit on the UALS is set to the BYPASS mode and neither loading nor downloading can occur (fig. 1-50). Therefore, cranking while in the BYPASS mode is limited to the few turns needed to shift the interface unit to the LOAD mode after mating and to shift back to the BYPASS mode for disconnecting.

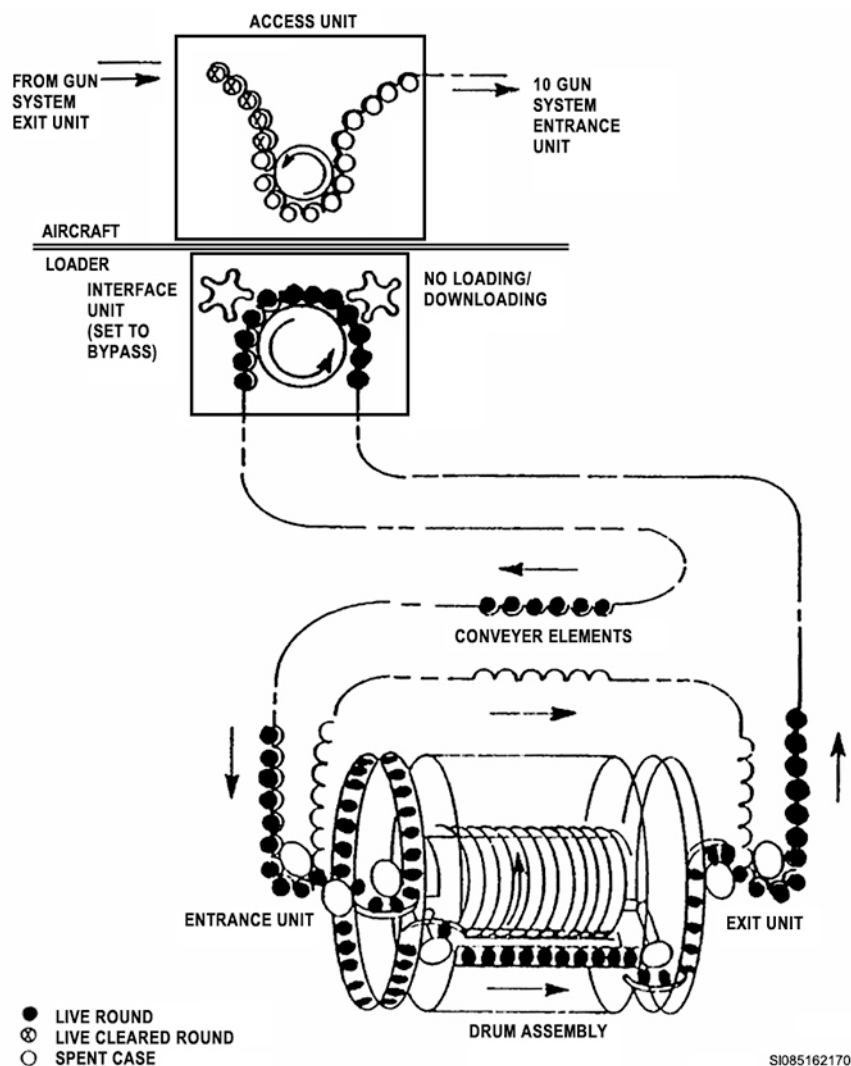


Figure 1-50. UALS in BYPASS mode.

When the interface unit is shifted to the LOAD/DOWNLOAD mode, cycling of the system will transfer live rounds from the interface unit to the aircraft loader adapter unit and into the gun system as shown in (fig. 1-51). Simultaneously, spent cases and unfired rounds will be transferred from the loader adapter unit to the interface unit and into the drum assembly of the UALS. Continue to cycle the system until it is fully loaded with live rounds and all spent cases and unfired rounds are downloaded from the gun system. The interface unit is then set to BYPASS mode, rotated a few turns using a hand crank, timed and removed from the loader adapter unit.

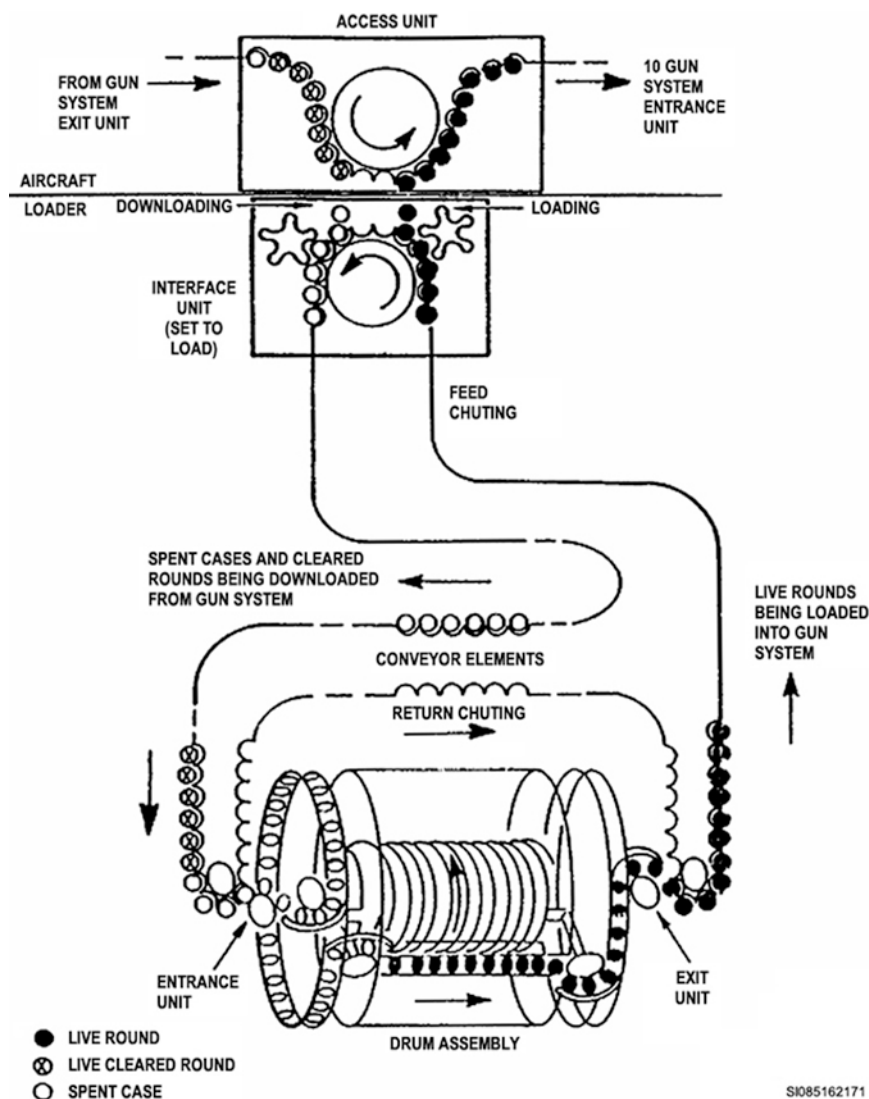


Figure 1-51. UALS in LOAD/DOWNLOAD mode.

### 30 mm systems

There are two 30 mm ALSs now in Air Force inventory. They're different in design, but they have the same basic functions as all other ALSs. One system is used strictly to load and unload the A-10 aircraft gun system.

### A-10 ammunition loading system

When the GAU-8/A gun came into use, loading the gun system was slow. A table loader was designed to load ammunition into the gun system, but it wasn't fast enough. The A-10 needed a faster system, so the GFU-7/E was built, commonly called the ammunition loading assembly (ALA), and it is able to load up to 300 rounds of 30 mm ammunition per minute. To make the complete ALS, we need a GFU-7/E ALA, CNU-309/E ammunition containers, and link tube carriers (LTC), as shown in figure 1-52. We would also need some kind of drive system. We could use either the aircraft hydraulic system or the GFU-8/E auxiliary drive assembly (ADA).

The prelinked ammunition is pulled into the ALA, and then it is separated from the LTCs and loaded into the gun system. The spent ammunition and/or unfired rounds are passed out of the gun system and into the ALA where it is fed back into LTCs and then into empty CNU-309 ammunition containers.

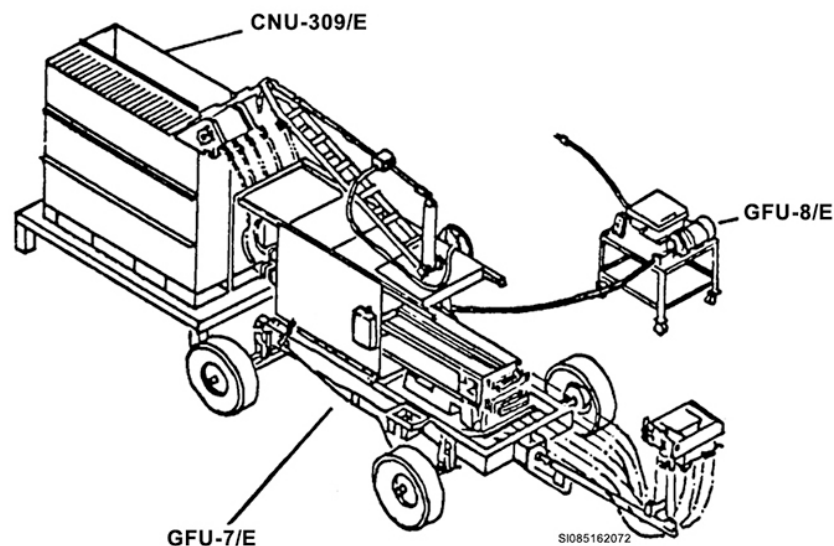


Figure 1-52. A-10 ALA.

The GFU-7/E ALA interfaces directly with the A-10 to load ammunition from storage containers into the gun system and simultaneously unload and deposit spent and/or live rounds of ammunition from the aircraft gun system into empty ammunition shipping and storage containers. During normal loading and unloading, the aircraft's hydraulic system provides ALA operating power. The ALA is comprised of 21 major components and 10 operating controls/indicators used to cycle the ALA through its functional procedures. Figure 1-53 shows the positions and direction of loading the aircraft. Refer to TO 35D30-4-12-2, *Loader, Ammunition, GFU-7/E*, for further information on the ALS.

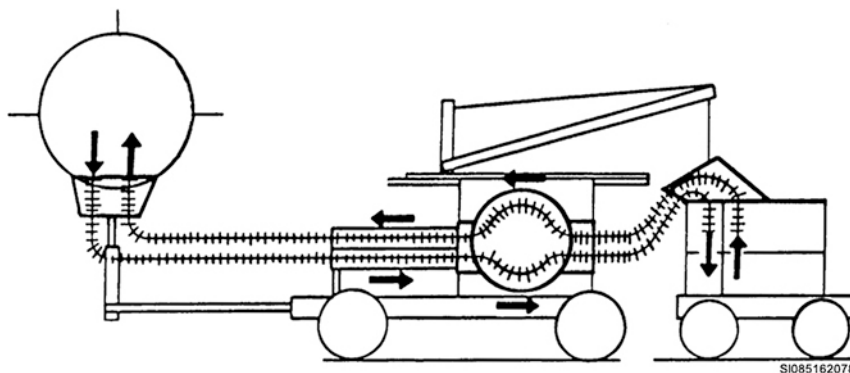


Figure 1-53. ALA ammunition flow.

## Self-Test Questions

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

### 007. Ammunition and loading systems models and uses

1. State the two basic uses of an ALS.
2. What round capacity number is the maximum for the LALS?

3. What is the main difference between the UALS and the LALS?
4. What provides power for the ALA during normal A-10 gun system loading and unloading?
5. What interfaces directly with the A-10 to load ammunition from storage containers into the 30 mm gun system?

---

### Answers to Self-Test Questions

#### 001

1. 3,000 pounds.
2. A hydrostatic drive system.
3. 25.2-horsepower, diesel.
4. (1) Fluid coupling.  
(2) Variable displacement hydraulic pump.  
(3) A fixed displacement motor.
5. Changing the position of the accelerator pedal varies the flow rate of the hydraulic pump.
6. By controls at the driver's position or controls directly behind the cradle.

#### 002

1. 10,000 pounds.
2. Hydraulic locking valve.
3. Longitudinal, lift, roll, azimuth, tilt, yaw, and ram up/down.
4. Flexible electrical cord.

#### 003

1. Lift, transport, and load/unload munitions and stores weighing up to 7,000 pounds.
2. Air-cooled, 25.2-horsepower, diesel engine.
3. Lift boom.
4. Parking brakes are controlled by a locking valve located to the left of the steering wheel. With the locking valve in the closed position, the parking brake is set by depressing the service brake pedal.
5. The MHU-83 D/E.
6. To operate the hydraulic system, should the engine quit.

#### 004

1. All.
2. 3,000 pounds.
3. To secure the load to the lift table or loading adapter.
4. To support munitions temporarily.
5. To support TERs temporarily.
6. MK 4 MOD 0, MK 55, or H1004.
7. 4,600 pounds.
8. 6,000 pounds.

9. 107.5 inches.
10. Everything from facilitating storage to transporting, loading, and unloading aircraft suspension equipment.
11. To load internal and external stores on the B-52 aircraft.
12. MJ-40 and MHU-83 D/E model only.

**005**

1. The trailer's inter-vehicular harness.
2. Rail extenders.
3. 3,000 pounds.
4. There are 24 trolleys and 48 chocks (with tie-down straps) to accommodate a variety of munitions.
5. These hatchways allow a lift truck to be driven directly under the trailer and pick up a munition positioned toward the center of the trailer.
6. If the trailer becomes disengaged from the tow vehicle, the breakaway cable will pull a lever in the surge brake forward, applying the trailer brakes.

**006**

1. B-52, B-1B, and B-2.
2. The MHU-204/M and MHU-196/M.
3. 40,000 pounds.
4. For various load widths.
5. The jacks are used to lift the trailer and to adjust to variables in the terrain. Independent or paired motion of the jacks translates to attitude changes to the lift trailers and load in pitch and roll. An X-Y pad is attached to the base of each jack assembly. During loading, the jacks are deployed to place the X-Y pads on the ground. Hydraulic cylinders within each X-Y pad provide precise lateral (X) and longitudinal (Y) positioning corrections to the lift trailers and load during lifting operations.
6. MHU-196/M, 12 feet and MHU-204/M, 8 feet 4 inches.
7. There must be 105 psi in the air tank before loading with the MHU-204/M and a minimum of 90 psi in the tank before loading with the MHU-196/M.

**007**

1. (1) It transfers linkless ammunition into an aircraft gun system.  
(2) It carries ammunition from the storage areas to aircraft loading sites.
2. 2,100 rounds.
3. The linkless capability and the use of a tray assembly to hold the ammunition before loading.
4. The aircraft's hydraulic system or GFU-8/E ADA.
5. GFU-7/E ALA.

**Complete the unit review exercises before going to the next unit.**



## Unit Review Exercises

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

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

1. (001) The *most* commonly used powered bomb lift trucks are the
  - a. MHU-196/E, MHU-173, MHU-204/M, and MJ-40.
  - b. MJ-1/B, MHU-83, MHU-196/E, and MJ-40.
  - c. MHU-83, MHU-204, MJ-40, and MJ-1/B.
  - d. MJ-1/B, MHU-83, and MJ-40.
2. (001) Which part of the MJ-1/B controls the engine speed?
  - a. Hand throttle located to the left of the steering wheel.
  - b. Hand throttle located to the right of the steering wheel.
  - c. Pedal located on the left side of the operator's position.
  - d. Pedal located on the right side of the operator's position.
3. (001) Changing the position of the MJ-1B accelerator pedal
  - a. changes the engine throttle position.
  - b. increases/decreases the engine rpms.
  - c. adjusts clutch force in the Ackerman drive.
  - d. varies the flow rate of the pump in the hydrostatic drive.
4. (001) Which part of the hydrostatic drive system is supported by the lift arms and used to hold the munition or store to be loaded?
  - a. Cradle assembly.
  - b. Hydraulic pump.
  - c. Hydraulic motor.
  - d. Cantilever lift arms.
5. (002) The lifting capacity of the MJ-40 lift truck is
  - a. 2,450 pounds.
  - b. 3,000 pounds.
  - c. 7,000 pounds.
  - d. 10,000 pounds.
6. (002) Which aircraft loading missions are supported by the MJ-40 lift truck?
  - a. B-1, B-2.
  - b. B-1, B-2, B-52.
  - c. All fighter aircraft.
  - d. All Air Force aircraft.
7. (002) Which loading controls are found *only* on the MJ-40 lift truck remote?
  - a. Boom up/down.
  - b. Yaw right/left.
  - c. Ram up/down.
  - d. Tilt right/left.
8. (003) What number of pounds is the lift capacity of the MHU-83 lift truck?
  - a. 7,000.
  - b. 6,000.
  - c. 3,000.
  - d. 1,250.

9. (003) Which fuel type is the MHU-83 lift truck capable of using?
  - a. Diesel only.
  - b. Mogas only.
  - c. Diesel or JP-8.
  - d. Diesel, JP-8, or Mogas.
10. (003) The controls for adjusting the side frame width of the MHU-83 lift truck are located at the
  - a. remote control unit only.
  - b. operator's position only.
  - c. forward end of the boom only.
  - d. remote control unit and operator's position.
11. (003) Which device ensures the boom *cannot* fall in the event hydraulic power is lost, a component fails, or a line breaks on the MHU-83 series lift trucks?
  - a. Cantilever valve.
  - b. Counterbalance valve.
  - c. Hydraulic system safety interlocks.
  - d. Mechanical ratchet safety interlocks.
12. (003) The MHU-83 lift truck component used to lift the front wheels off the ground to allow side frame width adjustment is the
  - a. lift boom.
  - b. outriggers.
  - c. jack assemblies.
  - d. fork assemblies.
13. (003) The parking brake on the MHU-83 lift truck is set by
  - a. setting the locking valve.
  - b. closing the locking valve then depressing the brake pedal.
  - c. actuating the parking brake lever under the operator's seat.
  - d. depressing the parking brake pedal at the operator's position.
14. (003) Which variant of the MHU-83 lift truck incorporates a remote control unit and hydraulic servicing lines/connectors to perform tasks that once necessitated the use of the MJ-40 lift truck?
  - a. MHU-83 C/E.
  - b. MHU-83 D/E.
  - c. MHU-83 Block 5.
  - d. MHU-83 Block 10.
15. (003) The purpose of the hydraulic hand pump located on the right hand side of the MHU-83 lift truck is to
  - a. operate the hydraulic system should the engine quit during loading operations.
  - b. act as a backup starting mechanism if the engine starting system fails.
  - c. adjust hydraulic system pressure during maintenance.
  - d. service the hydraulic system.
16. (004) Which type of movement do bomb lift truck rollers provide during loading?
  - a. Tilt.
  - b. Yaw.
  - c. Rotation.
  - d. Azimuth.

17. (004) How many pounds is the lift capacity of a MJ-1 lift truck with aluminum rollers installed?
- a. 1,200.
  - b. 2,450.
  - c. 2,700.
  - d. 3,000.
18. (004) What number of pounds is the lift capacity of an MHU-83 lift truck with aluminum rollers installed.
- a. 5,000.
  - b. 6,000.
  - c. 7,000.
  - d. 10,000.
19. (004) Which bomb support rollers may be used with roller extensions?
- a. Aluminum rollers.
  - b. Rubber rollers.
  - c. Steel rollers.
  - d. All rollers.
20. (004) Which type of load binder is attached to bomb support beams?
- a. Teflon.
  - b. Nylon.
  - c. Rayon.
  - d. Dacron.
21. (004) How many pounds is the lifting capacity of the sling assembly used on lift trucks or forklift adapters?
- a. 2,000.
  - b. 2,500.
  - c. 3,400.
  - d. 4,600.
22. (004) The proper method to install the extension lift arms on the MJ-1A/B lift truck is by inserting the ends of the arms into slots
- a. in the lift arms.
  - b. on the main frame.
  - c. in the table assembly.
  - d. bolted to ends of the arms.
23. (004) Which device *must* be used when forklift adapters are installed on the lift trucks?
- a. Load binders.
  - b. Rail extenders.
  - c. Roller assemblies.
  - d. Cradle extensions.
24. (004) What weight is the MJ-40 and MHU-83 series lift truck limited to when using the fork adapter assembly?
- a. 7,500 pounds.
  - b. 7,000 pounds.
  - c. 6,000 pounds.
  - d. 5,000 pounds.

25. (004) Which component is used in conjunction with the MHU-83-series lift truck to load external heavy stores on a B-52?
- Extension lift arms.
  - Fork adapter assembly.
  - MAU-114 and pylon loading adapter.
  - Load binder adapter and two tie-down straps.
26. (004) Which devices attach the fork adapters to the MHU-83-series lift truck's table assembly?
- Two quick-release pins.
  - Four quick-release pins.
  - Two bolts with self-locking nuts.
  - Four bolts with castle nuts and cotter pins.
27. (004) How many *inches* is the *maximum* lifting height when the adapter assembly is inverted on the MHU-83-series lift truck?
- 90.
  - 107.5.
  - 113.
  - 140.5.
28. (004) Pylons are attached to pylon handling adapters for mounting or removing from aircraft with
- load binders.
  - ratcheting tie down straps.
  - the pylons bomb rack hooks.
  - pylon mounting blocks and spacer bars.
29. (004) Which bomb loading adapter is used in loading internal and external stores on the B-52?
- Fork adapter assembly.
  - ADU-314/E, preload adapter.
  - F310707-500 bomb loading adapter.
  - ADU-328/E, aerial stores lift truck loading adapter.
30. (004) Where does the mechanical ram assembly (MRA) receive its power?
- 25.2 horsepower diesel engine.
  - Through an electrical cable attached to the lift truck.
  - From an A/M 32A-86 or A/M 32A-95 generator set.
  - Through two hydraulic service lines attached to the lift trucks lift boom.
31. (004) How is the mechanical ram assembly (MRA) *primarily* controlled and operated?
- The lift trucks operator's controls.
  - The lift trucks remote control unit.
  - The controls located on the units control panel.
  - On the lift trucks boom mounted control panel.
32. (004) How many *inches* high is the mechanical ram assembly (MRA) when fully extended?
- 73.
  - 83.
  - 97.
  - 107.5.
33. (004) How many pounds is the lift capacity of the mechanical ram assembly (MRA).
- 5,000.
  - 6,000.
  - 7,000.
  - 10,000.

- 
- 
34. (005) The *maximum* load capacity of a MHU-141/M trailer is
- a. 4,500 pounds.
  - b. 5,000 pounds.
  - c. 5,500 pounds.
  - d. 6,000 pounds.
35. (005) What number of pounds is the *maximum* load capacity of an MHU-110/M trailer.
- a. 10,000.
  - b. 15,000.
  - c. 15,500.
  - d. 20,000.
36. (005) How many *main* rail assemblies can be installed on the deck of the MHU-110/M trailer?
- a. Two.
  - b. Three.
  - c. Four.
  - d. Six.
37. (005) How many trolleys and chocks can the MHU-110/M trailer be configured with for round-shaped stores?
- a. 12 trolleys and 24 chocks.
  - b. 20 trolleys and 40 chocks.
  - c. 24 trolleys and 48 chocks.
  - d. 48 trolleys and 24 chocks.
38. (005) How many hand brake lever(s) are located on the MHU-226/M munitions handling trailer?
- a. One.
  - b. Two.
  - c. Three.
  - d. Four.
39. (006) The lift capacity of the MHU-204/M and MHU-196/M lift trailers is
- a. 27,000 pounds.
  - b. 27,500 pounds.
  - c. 40,000 pounds.
  - d. 50,000 pounds.
40. (006) To prevent personnel injury or equipment damage, each operational mode of the MHU-204/M and the MHU-196/M lift trailers automatically shuts off when either one of two team members press a remote stop switch or when the
- a. tape switch encounters resistance.
  - b. ground safety interlock is engaged.
  - c. "deadman" switch is released on the PCU.
  - d. portable control unit (PCU) is powered down.
41. (006) During towing what is the travel of the tow bar of the MHU-204/M and MHU-196/M lift trailers limited to?
- a. 15°.
  - b. 30°.
  - c. 45°.
  - d. 90°.

42. (006) Which MHU-204/M and MHU-196/M lift trailer components allow for precise lateral and longitudinal positioning corrections to the lift trailers and load during lifting operations?
- a. X-Y pads.
  - b. Arc compensators.
  - c. Tilt compensators.
  - d. Lift mast assemblies.
43. (006) Independent operation of either lift arm mechanism on the MHU-196/M lift trailer results in
- a. tilting the load.
  - b. rolling the load.
  - c. moving the load laterally.
  - d. moving the load longitudinally.
44. (006) Which MHU-196/M lift trailer component supports the lift arms under transport conditions?
- a. Cable reel assemblies and chocks.
  - b. Interlocked chain load binders.
  - c. Retractable travel locks.
  - d. Retractable trolleys.
45. (006) How much air pressure *must* be in the compressor tank before loading with the MHU-196/M lift trailer?
- a. 45 pounds per square inch (psi).
  - b. 80 psi.
  - c. 90 psi.
  - d. 115 psi.
46. (007) How many rounds of ammunition is the capacity of the 20 mm linkless ammunition loading system (LALS).
- a. 1,250.
  - b. 1,533.
  - c. 1,800.
  - d. 2,100.
47. (007) Which component of the linkless ammunition loading system (LALS) transfers rounds into the gun systems loading adapter?
- a. Access unit.
  - b. Loader head.
  - c. Interface unit.
  - d. Ammunition loader assembly.
48. (007) Which component of the A-10 ammunition loading system (ALS) interfaces with the aircraft during ammunition loads?
- a. CNU-309/E.
  - b. MHU-309/E.
  - c. GFU-7E ALA.
  - d. MHU-7E ALA.
49. (007) During *normal* loading of the A-10 gun system, where does the ammunition loading assembly (ALA) get its power?
- a. The aircraft's pneumatic system.
  - b. The aircraft's hydraulic system.
  - c. The aircraft's electrical system.
  - d. An external electrical and hydraulic power source.

## **Student Notes**

**Please read the unit menu for unit 2 and continue ➔**

## **Student Notes**



## Unit 2. Flight-Line Support Equipment

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**F**LIGHT-LINE SUPPORT EQUIPMENT continues to be an important part of the aircraft armament systems specialty. In unit one, we discussed the equipment used for loading and handling munitions. Flight-line support equipment is used for electrical checks and various other job-related tasks. This unit discusses generators, air compressors, portable floodlight sets, and miscellaneous support equipment you will be using. You aren't responsible for maintaining this equipment, so our discussion centers on description. We'll also discuss some general inspection items relating to this support equipment.

### 2-1. Auxiliary Power Units

From your own personal experiences, you know the battery in your car will not let you operate the car's electrical system components for very long without recharging. The same is true for an aircraft with its many electrical systems. Most of the time, you'll use an auxiliary power unit (APU) to operate the aircraft electrical or environmental systems to provide electrical and/or pneumatic power for ground operations. They come in many different types and versions. We'll limit our discussion to the four units you are most likely to encounter as an aircraft armament systems specialist: the A/M 32A-60, the A/M 32A-86, the A/M32A-95, and the starter cart assembly (SCA).

#### 008. Auxiliary power units use and description

An APU is used when we need an external power source. We use them to provide electrical power to aircraft systems during operational and functional checks; pneumatic power for air-conditioning units to cool avionics components during "power on" electrical checks; and electrical power to other equipment, such as lift trailers, during flight-line loading and unloading. Sometimes we use them in the armament shop.

#### Auxiliary power unit description

All generator type APUs are basically designed the same. They're all set on a trailer frame with four wheels, a tow bar, an engine, generators, an electrical and fuel system to facilitate starting the engine, steering and braking systems, electrical power cables, and all the controls and indicators required to control the unit. This general description of APUs is very vague, so now let's take a brief look at the individual units we deal with daily.

### A/M 32A-60

The common term for this generator (fig. 2-1) is simply the “dash 60.” The -60’s three electrical outputs are 120 VAC, single-phase, 400 Hz; 120/208 VAC, three-phase, 400 Hz; and 28 VDC. The -60 also supplies pneumatic pressure through its bleed air system. There are three separate instrument panels on the -60: an AC panel, a DC panel, and a turbine engine panel. These panels are mounted in individual boxes on the left-hand forward side of the generator set. Each instrument panel contains all the switches and indicators for its individual function. These characteristics are listed in the following table.

A/M 32A-60 Characteristics	
AC instrument panel	Turbine instrument panel
Battery charger	Exhaust door
Cable bracket	Fuel filler cap
Fuel gauge	Auxiliary fuel tank
Battery	Battery connector

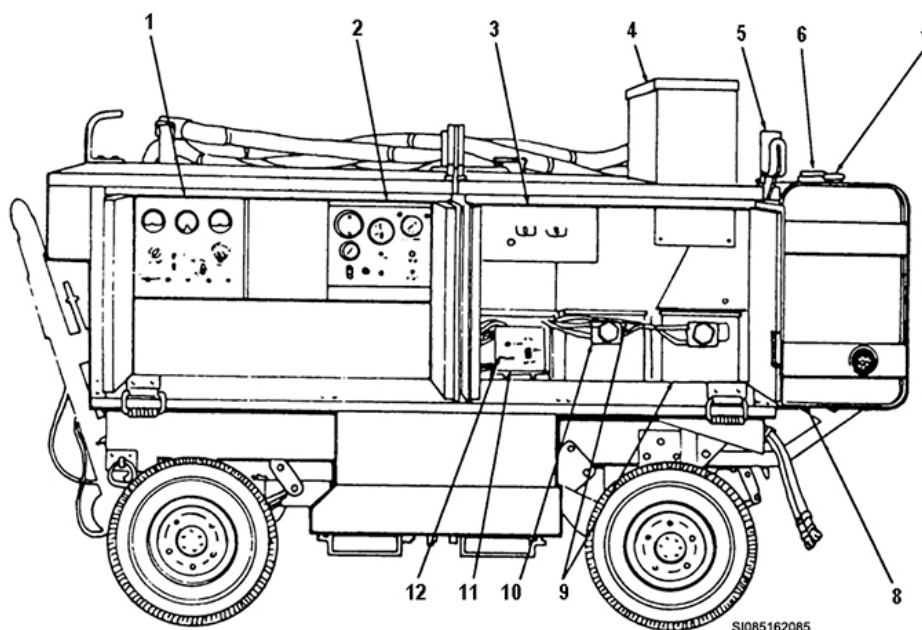


Figure 2-1. A/M 32A-60 generator.

The -60 consists of the following six major sub-assemblies you need to be familiar with.

- The DC instrument panel has the switches and controls necessary to operate the DC generator and to monitor the DC voltage output of the generator set. The switches and indicators on this panel are the DC contactor switch, DC contactor indicator light, a control circuit breaker, a DC voltmeter, and a DC ammeter.
- The AC instrument panel has the necessary instruments and controls to operate the AC generator and to monitor the generator’s AC voltage output. Instruments and controls include the AC voltmeter, frequency meter, AC ammeter, voltage adjustment switch, phase selector switch, AC contactor switch, and a contactor indicator light. At some time, you’ll use all of the controls on this unit.
- The power outlet panel is on the right side of the generator set, with access through a small door stenciled POWER OUTLET PANEL INSIDE. The panel has two single-phase AC outlets with individual circuit breakers, a three-phase AC receptacle, and a DC connector. The power outlet panel lets you supply electrical power to equipment other than the aircraft.

- The pneumatic bleed air duct hose assembly lets you transfer bleed air from the –60's turbine to the aircraft or support equipment to be serviced. This hose assembly is stored on top of the generator roof housing.
- The AC power supply cable is connected internally to the AC generator to supply power to the aircraft and/or other equipment. This cable is stored on the bracket mounted on top of the generator set.
- The brake system has standard automotive brakes on the rear wheels only. When the tow bar is in the vertical position, a mechanical linkage automatically engages the brakes to prevent the generator set from accidentally moving. Lowering the tow bar automatically releases the brakes.

### A/M32A-95

The A/M32A-95 Gas Turbine Compressor supplies pressurized air (bleed air) to aircraft on the ground (fig 2-2). While technically not what most people would consider a “generator,” the –95 fits into this category because of its similarities to the –60 and the fact it supplies a source of power (i.e., bleed air in this case) that the engines would normally provide. The discharge hose connects to the number 2 engine strut (from the left) of an aircraft. Bleed air operates the environmental control system (ECS) of the B-52. This allows aircraft components, weapons, and the crew to be cooled.

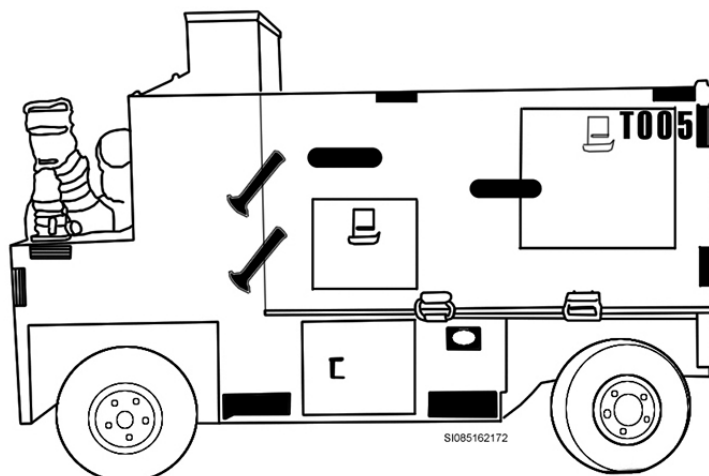


Figure 2-2. A/M 32A-95.

A/M32A-95 is a trailer-mounted turbine engine containing numerous sub-assemblies. Orientation of the sub-assemblies is determined by: (1) locating the front of the unit, which has the drawbar (i.e., tow bar), and (2) determining the left and right sides of the unit by standing at the rear of the unit. The –95 consists of the following six major sub-assemblies:

Sub-Assembly	Description
Trailer	The trailer assembly of the A/M32A-95 contains the frame, running gear, and removable enclosure. The frame is simply the supporting structure to which everything else attaches. It also has forklift receivers and tie down rings for transporting the unit. The running gear is made of the wheels, brakes, and axles of the unit. A removable enclosure covers the unit's engine in the same way a car uses a hood
Engine Installation Assembly	The engine installation assembly contains the engine, tailpipe, alternator, and rigid bleed air duct. It is located inside the removable enclosure at the front. The turbine engine is actually a small jet engine with the intake at the front, and the exhaust at the top. The tail pipe channels the exhaust upward and out the

Sub-Assembly	Description
	exhaust door on the top of the unit. An alternator is driven directly from the engine and is used to charge the battery. The rigid bleed air duct carries the pressurized air from the engine to the swivel elbow on the rear of the unit
Discharge Hose	The discharge hose assembly attaches to the swivel elbow at one end of the hose and a coupling assembly at the other end. The coupling assembly will attach to the aircraft's #2 engine strut.
Lubricating Oil Tank	The lubricating oil tank is located behind a door on the right side in the center. It contains oil designed for turbine engines and is toxic to human eyes, skin, and respiratory tract. A sight glass on the tank allows the operator to verify fluid level without touching it
Fuel Tank	The fuel tank is located on the back of the unit. It holds 130 gallons of fuel. It is filled with approximately 65 gallons (1/2 full) due to the expansion of the fuel. If the fuel tank has been modified, then it can hold over half a tank. Normally the tank will contain JP-8 or in an emergency, diesel. The inlet and fuel gauge are inside a door-at the rear of the unit.
Control Panel	The control panel is on the right front side of the unit (fig. 2-3). The panel inside the control box contains the controls for operating and monitoring the engine and output air.

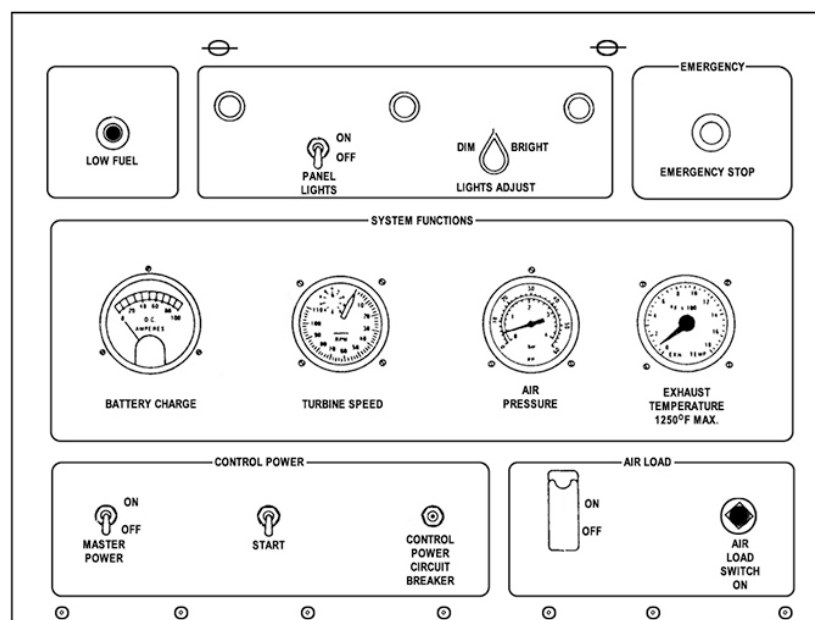


Figure 2-3. A/M 32A-95 control panel.

### A/M 32A-86D

The A/M 32A-86 (fig. 2-4) is a diesel-engine-driven generator set. This self-contained unit can supply electrical outputs compatible with different aircraft systems. The generator set produces 400 Hz, three-phase power at 115/200 VAC or 230/400 VAC. It's transported on a trailer compatible with the -86 generator set. A drawbar attached to the front axle of the trailer lets you attach the unit to a towing vehicle. The two rear wheels carry the unit's brakes. The three panels you will use when operating the set are the engine control panel, generator control panel, and the external AC panel.

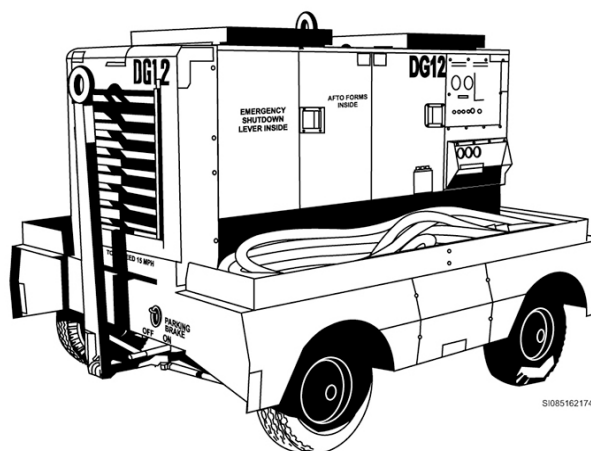


Figure 2-4. A/M 32A-86D generator.

The engine control panel is on the lower, left-hand side, toward the rear of the unit (fig. 2-5 bottom panel). It has the engine controls, the generator output controls (fig. 2-5 top panel), and the engine indicators necessary to operate and monitor the engines. The generator control panel has the controls for monitoring the output voltage and amperage (current) of the unit. The lower part of the panel has numerous warning lights. If any of these lights come on while you're operating the unit, you must shut down the unit. The external AC panel is mounted on the left side of the generator set, next to the engine control panel. It provides a receptacle for a power cable that can be connected to other equipment and a circuit breaker to shut off the flow of current in case of an overload.

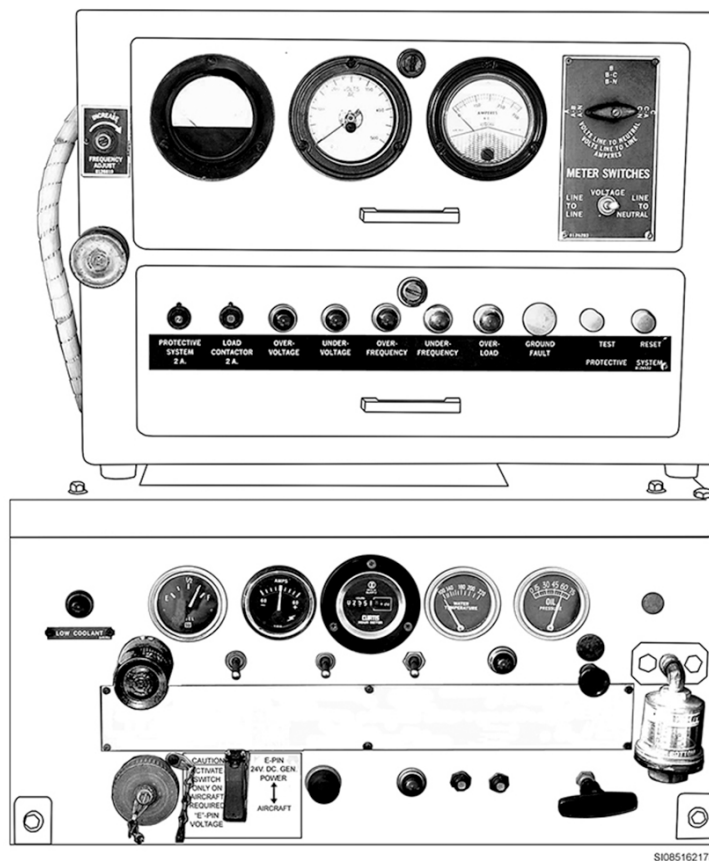


Figure 2-5. A/M 32A-86D engine controls (bottom) and generator output controls (top).

### Starter cart assembly

With the introduction of the MQ-1 and MQ-9, there was a need to create a different kind of APU to meet the needs of these aircraft. Manned fighter, bomber, and attack aircraft require huge amounts of power to supply their massive number of systems; however, this is not the case with the smaller remotely piloted aircraft (RPA). Our RPAs can use their own onboard battery as a power source for 28 volts DC. However, during extended ground operation or maintenance processes, the SCA shown in figure 2-6 is used to provide an external source of power.

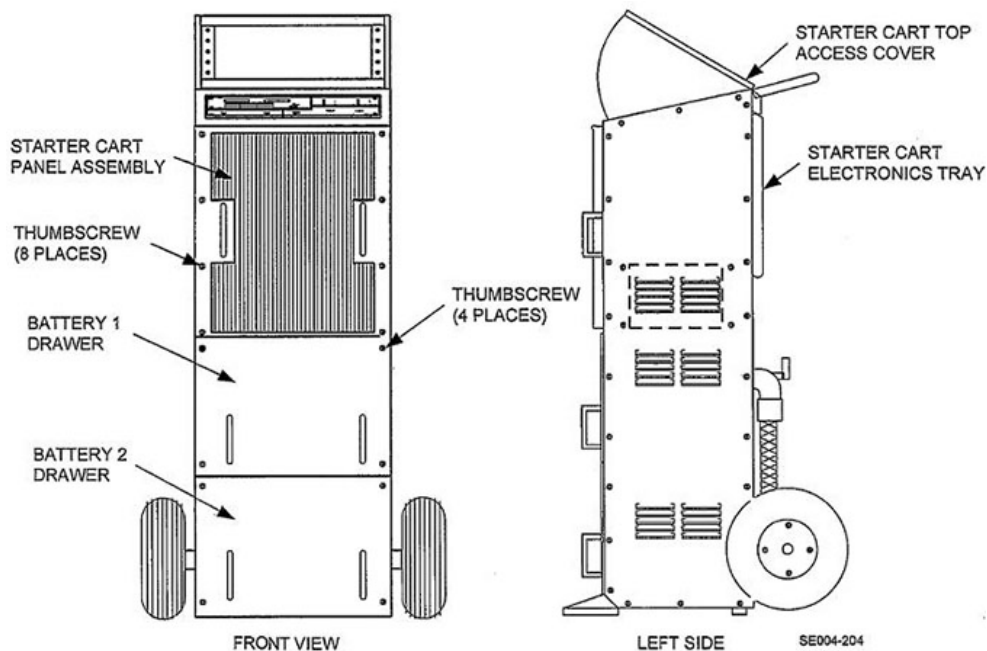


Figure 2-6. SCA.

The SCA can use two onboard batteries as a power source or receive power from an external source such as a wall outlet. The SCA has an umbilical cable, which attaches to connectors on the aircraft ground power panel. One plug on the cable provides 28 VDC to the aircraft electrical power and distribution system.

The SCA has two basic systems. One is DC power and electrical distribution, and the other system is the start system. The electrical power and DC distribution system supplies 24-volt DC power from its batteries to the cart components and converts 24 volts DC to 28 volts DC to power the aircraft avionics systems or support equipment. The start system provides logic signals and 18 volts AC to power the aircraft starter. The operator interfaces with the SCA through the starter cart control panel assembly (fig. 2-7). The starter cart control panel assembly is divided into four areas. The upper left area provides meter readings for most internal functions, and the upper right area provides indicator lights for most internal functions. The lower left area provides a ground power supply control switch. The lower right area provides starter control switches.

The mobility of the SCA is provided by two wheels mounted on an offset axle mounted at the bottom of the unit. The unit is supported by the wheels and two skid plates are mounted opposite the tires. A push handle mounted at the top of the unit allows the cart to be tilted off of its skid plates and rolled to a new location. The cover at the top of the unit swings upward to open and provide access to the starter cart control panel assembly. The starter cart electronics tray on the rear of the cart swings downward to provide accessibility to the start system internal electronic components. The starter cart panel assembly on the front of the cart is removable and provides internal access to the power supply electronic components. The upper and lower battery drawers slide outward to provide access to the 12-volt DC sealed gel batteries.



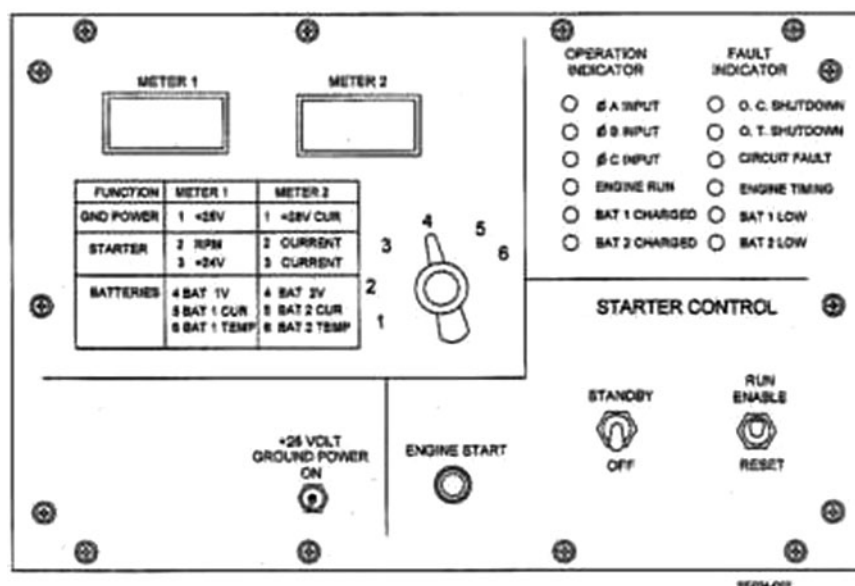


Figure 2-7. SCA control panel.

### 009. Generator safety precautions

Generators should not be operated without knowing the precautions to take in preventing accidents or damage to the equipment. Within this lesson, we'll discuss some of the most common safety rules/precautions you must follow when operating a generator.

#### Operational rules

Only qualified and authorized personnel may start and operate APUs. All operators must do a pre-use inspection before operating an APU. Anyone operating a generator set should be aware of the following set of rules:

1. Operators must remain at the unit or in the immediate vicinity when munitions loading are in process. The exception is this is not required during practice loading using training inert munitions.
2. Make sure proper fire-fighting equipment is readily available at all times during an APU operation.
3. All APUs must be placed at the end of their fully extended power cables when they're positioned next to an aircraft.

**NOTE:** During combat or simulated combat operation, fighter aircraft may be exempt from the 50-foot distance requirements according to the TO or approval of the wing commander or designated representative.

4. Place the unit upwind from the aircraft, if at all possible.
5. Make sure the parking brake is set to prevent the unit from moving.

#### Precautions

For your safety, please adhere to the following precautions:

1. Make sure either earplugs or earmuff-type ear protectors are worn around operating APUs to prevent hearing damage.
2. If the unit has pneumatic (bleed air) capability, make sure the bleed air hose coupling is connected properly before applying pneumatic pressure. Failure to do this allows the bleed air hose to whip around and possibly damage equipment or injure people.

3. During operation of units powered by turbine engines, stand clear of the engine's plane of rotation, which is easily identified by two red vertical lines painted on each side of the APU.
4. Make sure you don't put yourself in a situation where you could come in direct contact with the voltage being produced by the unit.
5. Liquids under high pressure are generated as a result of operating some APUs. Don't expose any part of your body to a high-pressure leak in the fuel injector systems.
6. If the use of starting fluids is authorized during extremely cold weather, be careful not to overload the engine and cause an explosion.

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### Self-Test Questions

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

#### 008. Auxiliary power units use and description

1. State the uses of an APU in flightline situations.
2. The -60 generator set provides what type of power?
3. Where are the three instrument panels located on the -60 generator?
4. What electrical service provisions are made possible by the power outlet panel on the -60 generator?
5. What does the A/M32A-95 supply to aircraft?
6. How may the operator verify the fluid level in the lubricating oil tank of the A/M32A -95?
7. What type of power is supplied by the A/M 32A-86?
8. What three panels will you use during the operation of the -86 generator?
9. What panel has the indicators that monitor voltage output and current while the -86 is operating?
10. What aircraft are supported by the starter cart assembly?



**009. Generator safety precautions**

1. Who may start and operate APUs?
2. When are APU operators not required to stay in the immediate vicinity of the unit during munitions loading?
3. When may fighter aircraft be exempt from the 50-foot positioning requirements for APUs?
4. Where do you *not* stand when operating an APU with a turbine engine?

**2-2. Air Compressors**

The Air Force uses many types of air compressors varying in shape, size, pressure output, and how they are driven. They are classified in two categories: low-pressure, 0–200 psi (e.g., called a low pack), and high-pressure, over 200 psi (e.g., called a high pack). In this section, we will limit this lesson to the MC-2A air compressor because it is the only compressor armament personnel will have direct interaction with on a regular basis.

**010. Air compressor uses and descriptions**

Air compressors are used every day somewhere by an aircraft armament systems specialist. You will find them in the backshop and on the flightline. They power many of the tools which require the use of pneumatics. Within this lesson, we will cover the uses of air compressors used by our personnel in performance of their normal duties and the description of the MC-2A air compressor.

**Uses**

The uses of air compressors are many and varied, but in our specialty, the normal everyday uses by 2W1X1 personnel are identified by these four statements:

1. Cycle gun systems and ammunition loaders during system maintenance and loading and unloading.
2. Power pneumatic tools.
3. Provide compressed air for cleaning and drying equipment components.
4. Re-charge pneumatic systems and associated components on aircraft or equipment such as lift trailers.

### MC-2A description

The MC-2A (fig. 2-8) or “low-pack” is a portable unit providing pneumatic power to operate small pneumatic tools, greasing equipment, paint spray guns, and other similar equipment. It’s powered by a two-cylinder, gasoline engine used to drive the compressor through a direct drive assembly. This sliding-vane-type rotary compressor can produce 15 cubic feet of free air per minute at 200 psi. The compressor and engine are protected from the weather by a housing with hinged doors making the internal components and controls accessible to the operator. The controls for starting, stopping, and operating the unit are on the left forward side of the unit. A toolbox attached to the front frame, just in front of the air tank, stores miscellaneous accessories and the unit equipment forms. The axle, running gear, and brake assembly forms a self-contained unit attached to the frame assembly. The brake assembly has a left-hand and right-hand brake, operated by pulling the brake handle toward the compressor. The small size and low weight of the MC-2A make it towable by every vehicle equipped with the appropriate towing hitch.

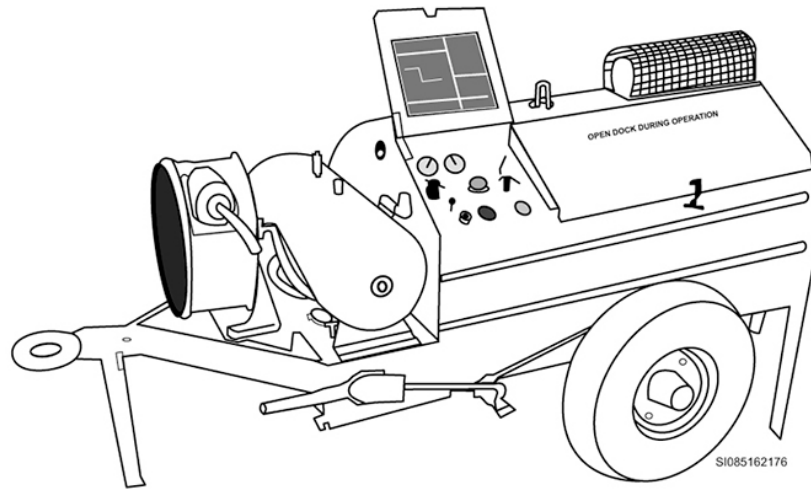


Figure 2-8. MC-2A air compressor (low-pack).

### 011. Dangers associated with air compressors

Serious injuries have been caused by using compressed air to blow dirt or dust from work clothes or by using it to clean up filings, chips, and shavings from repair jobs. Any air pressure strong enough to clean dust or dirt is also strong enough to injure your eyes, ears, or to penetrate your body through a break in your skin.

#### Compressed air safety precautions

Serious injuries can be caused by air pressure as low as 10 to 15 psi. Compressed air must be handled with extreme care. Never use compressed air pressure above 30 psi for cleaning equipment or work areas. When using compressed air, always use the protective equipment identified in ~~Air Force Consolidated Occupational Safety Instruction 91-203, Air Force Consolidated Occupational Safety Instruction~~. Additionally, when you are working with or around air compressors, there must be adequate ventilation. Using an air compressor in an enclosed area could result in asphyxiation or even death. Never fill the fuel tank while the engine is operating or hot; a spark could cause an explosion or fire. Make sure the air hoses aren't frayed, cracked, kinked, or deteriorated in any way and all air fittings are serviceable. Never connect or disconnect a high-pressure service hose without making sure there's no pressure in the system. The pressure coming out of the hose could cut your skin and push air into your bloodstream. This mistake could result in death. Lastly, never connect high-pressure air to a low-pressure air system. Normally the chucks and connections for high- and low-pressure equipment aren't interchangeable, but you still need to take extreme care to preclude any chance of servicing a low-pressure system with high-pressure equipment.

## Self-Test Questions

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

### 010. Air compressor uses and descriptions

1. List the everyday 2W1X1 uses of air compressors.
2. What is the air capacity of the MC-2A?

### 011. Dangers associated with air compressors

1. What is the maximum compressed air pressure for cleaning?
2. What might happen if you use an air compressor in an enclosed area?

## 2-3. Portable Floodlight Sets

Every day when we work on the flightline, we probably don't think much about lighting because the sun provides plenty of light for us to see. However, at night without sunlight, using moonlight or a flashlight just doesn't produce enough adequate light to safely work. So to preclude having to work in such inadequate night conditions, floodlight sets were designed.

### 012. Floodlight set uses and descriptions

Many loading operations occur at night and the use of portable lighting is essential to a safe operation. There are two types of portable lighting systems still in service, but we will only discuss the much more common FL-1D floodlight.

#### Uses and general features

A portable floodlight set furnishes the light for loading and unloading air munitions, for armament systems maintenance, and for emergency and remote-area lighting. Since a floodlight set is essentially a small generator with lights mounted to it, we as maintainers are able to take advantage of this portable electrical power source in a few different ways. One of the most common uses is the capability to provide 115-120 VAC operating power for common electrically powered hand tools such as soldering irons, electric drills, or other similar accessory equipment. The portability of this power source allows you to fix equipment on the spot as opposed to removing equipment or components from the aircraft, transporting them to a backshop, repairing them, returning them to the aircraft, and then reinstalling them.

The floodlight's generator will also produce 220-240 VAC for particular applications. One of the applications where this is most useful to 2W1 personnel is in support of the MQ-1 and the MQ-9 predator aircraft. When used in conjunction with the DCS40-75 "Sorensen" power supply unit, (fig. 2-9) the FL-1D can serve as the ground power source for these aircraft in the same way the -60 or the -86 units are used to supply power for operating other aircraft.

**FL-1D**

The FL-1D (fig. 2-10) is the newest of the floodlights and is replacing the older NF-2 units. The FL-1D has a three-cylinder, 10.5-horsepower, naturally aspirated, water-cooled, diesel-engine-driven generator mounted on a four-wheel trailer with steerable front wheels and parking-brake-equipped rear wheels. Two floodlight assemblies, attached to a telescoping mast, are raised for operation and lowered for transportation between worksites. The mast extends up to 12 feet, and each floodlight can rotate 360°. The floodlight assembly consists of two 1,000-watt, clear BT-37 metal halide lamp fixtures sealed for all-weather use. The lamps produce 110,000 lumens each. These lights require a two to four minute warm-up time, and once they are shut down, you're required to leave them off for a minimum of 10 to 15 minutes before restarting.

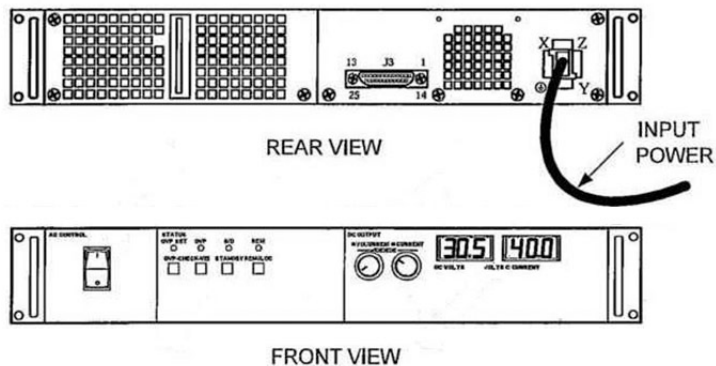


Figure 2-9. DCs40-75 (Sorensen).

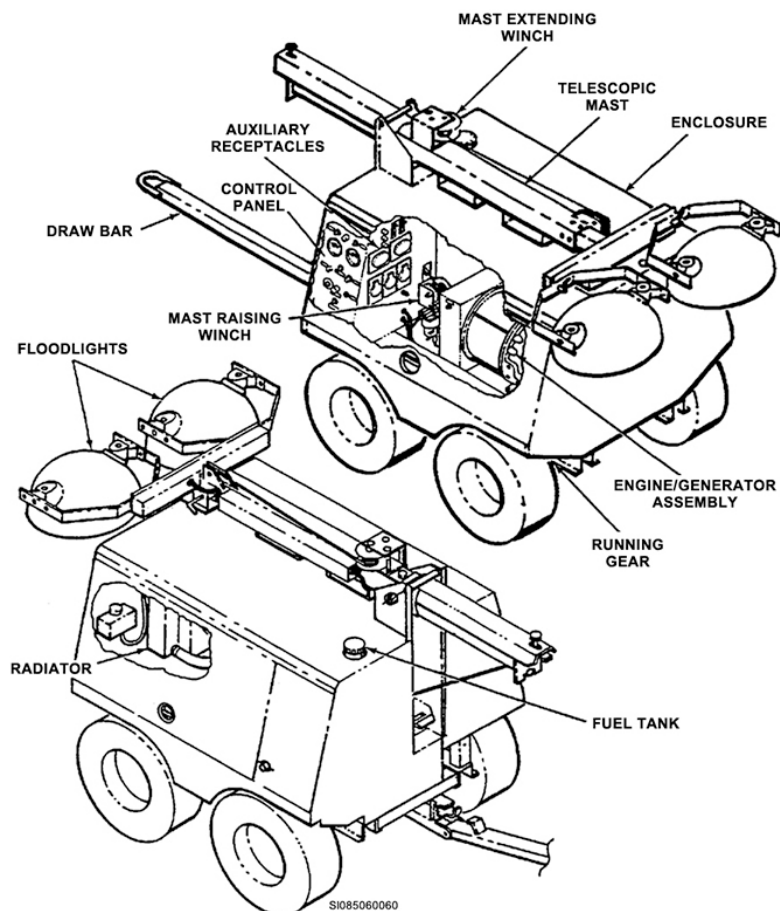


Figure 2-10. FL-1D floodlight.

**013. Floodlight set safety precautions**

Safety is essential to all aspects of maintenance and the use of portable lighting is no exception. The proper use of portable lighting should be safe and without hazards to you or those who work with you.

**Precautions**

Never use the receptacles specifically for floodlights for external power, because 235–300 VAC will overload your other equipment. Make sure the hoist brake assembly is engaged properly when you raise the platform, or it could let the hoist fall, damaging equipment or injuring people. In fact, you should stay clear of the raised lights at all times, just in case the brake disengages inadvertently. Never use the unit as a work platform for any type of maintenance. Never touch the floodlights while they're on or shortly after they are turned off—you're certain to burn your hands severely.

Always keep in mind the floodlights' position in relationship to the aircraft. They should be as far away from the aircraft as possible, while still providing adequate lighting. When you tow floodlights, lower the lights completely to prevent damaging the unit.

---

**Self-Test Questions**

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

**012. Floodlight set uses and descriptions**

1. What must be used in conjunction with the FL-1D to provide power to the MQ-1 or the MQ-9 aircraft?
2. What kind of engine is in the FL-1D floodlight?
3. What is the required warm-up time of the FL-1D floodlight set?

**013. Floodlight set safety precautions**

1. Why must the hoist brake assembly be engaged properly when the floodlights platform is raised?
2. How should the floodlights be positioned in relationship to an aircraft?

## 2-4. Miscellaneous Flight-Line Support Equipment

The support equipment 2W1s use is generally limited to lift trucks, trailers, generator sets, and air compressors. But there are other pieces of equipment we use quite often. These include such items as air-conditioning units, nitrogen servicing carts, hydraulic test stands, maintenance stands, and platforms.

### 014. The A/M 32C-10A air conditioner

Air conditioners are used to wash or clean air, to humidify or dehumidify the air, and to provide cool air for ventilating an aircraft's cockpit or electronic equipment compartments. In this lesson, we will cover the A/M 32C-10A air conditioner and the operating precautions of the equipment.

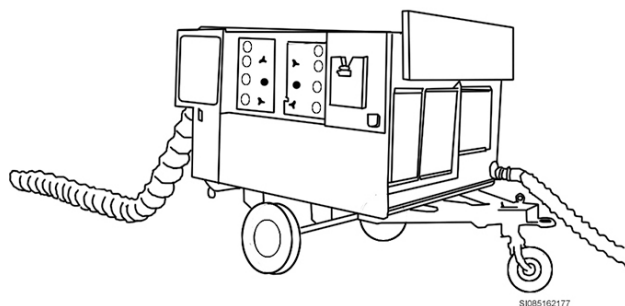


Figure 2-11. A/M 32C-10A air conditioner.

#### A/M 32C-10A

There are different types of air conditioners used in the Air Force, but we will hold our discussion to the A/M 32C-10A, which is (fig. 2-11) (commonly referred to as the C-10) designed to provide cooling air for the electronic systems in today's modern aircraft (i.e., F-15, F-16). Proper cooling prevents overheating and ultimately any damage to the computer systems controlling the aircraft armament systems. The system is operated by bleed-air pressure from an A/M 32A-60 generator set. The A/M 32C-10 air conditioner can deliver conditioned air to two aircraft simultaneously.

#### Characteristics

The air conditioner consists of a two-wheel trailer frame and a retractable front wheel. The frame contains the heat exchangers, air cycle machine, water eliminators and separator, and valves and controls for supplying conditioned air. At the rear of the unit is a storage compartment for four 15-foot conditioned-air hoses and outlets used to connect the aircraft to the high-pressure and conditioned-air outlets. There's also a bleed-air inlet on the front of the unit and an ambient-air outlet on top and to the rear of the unit.

The instrument panel, on the upper left side of the unit, has all the controls necessary to provide conditioned and high-pressure air service. The controls are grouped with the conditioned air to the left and high-pressure air to the right. The instruction plates attached to each group for quick reference during operation do not preclude the need for proper operational training. You should be concerned mainly with the conditioned-air controls, since you won't need high-pressure air for aircraft armament systems operational checks.

#### Operating precautions

As with all aerospace ground equipment (AGE), the air conditioner is not without its do's and don't's. Towing and positioning the air conditioner is one of our tasks. When you're towing the air conditioner, make sure the retractable front wheel is in the vertical, up, position. This wheel is not used during towing; it is used only to support the unit and for hand positioning. Maximum towing speed is 20 miles per hour (mph) on smooth pavement and 10 mph on rough roads. Position the unit between 15 and 30 feet from the aircraft being serviced to allow for optimum unit operating efficiency and safety. Coupling two or more hoses together is normally required because the air hoses come in 15-foot lengths.



Connecting the air conditioner to an aircraft also requires some precautions. When you couple air hoses together or couple hoses to an adapter, there must be a gasket between the connectors or you'll have a severe loss of cooling air. The hoses must be stretched out straight with no twisting and held securely to keep them from whipping around when you apply air pressure. A hose whipping around could damage equipment or injure people. Never connect an air conditioner to a bleed-air turbine compressor supplying more than 45 psi of bleed-air pressure.

This air conditioner has no shutdown valves, so the only way to shut it down is to shut off bleed air at the gas turbine compressor. It takes two people to operate this unit: one to monitor the air conditioner and another to operate the gas turbine compressor. This may not sound as though it has a safety bearing, but if something were to happen while the unit is running and no one was there to shut it down, the amount of damage could be extensive.

### 015. The polyalphaolefin/air cooling cart

The F-22 usually uses its self-contained APU to provide cooling for the onboard avionics. If the APU is inoperable for any reason, the polyalphaolefin (PAO)/air cooling cart is used to provide the needed cooling capability. In this lesson, we will cover the uses and description of the air cooling cart and the operating precautions of the equipment.

#### Cart uses and description

The diesel polyalphaolefin air cooling cart is a self-contained diesel engine powered unit (fig. 2-12). The cart provides temperature conditioned air and temperature controlled PAO liquid coolant to the aircraft environmental control system. The purpose of servicing the aircraft PAO system and avionics is for the cooling of components during ground maintenance and servicing operations. The following table contains the cooling cart's characteristics:

- The cart uses internal pumps for circulation of the PAO fluid through the aircraft systems.
- The PAO cooling pump circulates PAO fluid through the cooling system of the cart and provides pressurized fluid to the aircraft.
- The PAO heat exchanger transfers heat to out-side air by radiating heat through heat exchanger coils and fins into the air passing over them.
- The PAO chiller reduces PAO coolant temperature before transfer to aircraft.
- The PAO reservoir heater provides a means of heating PAO fluid to operating temperature during cold weather operations.

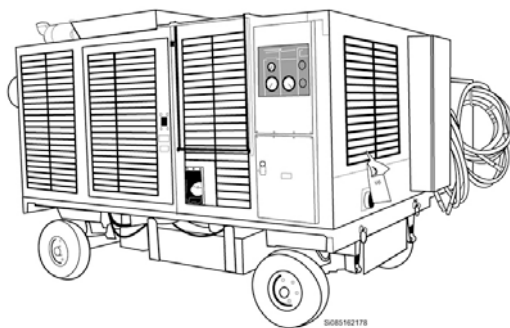


Figure 2-12. PAO/air cooling cart.

The cart can be operated in two PAO fluid temperature modes, forward (FWD) loop mode and aft (AFT) loop mode. Two PAO fluid delivery pressure modes (RATED and VARIABLE) are also available. The PAO fluid delivery temperature is automatically regulated by the PAO cart refrigeration system and is automatically regulated at all times the cart is in operation. The PAO cart controls will prevent the delivery of PAO fluid to the aircraft until the fluid temperature meets the

requirements for the particular temperature mode selected. The cart circulates the PAO fluid within the cart to determine if the PAO fluid temperature is within acceptable limits. At the proper temperature (32° F to 95° F in FWD and 32° F to 120° F in AFT), the cart will automatically begin delivering PAO fluid to the aircraft. Initial fluid delivery pressure will be regulated at 120 pounds per square gage (psig) at the aircraft interface. This reduced pressure delivery is intended to prevent over pressurization of aircraft environmental control system (ECS) components when temperature are stabilized at low/extreme low temperatures.

The cart will monitor the temperature of the return PAO fluid and when within 10° F of the PAO fluid delivery temperature, the cart automatically raises the PAO fluid delivery pressure to 195 psig at the aircraft interface. This ensures PAO fluid in the aircraft is replaced with PAO fluid within temperature specification for the loop selected. When operating in the RATED mode, the PAO cart automatically regulates the PAO delivery pressure at the aircraft interface.

The cart operates in temperatures of -40 F to +120° F and tolerates temperatures of -65° F to 160° F at altitudes from sea level to 7000 feet. The cart can withstand exposure to rain-fall at a rate of 1.4 inches per hour with wind speeds up to 35 mph during operation or storage without damage or degradation of performance. It is capable of operating while exposed to chemical/biological warfare agents and is designed to withstand decontamination with no degradation to structure or function.

### **Operating precautions**

As with any pressurized fluid system, you must make sure the system is depressurized before making or breaking connections with the aircraft. Failure to do so will cause the PAO fluid to spray in all directions. PAO fluid is potentially toxic. Air Force instructions require the use of appropriate personal protective equipment (PPE) suited to application methods. Check input conditions for local bioenvironmental engineering PPE recommendations and provide adequate ventilation. Failing to comply may result in injury and/or illness to personnel.

## **016. The MJ-2A hydraulic test stand**

One of the systems we are required to test is the hydraulic system. To perform this task requires the use of a special piece of AGE equipment—the MJ-2A hydraulic test stand. Within this lesson, we will go over the description and operating precautions of the MJ-2A hydraulic test stand.

### **Test stand uses and description**

Figure 2-13 shows the MJ-2A hydraulic test stand or “MULE” as it’s commonly called. This is a trailer-mounted, self-contained hydraulic unit, mainly used to test an aircraft’s hydraulic system for external and internal leaks and to drain, flush, and refill the system. It’s also used to actuate certain hydraulic devices and controls of the aircraft during system operational and functional tests. We, as 2W1s, use the MULE for functional and operational checks on aircraft gun systems, weapons bay doors, and some weight-off-wheel checks.

The test stand itself has two independently operated and separately controlled hydraulic systems. Designated as “primary” and “secondary,” the systems have the same capabilities; they are driven by the same gas engine and they may be operated independently. Since these two systems have identical capabilities, either may be used as needed. The components of the test stand, including the control panel, are enclosed in a weather-resistant steel cabinet. This cabinet has hinged doors on all sides to permit access to all of the internal components. The doors completely enclose the test stand when it’s not being used. On top of the stand is a cool-air hatch to let cool air enter the unit. This cool-air hatch has support rods to hold it open when the unit is in use. Hose hangers on the right side of the unit provide temporary storage for the external hose. There’s a toolbox and a battery box on the left side of the unit, under the frame. A horizontally opposed, air-cooled, six-cylinder engine supplies power for the unit. The fuel tank is on the right side, under the frame.



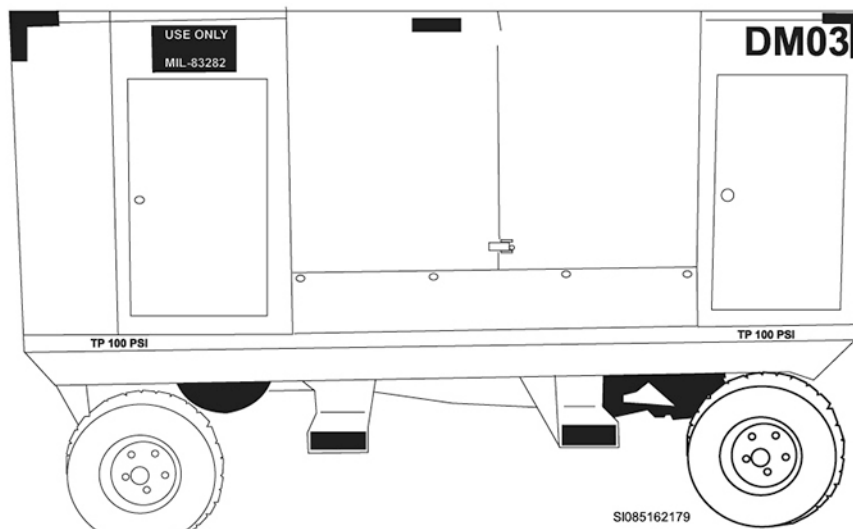


Figure 2-13. MJ-2A hydraulic test stand.

The operator's controls and instruments are at the rear of the unit (fig. 2-14); functionally grouped on a main panel, top panel, lower sub-panel, and two wing panels. The main control panel has most of the operating controls you use in operating the unit. The controls for the primary system have a red background, and the secondary controls have a green background. The system you use doesn't matter; both work the same. The thing to remember is to make sure the correct system's hoses are connected between the aircraft and the hydraulic unit. External test connections are on a recessed panel at the right rear of the test stand. The unit has hoses for connection to an aircraft.

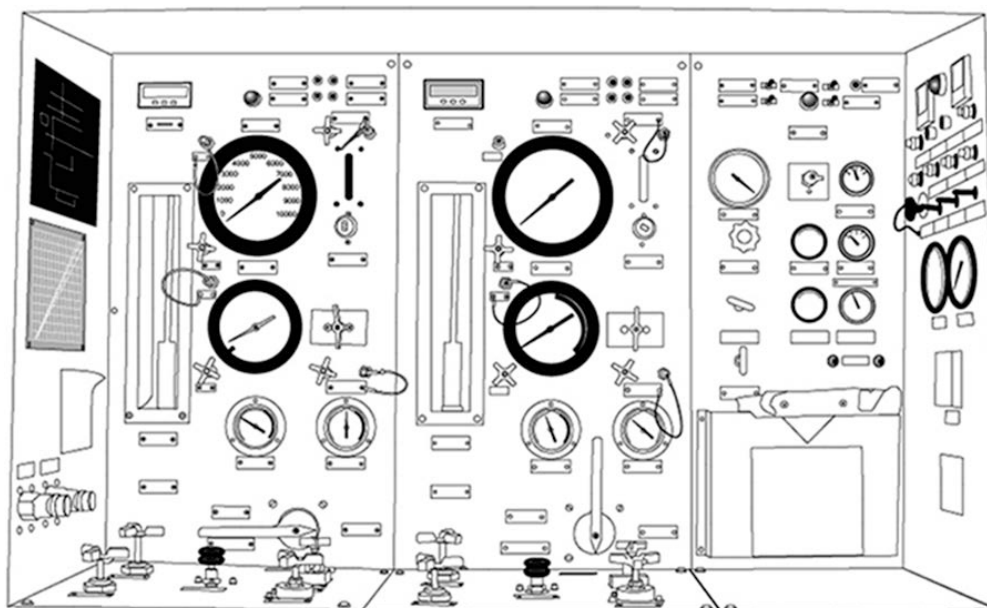


Figure 2-14. MJ-2A hydraulic test stand control panel.

### Operating precautions

Any time you use any piece of equipment, there are safety precautions involved whether you realize it or not. When you're working around the MJ-2A, be sure to always wear proper ear protection, because this unit is quite loud and could damage your hearing. Operate the unit only in areas with adequate ventilation; exhaust fumes could cause asphyxiation or carbon monoxide poisoning. Never connect or disconnect hydraulic hoses with hydraulic pressure applied to them. This will cause

hydraulic fluid to spray in all directions, and the likelihood of hydraulic fluid getting in your eyes is very great. The fluid is extremely dangerous, especially if it contacts your eyes. If this happens, flush your eyes with water immediately and seek medical attention. Never connect the unit's hose to dirty aircraft fittings; clean off any dirt or debris first. It only takes a small amount of dirt inside of a hydraulic system to do a tremendous amount of damage to lines, valves, and so forth.

### 017. Self-generating nitrogen servicing cart

The internal AIM-120 missiles on the F-22 are loaded onto launcher adapter units that require pressurized nitrogen gas in order to launch, thus they require servicing. To do this servicing, armament personnel are required to use the self-generating nitrogen servicing cart (SGNSC). Within this lesson, we will cover the operation and characteristics of the SGNSC.

#### Self-generating nitrogen servicing cart operation

The SGNSC is powered by a 49-hp diesel engine drawing in ambient air through an intake filter and compresses the air to as high as 200 psig (fig. 2-15). The compressed air passes through a series of filters to remove liquid droplets. This air is reheated, then passes through an activated carbon absorber filter to remove oil vapors. The clean air then enters a separation membrane where the oxygen, carbon dioxide, water vapor, and some nitrogen permeate through the walls of hollow synthetic fibers, which are then vented to the atmosphere. The remainder of the nitrogen, with very small amounts of oxygen (4.5 percent or less), exits the separation membrane and is directed to a booster compressor. The booster compressor compresses the nitrogen to pressures as high as 4,400 psig. The high-pressure nitrogen is delivered to the on board high-pressure cylinders for storage, or to devices connected to the high-pressure or low-pressure service hoses through the high- or low-pressure regulators.

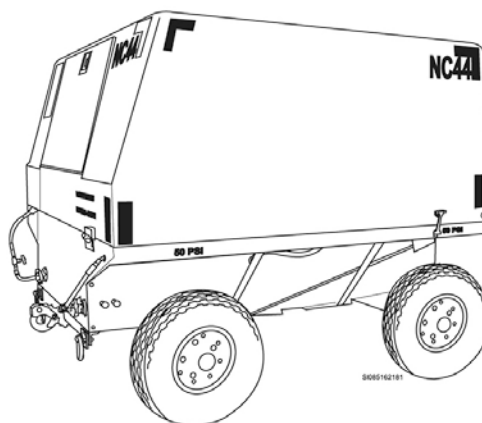


Figure 2-15. Self-generating nitrogen servicing cart.

#### Self-generating nitrogen servicing cart characteristics

The SGNSC is designed to be operated outdoors but can be operated indoors if the proper precautions are taken to make sure the engine exhaust does not accumulate indoors causing a potentially fatal build-up of carbon monoxide. However, it is not recommended the SGNSC be operated indoors. The operator of the SGNSC must be completely familiar with the functions and components of the servicing cart. The operator must also know the location and purpose of all operating controls and indicating instruments (fig. 2-16).

#### General safety

The purpose of the SGNSC is to separate nitrogen from air and make the nitrogen available at high pressures. In doing so, the waste gas product becomes highly enriched with oxygen (about 33 percent oxygen). If nitrogen is allowed to accumulate in an enclosed area, high concentrations of oxygen can occur causing an increased hazard of fire or explosion. Fuel vapors, fuel spillage, and engine exhaust gases are hazards which must be taken into consideration when handling or operating the SGNSC. The SGNSC generates high-pressure nitrogen (up to 4,400 psig) and stores it in cylinders mounted on the unit. This high-pressure gas is dangerous and must be treated as such.

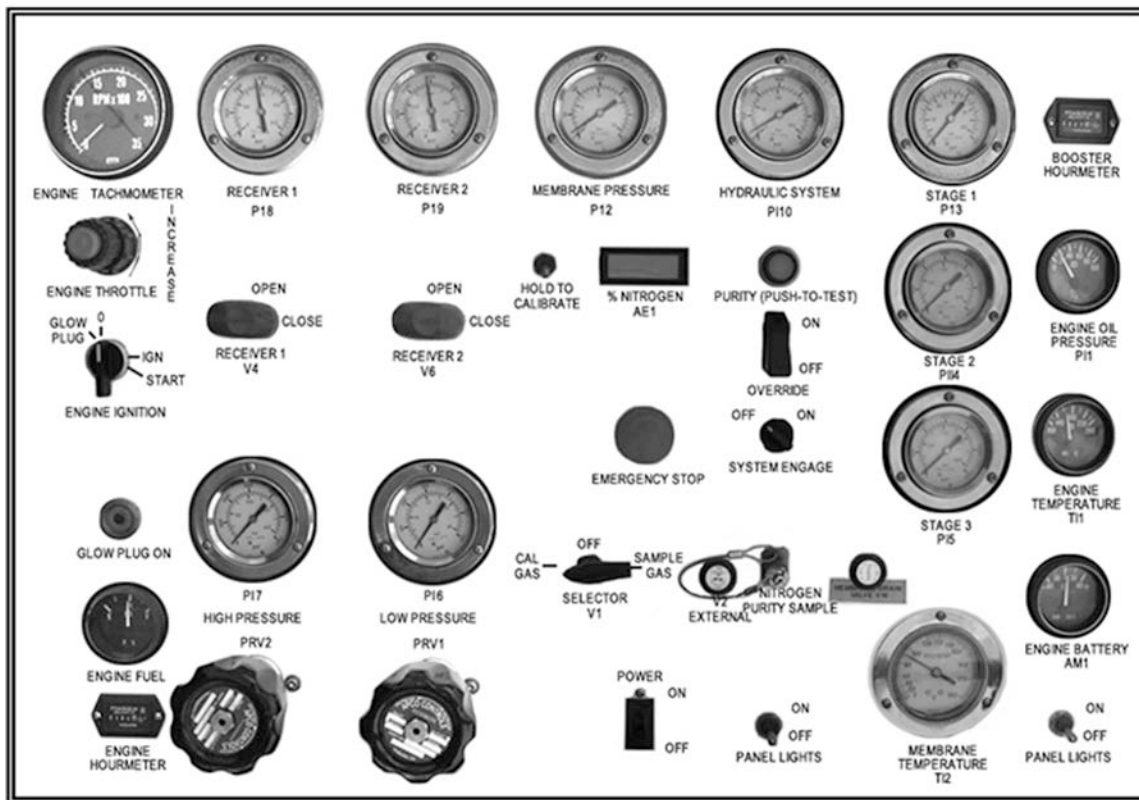


Figure 2-16. Self generating nitrogen servicing cart control panel.

### *Oxygen enriched by product*

The SGNSC must be operated in a well-ventilated area to prevent the buildup of oxygen in the immediate area. If the oxygen concentration increases above 23 percent, flammable materials are easier to ignite and the flames can spread more rapidly than in normal air. This makes it more difficult to extinguish the fire before it spreads to a large area.

### *Nitrogen*

The SGNSC produces high-purity nitrogen (95.5 percent and above). If the nitrogen is allowed to accumulate in an enclosed area, it can displace the oxygen in the air, making it possible for a person to suffocate without warning. You must be very careful not to vent the nitrogen from the storage cylinders into an enclosed space unless there is adequate ventilation.

### *High-pressure gas*

The cylinders and tubing may contain high-pressure gas (up to 4,400 psi). You must be careful when attempting to loosen fittings or remove tubes or hoses. Always follow proper safety procedures when attempting to do so. Whenever it is necessary to loosen fittings, or remove tubes or hoses, always vent the pressure from that part of the system through the appropriate valve before attempting to do so.

For additional servicing and safety operations, refer to TOs 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding* and 35D29-7-6-1, *Self Generating Nitrogen Servicing Cart*.

## **018. Maintenance stands and platforms**

Maintenance stands are an integral part of performing maintenance on aircraft. Many activities require you to work on the upper surface or the wing area of aircraft. Additionally, other activities may require you to be as far up as two stories above the ground. A maintenance stand can make your maintenance effort much easier.

## Maintenance stands

Maintenance stands provide working platforms at variable heights, and may be powered or unpowered. A basic stand consists of a base assembly, upper structure assembly, platform assembly, and a hydraulic system for raising and lowering the platform. (i.e., larger stands). A maintenance stand is often referred to as simply “a platform.” The base assembly is made of welded steel tubing and the platform assembly has a steel frame with a steel mesh base and guardrails on three sides for safety. The hydraulic system consists of a reservoir, a hand pump, a control valve, and an actuating cylinder to raise or lower the platform. Safety locks keep the platform from lowering while it’s in use. Maintenance stands have wheel brakes to hold them in position. As an aircraft armament systems specialist, you should be familiar with maintenance stands in order to select the proper one for each job. There are several types of stands in common use, but we’ll just discuss the stands you’re most likely to use.



Figure 2-17. B-1 maintenance stand.

### *B-1 maintenance stand*

The B-1 maintenance stand is a hydraulically operated combination of stair structure and work platform, mechanically linked together to keep them level throughout the height range of the stand (fig. 2-17). The platform height is easily adjusted with a hydraulic hand pump to any height between three and 10 feet. Stair support members and stair handrails are self-aligning at all platform levels. The handrails of the stairs and the work platform let you work at various extended heights in relative safety.

The stand’s base assembly frame, made of welded tubular steel, is 11 feet long and 4 feet wide. A cylindrical hydraulic fluid reservoir is welded across the width of the frame to form an

integral part of the base frame assembly. The platform lifting mechanism, called the hydraulic cylinder assembly, is operated by a group of hydraulic system units also mounted on the base. The hydraulic cylinder assembly connects the base to the upper structure for lifting and to provide support for the stairs and platform in all extended positions. The stand has a tow bar bolted to the front of the base frame and a wheel mounted at each corner of the base. The two rear wheels have 16-inch pneumatic tires and don’t swivel. The front wheels are casters with ball bearings on the wheel axles and the pivot shafts. This stand was designed to be towed with the front wheels off the ground. The caster front wheels make maneuvering possible.

To stabilize the base structure when the stand is extended, the base has caster locks, base locks, and steady braces. Each caster’s lock wedges into caster horns to prevent swiveling. Two base locks bolted to the forward end of the frame prevent stand movement. These locks are spring-loaded, vertical steel stems with footplates, and they contact the floor when the foot pedals are depressed. In the down position, the locks relieve the weight imposed on the casters and prevent their movement. Two steady braces are arranged to swing outward, in outrigger fashion, from the stowed position at the rear of the stand. Each steady brace has a crank handle, a thread screw, and a steel footplate. When the steady braces are positioned outside the frame, their footplates are lowered by means of the cranks, thus stabilizing that end of the base frame.

The work platform is mounted on the upper structure of the stair support assembly. The platform can sustain a static load of 500 pounds. Platform handrails are one-piece, inverted, U-shaped, steel tubes inserted into the platform sockets and secured with nuts and bolts.



***B-4 maintenance stand***

The B-4 maintenance is a scissors-type, variable-height platform mounted on a caster-equipped base (fig. 2-18). Each wheel has a brake and also can be locked at each 90° position. A hydraulic actuator near the bottom of the platform lets you vary the platform height from three to seven feet. A reservoir with a hand pump and control valve is mounted on the platform near the ladder.

***B-5 maintenance stand***

The B-5 maintenance stand (fig. 2-19) is another scissors-type, variable-height platform, mounted on a long-legged, caster-equipped base. A hydraulic actuating cylinder near the bottom of the platform can vary the height of the platform from seven to 12 feet. A hand pump and control valve are on top of the system reservoir. The reservoir is mounted on the platform near the top of the ladder.

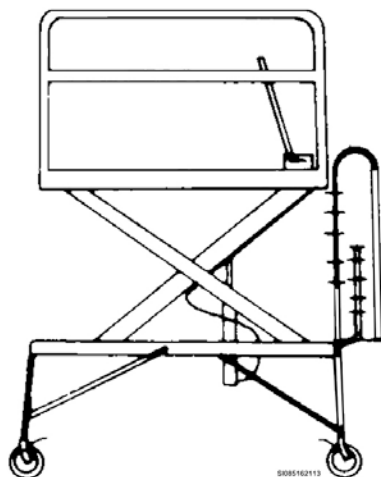


Figure 2-18. B-4 maintenance stand.

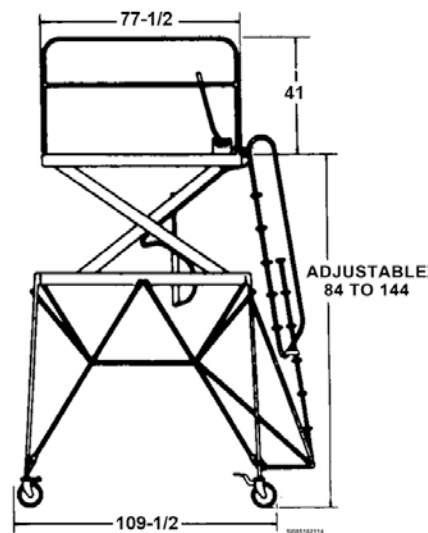


Figure 2-19. B-5 maintenance stand

***C-1 maintenance stand***

The type C-1 maintenance stand is also called the crew chief stand. As you can see in figure 2-20, it is a nonadjustable 4-foot platform with wheels on the back legs. One person can easily move the C-1. When the C-1 stand is set in position, the wheels leave the ground and the stand rests on its four legs. The C-1 stand can be used independently, or it can be installed as an extension on the B-1 maintenance stand.

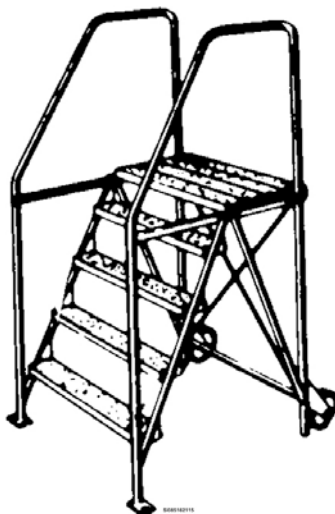


Figure 2-20. C-1 maintenance stand.

### Motorized maintenance platforms

The only motorized maintenance platform now in use is the split-deck maintenance platform (fig. 2-21). It's now used for chaff and flare loading and unloading on the B-1B. This platform is a diesel-powered, self-propelled, hydraulically operated, and electrically controlled, fabricated, steel scissor lift.

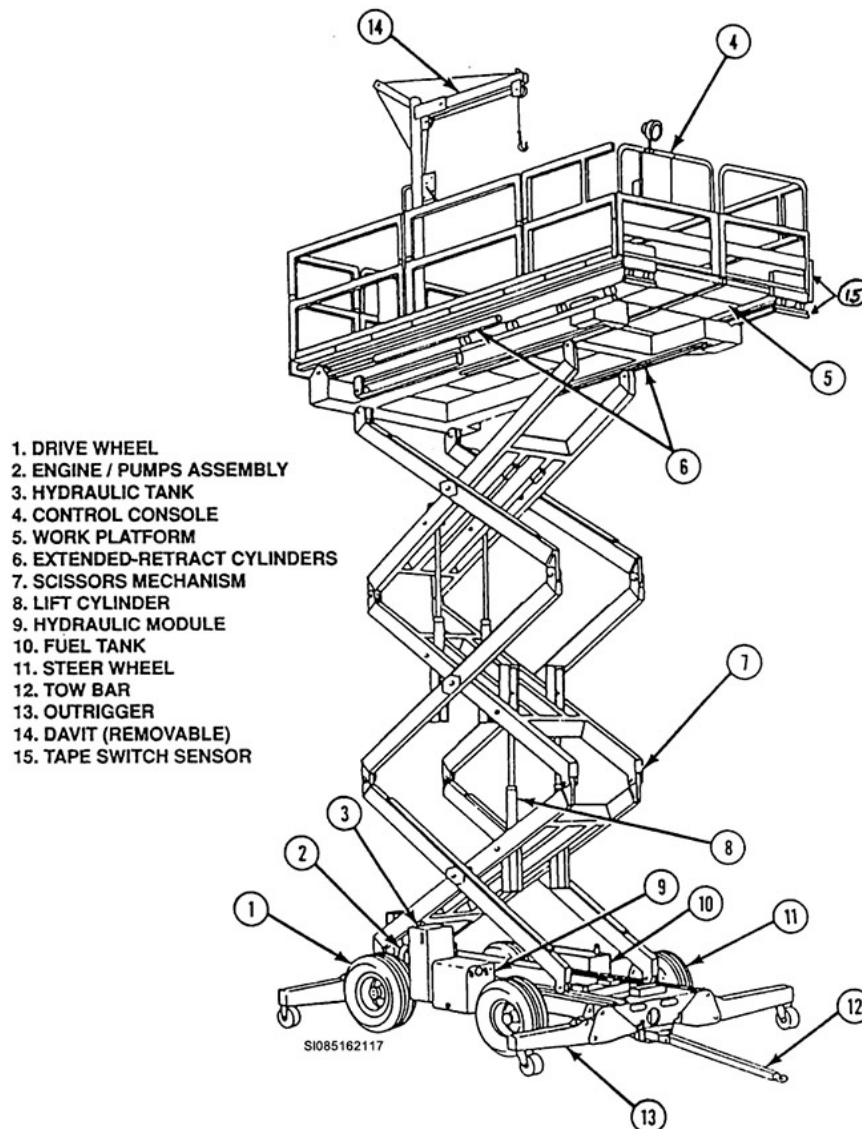


Figure 2-21. Split-deck maintenance platform.

The work platform's guardrails are attached to all four sides of its deck to keep workers relatively safe while the unit is in use. The guardrails also provide an attachment point for the unit's control console. The platform is about 8 by 15 feet, with the rearmost five feet of a stationary nonskid deck material. The remaining forward section is a series of deck panels which separate along the centerline and may be slid apart to form an opening about 4½ feet wide to facilitate aircraft maintenance. Each of the deck panels is about two feet wide and is made of "see through" deck material with a nonskid surface. There are two davit-mounting points at the rear of the platform deck to let you position the davit in the spot most appropriate for the lifting and lowering you're doing. The davit can lift between 250 and 500 pounds, depending on its configuration. There are safety attach points on the deck to secure lanyards from personnel safety harnesses when the unit is in the extended position.

The platform itself may be hydraulically extended forward to give workers some operating flexibility after initially positioning the unit (fig. 2-22). This lets us position the platform over and close to the top of the aircraft's fuselage, gaining easier access to the chaff and flare dispenser components. The platform also has electronic tape switches on the front, side, and bottom of the work platform to detect any obstruction in these areas while the unit is in operation. They automatically stop the forward drive, platform extension, and platform lowering if they detect an obstruction, thus preventing damage to the unit and the aircraft.

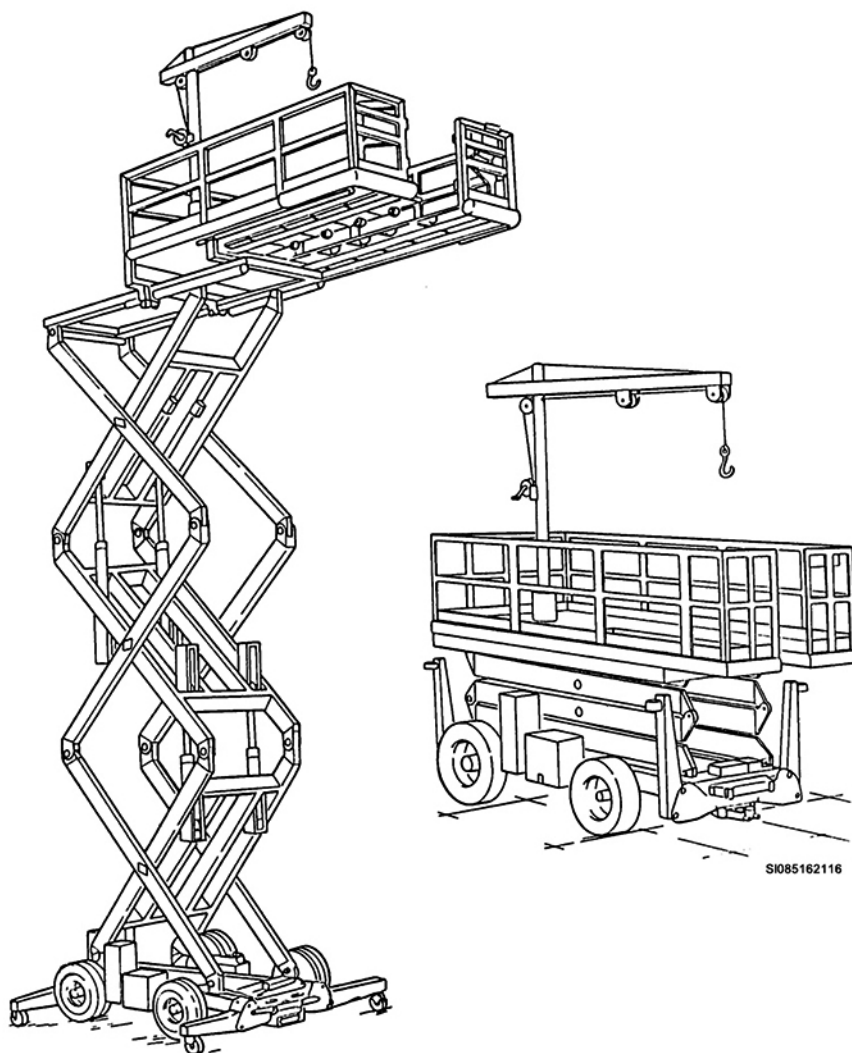


Figure 2-22. Split-deck with platform extended.

The scissor mechanism is hydraulically extended to about 36 feet by four lift cylinders working in conjunction. The scissor mechanism, lift cylinders, and work platform in operation have a total lift capacity of 2,000 pounds. The extension and retraction of the scissor mechanism is normally hydraulically operated and electrically controlled, but in case of a hydraulic or electrical failure, the system may be operated manually from the ground or platform. Four castor equipped outriggers on the corners of the frame stabilize the unit during platform and scissor lift extension. The scissor lift mechanism can't be extended nor can the platform be raised without the outriggers being fully extended.

The maintenance platform is run from a control console on the platform deck, using a driving lever and toggle switches to control all of the unit's functions (fig. 2-23). Manual controls on the hydraulic control module duplicate those at the platform level, with additional controls for steering release;

wheel brakes, backup emergency platform lowering, accumulator pressure bleed-off, and main disconnect battery power.

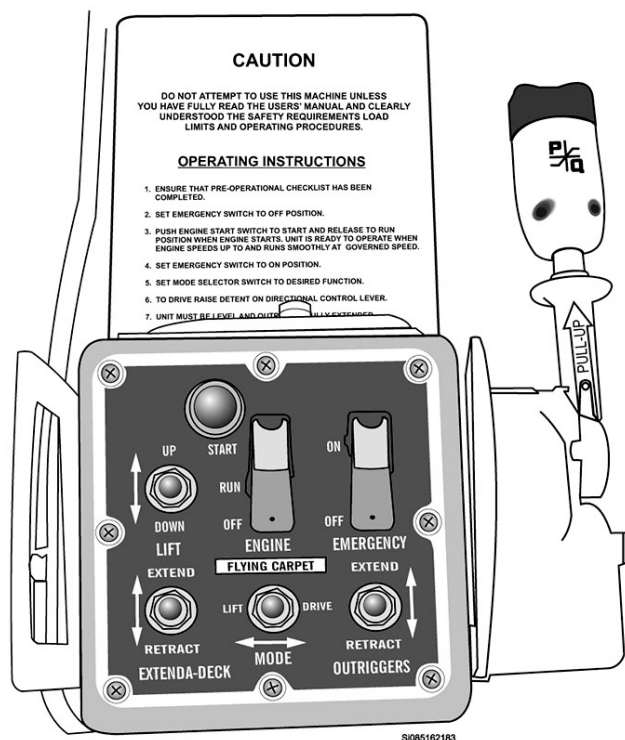


Figure 2-23. Split-deck maintenance platform controls.

The unit may be driven or towed with its platform extended or retracted. Although self-propelled, the platform should be driven only in the area of the work site and not long distances. The maximum operational speed for the unit during self-propulsion with the platform lowered is three miles per hour; with the platform raised, it is limited to 0.3 mph. The unit's maximum towing speed is 15 mph. Always tow the unit when you have to move it long distances or when it's impractical to use self-propulsion. Never use the platform as a crane or as a towing or pushing vehicle. Note: the unit's rough-terrain capabilities are extremely limited. If you need more information on the split deck, refer to TO 35A4-2-60-1, *Operation and Maintenance Instruction with IPB—Maintenance Platform, Split Deck, Diesel*.

### 019. General inspection items

AGE maintenance isn't normally an aircraft armament systems specialist's responsibility, right? Right; but, of course, there's always an exception to the rule. Within this lesson, we will cover AGE maintenance and common inspection items of an AGE.

#### Aerospace ground equipment maintenance

An operator's inspection or pre-use inspection is required on every piece of AGE before it's put into use. If we're going to use this equipment, these inspections automatically become our responsibility. A perfectly rational first question might seem to be, "Why do we perform these inspections?" Well, actually the answer to this question is twofold. First, there is a TO requirement. Each piece of AGE requires one of these two types of inspections before using the unit, according to its TO. Second, we must ensure the safety and serviceability of the unit before we use it. We must, to the best of our ability, make sure we are using the most reliable units available. We absolutely do not want to have problems while using a piece of equipment. If a unit is placed in use and isn't serviceable, the result could be detrimental to the entire Air Force mission. By using unserviceable equipment, we could end up causing damage to equipment or injuring people involved in a particular operation. Another result could be a delayed or even a canceled aircraft mission or sortie. During contingency operations, a



problem of this sort would be totally unacceptable. A break in the chain of events as simple as this could result in the loss of a countless number of lives on the front lines.

### **Common inspection items**

Each AGE unit has specific items to be checked during one of these inspections, and you find these items listed in the unit's TO. Visual examinations are made of the entire unit. During these inspections, the unit must be checked thoroughly. These are some of the more common things to look out for in the following list:

- Defects in cables (i.e., frays), hoses (i.e., cracks).
- Inadequate servicing of fuel, oil, hydraulic fluid (if applicable).
- Evidence of fluid leaks (if applicable).
- Exterior damage to units.
- Insecurity of accessories attached to the units.
- Improper unit operation.

Cycle the unit completely through its ranges of capabilities. If you find a defect in any of these areas, notify the appropriate AGE repair personnel and annotate the equipment forms—AFTO Form 244, Industrial/Support Equipment Record, and AFTO Form 245, Industrial/Support Equipment Record (Continuation Sheet). You'll be thoroughly trained on these inspections at your base. What you must remember from this section are the common things to check during an inspection and these inspections must be performed.

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## **Self-Test Questions**

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

### **014. The A/M 32C-10A air conditioner**

1. State the uses of air conditioners.
2. Air conditioners are currently used on which aircraft?
3. What two types of air may be controlled from the instrument panel of the A/M 32C-10A?
4. What are the positioning requirements for the portable air conditioner around aircraft?
5. How many people are required for operating the air conditioner?

### **015. The polyalphaolefin / air cooling cart**

1. What is the function of the PAO heat exchanger?

2. The PAO cart can operate in how many fluid temperature modes?
3. What is the initial fluid delivery pressure regulated to when the cart initially begins delivering PAO fluid to the aircraft?
4. What is the temperature range for operating the PAO cart?
5. What must you do before making or breaking connections between the PAO cart and the aircraft?

**016. The MJ-2A hydraulic test stand**

1. For what do 2W1s commonly use hydraulic test stands (MULE)?
2. Which hydraulic test stand system, primary or secondary, is used during functional checks?
3. How are the hydraulic system hoses connected to the aircraft, and what precautions should you take in making connections?

**017. Self-generating nitrogen servicing cart**

1. What powers the SGNSC?
2. Where is high-pressure nitrogen delivered by the system for storage?
3. Why is it important to prevent nitrogen accumulation in an enclosed area?
4. What must be done prior to loosening fittings, or remove tubes or hoses?

**018. Maintenance stands and platforms**

1. What are the basic uses of maintenance stands?

2. Describe the B-1 maintenance stand.
3. Describe the B-4 maintenance stand.
4. Describe the B-5 maintenance stand.
5. What is the purpose of the split-deck maintenance platform?

**019. General inspection items**

1. What type of inspections do 2W1s make on AGE?
2. Why do we inspect AGE?

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**Answers to Self-Test Questions****008**

1. They provide electrical power to aircraft systems during loading and unloading and during operational and functional checks; pneumatic power for air-conditioning units to cool avionics components during “power on” electrical checks; and electrical power to other equipment, such as lift trailers, during flight-line loading and unloading.
2. AC and DC electrical power and high-pressure pneumatic power.
3. On the left-hand forward side of the generator set.
4. It lets you supply electrical power to equipment other than the aircraft.
5. Bleed air.
6. Through the sight glass.
7. 400 Hz, three-phase, 115/200 VAC or 230/400 VAC.
8. (1) The engine control panel.  
(2) Generator control panel.  
(3) The external AC panel.
9. The generator control panel.
10. MQ-1 and MQ-9.

**009**

1. Only qualified and authorized personnel.
2. When it's a practice operation using training inert munitions.
3. During combat or simulated combat operations with TO approval or approval of the wing commander or authorized representative.

4. The engine's plane of rotation, which is easily identified by two red vertical lines painted on each side of the unit.

**010**

1. (1) To cycle gun systems and ammunition loaders during system maintenance and loading and unloading.  
(2) To power pneumatic tools; to provide compressed air for cleaning and drying components.  
(3) To recharge pneumatic systems and associated components on aircraft or equipment such as lift trailers.
2. 15 cubic feet of free air per minute at 200 psi.

**011**

1. 30 psi.
2. Asphyxiation or even death.

**012**

1. The DCS40-75 Sorensen power supply unit.
2. Three-cylinder, naturally aspirated, water-cooled, 10.5-horsepower diesel.
3. 2 to 4 minutes.

**013**

1. Damage to the platform or injury to personnel could result.
2. They should be kept as far away as possible, while still providing adequate lighting.

**014**

1. To wash or clean air, to humidify or dehumidify the air, and to provide cool air for the ventilation of an aircraft's cockpit or electronic equipment compartments.
2. The F-15, F-16 aircraft.
3. Conditioned and high-pressure air.
4. Position it between 15 and 30 feet from the aircraft being serviced.
5. Two: one monitoring the air conditioner and the other operating the gas turbine compressor.

**015**

1. Transferring heat to out-side air by radiating heat through heat exchanger coils and fins into the air passing over them.
2. Two, forward (FWD) loop mode and aft (AFT) loop mode.
3. 120 psig.
4. -40° F to +120° F.
5. You must make sure the system is depressurized.

**016**

1. For operational and functional checks on aircraft gun systems, weapons bay doors, and some weight-off-wheel checks.
2. Either system may be used; both have the same capabilities.
3. The hoses are connected with no hydraulic pressure applied to them. You must be extremely careful hydraulic fluid does not get into your eyes.

**017**

1. A 49-hp diesel engine.
2. On board high-pressure cylinders.
3. If the nitrogen is allowed to accumulate in an enclosed area, high concentrations of oxygen can occur, causing an increased hazard of fire or explosion.
4. Always vent the pressure from that part of the system through the appropriate valve before attempting to loosen fittings, or remove tubes or hoses.

**018**

1. Maintenance stands provide working platforms at variable heights.
2. It is a hydraulically operated combination of stair structure and work platform. The platform height is easily adjusted (with a hydraulic hand pump) to any height between three and 10 feet.
3. It is a scissors-type, variable-height platform with a hydraulic actuator near the bottom of the platform lets you vary the platform height from three to seven feet.
4. It is a scissors-type, variable-height platform with a hydraulic actuating cylinder near the bottom of the platform so you can vary the height of the platform from seven to 12 feet.
5. For chaff and flare loading and unloading on the B-1B aircraft.

**019**

1. Operator's and pre-use inspections.
2. It's a TO requirement, and we must ensure the safety and serviceability of any piece of AGE we use.

## Unit Review Exercises

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

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

50. (008) How many different outputs can an A/M 32A-60 generator provide?
  - a. Two.
  - b. Three.
  - c. Four.
  - d. Five.
51. (008) Which unit is the *only* auxiliary power unit (APU) to provide both electrical and pneumatic power?
  - a. A/M 32A-60.
  - b. A/M 32A-86.
  - c. A/M 32A-95.
  - d. MC-2A.
52. (008) Which A/M 32A-60 control panel has the switches and controls necessary to operate the direct current (DC) generator and to monitor the DC voltage output of the generator set?
  - a. Power output.
  - b. DC instrument.
  - c. Generator control.
  - d. Auxiliary power unit (APU) output.
53. (008) What source is the output of the A/M32A-95 Gas Turbine Compressor?
  - a. Bleed air.
  - b. 28 volts, direct current (VDC).
  - c. 120 volts, alternating current (VAC), single-phase, 400 hertz (Hz).
  - d. 120/208 VAC, three-phase, 400 Hz.
54. (008) Due to the expansion properties of fuel, an unmodified A/M32A-95 Gas Turbine Compressor fuel tank should *not* be filled more than approximately how full?
  - a.  $\frac{1}{3}$ .
  - b.  $\frac{1}{2}$ .
  - c.  $\frac{3}{4}$ .
  - d.  $\frac{5}{8}$ .
55. (008) How many instrument/control panels *must* the operator make use of during operation of the A/M 32A-86 generator set?
  - a. One.
  - b. Two.
  - c. Three.
  - d. Four.
56. (008) Which A/M 32A-86 control panel contains the gauges and controls required for monitoring the output voltage and amperage of the unit during operation?
  - a. External alternating current (AC).
  - b. Generator control.
  - c. Engine control.
  - d. Output control.

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57. (008) Which panel of the A/M 32A-86 generator set has the circuit breaker to shut off current flow in case of an overload?
- a. Engine control.
  - b. Generator control.
  - c. External direct current (DC).
  - d. External alternating current (AC).
58. (008) Which auxiliary power unit serves as an external power source for the MQ-1 and MQ-9 aircraft?
- a. A/M 32A-60.
  - b. A/M 32A-86.
  - c. A/M 32A-95.
  - d. Starter cart assembly (SCA).
59. (008) Which type of power is provided to the MA-1 and MQ-9 aircraft by the starter cart assembly (SCA) for use in avionics systems?
- a. 18 volts, alternating current (VAC).
  - b. 24 volts, direct current (VDC).
  - c. 28 VDC.
  - d. 28 VAC.
60. (008) Where is the control panel of the starter cart assembly (SCA) located?
- a. On the power outlet panel located on the right side of the generator set.
  - b. Underneath a cover located at the top of the unit.
  - c. On the starter cart assembly electronics tray.
  - d. On the engine monitoring panel.
61. (009) An operator *not* required at or in the immediate vicinity of an in-use auxiliary power unit (APU) when they are practice loading
- a. high explosive munitions.
  - b. live chemical munitions.
  - c. inert training munitions.
  - d. live nuclear weapons.
62. (009) Fighter aircraft may be exempted from the 50-foot distance placement requirements of an auxiliary power unit (APU) during
- a. combat operations only.
  - b. simulated combat operations only.
  - c. combat or simulated combat operations.
  - d. combat, simulated combat, or adverse weather conditions.
63. (010) Which air compressor may be used to operate *small* pneumatic tools?
- a. MC-1A.
  - b. MC-2A.
  - c. MD-3.
  - d. A/M 32A-60.
64. (010) How much air pressure is produced by the MC-2A air compressor?
- a. 5 cubic feet per minute (cfm) at 200 pounds per square inch (psi).
  - b. 15 cfm at 200 psi.
  - c. 5 cfm at 3,200 psi.
  - d. 15 cfm at 3,500 psi.

65. (011) How many pounds per square inch (psi) is the *maximum* air pressure you may use for cleaning equipment or work areas.
- 15 psi.
  - 20 psi.
  - 25 psi.
  - 30 psi.
66. (011) Before you connect or disconnect a high-pressure service hose, you *must* make sure the system is *not*
- pressurized with more than 100 pounds per square inch (psi).
  - pressurized with more than 15 psi.
  - pressurized fully.
  - pressurized.
67. (012) Which power output of a portable floodlight set is used for powering common electrically powered hand tools?
- 28 volts, direct current (VDC).
  - 115-120 volts, alternating current (VAC).
  - 220-240 VAC.
  - 225-300 VAC.
68. (012) The FL-1D floodlight can serve as a ground power source for MQ-1 and MQ-9 aircraft when used in conjunction with a/an
- MC-2A air compressor.
  - A/M 32A-60 generator set.
  - A/M 32C-10A air conditioner.
  - DCs40-75 "Sorensen" power supply unit.
69. (012) How long can the lights of a FL-1D floodlight *must* be left off before you should restart them.
- 2-3 minutes.
  - 4-6 minutes.
  - 7-9 minutes.
  - 10-15 minutes.
70. (013) When can you use the floodlight receptacles for external power to operate accessories?
- When 115-120 VAC is required.
  - When 110-115 VAC is required.
  - When 235-300 VAC is required.
  - Never, these receptacles cannot be used to operate accessories.
71. (013) In which position *must* the FL-1D floodlight's platform be placed during towing?
- Any position.
  - Lowered halfway.
  - Lowered completely.
  - Lowered just enough to clear overhead obstacles.
72. (014) Which additional piece of aerospace ground equipment (AGE) generator set is required during operation of the A/M 32C-10 air conditioner?
- A/M 32A-60.
  - A/M 32A-86.
  - MC-2A.
  - MD-3.



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73. (014) How far from the supported aircraft should the A/M 32C-10 air conditioner be positioned for optimum unit operating efficiency and safety?
- a. 8 to 10 feet.
  - b. 10 to 12 feet.
  - c. 15 to 30 feet.
  - d. 50 feet minimum.
74. (014) Which pound per square inch (psi) is the *maximum* amount of bleed-air pressure that may be applied to the A/M 32C -10 air conditioner?
- a. 25 psi.
  - b. 30 psi.
  - c. 35 psi.
  - d. 45 psi.
75. (014) How many operators are required to be present during the operation of the -10 air conditioner?
- a. One.
  - b. Two.
  - c. Three.
  - d. Four.
76. (015) Which additional piece of aerospace ground equipment (AGE) is required during the operation of the polyalphaolefin (PAO)/air cooling cart?
- a. A/M 32A-60 generator set.
  - b. A/M 32A-86 generator set.
  - c. A/M 32A-95 generator set.
  - d. None, it is a self-contained system.
77. (015) How many fluid temperature modes are available on the polyalphaolefin (PAO)/air cooling cart?
- a. One.
  - b. Two.
  - c. Four.
  - d. Six.
78. (015) Which action *must* be ensured before making or breaking a connection between the polyalphaolefin (PAO)/ air cooling cart and the aircraft?
- a. Cart power is off.
  - b. System is depressurized.
  - c. Servicing lines are bled.
  - d. Servicing lines are free of kinks.
79. (016) The cool-air hatch on the MJ-2A hydraulic test stand is located on the unit, but which location on the unit?
- a. Rear.
  - b. Front.
  - c. Side.
  - d. Top.
80. (016) Which panel(s) of the MJ-2A hydraulic test stand has *most* of the operating controls?
- a. Top panel.
  - b. Main panel.
  - c. Wing panels.
  - d. Lower subpanel.

81. (016) If hydraulic fluid comes in contact with your eyes during a MJ-2A hydraulic test stand operation, what should you do?
- a. Flush eyes with water and seek medical attention.
  - b. Wipe eyes with soft cloth and seek medical attention.
  - c. Flush eyes with water only, as seeking medical attention is not necessary.
  - d. Wipe eyes with soft cloth only, as seeking medical attention is not necessary.
82. (016) What reason is necessary for making sure aircraft fittings are clean before attaching hydraulic servicing hoses?
- a. Dirty fittings will cause damage to the threads of the connectors on the test stand.
  - b. Dirty fittings can cause an incomplete seal with the hoses resulting in leaks at the attach points.
  - c. Dirty fittings can introduce contaminants to the hydraulic systems causing damage to valves and lines.
  - d. Dirt can scour protective coatings off of the fittings that will allow them to corrode when bare metal is subjected to the environment.
83. (017) Which aircraft(s) require aircraft armament system personnel to use the self-generating nitrogen servicing cart (SGNSC)?
- a. F-15, F-16, and F-22.
  - b. B-1, B-2, and B-52.
  - c. F-15 and F-15E.
  - d. F-22 only.
84. (017) When using the self-generating nitrogen servicing cart (SGNSC) why is it *important* that waste gasses are *not* allowed to accumulate in an enclosed space?
- a. Dangerous levels of carbon monoxide can build up displacing oxygen.
  - b. Dangerous levels of carbon dioxide can build up displacing oxygen.
  - c. Excess nitrogen can pose a fire or explosion hazard.
  - d. Excess oxygen can pose a fire or explosion hazard.
85. (017) Why is it *important* to prevent venting the self-generating nitrogen servicing cart (SGNSC) storage tanks in an enclosed space without sufficient ventilation?
- a. Excess nitrogen can pose a fire/explosion hazard.
  - b. Venting of high pressure gas is extremely loud and could damage hearing.
  - c. Large volumes of nitrogen can displace the oxygen in the air if there is inadequate ventilation.
  - d. A dangerous overpressure situation could occur causing harm to personnel and damage to structures.
86. (017) Which precaution *must* be taken prior to attempting to loosen fittings, or removing tubes or hoses when using the self-generating nitrogen servicing cart (SGNSC)?
- a. Ensure cart power is off.
  - b. Ensure the entire system is depressurized.
  - c. You must vent the pressure from that part of the system through the appropriate valve.
  - d. Ensure the carts high pressure storage tanks main shutoff valves are in the "NO-FLOW" position.
87. (018) What range in feet is the height of the B-1 maintenance stand?
- a. 1 to 7.
  - b. 1 to 12.
  - c. 3 to 10.
  - d. 3 to 15.

88. (018) The *maximum* static load the B-1 maintenance stand can sustain is
- a. 300 pounds.
  - b. 500 pounds.
  - c. 650 pounds.
  - d. 750 pounds.
89. (018) What range in feet is the platform height of the B-4 maintenance stand?
- a. 3 to 7.
  - b. 1 to 10.
  - c. 3 to 12.
  - d. 1 to 15.
90. (018) The hand pump for raising the B-4 maintenance stand is located on the
- a. platform near the ladder.
  - b. remote control unit (RCU).
  - c. base of the stand near the aft castors.
  - d. base of the stand near the forward castors.
91. (018) Which maintenance stand is described as a scissors-type, with a variable-height platform, and mounted on a long-legged caster-equipped base?
- a. B-1.
  - b. B-4.
  - c. B-5.
  - d. C-1.
92. (018) What range in feet is the platform height of the B-5 maintenance stand?
- a. 1 to 7.
  - b. 1 to 10.
  - c. 7 to 12.
  - d. 7 to 15.
93. (018) Which maintenance stand is described as a nonadjustable 4-foot platform with wheels on the back legs?
- a. B-1.
  - b. B-4.
  - c. B-5.
  - d. C-1.
94. (018) Which maintenance stand can be used independently, or can be installed as an extension on the B-1 maintenance stand?
- a. B-2.
  - b. B-4.
  - c. B-5.
  - d. C-1.
95. (018) The split-deck maintenance platform is currently being used with which aircraft?
- a. B-1B.
  - b. B-52G.
  - c. B-52H.
  - d. F-16.

96. (018) The lifting capacity of the davit on the split deck maintenance platform is
- 200-500 pounds.
  - 250-500 pounds.
  - 300-500 pounds.
  - 350-500 pounds.
97. (018) If the split-deck maintenance platform's tape switches detect an obstruction during an operation, what will the switches stop on the unit?
- Forward drive capability only.
  - Platform extension capability only.
  - Platform extension and lowering capabilities only.
  - Forward drive, platform extension, and lowering capabilities.
98. (018) What number of pounds is the total lift capacity of the split-deck maintenance platform?
- 2,000.
  - 2,200.
  - 2,500.
  - 3,000.
99. (019) During an operator's pre-use inspection of aerospace ground equipment (AGE), what action is required by the operator to *ensure* proper unit operation?
- Check the Air Force Technical Order (AFTO) 781K forms for any defects.
  - Check with AGE personnel as to the status of the unit.
  - Cycle the unit completely through its range of capabilities.
  - Cycle the unit only through the capabilities that you will use.
100. (019) Which Air Force Technical Order (AFTO) form(s) is/are used to annotate any defects you may find on your aerospace ground equipment (AGE)?
- AFTO Forms 244 and 245.
  - AFTO Form 349.
  - AFTO Form 350.
  - AFTO Form 781.

## Glossary Abbreviations and Acronyms

<b>AC</b>	alternating current
<b>AFT</b>	aft
<b>ADA</b>	auxiliary drive assembly
<b>AGE</b>	aerospace ground equipment
<b>AGM</b>	air-to-ground missile
<b>ALA</b>	ammunition loading assembly
<b>ALS</b>	ammunition loading system
<b>APU</b>	auxiliary power unit
<b>cfm</b>	cubic feet per minute
<b>DC</b>	direct current
<b>ECS</b>	environmental control system
<b>FWD</b>	forward
<b>Hz</b>	hertz
<b>LALS</b>	linkless ammunition loading system
<b>LMHA</b>	launcher/module handling adapter
<b>LTC</b>	link tube carrier
<b>MER</b>	multiple ejector rack
<b>mm</b>	millimeter
<b>mph</b>	miles per hour
<b>MHU</b>	munitions handling unit
<b>MRA</b>	mechanical ram assembly
<b>PAO</b>	polyalphaolefin
<b>PCU</b>	portable control unit
<b>PPE</b>	personal protective equipment
<b>psi</b>	pounds per square inch
<b>psig</b>	pounds per square gauge
<b>QRP</b>	quick release pins
<b>RCU</b>	remote control unit
<b>RPA</b>	remotely piloted aircraft
<b>rpm</b>	revolutions per minute
<b>RPV</b>	remotely piloted vehicle
<b>SCA</b>	starter cart assembly

<b>SGNSC</b>	self-generating nitrogen servicing cart
<b>TER</b>	triple ejector rack
<b>TO</b>	technical order
<b>UAIU</b>	universal aircraft interface unit
<b>UALS</b>	universal ammunition loading system
<b>VAC</b>	volts, alternating current
<b>VDC</b>	volts, direct current
<b>WRA</b>	weapons replaceable assemblies
<b>X</b>	lateral
<b>Y</b>	longitudinal

## **Student Notes**

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