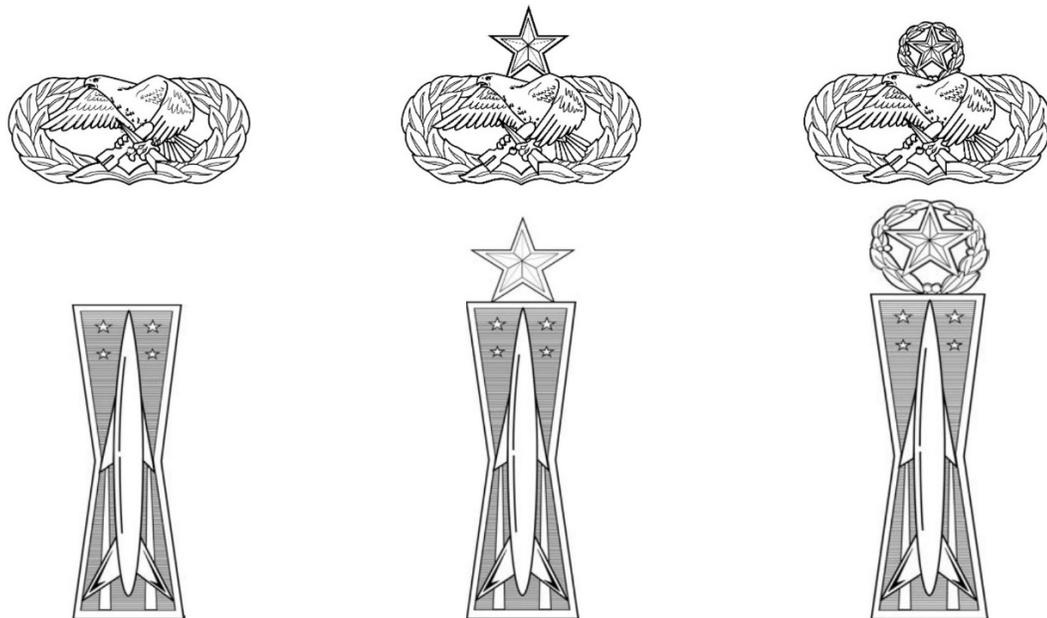


CDC 2M052

Missile and Space Systems Maintenance Journeyman

Volume 3. Vehicles, Equipment, and Maintenance



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THIS THIRD VOLUME of career development course (CDC) 2M052, *Missile and Space Systems Maintenance Journeyman*, pertains to the vehicles and equipment used to maintain the intercontinental ballistic missile (ICBM) weapon system. The subjects covered in this volume range from the hydraulic and pneumatic principles used in the design of ICBM special-purpose maintenance vehicles and support equipment to the function and operation of specific vehicles and pieces of equipment.

Unit 1 describes the function and operation of several special-purpose maintenance vehicles 2M0X2 technicians use to maintain the Minuteman III ICBM weapon system.

Unit 2 describes the function and operation of several types of support equipment 2M0X2 technicians use to maintain the Minuteman III ICBM weapon system.

Unit 3 discusses aerospace vehicle equipment (AVE) inspections, loading/unloading, transportation, and launch facility (LF) maintenance.

Unit 4 covers the Minuteman III missile downstage transportation and maintenance. It also covers some of the emergency procedures 2M0X2 technicians could perform.

A glossary is included for your use.

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For Guard and Reserve personnel, this volume is valued at 12 hours and 3 points.

NOTE:

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

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Unit 1. Special-Purpose Vehicles

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AS A MISSILE MAINTENANCE technician, you will use a variety of special-purpose vehicles to maintain the Minuteman III intercontinental ballistic missile (ICBM) weapon system. Each of these vehicles operate differently and are designed to provide a different function based on the type of maintenance that needs to be accomplished.

You will use these vehicles to perform the following operations:

- Transport support equipment between the missile support base (MSB) and the launch facility (LF).
- Transport missile downstages between the MSB and the LF.
- Transport aerospace vehicle equipment (AVE) components between the MSB and the LF.
- Remove and install missile downstages at the LF.
- Remove and install AVE components at the LF.
- Store missile downstages at the MSB.

You will likely operate and maintain these special-purpose vehicles as a missile maintenance team (MMT) technician at some point in your Air Force career. This unit covers the payload transporter (PT), transporter-erector (TE), missile transporter (MT), and rocket motor trailer (RMT).

401. Payload transporter description

While other work centers and career fields maintain different parts of the PT (fig. 1-1), the PT is your main workhorse as a missile maintenance technician. It is used to load, unload, transport, remove, and replace AVE components at the MSB and the LF. Mechanical and pneumatic section (MAPS) technicians maintain the PT structural and hoisting components. However, MMT uses it every day to carry out maintenance in the missile field. It is important that you become familiar with the PT since you could either be performing maintenance on it, or driving it to the field and operating it. This lesson begins with the tractor and then moves to the rear of the trailer.



Figure 1-1. Payload transporter.

Tractor and auxiliary power unit

Technicians use the PT tractor to pull the PT semitrailer during transportation operations. The tractor fuel tanks supply fuel to the tractor as well as the auxiliary power unit (APU). There are two versions of PT tractors in use today, the cab-over, and the conventional. Their checkout and driving characteristics vary slightly, but they have the same major components and accomplish the same mission. The two major items you should be familiar with on the PT tractor are the pneumatic system and the APU.

Pneumatic system

The pneumatic system supplies compressed air for the trailer's pneumatic equipment, provides the controls and instrumentation for the system, and provides braking and air suspension for the truck and trailer. An alcohol injector helps prevent moisture from freezing in the air lines when it is exposed to freezing temperatures for long periods of time. Pneumatic lines distribute air to the various components of the tractor's pneumatic system.

The tractor air suspension system also receives air from the tractor pneumatic system. A switch located inside the cab of the tractor actuates the eight air bags that are used to raise or lower the rear suspension of the tractor. Automatic height control valves maintain the proper level of air pressure in the air bags.

Auxiliary power unit

The PT APU (fig. 1-2) supplies the electricity required to operate the PT environmental control system (ECS) and hoist whenever site power is unavailable. It consists of a diesel engine and generator that provides the same 120/208 volts alternating current (VAC), 3-phase power as the site power cable. The APU is located directly behind the tractor cab. An additional cable similar to a site power cable is needed to route power from the APU to the PT trailer.



Figure 1-2. PT auxiliary power unit.

The APU must be started manually using the control panel on the left side. It uses a 12 volts direct current (VDC) starting system that is shared with the PT tractor power system. This means that if the PT tractor batteries are too discharged to start the PT tractor's engine the APU will not start either. The 12-volt battery charger maintains the tractor batteries in a fully charged condition when the APU is operating and the tractor engine is not. When the tractor engine is running, a relay in the APU electrically removes the APU battery charger from the battery circuit to avoid interfering with the tractor alternator charging system.

The APU immersion heater warms the APU engine block using electricity it receives from an extension cord that is plugged into a 120 VAC outlet. The heater must be used if the ambient temperature is below 40 degrees Fahrenheit (°F).

Semitrailer

The PT semitrailer is 44 feet long, 10 feet wide, and 13 feet 6 inches high. It provides the ability to load, unload, transport, and remove and replace AVE components. The major systems and equipment of the semitrailer include the following:

- Structure.
- Electrical system.
- Hoist system.

- Pneumatic system.
- Running gear and suspension system.
- Air pallets.
- Guidance and control (G&C) section purging manifold.
- ECS.

Structure

The semitrailer structure is composed of the following items:

- Chassis and framework.
- Adjustable landing gear.
- Personnel exits.
- Cargo doors.
- Floor hatch.
- Environmental control panel.
- Environmental flaps.
- Small arms protection (SAP).

Chassis and framework

The PT semitrailer is similar to a trailer you might find in the commercial sector. The center portion of the trailer is lower, while the front and rear sections are elevated to accommodate the wheels of the tractor and the trailer.

Adjustable landing gear

There are four adjustable landing gear assemblies, one at each corner of the lower section of the PT trailer. This landing gear is used to support and stabilize the trailer while AVE components are being emplaced or removed at the LF. During LF preparation procedures for AVE removal or installation, the landing gear will be extended prior to deflating the semitrailer suspension air bags. This ensures that the trailer is stable and level before deploying the environmental flaps and using the hoist. When preparing the semitrailer for travel, retract the landing gear after inflating the suspension air bags. Additionally, the forward set of landing gear supports the semitrailer when the tractor is not connected.

Personnel exits

A personnel access door is located on the rear driver's side of the trailer. An optional set of stairs can be connected, or you can use the folding foot-holds to climb up to the access door. A second personnel access door is located on the front driver's side of the trailer. It is typically only used during an emergency. The rear door can be opened from the outside or inside, while the front emergency door can only be opened from the inside.

Cargo doors

Two large outward-swinging cargo doors located at the rear of the trailer allow AVE components to be loaded onto or removed from the trailer.

Floor hatch

A floor hatch located in the center dropped section of the trailer also allows AVE components to be loaded onto or removed from the trailer.

Environmental control system control panel

The ECS control panel (fig. 1-3) is located on the front driver's sidewall on the outside of the semitrailer, near the emergency door. This panel houses the switches and indicators that are used to operate the ECS in order to maintain the internal temperature of the semitrailer between 50 and 80°F.

The control panel is covered by a hinged access door with a viewing window that allows you to see the panel's indicator lights.



Figure 1-3. PT ECS control panel.

Environmental flaps

The semitrailer is equipped with four environmental flaps. Two are installed on the sides and two are installed on the bottom of the semitrailer. These flaps provide a weather seal around the top of the launch tube whenever the launcher closure (LC) door is rolled open. The two main flaps located on the sides of the semitrailer are raised and lowered with cables and manual winches. The flap segments are extended and retracted manually and are secured with palm knobs and locking pins when the trailer is in transit. The two underbody flaps are repositioned manually, and retaining pins hold the flaps in the stowed position during transit.

Small arms protection (SAP) system

The front raised section of the trailer (closest to the tractor) is surrounded by thick armor plating to protect any AVE components on the forward pallet from small arms fire. In addition to this, two armored bi-fold doors can also be manually closed to isolate the forward pallet from the rest of the trailer.

Semitrailer lighting

The semitrailer contains explosion-proof interior and launch-tube lights along with running lights. A total of ten interior lights (fig. 1-4) illuminate the inside of the trailer while four additional lights can be used to illuminate the launch tube during maintenance.

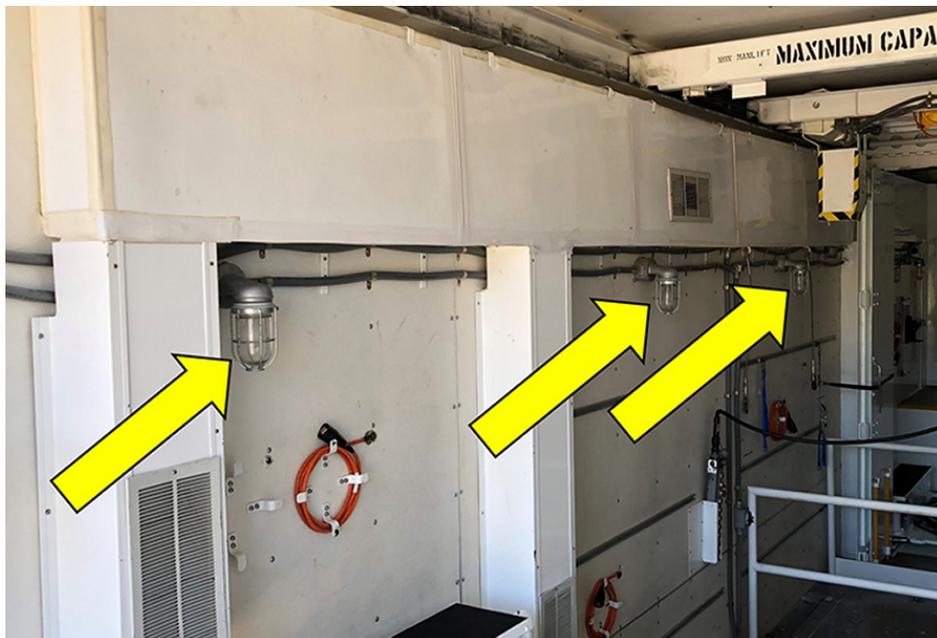


Figure 1-4. PT interior lighting.

Electrical system

The majority of electrical equipment inside the PT semitrailer requires 120/208 VAC, 3-phase power. This is typically supplied by facility power, but the APU can also provide electricity during transit or when no facility power is available. Some electrical equipment requires direct current power. Therefore, the electrical system is divided into the alternating current and direct current subsystems.

The 120/208 VAC, 3-phase power is supplied to the PT trailer by either the site power cable or the APU and then routed to facility power switch S-1 located on the front side of the PT trailer. Power then flows to the PT power distribution assembly. The hoist and the ECS require 120/208 VAC, 3-phase power.

Single phase 120 VAC is supplied to the following:

- Lights.
- ECS control box.
- Power receptacles.
- APU immersion heater.
- Tractor engine immersion heater.
- Rear compartment battery charger.

PT hoist description

The PT hoist (fig. 1-5) is a major component of the semitrailer and has a maximum lifting capacity of 3,000 pounds.

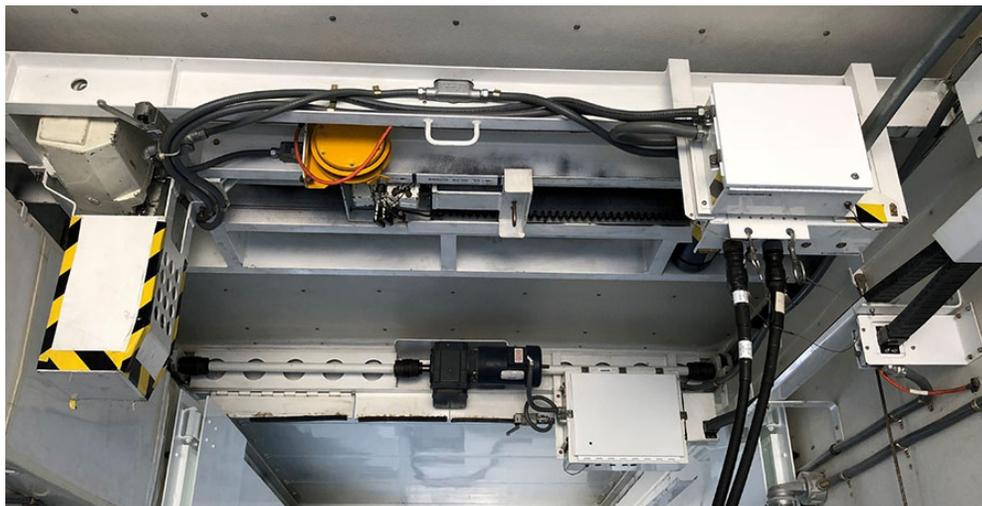


Figure 1-5. PT hoist.

The PT hoist features one constant-speed and two variable-speed motors that are all mounted to the hoist frame. These motors perform the following functions:

- Left and right motion of the trolley at a constant speed.
- Raising and lowering of the lifting block at two variable speeds.
- Forward and reverse motion of the bridge at two variable speeds.

The hoist is controlled using one of the two hoist control pendants—the semitrailer control pendant and the launch tube control pendant. Both of these pendants are identical but operate differently depending on whether they are being used from within the semitrailer or within the launch tube; in which case, the launch tube pendant will override the function of the semitrailer pendant.

Semitrailer hoist control pendant

The PT semitrailer hoist control pendant (fig. 1-6) contains eight pushbutton switches, one push-pull STOP button, and one rotary SLOW/OFF/FAST selector switch. The pushbutton switches control the different hoist motors to move the hoist laterally, horizontally, or vertically. The SLOW/OFF/FAST rotary switch controls the speed of the hoisting motor and supplies power to the pendant. Setting the switch to OFF disables all pendant functions, and in an emergency, pressing the STOP button will also disable all pendant functions. When the STOP button is pushed, two brakes are actuated to stop the movement of the hoist chains. After the STOP button has been pushed, a technician must pull the button back out and press the ON/RESET button to restore pendant operation.



Figure 1-6. PT hoist control pendant.

Launch tube hoist control pendant

The two pendants are physically identical, however, the pendant inside the semitrailer will be disabled whenever the SLOW/OFF/FAST button on the launch tube pendant is set on SLOW or FAST. The semitrailer pendant can only control the hoist when the launch tube pendant is set to OFF or completely disconnected.

NOTE: The launch tube pendant cannot control the hoist unless the semitrailer pendant is connected.

Once missile components are lowered far enough into the launch tube, the technicians in the launcher equipment room (LER) and launch tube will use the launch tube control pendant to make very fine adjustments so that missile components fit together properly.

The topside technicians inside the trailer could not do this accurately with their pendant, and the team in the launch tube would not be able to maneuver components within the trailer. This is why two pendants are needed and why the launch tube pendant will always override the semitrailer pendant.

Hoist brakes

The hoisting unit provides up and down motion, and is equipped with both electrical and mechanical brakes. The electrical brake is engaged when electrical power is removed from the brake solenoids and disengaged whenever power is applied, allowing the hoist to operate. The mechanical brake is actuated by the absence of torque on the motor shaft. If something causes the motor to stop while power is still applied to the brake solenoids, the mechanical brake will halt hoist movement.

Both brakes are used during normal operation, but each brake is strong enough on its own to support the maximum rated load of the hoist.

Bridge assembly

The bridge provides forward and reverse motion of the hoist. With the back doors of the PT open, the bridge can extend out of the rear of the semitrailer to hoist equipment at a dock or at ground level.

Trolley assembly

The trolley is mounted on the bridge and is responsible for left and right movement of the hoist. The trolley motor is a constant speed motor that operates when the LEFT or RIGHT buttons are pressed on either pendant. A time delay mechanism provides a one-second time delay between commands from the LEFT and RIGHT pendant buttons. This function is built in to prevent successive left-right-left hoist movements that would cause the load to sway back and forth.

Hoisting unit

The hoisting unit is responsible for the actual lowering and raising of components. The hoisting motor is controlled by the UP or DOWN buttons on the pendants and can operate in either slow or fast modes as described below:

- SLOW mode allows a maximum load movement speed of 2 feet per minute.
- FAST mode allows a maximum load movement speed of 6 feet per minute.

The hoist motor is also equipped with an INCH button that allows very small and precise movements of 0.030 inches (30 thousandths of an inch). This function is especially useful for the final mating of two components.

Pneumatic system

The tractor's pneumatic pump supplies compressed air to the semitrailer pneumatic system, which then distributes air to the braking and suspension systems and air pallets. The braking system contains two reservoirs; one is used for the service brake and the other is used for the spring (parking) brake. Supply pressure releases the parking brakes, by depressurizing the system that applies the brakes. The harder the brake pedal in the tractor is pressed, the stronger the braking action is.

Running gear and suspension system

The running gear and suspension system provide braking action and help to protect the semitrailer from road shock and vibration. The trailer's self-leveling air bags provide shock attenuation, and are controlled manually using a two-position valve. The air bags are deflated during semitrailer stabilization over a LF and are inflated for over-the-road travel.

Air pallets

The air pallets provide load support, stability, and shock mitigation for AVE components. A manual control valve on each air pallet controls airflow to that pallet. Height control valves on each pallet control pallet height. The compressed air for air-bag inflation is provided by the PT tractor through the semitrailer pneumatic system.

Guidance and control section purging manifold

The G&C section purging manifold (fig. 1-7) is installed on the right-rear wall of the semitrailer and is used for purging coolant from the missile guidance set (MGS). A pneumatic hose is routed internally through the trailer structure from the manifold to the left interior wall above the floor hatch. The manifold consists of three standard nitrogen tanks, associated valves, hoses, and a frame.



Figure 1-7. G&C purging manifold.

Environmental control system

The ECS provides heating, cooling, and ventilation for the interior of the semitrailer. A supply duct that runs the entire length of the trailer supplies the conditioned air throughout the trailer. The ECS has two supply air blowers, a refrigeration system for cold air, and a three-stage heating system for hot air. A temperature sensor in the forward section of the trailer is located on the return air duct and monitors the return air temperature. The normal temperature for the interior of the semitrailer is between 50 and 80°F. When the temperature is outside of this normal range, the RED fault indicator light illuminates on the ECS control panel.

In this lesson, we focused on PT. This special-purpose vehicle is a critical part of the maintenance mission. It is a complex piece of equipment and as a 2M0X2 technician you will be responsible for not only operating the vehicle, but also maintaining many of its systems.

402. Transporter-erector description

As the PT is the workhorse of MMT, the TE is the workhorse for the missile handling teams (MHT). It is one of the most recognizable vehicles at a missile wing, as well as one of the largest, being that it is over weight, over width, and over length.

The TE (fig. 1-8) is used to transport, remove, and install the missile downstage. When loaded with a downstage, the TE weighs more 140,000 pounds. Similar to the PT, MAPS technicians perform much of the maintenance on the TE.

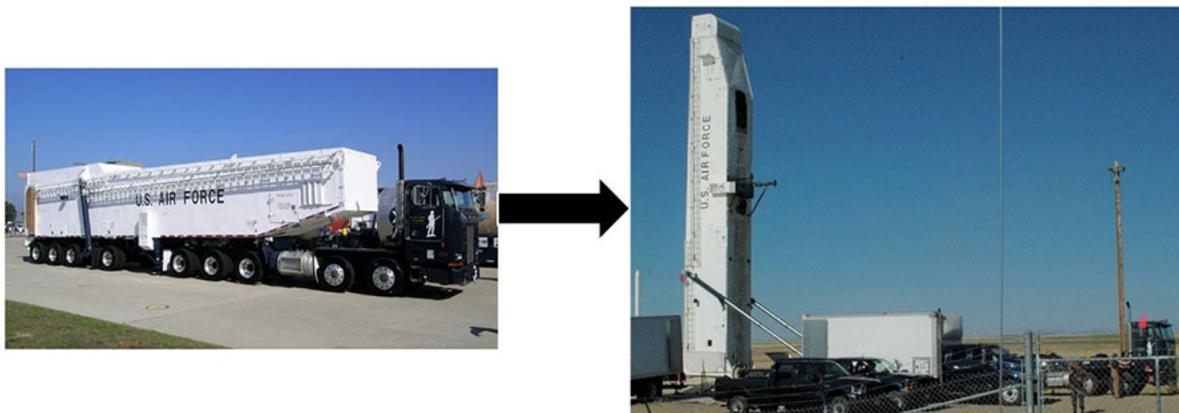


Figure 1-8. Transporter erector.

Transporter-erector tractor

The TE tractor (fig. 1-9) is a motor vehicle used to tow the TE semitrailer. Beyond the normal components that make up a tractor, such as the cab and the engine, TE tractors also consist of the following major components:

- Power takeoff (PTO) unit.
- Hydraulic power supply.
- Electrical system.
- Pneumatic system.

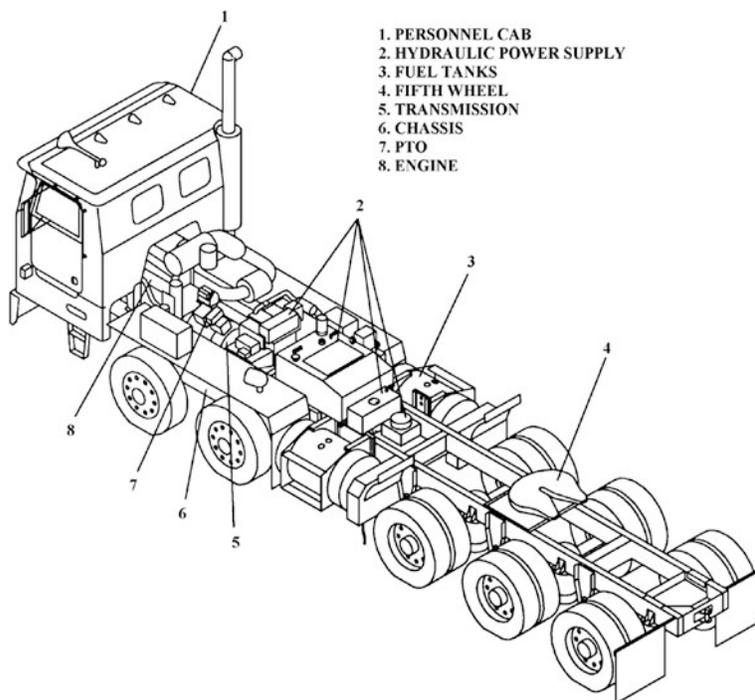


Figure 1-9. TE tractor.

Power take-off unit

The PTO unit (fig. 1-9, item 7) is a clutch located on the transmission. When the PTO is engaged it drives the auxiliary hydraulic pump that will provide the needed hydraulic power.

Hydraulic power supply

The TE tractor hydraulic power supply (fig. 1-9, item 2) provides the required fluid pressure to operate the TE emplacement system and missile positioner. The hydraulic power supply (fig. 1-10) consists of the following components:

- APU diesel engine.
- Two axial-piston hydraulic pumps.
- Main hydraulic reservoir.
- Tractor auxiliary hydraulic reservoir.
- Hydraulic power supply manifold assembly.
- Hydraulic heat exchanger.

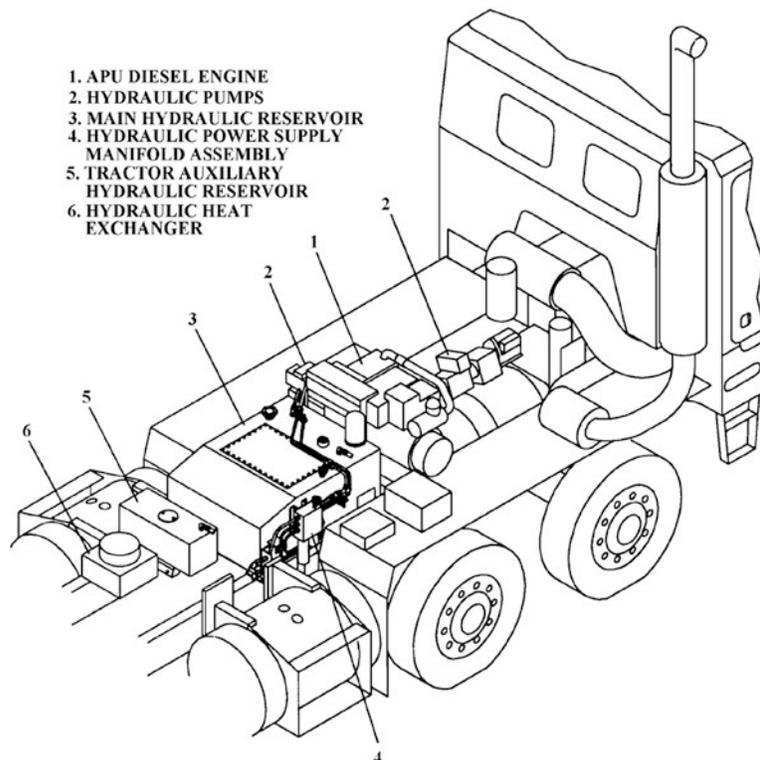


Figure 1-10. TE tractor hydraulic power supply.

The APU diesel engine powers the main hydraulic pump, and the PTO powers the auxiliary hydraulic pump located on the tractor's transmission. MHT personnel use the main hydraulic pump during normal use and the auxiliary pump during standby or emergency. The hydraulic fluid passes through the hydraulic power supply manifold assembly for filtering and pressure control. The pressurized fluid is then sent to the semitrailer.

Two quick-disconnect hose fittings on the aft portion of the TE tractor provide the interface between the tractor hydraulic system and the semitrailer. A heat exchanger cools the hydraulic fluid before it flows back into the reservoir. The hydraulic system features a 115-gallon main reservoir as well as a 10-gallon auxiliary reservoir. A fluid sight gauge allows you to verify the level of the hydraulic fluid.

Electrical system

The tractor's 12 VDC system supplies the power required to operate the standard tractor components and semitrailer automotive lighting and acts as a secondary power source for the components that monitor and control systems within the semitrailer.

The tractor non-automotive electrical system consists of the following components:

- APU.
- Electrical box.
- Auxiliary power monitor panel.

The TE tractor electrical box houses the controls for the following components:

- PTO clutch.
- Battery heater.
- Tractor floodlights.
- Transmission oil heater.
- Tractor engine oil pan heater.
- Tractor engine coolant heater.
- APU diesel engine oil pan heater.

Auxiliary power unit

As an MHT technician, you will be responsible for inspecting and operating the TE APU (fig. 1-11). The APU is mounted on the rear of the tractor behind the cab. The APU generates 120/208 VAC, 3-phase, 60-hertz (Hz) power that runs the main hydraulic pump and provides auxiliary power to other parts of the TE trailer, such as the interior lights and power receptacles.



Figure 1-11. TE auxiliary power unit.

In cold weather, the preheater must be energized for 30 seconds prior to attempting to start the engine. The preheater elements are located inside of the intake manifold. Their purpose is to heat the intake air and make the engine easier to start in cold weather.

Auxiliary power unit monitor panel

The APU monitor panel (fig. 1-12) is located on the dashboard of the tractor and consists of the following items:

- Voltmeter.
- Frequency meter.

- Axle lock switch.
- Two panel lights.
- Axle lock indicator.

The APU monitor panel allows the tractor driver to monitor the output voltage and frequency of the APU while the TE is in transit.

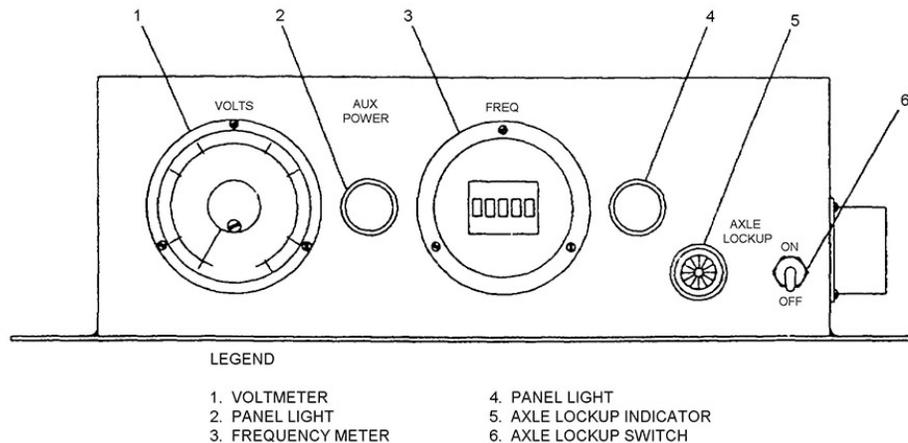


Figure 1-12. TE tractor auxiliary power unit monitor panel.

Pneumatic system

The TE pneumatic system consists of an air brake and an air suspension system. The tractor's engine drives an air compressor that supplies 120 pounds per square inch (psi) of compressed air to the tractor and semitrailer brakes and suspension systems. Equipment common to both the tractor and the trailer includes the compressor governor, a wet-dry tank, and various valves and lines. The braking system uses standard brake components to provide an axle-by-axle protection system. The air suspension system, which must always be charged during transport, consists of air bags for each wheel, height control valves, axle control arms, and shock absorbers. A pressure protection valve, located downstream from the wet-dry tank, opens to ensure that a minimum of 65 psi is always supplied to the airbrake system.

Semitrailer description

The TE trailer is just as unique as its tractor. The TE semitrailer (fig. 1-13) consists of the following components and systems:

- Missile container.
- Bogie assembly.
- Electrical system.
- ECS.
- Missile emplacement system.
- Container hydraulic system.



Figure 1-13. TE semitrailer.

TE missile container

The TE missile container provides structural support and a protective environment for the missile downstage. The frame is built from high-strength steel-tubing that is covered with foam-insulated aluminum skin. Wheels on the missile carriage roll on V-shaped rails that are built into the container floor. During transport, the downstage is tied down to restraints that are built into the rails. The hoist is located in the large compartment at the forward end of the container (closest to the tractor).

The container is equipped with a number of access doors. Two large cargo doors at the rear of the container are used for loading and unloading, as well as emplacement and removal of the missile downstage. The left cargo door houses return and supply air ports used for attaching an external ECS when a downstage is stored in a TE outside on a storage pad. Large personnel access doors on both sides of the forward end of the container provide access to the interior while smaller doors along both sides provide access to missile first-stage carriage tie-downs. The hoist can be accessed using the door located in the right-forward side of the hoist compartment.

The missile positioner (fig. 1-14) is located inside the rear of the TE container. The missile positioner uses hydraulic power to maneuver the missile downstage into either the transport or emplacement position.



Figure 1-14. Missile positioner.

Bogie assembly

The various components of the TE trailer are attached to a steel frame called the bogie assembly. The bogie provides mobility of the container during transport and support during missile emplacement and removal operations. A hinged screw jack on the front of the bogie is used to tie the forward end down to the ground, and hinge fittings on the rear are used to anchor the TE container to the TE pylons at the LF. The bogie also houses a metal tray called the raceway, which is used to support the air and electrical lines that come from the tractor.

Container electrical system

The electrical system for the inside of the TE container consists of interior lighting and electrical outlets. The left and right edges of the ceiling have four light fixtures that operate on 120 VAC.

There are also two 120 VAC service outlets; one is in the rear of the container, and the other is in the forward area. The electrical wires that carry power to the ceiling lights and outlets run through conduits, under the foam insulation and along the container walls. The switch that controls the ceiling lights is located at the rear of the container near the cargo doors.

Environmental control unit

The TE environmental control unit (ECU) (fig. 1-15) is bolted to the bogie, and it stays at ground level even when the container is erect. The ECU supplies hot or cold air to maintain the temperature inside the container between 60 and 100°F through inflatable fabric ducting that runs the length of the container.

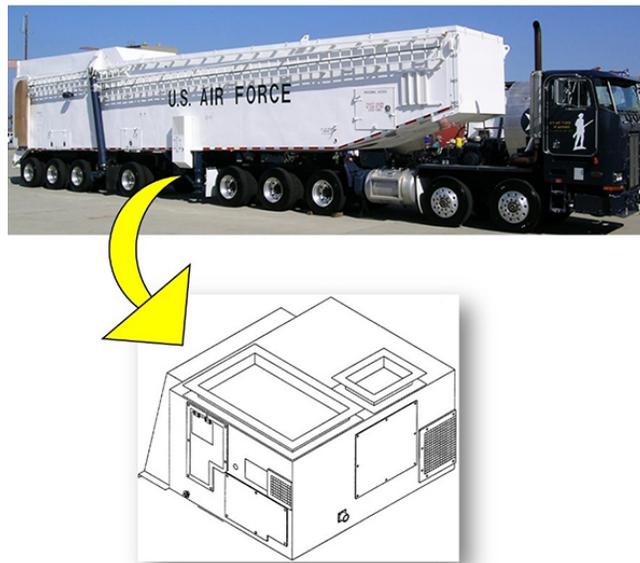


Figure 1-15. TE environmental control unit.

Container heating

The ECU contains six thermostatically controlled electrical heaters, made up of two banks that are used when the air entering the container needs to be heated. Both heater banks are controlled by a single thermostat. One bank of heaters will energize when the temperature in the container drops to 72°F, and the second bank of heaters will energize if the temperature drops to 68°F. As a precaution, all heater elements will be de-energized if the air temperature in the heater duct exceeds 150°F.

ECU control panel

The control panel is located on the side of the ECU. It houses circuit breakers that supply power to the unit as well as the four-position switch that allows the technician to choose between the OFF, AUTO, COOL, and HEAT modes.

OFF

This setting will shut the ECU down so no hot or cold air will be provided to the container regardless of the temperature.

AUTO

AUTO enables the ECU to automatically maintain the temperature within the container between 60 and 100°F. The ECU blower fan will operate continuously and hot or cold air will be added as needed. Regardless of the container temperature, if the outside air temperature is below 50°F, the ECU refrigeration system will not operate—only hot air will be provided.

COOL

In COOL mode, the heater circuits are disabled and cool air will be provided regardless of the temperature inside or outside of the container.

HEAT

In HEAT mode, both heating elements are activated and heated air will flow into the container regardless of the temperature inside the container. The circuits that supply power to the condenser fan and refrigerant compressor motor starters will be open; therefore, cooling air will not be available.

TE missile emplacement system

The TE missile emplacement system (fig 1-16) is used to hydraulically raise and lower the container; raise, lower, and traverse the missile downstage; and sequence and monitor those operations. The missile emplacement system is electrically controlled and hydraulically operated. It consists of the following systems:

- Container erection.
- Hoist.
- Missile erection control.

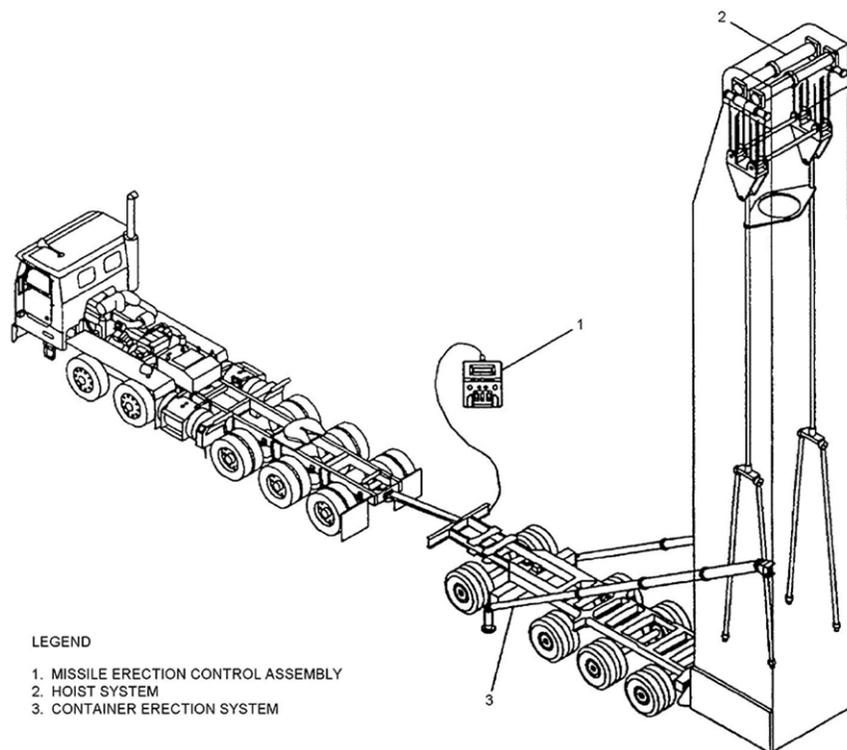


Figure 1-16. TE missile emplacement system.

Container erection system

The container erection system is used to raise the container to the vertical position, hold the container erect during missile emplacement or removal procedures, and lower the container back to the horizontal position. The erection system consists of the following components:

- Two three-stage telescoping actuators.
- Erection control manifold.
- Emergency flow limiter manifold.
- Two leveling jacks.
- Two flowmeters.

The two hydraulic actuators (fig. 1-16, item 3) attached to each side of the container and rear carriage raise and lower the TE container. The erection control manifold routes hydraulic fluid through a series of valves and orifices to establish the pressure necessary to operate the actuators. An emergency flow limiter manifold mounted on the actuator support structure of the rear carriage prevents the container from freefalling from the vertical position if a hydraulic line fails.

A manually operated leveling jack is located on the end of each actuator. These jacks are used to level the semitrailer prior to raising the container. Once the container is vertical, the leveling jacks are adjusted during downstage emplacement and removal to ensure that the missile clears the carriage. Two flowmeters located on the left side of the container allow the technician to verify all air has been removed from the hydraulic lines during bleeding operations. Air bubbles flowing through the indicators means air is still being bled from the system. The hydraulic system is considered to be free of air when air bubbles no longer appear.

Hoist system

The TE hoist (fig. 1-17) is the heart of the TE. The hoist is driven by hydraulic power, and is used to raise, lower, and rotate the missile downstage while the container is erect. The hoist is capable of raising and lowering a load of 80,000 pounds a distance of 82 feet, even if only one of its two cables is operational.



Figure 1-17. TE hoist.

Missile erection control system

The missile erection control system provides technicians the ability to sequence and monitor the TE emplacement system. The missile erection control system consists of a hand-held control unit (HHCU) (fig. 1-18), an interconnect cable, a storage case, and an input/output unit mounted on the semitrailer. The 12 VDC required to operate the missile erection control system is provided by the semitrailer. The HHCU and interconnect cable are stored in a storage case in the support truck when they are not being used or the TE is in transit.



Figure 1-18. TE HHCU.

Container hydraulic system

The container hydraulic system (fig. 1-19) provides supply, return, and bi-directional lines for the landing gear, missile positioner (fig. 1-19, item 4), erection actuator bleed circuit, and hoist assembly. An auxiliary 6-gallon tank supplies hydraulic fluid to a hand pump that operates the missile positioner and the landing gear in the event the main hydraulic system malfunctions.

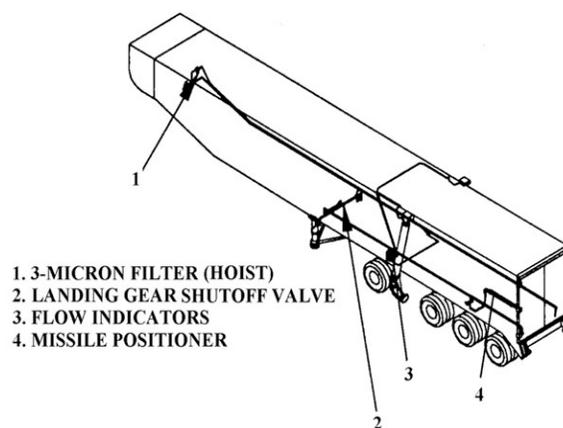


Figure 1-19. TE container hydraulic system.

Without the TE it would be impossible to lower and raise the missile downstages into and out of the launch tube. As a technician working in MAPS or MHT, you are responsible for the safe operation and maintenance of this unique vehicle.

403. Missile transporter and rocket motor trailer description

MHT technicians use the MT semitrailer for road transportation, roll transfer, and storage of the missile downstage. Depot personnel at Hill Air Force Base (AFB), Utah use the RMT to transport rocket motors in a controlled environment.

Missile transporter

As an MHT technician at a missile wing, you will use the MT to perform several key functions. These functions are described in the following paragraphs.

Truck tractor

The MT tractor pulls the semitrailer and provides the direct current power and compressed air that are required to operate certain systems on both the tractor and the semitrailer.

Semitrailer

The MT semitrailer (fig. 1-20) consists of the following assemblies, units, and systems:

- Container assembly.
- ECS.
- Hydraulic power unit (HPU).
- Winch.
- Landing gear.
- Electrical system.
- Pneumatic system.

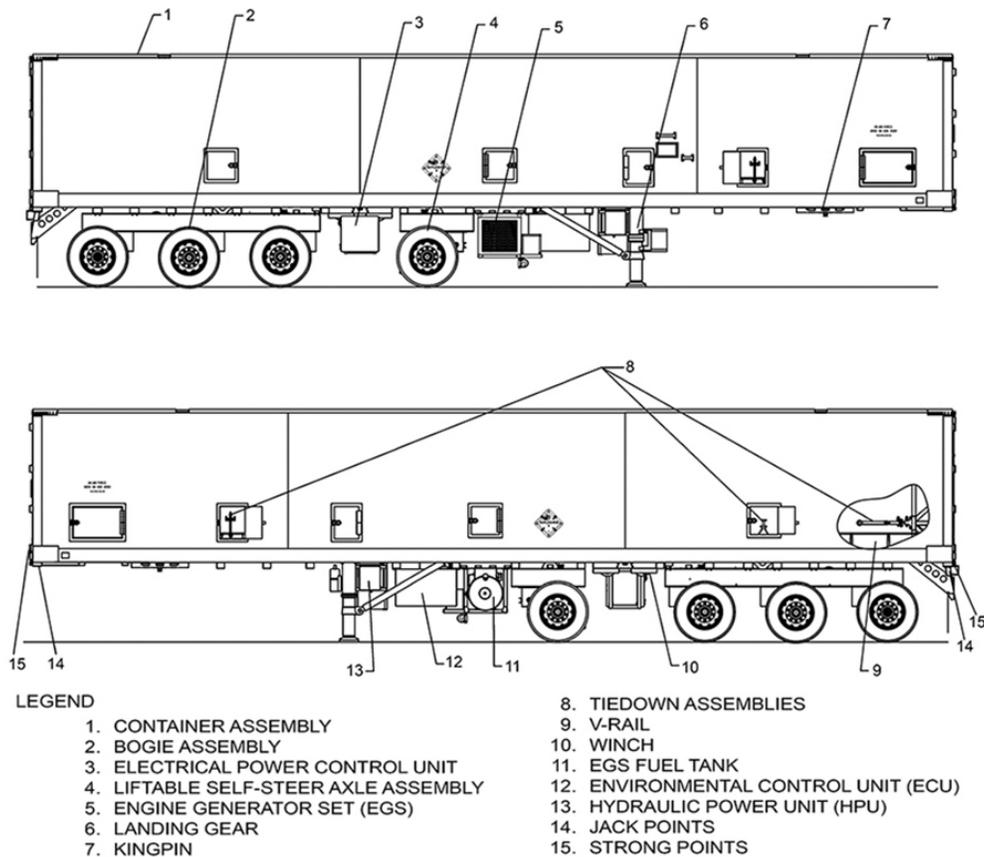


Figure 1-20. Missile transporter semitrailer.

Container assembly

The MT container provides a safe environment for the downstage. The roll and transfer carriages that support the downstage roll on two rails that are mounted to the floor of the MT semitrailer.

Access panels located on both sides of the semitrailer are used to install and remove alignment and booster restraining equipment. The downstage is loaded and unloaded through large access doors located at both the front and rear of the trailer.

Environmental control system

The MT ECS maintains the environment within the semitrailer during transportation and storage of the missile. It consists of the following components:

- ECU.
- Remote monitor assembly.
- Ductwork.

The ECU maintains the correct temperature and humidity within the semitrailer. It operates on 120/208 VAC, 3-phase, 60-hertz (Hz) power that is supplied by either the engine generator system (EGS) or facility power. The ECU selector switch is used to select between four different modes of operation—AUTO, HEAT, OFF, and COOL. Air temperature and humidity are monitored at both the ECU intake and within the container.

The remote monitor is located on the front roadside corner and provides the ability to monitor the environment inside the container. Lights on the remote monitor will illuminate when the temperature inside the container exceeds 94°F or falls below 65°F, and if humidity exceeds a 57°F dew point.

An air duct runs the length of the trailer and distributes conditioned air throughout the trailer. An external unit called a portable air conditioner (PAC) is used to supply conditioned air to the container when it is parked. You will learn more about the PAC in another unit of this career development course (CDC).

Hydraulic power unit

The HPU (fig. 1–20, item 13) provides the hydraulic power needed to operate the landing gear and winch. It is mounted to the underside of the semitrailer, just forward of the ECU and aft of the landing gear. The HPU can operate on either EGS power or facility power.

Winch

The winch (fig. 1–20, item 10) is a hydraulically powered system mounted in the floor of the semitrailer that is used to load and unload a downstage from the MT semitrailer. Controls for the winch are on the HPU control unit and on a control pendant, which is accessible from side of the semitrailer.

Landing gear

The semitrailer landing gear (fig. 1–20, item 6) is used to raise, lower, support, and level the forward end of the semitrailer, and is mounted just forward of the HPU. The HPU supplies hydraulic power to operate the landing gear. A manual hand pump is used if electrical power is not available to operate the HPU.

Electrical system

The semitrailer electrical system consists of both VAC and VDC systems. The tractor supplies 12 VDC to operate of the lights. 120/208 VAC, 3-phase, 60-Hz power is supplied to the ECU, HPU, and semitrailer internal lighting by either the EGS or site power. Additionally, 24 VAC to operate both hydraulic system solenoid valves and the indicators on the ECS remote monitor is supplied by the VAC system.

Pneumatic system

The semitrailer pneumatic system consists of the following three interconnected systems:

1. Suspension system.
2. Self-steer axle assembly.
3. Brake system.

If necessary, the tractor's emergency air connection is capable of supplying air to all three systems.

Suspension system

The semitrailer suspension system consists of the following components:

- One leveling valve.
- Two air springs per axle.
- Manual suspension air on/off valve.
- Two steering dampers with a regulator.
- Safety relief valve.
- Reservoir.

During normal operation, the leveling valve automatically modulates the amount of air supplied to the suspension system air springs as needed to maintain a level ride height. The manual suspension air ON/OFF valve is used to vent air from the suspension system air springs to accommodate various modes of operation or to charge the suspension system air springs after they have been vented.

The self-steer axle is the front-most axle on the trailer. It provides load-bearing and steering capabilities. This axle features an air suspension system and shock absorbers similar to the rear axles. It houses a regulator used to maintain a constant pressure to control the steering dampers.

Air for the braking system is generated by the air compressor on the tractor and then routed to components through two pneumatic hoses.

Semitrailer functions

The MT semitrailer accomplishes the following functions relating to the downstage:

1. Road transport.
2. Roll transfer.
3. Storage.

Road transport

During road transport, the downstage is secured by a restraint system and the ECU uses power supplied by the EGS to maintain the environment inside the container.

Roll transfer

During a roll transfer, the MT winch transfers the downstage either to or from the semitrailer to or from one of the following structures or vehicles:

- Missile storage building.
- Roll transfer facility.
- Missile assembly and maintenance shop.
- TE.

Storage

During storage (parked), the trailer provides environmental control for the downstage using its own ECU or conditioned air supplied by an external portable unit called a PAC.

Rocket motor trailer

The RMT (fig. 1-21) is a van-type transporter used by depot personnel at Hill AFB to transport individual missile stages.

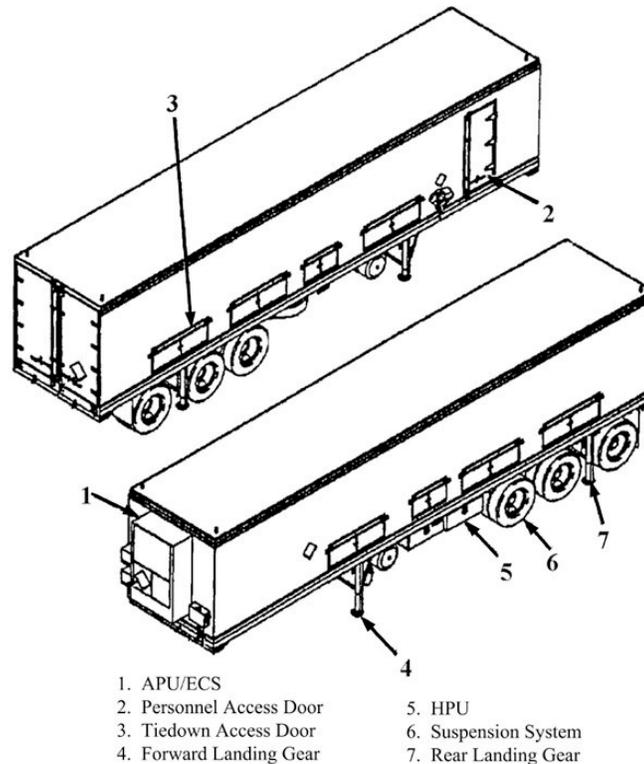


Figure 1-21. Rocket motor trailer.

Major components

The RMT consists of the following major systems and components:

- Suspension system.
- Leveling jack system.
- APU and ECS unit.
- Winch assembly.

Suspension system

The RMT suspension system utilizes a standard air-ride suspension to suppress vibration and shock.

Leveling jack system

Technicians use the hydraulic leveling jack system to adjust the height of the RMT during dock loading operations. The HPU supplies and controls the hydraulic power used to extend the hydraulic leveling jacks. The jack system is equipped with a hand pump for emergency operation.

Auxiliary power unit/environmental control system

The RMT is equipped with an APU/ECS combination unit that is mounted to the front of the trailer. The APU supplies the 240 VAC that operates the winch, HPU, and ECS.

Winch assembly

The electrical winch pulls the rocket motors into position on the internal rails of the RMT. Unlike the MT, the winch in the RMT is located at the front of the trailer, and not on the floor.

Self-Test Questions

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

401. Payload transporter description

1. What is the purpose of the PT tractor?
2. What is the purpose of the alcohol injector in the PT tractor pneumatic system?
3. What is the purpose of the PT semitrailer?
4. What action ensures that the PT semitrailer is stable and level before deploying the environmental flaps and using the hoist?
5. How many environmental flaps are on the PT semitrailer, and where are they located?
6. What is the purpose of facility power switch S-1 located on the front of the PT semitrailer?
7. What functions do the PT hoist motors provide?
8. Why can the PT hoist be controlled by two different pendants?
9. What supplies the control air to the air pallets in the PT semitrailer?
10. What is the purpose of the PT semitrailer G&C purging manifold?
11. What will occur when the temperature inside the PT semitrailer is out of tolerance?

402. Transporter-erector description

1. What functionality does the TE tractor hydraulic power supply provide?
2. When are the TE tractor main hydraulic pump and the auxiliary hydraulic pump used?
3. What is the purpose of the TE tractor APU monitor panel?
4. What is the purpose of the two ports in the cargo door of the TE container?
5. At what temperatures do the TE ECU electric heater banks energize?
6. Explain how the TE ECU operates when set to *COOL* mode.
7. What is the purpose of adjusting the leveling jacks once the TE container is erected?

403. Missile transporter and rocket motor trailer description

1. What is the purpose of the MT semitrailer roll and transfer carriages?
2. State the purpose of the MT trailer ECU.
3. State the purpose of the MT semitrailer landing gear.
4. How does the MT semitrailer leveling valve function?

Answers to Self-Test Questions**401.**

1. To pull the PT semitrailer during transportation operations.
2. Prevent moisture from freezing in the air lines.
3. Provides the ability to load/unload, transport, and remove/replace AVE components.
4. The trailer's landing gear is extended prior to deflating the suspension airbags.

5. Four, one on each side and two on the bottom.
6. Receives power supplied by either the site or APU and feeds it to the power distribution assembly.
7. Forward and reverse motion of the bridge at two variable speeds. Left and right motion of the trolley at a constant speed. Up and down motion of the hoist lifting block at two variable speeds.
8. Because the topside, board, or cage technicians can accurately perform the other teams' duties.
9. The PT tractor.
10. Purging coolant from the MGS.
11. The RED fault indicator light will illuminate on the ECS control panel.

402.

1. The fluid pressure required to operate the TE emplacement system and missile positioner.
2. The main hydraulic pump is used during normal operation and the auxiliary pump is used during standby or emergency use.
3. Allow maintenance personnel in the TE tractor to monitor the output voltage and frequency of the APU while the transporter erector is in transit.
4. Used for attaching an external ECS when a downstage is stored in a TE outside on a storage pad.
5. Bank 1 energizes when the temperature in the container drops to 72°F; bank 2 energizes if the temperature continues to drop to 68°F.
6. The heater circuits are disabled and the ECU will continue to provide cold air regardless of the temperature inside and outside of the container.
7. So that the missile clears the carriages during emplacement and removal procedures.

403.

1. Support the downstage roll on two rails.
2. Control the temperature and humidity inside of the semitrailer.
3. Raise, lower, support, and level the forward end of the semitrailer.
4. Automatically applies or vents air to or from the suspension system air springs as needed to maintain a level ride height.

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. (401) The payload transporter (PT) auxiliary power unit (APU) immersion heater warms the APU
 - a. oil.
 - b. fuel.
 - c. engine block.
 - d. fuel injectors.
2. (401) Which action occurs when the STOP button is pressed on the payload transporter (PT) semitrailer hoist control pendant?
 - a. Two brakes are actuated to halt movement of the hoist.
 - b. Electricity is removed from the two brakes in the hoist.
 - c. Hydraulic pressure is removed to halt movement of the hoist.
 - d. Pneumatic pressure is removed to halt movement of the hoist.
3. (401) Identify the condition(s) that must be met in order for the *semitrailer* pendant to *control* the payload transporter (PT) hoist.
 - a. Launch tube pendant set to FAST.
 - b. Launch tube pendant set to SLOW.
 - c. Launch tube pendant set to OFF or disconnected.
 - d. ON/RESET button pressed on the semitrailer pendant.
4. (401) Select the purpose of the air pallets in a payload transporter (PT) semitrailer.
 - a. Provide cooled air to the aerospace vehicle.
 - b. Level the aerospace vehicle at the launch facility (LF).
 - c. Support and stabilize aerospace vehicle equipment (AVE) components.
 - d. Provide small arms protection (SAP) for AVE components.
5. (402) The transporter erector (TE) is used to
 - a. store rocket motors at Hill Air Force Base (AFB).
 - b. store missile downstages at Hill AFB.
 - c. install aerospace vehicle equipment (AVE) components.
 - d. transport, remove, and install missile downstages.
6. (402) The transporter erector (TE) tractor power take-off (PTO) unit
 - a. drives the auxiliary hydraulic pump.
 - b. locks the center differential to provide more traction.
 - c. provides additional torque to the wheels that is needed to start the tractor rolling.
 - d. provides the extra torque necessary to cruise at highway speeds while fully loaded.
7. (402) The transporter erector (TE) auxiliary power unit (APU) preheater elements need to be energized for 30 seconds prior to starting in cold weather conditions to preheat the
 - a. fuel.
 - b. intake air.
 - c. crankcase oil.
 - d. hydraulic fluid.

8. (402) What is the purpose of the transporter erector (TE) rail restraints?
 - a. Keep the rear doors of the container open during missile emplacement or removal.
 - b. Provide personnel anchor points when maneuvering around the open launcher closer (LC).
 - c. Secure the downstage during transport.
 - d. Secure equipment during transport.
9. (402) The purpose of the transporter erector (TE) environmental control unit (ECU) is to maintain the
 - a. comfort of personnel operating the TE tractor.
 - b. temperature of the TE container within certain limits.
 - c. proper temperature of the TE engine, oil, and hydraulic fluid.
 - d. proper temperature of the aerospace vehicle and its test equipment.
10. (402) The transporter erector (TE) emergency flow limiter manifold prevents the
 - a. downstage from freefalling if the hoist fails.
 - b. container from freefalling if a hydraulic line fails.
 - c. hydraulic pressure from exceeding the preset limit.
 - d. aerospace vehicle equipment (AVE) from freefalling if the hoist fails.
11. (403) Identify the purpose of the missile transporter (MT) semitrailer's front and rear access doors.
 - a. Provide for missile loading and unloading.
 - b. Allow airflow to prevent the buildup of propellant vapors.
 - c. Provide for missile and aerospace vehicle loading and unloading.
 - d. Allow technicians access to install and remove alignment and restraining equipment.
12. (403) The missile transporter (MT) semitrailer winch is used for
 - a. loading and unloading a downstage from the semitrailer.
 - b. lowering and raising a downstage at the launch facility (LF).
 - c. loading and unloading rocket motors at Hill Air Force Base (AFB).
 - d. loading and unloading aerospace vehicle equipment (AVE) at the LF.
13. (403) Select the vehicle that is involved in roll transfer operations with the missile transporter (MT).
 - a. Ballistic missile trailer.
 - b. Rocket motor trailer (RMT).
 - c. Transporter erector (TE).
 - d. Payload transporter (PT).

Unit 2. Missile Maintenance Support Equipment

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THIS UNIT focuses on key pieces of support equipment used at the MSB, missile alert facility (MAF), and LF that support the ICBM mission. Operating and maintaining this equipment is a very important aspect of ensuring safe and successful maintenance. We will begin with hydraulic and pneumatic equipment, and then look at maintenance support equipment.

2-1. Hydraulic Equipment

The information in this section covers several pieces of hydraulic support equipment that you will use as a 2M0X2 technician to pressurize and purge hydraulic systems and open the LF launcher closure (LC) door. The following lessons provide a description of the hydraulic pressure charging set, hydraulic purge set, and hydraulic pusher set (HPS). HPS servicing and inspection will also be covered in this section.

404. Hydraulic pressure charging set and hydraulic purge set description

This lesson focuses on two pieces of hydraulic equipment used at ICBM wings—the hydraulic pressure charging set and the hydraulic purge set. The hydraulic pressure charging set is used at the LF and the hydraulic purge set is used on the TE.

Hydraulic pressure charging set

The charging set is transported out to the LF in a maintenance vehicle and then lowered into the LER. Survivable systems team (SST) technicians use the hydraulic pressure charging set to service the liquid/mechanical shock isolators in the LER as well as the missile suspension system (MSS) in the launch tube with silicon fluid.

The hydraulic pressure charging set consists of the following major components:

- Gas hose.
- Gas pressure gauge and regulator.
- Hydraulic pump.
- Hydraulic reservoir.
- Hydraulic pressure gauge.

Compressed nitrogen flows through a hose from a bottle in the maintenance vehicle, down to the hydraulic pressure charging set in the LER, where the gas drives a hydraulic pump. A technician uses a throttle valve to regulate the nitrogen pressure until the correct amount of silicon fluid is added to the LER floor shock isolator or MSS.

Hydraulic purge set

Technicians install the hydraulic purge set (fig. 2-1) into the TE hydraulic system to collect fluid samples or decontaminate the hydraulic system.

The hydraulic purge set is a relatively simple device that has an inlet line, a filter, outlet line, and a bypass valve. The purge filter may be equipped with two different types of filter elements. The Type I filter element is a disposable single filter assembly made up of three primary filters and one secondary filter. The Type II filter element can be cleaned and reused.

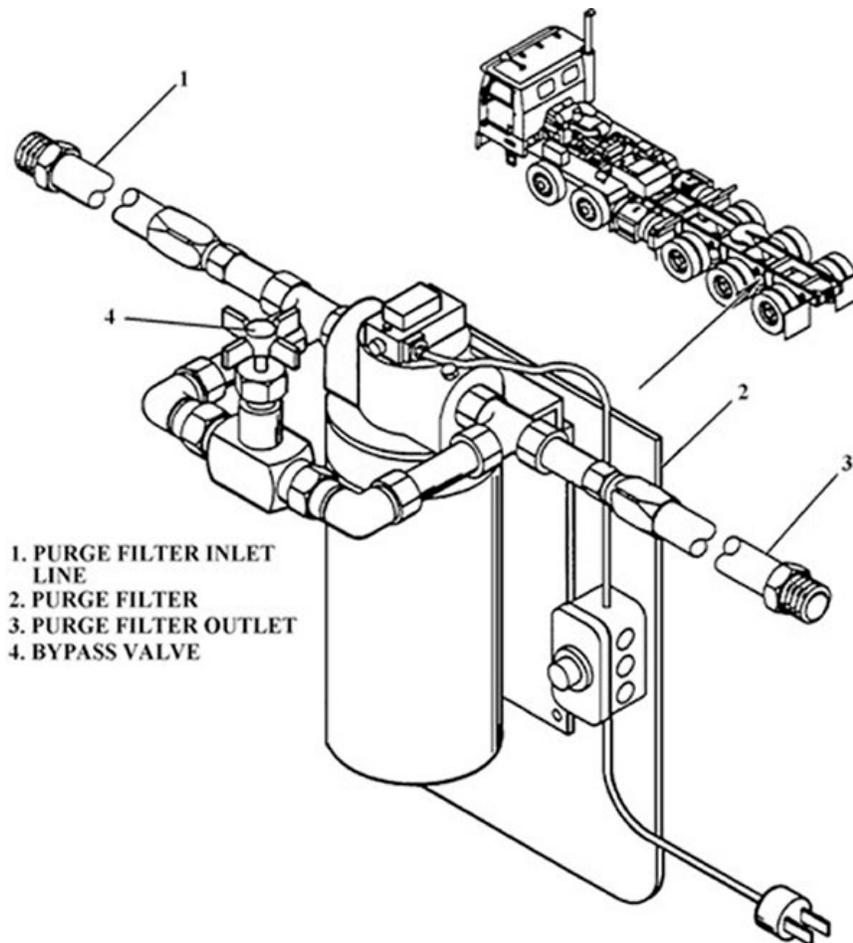


Figure 2-1. Hydraulic purge set.

Technicians also use the purge filter to decontaminate just the tractor hydraulic system.

These two systems allow the MAPS and SST to maintain vital systems and vehicles in optimal condition.

405. Hydraulic pusher set description, inspection, and servicing

The LC door at the LF is very large and very heavy. The LC is rolled away from the launch tube by the ballistic gas generators (BGG) under emergency conditions, but other methods are used to roll the LC back when normal maintenance is being completed.

Maintenance technicians use the HPS (fig. 2-2) to open and close the LC while performing maintenance at the LF. MMT technicians transport, install/remove, and use the HPS, while MAPS technicians are responsible to ensure that it is serviced properly. Therefore, this lesson briefly covers the description and operation of the HPS along with inspection and servicing procedures.

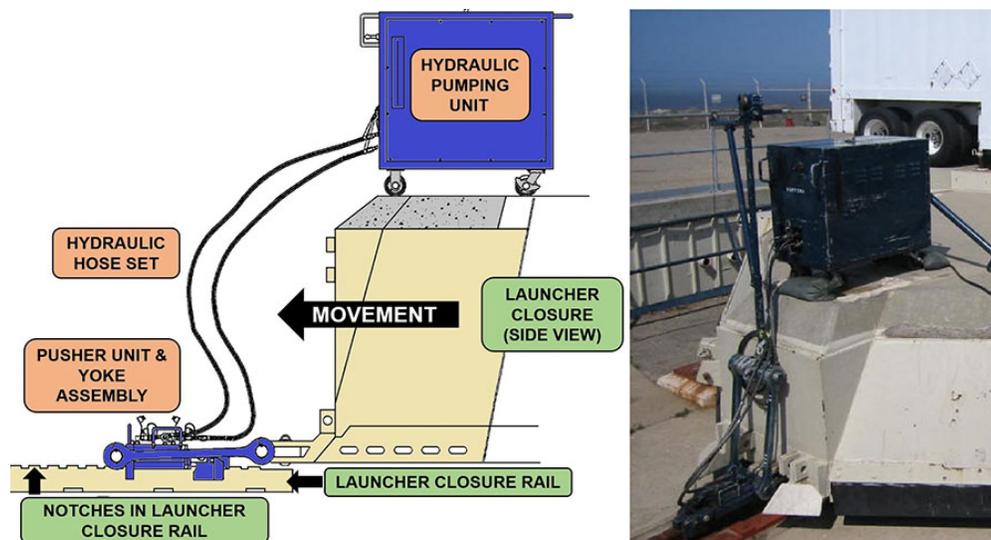


Figure 2-2. Hydraulic pump unit, pusher unit, and hose assembly.

Description

The HPS consists of the following major components:

- Hydraulic pumping unit.
- Hydraulic pusher unit.
- Yoke assembly.
- Hose set.

Hydraulic pumping unit

The hydraulic pumping unit (fig. 2-2) provides 4,200 psi of hydraulic pressure to the pusher unit. The pump is self-contained in a weatherproof housing that protects the electrical control assembly and the pump. The power cable and the hoses are stored in the bottom of the housing. The pump also has a 10-gallon fluid reservoir with a sight glass which allows you to visually verify the fluid level. On the outside of the pump is the ON/OFF switch with an indicator lamp, an EXTEND/RETRACT handle for operation, and two pairs of quick-disconnect fittings that are used to connect the pump to the pusher unit. When electric power is not available, a hand pump will be used instead of the electric pump.

Hydraulic pusher unit

The hydraulic pusher unit (fig. 2-3) provides 110,000 pounds of mechanical force required to roll the LC open or closed. The support plate and the front assembly secure the pusher onto the LC rail. Additionally, the support plate holds the rollback pawl assembly in place. The rollback pawl prevents the LC from rolling back toward the launch tube during opening procedures. It can be locked in the UP position by the operator to allow for manual movement of the pusher unit along the rail. Hydraulic cylinders on the front of the pusher unit extend to apply the horizontal force required to move the LC. The main pawl on the front assembly applies the horizontal

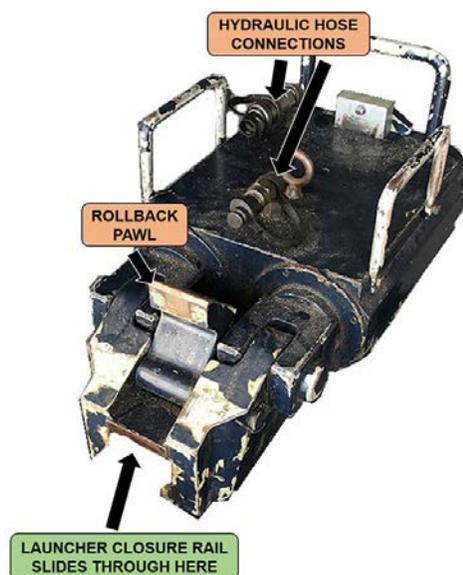


Figure 2-3. HPS pusher unit.

force required to move the LC when the cylinders extend. Handles on the pusher unit allow technicians to safely handle and transport the 180-pound unit.

Yoke assembly

The machined steel yoke assembly (fig. 2-4) connects the pusher unit to the LC. The yoke is the piece of equipment responsible for physically transferring the force from the hydraulic pusher unit to the LC. The yoke also allows two pushers to be used simultaneously in the event that a lone pusher cannot provide enough force to roll the LC.

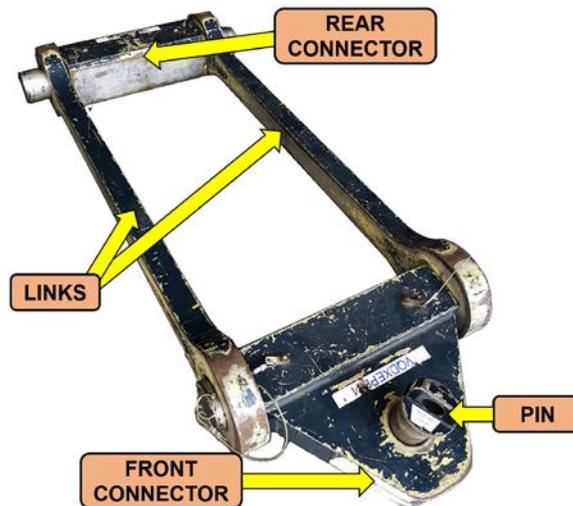


Figure 2-4. HPS yoke assembly.

The yoke assembly consists of the following items:

- Two links.
- Front connector.
- Rear connector.
- Pin.

Hose set

The interconnecting hydraulic hose set (fig. 2-2) provides the interface between the hydraulic pump and the pusher unit. Each hose has constraints located at each end to prevent them from whipping around violently if the hose breaks or a fitting fails. Quick-disconnect fittings are located on both ends of each hose allow technicians to easily and securely connect the hoses to the power unit and the pusher unit. The arrangement of the quick-disconnect fittings prevent technicians from improperly connecting the hoses to the pump and pusher unit.

Inspecting the hydraulic pusher set

MAPS technicians inspect the HPS at periodic intervals to ensure it is in serviceable condition. In order to provide you with a general concept of the steps that are included in this inspection, the following information provides a brief description of the actual technical order procedures used by the MAPS technicians.

The table below lists and describes the in-shop inspection of the HPS components.

HPS In-Shop Inspection	
Component	Inspection Description
Hydraulic pump unit	Damage to the power cable covering and connector. Defects on the casters that could cause the unit to roll unevenly. Loose or damaged hardware.
Hydraulic pusher unit	Damage to the pawl surface that engages the LC rack rail. Loose or damaged hardware.
Yoke assembly	Frayed lanyards and deformed retaining pins. Cracks (if cracks are detected, replace the defective yoke component).
Hose set	Fittings and the quick disconnects for leaks.

NOTE: Remember, this is just a general description of the HPS inspection procedure.

Servicing the hydraulic pusher set

As an example, let's say that you are an MMT technician and you discover the level of hydraulic fluid in the HPS is low. You would discontinue the use of the HPS and you or someone in your shop would document the discrepancy in the Integrated Maintenance Data System (IMDS).

Once it is documented in the IMDS a MAPS technician will inspect and service the pump unit. The technicians will first open the access panel and remove the top panel. Next, he or she would remove the reservoir filler cap and add hydraulic fluid until the fluid level is +0, -1 inch within the thick black line on the sight gauge. Finally, the technician would install the filler cap, replace the top panel, and close the access panel.

In this lesson, we covered a description of the hydraulic pusher set and how to inspect and service it. Without the HPS, there is no way to get the LC open, making it impossible to remove the missile or its components out of the launch tube. It is up to MAPS technicians to make sure the HPS is fully operational so MMT can complete its maintenance in the field.

Self-Test Questions

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

404. Hydraulic pressure charging set and hydraulic purge set description

1. List the major components of the hydraulic pressure charging set.
2. What is the purpose of the purge filter of the hydraulic purge set?

405. Hydraulic pusher set description, inspection, and servicing

1. List the major components of the HPS.
2. What will the HPS hydraulic hose fittings and quick disconnects be inspected for?

- When servicing the HPS, what steps are required to be accomplished before hydraulic fluid can be added to the unit?

2-2. Pneumatic Equipment

Maintenance technicians use pneumatic support equipment every day to maintain the ICBM weapon system. As a 2M0X2 technician, you will likely perform maintenance on or work directly with this equipment as part of your maintenance duties. In this section, we discuss the operation of the cable retractor test kit, leak test fixture, the guidance and control purging manifold, and the compressed gas cylinder/valve assembly.

406. Cable retractor test kit description

The blast valves at the MAF use hydraulic pressure to close as quickly as possible in the event of a harmful overpressure condition. This lesson will focus on one of the tools that SST technicians use to maintain that system.

The cable retractor test kit (fig. 2-5) is used to pressurize the blast valve accumulators that maintain the hydraulic pressure required to close the MAF blast valves. The cable retractor test kit uses a nitrogen cylinder to pressurize a permanently installed nitrogen cylinder called an accumulator.

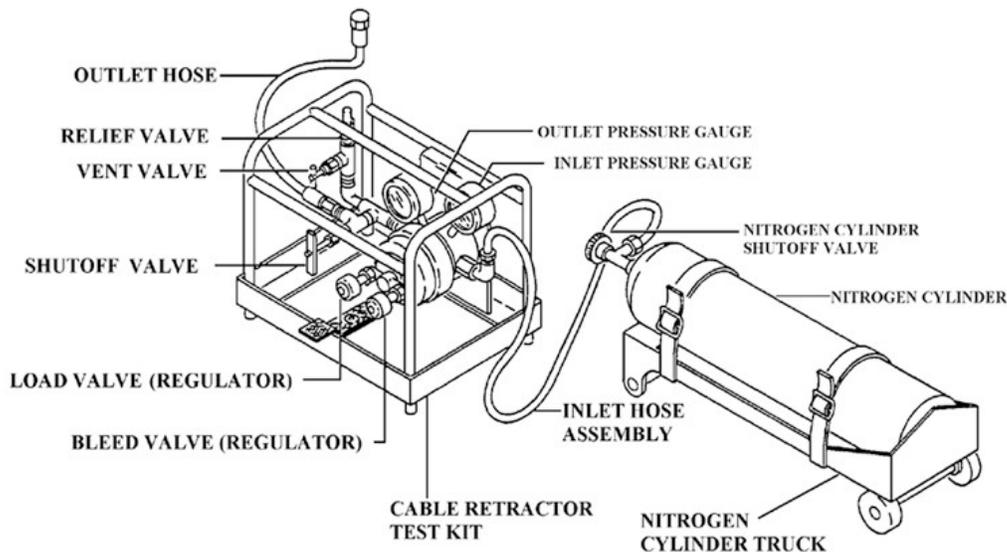


Figure 2-5. Cable retractor test kit.

An accumulator is a free piston-type cylinder that stores hydraulic energy for automatic operation of the blast valves that is located in the MAF hydraulic pump unit.

One side of the blast valve piston connects to the hydraulic system, and the other connects to the nitrogen supply. The cable retractor test kit is used to pressurize the blast valve accumulators after they have been replaced or when one is found to be under-serviced during checkout. The cable retractor test kit consists of the following components:

- Inlet and outlet pressure gauges.
- Bleed valve (regulator).
- Load valve (regulator).

- Shutoff valve.
- Vent valve.
- Relief valve.
- Outlet hose.

This brief lesson provided a basic description of the cable retractor test kit that you will use as a technician in the SST shop.

407. Leak test fixture description and operation

The leak test fixture uses compressed nitrogen to check for leaks in the MGS and G&C umbilical. The MAPS performs troubleshooting and repairs on the leak test fixture, but MMT uses it in the field. The following information provides a description of the leak test fixture as well as the steps required to operate it.

Description

You will use the leak test fixture (fig. 2-6) to check for leaks after the upper umbilical is connected to the MGS receptacle. If this initial leak test fails, the leak test fixture can also be used to further troubleshoot and isolate the leak by checking the MGS by itself or the upper umbilical by itself.



Figure 2-6. Leak test fixture.

The leak test fixture consists of the following components:

- Carrying case.
- Long and short hose assemblies.
- Connector assembly.
- Pressure gauge.
- Pressure valve.
- Adapter assembly.
- Quick-disconnect fittings.

Operation

Dry nitrogen gas is used to pressurize the leak test fixture during operation. The nitrogen cylinders on the PT purge manifold are typically used to supply pressurized nitrogen to the leak test manifold.

As we stated above, the most common use of the leak test fixture is to check for leaks and perform isolation procedures following the connection of the upper umbilical plug at the LF. The steps that follow are a summary of how a team of technicians would use the leak test fixture to test for leaks after the umbilical is connected.

First, verify that the MGS is purged of coolant prior to performing the leak test. Then inspect and connect one end of the leak test fixture hose to the leak test fixture and connect the other end of the hose to the return quick-disconnect fitting on the umbilical plug.

NOTE: Remember, this test is performed at the LF with the umbilical plug connected to the MGS receptacle.

Next, ensure the leak test fixture pressure valve is closed and then open the valve on the nitrogen cylinder. Ensure the low-pressure gauge on the PT purge manifold indicates between 16 and 22 psi and then connect the air hose from the purge manifold to the leak test fixture. With pressure on the hose, slowly open the leak test pressure valve and adjust until the fixture pressure gauge needle stops moving. Once the pressure is within tolerance, close the fixture pressure valve and disconnect the purge manifold air hose from the leak test fixture. Record the exact reading on the leak test fixture pressure gauge and then continue to monitor the gauge reading.

During the monitoring period, you must avoid inadvertent movement or bumping of the leak test hose, because this could result in an invalid test reading. A minimum of 5 minutes is required to allow the pressure in the MGS coolant system and leak test fixture to stabilize. If the pressure does not drop during the first 5 minutes, use it as part of the required 10-minute monitoring period. If pressure does drop during the stabilization period, then the 10-minute monitoring period begins once the pressure on the leak test gauge stabilizes. A drop of 0.50 psi or greater during the 10-minute monitoring period is unacceptable and results in a failed test.

If the test fails, perform isolation procedures to locate the leak. Once the test is successfully completed, close the nitrogen cylinder valve and install the adapter assembly to the fixture quick-disconnect fitting. Open the leak test fixture pressure valve and bleed off pressure from the fixture through the adapter assembly. Place the fixture in its carrying case and proceed with the upper umbilical procedures.

408. Guidance and control purging manifold description

Certain procedures must be accomplished to remove the fluid from the MGS prior to disconnecting the upper umbilical, or else the fluid will contaminate the missile and launch tube. This lesson focuses on the equipment used to purge the MGS.

At the LF, the G&C purging manifold (fig. 2-7) is used to remove coolant from the MGS prior to disconnecting the upper umbilical. The manifold is located on the right rear wall of the PT semitrailer and contains three standard nitrogen cylinders.



Figure 2-7. Guidance and control purging manifold.

The manifold uses two pressure regulators to reduce the pressure from over 500 to 16–22 psi. The manifold also has a high and low-pressure gauge, three check valves, a bleed valve, and a safety relief valve.

The purge manifold is used during leak test fixture operation. One major difference is that only one purge manifold nitrogen cylinder is used instead of three to provide air for leak test operation. The MAPS will troubleshoot, repair, inspect, and calibrate the gauges on the purging manifold.

409. Compressed gas cylinder and valve assembly description

As you have already noticed, there are many pieces of equipment required to roll the LC away from the launch tube in order to perform maintenance. This lesson will focus on the compressed gas cylinder and valve assembly (CVA).

The CVA (fig. 2-8) is used to draw down the LC lock pin and maintain pressure on the ballistic actuator cables during LC opening and closing. It is comprised of three components:

1. Pressure regulator.
2. Hose.
3. Control unit.



Figure 2-8. Compressed gas cylinder and valve assembly components.

Pressure regulator

Attach the pressure regulator to the nitrogen cylinder to reduce and maintain the required pressure to the control unit. The regulator consists of the following components:

- High-pressure gauge.
- Low-pressure gauge.
- Relief valve.
- Bleed valve.

Hose

The hose is a flexible airline that is used to connect the pressure regulator and the control unit.

Control unit

The control unit is used to direct the flow of nitrogen gas from the regulator to the LC actuator cylinder in the LER. You can use the control unit to apply and vent pressurized nitrogen gas to unlock, lower, raise, and lock the LC actuating and locking mechanism. The control unit consists of the following components:

- Four-way directional control valve.
- Two pressure gauges.
- Two check valves.
- Pressure relief valve.

All the above, along with associated hoses and fittings, are mounted in a steel frame to make up the control unit.

Self-Test Questions

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

406. Cable retractor test kit description

1. What is the cable retractor test kit used to pressurize?
2. List the components of the cable retractor test kit.

407. Leak test fixture description and operation

1. What can the leak test fixture be used for if the initial leak test fails?
2. When operating the leak test fixture, what action must happen *prior* to closing the pressure valve and disconnecting the purge manifold air hose from the leak test fixture?
3. When operating the leak test fixture, what indication results in a failed test?

408. Guidance and control purging manifold description

1. Where is the G&C purging manifold located?
2. What can the G&C purging manifold also be used for, and what is different when using it for this alternate purpose?

409. Compressed gas cylinder and valve assembly description

1. What is the purpose of the hose assembly in the compressed gas CVA?
2. What is the purpose of the control unit of compressed gas CVA?

2-3. Maintenance Support Equipment

In addition to the hydraulic and pneumatic equipment, there are numerous pieces of other vital support equipment that you will use and maintain. This equipment provides you with a variety of capabilities necessary to successfully accomplish your maintenance. In order to be successful in your career field, you must have a fundamental understanding of how to maintain and operate the support

equipment. Therefore, this section covers the various functions along with operating and inspection procedures of a few select pieces of support equipment that you may work on or use as a missile maintenance technician. Below are some of the common pieces of support equipment:

- Guided missile maintenance platform (GMMP).
- PAC.
- Explosive set circuitry test set (ESCTS).
- Megohmmeter insulation tester.

410. Guided missile maintenance platform description, function, and inspection

In this lesson, we cover the description and function of the GMMP that MMT technicians use to perform maintenance as well as provide a general explanation of the procedures used to inspect it.

Description and function

The GMMP (fig. 2-9) provides a moveable platform that allows work from virtually anywhere in the launch tube. It is a piece of self-contained, portable equipment that is transported, installed, and operated as necessary to perform maintenance in the launch tube. The GMMP consists of the support structure, bucket, and the associated electrical cables.

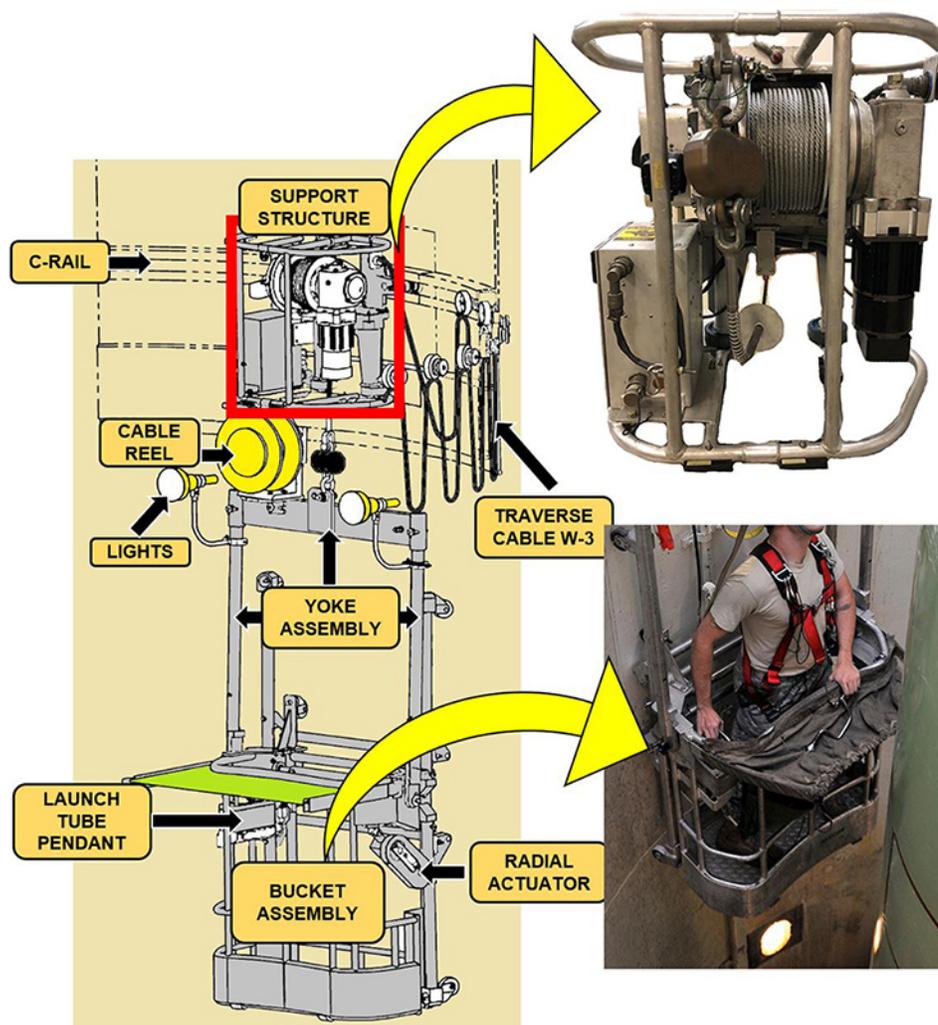


Figure 2-9. Guided missile maintenance platform.

Support structure assembly

The GMMP support structure (fig. 2-9) features subsystems that allow the user to traverse (move left and right) as well as hoist (move up and down) within the launch tube at the LF. The support structure consists of the following components:

- Traverse motor and clutch.
- Traverse drive wheels.
- Trolley wheels.
- Motor and a drum hoist.
- Limit switches.
- Electrical control box.
- Protective frame.
- Lifting lug and shackle.

The traverse drive system is used to traverse the support structure around the circumference of the launch tube. It consists of a motor and clutch that work together to operate two drive wheels that are interconnected by a chain. Once installed, the structure hangs from the support rail (c-rail) in the launch tube by two captive roller assemblies. The captive rollers function as the hard points from which the support structure connects to the launch tube c-rails. The drive wheels of the traverse drive make traction with the lower surface of the c-rail to traverse the support structure left and right. Attached to the bottom of the support structure are two trolley wheels that allow the bottom of the support structure to roll along the launch tube wall.

The hoist system consists of a drum hoist that contains approximately 83 feet of cable. A shackle on the end of the cable connects to the bucket assembly. An upper-limit switch in the structure prevents the bucket assembly from traveling up too far and contacting the support structure. A lower-limit switch stops the motor from running once only four cable wraps remain on the drum. The electrical control box is located on the side of the support structure. This box contains the control circuitry for the hoist and traverse systems and is where the cable reel from the bucket connects.

A protective frame surrounds the support structure and protects it during transportation and handling. A lifting lug with a shackle is located at the top of the structure that is used to lower or raise the structure during installation and removal.

The support structure (fig. 2-9) is connected electrically to the lower distribution box via the traverse roller cable.

Bucket

The GMMP bucket (fig. 2-9) is the component that physically supports the technicians while they perform maintenance in the launch tube. The bucket is capable of holding two technicians and equipment with a weight limit not to exceed 600 pounds. The launch tube pendant (fig. 2-9) is mounted in the bucket and houses a joystick that controls the hoist and traversing functions of the GMMP. The control positions of the joystick are UP, DOWN, RIGHT, and LEFT to correspond with the movement of the GMMP. Additionally, the bucket pendant and LER pendant feature a STOP switch that halts all GMMP operations. The bucket pendant also has a toggle switch that controls the lights.

Two vertical support tubes connect the bucket assembly to the yoke assembly (fig. 2-9). The support structure cable is connected to a lifting plate that is welded onto the yoke. Two lights (fig. 2-9) are mounted on the vertical support tubes of the bucket to increase visibility while performing maintenance in the otherwise dark launch tube. The cable reel is spring loaded to ensure the electrical cable that runs between the bucket and the support structure is always taut. This electrical cable carries the commands from the pendant in the bucket up to the support structure.

The bucket also features an upper and a lower extension leg frame that is attached to the bucket prior to use. Each side of the leg frame houses two wheels that allow the bucket to roll smoothly along the launch tube liner. In addition, a radial actuator (fig. 2-9) controls the extension of the upper and lower legs of the bucket assembly to allow technicians to extend the bucket assembly away from the launch tube liner. A safety net can be installed on the front of the bucket to hold tools and equipment during maintenance operations.

Launcher equipment room power distribution and control

The LER power distribution and control subsystem (fig. 2-10) consists of the power distribution box and LER pendant. The power distribution box provides facility power to the support structure through the traverse roller cable. Four circuit breakers on the distribution box provide over-current protection for the hoist motor, traverse motor, control circuitry, and bucket lights. The LER pendant connects to the distribution box and controls the movement of the bucket during installation and removal of the GMMP and also during abnormal and emergency conditions. The LER pendant functions in the same manner as the bucket pendant except there is no toggle switch to control the lights.

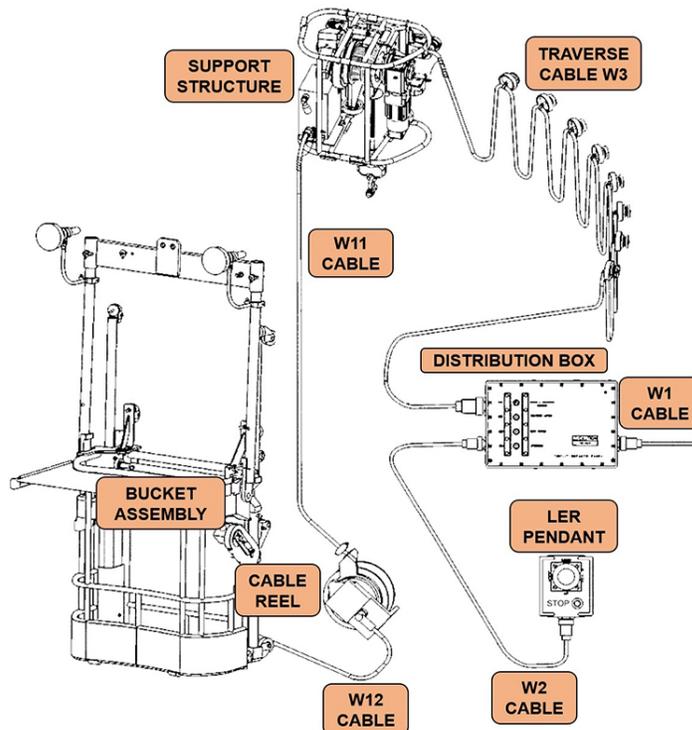


Figure 2-10. GMMP LER power distribution and control subsystem.

Inspection

To maintain the GMMP in peak condition, MAPS technicians perform thorough inspections on the GMMP at regular intervals. Technicians in the power, refrigeration, and electrical (PREL) shop also perform inspection of the GMMP electrical components.

Support structure inspection

The support structure inspection includes inspecting the support structure frame and traverse traction wheels for damage. It also includes inspecting the support structure hoist cable for kinking, crushing, corrosion, broken wires, and broken strands. Additionally, 2M0X3 technicians in the PREL shop will verify the oil level in the support structure hoist gearbox is even with the fill plug and inspect for any oil leaks around the seals.

Bucket inspection

A full GMMP inspection also includes the bucket. A few of the steps include inspecting the yoke and vertical tubes for cracks and distortion. You will inspect each of the quick-release (QR) pin mounting holes to ensure that the QR pin fits snugly and securely. Check the condition of the bucket pendant and the extension legs for bends or cracks. Lastly, verify the overall proper operation of the GMMP.

Launcher equipment room electrical equipment inspection

The LER electrical equipment items that also must be inspected include the power distribution box, associated electrical cables, and the LER pendant. The power distribution box circuit breakers must operate properly and be free of damage. The insulation on the electrical cables is inspected for cuts, frays, or exposed conductors, as well as ensuring all cable connectors are in serviceable condition. The LER pendant must be in serviceable condition, and the rubber joystick boot must not have any punctures or tears. Finally, the stop switch is inspected for damage and proper operation.

411. Portable air conditioner description

As you know, the three boosters of the Minuteman III missile are stacked on top of one another to form the downstage, and you know that the downstage is transported to the LF in a TE. Spare downstages that are awaiting processing or some other action are stored in a MT. Therefore, the temperature and humidity of the MT must be controlled. That is where the PAC comes into the picture.

The PAC (fig. 2-11) controls the temperature and humidity within the MT or TE containers when missile downstages are stored at the MHT section. As a technician in the MHT section, you will be responsible for ensuring the PAC is functioning properly so that a missile downstage is not exposed to extreme high or low temperatures. Two flexible ducts are connected between the PAC inlet/outlet ports and the inlet/outlet ports on the trailer. Air is then either warmed by electric heater elements or cooled by the PAC's refrigeration system and circulated into the trailer in order to maintain the temperature inside the container between 60 and 100°F.



Figure 2-11. Portable air conditioner.

The PAC consists of the following systems:

- Electrical.
- Heating and refrigeration.

All operations of the PAC can be controlled and monitored on the control panel (fig. 2-12).

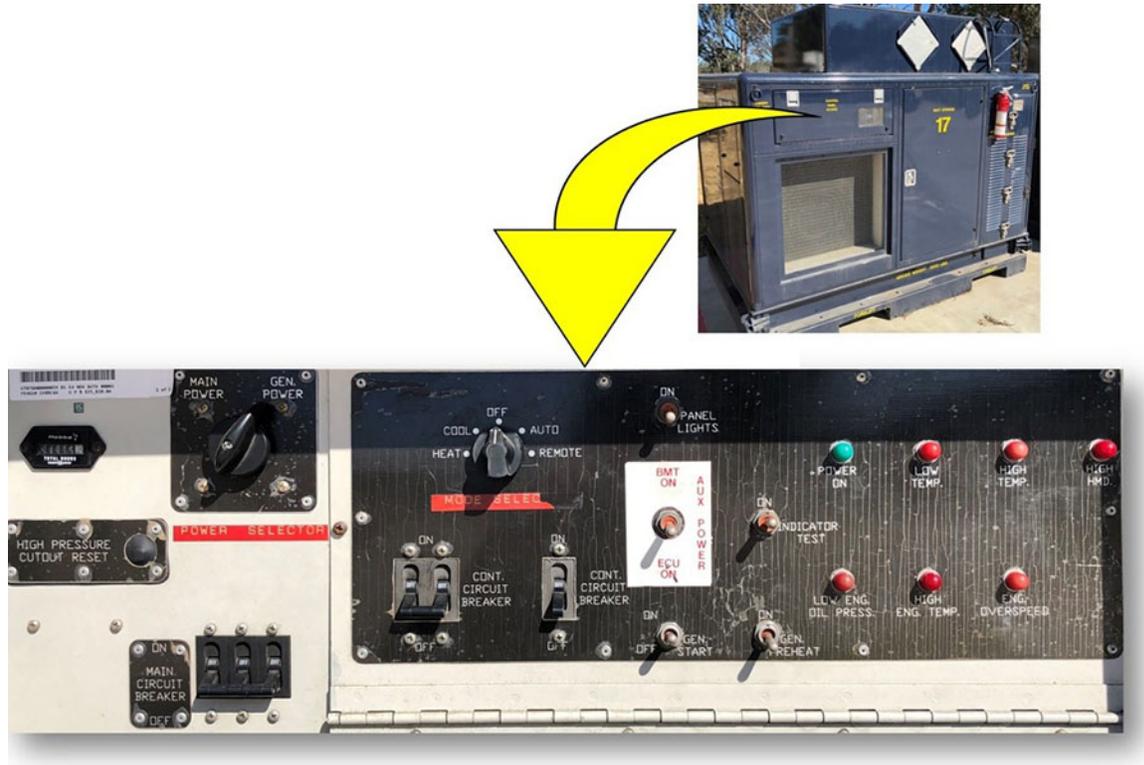


Figure 2-12. PAC control panel.

Electrical system

120/208 VAC, 3-phase, 60-Hz power is supplied to the major components in the PAC by the PAC's internal APU or through a power cable from an external facility power source.

Auxiliary power unit

The APU (fig. 2-13) supplies electricity to operate the PAC's refrigeration and heating systems. The APU uses the same technical order as the APU on the TE tractor because the two APUs are virtually identical in design. The engine utilizes a 12 VDC starting system and is equipped with a battery heater, since the unit is generally stored outdoors. Fuel is supplied to the APU by a 100-gallon tank that is built into the base of the PAC.

External power source (site power)

The PAC heating and air conditioning systems can also operate on power supplied by a maintenance facility. The power control switch selects the power source that will be used.



Figure 2-13. PAC auxiliary power unit.

Heating and refrigeration system

As covered earlier, the PAC provides environmental control for the downstage by maintaining the temperature of the air inside the container between 60 and 100°F, maintaining a dew point of 57°F. Air warmed by electric heaters or cooled by a refrigerating system is circulated continuously between the PAC and the container in a closed-loop system to maintain the desired conditions.

The mode control (system control) switch is located on the PAC control panel (fig. 2-12); where you can select one of the following five modes:

1. Heat.
2. Cool.
3. Off.
4. Auto.
5. Remote.

The heat, cool, and auto operating positions provide constant heat, constant cooling, or automatic temperature control.

412. Explosive set circuitry test set and megohmmeter insulation tester operation

As a technician in the MMT career field you will often perform various electrical checks on sensitive components of the ICBM weapon system. This lesson will focus on two pieces of equipment that are used to accomplish this—the ESCTS and megohmmeter insulation tester.

One of the most important pieces of test equipment you will use on a daily basis is the ESCTS, which is typically referred to as a ‘hazi-meter.’

Explosive set circuitry test set

The ESCTS (fig. 2-14) is an automatic test system that is housed in a padded, portable case designed to protect it during transport, from the environment, and during raising and lowering operations. Electrical test leads are connected to jacks J1 and J2 to perform electrical checks on sensitive circuits.



Figure 2-14. Explosive set circuitry test set.

The ESCTS features a grounding lug that is used to connect the test set to a facility ground point. An instrument panel located on the front of the test set contains keypads, switches, and indicators that you will use to control the unit. Power is supplied to the ESCTS by an internal rechargeable battery pack.

The ESCTS is composed of a power supply, resistance measurement system, amperage measurement system, battery, and a microprocessor to control all functions. The ESCTS measures the absolute resistance of electrical explosive devices (EED) without applying energy that might detonate the device, and it is also capable of measuring any current present in an ordnance circuit before connecting it to an EED. Now that we have described the ESCTS, let's discuss how it operates.

Operation

Since your job requires you to operate the ESCTS almost daily, let's discuss some of the unit's general operating features. Whenever you start up the ESCTS you must first perform a self-test to confirm it is operating properly. If you are conducting more than one test, the ESCTS may remain on; therefore, no additional self-test is required. If left unattended, the ESCTS liquid crystal display (LCD) back light shuts down in 20 minutes to conserve battery energy.

To operate the ESCTS, use the keypad to select either AMPS or OHMS. Test results will appear on the LCD display on the front panel. If a fault exists, the fault light will illuminate, an audible "beep" will sound, and a message will appear to indicate the faulty subassembly. In some instances the display will not show the faulty subassembly, at which point you will need to refer to the technical order to identify the fault.

The ESCTS can be operated in either AUTO or MANUAL mode. Both modes will be used when performing maintenance on the weapon system. AUTO mode allows the meter to automatically test each pin pair that is available in a given test lead. MANUAL mode allows the user to individually

select which pin pairs to test. You can return to the standard display by selecting the opposite mode from the one you are currently in.

Test lead checkout

Before using any test leads with the ESCTS, you must first perform a checkout of the test leads to ensure they are functioning correctly. Connect the test lead(s) required for the test to the appropriate connector(s) on the ESCTS. Then perform the checkout of the test lead to obtain the correct cable identification (ID) as dictated by the technical order. After the ESCTS display shows the correct test lead ID, use that test lead to test the circuit.

Battery charging

When a low-battery indication appears on the ESCTS display, the battery will need to be charged. To charge the ESCTS battery pack (power module assembly), you will first need to remove the battery pack from the ESCTS. Next, turn the battery pack ON/OFF power switch to OFF and plug one end of the ESCTS AC power cable into a 120 VAC source and the other end into the battery pack. Then, place the battery pack with the light-emitting diode (LED) indicators visible and turn the ON/OFF power switch to ON. The battery is fully charged when the ESCTS charge indicator turns green. A discharged battery will need approximately 3 to 6 hours to reach maximum charge.

Megohmmeter insulation tester

A megohmmeter (fig. 2-15) is used to measure the insulation resistance of transformers, motors, cables, and similar components and networks. However, you will use the meter primarily to troubleshoot cabling such as the umbilical cables and security pit vault door penetration circuit. Comparing the readout on the meter to the specifications in the technical order will help you determine if a circuit is broken (open) or shorted to another circuit.

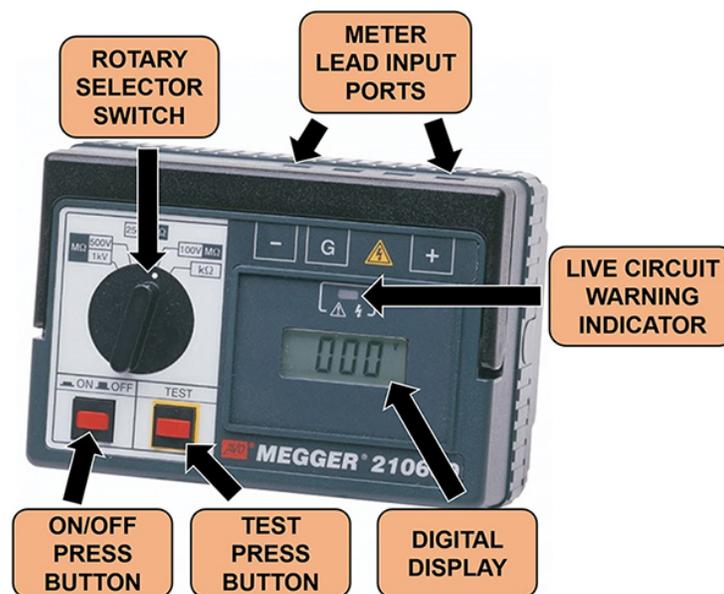


Figure 2-15. Megohmmeter.

Megohmmeter features

The megohmmeter is relatively streamlined and easy to use, and the focus of this part of the lesson is to familiarize you with the different parts of the meter.

ON/OFF press button

This button switches the meter on when you are ready to use it, and switches it off when your checkouts are complete.

Rotary selector switch

The rotary selector switch allows you to choose how many volts the meter will deliver when performing an insulation resistance test. The technical order will specify what voltage the switch should be set to when performing a given test.

Meter lead input ports

The ports for inserting the positive and negative leads are located on the top-right portion of the meter.

Live circuit warning indicator

The live circuit warning indicator will illuminate when the circuit you are testing is energized. Circuits that are being tested should not have voltage applied; discontinue your current test if the live circuit warning indicator illuminates.

Digital display

The digital display will show you how much resistance is on the circuit you are testing. Compare this number to the number provided in the technical order.

TEST press button

The TEST press button sends voltage through the circuit to determine the insulation resistance.

Self-Test Questions

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

410. Guided missile maintenance platform description, function, and inspection

1. What is the purpose of the GMMP traverse drive system?
2. What is the purpose of the STOP switch on the GMMP launch tube pendant?
3. What items are inspected on the GMMP bucket assembly?

411. Portable air conditioner description

1. How does the PAC control the temperature inside of an MT or TE?
2. What source(s) can the PAC use for power?

412. Explosive set circuitry test set and megohmmeter insulation tester operation

1. How does a technician select either AMPS or OHMS on the ESCTS?
2. Provide a brief description of how the explosive set circuitry test set battery is charged.
3. Which feature on the megohmmeter allows the user to choose how much voltage is be delivered to the circuit that is being tested?
4. Which feature on the megohmmeter notifies the user that power is still applied to the circuit that is being tested?

Answers to Self-Test Questions**404.**

1. Gas hose, gas pressure gauge and regulator, hydraulic pump, hydraulic reservoir, hydraulic pressure gauge.
2. Decontaminate only the tractor hydraulic system.

405.

1. Hydraulic pump unit, hydraulic pusher unit, yoke, and hoses.
2. Leaks.
3. Remove the panel and the lid to the reservoir.

406.

1. The blast valve accumulators, after they have been replaced, or when one is found to be under-serviced during checkout.
2. Inlet and outlet pressure gauges, bleed valve (regulator), load valve (regulator), shutoff valve, vent valve, relief valve, and outlet hose.

407.

1. Can be used to further troubleshoot and isolate the leak by checking the MGS by itself or the upper umbilical by itself.
2. The pressure must be within tolerance.
3. A drop of 0.50 psi or greater during the 10-minute observation period.

408.

1. The right-rear wall of the PT semitrailer.
2. During leak test fixture operation; only one nitrogen bottle is used.

409.

1. Connects the pressure regulator and the control unit.
2. Applies and vents pressurized nitrogen gas to unlock, lower, raise, and lock the LC actuating and locking mechanism.

410.

1. Used to traverse (move left or right) the support structure around the circumference of the launch tube.
2. Halts all GMMP operations.
3. Elongated holes that could cause QR pins not to fit securely in their holes, proper operation and the condition of the bucket pendant, and bent or broken extension legs.

411.

1. Cool air is supplied by the refrigeration system and hot air is supplied by heating elements.
2. Site power or its APU.

412.

1. With the keypad.
2. Remove the battery, turn the battery pack ON/OFF power switch to OFF and plug the ESCTS AC cable into a 120 VAC source and to the battery pack. Then, place the battery pack with the LED indicators visible and turn the ON/OFF power switch to ON.
3. Rotary selector switch.
4. Live circuit warning indicator light.

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.

14. (404) The purpose of the hydraulic pressure charging set is to service the
 - a. shock isolators and the missile suspension system (MSS) with nitrogen gas.
 - b. shock isolators and the MSS with silicon fluid.
 - c. payload transporter (PT) suspension system with silicon fluid.
 - d. ballistic actuator with silicon fluid.
15. (404) Select the purpose of the hydraulic purge set.
 - a. Collect fluid samples from or decontaminate the transporter erector (TE) hydraulic system.
 - b. Collect fluid samples from or decontaminate the ballistic actuators.
 - c. Purge shock isolators and the missile suspension system (MSS).
 - d. Purge payload transporter (PT) suspension system.
16. (405) The purpose of the hydraulic pusher set (HPS) is to
 - a. raise and lower the hydraulic secondary door (B-plug).
 - b. open and close the hydraulic personnel access hatch.
 - c. open and close the launcher closure (LC) during maintenance activities.
 - d. open the launcher closure (LC) during operational launch.
17. (405) The constraints on the hydraulic hoses of the hydraulic pusher set (HPS)
 - a. ensure the equipment is tied down during transit.
 - b. prevent hoses from whipping around violently if a hose or fitting fails.
 - c. prevent the pumping unit from rolling off the top of the launcher closure (LC).
 - d. prevent the hoses from getting under the hydraulic pusher set (HPS) and being crushed.
18. (405) Where should the hydraulic fluid level be from the black line on the sight gauge when servicing the hydraulic pusher set (HPS)?
 - a. At the black line.
 - b. +0, -1 inch.
 - c. +1, -0 inch.
 - d. +3, -3 inch.
19. (406) Identify the component that the cable retractor test kit pressurizes.
 - a. Blast valve accumulators.
 - b. Hydraulic pusher set (HPS) skids.
 - c. Payload transporter (PT) pallets.
 - d. Transporter erector (TE) hydraulic system.
20. (407) The leak test fixture used at the launch facility (LF) is used to check for leaks after
 - a. the upper umbilical has been connected to the missile guidance set (MGS).
 - b. a new guidance and control (G&C) chiller unit has been installed.
 - c. the lower umbilical has been connected to the missile skirt.
 - d. a new refrigeration system has been installed.
21. (407) Select the first step when using the leak test fixture at the launch facility (LF).
 - a. Verify the refrigeration system is purged.
 - b. Verify the missile guidance set (MGS) is purged.
 - c. Perform a self-test on the test fixture.
 - d. Verify the guidance and control (G&C) chiller unit is purged.

22. (407) When using the leak test fixture, which step is accomplished *prior* to connecting the nitrogen hose between the purge manifold and leak test fixture?
 - a. Ensure the low-pressure gauge on the payload transporter (PT) purge manifold indicates between 16 and 22 pounds per square inch (psi).
 - b. Ensure the high-pressure gauge on the PT purge manifold indicates between 25 and 32 psi.
 - c. Connect one end of the hose assembly to the return quick-disconnect fitting.
 - d. Perform isolation procedures and locate the leak.
23. (408) The guidance and control (G&C) purging manifold is used to
 - a. remove coolant from the missile guidance set (MGS) prior to disconnecting the upper umbilical.
 - b. remove nitrogen from the MGS prior to disconnecting the upper umbilical.
 - c. purge the MGS with nitrogen prior to installing the upper umbilical.
 - d. purge the MGS with coolant prior to installation to check for leaks.
24. (409) The compressed gas cylinder and valve assembly (CVA)
 - a. releases pressure on the ballistic actuator cables during launcher closure (LC) movements.
 - b. maintains pressure on the lower umbilical cable during downstage removal.
 - c. maintains pressure on the ballistic actuator cables during LC movements.
 - d. locks the launcher closure (LC) lock pin in place while on alert status.
25. (409) Identify the purpose of the compressed gas cylinder and valve assembly (CVA) *control unit*.
 - a. Direct the flow of nitrogen gas from the regulator to the launcher closure (LC) actuator cylinder.
 - b. Maintain pressure on the ballistic actuator cables during launcher closure (LC) movements.
 - c. Maintain pressure on the missile guidance set (MGS) cooling system during removal.
 - d. Maintain pressure on the lower umbilical cable during downstage removal.
26. (410) Which function does the guided missile maintenance platform (GMMP) provide?
 - a. Moveable platform that allows technicians to perform maintenance in the launch tube.
 - b. In-place platform that allows removal and replacement of the reentry system (RS) from the missile.
 - c. Mobile platform that allows technicians to perform maintenance in the launcher equipment room (LER).
 - d. In-place platform that allows removal and replacement of the post-boost control system (PBCS) from the missile.
27. (410) The guided missile maintenance platform (GMMP) bucket assembly
 - a. supports technicians.
 - b. contains tools and equipment required for GMMP installation.
 - c. contains tools and equipment required for missile guidance set (MGS) installation.
 - d. supports the GMMP until the in-place platform is lowered and locked into position.
28. (411) The portable air conditioner (PAC) controls the temperature and humidity of the
 - a. missile transporter (MT) only.
 - b. transporter erector (TE) only.
 - c. missile transporter (MT) and transporter erector (TE).
 - d. missile transporter (MT), transporter erector (TE), and payload transporter (PT).
29. (411) The portable air conditioner (PAC) auxiliary power unit (APU) provides electricity to the PAC's
 - a. refrigeration and heating systems.
 - b. refrigeration, heating, and hydraulic systems.
 - c. refrigeration, heating, and dehydration systems.
 - d. refrigeration, heating, dehydration, and hydraulic systems.

30. (412) Identify the *first* step to be performed whenever the explosive set circuitry test set (ESCTS) is started up.
- a. Self-test.
 - b. Reset testing parameters.
 - c. Select AMPS or OHMS.
 - d. Connect the test leads to the appropriate ESCTS connector.

Please read the unit menu for unit 3 and continue →

Student Notes

Unit 3. Aerospace Vehicle Maintenance

3-1. Inspecting, Loading, and Unloading Aerospace Vehicle Equipment.....	3-1
413. Aerospace vehicle equipment insulation inspection and repair procedures.....	3-1
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THE AVE COMPONENTS of the Minuteman III missile are critical to the weapon system executing its mission with success. 2M0X2 technicians just like you are solely responsible for maintenance actions of those components in the missile field. If any of these actions are performed incorrectly, multi-million-dollar equipment could be damaged or someone could be injured. Therefore, the purpose of the lessons in this unit is to provide you with a fundamental understanding of some of the critical maintenance procedures that involve AVE components.

3-1. Inspecting, Loading, and Unloading Aerospace Vehicle Equipment

The AVE components are the vital parts that make the Minuteman III weapon system a reliable and accurate nuclear deterrent. Therefore, you must have a thorough understanding of the inspection, loading, and unloading procedures for AVE components. You must correctly perform all AVE related tasks as directed by technical data to prevent damage to AVE components or injury to personnel, and also to ensure that the weapon system will perform its mission if necessary. The following procedures are covered in this section:

- Inspecting and repairing the reentry system (RS) insulation.
- Inspecting and repairing the MGS insulation.
- Inspecting and repairing the propulsion system rocket engine (PSRE) insulation.
- Loading and unloading the RS.
- Loading and unloading the MGS.
- Loading and unloading the PSRE.
- Loading and unloading the post-boost control system (PBCS).

413. Aerospace vehicle equipment insulation inspection and repair procedures

The AVE consists of the RS, MGS, and PSRE. The majority of the maintenance you will perform involves the handling of AVE components, and this requires you to inspect the AVE insulation for damage and perform insulation repair procedures, if necessary. Therefore, the following paragraphs are important to you because they will provide you with some basic information on how to perform these duties.

Reentry system insulation inspection procedures

The RS is comprised of two sections called the forward and aft shrouds. The inspection of the RS insulation is performed at the LF, and consists of a visual inspection of the insulation, evaluating any damage, and performing cleaning procedures. You will also inspect the external metallic portion of the RS shroud for scratches, dents, and cracks.

Scratches

If a scratch is discovered on any portion of the shroud insulation, the depth of the scratch must be measured with a depth gauge called a micrometer. If the scratch does not exceed the technical order criteria, a work order is created for repair of the scratch. However, if the scratch does exceed the technical order criteria, notify the missile maintenance operations center (MMOC) who will then contact munitions personnel for further damage evaluation procedures.

Dents

If a dent is found on the forward shroud, you will again notify the MMOC, who will then contact munitions personnel for further damage evaluation procedures.

If a dent is discovered on the aft shroud, you will measure the depth of the dent with a micrometer depth gage. If the dent does not exceed the technical order criteria, a work order will be created for repair. However, if the dent does exceed the technical order criteria, you will notify the MMOC and they will contact munitions personnel for further damage evaluation procedures.

Cork insulation

The RS cork insulation inspection is limited to inspecting and evaluating damage using the criteria described in the technical order. This inspection includes inspecting for the following abnormalities:

- Cracks.
- Scratches.
- Abrasions.
- Cork-to-metal separation.

You will notify MMOC and they will contact munitions personnel for further damage evaluation procedures if the damage to the RS cork insulation exceeds the “no repair required” corrective action listed in the technical order criteria.

Reentry system insulation repair procedures

No repair of the RS shroud insulation is performed at the LF. All damage repair is completed at the munitions facility (MF).

Missile guidance set and propulsion system rocket engine insulation inspection procedures

The MGS and PSRE are separate components; however, when these two components are mated, they are referred to as the PBCS. Since the insulation on the MGS and PSRE is similar, we will cover the inspection for both components at the same time.

The PBCS insulation inspection is performed at the following various locations:

- MSB.
- Topside at the LF.
- Inside the launch tube.

The PBCS is inspected for damage, cracks, or voids (cork-to-metal separation) in the external insulation or damage to the protective coating. Additionally, the PSRE nozzle closures are inspected for damage, cracks, and voids in the bonding surface. No repair is required for water or coolant stains or scuff marks that do not penetrate the insulation surface.

Any damage you discover will be evaluated using the criteria in the technical order. To determine the extent of damage to the PBCS insulation, you must first determine the amount of insulation that is missing. A blunt-end sewing needle with a sliding nylon or Teflon stop and a micrometer are used to determine the depth of the damage. Insert the needle into the damaged area and slide the stop down until it contacts the cork surface. After removing the needle, use a micrometer depth gage to measure the damage recorded with the needle.

Missile guidance set and propulsion system rocket engine insulation repair procedures

Repair procedures for insulation on the MGS and PSRE varies depending on the type of damage discovered during the inspection. If damage to the cork insulation on the MGS and PSRE exceeds the allowable field repair limits in the technical order, the component must be shipped to the depot at Hill AFB to be repaired.

Hypalon fungicide paint solution application

For certain types of damage, the repair action is to apply a Hypalon fungicide solution to the damaged area. This repair includes sanding the damaged area on the cork to create a smooth surface and then wiping the area with isopropyl alcohol. You'll then use a paintbrush to apply the Hypalon fungus resistant paint to the damaged area, and allow each coat to dry for 15 minutes before applying another.

Trowelable cork application

This type of repair to the PBCS is accomplished by applying trowelable cork to the damaged area. Use a plastic scraper and/or coated knife to remove the cork from the damaged area; it should be scraped down to the first layer of adhesive. Clean the area by wiping it down with isopropyl alcohol. Thoroughly mix the three components that make up the trowelable cork. Apply the trowelable cork to the damaged area with a spatula and allow it to cure for a minimum of 24 hours at room temperature. When cured, smooth the trowelable cork with a sanding cloth and block to match the contour of the original cork. Finally, clean the repaired area and use a paintbrush to apply the Hypalon fungus-resistant paint.

The insulation of the AVE protects the missile from the heat generated by friction during flight. It is important that you maintain it properly so the missile is not degraded.

414. Reentry system loading and unloading procedures

You will often load and unload the RS into the PT at the MF, which will typically be referred to as the weapon storage area (WSA). Before loading the RS or any AVE, the PT and RS handling fixture must both be thoroughly inspected to ensure the vehicle and equipment are in serviceable condition. The RS handling fixture consists of the following support rings and assemblies:

- Upper support ring.
- Lower support ring.
- Four upper support rod assemblies.
- Four lower support rod assemblies.
- Four tie-down assemblies.

Preparing the payload transporter at the munitions facility

After inspecting the PT, it will be driven to the MF pit. Upon arrival at the pit, the PT will be prepared for loading the RS. First, the MF door must be securely closed so that it remains closed when the PT is driven over the pit. Then, all snow and ice must be removed from the PT so that it cannot fall into MF pit and possibly onto personnel, equipment, or the RS. Using the alignment marks on the MF floor, the PT is positioned over the MF pit so that the PT floor hatch lines up with MF floor marks. Facility power or the APU will be used to provide power to the PT. Once these steps are all accomplished, you will enter the PT trailer, set all pallet control switches to lower, open the rear trailer doors, and then prepare the hoist for use.

Reentry system loading

The complete RS assembly is loaded into the PT in two parts: (1) the forward shroud and (2) the large aft shroud (shroud assembly). Each part of the RS must be inspected prior to loading it into the PT.

Reentry system forward shroud inspection

Topside technicians will perform this inspection to ensure there is no damage to the RS forward shroud, to identify deficiencies, and to take the necessary corrective actions prior to loading the forward shroud into the PT. Some of the components of the RS handling fixture (fig. 3-1) will have been preinstalled on the forward shroud by munitions personnel. This inspection includes checking for the following:

1. Cable connector is connected to the dummy connector located on the upper support ring.
2. 12 sleeve bolts used to mechanically connect the forward shroud to the aft shroud are in a plastic bag attached to the upper support ring.
3. Four special QR pins securing the RS handling fixture upper support ring to the forward shroud are properly attached, with the knurled nuts tightened down.
4. Grounding shoulder screw is secured to the handling fixture upper support ring.
5. All exposed forward shroud surfaces are free of damage and foreign material.

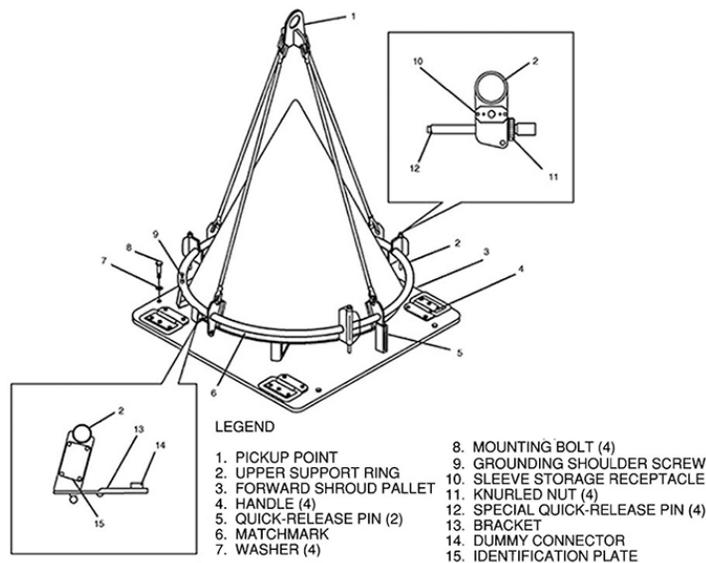


Figure 3-1. RS forward shroud with upper support ring and pallet.

Reentry system aft shroud inspection

After completing the forward shroud inspection, the topside technicians will then go into the MF pit to ensure the RS shroud is not damaged, identify deficiencies, and take the necessary corrective actions prior to loading the aft shroud into the PT. Some of the components of the RS handling fixture will be pre-installed on the RS aft shroud by munitions personnel. This inspection includes checking for the following:

1. RS handling fixture tie-down assemblies are secured between lower support ring and pallet plate eyebolts.
2. RS aft shroud pickup pins on the lower support ring are properly installed into the aft shroud hard points and locked in position by QR pins.
3. Four hard-point plugs are removed from shroud and secured to the lower support ring.
4. All exposed aft shroud surfaces are free of damage and foreign material.
5. RS shroud shunt cap is installed, indicated by the red streamer on the upper portion of the RS element.
6. The cover is properly installed over the top of the RS aft shroud.

7. Serviceable aft shroud interface door and safing pin access door sleeve bolts with caged or non-caged retaining ring.
8. The safing pin shows “S.”
9. The aft shroud release shield is properly installed.

The serial numbers on the forward shroud, aft shroud, and all the custody paperwork must also match. Notify WSA personnel if these numbers do not match.

Loading the reentry system forward shroud into the payload transporter

The procedure described in this paragraph covers loading the forward shroud using the PT hoist. However, it can be loaded manually by using a *minimum* of two maintenance personnel.

First, position the forward shroud and the attached forward handling fixture between the open PT rear doors. Then position the PT hoist directly above the forward shroud and attach it to the pickup point on top of the handling fixture. Raise and guide the forward shroud to its transportation position located in the forward end of the PT. Lower the forward shroud and pallet onto the floor of the PT and secure the assembly with four bolts tightened to approximately 175 inch-pounds. Next, attach the PT ground cable to the grounding screw on the upper support ring. Finally, disconnect the PT hoist from the handling fixture and raise the hoist.

Loading the reentry system aft shroud from the munitions facility pit into the payload transporter

As you learned earlier, the aft shroud is normally loaded from the MF pit up through the PT floor hatch. To accomplish this, first connect the beam-type sling (fig. 3-2) to the PT hoist using attach point 3, and then connect four RS handling fixture lower support rods to the sling. Next, raise and stow the PT access hatch doors.

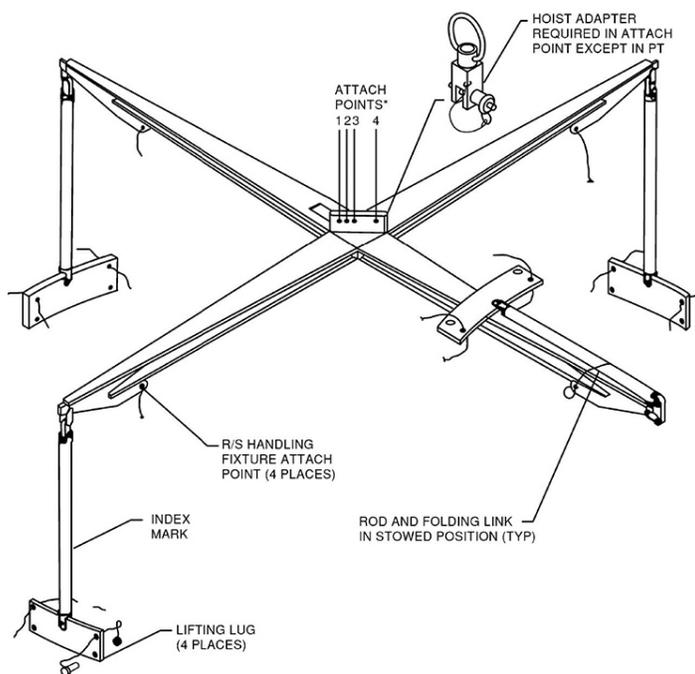


Figure 3-2. Beam-type sling.

Because you will be exposed to a fall hazard once the MF pit door is opened, you must wear a safety harness with a lanyard attached to an approved lifeline attach point inside the PT.

After opening the closure on the MF pit, use the PT hoist to lower the beam-type sling with the four support rods into the pit and over the RS aft shroud. Using QR pins, attach the four support rods to the handling fixture lower support ring (fig. 3-3). Next, attach two tag lines to the lower support ring and use them to guide the RS aft shroud as the PT hoist raises it into the PT.

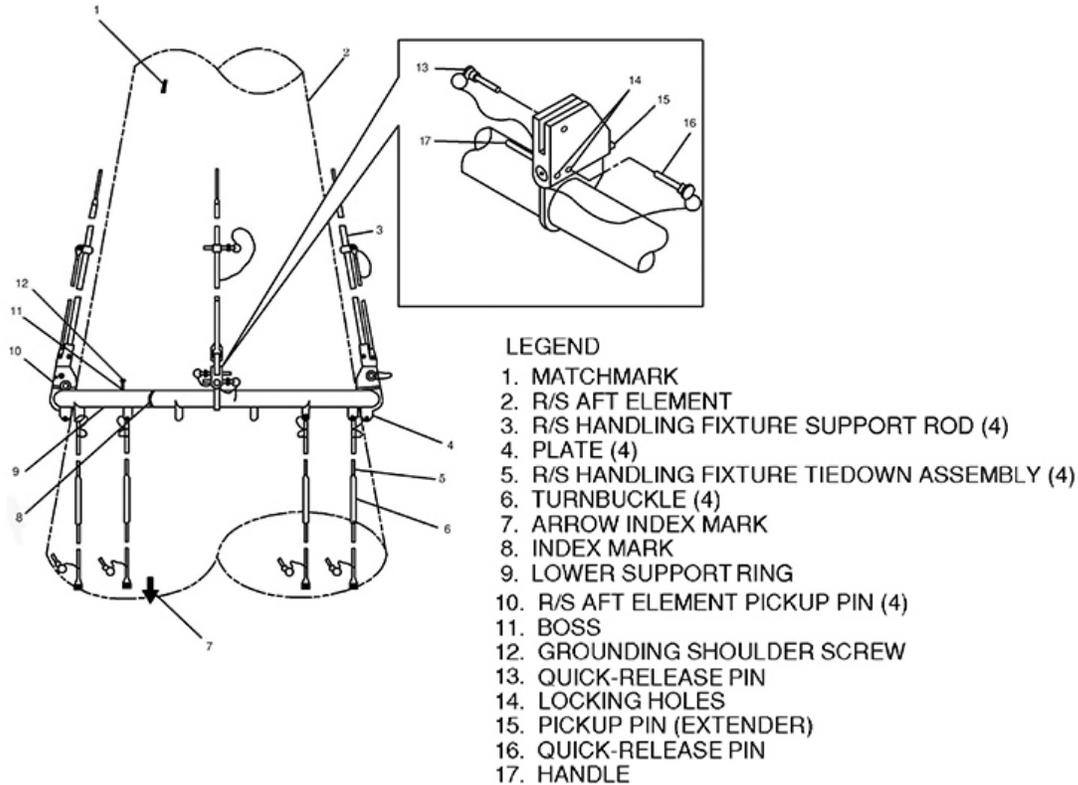


Figure 3-3. Aft shroud and handling equipment.

Once the aft shroud is inside the PT, close and lock the pit door. Next, use the hoist to move the RS aft shroud over the PT forward air pallet, align the aft shroud pallet plate mounting holes (fig. 3-4) with the holes in the PT pallet. After lowering the aft shroud, install four bolts and torque them to approximately 550 inch-pounds to secure the RS aft shroud pallet plate to the PT air pallet. Next, attach a PT ground cable to the grounding screw on the lower support ring of the handling fixture and lower and secure the PT access hatch door. Finally, remove the support rods and beam-type sling from the hoist and stow it.

Securing the payload transporter after loading the reentry system

The semitrailer must be secured after the RS is loaded onto the PT. First, set all the air pallet control switches to RAISE. If not raised before moving the PT, the pallets and/or AVE may be damaged. Next, close and latch the PT SAP doors and stow the PT hoist. You'll secure any loose equipment inside the semitrailer and then close and lock the rear doors. Now disconnect APU or facility power and lock the personnel access door. If required, display warning signs on the exterior of the PT indicating the class of hazardous material inside the semitrailer.

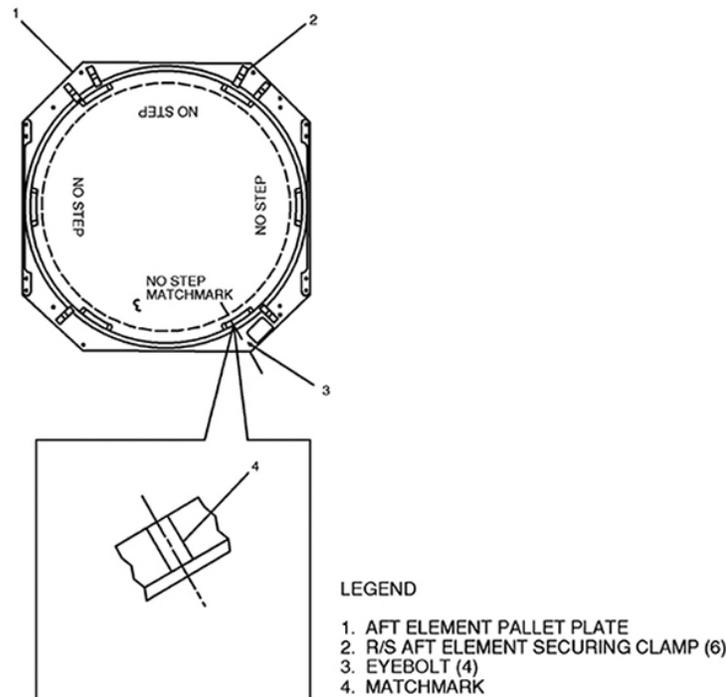


Figure 3-4. Aft shroud pallet.

Unloading the reentry system at the munitions facility

The RS unload procedures are essentially the load procedures performed in reverse order.

Preparing the payload transporter at the munitions facility

At the MF pit, prepare the PT for unloading of the RS in the same manner as you did for loading the RS. Check that the MF pit is securely closed; remove all ice, snow, and mud from the underside of the PT, and position the PT over the MF pit. Next, connect the PT to APU or facility power. Open the SAP and rear PT doors, lower all the air pallets, and prepare the hoist for use.

Moving the reentry system aft shroud from the payload transporter into the munitions facility

First, the topside technicians inspect the RS aft shroud prior to lowering it into the pit. The RS aft shroud is inspected to ensure the following actions have been completed:

1. RS handling fixture tie-down assemblies are secured between lower support ring and pallet plate eyebolts.
2. RS aft shroud pickup pins on the lower support ring are properly installed into the aft shroud hard points and locked in position by QR pins.
3. RS shroud shunt cap is installed, which is indicated by the red streamer on the upper portion of the RS element.
4. RS aft shroud cover is properly installed.
5. Serviceable aft shroud interface door and safing pin access door sleeve bolts with caged or non-caged retaining ring are installed.
6. Ensure that the grounding shoulder screw is secured to the lower support ring.

Next, connect the beam-type sling to the PT hoist using attach point 3, and then connect four RS handling fixture lower support rods to both the sling and to the RS handling fixture lower support ring. Then raise and stow the PT access hatch doors. Remove the four bolts that secure the aft shroud pallet plate to the PT, and then disconnect the PT ground strap from the RS.

Using the PT hoist, raise and position the aft shroud over the access hatch. Attach two tag lines to the lower support ring 180 degrees apart. Open the MF pit door and transfer the tag lines to the technicians in the MF pit. Use the PT hoist to lower the aft shroud down towards the MF pit floor. Technicians in the pit will then use the tag lines to guide the aft shroud through the PT access hatch and onto the MF pit floor. Once lowered, remove the sling rods and tag lines from the lower support ring. The tag lines are attached to the lower end of the support rods and used by the technicians in the pit to guide the rods away from the aft shroud as the rods are raised by the PT hoist. Once the hoist is in the PT, close the MF pit, and remove the support rods and beam-type sling from the hoist.

Unloading the reentry system forward shroud from the payload transporter

As with the RS aft shroud, the RS forward shroud must be inspected before it is unloaded to ensure that the four special QR pins are properly installed and the grounding shoulder screw is secured to the upper support ring. After inspecting the forward shroud, remove the four bolts securing the forward shroud pallet to the PT floor and remove the PT ground strap from the grounding screw on the RS handling fixture upper support ring. Using a minimum of two technicians, or the PT hoist, unload the forward shroud from the PT and transfer it to a designated area.

Securing the payload transporter after unloading the reentry system

Now that the RS aft and forward shrouds have been unloaded, the PT is prepared for departure. Set all air pallet control switches to RAISE and close the PT rear doors. Secure all loose equipment, disconnect APU or facility power, and close the personnel access door.

This lesson focused on the tasks required to load and unload an RS at the WSA, which will often be both your first and last stop when performing any RS maintenance. If not done properly, the surety of the weapon system could be in question.

415. Missile guidance set, propulsion system rocket engine, and post-boost control system loading and unloading procedures

The MGS or the PSRE can be loaded or unloaded individually. However, if the day's job requires a PBCS, the MGS will be loaded prior to the PSRE at the beginning of the day, and then unloaded after the PSRE upon return to MSB. These actions are taken so that the PSRE is not transported unnecessarily, and also ensures that it is never transported into unauthorized areas of the MSB.

Prior to loading the MGS, PSRE, or PBCS, you must perform the pre-operational checkout of the PT. Once this is completed, the PT is connected to APU or facility power and the ECS is set to AUTO. Once you are inside the PT, open the rear PT doors, lower the air pallets, and prepare the hoist for use.

Missile guidance set loading

Before handling and loading the MGS, you must observe the following cautions whenever you handle the MGS:

- You must be extremely careful not to damage the radiation shielding or the conductive finish (Alodine chemical film) located on the MGS upper mating surface and positioning ramp. Damage to either of these surfaces could impair the MGS's capability to shield against radiation and electromagnetic pulse.
- Exposing the MGS to temperatures below 45 or above 145°F could affect its performance. In the event the MGS is exposed to temperatures outside of this range, you must notify MMOC of the temperature and the duration of the exposure.

Missile guidance set inspection

Technicians in the electronics laboratory (ELAB) maintain day-to-day custody of the MGSs when they are in storage. They will prepare the MGS for loading by removing it from the storage area and removing the lid to the storage container prior to your arrival. Before loading the MGS onto the PT, perform the following inspection on the MGS:

1. Verify the MGS serial number is the correct one for the applicable LF.
2. Ensure that the collimator window is covered.
3. Inspect the battery for activation.
4. Ensure that all the coolant line quick-disconnect fittings are mated.
5. Inspect the external insulation for damage.
6. Inspect the conductive finish (Alodine) on the upper mating surface.
7. Inspect the MGS radiation shielding.
8. Inspect the MGS to RS extender cable connectors for damage and proper configuration.
9. Inspect the MGS umbilical receptacle for contamination, damaged threads, and connector contacts.
10. Inspect the elastomer boots, if installed on the cable.

Missile guidance set loading

Position the lower section of the MGS shipping container between the open PT rear doors. Next, connect the beam-type sling to the PT hoist using attach point 2, and move the hoist to the rear of the PT and over the MGS. Align the beam-type sling with the index mark on the MGS, and then connect the beam-type sling lifting lugs to the top MGS mating bolt holes, ensuring that there are 12 bolt holes between each lifting lug. Using the PT hoist, raise the MGS and attached handling ring, and move them into the PT and over the air pallet. Then, ensure the PT pallet and bottom of the MGS handling ring are clear and free of debris that could cause the handling ring to warp. Next, lower the MGS and handling ring onto the PT pallet. Secure the handling ring to the PT pallet with four tie-down clamps and bolts, and then torque the bolts to approximately 550 inch-pounds. Finally, disconnect and remove the beam-type sling from the MGS.

Securing the payload transporter after loading the missile guidance set

After the MGS is loaded, the PT must be secured and prepared for departure. Set the air pallet control switches to RAISE and close the PT rear doors. Secure the hoist and all loose equipment inside the PT. Next, you'll need to disconnect facility power; or if the PT is running on APU power, and the ECS is no longer required, shut down the APU. Lastly, you'll close and lock the PT personnel access door.

Missile guidance set unloading

Procedures to unload the MGS are essentially the loading procedures performed in reverse order.

Procedures for unloading the missile guidance set

First, configure the PT the same as you did for loading the MGS. With the beam-type sling attached to the PT hoist, lower the sling and attach it to the MGS. Remove the four tie-down clamps securing the MGS handling ring and transfer the MGS to the rear of the PT above the MGS shipping container lower section. Align the MGS handling ring with the shipping container, and then lower the MGS into the shipping container. Disconnect the beam-type sling, and then raise and traverse the sling until it is clear of the MGS. Remove the sling from the PT hoist. Lastly, ELAB technicians take custody of the MGS.

Securing the payload transporter after missile guidance set unloading

Now that the MGS is unloaded, prepare the PT for departure. Set the air pallet control switches to RAISE and close the PT rear doors. Secure all loose equipment inside the PT, remove facility or APU power, and close the personnel access door.

Propulsion system rocket engine loading

The MMT section is responsible for the safe storage of the PSRE. They are stored away from the main base area in an unmanned facility. You need to be aware of the following precautions prior to handling the PSRE:

- Propellants in the PSRE are extremely toxic in liquid or vapor state and, therefore, very hazardous to personnel.
- Exposing the PSRE to temperatures below 20 or above 125°F could cause equipment damage. In the event the PSRE is exposed to temperatures outside this range, you must notify the MMOC.

Propellant vapor check

Before entering the PSRE storage building, a PT with a PSRE inside, or opening a PSRE shipping container, you must use the gas detector to verify the absence of vapor. The propellant vapor check is performed at the test valve on the PSRE shipping container. Notify the MMOC immediately if any vapor is detected.

Propulsion system rocket engine inspection

After removal of the upper section of the PSRE shipping container, you must inspect the PSRE prior to loading it onto the PT. First, verify the PSRE safe and arm pins are installed. Next, inspect the PSRE insulation along with the conductive finish (Alodine) located on the PSRE upper mating surface for damage.

You must also verify that the P107 bellows retainer plate, spanner nuts, and shielding caps are installed on the PSRE electrical connectors. Also ensure that the gas storage assembly (GSA) cover is installed over the helium tank cover (fig. 3-5). Inspect the top of the PSRE for any damaged or missing nut plates. Verify the condition of the basket nuts by installing a spare mating bolt finger tight into each nut plate. The basket nut is defective and must be replaced if you are able to thread the bolt completely through the nut using only finger pressure.

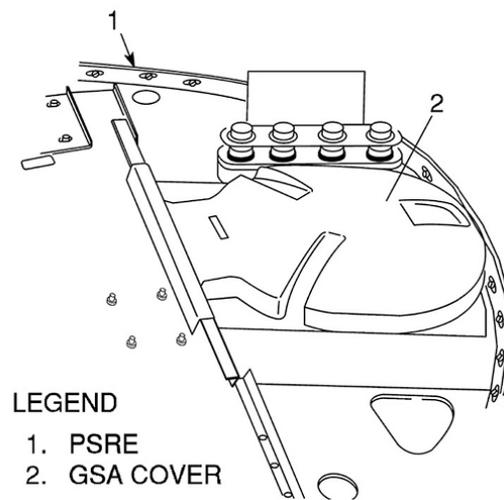


Figure 3-5. GSA cover on helium tank.

Next, remove the PSRE electrical connector access door (fig. 3-6). Check that the free torque on PSRE connector P107 does not exceed the amount specified in the technical order and then reinstall the access door.

NOTE: Static discharge can cause firing of the PSRE ordnance devices. Therefore, you must properly ground yourself prior to working with the P107 connector, or when there is any possibility that you might come in contact with an ordnance device.

Procedures for loading the propulsion system rocket engine

First, position the PSRE between the open PT rear doors. Next, connect the beam-type sling to the PT hoist using attach point 4, and then move the hoist to the rear of the PT and over the PSRE. Align the beam-type sling with the index mark on the PSRE, and then connect the sling lifting lugs to the top PSRE mating bolt holes, ensuring that 12 bolt holes are between each lifting lug.

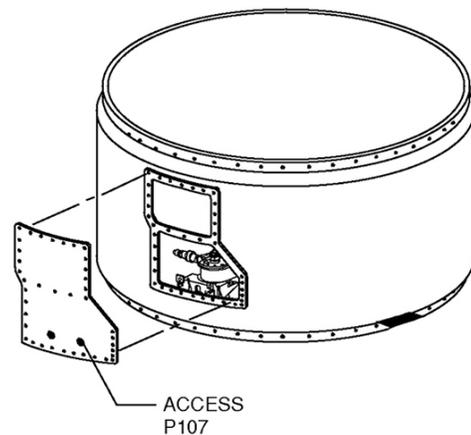


Figure 3-6. PSRE P107 access.

Using the PT hoist, raise the PSRE and attached handling ring, and move them into the PT and over the air pallet. Next, lower the PSRE and handling ring onto the PT pallet. Secure the handling ring to the pallet with four clamps and torque the clamp bolts to approximately 550 inch-pounds. Since the PSRE is an explosive component, the PT grounding cable must be connected to the grounding lug located on the PSRE handling ring. Finally, disconnect and remove the beam-type sling from the PSRE.

Securing the payload transporter after loading the propulsion system rocket engine

After loading the PSRE, you must secure the PT and prepare it for departure. Set all the air pallet control switches to RAISE and close the PT rear doors. Secure the hoist and all loose equipment inside the PT. Next, you'll need to disconnect facility power; or if the PT is running on APU power, and the ECS is no longer required, shut down the APU. Because the PSRE contains explosives, you must display the proper warning placards on the exterior of the PT to identify the type of hazardous material onboard. Finally, close and lock the PT personnel access door.

Unloading the propulsion system rocket engine

You must always perform a propellant vapor check prior to entering a PT that is loaded with a PSRE. This check is performed at the PT vapor ports using the gas detector. Again, you must immediately notify the MMOC if any vapor is detected.

Procedures for unloading the propulsion system rocket engine

Procedures to unload the PSRE are essentially the loading procedures performed in reverse order. Use the gas detector to perform a propellant vapor check prior to entering the PT. Then, configure the PT the same as you did for loading the PSRE. Move an empty shipping container to the rear of the PT and remove the lid. Inspect the shipping container for damage prior to placing the PSRE into the container.

Attach the beam-type sling to the PT hoist, lower the sling, and attach it to the PSRE. Remove the PT ground strap from the lug on the PSRE ring. Remove the four clamps securing the PSRE handling ring, and then transfer the PSRE to the rear of the PT. Place the PSRE above the PSRE shipping container lower section or rubber pad. Lower the PSRE onto the shipping container and torque the container handling ring bolt to 170 inch-pounds. Disconnect the beam-type sling from the PSRE, then

raise, and traverse the sling clear of the PSRE. Finally, install the shipping container lid and place the entire shipping container in storage.

Securing the payload transporter after unloading the propulsion system rocket engine

Now that the PSRE is unloaded, the PT must be prepared for departure. Set all air pallet control switches to RAISE and close the PT rear doors. Secure all loose equipment, remove facility or APU power, and close the personnel access door.

Loading the post-boost control system

When required, the MGS and PSRE AVE components may be mated together and loaded as one unit called the PBCS. The MGS will be loaded into the PT at the MGS vault, and then transported to the PSRE storage facility. There, the PT is prepared for loading the PBCS as described at the beginning of this lesson.

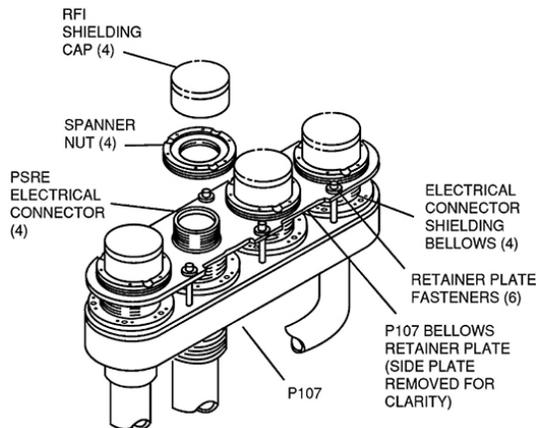


Figure 3-7. P107 bellows retainer plate, spanner nuts, shielding caps and gas storage assembly cover.

remove the shielding caps, spanner nuts, and P107 bellows retainer plate from the four electrical connectors on top of the PSRE (fig. 3-7).

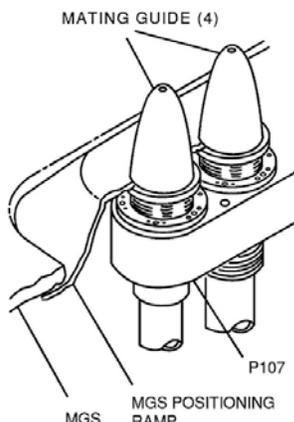


Figure 3-8. Mating guides.

Next, install four mating guides (fig. 3-8) on the PSRE electrical connectors to prevent the connectors from being damaged while mating the MGS to the PSRE. Because of the different threads on the J6 connector, the red mating guide is the only mating guide designed to be installed on the J6 connector. Finally, remove the GSA cover from over the helium tank.

Position the PSRE at the rear of the PT between the open rear doors. Then, remove the shielding caps, spanner nuts, and P107 bellows retainer plate from the four electrical connectors on top of the PSRE (fig. 3-7).

Mating the missile guidance set to the propulsion system rocket engine

The PSRE and MGS are now ready to be mated. Start by connecting the beam-type sling to the PT hoist using attach point 2. Next, move the PT hoist and sling to the rear of the PT over the MGS. (Remember that the MGS was loaded onto the PT earlier at the MGS vault.)

Align the beam-type sling with the index mark on the MGS and then connect it to the MGS top mating bolt holes, and be sure that

Preparing the propulsion system rocket engine

The PSRE is prepared for loading in the same manner as described above in the *procedures for loading the propulsion system rocket engine*; however, some additional work must be performed on the PSRE before it is mated with the MGS.

Position the PSRE at the rear of the PT between the open rear doors. Then,

Once the MGS is resting firmly on the PSRE, secure the MGS to the PSRE using 60 interface bolts. Torque the interface bolts to approximately 175 inch-pounds. Move the PT hoist from attach point 2 to attach point 3 on the beam-type sling. Then, remove the mating guides from the PSRE electrical connectors and install, torque, and secure the spanner nuts onto the connectors with safety wire (fig. 3-9).

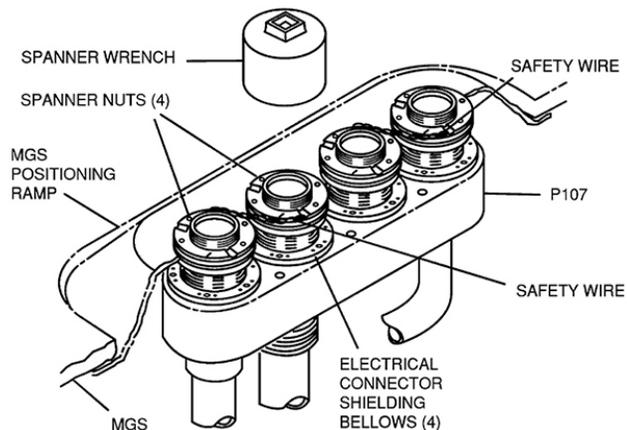


Figure 3-9. Spanner nut with safety wire.

Next, carefully align and connect only three MGS cables to PSRE connectors J3, J4, and J5 (fig. 3-10). The fourth cable, which connects to the flight battery, is tested and connected to PSRE connector J6 at the LF in the launch tube; for now, cover the J6 connector with a shielding cap.

As you will recall, a PSRE mated with an MGS is called a PBCS. Raise the PBCS into the PT, place it onto the air pallet and use four clamps to secure the PSRE handling ring to the pallet. Torque the clamp bolts to approximately 550 inch-pounds. Because the PBCS is an explosive component, the PT grounding cable must be connected to the grounding lug located on the PSRE handling ring. Finally, disconnect and remove the beam-type sling from the top of the MGS.

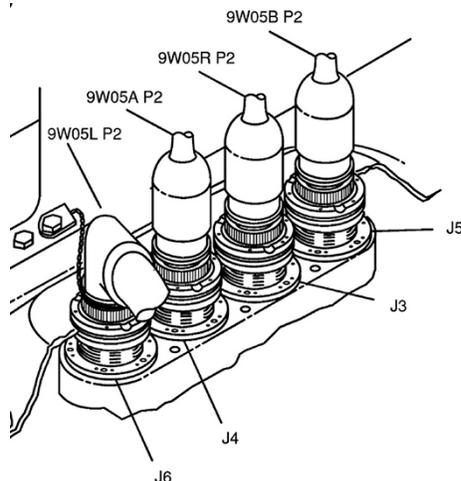


Figure 3-10. MGS cables connected to PSRE.

Securing the payload transporter after loading the post-boost control system

After loading the PBCS, you must secure the PT and prepare it for departure. Set all the air pallet control switches to RAISE and close the PT rear doors. Secure the hoist and all loose equipment inside the PT. Next, disconnect facility power; or if the PT is running on APU power, and the ECS is no longer required, shut down the APU. Because the PBCS is an explosive component, you must

display the proper warning signs on the exterior PT. Finally, close and lock the PT personnel access door.

Unloading the post-boost control system

As mentioned before, when the PBCS is aboard the PT and the PT has been moved, you must perform a propellant vapor check prior to entering the PT. Once again, notify the MMOC immediately if any vapor is detected.

Procedures for unloading the PBCS are essentially the loading procedures performed in reverse order. First, configure the PT, then prepare the PSRE shipping container using the same steps that you used to unload the PSRE. Use the PT hoist to attach the beam-type sling to the PBCS. Remove the PT ground strap from the lug on the PSRE ring. Remove the four clamps securing the PSRE handling ring and transfer the PBCS to the rear of the PT, and then move the PSRE onto the shipping container lower section or rubber pad. Move the PT hoist from attach point 3 to attach point 2 on the beam-type sling.

Disconnect the three MGS cables from the PSRE. Cut the safety wire on the spanner nuts and remove the spanner nuts from the PSRE connectors. Next, install four mating guides on the connectors to prevent the PSRE connectors from being damaged when lifting the MGS off the PSRE. Remember that the red mating guide must go on the PSRE J6 electrical connector to prevent damage to the threads on the connector. Remove the 60 interface bolts and washers securing the MGS to the PSRE and raise the MGS from the PSRE.

Lower the MGS onto the MGS handling ring and secure it to the ring with bolts. Disconnect the beam-type sling from the MGS and then from the PT hoist. Remove the mating guides from the PSRE connectors. Install the P107 bellows retainer plate and torque to 20–25 inch pounds. Next, install the spanner nuts, and shielding caps onto the four electrical connectors on top of the PSRE. Also, install the GSA cover to protect the PSRE helium tank. Finally, place the PSRE shipping container over top of the PSRE and secure it to the lower section. The PSRE can be placed into storage once all of these steps are completed.

Now that the PSRE is unloaded, prepare the PT for departure. Set the air pallet control switches to RAISE, and close the PT rear doors. Secure all loose equipment inside the PT. disconnect APU or facility power and close the personnel access door. The MGS is returned and unloaded at the MGS vault using the MGS unloading procedures described earlier in the lesson.

This lesson focused on loading and unloading the MGS, PSRE, and PBCS. Each of these components require special attention and care. If load or unload procedures are performed incorrectly, these components could be rendered unserviceable.

Self-Test Questions

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

413. Aerospace vehicle equipment insulation inspection and repair procedures

1. What will you inspect the external metallic portion of the RS shroud for?
2. What will you inspect the PSRE nozzle closures for?
3. If applying trowelable cork to the PBCS, what step will be accomplish *after* it has had time to cure?

414. Reentry system loading and unloading procedures

1. Why is the PT thoroughly cleaned prior to moving it over the MF pit?
2. What action is taken if serial numbers on the forward shroud, aft shroud, and the custody paperwork do not match?
3. What might occur if the air pallet control switches in the PT are not set to RAISE after loading the RS?

415. Missile guidance set, propulsion system rocket engine, and post-boost control system loading and unloading procedures

1. What step must be taken if the MGS has been exposed to temperatures below 45 or above 145°F?
2. What section is responsible for storage of the PSRE?
3. What step must be accomplished prior to entering the PSRE storage building, a PT with a PSRE inside, or opening a PSRE shipping container?
4. Why must the PT grounding cable be connected to the grounding lug on the PSRE handling ring?
5. What step must be accomplished before a PSRE is placed in a container?
6. Why are four mating guides installed on the PSRE electrical connectors prior to mating to the MGS?

3-2. Aerospace Vehicle Equipment Transportation and Maintenance

This section covers the procedures that are at the heart of what the missile and space system maintenance career field is all about. Transporting, removing, and installing AVE components is the bulk of what you do every day.

To keep missiles on alert, you must safely transport AVE components over the many miles of public highways and dirt roads to and from the LF on a daily basis. Due to the potential hazards associated with AVE components, transportation of these components must comply with specific established

operating procedures. Potential hazards with AVE components still exist even after the components have arrived safely at the LF. Therefore, knowledge of proper handling during installation and removal of AVE components will prevent mishaps that could damage equipment or injure personnel.

416. Aerospace vehicle equipment component transportation procedures

Transporting AVE components (RS, MGS, PSRE, and PBCS) shall be done in accordance with federal regulations, Air Force standard operating procedures, and Air Force Manual (AFMAN) 91-201, *Explosives Safety Standards*. These regulations and procedures provide guidance on such topics as classification of hazardous materials, marking hazardous materials, and separating and segregating hazardous materials for transportation.

Temperature limits for aerospace vehicle equipment components

As stated earlier, the primary concern when transporting AVE components is maintaining the components within their thermal limits. As a review the following limits are given:

- The RS shall not be exposed to any temperature below -35°F or above 125°F . Also, the relative humidity limits for the RS are 0 to 100 percent with an 80°F maximum dew point.
- The MGS performance could be affected by exposure to temperatures below 45°F or above 145°F .
- The PSRE shall not be exposed to any temperature below 20°F or above 125°F .

Because the MGS and PSRE are temperature sensitive, the thermal environmental limits in a PT loaded with the MGS or PSRE is maintained between 50 and 80°F .

Preparing the payload transporter to transport aerospace vehicle equipment

Before you can transport any AVE components in the PT, you must prepare the PT in accordance with applicable regulations and procedures. For example, to maintain the environment inside the PT within the thermal limits required by the technical order, you must sometimes operate both the PT APU and ECS while transporting AVE components. Operate the APU in accordance with technical order procedures to provide power to the ECS. Once APU power is applied, turn on and set the ECS mode control switch to AUTO. In the AUTO mode, the ECS will maintain the interior of the PT semitrailer within the 50 to 80°F range.

Additionally, you must display warning placards on the exterior of the PT semitrailer of the most hazardous class of explosive being transported in the PT. However, placards are not required on a PT when in a nuclear weapon storage area. The proper warning placard for each AVE component is identified in the table below.

Required PT AVE Warning Sign and Placard	
AVE Component	Warning Placard to be Displayed
RS	Explosives 1.1D or Explosive 1.3C
MGS	None
PSRE	Explosives 1.3L and Poison
PBCS	Explosives 1.3L and Poison

Transporting aerospace vehicle equipment components

Requirements for transporting AVE components include the following:

- The driver of a PT loaded with AVE components must be qualified to operate the vehicle and be knowledgeable of the explosives being transported and associated hazards.
- Vehicle speed limits will be determined by local directives.
- During normal maintenance, the RS and PSRE will not be transported in the same PT.

This lesson focused on the transportation of AVE. As a maintenance professional, you are charged with transporting the AVE hundreds of miles safely. Doing that every day is what makes you an important part in accomplishing the Air Force mission of nuclear deterrence.

417. Safing pin installation and removal procedures

The missile contains several different types of explosive charges and assemblies. As a maintenance technician, you need to know how and when to install safing pins in the missile so that you can safely perform maintenance without inadvertently setting off any of these devices.

Safing pin installation

You must install missile safing pins in the arm/disarm devices of the missile when performing any of the following procedures:

- Maintenance on the distribution box (D-box).
- Connecting and disconnecting G&C or skirt umbilical at the D-box.
- Connecting and disconnecting G&C or skirt umbilical at the missile.
- Removing, replacing, troubleshooting, or performing maintenance on the missile, RS, MGS, or PSRE.

The technical order will tell you exactly when and in what locations to install safing pins, depending on the type of maintenance that your team is performing that day.

NOTE: During safing pin installation, if the safe-arm indicator indicates “A” or if the “S” is not entirely visible, the component/missile is considered armed. Contact the MMOC if this occurs.

Before installing safing pins in the missile, you must verify the following:

- The key for the safety control switch (SCS) lock pin assembly is in the pocket of the technician who will be physically installing the safing pins.
- Only essential personnel are in the LER.
- Safety harnesses and lanyards are used.
- The three safing pin wrenches (fig. 3-11) are operational (the safing pin wrenches may be used interchangeably).

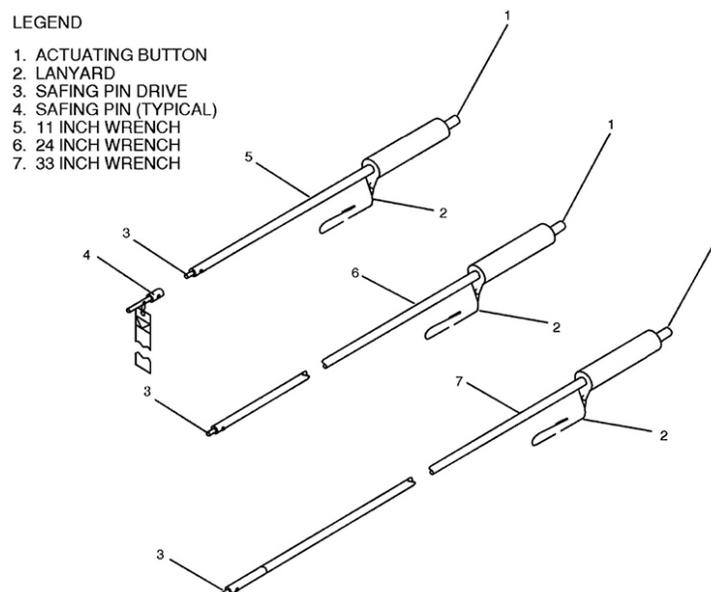
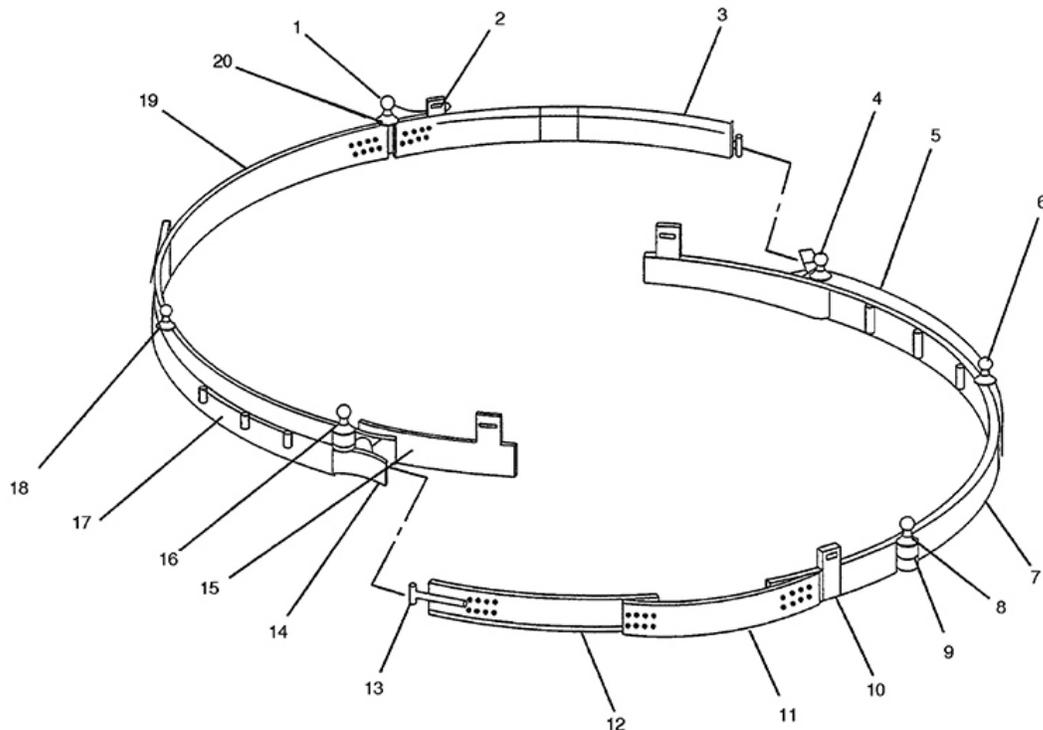


Figure 3-11. Safing pin wrenches.

Installing the reentry system aft shroud release shield

Installing safing pins normally includes installing the RS aft shroud release shield or the “belly band” (fig. 3-12) only when technicians are performing maintenance beyond safing at or above the PSRE/third stage interface. This device protects personnel from inadvertent release of the RS V-band clamp. Assemble and attach the two sections of the RS shroud release to the bottom of the RS aft shroud with six thumbscrews, using care not to damage the cork insulation. The two sections are connected together by raising a latch, inserting a T-bolt on each side and alternately torquing the T-bolt nuts so that the release shield is tightened evenly around the entire circumference of the RS.



LEGEND

- | | |
|----------------------|-----------------------|
| 1. QUICK-RELEASE PIN | 11. BRIDGE |
| 2. THUMBSCREW (6) | 12. BRIDGE BAND |
| 3. LONG BAND | 13. T BOLT (2) |
| 4. QUICK-RELEASE PIN | 14. LATCH (2) |
| 5. TWO-PIECE BAND | 15. SUPPORT BAND (2) |
| 6. QUICK-RELEASE PIN | 16. QUICK-RELEASE PIN |
| 7. SHORT BAND | 17. TWO-PIECE BAND |
| 8. QUICK-RELEASE PIN | 18. QUICK-RELEASE PIN |
| 9. HINGE TYPE JOINT | 19. SHORT BAND |
| 10. EXTENSION | 20. HINGE TYPE JOINT |

Figure 3-12. RS aft shroud release shield.

Installing safing pins

Safing pins may be installed in the missile starting from the top working to the bottom or starting from the bottom working to the top (fig. 3-13). Whether working from the GMMP or the launch tube access door, position yourself as necessary to reach the arm/disarm device access door. Not all access doors are the same; they vary in both size and mounting hardware. Refer to figure 3-13 as you read the following paragraphs to help you to better understand safing pin installation procedures.

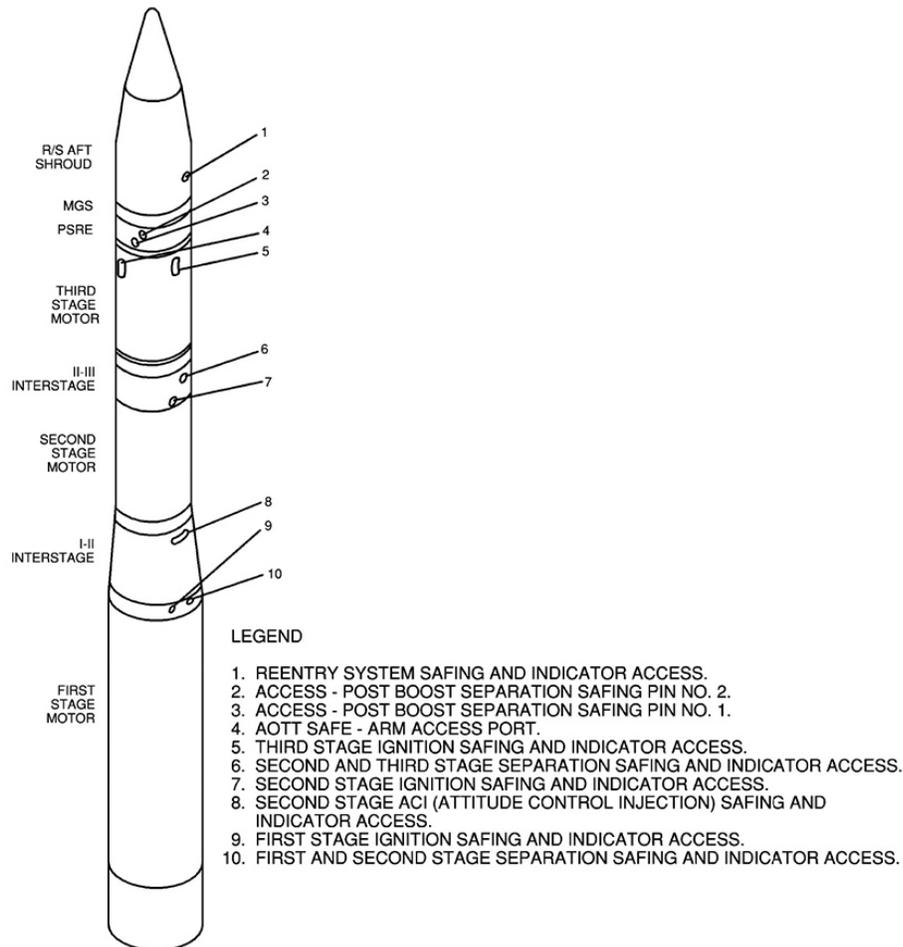


Figure 3-13. Missile safing pin installation locations.

You should also be aware of the different styles of safing pins that are available. There are A-style pins (fig. 3-14), B-style pins (fig. 3-14), a unique pin for the RS, and the all ordnance thrust termination (AOTT) device. Each pin should have a streamer that indicates what device it is installed into, but any A-style pin can be correctly installed into any 'A' safe-arm device, and any B-style pin can be installed into any 'B' safe-arm device. Safe-arm devices that use A-style pins are the individual stage ignition pins. The B-style pins are installed in the PSRE, both stage separation, and the second stage attitude control injection (ACI).

Reentry system safing pin

Remove the access door and use a flashlight to verify the safe-arm indicator shows "S." Attach the correct safing pin onto the tip of the safing pin wrench. Insert the safing pin into the safing pin drive so that the slot on the safing pin engages the tang on the arm/disarm switch. Insert the safing pin drive until a definite stop is reached, and then rotate the safing pin clockwise about 90 degrees until it stops. Pull slightly on the safing pin wrench to ensure that the safing pin is locked into place. Remove the wrench from the safing pin and verify that the "S" is visible on the safe/arm indicator.

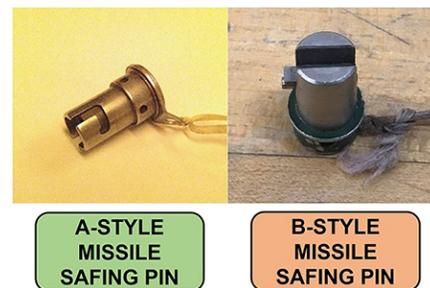


Figure 3-14. A-style and B-style missile safing pins.

Propulsion system rocket engine safing, stage separation, and second stage ACI pins

Perform this procedure to install PSRE safing pins, stage separation pins and the second stage ACI safing pin: remove the access doors and use a flashlight to verify that the safe-arm indicator shows “S.” Attach the correct safing pin onto the tip of the safing pin guide. Insert the safing pin into the safing shaft so the slot on the safing pin engages the safing shaft tang and the post on the safing pin enters the tang slot in the sleeve. Insert the safing pin drive until a definite stop is reached, and then rotate the safing pin clockwise about 90 degrees until it stops. Pull slightly on the safing pin wrench to ensure the safing pin is locked in place, and remove the wrench from the safing pin. Verify the “S” is visible on the safe/arm indicator.

All-ordnance thrust-termination safing pin

Remove the AOTT access door and use a flashlight to verify that the safe/arm indicator shows “S.” Attach the correct safing pin onto the tip of the safing pin wrench, and insert the safing pin into the safing shaft so the slot on the safing pin engages the safing pin guide. Continue inserting the safing pin drive until a definite stop is reached and rotate the safing pin clockwise about 90 degrees until it stops. Pull slightly on the safing pin wrench to ensure the safing pin is locked in place. Then remove the wrench from the safing pin.

First-, second-, and third-stage ignition safing pins

Perform this procedure to install all three ignition safing pins: remove the access door and use a flashlight to verify that the safe/arm indicator shows “S.” Attach the correct safing pin onto the tip of the safing pin drive. Align the groove in the safing pin with guide pins in the safing shaft and insert the safing pin drive until a definite stop is reached. Then rotate the safing pin clockwise until a definite stop is reached. Pull slightly on the safing pin wrench to ensure the safing pin is locked in place. Apply a slight clockwise force on the safing pin drive and then remove the drive from the safing shaft.

Safing pin removal

Once maintenance is complete and the missile is ready to be returned to alert status, the safing pins must be removed. Just as with installation, verify the following before removing the safing pins from the missile:

- The SCS lock pin assembly key is in the pocket of the technician who will physically remove the safing pins.
- Only essential personnel are in the LER.
- Safety harnesses and lanyards are used.
- The three safing pin wrenches are operational.

NOTE: During safing pin removal, if the safe/arm indicator indicates “A” or if the “S” is not entirely visible, the component/missile is considered armed and the safing pin should not be removed. Contact the MMOC if this occurs.

Removing aft shroud release shield

If installed, remove the RS aft shroud release shield by loosening the two t-bolt nuts. Then remove the T-bolt from the latch to separate the two halves. Remove each section one at a time by removing the thumb screws, using care not to damage the cork insulation. Install the screws back into the RS and torque to 25 inch-pounds.

Procedures for removing safing pins

Again, safing pins may be removed from the missile starting from the top working to the bottom or starting from the bottom working to the top. Two qualified technicians are required for removing the safing pins from the missile. One technician will remove the safing pins and the second technician will verify the procedure is performed properly.

Reentry system safing pin

Remove the access door and use a flashlight to verify the safe/arm indicator shows “S.” Insert the safing pin guide into the safing pin, press and rotate the pin counterclockwise until a definite stop is reached and remove the safing pin. Verify that the “S” is visible on the safe/arm indicator and that the outer face of the tang is flush with or extends beyond the face of the sleeve. Install the access cover and torque fasteners.

Propulsion system rocket engine safing, stage separation, and second stage ACI pins

Perform this procedure to remove the safing pins from the PSRE, stage separation sections, and the second stage ACI. Use a flashlight to verify the safe-arm indicator shows “S.” Insert the safing pin guide into the safing pin, push in on the guide until a definite stop is reached, then release pressure on the guide. Rotate the pin counterclockwise about 90 degrees until a definite stop is reached and pull the safing pin straight out. Verify that the “S” is visible on the safe/arm indicator and that the outer face of the tang is flush with or extends beyond the face of the sleeve. Apply a light coating of dry lubricant to the access doors and nut plates for the first- and second-stage separation and second-stage ACI, and then install and torque the access cover.

All-ordnance thrust-termination safing pin

Use a flashlight to verify the safe/arm indicator shows “S.” Insert the safing pin guide into the safing pin, push in on the wrench until it bottoms out, and then rotate the pin counterclockwise about 90 degrees until a definite stop is reached. Pull the safing pin straight out. Verify that the “S” is visible on the safe/arm indicator, install the access cover, and torque the fasteners.

First-, second-, and third-stage ignition safing pins

Perform this procedure to remove all three ignition safing pins. Use a flashlight to verify the safe-arm indicator shows “S.” Insert the safing pin guide into the safing pin, press and rotate the pin counterclockwise until a definite stop is reached, and then remove the safing pin. Verify that the “S” is visible on the safe/arm indicator. Apply a light coating of dry lubricant to the access door and nut plates, then install the access cover and torque the fasteners. Installation of safing pins is an integral part to ensuring that maintenance on an assembled weapon system is completed safely and reliably.

418. Reentry system removal, installation, and handling procedures

Maintenance involving the RS is the most high-profile maintenance that occurs at a missile wing. You routinely perform maintenance tasks involving the RS to facilitate other maintenance tasks on the missile. These tasks include:

- Handling the RS prior to installing on the missile.
- Handling the RS after it is removed from the missile.
- Installing the RS.
- Removing the RS.

The following is a normal flow of the procedures required to remove and replace an RS. If there are other maintenance actions that are going to take place, they will be inserted in the middle of the RS tasks.

Reentry system removal

To prepare an LF for RS removal, you must perform the following tasks prior to actually removing the RS:

- Penetrate the LF.
- Remove missile power.
- Install the GMMP.
- Position and stabilize the PT.

- Install missile safing pins.
- Open the LC.

After accomplishing the above tasks, you are ready to remove the RS from the missile by performing the following sub-tasks:

- Electrically disconnecting the RS.
- Installing the RS handling fixture.
- Mechanically disconnecting and hoisting the RS from the launch tube.

Electrically disconnecting the reentry system

To accomplish this procedure, verify with your team chief that missile power has been removed. Then, before removing the RS, ensure the skirt umbilical is connected to the missile, or that a missile grounding cable is connected between making the missile skirt grounding strap and the launch tube grounding point. If the missile was on alert, ensure the skirt umbilical cable is connected to the missile and that a missile grounding cable is not installed. Ensuring the missile is properly grounded eliminates the possibility of a static charge causing any of the missile ordnance squibs to fire.

To electrically disconnect the RS, you will work from the GMMP in the launch tube and remove the RS outer and inner interface connector access doors. Once the connector access doors are removed, disconnect the MGS-to-RS interface cables from the RS connectors J2501 (if installed), J2500, and J2502, and install protective caps on all interface connectors. When all the caps have been installed, route the cables so that they are free and clear of the RS and will not get caught when the RS is raised out of the launch tube. Re-install and secure the RS inner access door with only two bolts finger tight, and the outer interface door with four bolts finger tight.

Installing the reentry system handling fixture

While you are in the launch tube preparing the RS for removal, other technicians topside in the PT will assemble the RS handling fixture. With the RS forward shroud handling fixture on the PT access hatch doors, lower the PT hoist clevis and attach it to the forward shroud handling fixture. Next, raise the PT hoist about 6 feet above the PT floor. At this point, you will manually position the RS handling fixture lower support ring on the closed PT access hatch doors. With the forward handling fixture directly above the lower support ring, use QR pins to connect the four support rods to the upper and lower support rings of the RS handling fixture. Then, raise the PT hoist as high as possible and move the handling fixture as needed in order to open the PT access hatch doors. Position the assembled RS handling fixture over the open launch tube.

NOTE: A fall hazard exists inside the PT when the PT hatch door and launcher closure are open. Therefore, when working around the open PT access hatch, wear a safety harness with lanyard attached to approved lifeline attachment point inside the PT.

Next, connect the launch tube hoist control cable to the PT hoist short cable and lower the pendant into the launch tube. This pendant allows the technicians in the LER to operate the PT hoist during critical de-mating and mating operations. Use the PT hoist to lower the RS handling fixture about four feet above the RS.

Mechanically disconnecting and hoisting the reentry system from the launch tube

To perform this procedure, use the PT hoist to lower and align the RS handling fixture with the index mark on the aft shroud. Remove the hard point plugs from the aft shroud, then insert and lock the lower support ring pickup pins into the four RS aft shroud hard points with QR pins. Next, remove the 60 mating bolts securing the RS to the MGS. The RS will be slowly raised roughly 2 to 3 inches so that you can verify that the electrical cables are clear and free of obstruction. Lastly, raise the RS out of the launch tube and into the PT, and then install the AVE protective cover over the now exposed MGS in the launch tube.

Reentry system handling after removal from the missile

Two MMT technicians in the PT perform the RS handling procedures after the RS is removed from the missile and hoisted into the PT. The purpose of this procedure is to safely disassemble the RS and secure it inside the PT. The topside technicians accomplish this by removing the RS forward shroud and securing the RS aft shroud in the PT. Let's take a closer look at each of these subtasks.

Removing the reentry system forward shroud

The complete RS must be disassembled because it is too tall to fit into the PT. Use the following procedures to remove the RS forward shroud. Raise the RS enough so that the cable assemblies on the handling fixture support rods can be attached to the four PT floor hard points (fig. 3-15). Once the cable assemblies are connected to the PT hard points, lower the RS until it is supported by the cable assemblies on the handling fixture. Disconnect the four support rods from the forward handling fixture upper support ring. Next, remove the four captive bolts from the forward shroud hard points and stow the bolts in a plastic bag. Then, insert and secure the four special QR pins through the upper support ring and into the forward shroud bolt holes. Remove the remaining eight bolts that are securing the forward shroud to the aft shroud and add them to the plastic bag.

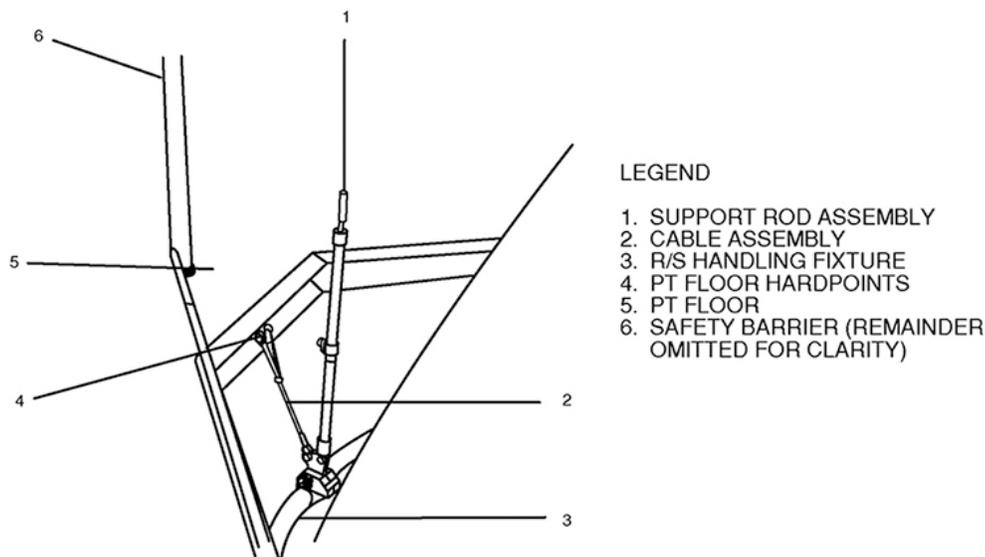


Figure 3-15. Cable assemblies connected to PT floor hard points.

Raise the forward shroud about 6 inches (fig. 3-16), and then connect PT ground straps between the upper support ring grounding screw and the RS aft shroud connector (J2593) support bracket inside the top of the aft shroud. Next, disconnect the forward shroud electrical connector (P2593) from the aft shroud connector (J2593) and install the RS shroud shunt cap on J2593. Remove the dummy connector bracket, rotate it 90 degrees, and reinstall it to the RS handling fixture. Secure forward shroud connector P2593 to the dummy connector bracket and remove the ground straps. Use the PT hoist to maneuver the forward shroud onto the forward shroud pallet and secure it with two QR pins. Connect the PT ground cable to the upper support ring grounding screw, and disconnect the hoist from the forward handling fixture.

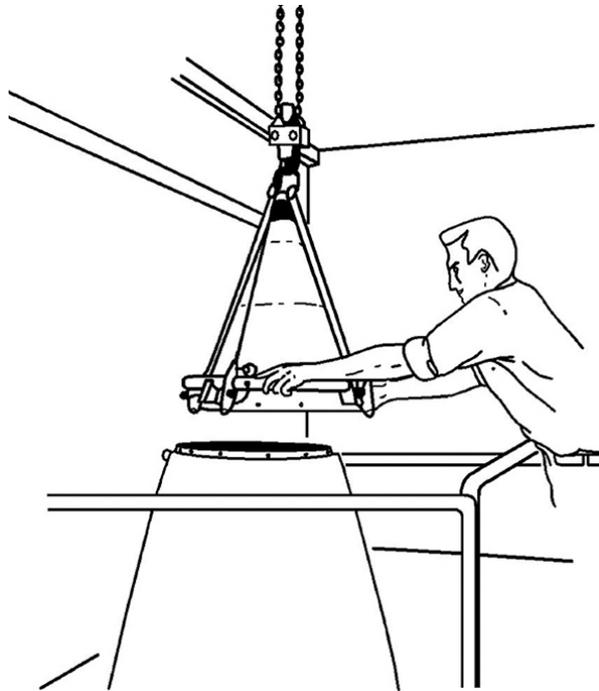


Figure 3-16. Removal of RS forward shroud.

Securing the reentry system aft shroud in the PT

To secure the RS aft shroud inside the PT, connect the PT hoist to the beam-type sling attach point 3 and position it over the aft shroud. Then, connect the four support rods to the beam-type sling and slowly raise the aft shroud a few inches up into the PT. With the weight of the aft shroud now supported by the hoist, disconnect the support rod cable assemblies from the PT floor hard points (fig. 3-15).

Next, raise the aft shroud to the maximum hoist height, move the safety barrier, and use the hoist to position the aft shroud over the aft shroud pallet plate. Lower the aft shroud onto the pallet plate and secure it with the six securing clamps and four turnbuckle tie-downs. Torque the six securing clamps to 140 inch-pounds. Connect the PT ground cable to the lower support ring grounding screw and inspect the forward and aft shrouds for damage and foreign material. Finally, remove the support rods and beam-type sling from the aft shroud. If required, you can now prepare the PT for departure from the LF.

Reentry system handling prior to installation on the missile

Prior to installing the RS onto the missile, perform the following RS handling procedures to reassemble the RS:

- Prepare the RS aft shroud for installation.
- Install the forward shroud onto the RS aft shroud.

Preparing reentry system aft shroud for installation

To prepare the RS aft shroud for installation, first raise it clear of the pallet plate and inspect the conductive finish on the mating surface for damage. Position the RS aft shroud over the PT access hatch and then lower it into the launch tube just far enough so that the support rod cable assemblies can be attached to the PT floor hard points. Once all the weight of the RS is being supported by the cable assemblies, disconnect the sling rods from the beam-type sling and remove the beam-type sling from the top of the RS so that it can later be removed from the PT hoist. Finally, inspect the interior of the RS for damage or foreign material.

Preparing reentry system forward shroud for installation

To prepare the RS forward shroud for installation, attach the PT hoist to the forward shroud handling fixture and position the shroud over the aft shroud. Connect the ground straps between the RS handling fixture upper support ring grounding screw and the support bracket of connector J2593 on the RS aft shroud. Loosen the knurled nut and remove the connector storage plate from the upper support ring. Remove the forward shroud connector P2593 from the dummy connector bracket and re-install the plate stowed position. Remove the shunt cap from the RS aft shroud connector J2593 and connect P2593 to J2593. Verify that the cable is properly connected using a flashlight and an inspection mirror to ensure that the locking pins are visible in the connector inspection ports.

Next, disconnect the ground straps and slowly lower the forward shroud onto the aft shroud. Install eight of the shroud mating bolts, then release and stow the four special QR pins. You will need to rotate the support ring to gain access to the four remaining shroud mating bolt holes. Insert and torque the four remaining bolts, then attach the support rods to the upper support ring. Inspect the forward shroud and upper aft shroud insulation for damage and foreign material. Raise the RS and disconnect the cable assemblies from the PT floor hard points. Lastly, lower the RS into the launch tube until top of the RS is just below the PT access hatch.

Reentry system installation

While technicians in the PT prepare to lower the RS into the launch tube, technicians in the LER and launch tube perform procedures to prepare the missile prior to installing the RS. The RS can be installed once those tasks are complete. At this point, the following tasks still need to be completed:

- Warhead monitor loop continuity check and arm/disarm circuit hazardous check.
- Radiation shielding inspection.
- Mechanically mating the RS to the MGS, performing RS system electrical system checkout, and electrically mating the RS to MGS.

Warhead monitor loop continuity check and arm/disarm circuit hazardous current check

Before placing the RS on the MGS and electrically connecting them, you must perform the warhead monitor loop continuity check and arm/disarm circuit hazardous current check. To perform these checks, you need the ESCTS and the required test lead. Also, be sure that both the G&C (upper umbilical) and skirt umbilical (lower umbilical) are connected. If they are not, connect the umbilical cables in accordance with the technical order procedures prior to conducting the test. Remove missile power and then perform a self-test of the ESCTS and test cable. Connect J1 of the test lead to the RS interface cable P2502, which is also known as W5H.

Once the test lead is connected, the team chief will restore monitoring power to the missile. Using the fault locating indicator (FLI) or communicating directly with the launch control center (LCC), the team chief will verify that ground maintenance responses (GMR) 7 and GMR-8 are reporting. At this point you will input pin pair 4 and 6 in to the ESCTS, and then press and hold the LOOP button. The team chief will verify that a GMR-7 reports and a GMR-8 does not. You will then release the LOOP button, input pin pair 5 and 6, and then again press and hold the LOOP button. The GMR-8 will report and the GMR-7 will not. You will then release the LOOP button, input pin pair 4 and 5, then press and hold the LOOP button for a final time. GMRs 7 and 8 will both report until the LOOP button is released.

The team chief will now remove monitoring power from the missile, and you will use the ESCTS meter to perform a hazardous current checkout using pin pairs 1 and 2, 1 and 3, and 2 and 3. Each pin pair should display less than 100 mA and less than 250 mV. When all three pin pairs have been tested, you can disconnect the test lead from the P2502 port on the MGS to RS interface cable.

Radiation shielding inspection

The entire MGS will be inspected for damage and proper configuration prior to installing an RS. However, in this area we will only focus the radiation shielding inspection. You will see more of the internal parts of the MGS as you progress as a maintenance technician. The MGS radiation shielding protects the electrical components installed in the missile guidance computer (MGC), missile guidance set computer (MGSC), gyro stabilized platform (GSP), and the cable connections inside the MGS. Since these components are vital to the function of the missile, it is extremely important to inspect these components for any defects that could affect their operation and longevity. You will inspect these components upon uploading the MGS from the ELAB, and prior to mating the RS to the MGS.

The radiation shielding covering, MGC, MGSC, and cable connections can be in several different configurations depending on the MGS. There can be a white box (WBox) or gray box (GBox) for the MGC and MGSC. The cable connections can be gray coated or wrapped in an elastomer wrap. The MGS can have multiple configurations of WBox and GBox and cable connections, such as two WBox and elastomer cables, or one WBox and one GBox with an elastomer cable to the WBox and a gray-coated cable to the GBox. It is important that you verify the correctness of the configuration using the specifications in your technical order. Now that we have discussed the different configurations that the radiation shielding can be in, let's talk about the inspection criteria for each one.

White box

NOTE: WBox can be easily damaged. Due to this, it is important to use care when handling or working around them. Use protective covers whenever WBox components are exposed.

The WBox (fig. 3-17) is a thin white painted metal cover that covers the electronic components within the MGC and the MGSC. There are two parts, an upper section and a lower section. Inspect the WBox for the following:

- Scratches, nicks, or gouges that protrude into the base metal.
- Dents that protrude into the base metal or exceed 1/8 inch in depth.
- Distortion that permits line-of-sight to the inner chassis of the component.
- Cracks in the welds.



Figure 3-17. MGS white box with elastomer boots.

Ensure that the shield covers MGC connectors J1, J3, J4, and MGSC connectors J3, and J5 are white painted metal or elastomer. The J2 connector (permutation plug [P-plug]) on the MGC can be white painted, elastomer, or stainless steel.

To complete this inspection, use a mirror and a flashlight. When measuring the depth of a scratch, use care to not further damage the radiation shielding.

Gray box

The GBox (fig. 3-18) is a sturdier configuration than the WBox, and because of this, the inspection has fewer steps. Inspect the GBox for the following:

- Damage.
- Scratches, nicks or gouges that go through the paint and primer, and into the base metal.

Ensure that the shield covers for the MGC connectors J1, J3, J4 and MGSC connectors J3, and J5 are white painted, gray painted, or elastomer. The J2 connector (P-plug) on the MGC can be white painted, elastomer, or stainless steel.

Use a flashlight and mirror to complete this inspection. When measuring the depth of a scratch, use care to not further damage the radiation shielding.



Figure 3-18. MGS gray box.

Elastomer connector shields, wraps, and skirts

Elastomer connector shields are one-piece units that cover test connectors and plugs and are attached using rings and captive screws. Elastomer wraps are used to cover unshielded cable connectors inside the MGS. These are secured in place using zip ties. The elastomer skirts are used to protect the corresponding unshielded plugs inside the MGS.

Elastomer material can show evidence of a crystalized growth of 2,4-Dichlorobenzoic acid, commonly known as acid bloom. This acid bloom is a skin, eye, and respiratory irritant. You must inspect for acid bloom each time elastomer material is initially exposed during maintenance procedures. If it is found, it must be removed using isopropyl alcohol and a lint free cloth.

Complete a full inspection of the elastomer material upon uploading the MGS from ELAB, and prior to mating an RS to the MGS. The elastomer is inspected for the following:

- Damage (cut, nick, abrasion, or a gouge).
- A separation of the first and second layer of a wrap, which would hinder line-of sight.
- A line-of-sight separation between the elastomer wrap and skirt.
- A line-of-sight separation between the skirt and the component.
- Wrap zip ties must be secured in the ribs of the wrap.

Use a flashlight and mirror to complete this inspection, and take care to not damage the elastomer with your tools.

Gyro stabilized platform shield

The gyro stabilized platform shield is typically a silver- or brass-colored metal cover. This cover will be inspected for the following defects:

- scratches, nicks or gouges that protrude into the base metal, and
- dents that protrude into the base metal or exceed 1/8 inch in depth.

Mechanically mating the reentry system to the missile guidance set

Once the inspections and checkouts are completed, the RS is ready to be mated onto the MGS. First, lower the RS until it is about 6 inches above the MGS, align the markings on the RS with the markings on the MGS, and ensure the RS interface cables are clear. Then, lower the RS onto the MGS and secure the two with a minimum of two mating bolts, approximately 180° apart. Once the two bolts are installed, remove the RS handling fixture by disconnecting the four pick-up pins from the lift points on the RS. Install the hard-point plugs into the lift point holes and torque the plugs. This must be accomplished prior to the RS resistance check.

The resistance check is used to verify that an adequate path to ground exists for the discharge of static electricity that may have built up on the missile. The check can be accomplished using either a digital multimeter with the proper range, or the ESCTS meter. Measure resistance by placing one test lead to the RS interface access door mating surface, and the other test lead to an electrical ground in the LER. The most common ground point that is used in the LER is the ground strap for the retraction actuator. The resistance reading shall not exceed 0.03 ohms. The RS can be electrically connected once the resistance check is complete and meets technical order specifications.

The remaining mating bolts can be installed at any point before the safing pins are removed, and they must be torqued in sequence to 175 inch-pounds.

Reentry system electrical checkout and electrically mating the RS to MGS

You will need to remove the RS interface outer and inner doors to gain access to the RS electrical connectors. Perform self-test of the ESCTS and checkout of the LF RS test adapter cable if not already accomplished. The test adapter cable must first be nulled with the ESCTS. Remove the shorting plugs and use a meter to ensure that each pin pair has greater than 50 ohms of resistance.

Connect the LF RS test adapter cable to the required RS connectors to perform the RS electrical checkout. You can disconnect the RS test adapter cable once all of the pin pairs have been successfully tested.

Two qualified technicians are required to connect the RS interface cables (fig. 3-19). One technician connects the cables and the other technician verifies that the cables have been connected correctly by verifying that the cable collar pins are visible in the inspection ports. When the electrical checkout is completed, the RS is ready to be electrically connected to the MGS. Due to the limited amount of space, it is easiest to connect the cables from the bottom cable and then moving upward.

Remove the caps from the RS and the cable connectors. Inspect the cables and the connector to ensure that the radio frequency interference (RFI) band of the MGS-to-RS extender cable is not damaged. Once the cables are connected, visually verify that each connector is locked by ensuring that pins are visible in the inspection ports of the cable collar. Each cable collar has 3 pins. When all the cables are connected, the team chief will restore monitor power, and verify with the LCC that there are no warhead alarms, and that GMRs 7, 8, 9 are not reporting. Install and torque the inner and outer access doors, and inspect the lower section of the aft shroud for damage and foreign material.

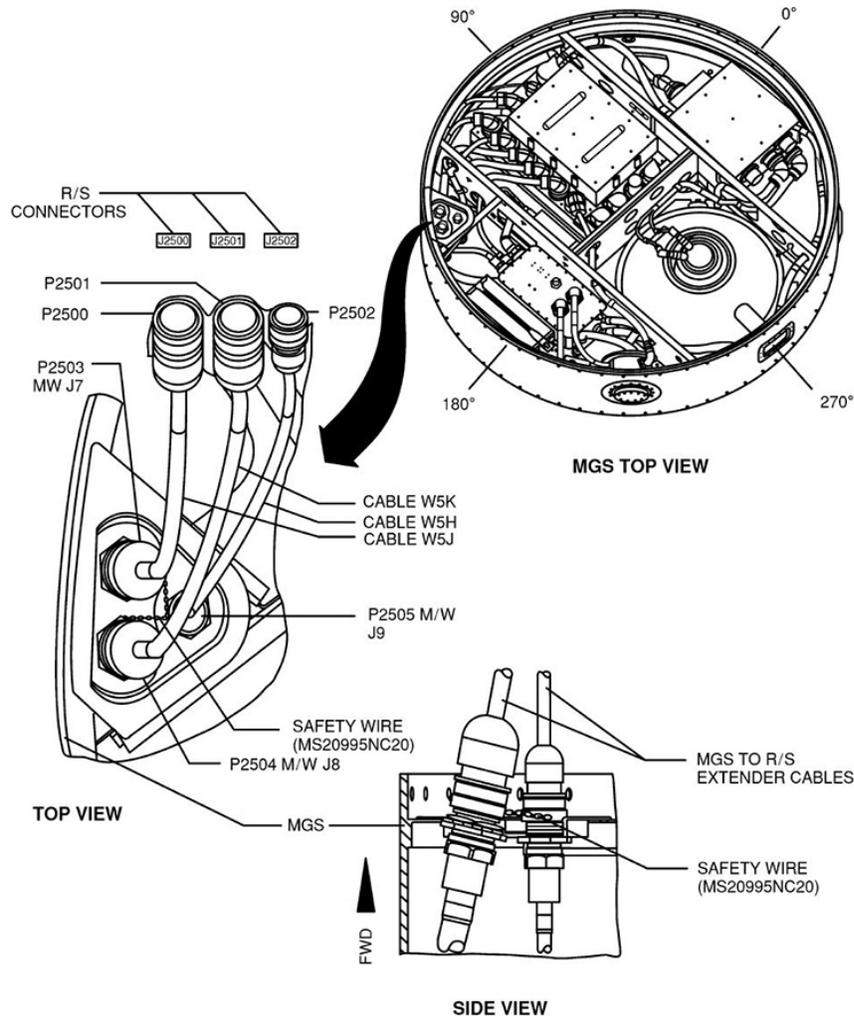


Figure 3-19. MGS-to-RS interface cables.

This lesson focused on the installation and removal of the RS. Both of these tasks are extremely important, and can have an enormous impact on the alert rate of the ICBM fleet.

419. Missile guidance set and post-boost control system removal and installation procedures

In addition to performing maintenance on the RS, you will also perform maintenance tasks involving the MGS and PBCS. There are no procedures to install and remove the PSRE by itself, unless it is for emergency procedures. If you do have a work order that requires only a PSRE removal and replacement, you will perform the required steps to install and remove a PBCS, but the MGS will be transferred from the old PSRE to the new PSRE inside of the PT. Emergency handling procedures of the PSRE will be discussed in a later unit. In this lesson you will learn some basic information about the tasks required to perform the following:

- Removing the MGS.
- Installing the MGS.
- Removing the PBCS.
- Installing the PBCS.

Missile guidance set removal

Removal of the MGS from the missile is required when the MGS fails, or to facilitate other maintenance on the missile. Before removing the MGS from the missile, accomplish the following three tasks:

1. Remove the RS.
2. Purge all the coolant from the MGS.
3. Disconnect the G&C umbilical (upper umbilical) from the MGS.

After the tasks above are complete, you will remove the MGS from the missile by electrically and mechanically disconnecting the MGS from the PSRE.

Electrically disconnecting the missile guidance set from the propulsion system rocket engine

Verify that missile power has been removed prior to electrically disconnecting the MGS. Being careful not to drop any safety wire into the MGS, cut the safety wire from the cable connected to J6. Disconnect the four MGS electrical cables from PSRE connectors J3, J4, J5, and J6, and install dust covers on the exposed electrical connectors. Next, cut the safety wire off of the spanner nuts and remove them. You may use the pin-type spanner wrench to break torque on the spanner nuts, not to exceed one full rotation of the nut. Once the torque is broken, remove the spanner nuts by hand. Install the four mating guides to protect the PSRE connectors from damage. Install the red mating guide on connector J6 to prevent damage to its connector threads.

Mechanically disconnecting the missile guidance set from the propulsion system rocket engine

Once the MGS is electrically disconnected, you'll use the PT hoist for mechanical disconnection. Lower the beam-type sling to the top of the MGS mating surface and then attach the sling to the MGS while being sure to leave 12 bolt holes between each lifting lug. If you have not already done so, attach the PT load block to lifting point 2 on the sling. Remove the 60 mating bolts that secure the MGS to the PSRE, and then lift the MGS straight up while simultaneously verifying that all connectors are disconnected and that the GSP does not touch the inside of the MGS. Once the MGS is inside of the PT, inspect the PSRE for any evidence of chromate leakage, and then install the protective cover over the exposed PSRE.

Missile guidance set handling

Once the MGS is inside the PT, you will move it over the handling ring which has already been secured to the PT air pallet. Align the MGS and handling ring index marks and lower the MGS onto the ring, while simultaneously ensuring that the bolt holes remain in alignment. Remove the beam-type sling from the MGS and stow if required.

NOTE: When counting the tie-down bolt holes to the left and to the right of the 270° index triangle, be sure not to count the bolt hole directly above the index triangle.

Install the tie-down bolts in the required bolt holes, and torque the bolts to 95 inch-pounds. Secure the MGS electrical cables so that they will not be damaged during transport.

To prepare a new MGS for installation, remove the string or cord used to secure the MGS electrical cables. Attach the beam-type sling to the MGS, and maintain 12 bolt holes between each of the lifting lugs. If not already accomplished, place the PT load block in attachment point 2 on the beam-type sling. Remove all of the tie-down bolts and raise the MGS from the MGS handling ring. Position the MGS over the PT hatch, inspect the Alodine conductive finish on the lower mating surface of the MGS, and then lower the MGS into the launch tube.

Missile guidance set installation

Perform the following procedures to install the MGS onto the missile:

- Mechanically mate the MGS to the PSRE.
- Perform the accidental missile ignition (AMI) test.
- Electrically mate the MGS to the PSRE.

Before you lower the MGS into the launch tube, visually inspect it and the PSRE for damage. Lower the MGS until it is approximately 3 feet above the PSRE. Remove the AVE cover from the PSRE and ensure that the mating guides are on the four top PSRE connectors, with the red mating guide on connector J6.

Mechanically mating the missile guidance set to the propulsion system rocket engine

To mechanically mate the MGS and the PSRE, align the MGS with the PSRE, and then lower the MGS until it rests firmly on the PSRE. Ensure that the mating guides are aligned, and ensure that the GSP does not strike the inside of the PSRE during mating. Install at least two mating bolts approximately 180° apart and then remove the beam-type sling from the MGS.

At this point one technician can proceed with the following “Four Bs” of MGS install:

- Bonding check—Perform a resistance check between the MGS and the body of the 3rd Stage using the ESCTS or a digital multimeter. Notify the MMOC if the resistance reading exceeds 0.03 ohms.
- Battery hazardous current checkout—Complete the hazardous current checkout of the flight battery.
- Bolts—Install mating bolts under the G&C umbilical receptacle while they are easy to access prior to connecting the umbilical to the MGS.
- Begin G&C umbilical connection—Connect the G&C umbilical to the MGS receptacle.

The second technician will begin electrically connecting the MGS to the PSRE once the resistance check is complete.

The rest of the mating bolts can be installed at any point prior to removing the safing pins. Torque the mating bolts to 175 inch-pounds using the proper torquing sequence.

Power-fault-to-ground check

The PSRE must be electrically mated to the third stage prior to mating the MGS to the PSRE. If you are connecting the upper and lower umbilical cables to the D-box, you must perform a power-fault-to-ground check at the LER battery charger using a digital multimeter. This check verifies that no hazardous electrical current is present on any of the LER ground circuits. If the check does reveal the presence of hazardous current, perform the power-fault-to-ground trouble analysis check to locate the problem. Leave the meter connected until all connections requiring a power-fault-to-ground check are completed. The power-fault-to-ground reading can change, so you will need to verify the reading prior to connecting each cable.

Electrically mating the missile guidance set to the propulsion system rocket engine

Begin this procedure by using the ESCTS on the MGS battery cable to ensure that the battery has not been activated. Then, remove the mating guides from the PSRE electrical connectors, install the four spanner nuts, and seat them on the positioning ramp by hand before torquing the spanner nuts. Apply safety wire to the four spanner nuts at this time. Prior to connecting each cable in the MGS, verify that missile power has been removed, verify that no power-fault-to-ground condition exists, and then inspect each cable. Mate the four MGS cables, and prevent cross-threading by maintaining the cable in a vertical position during connection. You will know when each of the four cables are properly

connected when the insertion stripes become visible. Now, apply safety wire between the connected battery cable and the eyelet inside the MGS, place the AVE cover on top of the MGS, and connect the G&C umbilical to the MGS receptacle.

Accidental missile ignition test

Using the ESCTS and test lead, perform the AMI test when the MGS, PSRE, or the downstages of the missile have been replaced, or before the RS is initially installed on the missile. Ensure the lower umbilical is connected to the missile, and also that the MGS and PSRE are electrically connected to the downstage. Remove missile power and then perform a self-test of the ESCTS and checkout of test lead. Null the test lead, remove the shorting plugs, and verify that each of the pin pairs shows greater than 50 ohms. Connect the test lead to P2502 of extender cable W5H, and then to P2501 of extender cable W5K. Perform the test according to the technical order, and then remove the test lead. If W5K is not required for the RS configuration being installed, remove the cable. Install a shielding cap and secure it with safety wire.

Post-boost control system removal

Removal of the PBCS from the missile is required when the PSRE fails, or to facilitate other maintenance on the missile. Before removing the PBCS from the missile, you must first complete the following three tasks:

1. Remove the RS.
2. Purge all the coolant from the MGS.
3. Disconnect the G&C umbilical from the MGS.

After accomplishing the above tasks, remove the PBCS from the emplaced missile by first electrically disconnecting the PBCS and then mechanically disconnecting the PBCS from the third stage.

Electrically disconnecting the post-boost control system from third stage

NOTE: Because of the ordnance device that is near the P107 connection, you must ensure that you are properly grounded to an earth ground before you reach into the area of the P107 connector.

During PBCS electrical de-mate, disconnect the MGS battery cable from the PSRE (J6) from inside the MGS. Then, install the shielding cap on J6. Next, remove the PSRE connector P107 access door. Install four retainer assemblies to secure the third-stage connector P114, and then loosen the right rotational device screw, and bolts A and B to allow free movement of the PSRE P107 connector bracket. Rotate the center shaft counterclockwise, being sure not to exceed 100 inch-pounds of torque, until the PSRE P107 connector is disconnected, and then raise the PSRE connector fully upward. Lastly, tighten bolts A and B as well as the right rotational device screw to secure the P107 connector in the fully upward position.

Mechanically disconnecting the post-boost control system from the third stage

To mechanically disconnect the PBCS, first connect the PT hoist to attach point 3 on the beam-type sling, and then lower and secure the sling to the MGS. Remove the 60 mating bolts securing the PBCS, then raise the PBCS about 2 feet and reposition it so your hands are not in danger of being crushed between it and the third-stage motor. Remove the P114 transfer collar from the PSRE P107 connector and secure it to the third stage P114 connector with two pip pins (fig. 3-20). Place dust caps on both connectors and then raise the PBCS into the PT. Place the AVE cover on top of the third-stage motor if the PSRE is to be replaced, or bolt the stabilizing ring hoisting adapter to the third-stage motor if the missile downstage is to be replaced.

Post-boost control system handling

Next guide the PBCS through the PT access hatch and position it over the PSRE handling ring. Align the index marks and bolt hole, then lower the PBCS onto the PSRE handling ring. Install the tie-down bolts in the required holes and torque them to 95 inch-pounds. Connect the ground cable to

the ground stud on the handling ring. Next, verify that the free torque on the center shaft does not exceed 15 inch-pounds, and install the access door finger tight. Finally, remove and stow the beam-type sling.

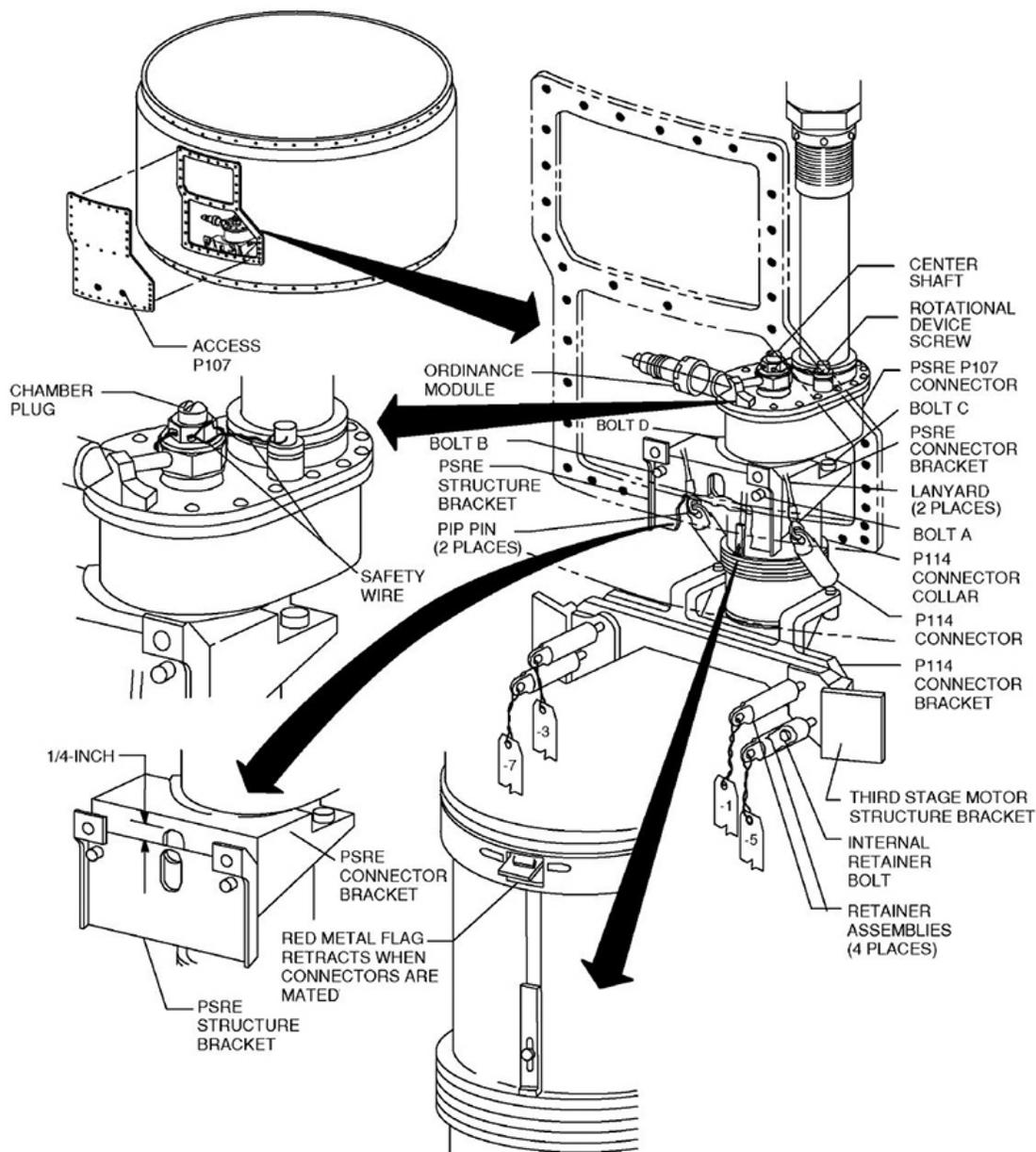


Figure 3-20. PSRE-to-third stage electrical connectors.

To prepare the PBCS for installation, first verify the free torque and then verify that P107 is in the fully upward position. Ensure there are 12 bolt holes between each of the lifting lugs on the beam-type sling. Remove the tie-down bolts, raise the PBCS, and position it over the access hatch. Inspect the Alodine conductive finish on the bottom of the PSRE as well as the PSRE thermal blanket for damage. Finally, lower the PBCS into the launch tube.

Post-boost control system installation

Install the PBCS onto the downstage by mechanically mating the PBCS to the third stage. Before mating the PBCS to the third-stage motor, you must inspect the third-stage motor for damage, and then perform a hazardous current check on the third-stage connector P114 using the ESCTS. P114 must also be configured to allow for proper mating of P107 by installing the pip pins and ring expanders in the P114 transfer collar.

Mechanically mating the post-boost control system to the third stage

To mechanically mate the PBCS to the third stage, first remove the AVE cover from the third stage and lower the PBCS until it is approximately 1 foot above the third-stage motor. Route the pip pin lanyards so that they run through the PSRE P107 connector access door, and *not* between the PSRE and third-stage motor. Ensure they are not crossed. Use two pip pins and ring expanders to secure the P114 transfer collar retainer spring in the expanded position. Then lower the PBCS onto the third-stage and secure it with at least two mating bolts positioned approximately 180 degrees apart. Remove the sling from the MGS and then use the ESCTS or a digital multimeter with the appropriate range to perform a resistance check between the MGS and the body of the third stage. The resistance reading cannot exceed 0.03 ohms. The PBCS can be electrically mated once this resistance check is satisfactorily completed.

The rest of the mating bolts can be installed at any point prior to removing the safing pins. Torque the mating bolts to 175 inch-pounds using the proper torqueing sequence.

Electrically mating the post-boost control system to the third stage

The first step is to electrically mate the PBCS with the third-stage motor. This is accomplished by loosening the right-hand rotational device screw, as well as bolts A, B, C, and D. Verify that missile power is off, and that no power-fault-to-ground indications exist. Align the PSRE P107 connector with the third-stage P114 connector and rotate the center shaft clockwise until the red flag retracts and the center shaft nut reaches the proper torque.

Apply safety wire to the center shaft hex nut and chamber plug to the rear near the center shaft. Then torque the right-hand rotational device screw as well as bolts A, B, C, and D to the required torque specification, and then apply safety wire to the right-hand rotational device. Remove the four retainer assemblies and install the four filler plugs. Remove both pip pins, verify the collar has transferred to the PSRE P107, and install the access door. Next, inspect and connect the MGS battery cable to the PSRE. Place the AVE cover on top of the MGS and connect the G&C umbilical to the MGS receptacle.

This lesson focused on the installation and removal of the MGS, PSRE, and PBCS. Of course, these components are critical for missile launch and getting the missile to its target.

420. Missile guidance set component removal and installation procedures

The internal components of the MGS are normally already installed by ELAB technicians. However, there may be situations when you will be required to remove or install MGS components at the LF. The MGS is built from many different components, but this lesson will focus only on the components that you are likely to remove or replace as an MMT technician.

Missile guidance set to reentry system interface cable installation, checkout, and removal

You must inspect the MGS to RS interface cables prior to installing them. After inspection, connect one end of the cable to the receptacle on the MGS. Verify proper connection by observing that no threads are visible above the insertion stripe. Once the cables are connected and verified, apply safety wire to the small holes in the connector shell lip. If the holes are missing, you will have to drill a hole through the edge of the coupling nut. Since the interface cable is the primary means for connecting the MGS to the RS, you must perform a checkout on the interface cable using the ESCTS in order to verify that the interface cable will allow communication between the MGS and RS.

Special cable gear is used to perform the checkout of the RS-to-MGS cables. To make it easier to compare readings from the ESCTS, be sure to record the values that you obtain for each switch position.

Per the usual, you must perform a self-test of the ESCTS prior to using it for any measurements. The AVE cover must be installed to prevent damage to the GSP connectors. Verify that the MGS umbilical is connected to the MGS, and that the D-box and other MGS cables are properly connected. You are now prepared to perform the checkout with the ESCTS.

Connect the MGS-to-RS extender cables or shorting plugs when required by the technical order. During each connection, ensure that each pin pair you test falls within the values dictated by the technical order.

If any indications are incorrect, perform troubleshooting procedures. The troubleshooting procedure will narrow down and pinpoint the component that is causing the incorrect readings. For example, a junction box is among the associated equipment, and you will perform a self-test of the junction box during the first part of the troubleshooting process. Once the junction box has been eliminated as a possible problem, you can then focus on the interface cables. Troubleshooting can be a time-consuming process, so you must exercise patience to avoid condemning serviceable components or equipment.

There are a few reasons that MGS-to-RS extender cables may need to be removed. One reason is that the cable fails a checkout. There are also some test programs that occur on site that require the cables to be removed so that other equipment can be installed. The process of removing the interface cables is the opposite of installation. Remove the lock wire and disconnect the cables from the MGS cable receptacles and store or process the interface cables to receive a replacement.

Missile guidance set battery assembly installation and removal

The MGS flight battery is replaced if it fails the ESCTS checkout. Usually it is removed because of a test program that is occurring at the LF, or if the battery's expiration date has been exceeded.

Battery inspection

Prior to handling the MGS battery (fig. 3-21), eliminate any static charge you may be carrying by touching a facility ground point. Remove the battery and its hardware from the shipping container and inspect the battery using technical order procedures. Inspect for leaks, dents, punctures, corrosion, and other obvious damage. Verify that the battery has not been activated by accomplishing a DC voltage check with a multimeter.

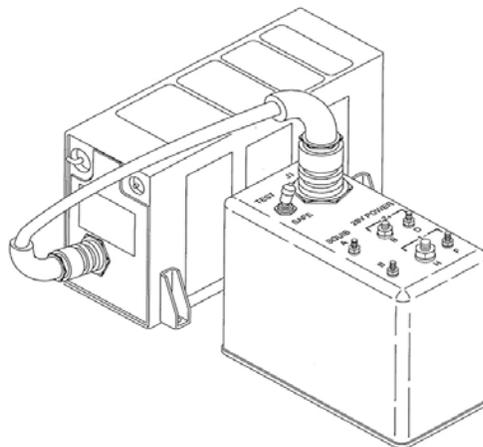


Figure 3-21. Battery-to-battery test adapter interface.

Battery installation

Ground yourself to a facility ground point prior to touching the battery. Inspect again for any rejection criteria as outlined in your technical order. Inspect the conductive finish of the battery mounting brackets and the MGS battery interface area. These two areas must be free of grease, dirt, corrosion, and any foreign matter that may interfere with proper grounding. Space is limited, and components next to the battery are easily damaged. Due to this, use string or safety wire to hold the hardware on the internal hex driver/extension until the first few threads of the hardware are engaged.

After placing the battery on the mounting surface, install the hardware and torque to the specified value. Now that you have the battery installed, perform a resistance check between the battery and MGS. This is where cleanliness of the mounting surface will play an important role. If the mounting surface is not clean or foreign matter is present, you may not receive the correct readings for the resistance check. If you do not receive the correct readings, remove the battery and clean the mounting surface. If the resistance check is successful, ground yourself and connect the MGS battery connector to the power distribution unit (PDU) in the MGS.

Battery removal

Remove the battery using the same safety precautions that you used to install it. These precautions include not damaging any of the components next to the battery, and grounding yourself to prevent a stray electric charge from activating the battery.

Once you ground yourself, disconnect the battery assembly cable from the MGS, install a shielding cap, and remove the battery mounting hardware. Again, space is limited, and you may need to tether the hardware to yourself to avoid dropping it. Once the battery has been removed, you can avoid misplacing the mounting hardware by threading it back into the battery surface mounting holes.

Permutation plug installation and removal

Before installing or removing the P-plug, first place the AVE protective cover on top of the MGS. You must also remember that the MGS contains electrostatic discharge (ESD) sensitive components.

Use caution when positioning the AVE cover because you could damage the GSP connectors by bumping or resting the segment covers on them. If this happens, the inertial measurement unit (IMU) could lose pressure and the MGS may fail.

To install the P-plug, first remove the hardware securing the P-plug connector shield-retaining ring with a hex head bit, *do not* use an Allen wrench as it could damage the radiation shielding. After removing the hardware, remove the retaining ring, connector shield, and dust cap. Visually inspect the interior of the P-plug gender-changer for signs of tampering or unauthorized connection. If evidence of this is found, contact the MMOC. After your inspection, remove the dust caps and install the P-plug into the gender-changer of the MGS. Then hand-tighten the P-plug and verify that the insertion stripe is not visible. Install the connector shield and retaining ring over the P-plug, then torque the hardware you removed.

When removing the P-plug, use the same precautions as you did when installing the P-plug, such as installing the AVE protective cover and being careful not to bump or rest objects on the cover of the GSP connectors. Remove the P-plug connector shield-retaining ring hardware with a hex head bit. Once this is done, remove the retaining ring and connector shield. Remove the P-plug from the gender-changer of the MGC and install a dust cap on the gender-changer and P-plug. Place the P-plug in a carrying case and ensure proper code handling control procedures are maintained on the P-plug. Install the connector shield and retaining ring over the P-plug and torque the hardware.

This lesson focused on installing and removing components in the MGS. Being able to install and remove components while in the LF is critical in returning the missile to alert quickly.

Self-Test Questions

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

416. Aerospace vehicle equipment component transportation procedures

1. What steps are taken to control the temperature of AVE during transit?
2. What requirements must the PT driver meet to transport AVE components?

417. Safing pin installation and removal procedures

1. What procedures require the installation of the missile safing pins?
2. Why is installing the RS aft shroud release shield so important?
3. What order should you follow when installing the missile safing pins?
4. How far should the RS safing pin rotate before it comes to a stop?
5. What are the final steps for removing the AOTT safing pin?

418. Reentry system removal, installation, and handling procedures

1. What sub-tasks are required prior to removing the RS from the missile?
2. When removing the RS forward shroud, what step must be completed prior to lowering the RS?
3. During RS handling, prior to installation on the missile, what step occurs after preparing the RS aft shroud for installation?
4. What is the WBox inspected for when accomplishing the inspection of the radiation shielding?

5. List two criteria that the elastomer is inspected for during the inspection of the radiation shielding.
6. Why are two qualified technicians required to connect the RS interface cables?

419. Missile guidance set and post-boost control system removal and installation procedures

1. What tasks must be accomplished before MGS removal?
2. What is the first step in preparing a new MGS for installation?
3. What steps are accomplished if the W5K cable is not required due to the configuration of the RS?
4. What is accomplished *prior* to mating the PBCS to the third stage motor?

420. Missile guidance set component removal and installation procedures

1. What criteria will the MGS battery be checked for after it is removed it from the shipping container?
2. When installing the permutation plug, why should only a *hex head bit* be used to remove the hardware securing the connector shield-retaining ring?

Answers to Self-Test Questions

413.

1. Scratches, dents, and cracks.
2. Scratches and cracks, as well as voids in the bonding surface.
3. Smooth it with a sanding cloth and block to match the contour of the original cork.

414.

1. So that snow, ice, or other debris do not fall into the MF pit and onto the RS, equipment, and personnel.
2. Notify WSA personnel.
3. The air pallets and/or the RS can be damaged.

415.

1. Notify the MMOC of the temperature and the duration of exposure.
2. MMT section.
3. Check for propellant vapors.
4. Because the PSRE is an explosive component and it must be grounded.
5. The container must be inspected for serviceability.
6. To prevent connector damage while mating the MGS to the PSRE.

416.

1. Operate the APU and ECS.
2. Must be qualified to operate the vehicle and knowledgeable of the explosives being transported and associated hazards.

417.

1. D-box maintenance, connecting/disconnecting G&C or skirt umbilical at the D-box, connecting/disconnecting G&C or skirt umbilical at the missile, removing, replacing, troubleshooting, or performing maintenance on the missile, RS, MGS, or PSRE.
2. Because it protects personnel from inadvertent release of the RS V-band clamp.
3. Install them from the bottom up or the top down.
4. Approximately 90 degrees.
5. Verify that the "S" is visible on the safe/arm indicator, install the access cover, and torque the fasteners.

418.

1. Electrically disconnecting the RS, installing the RS handling fixture, and mechanically disconnecting.
2. Cable assemblies must be connected to the PT hard points.
3. Preparing RS forward shroud for installation.
4. Scratches, nicks, or gouges that go into the base metal, dents that protrude into the base metal or exceed 1/8 inch in depth, distortion that permits line-of-sight to the inner chassis of the component, and cracks to the welded areas.
5. Cuts, nicks, abrasion, or gouges, separation of the first and second layer of a wrap which would permit line-of-sight, line-of-sight separation between the elastomer wrap and skirt, line-of-sight separation between the skirt and the component, and zip ties for security.
6. One technician is required to connect the cables and the second is required to verify that they have been connected properly by inspecting the pins in the cable collar are visible in the inspection ports.

419.

1. Remove the RS, purge all the coolant from the MGS, and disconnect the G&C umbilical (upper umbilical) from the MGS.
2. Remove the string or cord used to secure the MGS electrical cables.
3. Remove the cable, install a shielding cap, and secure it with safety wire.
4. Inspect the third-stage motor for damage, perform a hazardous current check on third-stage connector P114.

420.

1. Use technical order procedures to check for leaks, dents, punctures, corrosion, and other obvious damage.
2. Using an Allen wrench could damage the radiation shield.

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 AFCDA.

31. (413) Identify the step that is accomplished after finding a scratch on any portion of the reentry system (RS) shroud insulation during an inspection.
 - a. Perform shroud repair procedures.
 - b. Measure the depth with a micrometer.
 - c. Mark the scratch with an oil pen and proceed with the inspection.
 - d. Annotate the scratch in the Integrated Maintenance Data System (IMDS).
32. (413) Identify the step that is accomplished when the reentry system (RS) shroud insulation is damaged at the launch facility (LF).
 - a. Annotate the damage in the Integrated Maintenance Data System (IMDS).
 - b. Mark the damage with an oil pen and proceed with the next step.
 - c. Perform RS shroud insulation repair procedures.
 - d. Return the RS to the munitions facility (MF).
33. (413) Select the step that is accomplished to *prepare* the post-boost control system (PBCS) for the application of trowelable cork.
 - a. Apply the fungus-resistant paint.
 - b. Clean the area with isopropyl alcohol.
 - c. Sand the area with sanding cloth and a block.
 - d. Fill in and sand the damaged or cracked insulation.
34. (414) Which step is verified during the reentry system (RS) forward shroud inspection before loading the RS into the payload transporter (PT) at the munitions facility (MF)?
 - a. Four special quick-release (QR) pins are properly attached.
 - b. Four hard-point plugs are removed from the shroud.
 - c. Four shroud grounding wires are attached.
 - d. Shroud release shield is properly installed.
35. (414) Approximately how many inch-pounds of torque are applied to the four bolts that secure the forward shroud and pallet to the floor of the payload transporter (PT) when loading the reentry system (RS) forward shroud into the PT?
 - a. 75.
 - b. 125.
 - c. 175.
 - d. 225.
36. (414) Identify the step that is accomplished directly *after securing* the reentry system (RS) aft shroud pallet plate to the payload transporter (PT) pallet when loading the RS aft element into the PT at the munitions facility (MF).
 - a. Torque the four bolts to 550 *inch*-pounds.
 - b. Torque the four bolts to 550 *foot*-pounds.
 - c. Attach the PT ground cable.
 - d. Stow the beam-type sling.

-
-
37. (414) While unloading the reentry system (RS) aft element at the munitions facility (MF), what is the *first* step that is accomplished prior to unloading the RS into the pit?
- Topside technicians inspect the RS aft shroud.
 - Transfer tag lines to technicians in the payload transporter (PT).
 - Attach tag lines 120 degrees apart.
 - Attach the payload transporter (PT) ground cable.
38. (415) Which action must occur prior to loading a missile guidance set (MGS), propulsion system rocket engine (PSRE), or post-boost control system (PBCS) into a payload transporter (PT)?
- Pre-operational checkout of the PT.
 - Inspection of the PSRE propellant tanks.
 - Inspection of the MGS, PSRE, and PBCS insulation.
 - Pre-operational checkout of the PT auxiliary power unit (APU).
39. (415) Select the step that is accomplished to ensure the connectors of the post-boost control system (PBCS) are not damaged when the missile guidance set (MGS) is lifted off.
- Mating guides are installed.
 - Tag lines are attached to the MGS.
 - P107 bellows protection plate is installed.
 - Safety cones are installed on the PBCS spanner nuts.
40. (416) Identify the primary concern when transporting aerospace vehicle equipment (AVE) components.
- Ensuring no leaks develop on any of the AVE components.
 - Maintaining the proper pressures on the AVE subsystems.
 - Maintaining components within their thermal limits.
 - Displaying the proper warning signs and placards.
41. (416) Which placard(s), if any, will be displayed when transporting a post-boost control system (PBCS) in a payload transporter (PT)?
- Explosives 1.1D or Explosives 1.3C.
 - Explosives 1.3L and Poison.
 - Explosives 1.3C.
 - None.
42. (417) Where must the safety control switch (SCS) lock pin assembly key be when installing safing pins into the missile?
- With the team chief or senior-ranking individual.
 - With the technician that is physically installing the pins.
 - In the safing pin bag located in the launcher equipment room (LER).
 - With the individual who is controlling the guided missile maintenance platform (GMMP).
43. (418) When removing the reentry system (RS) from the missile, the possibility of a static charge causing a missile ordnance squib to fire is eliminated by ensuring the
- missile combat crew (MCC) has accomplished Pendulous Integrating *Gyroscopic* Accelerometer leveling.
 - safety control switch (SCS) lock pin is installed and the key is removed.
 - RS handling fixture is properly grounded.
 - missile is properly grounded.
44. (418) Select the item(s) that is/are required to perform the radiation shield inspection.
- Megohmmeter.
 - Flashlight and mirror.
 - White box (WBox) and gray box (GBox).
 - Explosive set circuitry test set (ESCTS).

45. (418) When mechanically mating the reentry system (RS) to the missile guidance set (MGS), which step is performed after the RS is lowered onto the MGS?
- Install two mating bolts roughly 180 degrees apart.
 - Electrically mate the RS to the MGS.
 - Perform the RS resistance check.
 - Remove the RS handling fixture.
46. (419) Which step must be completed when connecting the upper and lower umbilical cables to the distribution box (D-box) prior to the missile guidance set (MGS) being electrically mated to the propulsion system rocket engine (PSRE)?
- Charge the MGS with coolant.
 - Install the lower umbilical cable first.
 - Perform accidental missile ignition test.
 - Perform the power-fault-to-ground check.
47. (420) How do you know when the interface cable is properly connected to the missile guidance set (MGS)?
- Three threads will be visible above the insertion stripe.
 - Three threads will be visible below the insertion stripe.
 - No threads will be visible above the insertion stripe.
 - The lock wire holes will be aligned.
48. (420) Prior to removing the permutation plug (P-plug) from the missile guidance set (MGS)
- ensure the safety control switch (SCS) lock pin key is in your possession.
 - place the aerospace vehicle equipment (AVE) protective cover on the MGS.
 - visually inspect the MGS mating surfaces.
 - ground yourself to remove any static charge.

Unit 4. Missile Downstage Maintenance and Emergency Procedures

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THE MISSILE DOWNSTAGE is essential for delivery of the RS to its intended target. Safely transporting and installing the downstage in the LF launch tube is the first step to putting the Minuteman missile on strategic alert. The missile combat crew (MCC) must be able to maintain communication with the missile at all times, which is accomplished through two large umbilical cables that connect to both the bottom and top of the missile. The only way a missile can communicate with the LF or LCC is through these umbilical cables.

Considering the complexity of the Minuteman III weapon system, some potential for a hazardous condition is always present. As you might expect, robust emergency procedures have been created to mitigate most of these situations. This unit will provide information on the transportation of the missile downstage and its maintenance. It will also provide information on the upper and lower missile umbilical cables. Additionally, we will cover some emergency procedures you may be required to perform as a 2MOX2 technician. We will begin with missile downstage transportation and maintenance. The mated first, second, and third stage boosters form the missile downstage, but are referred to as the *downstage* from this point forward.

4-1. Downstage Transportation and Maintenance

In the last unit, we discussed AVE transportation and maintenance. However, there is another part of the weapon system that is just as important, the downstage. Without the downstage, the PSRE, MGS, and RS could not reach Earth's orbit; therefore, the weapon would not be delivered to its target. As a maintenance technician you may be assigned to the missile handling section, which performs all of the tasks we are about to cover. In this lesson, we will cover downstage transportation and maintenance and some of the associated tasks.

421. Downstage handling and transport description

Movement of the downstage is a tremendous task, and extreme care must be taken to ensure it is handled and transported properly. As a missile handling technician, you will have the opportunity to transport the downstage and lower it into the launch tube at the LF. Maneuvering and transporting the downstage is more than just moving it from storage to a vehicle or emplacing it in the launch tube. It includes all operations required to deliver and emplace a downstage into an LF, to include removing and returning the downstage to the depot, if necessary. It also includes all handling operations performed at missile handling facilities, as well as all transporting operations, such as shipping the downstage between facilities. In this lesson, we will discuss what you may encounter as a member of a missile handling team. Before we get into the lesson, you must understand the characteristics and safety practices of the propellant in the downstage rocket motors. Safety is of utmost importance during any operation involving the downstage.

Safety precautions

During downstage handling, electrically ground the downstage since its components are sensitive to ESD. When grounding the downstage, always attach the ground cable or strap to the ground attach point closest to the first stage motor. Then connect the other end to the grounding attach point farthest away from the downstage. This keeps any potential static spark away from the downstage and its propellant.

There may be times when lightning or a thunderstorm moves into the area while you are emplacing a downstage. If this does occur, your technical order will direct you to immediately cease all handling operations and evacuate the LF. After the storm ends or has moved out of the area, resume maintenance operations with the minimum number of technicians required as your team chief dictates. Due to its height, an erected TE is a prime target for lightning. In situations where the downstage is emplaced, and the LC is closed, you must still stay clear of an erected TE during a lightning storm.

One other major safety concern is the size of the equipment you are using. Much of the equipment and vehicles are large and heavy. Be aware of your surroundings when performing maintenance. Having a lapse in awareness of what is happening around you can have dire consequences.

Downstage transport

You will transport the downstage to the LF for emplacement, from the LF to the MSB, or you will receive the downstage from depot to put into storage. Before transporting the downstage to or from any location, perform the required pre-operational checks and form a vehicle convoy according to local procedures.

Pre-operational checks

The TE requires a pre-operational inspection and checkout prior to any downstage handling operation. Since you will travel over public highways and roads, the checkout and inspection is very important. Remember to check the condition of the TE tractor and TE semitrailer. A pre-operational inspection is a functional checkout designed to discover problems with the equipment before they can impact your operations at the MSB and the LF. Perform a pre-operational checkout and inspection of the TE using technical order procedures.

The preliminary pre-operational procedures include inspection and checkout of the TE support truck since this vehicle will transport support equipment used in downstage handling operations. The TE support truck is an M-van that is loaded with all the parts and equipment that the MHT will need to complete an emplacement or removal at an LF. There are numerous items to check prior to transporting and emplacing the downstage, and these procedures are located in the technical order. Once the pre-operational checkout is complete, prepare for the convoy.

Convoy preparation and movement

Prior to transporting a downstage on the highway, check all regulations concerning downstage transport. Then assemble the TE and required escort vehicles into a convoy. The convoy consists of a lead vehicle, the TE, and the TE support truck (an M-van) following in the rear.

During the actual movement of the convoy, the TE provides the environmental control of the container. This requires running the tractor's APU. Be sure the power monitor panel in the tractor shows the appropriate indications. Periodically check the ECU warning light display panel for any warning lights.

Roughly every 100 miles during a downstage movement, perform the required enroute inspections. Conduct these inspections in accordance with the number of miles traveled as stated in the technical order or local procedures and prior to continuing movement after a food or rest stop. The enroute inspection includes checking panels and doors, container exterior, wheels, brakes, suspension system, lights, and all system reservoirs and lines. Generally, check everything for damage and leaks and

check for malfunctioning systems. Once the convoy reaches its destination, make a post-operation inspection. In addition to a general walk around inspection, drain any water that may have accumulated in the air tanks of the TE pneumatic system.

Downstage handling at the launch facility

MHT technicians are responsible for handling the downstage for emplacement and removal, (fig. 4-1) while MMT technicians complete the required tasks inside the launch tube. When the TE container is on the ground (horizontal), MHT technicians prepare the downstage for emplacement, or tie it down for transport. To accomplish either task, they move the downstage using the carriages and the missile positioner along the V-rail and install or remove the tie-down bands.



Figure 4-1. Downstage emplacement operation at the LF.

During these operations you will be in close contact with the fungicide treated cork insulation, and you must use care not to damage it. Because of the fungicide, technicians must wash their hands prior to eating, drinking, or using tobacco products. The carriages inside of the container must be tied down and the nozzle shipping links must be removed or installed prior to erecting the TE. These shipping links maintain the nozzles in a fixed position for transport to reduce the possibility of damage.

The downstage is raised and lowered through the use of four sling rods that are bolted to the downstage adapter ring. During the raising and lowering operations, the MHT technician operating the HHCU (fig. 4-2) is in continual verbal contact with MMT in the LER to ensure the downstage is clear of any obstructions. It is especially important to ensure the first stage of the downstage clears the first stage carriage band. If it has not and hoisting operations begin, it could cause major damage to the downstage and TE.

Downstage handling on the support base

Downstage handling on the MSB involves roll transfers and storage of the downstage prior to shipment to depot, or installation in an LF. MHT performs two different types of roll transfers, commonly referred to

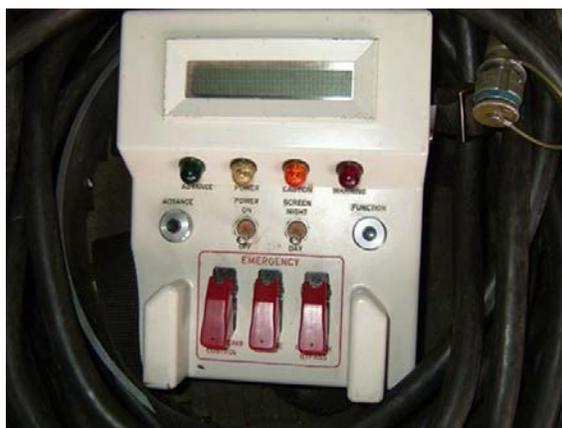


Figure 4-2. Hand-held control unit.

simply as forward rolls and back rolls. A forward roll is a roll transfer from the MT into the TE. A back roll is a roll transfer from the TE into the MT. Regardless of the direction of the roll, there is a significant amount of preparation required before a team can even begin to move a downstage from one trailer to another.

The downstage must be inspected to ensure the safing pins are installed and it is free of any damage. This inspection is lengthy; therefore, we will only cover a generalization of the steps that are required. The inspection includes inspecting the first stage nozzles and nozzle exit cones for cracks, the nozzle throat for scratches or cuts, skirt umbilical receptacle for damage, nozzle control unit actuation arm for hydraulic fluid leakage, and the insulation at the aft end of the downstage for cracks or voids. After the downstage passes the inspection, handling operations can continue to prepare the downstage for transport or storage.

You may also be required to level and align the TE and MT trailers. This will allow for the V-rails between both trailers to be at identical heights, providing a smooth roll for the downstage from one trailer to the other. The winch system in the MT moves the downstage from one container to the other.

Storage of a downstage at the MSB is also considered a handling operation. The downstages are stored in the trailers that are located on outdoor storage pads. These trailers are connected to a PAC to maintain the downstage within the desired temperatures. A Sensaphone system is also used to monitor the temperature inside a container that a missile is stored in and will automatically dial a preprogrammed phone number when the temperature is out of tolerance. This allows MHT technicians to respond and correct the problem before the downstage is exposed to temperatures outside its limit for too long.

This lesson focused on downstage handling and transport. The missile would not be able available for launch if it was not for MHT completing their handling and transport of the downstage in a safe and secure manner. As a 2M0X2 technician, it is important that you understand the procedures that must be performed in order to maintain the downstage.

422. Handling equipment description

In addition to the vehicles you have already learned about, MHT technicians also operate a wide array of specialized equipment that enables them to maneuver the assembled downstage. We will not be able to discuss each of these pieces of equipment in detail, but we will discuss some of the more commonly used items.

Missile emplacement guide set

The missile emplacement guide set (fig. 4-3) is commonly called “skids and rollers.” The set includes three guides, four fixed skids, and one roller skid. The set is installed on the missile adapter ring and is used to guide the downstage while it is being lowered or raised through the MSS in the launch tube. Without it, the downstage could catch an edge on the MSS, which could result in damage to the downstage, or MSS.

There are three sizes of guides that are installed on the adapter ring—large, medium, and small. Each guide installs into a specific sector of the adapter ring, and these correspond with a specific corridor of the MSS in the launch tube. When installing the guides, a T-bolt tool screws into a threaded hole in the side of the adapter ring to secure the guide to the ring. A hand knob is used to provide tension against the top of the ring, securing the guide firm against the ring. The skids are installed over the sling rod bolts and onto the lug of the missile adapter ring, and are held into place with several QR pins. The roller skid is always installed over the sling rod to the left of the medium guide, close to the 210-degree position of the missile adapter ring.

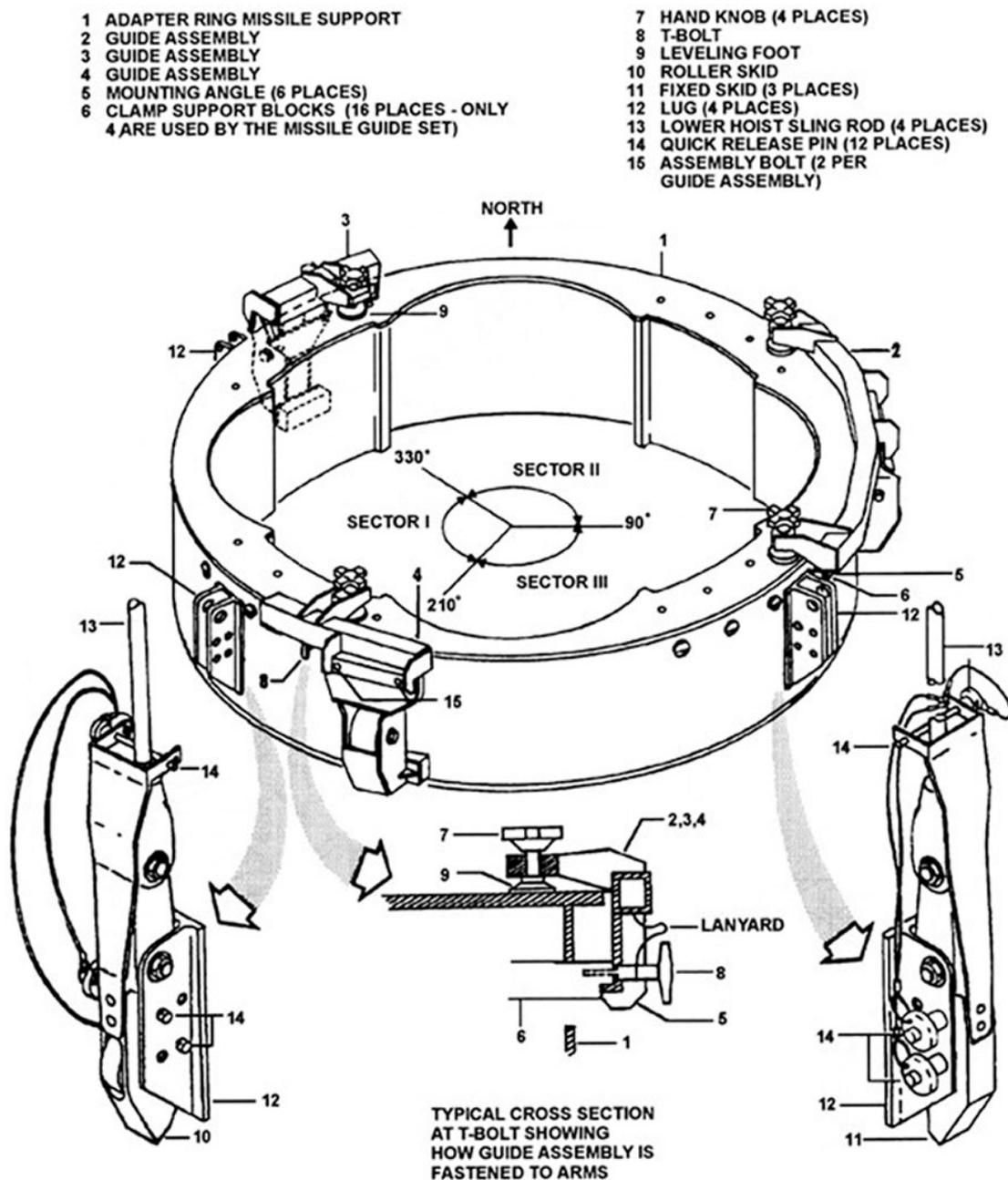


Figure 4-3. Adapter ring missile support and missile emplacement guide set.

Translating and leveling jacks

The translating and leveling jacks are hydraulically powered jack sets used to adjust the TE and MT containers so MHT can perform a roll transfer. Without them, the V-rails of both containers will not align properly and the missile carriages would not be able to roll safely.

The translating jacks support and position the TE for the roll transfer. The set consists of the following items:

- Fifth wheel translating jack with a fifth wheel socket (fig. 4-4).



Figure 4-4. Fifth wheel translating jack.

- Left side translating jack (fig. 4-5).
- Right side translating jack (fig. 4-5).



Figure 4-5. Left and right translating jacks with carriage links.

- Axle chains.
- Two lower carriage links.
- One upper carriage link.

The translating jacks support the entire weight of the TE. The axles are kept secured off the ground using the axle chains. The translating jacks allow for left and right and forward and aft movement of the TE while being supported by the jack set. The left and right jacks are attached under the hinges of the TE and are connected to each other using the upper and lower links. The left side jack provides the movement to the left and right directions, and the right-side jack follows along because of the carriage links. Both rear jacks will move forward and aft following the fifth wheel jack.

The leveling jack set is connected to the MT and consists of the following items:

- Fifth wheel leveling jack (fig. 4-6) with a fifth wheel socket.



Figure 4-6. Fifth wheel leveling jack.

- Two rear hinge leveling jacks (fig. 4-7).



Figure 4-7. Rear hinge leveling jack.

The leveling jacks can be operated independently and only travel up and down so that the MT can be leveled in order to perform a roll transfer.

Optical alignment set

Setting up a TE and MT for a roll transfer must be accomplished with precision. It is not as simple as backing the TE up to the front of the MT and making the transfer. If the two vehicles are not properly aligned, the V-rail bridge cannot be installed, and the downstage will not transfer from one trailer to the other. To eliminate the human element of alignment as much possible, MHT technicians use the optical alignment set (fig. 4-8) to line up the TE and MT. The set consists of the following:

- A special level.
- A scope.
- Three set targets.
- Four mounting brackets.



Figure 4-8. Optical alignment set.

The special level is installed between the V-rails at the rear of the TE. The mounting brackets, targets, and scope are mounted to the side of the MT and TE. The optical alignment scope (fig. 4-9) is attached to the MT so it can look down through the targets, with the final target being mounted to the last bracket on the TE.



Figure 4-9. Optical alignment scope.

The technician first aligns the scope with the target mounted on the MT. When the scope is properly configured, that target from the MT will be removed. The technician will peer through the scope and use the TE translating jacks to move the TE vertically and horizontally until it is level and the targets are properly aligned with the scope.

This lesson focused on the tools MHT uses to both adjust and align the different containers so that a downstage roll transfer goes as smoothly as possible.

423. Guidance and control umbilical description

The G&C and skirt umbilical cables are the lifelines to the missile while it is in the launch tube. The umbilical cables contain the necessary wiring to provide power and monitoring capability for the emplaced missile. The umbilical cables are normally connected between the emplaced missile and LF; however, many maintenance tasks require technicians to routinely disconnect and connect both umbilical cables. In this lesson, we will cover the functions of each umbilical and gain a general overview of a few of the umbilical maintenance tasks.

The G&C umbilical (fig. 4-10) is also referred to as the upper umbilical. It consists of three electrical cables and two coolant hoses that terminate in a single plug.

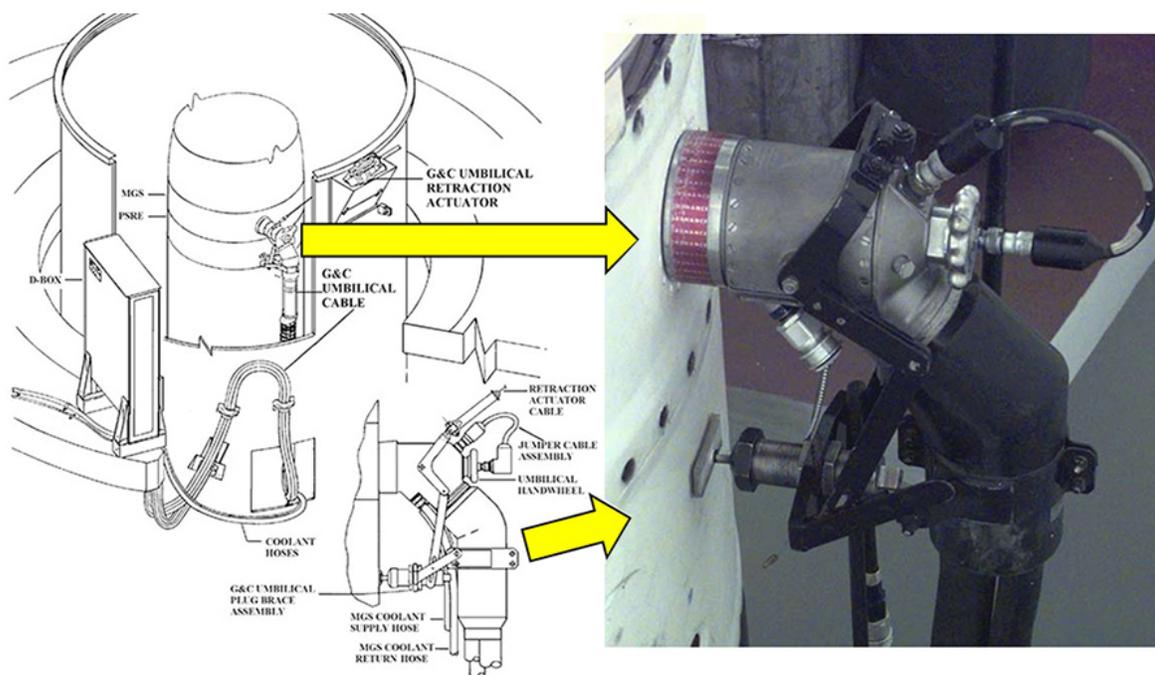


Figure 4-10. G&C umbilical.

The three electrical cables connect to the main distribution box on the first level LER, route down to the second level LER through the launch tube liner umbilical access slot, and connect to the MGS. These three electrical cables provide circuitry necessary to power and monitor the MGS electronics. The coolant supply hoses of the umbilical provide a path for chilled coolant (sodium chromate) to flow from the G&C chiller on the first LER through the MGS, thereby controlling the temperature of the MGS. The warm coolant then returns to the chiller unit through the umbilical coolant return hose. The G&C umbilical cable plug attaches the umbilical electrical cable and coolant hoses to the MGS receptacle. A threaded hand wheel center mechanism secures the plug to the MGS, and a brace assembly supports the plug when it is connected to the MGS. A device called the G&C umbilical retraction actuator contains a small explosive charge that rapidly disconnects the upper umbilical from the MGS during launch.

The function of the G&C umbilical retraction actuator is to prevent the disconnected umbilical cable from contacting the missile during launch. A wire cable extends from the actuator and connects to the umbilical plug. During launch, the actuator's explosive charge activates immediately after the jumper cable assembly charge activates. This explosive charge generates gas pressure that rotates the actuator and draws the attached G&C umbilical cable into a locked position against the launch tube wall and away from the missile.

This lesson focused on the G&C umbilical. This cable provides a pathway for both cooling fluid and electrical signals to flow between the D-box and the MGS. As a technician it will be up to you to ensure this critical component is maintained properly.

424. Skirt umbilical description

We have already covered the G&C umbilical; now we will look at the skirt umbilical. The skirt umbilical (fig. 4-11), also referred to as the lower umbilical, provides a pathway for electrical signals and power to flow between the D-box and the first and second stage missile boosters. It also provides the signals so that electromechanical maintenance team (EMT) technicians can complete coding operations on the command signal decoder that is installed on the top of the first stage. The lower umbilical consists of four electrical cables that terminate at the skirt umbilical plug. Three of the umbilical electrical cables provide an electrical path for the signals used to monitor and supply power to electrical components in the first and second stages. The fourth cable provides a path for the electrical signals required for operation of the missile command signal decoder.

The four cables connect to the main D-box on the first level LER, route down to the second level LER, then through the launch tube liner umbilical access slot and into the launch tube. Inside the launch tube the cables route down along the launch tube liner and missile alignment structure and are secured by a combination of clamps and cable trays. The cables then pass through an access hole in the frustum and then through the umbilical support clamp attached to the missile support adapter ring. The umbilical support clamp is spring loaded in order to maintain upward pressure on the cable and keep it connected to the missile receptacle. During a launch, the clamp will hold the cable in place, clamped to the inside of the missile adapter ring.



Figure 4-11. Skirt umbilical.

When performing maintenance that includes disconnecting the lower umbilical, it is important to coordinate that action with the MCC. Even if missile power is removed, the LCC will receive a missile away indication when the skirt umbilical is disconnected from the missile. If this action was not previously coordinated, the crewmembers could interpret this indication as an emergency at the LF.

This lesson focused on the skirt umbilical. This umbilical provides a pathway for electrical signals and power to flow between the D-box and first and second stage missile boosters.

Self-Test Questions

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

421. Downstage handling and transport description

1. How should the downstage be grounded?
2. What does a downstage movement convoy consist of?
3. What could occur if the technician operating the TE HHCU was not in constant contact with the MMT technicians in the LER?
4. What is the purpose of the MT winch system?

422. Handling equipment description

1. What purpose does the missile emplacement guide set serve?
2. What is the purpose of the translating jacks?
3. What purpose do the leveling jacks serve?
4. What will occur if the TE and MT are not precisely aligned during a downstage roll transfer?

423. Guidance and control umbilical description

1. What is the G&C umbilical typically called and where does it connect to the Minuteman III missile?
2. How does the G&C umbilical retraction actuator operate?

424. Skirt umbilical description

1. What is the skirt umbilical typically referred to as, and what is it composed of?

2. What actions occur to the skirt umbilical during an actual launch?

4-2. Emergency Procedures

There are many inherent dangers that you will be exposed to when performing maintenance on the Minuteman III weapon system. You need to know what actions to take in case of an emergency. Emergencies can present themselves in many forms, such as an electrical problem or fire. This section provides information on what actions to take in certain situations at the LF that will require immediate action. We will also cover some emergency situations with the PSRE and the final lesson will cover LF forced entry.

425. Launch facility emergency procedures

The LF emergency procedures include LF shutdown, launcher support building (LSB) electrical isolation, and LF emergency war order (EWO) launch evacuation. You can find these procedures in the bold hash-marked bordered pages in the technical order (TO) 21M-LGM30G-2-10, *Launch Facility and Support Building Procedures*. These procedures are also included in the corresponding technical order checklist. The following information provides fundamental LF emergency procedures. These lessons are not designed to replace technical order procedures, and as such do not include step-by-step instructions for each individual wing.

Launch facility shutdown

Emergency LF shutdown is performed in the event of fire, loss of cooling air, or other abnormal condition at the LF. The purpose of these emergency procedures is to rapidly remove power from the majority of weapon system equipment. In the event of an emergency, the team chief or senior ranking person at the LF makes the decision to shut down the LF and is not required to contact the MMOC prior to executing the shutdown. An emergency condition exists; therefore, speed is of the utmost importance.

Once the decision is made to perform emergency LF shutdown, the procedure must be performed quickly and properly to minimize the hazard to equipment and personnel. The first step in LF shutdown is performed at the D-box—verify the SCS is locked and the safe/arm indicator shows “S.” Then open all D-box circuit breakers. Next, turn the emergency ECS fan key switch to OFF. At the power supply group located on the shock-isolated floor, turn off the secure data unit (SDU) power switch, and open all direct current and alternating current circuit breakers.

Next, open circuit breaker A1 on the battery charger alarm set group. Then, position the emergency power DC switch next to the motor generator to OFF, exit the LER, and move quickly to the support building. In the support building, set the Minuteman power processor (MPP) power switch to OFF. Finally, evacuate the LF, maintain surveillance, and notify MMOC and the MCC on the condition and status of the LF.

Launcher support building emergency electrical isolation

Perform the LSB emergency electrical isolation procedures whenever an abnormal condition requires complete electrical isolation of the LF support building from commercial and standby power and from the launcher.

To electrically isolate the LSB place the MPP power switch to OFF. This will prevent the diesel from starting once commercial power is removed. Next, remove commercial power by setting the appropriate circuit breakers in the LSB to OFF.

After electrically isolating the LSB, notify MMOC and MCC that commercial power has been disconnected and diesel generator has been disabled. Give MMOC and MCC the reason for the power shutoff and an estimated time for correcting the abnormal condition. Keep in mind that as long as commercial and diesel power are unavailable, the LF will be operating on emergency battery power.

Launch facility evacuation for emergency war order launch

LF evacuation for an EWO launch is performed if the MCC instructs maintenance personnel at an LF to prepare the LF for launch, and the missile is on strategic alert or has entered a launch capable mode. Again, this procedure must be performed quickly and accurately to have the LF and the missile ready for launch.

First, complete all EWO essential maintenance. This means perform whatever maintenance is required to put the missile on alert. After essential maintenance is complete, remove all missile safing pins. Next, remove the missile support lockout set (if installed) from the missile suspension system. Remove the GMMP and secure the launch tube. If the LC door is open and the PT is positioned over it, close the closure door and remove the PT.

Remove all tools and small equipment from the LER. Then move all large equipment off and from under the shock-isolated floor. At the D-box, remove the SCS lock pin assembly, and then raise and secure the LER hinged platforms. Stow and secure all safety straps and chains to allow the isolated floor to move freely. Evacuate all personnel from the LER. Simultaneously raise the secondary door and close the primary door; however, do not lock either door.

Then, evacuate all personnel and vehicles from the LF to a minimum distance of 2,000 feet in the most upwind direction. Inform the MCC that the SCS lock pin assembly has been removed and the LF has been evacuated. This is normally done using the very-high frequency (VHF) radio. If no radio is available, contact the MCC on the LF communications network prior to evacuating the LF. Maintain surveillance of the LF and proceed as directed by the MCC. Remember, all emergency procedures must be completed as quickly as possible while maintaining safety and accuracy.

426. Propulsion system rocket engine emergency handling description

As we all know, while most accidents are preventable, some situations are simply out of our control. As a missile maintenance technician, you will be responsible for transporting the PSRE, which contains tanks filled with hazardous fuel and oxidizer. An incident or accident involving the PSRE can occur at the support base or during transport to or from an LF. It is important for you to have a general knowledge of safety precautions, how to respond and handle an emergency involving the PSRE, and the type of personnel protective equipment (PPE) to use. This lesson is not intended to cover all PSRE emergency procedures, but rather covers general guidelines necessary for handling an incident or accident.

Safety precautions

The fuel stored within one of the two propellant storage assemblies (PSA) of the PSRE will exist as either a liquid or a vapor. Regardless of the state, this chemical is volatile and toxic, and can cause dizziness, respiratory distress, and may affect the central nervous system. If fuel comes in contact with your skin for any reason, flush the affected area immediately with large amounts of water and seek immediate medical attention at the nearest medical facility.

The oxidizer will also exist as either a liquid or a vapor. It is yellowish to reddish in color, and it is possible to both see and smell the fumes. It is also possible to sense the oxidizer in your eyes and throat if exposed to it, and symptoms or illness may not appear until hours after exposure.

Together the fuel and oxidizer pose a fire and explosive hazard. While the fuel will not explode due to shock, it will burn on contact (hypergolic) with the oxidizer. If fires produced by the hypergolic reaction of the fuel and oxidizer are small, it is possible to extinguish the fire with water fog since the water acts as a cooling and diluting agent.

As you can see, handling and transporting the PSRE poses a potential hazard. Especially if it becomes damaged, since the hazards present are the highly toxic propellant vapors, the hypergolic reaction of the propellants, and the fragmentation of the 3,200 psi helium gas storage assembly. This is why any incidents or accidents involving the PSRE require special emergency response and personnel trained to respond to PSRE incidents or accidents. These specially trained personnel make up the wing or base emergency response team (ERT) that will respond to any PSRE propellant leak. The agencies that make up the ERT usually include at least a qualified MMT team, bioenvironmental engineering (BEE), the base fire department, security forces personnel, and medical responders from the medical group.

The LF will be penetrated by two specially trained technicians qualified to operate the gas detection monitor as well as a representative from BEE who will determine whether the area is safe for personnel to work without personnel protective equipment (PPE). The BEE representative determines the level of protection to wear. The ERT will wear Level A type suits that protect them from potential exposure to fuel or oxidizer vapors. The ERT verifies the leak and determines the concentration of the vapor in the surrounding areas.

Upon verification, the ERT notifies the MMOC to request assistance from the emergency response depot team (ERDT) whether the accident occurred at the LF, in-transit, or at the MSB. This depot team is alerted as soon as possible after confirmation of a damaged PSRE in accordance with the wing missile potential hazard network (MPHN) plans. Bases or units activate the MPHN whenever they exhaust technical data or believe a situation is beyond their ability to recover to a safe configuration. Note that the ERDT is located at Hill AFB, Utah, and it may some time for them to arrive at your wing.

Responding to a propulsion system rocket engine incident or accident

As mentioned earlier, an incident or accident can happen while you are handling the PSRE and depending on the location, you may be required to respond to the situation. The following are the most likely situations where a PSRE may be damaged:

- Dropping the PSRE during handling.
- Dropping an object on the PSRE.
- Fire from external source.
- Collision during transit.

All of the above examples pose hazards to personnel, and in the event of an incident or accident, determine if an emergency condition exists. If an emergency condition does exist, take actions to assess the damage to the PSRE, identify actual and potential hazards, identify and implement recovery methods, and identify and implement any environmental actions that need to be taken. The condition of the PSRE is determined before any movement can take place. If it is determined the PSRE has a propellant leak, the maintenance team must secure and evacuate the affected area to a distance of 600 feet upwind or 2,500 feet upwind of the LF if fire or explosion is imminent. Notify MMOC and request an ERT and medical assistance if needed.

If a leak is suspected at a LF, all nonessential personnel must evacuate. The maintenance team will contact the MMOC to verify an emergency condition exists and request assistance from the ERT. Upon arrival, the ERT will determine the nature of the emergency. The ERT will proceed into the launcher, obtaining air samples as they move down the primary access hatch, into the LER, and into the launch tube, within the vicinity of the PSRE. If vapors are detected during any of the sampling, the LF is evacuated and purged. After BEE determines the vapors are at a safe level, recovery may

continue. Recovery may depend on whether the PSRE was dropped down the launch tube itself or dropped with the MGS mated to it. If the PSRE was dropped inside the PT, the LC door is closed and the PT is moved to another area of the LF.

The MMOC will request assistance from the ERDT to aid in the recovery process. A flatbed trailer may be included in the equipment required for this type of emergency condition. The flatbed should be parked between the PT doors so the flatbed can be electrically grounded and the PT hoist can be used to load the PSRE onto the flatbed. The PSRE is separated from the MGS, if necessary. The ERDT will direct the chemical de-tanking and the PSRE will be loaded on the flatbed trailer. Four-by-four inch timbers will support the PSRE when it is secured to the trailer. The trailer is then relocated to a remote area and electrically grounded.

Leak discovered during transport

If a leak is discovered while the PSRE is in the PT, the PT is evacuated, MMOC is notified, and a determination is made as to whether an emergency condition exists or not. Upon verification, request assistance from the wing ERT. Once the wing or base ERT arrives, they will check for vapors. If vapors are present, open the PT doors to allow for maximum ventilation. When vapors are at a safe level, prepare the PSRE for movement. The position and condition of the PT as the result of an accident may require depot assistance.

427. Forced entry procedures after secondary door lockout

You will perform LF forced entry procedures for a secondary door (B-plug) lockout if all other nondestructive methods of opening the secondary door have failed. The overall concept of this procedure is to remove a portion of the LC so that it can be unlocked and opened. Technicians can then be lowered into the launcher with a crane. Once inside the launcher, the technicians perform the necessary maintenance required to open and lower the secondary door.

Break-in team and tools

Although you will not perform an LF forced entry on a regular basis, this procedure involves the combined effort of personnel from several different base agencies who perform as a “break-in” team. This break-in team consists of the following personnel:

- Welding technician (electric arc and acetylene).
- EMT.
- MMT.
- Pavement team.
- Crane operator.

In addition to using the normal tools required for the forced entry procedure, the break-in team uses specialized tools that are stored in kits located at each wing. The following is a list of some of the equipment found in these kits:

- T-bar wrench.
- Lock removal rod.
- Steel blocks.
- Steel I-beam.
- Hydraulic ram.
- Lock retainer wrench.
- Lock retainer tool.
- Locking rod.
- Recovery strap.

- Lifting bridle.
- Safety/lifting harness.

Unlocking the launcher closure

To gain access to the LC door lock, a portion of the LC must be demolished. On the south end of the LC, directly above the lock pin access area, the pavement team uses a jackhammer to break up and remove the concrete. In addition, a welding technician uses an acetylene torch to remove the rebar located in the concrete.

After personnel remove the concrete and rebar, they reach a series of plates. The welder attaches handles to the first plate and cuts it out from the lock access area using the acetylene cutting torch, and then repeats the same steps on the next plate. A vacuum cleaner is used to remove the debris from the lock and lock housing area.

Then MMT will use the T-bar wrench to thread the lock removal rod into the hole in LC lock (fig. 4-12). This drives the lock cam down far enough for the lock pins to clear the lock housing, and the LC lock is released. Steel blocks are welded against the closure lock access liner to brace the steel I-beam that is used in conjunction with the hydraulic ram to force the lock pin down. The hydraulic ram will be extended until the lock bottoms out. Then, a lock retainer wrench will be used to install the lock retainer between the lock pin and lock housing with the purpose of holding the lock pin down (fig. 4-12). Once the lock pin is secured in the downward position, pressure can be relieved from the hydraulic ram, equipment can be removed, and technicians can prepare to open the LC.

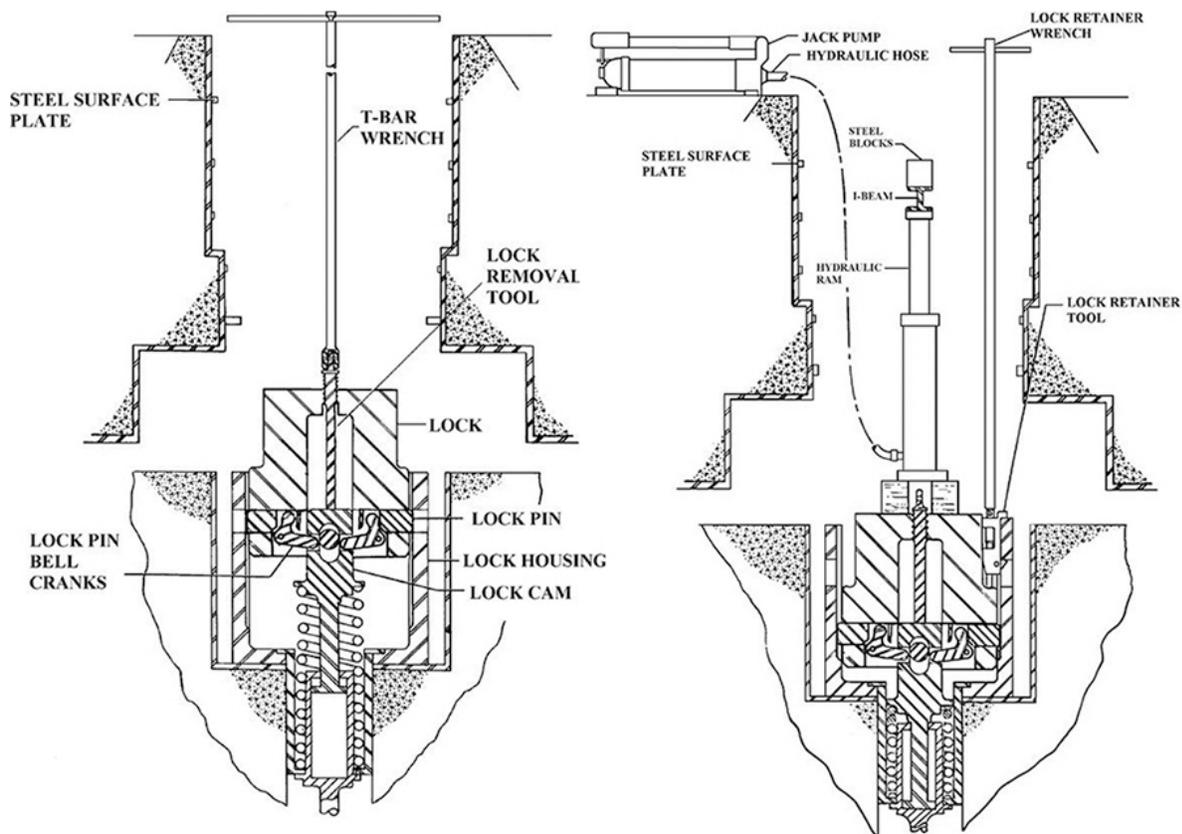


Figure 4-12. Unlocking the launcher closure lock.

Opening the launcher closure

Before the LC can be opened, the launcher safety barrier must be set up and the HPS and recovery strap must be installed on the south end of the LC. A second HPS must be installed in the opposite direction of the first so that the LC can be stopped if it begins to free-roll. Measurements must be taken and reference points must be marked along the LC rail and bulb seal so that the team knows exactly how far the LC has moved while being opened.

The LC is opened using the main HPS until the LC reaches a predetermined reference point, at which time a locking rod is installed. This locking rod will apply a horizontal load to the LC multiplying linkage to prevent the cable pin underneath the LC from dropping onto and damaging the missile. The LC is opened until it reaches another reference point, at which point the recovery strap is installed on the cable pin (fig. 4-13). The purpose of the recovery strap is to secure the cable pin to the multiplying linkage, thereby preventing it from falling out and onto the missile. After the recovery strap is installed, continue to open the LC to a maximum of 29 inches. Opening the LC past this point would leave too much slack in the cables under the LC and would allow them to contact the missile. With the LC open, members of the break-in teams will be able to enter the LER.

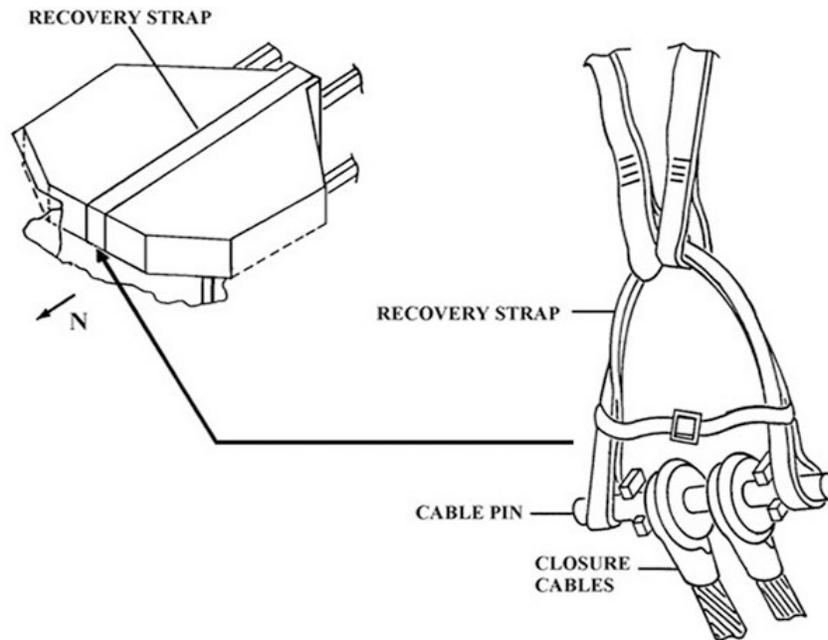


Figure 4-13. Recovery strap.

Entering equipment room

The crane operator positions a man-lift-approved crane near the opened launch tube. One of the two EMT technicians who will be lowered into the LER must be qualified to work on the secondary door. Before being lowered into the launch tube, the EMT technician must obtain a ratchet wrench with a 9/16-inch socket. The lifting bridle is connected to the crane, and then to the shoulder D-rings on the technician's safety harness.

The crane operator lowers the EMT technician near the multiplying linkage to ensure the recovery strap is securely installed on the cable pin. Once the strap installation is verified, the crane operator continues to lower the technician into the launch tube, and then moves him or her next to the emergency access opening (fig. 4-14). The EMT technician then uses the ratchet wrench and socket to remove the eight screen cover access bolts and swings the cover open to gain access to the LER.

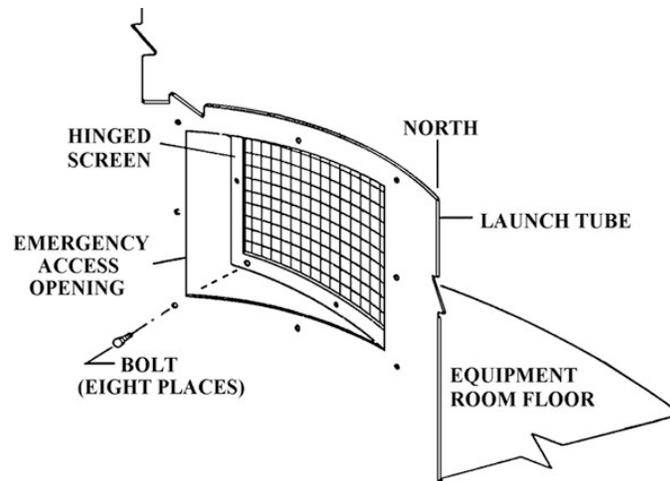


Figure 4-14. Launch tube emergency access opening.

Once safely inside the LER, the EMT technician disconnects the lifting bridle from the safety harness which remains visible at the emergency access opening until the second EMT technician is lowered into the LER. The SCS lock pin, headsets, and flashlight are lowered to the two technicians in the LER. After the second technician enters the LER, they install the SCS lock pin into the D-box and retain the key in their possession. Now they can proceed to open the secondary door.

Securing the launcher

The LC will be closed only after the secondary door has been completely lowered. Close the LC to a reference point where the locking rod can be removed. Next, the compressed gas cylinder valve assembly will be installed and will work in conjunction with the HPS to move the LC back to the reference point, and the recovery strap will be removed. After this, the lock retainer tool and all other tools and equipment will be removed, and one complete open-and-close cycle of the LC will be completed to ensure that it is functioning properly. The welding technician will weld new plates and rebar into the lock access area, and the pavement team will pour new concrete to replace what was removed with the jackhammer.

Self-Test Questions

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

425. Launch facility emergency procedures

1. What is the intent behind an LF shutdown?

2. What action(s) will you take after electrically isolating the LSB?

3. Why are the steps of LF EWO launch completed?

426. Propulsion system rocket engine emergency handling description

1. What should you do if you come in contact with the PSRE oxidizer?
2. What is the *first* step that will be accomplished if a PSRE propellant leak is suspected at an LF?
3. What steps are accomplished if a PSRE propellant leak is suspected in the PT during transit?

427. Forced entry procedures after secondary door lockout

1. What teams and/or technicians are required for a LER forced entry due to a secondary door (B-plug) lockout?
2. Why is a second HPS (pipe pusher) installed during forced entry procedures?
3. How does the EMT technician get into the LER during forced entry procedures?
4. At what point will the LC be closed after the EMT technicians have been lowered into the LER?

Answers to Self-Test Questions**421**

1. Connect one side of the ground cable to the ground attach point closest to the missile, preferably to the first stage and the other end to the ground point farthest from the missile.
2. A lead vehicle, the TE, and the TE support truck (an M-van) following in the rear.
3. The first stage of the missile may not be clear of the first stage carriage band and damage to the missile and TE could occur.
4. Move the downstage from one container to another.

422

1. It is installed on the missile adapter ring; it guides the missile while it is being lowered or raised through the MSS in the launch tube.
2. Supports and positions the TE for the roll transfer.
3. They can be operated independently and they only travel up and down so that MT can be leveled for a roll transfer.
4. The V-rail bridge will not be able to be installed, and the missile will not be able to transfer from one trailer to the other.

423

1. Upper umbilical. At the MGS.
2. During launch, the actuator's explosive charge activates immediately after the jumper cable assembly charge activates. This explosive charge generates gas pressure that rotates the actuator and draws the attached G&C umbilical cable into a locked position against the launch tube wall away from the missile.

424

1. Lower umbilical. Four cables.
2. A clamp will hold the cable in place, clamped to the inside of the missile adapter ring.

425

1. To rapidly remove power from the majority of weapon system equipment.
2. Notify the MMOC and the MCC that commercial power and standby power has been shut off at the LF.
3. In order to prepare the LF for launch when the missile is on strategic alert or has entered a launch capable mode.

426.

1. Immediately flush the affected areas with large amounts of water and seek medical attention.
2. All nonessential personnel must be evacuated.
3. PT is evacuated, the MMOC is notified, and a determination must be made as to whether an emergency condition exists or not.

427.

1. Pavement team, welding technician (electric arc and acetylene), MMT, EMT, crane operator.
2. To stop the launcher closure if it begins to free-roll.
3. They put on a harness and are lowered into the launch tube with a crane.
4. Only after the secondary door (B-plug) has been completely lowered.

Complete the unit review exercises.

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 AFCDA.

49. (421) Why is the missile grounded during downstage handling operations?
- Components are sensitive to electrostatic discharge (ESD).
 - An electrocution hazard exists without proper grounding.
 - Hazardous voltage checks are not accurate without proper grounding.
 - Power cannot flow through electrical circuits without proper grounding.
50. (421) Identify the purpose of the shipping links that are installed on the first stage nozzles during transit.
- Preserve the factory orientation of the nozzles.
 - Ensure nozzle control hydraulics do not lose pressure.
 - Keep nozzles in a fixed position to avoid possible damage.
 - Prevent the nozzles from pivoting more than two degrees in any direction.
51. (421) The missile Sensaphone monitoring system monitors the environment inside the container the missile is stored in and automatically
- sends a text if the temperature is out of tolerance.
 - sends a text if the relative humidity is out of tolerance.
 - dials a phone number if the temperature is out of tolerance.
 - dials a phone number if the relative humidity is out of tolerance.
52. (422) Identify the purpose of the leveling jacks used by missile handling teams (MHT).
- Adjustment of transporter erector (TE) and missile trailer (MT) containers prior to a roll transfer.
 - Ensures the missile lowers into the launch tube in a perfectly vertical position.
 - Ensures that the TE container is level during proof-load testing.
 - Alignment of the TE onto the launch facility (LF) TE pylons
53. (422) The optical alignment set used by missile handling teams (MHT) ensures the
- transporter erector (TE) container is level during proof-load testing.
 - missile lowers into the launch tube in a perfectly vertical position.
 - alignment of the TE onto the launch facility (LF) TE pylons.
 - alignment of the TE and missile trailer (MT) containers prior to a roll transfer.
54. (423) Identify one purpose of the guidance and control (G&C) umbilical cable.
- Provide a path for coolant flow to and from the propulsion system rocket engine (PSRE).
 - Provide a path for coolant flow to and from the missile guidance set (MGS).
 - Deliver targeting data to the reentry system (RS).
 - Provide electrical signals to the PSRE.
55. (423) The guidance and control (G&C) umbilical retraction actuator draws the G&C umbilical cable
- to the launch tube wall during missile launch.
 - away from the missile for maintenance actions.
 - into position for alignment to the missile guidance set (MGS).
 - away from the missile lower skirt and holds it against the launch tube wall during launch.

56. (424) The skirt umbilical provides
- coolant flow to the third stage motor.
 - monitoring circuitry for the third stage motor.
 - monitoring circuitry for the propulsion system rocket engine (PSRE).
 - a pathway for electrical signals and power to flow between the distribution box (D-box) and the first and second stage missile boosters.
57. (424) When the lower umbilical is disconnected from the missile, the missile combat crew (MCC) will
- receive a missile away indication from that launch facility (LF).
 - lose the ability to monitor any site status from that LF.
 - receive a fault indication asking for a reset action.
 - receive a "Lower umbilical disconnect" signal.
58. (425) What is the *first* step of a launch facility (LF) shutdown?
- Verify the safety control switch (SCS) is locked and the safe/arm indicator shows "S."
 - Open all circuit breakers on the distribution box (D-box) and power supply rack.
 - Turn the emergency environmental control system (ECS) fan to OFF.
 - Call the missile combat crew (MCC) to request authorization.
59. (425) Identify the *first* step of launcher support building (LSB) electrical isolation.
- Remove commercial power.
 - Open all diesel generator circuit breakers.
 - Turn the environmental control system (ECS) to OFF.
 - Place the Minuteman power processor (MPP) power switch to OFF.
60. (425) The *first* step of launch facility (LF) evacuation for an emergency war order (EWO) launch is to
- verify the safety control switch (SCS) is locked and the safe/arm indicator shows "S."
 - verify the Minuteman power processor (MPP) power switch to ON.
 - verify all circuit breakers on the distribution box (D-box) are closed.
 - complete all EWO essential maintenance.
61. (426) Which action is taken if the propulsion system rocket engine (PSRE) is leaking propellant at a launch facility (LF)?
- Complete all essential maintenance and evacuate.
 - Open the PSRE circuit breakers on the distribution box (D-box).
 - Notify the missile combat crew (MCC) and await further instructions.
 - Evacuate 600 feet upwind; 2,500 feet if fire or explosion is imminent.
62. (426) Identify the action(s) taken when a propulsion system rocket engine (PSRE) leak is detected when it is in a payload transporter (PT).
- Evacuate the PT and notify the missile maintenance operations center (MMOC).
 - Ensure the PT environmental control system (ECS) is operating and notify the MMOC.
 - Evacuate 600 feet upwind; 2,500 feet if fire or explosion is imminent.
 - Open the PT doors and wait for the emergency response team.
63. (427) Which actions do missile maintenance teams (MMT) take when accomplishing forced entry procedures following a secondary door (B-plug) lockout?
- Use an acetylene torch to remove the rebar located in the launcher closure (LC) concrete.
 - Use the 'T-bar' wrench to thread the lock removal rod into the hole in the launcher closure (LC) lock.
 - Use a jackhammer to break up and remove concrete from south end of the launcher closure (LC).
 - Attach handles to the metal plates, cut them out, and remove them.

64. (427) What is the recovery strap used for when accomplishing forced entry procedures following a secondary door (B-plug) lockout?
- a. Lower a technician into the launch tube so they can unlock the secondary door.
 - b. Prevent the launcher closure (LC) door from opening more than 29 inches.
 - c. Prevent the multiplying linkage from falling onto the missile.
 - d. Prevent the cable pin from falling onto the missile.

Student Notes

Glossary

Abbreviations and Acronyms

°F	degrees Fahrenheit
ACI	attitude control injection
AFB	Air Force base
AFMAN	Air Force manual
AMI	accidental missile ignition
AOTT	all ordnance thrust termination
APU	auxiliary power unit
AVE	aerospace vehicle equipment
BEE	bioenvironmental engineering
BGG	ballistic gas generator
B-plug	secondary door
CDC	career development course
CVA	compressed gas cylinder and valve assembly
D-box	distribution box
ECS	environmental control system
ECU	environmental control unit
EED	electrical explosive device
EGS	engine generator system
ELAB	electronics laboratory
EMT	electromechanical maintenance team
ERDT	emergency response depot team
ERT	emergency response team
ESCTS	explosive set circuitry test set
ESD	electrostatic discharge
EWO	emergency war order
FLI	fault locating indicator
G&C	guidance and control
GBox	gray box
GMMP	guided missile maintenance platform
GMR	ground maintenance response
GSA	gas storage assembly

GSP	gyro stabilized platform
HHCU	hand-held control unit
HPS	hydraulic pusher set (pipe pusher)
HPU	hydraulic power unit
Hz	hertz
ICBM	intercontinental ballistic missile
ID	identification
IMDS	Integrated Maintenance Data System
IMU	inertial measurement unit
LC	launcher closure
LCC	launch control center
LCD	liquid crystal display
LED	light-emitting diode
LER	launcher equipment room
LF	launch facility
LSB	launcher support building
MAF	missile alert facility
MAPS	mechanical and pneudraulic section
MCC	missile combat crew
MF	munitions facility
MGC	missile guidance computer
MGS	missile guidance set
MGSC	missile guidance set computer
MHT	missile handling team
MMOC	missile maintenance operations center
MMT	missile maintenance team
MPHN	missile potential hazard network
MPP	Minuteman power processor
MSB	missile support base
MSS	missile suspension system
MT	missile transporter
PAC	portable air conditioner
PBCS	post-boost control system
PDU	power distribution unit

PPE	personnel protective equipment
P-plug	permutation plug
PREL	power, refrigeration, and electrical
PSA	propellant storage assembly
psi	pounds per square inch
PSRE	propulsion system rocket engine
PT	payload transporter
PTO	power take-off
QR	quick-release
RFI	radio frequency interference
RMT	rocket motor trailer
RS	reentry system
SAP	small arms protection
SCS	safety control switch
SDU	secure data unit
SST	survivable systems team
TE	transporter erector
TO	technical order
VAC	volts alternating current
VDC	volts direct current
VHF	very-high frequency
WBox	white box
WSA	weapon storage area

Student Notes

Student Notes

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