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INTRODUCTION TO THE JAVELIN WEAPON SYSTEM

AT1401

Student Handout

ANTI-TANK MISSLEMAN COURSE

M100352

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LEARNING OBJECTIVES

a. **Terminal Learning Objectives.** N/A

b. **Enabling Learning Objectives.**

(1) Given a list of choices, identify the characteristics of a M98A1 command launch unit in accordance with TM 09397B-12/1. (52TR.02.01a)

(2) Given a list of choices and a diagram of a M98A1 command launch unit, identify the nomenclature of a M98A1 command launch unit in accordance with TM 09397B-12/1. (52TR.02.01b)

1.**SYSTEM DESCRIPTION**. The Javelin is a fire-and-forget, man-portable, medium range, anti-tank weapon that consists of a Command Launch Unit (CLU) and a round. The Javelin's maximum effective range is 2,000 meters, while it's minimum arming distance is 65 meters for the direct attack and 150 meters for the top attack mode.

a. CLU. The CLU is the re-usable portion of the Javelin. It consists of a day sight, night vision sight, controls, and indicators.

b. Round. The round consists of a missile and a Launch Tube Assembly (LTA). The missile is environmentally sealed in the LTA. It is composed of a propulsion section, a guidance and control section, a warhead and fuse section, control surfaces, and a seeker section. The LTA serves as the launch platform and carrying container for the missile.

c. Missile Modes. The Javelin can kill a target at two thousand meters. Its minimum arming range is sixty-five meters. In addition, the missile has two gunner-selectable modes (top or direct). Each mode has its own peculiar flight path or "profile" for reaching the target.

1. Top Attack Mode. In the top attack mode, the missile comes from above the target to impact and detonate on the top of the target. This capability allows the gunner to attack a vehicle from the front, from the rear, or from a flank. Generally, armored vehicles have less protective armor on top. By striking the top of the vehicle, the missile penetrates the vehicle and still has enough explosive charge remaining to do extensive damage inside the vehicle. This mode greatly increases the probability of kill.

Top attack is the default mode when the missile seeker is first activated. The exact profile of the missile during flight depends on the range to the target and is determined automatically by the missile on board software. If the target is under a protective structure, using top attack may cause the missile to impact and detonate on the structure instead of the target. To avoid this, the missile can be programmed for direct attack mode.

2. Direct attack mode. In direct attack mode, the missile impacts and detonates on the side of the target. The direct attack mode flight allows the missile to reach a target under a protective structure at a maximum range of 2000 meters. To do this, the missile flies a more direct route from the gunner to the target vehicle.

The direct attack mode can be selected only after seeker activation when the gunner pushes the attack select (ATTK SEL) switch on the right handgrip. As in the top attack mode, the exact profile of the missile flight path depends on the range to the target.

d. JAVELIN FIELDS OF VIEW

Javelin is equipped with three optical systems, two in the CLU (day sight and NVS) and one in the round (seeker). The area of a scene that can be viewed at one time through a weapon system sighting system is called the field of view (FOV). The system's FOV is related to the system's magnification. The wider a FOV's coverage, the less magnification it has. The narrower a FOV's area of coverage, the greater magnification it has. Javelin has four FOV's. They include day FOV, WFOV, NFOV, and seeker FOV. The day sight provides the day FOV. The Night Vision Sight provides WFOV and NFOV. The seeker, found in the missile, provides seeker FOV.

1. Day sight. The day sight is like a telescope. It provides day FOV for the gunner. Day FOV is used when visibility is good. The gunner uses it to scan a large area while waiting for the NVS to cool. However, he is able to distinguish very little detail about any object he detects during periods of limited visibility.

2. Night Vision Sight (NVS). The NVS allows the gunner to see during conditions of limited visibility, including darkness.

(a) Wide field of view (WFOV)(X4): WFOV covers a large, or wide, area compared to NFOV. The gunner uses it to scan a large general target scene to detect possible targets. However, he is able to distinguish very little detail about any object he sees. As a result, WFOV is used for general surveillance and target detection.

(b) Narrow field of view (NFOV)(X9.2): NFOV covers a much smaller, or narrower, target scene than WFOV. The gunner would have to move the CLU back-and-forth and up-and-down in NFOV to cover the same area as WFOV. NFOV is used after a possible target has been located. Using NFOV, the gunner can see target details more clearly. This allows him to determine what the object really is. Thus, NFOV is

primarily used to classify and recognize a target. It can be used for battle damage assessment, also.

3. Seeker FOV. The seeker FOV is not used for surveillance or target detection. The gunner uses seeker FOV to lock the missile onto the target. Once the seeker is locked on the target, the gunner can launch the missile.

2. COMMAND LAUNCH UNIT CHARACTERISTICS

a. CLU Physical Data

(1) Weight: (average w/out battery, carry bag and cleaning kit) 9.77 pounds (4.48 kilograms)

(2) Dimensions:

(a) Length: 14.75 inches (37.46 cm)

(b) Width: 16.50 inches (41.91 cm)

(c) Height: 13.00 inches (33.02 cm)

b. CLU Sights

CLU Sight	Magnification	Field of View
Day	4x	4.8 x 6.4
Wide (WFOV)	4x	4.58 x 6.11
Narrow (NFOV)	9.2x	2 x 3

c. CLU battery. CLU battery life determines how long the CLU may be used. The CLU battery is the same as the battery used in the Single Channel Ground and Airborne Radio System (Lithium battery, BA-5590/U or Lithium battery, BA-390 Rechargeable). Therefore, if your CLU battery goes dead and you have no other replacements, you can use the SINCGARS battery until a replacement can be found.

d. Field of view (FOV) specifications. The magnification of an FOV determines when an FOV is used. Keep in mind that day FOV and wide field of view (WFOV) have lower magnification than narrow field of view (NFOV). Because of this, the gunner uses them to detect targets. Day FOV is used when visibility is clear. WFOV is used during all conditions. However, it is useful at night or during limited visibility. The NFOV is used to see the details of a target. Because NFOV's magnification is higher than day FOV or WFOV, target details can be seen better and target recognition is easier.

3. COMMAND LAUNCH UNIT NOMENCLATURE

a. Main housing. The main housing is the body of the CLU. It contains the system electronics and the various gunner controls, displays, day sight and night vision sight of the CLU.

b. Absorbers. The CLU has absorbers around the main housing to help protect the equipment during field operations. One of the absorbers is a face shield that protects the gunner's face during firing.

c. Handgrips. The handgrips are attached to either side of the main housing. They are used by the gunner to hold the CLU. The handgrips are equipped with the gunner controls. These controls govern all Javelin operations during an engagement.

d. Battery compartment. Located on the bottom of the main housing is the battery compartment. The battery compartment houses the BA-5590/U CLU battery. The battery compartment is equipped with a connector that connects to a corresponding connector on the battery. The battery compartment has a detachable cover that is held in place by a wire bail.

e. Day sight. The day sight works similar to a telescope. It develops a magnified, visible-light target image. It consists of the day sight lens, the status indicators, and the eyepiece.

f. Night Vision Sight (NVS). The NVS converts an infrared target image into a visible-light target image for the gunner. The NVS consists of the NVS lens, Detector Dewar Cooler, CLU status display, flipper mirror, status display, and eyepiece.

g. NVS lens. Unlike the day sight lens, the NVS lens is made up of a set of lenses. The NVS lens allows the gunner to change from WFOV to NFOV and back again. It also automatically changes the infrared image focus for the Detector Dewar Cooler. Each of these functions is accomplished by moving one of two lenses--one for FOV and the other for focus.

h. Detector Dewar cooler (DDC). The DDC acts like an eye for the NVS. It is the component that gives the CLU its "night vision" in both WFOV and NFOV. The DDC converts infrared energy into electrical signals. These signals are sent to the CLU display via the signal processor to provide the gunner with a picture of the target area.

i. Signal processor from the DDC. The signal processor is a collection of circuits that takes signals and converts it into video that is used by the CLU display to present a target image from the DDC.

j. CLU display. The CLU display is like a miniature television. It is used to make WFOV, NFOV, and seeker infrared images visible to the gunner. The CLU display converts electrical signals from the signal processor into visible images for the gunner. Mirrors inside the CLU reflect the CLU display images so that, to the gunner, they appear to come from the same place as the day sight images.

k. Status indicators. The status indicators are fourteen symbols, or "icons," that surround the CLU display so that the gunner can see them in all FOV's.

l. Eyepiece. The eyepiece allows the gunner to adjust the CLU focus to see the day FOV, WFOV, NFOV, seeker FOV, and the status indicators. It includes a lens assembly, an eyepiece, and a diopter adjust ring.

m. Flipper mirror. The flipper mirror allows the gunner to change between the day sight and the NVS and seeker target images. "Flipped" one way, it allows the gunner to see the day sight image. "Flipped" the other way, it allows the gunner to see the NVS and seeker images.

n. Test connector. The test connector is used to interface with Javelin training devices and to perform direct support or higher-level maintenance actions.

o. CLU interface connector. The CLU interface connector provides electrical interface between the CLU and the round. All signals passed between the CLU and the round--power, digital information, and seeker image signals--pass through this connector.

p. Humidity Indicator. The humidity indicator shows the humidity of the air inside the CLU (blue - OK, white or pink - replace).

4. JAVELIN CONTROLS. The Javelin controls allow the gunner to govern all Javelin operations. All the controls are located on the Command Launch Unit (CLU) with most of the positioned on the handgrips. The two exceptions to this are the diopter adjust ring and the power switch. The diopter adjust ring is located on the eyepiece. The power switch is located on the CLU main housing. The remaining controls are located on the left and right handgrips.

a. Diopter Adjust Ring.

(1) The diopter adjust ring is located on the CLU eyepiece. It is a hand-rotated ring that the gunner uses to adjust the focus of the CLU target image. The adjustment compensates for individual differences in vision. The ring is calibrated in steps known as "diopters" with an adjustment range from +2 to -6 diopters. This means that any gunner with vision correctable to 20/20 can use the CLU and see an in-focus image without using glasses. Once the gunner adjusts the focus, there is no need to readjust it until a different gunner uses the CLU.

b. Power Switch. The power switch is a rotary switch that is located on the left-hand side of the CLU main housing at the lower, rear corner. The power switch controls the Javelin's mode of operation by its position. Each position brings different components of the Javelin into operation. The power switch has four positions: OFF, DAY, NIGHT, and TEST.

(1) OFF position. When the power switch is in the OFF position, the Javelin is in the OFF mode. In this mode, no battery power is applied to the Javelin. The CLU's day field of view (FOV) can be used for surveillance and target detection. The Night Vision Sight (NVS) cannot be used, the seeker cannot be activated, nor can the missile be launched.

(2) DAY position. When the power switch is in the DAY position, the Javelin is in the day mode. In the day mode, power is applied to the CLU. The gunner has use of the day FOV but has no NVS. He also has full missile capability. (He can activate the seeker, lock the missile onto a target, and launch the missile).

(3) NIGHT position. When the power switch is in the NIGHT position, the Javelin is in the night mode. This mode gives the gunner full Javelin capability. Once the NVS is cool enough (approximately 2.5 to 3.5 minutes, dependent on the temperature), he can select either the NVS wide field of view (WFOV), the narrow field of view (NFOV), or the day FOV. Again, he has full missile capability.

(4) TEST position. When the power switch is in the TEST position, the Javelin enters a built-in-test (BIT) routine. The power switch does not stay in the TEST position when it is turned to the TEST position and released. The power switch is spring-loaded and returns to the NIGHT position.

(5) Prior to turning power switch to off, leave power switch in DAY position for at least one second to allow flipper mirror to move into day position.

5. HANDGRIP CONTROLS

a. Left Handgrip Controls. The left handgrip is equipped with the following controls: the focus (FOCUS) switch, sight select (SGT SEL) switch, filter (FLTR) switch, and seeker trigger. The controls on the left handgrip govern the CLU display target image. These controls allow the gunner to conduct surveillance, detect, classify, and recognize targets, activate the seeker, reacquire the target in seeker FOV, lock the seeker onto the target, perform battle damage assessment, and prevent the CLU from being detected by enemy countermeasures.

(1) Focus (FOCUS) switch. The FOCUS switch is the center switch on the left handgrip. It is a spring-loaded, self-centering thumb switch that moves up and down. It is used to adjust focus of the NVS (WFOV or NFOV). Up focuses objects at a longer range. Down focuses objects at a closer range. It is not operational when in day or seeker FOV.

(2) Sight select (SGT SEL) switch. The SGT SEL switch is the right switch on the left handgrip. It is a pushbutton switch that is used to cycle through the day FOV, WFOV, or NFOV. The appropriate indicator (DAY, WFOV, NFOV) on the CLU display lights when the SGT SEL switch is pressed. This switch is only active after the NVS cools down. If the gunner is in seeker FOV and needs to return to the day sight or NVS, he can do so by pressing the SGT SEL switch.

(3) Filter select (FLTR) switch. The FLTR SEL switch is the left switch on the left handgrip. It is a pushbutton switch used to select the NVS filter. The NVS filter is used to prevent the CLU from being detected by enemy countermeasures.

(4) Seeker trigger. The seeker trigger is located on the finger grip side of the left handgrip at the index finger position. A trigger guard, to prevent accidental activation of the seeker covers the seeker trigger. This trigger is used to activate the seeker, to lock the seeker on a target, and to enable the fire trigger.

b. Right Handgrip Controls. The right handgrip is equipped with the following controls: the attack select (ATTK SEL) switch, gate adjust/contrast & brightness (GATE ADJ/CTRS & BRT) switch, and fire trigger. These controls are used to change the attack mode, adjust the track gates to lock the seeker on a target, adjust NVS contrast and brightness, and also to launch the missile.

(1) Attack select (ATTK SEL) switch. The ATTK SEL switch is the right switch on the right handgrip. It is a pushbutton switch. It allows the gunner to select which missile flight profile (top attack or direct attack) to use for target engagement. The switch is active only after seeker activation and cool down. Top attack is the default mode.

Direct attack mode can be selected by pressing the ATTK SEL switch. The appropriate indicator lighting on the CLU display indicates the mode selected. The switch is deactivated after seeker lock-on is commanded.

(2) Gate adjust/contrast and brightness (GATE ADJ/CTRS & BRT) switch. The GATE ADJ/CTRS & BRT switch is the center switch on the right handgrip. It is a self-centering switch that moves up, down, left, and right. It serves two functions depending on whether the CLU display image is from the NVS or the seeker.

(3) NVS. When the CLU display shows an image from the NVS (WFOV or NFOV), the GATE ADJ/CTRS & BRT switch is used to adjust the contrast and brightness of the CLU display image. When the NVS first comes up, both the brightness and contrast are electronically preset. Therefore, a minimum amount of adjustment by the gunner is required.

(4) Brightness. Brightness is adjusted by moving the GATE ADJ/CTRS & BRT switch vertically (up-and-down). Brightness is decreased by pressing the ADJ/CTRS & BRT switch down and increased by pressing the switch up.

(5) Contrast. Contrast is adjusted by moving the GATE ADJ/CTRS & BRT switch horizontally (left-and-right). Contrast is decreased by pressing the ADJ/CTRS & BRT switch left and increased by pressing the switch right.

(6) Seeker. When the CLU display shows the seeker FOV, the GATE ADJ/CTRS & BRT switch is used to adjust the size of the track gates (the track gates are the four corners of the open-sided box shown in the seeker FOV).

(7) Fire trigger. The fire trigger is located on the finger grip side of the right handgrip at the index finger position. When the missile is locked-on to the target, squeezing the fire trigger launches the missile.

6. ROUND. The round is made up of a Launch Tube Assembly (LTA), Battery Coolant Unit (BCU), and missile. The LTA houses the missile and provides the interface with the CLU. The missile carries all the components necessary to kill a target. The round can be kept in storage for a long period of time with no need for maintenance. Because of this, it is referred to as a "wooden round." The only inspection requirement is for stockpile surveillance.

a. Round Physical Characteristics

(1) Round (LTA with missile - BCU installed)

(a) Weight: 34.09 lbs. (15.46 kg)

(b) Length: 47.60 inches (120.90 cm)

(c) Diameter: with End caps 11.75 inches (29.85 cm)

(d) Inside diameter: 5.515 inches (14 cm)

b. Missile

(1) Weight: 22.328 lbs. (10.126 kg)

(2) Dimensions:

(a) Length: 42.626 inches (108.27 cm)

(b) Diameter: 5.000 inches (12.70 cm)

c. Seeker

(1) Magnification – 9.2x

(2) FOV – 1° x 1°

d. Battery Coolant Unit (BCU)

(1) Weight: 2.91 lbs. (1.32 kg)

(2) Dimensions:

(a) Length: 8.160 in (20.726 cm)

(b) Width: 4.627 in (11.752 cm)

(3) Battery section

(a) Type: Lithium Iron Disulfide

(b) Life: 4 minutes minimum, or longer depending on temperature. The battery operating time decreases significantly at temperatures above 120-degrees Fahrenheit.

(4) Gas section (Argon)

(a) Volume: 12 cubic centimeters (0.732 cubic inches)

(b) Pressure: 7500 pounds per square inch (p.s.i)

7. ROUND COMPONENTS AND THEIR FUNCTIONS

a. Round interface connector. The round interface connector provides the electrical interface between the round and CLU. This is the counterpart to the CLU interface connector on the CLU. All signals passed between the CLU and round--digital information, power, and seeker image signals--go through this connector.

b. Launch Tube Assembly (LTA). The LTA serves as both a handling container and a launch platform for the missile. The LTA consists of a

launch tube, forward and aft end caps, carry handle, shoulder strap, round interface connector, and shoulder pad. Once the missile is launched, the LTA is discarded.

c. Launch tube. The launch tube houses the missile. It is a single-piece, composite graphite/epoxy design. The launch tube protects the missile from the environment before the missile is launched. All of the other LTA components mount externally onto this tube.

d. End caps. The end caps are designed to protect the missile from damage during transport and handling. There are two end caps on the LTA: the forward and aft end caps. Each has a foam shock absorber to protect the round from impact if it is dropped or otherwise abused. The end caps also provide stability and support when the round is strapped in vehicle transit racks or placed on the ground.

e. Forward end cap. The forward end cap protects the missile from moisture, dust, etc. It is not removed unless the missile is to be launched. The forward end cap is removed from the round after the CLU is connected to the round. If the missile is not launched, the forward end cap is reinstalled to prevent missile damage.

f. Aft end cap. The aft end cap is permanently attached to the LTA. During launch the center of the cap is designed to be blown out by the blast of the missile launch motor.

g. Carry handle. The carry handle is used to lift and carry the round.

h. Shoulder strap. The shoulder strap provides a means of carrying the round.

i. Shoulder pad. The shoulder pad provides a point of balance and support when the round is placed on the gunner's shoulder.

j. Battery Coolant Unit (BCU). The BCU consists of two sections: a battery section and a compressed-gas coolant section. The battery section powers the missile electronics before missile launch. The coolant section cools the missile seeker to its operating temperature before missile launch.

8. JAVELIN MISSILE. The Javelin missile provides the means for delivering a high explosive shaped charge to the target. Its functions are to acquire a target selected by the gunner, track the target during flight, and direct itself to intercept the target, and detonate the warhead on contact with the target. The missile consists of the guidance section, two-stage warhead, mid-body section, electronic safe, arm and fire (ESAF) unit, propulsion section, and control actuator section.

a. Warhead Section. The Javelin missile uses a dual-charge warhead. The two charges are the precursor charge and main charge.

(1) Precursor Charge. The precursor charge is a high explosive, antitank, shaped charge. Its purpose is to cause the reactive armor of the target to detonate before the main charge reaches the armor. Once the reactive armor is penetrated, the target's main armor is exposed to the warhead's main charge. If the target is not equipped with reactive armor, the precursor provides additional explosive to penetrate the main armor.

(2) Main Charge. The main charge is the second charge of the dual-charge warhead. It also is a high explosive, antitank, shaped charge and is the primary warhead charge. The main charge is designed to penetrate the target’s main armor to achieve a target kill.

b. Propulsion Section. The propulsion section provides the thrust for the missile to clear the LTA and reach the target. It, also, forms a subsection of the missile airframe. The propulsion section is made up of the launch motor and the flight motor.

(1) Launch Motor. The launch motor propels the missile out of the LTA. It provides the initial force to push the missile a safe distance from the gunner before the flight motor ignites. To ensure the gunner's safety, the launch motor is completely spent by the time the missile clears the LTA.

(2) Flight Motor. The flight motor provides the thrust needed to propel the missile to the target during flight. It ignites when the missile is a safe distance from the gunner. This protects him from hot exhaust gasses when the motor fires.

c. Control Actuator Section. The control actuator section maneuvers the missile during flight. It also provides internal electrical power to the missile during flight. The control actuator section consists of four control fins, four thrust vector control vanes, and a thermal battery.

(1) Control Fins. The control fins maneuver the missile during flight. When the missile is in the LTA, they are folded into recesses in the missile. The fins are spring-loaded and automatically deploy and lock into flight position after the missile clears the LTA. During flight, they adjust automatically to guide the missile to the target.

(2) Thrust Vector Control (TVC) Vanes. The TVC vanes, simply known as the vanes, aid the control fins in maneuvering the missile during flight. They do this by deflecting the flight motor exhaust. This changes the angle of thrust from the flight motor resulting in a change to the missile's flight path. This is especially important early in missile flight when the low missile speed decreases the control forces achieved by the control fins.

(3) Thermal Battery. The thermal battery provides all internal electrical power for the missile during flight. It is the same type battery (thermal, lithium) as the one used in the BCU.

9. TRAINING DEVICES. There are three training devices associated with the Javelin. They are the Basic Skills Trainer, the Field Tactical Trainer, and the Missile Simulation Round.

a. Basic Skills Trainer (BST). The BST consists of a student station and an instructor station. The BST runs engagement exercises that are displayed as computer-generated images in the simulated CLU. It is an indoor/ship board, training device that can test the gunner's skills in a wide variety of situations. The student station consists of a simulated CLU and Simulated Missile Round (SMR). The instructor station consists of an instructor station console, power supply, and miscellaneous components required to input data or control BST operations. The instructor station allows the instructor to view all of the gunner's actions and to create new training exercises.

b. Field Tactical Trainer (FTT). The FTT consists of a Simulated Round (SR) and an instructor station. The FTT is designed to be used as an outdoor trainer and is equipped with the Multiple Integrated Laser Engagement System (MILES).

c. Missile Simulation Round (MSR). The MSR consists of a sealed launch tube that contains no instruments or circuitry. It simulates the weight and balance of the round and has CLU and BCU connectors. The MSR is used to train gunners how to maintain, handle, and carry the round.

Reference and Pages: TM 09397B-12/1, Operator and Organizational Maintenance Manual for Javelin, M98A1, pages 1-10 through 1-15