# APPENDIX K. LASER EMPLOYMENT

Laser weapons systems consists of ground and airborne designators used with surface or air delivered guided munitions. Systems include laser designators/ rangefinders, laser acquisition/spot trackers or seekers, laser guided weapons, and delivery platforms. Laser systems are used by artillery FOs, NSF spotters, FACs, reconnaissance personnel, and fixed-and rotary-wing pilots. Several references for laser employment and procedures exist. Joint Pub 3-09.1, *JTTP for Laser Target Designation Operations*, provides detailed information on all Service laser systems and munitions. MCWP 3-16.6, *Supporting Arms Observer, Spotter, and Controller*, provides detailed information on ground laser systems.

## BASIC REQUIREMENTS

The five basic requirements to use laser designators with laser seekers or laser guided munitions follow.

A pulse repetition frequency (PRF) code is used for the laser designator, the laser spot tracker (LST), and the laser guided weapon (LGW). Each must use the same code when operating together.

An agreed upon direction of attack is necessary. The LST or LGW must be able to acquire the energy reflected from the target.

The laser designator must be lasing/designating the target at the correct time and for the proper duration.

The delivery system must release the munition within the specific munition delivery envelope.

Line of sight must exist between the designator and the target, as well as between the target and the tracker or LGW. The LGW can have LOS before or after launch, depending upon the system capabilities.

## LASER TARGET DESIGNATION, RANGING, AND POINTING SYSTEMS

Laser designators provide the energy source that is reflected from a designated target to provide terminal guidance for LGWs. These systems emit discrete pulses of infrared energy, invisible to the naked eye. Characteristics of these pulses are determined by a PRF code of the laser energy that can be set by a series of switches on the equipment. Laser target ranging systems provide accurate range, and in the case of the MULE direction and elevation information, for use in locating enemy targets or other positions but are not capable of designating for laser guided munitions. IR pointers simply provide visual identification of targets. Systems vary from handheld to aircraft-mounted devices. The laser designator/rangefinder inventory within the Marine Corps follows.

### Modular Universal Lasing Equipment

The modular universal laser equipment (MULE) (AN/ PAQ-3) is a laser designator/rangefinder capable of designating moving targets to a range of 2,500 meters or stationary targets to 3,000 meters. Maximum rangefinding capability is 10,000 meters. The MULE system has a north-seeking capability that allows self-orientation for direction and a readout of both grid and true azimuths. It is capable of detecting multitarget reflections. The MULE can be operated during periods of darkness or reduced visibility at slightly reduced ranges by use of a night vision device. It can interoperate directly with the digital message system (DMS), and indirectly, through the DMS, with the battery computer system (BCS). When used in conjunction with the precision lightweight GPS receiver (PLGR), it provides accurate observer and target location. The MULE is powered by vehicle for sustained operations or battery for a shorter duration.

### Target Location Designation and Hand-off System

The TLDHS is a modular, man-portable (43 pounds for LLDR and THS), automated target acquisition, location, and designation system that can digitally hand-off target data to fire support platforms. It has the capability of designating moving targets to 3,000 meters and stationary targets to 5,000 meters. Maximum rangefinding capability is 10,000 meters. TLDHS is comprised of two independent subsystems. The lightweight laser designator-rangefinder (LLDR) provides the target location and designation capability through the integration of day and thermal optics, eye-safe laser rangefinder, angle and vertical angle, GPS receiver, and a laser designator for LGWs and spot trackers. The second subsystem is the target hand-off

system (THS). THS provides the capability to compose, transmit, and receive digital fire support messages.

### Laser Infrared Observation Set (AN/GVS-5)

The AN/GVS-5 is a hand held, battery operated laser rangefinder. It has no ability to designate targets or determine direction. It has a 7 x 50 monocular sighting system and an accuracy of plus/minus 10 meters for distances from 200 to 9,990 meters. It can provide a maximum of 100 range readouts per battery charge.

### Laser Target Designator/Rangefinder Pod

The F/A-18 C/D is capable of carrying the AN/AAS-38 LTD/R pod which provides two functions. Its laser designator provides terminal weapons guidance for all LGWs, as well as designating targets for airborne coded laser acquisition/spot trackers (LSTs).

### Night Targeting System

The AH-1W attack helicopter contains the NTS, which provides laser target designator/rangefinder capability, as well as forward looking infrared (FLIR) visual capability and video capture. It performs the same functions as the LTD/R pod for fixed-wing platforms.

### Illumination Devices

Handheld lasers emit infrared (IR) light for compatibility with NVGs. These devices can either "flood" IR light within 1000 meters to enhance general NVG performance, or focus a small beam up to 4 kilometers to pinpoint a specific target or mark friendly positions with an IR light beam for any unit or weapon system employing NVGs. Examples include IZLID and GCB-1B.

## LASER ACQUISITION DEVICES

Laser acquisition devices are systems that allow visual acquisition of a coded laser designated target. They must be set to the same PRF code as the laser designator for the user to see the target being lased. There are two types of laser acquisition devices. Note that the AH-1W has the capability to use onboard Hellfire munitions as an improvised LST prior to firing.

### Laser Acquisition/Spot Tracker Pod

The coded laser acquisition/spot tracker (LST) can be carried on the F/A-18 A/C/D. Once it acquires the laser spot (target), it passes necessary ballistic information to allow FLIR or radar acquisition of target and visual display. Desired PRF codes are in-flight selectable. It then employs LGWs or executes visual deliveries of non-laser ordnance.

### Angle Rate Bombing System

The ARBS is used on the AV-8B. It consists of a 3-axis gimballed telivision/LST, enabling view of the laser spot. It provides day or night attack and reattack information for either LGW or non-guided bombs. The system allows in-flight selection of PRF codes but is affected by smoke or obscurants.

**WARNING**

Care must be taken to remain oriented on the target, ensuring that the LST has acquired and locked onto target reflected laser energy. There are instances when LSTs have acquired and locked onto the laser signature caused by atmospheric attenuation around the laser designator device.

## LASER GUIDED WEAPONS

These munitions hone in on reflected laser energy during the terminal portion of the attack. Such munitions are part of the precision guided munition (PGM) family.

### Copperhead

The Copperhead (M732 CLGP) is a 155 mm cannon-launched, laser-guided projectile used to defeat high payoff targets. It has a maximum range of 16,800 meters and a minimum range of 3,000 meters.

Copperhead targets can be designated by ground or airborne designators. Multiple targets in large target arrays or widely separated targets may be engaged. The projectile follows one of two trajectories depending on visibility conditions. Upon reaching a point on its descending trajectory, the laser designator

operator lases the target. The projectile acquires the reflected laser energy and maneuvers to the designated target. Its payload consists of a 15 pound shaped charge.

### Maverick

The Maverick AGM-65E is an air launched, laser guided air to ground missile employed on the AV-8B, and F/A-18 aircraft. It can be used against armored vehicles, field fortifications, or surface combatants. The missile requires lock on before launch. Once, the Maverick is launched, the aircraft can break away or launch another missile. It employs a 125 pound or 300 pound warhead. If Maverick loses the spot, the missile goes ballistic over the target and does not explode. The PRF code is cockpit selectable.

### Hellfire

The Hellfire (AGM-114) is a laser guided, anti-armor missile launched from the AH-1W/Z Super Cobra aircraft. It can be employed in indirect (lock on after launch) or direct (lock on before launch) fire methods. Hellfire can be launched in four firing modes: one missile (single), two or more missiles on the same code (rapid), two or more missiles launched on different codes using multiple laser designators (ripple), or multiple codes and designators used in combination of rapid and ripple fire. The PRF code is cockpit selectable.

### Laser-Guided Bombs

The MK-82, -83, and -84 are Marine Corps designations for the 500, 1,000, and 2,000 lb bombs that can be converted to the GBU-12, GBU-16, and GBU-10 laser guided bombs, respectively. These bombs use common laser guidance and control subassemblies, with only the aerodynamic surfaces changed to match the particular size of warhead.

Paveway I and II LGBs require ballistically accurate delivery (release within an envelope) and continuous laser energy during the last 10 seconds of flight. When delivered from a low-altitude loft maneuver, lasing is restricted to the last 10 seconds of flight to prevent bombs missing short. They can be employed in a standoff capacity. The PRF codes are set before aircraft launch.

## LASER GUIDED WEAPONS PLANNING

Due to the enhanced complexity of laser weapon systems and their specific requirements for employment, prior planning and coordination is required for optimal performance in battle.

### Integration

Optimum use of PGMs is on preplanned targets or engagement areas outside or at the maximum range of maneuver direct fire weapons (typically 3,000 meters). This allows for early engagement of high payoff targets and reduces the effects of an obscured battlefield. However, integration into the overall battle plan is necessary. Integration with direct fire weapons creates a combined arms effect as well as ensures mutual support.

### Environmental Conditions

LGWs require line of sight with both the designator and the target, and the LGW and the target. Irregular terrain and vegetation must be considered in the location of EAs, LTDs, and LGWs. Rain, snow, fog, and low clouds can reduce the effectiveness of laser guided munitions ability to acquire radiation. Laser designators line of sight can be reduced. Snow on the ground produces a negative effect on laser guided munition accuracy or cause spillover. Extreme temperatures (below 32 degrees) can affect MULE battery life. Obscuration of the battlefield can also reduce the effectiveness of LGWs. When possible, employ techniques such as attacking downwind targets first.

### Munition Employment Characteristics

The specific engagement requirements for each LGW varies and must be considered in planning. Considerations include minimum and maximum ranges, minimum visibility and required designation times, and maximum angle of acquisition. For example, Copperhead has engagement templates, a 13 second designation requirement, and a maximum acquisition angle of 800 mils (45 degrees) between the observer and GTL. The minimum visibility to effectively use Copperhead is 5,000 meters. The Maverick has a maximum range of 24 kilometers, requires continual lasing, and has a 60 degree maximum acquisition angle. The Hellfire has a 8

kilometer max range, a 60 degree maximum acquisition angle, and also requires continual lasing.

## Designator Location and Characteristics

Whether airborne or ground designator, the location of the laser designator must ensure line of sight to the target while allowing the LGW to acquire the target within the parameters of its attack angle, 1067 mils (60 degrees) in most cases. Preventing line of sight between the LGW and the laser designator reduces false lock-on. Airborne designators should remain behind delivery platforms while ground designators use terrain or vegetation to break line of sight when possible. The short lifespan of battery powered designators should be considered in extended operations.

## PRF Codes

Laser coding permits the simultaneous use of multiple laser designators and laser guided weapons/seekers. Laser designators and seekers use a PRF coding system to ensure that a specific seeker and designator combination work in harmony. By setting the same code in both the designator and the seeker, the seeker tracks only the target that is designated with that code.

### *Code Description*

The system uses either a three digit or four digit numeral system, depending on the type of laser equipment. Three digit settings range from 111 to 788, while four digit settings range from 1,111 to 1,788. All three and four digit designator/seekers are compatible. Lower numbered PRF codes provide higher quality designation due to faster pulse repetition.

### *Code Allocation and Assignment*

Laser guided weapons system codes must be controlled and coordinated. At the MAGTF level, different blocks of codes are assigned to artillery, air, and NGF to prevent interference between supporting arms activities. Each supporting arm then assigns codes to its subordinate units for individual missions and changes codes periodically as the situation requires. Subordinate FSCCs provide positive coordination of the code settings through the various fire support representatives. Normally codes are given to individual observers, however observers are able to use the same codes as long as it is coordinated; e.g. observers use the same code when one is a back-up.

Each MULE/TLDHS operator normally uses his own PRF code unless employing LGBs or for preplanned missions with distinct PRFs. His PRF code is confirmed before mission execution of aerial delivered LGWs. LGBs PRF codes cannot be changed in flight.

For preplanned CAS, codes are ultimately assigned to each flight. The LTD must match the preset LGB codes, while Maverick, Hellfire, and Copperhead can be set to match the designators PRF code.

### *Security*

The PRF codes are handled in the same manner as other classified material. Secure means should be used, if available, when codes are passed between laser designators and the munition delivery unit/ aircraft. However, the absence of compatible secure means should not normally dictate the termination of a laser guided munition attack. In certain situations, codes may have to be prebriefed.

## Safety

There are two hazards associated with laser systems applicable in both combat and peacetime training. The first is the ability of the LST or LGW to acquire and guide in on spillover laser energy rather than the target; i.e., the laser designator. This is known as false lock-on. The second is the laser beam's intense infrared radiation that can cause serious eye damage and blindness.

### *False Lock-on*

A seeker may detect scattered radiation that is caused by suspended matter in the atmosphere. It is called atmospheric scatter/attenuation or backscatter. To mitigate the effects of atmospheric scatter, 20 degree angle with its origin at the target and bisecting the laser designator establishes a safety exclusion zone for air delivered munitions (excluding Copperhead) and LSTs. Aerial platforms must avoid this zone during designation to reduce the likelihood of an LST or LGW acquiring the designator vice the target. The exclusion zone is not an absolute safety measure as some LSTs have acquired the atmospheric scatter in front of the ground laser designator even though the LSTs were outside the safety zone. In combat, attack headings should avoid this zone if possible. Peacetime employment follows training safety requirements.

### *Eye Hazard*

During combat, take care to avoid friendly casualties from indiscriminate laser designation. Be cautious in

designating highly reflective targets that can cause dangerous reflected beams. The policy of the United States Armed Forces prohibits employing laser weapons that are specifically designed to, or have a combat function of, causing permanent blindness. Peacetime use of lasers imposes strict safety requirements during training exercises. Range and unit safety SOPs must be adhered to in their employment.

## EMPLOYMENT

Key factors must be considered when employing laser systems. Adverse effects of these factors can often be overcome by planning and skillful employment of the designators.

### Ground Mode

Ground laser designators identify targets for artillery, NSFS, and aircraft delivered munitions. MULE equipped teams can designate for laser guided munitions as well as conventional ordnance delivered by LST. Standard calls for fire are used except that the laser code must be exchanged between the ground designator and the firing unit or the aircraft.

### Airborne Mode

Airborne laser target designators identify targets for all types of aircraft delivered munitions. Airborne designator systems operating in support of ground maneuver forces can employ all types of laser guided munitions. Standard calls for fire or request for air support are used, except that the code being used must be exchanged.

### Communications

Positive communications between the designator operator and the munition delivery means is required to coordinate the proper PRF code, the seeker/laser designator alignment, and target designation timing.

### Enemy Countermeasures (NATO)

Judicious use of laser target designators limit the enemy's countermeasure capability. Designator vulnerability must be considered when designating point targets such as tanks, BMPs, and guns that can detect radiation and suppress designators. Offset aim points reduce a target's ability to react.

### Aim Points

The nature of the target surface affects the aim point as it varies the amount and direction of reflected radiation. Concave or poorly defined targets such as caves and tunnels may absorb the laser spots. Horizontal flat surfaces can refract or cause enough spillover to cause misses.

### Battlefield Obscuration

Smoke, dust, and debris can impair the use of laser guided munitions. Reflective scattering of laser light by smoke particles may present false targets. The night sight, alternate positions on higher ground, and alternate designators can be useful in reducing smoke and dust effects.

### Darkness

Targets are more difficult to locate, range, and designate during low illumination. The night sight on the designator will overcome the effects of darkness and can assist during periods of poor visibility and inclement weather.