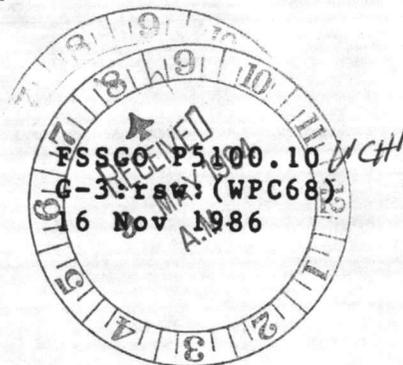


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UNITED STATES MARINE CORPS  
2D FORCE SERVICE SUPPORT GROUP (REIN)  
FLEET MARINE FORCE, ATLANTIC  
CAMP LEJEUNE, NORTH CAROLINA 28542-5701



# OFFICIAL FILE COPY

FORCE SERVICE SUPPORT GROUP ORDER P5100.10

From: Commanding General  
To: Distribution List

Subj: Light Amplification by Stimulated Emission of Radiation  
(Short Title: LASER SAFETY)

Ref: (a) American National Standard for the Safe Use of LASERS  
ANSI Z136.1 (NOTAL)  
(b) SECNAVINST 5100.14A  
(c) NAVELEXISNT 5100.12  
(d) NAVELEX TECH MANUAL EO410-BA-GYD-010/7034 LASERS  
(e) NAVMEDCOMINST 6470.2  
(f) MIL-STD-1425 Safety Design Requirements for Military  
LASERS and Associated Support Equipment (NOTAL)  
(g) MIL-STD-454J (NOTAL)  
(h) MCO P3750.1A Chapter 19  
(i) MCO 8220.5  
(j) ForO 5100.8

Encl: (1) Locator Sheet

Reports Required: I. Formal Safety School Requirements (Report  
Symbol FMFLant-5100-01)  
II. List of all Class IIb and Class IV  
Lasers (Report Symbol FMFLant 5100-02)

1. Purpose. To publish policy and assign responsibilities for the safe use of LASER systems within the 2d Force Service Support Group in accordance with the references.

2. Cancellation. LOI for the Implementation of the LASER, INFRARED OBSERVATION SET, AN/GVS-5 dated 13 Mar 1985.

3. Background. The introduction and fielding of LASER weaponry and target designators requires that the Marine Corps address new issues concerning safety. These are not unlike those addressed in the past, however specific requirements must be adhered to when operating or conducting maintenance of LASER emitting apparatus.

4. Action. Units holding or required to conduct maintenance on LASER devices will establish policies and procedures as outlined in this Order and applicable publications from higher headquarters.

5. Applicability. This Order is applicable to 2d Force Service Support Group activities operating or conducting maintenance on LASER equipment, regardless of classification and is intended

FSSGO P5100.10  
16 Nov 1986

to promote LASER Safety in all LASER operational maintenance and training evolutions.

*Wm. Fitts*  
W. M. FITTS  
Chief of Staff

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Locator Sheet

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(Short Title: LASER SAFETY)

Location: \_\_\_\_\_  
(Indicate the location(s) of the copies of this order)

ENCLOSURE (1)







# LASER SAFETY

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LASER SAFETY

CHAPTER 1

GENERAL INFORMATION

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# LASER SAFETY

## CHAPTER 1

### GENERAL INFORMATION

#### 1000. DEFINITIONS

1. LASER. Acronym for any device which produces or amplifies ultraviolet, visible radiation by the process of controlled stimulated emission.

2. Class I LASER. LASER or LASER system which emit levels of continuous wave (CW) optical energy which are eyesafe and consequently require no control.

3. Class II and IIIA LASER. LASER or LASER systems which emit visible optical radiation levels slightly above the MPE and would cause the normal observer to look away before damage occurs. Class IIIA LASER are hazardous if viewed with magnifying optics from within the beams.

4. Class IIIB LASER. (Medium power) LASER or LASER system are hazardous to personnel who are within the beam path and viewing the source (intra-beam viewing) directly or by specular reflection. They cannot produce hazardous diffuse reflections. Reflections off mirror-like surfaces or directing the beam at eye-level are the principal safety hazards with this class of LASER.

5. Class IV LASER. LASER or LASER systems that are high power LASER systems which can be hazardous to the eye from intra-beam viewing and specular reflections. They may be hazardous when viewing a diffuse reflection, exposing non-protected skin or material to the beam.

6. Military-Exempt LASER. All LASERS which due to their military application and/or security classification are not specifically identified as to class, function, or purpose and which may be exempt from the requirements contained in reference (a) and other regulatory publications.

#### 7. LASER SYSTEMS SAFETY OFFICER (LSSO)

a. Category I: An officer, warrant officer, or civil service employee who, upon successful completion of the NAVSEA LASER Safety School Course (Set 460), is technically qualified to conduct hazard analysis of LASERS and Laser Systems, formal LASER safety training of LASER Range Safety Officers, technical and administrative LASER safety mishap investigations, and establish and manage command LASER hazard preventive programs.

b. Category II. An officer or warrant officer, who upon successful completion of NAVSEA LASER Safety School Course (Set 460) is qualified to establish and manage command LASER hazard

prevention programs and conduct administrative LASER safety mishap investigations and LASER safety training of LASER operators, LASER operator supervisor personnel and incidental personnel.

8. Range LASER Safety Officer (RLSO). A range officer, mission commander or LASER operator supervisor certified to conduct LASER operations on authorized ranges upon satisfactory completion of formal RLSO training by the host command Category I LSSO.

9. LASER System Safety Instructor (LSSI). A category I LASER System Safety Officer qualified to conduct LSSO training and authorized by SPAWARSYSCOM (Code 00) to certify Category II LASER Systems Safety Officers.

10. LASER Personnel. Those personnel who routinely work in a LASER environment (e.g., operators, technicians, instructors).

11. Incidental Personnel. Those personnel whose work makes it possible but unlikely for them to be exposed to LASER energy sufficient to cause damage to eyes and skin (e.g., supervisors and safety personnel).

12. Nominal Ocular Hazard Distance (NOHD). That distance from a LASER within which a person without proper eye protection may receive severe eye damage from a LASER beam that is fired directly at him or reflected off a flat glass or mirror-like surface.

1001. PROGRAM ELEMENTS. LASER Safety Programs will include but are not limited to the following:

1. Local LASER Safety Organization.
2. Local LASER Safety Regulations.
3. Activity Audit of Lasers.
4. LASER Safety Training Program.
5. LASER Safety Goggles/Equipment Program.
6. Medical Surveillance Program.
7. Accident Investigation/Reporting Procedures.
8. Records.
9. Reporting.

1002. LASER INFORMATION. Maximum Permissible Exposure (MPE) levels have been established by the American National Standard Institute for the safe use of LASERs. Exposure to LASER beams above maximum permissible exposure limits will result in moderate to serious radiation burns. The type and extent of damage is a function of:

1. Energy Absorbed.
2. Wavelength of the radiation.
3. Duration of the exposure.
4. Specific body organs exposed.

The organ most sensitive to injury as a result of exposure to LASER radiation is the eye. The eyes ability to focus visible, near ultraviolet, and near infrared radiation is the most important physiological characteristic contributing to the LASER hazard.



LASER SAFETY

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# LASER SAFETY

## CHAPTER 2

### IMPLEMENTATION

2000. POLICY. In accordance with references (b) and (c), the following FSSG LASER safety policy is established for all subordinate commands engaged in the operation and maintenance of LASER devices.

1. A LASER safety organization will be established within each unit that possesses, operates, maintains, or trains with LASER devices. The LASER safety organization will be incorporated within existing safety elements. Technical expertise and LASER Systems Safety Officers (LSSO's) may be drawn from any available source, however, each will function through the organization existing safety establishment, under the auspices of the assigned FSSG LSSO.

2. The LSSO shall be appointed in writing by the commanding officer and will establish a Command LASER Safety Program and LASER Safety Committee in accordance with references (a), (c), and (d) and as outlined in this Order. The LASER safety requirements, when implemented, should reflect an approximate level of detail for each organization, commensurate with the 2d FSSG mission requirements, technical considerations, and LASER safety needs. LASER safety programs implemented at the user level (operational or maintenance) will contain specific and detailed safety instructions for personnel engaged in LASER operations, maintenance and training.

3. LASER installations are authorized only on the basis of mission requirements or as directed by higher authority.

4. All personnel engaging in LASER operations, maintenance, and training or directly involved as LASER users or operators will participate in a LASER safety training program, as outlines in reference (c).

5. Personnel exposed to LASER operations will be identified as either LASER personnel or Incidental personnel in accordance with reference (e).

### 2001. LASER SAFETY PROGRAM

1. Activities using LASERs must ensure certain events occur to establish and maintain an ongoing LASER safety program. These will include but are not limited to the following items.

a. LASER Safety Organization. All activities utilizing LASERs shall designate a LSSO by name, who shall have direct access to the commanding officer on all LASER safety matters. He shall have sufficient technical competence and the authority to approve or disapprove the local use of LASERs. He is responsible for the establishment of the units LASER program.

b. LASER Safety Regulations. All units utilizing LASERs must publish regulations which establish the units LASER safety policy and standing operating procedures for indoor and outdoor LASER operations. The LSSO is responsible for the publication of local procedures utilizing the guidance found in the references.

c. Activity Audit of LASERs

(1) LASER Audit. An annual audit must be conducted by the LSSO utilizing appendix F of this Order. The purpose of this audit is to conduct a LASER equipment inventory, identify personnel who require medical surveillance, and provide for a safety survey inspection of the LASER installation.

(2) A LASER equipment inventory and classification is required for hazard control. The inventory records must identify the type of LASER, operating characteristics, hazards classification, application, frequency of operation and physical location.

(3) During the audit, all personnel who operate or are exposed to LASER radiation should be identified as LASER personnel or Incidental personnel. Personnel records must be kept regarding equipment used, job assignments, LASER educations, training, time on the job, and LASER related medical history. All records shall be maintained for a period of five (5) years.

(4) Each individual LASER activity must be inspected at least once annually to ensure it meets safety standards. Inspections will include but need not be limited to a review of the standing operating procedures, operator training, equipment condition, and the condition and use of protective eye wear and other protective equipment. Additionally, the installation inspection must ensure the required warning systems and signs are posted in all appropriate locations for the protection of all personnel from LASER radiation.

2. A LASER safety training program will be established and required for all personnel using Class IIIb, Class IV or equivalent Military Exempt LASERs. It will consist of formal classroom training utilizing local lesson plans which have been approved by SPAWARSYSCOM (Code 00). Required areas of training are found in Appendixes (A) through (D) although training need not be limited to these subjects. Formal school quota requirements should be submitted to AC/S, G-3 (Training) by 15 July of each year for submission to higher headquarters by 1 August annually. AC/S, G-3 (Training) will coordinate all required training relative to LASER safety with higher headquarters which cannot be conducted locally by qualified LSSO's.

3. LASER protective goggles are required to ensure all personnel exposed to LASER radiation are adequately protected.

Goggles must have the proper optical density to protect at the wavelength the particular LASER device is emitting. These goggles must be properly labeled and periodically examined for serviceability.

4. A Medical Surveillance Program will be administered in accordance with reference (e). The LSSO shall designate which personnel involved with LASER operations in his unit who will participate in this program.

2002. ACCIDENT INVESTIGATION/REPORTING. If an over exposure occurs, the commanding officer will direct the LSSO to conduct the accident investigation. The commanding officer will prepare a report (Report Symbol MED 6470-13), which will be submitted via the chain of command to the Commander Naval Medical Command, (Code 212) Washington D. C., 20372 within thirty (30) days of the incident. A copy of the report will also be forwarded to Space Naval Warfare Systems Command, (Code 00), Washington D. C. 20360. The report will contain as a minimum a list of the exposed personnel, an estimate of the exposure received, a description of the physiological symptoms and retinal photographs if appropriate. An enclosure should also be included describing the situation which occurred and the corrective measures taken/recommendations necessary to prevent future accidents of this type.

2003. RECORDS. Records maintained will include but need not be limited to the following:

1. A log to record all operational, maintenance or training LASER firings to include date, time, location, mission, target, mission commander, operator, purpose, and personnel present. If the LASER is fired at an airborne target, include type of aircraft, Bureau Number (BUNO), location/heading, altitude, dive angle, airspeed and designated target. Include additional information as deemed appropriate.

2. An inventory record of all command held LASER devices along with a Description and Analysis Report will be maintained as required by references (b) and (c).

3. A current listing of all units and personnel who are authorized to engage in LASER operations and their specific function/limitations. This list should be readily accessible to the LSSO and updated as changes occur.

4. Training records of all personnel who engage in LASER operations, maintenance, or training, to include times and dates of training received, as well as copies of designations and assignments for LASER operations.

2004. LSSO RESPONSIBILITIES AND DUTIES

1. The LSSO must maintain and submit the following:

a. All necessary records required by reference (c) to Space Naval Warfare Systems Command, (Code 00), Washington D. C. 20360.

b. Submit an annual list of all Class IIIb and Class IV LASERS by 31 August of each year. This report will be submitted to AC/S, G-4/Safety by 1 August for compilation and submission to FMFLant by 15 August annually. (Report symbol FMFLant-5100-02).

c. Submit annual formal school requirements to AC/S, G-3/Training by 15 July for submission to FMFLant by 1 August annually.

d. Submit additional reports as requested and/or directed by higher headquarters.

2. LSSO Duties. The LSSO duties include but need not be limited to the following:

a. The LSSO shall have direct access to the commanding officer and possess sufficient technical competence and authority to approve or disapprove the location of the LASERS.

b. Maintain and submit to SPAWARSYSCOM (Code 00) all necessary records required by reference (c).

c. The LSSO shall be responsible for LASER Safety enforcement during all phases of LASER maintenance. To accomplish this, he shall:

(1) Designate responsible and technically competent personnel as LASER Safety Supervisors.

(2) Publish maintenance safety instructions to cover all aspects of maintenance procedures, for each type of LASER device ensuring compliance with all applicable maintenance and safety directives.

(3) Ensure each LASER is identified and the appropriate technical analysis is completed for each LASER in accordance with Appendix E of this Order. Due to the level of technical expertise required to properly complete this form, it will be completed only by individuals having successfully completed the NAVSEA LASER Safety School Course (Set 460) Category I or equivalent.

d. The LSSO is also responsible for implementation of the following:

(1) Establish a budget to ensure the funding of the safety training of follow-on LASER safety personnel and required safety equipment.

(2) Publish a local LASER Safety Program Command Policy, Safety Regulations and Standing Operating Procedures (to include operations, range procedures, maintenance training, safety instructions and precautions) signed by the commanding officer and approved by this Headquarters and FMFlant.

(3) Identify personnel risk categories and establish a Medical Surveillance Program as outlined in reference (e).

(4) Implement a supervisor/personnel training program.

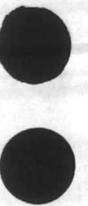
(5) Ensure that all required protective equipment necessary for LASER operations is provided, and that requirements for the periodic inspection of protective equipment are established.

(6) Establish accident investigation/reporting.

(7) Conduct periodic facilities inspections/ audit.  
Appendix G refers.

(8) Conduct periodic personnel briefings, training and evaluation procedures to ensure an adequate level of LASER safety.

(9) Establish and maintain all appropriate records and files.



LASER SAFETY

CHAPTER 3

LASER INFRARED OBSERVATION SET AN/GVS-5

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# LASER SAFETY

## CHAPTER 3

### LASER INFRARED OBSERVATION SET AN/GVS-5

3000. POLICY. The AN/GVS-5 is a binocular-like LASER device used for observation and target location, by providing an accurate determination of the range to a target. The AN/GVS-5 employs a 1.06 micron Neodymium YAG LASER and weigh five pounds. The AN/GVS-5 will be used to determine accurate target location by supporting arms observers, fire controllers, reconnaissance, and intelligence personnel. The AN/GVS-5 may also be used for battle area mapping by tactical commanders and provide a limited survey-type capability where range determination is required.

#### 3001. HAZARDOUS CHARACTERISTICS

1. This equipment contains a pulsed (Q-switched) Neodymium YAG laser transmitter. Severe eye damage may occur if the LASER range finder (LR) is fired in an unauthorized area or personnel are within the nominal ocular hazard distance without proper eye protection. The NOHDS contained in TM-11-5860-201-10 of FEB 82 are superseded. The new distances are contained in paragraphs 3001.2 and 3001.3 below.

2. The NOHD for unprotected personnel viewing the AN/GVS-5 are as follows:

a. For viewing the AN/GVS-5 beam without filtering: 2700 meters.

b. With the red attenuation filter attached: 290 meters.

c. With the yellow attenuation filter attached: 56 meters.

3. The NOHD for viewing the AN/GVS-5 with standard 7 X 50 binoculars are as follows (Use of binoculars within the LASER's range is prohibited):

a. For viewing the AN/GVS-5 without filtering: 13 Kilometers.

b. With the red attenuation filter attached: 1800 meters.

c. With the yellow attenuation filter attached: 140 meters.

4. The LASER operator must be careful not to range on unprotected personnel.

5. Proper eye protection must be worn by any person who is required to be down range and within the hazard distance of the LR when it is being operated.

6. If the operator suspects any of the following conditions have occurred, it should be reported to the commanding officer:

a. An unprotected person may have been in the beam path and was within the hazard distance when the LASER was fired.

b. An unprotected person was looking at a flat glass or mirror-like surface when it was illuminated by the firing of the LASER.

7. The commanding officer will make arrangements for the necessary Ophthalmological examination, and report it in accordance with reference (e).

8. The lense cleaning compound is poisonous if taken internally.

9. The power cable must not be connected to an external power source while installing the LR end of the power cable in the battery compartment.

#### 3002. CAPABILITIES AND FEATURES

1. The LR fires an invisible LASER beam at a target and detects LASER energy reflected from the target.

2. The LR is accurate from 200 to 9,900 meters plus or minus 10 meters.

3. The LR warns the operator when the internal battery is getting weak.

4. The LR informs the operator if it has been fired at more than one target.

5. The LR reticle is graduated in artillery mils.

3003. SPECIAL EQUIPMENT. Safety goggles are required for personnel involved in AN/GVS-5 LASER operations that are rated at OD 4.4 at 1.064m. Safety goggles are available through the supply system under NSN 8465-01-226-7986 for maintenance personnel. For operational personnel that are required to wear LASER safetygoggles, a green tinted type is available under NSN 4240-00-258-2054. These may be used until replacement glasses are fielded, Attenuation filters are also required to be mounted on the AN/GVS-5 for all firing under other than actual combat situations. They are available in two colors under NSN 5860-01-110-9852 (red filter) and NSN 5860-01-110-9982 (yellow filter).

LASER SAFETY

CHAPTER 4

MODULE UNIVERSAL LASER EQUIPMENT AN/PAQ-3

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# LASER SAFETY

## CHAPTER 4

### MODULE UNIVERSAL LASER EQUIPMENT AN/PAQ-3

4000. BACKGROUND. The MULE, AN/PAQ-3 is a man portable, battery operated, multi-functional LASER device designed to provide accurate target location data to support conventional ordnance beyond the conventional man portable offensive range, and the single pulse laser makes its operation virtually undetectable. The MULE system consists of three modules; LASER Designator Rangefinder Module (LDRM), Stabilized Tracking Tripod Module (STTM) and North Finding Module (NFM). It contains built in fail safe devices and Built In Test Equipment (BITE). The MULE will be employed to determine accurate target location and/or target designation by supporting arms observers.

#### 4001. HAZARDOUS CHARACTERISTICS

1. This equipment emits a coded single pulsed 1.06 neodymium LASER beam when activated. Severe eye damage may result from intra-beam viewing within the nominal ocular hazard distance (NOHD).

2. The NOHD for personnel involved around MULE operational areas are:

| <u>Type Operation</u>    | <u>Naked Eye</u> | <u>With TOW Scope</u> | <u>With 7X5 Binocular</u> |
|--------------------------|------------------|-----------------------|---------------------------|
| Range Finding            | 12 Kilometers    | 47 Kilometers         | 37 Kilometers             |
| Target Designation       | 20 Kilometers    | 64 Kilometers         | 53 Kilometers             |
| With Attenuation Filters | 2.7 Kilometers   | 22 Kilometers         | 13 Kilometers             |

3. The MULE System operator must be careful not to range or designate on unprotected personnel.

4. Proper eye protection must be worn by any person who is down range and within the NOHD when the system is activated.

5. If the operator suspects any of the following conditions have occurred it should be reported to the commanding officer.

a. An unprotected person may have been in the beam path within the NOHD when the system was activated.

b. An unprotected person was looking at a flat glass or mirror like surface when it was illuminated by activation of the MULE.

6. The commanding officer will make arrangements for the necessary Ophthalmological examination and report it in accordance with reference (e).

#### 4002. CAPABILITIES AND FEATURES

1. The MULE utilizes an invisible single pulsed LASER beam to determine target range and/or designate target location for sophisticated ordnance.
2. The MULE has a NOHD of up to 64 kilometers, however the addition of an attenuation filter reduces that distance to approximately 2.7 kilometers allowing for a more realistic training scenario.
3. Built into the MULE is a low battery power indicator and a test system which will indicate the necessity for evacuation of the system to the supporting intermediate maintenance facility.

4003. SPECIAL-EQUIPMENT. The attenuation filter will be mounted on the MULE and used for all firings under other than actual combat conditions. Safety goggles are required for designated personnel involved in MULE maintenance. Clear flat surfaced goggles are available for maintenance personnel under NSN 8465-01-226-7986. Clear flat surfaced LASER safetygoggles are the only type authorized for personnel involved with the maintenance of LASER systems. Green tinted glasses may be used by the operational forces until replacement glasses of the clear type are fielded.

LASER SAFETY

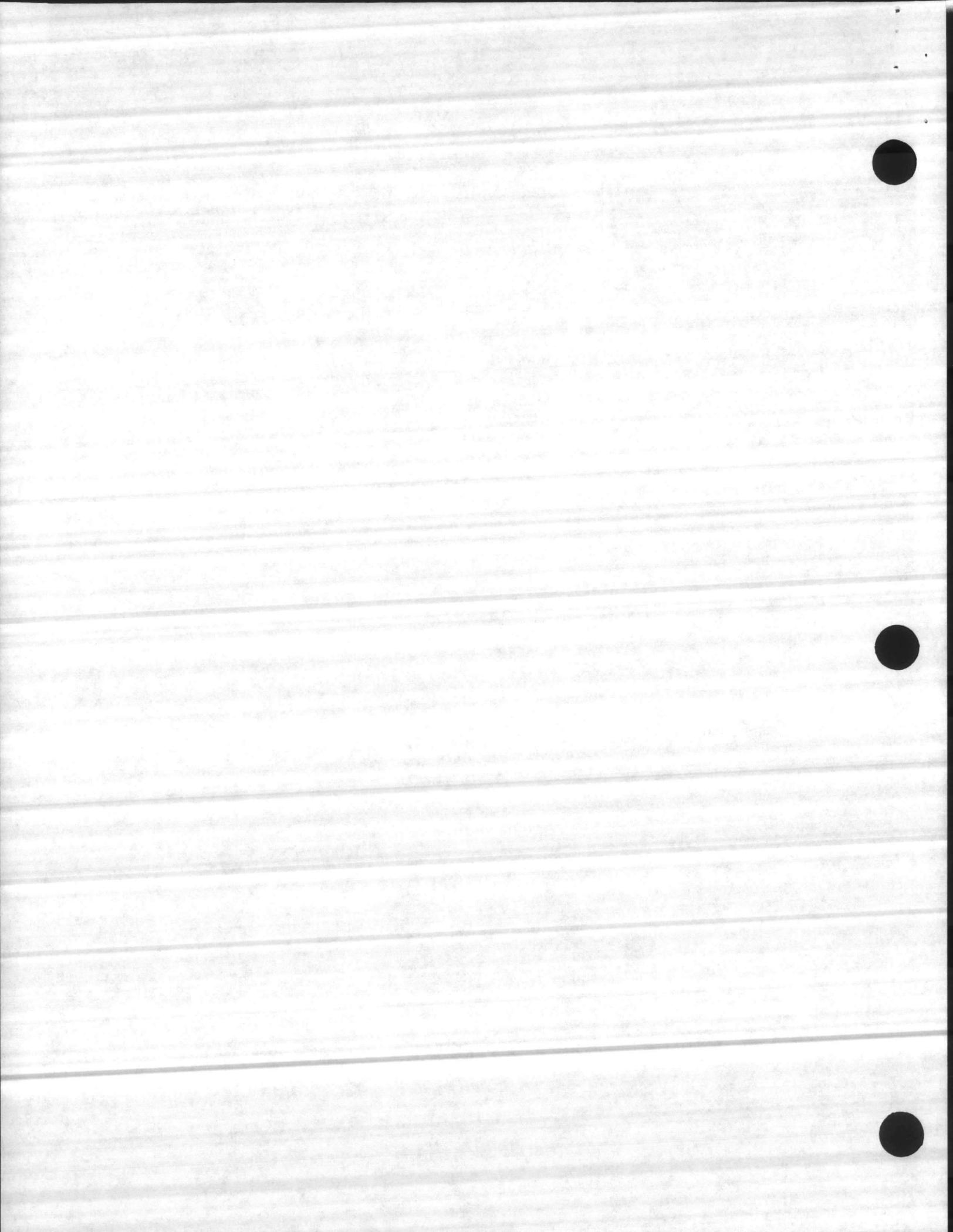
\* CHAPTER 5

M1A1 LASER RANGE FINDER, AN/VVG-3

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FIGURE

|   |     |
|---|-----|
| TABLE OF NOMINAL OCULAR HAZARD DISTANCES FOR<br>THE M1A1 LASER RANGE FINDER, AN/VVG-3 . . . . . | 5-5 |
|---|-----|



## LASER SAFETY

### \* CHAPTER 5

#### M1A1 LASER RANGE FINDER, AN/VVG-3

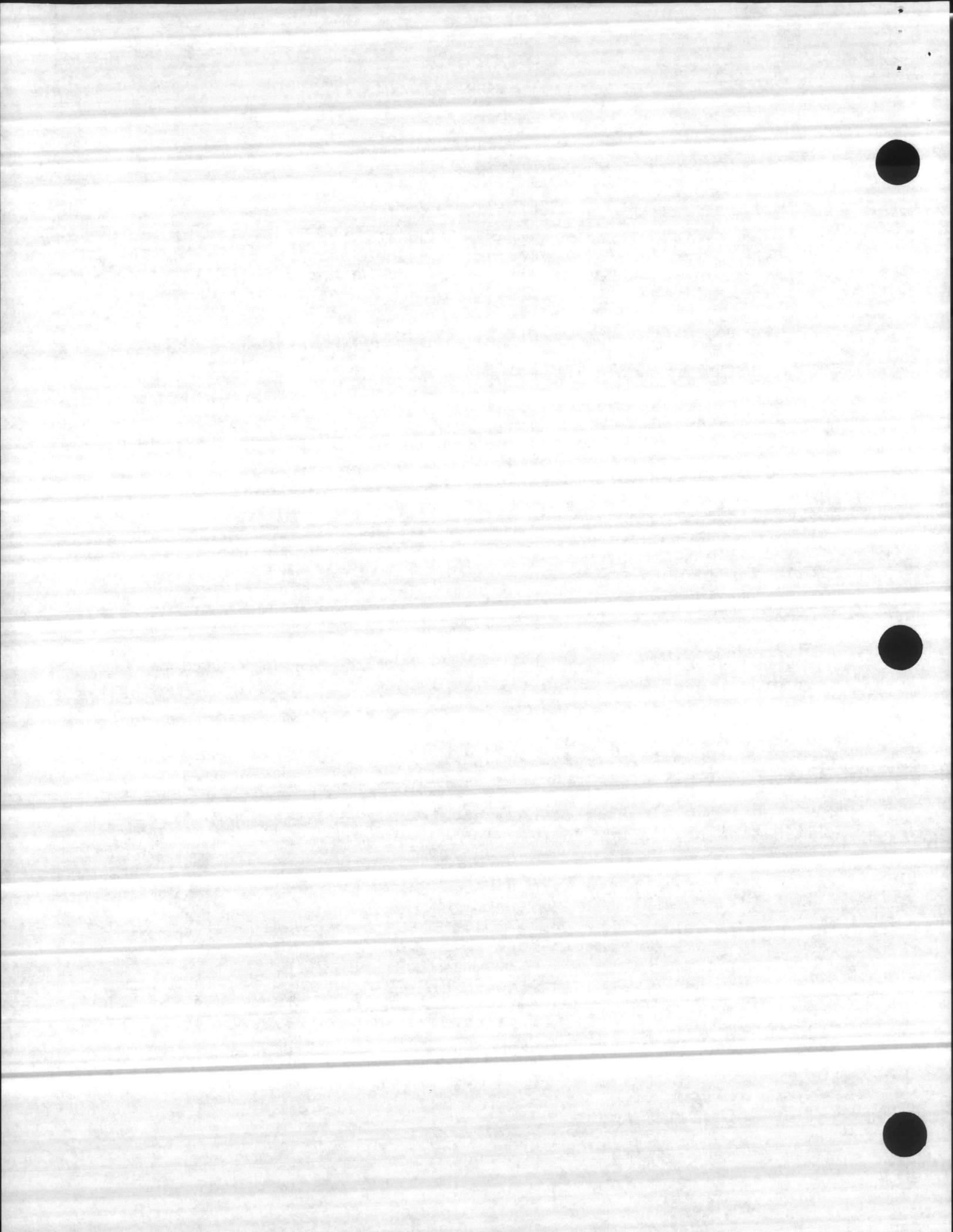
5000. BACKGROUND. The M1A1 LASER Range Finder (LRF) is an Integrated Fire Control Instrument, designed to provide accurate ranging information to the main 120mm gun on board the M1A1. It is a single-pulsed laser, that fires at 1064 nanometers (nm) of the electro-magnetic spectrum.

#### 5001. HAZARDOUS CHARACTERISTICS

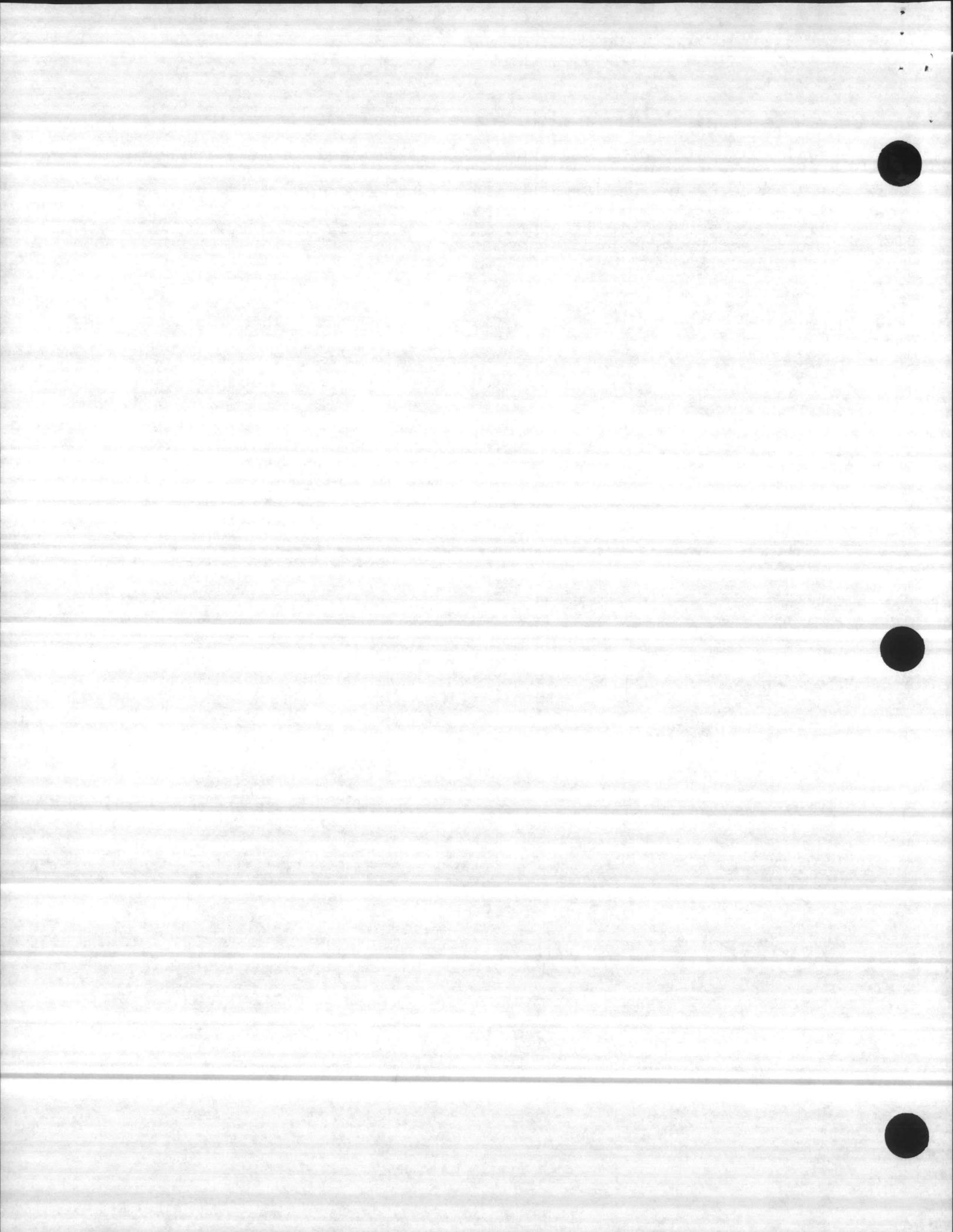
1. This equipment produces a single 1064nm pulse, with a power output of  $>10$  joule  $\text{cm}^{-2}$  or  $>0.5$  watt nominal to a hazardous range or Nominal Ocular Hazard Distances (NOHD) of 8000 meters (8752 yards). This power output is sufficient to produce range/attenuation dependent, severe to mild retinal necrosis, and the accompanying edema. Visual function defects to the point of total blindness are documented due to unsafe use of this form of LASER.
2. The NOHD for personnel involved around M1A1 operational areas are outlined in Figure 5-1.
3. M1A1 operators must be careful not to range on unprotected personnel.
4. Proper eye protection must be worn by any person within the operational NOHD when the system is in use.
5. If the operator or personnel within the NOHD suspects that an unprotected person may have been in the NOHD when the system was activated, this information should be reported to the LSSO, and a cessation of all operations should be called immediately.
6. The LSSO will make arrangements for the necessary ophthalmological examination(s), in accordance with reference (e).

#### 5002. CAPABILITIES AND FEATURES

1. The LRF utilizes a single-pulse LASER beam to determine target range for the 120mm smooth-bore main gun.
2. The LRF has a NOHD of up to 8000 meters unaided and 44km aided by 12cm objective lens. The Eye Safe Filter (ESF) attenuates the beam to a point where, if the LRF discharges in an area where unprotected personnel are in the NOHD, no hazard will exist.
3. The LRF self-tests prior to operation and will shut down prior to use, if damaged.



5003. SPECIAL EQUIPMENT. The ESF will be used at all times unless firing at a LASER-safe range. Eye protective goggles that filter at  $>4.7$  @ 1064nm are required by all personnel performing maintenance (NSN 4240-00-258-2054). Any safety goggles that attenuate  $>4.7$  @ 1064nm are acceptable if approved by the local category II LASER Systems Safety Officer.



## LASER SAFETY

### NOMINAL OCULAR HAZARD DISTANCES:

SINGLE PULSE = 7km (3.78nm)  
WITH 7X50 BINOCULARS = 25km\* (13.5nm)  
WITH 8cm OBJECTIVE LENS = 35km (18.89nm)  
WITH 12cm OBJECTIVE LENS = 44km\* (23.76nm)

### DIFFUSE REFLECTION HAZARD:

NONE

### SKIN HAZARD:

NONE

### MATERIAL HAZARD:

NONE

### EYE PROTECTION REQUIRED FOR INTRABEAM VIEWING:

UNAIDED OD = 4.7 @ 1064nm  
AIDED OD = 4.7 @ 1064nm

### ASSIGNED BUFFER ZONE:

2 MRAD (STATIC)  
5 MRAD (MOVING)

### REFERENCE:

RADIATION PROTECTION SPECIAL STUDY NO 25-42-0138-84,  
"HAZARD EVALUATION OF THE PRODUCTION MODEL M1 TANK  
LASER RANGEFINDER," 17-20 JULY 1983.

Figure 5-1.--Table of Nominal Hazard Distances for the M1A1 Laser  
Range Finder, AN/VVG-3.



# LASER SAFETY

## APPENDIX A

### LASER SAFETY TRAINING SYLLABUS OUTLINE

1. Theory of LASERs.
2. Operation of the LASER system used by the unit.
  - a. Theory.
  - b. Function.
  - c. Test Firing Hazard.
  - d. Range Firing Hazard.
  - e. Other Hazards, if any (cryogenics, high voltage, ultraviolet, etc.).
3. Protective Goggles, Signs, Interlocks
  - a. Goggles: Pre-use inspection, purpose, proper use of.
  - b. Signs: Where posted, purpose.
  - c. Interlocks: Purpose, importance of.
4. LASER Safety References
  - a. SECNAVINST 5100.14A.
  - b. NAVEXELINST 5100.12.
  - c. NAVMEDCOMINST 6470.2.
  - d. ANSI Z136.1 and NAVELEX TECH MANUAL E0410-BA-GYD-010/  
7034 LASER.
  - e. MCO 3570.1 Chapter 19.
  - f. Applicable FSSG directives.
5. Maintenance Operating Instructions
  - a. Review test bench procedures/checklists.
  - b. Review all safety interlocks.
  - c. Review all electrical and high intensity light hazards. Include cryogenics and other hazards, if applicable.
6. LASER Range Procedures

## LASER SAFETY

a. Review Mission Commander and Range Controller functions and responsibilities.

b. Describe approved ranges/targets using maps. Describe buffer zones, populated areas, etc..

c. Communications/identification procedures.

d. Routes of entry/exit.

### 7. Medical Aspects

a. LASER hazards associated with beam wave length, power, and pulse duration.

b. Eye hazards of LASERS.

c. Electrical hazards of LASERS.

d. Cyrongenic hazards of LASERS.

e. Examinations.

# LASER SAFETY

## APPENDIX B

### LASER SAFETY PROCEDURES FOR LASER RANGE USE

1. In addition to the usual range requirements for prior permission, target identification and adherence to scheduled target times, the following precautions shall apply to LASER targets:

a. Only targets surveyed and approved by NAVWPNCEN (Code E51) or Space Naval Warfare System Command (Code 00) may be used for LASER training. All LASER firings must be within the LASER certification parameters of the range being used.

b. Target clearance and target identification are required to ensure no unauthorized vehicle or personnel are in the target area or buffer zone.

c. LASER firing will be terminated, if necessary, to preclude any possibility of LASER beams leaving the immediate area. The beam should not enter the buffer zone. In no cases shall the beam be directed at or above the horizon.

d. Care shall be exercised that no specular reflectors (shiny surfaces) are fired upon with LASERs. The target and vicinity should be inspected with this in mind. For example, standing water could conceivably reflect the beam outside the permissible LASER firing area.

e. Deliberately firing of LASERs at wildlife is strictly forbidden.

f. LASER firing will not be allowed until the LASER system has been locked onto the target area.

g. LASER radiation backstops shall be used behind the target where warranted.

2. Additional procedures are required for the firing of LASERs at manned targets. This will be permitted only when the following criteria is met:

a. The mission commander has verification from target personnel that they have proper eye protection and all personnel have been briefed concerning its use and possible consequences of non-use.

b. Positive two way radio communication is established immediately prior to each LASER firing and permission to fire is received from the mission commander.

c. The safety requirements of the specific LASER weapons system have been met.

d. All local range safety regulations have been met.



# LASER SAFETY

## APPENDIX C

### LASER MISSION BRIEFING GUIDE

1. LASER missions will be briefed by the mission commander with reference to each of these three topics as a minimum:

a. LASER Range

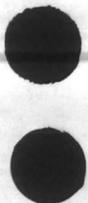
- (1) Boundries.
- (2) Permissable LASER firing area.
- (3) Buffer zones, backstops, terrain.

b. Target Identification Procedures

- (1) Target location and direction of fire (ground/airborne).
- (2) Clearing pass, heading, altitude (airborne).
- (3) Means of target identification.
- (4) Manned or unmanned by target personnel.
- (5) Radios, frequencies and call signs, if applicable.
- (6) Target time during which LASER firing operations have been scheduled.
- (7) Controlling authority, call signs/frequencies.

c. LASER Tactics

- (1) Expected ground targets, direction/heading of LASER firings (include aircraft flight profile and altitude if airborne).
- (2) Eye protection requirements, individual inspection and use of safety goggles, helmet visor, glasses, etc..
- (3) Other units/vehicles/aircraft, their locations and heading during LASER firing (include aircraft altitude, if airborne). Ordnance to be delivered.
- (4) Expected LASER "footprint" dimensions.



## LASER SAFETY

### APPENDIX D

#### LASER MAINTENANCE SAFETY PRECAUTIONS

1. LASER hazard warning signs shall be posted on all entrances to LASER maintenance areas in accordance with reference (c) so as to minimize the risk of accidental exposure. The LASER units and test benches shall be marked with warning signs as well.
2. All personnel engaged in essential duties concerned with LASER firing shall wear approved eye protection during the firing. Non-essential personnel shall leave the LASER area during firing.
3. All functional entrances to bench and boresight LASER firing areas shall be interlocked so that opening such a door will stop the LASER emission.
4. Equipment interlocks shall be maintained in operating condition at all times. If the event requires and approved maintenance procedures can only be accomplished by circumventing the interlock feature, that procedure can be performed only under the supervision of a designated LASER Safety Supervisor, with prior approval of a qualified LASER Systems Safety Officer or qualified maintenance officer. In all cases, a documented quality assurance inspection shall be performed upon completion of that work to ensure proper interlock operation has been restored.
5. Appropriate and adequate LASER safety containment procedures and devices shall be in effect whenever any LASER is fired. Examples of containment devices are lens covers, diffuser, shields, and enclosures.
6. The LASER test area shall be kept clear of all specular reflectors or diffuser surfaces with a high coefficient of reflection.
7. During LASER operations, the minimum amount of two personnel, shall be present.
8. A countdown procedure shall be followed prior the LASER firings.



LASER SAFETY

APPENDIX E

LASER SYSTEMS DESCRIPTION AND ANALYSIS FORMAT

File Number

1. Identification

- a. LASER type:
- b. Manufacturer, Model, and Model Number:
- c. Serial Number:
- d. Contract Number:
- e. Number of LASERs:
- f. National Stock Number (NSN) (if available):
- g. Plant Account Number(s) (if available):

2. Disposition.

- a. Program/User/Custodian(s):
- b. Location(s):
- c. Use(s):

3. LASER Characteristics.

- a. Wavelength(s) (Micrometers):
- b. Pulsed  CW  Both ; Scanned  Scan Rate (Hertz)
- c. Beam Shape: Circular  Rectangular  Elliptical
- d. Beam dimension (centimeters):  
(Identify whether 1/e or 1/e<sup>2</sup> points)
- e. Beam divergence (Radians):  
(Identify whether 1/e or 1/e<sup>2</sup> points)
- f. Pulse Length (seconds):
- g. Pulse Reception Rate (Hertz):
- h. CW Maximum Power (WATTS):
- i. Maximum Energy per pulse (joules):

LASER SAFETY

4. General

a. Maximum Personnel Exposure Duration (estimated):

Hours \_\_\_\_\_ Minutes \_\_\_\_\_ Seconds \_\_\_\_\_

b. Do the LASER characteristics change with the change in LASER systems mode of operation?

Yes \_\_\_\_\_ No \_\_\_\_\_ If yes, How? \_\_\_\_\_

---

---

5. Exempt Qualification (if applicable)

a. Check applicable boxes:

Combat \_\_\_\_\_

Combat training \_\_\_\_\_

Classified \_\_\_\_\_

b. Status:

Number of LASERS:

(1) In use \_\_\_\_\_ In storage \_\_\_\_\_ Awaiting Disposition \_\_\_\_\_

(2) Transferred within DOD to \_\_\_\_\_

Date \_\_\_\_\_ ASD approval date \_\_\_\_\_ (provide serial number)

6. Pulsed LASER System Hazard Analysis. Maximum permissible exposure:

a. Values:

b. Assumptions:

c. Corrective factors:

d. Calculations:

7. Pulsed LASER System Hazards Analysis. Installation Survey Results:

a. Special consideration of Constraints:

b. Other LASER Systems Hazards:

LASER SAFETY

APPENDIX F

LASER ANNUAL INVENTORY REPORT FORMAT

From:

To: Commanding General, 2d Force Service Support Group  
(G-4/Safety)

Subj: ANNUAL LASER INVENTORY REPORT FOR FY-\_\_\_\_\_

Ref: (a) NAVELEXINST 5100.12

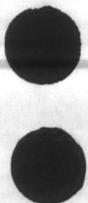
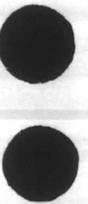
1. In accordance with the reference, the following annual report is submitted for FY-\_\_\_\_\_:

- a. LASER type:
- b. Manufacturer:
- c. Part Number: (if available)
- d. Contract Number: (if available)
- e. Number of LASERs:
- f. National Stock Number (NSN): (if available)
- g. Exempt Qualifications: (Check applicable blocks)  
Combat Training\_\_\_\_\_  
Classification\_\_\_\_\_

2. Status:

- a. Number of LASERs:  
In use\_\_\_\_In storage\_\_\_\_Awaiting disposition\_\_\_\_  
Transferred within DOD to\_\_\_\_\_date\_\_\_\_\_  
ASD approval date\_\_\_\_\_(Provide serial Number(s))

//Signature//



LASER SAFETY

APPENDIX G

LASER SAFETY INSPECTION CHECKLIST

Reference: NAVELEXINST 5100.12

1. Does the command have Class IIIb, Class IV LASERs or Military Exempt LASERs?

YES \_\_\_ NO \_\_\_ (If yes, continue with the following)

2. Has a LASER hazard control program been established?

YES \_\_\_ NO \_\_\_

3. Has a LASER Systems Safety Officer (LSSO) been designated in writing and does he have direct access to the commanding officer?

YES \_\_\_ NO \_\_\_

4. Does the LSSO have sufficient technical competence and authority to approve or disapprove the local use of LASERs?

YES \_\_\_ NO \_\_\_

5. Has the LSSO received a minimum of 20 hours of formal classroom training in LASER radiation? (LASER Safety School or equivalent)

YES \_\_\_ NO \_\_\_

6. Has a local LASER Safety Organization or Committee been established to assist the LSSO in discharging his responsibilities? (If warranted by the magnitude of the potential hazard in local operations)

YES \_\_\_ NO \_\_\_

7. Have all Class IIIb and Class IV LASER systems been reviewed by the LASER Safety Review Board (LSRB) and Space Naval Warfare Systems Command (Code 00) prior to utilization?

YES \_\_\_ NO \_\_\_

LASER SAFETY

8. Has each local LASER user been approved or submitted for safety approval to higher authority be the LSSO?

YES \_\_\_\_\_ NO \_\_\_\_\_

9. Does the LSSO maintain a list of all LASERS and their location?

YES \_\_\_\_\_ NO \_\_\_\_\_

10. Is a list of Class IIIb and Class IV LASERS submitted annually to Space Naval System Command (Code 00)?

YES \_\_\_\_\_ NO \_\_\_\_\_

11. Have local LASER safety regulations been established including standing operating procedures for indoor maintenance and outdoor LASER operations?

YES \_\_\_\_\_ NO \_\_\_\_\_

12. Have safety responsibilities been written for LASER or LASER System Supervisors which include normal operational procedures, emergency procedures and documentation of all LASER firing?

YES \_\_\_\_\_ NO \_\_\_\_\_

13. Are all local LASER installations surveyed at least annually for safety?

YES \_\_\_\_\_ NO \_\_\_\_\_

14. Are warning systems and signs placed in appropriate locations to protect all personnel from LASER radiation?

YES \_\_\_\_\_ NO \_\_\_\_\_

15. Has a LASER protective goggles program been established? Are they properly labeled and periodically inspected and evaluated?

YES \_\_\_\_\_ NO \_\_\_\_\_

16. Have all personnel in areas with LASERS been informed by formal classroom training about the potential hazards associated with accidental exposure to LASERS?

YES \_\_\_\_\_ NO \_\_\_\_\_

LASER SAFETY

17. Does training include actual demonstration of the LASERs destructible capability and the procedure for calculating the maximum permissible exposure levels?

YES \_\_\_\_\_ NO \_\_\_\_\_

18. Are local LASER radiations accidents and incidents investigated with appropriate recommendations and corrective actions initiated?

YES \_\_\_\_\_ NO \_\_\_\_\_

19. Is medical evaluations performed and an incident report submitted via the chain of command to Commander, Naval Medical Command (Code 212) within 30 days of the incident? (Ref: NAVMEDCOMINST 6470.2)

YES \_\_\_\_\_ NO \_\_\_\_\_

Medical Surveillance

Reference: NAVMEDCOMINST 6470.2

20. Has the LSSO determined and designated all LASER personnel?

YES \_\_\_\_\_ NO \_\_\_\_\_

(NOTE) Incidental personnel: Those whose work makes it possible but unlikely for them to be exposed to LASER energy sufficient to damage eyes or skin. (e.g., clerical, supervisory personnel)

LASER personnel: Those who work routinely in LASER environments (Reference NAVELEXINST 5100.12.)

21. Has the LSSO submitted records of personnel exposed to LASER emission to the medical officer for medical surveillance?

YES \_\_\_\_\_ NO \_\_\_\_\_

22. Are all personnel designated either as Incidental or LASER personnel enrolled in the appropriate medical surveillance program?

YES \_\_\_\_\_ NO \_\_\_\_\_

23. Are the required examinations performed prior to participation and upon termination of LASER work and following any suspected LASER injury?

YES \_\_\_\_\_ NO \_\_\_\_\_

Reference NAVMEDCOMINST 6470.2

LASER SAFETY

24. Have incidental personnel received eye examinations for visual activity?

YES \_\_\_ NO \_\_\_

25. Do LASER personnel receive visual activity determinations and eye examinations based on the wavelength of LASER radiation? Is a medical history taken?

YES \_\_\_ NO \_\_\_

Reference NAVMEDCONINST 6470.2

26. Is photographic documentation made of retinal lesions found in LASER workers during preplacement examinations?

YES \_\_\_ NO \_\_\_

27. Are there any Military Exempt LASERs? (Those designated for combat, combat training or classified).

YES \_\_\_ NO \_\_\_

Reference SECNAVINST 5100.14A

28. Have all Military Exempt LASERs in use been reviewed and approved safe by the Navy LASER Safety Review Board? (Contact Space Naval Warfare System Command (Code 00)).

YES \_\_\_ NO \_\_\_

Reference SECNAVINST 5100.14A

29. Is the required caution label affixed to all Military Exempt LASERs?

YES \_\_\_ NO \_\_\_

Reference SECNAVINST 5100.14A

30. Is an inventory and record of the status of all exempted LASER products maintained?

YES \_\_\_ NO \_\_\_

Reference SECNAVINST 5100.14A

LASER SAFETY

APPENDIX H

LASER RANGE FIRING LOG

COMMAND: \_\_\_\_\_

RANGE: \_\_\_\_\_

USER ACTIVITY: \_\_\_\_\_

DATE: \_\_\_\_\_

LASER SYSTEM: \_\_\_\_\_

MISSION COMMANDER: \_\_\_\_\_

| <u>FIRING #</u> | <u>TIME</u> | <u>TARGET#/LOCATION</u> | <u>LASER POSITION/HEADING</u> |
|-----------------|-------------|-------------------------|-------------------------------|
| *1              | _____       | _____                   | _____                         |
| 2               | _____       | _____                   | _____                         |
| 3               | _____       | _____                   | _____                         |
| 4               | _____       | _____                   | _____                         |
| 5               | _____       | _____                   | _____                         |

RANGE LASER SAFETY OFFICER: \_\_\_\_\_

\*NOTE: Fill in sheet with the number of firings as required.



# LASER SAFETY

## APPENDIX I

### SUMMARY OF REFERENCES

1. SECNAVINST 5100.14A: Provides policy and responsibilities outline for individual LASER products that are exempt from Radiation Safety Standards.
2. NAVELEXINST 5100.12: Provides LASER system safety criteria and evaluations, documentations, training programs, development of range safety programs, and range assistance surveys when requested. Naval Electronic Systems Command (NAVELEX) is also responsible for the development of the LASER Safety Review Board (LSRB).
3. ANSI Z136.1-1980 (NOTAL): Provides guidance for the safe use of LASERS and LASER systems by defining control measures for each of the four LASER classifications. Technical information on measurements, calculations, and biological effects are also provided.
4. NAVMEDCOMINST 6470.2: Establishes a standard for the evaluation of LASER hazards and guidance for medical surveillance of persons occupationally exposed to LASER radiation.
5. MIL-STD-1425: Provides the safety criteria applied throughout the development and procurement of systems using LASERS.
6. MCO P3750.1A: Chapter 1 provides general safety precautions necessary to minimize the possibility of accidents during range operations. Chapter 20 provides specific guidance for the use of LASERS.

### OTHER HELPFUL PUBLICATIONS:

1. U. S. Army Environmental Hygiene Agency: LASER and Optical Hazards Course Manual; 8th edition, Jan 1980. Comprehensive Technical Manual on all aspects of LASER function (theory), measurements, hazards, protective equipment, safety rules, etc..
2. NAVELEX Technical Manual E0140-BA-6YD-010/7034 LASER. Prescribes operating procedures and precautions to prevent LASER related injuries. Included are biological effects, types of LASERS, safety feature, hazards, safety equipment and other technical LASER discussions.
3. NAVSEA OP 3565/NAVAIR 16-1-529/NAVELEX 0967-LP-624-6010 (NOTAL). Lists precautions to be observed for biological radiation hazards for LASER devices.





UNITED STATES MARINE CORPS

2d FORCE SERVICE SUPPORT GROUP  
U.S. MARINE CORPS FORCES, ATLANTIC  
PSC BOX 20002  
CAMP LEJEUNE, NORTH CAROLINA 28542-0002

FSSGO P5100.10 Ch 1

3

24 May 96

FORCE SERVICE SUPPORT GROUP ORDER P5100.10 Ch 1

From: Commanding General  
To: Distribution List

Subj: LIGHT AMPLIFICATION BY STIMULATED EMISSION OF RADIATION  
(LASER) SAFETY PROCEDURES (SHORT TITLE: LASER SAFETY)

Encl: (1) New page inserts to FSSGO P5100.10

1. Purpose. To transmit new page inserts and direct pen changes to the basic Manual.

2. Action

a. Insert the new Chapter 5, contained in the enclosure, immediately following page 4-4 of the basic Manual.

b. On page iii, add "5 M1A1 LASER RANGE FINDER AN/VVG-3" directly underneath the Chapter 4 entry.

3. Summary of Changes. Chapter 5 provides guidance concerning the M1A1 Laser Range Finder, AN/VVG-3.

4. Change Notation. Significant changes in the new page inserts are denoted by an asterisk (\*) symbol.

5. Filing Instructions. File this Change transmittal immediately behind the signature page of the basic Manual.

6. Certification. Reviewed and approved this date.

J. B. BEAVERS  
Chief of Staff

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2d MaintBn

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AC/S, G-3 HSSE  
AC/S, G-4 Safety



