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QUESTIONS AND ANSWERS ON HAND-HELD LASER RANGEFINDER HAZARDS

U.S. Army Environmental Hygiene Agency
Aberdeen Proving Ground, Maryland 21010-5422

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QUESTIONS AND ANSWERS ON HAND-HELD LASER RANGEFINDER HAZARDS

1. **BACKGROUND.** This technical guide summarizes questions and answers on the hazards of hand-held laser rangefinders (LRF). It was prepared following briefings to units in the field by personnel from the U.S. Army Environmental Hygiene Agency (USAEHA).

2. **SCOPE.** The summary is directly applicable to the AN/GVS-5 Laser Infrared Observation Device, although many of the questions and answers can apply to other field devices.

3. **PURPOSE.** To ensure the use of LRF to their full potential, this TG has been prepared to put to rest unwarranted worries about laser hazards. The hand-held LRF has been shown to be a significant aid to the forward observer. It greatly improves first-round hit capability with conventional mortar and artillery ammunition.

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IS THE LASER REALLY SO MUCH MORE HAZARDOUS THAN CONVENTIONAL LIGHT SOURCES?

Yes. Conventional light sources, such as an electric lamp, send their light out in all directions. The light bulb directly viewed looks like an extended (large) source, and not a brilliant point source as does the laser. Figure 1 shows how laser light can be focused by the eye into a very small spot on the retina.

Compared with viewing a tank searchlight 100 meters (m) in front of a tank, the laser would appear more than 100 million times brighter if the laser emitted visible light. The search-light is only slightly less bright than the sun. The searchlight beam at 100 m is about 1/100 watt-per-square-centimeter, whereas the laser beam is about 80,000 watts-per-square-centimeter.

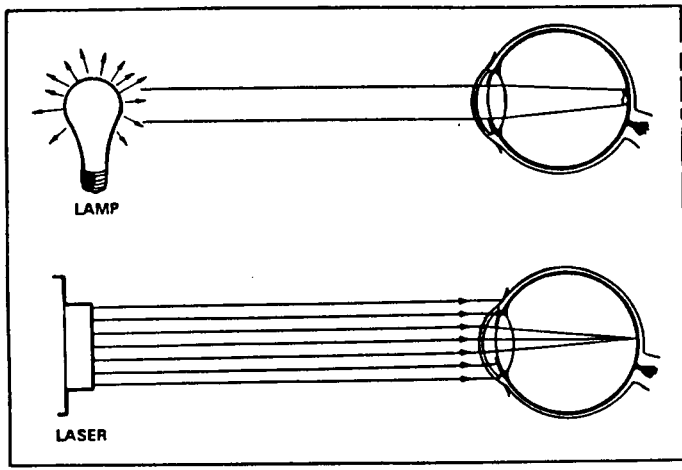

Figure 1. Comparison of Laser with Conventional Light Source

SUPPOSE I REALLY GET IN THE LRF BEAM, WHAT CAN HAPPEN TO ME?

If you are unlucky enough to have your eye in the central part of the unfiltered beam, and IF YOU ARE LOOKING BACK AT THE LRF AT A DISTANCE OF 30 m OR LESS, you will incur very serious eye injury in at least one eye. You will have a severe loss of vision for the rest of your life. As your distance from the laser increases, the severity of injury decreases.

- At 200 m, there is probably only a 50-50 chance of winding up with a very minimal injury - a tiny black speck in your field of view.
- At still greater distances, the chance of such injury is even less.
- Finally, at 2,700 m, it is permissible to view the beam directly without protection provided that binoculars or telescopes are not employed.

HOW CLOSE TO THE CENTER OF THE BEAM MUST SOMEONE BE TO GET HURT?

- As the beam leaves the LRF, it is only one centimeter (cm) (3/8 inch) in diameter.
- At 100 m, it is about 6 cm (2.4 inches) in cross-section.
- At 2,700 m, it is 66 cm (26 inches) across.

Unless a person's eye is within 1 radius of the beam center, there is little chance of injury. If it is raining, it is best to be one arm's length from the beam. Some people who have been in or near the beam downrange have seen a green flash at night, but were not injured because they were really not close enough to the center of the beam.

IF I AM DOWNRANGE AND SEE THE LRF BEAM IS COMING RIGHT AT ME, CAN I TAKE EVASIVE ACTION?

No. Each laser beam pulse lasts for only 6 billionths of a second. That time is so short that compared with 1 second, 1 second would correspond to about 5.3 years. Light traveling at 186,000 miles per second travels only 6 feet in this duration. You simply do not have time to take evasive action from a pulsed laser beam.

HAVE THERE BEEN MANY ACCIDENTS WITH LASERS?

Yes. Although there have not been an extremely large number of laser accidents, there have been several recorded. These accidents occurred due to insufficient training and improper use of the laser equipment. Note that these accidents occurred with hand-held laser rangefinders or designators either before or after the field training commenced or curtailed, not during field training.

IF A LASER WAS DELIBERATELY AIMED AT ME AT CLOSE RANGE, COULD I TAKE EVASIVE ACTION?

As pointed out previously, the beam is very small at close range. It would be extremely difficult, if not impossible, to deliberately aim this small laser beam, even into the eye of a cooperative subject trying to remain still. An uncooperative target would thus be nearly impossible to injure.

ARE REFLECTIONS OF THE LASER BEAM HAZARDOUS?

Only certain surfaces are shiny enough to cause hazardous reflections. These include glass, standing water, and other mirror-like surfaces. Follow this rule of thumb: if you can see your reflection by looking at the surface, it is likely to cause a hazardous reflection.

HOW FAR WILL A REFLECTION BE HAZARDOUS?

A mirror-like ("specular") reflection is a significant hazard only if the reflecting surface is flat. Curved surfaces (such as chrome bumpers and wraparound windshields) will spread the beam, and a hazardous condition will only exist within a few meters of these surfaces (Figure 2).

WHAT "MIRROR-LIKE" REFLECTIVE SURFACES SHOULD I WORRY ABOUT OUT IN THE FIELD?

Generally the only surfaces of concern are flat glass surfaces such as view-blocks and windows in target vehicles. Broken glass lying on the ground and pools of standing water (Figure 3) can reflect a fraction of the beam, but always in the downrange direction.

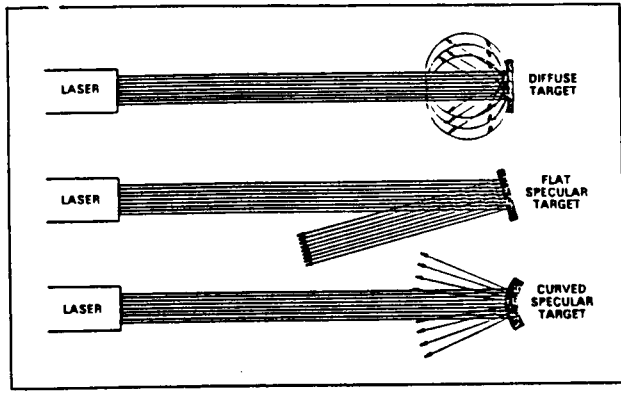

Figure 2. Only Flat, Mirror-Like Surfaces Produce Hazardous Reflections Over Significant Distances

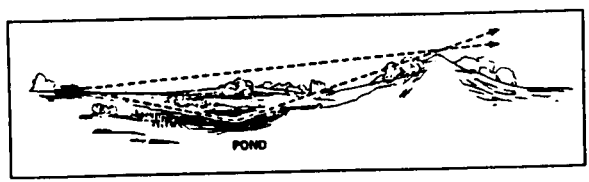

Figure 3. Specular Reflections From Standing Water

ARE REFLECTIONS FROM RAIN, SNOW, SLEET OR WET LEAVES HAZARDOUS?

We have measured reflections from all of these and found that beyond an arm's length from the beam path these reflections are not hazardous to view.

ARE REFLECTIONS FROM DULL, DIFFUSE, OR LUSTERLESS SURFACES EVER HAZARDOUS?

No. Once flat mirror-like surfaces have been masked or removed from the target area, you should have no fear of looking at the target (with or without binoculars) during laser ranging.

CAN THE LASER BEAM BE A HAZARD TO THE SKIN?

No. The output level is too low for most people to even feel its impact on the skin, but you should not intentionally place your hand or other exposed parts of your body into the beam near the exit port.

CAN THE LRF BEAM START A FIRE?

No.

WHO NEEDS LASER SAFETY GOGGLES?

Usually only personnel downrange who could be in the beam path need laser eye protection. If the range is cleared of exposed flat glass, no hazardous reflections could come back to the laser operator or other forward observers, or to anyone at the firing battery; hence, these personnel do <u>not</u> require eye protection.

WHERE CAN WE GET LASER SAFETY GOGGLES?

At the present time standardized anti-laser goggles are being developed for general use. Until the time these goggles become available, eye protection should be procured commercially. Assistance in this procedure can be obtained by contacting USAEHA.

In general, laser safety goggles are not considered necessary for routine training and testing of the AN/GVS-5 lasers. Protection for personnel involved in special two-sided tactical exercises and for downrange personnel operating moving targets requires the use of standard laser eye protection which offers a high optical density.

DO BINOCULARS AND OPTICAL SIGHTS INCREASE THE LASER HAZARD; AND WHY DO SOME SIGHTS HAVE LASER SAFETY FILTERS?

Yes, the hazard of looking into a direct beam (called "intrabeam viewing") is greatly increased when you are using a pair of binoculars, a battery commander's (BC) scope, or a telescopic sight in an armored vehicle. In effect, the viewer is placed closer to the laser by a factor of the magnifying power of the sight. As an example, if you are at 1,000 m from a laser, the hazard to your eye when looking through an 8X binocular is equivalent to the unaided eye located only 1/8 that distance, 125 m, from the source.

Since hard-point targets, such as armored vehicles or fixed bunkers, are the targets of fire-control lasers, the personnel using the optical instruments at these targets have a high probability of hazardous exposure. They need protection, and fortunately, modern technology permits the use of lighter color filters in binoculars and in telescopic sights than in personnel safety goggles. Therefore, the neodymium protective filter that is built into your AN/GVS-5 sight does not significantly reduce your visual ability to see targets.

DO GREEN LASER SAFETY GOGGLES IMPAIR YOUR VISION?

Yes, to some extent. The primary difficulty in developing a standard laser-protective goggle has been the determination of how much reduced red color vision could be acceptable in a combat environment. We have learned, however, that after you have worn the green laser-protective goggles for several minutes, your eyes adjust to permit more normal vision. The red-sensitive visual cells in your retina become more sensitive, thus partially compensating for the reduction of red light by the filters.

CAN WE USE SUNGLASSES FOR LASER PROTECTION?

ABSOLUTELY NOT. Sunglasses reduce the laser light entering your eye only by 50-75 percent. Goggles suitable for protection from a neodymium near infrared laser should have an optical density of 4.5 which is a 0.003-percent transmission at the laser wavelength. On the other hand, the laser eye protection may transmit more total light of other colors than sunglasses. Polarizing glasses are also of little or no value as laser eye protection.

WHY CAN'T WE USE THE LRF IN TWO-SIDED TACTICAL EXERCISES?

The headaches are many, but it is possible if all exposed personnel are equipped with laser eye protection and the maneuver site is not within line-of-sight of any uncontrolled area that can be occupied.

IS THERE REALLY ANY HAZARD TO PEOPLE IN A TOWN MORE THAN 2,700 m (THE NOMINAL OCULAR HAZARD DISTANCE) AWAY FROM THE LASER FIRING POSITION?

No. However, at one time consideration was given to the premise, if the laser is aimed in the general direction of the built-up area, one must always be concerned about the outside chance of someone in the town looking out toward the range with binoculars. Since binoculars extend the hazardous range, the thought was that there is no such thing as an absolutely safe distance from the laser. This is why laser range areas are selected for the presence of backstops. Recently, this type of thinking has been replaced with the idea that the probability of someone viewing the range with magnifying optics is so remote that there is no reason for concern.

MUST WE HAVE A MOUNTAIN OR HILL AS A BACKSTOP?

Anything opaque to light can serve as a backstop. A line of dense trees is suitable if you cannot see through them.

IS SKYLINE LASER OPERATION OR RANGING ON AIRBURSTS PERMITTED?

The laser can be aimed at a target on the skyline (no vertical buffer zone) or at an airburst above (or below) the skyline if the nautical airspace is restricted over the range area to a distance of 2,700 m from the laser. No land mass that can be occupied should exist along the line-of-sight behind this target. Ranging on clouds overhead is permitted only if specifically permitted in your local range regulation.

IS IT POSSIBLE FOR TRAINING PURPOSES TO FILTER OR OTHERWISE REDUCE THE OUTPUT ENERGY OF THE LRF FOR THE PURPOSE OF SHORTENING THE HAZARDOUS DISTANCE?

Unless the output is filtered down by a factor 5,000 times, the laser beam will be hazardous at some distance in front of you, and the use of sighting optics by others downrange will increase that distance. However, a 19 decibel (dB) safety filter when capped over the output port of the AN/GVS-5 will permit ranging out to 4 km in good weather and reduce the hazardous distance to about 290 m. More importantly, the increased hazard distance for telescopic viewing is only 1,800 m, which would normally be within the range area. In such cases, backstops would often not be required.

WHAT IS A CORNER-CUBE RETROREFLECTOR?

It is a glass prism which reflects a laser beam back precisely towards the laser, regardless of its orientation to the beam. Figure 4 shows how it works.

Reflective screens and bicycle reflectors work in a similar manner but are not nearly as efficient as a corner-cube. Firing a filtered laser beam at such a device would permit ranging to greater distances.

Training agencies in the Army are now studying whether this approach for total LRF training safety is practical, feasible, and economically justified.

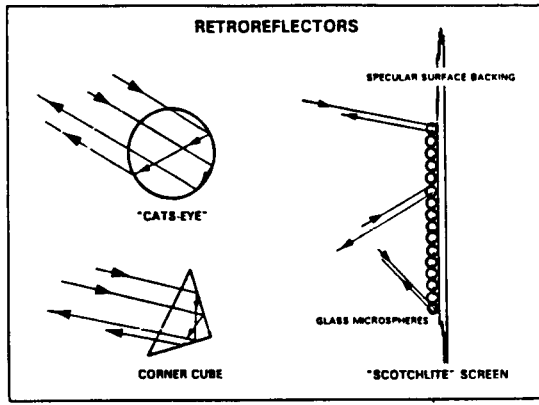

Figure 4. Retroreflection

WHO NEEDS A LASER EYE EXAMINATION?

Only those personnel who are considered to be routinely exposed to laser radiation in research, development, test and evaluation, and maintenance activities are presently included in a medical surveillance program.

However, if a suspected injury occurs, the individual should receive an eye examination as soon as possible from the nearest Army medical activity.

WHAT ARE THE SOURCE DOCUMENTS ON LASER HAZARDS; AND WHERE CAN WE GET FURTHER INFORMATION?

The source documents are:

- TB MED 524, Control of Hazards to Health from Laser Radiation, 20 June 1985.
- AR 40-46, Control of Health Hazards from Lasers and Other High Intensity Optical Sources, 6 February 1974
- AR 40-5, Preventive Medicine, 15 October 1990.
- DA Pam 385-63, Policies and Procedures for Firing Ammunition for Training, Target Practice, and Combat.

Additional information can be obtained by contacting Laser Microwave Division, USAEHA, Aberdeen Proving Ground, MD 21010

- DSN 584-3932/2331
- Commercial (410) 671-3932/2331

ARE LASER TRAINING DEVICES HAZARDOUS?

It depends upon which laser training devices you are referring to. For example:

- Most gallium-arsenide near-infrared firing simulators are not hazardous at all, or else they have such a low output power that they are only hazardous under direct optical viewing at very close range.

- The M-55 tank training device is not hazardous in the pulsed mode and can only be considered marginally hazardous in the alignment mode where the laser transmits continuously. Do not look into the alignment beam.

ARE THERE ANY MAINTENANCE PROCEDURES THAT HAVE AN IMPACT ON LRF HAZARDS?

There should be no hazards associated with operator maintenance. Read your operator's manual first. Maintenance by higher level requires the use of the Test Set TS-3620 for the AN/GVS-5. The LRF should only be fired when it is securely clamped to the test set.

IS THE LRF IN THE HAND-HELD LASER DESIGNATOR JUST AS HAZARDOUS AS THE GROUND-LOCATED LASER DESIGNATOR (GLLD) OR THE LRF IN THE M60 TANK?

No.