# Safety recommendations for laser pointers

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The use of laser diode pointers that operate in the visible radiation region (400–760 nm) is becoming widespread. These pointers are intended for use by educators while presenting talks in the classroom or at conventions and meetings. They are also useful in any situation where one needs to point out special items during any instructive situation. The pointers can be purchased in novelty stores, mail-order magazines, office supply stores, common electronic stores, and over the internet. The power emitted by these laser pointers ranges from 1 to 5 mW. The potential for hazard with laser pointers is generally considered to be limited to the unprotected eyes of individuals who might be exposed by a direct beam (intrabeam viewing). No skin hazard usually exists. There are, however, even more powerful laser pointers now appearing. The units are imported into the U.S. often without proper manufacturer certification or labeling. The potential for hazards with these devices is not well understood by the general public and workers, and numerous exposure incidents have been recorded by the authors. Users of these products need to be alerted to the potential hazards and be encouraged to follow appropriate safety recommendations. These factors are discussed and safety recommendations for laser pointers are presented.  [S1042-346X(98)00604-4]

Key words: laser safety, laser pointers, eye safety

## I. INTRODUCTION

The use of laser diode pointers that operate in the visible radiation region (400–760 nm) is becoming widespread. These pointers are intended for use by educators while presenting talks in the classroom or at conventions and meetings. They are also useful in any situation where one needs to point out special items during any instructive situation. The pointers can be purchased in novelty stores, mail-order magazines, office supply stores, common electronics stores, and over the Internet. The power emitted by these laser pointers ranges from 1 to 5 mW.

Many of these devices are low cost, operated with AAA batteries, produce a beam that can be seen easily hundreds of meters away yet are small enough to be carried in the pocket or on a key chain. One design is available where the laser pointer is co-housed with a functional writing pen. Pointers are now being manufactured that can project patterns of a star, circle, square, as well as the conventional circular dot pattern. Although most of these devices contain warning labels, as required by FDA regulations, many have been erroneously advertized as ''safe.'' At present there are no limitations on purchases and anyone can now buy a laser pointer that could be potentially hazardous if handled carelessly. The number in use today easily number in the millions.

The potential for hazard with laser pointers is generally considered to be limited to the unprotected eyes of individuals who might be exposed by a direct beam (intrabeam viewing). No skin hazard usually exists. The natural aversion response or blink reflex of the eye to a bright light ($t = 0.25$ s) would usually limit the intrabeam exposure to a safe level for devices emitting at Class II levels ($<1$ mW). The American National Standards Institute (ANSI) Z136.1 Standard ''For the Safe Use of Lasers''[1] would, however, suggest that an intentional intrabeam exposure with a 5 mW visible diode laser could require an eye filter of optical density (OD) of 0.7 for exposures in the order of 0.25 s. Longer exposure would require higher OD's. Diffuse viewing conditions for the laser pointers would need no eye protection.

There are, however, even more powerful laser pointers now appearing. The units are imported into the United States often without a proper manufacturer certification or labeling. One such pointer (reportedly imported from Russia) emits a green beam from a diode-pumped frequency-doubled Nd:YAG laser operating at 532 nm. The beam is the envelope of a series of 40 ns pulses of 0.5 $\mu$J/pulse energy emitted at approximately 1.7 kHz. This equates to an average power of about 0.85 mW. This pointer emission is a factor of 12 times higher per pulse than the maximum permissible exposures (MPE) limit allowed by the ANSI Z136 Standard—and therefore, *this type of pointer presents a significant potential for an eye hazard if viewed directly*.

Another diode-pumped frequency-doubled Nd:YAG laser operating at 532 nm is imported from China and emits 5 mW in a continuous wave (cw) beam as detailed in the data given in Appendix A. The pointer has no labeling and unscrewing the front end cap removes the 1064 nm blocking filter. In this case, the combined 1064 and 532 nm beams exceed 15 mW; clearly a Class IIIB emission. This design

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does not meet the Food and Drug Administration (FDA) criteria for a Class IIIA laser pointer.

Other concerns with these low power lasers include ocular effects such as flashblindness, afterimage, and glare. Persons exposed to the beams from pointers can be subject to such effects which could lead to temporary vision dysfunction and cause possible physical dangers if the exposed person is engaged in a vision-critical activity such as driving, flying or operating machinery.

The potential for hazards with these devices is not well understood by the general public and workers, and numerous exposure incidents have been recorded by the authors.[2] Users of these products need to be alerted to the potential hazards and be encouraged to follow appropriated safety recommendations. These factors will be discussed and safety recommendations for laser pointers will be presented.

## II. LASER POINTERS: CLASSES, DEFINITIONS AND CONCERNS

Laser pointers are today, usually Class IIIA (1-5 mW) devices as defined by the ANSI Z136.1 standards. Class IIIA lasers are moderate power lasers which could be hazardous even if viewed for a very short time. Until about 1993, most pointers were Class II ($<1$ mW) lasers. Class II lasers are low power devices that are safe to view for time periods less than 0.25 s or if the viewer overrides the urge to stare into the laser beam. The Class IIIA pointers can be recognized by the DANGER labels. Class II lasers will have a CAUTION label. Most laser pointers operate on a cw basis, however, there are some pointers commercially available that can operate having a repetitive pulse mode.

The FDA would include laser pointers under the definition of a demonstration laser product which is included in the U.S. Federal Laser Product Performance Standard: 21 CFR Part 1040.11 in the definitions for specific purpose laser products.[3] That section indicates:

''Demonstration Laser Products: Each demonstration laser product shall comply with all of the applicable requirements of 1040.10 for a Class I, IIa, II, or IIIa laser product and shall not permit human access to laser radiation in excess of the accessible emission limits of Class I and, if applicable, Class IIa, Class II, or Class IIIa.''

Hence, by this definition, laser pointers are technically limited to Class IIIa (5 mW) outputs. The detailed specification of one 5 mW laser pointer device is given in Appendix A.

## III. SAFETY ISSUES AND LASER BIOEFFECTS

### A. Concerns for the eye: Retinal burns

The end point of various research studies determined the lowest laser eye exposure level needed to cause a ''minimal'' retinal lesion (''burn'') using an ophthalmoscope to view the damage effects. Maximum permissible exposures were established in the late 1970's by the Z136 Committee of the American National Standards Institute ''about a factor of ten'' below the eye damage threshold level. It should be stressed that a retinal burn is unlikely the result from laser pointer exposure. Recently, a group of distinguished scientists and physicians warned that light induced damage was often mistakenly blamed for a patient's visual problems when, in reality, other causes were frequently more likely the cause.[4]

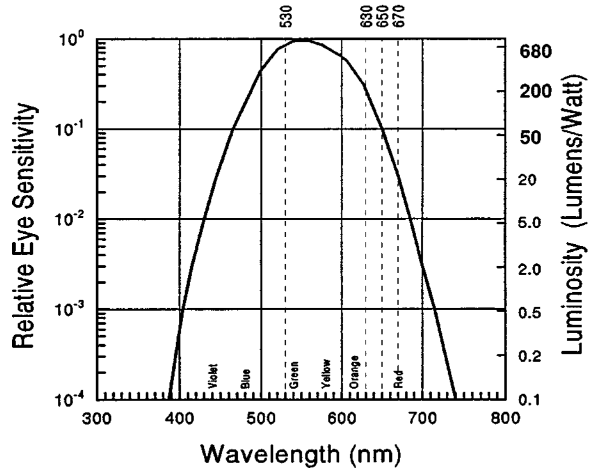


FIG. 1. Eye sensitivity—wavelength dependence.

The major potential hazard from pointers is limited to the unprotected eyes of individuals who look at the direct beam emitted from the laser since no skin hazard usually exists. The natural aversion response or blink reflex ($\sim 0.25$ s) of the eye from the bright laser light normally limits exposure to a safe level for those devices.

The ANSI Z136.1 standard bases the ''blink reflex'' MPE of an exposure on 0.25 s exposure. This yields a MPE of 2.5 mW/cm$^2$. When this irradiance is spread over a ''worst case'' 7 mm pupil opening (0.4 cm$^2$), the total power entering the eye can be then computed as follows: Power $= (2.5\ \text{mW/cm}^2)\times(0.4\ \text{cm}^2)=1.0$ mW. This suggests that laser pointer type devices might be limited to an output of 1 mW (Class II).

In some darkly lit environments, and at some wavelengths, a 1 mW pointer power is perhaps an option, but in rooms with a high ambient light level, and if operation is at the longer 670 nm wavelength, 1 mW is just marginal for visibility and, therefore, 3–5 mW is generally required for better visibility. Note that if the exposure is raised to a maximum of 5 mW (Class IIIA), then an eye filter with an optical density of 0.7 would be required for protection in the event of an intrabeam exposure of 0.25 seconds. *This suggests that caution is needed when the pointer emits near the 5 mW power level.*

## IV. WAVELENGTH CONCERNS

An evaluation of various laser pointers by the authors suggests that one needs to examine the photopic response curve of the eye (Fig. 1) to better understand the laser pointer visibility factors: That data suggest:

(1) Pointers at 670 nm emit a ''dark red''—and typical use conditions require 3–5 mW (Class IIIA) in order to be ''visible.''
(2) Pointers at 635 nm emit a ''brighter orange''—and typical use conditions require only about 1 mW (Class II) to be ''visible.''

(3) Some new ''pointers'' are diode-pumped frequency-doubled Nd:YAG lasers that emit at 532 nm and emit in the power range of 5 mW and higher. Note the eye response is much higher at this wavelength.

Some may argue that the more recently purchased laser pointers do not pose as much of an occupational or consumer risk as the earlier laser pointers because the wavelength has been shifted from the ''original'' 670 nm (dark red) to the ''new'' 635 nm (''bright'' orange red). (Fig. 1 illustrates this fact.) In this case, the older 670 nm pointers usually emitted a radiant power ranging from 3 to 5 mW (Class IIIA), while the new 635 nm pointers often emit less than 1.0 mW (Class II) and are perceived as ''brighter.'' It is concluded that the 635 nm pointers will not be as great a concern if one is pointed at someone's eye because of the lower power rating.

Laser pointers that are marked with a danger label (Class IIIA) can exceed momentary-viewing criteria, and *the user should never look directly into that beam*. As shown in Fig. 1, the 670 nm wavelength is only 10% as visible as the 630 nm diode laser wavelength, thus, it appears ''less dangerous'' than it really is.

It is noted that there are even more powerful laser pointers appearing in the current marketplace. A recent advertisement in a trade journal introduces a super power diode pointer that is 20 times brighter than other conventional pointers. These higher power lasers are capable of producing major biological effects and safety personnel need to be aware of such sources.

## V. EFFECTS OF VISION IMPAIRMENT

Often laser pointers can be used in situations where effects such as temporary flashblindness, afterimages, or glare can occur that cause the person to be distracted from his immediate work task. For example, there have been recent reports of laser light exposures of pilots at airports in regions where there were no known outdoor laser light show activities (see Appendix C). Suspicion of exposures to pilots from persons using such laser pointers has been reported in both the U.S. and the U.K. Similar concerns have been voiced for exposures to persons driving cars and buses. Bus driver and fire engine driver exposures have been reported in the U.K.

There is also the concern for glare when the beam strikes a highly reflecting surface. Such distraction could lead to other primary or secondary effects of a more serious nature. An example could be a lathe operator being ''flashed'' while concentrating on the work and losing concentration. This could cause the person to become temporarily distracted or startled and cause fingers or the whole hand to make contact with the lathe chuck and pose the potential for serious physical harm.

### A. Laser effects versus exposure level

The values of these different criteria are approximated in Fig. 2 below based upon the current knowledge for various vision effects. These visual impairment concepts are as follows.

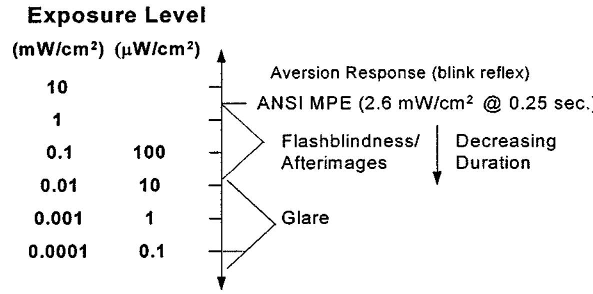


FIG. 2. Selected visual impairment effects defined by irradiance.

#### 1. Afterimage

The perception of light, dark, or colored spots after exposure to a bright light that may be distracting or disruptive. Afterimages may persist for several minutes.

#### 2. Flashblindness

A temporary vision impairment that interferes with the ability to detect or resolve a visual target following exposure to a bright light. This is similar to the effect produced by flashbulbs, and can occur at exposure levels below those that cause eye damage. This impairment is transitory, lasting seconds to minutes depending upon the laser light exposure level and time, the visual task, the ambient lighting, and the brightness of the visual target.

#### 3. Glare

A reduction or total loss of visibility, such as that produced by an intense light source, such as oncoming headlights, in the central field of vision. These visual effects last only as long as the light is actually present affecting the individual's field of vision. Visible laser light can produce glare and can interfere with vision even at low energies well below those that produce eye damage.

In addition to the above light induced factors that could certainly affect perception during vision-critical activities, the authors also believe there to be yet another factor. This is the case of an individual exposed and having the perception of significant potential harm. In some cases, this can lead to reactions based on factors other than retinal damage or flashblindness. This would be considered as the *concerns of a perceived hazard* (CPH). This is often referred to as ''outrage.'' There is growing evidence that adverse physical effects can be deemed by some who are exposed by what is usually considered as a nonharmful beam exposure. In this case, the exposed person feels ''victimized.'' In this case, the person becomes ''outraged'' at the perception of being harmed and is convinced that harm has been done.

## VI. NOMINAL HAZARD ZONES AND AIRSPACE CONCERNS

The ANSI Z136 standard defines the nominal hazard zone (NHZ) as: ''The Nominal Hazard Zone (NHZ) describes the space within which the level of direct, reflected, or scattered radiation during normal operation exceeds the MPE''.[5] The NHZ associated with open-beam Class IIIB and Class IV laser installations can be useful in assessing area hazards and implementing controls. The summary in Table I

TABLE I. Nominal hazard zones for visible diode pointers. Power: 5 mW; Divergence: 1 mr; and beam size: 2 mm. Based on: FAA 74002D outdoor laser/high intensity light demonstrations.

| Bioeffect condition | MPE level * ($W/cm^2$) | Nominal hazard zone (feet) |
|---|---|---|
| Blink reflex | $2.6\times10^{-3}$ | 51 |
| Flashblindness/ afterimage | $100\times10^{-6}$ | 262 |
| Glare | $5\times10^{-6}$ | 1171 |
| ''No effect'' | $50\times10^{-9}$ | 11 707 |

shows the magnitude of the NHZ's for a visible frequency laser pointer emitting 5mW.

The different visual effect ''MPE'' criteria used in the NHZ computations in Table I are based upon the U.S. Standard for the Federal Aviation Administration: FAA 74002D outdoor Laser/high intensity light demonstrations which provide a numerical basis for the various bioeffect criteria.[6] At this writing, these are the exposure level values now accepted by the FAA for the various visual functions designated in Fig. 1. Note that additional research has been recommended by the FAA to better establish these values.

Laser beams projected near airports or into any critical airspace can create the potential for permanent eye injury to pilots, crews and passengers of aircraft when they are within the NHZ. In addition, when laser beams are projected or reflected into airspace and intercept aircraft, unplanned exposure (incidents of illumination, startle and glare) may cause pilot distractions and/or create temporary vision impairment (e.g., flashblindness, afterimage).

Such effects pose significant flight safety hazards when the cockpit workload increases below 10 000 feet above ground level (AGL), in critical phases of flight (approach and landing), dense traffic areas (terminal environment and enroute areas), and in close proximity to airports.

## VII. LASER POINTER INCIDENTS

Over the past year there have been a number of laser pointer exposure incidents that have been reported. The authors believe that there are many more unreported incidents involving pointers than is reported to the authorities. Anecdotal reports are received by the authors on a regular basis. Limited information about a few of these reported pointer incidents is presented in the table in Appendix B and on the Internet.[7] These data show that laser pointer exposure incidents are occurring worldwide and are also occurring in all venues. This includes:

(1) at school events;
(2) in classrooms;
(3) college and professional sporting events;
(4) ''zapping'' the police;
(5) aimed at aircraft;
(6) bus drivers; and
(7) aimed within homes and offices.

### A. Are the concerns real or hysteria?

For example: November 1, 1997 when a pilot was landing in Manchester, England he was zapped by a laser pointer as he attempted to land the aircraft. In this case, the pilot is convinced that he narrowly avoided disaster after he was exposed by a laser pointer as he brought a packed holiday jet in to land. Captain John Middleton, carrying 180 passengers, was hit by a blinding red beam targeted at his plane 600 ft above the ground. He was forced to look away. He said: ''This could have caused dangerous problems. The laser could easily have damaged my eyesight.''

It should be stressed that there are those who have a completely different opinion regarding such events and have concluded that it seems highly improbable that anyone could effectively target a commercial airline pilot with a laser pointer.

None the less, the laser pointer exposures continue to be reported. As reviewed in Appendix B, a soccer player reported agonizing pain when exposed by a laser pointer beam, U.K. policemen took off work with severe headaches and sore eyes following exposures. Is there more hysteria than reality in these stories? Are these cases of ''outrage'' rather than true biological effects?

It should be noted that much of the laser bioeffects data is based on acute exposure and not chronic exposure. Long time viewing (such as 3–4 h) to the emissions of a laser pointer could be associated with vision dysfunction that may be recoverable over a few months. Some support for such a hypothesis comes from the recent episode of a female high school cheerleader who was exposed to a pointer beam at a football rally. While her vision dysfunction lasted months, she is now apparently regaining sight. Was this case real or ''outrage?''

## VIII. GOVERNMENT ACTIONS

### A. U.K. bans laser pointers

All of the stories from the U.K. led to action on October 28, 1997 when the U.K. banned laser pointers (>Class 2). Consumer Affairs Minister Nigel Griffiths acted swiftly on that day and urged the U.K. Trading Standards Departments to remove from sale potentially dangerous laser pointers (e.g., >Class 2). His action follows a series of incidents involving the misuse of laser pointers. The action also followed an analysis by Herriot–Watt University which found that 14 out of 17 laser pointers they tested actually failed safety regulations (e.g., they emitted above 1 mW). Note that Class I and Class II laser pointers, as specified in the European and international safety standards, continue to meet safety requirements and are still available.

### B. FDA issues warning on misuse of laser pointers

As the number of incidents in the U.S. has increased, the U.S. Food and Drug Administration also issued a warning on laser pointers on December 18, 1997. The warning is given in Appendix C and states, in summary, that laser pointers can be very safe when used as intended by teachers and lecturers. They are not toys and should be used by children only under supervision.

## IX. SAFETY PRACTICES

Generally speaking, the ANSI Z136.1 standard does not require the presence of a laser safety office or medical surveillance when working with lasers classified less than Class IIIB. Moreover, most laser safety officers (LSO's) or facility safety personnel would not consider devices such as a laser pointer as representing a major hazard. As a result very little information is available to users about safe work practices with these devices.

The problem of hazardous exposures with laser pointers can be solved by one of three approaches. One can either *regulate* the problem away, *legislate* the problem away, or *educate* the problem away. While all three approaches will work, some of the techniques required for legislation or regulation generally require lengthy discussions, money, and extensive time to allow for different views and opinions. Hence, the most viable option is education.

The horror stories described above about the use of these devices at sporting events, in classrooms, aimed at airplanes and inside homes or office buildings suggests the strong need for more education. Therefore, it appears reasonable to insist that users be made aware of the potential for health problems so that they are not used inappropriately.

The key approach in the safety program is to recommend education and training of all involved with these products. This approach has been fairly useful in educating the public regarding other significant public health problems (e.g., smoking, AIDS, seat belt use, etc.). It is the method that the authors believe will bring the most positive effects. Keep in mind that razor blades can cut you and, if used improperly, can kill you. However, every day, millions of men all over the world shave their faces without hurting themselves. They have learned to treat such sharp devices with care and caution. We believe such an approach can apply with laser pointers.

Educational activity should be implemented at all levels. This should include a safety emphasis in:

(1) equipment manufacture's literature;
(2) training at the secondary school level;
(3) industry association education (LIA, SPIE, IEEE, etc.); and
(4) government agency announcements (FDA, NIOSH, etc.).

Despite their size and the fact that most laser pointers are powered by small batteries, these devices are theoretically capable of causing eye damage as a consequence of improper operation. Users of laser pointers must never aim the pointer at anyone. Users should disable the power source or remove the batteries when storing the pointer. Despite their size and their low power, these pointing devices can cause, and have caused, eye damage as a consequence of improper operation.

### A. Suggested Safety Rules

The following safety rules are a few ''common sense'' rules recommended for laser pointers:

(1) NEVER point a laser pointer of any power at anybody. Pointers should be used to point out or emphasize inanimate objects such as slide images, pipes, asbestos, laboratory apparatus, be used in nonhuman scientific experiments, etc.

(2) Avoid ''mirror like'' (specular) targets and NEVER, NEVER stare into a pointer. Also, NEVER view a laser beam using an optical instrument (such as binoculars, microscope, etc.) unless the procedure has been technically approved by appropriate safety personnel.

(3) Always use LOWEST power rating possible and highest divergence where possible. No laser pointer rated at a Class 3B should ever be used without special provisions—such as medical surveillance and approval of a LSO.

(4) These laser pointers are not toys and should not be used by juveniles. As an aid for this suggestion, it is recommended that the batteries be taken out of the pointer when not in use.

(5) Some places may wish to require *facility registration* of these devices in order to impress on users the need for safety awareness. The appropriate safety personnel should require that all laser pointers be correctly and conspicuously labeled with the correct warning. Facilities may wish to develop their own one page advisory note for all registered laser pointer users.

(6) Safety personnel and pointer users should be aware that wavelengths around 400–500 nm (i.e., blue light region) can cause biological effects of a photobiological nature (e.g., like ''sunburn'').

(7) Lasers operating at the peak of the photopic response (Fig. 1) can produce significantly greater evoked response and should be used with great caution.

(8) One should NEVER use a laser pointer above 5 mW.

## APPENDIX A: LASER POINTER SPECIFICATIONS

Diode-pumped frequency-doubled Nd:YAG laser

| | |
|---|---|
| Output wavelength | 532 nm |
| Output power | 1 mW, 3 mW, or 5 mW (depending on model) |
| Beam diameter | $<2$ mm |
| Beam divergence | $<1$ mrad |
| Beam mode | $TEM_{00}$ |
| Pointing stability | $<20$ mrad |
| Power stability | $<5\%$ |
| Linewidth | $<0.05$ nm |
| Polarization | $>100:1$ |
| Operating temperature | 5–35 °C |
| Operating current | $<250$ mA |
| Power consumption | $<0.7$ W |
| Operating lifetime | $>10\,000$ hours |
| Power supply | 3.5 V—lithium battery, CR123A |
| Outline dimensions | Diameter 20 mm $\times$ length 140 mm |
| Weight | 68 g (without battery) or 85 g (with battery |

## APPENDIX B: LASER ACCIDENT SUMMARY

Reported laser pointer related exposure incidents recorded in the Rockwell Laser Industries laser accident database since 1986.

| Site (State) | Accident subject | Accident summary | Description |
|---|---|---|---|
| On board a bus (U.K.) | Bus driver | Bus driver exposed as he sat at the wheel | Bus driver was exposed while sitting at the wheel of the bus. At the time of the exposure, he was not sure whether the damage was permanent. Driver felt the laser pointers were ''dangerous weapon.'' |
| On board a bus (U.K.) | Bus driver | Bus driver exposed via rearview mirror reflection | Bus driver was dazzled while sitting at the wheel of the bus by a beam reflected from the rearview mirror. Beam came from a group of students. Driver was able to return bus to Depot in Chester and was treated in the hospital. |
| Soccer game (U.K.) | Soccer midfielder | Soccer player exposed during game | Soccer player was targeted by a group of so-called ''laser louts'' at a match at Leicester. No additional details. |
| Firehouse (U.K.) | Fireman | Fireman exposed and temporarily blinded | Fireman was temporarily blinded when he was exposed as he parked his fire engine at the Glenrothes fire station. He was targeted by a gang of youths. Treated at hospital for temporary blindness. |
| Livingroom (NY) | Persons in house | Persons in livingroom of home at risk | Persons in a home viewed a diode laser beam on the wall (immediately over the baby's bassinet). Homeowner realized it was a laser beam. Went outside and confiscated a laser pointer from a boy. Told him to return with parents. Later he was visited by police who then arrested him for stealing the laser pointer. Trial was postponed. |
| Livingroom (OH) | Persons in house | Persons in family room of home at risk | Persons in a home viewed a diode laser beam on the wall (immediately over the TV set). Homeowner realized it was a laser beam. Called parents of the young boys that were the cause. They quickly caused the young boys to stop and the pointer was confiscated by the parents. No further action. |
| Church (U.K.) | Minister | Minister exposed and temporarily blinded | Methodist minister was exposed through a window by a diode laser pointer. The minister halted his sermon. He said that ''felt disturbed and my vision became blurred.'' He was minister at the Avenue Methodist Church in Cheshire. |
| High school rally (WI) | Cheerleader | Vision loss from laser pointer exposure | High school cheerleader was exposed on three occasions. Third time in gym rally. Saw ''green,'' had vision loss. Consulted Ophthalmologist who saw no damage—none the less she reports permanent vision loss and is seeing light/shadows after many months. Exam in Jan. 1997 showed possible neural ''blockage;'' retina was okay. |
| High school classroom (WI) | High school teacher | Teacher gets 10 day afterimage from laser pointer | Shop teacher flashed at 5' by student with laser pointer during engine disassembly. He saw ''red light.'' Got severe headache. Fuzzy vision. Was similar to welding flash. Afterimage remained for ten days—then disappeared. |

| Site (State) | Accident subject | Accident summary | Description |
|---|---|---|---|
| Airport (U.K.) | Pilot | Pilot exposed by laser pointer while landing plane | Pilot was exposed in Manchester, England while landing a jet plane loaded with passengers. He was ''hit'' by the blinding beam while landing and was forced to look away during landing. He said that ''this could have caused dangerous problems, the laser could have easily damaged my eyesight.'' |
| Convenience store (FL) | Off-duty policeman | Aggressively scanned ground near policeman | Person located on porch of motel 150 ft. from store used a laser pointer on the ground to startle crowd in the store parking lot. Store security guard (off-duty police) was angered. Person then approached the crowd and was arrested. Laser confiscated. No eye exposure. At trial, person was sentenced: 1 yr probation—30 days suspended jail—$1000 fine. |
| University (CA) | Student | Unsuspected exposure from laser pointer | Student working at computer terminal received exposure from another student with laser pointer. Diagnosed with flash injury. Patient complained of acuity loss although ophthalmologist found NO retinal injury. No permanent injury. |

## APPENDIX C: FDA ISSUES WARNING ON MISUSE OF LASER POINTERS

(1) The Food and Drug Administration is warning parents and school officials about the possibility of eye damage to children from hand-held laser pointers.

(2) These products are generally safe when used as intended by teachers and lecturers to highlight areas on a chart or screen. However, recent price reductions have led to wider marketing, and the FDA is concerned about the promotion and use of these products as children's toys.

(3) The light energy that laser pointers can aim into the eye can be more damaging than staring directly into the sun. Federal law requires a warning on the product label about this potential hazard to the eyes.

(4) ''These laser pointers are not toys. Parents should treat them with the appropriate care,'' said FDA Lead Deputy Commissioner Michael A. Friedman, M.D. ''They are useful tools for adults that should be used by children only with adequate supervision.''

(5) The FDA's warning is prompted by two anecdotal reports it has received of eye injury from laser pointers—one from a parent, the other from an ophthalmologist.

(6) Momentary exposure from a laser pointer, such as might occur from an inadvertent sweep of the light across a person's eyes, causes only temporary flash blindness. However, even this can be dangerous if the exposed person is engaged in a vision-critical activity such as driving.

[1] American National Standards Institute, *American National Standard for the Safe Use of Lasers: ANSI Z-136.1*, 1993 (Laser Institute of America, Orlando, FL, 1993).

[2] R. J. Rockwell, Jr. ''Laser Accidents: Reviewing Thirty Years of Incidents: What Are the Concerns—Old and New?'' J. Laser Appl. **6**, 203–211 (1994).

[3] Food and Drug Administration: Performance Standard for Laser Products, Center for Devices and Radiological Health, Food and Drug Administration (DHHS), Code of Federal Regulations (CFR), 50 (161): pp. 33 682–33 702, Tuesday, August 20, 1985.

[4] M. A. Mainster, D. H. Sliney, J. Marshall, K. A. Warren, G. T. Timberlake, S. L. Trokel, ''Guest Editorial: But is it Really Light Damage?'' Ophthalmology **104**, 179–180 (1997).

[5] R. J. Rockwell, Jr., ''Utilization of the Nominal Hazard Zone in Control Measure Selection,'' in *Proceedings of the International Laser Safety Conference* (Laser Institute of America, Orlando, FL, 1991), pp. 7–25 and 7–42.

[6] FAA 74002D outdoor laser/high intensity light demonstrations, *Outdoor Laser/High Intensity Light Demonstrations*, Federal Aviation Administration, Chap. 34.

[7] Electronic mail: Lasernet: http://www.rli.com