

Laser Institute of America



# Laser Safety Guide

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Prepared by  
LIA Laser Safety Committee

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Orlando



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Through this committee, LIA provides its membership with up-to-date information regarding national laser safety guidelines through publications, conferences, and educational courses. LIA would like to thank the following individuals for their participation in the first edition as well as subsequent updates.

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# Table of Contents

I. Introduction.....	1
II. Laser Hazards .....	1
III. Eye Hazards .....	3
IV. Skin Hazards .....	6
V. Non-beam Hazards from High Power Lasers .....	6
VI. Laser Safety Standards and Hazard Classifications.....	7
VII. Viewing Laser Radiation .....	10
VIII. Safety Procedures for Each Laser Classification .....	15
IX. Controls for Outdoor Lasers including Surveying, Alignment, & Leveling Lasers.....	22
X. Eye Protection.....	23
XI. Laser Safety Officer .....	26
XII. Control of Non-beam Hazards .....	34
XIII. Laser Calculations and Measurements .....	40
XIV. Summary .....	41
XV. Appendix.....	44
XVI. List of Figures and Tables .....	49

## **I. Introduction**

The increasingly widespread use of lasers requires more people to become familiar with the potential hazards associated with the misuse of this valuable product of modern science. Lasers are used in many applications, including material processing, construction, medicine, communications, energy production, and national defense. Of importance from a safety consideration, however, is the introduction of laser devices into more consumer-oriented retail products, such as the laser scanning devices, office copy and printing machines, and audio/visual and computer CD systems. Most devices in these markets emit relatively low power levels and consequently, since their beams are enclosed, their use poses no laser hazard.

## **II. Laser Hazards**

The basic hazards from laser equipment can be categorized as follows:

### **A. Laser Radiation Hazards**

Current lasers emit beams of optical radiation. Optical radiation (ultraviolet, visible, and infrared) is termed non-ionizing radiation to distinguish it from ionizing radiation such as X-rays and gamma rays, which are known to cause different biological effects. X-ray lasers are under development, but are limited to a few special laboratories.

#### *1. Eye hazards*

Corneal or retinal burns (or both), depending upon laser wavelength, are possible from acute exposure. Corneal or lenticular opacities (cataracts), or retinal injury may be possible

## Laser Safety Guide

**Table IV\***

### Typical Laser Classification - Single-Pulsed Point-Source Lasers

Wavelength (nm)	Laser Type	Wavelength ( $\mu\text{m}$ )	Pulse Duration (s)	Class 1 (J)	Class 3b (J)	Class 4 (J)
Ultraviolet						
180 to 400	Excimer (ArF)	0.193	$20 \times 10^{-9}$	$\leq 2.4 \times 10^{-5}$	} > Class 1 but $\leq 0.125$	} > 0.125
	Excimer (KrF)	0.248	$20 \times 10^{-9}$	$\leq 2.4 \times 10^{-5}$		
	Neodymium: YAG Q-switched (Quadrupled)	0.266	$20 \times 10^{-9}$	$\leq 2.4 \times 10^{-5}$		
	Excimer (XeCl)	0.308	$20 \times 10^{-9}$	$\leq 5.3 \times 10^{-5}$		
	Nitrogen	0.337	$20 \times 10^{-9}$	$\leq 5.3 \times 10^{-5}$		
	Excimer (XeF)	0.351	$20 \times 10^{-9}$	$\leq 5.3 \times 10^{-5}$		
	Visible					
0.400 to 0.700	Rhodamine 6G (Dye Laser)	0.450-0.650	$1 \times 10^{-6}$	} $\leq 1.9 \times 10^{-7}$	} > Class 1 but $\leq 0.03$	} > 0.03
	Copper Vapor	0.510, 0.578	$2.5 \times 10^{-9}$			
	Neodymium: YAG (Doubled) (Q- switched)	0.532	$20 \times 10^{-9}$			
	Ruby (Q-switched)	0.6943	$20 \times 10^{-9}$			
	Ruby (Long Pulse)	0.6943	$1 \times 10^{-3}$			
Near Infrared						
0.700 to 1.4	Ti: Sapphire	0.700-1.000	$6 \times 10^{-6}$	$\leq 1.9 \times 10^{-7}$	} > Class 1 but $\leq 0.033^{\dagger*}$	} > 0.033 <sup>†</sup>
	Alexandrite	0.720-0.800	$1 \times 10^{-4}$	$\leq 7.6 \times 10^{-7}$		
	Neodymium: YAG (Q-switched)	1.064	$20 \times 10^{-9}$	$\leq 1.9 \times 10^{-6}$		
Far Infrared						
1.400 to $10^3$	Erbium: Glass	1.540	$10 \times 10^{-9}$	$\leq 7.9 \times 10^{-3}$	} > Class 1 but $\leq 0.125$	} > 0.125
	Co: Magnesium- Fluoride	1.8-2.5	$80 \times 10^{-6}$	$\leq 7.9 \times 10^{-4}$		
	Holmium	2.100	$250 \times 10^{-6}$	$\leq 7.9 \times 10^{-4}$		
	Hydrogen Fluoride	2.600-3.000	$0.4 \times 10^{-6}$	$\leq 1.1 \times 10^{-4}$		
	Erbium	2.940	$250 \times 10^{-6}$	$\leq 5.6 \times 10^{-4}$		
	Carbon Dioxide	10.6	$100 \times 10^{-9}$	$\leq 7.9 \times 10^{-5}$		
	Carbon Dioxide	10.6	$1 \times 10^{-3}$	$\leq 7.9 \times 10^{-4}$		

\* Copied with permission from ANSI Z136.1-2007, Table C2.

† Class 3B AEL varies from 0.033 to 0.480 J corresponding to wavelengths that vary between 720 and 800 nm.

**Table V**  
**States with some Form of Current Laser Safety Obligation.**

<b>State</b>	<b>Dept. or Agency</b>	<b>Title</b>
Alaska	Environmental Conservation	Title 18, Art 7
Arizona	Radiation Reg. Agency	Title 12, Art 14
Arkansas	Div. Radiation Control and Emergency Management	Act 460
Florida	Dept. Health/ Rehab Services	Non-ionizing Ch: 10D-89
Georgia	Dept. of Public Health	Ch: 290-5-27
Illinois	Dept. of Nuclear Energy	Title 32-II-315 (proposed)
Massachusetts	Dept. of Public Health	105 CMR 121
New York	Dept. of Labor	Code Rule 50
Texas	Dept. of Health	Title 25, Ch. 289
Washington	Labor and Industry	Ch: 296-62-WAC

## **XVI. List of Figures and Tables**

### **Figures**

Figure 1	Schematic of the human eye and its focusing effect.....	3
Figure 2	Optical absorption sites of laser radiation .....	5
Figure 3	Intrabeam viewing of direct (primary beam).....	14
Figure 4	Intrabeam viewing of flat surface, specularly reflected (secondary) beam.....	14
Figure 5	Intrabeam viewing of curved surface, specularly reflected (secondary) beam.....	14
Figure 6	Extended source viewing of normally diffuse reflection.....	14
Figure 7	Sample warning sign for Class 2, Class 2M and certain Class 3R lasers.....	17
Figure 8	Sample warning sign for certain Class 3R, Class 3B and Class 4 lasers.....	17
Figure 9	Sample IEC warning logo.....	18
Figure 10	Sample laser temporary controlled area sign.....	18
Figure 11	Filter lens divergence.....	24

### **Tables**

Table 1	Visible and Near-IR MPEs Values for Direct Ocular Exposure .....	11
Table 2a	Some Examples of Point Source Ocular Exposure Limits for Selected CW Lasers.....	12
Table 2b	Examples of Skin Exposure Limits for Selected CW Lasers.....	13
Table 3	Simplified Method for Selecting Laser Eye Protection .	25
Table 4	Duties of the Laser Safety Officer .....	27



Table 5	Engineering Control Measures for Each of the Laser Classifications.....	29
Table 6	Administrative and Procedural Control Measures for Each of the Laser Classifications.....	30

**XV. Appendix**

Table Ia	Point-Source Maximum Permissible Exposure Limits that are applicable to many common CW lasers for eye and skin exposure to laser radiation .....	44
Table Ib	Point-Source Maximum Permissible Exposure Limits that are applicable to many common pulsed lasers for eye and skin exposure to laser radiation.....	45
Table II	Useful Radiometric Terms and Units .....	45
Table III	Typical Laser Classifications for Continuous-Wave Lasers.....	46
Table IV	Typical Laser Classifications for Pulsed Lasers.....	47
Table V	States with some Form of Laser Safety Obligation .....	48