Laser Institute of America

Laser Safety Guide

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Prepared by
LIA Laser Safety Committee

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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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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

Table IV*
Typical Laser Classification - Single-Pulsed Point-Source Lasers

Wavelength (nm)	Laser Type	Wavelength (μm)	Pulse Duration (s)	Class 1 (J)	Class 3b (J)	Class 4 (J)
Ultraviolet						
180 to 400	Excimer (ArF)	0.193	20×10^{-9}	$\leq 2.4 \times 10^{-5}$		
	Excimer (KrF)	0.248	20×10^{-9}	$\leq 2.4 \times 10^{-5}$		
	Neodymium: YAG Q-switched (Quadrupled)	0.266	20×10^{-9}	$\leq 2.4 \times 10^{-5}$	> Class 1 but ≤ 0.125	> 0.125
	Excimer (XeCl)	0.308	20×10^{-9}	$\leq 5.3 \times 10^{-5}$		
	Nitrogen	0.337	20×10^{-9}	$\leq 5.3 \times 10^{-5}$		
	Excimer (XeF)	0.351	20×10^{-9}	$\leq 5.3 \times 10^{-5}$		
Visible						
0.400 to 0.700	Rhodamine 6G (Dye Laser)	0.450-0.650	1×10^{-6}	$\leq 1.9 \times 10^{-7}$	> Class 1 but ≤ 0.03	> 0.03
	Copper Vapor	0.510, 0.578	2.5×10^{-9}			
	Neodymium: YAG (Doubled) (Q-switched)	0.532	20×10^{-9}			
	Ruby (Q-switched)	0.6943	20×10^{-9}			
	Ruby (Long Pulse)	0.6943	1×10^{-3}	$\leq 3.9 \times 10^{-6}$		
Near Infrared						
0.700 to 1.4	Ti: Sapphire	0.700-1.000	6×10^{-6}	$\leq 1.9 \times 10^{-7}$		
	Alexandrite	0.720-0.800	1×10^{-4}	$\leq 7.6 \times 10^{-7}$	> Class 1 but ≤ 0.033†*	> 0.033†
	Neodymium: YAG (Q-switched)	1.064	20×10^{-9}	$\leq 1.9 \times 10^{-6}$	>Class 1 but ≤ 0.125	> 0.125
Far Infrared	Erbium: Glass	1.540	10×10^{-9}	$\leq 7.9 \times 10^{-3}$		
1.400 to 10^3	Co: Magnesium-Fluoride	1.8-2.5	80×10^{-6}	$\leq 7.9 \times 10^{-4}$		
	Holmium	2.100	250×10^{-6}	$\leq 7.9 \times 10^{-4}$	> Class 1 but ≤ 0.125	> 0.125
	Hydrogen Fluoride	2.600-3.000	0.4×10^{-6}	$\leq 1.1 \times 10^{-4}$		
	Erbium	2.940	250×10^{-6}	$\leq 5.6 \times 10^{-4}$		
	Carbon Dioxide	10.6	100×10^{-9}	$\leq 7.9 \times 10^{-5}$		
	Carbon Dioxide	10.6	1×10^{-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.

State	Dept. or Agency	Title
Alaska	Environmental Conversation	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

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