3.3 Laser and Laser System Hazard Classification Definitions.

This section provides technical definitions of laser and laser system hazard classifications.

3.3.1 Class 1 and 1M Lasers and Laser Systems.

3.3.1.1 Class 1. Any laser or laser system that cannot emit accessible laser radiation levels during operation in excess of the applicable Class 1 AEL for any emission duration within the maximum duration inherent in the design or intended use of the laser or laser system is a Class 1 laser or laser system during operation. A Class 1 laser or laser system is exempt from user control measures with the exception of requirements applicable for embedded higher class lasers (see Sections 4.4.1.1 and 4.4.2.1). The exemption strictly applies to emitted laser radiation hazards and not to other potential hazards (see Section 7). The maximum exposure duration for operating wavelengths less than 700 nm is assumed to be no more than 30,000 s. The maximum exposure duration used for infrared systems, $\lambda > 700$ nm, shall be 100 s. The time basis strictly applies to emitted laser radiation hazards and not to any other potential hazards (see Section 7). Lasers or laser systems intended for a specific use may be designated Class 1 by the LSO on the basis that use for a limiting exposure duration of T_{max} is less than 100 s. In that instance, the accessible laser radiation shall not exceed the corresponding Class 1 AEL for any emission duration within the maximum duration inherent in that specific use.

3.3.1.2 Class 1M. Any laser or laser system that cannot emit, during operation, accessible laser radiation levels in excess of the applicable Class 1 AEL under the conditions of measurement for the unaided eye, but exceeds the Class 1 AEL for telescopic viewing, Condition 1 in Table 11, and does not exceed the Class 3B AEL for any emission duration within the maximum duration inherent in the design or intended use of the laser or laser system, is a Class 1M laser or laser system. The maximum exposure duration is assumed to be no more than 30,000 s.

3.3.2 Class 2 and 2M Lasers and Laser Systems That Output Visible Radiation.

3.3.2.1 Class 2. Any laser or laser system that emits visible 400 nm to 700 nm CW or repetitive-pulsed output that can emit accessible radiant energy exceeding the appropriate Class 1 AEL for the maximum duration inherent in the design or intended use of the laser or laser system, but not exceeding the Class 1 AEL for any applicable pulse (emission) duration < 0.25 s is a Class 2 laser or laser system. The Class 2 AEL is based on the MPE for a 0.25 s exposure duration for a laser with a visible output.

3.3.2.2 Class 2M. Any laser or laser system that cannot emit, during operation, accessible laser radiation levels in excess of the applicable Class 2 AEL under the conditions of measurement for the unaided eye, but exceeds the Class 2 AEL for telescopic viewing, Condition 1 in Table 11, and does not exceed the Class 3B AEL for any emission duration within the maximum duration inherent in the design or intended use of the laser or laser system, is a Class 2M laser

or laser system. The maximum exposure duration is assumed to be no more than 0.25 s. Class 2M lasers and laser systems pose the same ocular hazards to the unaided eye as Class 2, but are potentially hazardous when viewed with optical aids.

3.3.3 Class 3R and 3B Lasers and Laser Systems.

3.3.3.1 Class 3R. Class 3R lasers and laser systems include those that have an accessible output between one and five times the Class 1 AEL for wavelengths shorter than 400 nm or longer than 700 nm, or less than five times the Class 2 AEL for visible wavelengths between 400 nm and 700 nm.

NOTE—Lasers can be classified as Classes 1M and 2M even if their output exceeds Class 3R in the case of a large output beam.

3.3.3.2 Class 3B. Class 3B lasers and laser systems include

a) Lasers and laser systems operating outside the retinal hazard region, that is, < 400 nm or > 1400 nm, that can emit accessible radiant power in excess of the Class 3R AEL during any emission duration within the maximum duration inherent in the design of the laser or laser system, but which

1. cannot emit an accessible average radiant power in excess of 0.5 W for $T \geq 0.25$ s,

or,

2. cannot produce accessible radiant energy greater than 0.125 J within an exposure duration $T < 0.25$ s.

b) Visible, 400 nm to 700 nm, and near infrared, 700 nm to 1400 nm, lasers and laser systems that emit in excess of the AEL of Class 3R, but which

1. cannot emit an accessible average radiant power in excess of 0.5 W for $T \geq 0.06\ C_A$ s,

and,

2. cannot emit an accessible radiant energy greater than $0.03\ C_A$ J per pulse for $t < 0.06\ C_A$ s when 0.5 W peak power is exceeded. In addition, the per pulse accessible radiant energy shall not exceed 0.125 J. For this limit, pulses separated by less than t_{min} (see Table 2) are to be considered one pulse.

3.3.4 Class 4 Lasers and Laser Systems. Class 4 lasers and laser systems are those that emit accessible laser radiation that exceeds the Class 3B AEL.