HARDWARE SAFETY LIST **(Rev. 7)** 28.11.05

International Laser Display Association
www.laserist.org

This guidance is based on the International Standard:	IEC 60825-1	www.iec.ch
Other standards may apply additionally or be harmonized such as :	ANSI	http://ansi.org
	CDRH	www.fda.gov/cdrh/
	DIN , VBG	

This guidance provides a summary of the engineering and labelling requirements defined in the IEC 60825.1 Laser Safety Standard that are most likely to be required of laser projection equipment used for display purposes. The guidance is not intended to replace the information present in the official Standard or its counterparts that are mandatory in various territories throughout the world. Reference should be made to IEC 60825-1 for the full requirements.

Some countries have adopted the IEC Standard under legislation (for example in Europe, it is a condition of CE marking for equipment covered by the Low Voltage Directive). In the USA, the Federal Product Performance Standard (Part 1040) applies to laser products. However, through Laser Notice 50 (July 26, 2001) products which comply with the IEC Standard may comply / be assumed to comply / with the requirements of Part 1040. Reference to the Laser Notice should be made for further information.

Governmental, country, state or county laws enforce appropriate behaviour of the user, the manufacture and the specifications of the product itself, which may override specific laser safety standards.

Principal definitions throughout this document use the words "*shall*" and "*should*". In keeping with the meanings defined in the International Standard, the word "*shall*" is to be considered as mandatory, and the word "*should*" is to be understood as advisory.

This guidance refers to edition 1.2 of IEC 60825-1: 2001. It will be updated as further editions are published

MPE = Maximum Permissible Exposure

WARNING !

Laser display applications shall not allow human access to laser radiation in excess of the allowed MPE at any time.

Contributors for this initial draft:

Peter Mayer	**Creative Laser Production, Germany**
John O'Hagan	**Health Protection Agency, United Kingdom**
James Stewart	**Laser Visuals Limited, United Kingdom**

Engineering Requirements

Laser products require certain built-in safety features, depending on the class to which they have been assigned by the manufacturer. The requirements for these are given in paragraphs 4.2 to 4.10 of the IEC 60825-1 Standard. A summary of these engineering requirements follows on Table 1.

The manufacturer shall ensure that the personnel responsible for the classification of the laser products and systems have received training to the appropriate level which allows them to understand the full implications of the classification scheme

Table 1 – Engineering Requirements

Specification	CLASS 2	CLASS 3R	CLASS 3B	CLASS 4	NOTES
PROPER HOUSING OF THE OPTICAL SECTION		X	X	X	The complete beam path shall be enclosed during normal use. Radiation shall only exit through intended apertures. **See note 1**
OPTO-MECHANICAL STABLE AND SAFE CONSTRUCTION	X	X	X	X	The complete optical assembly shall be stable under normal operation and transport conditions, including effects from vibration and climatic conditions **See note 1**
OPTICAL COMPONENT MATERIALS				!	All assemblies in the optical section should withstand or absorb full laser power without physical degradation
MECHANICAL OUTPUT APERTURE		X	X	X	The aperture shall limit the emission exit field physically to ensure that the MPE is not exceeded in locations of human access
STRAY LIGHT EMISSION		X	X	X	No stray light emitted should exceed AEL level allowed above Laser Class 2 **See note 1**
EXTERNAL INTERLOCK TO ACTIVATE EMISSION			X	X	Remote Interlock between Laser Projector and the Control System **See note 4**
KEYSWITCH TO START LASER EMISSION			X	X	The keyswitch shall not be removable when in the ”ON“ position **See note 3**
LASER EMISSION INDICATOR			X	X	**See note 2**
MECHANICAL SHUTTER (BEAM ATTENUATOR) (BEAM STOP)			X	X	**See note 6**
SCANFAIL DEVICE FOR AUDIENCE SCANNING			X	X	**See note 5**
LASER POWER SUPPLY MANUAL RESET FUNCTION				X	Manual Reset required to activate the laser following an interruption to emission caused by mains power or interlock loss **See note 7**
PRODUCT LABELLING	X	X	X	X	All laser products require specific labelling

Legend: X = shall be fulfilled ! = should be fulfilled

Note 1: Protective Housing IEC 60825-1 paragraph 4.2.1
Each laser product shall have a protective housing which, when in place, prevents human access to laser radiation (including errant laser radiation) in excess of Class 1, except when human access is necessary for the performance of the function(s) of the product.

Environmental Conditions IEC 60825-1 paragraph 4.13
The laser product shall meet the safety requirements defined in this standard under all expected operation conditions appropriate to the intended use of the product. Factors to be considered shall include:

- climatic conditions (e.g. temperature, relative humidity)
- vibration and shock

Alignment Aids IEC 60825-1 paragraph 4.11
Where routine maintenance requires the alignment of beam path components, then a safe means of achieving this shall be provided.

Note 2: Laser Emissions Indicator IEC 60825-1 paragraph 4.6
Each Class 3R laser system in the wavelength range below 400 nm and above 700 nm and each Class 3B and Class 4 laser system shall give an audible or visible warning when it is switched on or if capacitor banks of a pulsed laser are being charged or have not positively discharged. The warning device shall be fail-safe or redundant. Any visible warning device shall be clearly visible through protective eyewear specifically designed for the wavelength(s) of the emitted laser radiation. The visible warning device(s) shall be located so that viewing does not require exposure to laser radiation in excess of the AEL for Class 1 and 2.

Each operational control and laser aperture that can be separated by 2 metres or more from a radiation warning device shall itself be provided with a radiation warning device. The warning device shall be clearly visible or audible to the person in the vicinity of the operational control or laser aperture.

Where the laser emission may be distributed through more than one output aperture, then a visible warning device shall clearly indicate the output aperture or apertures through which laser emission can occur.

Note 3: Keyswitch Control IEC 60825-1 paragraph 4.5
Each Class 3B and Class 4 laser system shall incorporate a key-operated master control. The key shall be removable and the laser radiation shall not be accessible when the key is removed. In this part 1 the term "key" includes any other control devices, such as magnetic cards, cipher combinations, etc.

Note 4: Remote Interlock Connector IEC 60825-1 paragraph 4.4
Each Class 3B and Class 4 laser system shall have a remote interlock connector. When the terminals of the connector are open-circuited, the accessible radiation shall not exceed Class 1 or Class 2 as applicable.

Note 5: Scanning Safeguard IEC 60825-1 paragraph 4.10
Laser products intended to emit scanned radiation, and classified on this basis, shall not, as a result of scan failure or of variation in either scan velocity or amplitude, permit human access to laser radiation in excess of the AEL for the assigned class.

Note 6: Beam Stop or Attenuator IEC 60825-1 paragraph 4.7
Each Class 3B and Class 4 laser system shall incorporate one or more permanently attached means of attenuation (beam stop or attenuator, other than a laser energy source switch, mains connector or key control). The beam stop or attenuator shall be capable of preventing human access to laser radiation in excess of Class 1 or Class 2 as applicable.

Note 7: Manual Reset
Each Class 4 laser system shall incorporate a manual reset to enable resumption of accessible Class 4 laser radiation emission after interruption of emission caused by the use of the remote interlock connector or an interruption of longer than 5 seconds of electrical mains power.

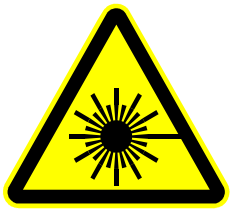
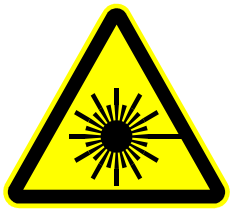
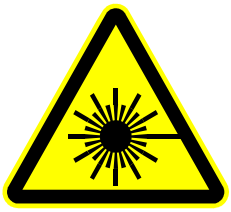
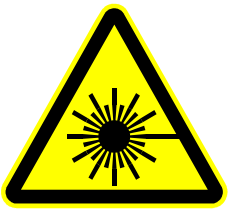
NOTE Manufacturers may include a second interlock connector that does not require active action for starting emission, but it is not required for a product to have two connectors."

Product Labelling IEC 60825-1 paragraph 5.1

Each laser product shall carry labels in accordance with the requirements of the laser projector classification. The labels shall be permanently fixed, legible, and clearly visible during operation, maintenance or service, according to their purpose. They shall be so positioned so that they can be read without the necessity for human exposure to laser radiation in excess of the AEL for Class 1. Text, symbols and boarders shall be black on a yellow background.

IEC 60825-1 Fig. 15 Explanatory Label

Table 2 – Labelling Requirements

	CLASS 2	CLASS 3R	CLASS 3B	CLASS 4
WARNING LABEL				
EXPLANATORY LABEL	**LASER RADIATION DO NOT STARE INTO BEAM CLASS 2 LASER PRODUCT**	**LASER RADIATION AVOID DIRECT EYE EXPOSURE CLASS 3R LASER PRODUCT**	**LASER RADIATION AVOID EXPOSURE TO BEAM CLASS 3B LASER PRODUCT**	**LASER RADIATION AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION CLASS 4 LASER PRODUCT**
RADIATION OUTPUT AND STANDARDS INFORMATION LABEL	Maximum Output of Laser Radiation Pulse Duration (if appropriate) Emitted Wavelength(s) Standard Name and Date	Maximum Output of Laser Radiation Pulse Duration (if appropriate) Emitted Wavelength(s) Standard Name and Date	Maximum Output of Laser Radiation Pulse Duration (if appropriate) Emitted Wavelength(s) Standard Name and Date	Maximum Output of Laser Radiation Pulse Duration (if appropriate) Emitted Wavelength(s) Standard Name and Date
APERTURE LABEL		LASER APERTURE or AVOID EXPOSURE – LASER RADIATION IS EMITTED FROM THIS APERTURE	**LASER APERTURE or AVOID EXPOSURE – LASER RADIATION IS EMITTED FROM THIS APERTURE**	**LASER APERTURE or AVOID EXPOSURE – LASER RADIATION IS EMITTED FROM THIS APERTURE**

Warning Label IEC 60825-1 paragraphs 5.3 – 5.6
Each Class 2, 3R, 3B and 4 laser product shall have affixed a warning label (IEC60825-1 figure 14) termed a "laser starburst" symbol.

Explanatory Label IEC 60825-1 paragraphs 5.3 – 5.6
Each Class 2, 3R, 3B and 4 laser product shall have an explanatory label bearing the correct wording appropriate for the laser product class, as shown in the table 2 (labelling requirements)

Aperture Label IEC 60825-1 paragraph 5.7
Each Class 3R, Class 3B and Class 4 laser product shall have affixed a label close to each aperture through which laser radiation in excess of the AEL for Class 1 or Class 2 is emitted.

Radiation Output and Standards Information IEC 60825-1 paragraph 5.8
Each laser product, except those of Class 1, shall be described on the explanatory label (figure 15 of IEC 60825-1) by a statement of the maximum output of laser radiation, the pulse duration (if appropriate) and the emitted wavelength(s). The name and publication date of the standard to which the product was classified shall be included on the explanatory label or elsewhere in close proximity on the product.