

TECHNICAL REPORT

IEC 60825-5

First edition
1998-11

Safety of laser products –

Part 5: Manufacturer's checklist for IEC 60825-1

Sécurité des appareils à laser –

Partie 5: Liste de contrôle du fabricant relative à la CEI 60825-1



Reference number
IEC 60825-5:1998(E)

Numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series.

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Commission Electrotechnique Internationale
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Международная Электротехническая Комиссия

PRICE CODE

R

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SAFETY OF LASER PRODUCTS –

Part 5: Manufacturer's checklist for IEC 60825-1

FOREWORD

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Technical reports do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

IEC 60825-5, which is a technical report, has been prepared by IEC technical committee 76: Optical radiation safety and laser equipment.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
76/160/CDV	76/187/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This document, which is purely informative, is not to be regarded as an International Standard.

SAFETY OF LASER PRODUCTS –

Part 5: Manufacturer's checklist for IEC 60825-1

SECTION ONE – GENERAL

NOTE – Numbers shown in parenthesis refer to the relevant clause in IEC 60825-1

1 Scope (1.1)

This technical report is applicable to laser products as described in IEC 60825-1.

2 Object (1.2)

The checklist is intended for use by manufacturers of laser products and their agents to establish that each new or modified design complies with the requirements of IEC 60825-1: 1993. The checklist is not a substitute for IEC 60825-1. It is necessary to use IEC 60825-1 in conjunction with the checklist, as relevant clauses and subclauses are referred to in the text.

The layout of the checklist is intended only as a guide. Manufacturers and examiners are encouraged to produce their own document, omitting questions and clauses that are not relevant to the types of product under examination, but noting in the appropriate positions the numbers of such clauses stating, for example: "subclause 4.3.2: Question omitted – not applicable".

The manufacturer should ensure that the examiner is a person competent in the inspection and classification of laser products.

3 Definitions

The definitions of IEC 60825-1 apply.

4 Identification

4.1 Details of examiner

Identification of the person responsible for examining and classifying the product under inspection:

Name: _____ Position: _____
print full name print full title

If the above named person is not an employee of the manufacturer of the laser product to be examined, state the details of the employing organization:

Organization: _____

Address: _____

4.2 Laser product

Details of product to be inspected:

Manufacturer: _____

Address: _____

Name and/or Model Number of laser product: _____

Serial Number of laser product: _____

Date of manufacture (if known): _____ Date of examination: _____



SECTION TWO – MANUFACTURING REQUIREMENTS

NOTE 1 – Numbers shown in parenthesis and italics refer to the relevant clause in IEC 60825-1.

NOTE 2 – Where a YES or NO answer is shown in this text as underlined, failure to give that answer, if applicable for this product, implies failure to comply with the requirements of IEC 60825-1 and corrective action will be required by the manufacturer or his agent if compliance is to be achieved.

NOTE 3 – If additional information is available to support answers given, write ENCL. in the right hand column and attach the information to the back of the checklist, referencing the relevant clause in the checklist.

NOTE 4 – If a question is not applicable to the laser product being examined, write N/A in the right hand column.

5 Tests

5.1 Measurements for determining classification

5.1.1 Have measurements of laser radiation been carried out in accordance with the requirements of clause 8 of IEC 60825-1? YES/NO

5.1.2 If NO, have measurements been deemed unnecessary by virtue of the physical characteristics and limitations of the laser source, so that the laser product is placed clearly in a particular class according to IEC 60825-1, clause 9? YES/NO

– *If NO, measurements for the determination of classification are required and shall be carried out in accordance with the requirements of clause 8 of IEC 60825-1 before proceeding further. See annex A of this technical report for guidance.*

5.1.3 If YES to either 5.1.1 or 5.1.2, state the following:

– wavelength or wavelength range of accessible laser radiation*:

– maximum level of accessible laser radiation*:

6 Classification

6.1 Classification procedure

See annex A

State the Class assigned to the laser product: _____

7 Labelling for Laser Radiation (5)

NOTE 1 – For all labels for light emitting diodes the word "laser" shall be replaced by "LED".

NOTE 2 – The words "laser light" on explanatory labels may be substituted for "laser radiation" if the output of the laser is in the visible range of 400 nm – 700 nm wavelength.

NOTE 3 – The words "invisible laser radiation" shall be substituted for "laser radiation" if the output of the laser is outside the visible range of 400 nm – 700 nm wavelength.

NOTE 4 – The words "visible and invisible laser radiation" shall be substituted for "laser radiation" if the output of the laser is both inside and outside the visible range of 400 nm – 700 nm wavelength.

* Values should be expressed in units according to, and in consideration of, subclauses 8.2f to 8.2k of IEC 60825-1.

NOTE 5 – All labels shall be:

- permanently affixed;
- legible and clearly visible during operation, maintenance or service, according to their purpose;
- positioned so that they can be read without the necessity for human exposure to laser radiation in excess of the AEL for Class 1;
- with black text on a yellow background, except where specified.

If the size or design of the product makes labelling impractical, the labels should be included with the user information or the package

7.1 Class 1 laser products

7.1.1 Is the following explanatory label (IEC 60825-1, figure 15) affixed to the product or included in the information for the user?

CLASS 1 LASER PRODUCT YES/NO

NOTE –The colour combination of black/yellow is optional for this label.

7.2 Class 2 laser products

7.2.1 Is a warning label affixed to the product (IEC 60825-1, figure 14)? YES/NO

7.2.2 Is the following explanatory label (IEC 60825-1, figure 15) affixed to the product?

LASER RADIATION
DO NOT STARE INTO BEAM
CLASS 2 LASER PRODUCT YES/NO

(See 7.6 for additional requirements for this label.)

7.3 Class 3A laser products

7.3.1 Is a warning label affixed to the product (IEC 60825-1, figure 14)? YES/NO

7.3.2 Is the following explanatory label (IEC 60825-1, figure 15) affixed to the product?

LASER RADIATION
DO NOT STARE INTO BEAM OR VIEW
DIRECTLY WITH OPTICAL INSTRUMENTS
CLASS 3A LASER PRODUCT YES/NO

(See 7.6 for additional requirements for this label.)

7.4 Class 3B laser products

7.4.1 Is a warning label affixed to the product (IEC 60825-1, figure 14)? YES/NO

7.4.2 Is the following explanatory label (IEC 60825-1, figure 15) affixed to the product?

LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT YES/NO

(See 7.6 for additional requirements for this label.)

7.4.3 An aperture warning label shall be affixed on Class 3B laser products close to each laser aperture through which laser radiation in excess of the AEL for Class 1 or Class 2 is emitted. The label should bear the words:

LASER APERTURE

or the words:

AVOID EXPOSURE – LASER RADIATION IS EMITTED
FROM THIS APERTURE

Aperture warning label(s) affixed? YES/NO

7.5 Class 4 laser products

7.5.1 Is a warning label affixed to the product (IEC 60825-1, figure 14)? YES/NO

7.5.2 Is the following explanatory label (IEC 60825-1, figure 15) affixed to the product?

LASER RADIATION
AVOID EYE OR SKIN EXPOSURE TO
DIRECT OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT YES/NO

(See 7.6 for additional requirements for this label.)

7.5.3 An aperture warning label shall be affixed on Class 4 laser products close to each laser aperture through which laser radiation in excess of the AEL for Class 1 or Class 2 is emitted. The label should bear the words:

LASER APERTURE

or the words:

AVOID EXPOSURE – LASER RADIATION
IS EMITTED FROM THIS APERTURE

Aperture warning label(s) affixed? YES/NO

7.6 Radiation output and standards information

7.6.1 If the laser product is in Class 2, Class 3A, Class 3B or Class 4, does the explanatory label include statements of:

- the maximum output of laser radiation? YES/NO
- the pulse duration (if appropriate)? YES/NO
- the emitted wavelength(s)? YES/NO
- the name and publication date of the standard to which the laser product was classified (may be included elsewhere on the laser product, close to the explanatory label)? YES/NO

Is this information included on the explanatory label? YES/NO

If NO, is it included elsewhere on the laser product? YES/NO

8 Engineering specifications

8.1 Protective housing (4.2)

8.1.1 Does the laser product have a protective housing which, when in place, apart from laser apertures, prevents human access to laser radiation in excess of Class 1, except where human access is necessary for the performance of the functions of the product? (3.32 and 4.2.1) YES/NO

The laser product cannot be certified to comply with the requirements of IEC 60825-1 unless all deficiencies are corrected.

8.1.2 Is a removable laser product included within the protective housing? (4.2.3) YES/NO

– If NO:

Answer questions below as appropriate to the laser classification.

– If YES:

Can the laser product be removed from the protective housing and operated without modification? YES/NO

– If NO, answer questions below as appropriate to the laser class assigned to the complete system.

– If YES, the removable laser product shall comply with the requirements of clauses 4 and 5 of IEC 60825-1 appropriate to its class and should additionally be inspected according to the appropriate questions in this checklist.

8.2 Access panels and safety interlocks (4.2 and 4.3)

8.2.1 Are all non-interlocked panels which are intended for removal or displacement for service and which would allow access to laser radiation in excess of the AEL assigned, secured in such a way that removal or displacement requires the use of tools? (4.2.2) YES/NO

NOTE – The labels described in 8.2.2 and 8.2.6 below shall be subject to the same wording changes as described in the introductory notes to clause 7 as appropriate for LED and visible and/or invisible radiation products.

8.2.2 Is each non-interlocked panel or connection, which would allow access to laser radiation in excess of the AEL of Class 1 when removed or displaced, fitted with a label bearing the following words? (5.9.1):

- For accessible radiation not exceeding the AEL for Class 2:

CAUTION – LASER RADIATION WHEN OPEN
DO NOT STARE INTO BEAM

- For accessible radiation not exceeding the AEL for Class 3A:

CAUTION – LASER RADIATION WHEN OPEN
DO NOT STARE INTO BEAM OR
VIEW DIRECTLY WITH OPTICAL INSTRUMENTS

- For accessible radiation not exceeding the AEL for Class 3B:

CAUTION – LASER RADIATION WHEN OPEN
AVOID EXPOSURE TO BEAM

- For accessible radiation exceeding the limits for Class 3B at any wavelength:

CAUTION – LASER RADIATION WHEN OPEN
AVOID EYE OR SKIN EXPOSURE TO
DIRECT OR SCATTERED RADIATION

Correct label(s) fitted? YES/NO

8.2.3 Are all panels, which are intended for removal or displacement in order to gain access during maintenance or operation, interlocked to prevent human access to interior laser radiation as indicated in the table below? (4.3.1)

Product Class	Interlock required when accessible emission is of the following class or higher
1	3B
2	3B
3A	3B
3B	3B*
4	3B*

* Not required if the interior accessible laser radiation is Class 3B, is in the range 400 nm – 700 nm, and is less than five times the AEL of Class 2.

Relevant panels interlocked? YES/NO

8.2.4 Where interlocked panels are removable, is the safety interlock of a design which ensures that the accessible laser radiation falls below that of the assigned Class, or below the limits specified in 4.3.1b of IEC 60825-1 before removal is possible? (4.3.1) YES/NO

8.2.5 Is inadvertent resetting of any interlock of a removable panel possible, so that laser radiation is restored above that of the AEL of the assigned Class, or above the limits assigned in the table in 8.2.3? (4.3.1) YES/NO

8.2.6 If an interlock override system is provided (4.3.2):

– Are safe working instructions provided? YES/NO

– Is it possible to leave the override system in operation when the access panel is returned to its normal position? YES/NO

– Is an interlock override warning visible or audible whenever the override is in operation and the laser is energized or its capacitor banks are not fully discharged, whether or not an interlocked panel is removed or displaced? YES/NO

– Are visible warnings clearly visible through protective eyewear specifically designed or specified for the wavelength(s) of the accessible laser radiation? YES/NO

– Is a warning label clearly associated with each interlocked opening, as follows, and visible prior to and during interlock override? (5.9.2)

– For accessible radiation not exceeding the AEL for Class 2:

CAUTION – LASER RADIATION WHEN OPEN
AND INTERLOCKS DEFEATED
DO NOT STARE INTO BEAM

– For accessible radiation not exceeding the AEL for Class 3A:

CAUTION – LASER RADIATION WHEN OPEN
AND INTERLOCKS DEFEATED
DO NOT STARE INTO BEAM OR
VIEW DIRECTLY WITH OPTICAL INSTRUMENTS

– For accessible radiation not exceeding the AEL for Class 3B:

CAUTION – LASER RADIATION WHEN OPEN
AND INTERLOCKS DEFEATED
AVOID EXPOSURE TO BEAM

– For accessible radiation exceeding the limits for Class 3B at any wavelength:

CAUTION – LASER RADIATION WHEN OPEN
AND INTERLOCKS DEFEATED
AVOID EYE OR SKIN EXPOSURE TO
DIRECT OR SCATTERED RADIATION

Correct label(s) fitted? YES/NO

8.3 Remote interlock connector (4.4)

8.3.1 If the laser product is in one of the following classes:

- Class 3B, except for Class 3B with not more than five times the AEL of Class 2 in the wavelength range 400 nm – 700 nm.
- Class 4

is a remote interlock connector provided? YES/NO

- When the terminals are open circuited, will this prevent access to laser energy in excess of the AEL for Class 1, Class 2 or Class 3A? YES/NO

8.4 Key Control (4.5)

8.4.1 If the laser product is in one of the following classes:

- Class 3B, except for Class 3B with not more than five times the AEL of Class 2 in the wavelength range 400 nm – 700 nm.
- Class 4

is a key control provided? YES/NO

8.4.2 If a key control is provided:

is the key removable? YES/NO

is laser radiation accessible when the key is removed? YES/NO

State the form that the key takes (e.g. conventional key, cipher combination, magnetic card, etc.):

8.5 Laser radiation emission warning (4.6)

8.5.1 If the laser product is in one of the following classes:

- Class 3B, except for Class 3B with not more than five times the AEL of Class 2 in the wavelength range 400 nm – 700 nm.
- Class 4

is an audible or visible warning device provided? YES/NO

is the warning device fail-safe or redundant? YES/NO

- If a visible warning is provided, is it clearly visible through protective eyewear specifically designed or specified for the wavelength(s) of the emitted laser radiation? YES/NO

- Are visible warning devices located so that viewing does not require exposure to laser radiation in excess of the AEL for Class 1 or Class 2? YES/NO
- Can operational controls be separated by 2 metres or more from a radiation emission warning device? YES/NO
- If YES, are the operational controls provided with audible or visible warning devices? YES/NO
- Can the laser aperture be separated by 2 metres or more from a radiation emission warning device? YES/NO
- If YES, is the laser aperture provided with an audible or visible warning device? YES/NO
- Where more than one output aperture is provided, does a visible warning device located at each aperture clearly indicate through which aperture(s) laser emission can occur? YES/NO

8.6 Beam stop or attenuator (4.7)

- 8.6.1** If the laser product is in one of the following classes:
- Class 3B, except for Class 3B with not more than five times the AEL of Class 2 in the wavelength range 400 nm – 700 nm. YES/NO
 - Class 4 YES/NO
- is a beam stop or attenuator provided? YES/NO
- When the beam stop or attenuator is closed, will this prevent access to laser energy in excess of the AEL for Class 1, Class 2 or Class 3A? YES/NO

8.7 Controls (4.8)

- 8.7.1** Are the controls for the laser product located so that adjustment and operation do not require exposure to laser radiation in excess of the AEL for Class 1 and Class 2? YES/NO

8.8 Viewing optics (4.9)

- 8.8.1** If viewing optics, viewport or display screens are provided, is attenuation of laser radiation sufficient to prevent human access in excess of the AEL for Class 1? YES/NO
- 8.8.2** If a shutter or variable attenuator is incorporated in the viewing optics, viewport or display screen:
- are means provided to prevent human access to laser radiation in excess of the AEL for Class 1 when the shutter is open or the attenuation is varied? YES/NO

- is the shutter prevented from opening or is the attenuator prevented from variation when exposure to laser radiation is possible in excess of the AEL for Class 1? YES/NO

8.9 Scanning safeguard (4.10)

8.9.1 Does the laser product include means of scanning the emitted laser radiation? YES/NO

- If YES, has the laser product been classified on this basis? YES/NO

- If YES, is human access to laser radiation in excess of the AEL for the assigned class prevented if there is a scan failure or if there is unscheduled variation in either scan velocity or amplitude? YES/NO

8.10 Alignment aids (4.11)

8.10.1 Is a safe means provided for the alignment of beam path components where this is required as part of the routine maintenance? YES/NO

8.11 "Walk-in" access (4.12)

8.11.1 If the protective housing is equipped with access panels which provide "walk-in" access:

- Are means provided so that any person entering the housing can prevent unintentional activation of the laser, except for Class 1, Class 2, Class 3A or Class 3B with not more than five times the AEL for Class 2 in the wavelength region of 400 nm to 700 nm? YES/NO

- Is an emission warning device located so as to provide adequate warning to any person who might be within the housing of emission of laser radiation in excess of the AEL for Class 3A, and those Class 3B lasers with less than five times the AEL for Class 2 in the wavelength region of 400 nm to 700 nm? YES/NO

8.12 Environmental considerations (4.13)

8.12.1 Does the laser product meet the safety requirements defined in IEC 60825-1 or any relevant product safety standard under all expected operating conditions appropriate for the intended use of the product, including:

- Climatic conditions (e.g. temperature, relative humidity)? YES/NO

- Vibration and shock YES/NO

8.13 Protection against other hazards (4.14)

8.13.1 Are the requirements of relevant product safety standards fulfilled during normal operation and in the event of a single fault for the following:

- Electrical hazards? YES/NO
- Excessive temperature? YES/NO
- Spread of fire from the equipment? YES/NO
- Sound and ultrasonics? YES/NO
- Harmful substances? YES/NO
- Explosion? YES/NO

8.13.2 Does the protective housing protect against human access to the hazards of collateral radiation (e.g. UV, visible, IR)? YES/NO

- If NO, has the radiation been evaluated and found not to be above the permitted MPE level(s)? YES/NO

9 Other informational requirements

9.1 Information for the user (6.1)

- 9.1.1** Is an operation manual, or are user instructions supplied with the laser product? YES/NO
- If NO, state the name of the person/company who will provide the manual/instructions:

This person/company shall be asked to provide answers to the remaining questions. of subclauses 9.1 and 9.2, as appropriate.

- If YES, inspect the manual/instructions and answer the following questions:

This requirement is implied in IEC 60825-1, subclause 6.1

9.1.2 Are adequate instructions included:

- for proper assembly of the product? YES/NO
- for proper maintenance of the product? YES/NO
- for the safe use of the product, including clear warnings concerning precautions to avoid possible exposure to hazardous laser radiation? YES/NO

9.1.3 Statements should be provided, in appropriate units, for the following characteristics of the laser output.

Write the stated values in the spaces below:

- Beam divergence of collimated beams: _____

- Pulse duration: _____

- Maximum output: _____

Has allowance been made in the above stated values to the magnitudes of the cumulative measurement uncertainty and any expected increase in the measured quantities at any time after manufacture? YES/NO

Duration of pulses resulting from unintentional mode-locking need not be specified; however, those conditions associated with the product known to result in unintentional mode-locking shall be specified.

9.1.4 Are legible reproductions (colour optional) of all required labels included in the manual/instructions? YES/NO

- Is the corresponding position of each label on the product indicated: YES/NO

- If NO:

- are the labels provided with the product but not affixed? YES/NO

- is a statement made in the information that the labels have been provided separately, including a description of the form and manner in which they have been provided? YES/NO

9.1.5 Is information provided in the operation manual/user instructions indicating the positions of all laser apertures? YES/NO

9.1.6 Does the operation manual/user instructions include a listing of:

- the controls? YES/NO

- the adjustments? YES/NO

- procedures for operation? YES/NO

- procedures for maintenance? YES/NO

9.1.7 Does the operation manual/user instructions include the following statement:

"CAUTION – USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE"

YES/NO

9.1.8 Is the laser energy source necessary for laser emission included in the laser product? YES/NO

– If NO, does the operation manual/user instructions include a statement of the compatibility requirements for a laser energy source in order to ensure safety. YES/NO

9.1.9 For embedded laser products and other incorporated laser products, is similar information to the above provided to describe the incorporated laser, including appropriate safety instructions to avoid inadvertent exposure to hazardous laser radiation? YES/NO

9.2 Purchasing and service information (6.2)

9.2.1 Is the safety classification of the laser product stated in all:

– catalogues? YES/NO

– specification sheets? YES/NO

– descriptive brochures? YES/NO

9.2.2 Are adequate instructions provided to servicing dealers, distributors, and to others upon request, for service adjustments and procedures as follows?

– clear warnings and precautions to be taken to avoid possible exposure to laser radiation and other hazards? YES/NO

– a schedule of maintenance necessary to keep the product in compliance? YES/NO

– a listing of controls and procedures which could be utilised by persons other than the manufacturer or his agents to increase accessible emission levels of radiation? YES/NO

– a description of the location of displaceable portions of the protective housing which could allow access to laser radiation in excess of the accessible limits in tables 1, 2, 3 and 4 of IEC 60825-1? YES/NO

– protective procedures for service personnel? YES/NO

– legible reproductions (colour optional) of the required labels and hazard warnings? YES/NO

Annex A

Classification procedure

NOTE – This procedure is given as an interim guide to aid the assessment of classification. Work currently under way in IEC TC76 WG3 is expected to supersede this annex.

Test measurements and the classification of laser products are described in clauses 8 and 9 of IEC 60825-1. The following is provided as a step-by-step guide to these requirements.

The laser classification procedure can be carried out as follows:

Subclause 8.1 of IEC 60825-1 states that tests shall be carried out during operation of the laser product, and under each and every reasonably foreseeable single fault condition.

- a) Read 8.2 of IEC 60825-1 and Amendment 1 to establish conditions under which measurements should be made.
 - 1) Assume a trial Class (e.g. Class 1)
 - 2) Determine the emission wavelength(s)
 - 3) Determine the appropriate timebase for the product (IEC 60825-1, Amendment 1, 9.3 e).
 - 4) Assess the angular subtense of the source (IEC 60825-1, 9.3 d).
 - 5) Obtain data on the emission time profile (pulse repetition rate, pulse length, peak power, etc.).
 - 6) Determine the measurement aperture and measurement distance (IEC 60825-1 with Amendment 1, 8.2f, 8.2g, 8.2h and 8.2i).
 - 7) Determine the position of the apparent source. This is necessary in order to place the measurement aperture at the required measurement distance.
 - 8) Obtain data on the beam spatial profile at the required measurement distance. This is required to determine the most restrictive point and to calculate the radiation passing through the measurement aperture.
- b) Calculate the trial AEL (e.g. AEL for Class 1) using tables 1 to 4 in IEC 60825-1. (C_1 to C_7 , T_1 and T_2 are calculated using the notes to tables 1 to 4).

For multiple wavelengths, relevant parameters must be obtained for each separate wavelength.

NOTE 1 – If the wavelengths are additive (IEC 60825-1, table 5), conformance is calculated by adding partial fractions of AEL (IEC 60825-1, 9.3 b).

NOTE 2 – If the wavelengths are not additive, they must be treated independently.

- c) Establish conditions under which measurements shall be made (IEC 60825-1, 8.2)
- d) Check conformity by calculation for all additive wavelengths, if reasonably possible.
- e) Check conformity by measurement for all additive wavelengths, if necessary. This is definitive (IEC 60825-1, clause 8).
- f) Check as necessary for all multiple pulse conditions (IEC 60825-1, 9.4).
- h) Iterate as necessary if multiple sources are present (IEC 60825-1, 8.2 h).
- i) Repeat as necessary by changing the trial Class to achieve conformity.
- j) Repeat for each wavelength.