

Australian/New Zealand Standard™

**Safety of laser products**

**Part 1: Equipment classification and  
requirements**



## **AS/NZS IEC 60825.1:2011**

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee SF-019, Personal Protection Against Laser Radiation. It was approved on behalf of the Council of Standards Australia on 20 October 2011 and on behalf of the Council of Standards New Zealand on 25 October 2011. This Standard was published on 5 December 2011.

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*This Standard was issued in draft form for comment as DR AS/NZS IEC 60825.1.*

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# Australian/New Zealand Standard™

## Safety of laser products

### Part 1: Equipment classification and requirements

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## PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee SF-019, Personal Protection Against Laser Radiation, to supersede Sections 1 and 2 of AS/NZS 2211.1:2004, *Safety of laser products, Part 1: Equipment classification, requirements and user's guide, (IEC 60825-1:2001, MOD)*.

The objectives of this Standard are as follows:

- (a) To protect people from laser radiation in the wavelength range 180 nm to 1 mm by introducing a system of classification of lasers and laser products according to their degree of optical radiation hazard.
- (b) To lay down requirements for the manufacturer to supply information so that proper precautions can be adopted.
- (c) To ensure adequate warnings are provided to individuals of hazards associated with accessible radiation from laser products through the use of labels and instructions.
- (d) To reduce the possibility of injury by minimizing unnecessary accessible radiation and to give improved control of the laser radiation hazards through protective features.

This Standard is identical with, and has been reproduced from IEC 60825-1, Ed.2.0 (2007), *Safety of laser products—Part 1: Equipment classification and requirements*. IEC Interpretation Sheets 1 and 2 have been incorporated after the contents list.

As this Standard is reproduced from an International Standard, the following applies:

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- (b) In the source text 'IEC 60825-1' should read 'This Australian/New Zealand Standard'.
- (c) A full point substitutes for a comma when referring to a decimal marker.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

<i>Reference to International Standard</i>		<i>Australian/New Zealand Standard</i>	
IEC		AS	
60601	Medical electrical equipment	3280	Medical electrical equipment
60601-2-22	Part 2-22: Particular requirements for basic safety and essential performance of surgical, cosmetic, therapeutic and diagnostic laser equipment	3280.2.22	Part 2.22: Particular requirements for basic safety and essential performance of surgical, cosmetic, therapeutic and diagnostic laser equipment
61010	Safety requirements for electrical equipment for measurement, control and laboratory use	61010	Safety requirements for electrical equipment for measurement, control and laboratory use
61010-1	Part 1: General requirements	61010.1	Part 1: General requirements (IEC 61010-1:2001, MOD)

The term 'informative' has been used in this Standard to define the application of the annex to which it applies. An 'informative' annex is only for information and guidance.

Standards in the IEC 60825 series may have been adopted as either AS/NZS IEC 60825 series standards, e.g. IEC/TR 60825-14 has been adopted as AS/NZS IEC 60825.14, or AS/NZS 2211 series standards, e.g. IEC 60825-4 has been adopted as AS/NZS 2211.4.

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## INTERPRETATION SHEET 1

**Subclauses 9.2 and 9.3**

*These subclauses are clarified by the following:*

**Introduction**

For emissions in the wavelength range of 400 nm to 1 400 nm, the need to perform measurements for Condition 2 (eye loupe viewing) can be greatly reduced by recognising that Condition 3 (unaided viewing) in many cases will be the most restrictive criterion.

**Interpretation**

The following table outlines the process in this interpretation of IEC 60825-1, subclauses 9.2 and 9.3.

IF	THEN
Angular Subtense > 1,5 mrad @ 100 mm from the reference point	Condition 2 need not be considered
Angular Subtense $\leq$ 1,5 mrad @ 100 mm; or the angular subtense is not determined	Use simplified Condition 2, $C_6 = 1$
<i>Optional for intermediate sources:</i> Angular Subtense $\leq$ 1,5 mrad @ 100 mm AND > 1,5 mrad using Figure 5	CAN use Figure 5 (with $C_6$ determined using Figure 5) if simplified Condition 2 is too restrictive for the application

## Rationale

Based on independent studies (see for instance reference [1]), it is found that for extended sources and for radiation in the wavelength range of 400 nm to 1 400 nm, Condition 3 will in most cases be more restrictive than Condition 2 for extended sources (Figure 5). The main reason for this is the magnification of the source obtained with Condition 2. Also, the aperture stop of Condition 2 is limited to 3,5 mm since it simulates a case where there is a high level of ambient lighting, while Condition 3 uses a 7 mm aperture stop, as it simulates a general viewing condition including accidental exposure.

*Row 1 in the table above:*

If it can be shown that the apparent source is extended ( $\alpha > 1,5$  mrad) for unaided viewing at 100 mm distance from the reference point, Condition 2 does not have to be considered.

*Row 2 in the table above:*

If the source is not extended for unaided viewing (i.e. the angular subtense of the apparent source is less than 1,5 mrad at 100 mm distance from the reference point), or if the angular subtense of the apparent source is not determined (default simplified evaluation), Condition 2 needs to be considered, as it could be more restrictive than Condition 3.

*Row 3 in the table above:*

For the case that the optional application of Condition 2 for extended sources (Figure 5) is considered, the following cases can be distinguished:

- a) if the angular subtense of the apparent source is determined to be less than 1,5 mrad at 100 mm from the reference point, but appears extended ( $\alpha > 1,5$  mrad) using Condition 2 for extended sources (Figure 5) (due to the magnification of the eye loupe), Condition 2 for extended sources may be less restrictive than the simplified Condition 2 and can be applied for the test. If Condition 2 for extended sources (per Figure 5) is used, the corresponding angular subtense is also to be determined using this measurement setup. It should be noted that in this case Condition 3 (where  $C_6 = 1$ ) can be more restrictive than Condition 2 for extended sources (Figure 5) and has to be considered.
- b) if the angular subtense of the apparent source is determined to be less than 1,5 mrad at 100 mm from the reference point, and is also less than 1,5 mrad using Condition 2 for extended sources (Figure 5), the simplified Condition 2 (Table 11) is applicable.

NOTE For the default (simplified) evaluation described in 9.3.2 of the standard, it is not necessary to determine the angular subtense of the apparent source. The apparent source can be assumed to be a small source to simplify the analysis, since this would be the most restrictive case. The simplified measurement conditions listed in Table 11 would apply (Row 2 in the table above).

## References

[1] *Influence of magnifiers on ocular exposure levels*, G Veas, R Gilber and K Schulmeister, ILSC Paper 503, ILSC 2009 Proceedings (Laser Institute of America)

## INTERPRETATION SHEET 2

**Subclause 8.3 f 3)**

*This subclause is clarified by the following:*

**Introduction**

For pulse durations shorter than 1 ns, the application of the criterion given in 8.3 f 3) a) (the „N<sup>-0,25</sup> criterion“) produces overly-restrictive results when compared to the TOTP criterion 8.3 f 3) b).

NOTE This Interpretation Sheet also applies to MPE analyses (subclause A.3 c)).

**Interpretation**

In the wavelength range of 400 nm to 1 400 nm, the TOTP criterion (8.3 f 3) b)) can be applied for the case of pulse trains with pulses of the same energy and duration.

NOTE 1 If the “N<sup>-0,25</sup> criterion” is applied, it would have to be adopted as follows so that it results in equivalent evaluations as the TOTP criterion:

Pulses with durations less than  $T_i$  are assigned pulse durations of  $T_i$ . If two or more pulses occur within a duration of  $T_i$ , these pulse groups are assigned a pulse duration of  $T_i$ . The reduction factor  $C_5$  is applied to the AEL that is applicable for  $T_i$  (i.e.  $C_5 \cdot \text{AEL}(T_i)$ ). If one pulse occurs within  $T_i$ , the energy of that pulse is compared with the reduced AEL, i.e. with  $C_5 \cdot \text{AEL}(T_i)$ . If more than one pulse occurs within  $T_i$ , the sum of the energies of these pulses is compared with the reduced AEL.

NOTE 2 For the heading of 8.3 f 3) b)), instead of “for varying pulse widths or varying pulse durations” the intended wording was “for varying pulse widths or varying pulse intervals” as corrected in Corrigendum 1”.

**Rationale**

For constant pulse durations and energies, the two criteria (the N<sup>-0,25</sup> and the TOTP criterion) should be, as a general principle, equivalent for all pulse durations, as both reflect the same

thermal additivity of multiple pulse exposures and constant pulse trains are a special case of non-constant pulse trains.

For pulse durations longer than  $T_i$ , the TOTP and the  $N^{-0,25}$  criteria, as given in IEC 60825-1:2077, do produce mathematically identical evaluations. For pulse trains where individual pulse durations are shorter than 1 ns, because the  $N^{-0,25}$  criterion is applied in IEC 60825-1 to the AEL for the single pulse (which for pulse durations less than 1 ns is smaller than the AEL for  $T_i$  of 18  $\mu\text{s}$  or 50  $\mu\text{s}$ ), the  $N^{-0,25}$  criterion and the TOTP criterion produce different results. Since both rules are intended to reflect thermal additivity of pulses, the TOTP is the more general criterion. Criteria that would make the current  $N^{-0,25}$  criterion equivalent with the TOTP criterion are outlined in NOTE 1 above.

This instruction will remain valid until a new version of IEC 60825-1 is published.

## AUSTRALIAN/NEW ZEALAND STANDARD

**Safety of laser products****Part 1:  
Equipment classification and requirements****1 Scope and object**

IEC 60825-1 is applicable to safety of laser products emitting laser radiation in the wavelength range 180 nm to 1 mm.

A laser product may consist of a single laser with or without a separate power supply or may incorporate one or more lasers in a complex optical, electrical, or mechanical system. Typically, laser products are used for demonstration of physical and optical phenomena, materials processing, data reading and storage, transmission and display of information, etc. Such systems have found use in industry, business, entertainment, research, education, medicine and consumer products.

Laser products that are sold to other manufacturers for use as components of any system for subsequent sale are not subject to IEC 60825-1, since the final product will itself be subject to this standard. However, if the laser system within the laser product is operable when removed from the equipment, the requirements of this Part 1 apply to the removable unit.

NOTE 1 Operable equipment does not require a tool to prepare for operation.

Any laser product is exempt from all further requirements of this Part 1 if classification by the manufacturer of that product according to Clauses 3, 8 and 9 shows that the emission level does not exceed the AEL (accessible emission limit) of Class 1 under all conditions of operation, maintenance, service and failure.

NOTE 2 The above exemption is to ensure that inherently safe laser products are not unnecessarily subject to the standard.

In addition to the hazards resulting from laser radiation, laser equipment may also give rise to other hazards such as fire and electric shock.

NOTE 3 However, the classification and other requirements of this standard are intended to address only the laser radiation hazards to the eyes and skin. Other hazards are not included within its scope.

This Part 1 describes the minimum requirements. Compliance with this Part 1 may not be sufficient to achieve the required level of product safety. Laser products must conform to the applicable performance and testing requirements of the applicable product safety standards.

NOTE 4 Other standards may contain additional requirements. Consideration should also be given to the intended application and user group. For example, a class 3B or class 4 laser product may not be suitable for use as a consumer product.

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