

BRITISH STANDARD 4727 : Part 4 : Group 01 : 1971

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CONFIRMED AUGUST 1980

**GLOSSARY OF
ELECTROTECHNICAL, POWER,
TELECOMMUNICATION,
ELECTRONICS, LIGHTING AND
COLOUR TERMS**

**PART 4. TERMS PARTICULAR TO
LIGHTING AND COLOUR**

Group 01. Radiation and photometry

BRITISH STANDARDS INSTITUTION

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BRITISH STANDARDS INSTITUTION

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The following BSI references relate to the work on this standard:
Committee reference LGE/2 Draft for comment 69/13338

CO-OPERATING ORGANIZATIONS

The Illumination Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Association of Public Lighting Engineers
British Electrical and Allied Manufacturers' Association
British Glass Industry Research Association
British Railways Board
Board of Trade
Council of British Manufacturers of Petroleum Equipment
Department of Employment and Productivity
Electricity Council, the Central Electricity Generating Board and the Area Boards in England and Wales
Engineering Equipment Users Association
Gas Council
Glass Manufacturers' Federation

*Illuminating Engineering Society
Institution of Electrical Engineers
Institution of Municipal Engineers
*Lighting Industry Federation Ltd.
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Ministry of Public Building and Works—Building Research Station
*Ministry of Transport
*National Physical Laboratory—Ministry of Technology
Royal Institute of British Architects
Society of British Gas Industries
Society of Glass Technology

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

British Colour Council
Institute of Physics and the Physical Society
National Illumination Committee of Great Britain

P.I.R.A.
Society of Dyers and Colourists
Trinity House Lighthouse Service

GUIDE TO THE GLOSSARY

Part 1. Terms common to power, telecommunications and electronics

- Group 01. Fundamental concepts
- Group 02. General technological terminology
- Group 03. Relay terminology
- Group . Semiconductor terminology*
- Group . Electronic tube terminology*
- Group . Measurement terminology*
- Group . Magnetism terminology*
- Group . Radiological terminology*
- Group . Radio interference terminology*
- Group . Integrated electronic circuit terminology*

Titles to any further groups will be added in due course.

Part 2. Terms particular to power engineering

- Group 01. General power terminology
- Group 02. Static convertor terminology
- Group 03. Rotating machinery terminology
- Group 04. Transformer terminology*
- Group . Power switchgear terminology*
- Group . Power systems terminology*
- Group . Systems operation terminology*
- Group . Traction terminology*
- Group . Tariffs terminology*

Titles to any further groups will be added in due course.

* Not yet published.

Part 3. Terms particular to telecommunications and electronics

- Group 01. General telecommunications and electronics terminology
- Group 02. Telephony terminology*
- Group 03. Telegraphy, including facsimile, terminology*
- Group 04. Broadcasting, radio and television terminology*
- Group 05. Propagation and media terminology*
- Group 06. Radio location and navigation terminology*
- Group 07. Radiocommunications terminology*

Titles of any further groups will be added in due course.

Part 4. Terms particular to lighting and colour

- Group 01. Radiation and photometry
- Group 02. Vision and colour*
- Group 03. Lighting technology*

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BRITISH STANDARD GLOSSARY OF ELECTROTECHNICAL, POWER, TELECOMMUNICATION, ELECTRONICS, LIGHTING AND COLOUR TERMS

Part 4. Terms Used in Lighting

Group 01. Radiation and photometry

FOREWORD

This Group of Part 4 of this British Standard Glossary, prepared under the authority of the Illumination Industry Standards Committee, contains terms and definitions relating to radiation and photometry and supersedes Sections 1 to 4 of BS 233*. The terms and definitions are in close agreement with those of Group 45 of the third edition of the International Electrotechnical Vocabulary, prepared jointly by the Commission Internationale d'Eclairage (CIE) and the International Electrotechnical Commission (IEC).

In this new glossary a number of significant changes have been introduced. It has been decided to combine into one glossary the subjects previously covered by BS 204†, BS 205‡, BS 233* and BS 1611§ glossaries. The glossary is divided into four main Parts, each of which is subdivided into groups. Each group will comprise the terms and definitions used in a particular branch of electrical engineering and will be issued individually as soon as it is completed. This arrangement makes it possible to add new groups, or revise existing groups, at any time without affecting the remainder of the glossary.

The four main Parts of the glossary are as follows:

- Part 1. Terms common to power, telecommunications and electronics.
- Part 2. Terms particular to power engineering.
- Part 3. Terms particular to telecommunications and electronics.
- Part 4. Terms particular to lighting and colour.

As groups of terms within the new framework are published, the corresponding parts of the relevant British Standards will be withdrawn. Ultimately the new glossary will replace these standards completely and they will then be withdrawn.

Fundamental and general terms common to power, telecommunications and electronics form the first group of Part 1. General terms particular to Part 2 and Part 3 similarly form the first groups of their respective Parts. The specialist groups contain only the terms and definitions relating to their subject.

As far as has been practicable all terms and definitions established in current usage and falling within the scope of this glossary have been included. Experience has shown that it is rarely possible to replace, or even to modify, a well established term no matter what the logical or aesthetic shortcomings of that term may be. Current usage has therefore been accepted as the authority for terms and their meanings except where there has been a very good reason for doing otherwise, as, for example, where terms have been considered to be fundamentally wrong, ambiguous, superfluous or in need of standardization. Where two or more synonymous terms are in use, those which are deprecated synonyms are omitted from the body of the text but are entered in the alphabetical index with a cross reference to the standard term. In cases where it was felt that the time was not yet right to deprecate a synonym, preferred terms are given first and other terms are printed in less prominent type to indicate the intention to deprecate them in the course of time. Where synonyms are considered of equal value they are shown in the same type.

* BS 233, 'Glossary of terms used in illumination and photometry'.

† BS 204, 'Glossary of terms used in telecommunication (including radio) and electronics'.

‡ BS 205, 'Glossary of terms used in electrical engineering'.

§ BS 1611, 'Glossary of colour terms used in science and industry'.

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Where terms are used with somewhat different meanings in different branches of electrical engineering, appropriate definitions are given in the groups of the glossary corresponding to these branches. Such a definition, when taken out of the context of its group, should always be quoted with a preamble indicating its proper context.

It is to be noted that the given definition of a term represents the generally accepted meaning of that term. Under no circumstances should it be regarded as taking the place of a specification.

An effort has been made to arrange the terms in a logical order proceeding from the general to the specific and from the whole to the part and placing allied terms in proximity within a subsection or section of the group. Each term has assigned to it a Part number (one digit) and a Group number of two digits followed by a space and four digits, the first digit of which represents the section, the second digit the subsection, and the last two digits the place within the subsection.

A general view of the arrangement of the group in the glossary can be obtained from the Guide to the Glossary. An alphabetical index of the terms of the group is provided at the end to facilitate reference to particular terms. For simplicity, only the last four digits of a term's number are quoted in the index. It is recommended that the user of any group of the glossary should consider the group in association with the groups covering general or fundamental terms within the Part, for Parts 2 and 3 and also together with Groups 01 and 02 of Part 1.

In this glossary round brackets () enclose words or phrases which are not part of the term or definition and can be omitted without affecting the meaning.

Square brackets [] enclose words which may replace a preceding part of an expression. The limiting sign $\sqsubset$ indicates how many of the preceding words are replaced.

401 1 RADIATION

No.	Term	Definition
401 11	<i>Fundamental concepts</i>	
401 1101	radiation	1. Emission or transfer of energy in the form of electromagnetic waves or particles. 2. These electromagnetic waves or particles. NOTE. In general, nuclear radiations and radio waves are not considered in this glossary but only optical radiations, that is electromagnetic radiations (photons) of wavelength lying between the region of transition to X-rays (≈ 1 nm) and the region of transition to radio waves (≈ 1 mm).
401 1102	irradiation	Application of radiation to an object.
401 1103	monochromatic radiation	1. Radiation characterized by a single frequency. 2. By extension, radiation of a very small range of frequencies or wavelengths, which can be described by stating a single frequency or wavelength.
401 1104	complex radiation; polychromatic radiation	Radiation composed of a number of monochromatic radiations.
401 1105	visible radiation LIGHT	Any radiation capable of causing a visual sensation directly. NOTE. The limits of the spectral range of visible radiation are not well defined and may vary according to the user. The lower limit is generally taken between 380 and 400 nm and the upper limit between 760 and 780 nm.
401 1106	infrared radiation	Radiation for which the wavelengths of the monochromatic components are greater than those for visible radiation and less than about 1 millimetre. NOTE. The limits of the spectral range of infrared radiation are not well defined and may vary according to the user. The CIE distinguishes in this spectral range: IR-A 780 nm to 1400 nm IR-B 1.4 μm to 3 μm IR-C 3 μm to 1 mm

No.	Term	Definition
401 1107	ultraviolet radiation	Radiation for which the wavelengths of the monochromatic components are smaller than those for visible radiation and more than about 1 nanometre. NOTE. The limits of the spectral range of ultraviolet radiation are not well defined and may vary according to the user. The CIE distinguishes in this spectral range: UV-A 315 nm to 400 nm UV-B 280 nm to 315 nm UV-C 100 nm to 280 nm
401 1108	spectrum	<i>Of a radiation.</i> 1. Spatial display of a complex [polychromatic] radiation produced by separation of its monochromatic components. 2. Composition of a complex [polychromatic] radiation. NOTE. Examples of sense 2: continuous spectrum line spectrum.
401 1109	spectrum line	Image (generally of a slit) produced in a dispersing system by a monochromatic radiation. NOTE. Also used in the sense of: a monochromatic radiation emitted or absorbed in a transition between two atomic or molecular levels.
401 1110	emission	Release of radiant energy.
401 1111	reflection	Return of radiation by a surface without change of frequency of the monochromatic components of which the radiation is composed.
401 1112	transmission	Passage of radiation through a medium without change of frequency of the monochromatic components of which the radiation is composed.
401 1113	absorption	Transformation of radiant energy to a different form of energy by interaction with matter.
401 1114	diffusion	Change of the spatial distribution of a beam of radiation when it is deviated in many directions by a surface or by a medium.
401 1115	scatter	<i>In a medium.</i> Diffusion of radiation in the course of its passage through a medium containing particles the size of which is comparable with the wavelength of the radiation or smaller.
401 1116	Rayleigh scatter	<i>In a medium.</i> Diffusion of radiation in the course of its passage through a medium containing particles the size of which is small compared with the wavelength of the radiation.
401 1117	refraction	Change in the direction of propagation of radiation determined by change in the velocity of propagation in passing through an optically non-homogeneous medium, or in passing from one medium to another.
401 1118	dispersion	1. Phenomenon of the change in velocity of propagation of radiation as a function of its frequency, which causes a separation of the monochromatic components of a complex radiation. 2. Property of an optical device or medium giving rise to this phenomenon. 3. Quantity characterizing this property.
401 1119	interference	Attenuation or reinforcement of the amplitudes of the vibrations of a radiation, occurring where coherent wave-trains overlap.
401 1120	diffraction	Deviation of the direction of propagation of a radiation, determined by the wave nature of radiation, and occurring when the radiation passes the edge of an obstacle.

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No.	Term	Definition
401 1121	photon	Elementary quantity of radiant energy [quantum] whose value is equal to the product of Planck's constant h and the frequency ν of the electromagnetic radiation.
401 1122	point source	Source of radiation the dimensions of which are small enough, compared with the distance between source and receptor, for them to be neglected in calculations.
401 1123	uniform point source	A point source which emits uniformly in all directions.
401 12	Quantities	
		NOTE 1. <i>Distinction between radiant and luminous quantities.</i> Pure physical quantities for which radiation is evaluated in energy units are defined in this section. Each one of these quantities corresponds to another quantity for which the radiation is evaluated by means of a standard photometric observer. These two kinds of quantities are represented by the same principal symbol distinguished by adding the subscript e (energy) in the case of physical quantities, and the subscript v (visual) in the case of photometric quantities. Should there be no possibility of confusion, the subscripts may be omitted.
		NOTE 2. <i>Use of the adjective 'spectral'.</i> When certain quantities, such as emissivity, luminous efficacy, transmittance, etc., are considered for monochromatic radiation, they are functions of wavelength (or frequency, or wave number, etc.); they may then be designated by the same term preceded by the adjective 'spectral', and by the same symbol followed by λ (or ν , or σ , etc.) in parenthesis; example: spectral emissivity, $\epsilon(\lambda)$.
		If the spectral concentration of a quantity X is considered, it may also be designated by way of abbreviation by the name of the quantity preceded by the adjective 'spectral' as before, and by the symbol for the quantity with the subscript λ (or ν , or σ etc.), but care must be taken to remember that X and X_λ are quantities of a different kind because $X_\lambda = dX/d\lambda$.
401 1201	period	Size of the minimum interval of the independent variable after which the same characteristics of a periodic phenomenon recur. NOTE. In radiation the independent variable is the time and the corresponding quantity is known as the 'periodic time': symbol T ; unit, second, s.
401 1202	frequency	Reciprocal of the period. symbol: f , ν NOTE. When the independent variable is time, the unit of frequency is the hertz, Hz ($1 \text{ Hz} = 1 \text{ s}^{-1}$). This unit was formerly called 'cycle per second', c/s.
401 1203	wavelength	Distance in the direction of propagation of a periodic wave between two successive points at which the phase is the same (at the same time). symbol: λ ; unit: metre, m NOTE 1. The wavelength in a medium is equal to the wavelength in vacuo divided by the refractive index of the medium. Unless otherwise stated, values of wavelength are generally those in air. The refractive index of standard air (15°C , $101\,325 \text{ N m}^{-2}$) lies between 1.000 27 and 1.000 29 for visible radiations. NOTE 2. The reciprocal of the wavelength is the 'wave number': symbol, σ ; unit, m^{-1} .
401 1204	radiant energy	Energy emitted, transferred or received in the form of radiation. symbol: Q_e , Q unit: joule, J NOTE. In ultraviolet radiation therapy and photobiology this quantity is called 'integral dose' (International Photobiology Committee, 1954).
401 1205	radiant flux; radiant power	Power emitted, transferred, or received in the form of radiation. symbol: Φ_e , Φ , P ; $\Phi_e = \frac{dQ_e}{dt}$ unit: watt, W
401 1206	radiant efficiency	<i>Of a source of radiation.</i> Ratio of the radiant flux [power] emitted to the power consumed. symbol: η_e , η NOTE. The radiant efficiency of a source in a limited region of the spectrum may also be considered, that is the ratio of the radiant flux [power] emitted in this spectral region to the power consumed.

No. Term
401 1207 radiant intensity

Definition

Of a source in a given direction. Quotient of the radiant flux leaving the source, propagated in an element of solid angle containing the given direction, by the element of solid angle.

symbol: I_e , I ; $I_e = \frac{d\Phi_e}{d\Omega}$

unit: watt per steradian, W. sr⁻¹

NOTE. For a source which is not a point source: The quotient of the radiant flux received at an elementary surface by the solid angle which this surface subtends at any point of the source, when this quotient is taken to the limit as the distance between the surface and the source is increased.

401 1208 radiance

In a given direction, at a point on the surface of a source or a receptor, or at a point on the path of a beam. Quotient of the radiant flux [power] leaving, arriving at, or passing through an element of surface at this point and propagated in directions defined by an elementary cone containing the given direction, by the product of the solid angle of the cone and the area of the orthogonal projection of the element of surface on a plane perpendicular to the given direction:

symbol: L_e , L ; $L_e = \frac{d^2\Phi_e}{d\Omega \cdot dA \cdot \cos \theta}$

unit: watt per steradian and per square metre, W. sr⁻¹, m⁻²

NOTE. Three special cases may be noted.

(1) At a point on the surface of a source, in a given direction, radiance is also the quotient of the radiant intensity in the given direction of an element of the surface at this point, by the area of the orthogonal projection of this element on a plane perpendicular to this direction. (Radiant intensity per unit projected area.)

$$L_e = \frac{dI_e}{dA \cdot \cos \theta}$$

(2) At a point on the surface of a receptor, in a given direction, radiance is also the quotient of the irradiance which is received at this point on a surface perpendicular to the given direction, by the solid angle of the elementary cone containing this direction and surrounding the beam which produces this irradiance. (Perpendicular irradiance per unit solid angle.)

$$L_e = \frac{dE_e}{d\Omega}$$

(3) On the path and in the direction of an element of a beam, in a non-diffusing non-absorbing medium, the radiance is also the quotient of the radiant flux $d\Phi_e$ transported by the beam, by the geometric extent dG of the beam. The 'geometric extent', which may be defined by two sections of the beam of areas dA and dA' , of separation l and having angles θ and θ' between their normals and the direction of the beam, is $dG = dA \cdot \cos \theta \cdot d\Omega$, where the numerical value in steradians of $d\Omega$ is $dA' \cdot \cos \theta' \cdot l^{-2}$.

$$L_e = \frac{d\Phi_e}{dG} = \frac{d^2\Phi_e}{d\Omega \cdot dA \cdot \cos \theta}$$

In the absence of diffusion, it can be demonstrated in geometrical optics that the 'optical extent', product of the geometric extent of an element of a beam and the square of the refractive index of the medium of propagation, is an invariant along the length of the beam whatever the deviations which it undergoes by reflection or refraction ($dG \cdot n^2 = \text{constant}$). In consequence, the 'basic radiance', quotient of the radiance by the square of the refractive index, is invariant along the length of an element of a beam if the losses by absorption or by reflection are taken as zero ($L_e \cdot n^{-2} = \text{constant}$).

401 1209 radiant flux (surface)
density

At a point of a surface. Quotient of the radiant flux [power] at an element of the surface containing the point, by the area of that element.

symbol:; = $\frac{d\Phi_e}{dA}$

unit: watt per square metre, W. m⁻².

NOTE. See also 401 1210 and 401 1212.

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No.	Term	Definition
401 1210	irradiance	<i>At a point of a surface.</i> Quotient of the radiant flux [power] incident on an element of the surface containing the point, by the area of that element. symbol: E_e, E; $E_e = \frac{d\Phi_e}{dA}$ unit: watt per square metre, W, m⁻² NOTE. In ultraviolet radiation therapy and photobiology this quantity is called 'dose-rate' (International Photobiology Committee, 1954).
401 1211	radiant exposure	<i>At a point of a surface.</i> 1. Surface density of the radiant energy received; 2. Product of an irradiance and its duration. symbol: H_e, H; $H_e = \frac{dQ_e}{dA} = \int E_e dt$ unit: joule per square metre, J, m⁻² NOTE 1. Formerly 'irradiation'. NOTE 2. In ultraviolet radiation therapy and photobiology this quantity is called dose (International Photobiology Committee, 1954).
401 1212	radiant exitance	<i>At a point of a surface.</i> Quotient of the radiant flux [power] leaving an element of the surface containing the point, by the area of that element. symbol: M_e, M; $M_e = \frac{d\Phi_e}{dA} = \int L_e \cos\theta \cdot d\Omega$ unit: watt per square metre, W, m⁻² NOTE 1. The name 'radiant emittance' previously given to this quantity is abandoned because it has given rise to confusion. Thus the term 'emittance' has been used to designate either the flux per unit area leaving a surface (whatever the origin of the flux), or the flux per unit area emitted by a surface (flux originating in the surface), or, principally in certain circles in the United States of America, a quantity without dimensions similar to 'emissivity' but applicable only to a specimen. NOTE 2. The expression 'self-radiant exitance' ($M_{e,s}$) indicates that the flux considered does not include reflected or transmitted flux. The expression 'thermal radiant exitance' ($M_{e,th}$) indicates that the flux considered is produced by thermal radiation. These same adjectives ('self', 'thermal') are equally applicable to other quantities such as luminance, etc. NOTE 3. In the case of a full radiator the radiance L_e is uniform in all directions. In consequence, when the solid angle is measured in steradians the radiant exitance has the numerical value $M_e = \pi L_e$.
401 1213	emissivity	<i>Of a thermal radiator.</i> Ratio of the thermal radiant exitance of the radiator to that of a full radiator at the same temperature. symbol: ϵ; $\epsilon = \frac{M_{e,th}}{M_{e,(t=1)}}$
401 1214	directional emissivity	<i>Of a thermal radiator.</i> Ratio of the thermal radiance of the radiator in a given direction to that of a full radiator at the same temperature. symbol: $\epsilon(\theta, \varphi)$; $\epsilon(\theta, \varphi) = \frac{L_{e,th}(\theta, \varphi)}{L_{e,(t=1)}}$ where θ and φ are the angular coordinates defining the given direction.
401 1215	spectral concentration	<i>Of a radiometric quantity, e.g. radiant flux [power], radiant intensity</i> Quotient of the radiometric quantity X_e, taken over an infinitesimal range on either side of a given wavelength, by the range. $X_{e,\lambda} = \frac{dX_e}{d\lambda}$ NOTE 1. Frequencies, wave-numbers or their logarithms may also be used; if there is a risk of ambiguity this should be avoided by means of the wording: 'spectral concentration in terms of frequency', etc. NOTE 2. See Note 2 to Subsection 12, 'Quantities'.