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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial electroheating equipment - Test methods for intrared emitters

Chauffage électrique industriel – Méthodes d'essais des émetteurs de rayonnement infrarouge

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Industrial electroheating equipment + Test methods for infrared emitters

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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CONTENTS

FO	REWO	RD	5
INT	rrodu	CTION	6
1	Scop	e and object	7
2	Norm	ative references	8
3	Term	s and definitions	8
-	3 1	General	8
	3.2	Radiation	.0
4	Class	ification of infrared emitters	10
5	Type	of tests and general conditions of their performance	12
0	турс 5 1	Conoral list of tosts	12
	5.2	Test conditions	12
	521	Operating conditions during tests	15
	522	Standard environment for tests	15
	523	Non-standard environment for tests	15
	5.2.4	Supply voltage	15
	53	Stationary condition	16
	5.4	Number of emitters for tests	16
6	Meas	urements iTeh STANDARD PREVIEW	16
-	6 1	General (standards itab ai)	16
	6.2	Time resolution	16
	6.3	Measurement of electric data IEC 62708:2014	16
	6.4	Temperatilize/measurementatalos/standards/sist/b8b6141d-2c49-448c-ae69-	17
	6.5	Irradiance and radiance measurement-62798-2014	17
	6.6	Spectral measurements	18
	661	General	18
	662	Calculation as a surrogate for measurement	18
	663	Required spectral range	18
	664	Measurement conditions	18
	665	Spectral measurements	19
7	Tech	nical tests	19
-	7 1	General	10
	7.2	Tests concerning cap and holder of emitter	19
	721	General	19
	722	Cap and holder interchangeability	19
	7.2.3	Cap twist-off test	19
	7.3	Power consumption characteristics	19
	7.3.1	Rated power	19
	7.3.2	Variation of power with voltage	19
	7.3.3	Inrush current	20
	7.3.4	Emitter resistivity as estimate for rated power	20
	7.4	Emitter temperature tests	20
	7.4.1	Rated temperature	20
	7.4.2	Variation of source temperature with voltage	21
	7.4.3	Source temperature rise time	21
	7.4.4	Source temperature cooling time for quartz tube emitters	22

7.4.5	Source temperature cooling time for other emitters	22
7.4.6	Quartz tube cooling time for quartz tube emitters	22
7.4.7	Source temperature distribution	22
7.4.8	Average temperature calculation from a thermal image	23
7.4.9	Surface temperature distribution	23
7.4.10	Distribution temperature	24
7.4.11	Thermal ruggedness	25
7.4.12	Pinching temperature of pinched emitters	25
7.5 Rad	liation characteristics	25
7.5.1	General	25
7.5.2	Radial irradiation distribution of tubular emitters	26
7.5.3	Reflectivity of a tubular emitter with applied reflector	26
7.5.4	Planar irradiation field caused by an emitter	26
7.5.5	Angular irradiation distribution caused by an emitter	27
7.5.6	Emitted spectrum	27
7.5.7	Rated total radiant power	28
7.5.8	Irradiation reaction time	29
7.6 Mec	hanical ruggedness	29
7.6.1	Acceleration	29
7.6.2	Vibration	29
7.7 Life	time of infrared emitters NDARD PREVIEW	29
7.7.1	General	29
7.7.2	Criteria defining end of life	30
7.7.3	Lifetime measurement	30
7.7.4	Induced lamp death for emitter with a tungsten coil 413000000	31
7.7.5	Induced lamp death for others emitter 798-2014	31
7.7.6	Lifetime statement	31
8 Emitter ef	fficiency	32
8.1 Gen	eral	32
8.2 Con	version efficiency	
8.3 Trai	nsfer efficiency	
8.3.1	General	
8.3.2	Simple approach	
8.3.3	Ray-tracing	
8.4 Irra	diation efficiency	
Annex A (infor	mative) Thermal infrared radiation	
A 1 Gen	neral	34
A 2 Sne	ctral emission	
A 3 Emi	ssivity	
	servation of étendue	36
Annex B (infor	mative) Infrared classification not used in this standard	
	native) Measurement of exectral emission, and exectral data of the	
emitter		38
C.1 Gen	eral	38
C.2 Con	nparative method	38
C.3 Mea	surement of the spectral emissivity	39
Annex D (infor	mative) Zonal spherical factors	40
Annex E (infor	mative) Distribution of measurement positions for temperature	
measurements	S	42

E.1	Reference operating temperature	42
E.2	Temperature distribution coefficient	42
Annex F (informative) End of life criteria for infrared emitter	43
Annex G	(normative) Cold state resistivity and rated power	45
G.1	General	45
G.2	Measuring with high accuracy for comparison	45
G.3	Temperature influences on measurement accuracy	45
G.4	Emitter manufacturing effects	46
G.5	Error contributions	46
Bibliograp	ohy	47

Figure A.1 – Spectral emissive power and accumulated power of a grey emitter at 1 800 °C	35
Figure D.1 – Illustration of the measurement geometry for zonal spherical factors	41
Table 1 – Classification of infrared emitters by spectral emission	11
Table 2 – List of tests, their applicability to different classes of infrared emitters and the number of emitters needed for the tests	13
Table A.1 – The generalised Wien's displacement law	35
Table B.1 – Classification based on terms defined in IEC 60050-841:2004	37
Table D.1 – Zonal spherical factors and corresponding angles	40
Table F.1 – Instantaneous end-of-life	43
Table F.2 – Gradual degradation	44
https://standards.iteh.ai/catalog/standards/sist/b8b6141d-2c49-448c-ae69-	
ec814f79138a/iec-62798-2014	

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INDUSTRIAL ELECTROHEATING EQUIPMENT -

Test methods for infrared emitters

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International Standard IEC 62798 has been prepared by IEC technical committee 27: Industrial electroheating and electromagnetic processing.

The text of this standard is based on the following documents:

CDV	Report on voting
27/938/CDV	27/942/RVC

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The contents of the corrigendum of November 2014 have been included in this copy.

INTRODUCTION

This standard on particular test methods for infrared electroheating emitters is one of TC 27 standards that describe test methods for various types of electroheating installations.

This standard is solely concerned with tests for infrared emitters. Tests that focus on the performance of infrared equipment or installations are covered by IEC 62693, *Industrial electroheating installations – Test methods for infrared electroheating installations*. The rationale for this separation is that infrared installations are usually manufactured by other companies than infrared emitters. Still, infrared emitters are a very important and distinct part of infrared installations and a set of tests that allow for proper characterisation, comparison of different infrared emitters is valuable to manufacturers of infrared installations.

The major guiding principle for this standard is to determine

- simple tests that define the basic characteristics of all infrared emitters and can be performed with the usual test and measuring equipment available to different kinds of companies, large or small;
- more complex tests that provide valuable extra information, but need a well-equipped laboratory.

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INDUSTRIAL ELECTROHEATING EQUIPMENT –

Test methods for infrared emitters

1 Scope and object

This International Standard specifies test procedures, conditions and methods according to which the main parameters and the main operational characteristics of industrial infrared emitters are established.

A limitation of the scope of this standard is that the infrared emitters have a maximum spectral emission at longer wavelengths than 780 nm in air or vacuum, and are emitting wideband continuous spectra such as by thermal radiation or high pressure arcs.

IEC 60519-1:2010 [1] ¹ defines infrared as optical radiation within the frequency range between about 400 THz and 300 GHz. This corresponds to the wavelength range between 780 nm and 1 mm in vacuum. Industrial infrared heating usually uses infrared sources with rated temperatures between 500 °C and 3 000 °C; the emitted radiation from these sources dominates in the wavelength range between 780 nm and 10 μ m.

Industrial infrared emitters under the scope of this standard typically use the Joule effect for the conversion of electric energy in one or several sources into infrared radiation, which is emitted from one or several elements. Such infrared emitters are especially

- thermal infrared emitters in the form of <u>dubular</u> plate-like or otherwise shaped ceramics with a resistive element inside; ai/catalog/standards/sist/b8b6141d-2c49-448c-ae69-
- infrared quartz glass tube or halogen7lamp/emitters-with a hot filament as a source;
- non-insulated elements made from molybdenum-disilicide, silicon-carbide, iron-chromiumaluminium alloys or comparable materials;
- wide-spectrum arc lamps.

This standard is not applicable to

- infrared emitters which are lasers or light-emitting diodes (LEDs);
- infrared emitters for use by the general public;
- infrared emitters for laboratory use.

Most of the tests described, especially the destructive tests, are for type testing.

The tests specified in this standard are intended to be used for evaluating or comparing the performance of emitters belonging to the same category.

Tests related to performance of industrial infrared electroheating installations are specified in IEC 62693:2013.

Most tests specified in this standard are applicable to wide-spectrum arc lamps, but not all.

¹ Numbers in square brackets refer to the Bibliography.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60061-1, Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp caps

IEC 60061-2, Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 2: Lampholders

IEC 60061-3, Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 3: Gauges

IEC 60068-2-6, Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)

IEC 60068-2-7, Basic environmental testing procedures – Part 2-7: Tests – Test Ga and guidance: Acceleration, steady state

IEC 60432-1:1999, Incandescent lamps – Safety specifications – Part 1: Tungsten filament lamps for domestic and similar general lighting purposes. IEC 60432-1:1999/AMD1:2005 TANDARD PREVIEW IEC 60432-1:1999/AMD2:2011

(standards.iteh.ai)

IEC 60519-12, Safety in electroheating installations – Part 12: Particular requirements for infrared electroheating installations IEC 62798:2014

https://standards.iteh.ai/catalog/standards/sist/b8b6141d-2c49-448c-ae69-

IEC 60682:1980, Standard method of measuring the pinch temperature of quartz-tungstenhalogen lamps IEC 60682:1980/AMD1:1987

IEC 60682:1980/AMD2:1997

IEC 62693:2013, Industrial electroheating installations – Test methods for infrared electroheating installations

EN 993-11, Methods of test for dense shaped refractory products – Part 11: Determination of resistance to thermal shock

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60519-12, IEC 62693 as well as the following apply.

NOTE General definitions are given in the International Electrotechnical Vocabulary, IEC 60050 [2]. Terms relating to industrial electroheating are defined in IEC 60050-841.

3.1 General

3.1.1

infrared radiation

optical radiation for which the wavelengths are longer than those for visible radiation

Note 1 to entry: The infrared radiation range between 780 nm and 1 mm is commonly subdivided into:

IR-A 780 nm to 1 400 nm, or for a grey emitter 3 450 °C to 1 800 °C surface temperature;

IR-B 1 400 nm to 3 000 nm, or for a grey emitter 1 800 °C to 690 °C surface temperature;

IR-C 3 000 nm to 1 mm, or for a grey emitter less than 690 °C surface temperature.

The temperature corresponds to a spectrum where maximum intensity is at the wavelength of the limit.

These ranges comply with IEC 62471:2006 [3].

Note 2 to entry: In IEC 60050-841:2004 the following terms are defined:

841-24-04 - shortwave infrared radiation or near infrared radiation (780 nm to 2 µm);

841-24-03 – mediumwave infrared radiation or medium infrared radiation (2 μ m to 4 μ m);

841-24-02 - longwave infrared radiation or far infrared radiation (4 µm to 1 mm).

These terms are not used in this standard.

[SOURCE: IEC 60519-12:2013, 3.101]

3.1.2

emitter category

group of emitters using the same principle for applying thermal energy to the workload

3.1.3

inrush current

short term high lamp current occurring during the transient period from the moment of applying voltage to a cold emitter to steady state

3.1.4

average electrical lifetime STANDARD PREVIEW net operating time of infrared emitters at rated voltage under intended conditions when 50 % of all emitters are still operating(standards.iteh.ai)

3.2 Radiation

IEC 62798:2014 https://standards.iteh.ai/catalog/standards/sist/b8b6141d-2c49-448c-ae69ec814f79138a/iec-62798-2014

3.2.1 radiant power

radiant flux power emitted, transmitted or received in the form of radiation

3.2.2

irradiance

irradiation

quotient of the radiant power incident on a surface element containing the point, by the area of that element

3.2.3

radiance

quantity *L* defined by the formula $L = \frac{u\varphi}{dA \cdot \cos \theta \cdot d\Omega}$ dΦ

where

- dΦ is the radiant power or flux transmitted by an elementary beam passing through the given point and propagating in the solid angle containing the given direction;
- $d\Omega$ is the solid angle;
- dAis the area of a section of that beam containing the given point;

 $\cos\theta$ is the angle between the normal to that section and the direction of the beam.

3.2.4

radiant exitance, <of a body>

quotient of the radiant flux emitted by a body into the hemispherical space (2π sr) by the surface unit area of that body

Note 1 to entry: The body can be an infrared emitter or a source of an infrared emitter.

3.2.5

spectral distribution

spectrum

quotient of a radiant quantity $dX(\lambda)$ contained in an elementary range $d\lambda$ of wavelength at the wavelength λ by that range

Note 1 to entry: The term spectral distribution is preferred when dealing with the function $X\lambda(\lambda)$ over a wide range of wavelengths, not at a particular wavelength.

3.2.6

spectral radiance

ratio of the radiant power $d\Phi(\lambda)$ passing through a point and propagating within the solid angle $d\Omega$ in the given direction, to the product of the wavelength interval $d\lambda$ and the area of a section of that beam on a plane perpendicular to this direction ($\cos\theta \cdot dA$) containing the given point and to the solid angle $d\Omega$

3.2.7

spectral radiant exitance

quotient of the radiant flux emitted by a body into the hemispherical space (2π sr) by the surface unit area of that body and by the unit wavelength interval

3.2.8

radial irradiation distribution

irradiation caused by any emitter of axial symmetry on a circumference around the axis of symmetry of the emitter on a plane perpendicular to that axis and centred at mid-length of the Stanuarus.nen.ai emitter

Note 1 to entry: Axial symmetry does not imply round 2798:2014

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3.2.9 rated total radiant power

radiant power emitted by the emitter at rated voltage

Classification of infrared emitters 4

The most common industrial infrared emitters under the scope of this standard emit broadband thermal spectra. Annex A provides basic definitions and concepts of thermal infrared radiation. Thermal emitters usually have a clear correlation between the maximum of the spectral radiant power and the temperature of the source of the emitter, called Wien's law; in this case the rated temperature indicates the spectrum of the emitter. Arc lamps generate a non-thermal spectrum.

The most relevant design element of infrared emitters influencing the spatial irradiation pattern is the size and dimension of the surface of the source emitting the radiation. As industrial infrared emitters are usually used in close vicinity of the workload, there are

- very small sources which act like point sources for example small light bulbs or arc lamps with a very short arc; infrared laser and LED are point sources as well, but are outside the scope of this standard;
- near ideal line sources for example halogen emitter, tungsten coil emitter, arc or flash lamps; their source may be bent;
- tubular or line sources with a large diameter for example ceramic tube emitters, heating rods made from materials like graphite or silicon carbide;
- planar or two-dimensional sources for example ceramic tile type emitters.

Radiation sources can be divided into point like sources and extended sources depending on the size of the source and observation distance. If the distance between the radiation source of the emitter and the observation point is greater than 10 to 50 times the maximum dimension of the radiation source, this source can be approximated as a point source. In most industrial installations the infrared emitters are in close vicinity to the workload and are thus extended sources. The approximate value of 10 to 50 depends on the problem and the intended accuracy of a measurement.

NOTE 1 When the observing distance is greater than 10 times the maximum dimension of the radiation source, the resulting error for calculating the irradiance is less than 1 %.

Commonly available industrial infrared emitters classified according to their spectral emission and rated temperatures are listed in Table 1.

NOTE 2 In industry a different classification than the one used in this standard and given in 3.1.1 is also known, it is provided for information in Annex B.

Spectral band where maximum of emission occurs	Rated temperature of thermal emitter	Category Comments
IR-A	1 800 °C to 3 450 °C	- halogen emitter Other names for this
780 nm to 1 400 nm		 tungsten quartz tube emitter spectral range used in industry are: near infrared_NIR_short-
		 high power laser diodes¹
i	Feh STANDA	B Darc lamp ¹
IR-B	690 °C to 5800 16 dard	S hatogen emitter Other name for this
1 400 nm to 3 000 nm		 tungsten quartz tube emitter spectral range used in industry is "medium-
letter ov/	<u>IEC 627</u>	98:2014 wave**.
nups7/	ec814f79138a/i	 heating wire made c-62 from hickel-chromium alloys – nichrome
		 heating wire made from alloys of nickel- chromium, or iron- chromium-aluminium
		 quartz tube emitter with heating wire coil (Cr, Al, Fe)
		 quartz tube emitter with carbon filament
		 quartz tube emitter with tungsten coil
		 silicon carbide heating rod
		 graphite heating rod
		 molybdenum disilicide heating element
		 high temperature metal tube element
		 high temperature ceramic element
IR-C	< 690 °C	 metal tube element Not in the scope of this stondard if convertion
3 000 nm to 1 mm		 ceramic emitter element standard, if convection dominates.
¹ included for reference o	nly; rated temperature is not	applicable
² short wave and medium	wave can denote differing sp	ectral ranges, see Annex B

Table 1 – Classification of infrared emitters by spectral emission

5 Type of tests and general conditions of their performance

5.1 General – list of tests

Table 2 summarises the tests covered by this standard and their applicability to different categories of infrared emitters. It also includes references to other standards with applicable tests. Additional tests may be covered by commissioning and operation manuals issued by the manufacturer or may be agreed on between the manufacturer and user.

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<u>IEC 62798:2014</u> https://standards.iteh.ai/catalog/standards/sist/b8b6141d-2c49-448c-ae69ec814f79138a/iec-62798-2014 Table 2 – List of tests, their applicability to different classes of infrared emitters and the number of emitters needed for the tests

			Emitter category		Manufacturing	1
Test	Subclause	Copen Ceramic heating heating element element	PREVIEW Infrared quartz	Halogen quartz	Standard, mass produced	Made to order
emitter geometry	-	test is defined between the I	manufacturer and user			
interchangeability of cap and holder, standard	7.2.1 https://standan	not applicable <u>C 62798:2014</u> Is iteh ai/cataboo/standards/sist//	If cap and holder combinati	ions from Parts 1, 2 and 3 of the I	IEC 60061 series are used, IEC	: 60061-3 is
interchangeability of cap and holder, other	7.2.2	as agreed 47 between the n	antifacturer and user			
cap twist-off test	7.2.3	not applicable	IEC 60432-1 is applicable f	or caps covered by that standard		
rated power	7.3.1				1/100	1/100 or 1/batch
power variation with voltage	7.3.2	applicable				
inrush current	7.3.3	usually not necessary	usually applicable ¹	applicable ²	1/type	1/type
emitter resistivity as estimate for rated power	7.3.4	may be applicable		not applicable		
rated temperature	7.4.1				IEC 60432-1 applies	1/batch
variation of source temperature with voltage	7.4.2	applicable				
source temperature rise time	7.4.3					
cooling time	7.4.4, 7.4.5, 7.4.6	source cooling = surface co	oling in 7.4.5	source cooling in 7.4.4 surface cooling time in 7.4.6	1/type	1/type
temperature homogeneity	7.4.8				after change in production	
surface temperature distribution	7.4.9	applicable				
distribution temperature	7.4.10					
thermal ruggedness	7.4.11	applicable	non applicable	application dependent		10/type

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