# THORN



# EN12464-1:2011

Light and lighting – Lighting of workplaces Part 1: Indoor work places

Peter Thorns · Head of Strategic Lighting Applications

# EN12464-1:2011 The international framework of bodies

	Societies	Associations	Standards	Laws and directives
World	CIE	WTO	ISO	UN
Continents	IESNA, CIEChina, IESAustralia	NEMA CCI AMF	ANSI, ASTM CCC ASI	Federal Governments
European	(Lux Europa)	CELMA ELC	CEN	EU
National, in each country, f.e.	LiTG, SLL, ILP, LTG, SLG, AFE, NsVV,	ZVEI, FEEI, LIA, SdIE	DIN, BSI, ON, AFNOR, SNI,	National laws e.g. Building regulations

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Exploitation	Dedicated lighting experts	Companies lighting experts	Appointed national delegates	Politicans, Iobbyists

# EN12464-1:2011 Lighting design

 Lighting design practice is influenced by lighting societies and learned bodies, lighting associations, lighting standards and legislation



# EN12464-1:2011 Interaction between external market drivers



There is a large interaction between the different activities



# EN12464-1:2011 Definition of standards and directives

Directives:	Standards:
Directives are European laws that apply to all EU member states.	A standard is a document that provides rules guidelines or characteristics for activities or their results, aimed at achieving the optimum degree of order in a given contex
member states some local variation during translation into law.	A standard may include recommendations fo best practice
Directives that follow Article 95 apply equally and unaltered to all member states	
An example of a directive transcribed into national law is the Energy performance of buildings directive, where the requirements are incorporated into Part L of the UK Building Regulations	



# EN12464-1:2011 Some examples of standards and directives

Directives:	Standards:
Laws:	Recommendations:
<b>ELPD – Energy Efficiency Labelling of Products</b> Lamp and ballast labelling to show efficiency	EN 12 464-1 Light and lighting – Lighting of work places – Part 1 : Indoor work places European indoor lighting standard. Defines lighting
EPBD – Energy Performance of Buildings	requirements for indoor work areas
efficiency	EN 12 464-2 Light and lighting – Lighting of work place – Part 2 : Outdoor work places
<b>ErPD – Energy related Product</b> Ecodesign and energy efficiency during the life of an energy using product	European outdoor lighting standard. Defines lighting requirements for outdoor work areas
WEEED – Waste of Electrical and Electronic	EN 15193 Energy performance of buildings – Energy requirements for lighting
Equipment Producer responsibility for end of life take back and recycling of products	Defines the energy performance of the building on an annual basis using the LENI calculation. LENI = W/A (kWh/(m <sup>2</sup> x an)) where W is annual wattage used and A is the surface considered. Target values are specified.
<b>RoHSD – Restriction of Hazardous Substances</b> Restricts use of hazardous substances by designing out	<b>EN 1838 Lighting Applications – Emergency lighting</b> Defines the luminous requirements for emergency lighting
<b>B&amp;AD – Battery and Accumulators</b> Ban the use of heavy metals	systems installed in premises or locations where such systems are required.

# EN12464-1:2011 Codes of practice

**Codes of practice** 

Codes of practice are recommendations of good practice from societies or associations.

These bodies may not be internationally recognised in the same manner standards institutions are. (An example of an exception to this is CIE which is recognised by ISO and therefore some CIE documents become ISO standards).

Unless specifically mentioned in a law, directive or standard they have no official recognition although a client may refer to them in a specification.

#### **Examples are**

SLL code of lighting (similar to EN 12 464) - UK

BREEAM – Energy Limits for Buildings – Best Practise for Energy Savings - UK

**Recommendations from Syndicate D L'Eclairage – France** 

Lighting association LIGHT GUIDE (ROOM LIGHTING) - Nordic



# EN12464-1:2011 CEN activities

 For most of us CEN as a producer of European standards is a very important market driver

	Societies	Associations	Standards	Laws and directives
World	CIE	wто	ISO	UN
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Exploitation	Dedicated lighting experts	Companies lighting experts	Appointed national delegates	Politicans, lobbyists



# EN12464-1:2011 CEN activities

- For lighting CEN/TC 169 Light and Lighting is most important
- CEN/TC 169 has 14 working groups (WG)
- Each WG has a convener who is responsible for the output of the WG and a team of experts to help with the work

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# EN12464-1:2011 CEN activities

- CEN/TC 169 Light and Lighting
  - WG1 Basic terms and criteria
  - WG2 Lighting of work places
  - WG3 Emergency lighting in buildings
  - WG4 Sports lighting
  - WG6 Tunnel lighting
  - WG7 Photometry
  - WG8 Photobiology

- WG9 Energy performance of buildings
- WG10 Performance of optical materials for luminaires
- WG11 Daylight
- WG12 JWG with CEN/TC226\* Road lighting
- WG13 Non-visual effects of light on human beings

- WG14 ErP Lighting Mandate Management Group
- \* CEN/TC 226 Road Equipment

# EN12464-1:2011 What is EN12464-1?

- EN12464-1 is the European standard for Indoor lighting
- Associated documents outside the EU are ISO 8995-1:2002 and CIE S 008/E:2001.
- Legally you do not have to comply with this standard, it is a recommendation
- Most lighting EU Directives, which are legally binding, refer to it.

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#### Lighting in the workplace: Good practice

**39** Both interior and exterior lighting need to achieve a reasonable uniform illuminance in all relevant working areas, ie illuminance across any given task area needs to be uniform. For more information see **CIBSE Code for lighting.** 

#### Minimum lighting recommendations

**93** The illuminance needed depends on how much detail needs to be seen. It also depends on the age of the worker, and the speed and accuracy by which the task needs to be performed. These performance-related requirements and light levels are detailed in the **CIBSE Code for lighting**.

# HSE

Health and Safety Executive

#### **Lighting at work**



This is a free-to-download, web-friendly version of H5G38 (Second edition, published 1997). This version has been adapted for online use from H55's current printed version.

You can buy the book at www.hsabooks.co.uk and most good bookshops.

ISBN 978 0 7176 1232 1 Price £9.25

This guidance explains how lighting contributes to the heath and safety of people at work, it deals with assessing and managing the heath and safety risks attributable to lighting in the workplace, good practice and the minimum recommanded illumination levels that meet heath and safety requirements.

Although aimed primarily at those who are responsible for health and safety at work, all employees may also find it useful.

**HSE Books** 

Page 1 of All



# EN12464-1:2011 Scope

#### EN 12464-1: 2011 Lighting of Indoor Work Places

- This European Standard specifies requirements for lighting solutions for most indoor work places and their associated areas in terms of quantity and quality of illumination. In addition recommendations are given for good lighting practice.
- This European Standard neither provides specific solutions, nor restricts the designers' freedom from exploring new techniques nor restricts the use of innovative equipment. The illumination can be provided by daylight, artificial lighting or a combination of both.
- This European Standard is not applicable for the lighting of outdoor work places and underground mining or emergency lighting. For outdoor work places, see EN 12464-2 and for emergency lighting, see EN 1838 and EN 13032-3.

# EN12464-1:2011 Scope

#### Covers

- Traffic zones inside buildings
- Industrial activities and crafts
- Offices
- Retail premises
- Places of public assembly
  - Restaurants/hotels
  - Theatres/cinemas
  - Libraries/museums
  - Indoor car parks
- Educational premises
- Health care premises
- Transportation areas
  - Airports
  - Railway installations

























The reflectance of major objects (like furniture, machinery, etc.) should be in the range of 0,2 to 0,7.











#### Task Area

Immediate Surrounding Area +0.5m

Background Area ≥3m



Task	Immediate Surround	Background
 lx 🛛	Ix	Ix
≥750	500	100
500	300	100
300	200	50
200	150	50
150	Etask	50
100	Etask	50
< 50	Etask	Etask/2
	Uo>0.4	Uo>0.1
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For work stations where the size and/or location of the task area(s) is/are unknown, either:

- the whole area is treated as the task area or
- the whole area is uniformly (Uo ≥ 0,40) lit to an illuminance level specified by the designer; if the task area becomes known, the lighting scheme shall be re-designed to provide the required illuminances.

If the type of the task is not known the designer has to make assumptions about the likely tasks and state task requirements.



A new definition of the illuminance grid for calculation and verification.

• Using this method the maximum grid size shall be:

$$p = 0.2 \times 5^{\log_{10}(d)}$$

- where *p* is the maximum grid cell size
- *d* is the longer dimension of the area (m).
- The number of grid points is then *d/p*.





#### A new definition of the illuminance grid for calculation and verification.

Length of the area (m)	Max. distance between grid points (m)	Min. number of grid points
0.40	0.15	3
0.60	0.20	3
1.00	0.20	5
2.00	0.30	6
5.00	0.60	8
10.00	1.00	10
25.00	2.00	12
50.00	3.00	17
100.00	5.00	20



- I place a spotlight in a room and calculate...
  - Eav 26 lx
    Emin 1.11lx
    Emax 2253lx

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- I modify it to use the standard grid and calculate...
  - Eav 25 lx
    Emin 1.11lx
    Emax 963lx





- I modify it to use the standard grid and calculate...
  - Eav 25 lx
    Emin 1.11lx
    Emax 963lx

So Emax has changed by 234%!

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# EN12464-1:2011 Discomfort Glare

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2H	зн	2.6	3.7	2.9	4.0	4.4	12.0	13.2	12.4	13.5	13.8		
2H	4H	2.5	3.6	2.9	3.9	4.3	11.9	13.0	12.3	13.3	13.7		
2H	6H	2.5	3.4	2.9	3.8	4.2	11.9	12.8	12.3	13.2	13.6		
2H	вн	2.5	3.4	2.9	3.7	4.1	11.9	12.8	12.3	13.1	13.5		
2H	12H	2.4	3.3	2.9	3.7	4.1	11.8	12.7	12.2	13.1	13.5		
4H	2H	2.5	3.6	2.9	3.9	4.3	11.9	13.0	12.3	13.3	13.7		
4H	зн	2.4	3.3	2.8	3.6	4.1	11.8	12.7	12.2	13.0	13.5		
4H	4H	2.4	3.1	2.9	3.6	4.0	11.8	12.5	12.2	12.9	13.3		
4H	6H	2.5	3.1	3.0	3.6	4.0	11.8	12.4	12.3	12.8	13.3		
4H	вн	2.3	2.9	2.8	3.4	3.9	11.6	12.2	12.1	12.7	13.1		
4H	12H	2.3	2.8	2.8	3.3	3.8	11.6	12.1	12.1	12.6	13.1		
8H	4H	2.3	2.9	2.8	3.3	3.8	11.6	12.2	12.1	12.6	13.1		
8H	6H	2.3	2.7	2.8	3.2	3.7	11.5	12.0	12.0	12.5	13.0		
8H	вн	2.3	2.7	2.8	3.2	3.7	11.5	11.9	12.0	12.4	12.9		
8H	12H	2.2	2.6	2.8	3.1	3.7	11.4	11.8	11.9	12.3	12.8		
12H	4H	2.2	2.8	2.7	3.2	3.7	11.5	12.1	12.0	12.5	13.0		
12H	6H	2.2	2.6	2.7	3.1	3.7	11.4	11.9	12.0	12.4	12.9		
12H	вн	2.2	2.6	2.7	3.1	3.6	11.4	11.8	11.9	12.3	12.8		

 $UGR = 8\log_{10}\left(\frac{0.25}{L_{p}}\sum \frac{L^{2}\omega}{p^{2}}\right)$ 

#### **Based on CIE 117-1996**



# EN12464-1:2011 Discomfort Glare

The rating of discomfort glare caused directly from the luminaires of an indoor lighting installation shall be determined using the CIE Unified Glare Rating (UGR) tabular method, based on the formula:

Walls Ceiling		70/50/20	70/30/20	50/50/10	50/30/10	30/30/10	70/50/20	70/30/20	50/50/10	50/30/10	30/30/10
Х	Υ	Transverse direction of view				Parallel direction of view					
2H	2H	2.7	4.0	3.0	4.3	4.6	12.1	13.4	12.5	13.7	14.1
2H	зн	2.6	3.7	2.9	4.0	4.4	12.0	13.2	12.4	13.5	13.8
2H	4H	2.5	3.6	2.9	3.9	4.3	11.9	13.0	12.3	13.3	13.7
2H	6H	2.5	3.4	2.9	3.8	4.2	11.9	12.8	12.3	13.2	13.6
2H	8H	2.5	3.4	2.9	3.7	4.1	11.9	12.8	12.3	13.1	13.5
2H	12H	2.4	3.3	2.9	3.7	4.1	11.8	12.7	12.2	13.1	13.5
4H	2H	2.5	3.6	2.9	3.9	4.3	11.9	13.0	12.3	13.3	13.7
4H	зн	2.4	3.3	2.8	3.6	4.1	11.8	12.7	12.2	13.0	13.5
4H	4H	2.4	3.1	2.9	3.6	4.0	11.8	12.5	12.2	12.9	13.3
4H	6H	2.5	3.1	3.0	3.6	4.0	11.8	12.4	12.3	12.8	13.3
4H	8H	2.3	2.9	2.8	3.4	3.9	11.6	12.2	12.1	12.7	13.1
4H	12H	2.3	2.8	2.8	3.3	3.8	11.6	12.1	12.1	12.6	13.1
8H	4H	2.3	2.9	2.8	3.3	3.8	11.6	12.2	12.1	12.6	13.1
8H	6H	2.3	2.7	2.8	3.2	3.7	11.5	12.0	12.0	12.5	13.0
8H	8H	2.3	2.7	2.8	3.2	3.7	11.5	11.9	12.0	12.4	12.9
8H	12H	2.2	2.6	2.8	3.1	3.7	11.4	11.8	11.9	12.3	12.8
12H	4H	2.2	2.8	2.7	3.2	3.7	11.5	12.1	12.0	12.5	13.0
12H	6H	2.2	2.6	2.7	3.1	3.7	11.4	11.9	12.0	12.4	12.9
12H	8H	2.2	2.6	2.7	3.1	3.6	11.4	11.8	11.9	12.3	12.8

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				UG	R tab	le (C						
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UGR b	ased on	3600 Im	1					Fit	ting	g1		
Useful Wa Ceili	plane Ils ing	70/50/20	70/30/20	50/50/10	50/30/10	30/30/10	70/50/20	70/30/20	50/50/10	50/30/10	30/30/10	
х	Y	Tra	nsverse	directio	n of vie	w	P	arallel d	lirection	of view		
2H	2H	2.7	4.0	3.0	4.3	4.6	12.1	13.4	12.5	13.7	14.1	
2H	зн	2.6	3.7	2.9	4.0	4.4	12.0	13.2	12.4	13.5	13.8	
2H	4H	2.5	3.6	2.9	3.9	4.3	11.9	13.0	12.3	13.3	13.7	
2H	6H	2.5	3.4	2.9	3.8	4.2	11.9	12.8	12.3	13.2	13.6	
2H	8Н	2.5	3.4	2.9	3.7	4.1	11.9	12.8	12.3	13.1	13.5	
2H	12H	2.4	3.3	2.9	3.7	4.1	11.8	12.7	12.2	13.1	13.5	
4H	2H	2.5	3.6	2.9	3.9	4.3	11.9	13.0	12.3	13.3	13.7	
4H	зн	2.4	3.3	2.8	3.6	4.1	11.8	12.7	12.2	13.0	13.5	
4H	4H	2.4	3.1	2.9	3.6	4.0	11.8	12.5	12.2	12.9	13.3	
4H	6H	2.5	3.1	3.0	3.6	4.0	11.8	12.4	12.3	12.8	13.3	
4H	вн	2.3	2.9	2.8	3.4	3.9	11.6	12.2	12.1	12.7	13.1	
4H	12H	2.3	2.8	2.8	3.3	3.8	11.6	12.1	12.1	12.6	13.1	
8H	4H	2.3	2.9	2.8	3.3	3.8	11.6	12.2	12.1	12.6	13.1	
8H	6H	2.3	2.7	2.8	3.2	3.7	11.5	12.0	12.0	12.5	13.0	
8H	8H	2.3	2.7	2.8	3.2	3.7	11.5	11.9	12.0	12.4	12.9	
SН	12H	2.2	2.6	2.8	3.1	3.7	11.4	11.8	11.9	12.3	12.8	
12H	4H	2.2	2.8	2.7	3.2	3.7	11.5	12.1	12.0	12.5	13.0	
12H	6H	2.2	2.6	2.7	3.1	3.7	11.4	11.9	12.0	12.4	12.9	
12H	вн	2.2	2.6	2.7	3.1	3.6	11.4	11.8	11.9	12.3	12.8	

				UG	R tab	le (C				•	
UGR ba	ased on	3600 Im	1					Fit	tin	g2	
Useful Wa Ceili	plane Ils ing	70/50/20	70/30/20	50/50/10	50/30/10	30/30/10	70/50/20	70/30/20	50/50/10	50/30/10	30/30/10
х	Y	Tra	nsverse	directio	n of vie	w	P	arallel d	irection	of view	
2H	2H	15.9	16.9	17.7	18.9	19.1	17.3	18.3	19.1	20.3	20.5
2H	зн	15.8	16.7	17.7	18.8	19.0	17.1	18.0	19.1	20.1	20.4
2H	4H	15.7	16.5	17.7	18.7	19.0	17.1	17.9	19.1	20.1	20.3
2H	6H	15.6	16.4	17.7	18.6	18.9	17.0	17.8	19.1	20.0	20.3
2H	8H	15.6	16.3	17.7	18.6	18.9	16.9	17.7	19.1	20.0	20.3
2H	12H	15.5	16.2	17.7	18.6	18.9	16.9	17.6	19.1	19.9	20.2
4H	2H	15.8	16.7	17.8	18.8	19.1	17.1	17.9	19.1	20.1	20.4
4H	ЗH	15.7	16.4	17.9	18.7	19.0	16.9	17.6	19.1	20.0	20.3
4H	4H	15.6	16.2	17.9	18.6	19.0	16.9	17.5	19.2	19.9	20.2
4H	6H	15.5	16.1	17.9	18.6	18.9	16.8	17.3	19.2	19.9	20.2
4H	8Н	15.5	16.0	17.9	18.5	18.9	16.7	17.3	19.2	19.8	20.2
4H	12H	15.4	15.9	17.9	18.5	18.9	16.7	17.2	19.2	19.8	20.2
8H	4H	15.5	16.0	17.9	18.5	18.9	16.7	17.2	19.2	19.8	20.2
8H	6H	15.4	15.8	18.0	18.5	18.9	16.7	17.1	19.2	19.8	20.2
8H	8H	15.3	15.7	18.0	18.5	18.9	16.6	17.0	19.3	19.7	20.2
8H	12H	15.3	15.6	18.0	18.4	18.9	16.6	16.9	19.3	19.7	20.1
12H	4H	15.4	15.9	17.9	18.5	18.9	16.7	17.2	19.2	19.8	20.2
12H	6H	15.3	15.7	18.0	18.5	18.9	16.6	17.0	19.3	19.7	20.2
12H	8H	15.3	15.6	18.0	18.4	18.9	16.6	16.9	19.3	19.7	20.1







- UGR can be calculated with two arrangements
  - Spacing equal to mounting height above observer eye (2m : 2m)
  - Spacing equal to one quarter of the mounting height above obeserver eye (0.5m : 2m)
- The limiting criteria in EN 12464-1 is identical for both situations





- UGR can be calculated with two arrangements
- Generally this makes little difference...
- ...unless the distribution cut-off hits the boundary and
  - Is cut-off for 1:1 spacing
  - Is NOT cut-off for 0.25:1 spacing



 Different countries require the calculation to be performed a specific way, e.g.

UK 1:1Germany 0.25:1





				UG	R tab	le (Cl	E)				
UGR ba	ased on	3600 Im	1						Sp	acing: 1	.00 H
Useful Wa Ceili	plane Ils ng	70/50/20	70/30/20	50/50/10	50/30/10	30/30/10	70/50/20	70/30/20	50/50/10	50/30/10	30/30/10
×	Y	Tra	nsverse	directio	n of vie	w	P	arallel d	lirection	of view	
2H	2H	2.7	4.0	3.0	4.3	4.6	12.1	13.4	12.5	13.7	14.1
2H	зн	2.6	3.7	2.9	4.0	4.4	12.0	13.2	12.4	13.5	13.8
2H	4H	2.5	3.6	2.9	3.9	4.3	11.9	13.0	12.3	13.3	13.7
2H	6H	2.5	3.4	2.9	3.8	4.2	11.9	12.8	12.3	13.2	13.6
2H	вн	2.5	3.4	2.9	3.7	4.1	11.9	12.8	12.3	13.1	13.5
2H	12H	2.4	3.3	2.9	3.7	4.1	11.8	12.7	12.2	13.1	13.5
4H	2H	2.5	3.6	2.9	3.9	4.3	11.9	13.0	12.3	13.3	13.7
4H	зн	2.4	3.3	2.8	3.6	4.1	11.8	12.7	12.2	13.0	13.5
4H	4H	2.4	3.1	2.9	3.6	4.0	11.8	12.5	12.2	12.9	13.3
4H	6H	2.5	3.1	3.0	3.6	4.0	11.8	12.4	12.3	12.8	13.3
4H	вн	2.3	2.9	2.8	3.4	3.9	11.6	12.2	12.1	12.7	13.1
4H	12H	2.3	2.8	2.8	3.3	3.8	11.6	12.1	12.1	12.6	13.1
8H	4H	2.3	2.9	2.8	3.3	3.8	11.6	12.2	12.1	12.6	13.1
8H	6H	2.3	2.7	2.8	3.2	3.7	11.5	12.0	12.0	12.5	13.0
8H	вн	2.3	2.7	2.8	3.2	3.7	11.5	11.9	12.0	12.4	12.9
8H	12H	2.2	2.6	2.8	3.1	3.7	11.4	11.8	11.9	12.3	12.8
12H	4H	2.2	2.8	2.7	3.2	3.7	11.5	12.1	12.0	12.5	13.0
12H	6H	2.2	2.6	2.7	3.1	3.7	11.4	11.9	12.0	12.4	12.9
12H	8H	2.2	2.6	2.7	3.1	3.6	11.4	11.8	11.9	12.3	12.8

				UG	R tab	le (Cl	E)				
UGR ba	ased on	3600 Im	1						Sp	acing: 0	.25 H
Useful ( Wal Ceili	plane Is ng	70/50/20	70/30/20	50/50/10	50/30/10	30/30/10	70/50/20	70/30/20	50/50/10	50/30/10	30/30/10
х	Y	Tra	nsverse	directio	n of vie	w	P	arallel d	irection	of view	
2H	2H	15.9	16.9	17.7	18.9	19.1	17.3	18.3	19.1	20.3	20.5
2H	зн	15.8	16.7	17.7	18.8	19.0	17.1	18.0	19.1	20.1	20.4
2H	4H	15.7	16.5	17.7	18.7	19.0	17.1	17.9	19.1	20.1	20.3
2H	6H	15.6	16.4	17.7	18.6	18.9	17.0	17.8	19.1	20.0	20.3
2H	SН	15.6	16.3	17.7	18.6	18.9	16.9	17.7	19.1	20.0	20.3
2H	12H	15.5	16.2	17.7	18.6	18.9	16.9	17.6	19.1	19.9	20.2
4H	2H	15.8	16.7	17.8	18.8	19.1	17.1	17.9	19.1	20.1	20.4
4H	ЗH	15.7	16.4	17.9	18.7	19.0	16.9	17.6	19.1	20.0	20.3
4H	4H	15.6	16.2	17.9	18.6	19.0	16.9	17.5	19.2	19.9	20.2
4H	6H	15.5	16.1	17.9	18.6	18.9	16.8	17.3	19.2	19.9	20.2
4H	sн	15.5	16.0	17.9	18.5	18.9	16.7	17.3	19.2	19.8	20.2
4H	12H	15.4	15.9	17.9	18.5	18.9	16.7	17.2	19.2	19.8	20.2
8H	4H	15.5	16.0	17.9	18.5	18.9	16.7	17.2	19.2	19.8	20.2
SН	6H	15.4	15.8	18.0	18.5	18.9	16.7	17.1	19.2	19.8	20.2
8H	вн	15.3	15.7	18.0	18.5	18.9	16.6	17.0	19.3	19.7	20.2
8H	12H	15.3	15.6	18.0	18.4	18.9	16.6	16.9	19.3	19.7	20.1
12H	4H	15.4	15.9	17.9	18.5	18.9	16.7	17.2	19.2	19.8	20.2
12H	6H	15.3	15.7	18.0	18.5	18.9	16.6	17.0	19.3	19.7	20.2
12H	SН	15.3	15.6	18.0	18.4	18.9	16.6	16.9	19.3	19.7	20.1



## EN12464-1:2011 Illuminance – Mean Cylindrical Illuminance

- A new illuminance measure to help light for good communication
- New guidance on the maintained mean cylindrical illuminance requirements to ensure good visual communication.







## EN12464-1:2011 Illuminance – Mean Cylindrical Illuminance

- A new illuminance measure to help light for good communication
- New guidance on the maintained mean cylindrical illuminance requirements to ensure good visual communication.



Recommended Ē<sub>z</sub> ≥ 50 lx with U<sub>o</sub> ≥ 0.1 on a horizontal plane

1.2m above the floor, seated people,
6m above the floor, standing people.

Where good visual communication is important, for example some office spaces, meeting and teaching areas, the recommended level of  $\overline{E}_{z}$  is  $\geq$  150 lx with U<sub>o</sub>  $\geq$  0.10.





## EN12464-1:2011 Lighting the interior space – Modelling Index

- A new section has been added giving guidance on the modelling within a space to reveal form and texture with respect to structural features, people and objects within the space.
- This section defines the concept of modelling index, which is the ratio of cylindrical to horizontal illuminance at a point.







## EN12464-1:2011 Directional light and possible problems

#### Tight cut off luminaires or directional lighting

- Strong directional lighting will lead to strong modelling, shadows, high contrast which in turn will inhibit performance, and communication.
- Used correctly it will create visual interest and lightness.



## EN12464-1:2011 Directional light and possible problems

#### Tight cut off luminaires or directional lighting

- Strong directional lighting will lead to strong modelling, shadows, high contrast which in turn will inhibit performance, and communication.
- Used correctly it will create visual interest and lightness.





## EN12464-1:2011 Directional light and possible problems

- Mean cylindrical illuminance (E<sub>c</sub>) requirements in the activity space
   E<sub>c</sub> = 50 lx Uo 0.10(in offices, teaching areas 150 lx) at 1.2m above floor
- Modelling E<sub>c</sub>/E<sub>h</sub> of 0.30 – 0.60 at 1.2m above floor is an indicator of good modelling

Directional lighting of visual task
 Lighting from specific direction can reveal more details in the
 visual task, increase the task visibility and form, and create
 helpful shadows









## EN12464-1:2011 **Lighting the interior space – Modelling Index**



## EN12464-1:2011 **Lighting the interior space – Modelling Index**





## EN12464-1:2011 Category system

In LG3 : 1989

- Category 1 luminaire : Average luminance ≤ 200 cd/m<sup>2</sup> above 55°
- Category 2 luminaire : Average luminance ≤ 200 cd/m<sup>2</sup> above 65°
- Category 3 luminaire : Average luminance ≤ 200 cd/m<sup>2</sup> above 75°
- LG3 : 1989 had 32 pages
- The category system was discussed in pages 11-12
- Generally people ignored the rest of the document!



## EN12464-1:2011 Category system

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- LG3 : 1989 had 32 pages
- The category system was discussed in pages 11-12
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## EN12464-1:2011 Category system

 The category rating system was withdrawn a number of years ago, though we do talk of luminance limits still at 65°.





## EN12464-1:2011 Luminance problems or myth?



EN12464-1:2011 · Peter Thorns · 14-Feb-2010 © ZLD

## EN12464-1:2011 Screen types and luminance limits

### •Three screen types and appropriate luminance limits:

Screen type	Maximum Luminance (cd/m <sup>2</sup> ) where some Negative polarity software used
Type I and II Good or moderate screen treatment	1000 cd/m <sup>2</sup>
Type III No screen treatment	200 cd/m <sup>2</sup>

**Negative polarity** 



**Positive polarity** 



Where positive polarity software only is being used on Type I and II screens the luminance limit can be increased to 1500 cd/m<sup>2</sup>.

Where positive polarity software only is being used on Type III screens the luminance limit can be increased to 500 cd/m<sup>2</sup>



## EN12464-1:2011 Lighting Display Screen Equipment – Limiting Luminance

#### ISO2419 and EN12464 recognise screen technology has moved on



#### EN12464-1:2011 · Peter Thorns · 14-Feb-2010 © ZLD

Based on ISO 9241-307 luminance limits for luminaires likely to be reflected in display screen equipment tilted by up to 15°

Screen high state Luminance of Flat screen	High > 200 cd/m²	Medium < 200 cd/m <sup>2</sup>
Case A	≤ 3000 cd/m²	≤ 1500 cd/m²
Case B	≤ 1500 cd/m²	≤ 1000 cd/m²

**Case A:** positive polarity and normal requirements concerning colour and details of the shown information (like those used in office, education etc) **Case B:** negative polarity and/or higher requirements concerning colour and details of the shown information (like those used for CAD, colour inspection, etc)

## EN12464-1:2011 Maintenance factor

- The lighting scheme should be designed with an overall maintenance factor (MF) calculated for the selected lighting equipment, environment and specified maintenance schedule.
- The MF has a great impact on energy efficiency. The assumptions made in the derivation of the MF shall be optimized in a way that leads to a high value. Guidance on the derivation of MF for artificial lighting systems can be found in CIE 97-2005.



## EN12464-1:2011 Maintenance factor

```
MF = LLMF * LSF * LMF * RSMF
```

MF = 0.91 \* 0.95 \* 0.80 \* 0.94

Office (lit with T5 lamps) Operating hours 2500 hours/year

Clean surfaces every 5 years Clean luminaires every 2 years Bulk change lamps every 4 years

#### MF = 0.65

This means to ensure that the installation never falls below the maintained light level (assuming the maintenance schedule is adhered to) we must OVERLIGHT the area to 154% of the design level. So for example

Maintained light level = 500lx

```
Initial light level = 769lx
```



- LENI is the total annual energy used for lighting per square meter (kWh/(m<sup>2</sup> year)
- It is composed of 3 main parts
  - Energy required to fulfill the illumination function (W<sub>L</sub>)
  - Parasitic energy of emergency lighting and lighting controls in standby (W<sub>P</sub>)
  - Total useful floor area (A)







 Parasitic energy of emergency lighting and lighting controls in standby (W<sub>P</sub>)

Annual hours lights are turned off

Installed parasitic power

Emergency lighting charging power

 $\frac{\left\{\left\{P_{pc}\times\left[t_{y}-\left(t_{D}+t_{N}\right)\right]\right\}+\left(P_{em}\times t_{e}\right)\right\}}{1000}$ 







The values are valid for normal visual conditions and take into account the following factors:

- psycho-physiological aspects such as visual comfort and wellbeing;
- requirements for visual tasks;
- visual ergonomics;
- practical experience;
- contribution to functional safety;
- economy



The required maintained illuminance should be increased when:

- visual work is critical;
- errors are costly to rectify;
- accuracy, higher productivity or increased concentration is of great importance;
- task details are of unusually small size or low contrast;
- the task is undertaken for an unusually long time;
- the visual capacity of the worker is below normal.



The required maintained illuminance may be decreased when:

- task details are of an unusually large size or high contrast;
- the task is undertaken for an unusually short time.



D	Table 5.24 — Industrial activities	and cra	fts – Ve	hicle co	nstruct	ion and repair
Ref. no.	Type of area, task or activity	<i>Ē</i> m lx	UGR_	U.,	R <sub>a</sub>	Specific requirements
5.24.1	Body work and assembly	500	22	0,60	80	
5.24.2	Painting, spraying chamber, polishing chamber	750	22	0,70	80	
5.24.3	Painting: touch-up, inspection	1 000	19	0,70	90	4 000 K $\leq T_{CP} \leq 6500$ K
5.24.4	Upholstery manufacture (manned)	1 000	19	0,70	80	
5.24.5	Final inspection	1 000	19	0,70	80	
5.24.6	General vehicle services, repair and testing	300	22	0,60	80	Consider local lighting.

Ref. no.	Type of area, task or activity	Ē <sub>m</sub> lx	UGR	U <sub>0</sub>	R.	Specific requirements
5.20.1	Fuel supply plant	50	-	0,40	20	Safety colours shall be recognisable.
5.20.2	Boiler house	100	28	0,40	40	
5.20.3	Machine halls	200	25	0,40	80	
5.20.4	Side rooms, e.g. pump rooms, condenser rooms, etc.; switchboards (inside buildings)	200	25	0,40	60	
5.20.5	Control rooms	500	16	0,70	80	<ol> <li>Control panels are often vertical.</li> <li>Dimming may be required.</li> <li>DSE-work, see 4.9.</li> </ol>

Table 5.20 - Industrial activities and crafts - Power stations



## EN12464-1:2011 Verification

#### 6.2 Illuminances

When verifying conformity to the illuminance requirements the measurement points shall coincide with any design points or grids used. Verification shall be made to the criteria of the relevant surfaces.

#### 6.3 Unified Glare Rating

Authenticated UGR data produced by the tabular method shall be provided for the luminaire scheme by the manufacturer of the luminaire. The spacing shall be declared for the UGR-tables provided.



## EN12464-1:2011 Illuminance – Calculation Grids

- I place a spotlight in a room and calculate...
  - Eav 26 lx
    Emin 1.11lx
    Emax 2253lx

Contraction of the second second second		
And and American Inch. (add )	Powerks - serve dar - son -   Britekels, mark dar - o.s.   Browerks - sacket dar - st   Prometric second dar son - O. Anna Ora	
contra dan Long Tran Corran Co.	1400+	
Ogranel construction of		
Objaca	138 138 188 188 189 220 232 232 230 249 124 177 171	
Charles (1991) Court (1997)	138 138 138 199 191 228 241 242 226 221 194 179 179	
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Determine nin, max, and average values from	144 146 170 217 251 476 846 538 556 251 230 168 164	
(Count Set	1.46 1.46 1.71 2.28 3.78 10 15 19 13 8.74 2.57 1.88 1.64	
Occupation	1.62 1.62 1.69 2.01 7.10 19 19 20 17 12 4.03 2.23 2.19	
Conduction of the Conduction o	140 140 140 127 121 11 10 40 100 26 46 6.03 2.30 2.10	
	180 180 180 180 18 19 25 277 527 88 07 602 238 219	
Total Inc.	145 146 206 435 45 24 962 1468 968 96 239 230	
Sector Statements	166 166 209 446 10 22 521 1121 179 10 524 124 120	
PLAN BOARD AND AND AND AND	180 180 186 282 13 21 224 429 70 17 770 226 214	
Roun elevents (markets lef)	180 180 194 2.11 10 17 38 88 22 18 559 2.36 2.18	
Sport Stee (layout plan)	160 160 180 271 6.61 16 19 17 12 276 224 219	
[] Sport Stes (Coordinates Lat)	1.40 1.40 1.50 2.20 2.40 4.12 14 15 12 5.03 2.51 1.82 1.00	
TV Carterias (Coot-Bruttes SHI)	140 140 187 218 237 428 720 810 872 310 223 180 180	
Pole Postoris (Coordinates List)	140 140 157 240 249 272 335 159 200 250 247 130 166	
don't Later area (Coordinates Lat)	120 120 134 187 188 148 216 206 146 170 188 188	
Calculation Gnt1 (Coundinates List)	120 120 120 120 120 127 122 220 226 124 120 120 120 120	
Calculation surfaces (coordinates lat)	111 111 120 140 140 140 147 157 151 151 144 128 128	
Task Area (coordinates bat)	1.11 1.11 1.20 1.42 1.42 1.00 1.07 1.01 1.01 1.44 1.30 1.30	
	111 111 120 140 140 100 100 101 101 101 144 136 136	
SZ al Photometric Results		
🖸 🧾 Calculation suffaces (results overview)		
Calculation points (results overview)		
(102) Charve (results overview)	0.00 8.00 %	
TT R 30 Rendered	Values in Los. Scale 1	21
False Colour Rendering	Fort all calculated values could be displayed.	
🖶 🛄 Poon Sufaces		
🗰 🛄 Workplane	Working dama with 0.500 m Bandland Zana	
La (g), Isolves (C)	Marinet pour, (1.500 m, 0.500 m, 0.750 m)	
Construction (C)		
Titte (2)		
# Ca Ploor		
# 🕞 Celing	No	
a a wall		
w Ca Web 3	Ged 128 s 128 Poets	
# Ca Wel 4	E_DI E_DI E_DI A E_/E	1
the file file and the standard and		1144



## EN12464-1:2011 Verification

- I modify it to use the standard grid and calculate...
  - Eav 25 lx
    Emin 1.11lx
    Emax 963lx

So Emax has changed by 234%!

However EN 12464-1 verification procedures may mean you have to measure <u>EVERY</u> calculated point (121 points vs. 16384 points)





# THORN



## EN12464-1:2011

Light and lighting – Lighting of workplaces Part 1: Indoor work places

Peter Thorns · Head of Strategic Lighting Applications