Associazione Nazionale
Produttori Illuminazione

ANIE FEDERAZIONE

CONFINDUSTRIA

Outlook sulle attività di standardizzazione in CEN e ISO

revisione della EN 12464-1 e prossime pubblicazioni ISO (ISO/CIE FDIS 20086 e ISO/CIE DTS 22012)

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Attività di standardizzazione in CEN e ISO

Associazione Nazionale
Produttori Illuminazione

- Revisione della **EN 12464-1** "Light and lighting - Lighting of work places - Part 1: Indoor work places“

- ISO/CIE FDIS **20086** "Light and lighting — Energy performance of lighting in buildings“

- ISO/CIE DTS **22012** "Light and lighting - Maintenance factor determination - Way of working"

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CEN: Revisione EN 12464-1

Associazione Nazionale
Produttori Illuminazione

- **PWI 00169075** “Light and lighting — Lighting of work places — Part 1: Indoor work places”

- Approvazione WI 00169075: 31 marzo 2018

- Possibile votazione FprEN 12464-1: **marzo 2019**


EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 12464-1

June 2011

English Version

Light and lighting - Lighting of work places - Part 1: Indoor work places

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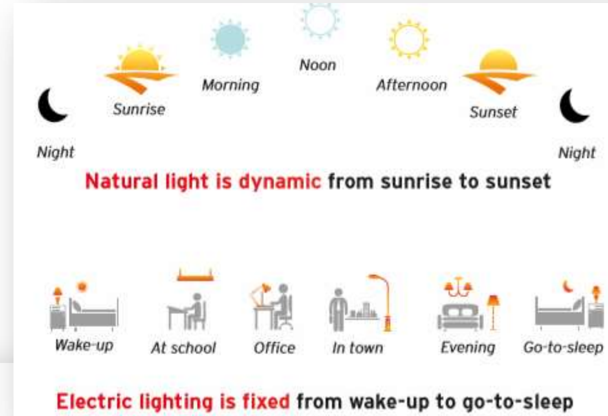
CEN: Revisione EN 12464-1

- Nel 2014 LightingEurope ha richiesto al CEN TC 169 di includere nella norma gli "effetti non visivi della luce“ dando così il via al processo di revisione della EN 12464-1:2011;

- Ulteriori elementi per la revisione sono poi stati palesati durante l’inchiesta di ottobre 2015 (N1350) per la revisione sistematica;

- Da allora il gruppo di lavoro ha esaminato i diversi argomenti e preparato la bozza di lavoro per il NWIP.



LIGHTINGEUROPE

HUMAN CENTRIC LIGHTING
A basic overview
September 2014

For a long time we have known that light allows us to see, aiding orientation and enhancing safety. But light can do more than enabling vision. Light has the power to energize, relax, increase alertness, cognitive performance and mood, and to improve the day-night-rhythm of people. These biological and emotional benefits of light should not be underestimated. Recent research has shown these benefits in nearly every area of application.

Despite current trends in legislation and practice, light is concerned with much more than energy efficiency. The true value lies in the combination of excellent visual, biological and emotional benefits. Within LightingEurope we call lighting combining all three benefits "Human Centric Lighting". And it is now possible to include biological and emotional benefits into modern lighting solutions.

At the beginning of this millennium, a third photo receptor in the eye (in addition to rods and cones) was discovered. With this discovery, it became evident that human biological rhythms and cognitive performance are influenced by specific light conditions. In other words, lighting has tremendous effects on human health, productivity, and well-being.

Initial potential benefits of human centric lighting include improved sleep/wake cycles, daily changes in alertness, performance and mood (circadian changes), as well as responses to seasonal changes. Benefits can be achieved with new technology that allows for greater adaptation of light's colour temperature, illuminance levels, and distribution so it more closely resembles natural conditions. Applications where benefits may be achieved include healthcare, education, workplace, smart cities and domestic lighting.

The ability of light to achieve these various non-visual effects depends on the spectrum, intensity, and temporal pattern of the light, as well as the light-exposure history and preceding sleep patterns of the individual. Therefore, the optimization of a Human Centric Lighting solution for a given non-visual effect is only possible when the user context is accounted for. This requires a dedicated and tailor-made design, based on a profound understanding of the personal and environmental conditions of the use-case(s). A "one size fits all" Human Centric Lighting solution does not exist, and one may even do more harm than good when applying a solution beyond the context and scope it was designed for.

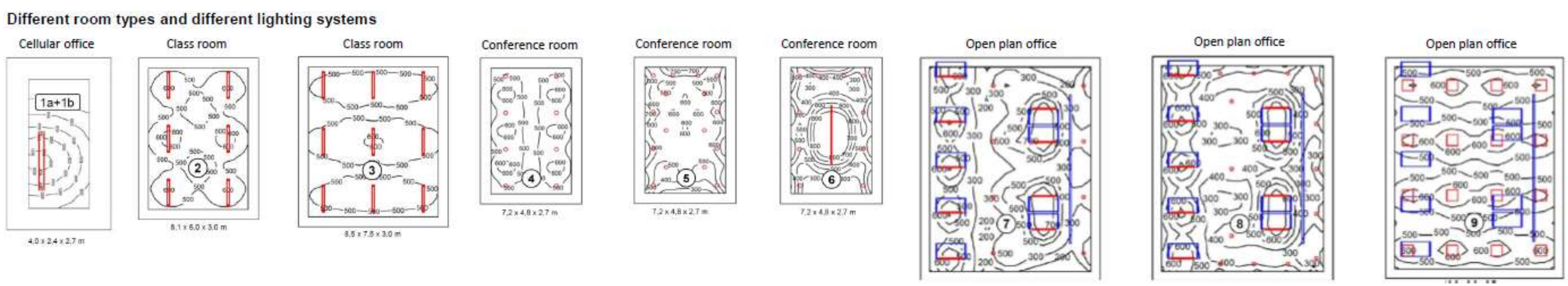
The consequences for these new findings are profound. As recognized by the European Commission with the awarding of the SSL-erate project and the United States Department of Energy in a recent solid state lighting fact sheet, "The non-visual needs should also be considered". This simple statement shows that it is no longer enough to see and be seen. It is now crucial to get the right light at the right time.

HUMAN CENTRIC LIGHTING A basic overview September 2014
http://www.lightingeurope.org/images/publications/general/Human_Centric_Lighting_general_overview_September_2014.pdf

CEN: Revisione EN 12464-1

Nuovo capitolo su "***Design considerations***"

•Il nuovo capitolo “*considerazioni sulla progettazione*” fornirà indicazioni su come selezionare correttamente i requisiti per l’illuminazione durante l'attività (***Visual task***) o per l’area (***task Area***), nonché indicazioni per progettare anche il corretto funzionamento dell’impianto di illuminazione (es. *multiple tasks, dynamic lighting, daylight adaptation, ...*)



Nuovo **CEN / TS 17165** "*Lighting Systems Design Process*" e verrà fornito un riferimento a tale documento (equivalente alla UNI 11630).

CEN: Revisione EN 12464-1

Ambient lighting

La luminosità delle stanze è importante per il benessere e il comfort visivo. I requisiti dipendono dall'applicazione. Inoltre, gli aspetti non visivi possono essere coperti dall'illuminazione ambientale. Questo verrà introdotto probabilmente in un allegato informativo della norma.

D1.1 Ambient illuminance

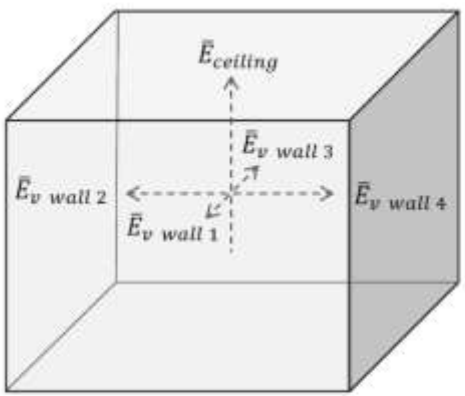
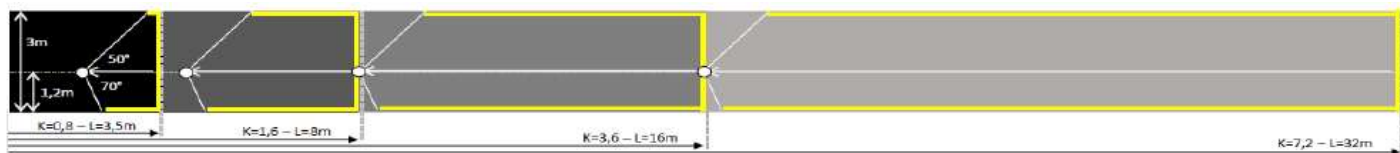


Figure 1 - The five major room surfaces used in the calculation.

D1.4 Adaptation luminance within the normal field of view



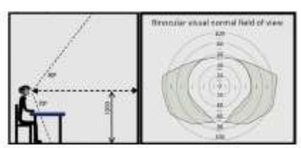


Figure 2 - Normal visual field vs. space dimensions

CEN: Revisione EN 12464-1

Associazione Nazionale
Produttori Illuminazione

Adattamento delle **tabelle sez. 5**

Le Tabelle alla sezione 5 sono un elemento centrale della norma. L'attenzione è spesso rivolta principalmente a questi valori e limiti. Le tabelle avranno un nuovo layout in modo che le informazioni aggiuntive come **E_{wall}** e **$E_{ceiling}$** che sono attualmente "nascoste" nel testo principale, saranno riportati nella tabella.

Vi sarà anche un "limite superiore" dell'illuminamento mantenuto per dare più libertà al progettista di scegliere una fascia di illuminamento per le diverse esigenze “visive” e per le esigenze “non visive”. Ciò consente anche di sfruttare meglio i controlli.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Line no	Table	Ref. no.	Type of area, task or activity	Task (T)/ Activity (A)	$\bar{E}_{m-r}$ lx	$\bar{E}_{m-upper}$ lx	U_o	$\bar{E}_z$ lx	R_{UGL}	$\bar{E}_{m-wall}$ lx	$\bar{E}_{m-ceiling}$ lx	R_a	Specific requirements
2	2	Table 5.1 — Traffic zones inside buildings												
3	3	Table 5.1	5.1.1	Circulation areas and corridors	A	100		0,40		28			40	· Illuminance at floor level. · Ra and UGR similar to adjacent areas. · 150 lx if there are vehicles on the route. · The lighting of exits and entrances shall provide a transition zone to avoid sudden changes in illuminance between inside and outside by day or night. · Care should be taken to avoid glare to drivers and pedestrians
4	8	Table 5.1	5.1.2	Stairs, escalators, travolators	A	100		0,40		25			40	Requires enhanced contrast on the steps.
5	9	Table 5.1	5.1.3	Elevators, lifts	A	100		0,40		25			40	Light level in front of the lift should be at least $\bar{E}_m$ = 200 lx.
6	10	Table 5.1	5.1.4	Loading ramps/bays	A	150		0,40		25			40	
7	11	Table 5.2 —General areas inside buildings – Rest, sanitation and first aid rooms												
8	12	Table 5.2	5.2.1	Rest rooms	A	100		0,40		22			80	
9	13	Table 5.2	5.2.2	Rooms for physical exercise	A	300		0,40		22			80	
10	14	Table 5.2	5.2.3	Cloakrooms, washrooms, bathrooms, toilets	A	200		0,40		25			80	In each individual toilet if these are fully enclosed.
11	15	Table 5.2	5.2.4	Sick bay	A	500		0,60		19			80	
12	16	Table 5.2	5.2.5	Rooms for medical attention	A	500		0,60		16			90	4 000 K ≤ T_{CP} ≤ 5 000 K
13	19	Table 5.3 — General areas inside buildings – Control rooms												
15	22	Table 5.3	5.3.1	Plant rooms, switch gear rooms	A	200		0,40		25			60	
16	23	Table 5.3	5.3.2	Telex, post room, switchboard		500		0,60		19			80	
17	24	Table 5.4 — General areas inside buildings – Store rooms, cold stores			A									

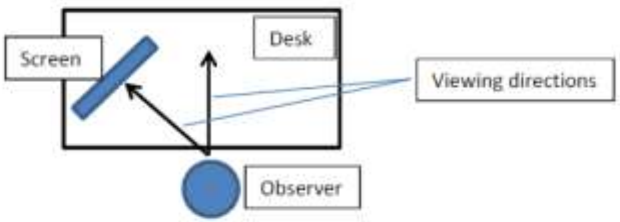
CEN: Revisione EN 12464-1

UGR

Le attuali incomprensioni nell'applicazione del metodo UGR dovranno essere ridotte.

Si utilizza il metodo tabulare per scegliere un apparecchio per l'applicazione specifica.

$$UGR = 8\log_{10}\left(\frac{0{,}25}{L_B}\sum\frac{L^2\omega}{p^2}\right)$$



LUMINAIRE Linear 1 x FD 58W

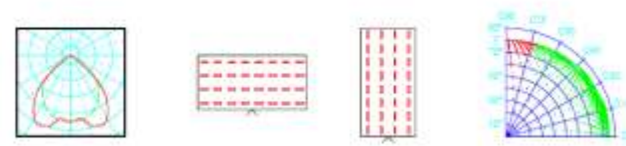


TABLE OF CORRECTED UNIFIED GLARE RATINGS (UGR)

Spacing s/h = 0.25

		Reflectances									
Ceiling		0.70	0.70	0.50	0.50	0.30	0.70	0.70	0.50	0.50	0.30
Walls		0.50	0.30	0.50	0.30	0.30	0.50	0.30	0.50	0.30	0.30
Floor		0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Dimensions		Corrected Glare Ratings - Luminous Flux 5200 lm									
X	Y	Viewed crosswise					Viewed endwise				
2H	2H	16.4	18.0	16.8	18.3	18.6	17.4	19.0	17.7	19.2	19.5
	3H	16.3	17.7	16.6	18.0	18.3	17.2	18.6	17.6	19.0	19.3
	4H	16.2	17.5	16.6	17.9	18.2	17.2	18.5	17.5	18.8	19.2
	6H	16.2	17.4	16.6	17.7	18.1	17.1	18.3	17.5	18.7	19.0
	8H	16.2	17.3	16.6	17.6	18.0	17.1	18.2	17.5	18.6	18.9
	12H	16.1	17.2	16.5	17.5	17.9	17.1	18.1	17.5	18.5	18.9
4H	2H	16.4	17.7	16.8	18.1	18.4	17.3	18.6	17.6	18.9	19.2
	3H	16.3	17.4	16.7	17.7	18.1	17.1	18.2	17.5	18.6	19.0
	4H	16.2	17.2	16.7	17.6	18.0	17.1	18.0	17.5	18.4	18.8
	6H	16.1	17.0	16.6	17.4	17.8	17.0	17.8	17.4	18.2	18.6
	8H	16.1	16.8	16.5	17.3	17.7	[illegible]	17.7	17.4	18.1	18.6
	12H	16.1	16.7	16.5	17.2	17.6	16.9	17.5	17.4	18.0	18.5
8H	4H	16.1	16.8	16.5	17.3	17.7	16.9	17.7	17.4	18.1	18.6
	6H	16.0	16.6	16.5	17.1	17.6	16.9	17.4	17.3	17.9	18.4
	8H	16.0	16.5	16.5	17.0	17.5	16.8	17.3	17.3	17.8	18.3
	12H	15.9	16.3	16.4	16.8	17.4	16.7	17.2	17.2	17.7	18.2
12H	4H	16.1	16.7	16.5	17.2	17.6	16.9	17.5	17.4	18.0	18.5
	6H	16.0	16.5	16.5	17.0	17.5	16.8	17.3	17.3	17.8	18.3
	8H	15.9	16.3	16.4	16.8	17.4	16.7	17.2	17.2	17.7	18.2

Variations of glare ratings with observer position
reflectances 0.70 / 0.50 / 0.20

s / h = 1.00	-7.0 / +3.2	(+14.5)	-2.5 / +1.9	(+16.4)
s / h = 1.50	-20.1 / +10.5	(+8.7)	-25.1 / +7.9	(+11.5)
s / h = 2.00	-19.9 / +16.8	(+4.1)	-20.8 / +15.3	(+6.0)

UGR – possibile testo

The rating of discomfort glare caused directly from the luminaires shall be determined using the CIE Unified Glare Rating (UGR) tabular method.

"All assumptions made concerning luminaire, room dimensions, room reflectance's and spacing to height ratio in the determination of the UGR shall be stated in the scheme documentation. The UGR value as determined by the tabular method ***shall not exceed*** *the value given in Clause 5."*

The recommended limiting values of the UGR form a series whose steps indicate noticeable changes in glare.

The series of UGR is: 10, 13, 16, 19, 22, 25, 28.

NOTE 1 The variations of UGR within the room can be determined using the comprehensive tables for different observer positions, as detailed in CIE 117-1995 and CIE 190.

FLICKER ed effetti stroboscopici - possibile testo

In ragione delle maggiori conoscenze sul fenomeno, saranno introdotti requisiti a tal riguardo

4.8 Flicker and stroboscopic effects

4.8.1 General

Flicker and stroboscopic effect (also called temporal lighting artefacts - TLA) can lead to undesired effects such as reducing visual comfort and reducing task performance and can lead to physiological effects such as fatigue or headaches.

Additionally, stroboscopic effect can also lead to dangerous situations by changing the perceived motion of rotating or reciprocating machinery. This is, however, outside of the scope of this standard. Lighting systems should be designed to avoid the negative effects of flicker and stroboscopic effect.

Background information and methods to objectively quantify these effects can be found in CIE TN 006:2016.

4.8.2 Flicker

Flicker is specified by using the IEC short-term flicker indicator (Pst) and test method as described in IEC TR61547-1:2015.

To prevent adverse direct perception of flicker, the individual light sources of a lighting system shall comply with $P_{st} \leq 1.0$ recommend limits can be found in e.g. IEC TR 61547-1 and IEC/EN 61000-3-3.

4.8.3 Stroboscopic effect

Stroboscopic effect perceived by individuals in indoor work places executing typical tasks, can be objectively quantified using the Stroboscopic Effect Visibility Measure (SVM). The SVM can be used to quantify the visibility of this effect for applications where human motion is dominant and $\bar{E}$ > 100 lx. Limits for this measure are application dependent and currently under consideration.

NOTE: SVM is not suitable to quantify the effects on rotating or reciprocating machinery as described in 4.8.1.

Benefits of daylight - possibile testo

Si farà riferimento alla nuova norma EN 17037 per i limiti di abbagliamento

4.5.2 Discomfort glare

For the rating of discomfort glare from windows currently prEN 14501 and prEN 17037 provide glare limits based upon DGP (daylight glare probability)

5.4 Additional benefits of daylight

Daylight can provide significant quantities of light indoors, with high colour rendering and variability in level, direction and spectral composition throughout the day and season. Daylight openings in a vertical, inclined or horizontal surface are strongly favoured in work places for the light they deliver, and for the visual contact they provide with the outside environment. Additionally, daylight provides variable modelling and luminance patterns, which is also perceived as being beneficial for people in indoor working environments. For any space with daylight openings, it is recommended to use shading devices to reduce risk of glare or thermal discomfort, and direct view to the sun or a reflection of it should be avoided. Note that glare caused by daylight differs from glare caused by electric light sources regarding size of the glare sources, complex luminance distribution and acceptance of the users.

5.2 Maintenance factor – possibile testo

Esplicito riferimento (e allineamento) alla nuova norma ISO TS 22012

The lighting scheme shall be designed taking into account an overall maintenance factor (f_M) calculated for the selected lighting equipment, environment and specified maintenance schedule.
The illuminance requirements for each task as specified in table x are given as maintained illuminance (E_m) values. The initial illuminance can be calculated from E_m as follows:

$$E_{in} = \frac{E_m}{f_M} \tag{x}$$

where

E_m is maintained illuminance
E_{in} is initial illuminance
f_M is maintenance factor

The designer shall:

- state the f_M and list all assumptions made in the derivation of the value,
- specify lighting equipment suitable for the application environment and
- prepare a maintenance schedule to include e.g. frequency of light source replacement, luminaire and room cleaning intervals.

The f_M has a large impact on energy efficiency. The assumptions made in the derivation of the f_M shall be optimized in a way that leads to a high value.

Note 1: Guidance on the determination of the maintenance factor can be found in **ISO TS 22012:2018** and further information on the derivation of f_M for artificial indoor lighting systems can be found in CIE 97-2005.
Note 2: For daylight calculations, reduction of transmittance of daylight openings due to dirt deposition should be taken into account.

Attività di standardizzazione in CEN e ISO

Associazione Nazionale
Produttori Illuminazione

- Revisione della **EN 12464-1** "Light and lighting - Lighting of work places - Part 1: Indoor work places"

- ISO/CIE FDIS **20086** "Light and lighting — Energy performance of lighting in buildings"

- ISO/CIE DTS **22012** "Light and lighting - Maintenance factor determination - Way of working"

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ISO/CIE FDIS **20086**

Associazione Nazionale
Produttori Illuminazione

- **ISO/CIE FDIS 20086** “Light and lighting - Energy performance of lighting in buildings“

- Approvazione ISO/NP 20086: 9 novembre 2015 (development track 36 mesi)

- Possibile votazione ISO/CIE FDIS 20086: **giugno 2018**

ISO/TC 274/SC

Date: 2018-03-01

ISO/FDIS 20086:2018(E)

ISO/TC 274/SC /WG 1

Secretariat: DIN

Energy performance of lighting in buildings

Performance énergétique de l'éclairage des bâtiments

Document type: International Standard
Document subtype:
Document stage: (50) Approval
Document language: E

STD Version 2.9d

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ISO/CIE FDIS **20086**

•Nel 2015 il TC 274 ISO ha ritenuto importante procedere alla trasposizione del documento del CEN TC 169, la prEN 15193-1 Energy performance of buildings - Energy requirements for lighting - Part 1: Specifications, Module M9 (norma EN dal 2017)

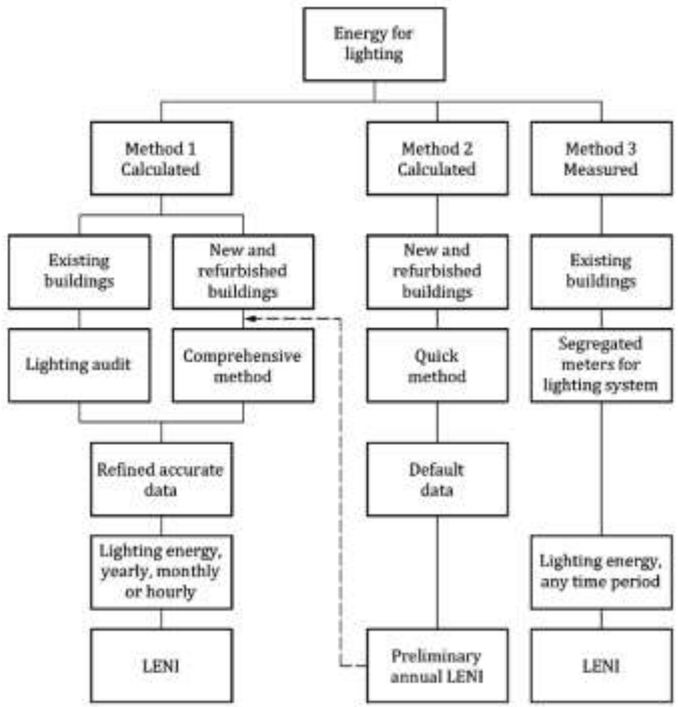

Figure 1 — Flow chart illustrating alternative routes to determine energy use

Principali differenze dalla EN 15193-1:2017

6.4.3.5 Daylight dependency factor (F_D)

The daylight dependency factor F_D shall be calculated for a room or zone in the building as a function of the daylight supply factor $F_{D,S}$ and the daylight dependent electric lighting control factor $F_{D,C}$ by the equation:

$$F_D = 1 - (F_{D,S} \times F_{D,C}) \quad (7)$$

The method for the determination of the daylight supply factor $F_{D,S}$ and the daylight dependent electric lighting control factor $F_{D,C}$ are given in ISO 10916.

Si ritiene comunque che aver riferito il calcolo del fattore F_D alla ISO 10916 sia riduttivo quando sono utilizzati lucernari, per tale ragione si mira ad avere presto una revisione della ISO 10916:2016 del TC 163 con la collaborazione del TC 274.

https://www.iso.org/standard/46394.html

Principali differenze dalla EN 15193-1:2017

In base alle recenti attività del WG si ritiene necessario migliorare/correggere la simbologia utilizzata per ridurre possibili errori di interpretazione; a tal proposito la tabella dei simboli sarà probabilmente corretta come segue:

Table 3, all items can be moved to table 1 with their proper symbols. I would also change them to their more generic terms (in JWG 3 we made them 'technology independent' by removing the 'lamp' part for example. So the terms will be:

a. f_{M} Maintenance Factor (unit = 1)
b. f_{LF} Luminous Flux Factor (unit = 1)
c. f_{S} Survival Factor (unit = 1)
d. f_{LM} Luminaire maintenance factor (unit = 1)
e. f_{SM} Surface maintenance factor (unit = 1)
f. Please note that in a to e, 'f' is to be written in italics and all subscripts are capitals, not in italics

Attività di standardizzazione in CEN e ISO

- Revisione della **EN 12464-1** "Light and lighting - Lighting of work places - Part 1: Indoor work places"

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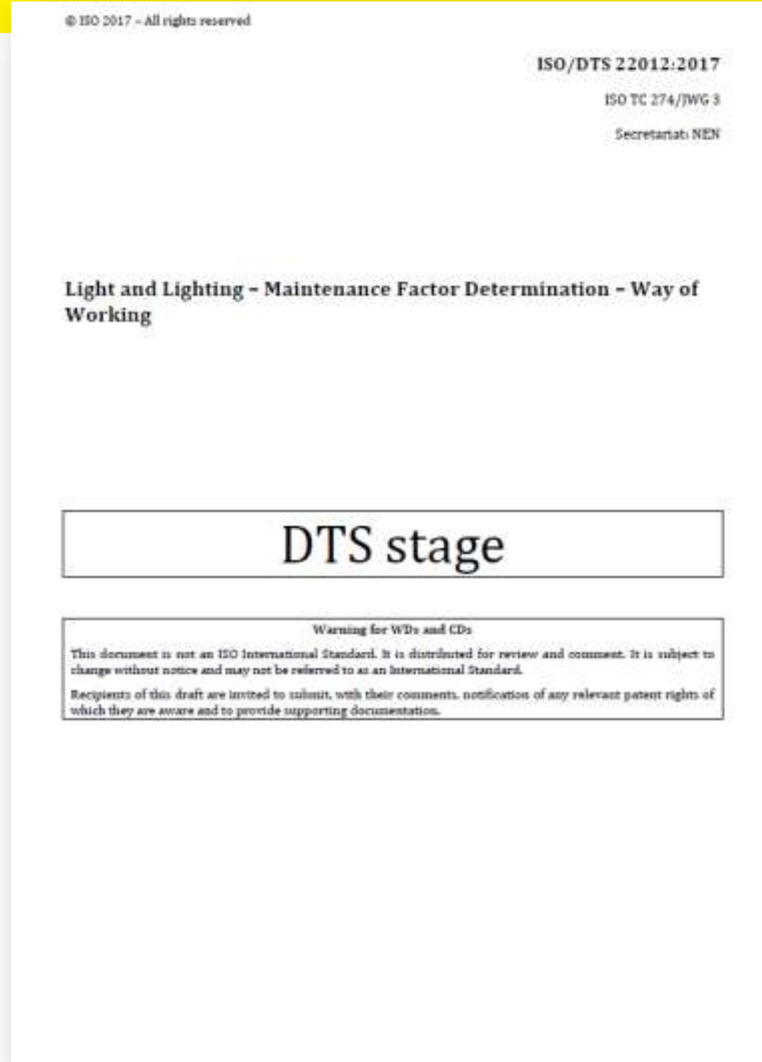
ISO/DTS 22012:2017

- **ISO/DTS 22012:2017** “Light and Lighting – Maintenance Factor Determination – Way of Working“

- Approvazione **ISO/NP TS 22012**: 16 dicembre 2016 (development track 36 mesi)

- Possibile votazione ISO/DTS 22012: **maggio/giugno 2018**



ISO/DTS 22012:2017

ISO TC 274/JWG 3

Secretariat: NEN

Light and Lighting – Maintenance Factor Determination – Way of Working

DTS stage

Warning for WDs and CDs

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

ISO/DTS 22012:2017

SCOPE *- This Technical Specification provides a standardized way of working for determining the maintenance factor for both outdoor and indoor lighting installations using the methodology as described in CIE 154:2003 and CIE 097:2005.*

- La metodologia per determinare il fattore di mantenimento è stata ampiamente documentata dalla CIE
- Questi rapporti tecnici sono però incentrati su sorgenti luminose ad incandescenza e a scarica di gas
- È necessaria maggiore chiarezza per applicare la metodologia esistente anche alle nuove tecnologie (LED).

ISO/DTS 22012:2017

- Questa specifica tecnica combina approfondimenti dalle norme IEC relative alle prestazioni di prodotto (apparecchi di illuminazione e sorgenti luminose) con la metodologia di determinazione esistente derivata dai rapporti tecnici CIE.

- Inoltre, fa riferimento ai dati contenuti nei rapporti tecnici CIE in relazione all'impatto delle condizioni ambientali sugli apparecchi (accumulo di sporco sulle superfici e sugli apparecchi di illuminazione).

Nel DTS 22012 avremo:

•Informazioni di base in merito ai principi del fattore di manutenzione e ai parametri relativi ad applicazioni indoor ed outdoor

6.1 Basic description of the method

The maintenance factor f_M is determined using the following formula:

$$f_M = f_{LF} \cdot f_S \cdot f_{LM} \cdot f_{SM}$$

For LED-based luminaires the luminous flux factor f_{LF} shall be determined based upon the light source or luminaire replacement interval and shall be provided by the luminaire supplier according to the definitions in IEC 62722-2-1.

The replacement interval can correspond to the median useful life L_x. In this case the luminous flux factor f_{LF} equals $x/100$.

EXAMPLE 1: L_{80} = 50 000 h translates to 80 % remaining luminous flux at 50 000 h. If the luminaire or light source is also planned to be replaced at 50 000 h this would result in a luminous flux factor f_{LF} = 0,80.

If the replacement interval is different from the published values, the correct luminous flux factor f_{LF} needs to be supplied by the manufacturer. Alternatively, the table with example values provided in Annex B can be used such as an approximation.

NOTE 3 In some cases the depreciation values are not individually stated, but can be obtained from the lifetime values which will be presented as the median useful life L_x or the useful life 'L_xB_y' value. In both cases, only the x value of the L_x value is relevant for the luminous flux factor determination, the B_y element of 'L_xB_y' is not taken into account in the f_M determination (e.g. the luminous flux factor f_{LF} = 0,80 after 50 000 h for both $L_{80}B_{50}$ =50 000 h and $L_{80}B_{10}$ = 50 000 h specifications).

6.4.2 Indoor luminaires

The luminaire maintenance factor f_{LM} for indoor luminaires shall be based upon the combination of the luminaire design, environmental pollution category and cleaning interval.

Example tables containing the classification of luminaire designs, applications and example luminaire maintenance factors f_{LM} based upon the cleaning interval can be found in C.1.

For accurate data always consult the manufacturer.

6.4.3 Outdoor luminaires

The luminaire maintenance factor f_{LM} for outdoor luminaires shall be based upon the combination of luminaire design (rated according to IP classification) and the environmental pollution category and cleaning interval.

Example tables containing the classification of luminaire designs, environmental pollution category and example luminaire maintenance factors f_{LM} based upon the cleaning interval can be found in C.2.

ISO/DTS 22012:2017

Nel DTS 22012 avremo:

- Una descrizione dettagliata su come applicare il metodo di determinazione del fattore di manutenzione (come descritto nelle CIE 154: 2003 e CIE 097: 2005) per i progetti di illuminazione per esterni ed interni che utilizzano le tecnologie disponibili sul mercato

7 Use of the maintenance factor

7.1 Lighting design using the maintenance factor

The maintenance factor f_M shall be employed in lighting designs to ensure that the target requirements are met throughout the agreed life of the installation when the installation is maintained according to the defined maintenance schedule. The customer needs to be consulted to generate the required input parameters.

Generally, the maintenance schedule is a balance between the cost of compensating for loss of performance of the lighting installation compared with the cost of performing the maintenance operation(s).

The maintained illuminance E_m shall be calculated as follows:

$$E_m = E_{in} \cdot f_M \quad (5)$$

Or for luminance-based designs

$$L_m = L_{in} \cdot f_M \quad (6)$$

ISO/DTS 22012:2017

Nel DTS 22012 avremo:

•Spiegazione ed esempi su come applicare il fattore di manutenzione e su come assicurare un funzionamento appropriato dei prodotti nel tempo corrispondente ai valori determinati.

Maintenance factor determination examples

A.1 Example 1: Parking area project 100 000 h, using spot replacement

Project information:

- Installation lifetime: 100 000 h
- Burning hours per year: 4 000 h
- Repair strategy: Spot replacement
- Luminaire cleaning interval: 3 years
- Pollution category: Low

Luminaire information:

- Luminaire type: Flood lighting LED luminaire with integrated driver
- Median useful life L_{80}: 100 000 h (no CLO)
- IP Class: IP66
- Driver failure rate: 0,5 % per 5 000 h

Determination:

1. Luminous flux factor: Installation lifetime is equal to to the given median useful life at L_{80}. As such, the luminous flux factor f_{LF} =0,80.
2. Survival factor: Project employs a spot replacement strategy. As such, the mentioned failure rate is not relevant, the survival factor f_S=1,0.
3. Luminaire maintenance factor: Based on Table C.5, an IP6X luminaire, with pollution category "low", with a 3 years cleaning interval results in a luminaire maintenance factor f_{LM}=0,90.
4. Surface maintenance factor: Only relevant for indoor installations and outdoor tunnels and underpasses. Not applicable for this situation, f_{SM} = 1,0.

Maintenance factor f_M = 0,80 × 1,0 × 0,90 × 1,0 = 0,72

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Vi ringraziamo per l'attenzione!

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