EN12464-1





Content of EN 12464-1



The establishment of the standard

The standard was written by Work Group 2 of the Technical Committee TC 169 of the European Committee for Standardisation (CEN). The first meeting was held in June 1990. Thirteen years (and almost thirty international meetings) later, the EN 12464-1 standard has come into force in Europe.

Scope of the standard

The standard governs indoor workplace lighting. As with most standards, minimum requirements are laid down. In other words, it concerns a minimum that workplace lighting and the direct environment needs to meet. Standard compliant lighting is no guarantee in itself for good lighting. For this, application know-how, product know-how and an understanding of the customer's situation are required.

EN 12464-1 is an application standard. In this document the standard is described with a view to developing a lighting solution:

- gathering the necessary project data and laying down the preconditions;
- considering different alternatives (determining the most suitable lighting concept, choice of luminaire type, choice of lamp, ...); • calculating and documenting.

Gathering project data and laying down preconditions

Defining the application

In most projects, the application type for which the lighting needs to be defined is determined first. Obviously the needs of a school are not the same as the needs in an office or an industrial hall. The appendix of the standard includes a 14 page list with such applications. Three criteria are specified for each application:

- the minimum required average illuminance (i.e. maintained illuminance) per task;
- the minimum required colour rendering. The choice of lamp is decisive for this. In rooms where people need to work or stay for longer periods, lamps with a Ra of at least 80 are required;
- the maximum UGR ('Unified Glare Rating'). The UGR is an approximate model that expresses the chance of direct glare by luminaires. The higher this figure, the greater the chance of glare. For each luminaire, a standardised table can be calculated with UGR values. The parameters are the size of the room, the reflection factors and the observer's orientation in the room. The appendices of the standard specify the UGR value that may not be exceeded for each application.

Typical limits are applied in the standard.

3	Offices			
Ref. no.	Interior type, task or activity	E _m	UGR_{L}	R _a
3.1	Performance of work, copying, etc.	300	19	80
3.2	Writing, typing and reading,	500	19	80
	data processing on a PC			
3.3	Technical drawing	750	16	80
3.4	CAD workstations	500	19	80
3.5	Conference and meeting rooms	500	19	80
3.6	Reception desks	300	22	80
3.7	Archives	200	25	80



ETAP 3

Gathering project data and laying down preconditions



UGR UGR ≤22 ≤19







with reference to surface reflectances and room geometry. UGR values are usually expressed in steps of 3. For example a typical office environment requires a UGR of 19 or less.

Luminaire manufacturers produce UGR data

tables which express the UGR of a luminaire



Work on Display Screen Equipment (DSE) or otherwise

When Display Screen Equipment is used, the standard specifies luminance limits for luminaires, the value of which depends on the quality of the screen. A cut-off angle of 65° is usually applied.

Screen classes in accordance with ISO 9241-7	1 11			
Screen quality	good	medium	weak	
Average luminances of luminaires which are reflected in the screen	≤ 100	\leq 200 cd/m ²		



EQUILUM® baffles for a uniform luminance in all directions around the luminaires.

In case of critical DSE usage (e.g. when drawings show small details) or variable inclination of the screens, a 55° limit should be applied. This means 4 categories can be distinguished, the specified luminance limits always need to be evaluated all around the entire luminaire.



Peak luminances as such are not specified in the standard. Naturally, good peak luminance control still has a positive effect on the average luminance and guarantees a uniform and comfortable reflector image.

Taking into account specific conditions

do better than the minimum of the standard.



- the required illuminance should be increased if the 'visual conditions differ from the normal assumptions', e.g.: if errors are costly to rectify; if accuracy or higher productivity is of great importance; if task details are of unusually small size or low contrast; if the visual capacity of the worker is below normal; ...
- a lighting solution must enable the workers to perform their visual tasks, 'even under difficult circumstances and during longer periods'.
- lighting from a specific direction may reveal details within a visual task, increasing their visibility and making the task easier to perform.







As specified in the introduction, the standard lays down minimum requirements. However, the standard also specifies that sometimes 'more' is required, depending on the situation. This is not always specified in detail, but the fact that it is mentioned is an invitation to everyone to

Considering different alternatives



Thalia[®] for an efficient direct lighting.



Spatial 360[™] enhances ceiling illuminance.

Lighting experience: choice of lighting concept

EN 12464-1 deals with a number of aspects concerning the lighting experience in a room. It is positive that attention is paid to this. However, the aspects have been described rather noncommittally and therefore are difficult to verify. This means it is entirely up to the lighting designer to convert this to concrete lighting solutions.

The main aspect remains the attention for visual comfort: which must be provided because this can result in a positive feeling of well-being and higher productivity. Attention needs to be paid to all the surfaces in a room: walls and ceiling especially must have a certain brightness. The luminance distribution in the space needs to be well thought out: luminance differences that are too high or too low are not good.

How visual comfort needs to be achieved has not been specified in the standard. This is the lighting designer's responsibility but the customer also has a say. Both direct lighting and indirect lighting, reflector luminaires and Softlight, general lighting and task lighting, ... can be used to guarantee visual comfort, provided their application has been well thought-out.

Daylight is also an experience element. It provides variation in the environment and visual contact with the outside world which is appreciated by most people.

Defining the task area and the environment

Depending on the situation, the task area on the working plane can be defined as follows:

- required to change the task area at a later stage.
- surrounding area.

The required minimum illuminance on the task is specified in the standard. If not the entire room but individual tasks are lit, the illuminance in the immediate surrounding areas can be 1 step lower. These steps have been defined in the standard as follows (values in lx):

20-30-50-75-100-150-200-300-500-750-1000-1500-2000-3000-5000

The immediate surrounding area is often defined as 'the rest of the space' to avoid a restricted interpretation of the standard resulting in imperfect solutions (e.g. offices where large areas only have 200 lx). A peripheral zone is not explicitly specified in the standard, but it is alluded to. In the following example, we are assuming a peripheral zone of 0.6 m.



ALTER Softlight, 'soft' light for airy and light spaces.



UM1 with MesoOptics[™], perfect visual comfort.



With regard to an office, this would result in the following options:

boundary zone 0.6m	boundary zone 0.6m
500 lx uniform 0.7	task area: Min. 1.6 x 1.8m 500 lx uniform 0.7
Office: the complete room is the task area	Office: one task area, the res surrounding area
boundary zone 0.6m	boundary zone 0.6m
task area: Min. 1.6 x 1.8m 500 lx uniform 0.7 300 lx uniform 0.5	task area: Min. 1.6 x 1.8m 500 lx uniform 0.7
Office: one task area near the window, the rest is surrounding area	Office: multiple task areas

• An entire room can be considered as task area: this could be useful if the exact location of the task area is not yet known, or if flexibility is

• Task-oriented thinking is also possible: in this case, a distinction can be made between the areas where the task takes place and the



In a typical industrial application, this gives the following alternatives:

Considering different alternatives

Low-energy lighting

The standard specifies explicitly that when working out a lighting solution, the energy consumption is also important: the lighting requirements should be met without waste of energy. However, it is important not to compromise the visual aspects of a lighting installation simply to reduce energy consumption. In this respect, the use of control systems is an ideal way to reconcile visual comfort and low<u>ene</u>rgy demands. And of course high lumit = LORs, the use of high efficiency lamps, etc. assist in providing lowenergy solutions.

EN 12464-1 does not go into detail though: don't forget it is an application standard and not an energy performance standard. A European standard is currently under development that deals with these energy aspects in more detail. A European directive (Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings') has obliged every member state or region to draw up rules and regulations regarding the energy performance of buildings, for both residential and non-residential buildings. This needs to be implemented by the 4th of January 2006 at the latest.

The use of daylight is also recommended in the standard. This provides variability within an interior (thanks to the variation in level and spectral composition with time) and may contribute to a good 3D rendering of objects. In addition, visual contact with the outside world is preferred by most people. Of course, the use of daylight control systems will help to increase the energy efficiency of the lighting system.





The correct choice of luminaires and components simplifies visual tasks.

Choice of luminaires and components Once the lighting concept has been chosen, the luminaires need to be chosen and details such as lamp positions, ballasts types, lamp types, ... need to be filled in.

The following needs to be taken into account according to the standard:

- The aforementioned preconditions: both the direct glare (via UGR) requirements and the luminance limits in case of display screen equipment need to be met.
- Choice of lamp type: colour rendering, colour temperature, dimmability, start up behaviour, lamp output, depreciation, ... are all factors that contribute to choosing the right lamp type. • For the colour rendering index, (Ra),
 - Ra of at least 80 are required.
- The choice of a certain colour temperature of the light source is down to psychology, aesthetics and feeling. This

Lamp luminance cd/m ²	Minimum shielding angle		
20.000 till < 50.000	15°		
50.000 till < 500.000	20°		
≥500.000	30°		

Examples:

- T5-ø26mm lamps have luminances from 10,000 to 15,000 cd/m².
- The HE T5-ø26mm lamps have luminances starting from approximately 17,000 cd/m².
- For the T5-ø26mm HO lamps this varies between 23.000 (for 49W) and 33000 cd/m² (for 80W).



Sophisticated reflectors direct the light wherever necessary.

High Reflection Aluminium increases reflector efficiency by an average of 10%.

ELS, ETAP daylight control system, energy saving per luminaire.

Visual comfort.

the standard specifies a minimum requirement for practically all tasks. In rooms where people need to work or stay for longer periods, lamps with an

- choice depends on the colours in the room, the application, the climate, market practice,...
- The other aspects (dimmability, ...) depend on the application.
- Choice of possible light controls (see higher)
- Choice of ballast type. Flicker (e.g. when luminaires with CDM-T lamps are used in stores) and stroboscopic effect (in industries with revolving machines) need to be avoided. This is usually solved by using electronic ballasts which are also more energy efficient, another point of interest in the standard.
- Minimum lamp shielding to prevent glare: bright light sources can cause glare. This is why the standard specifies a minimum shielding angle depending on the lamp luminance.

- For compact lamps, these values vary between 20,000 and 70,000 cd/m².
- For a low-voltage halogen spot this varies between 9,000 and 480,000 cd/m².
- CDM-T lamps always have values in excess of 500,000 cd/m², and therefore always require a minimum shielding of 30°.

Calculating and documenting

Uniformity to be employed

Usually, a uniformity of 0.7 is specified, in the surrounding area 0.5 suffices.

The maintenance factor

The standard specifies the maintained illuminance (Em). The maintained illuminance is the value below which the average illuminance on the specified surface is not allowed to fall throughout the life of the installation. Age and dirt accumulation have a negative effect on the light yield and the lighting design needs to take this into account.

In calculations, the maintenance factor compensates these negative effects. EN 12464-1 specifies that when determining the maintenance factor, the following factors need to be taken into account:

- a drop in light output of the lamps;
- pollution of the room
- how the luminaires are maintained or cleaned
- how the room is maintained or cleaned
- the accumulation of dirt on the luminaires;
- the room and how they are maintained or cleaned.

The danger is that wrong comparisons are made in the calculations between manufacturers due to differences in assumptions concerning the maintenance factor. This is why ETAP, Philips, Zumtobel Staff and Osram have requested an independent scientific institute to draw up a report to determine the maintenance factor. This report specifies factors for certain types of dust pollution, luminaire types, ...



Dust protection during construction.



Uplight slots create a special air circulation that prevents annoying dust accumulation on the reflector.



This has resulted in the following table that applies to aluminium reflector luminaires with electronic ballasts in a room that is cleaned regularly. When all the lamps are replaced at the same time (group replacement), the assumption is that the room and the luminaires are thoroughly cleaned.

Maintenance factor (MF)	Dust pollution levels				
	minimum ⁽¹⁾	low ⁽²⁾	medium ⁽³⁾	high ⁽⁴⁾	
Open luminaires for direct lighting (T5 - Ø16 mm or T8 - Ø26 mm: Ra > 85)					
group replacement	0.85	0.80	0.75	0.70	
replace lamp + group replacement	0.90	0.85	0.80	0.70	
correction factor for			·		
luminaires with cover for direct lighting		MF x 0,95			
luminaires with painted reflector		MF x 0,90			
Uplights (T5 - Ø16 mm or T8 - Ø26 mm: Ra > 85)					
group replacement	0.85	0.70	0.65	0.65	
replace lamp + group replacement	0.90	0.75	0.70	0.65	
correction factor for					
luminaires with painted reflector	MF x 0,90				
Luminaires with up- and downlight (T5 - Ø16 mm or T8 - Ø26 mm: Ra > 85)					
group replacement	0.85	0.75	0.70	0.65	
replace lamp + group replacement	0.90	0.80	0.75	0.70	
correction factor for					
luminaires with painted reflector	MF x 0.90				

(1) A dust and smoke free room that is thoroughly cleaned every day. e.g. cleanrooms, operating rooms, (2) A room where hardly any dust or smoke is produced. e.g. offices, hospital rooms, ... (3) A room near an environment where dust or smoke is produced, where a limited amount of dust or smoke is produced. e.g. restaurants, bakeries, . (4) A room where more dust or smoke is produced. e.g. industry, .





Minimal shielding angle, MF x 0,95.

Documenting the maintenance factor

EN 12464-1 specifies that the person who makes the lighting study needs to list the assumptions (concerning the drop in light output of the lamps, dust pollution of luminaires and room, the cleaning of the luminaires and the room) that were made to apply a certain maintenance factor. Therefore, these assumptions need to be included in the study.



Aluminium reflector luminaires



Luminaire with cover plate, MF x 0,95.



Luminaire with painted reflector, MF x 0,90.

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ETAP offers:

- in-depth know-how of the standard
- studies in accordance with the standard
- a multitude of ergonomic and economic applications
- continuous consultation and research in light and ergonomics

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