# Addendum 1 for

## ANSI/IES RP-1-12, *American National Standard Practice for Office Lighting*

If you, as a user of ANSI/IES RP-1-12, believe you have located an error not covered by the following revisions, you should e-mail your information to Pat McGillicuddy, pmcgillicuddy@ies.org, or send a letter to Pat McGillicuddy, Manager of Standards Development, IES,120 Wall St., 17th Floor, New York, NY 10005. Additions will be posted as they become available.

**Addendum 1 was approved by the IES Standards Committee on Nov. 20, 2017 and by the American National Standards Institute on April 24, 2018.**

*In this Addendum, additions to text are indicated in* ***bold****.* ~~*Strikethroughs*~~ *indicate deletions.*

*Exponents refer to the Endnotes section in RP-1-12 or at the end of this Addendum.*

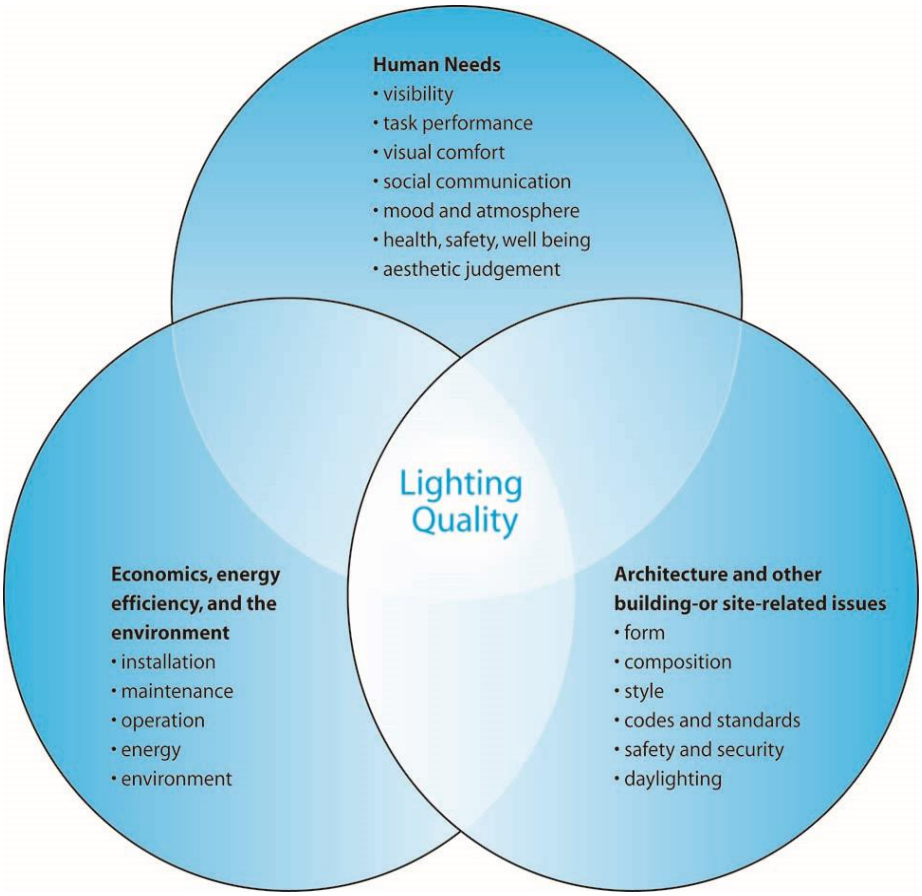


Figure 1. Lighting quality: the integration of human needs, architecture, and economics and the environment. **(Source: IES DG-18-08.)**

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### 3.2.3 Quantity of Illumination

**Table B1** (see **Annex B**) suggests target illuminances for office task visibility[7] for the most commonly occurring office tasks. For tasks not included in **Table B1**, the lighting designer should choose a listed task that closely resembles the task in question (similar contrast and difficulty). If a task is not similar to one of those listed in **Table B1**, the "type of activity" column of **Table B1** may be used; this column matches general descriptions of tasks and activities to illuminance categories. The illuminance levels are described as value ranges. **Section 2.1** provides a description of the IES Illuminance Selection Procedure.

Delivered illuminance should account for system light loss over time. Therefore, light loss factors such as luminaire dirt depreciation and lamp lumen depreciation ~~must~~ **need to** be considered to maintain desired lighting levels (see **Annex A**). One should also account for light loss due to office furnishings (see **Annex A**).

When multiple tasks require different illuminances, the designer ~~must~~ **needs to** make a choice based on the relative importance of each task. Using an "ambient/task" approach, the designer will provide a general light level to satisfy the most-reasonable, common task (e.g., circulation or conversation), with supplementary task lighting to provide higher levels where and when needed (e.g., at reading or drafting tasks).

In many cases, the occupants and their exact visual tasks are unknown. Here, the logical recourse is to design for the modern electronic office with a general population and combination of tasks.

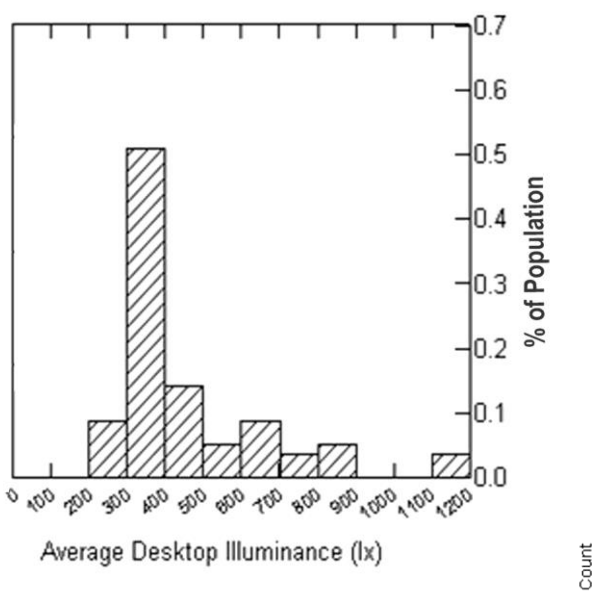


Figure 2. **Preferred average desktop illuminance in office environments, as a percentage of population. (Source:** ~~from~~ Boyce et al., 2006)

3.3.1 What is Luminance?

Luminance is the amount of light coming from ~~a surface or point~~ **an area**, and it is measured in candelas per square meter (cd/m$^2$). Some objects are self-luminous; that is, they generate light. Lamps and computer screens are examples. Other objects simply reflect light from other sources; office walls, for example. In the latter case, the surface luminance is a function of the surface illuminance and the

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reflective properties of the surface. For example, a dark gray surface and a light gray surface can be lit with the same illuminance yet will have very different luminances **(see Figure 3)**. This also exemplifies why room surface finishes should also be considered as an integral part of the lighting design.

Figure 3. The same lighting applied to two rooms that are geometrically identical but have different surface reflectances. (Images courtesy of Guy Newsham)

The human eye responds to luminance, not illuminance (see Visibility Sidebar). The predominance of illuminance in recommendations is partly due to the fact that illuminance is easier to measure and calculate.

### 3.3.2 Brightness and Adaptation

Luminance leads to the sensation of brightness. Although colloquially these words are often used interchangeably, they describe two different, though related, things. *Luminance* is the physical quantity of light, while *brightness* is the subjective response to that luminance, and is also a function of adaptation. For example, a computer screen **of fixed luminance** might appear bright in an otherwise unlit room, whereas it might appear dim when placed in front of a window at noon. (For additional information on adaptation, refer to Annex C – Glossary.)

## 3.4 Glare

Glare occurs when luminances, or luminance ratios, are excessively high in relation to the state of adaptation. The consequences of glare may be disability (a reduction in visual capabilities), or discomfort (without necessarily affecting the ability to see). Forms of these conditions may be given other names depending on the context in which the undesirable conditions occur.

Glare may be caused by light reaching the eye directly from a light source (direct glare), or indirectly from a ~~reflective~~ **high-reflectance** surface (reflected glare). A single bright light source or reflection may result in both discomfort and disability.

### 3.4.1 Discomfort ~~from~~ Glare

Discomfort ~~from~~ glare, as the name suggests, describes a subjective experience of discomfort rather than an inability to see. This may be caused by high luminance electric sources or by direct sunlight or sky light.

As the luminance and size of the glare source increases, discomfort increases. As the number of glare sources increases, the sensation of glare also increases. As the difference between the luminance of the

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glare source and the background decreases, discomfort decreases. As the glare source gets further from the line of sight, discomfort decreases.

### 3.4.2 Glare Causing Disability and Veiling Reflections

Disability occurs when light is scattered in the eye, thereby casting a luminous "veil" across the retinal image, as though the viewer were suddenly looking at a scene through a sheer curtain or smeared eyeglasses. The effect of this veil is to reduce the contrast of the retinal image and de-saturate any colors. The eyes of older individuals have more opacities and elements that fog the visual image in them, and so are prone to scatter more light. As a result, older people are more likely to experience disability from glare. The most common form of direct glare causing disability in offices is bright sunshine coming into an occupant's eyes through a window.

Veiling reflections are high luminance patches reflected by specular surfaces such as glossy reading materials or computer screens (see **Error! Reference source not found.**4), and are a common source of complaint. They are related to disability ~~from~~ glare in that the viewer is unable to see the task—although in this case, the disabling light scatter occurs on the task itself rather than in the eye. The presence of veiling reflections has been associated with various negative effects[28]; therefore, if good alternatives exist, glossy surfaces should be avoided.[29]

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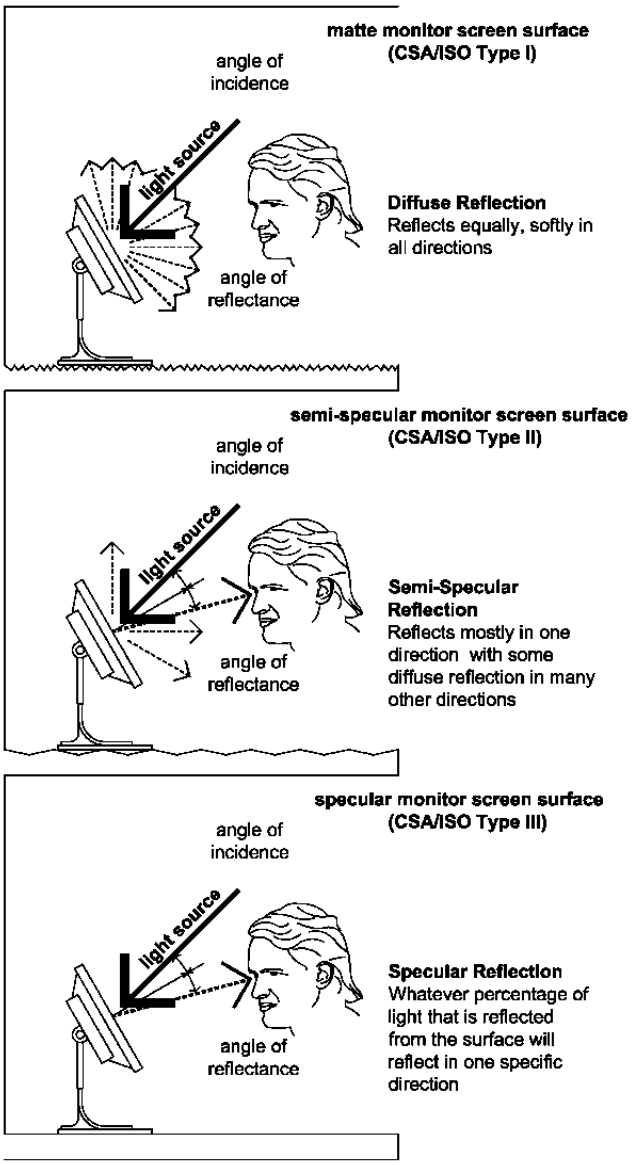


Figure 5. ~~Computer Screen Reflection Character.~~ **Types of computer screen reflections.**

Table 2. Default Luminance and Luminaire Intensity Recommendations for VDT Applications. "Normal use" refers to typical office work with a mix of computer-based, paper-based, and other tasks. "Critical use" refers to work that is almost entirely computer-based, such as ~~programmers~~ **programming** for commercial or military software.

*[Table 2 is replaced with the table below.]*

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| Luminance Source | VDT Viewing Signficance[a] | Application[b] | Average Initial Luminaire Luminance Option[c] | | | | Maximum Initial Luminaire Candlepower Option[d] |
|---|---|---|---|---|---|---|---|
| | | | VDT Monitor Screen Reflection Properties | | | | Luminaire Candlepower Limits |
| | | | **Medium-to-good**[e] CSA/ISO Types I and II Monitors | | **Poor**[e] CSA/ISO Type III Monitors | | |
| | | | Positive Polarity | Negative Polarity | Positive Polarity | Negative Polarity | |
| Luminaires (direct component) | Secondary | •Industrial | ≤ 2570 cd/m$^2$ at 65° and above | | | | NA |
| | | •Conference Room<br>• Transitional Space | ≤ 1715 cd/m$^2$ at 65° and above | | | | 300cd @ 65°, 185 cd @ 75°, 60 cd @ 85° |
| | Normal | •Classroom<br>•High Tech Industrial<br>•Office | ≤ 1500 cd/m$^2$ at 65° and above | ≤ 1000 cd/m$^2$ at 65° and above | ≤ 500 cd/m$^2$ at 65° and above | ≤ 200 cd/m$^2$ at 65° and above | 300cd @ 65°, 185 cd @ 75°, 60 cd @ 85° |
| | High | •Call Centers<br>•Programming[f] | ≤ 1500 cd/m$^2$ at 55° and above | ≤ 1000 cd/m$^2$ at 55° and above | ≤ 500 cd/m$^2$ at 55° and above | ≤ 200 cd/m$^2$ at 55° and above | 300cd @ 55°, 220 cd @ 65°, 135 cd @ 75°, 45 cd @ 85° |
| | Critical | •Air Traffic Control<br>•CAD<br>•Programming[g]<br>•Command Centers<br>•Medical Lab<br>•Monitoring | ≤ 200 cd/m$^2$ at 55° and above | | | | 300cd @ 55°, 220 cd @ 65°, 135 cd @ 75°, 45 cd @ 85° |

| Luminance Source | VDT Viewing Signficance[a] | Application[b] | Average Initial Luminance | Maximum Ceiling Luminance Gradient from Uplights[h] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CSA/ISO Types I and II Monitors | | | | CSA/ISO Type III Monitors | | | |
| | | | | Positive Polarity | | Negative Polarity | | Positive Polarity | | Negative Polarity | |
| | | | | Typical Spacing of Uplights | | | | | | | |
| Room Surfaces | | | | 8 ft. | 12 ft. | 8 ft. | 12 ft. | 8 ft. | 12 ft. | 8 ft. | 12 ft. |
| | | | | Values below are rates of change in units of cd/m$^2$ per meter of ceiling surface — this constitutes the recommended maximum change in luminance over a meter of ceiling based on the luminance ratios cited 10e Handbook Table 12.5 to minimize veiling reflections | | | | | | | |
| | Secondary | | ≤ 1715 cd/m$^2$ | 1965 | 1275 | 1965 | 1275 | 1680 | 1100 | 1680 | 1100 |
| | Normal | | ≤ 855 cd/m$^2$ | 980 | 640 | 980 | 640 | 840 | 550 | 840 | 550 |
| | High | | ≤ 855 cd/m$^2$ | 980 | 640 | 840 | 550 | 840 | 550 | 840 | 550 |
| | Critical | | ≤ 615 cd/m$^2$ | 705 | 460 | 600 | 400 | 600 | 400 | 600 | 400 |

| Luminance Source | VDT Viewing Signficance[a] | Application[b] | Average Initial Luminance |
|---|---|---|---|
| Daylight Media | Secondary | •Conference Room<br>•Transitional Space | ≤ 3425 cd/m$^2$ |
| | | •Industrial | ≤ 2570 cd/m$^2$ |
| | Normal | | ≤ 855 cd/m$^2$ |
| | High | | ≤ 855 cd/m$^2$ |
| | Critical | | ≤ 615 cd/m$^2$ |

a. The significance of viewing the VDT monitor screen with respect to the overall work.

b. Some applications share similar visual tasks of similar significance and therefore have similar luminance limits.

c. Values are based on several references [1,2,3,4,5,6]. Conversions rounded to nearest five. Because of the nature of practical photometry and luminance calculations, the reference here to "average" is to the average luminance value reported in or calculated from available photometric data for the projected area of interest. Mockup anticipated VDT monitors with proposed luminaires to confirm the interaction of latest computer, lamp and luminaire technologies. *Add figure showing angles*

d. Intensity maximums are based on guidelines introduced by the IES Office Lighting Committee in RP-1-2004 and adopted by consensus. Mockup anticipated VDT monitors with proposed luminaires to confirm the interaction of latest computer, lamp and luminaire technologies. *Add figure showing angles.*

e. See Figure 5.

f. Computer programming of typical commercial software.

g. Computer programming of critical commercial or military software.

h. Luminance gradient on ceiling when using uplighting. Offered for typical luminaire spacings. Use reference formula for other spacings.[7]

[1] G.R. Newsham, R.G. Marchand, J.A. Vietch, Preferred surface luminances in offices, by evolution, *Journal of the Illuminating Engineering Society*, Winter 2004, (IESNA JIES, 2004), pp..14-29.

[2] Gary R. Steffy, Lighting the Electronic Office (New York: Van Nostrand Reinhold, 1995), pp. 79-84.

[3] CIBSE, Addendum to CIBSE Lighting Guide 3 (London: Chartered Institution of Building Services Engineers, 2001), p. 4.

[4] Mark S. Rea, ed. The IESNA Lighting Handbook: Reference and Application, Ninth Edition (New York: Illuminating Engineering Society of North America, 2000), chapter 11.

[5] European Committee for Standardization, European Standard EN 12464-1, Light and lighting – Lighting of work places – Part 1: Indoor work places (Brussels: European Committee for Standardization, 2002), p. 12.

[6] CIBSE Society of Light and Lighting, Code for Lighting 2006/CD-ROM (London: Chartered Institution of Building Services Engineers, 2006), Direct Lighting and Display Screens.

[7] Ian Ashdown and Peter J. Franck, Luminance Gradients: Photometric Analysis and Perceptual Reproduction, *Conference Proceedings - 1995 IESNA Annual Conference* (New York: Illuminating Engineering Society of North America, 1995), Paper #47.

### 3.4.2.2 Indirect Lighting

Indirect lighting illuminates the ceiling, which in turn reflects light downwards. Thus, the ceiling becomes the brightest surface in the visual field. ~~Illumination directed at~~ **Illuminance on** the ceiling should be evenly distributed to avoid excessive luminance, and to avoid bright spots on the ceiling becoming reflected glare sources. Thus, the important design criteria are **the** maximum ceiling luminance and **the** ceiling-**to-task** luminance ratio**s, taken** across the ceiling.

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