DIN/TS 5031-100:2021-11 (E)

Optical radiation physics and illuminating engineering - Part 100: Melanopic effects of ocular light on human beings - Quantities, symbols and action spectra

Contents

Page

Foreword ... 4

Introduction ... 5

1 Scope ... 6

2 Normative references ... 6

3 Terms and definitions ... 6

4 Melanopic effects of light ... 19
4.1 General ... 19
4.1.1 Overview of melanopic effects of light ... 19
4.1.2 Suppression of melatonin at night ... 20
4.1.3 Shift of the circadian phase ... 20
4.1.4 Change of circadian amplitude ... 21
4.1.5 Activation with light ... 21
4.1.6 Control of the pupillary light reflex ... 21
4.1.7 Treatment of seasonal affective disorder (SAD) ... 21
4.2 Melanopic evaluation of light ... 22
4.3 Action spectrum for the melanopic evaluation of light ... 22
4.4 Specification of lamp and luminaire data ... 25
4.4.1 General ... 25
4.4.2 Melanopic equivalent daylight luminous flux of light sources ... 26
4.4.3 Melanopic operating efficiency of luminaires ... 27
4.4.4 Melanopic dynamic range of luminaires ... 28

5 Light technology description of the exposure ... 28
5.1 Light source description ... 28
5.2 Exact description for simple light sources ... 29
5.3 Simplified description for simple light sources ... 30
5.4 Description for complex light sources ... 31
5.5 Assessment of photobiological safety ... 31

Annex A (informative) **Spectral power distributions of modern light sources** ... 32

Annex B (informative) **Examples of melanopic equivalent daylight quantities** ... 37

Annex C (informative) **Action spectrum for melanopic evaluation of light in 5-nm-steps** ... 39

Annex D (informative) **Melanopic daylight efficacy ratios, melanopic factors and correction factors for age-related lens transmittance** ... 40

Annex E (informative) **Correction factors for the evaluation of the influence of transmission and reflection on the assessment of light with regard to melanopic effects** ... 43

Bibliography ... 44

Figures

Figure 1 — Correction factor k_{mel} (A) according to Equation (18) ... 13

Figure 2 — Correction factor k_{mel} (A) according to Equation (19) ... 13

Figure 3 — Action spectrum $s_{mel}(\lambda)$ for melanopic effects of light 25

Figure 4 — Schematic representation of the geometry for the description of light sources 29

Figure A.1 — Graphical representation of the relative spectral power distribution of white LEDs according to Table A.1 35

Figure A.2 — Graphical representation of the relative spectral power distribution of fluorescent lamps with high colour temperature according to Table A.1 36

Tables

Table 1 — Spectral optical density $D(\lambda)$ and spectral transmittance $\tau(\lambda)$ according to Equation (21) and Equation (22) for the age groups 25, 32, 50, 75 and 90 years as a function of the wavelength λ 16

Table 2 — Approximate correction factor for age-related lens transmittance for age A for white light according to Equation (23) 17

Table 3 — Correction factor for age-related reduction of pupil diameter according to Equation (24) 17

Table 4 — Luminance dependent factor $c(L)$ 18

Table 5 — Melanopic effects of light 20

Table 6 — Action spectrum for melanopic effects of light $s_{mel}(\lambda)$ as a function of wavelength λ within the definition range λ_u = 380 nm to λ_o = 780 nm in 1-nm steps. 22

Table 7 — Comparison of the photopically and melanopically weighted luminous flux for different types of light. 26

Table A.1 — Spectral power distributions of modern light sources normalised to the maximum value 1 32

Table B.1 — Compilation of melanopic equivalent daylight quantities 37

Table C.1 — Action spectrum for melanopic effects of light $s_{mel}(\lambda)$ as a function of wavelength λ within the definition range λ_u = 380 nm to λ_o = 780 nm 39

Table D.1 — Melanopic daylight efficacy ratio (MDER), melanopic factor and correction factors for age-related lens transmittance for different types of light according to DIN 5033-7 and CIE 15:2018 40

Table D.2 — Melanopic daylight efficacy ratio(MDER), melanopic factor and correction factors for age-related lens transmittance for various modern light sources 41