

# DIN V 18599-4:2007-02 (E)

## Energy efficiency of buildings - Calculation of the net, final and primary energy demand for heating, cooling, ventilation, domestic hot water and lighting - Part 4: Net and final energy demand for lighting

---

<b>Contents</b>		<b>Page</b>
Foreword .....		5
Introduction .....		7
<b>1</b>	<b>Scope .....</b>	<b>8</b>
<b>2</b>	<b>Normative references .....</b>	<b>9</b>
<b>3</b>	<b>Terms and definitions, symbols and units .....</b>	<b>10</b>
3.1	Terms and definitions .....	10
3.2	Symbols, units and subscripts .....	13
3.2.1	Symbols and units .....	13
3.2.2	Subscripts .....	13
<b>5</b>	<b>Calculations .....</b>	<b>15</b>
5.1	Principle of the balance calculations .....	15
5.2	Subdivision of a building zone .....	17
5.2.1	Subdivision into evaluation areas .....	17
5.2.2	Daylight area .....	18
5.3	Operating times .....	19
5.4	Artificial lighting .....	19
5.4.1	Tabular method .....	19
5.4.2	Simplified utilization factor method .....	22
5.4.3	Detailed engineering planning .....	23
5.4.4	Determination of the specific electrical evaluation power in existing buildings .....	23
5.5	Daylight .....	24
5.5.1	Annual daylight supply with vertical façades .....	26
5.5.2	Annual daylight supply through rooflights .....	37
5.5.3	Daylight-responsive control systems .....	44
5.5.4	Monthly evaluation method .....	45
5.6	Occupancy (presence) .....	46
<b>Annex A (normative)</b>	<b>Reduction factor <math>k_A</math> to take into account the relative proportion of the area needed for the visual task .....</b>	<b>48</b>
<b>A.1</b>	<b>General .....</b>	<b>48</b>
<b>A.2</b>	<b>Detailed calculation of <math>CTL_{Vers,Sa,j}</math> .....</b>	<b>49</b>
<b>A.3</b>	<b>Examples of the electrical evaluation power of various illumination solutions .....</b>	<b>56</b>
A.3.1	General .....	56
A.3.2	Personal offices (single occupant) .....	57
A.3.3	Office for two occupants .....	60
A.3.4	Workgroup offices .....	63
A.3.5	Call centres (landscaped offices) .....	66
A.3.6	Corridors .....	70
A.3.7	Production hall .....	72
<b>A.4</b>	<b>Example: Determination of the daylight supply factor <math>CTL_{Vers,j}</math> for a space with rooflights .....</b>	<b>74</b>
A.4.1	General .....	74
A.4.2	Determination of the electrical evaluation power .....	74

A.4.3	Determination of the daylight supply factor $CTL_{Vers}$ .....	75
A.4.4	Determination of the annual and monthly energy use for lighting .....	76
	Bibliography .....	79
--	Prestandard -- Figures Figure 3 -- Flowchart showing calculation of the energy need for lighting .	17
Figure 4	-- Determination of height $h'R$ (schematic diagram) .....	21
Figure 5	-- Three-stage approach for determining the daylight supply factor $CTL_{Vers,j}$ .....	25
Figure 6	-- Effect of the angle of elevation of a linear obstruction $V,IV$ (schematic diagram) .....	27
Figure 7	-- Effect of the horizontal obstruction angle due to an overhang $V,hA$ (schematic diagram)	27
Figure 8	-- Effect of the vertical obstruction angle $V,vA$ due to a side fin (schematic diagram) .....	28
Figure 9	-- Geometrical parameters used to define the well index $w_i$ (notation) .....	29
Figure 10	-- Example of a set of functions to determine the daylight supply factor $CTL_{Vers,SNA,j}$ as a function of $DR_b$ and $eff_{SNA,j}$ according to equation (28) for $mE = 500$ lx and a south-facing façade .....	36
Figure 11	-- Notation used to describe the geometry of the upstands of spaces with dome lights and continuous rooflights .....	40
Figure 12	-- Notation used to describe the geometry of rooflights in sawtooth roofs (sheds) .....	40
Figure A.1	-- Task area $AS$ and immediate surrounding area $AU$ (schematic diagram) .....	49
Figure A.2	-- Effective light transmittances $eff_{u,SA}$ into the lower quarter-space and $eff_{o,SA}$ into the upper quarter-space (schematic diagram) .....	53
Figure A.3	-- Factor $C'TL_{Vers,SA}$ for areas with activated solar radiation protection and/or glare protection as a function of the total light transmittance $eff_{SA}$ and the distribution key factor $v_{SA}$ for $mE = 500$ lx .....	55
Figure A.4	-- Daylight supply factor $CTL_{Vers,SA}$ for areas with activated solar radiation protection and/or glare protection as a function of the factor $C'TL_{Vers,SA}$ and the daylight factor $DR_b$ of the building carcass roof opening .....	56
Figure A.5	-- Personal office - illumination solution 1 .....	57
Figure A.6	-- Personal office - illumination solution 2 .....	58
Figure A.7	-- Personal office - illumination solution 3 .....	59
Figure A.8	-- Office for two occupants -- illumination solution 1 .....	60
Figure A.9	-- Office for two occupants - illumination solution 2 .....	61
Figure A.10	-- Office for two occupants - illumination solution 3 .....	62
Figure A.11	-- Workgroup office - illumination solution 1 .....	63
Figure A.12	-- Workgroup office - illumination solution 2 .....	64
Figure A.13	-- Call centre - illumination solution 1 .....	66
Figure A.14	-- Call centre - illumination solution 2 .....	68
Figure A.15	-- Corridor - illumination solution 1 .....	70

Figure A.16 -- Corridor - illumination solution 2 .....	71
Figure A.17 -- Production hall - illumination solution 1 .....	72
Figure A.18 -- Production hall - illumination solution 2 .....	73
Figure A.19 -- Rooflights .....	74
-- Prestandard -- Tables Table 1 -- Calculation values of the specific electrical evaluation power $p_{j,lx}$ in relation to the floor area per lx of maintained illuminance at the work plane, for luminaires with tubular fluorescent lamps and electronic ballast (EB) .....	20
Table 2 -- Correction factor $k_L$ to account for different types of lamp, with reference to Table 1 .....	21
Table 3 -- Correction factor $k_R$ to account for the effect of the space geometry in relation to the room index $k$ .....	22
Table 4 -- Utilization factors $R$ as a function of the illumination type and the room index .....	23
Table 5 -- Factor $k_{BG}$ for determining the power of a system from the power consumption of lamps .....	24
Table 6 -- Daylight supply classification as a function of the daylight factor $DR_{b,j}$ of the building carcass opening .....	30
Table 7 -- Relative times $t_{rel,TL,SNA,j}$ and $t_{rel,TL,SA,j}$ for de-activated and activated solar radiation and/or glare protection systems, as a function of the façade orientation .....	31
Table 8 -- Typical values of light transmittance $D_{65,SNA}$ of transparent building components .....	33
Table 9 -- Daylight supply factor $CTL,Vers,SNA,j$ as a function of the effective light transmittance of the façade, daylight supply factor, maintained illuminance and façade orientation .....	34
Table 10 -- Parameters $a_1$ und $a_2$ to be used in equation (28), as a function of the maintained illuminance $mE$ .....	35
Table 11 -- Parameter $a_3$ to be used in equation (28) to account for the façade orientation .....	35
Table 12 -- System solutions (to be applied for the period $t_{rel,TL,SA,j}$ ) .....	36
Table 13 -- Typical values of light transmittance $D_{65}, U$ and $g$ of components frequently used in rooflight construction .....	38
Table 14 -- External daylight factor $Da$ as a function of the façade slope $F$ for a floor reflectance $B$ of 0,2 (without taking obstruction into account) .....	40
Table 15 -- Dome light utilization factors $R$ , as a function of the room index $k$ and the geometry parameters of the upstand design .....	41
Table 16 -- Utilization factors $R$ of rooflights in sawtooth roofs (sheds), as a function of the room index and the geometry parameters .....	42
Table 17 -- Classification of daylight supply as a function of the daylight factor $jD$ .....	43
Table 18 -- Daylight supply factor $CTL,Vers,j$ of spaces with rooflights as a function of the daylight supply classification and the maintained illuminance for façades with different orientations and slopes .....	43
Table 19 -- Correction factor $CTL,kon,j$ to account for the effect of daylight-responsive control systems in a zone $n$ , as a function of the maintained illuminance $mE$ and the daylight supply classification .....	45

<b>Table 20 -- Monthly distribution key factors <math>v_{\text{Monat},i}</math> for vertical façades .....</b>	<b>46</b>
<b>Table 21 -- Monthly distribution key factors <math>v_{\text{Monat},i}</math> for rooflights .....</b>	<b>46</b>
<b>Table 22 -- Factor <math>C_{\text{Prä},\text{kon},j}</math> to account for the efficiency of presence detection systems .....</b>	<b>47</b>
<b>Table A.1 --Typical effective light transmittance <math>\text{eff}_{\text{SA}}</math> of various types of solar radiation protection and/or Table A.2 -- Typical values of the distribution key factor <math>V_{\text{SA},j}</math> for various types of façade components .....</b>	<b>53</b>
<b>Table A.3 -- Monthly energy use for continuous-type rooflights .....</b>	<b>78</b>
<b>Table A.4 -- Monthly energy use for shed rooflights .....</b>	<b>78</b>