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4.5 Luminaire photometric data

4.5.1 The luminous intensity table

Luminaire photometry (its optical performance) is generally crucial for lighting design. The luminous intensity table represents the basic photometric data of a luminaire. Other photometric information (both numerical data and graphic documents) can be deduced from it. The luminaire luminous intensities are measured in a laboratory at strictly defined directions passing through the luminaire optical centre. Each direction is generally determined by two angles shown in **Fig. 4.10**: the azimuthal angle (C), belonging to the range of $0^{\circ} \leq C < 360^{\circ}$, and the elevation angle (γ), ranging from 0º to 180º. The azimuthal angle is determined by the position of a vertical half-plane containing the considered direction related to the reference half-plane (C = 0º), while the elevation angle is determined by the considered direction and the downward vertical axis of the luminaire (nadir).

A measurement device called the goniophotometer enables the step-wise adjustment of ΔC and $\Delta\gamma$, thus determining all necessary directions at which the luminous intensity should be measured (ΔC and $\Delta\gamma$ are specified in CIE (2019b)).

A part of the luminous intensity table corresponding to a street lighting luminaire is given in **Table 4.1**. In the case of rotationally symmetric luminaires (e.g., industrial ones, an example of which is shown in **Fig. 4.11**), the luminous intensity table is reduced to one column only, because the luminous intensity distribution is equal in each C half-plane.The data presented in luminous intensity tables is usually normalised, i.e. the luminous intensity values correspond to the hypothetical case when the total luminous flux of all lamps in the luminaire equals 1000 lm. In this way, the same table can be used for different light sources of the same type and dimensions (two examples of such lamps are normal incandescent lamps with different wattages not exceeding 100 W and tubular fluorescent lamps with equal wattage but with different luminous fluxes due to different colour appearance). Since luminous intensities are linearly proportional to luminous flux, their actual values are obtained multiplying the normalised table values by the factor $K = \Phi/1000$, where Φ denotes the total luminous flux of all luminaire lamps, expressed in lumens.

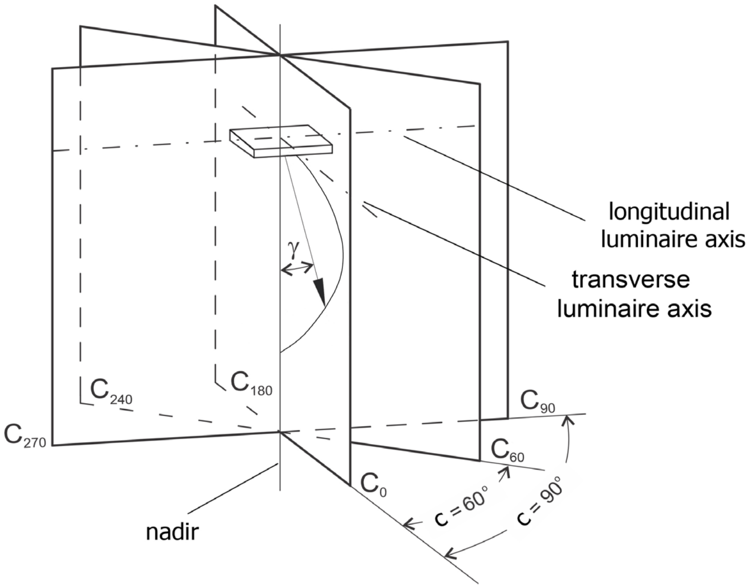

Figure 4.10 Standard C-γ system for recording the luminaire luminous intensity table

Table 4.1 A part of a luminous intensity table (courtesy of Minel-Schreder)

γ\C	90.0	105.0	120.0	130.0	135.0	140.0	145.0	150.0	155.0	160.0	165.0	170.0	175.0	180.0
0.0	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5
10.0	284.1	283.0	280.9	279.3	278.6	276.7	275.2	273.5	271.2	269.2	267.2	264.6	262.2	259.2
20.0	288.5	290.2	293.7	296.6	297.3	298.0	297.3	294.5	292.3	289.1	284.4	279.4	273.4	267.3
30.0	259.5	265.1	280.8	293.7	303.1	309.9	315.6	318.3	318.9	316.4	312.4	304.1	296.5	284.1
35.0	232.0	239.5	262.1	282.7	296.0	308.9	320.3	329.5	334.4	335.4	330.1	322.4	311.0	298.5
40.0	185.5	197.0	230.8	262.6	280.1	299.6	320.6	337.4	349.4	354.9	352.5	343.4	327.9	310.7
45.0	132.5	143.0	183.6	227.4	253.8	284.0	313.4	341.3	363.7	375.3	373.8	366.5	350.1	325.8
47.5	106.2	136.0	156.1	203.9	235.3	270.7	306.3	340.7	368.2	385.3	387.2	378.2	360.2	333.6
50.0	84.1	92.1	130.4	179.8	212.6	252.6	295.4	336.4	371.6	394.4	400.4	390.4	369.5	340.3
52.5	67.8	74.6	106.4	154.3	188.2	230.8	280.0	328.3	374.3	401.8	411.4	400.1	378.8	345.0
55.0	57.4	62.3	86.5	129.4	162.3	206.7	259.0	317.5	372.1	410.2	421.6	410.6	387.0	351.8
57.5	50.9	53.7	71.9	107.9	137.1	179.3	234.2	302.3	369.2	415.4	430.1	421.6	394.6	356.1
60.0	45.9	47.1	60.1	88.0	114.1	151.6	206.0	282.4	362.3	417.7	439.2	460.0	401.1	358.1

Figure 4.11 A rotationally symmetric luminaire

4.5.2 Polar diagrams

The luminous intensity distribution in any C half-plane may be presented graphically, generally using polar coordinates I and γ. In this way, the so-called polar diagrams are obtained, allowing the designer to make a visual assessment whether the luminaire light distribution is suitable for the illumination of the considered surface or space. The polar luminous intensity curves of luminaires intended for general interior lighting are given in the $C_{0º}$, $C_{90º}$, $C_{180º}$ and $C_{270º}$ half-planes shown in **Fig. 4.10**, while those for road lighting luminaires are usually given in the six characteristic C half-planes:

- C = 0º and C = 180º (C half-planes parallel to the road axis – see **Fig. 4.12**),
- C = 90º and C = 270º (C half-planes perpendicular to the road axis, the first in front of, and the second behind the luminaire – as in **Fig. 4.12**), and
- two C half-planes containing the directions with the maximum luminous intensity (the so-called principal C half-planes – C = 15º and C = 165º in **Fig. 4.13**).

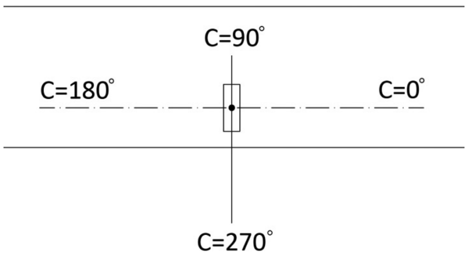

Figure 4.12 Orientation of C half-planes in case of road lighting luminaires

Rotationally symmetric luminaires, such as industrial lighting luminaires, are characterised by the same polar curve in each C half-plane.

Note that polar diagrams are generally normalised.

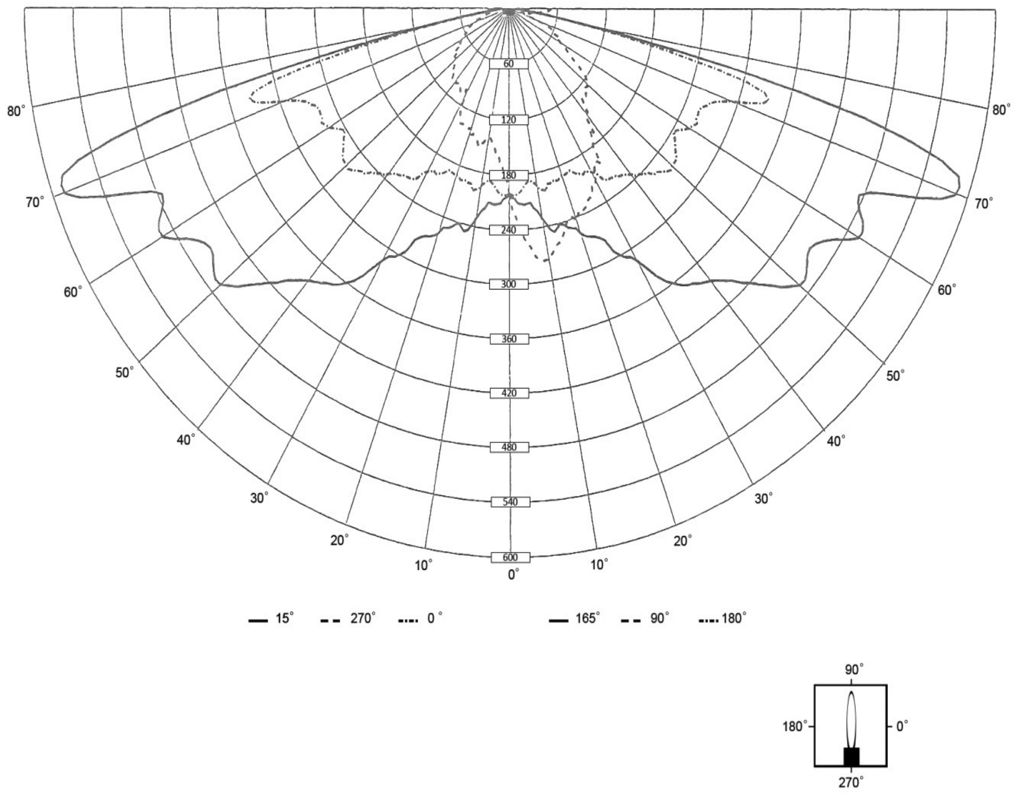

Figure 4.13 Polar diagram of a road lighting luminaire

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