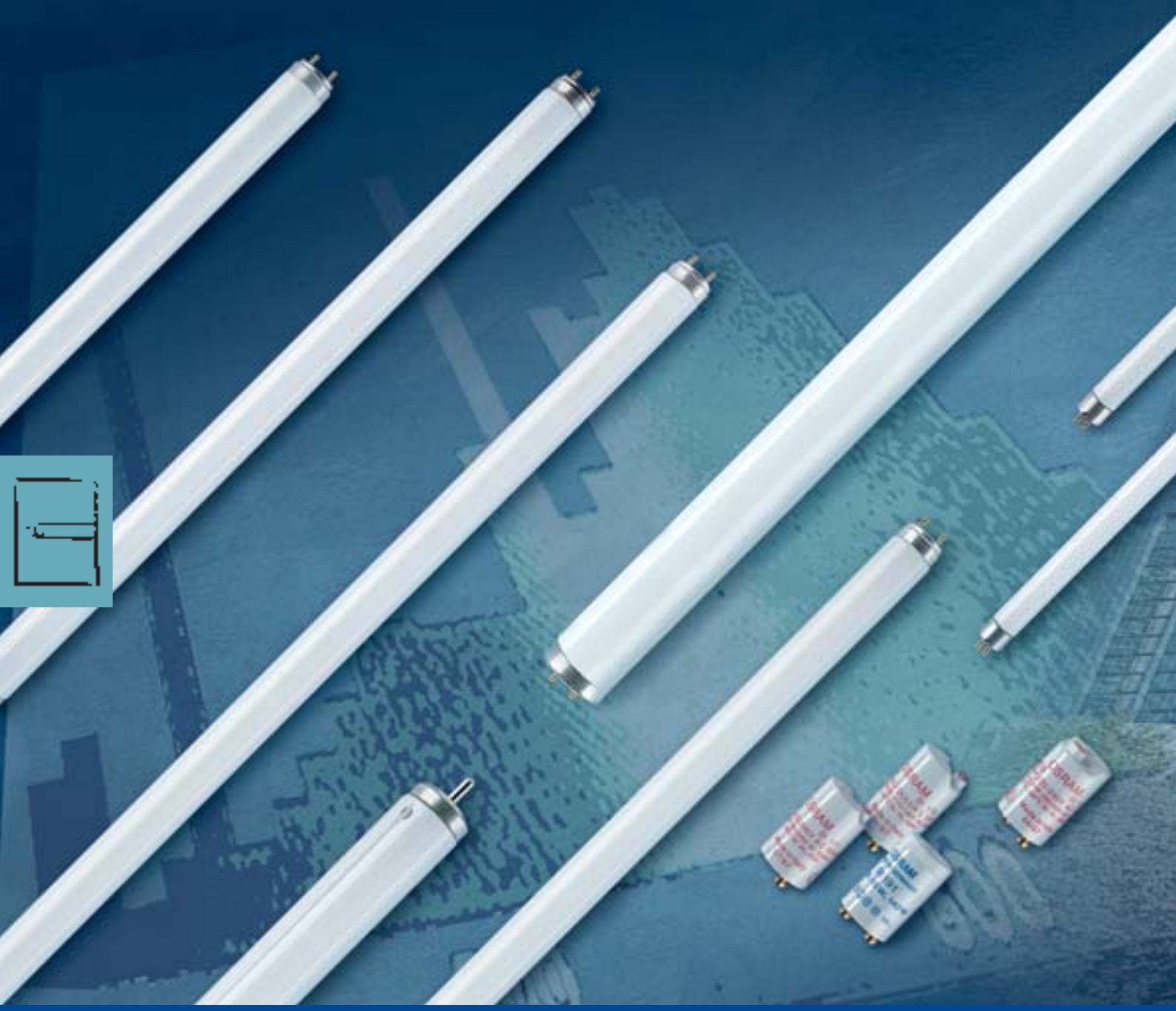


Fluorescent lamps

First choice for durability
Fluorescent lamps produce 70 percent of artificial light throughout the world. For economical reasons they are the first choice for many applications because they combine high luminous efficacy with low power consumption.

A fluorescent lamp needs only around one fifth of the electricity that an ordinary light bulb needs. The average life is 12,000 hours, whereas an ordinary light bulb will last only about 1000 hours.

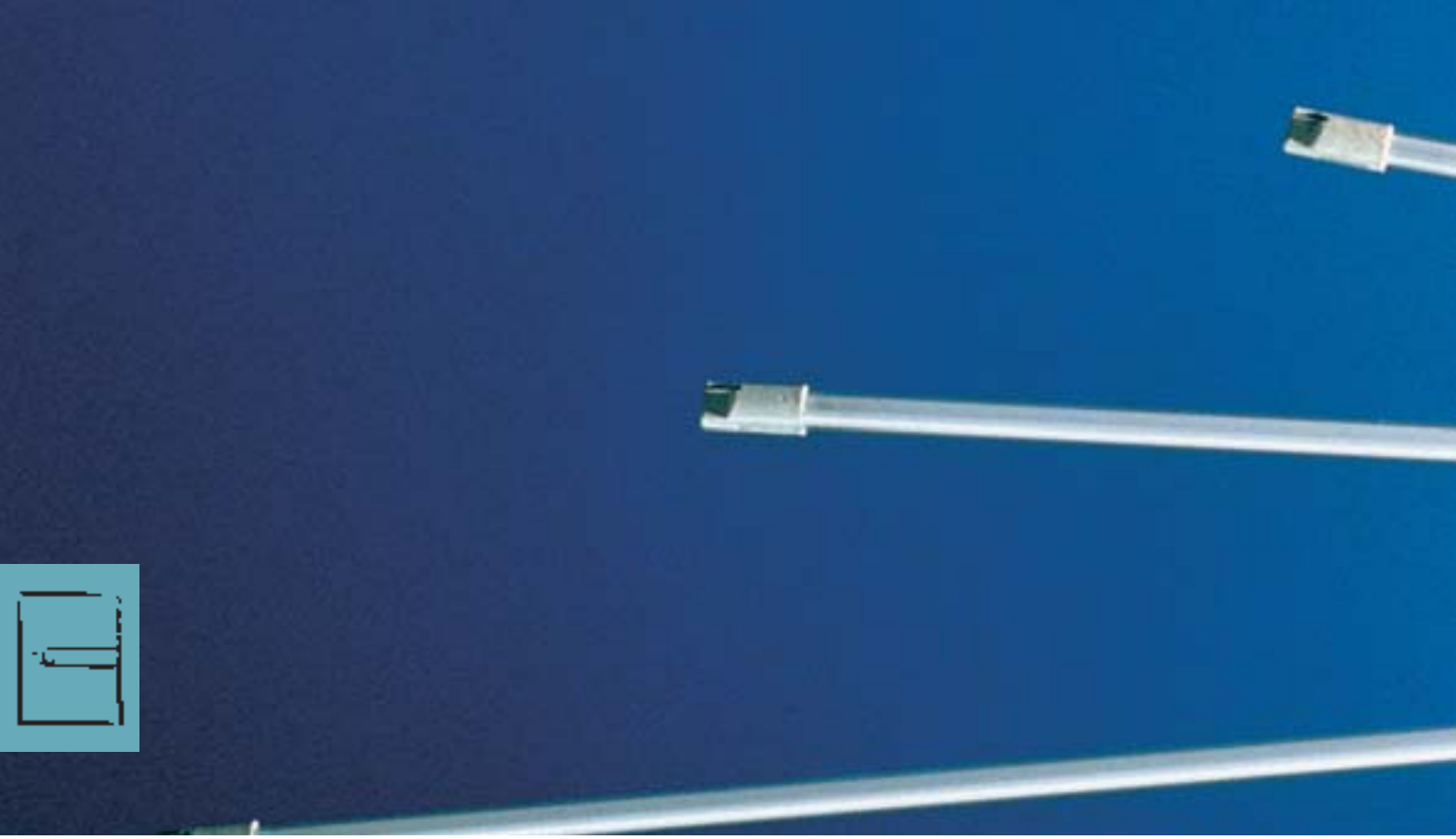
Trend for smaller tube diameters
The widely available LUMILUX® lamps have a diameter of 26 mm. The new generations such as the economical FH® HE lamps and the high intensity FQ® HO lamps are only 16 mm diameter.

For special applications there is even a 7 mm diameter fluorescent lamp, the FM®. The thin circular FC® lamp provides an interesting alternative to the tubular lamps.

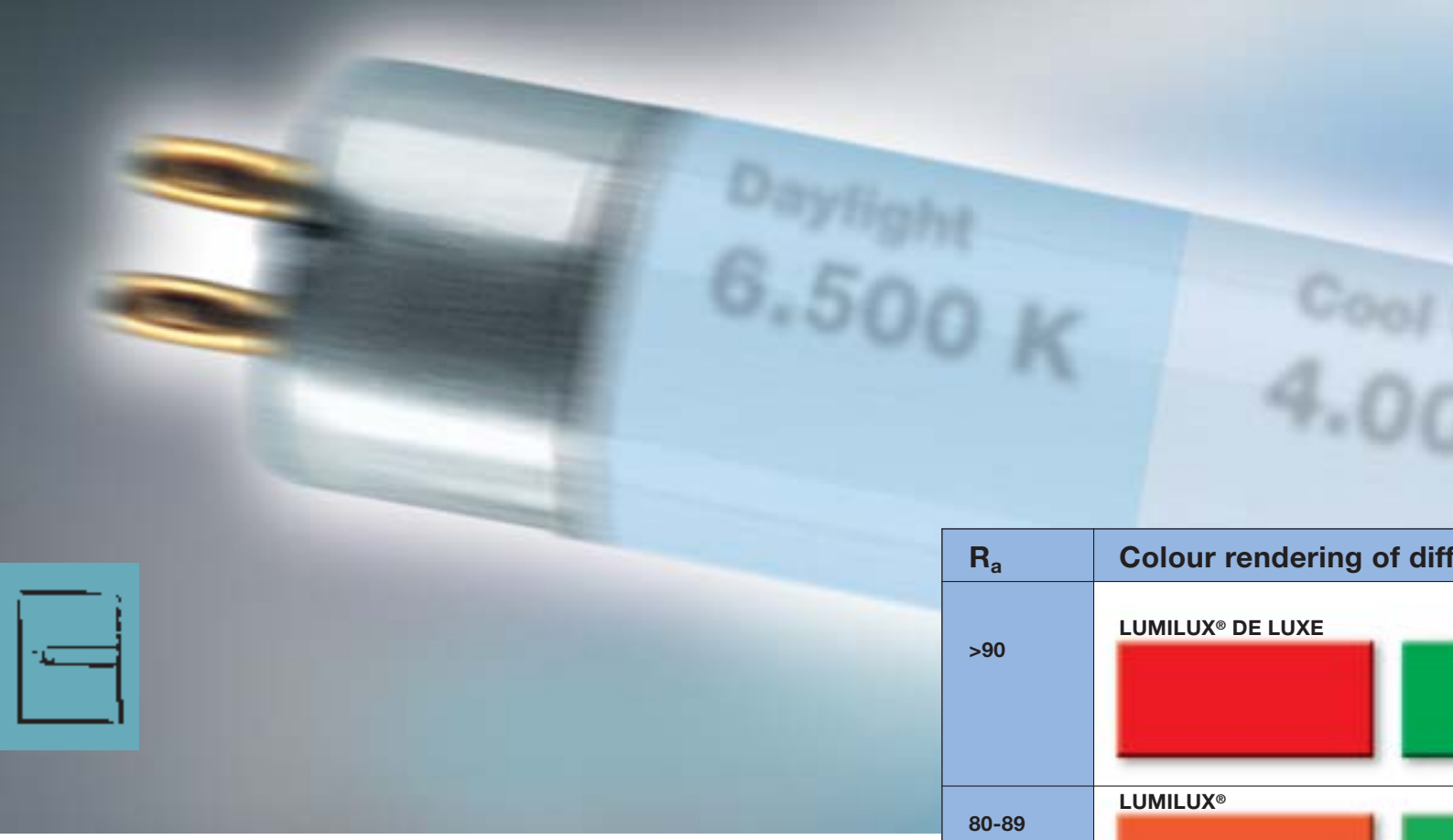
Successful throughout trade and industry
With their special properties, fluorescent lamps have conquered every area in which artificial light is used, from offices and sales outlets to trade fairs, factories, hospitals and roads. Fluorescent lamps are used wherever a large amount of light is needed (see also page 4.24).

With new shapes, fluorescent lamps are giving designers more and more freedom. Electronic control gear such as QUICKTRONIC® from OSRAM ensures they provide high-quality light throughout their long service lives.

Environmentally friendly
Low power consumption and long life mean that fluorescent lamps are kind to the environment. Their recycling quota is another plus for the environment. More than 90% of the weight of an OSRAM fluorescent lamp can be reused for manufacturing lamps and 5 to 10% can be used in the manufacture of other materials.



Contents



R_a	Colour rendering of diff
>90	LUMILUX® DE LUXE
80-89	LUMILUX®
<80	BASIC

White, white or white

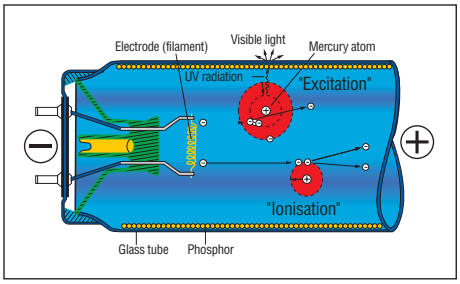
White is not always white
OSRAM fluorescent lamps are available in up to four different shades of white: Daylight (5400 K and 6500 K), Cool White (4000 K), Warm White (3000 K) and LUMILUX INTERNA® (2700 K). But which of the four is right for which application?

Choosing one or other of the shades is a matter of personal taste, individual perception and local preference, and a question of the atmosphere to be created. Cultural influences should not be underestimated. People in northern Europe prefer warm white, while people in southern Europe tend to choose cool white.

For recommendations of which shade is best suited for which application see pages 4.24 to 4.26 and 4.36 to 4.37 in this section.

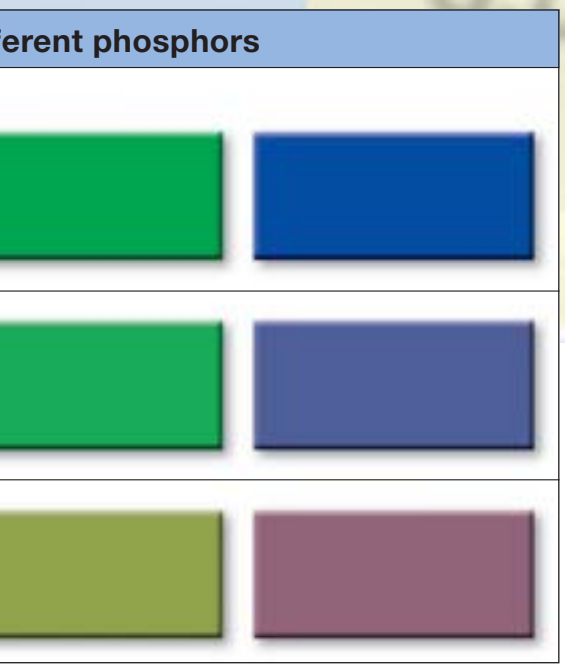
Environmentally friendly LUMILUX® lamps
The life of T8 lamps has been considerably improved by the development of a new phosphor. Loss of luminous flux after 10,000 hours has been reduced to just 8%, and to only 12% with ECG after 20,000 hours. The greatly reduced mercury content also helps the environment.

How a fluorescent lamp works
Fluorescent lamps are gas discharge lamps. The glass tube contains mercury vapour at low pressure. The inner wall of the glass tube is coated with a phosphor that reacts to ultra-violet radiation. At the ends of the glass tube are electrodes. When an electrical charge is passed between them the mercury vapour emits UV radiation. This radiation is converted by the phosphor into visible light. The colour appearance of the light varies according to the phosphor used.



The principle of light generation in fluorescent lamps (hot-cathode type).

Smaller size, greater efficiency, better performance: the economical LUMILUX® T5 HE system
HE stands for High Efficiency. With a tube diameter of only 16 mm, these lamps offer an extremely high luminous efficacy of up to 104 lm/W. They are designed for modern electronic control gear with cut-off technology[1)] and are up to 20% more efficient than T8 lamps. This system and the com-

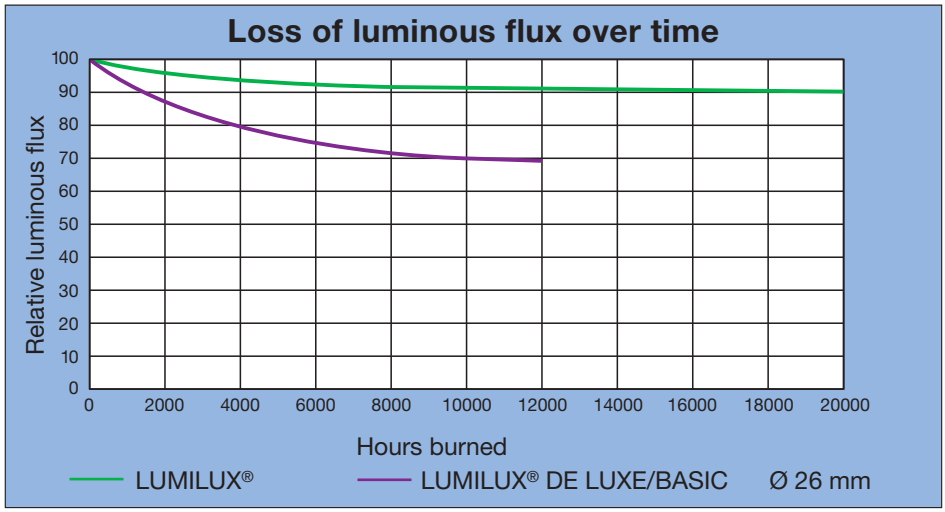


LUMILUX® fluorescent lamps have very good colour rendering. The very best colour rendering is achieved by LUMILUX® DE LUXE fluorescent lamps.

pact ECG means that extremely slim luminaires can be created. They are 50% smaller in volume and 5 cm shorter in length, which means they fit perfectly in 60 and 120 cm modular ceiling grids.

The particularly bright LUMILUX® T5 HO system
HO stands for High Output. This lamp system is particularly noted for its high luminaire efficiency due, among other things, to the small tube diameter. The FQ® 54 W HO, for example, with a length of 1149 mm and a diameter of 16 mm, offers the same luminous flux as a standard T8 58 W lamp with a diameter of 26 mm and length of 1500 mm. HO lamps are designed only for ECG operation with cut-off technology[1)] and are much more economical.

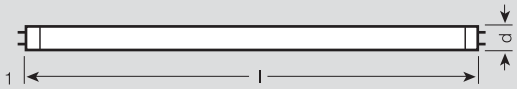
The small LUMILUX® T2 FM® system
FM® stands for Fluorescent Miniature. Combined with the QUICKTRONIC® FM mini ECG, they deliver brilliant economic light of high luminance and very good colour rendering. With a tube diameter of only 7 mm, it is ideal for small luminaires such as acrylic illuminated display panels.



A comparison of the luminous flux curves for LUMILUX®, LUMILUX® DE LUXE and BASIC fluorescent lamps. The LUMILUX® range shows its advantage.

1) see also Chapter 9, ECGs for T5 (Ø 16 mm) fluorescent lamps.

Fluorescent lamps, tubular, 16 mm tube diameter
LUMILUX® T5 HE HIGH EFFICIENCY



LUMILUX® lamps are environmentally friendly fluorescent lamps with a low mercury content.

Product reference	Product number	W		Ra	lm 25°C [1)2)]	TUBE d [mm]	l [mm]	No.	[3)]
LUMILUX® T5 HE HIGH EFFICIENCY[1)2)], for ECG operation only, G5 base									
FH 14 W/865 HE	4050300**464848**	14	LUMILUX Daylight	80…89	1100	16	549	1	40[1)]
FH 14 W/840 HE	4050300**464688**	14	LUMILUX Cool White	80…89	1200	16	549	1	40
FH 14 W/830 HE	4050300**464824**	14	LUMILUX Warm White	80…89	1200	16	549	1	40
FH 14 W/827 HE	4050300**645933**	14	LUMILUX INTERNA	80…89	1200	16	549	1	40
FH 21 W/865 HE	4050300**464626**	21	LUMILUX Daylight	80…89	1750	16	849	1	40
FH 21 W/840 HE	4050300**464701**	21	LUMILUX Cool White	80…89	1900	16	849	1	40
FH 21 W/830 HE	4050300**464800**	21	LUMILUX Warm White	80…89	1900	16	849	1	40
FH 21 W/827 HE	4050300**645971**	21	LUMILUX INTERNA	80…89	1900	16	849	1	40
FH 28 W/865 HE	4050300**464640**	28	LUMILUX Daylight	80…89	2400	16	1149	1	40
FH 28 W/840 HE	4050300**464725**	28	LUMILUX Cool White	80…89	2600	16	1149	1	40
FH 28 W/830 HE	4050300**464787**	28	LUMILUX Warm White	80…89	2600	16	1149	1	40
FH 28 W/827 HE	4050300**646015**	28	LUMILUX INTERNA	80…89	2600	16	1149	1	40
FH 35 W/865 HE	4050300**464664**	35	LUMILUX Daylight	80…89	3050	16	1449	1	40
FH 35 W/840 HE	4050300**464749**	35	LUMILUX Cool White	80…89	3300	16	1449	1	40
FH 35 W/830 HE	4050300**464763**	35	LUMILUX Warm White	80…89	3300	16	1449	1	40
FH 35 W/827 HE	4050300**646053**	35	LUMILUX INTERNA	80…89	3300	16	1449	1	40

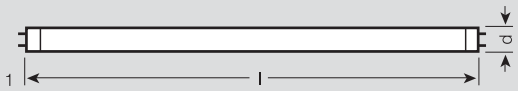
These lamps offer an even higher luminous flux if operated within the luminaire at their optimum ambient temperature (see technical data pages 4.27 to 4.37).

LUMILUX® lamps (16 mm) offer excellent luminous efficacy and economy, and improved environmental compatibility. With warm start ECGs, an average life of 20,000 hours and a service life of 16,000 hours (80% system luminous flux) can be achieved.

1) These values are obtained at 25°C (acc. to DIN IEC 60081 lumen values for fluorescent lamps must always be specified for 25°C).
However, the lamps provide even higher lumens if they are operated at their optimum ambient temperature within the luminaire (see Technical data, pages 4.27 to 4.37).

2) For data for reference measurements and lighting design see pages 4.27 ff.
3) Can also be supplied with sleeves in boxes of 20, or industrial boxes of 40.
For further technical data see pages 4.27 to 4.37.

Fluorescent lamps, tubular, 16 mm tube diameter
LUMILUX® T5 HO HIGH OUTPUT



Product reference	Product number	W		R_a	lm 25°C [1)2)]	TUBE d [mm]	l [mm]	No.	[3)]
LUMILUX® T5 HO HIGH OUTPUT[1)2)], for ECG operation only, G5 base									
FQ 24 W/865 HO	4050300**453453**	24	LUMILUX Daylight	80…89	1600	16	549	1	40
FQ 24 W/840 HO	4050300**453477**	24	LUMILUX Cool White	80…89	1750	16	549	1	40
FQ 24 W/830 HO	4050300**453491**	24	LUMILUX Warm White	80…89	1750	16	549	1	40
FQ 24 W/827 HO	4050300**646091**	24	LUMILUX INTERNA	80…89	1750	16	549	1	40
FQ 39 W/865 HO	4050300**453514**	39	LUMILUX Daylight	80…89	2850	16	849	1	40
FQ 39 W/840 HO	4050300**453538**	39	LUMILUX Cool White	80…89	3100	16	849	1	40
FQ 39 W/830 HO	4050300**453552**	39	LUMILUX Warm White	80…89	3100	16	849	1	40
FQ 39 W/827 HO	4050300**646138**	39	LUMILUX INTERNA	80…89	3100	16	849	1	40
FQ 49 W/840 HO	4050300**657134**	49	LUMILUX Cool White	80…89	4300	16	1449	1	40
FQ 49 W/830 HO	4050300**657158**	49	LUMILUX Warm White	80…89	4300	16	1449	1	40
FQ 49 W/827 HO	4050300**657172**	49	LUMILUX INTERNA	80…89	4300	16	1449	1	40
FQ 54 W/865 HO	4050300**453378**	54	LUMILUX Daylight	80…89	4050	16	1149	1	40
FQ 54 W/840 HO	4050300**453392**	54	LUMILUX Cool White	80…89	4450	16	1149	1	40
FQ 54 W/830 HO	4050300**453415**	54	LUMILUX Warm White	80…89	4450	16	1149	1	40
FQ 54 W/827 HO	4050300**646176**	54	LUMILUX INTERNA	80…89	4450	16	1149	1	40
FQ 80 W/865 HO	4050300**515113**	80	LUMILUX Daylight	80…89	5700	16	1449	1	40
FQ 80 W/840 HO	4050300**515151**	80	LUMILUX Cool White	80…89	6150	16	1449	1	40
FQ 80 W/830 HO	4050300**515137**	80	LUMILUX Warm White	80…89	6150	16	1449	1	40
FQ 80 W/827 HO	4050300**646213**	80	LUMILUX INTERNA	80…89	6150	16	1449	1	40

These lamps offer an even higher luminous flux if operated within the luminaire at their optimum ambient temperature (see technical data pages 4.27 to 4.37).

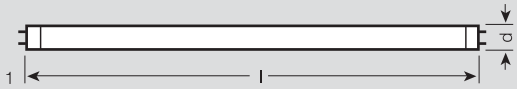
LUMILUX® lamps are environmentally friendly fluorescent lamps with a low mercury content.

As in the case of T5 HO fluorescent lamps, T5 HE fluorescent lamps produce their maximum luminous flux at 35°C, compared with 25°C for T8 fluorescent lamps with a tube diameter of 26 mm. Since the temperatures in the luminaire are higher than the ambient temperature of, say, 20° to 25°C, the efficacy is at least 5% higher than for T8 fluorescent lamps. The small tube diameter of 16 mm also leads to an increase in the efficiency of the luminaire.

1) These values are obtained at 25°C (acc. to DIN IEC 60081 lumen values for fluorescent lamps must always be specified for 25°C). However, the lamps provide even higher lumens if they are operated at their optimum ambient temperature within the luminaire (see Technical data, pages 4.27 to 4.37).

2) For data for reference measurements and lighting design see pages 4.27 ff.
3) Can also be supplied with sleeves in boxes of 20, or industrial boxes of 40. For further technical data see pages 4.27 to 4.37.

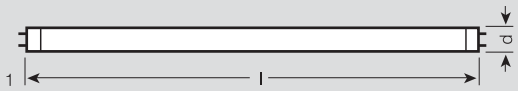
Fluorescent lamps, tubular, 16 mm tube diameter
LUMILUX® DE LUXE T5 HO



Product reference	Product number	W		R_a	lm 25°C	TUBE d [mm]	l [mm]	No.	
LUMILUX® DE LUXE T5 HO HIGH OUTPUT, for ECG operation only, G5 base									
FQ 24 W/940	4050300**823751**	24	LUMILUX DE LUXE Cool White	> 90	1400	16	549	1	15
FQ 24 W/965	4050300**823775**	24	LUMILUX DE LUXE Daylight	> 90	1300	16	549	1	15
FQ 49 W/940	4050300**823874**	49	LUMILUX DE LUXE Cool White	> 90	3500	16	1449	1	15
FQ 49 W/965	4050300**823898**	49	LUMILUX DE LUXE Daylight	> 90	3450	16	1449	1	15
FQ 54 W/940	4050300**823935**	54	LUMILUX DE LUXE Cool White	> 90	3500	16	1149	1	15
FQ 54 W/965	4050300**823959**	54	LUMILUX DE LUXE Daylight	> 90	3450	16	1149	1	15

The combination of a small tube diameter of 16 mm and excellent colour rendering of R_a > 90 makes the ideal solution for attractive lighting tasks, for example in museums, art galleries and even in the home.

Fluorescent lamps, tubular, 16 mm tube diameter
L4 … 13 W

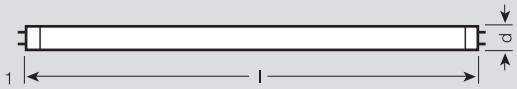


Product reference	Product number	W		Ra	lm ECG	TUBE d [mm]	l [mm]	No.	
LUMILUX® version, G5 base									
L 8 W/840	4050300**241623**	8	LUMILUX Cool White	80…89	450	16	288	1	25
L 8 W/827	4050300**008943**	8	LUMILUX INTERNA	80…89	450	16	288	1	25
L 13 W/840	4050300**241647**	13	LUMILUX Cool White	80…89	950	16	517	1	25
L 13 W/827	4050300**008967**	13	LUMILUX INTERNA	80…89	950	16	517	1	25
LUMILUX® DE LUXE version, G5 base									
L 6 W/930	4050300**015880**	6	LUMILUX DE LUXE Warm White	> 90	220	16	212	1	25
L 8 W/954	4050300**018232**	8	LUMILUX DE LUXE Daylight	> 90	300	16	288	1	25
L 8 W/930	4050300**015897**	8	LUMILUX DE LUXE Warm White	> 90	300	16	288	1	25
L 13 W/930	4050300**015903**	13	LUMILUX DE LUXE Warm White	> 90	600	16	517	1	25
BASIC version, G5 base									
L 4 W/640	4050300**008875**	4	Cool White	60…69	140	16	136	1	25
L 6 W/640	4050300**008899**	6	Cool White	60…69	270	16	212	1	25
L 8 W/640	4050300**008912**	8	Cool White	60…69	385	16	288	1	25
L 13 W/640	4050300**008974**	13	Cool White	60…69	830	16	517	1	25

For circuit see page 4.34, Fig. 9
For electronic control gear see Section 9
For further technical data see pages 4.27 to 4.37

Compact low wattage lamps with low power consumption are also replacing incandescent lamps in emergency lighting systems.

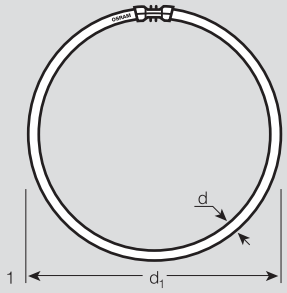
Fluorescent lamps, tubular, 16 mm tube diameter
T5 HE HIGH EFFICIENCY, coloured and T5 HO HIGH OUTPUT, coloured



Product reference	Product number	W		lm	TUBE d [mm]	l [mm]	No.	
T5 HE HIGH EFFICIENCY, coloured fluorescent lamps, for ECG operation only, G5 base								
FH 14 W/60 HE	4050300**646299**	14	Red	930	16	549	1	40
FH 14 W/66 HE	4050300**646459**	14	Green	1550	16	549	1	40
FH 14 W/67 HE	4050300**646619**	14	Blue	300	16	549	1	40
FH 21 W/60 HE	4050300**646312**	21	Red	1500	16	849	1	40
FH 21 W/66 HE	4050300**646473**	21	Green	2500	16	849	1	40
FH 21 W/67 HE	4050300**646633**	21	Blue	500	16	849	1	40
FH 28 W/60 HE	4050300**646336**	28	Red	2100	16	1149	1	40
FH 28 W/66 HE	4050300**646497**	28	Green	3500	16	1149	1	40
FH 28 W/67 HE	4050300**646657**	28	Blue	700	16	1149	1	40
FH 35 W/60 HE	4050300**646350**	35	Red	2650	16	1449	1	40
FH 35 W/66 HE	4050300**646510**	35	Green	4450	16	1449	1	40
FH 35 W/67 HE	4050300**646671**	35	Blue	875	16	1449	1	40
T5 HO HIGH OUTPUT, coloured fluorescent lamps, for ECG operation only, G5 base								
FQ 24 W/60 HO	4050300**646374**	24	Red	1500	16	549	1	40
FQ 24 W/66 HO	4050300**646534**	24	Green	2500	16	549	1	40
FQ 24 W/67 HO	4050300**646695**	24	Blue	525	16	549	1	40
FQ 39 W/60 HO	4050300**646398**	39	Red	2450	16	849	1	40
FQ 39 W/66 HO	4050300**646558**	39	Green	4100	16	849	1	40
FQ 39 W/67 HO	4050300**938899**	39	Blue	850	16	849	1	40
FQ 54 W/60 HO	4050300**646411**	54	Red	3300	16	1149	1	40
FQ 54 W/66 HO	4050300**646572**	54	Green	5550	16	1149	1	40
FQ 54 W/67 HO	4050300**646718**	54	Blue	1150	16	1149	1	40
FQ 80 W/60 HO	4050300**646435**	80	Red	4525	16	1449	1	40
FQ 80 W/66 HO	4050300**646596**	80	Green	7650	16	1449	1	40
FQ 80 W/67 HO	4050300**646732**	80	Blue	1550	16	1449	1	40

For further technical data see pages 4.27 to 4.37

Fluorescent lamps, circular, 16 mm tube diameter
LUMILUX® T5 FC® FLUORESCENT CIRCLINE



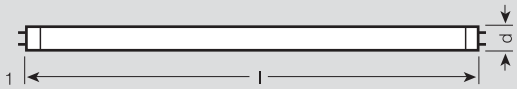
Product reference	Product number	W		R_a	lm	TUBE d [mm]	d_1 [mm]	No.	
LUMILUX® T5 FC® FLUORESCENT CIRCLINE circular fluorescent lamps[1] for ECG operation only, 2GX13 base									
FC 22 W/865	4050300**528441**	22	LUMILUX Daylight	80…89	1700	16	225	1	12
FC 22 W/840	4050300**528465**	22	LUMILUX Cool White	80…89	1800	16	225	1	12
FC 22 W/830	4050300**528489**	22	LUMILUX Warm White	80…89	1800	16	225	1	12
FC 22 W/827	4050300**646237**	22	LUMILUX INTERNA	80…89	1800	16	225	1	12
FC 40 W/865	4050300**528502**	40	LUMILUX Daylight	80…89	3000	16	300	1	12
FC 40 W/840	4050300**528526**	40	LUMILUX Cool White	80…89	3200	16	300	1	12
FC 40 W/830	4050300**528540**	40	LUMILUX Warm White	80…89	3200	16	300	1	12
FC 40 W/827	4050300**646251**	40	LUMILUX INTERNA	80…89	3200	16	300	1	12
FC 55 W/865	4050300**528564**	55	LUMILUX Daylight	80…89	3800	16	300	1	12
FC 55 W/840	4050300**528588**	55	LUMILUX Cool White	80…89	4200	16	300	1	12
FC 55 W/830	4050300**528601**	55	LUMILUX Warm White	80…89	4200	16	300	1	12
FC 55 W/827	4050300**646275**	55	LUMILUX INTERNA	80…89	4200	16	300	1	12

T5 FC® circular lamps are a must for modern architecture. They have a tube diameter of 16 mm and can be operated only with QUICKTRONIC® QT-FC with cut-off technology.

A round tower in more ways than one. The Main Tower in Frankfurt is an impressive landmark in the area of the city that has come to be known as "Mainhattan" after the River Main that runs through the city. Even the lighting in this round tower is round. 7,500 circular T5 fluorescent lamps with dimmable control gear provide optimum lighting conditions and excellent energy savings.

1) Cut-off ECG see Section 9
For further technical data see pages 4.27 to 4.37

Fluorescent lamps, tubular, 26 mm tube diameter
LUMILUX® T8



Product reference	Product number	W		Ra	Im CCG	TUBE d [mm]	l [mm]	No.		
LUMILUX® T8, G13 base										
L 10 W/827	4050300**446165**	10	LUMILUX INTERNA	80…89	650	26	470	1	25	3500
L 15 W/840	4050300**446004**	15	LUMILUX Cool White	80…89	950	26	438	1	25	3500
L 15 W/830	4050300**446028**	15	LUMILUX Warm White	80…89	950	26	438	1	25	3500
L 15 W/827	4050300**446042**	15	LUMILUX INTERNA	80…89	950	26	438	1	25	3500
L 16 W/840	4050300**446066**	16	LUMILUX Cool White	80…89	1250	26	720	1	25	2250
L 16 W/827	4050300**446080**	16	LUMILUX INTERNA	80…89	1250	26	720	1	25	2250
L 18 W/865	4050300**517773**	18	LUMILUX Daylight	80…89	1300	26	590	1	25	2500
L 18 W/840[1)]	4050300**517797**	18	LUMILUX Cool White	80…89	1350	26	590	1	25	2500
L 18 W/830	4050300**517810**	18	LUMILUX Warm White	80…89	1350	26	590	1	25	2500
L 18 W/827[1)]	4050300**517834**	18	LUMILUX INTERNA	80…89	1350	26	590	1	25	2500
L 30 W/865	4050300**518015**	30	LUMILUX Daylight	80…89	2350	26	895	1	25	1750
L 30 W/840	4050300**518039**	30	LUMILUX Cool White	80…89	2400	26	895	1	25	1750
L 30 W/830	4050300**518053**	30	LUMILUX Warm White	80…89	2400	26	895	1	25	1750
L 30 W/827	4050300**518077**	30	LUMILUX INTERNA	80…89	2400	26	895	1	25	1750
L 36 W/865	4050300**517858**	36	LUMILUX Daylight	80…89	3250	26	1200	1	25	1200
L 36 W/840[1)]	4050300**517872**	36	LUMILUX Cool White	80…89	3350	26	1200	1	25	1200
L 36 W/830	4050300**517896**	36	LUMILUX Warm White	80…89	3350	26	1200	1	25	1200
L 36 W/827[1)]	4050300**517919**	36	LUMILUX INTERNA	80…89	3350	26	1200	1	25	1200
L 36 W/840-1	4050300**518091**	36	LUMILUX Cool White	80…89	3100	26	970	1	25	1200
L 36 W/827-1	4050300**518114**	36	LUMILUX INTERNA	80…89	3100	26	970	1	25	1200
L 38 W/840	4050300**518138**	38	LUMILUX Cool White	80…89	3300[2)]	26	1047	1	25	1200
L 38 W/830	4050300**518152**	38	LUMILUX Warm White	80…89	3300[2)]	26	1047	1	25	1200
L 58 W/865	4050300**517933**	58	LUMILUX Daylight	80…89	5000	26	1500	1	25	1200
L 58 W/840[1)]	4050300**517957**	58	LUMILUX Cool White	80…89	5200	26	1500	1	25	1200
L 58 W/830	4050300**517971**	58	LUMILUX Warm White	80…89	5200	26	1500	1	25	1200
L 58 W/827[1)]	4050300**603049**	58	LUMILUX INTERNA	80…89	5200	26	1500	1	25	1200

For QUICKTRONIC® electronic control gear see Section 9

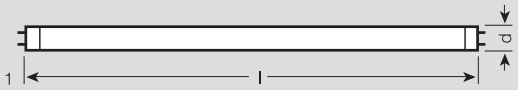
The new LUMILUX® lamps offer excellent luminous flux and economy, and improved environmental compatibility. Their loss of luminous flux over their entire service life has been reduced to around 8% compared with previous levels of 18% after 10,000 hours. With warm start ECGs, an average life of 20,000 hours and a service life of 18,000 hours (80% system luminous flux) can be achieved.

LUMILUX® are the environmentally friendly fluorescent lamps with a low mercury content that already meet ROHS[3)] requirements.

Fluorescent lamps in LUMILUX® and BASIC colour appearances offer up to 10% energy savings compared with previous fluorescent lamps with a 38 mm tube diameter.
They are designed to operate with conventional control gear and starters or with QUICKTRONIC® electronic control gear. If used in starter circuits, these lamps can operate with standard control gear and recommended compensation capacitors.

1) Also available in industrial packs (IVP) for bulk orders. Contains 30 lamps
2) 3400 lm when operated with 42 W control gear
3) ROHS Restriction of Hazardous Substances (2002/95/EC)
For further technical data see pages 4.27 to 4.37

Fluorescent lamps, tubular, 26 mm tube diameter
LUMILUX® F 4Y®



Product reference	Product number	W		Ra	lm CCG	TUBE d [mm]	l [mm]	No.		
LUMILUX® F 4Y® Fluorescent 4 Years, specifically for CCG operation, G13 base										
F 4Y 36W/840	4050300**623542**	36	Cool White	80…89	3200	26	1200	1	25	1250
F 4Y 36W/830	4050300**623528**	36	Warm White	80…89	3200	26	1200	1	25	1250
F 4Y 58W/840	4050300**623580**	58	Cool White	80…89	5000	26	1500	1	25	1250
F 4Y 58W/830	4050300**623566**	58	Warm White	80…89	5000	26	1500	1	25	1250

New

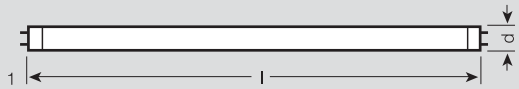
LUMILUX® F 4Y® is a new series of lamps with long service lives and was developed specifically for cost-saving outdoor and street lighting. The lamps are also ideally suited to factories with difficult access for relamping (such as turbine halls).

- The F 4Y® lamp is a new type of 26 mm fluorescent lamp (T8) for outdoor lighting, optimised for operation on conventional control gear with a new gas filling and a filament capable of withstanding higher loads
- Thanks to their high level of reliability and long life, F 4Y® lamps also allow a four-year relamping and maintenance cycle
- The failure rate after 16,000 hours is only 5% for an average life of 24,000 hours
- Simple direct replacement for comparable T8 fluorescent lamps
- Further benefits result from their high luminous flux, high luminous efficacy and excellent colour rendering

F 4Y® lamps have been developed specially for a variety of high-intensity applications in street lighting and wherever access for changing lamps is difficult (e.g. in factories with high ceilings).

For further technical data see pages 4.27 to 4.37

Fluorescent lamps, tubular, 26 mm tube diameter
LUMILUX® DE LUXE T8

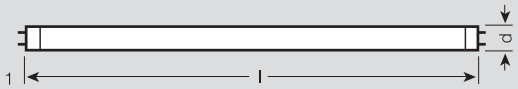


Product reference	Product number	W		Ra	lm CCG	TUBE d [mm]	l [mm]	No.		
LUMILUX® DE LUXE T8, G13 base										
L 15 W/954	4050300**018249**	15	LUMILUX DE LUXE Daylight	> 90	680	26	438	1	25	3500
L 15 W/930	4050300**014395**	15	LUMILUX DE LUXE Warm White	> 90	650	26	438	1	25	3500
L 16 W/930	4050300**242361**	16	LUMILUX DE LUXE Warm White	> 90	850	26	720	1	25	2250
L 18 W/954	4050300**018256**	18	LUMILUX DE LUXE Daylight	> 90	1000	26	590	1	25	2500
L 18 W/940	4050300**011257**	18	LUMILUX DE LUXE Cool White	> 90	950	26	590	1	25	2500
L 18 W/930	4050300**011264**	18	LUMILUX DE LUXE Warm White	> 90	900	26	590	1	25	2500
L 30 W/930	4050300**014432**	30	LUMILUX DE LUXE Warm White	> 90	1600	26	895	1	25	1750
L 36 W/954	4050300**018263**	36	LUMILUX DE LUXE Daylight	> 90	2300	26	1200	1	25	1200
L 36 W/940	4050300**011301**	36	LUMILUX DE LUXE Cool White	> 90	2250	26	1200	1	25	1200
L 36 W/930	4050300**011318**	36	LUMILUX DE LUXE Warm White	> 90	2200	26	1200	1	25	1200
L 36 W/954-1	4050300**024196**	36	LUMILUX DE LUXE Daylight	> 90	2100	26	970	1	25	1200
L 58 W/954	4050300**018270**	58	LUMILUX DE LUXE Daylight	> 90	3700	26	1500	1	25	1200
L 58 W/940	4050300**011356**	58	LUMILUX DE LUXE Cool White	> 90	3600	26	1500	1	25	1200
L 58 W/930	4050300**011363**	58	LUMILUX DE LUXE Warm White	> 90	3500	26	1500	1	25	1200

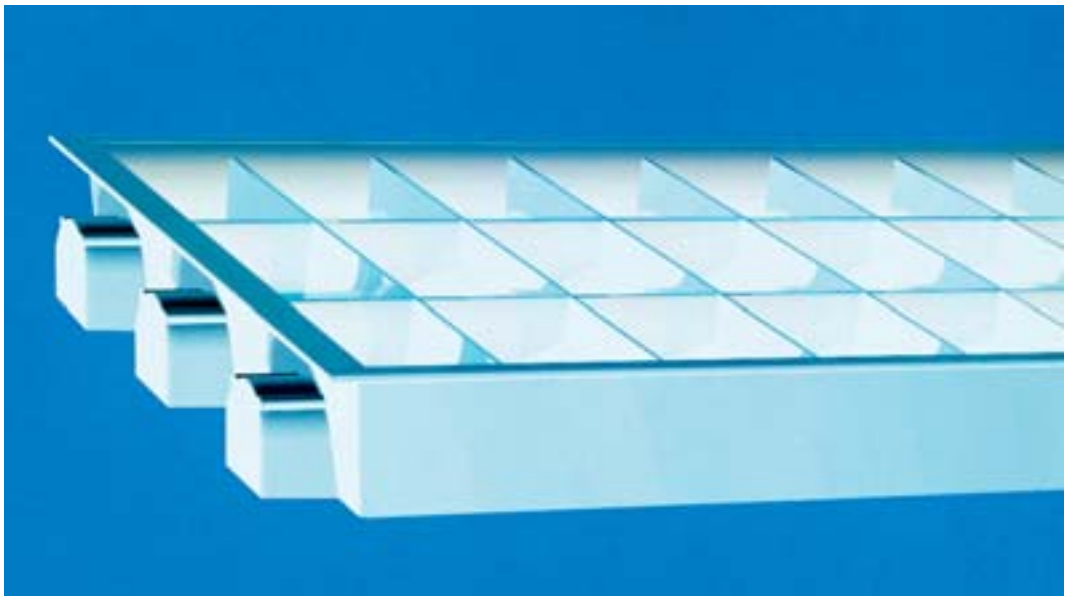
The light from LUMILUX® DE LUXE Daylight lamps is as cheerful and refreshing as natural daylight. Every changing cubicle should have one.

For further technical data see pages 4.27 to 4.37

Fluorescent lamps, tubular, 26 mm tube diameter
BASIC T8



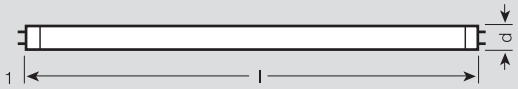
Product reference	Product number	W		Ra	lm CCG	TUBE d [mm]	l [mm]	No.		
BASIC T8, G13[2] base										
L 18 W/640	4050300**001647**	18	Cool White	60…69	1200	26	590	1	25	2500
L 36 W/640[1]	4050300**001708**	36	Cool White	60…69	2850	26	1200	1	25	1200
L 58 W/640[1]	4050300**001784**	58	Cool White	60…69	4600	26	1500	1	25	1200



Suitable for applications in which colour rendering is not a primary concern, such as cellars, garages and outdoor lighting.

1) Also available in industrial packs (IVP) for bulk orders. Contains 30 lamps
2) Light colour 740 (old: 25) – discontinued
For further technical data see pages 4.27 to 4.37

Fluorescent lamps, tubular, 26 mm tube diameter
Special colour appearances



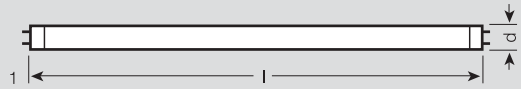
NATURA is the right light source (DIN 10504) for displaying food such as meat and sausages.

Product reference	Product number	W		Ra	lm CCG	TUBE d [mm]	l [mm]	No.		
NATURA, G13 base										
L 15 W/76	4050300**018287**	15	NATURA	70…79	500	26	438	1	25	3500
L 18 W/76	4050300**010519**	18	NATURA	70…79	750	26	590	1	25	2500
L 30 W/76	4050300**010540**	30	NATURA	70…79	1300	26	895	1	25	1750
L 36 W/76-1	4050300**010557**	36	NATURA	70…79	1600	26	970	1	25	1200
L 36 W/76	4050300**010526**	36	NATURA	70…79	1800	26	1200	1	25	1200
L 58 W/76	4050300**010533**	58	NATURA	70…79	2850	26	1500	1	25	1200

For QUICKTRONIC® electronic control gear see Section 9

For further technical data see pages 4.27 to 4.37

Fluorescent lamps, tubular, 26 mm tube diameter
Special colour appearances



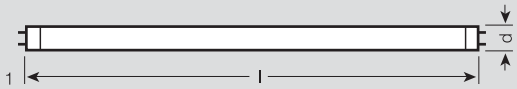
Product reference	Product number	W		Ra	lm CCG	TUBE d [mm]	l [mm]	No.		
LUMILUX® DE LUXE BIOLUX®, G13 base										
L 18 W/965	4050300**270807**	18	BIOLUX	1 A	1000	26	590	1	25	2500
L 30 W/965	4050300**302461**	30	BIOLUX	1 A	1600	26	895	1	25	1750
L 36 W/965	4050300**270821**	36	BIOLUX	1 A	2300	26	1200	1	25	1200
L 58 W/965	4050300**370613**	58	BIOLUX	1 A	3700	26	1500	1	25	1200

For QUICKTRONIC® electronic control gear see Section 9

The BIOLUX® versions of OSRAM LUMILUX® DE LUXE lamps have a spectral distribution that closely matches that of natural sunlight.

For further technical data see pages 4.27 to 4.37

Fluorescent lamps, tubular, 26 mm tube diameter
Special colour appearances



OSRAM FLUORA® lamps are the light sources for plants and aquariums. They emit most of their light at the blue and red ends of the spectrum. They have a positive effect on photo-biological processes and therefore help stimulate healthy growth in plants.

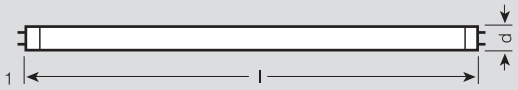
Product reference	Product number	W		lm CCG	TUBE d [mm]	l [mm]	No.		
FLUORA® lamps for plants and aquariums, G13 base									
L 15 W/77	4050300**003214**	15	FLUORA	400	26	438	1	25	3500
L 18 W/77	4050300**004235**	18	FLUORA	550	26	590	1	25	2500
L 30 W/77	4050300**003238**	30	FLUORA	1000	26	895	1	25	1750
L 36 W/77	4050300**003184**	36	FLUORA	1400	26	1200	1	25	1200
L 58 W/77	4050300**004259**	58	FLUORA	2250	26	1500	1	25	1200

For fluorescents with black glass bulbs see page 6.09
For QUICKTRONIC® electronic control gear see Section 9

Thanks to FLUORA® light, plants thrive even when there is little or no natural daylight.

For further technical data see pages 4.27 to 4.37

Fluorescent lamps, tubular, 26 mm tube diameter
Coloured, UV and splinter protection



Product reference	Product number	W		Ra	lm CCG	TUBE d [mm]	l [mm]	No.		
Coloured lamps, G13 base										
L 18 W/60	4050300**024219**	18	Red		900	26	590	1	25	2500
L 18 W/62	4050300**443249**	18	Yellow		900	26	590	1	30	2160
L 18 W/66	4050300**024226**	18	Green		1800	26	590	1	25	2500
L 18 W/67	4050300**024233**	18	Blue		400	26	590	1	25	2500
L 30 W/67	4050300**366920**	30	Blue		600	26	895	1	25	1750
L 36 W/60	4050300**024240**	36	Red		2400	26	1200	1	25	1200
L 36 W/62	4050300**443263**	36	Yellow		2100	26	1200	1	30	1350
L 36 W/66	4050300**024257**	36	Green		4400	26	1200	1	25	1200
L 36 W/67	4050300**024264**	36	Blue		900	26	1200	1	25	1200
L 58 W/60	4050300**024271**	58	Red		3800	26	1500	1	25	1200
L 58 W/62	4050300**443287**	58	Yellow		3200	26	1500	1	30	1200
L 58 W/66	4050300**024288**	58	Green		6700	26	1500	1	25	1200
L 58 W/67	4050300**024295**	58	Blue		1600	26	1500	1	25	1200

For fluorescents with black glass bulbs see page 6.09
For QUICKTRONIC® electronic control gear see Section 9

With UV and Splinter Protection (Protective sleeve)[1], G13 base										
L 18 W/840 SPS	4050300**429717**	18	LUMILUX Cool White	80…89	1300	26	590	1	30	2160
L 18 W/940 UVS	4050300**430119**	18	LUMILUX DE LUXE Cool White	> 90	910	26	590	1	30	2160
L 18 W/62	4050300**443249**	18	Yellow	–	900	26	590	1	30	2160
L 18 W/76 SPS	4050300**864679**	18	NATURA	70…79	700	26	590	1	30	2160
L 36 W/840 SPS	4050300**429731**	36	LUMILUX Cool White	80…89	3150	26	1200	1	30	1350
L 36 W/940 UVS	4050300**430133**	36	LUMILUX DE LUXE Cool White	> 90	2150	26	1200	1	30	1350
L 36 W/62	4050300**443263**	36	Yellow	–	2100	26	1200	1	30	1350
L 36 W/76 SPS	4050300**864693**	36	NATURA	70…79	1700	26	1200	1	30	1350
L 58 W/840 SPS	4050300**430096**	58	LUMILUX Cool White	80…89	5050	26	1500	1	30	1200
L 58 W/940 UVS	4050300**430157**	58	LUMILUX DE LUXE Cool White	> 90	3450	26	1500	1	30	1200
L 58 W/62	4050300**443287**	58	Yellow	–	3200	26	1500	1	30	1200
L 58 W/76 SPS	4050300**864716**	58	NATURA	70…79	2750	26	1500	1	30	1200

If a lamp should burst, the sleeve fixed around the glass tube ensures that shards cannot escape. The sleeve also acts as an effective UV filter.

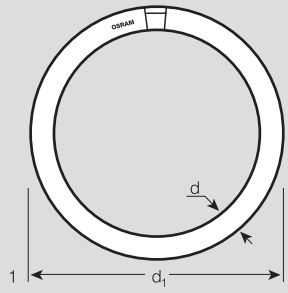
Colours 840 and 940 with their outstanding colour rendering are ideal for:
- museums, offices, exhibitions, trade fairs and sports halls
- the graphics industry, laboratories, art galleries, photographic studios, watchmakers and jewellers
- the food industry.

Light colour 76 with splinter protection is used in sensitive areas in the food industry and for shop lighting.

Colour 62 is ideal for:
- microchip fabrication plants and other places where UV radiation and light from the blue end of the spectrum are unwanted (print shops for example)
- shop windows and shop interiors
- theatres for decorative lighting and lighting effects
- patio and balcony lighting because the light does not attract insects
- SPS and UVS lamps have only a very small UV-A content (no UV-B or UV-C).

1) Lamps need to be replaced after 10,000 hours (under normal conditions)
For further technical data see pages 4.27 to 4.37

Fluorescent lamps, circular, 29 – 30 mm tube diameter
Fluorescent lamps, U-shaped, 26 mm tube diameter

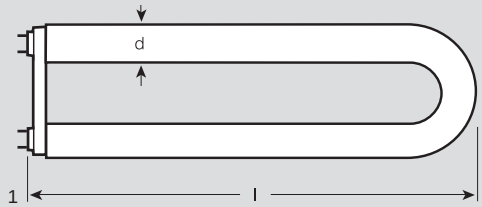


Electronic control gear such as the QUICKTRONIC® for OSRAM DULUX® L is suitable for circular lamps. Because of their shape, these fluorescent lamps distribute the light very evenly.

Product reference	Product number	W		Ra	Im CCG	TUBE d [mm]	d_1 [mm]	No.		
Circular fluorescent lamps, G10q base										
LUMILUX® version										
L 22 W/840 C	4050300**365978**	22	LUMILUX Cool White	80…89	1350	29	216	1	12	720
L 22 W/827 C	4050300**365992**	22	LUMILUX INTERNA	80…89	1350	29	216	1	12	720
L 32 W/840 C	4050300**018379**	32	LUMILUX Cool White	80…89	2050	30	307	1	12	336
L 32 W/827 C	4050300**014821**	32	LUMILUX INTERNA	80…89	2050	30	307	1	12	336
L 40 W/840 C	4050300**014845**	40	LUMILUX Cool White	80…89	2900	30	409	1	12	216
L 40 W/827 C	4050300**014838**	40	LUMILUX INTERNA	80…89	2900	30	409	1	12	216
BASIC version										
L 22 W/740 C	4050300**011417**	22	Universal White	70…79	1000	29	216	1	12	720
L 32 W/740 C	4050300**003252**	32	Universal White	70…79	1700	30	307	1	12	336
L 40 W/740 C	4050300**003269**	40	Universal White	70…79	2300	30	409	1	12	216

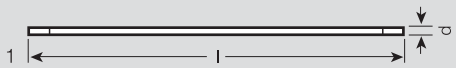
OSRAM U lamps make compact space-saving lighting systems economical.

Product reference	Product number	W		Ra	Im CCG	TUBE d [mm]	l [mm]	No.		
U-shaped fluorescent lamps, 2G13 base										
BASIC version[1)]										
L 18/740 U	4050300**530772**	18	Universal White	70…79	950	26	304	1	24	1152
L 36/740 U	4050300**530871**	36	Universal White	70…79	2400	26	601	1	12	576
L 36/530 U	4050300**530857**	36	Warm White	50…59	2700	26	601	1	12	576
L 58/740 U	4050300**531038**	58	Universal White	70…79	3900	26	759	1	12	504
L 58/530 U	4050300**531014**	58	Warm White	50…59	4500	26	759	1	12	504



1) To be discontinued, individual fittings only
For further technical data see pages 4.27 to 4.37

Fluorescent lamps, tubular, 7 mm tube diameter
LUMILUX® T2 FM® FLUORESCENT MINIATURE



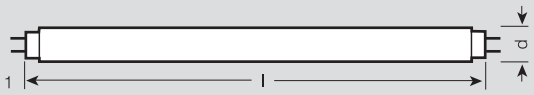
Product reference	Product number	W		Ra	lm ECG	TUBE d [mm]	l [mm]	No.		
LUMILUX® T2 FM® FLUORESCENT MINIATURE, W4,3 x 8,5d base										
for ECG operation only										
FM 6 W/760	4050300**579931**	6	Daylight	70…79	310	7	218.3	1	20	24000
FM 6 W/740	4050300**579658**	6	Cool White	70…79	330	7	218.3	1	20	24000
FM 6 W/730	4050300**579917**	6	Warm White	70…79	330	7	218.3	1	20	24000
FM 8 W/760	4050300**579559**	8	Daylight	70…79	500	7	319.9	1	20	16000
FM 8 W/740	4050300**579672**	8	Cool White	70…79	540	7	319.9	1	20	16000
FM 8 W/730	4050300**579511**	8	Warm White	70…79	540	7	319.9	1	20	16000
FM 11 W/760	4050300**579979**	11	Daylight	70…79	680	7	421.5	1	20	12000
FM 11 W/740	4050300**579696**	11	Cool White	70…79	750	7	421.5	1	20	12000
FM 11 W/730	4050300**579955**	11	Warm White	70…79	750	7	421.5	1	20	12000
FM 13 W/760	4050300**579573**	13	Daylight	70…79	860	7	523.1	1	20	8000
FM 13 W/740	4050300**579719**	13	Cool White	70…79	930	7	523.1	1	20	8000
FM 13 W/730	4050300**579535**	13	Warm White	70…79	930	7	523.1	1	20	8000

For circuit see page 4.34, Fig. 8
For electronic control gear see Section 9

In LUMILUX® Daylight, colours look as vibrant as in natural sunlight.

For further technical data see pages 4.27 to 4.37

Fluorescent lamps, tubular, 38 mm tube diameter
Special cases for indoor and outdoor lighting



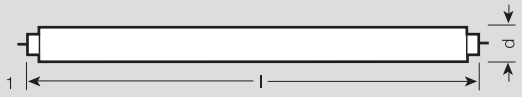
Product reference	Product number	W		Ra	Im CCG	TUBE d [mm]	l [mm]	No.		
S-type fluorescents[1], G13 base										
BASIC version										
L 20 W/640 S	4050300**014685**	20	Cool White	60…69	1150	38	590	1	25	1400
L 40 W/640 S	4050300**014708**	40	Cool White	60…69	2800	38	1200	1	25	700
L 65 W/640 S	4050300**014739**	65	Cool White	60…69	4400	38	1500	1	25	600
SA-type fluorescents with external ignition strip[1], G13 base										
BASIC version										
L 40 W/640 SA	4050300**018331**	40	Cool White	60…69	2800	38	1200	1	25	700
L 65 W/640 SA	4050300**018201**	65	Cool White	60…69	4400	38	1500	1	25	600

S-type fluorescents:
For operation with starters (ST 111, ST 151, ST 171). Intended for systems with luminaires that are unsuitable, because of their design, for energy-saving 26 mm fluorescent lamps (e.g. certain all-plastic luminaires and outdoor luminaires with minimal thermal insulation or none at all). For Rapid Start (RS) units. Rated heating voltage 3.6 V in accordance with IEC Publication 81.

SA-type fluorescents:
For resonance double-choke (RD) circuits at normal and low ambient temperatures. Rated heating voltage 3.6 V in accordance with IEC Publication 81.

1) Delivery may take longer; please note when ordering
For further technical data see pages 4.27 to 4.37

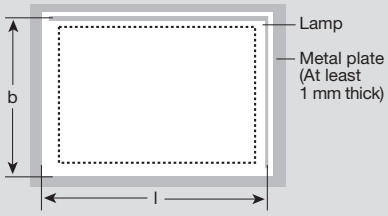
Fluorescent lamps, tubular, 38 mm tube diameter
Special cases for indoor and outdoor lighting

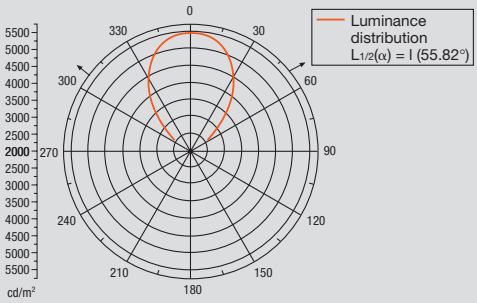


Product reference	Product number	W		Ra	lm CCG	TUBE d [mm]	l [mm]	No.		
Fluorescent lamps for explosion-proof luminaires with long life (Type of protection “increased safety”)										
BASIC version, Fa6 base										
L 20 W/640 XL	4050300**014630**	20	Cool White	60…69	1000	38	574	1	25	1050
L 40 W/640 XL	4050300**014654**	40	Cool White	60…69	2350	38	1183.5	1	25	700
L 65 W/640 XL	4050300**014616**	65	Cool White	60…69	4600	38	1484	1	25	500

For further technical data see pages 4.27 to 4.37

OSRAM PLANON®





OSRAM recently received the coveted Archi-Tech award in the USA. The jury was impressed by the innovative way in which PLANON® lighting systems were integrated in the façade of the headquarters of KPN, the Dutch telecommunications company based in Rotterdam.

Product reference	Product number	W	Ra 4)	K 4)	cd/m²	AC/DC	W
OSRAM PLANON®							
PLANON 10.4″/880 6	4050300**784304**	24	86	8000	5200	24 V DC	20% PWM 2)
PLANON 15.0″/868 2 1)	4050300**942971**	56	86	6800	5900	24 V DC	50% Analog
PLANON 15.0″/880 2 1)	4050300**784328**	56	86	8000	5900	24 V DC	50% Analog
PLANON 15.0″/868 6 1)	4050300**625034**	40	86	6800	4400	24 V DC	20% PWM 2)
PLANON 15.0″/880 6	4050300**784366**	40	86	8000	4400	24 V DC	20% PWM 2)
PLANON 18.1″/880 2-5 1)	4050300**784380**	90	86	8000	5900	230 V AC	50% Analog
PLANON 18.1″/874 6 1)	4050300**666761**	80	86	7400	5600	24 V DC	20% PWM 2)
PLANON 18.1″/880 6 1)	4050300**784403**	80	86	8000	5600	24 V DC	20% PWM 2)
PLANON 18.1″/880 8	4050300**789187**	65	86	8000	5100	24 V DC	20% PWM 2)
PLANON 20.1″/880 8	4050300**803883**	65	86	8000	4100	24 V DC	20% PWM 2)
PLANON 21.3″/863 2-5 1)	4050300**610443**	108	86	6300	5800	230 V AC or 24 V DC	50% Analog
PLANON 21.3″/880 2-5 1)	4050300**784441**	108	86	8000	5800	230 V AC or 24 V DC	50% Analog
PLANON 21.3″/880 8	4050300**803906**	65/130	86	8000	4000/7800	24 V DC	20% PWM 2)

Product reference	l [mm]	b [mm]	h [mm]		ECG reference
PLANON 10.4″/880 6	231	174	8.5	5	QT PLANON 10.4″/20/24 6 or QT PLANON 10.4″/40/24 6
PLANON 15.0″/868 2 1)	324	258	8.5	5	QT PLANON 15.0″/50/24 2 1)
PLANON 15.0″/880 2 1)	324	258	8.5	5	QT PLANON 15.0″/50/24 2 1)
PLANON 15.0″/868 6 1)	324	258	8.5	5	QT PLANON 15.0″/40/24 6
PLANON 15.0″/880 6	324	258	8.5	5	QT PLANON 15.0″/40/24 6
PLANON 18.1″/880 2-5 1)	384	317	8.5	5	2xQT PLANON 18.1″/40/24 2 1) or QT PLANON 18.1″/68/100-240 5 1)
PLANON 18.1″/874 6 1)	384	317	8.5	5	2xQT PLANON 18.1″/40/24 6 1)
PLANON 18.1″/880 6 1)	384	317	8.5	5	2xQT PLANON 18.1″/40/24 6 1)
PLANON 18.1″/880 8	384	317	8.5	5	QT PLANON 18.1″/80/24 8
PLANON 20.1″/880 8	433	320	8.5	5	QT PLANON 20.1″/80/24 8
PLANON 21.3″/863 2-5 1)	452	353	8.5	5	QT PLANON 21.3″/90/100-240 5 1)3)
PLANON 21.3″/880 2-5 1)	441	359	8.5	5	QT PLANON 21.3″/90/100-240 5 1)3)
PLANON 21.3″/880 8	441	359	8.5	5	QT PLANON 21.3″/80/24 8

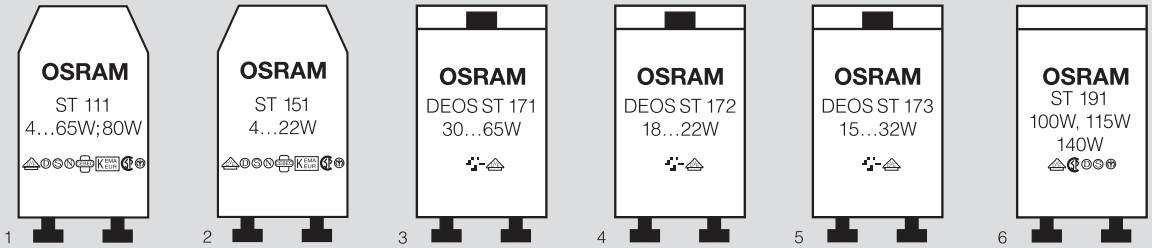
OSRAM PLANON®: A completely new dimension
- Two-dimensional, mercury-free discharge lamp
- Lamp size (diagonal) from 10.4 to 21.3 inches
- Ultra low profile = 10 mm
- Luminances from 3000 to 10,000 cd/m²
- Homogeneous brightness distribution over the entire surface
- Dimmable in the ratio of 1:5 (20% of rated output)
- Extremely long life of up to 100,000 h (MTTH = Mean Time to Half Brightness)
- Lamp life unaffected by switching cycle
- Lamp and control gear (ECG) available as a system

Mercury-free technology:
- Luminous flux unaffected by temperature in the range from –30°C to +85°C
- Instant light (no warm-up time)
- Environmentally friendly product (waste disposal)

Applications:
- Lighting for indoors and outdoors
- LCD backlighting
- Industrial image processing
- Architecture lighting and image information systems
- Lighting for film and photography

1) Discontinued
2) PWM = Pulse Width Modulation
3) Or operated with 2xQT PLANON 15.0″/50/24 2 (discontinued)
4) Nominal values

Starters



1 2 3 4 5 6

Product reference	Product number	For fluorescent lamps 4 6 8 W	10 13 W	15 16 W	18 20 W	22 W	30 32 W	38 W	36 40 W	58 65 80 W	100 115 140 W	For OSRAM DULUX® L 18 24 W	36 W	No.	
For single operation on 230V ~															
ST 111 25ER	4050300**854045**	X	X	X	X	X	X	X	X	X		X	X	1	25/400
ST 111 GRP	4050300**270166**	X	X	X	X	X	X	X	X	X		X	X	1	1200
ST 171 10ER	4050300**834337**						X	X	X	X[1]			X	3	10/200
ST 171 25ER	4050300**854106**						X	X	X	X[1]			X	3	25/200
ST 171 GRP	4050300**422855**						X	X	X	X[1]			X	3	1200
ST 173 10ER	4050300**834399**			X	X	X	X					X		5	10/200
ST 173 25ER	4050300**854120**			X	X	X	X					X		5	25/200
ST 173 GRP	4050300**400785**			X	X	X	X					X		5	1200
ST 191 50ER	4050300**839165**										X			6	50/800
For series operation on 230V ~															
ST 151 25ER	4050300**854083**	X[2]		X[2]	X[2]	X[2]						X[2][3]		2	25/400
ST 151 GRP	4050300**012803**	X[2]		X[2]	X[2]	X[2]						X[2][3]		2	1200
ST 172 10ER	4050300**835433**				X[2]	X[2]						X[2][3]		4	10/200
ST 172 25ER	4050300**854069**				X[2]	X[2]						X[2][3]		4	25/200
ST 172 GRP	4050300**308357**				X[2]	X[2]						X[2][3]		4	1200

OSRAM high quality starters ST 111, ST 151, ST 171, ST 172, ST 173 and ST 191.
OSRAM starters ignite every time, reliably and quickly. And they are gentle on lamps. Each starter is subjected to strict manufacturing and quality control tests. All starters have a self-extinguishing insulated housing made of Makrolon and meet the conditions laid down for protection class II.

They are equipped with a special compensating capacitor (foil wound capacitor), are VDE approved and carry the and marks.

To ensure reliable ignition we recommend that you also replace the starter when you replace the lamp – except in the case of DEOS®.

The features and benefits of DEOS® ST 171, DEOS® ST 172 and DEOS® ST 173 safety starters are as follows:
- DEOS® ST 171, DEOS® ST 172 and DEOS® ST 173 are safety starters
- DEOS® ST 172 is a safety starter for series circuits (tandem circuits).
- DEOS® ST 171, DEOS® ST 172 and DEOS® ST 173 are designed to operate with conventional control gear (CCG) and low-loss gear (LLG).
- They reliably disconnect burnt-out or faulty lamps under inductive or capacitive operating conditions.
- They are instantly ready for operation when the red button is pressed in (there must be an audible click).
- The automatic cut-out circuit protects the choke and the starter itself.
- Their service life is four times that of conventional starters.
- To ensure reliable ignition the DEOS® ST should be replaced after every four lamp replacements.
- Temperature range for reliable cut-out: –20°C to +80°C.

1) Except L 65 W/… UK 570 mm and L 80 W/…
2) Also for single operation on 110/127 V AC
3) Not suitable for seriel connection of DULUX® L or F 24 W

Fluorescent lamps
Which colour appearance for which application?

High luminous efficacy, low power consumption, different shapes and long life make OSRAM fluorescent lamps some of the most economical light sources available. They are therefore popular in factories, offices and homes throughout the world.

Applications	Daylight			Cool White		Warm White		INTERNA®	NATURA
	865	954	965	840	940	830	930	827	76
Office buildings									
Offices, corridors			●	●		●			
Conference rooms						●		●	
Industry, trade and commerce									
Electrical industry				●					
Textile industry	●	●	●	●	●				
Woodworking industry	●	●	●	●					
Printing offices, laboratories	●	●	●	●		●			
Colour matching		●	●		●				
Warehouses, transport depots				●					
Schools and lecture rooms									
Auditoriums, classrooms,									
Kindergardens			●	●		●		●	
Libraries, reading rooms			●	●		●		●	
Retail premises									
Groceries	●			●		●		●	
Bakeries								●	
Refrigerated counters and									
Deepfreezers	●								
Dairy goods, fruit, vegetables								●	
Fish								●	
Meat, sausages									●
Textiles, leather goods	●	●	●		●	●	●	●	
Furniture, carpets						●	●	●	
Sporting goods, toys, stationery				●	●	●	●		
Photo, watchmakers,									
jewellers shops	●	●	●			●	●		
Cosmetics, hairdressers							●	●	
Flowers		●	●				●	●	●
Department stores, supermarkets			●	●	●	●	●	●	
Public buildings									
Restaurants, hotels, inns								●	
Theatres, concert halls, foyers								●	
Exhibition rooms									
Exhibition halls, trade fairs				●		●			
Sports and multi-purpose halls				●					
Art galleries, museums	●	●		●	●		●	●	
Hospitals and surgeries									
Consulting and treatment rooms	●	●	●						
Hospital wards, waiting rooms			●				●	●	
Homes									
Living rooms							●	●	
Kitchen, bathrooms,				●	●		●	●	
Hobby rooms, cellars									
Outdoor lighting									
Streets, roads, pedestrian zones				●		●			

See pages 4.36 and 4.37 for spectral power distributions

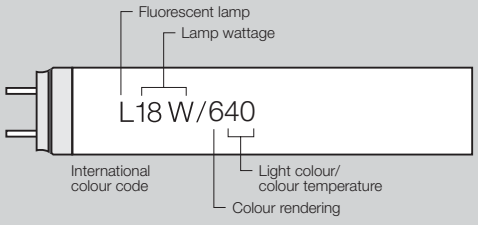
Light colours and colour rendering properties of fluorescent lamps to EN 12464-1

Colour rendering index (R_a)		Colour appearance Daylight above 5300 K	Colour appearance Cool White 3300 K to 5300 K	Colour appearance Warm White below 3300 K
Excellent	R_a 90 – 100	954 LUMILUX® DE LUXE Daylight 5400 K 965 BIOLUX® 6500 K	940 LUMILUX® DE LUXE Cool White 3800 K	930 LUMILUX® DE LUXE Warm White 3000 K
	R_a 80 – 89	865 LUMILUX® Daylight 6500 K	840 LUMILUX® Cool White 4000 K	830 LUMILUX® Warm White 3000 K 827 LUMILUX INTERNA® 2700 K
Good	R_a 70 – 79	765 Daylight 6500 K	740 Universal White 4000 K	
	R_a 60 – 69		640 Cool White 4000 K	
Acceptable	R_a 40 – 59			530 Warm White 3000 K

OSRAM type designations:

The international colour code:
The first digit stands for the colour rendering group
9 = colour rendering group R_a 90-100
8 = colour rendering group R_a 80-89
7 = colour rendering group R_a 70-79
6 = colour rendering group R_a 60-69
5 = colour rendering group R_a 50-59
4 = colour rendering group R_a 40-49

The next digits stand for the light colour/colour temperature, e.g. for LUMILUX®
27 = LUMILUX INTERNA® (2700 K)
30 = LUMILUX® Warm White (3000 K)
40 = LUMILUX® Cool White (4000 K)
54 = LUMILUX® Daylight (5400 K)
65 = LUMILUX® Daylight (6500 K)
65 = LUMILUX® BIOLUX® (6500 K)



Light colour codes for BASIC lamps

Old		**New**	**R_a**	**Colour temperature in K**
10	Daylight	765	70-79	6500
20	Cool White	640	60-69	4000
23	White	535	50-59	3500
25	Universal White	740	70-79	4000
30	Warm White	530	50-59	3000

Light colours

LUMILUX®
Light colour 865 LUMILUX® Daylight
Light colour 840 LUMILUX® Cool White
Light colour 830 LUMILUX® Warm White
Light colour 827 LUMILUX® INTERNA®
are used in the most economical OSRAM LUMILUX® fluorescent lamps.

LUMILUX® colours combine very good colour rendering and high luminous efficacy in a single lamp.
Major benefits:
- reduced power consumption
- luminous efficacy of up to 104 lm/W
- excellent colour rendering to EN 12464 (R_a 80 to 89).

For LUMILUX® light colours it is best to use electronic control gear as this is the best way to achieve the maximum efficacy. This also applies to LUMILUX® DE LUXE.

LUMILUX® DE LUXE
Colour 954 LUMILUX® DE LUXE Daylight meets the highest demands with regard to colour rendering (5400 K, $R_a > 90$) and is therefore ideal for areas that require the refreshing effect of natural daylight, such as print shops, dental surgeries, dental laboratories, slide presentations and clothing stores.

Colour 940 LUMILUX® DE LUXE Cool White and colour 930 LUMILUX® DE LUXE Warm White meet the highest colour rendering demands ($R_a > 90$).

965 BIOLUX® has a light distribution curve which is similar to that of sunlight. It provides refreshing light in offices, banks and department stores that suffer from a lack of natural daylight. Because of its excellent colour rendering and high colour temperature (6500 K), it is ideal for colour matching (similar to D65).

Universal White
TYPE 740 (formerly TYPE 25)
This colour can be used for all indoor and outdoor lighting and is very similar to colour 640.

Special light colours
The red component of 76 NATURA is closely matched to other colour components. This results in natural colour rendering and makes items such as meat, sausages, delicatessen products, vegetables and flowers appear fresh and natural.

77 FLUORA® has been specially designed for plants and aquariums. Its light has an emphasis at the blue and red ends of the spectrum. It is therefore particularly good at promoting photo-biological processes.

60, 66 and 67 coloured fluorescents in red, green and blue respectively are ideal for creating decorative effects and special moods.

62 Yellow does not emit any UV radiation. This light colour is therefore suitable for clean-room production facilities, chip fabrication and general UV-free lighting.

For spectral power distributions see pages 4.36 and 4.37.

Lamps with the codes SPS or UVS as part of the lamp description still emit a small proportion of UV-A radiation (but no UV-B or UV-C).

See pages 4.36 and 4.37 for spectral power distributions

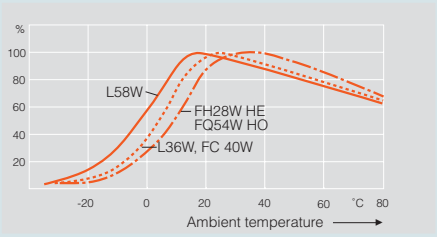
Technical data

Luminous flux and power consumption to DIN IEC 60081.
The minimum luminous flux of an individual lamp is 92% of the rated luminous flux at 25°C; the average is 95% of the rated luminous flux.

Lamp life. The recommended economical service life of 26 mm dia. LUMILUX® fluorescent lamps is 10,000 hours with conventional control gear/low-loss gear and 18,000 hours with warm-start electronic control gear (their actual rated average lives are 13,000 and 20,000 hours respectively). Operating the lamps above or below their rated power will reduce their service life.

Burning position. Universal for 26 and 38 mm diameters. When T5 HE and T5 HO lamps are installed in the vertical burning positions the stamp must be at the bottom. When T5 FC® lamps are installed in the vertical position the 2GX13 base must be at the bottom. If two T5 HE or T5 HO lamps are installed very close together, it is best to ensure that the stamped ends are next to one another.

Temperature characteristics



As with fluorescent lamps in general, the rated luminous flux for lamps with a diameter of 16 mm (T5 HE and TE HO fluorescent lamps) is specified at 25°C, and T5 HE and T5 HO achieve their the maximum luminous flux at temperatures between 34 and 38°C. In other words, one advantage of T5 lamps is their higher luminaire efficiency. T5 FC® circular fluorescent lamps achieve their maximum luminous flux between 25 and 30°C.

Max. luminous flux values for FH® and FQ® T5 (16 mm) fluorescent lamps

Type	max. luminous flux ϕ/lm at 35 °C	Type	max. luminous flux ϕ/lm at 35 °C
FH 14 W/860 HE	1300	FQ 24 W/865 HO	1900
FH 14 W/827, 830, 840 HE	1350	FQ 24 W/827, 830, 840 HO	2000
FH 21 W/865 HE	2000	FQ 39 W/865 HO	3325
FH 21 W/827, 830, 840 HE	2100	FQ 39 W/827, 830, 840 HO	3500
FH 28 W/865 HE	2750	FQ 49 W/827, 830, 840 HO	4900
FH 28 W/827, 830, 840 HE	2900	FQ 54 W/865 HO	4750
FH 35 W/865 HE	3500	FQ 54 W/827, 830, 840 HO	5000
FH 35 W/827, 830, 840 HE	3650	FQ 80 W/865 HO	6650
		FQ 80 W/827, 830, 840 HO	7000

The maximum luminous flux (ϕ max.) of a lamp is calculated from the rated luminous flux ϕ at 25ºC and a factor. ϕ max. = ϕ/F. As with all fluorescent lamps, the luminaire efficiency of T5 (16 mm) lamps is calculated at an ambient temperature of 25ºC. In other words the luminous flux of the lamp measured at 25ºC and the luminous flux of the luminaire measured at 25ºC are used as the basis for calculating the luminaire efficiency. Note that if measurements are taken with goniophotometers with moving lamps the air currents may cause the cool spot to shift from the stamp end of the lamp. Before the lux levels from T5 HE, T5 HO and especially FC® lamps are measured in luminaires, these lamps must be allowed to age for at least 100 hours. If two lamps are to be operated next to one another, make sure that the stamped ends are on the same side so that the cool spot is not heated up. The minimum recommended gap between two T5 lamps is 32 mm (important information for OEM).

Technical data

Control gear. In order to operate, each lamp needs control gear appropriate to its wattage. The control gear not only starts the lamp but also limits the current in the discharge phase. Please note: fluorescent lamps are guaranteed only if operated with approved control gear or with control gear declared to be suitable. Control gear must comply with EN standards. Modern control gear, such as QUICKTRONIC®, enables energy saving fluorescent lamps to be operated with optimum economy and lighting comfort, see Section 9. Control gear for use in the European Union must carry the ENEC mark to indicate that it has been tested to the appropriate EN (IEC) Standards. This safeguards the warranty for the lamps under normal operating conditions.

Circuit diagrams. See pages 4.33 to 4.35 and Section 9.

Supply voltage. Generally 230 V or 240 V AC. Temporary voltage fluctuations between 207 V and 254 V AC are permissible. Electronic control gear is considerably less affected by fluctuations in the supply voltage than conventional control gear. High voltage DC operation for emergency lighting systems in accordance with DIN VDE 0108 is permissible with high frequency electronic control gear.

Accessories. Control gear and lampholders are available from electrical wholesalers and retailers. OSRAM compact fluorescent lamps and fluorescent lamps are cadmium-free.

Technical data

Fluo-rescent lamp	Ø	Rated lamp current (CCG operation)	Lamp voltage UL after ignition (±10%)	Resistance/ Impedance Z (with CCG)	System Wattage with control gear[6] CCG operation	Pre-heat-ing current IEC 81	Luminance cd/cm² Colour 21-840, 31-830, 41-827	Colour 25	PFC capacitor[2] for power factor ≈ 1 with CCG	Series capacitor for CCG lead-lag circuit[3]
(W)	(mm)	(A)	(V)	(Ω)	(W)[7]	(mA)[8]	(cd/cm²)		(µF)	(µF/Vc)
4	16	0.17	29	170	10	220	–	0.85	2.0	–
6	16	0.16	42	260	12	220	–	0.95	2.0	–
8	16	0.145	56	385	14	220	–	0.95	2.0	–
10	26	0.17	64	375	14	220	–	0.50	2.0	–
13	16	0.165	95	590	19	220	–	0.95	2.0	–
15	26	0.33	55	165	25 (19.5[1])	440	1.0	0.75	4.5	–
16	26	0.20	90	450	21	260	0.8	0.60	2.5	–
18	26	0.37	57	155	30 (23[1])	550	1.0	0.75	4.5	2.7/480
18/… U	26	0.37	60	165	32	550	–	–	–	–
20	38	0.37	57	155	32 (26[1])	550	–	0.55	4.5	2.7/480
20/… XL	38	0.38	57	155	32	–	–	0.40	4.5	–
22 C	29	0.37	62	165	34	600	–	0.70	5.0	3.0/480
30	26	0.365	96	265	40	550	1.2	0.90	4.5	2.9/450
32 C	30	0.425	81	190	43	675	0.9	0.75	5.0	3.4/450
36	26	0.43	103	240	46	650	1.2	0.86	4.5	3.4/450
36/… U	26	0.43	108	250	53	650	–	–	–	–
36-1	26	0.556	81	145	46	730	1.3	–	6.0	4.3/480
38[4]	26	0.43	104	240	50	650	–	–	4.5	3.4/450
40	38	0.43	103	240	50 (55[5])	650	–	0.60	4.5	3.4/450
40 C	30	0.415	108	260	53	630	–	–	–	–
40/… SA	38	0.43	103	240	55	650	–	0.60	–	–
40/… DS®	38	0.43	103	240	56	650	0.7	0.60	–	–
40/… XL	38	0.415	103	240	54	–	–	0.45	4.5	–
40/… K	38	0.88	52							
58	26	0.67	110	165	71	1000	1.5	1.11	7.0	5.3/450
58/… U	26	0.67	115	170	80	1000	–	–	–	–
65	38	0.67	110	165	78	1000	–	0.80	7.0	5.3/450
65/… SA	38	0.67	110	165	84	1000	–	0.80	–	–
65/… DS®	38	0.67	110	165	87	1000	0.8	–	–	–
65/… XL	38	0.67	110	165	81	–	–	0.75	–	–

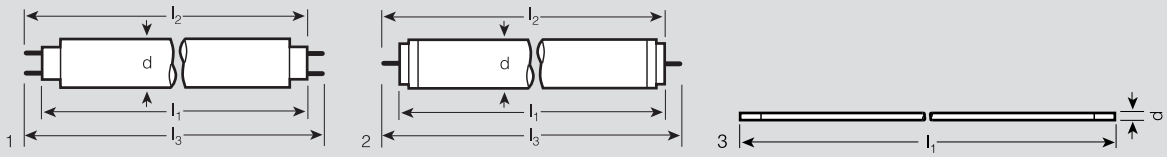
1) Series pair operation of two lamps on 230 Volt AC
2) For PF correction as per diagrams 1 and 2 see page 4.33
3) Lead-lag circuit as per circuit diagram 3 on page 4.33
4) With 40 W control gear
5) Starterless operation
6) Typical system wattage depending on manufacturer and control gear type
7) For system wattage with comparable electronic control gear see Section 9
8) Preheating current values are maximum values for a preheat time of 2 s

Technical data

Fluorescent lamp (W)	Ø (mm)	Rated lamp current (CCG operation) (±10%)[1] (A)	Lamp voltage UL after ignition[1] (V)	System wattage with electronic control gear[2] (W)	Preheating current IEC 81 (mA)	Luminance LF 840 (cd/cm²)
14 (FH HE)	16	0.165	86	16.0[2]	210	1.7
21 (FH HE)	16	0.165	126	23.5[2]	210	1.7
28 (FH HE)	16	0.170	166	30.5[2]	210	1.7
35 (FH HE)	16	0.175	205	38.5[2]	210	1.7
24 (FQ HO)	16	0.295	77	27.0[2]	440	2.5
39 (FQ HO)	16	0.325	118	45.5[2]	440	2.8
49 (FQ HO)	16	0.245	191[4]	49		2.3
54 (FQ HO)	16	0.455	120	61.0[2]	720	2.9
80 (FQ HO)	16	0.530	152	85.0[2]	765	3.2
22 (FC)	16	0.30	70	24.5[2]	440	1.7
40 (FC)	16	0.32	126	46.5[2]	440	2.1
55 (FC)	16	0.55	101	62.0[2]	765	2.6
6 (FM)	7	0.10	54	7.5[2]	120[5]	2.5
8 (FM)	7	0.10	80	10.0[2]	120[5]	2.5
11 (FM)	7	0.10	105	13.0[3]	120[5]	2.5
13 (FM)	7	0.10	132	16.0[3]	120[5]	2.5

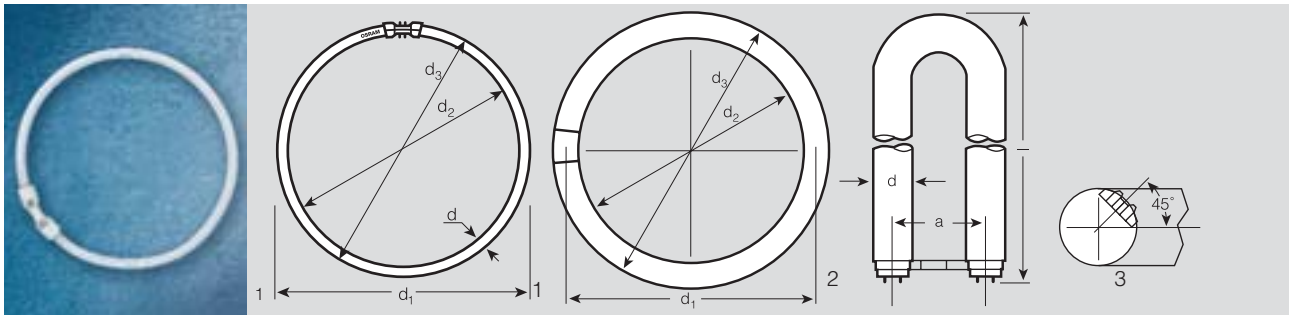
1) Values at 25°C on the reference control gear
2) Provisional values
3) For system wattage with comparable ECG types see Chapter 9
4) Values for 35°C; current is approx. 10 mA lower for 25°C
5) With reservation

Dimensions for tubular fluorescent lamps with tolerances



W		l_1 [mm]	l_2 [mm]	l_3 [mm]	d [mm]	No.
Tubular fluorescent lamps						
7, 16, 26 and 38 mm Ø, G5 base, G13 base, W4.3 x 8.5d base						
6 (FM)	W4.3x8.5d	218.3 ±1.0	–	–	6.6 +0.3	3
8 (FM)	W4.3x8.5d	319.9 ±1.0	–	–	6.6 +0.3	3
11 (FM)	W4.3x8.5d	421.5 ±1.0	–	–	6.6 +0.3	3
13 (FM)	W4.3x8.5d	523.1 ±1.0	–	–	6.6 +0.3	3
4	G5/11x15	135.7	141.7 ±1.2	150.0	15.5 ±0.5	1
6	G5/11x15	211.9	217.9 ±1.2	226.2	15.5 ±0.5	1
8	G5/11x15	288.1	294.1 ±1.2	302.4	15.5 ±0.5	1
13	G5/11x15	516.9	522.8 ±1.2	531.1	15.5 ±0.5	1
14 (FH HE)	G5/11x15	549.0	554.9 ±1.2	563.2	16.0	1
21 (FH HE)	G5/11x15	849.0	854.9 ±1.2	863.2	16.0	1
24 (FQ HO)	G5/11x15	549.0	554.9 ±1.2	563.2	16.0	1
28 (FH HE)	G5/11x15	1149.0	1154.9 ±1.2	1163.2	16.0	1
35 (FH HE)	G5/11x15	1449.0	1454.9 ±1.2	1463.2	16.0	1
39 (FQ HO)	G5/11x15	849.0	854.9 ±1.2	863.2	16.0	1
49 (FQ HO)	G5/11x15	1449.0	1454.9 ±1.2	1463.2	16.0	1
54 (FQ HO)	G5/11x15	1149.0	1154.9 ±1.2	1163.2	16.0	1
80 (FQ HO)	G5/11x15	1449.0	1454.9 ±1.2	1463.2	16.0	1
15	G13	437.4	443.3 ±1.2	451.6	25.0 ±1.5	1
16	G13	720.0	725.9 ±1.2	734.2	25.0 ±1.5	1
18	G13	589.8	595.7 ±1.2	604.0	25.0 ±1.5	1
30	G13	894.6	900.5 ±1.2	908.8	25.0 ±1.5	1
36	G13	1199.4	1205.3 ±1.2	1213.6	25.0 ±1.5	1
36-1	G13	970.0	975.9 ±1.2	984.2	25.0 ±1.5	1
38	G13	1047.0	1052.8 ±1.2	1061.2	25.0 ±1.5	1
58	G13	1500.0	1505.9 ±1.2	1514.2	25.0 ±1.5	1
20	G13	589.8	595.7 ±1.2	604.0	37.0 ±0.5/ –0.8	1
40	G13	1199.4	1205.3 ±1.2	1213.6	37.0 ±0.5/ –0.8	1
40 K	G13	589.8	595.7 ±1.2	604.0	37.0 ±0.5/ –0.8	1
65	G13	1500.0	1505.9 ±1.2	1514.2	37.0 ±0.5/ –0.8	1
80	G13	1500.0	1505.9 ±1.2	1514.2	37.0 ±0.5/ –0.8	1
100	G13	1763.8	1769.7 ±1.2	1778.0	37.0 ±0.5/ –0.8	1
Fluorescent lamps for starterless operation, 38 mm tube diameter X lamps. Fa6 base						
20/… XL	Fa6	574.0	590.8 ±1.2	611.0	37.0 ±2.0	2
40/… XL	Fa6	1183.5	1200.3 ±1.2	1220.5	37.0 ±2.0	2
65/… XL	Fa6	1484	1500.9 ±1.2	1521.1	37.0 ±2.0	2

Dimensions for circular and U-shaped fluorescent lamps with tolerances



Circular T5 FC® fluorescent lamps with 16 mm tube diameter

W		d2 max. [mm]	d3 max. [mm]	TUBE d [mm]	No.
2GX13 base					
22	2GX13	192 ± 5	225 ± 5	16.0	1
40	2GX13	266 ± 6	299 ± 6	16.0	1
55	2GX13	266 ± 6	299 ± 6	16.0	1

Circular fluorescent lamps

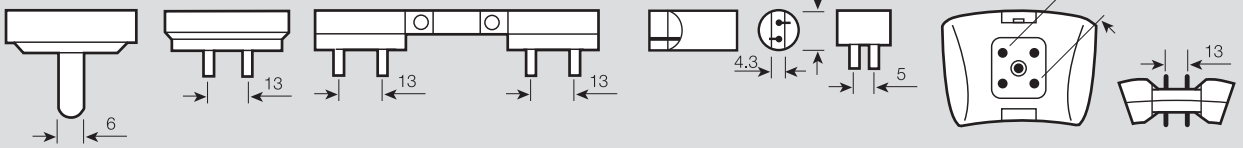
W		d1 max. [mm]	d2 max. [mm]	d3 max. [mm]	TUBE d [mm]	No.
G10q base						
22	G10q	157.2	155.6	215.9	28 ± 2	2
32	G10q	245.3	246.1	307.2	30 ± 1	2
40	G10q	346.9	347.7	408.8	30 ± 1	2
60	G10q	346.9	347.7	408.8	30 ± 1	2

U-shaped fluorescent lamps

W		l [mm]	a [mm]	d [mm]	No.
2G13 base					
18	2G13-92	304 – 10	92.0 ± 2	26 – 1	3
36	2G13-92	601 – 10	92.0 ± 2	26 – 1	3
58	2G13-92	759 – 10	92.0 ± 2	26 – 1	3

Caps
Circuit diagrams for fluorescent lamps

Caps IEC/EN 60061-1



Fa6 Sheet 7004-55 | G13 Sheet 7004-51 | 2G13 Sheet 7004-33 | W4.3 x 8.5d Sheet 7004-115 | G5 Sheet 7004-52 | G10q Sheet 7004-54 | 2GX13 Sheet 7004-125

CIRCUIT DIAGRAMS, SWITCH-START OPERATION

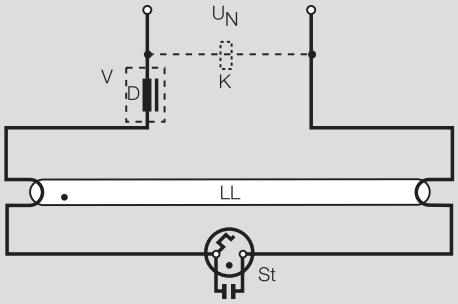


Fig. 1
Single lamp

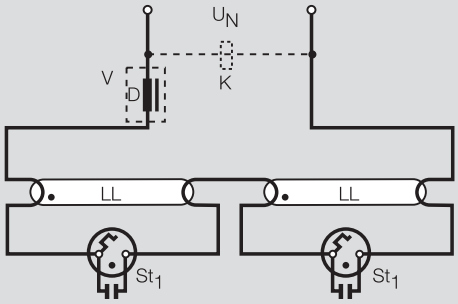


Fig. 2
Series connection for two lamps
4 W, 6 W, 8 W, 15 W, 18 W, 20 W/S
and 22 W on 220 V AC only with starter
ST 151 + ST 172 (see page 4.23 f.)

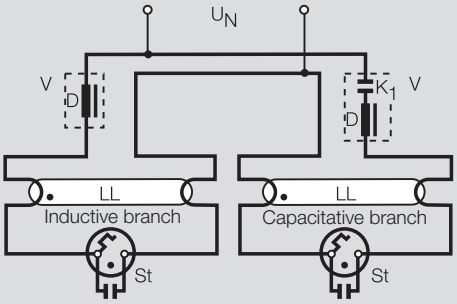


Fig. 3
Lead-lag circuit

STARTERLESS OPERATION

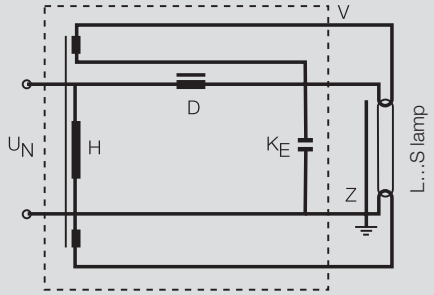


Fig. 4
Quick start circuit, inductive

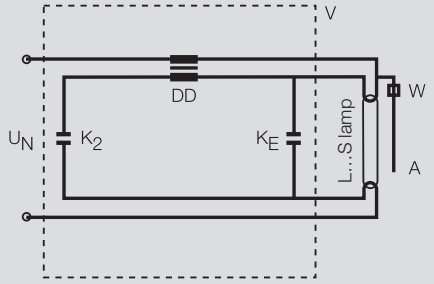
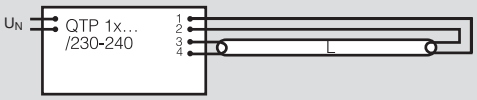


Fig. 5
Semi-resonant circuit

A = external starting strip
D = choke
DD = double choke
H = heating transformer
K = compensation capacitor (if required)
K_1 = series capacitor
K_2 = capacitor
K_E = radio interference capacitor 10 nF
LL = fluorescent lamp
St = starter
St_1 = starter[1)]
U_N = supply voltage
V = control gear
W = high ohmic resistor (built into lamp base)
Z = capacitor starting aid

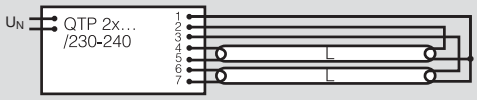
1) Prolonged ignition times, especially at low voltage, can be shortened by rotating one of the starters through 180°

Circuit diagrams for fluorescent lamps for HF operation (see also ECG section)



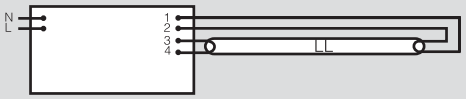
Earthing as per IEC 60598

Fig. 6
QUICKTRONIC® PROFESSIONAL for connecting one LUMILUX® 18W, 36W or 58W fluorescent lamp



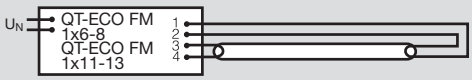
Earthing as per IEC 60598

Fig. 7
QUICKTRONIC® PROFESSIONAL for connecting two LUMILUX® 18W, 36W or 58W fluorescent lamps



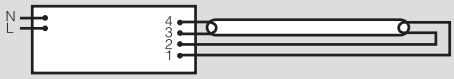
Earthing as per IEC 60598

Fig. 8
QUICKTRONIC® FM for connecting one 6W, 8W, 11W or 13W FM® lamp



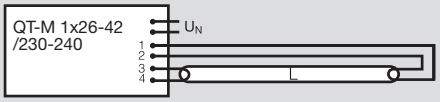
Earthing as per IEC 60598

Fig. 8 a
QUICKTRONIC® QT-ECO FM for connecting one 6W, 8W, 11W or 16W FM® lamp



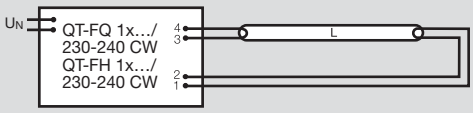
Keep lines 3 and 4 as short as possible

Fig. 9
QUICKTRONIC® for connecting one Ø 16 mm L 6W to L 13W



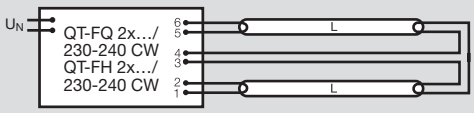
Earthing as per IEC 60598

Fig. 9 a
QUICKTRONIC® QT-M for connecting one LUMILUX 18W or 36W fluorescent lamp



Earthing as per IEC 60598

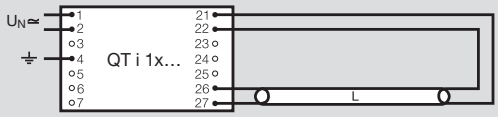
Fig. 10
QUICKTRONIC® FH or FQ for connecting one 14W, 28W or 35W FH® lamp or one 24W, 39W, 54W or 80W FQ® lamp



Earthing as per IEC 60598

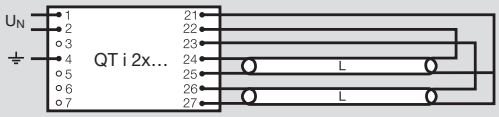
Fig. 11
QUICKTRONIC® FQ for connecting two 24W, 39W, 49W or 54W FQ® lamps

Circuit diagrams for fluorescent lamps for HF operation (see also ECG section)



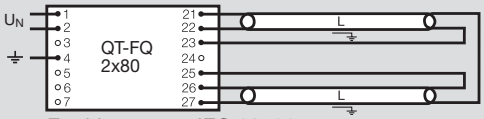
Earthing as per IEC 60598

Fig. 12
QUICKTRONIC® INTELLIGENT for connecting one 14W, 21W, 28W or 35W FH® lamp or one 24W, 39W, 49W, 54W or 80W FQ® lamp



Earthing as per IEC 60598

Fig. 13
QUICKTRONIC® INTELLIGENT for connecting two 14W, 21W, 28W or 35W FH® lamps or two 24W, 39W, 49W or 54W FQ® lamps



Earthing as per IEC 60598

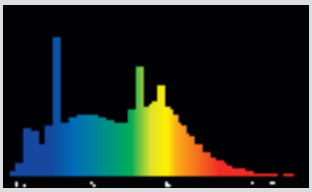
Fig. 14
QUICKTRONIC® for connecting two 80W FQ® lamps

Spectral power distribution of fluorescent lamps

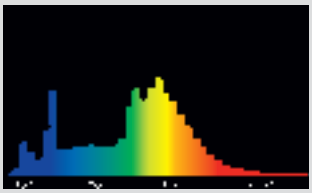
Visible range from 380 to 780 nm

Vertical scale = $\frac{400\ \text{mW}}{1000\ \text{lm} \cdot 10\ \text{nm}}$

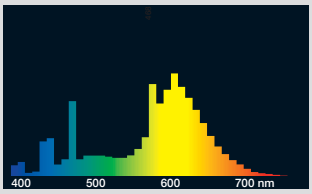
BASIC



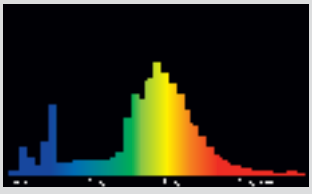
Colour 765 BASIC
Daylight



Colour 640 BASIC
Cool White

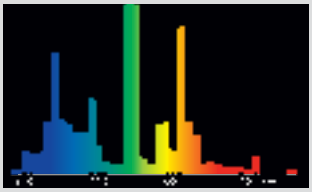


Colour 535 BASIC
Standard White

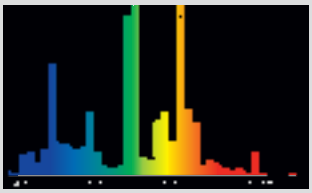


Colour 530 BASIC
Warm White

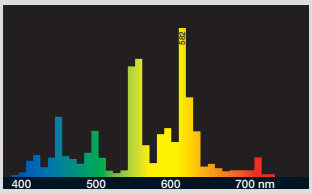
LUMILUX®



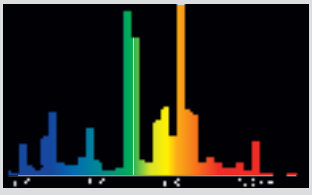
Colour 865 LUMILUX®
Daylight



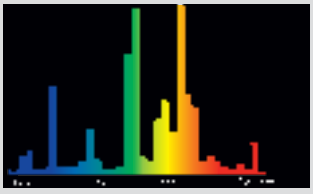
Colour 840 LUMILUX®
Cool White



Colour 835 LUMILUX®
Standard White

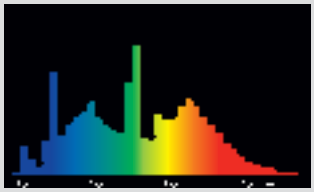


Colour 830 LUMILUX®
Warm White

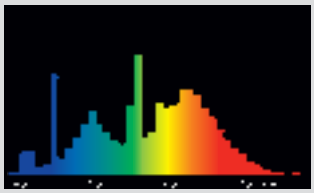


Colour 827 LUMILUX®
INTERNA

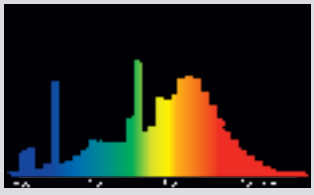
LUMILUX® DE LUXE



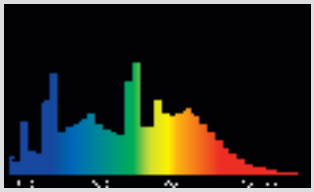
Colour 954
LUMILUX® DE LUXE
Daylight



Colour 940
LUMILUX® DE LUXE
Cool White



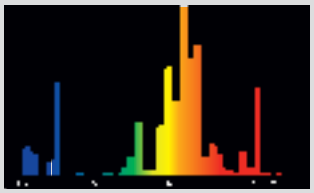
Colour 930
LUMILUX® DE LUXE
Warm White



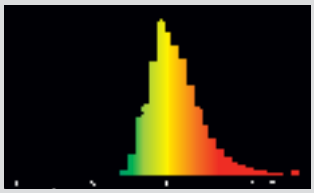
Colour 965 BIOLUX®

Note: These colour graphs does not show the colour distributions in great detail. The colour printing process is not able to provide an accurate match between the colours shown and the colours defined for the individual colour locations.

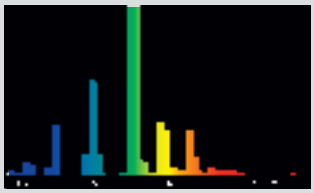
Spectral power distribution of fluorescent lamps



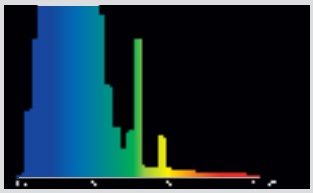
Colour 60
Red



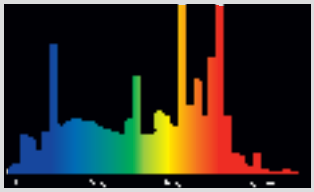
Colour 62
Yellow



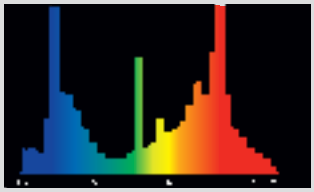
Colour 66
Green



Colour 67
Blue



Colour 76 NATURA



Colour 77 FLUORA®

Note: These colour graphs does not show the colour distributions in great detail. The colour printing process is not able to provide an accurate match between the colours shown and the colours defined for the individual colour locations.