

WOTAN

Indoor and Outdoor Lighting

Incandescent Lamps

Tungsten-halogen
Lamps

Compact Fluorescent
Lamps

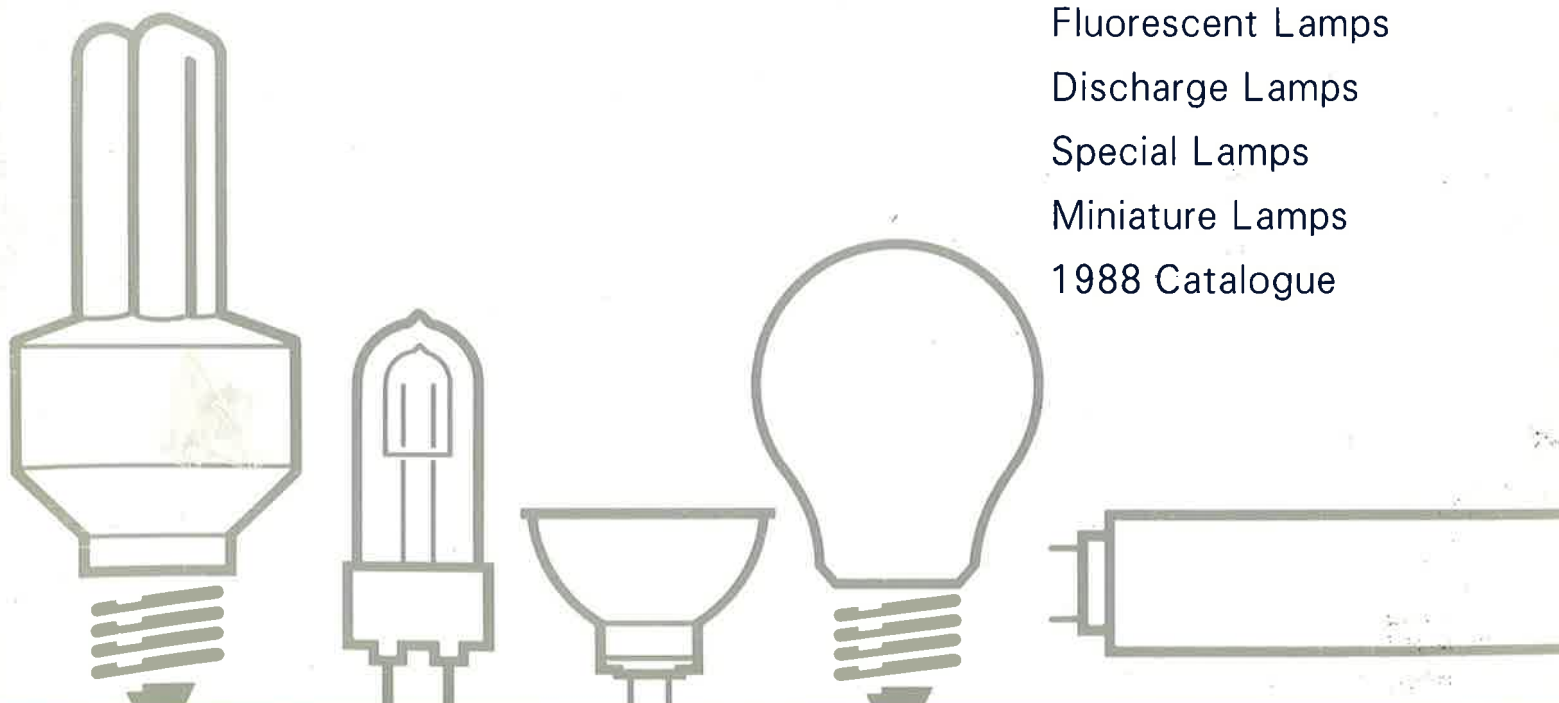
Fluorescent Lamps

Discharge Lamps

Special Lamps

Miniature Lamps

1988 Catalogue



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Decorative Lighting Sets and Luminaires

are shown in our new catalogue "Illuminating Ideas" which is available upon request.

Illuminating ideas are:

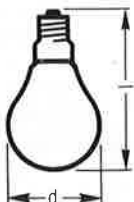
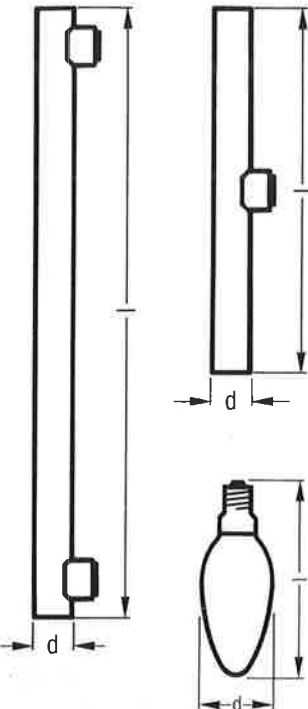
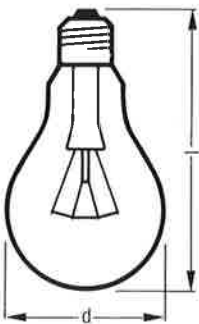
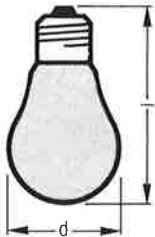
MAXILUX® COMBI
 WOTAN DULUX® COMBI
 WOTAN DULUX® CLIP
 WOTAN DULUX® TABLE
 WOTAN DULUX® CARRE
 WOTAN DULUX® PLAFOND
 LUMINESTRA®
 CIRCOLUX® RONDEL
 CIRCOLUX® Set
 MINISPOT
 MAXISPOT
 HALOTUBE
 MINI STAR
 MAXI STAR
 HALOSPOT
 HALOCENT
 HALOFLOOD
 TRISPOT
 FLORA Set
 FLUORA® COMBI
 GARTENSPOT
 POWER STAR COMBI
 JOGGILUX
 MULTI HALOGEN
 HOBBY HALOGEN
 SIGNAL HALOGEN
 HALOGEN MOBIL SPOT
 HALOGEN SERVICE SPOT
 COPILOT
 AGILETTE
 LINESTRA® Set
 LUNETTA
 THERMATHERM®

1

Incandescent Lamps



General Lighting Service LINESTRA Architectural Candle Round bulb



Lamp reference	Lamp voltage V	Lamp wattage W	Initial luminous flux lm	Diameter (d) mm	Length (l) max. mm	Base	Rated average life h	Luminous efficacy lm/W
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General lighting service

General lighting service lamps can be economically used in households as well as for commercial purposes. The pearl frosted lamps decrease glare and shadows whilst clear lamps emit a bright light.

Pearl or clear, coiled-coil filament

—	240	25 (1)	230	60	105	E 27 or B 22 d	1000	9
		40	430					11
		60	730					12
		75	960					13
		100	1380	14				
		150	2220	65	118			15
		200 (1)	3150	80	160			16

LINESTRA® architectural

These modern architectural lamps when suitably arranged enable an attractive linear illumination (e.g. in built-in cupboards, kitchens or drawing rooms). On account of their soft and flattering light they can be used also singly and can easily be installed over working areas in kitchens.

Silica

1603	240-250	35	220	30	300	S 14 s 2 bases	1000	6		
1604		60	420		500			7		
1104 (1)		120	840		1000					
1613 (1)		35	240		300	S 14 d 1 base				
1614 (1)		60	420		500					

(1) Possibly subject to minimum ordering quantity.

Plain candle

These small attractive lamps radiate a glare-free light and are particularly suitable for decorative lighting e.g. in crystal chandeliers or other decorative ceiling, wall or standard luminaries.

Clear

—	240	25	200	35	100	B 15 d	8
		40	400				10
		60	660				11
		25	200			B 22 d	8
		40	400				10
		60	660				11
		40	400			E 14	10

Silica

—	240	25	180	35	100	B 15 d	7
		40	360				9
		60	600				10
		25	180			B 22 d	7
		40	360				9
		60	600				10
		40	360			E 14	9

Round bulb

Round bulbs are particularly used for decorative lighting. Because of their space saving dimensions they are suitable for a multitude of small luminaries.

Silica

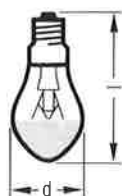
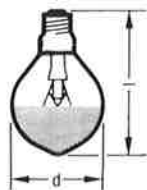
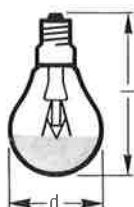
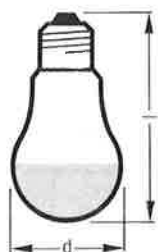
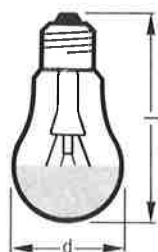
—	240	25	180	45	80	B 15 d	7
		40	360				9
		25	180			B 22 d	7
		40	360				9

1

Incandescent Lamps for Special Applications



CONCENTRA® PAR 38-EC DEKOLUX® Crown Silvered



Lamp reference	Lamp voltage V	Lamp power W	Initial luminous flux lm	Beam angle degrees	Diameter (d) mm	Length (l) max. mm	Mounting depth mm	Base	Rated life h	Luminous efficacy lm/W
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CONCENTRA® PAR 38-EC

An economical alternative lamp which brings 20% energy-cost savings compared to conventional PAR reflector lamps.

This advantage is obtained with the photometrically perfected reflector, the decreased diffusion loss and the new wattage range. The other characteristics of the PAR-lamps, e.g. double life, sturdy and compact construction as well as their weatherproofness remain the same for the CONCENTRA®-EC lamps.

CONCENTRA® "SPOT" sealed beam PAR 38-EC, internal reflector.

SP/EC	240-250	60	600	12°	122	136	123	E 27	2000	10
		80	800							
		120	1200							

CONCENTRA® "FLOOD" sealed beam PAR 38-EC, internal reflector.

FL/EC	240-250	60	600	30°	122	136	123	E 27	2000	10
		80	800							
		120	1200							

DEKOLUX® crown silvered

DEKOLUX® lamps are incandescent lamps with gold or silver crowns meeting the demands for decorative or spot lights in the domestic as well as the commercial sectors, e.g. in modern homes, show windows and sales rooms displays.

GLS bulb

Clear or pearl, silver or gold crown

—	240-250	40 (1)	290	—	60	104	—	E 27	1000	7
		60	500							8
		100	1000			65	123			10

GLS bulb

Pearl, silver crown

—	240-250	60 (1)	500	—	60	104	—	E 27	1000	8
		100 (1)	1000			65	123			10

Round bulb

Clear, silver or gold crown

—	240-250	25 (1)	160	—	45	80	—	E 14	1000	6
		40	280							7

DEKOLUX® S

Round bulb with pointed crown—a new reflector technique offers a better energy utilization

Clear, silver crown

—	240-250	40	320	—	45	78	—	E 14	1000	8
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Small round bulb with pointed crown.

Clear, silver crown

—	240-250	30 (1)	190	—	35	75	—	E 14	1000	6
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(1) Possibly subject to minimum ordering quantity.

CONCENTRA® Blown Glass Bulb



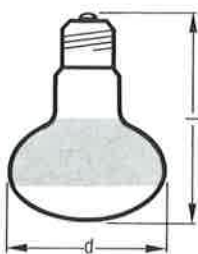
R 39



R 50



R 63



R 80



R 95

Lamp voltage V	Lamp wattage W	Initial luminous flux lm	Beam angle degrees	Diameter (d) mm	Length (l) max. mm	Mounting depth mm	Base	Rated average life	Luminous efficacy lm/W
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CONCENTRA® reflector lamps

Because of their focused light beam these lamps are especially suitable for effective illumination of rooms or large spaces, e.g. show windows, sales rooms, reception halls, arcades etc.

CONCENTRA® R 39

240-250	30 (1)	170	40°	39	66	58	E 14	1000	6
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CONCENTRA® R 50

240-250	25 (1)	180	35°	50	86	70	E 14	1000	7
	40	400							10

CONCENTRA® R 63, "SPOT" or "FLOOD"

240-250	40 (1)	340	35°	63	103	85	E 27	1000	8
	60 (1)	650							11
	40	340	70°						8
	60	650							11

CONCENTRA® R 80

240-250	40 (1)	320	80°	80	114	90	E 27	1000	8
	60	530							9
	75 (1)	730							10
	100	1080							11

CONCENTRA® R 95

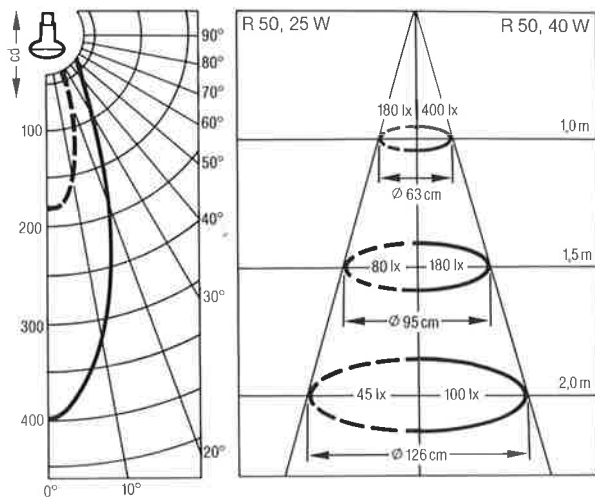
240-250	75	690	35°	95	134	110	E 27	1000	9
	100	1030							10
	150	1520							

(1) Possibly subject to minimum ordering quantity.

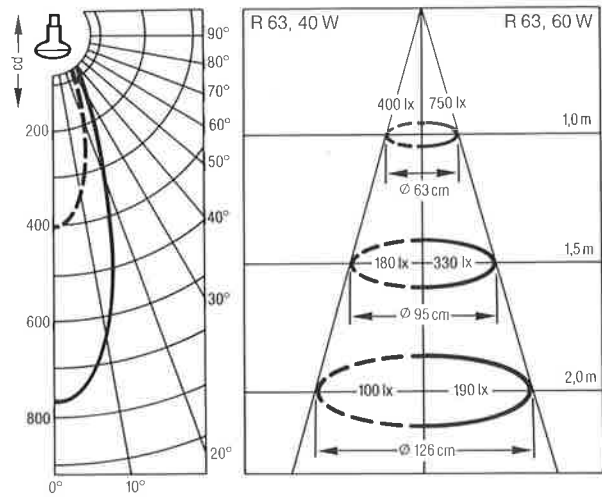
CONCENTRA®

Luminous Intensity in cd

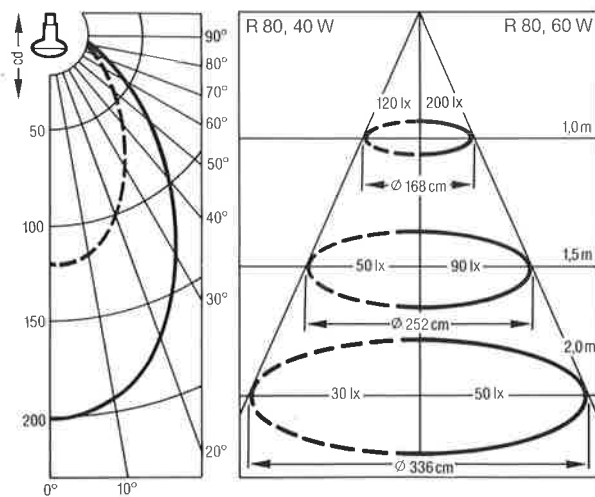
Illuminance in lx



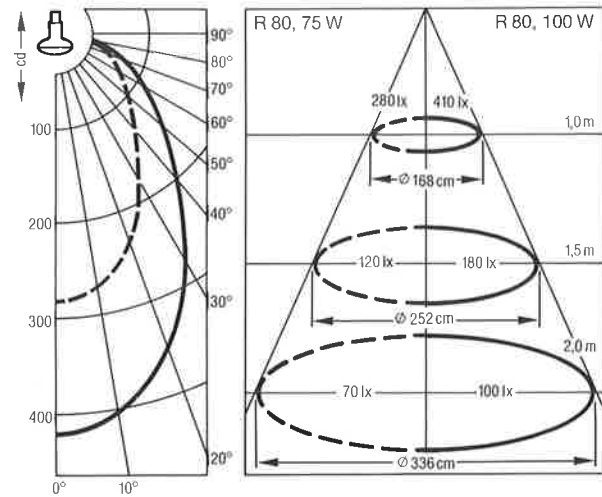
CONCENTRA® R 50, 35°, 25 W and 40 W



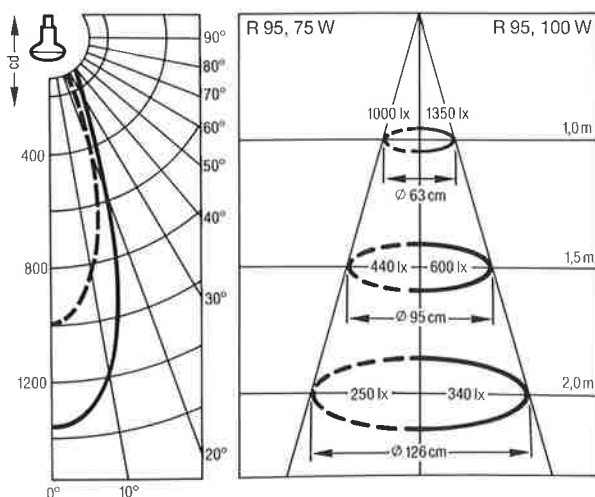
CONCENTRA® R 63, 35°, 40 W and 60 W



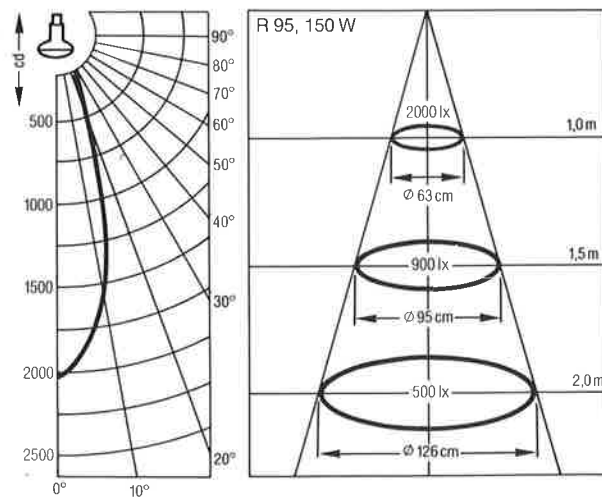
CONCENTRA® R 80, 80°, 40 W and 60 W



CONCENTRA® R 80, 80°, 75 W and 100 W

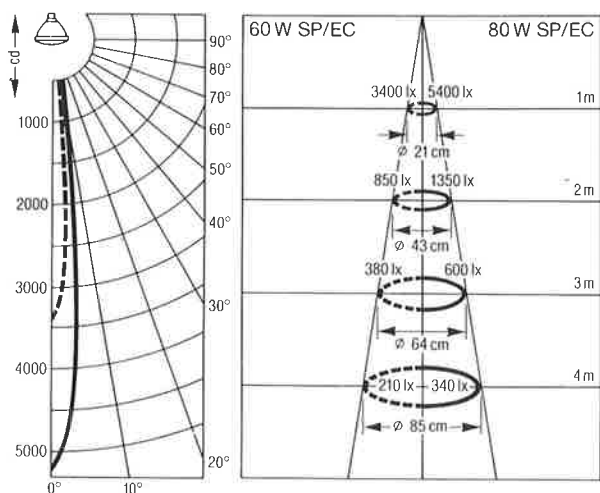


CONCENTRA® R 95, 35°, 75 W and 100 W

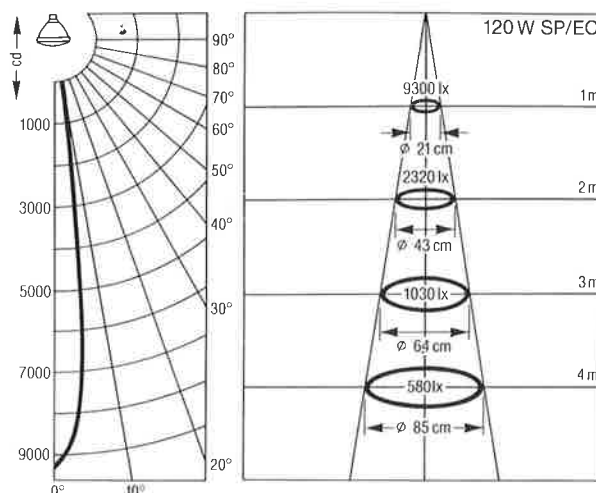


CONCENTRA® R 95, 35°, 150 W

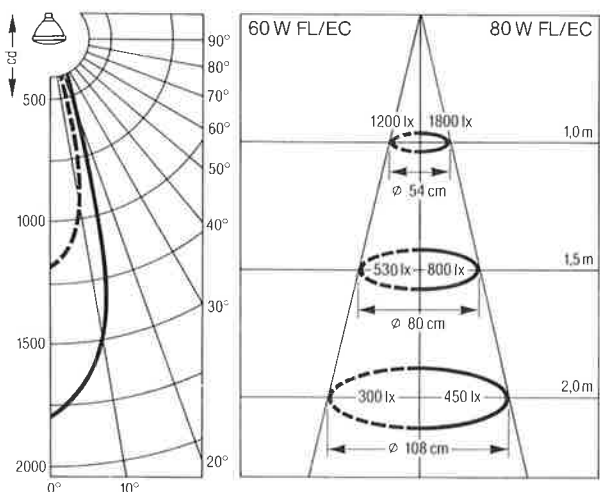
CONCENTRA® Luminous Intensity in cd Illuminance in lx



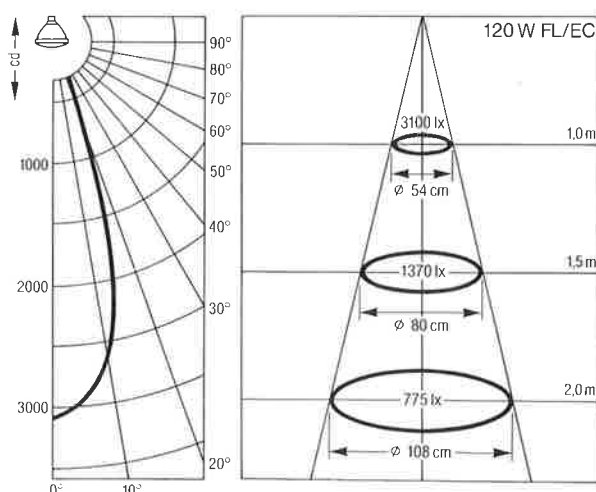
CONCENTRA® PAR 38-EC, 12°, 60 W SP and 80 W SP



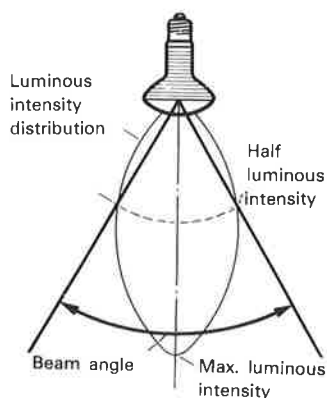
CONCENTRA® PAR 38-EC, 12°, 120 W SP



CONCENTRA® PAR 38-EC, 30°, 60 W FL and 80 W FL



CONCENTRA® PAR 38-EC, 30°, 120 W FL



Illuminance of reflector lamps

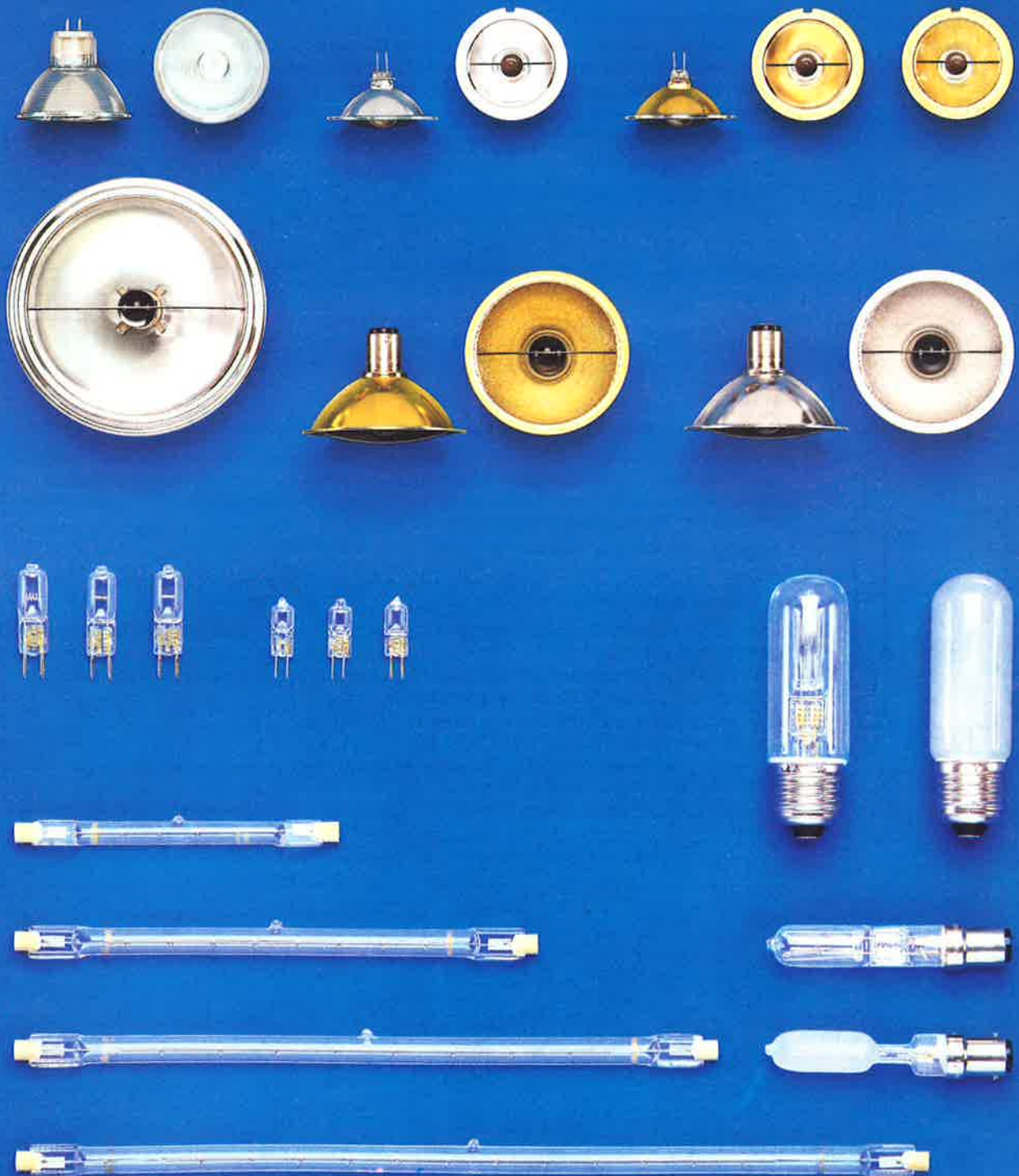
The listed illuminances in lux are maximum values. They decrease to the periphery by half.

Beam angle

The Beam Angle in an axially symmetrical light distribution is the angle through the points where the luminous intensity becomes half of its maximum value.

HALO STAR®
Tungsten-halogen Lamps
high constant luminous flux
2000 h average life
3000 K colour temperature
fully dimmable

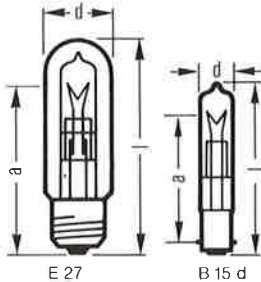
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HALO STAR

Mains Voltage Display

Floodlighting



HALO STAR mains voltage tungsten-halogen display

Modern light sources with long lamp life and yet high luminous efficacy. The filament segments which are almost parallel to the axis provide a 20% higher useful luminous efficacy in the reflector compared with GLS lamps.

Application:

Downlighters, wallwashers, floodlights and pendant lamps as used in lobbies, auditoriums, conference rooms, restaurants, in sales areas and modern living rooms.

Universal burning position. Pinch temperature max. 350°C.

Pearl or clear.

Colour temperature 3000 K.

Lamp reference	LIF designation	Lamp voltage V	Lamp wattage W	Luminous flux clear (1) lm	Diameter (d) max. mm	Length (l) max. mm	LCL (a) mm	Base	Rated average life h	Luminous efficacy clear lm/W
64474 (2)	—	75	1000		31.5	85	55	E 27	1000	13
64476 (2)	(K/16)	100	1400						1500	14
64478 (2)	(K/13)	150	2500		31	105	75		2000	17
64480 (2)		240-250	250	4200				B 22 d		
64473		75	1000		21.4	86	55		1000	13
64475	—	100	1400						1500	14
64477		150	2500		15.5	95	67		2000	17
64479		250	4200							

(1) Luminous flux of pearl lamps approx. 5% lower.

(2) With protective bulb, base edge temperature max. 250°C.

HALO STAR linear tungsten-halogen floodlighting

Bright, brilliant white light, pleasant colour rendering and high luminous flux combined with long lamp life are the advantages of these lamps. Direct use on supply without the need for a ballast is a further quality which make these HALO STAR ideal light sources for floodlighting installations.

Applications:

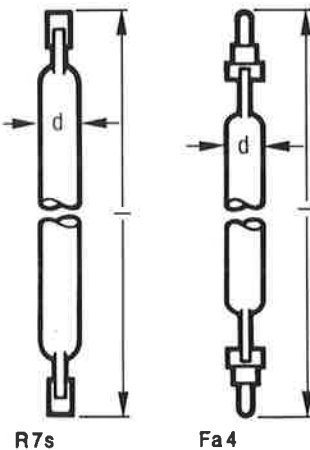
Floodlighting: Only a few lamps suffice to adequately illuminate buildings, monuments or fountains at night.

Sports: Small sports grounds and halls can be easily illuminated at night for training or competition matches.

Traffic installations: In streets, squares, large parking lots, these lamps with their constantly bright light facilitate a fast and safe traffic flow.

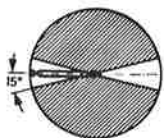
Also suitable for airports, building sites and factories.

Colour temperature 3000 K.



R7s

Fa4



□ permissible
▨ not permissible

Burning position

Lamp reference	LIF reference	Lamp voltage V	Lamp wattage W	Luminous flux lm	Base (2)	Filament length mm	Length l (contact to ceramic) mm	Diameter d mm	Rated avg. life h	Fuse quick acting A	Luminous efficacy lm/W
64690 (1)	K/14	100	1400			26	78.3				14
64695 (1)	K/12	240-250	150	2500						2	17
64698	K/11	200	3200						1500		16
64703		115-120	300	5250						4	18
64701	K/9	240-250	5000			60	117.6			2	17
64700		115-120	500	10500	R7s-15					6.3	21
64702	K/1	240-250	9500					12		4	19
64560	K/3	750	16500							6.3	22
64735	K/4	115-120	1000	23000		125	189.1		2000	10	23
64740			22000							6.3	
64780	K/5	240-250	1500	33000		165	254.1				
64783	K/6		2000	44000	Fa4	215	334 max.			10	22
64784 (1)	K/8				R7s-15	220	331.0				

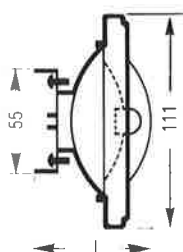
(1) Possibly subject to minimum ordering quantity.

(2) Max. pinch temperature 350°C.

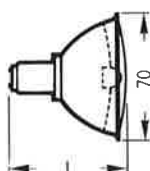
HALO STAR

Low Voltage

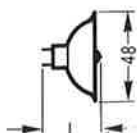
Metal Reflector



HALO STAR AR 111
SUPER SPOT



HALO STAR AR 70
MAXI SPOT



HALO STAR AR 48
MINI SPOT

Lamp reference	LIF reference	Lamp voltage	Lamp wattage	Beam angle degrees	Luminous intensity cd	Luminous flux lm	Base	Length l mm	Rated average life h	Luminous efficacy lm/W
HALO STAR tungsten-halogen low voltage metal reflector										
With their accurately computer-calculated reflectors these HALO STAR are especially suited to display objects of art. These small light sources make possible excellent floodlighting even in bright surroundings.										
HALO STAR with "Gold Reflector" provide decorative appearance and warm light.										
HALO STAR with reflector promote sales because they put the merchandise in the right light. The use of flood or spot lamps depends on the size of the objects and their distance from the light sources.										
SUPER SPOT and MAXI SPOT have an anti-glare grip cap preventing direct glare and permitting easy insertion into narrow luminaires.										
Universal burning position.										
HALO STAR AR 111, aluminium reflector of 111 mm dia.										
SUPER SPOT silver reflector Colour temperature: 3000 K										
41830 SSP		6	35	3	45000	600				17
41835 NSP				5	30000			45		
41835 SP			50	10	20000	950				19
41835 FL				30	2500			50		
41840 SP				10	25000			45		
41840 FL		12	75	30	4000	1500	G 53 (1)	50	2000	20
41840 WFL				60	800			48		
41850 SP				10	45000			45		
41850 FL			100	30	6000	2500		50		25
41850 WFL				60	1200			48		
HALO STAR AR 70, aluminium reflector of 70 mm dia.										
MAXI SPOT silver reflector Colour temperature: 3000 K										
41970 SP			20	10	5000	350				18
41970 FL				30	600					
41990 SP		12	50	10	10000	950	BA15d	50	2000	19
41990 FL				30	1100					
41980 SP				10	15000					20
41980 FL			75	30	3000	1500				
HALO STAR AR 70, aluminium reflector of 70 mm dia.										
MAXI SPOT gold reflector Colour temperature: 2600 K										
41995 SP		12	50	10	9000	950	BA15d	50	2000	19
41995 FL				30	950					
HALO STAR AR 48, aluminium reflector of 48 mm dia.										
MINI SPOT silver reflector Colour temperature: 3000 K										
41960 SP		6		10	1500	120				12
41910 SP (2)			10	10	1500	140				14
41910 FL (2)				15	400					
41900 SP (M/48)		12	20	10	3800	350	G4	31	2000	18
41900 FL				15	1000					
41920 SP (2)				10	6000	600				17
41920 FL (2)			35	15	1700					
41930 SP		24	20	10	3800	350			1000	18
HALO STAR AR 48, aluminium reflector of 48 mm dia.										
MINI SPOT gold reflector Colour temperature: 2600 K										
41905 SP		12	20	10	3100	350	G4	31	2000	18
41905 FL				15	850					

(1) Connection with flat plug 6.3 or screws M4.
(2) Preliminary information.

HALO STAR

Low Voltage

Dichroic Reflector

Display and Traffic Signal

HALO STAR tungsten-halogen dichroic reflector

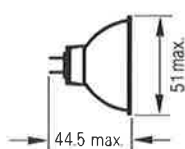
Cool Spot

The heat contained in the beams of these lamps is reduced by 66 %.
This makes these lamps especially suitable for the display of heat-sensitive goods.

HALO STAR KLR 51

Universal burning position
Base GX 5.3

Colour temperature 3000 K
Rated average life 2000 h



HALO STAR
KLR 51

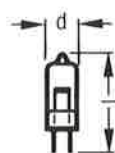
Lamp reference	LIF reference	ANSI reference	Lamp voltage V	Lamp wattage W	Beam angle degree	Maximum luminous intensity cd	Luminous flux lm	Luminous efficacy lm/W
41860 SP	M/68	ESX	12	20	12	3400	350	18
41860 WFL	M/94	BAB			36	600		
41870 SP	M/49	EXT			12	10000		
41870 FL	M/50	EXZ		50	24	3000	950	19
41870 MFL	—	ENL			30	2500		
41870 WFL	M/58	EXN			38	1500		
41880 SP	M/60	EYF		75	14	12500	1350	18
41880 FL	—	EYJ			24	4200		
41880 WFL	M/61	EYC			38	2200		

HALO STAR tungsten-halogen display and traffic signal

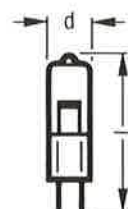
This range distinguishes itself on account of the high luminous efficacy of up to 25 lm/W as well as a sturdy and compact construction. These lamps are, therefore, well suited for very small fittings.

Universal burning position

Colour temperature 3000 K



G4



GY6.35

Lamp reference	LIF reference	Lamp voltage V	Lamp wattage W	Luminous flux lm	Diameter (d) mm	Length (l) max mm	LCL mm	Base	Rated average life h	Luminous efficacy lm/W
64410	M/42	6	10	120	9	31	19.5	G4	2000	12
64405	—	—	5	60						—
64415	—	12	10	140						14
64425	M/47	—	20	350						18
64435 (1)	—	24	—	—	12	44	30	GY6.35	2000	1000
64430	—	6	35	600						2000
64016	M/32	—	50	850						4000
64450	—	12	75	1350						18
64458	M/28	—	100	2500						25
64445 (1)	—	—	50	850						17
64455	—	24	75	1400						19
64460 (1)	M/67	—	100	2200						22
64465	—	—	150	3200						21

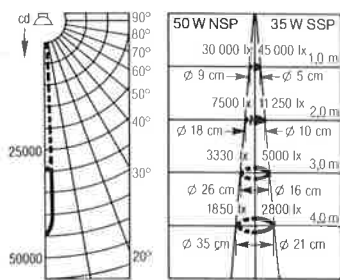
(1) Use quick-acting high breaking capacity fuse in line with lamp on secondary side of transformer: for 64435: 2 A, 64445: 4 A, 64455 and 64460: 6.3 A, 64465: 10 A.

HALO STAR

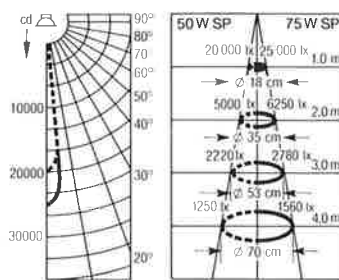
Low Voltage Reflector

Luminous Intensity in cd

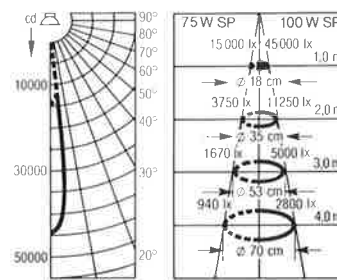
Illuminance in lx



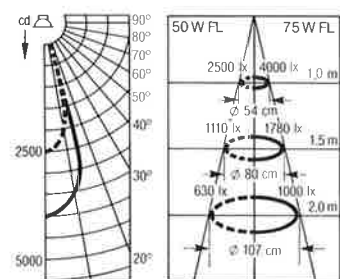
---41835NSP ---41830SSP



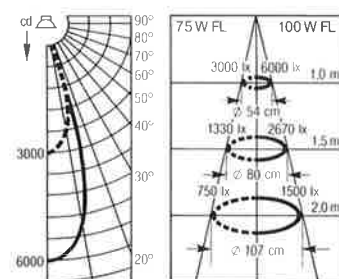
---41835SP ---41840SP



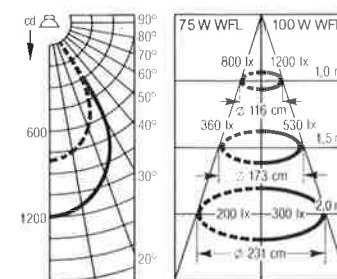
---41880SP ---41850SP



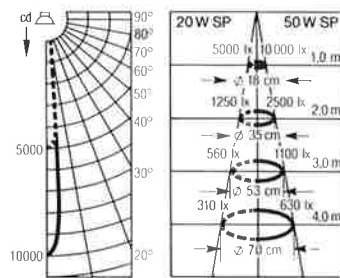
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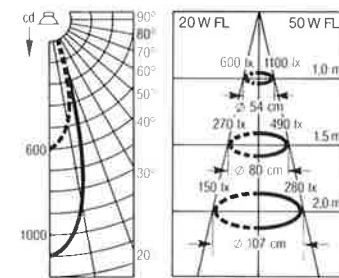
---41980FL ---41850FL



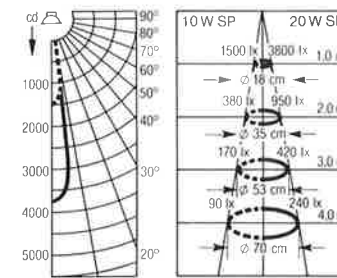
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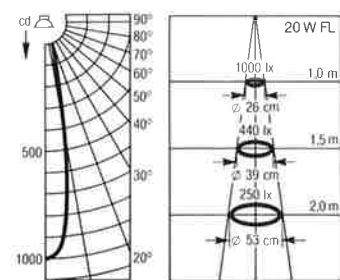
---41970SP ---41990SP



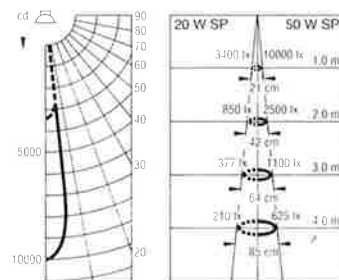
---41970FL ---41990FL



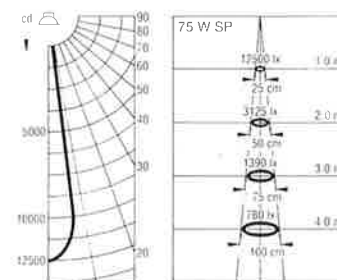
---41960SP ---41900SP/
41930SP



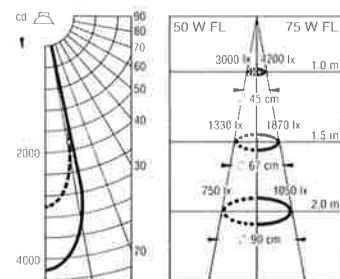
---41900FL



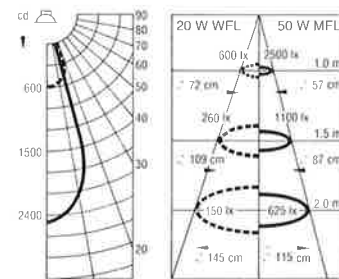
--- 41860 SP ---41870 SP



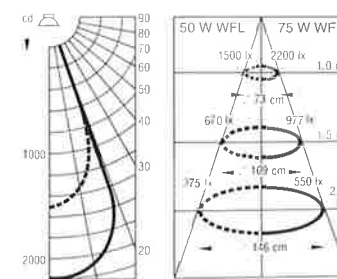
--- 41880 SP



--- 41870 FL --- 41880 FL



--- 41860 WFL --- 41870 MFL



--- 41870 WFL --- 41880 WFL

Voltage characteristics

Supply voltage variations affect the lamp characteristics of all incandescent lamps. The diagrams below show the relationships. Correct matching of lamps and supply voltage is therefore important.

Standards

WOTAN Incandescent Lamps comply with the following International and British Standards, where applicable:

IEC 61	Lamp Caps and Holders
IEC 64	Tungsten Filament Lamps for General Service
IEC 357	Tungsten-halogen Lamps (Non-vehicle)
BS 161	Tungsten Filament Lamps for General Service
BS 555	Tungsten Filament Miscellaneous Electric Lamps
BS 1075	Tungsten-halogen Lamps (Non-vehicle)
BS 5101	Lamp Caps and Holders

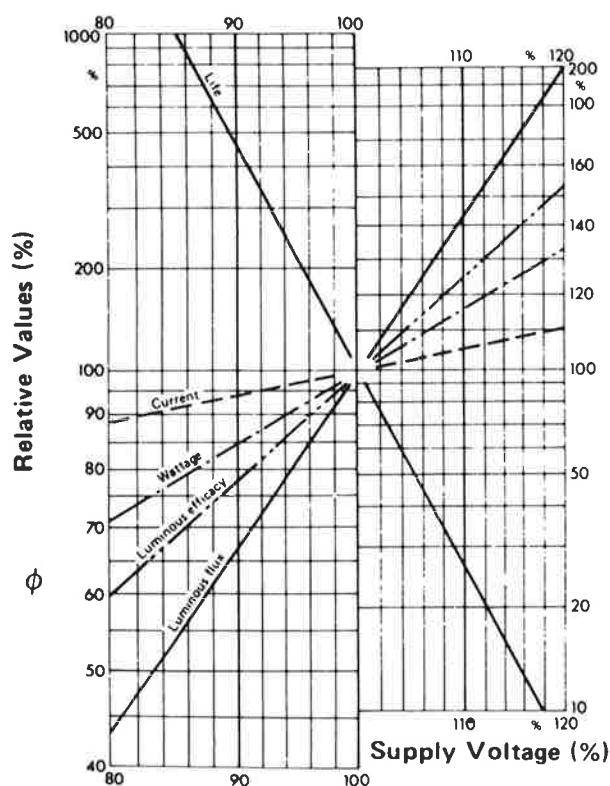
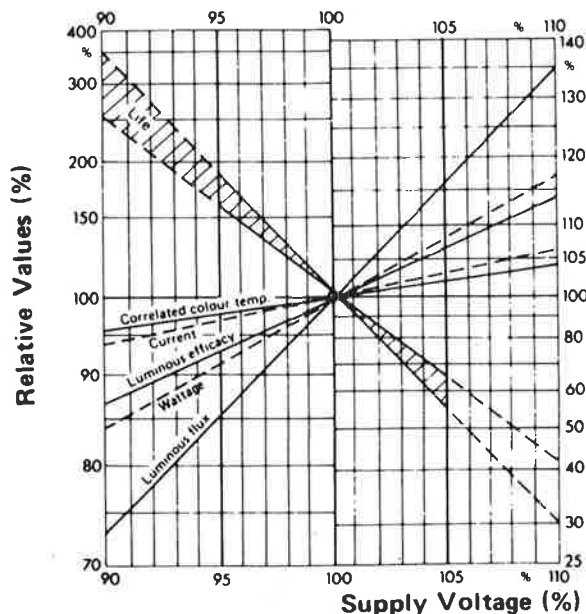
Rule of thumb:

5% overvoltage =

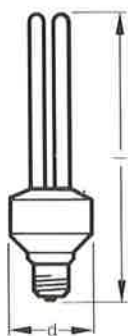
50% shorter life
15% higher luminous flux
8% higher power consumption
3% higher current
2% higher colour temperature

5% undervoltage =

100% longer life
15% lower luminous flux
8% lower power consumption
3% lower current
2% lower colour temperature

Voltage Characteristics Standard Incandescent Lamps**Voltage Characteristics Tungsten-halogen Lamps**





7 W	=	40 W	
11 W	=	60 W	
15 W	=	75 W	
20 W	=	100 W	

WOTAN DULUX® EL—the electronic GLS lamp with base E 27 or B 22d

The new WOTAN DULUX® EL contains an integral fully electronic ballast. It assures a soft instant start and guarantees high lighting comfort. The warm agreeable light is radiated equally all around.

The modern technology of the WOTAN DULUX® EL permits energy savings of up to 80% compared with equally bright GLS lamps.

WOTAN DULUX® EL lamps (7W, 11W) are not much bigger than standard GLS lamps and therefore fit almost any luminaire. Their life is six times as long as that of GLS lamps.

WOTAN DULUX® EL, the compact fluorescent lamp with convincing advantages:

- high luminous efficacy. Soft flickerfree instant start made possible by modern electronics
- up to 80% energy savings compared with conventional incandescent lamps
- six times the life of conventional GLS lamps
- free of radio interference as per EN 55015 = VDE 0875 Pt 2
- GLS base E 27 or B 22d — easily interchangeable
- warm agreeable incandescent light
- excellent colour rendering, outstanding light distribution
- because of its economy ideally suited for permanent lighting
- universal burning position
- low weight
- WOTAN DULUX® EL are suitable for emergency circuits on 240 V DC

Applications

In the household:

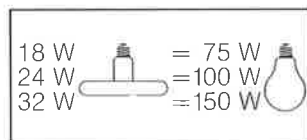
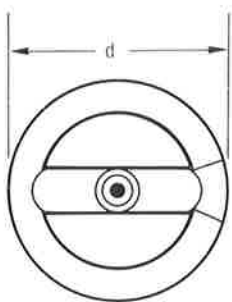
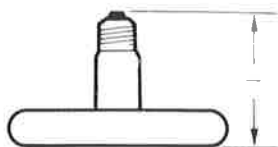
WOTAN DULUX® EL fit almost every domestic luminaire with E 27 or B 22d lampholder, particularly where permanent lighting is required.

In commerce:

In restaurants, hotels, foyers, counter halls, corridors, surgeries and offices, retrofitting with WOTAN DULUX® EL will extend replacement cycles considerably. The energy cost saving compared with GLS lamps is up to 80%

Lamp reference	WOTAN DULUX® EL			
	7	11	15	20
Supply voltage V	240-250			
Supply frequency Hz	50/60			
Circuit wattage W	7	11	15	20
Initial luminous flux lm	400	600	900	1200
Lighting design lumen lm	370	550	830	1100
Luminous efficacy lm/W	57	55	60	
Colour	41 MAXILUX® INTERNA			
Colour temperature K	2700 Warm like incandescent lamps			
CIE colour rendering group	1B, very good			
Length l mm	145		175	207
Diameter d mm	58			
Weight g	115		130	140
Burning position	Universal			
Base	E 27 or B 22d			
Average life h	6000			

- Not suitable for dimming circuits



CIRCOLUX® EL—an energy-saving compact fluorescent lamp with electronic ballast

A new lamp generation by WOTAN: the circular compact CIRCOLUX® EL fluorescent lamp for economical interior illumination.

The power consumption of CIRCOLUX® EL is low. With equal brightness it saves 3/4 of the energy costs. The design of CIRCOLUX® EL is that of a fluorescent lamp and, therefore, guarantees a long lamp life. It will last even longer with fewer switchings. On account of its low power requirement, it pays to keep this lamp burning!

CIRCOLUX® EL—a new type of lamp with convincing qualities:

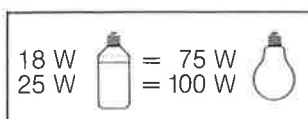
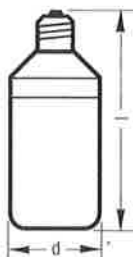
- Low power consumption, high luminous efficacy
- Bright as an incandescent lamp
- Pleasantly warm light
- Excellent colour rendering
- Instant flicker-free electronic start
- Approximately same height as a 75 W incandescent lamp
- 6 times life of GLS lamps
- Low weight

Application:

CIRCOLUX® EL is particularly suitable for places where long burning periods are required, e.g. restaurants, hotel foyers and banking halls. But also at home it offers many possibilities: as decorative illumination over dining and work tables, in floor and wall fittings, with sufficient space it provides good illumination of the lamp shade.

Lamp reference	CIRCOLUX® EL 18	CIRCOLUX® EL 24	CIRCOLUX® EL 32
Supply voltage and frequency	240–250 V 50/60 Hz		
Circuit power W	18	24	32
Initial luminous flux lm	1000	1450	2000
Lighting design lumen lm	920	1330	1850
Circuit efficacy lm/W	55	60	
Colour	41 MAXILUX® INTERNA®		
Colour temperature	2700 K warm like incandescent lamps		
CIE colour rendering group	1B, very good		
Overall diameter d mm	165		216
Lamp length l mm		100	
Burning position	Universal		
Weight g	210		240
Base	E27 or B22d		
Average life h	6000		

- Not suitable for dimming circuits



COMPACTA®—an energy-saving alternative to incandescent lamps for indoor and outdoor use

A range of compact fluorescent lamps with integrated starter and ballast. With their E 27 and B 22d bases COMPACTA® lamps can be interchanged with incandescent lamps.

In indoor and outdoor fittings with long burning cycles COMPACTA® lamps help to achieve considerable operating cost savings.

The most important advantages of COMPACTA® lamps are:

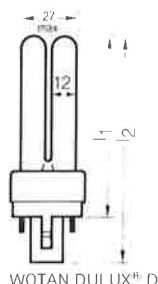
- pleasantly warm light comparable to that of incandescent lamps
- excellent colour rendering
- six times the life of incandescent lamps with the same luminous flux
- bases E 27 and B 22d
- universal burning position
- suitable for indoor and outdoor use

Lamp reference	COMPACTA® PRISMATIC	
	18	25
Supply voltage and frequency	240 V 50 Hz	
Circuit power W	18	25
Initial luminous flux lm	900	1200
Lighting design lumen lm	830	1100
Circuit efficacy lm/W	50	48
Colour appearance	41 MAXILUX® INTERNA®	
Colour temperature	2700 K, warm, like incandescent lamps	
CIE colour rendering group	1B, very good	
Height l mm	171	181
Diameter d mm	73	
Burning position	Universal	
Weight g	560	710
Base	E 27 and B 22d	
Service life h	6000	

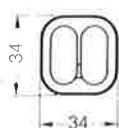
- Not suitable for dimming circuits



WOTAN DULUX® D WOTAN DULUX® S

2



WOTAN DULUX® D



10W		=	60W	
13W		=	75W	
18W		=	100W	
26W		=	2x75W	

WOTAN DULUX® D — the modern, energy-saving fluorescent lamp with the dimensions of a GLS lamp

The single-based WOTAN® D is only slightly longer than a GLS lamp but slimmer by a third. Therefore it is ideal for miniaturized, unconventional luminaires and downlights for shallow recesses and for new lighting systems. The starter is integral in the plug-in base.

- half the length of WOTAN DULUX® S
- as compact as GLS lamps, for space saving luminaires
- power consumption only 20 to 25% of equivalent GLS lamps
- symmetrical luminous intensity distribution as from GLS lamps
- pleasantly warm light with excellent colour rendering
- long relamping cycle due to lamp life of 5000 hours
- single plug-in base G 24 d-1 of 10 and 13 W, G 24 d-2 of 18 W and G 24d-3 of 26 W with integral starter and RF suppression capacitor.

Lamp reference	Lamp wattage W	Colour	Initial luminous flux lm	Lighting design lumen lm	Luminous efficacy lm/W	Length l ₁ max mm	Length l ₂ mm	CIE colour rendering group	CIE colour appearance group
WOTAN DULUX® D 10/21	10	21 MAXILUX® White	600	550	60	95	118	1B	I
WOTAN DULUX® D 10/41		41 MAXILUX® INTERNA							W
WOTAN DULUX® D 13/21	13	21 MAXILUX® White	900	850	69	130	153		I
WOTAN DULUX® D 13/41		41 MAXILUX® INTERNA							W
WOTAN DULUX® D 18/21	18	21 MAXILUX® White	1200	1100	67	150	173		I
WOTAN DULUX® D 18/41		41 MAXILUX® INTERNA							W
WOTAN DULUX® D 26/21	26	21 MAXILUX® White	1800	1650	69	170	193		I
WOTAN DULUX® D 26/41		41 MAXILUX® INTERNA							W

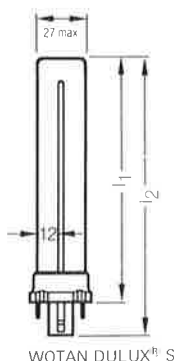
Circuits 1 and 2 see page 28

A four-pin version of the WOTAN DULUX® D for electronic ballasts, dimming, emergency system etc is available. It does not contain an integral starter. Lamp reference WOTAN DULUX® D/E

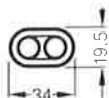
WOTAN DULUX® S — the single based compact fluorescent lamp



The WOTAN DULUX® S is very flat. Its thin tube diameter of 12 mm makes it the ideal lamp for creative luminaire design and modern lighting systems, eg for super flat ceiling and wall luminaires.

- high luminous efficacy and lighting comfort
- low power consumption: 5 W, 7 W, 9 W, 11 W
- as bright as GLS lamps with 25 W, 40 W, 60 W and 75 W
- life five times as long as and power consumption only 20 to 25% of that of incandescent lamps with equal luminous flux
- warm pleasant light, excellent colour rendering
- single plug-in base with integral starter and RF suppression capacitor.
- universal burning position
- small dimensions



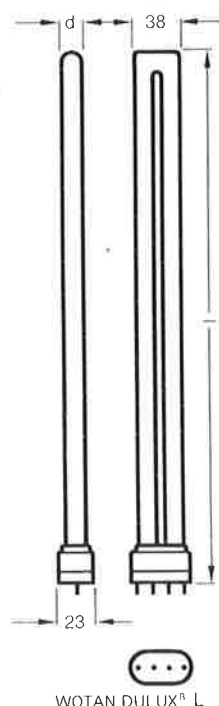
WOTAN DULUX® S



5W		=	25W	
7W		=	40W	
9W		=	60W	
11W		=	75W	

Lamp reference	Lamp wattage W	Colour	Initial luminous flux lm	Lighting design lumen lm	Luminous efficacy lm/W	Length l ₁ max mm	Length l ₂ mm	CIE colour rendering group	CIE colour appearance group
WOTAN DULUX® S 5/21	5	21 MAXILUX® White	250	230	50	85	108	1B	I
WOTAN DULUX® S 5/41		41 MAXILUX® INTERNA							W
WOTAN DULUX® S 7/21	7	21 MAXILUX® White	400	370	57	115	138		I
WOTAN DULUX® S 7/41		41 MAXILUX® INTERNA							W
WOTAN DULUX® S 9/21	9	21 MAXILUX® White	600	550	67	145	168		I
WOTAN DULUX® S 9/41		41 MAXILUX® INTERNA							W
WOTAN DULUX® S 11/21	11	21 MAXILUX® White	900	850	82	215	238		I
WOTAN DULUX® S 11/41		41 MAXILUX® INTERNA							W

Circuits 1 to 3 see page 28

**WOTAN DULUX® L****Compact fluorescent lamps for new short luminaires**

WOTAN DULUX® L are new compact fluorescent lamps of higher wattage ratings with high luminous intensity. With this new lamp range WOTAN offers a new light source with approximately the same luminous flux as conventional fluorescent lamps. WOTAN DULUX® L are available with 18 W, 24 W and 36 W ratings and the tried and tested colour appearances MAXILUX® White, MAXILUX® Warm White and MAXILUX® INTERNA®.

Their excellent colour rendering properties permit their use in the most demanding lighting situations.

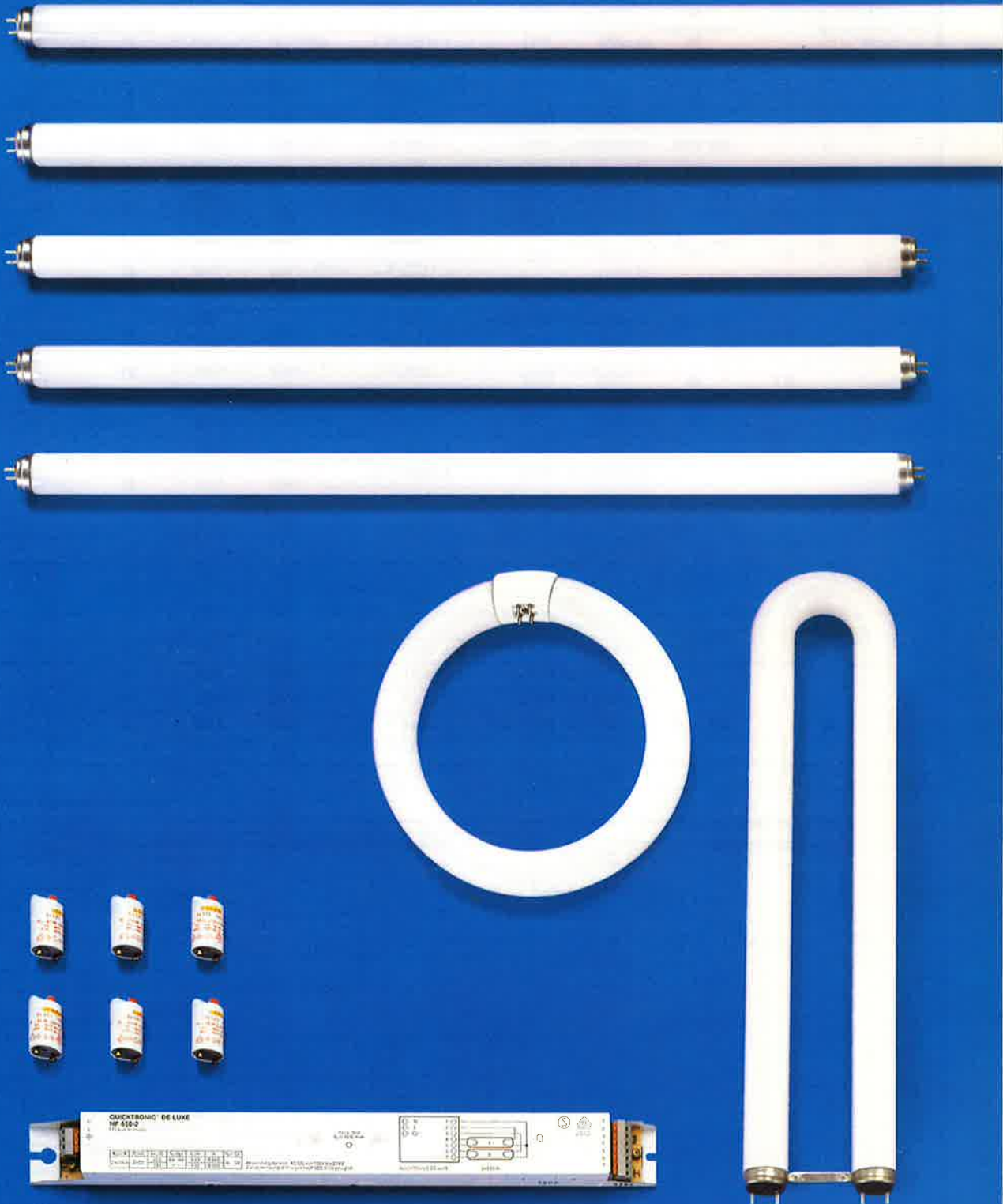
WOTAN DULUX® L—advantages which open up new vistas for designers and lighting consultants:

- powerful and yet compact
- luminous fluxes and power consumption similar to tubular fluorescent lamps but only 1/3 as long—more compact than U-shaped and circular lamps
- excellent colour rendering properties
- can be combined with existing MAXILUX® lighting installations
- suitable for operation with electronic or conventional ballasts
- single 4-pin base 2 G 11
- service life 7500 h

Application

WOTAN DULUX® L open up completely new and interesting dimensions for lighting designers to plan quite unconventionally and economical indoor and outdoor installations. Especially in oblong, square or round ceiling or wall luminaires for foyers, offices, sales and showrooms. Ideally suited also for new short louvre fittings with lengths of 30, 40 or 50 cm, e.g. 2 × WOTAN DULUX® L 36 W (5800 lm) in a 50 cm fitting instead of 1 × L 58 W (5400 lm) in a 160 cm long louvre luminaire.

Lamp reference	Lamp wattage W	Tube dia d mm	Colour	Initial luminous flux lm	Lighting design lumen lm	Luminous efficacy lm/W	Length l mm	CIE colour rendering group	CIE colour appearance group
WOTAN DULUX® L 18W/21	21		MAXILUX® White						I
WOTAN DULUX® L 18W/31	31		MAXILUX® Warm White	1200	1100	67	225		W
WOTAN DULUX® L 18W/41	41		MAXILUX® INTERNA						I
WOTAN DULUX® L 24W/21	21		MAXILUX® White						I
WOTAN DULUX® L 24W/31	31	17.5	MAXILUX® Warm White	1800	1650	75	320	1B	W
WOTAN DULUX® L 24W/41	41		MAXILUX® INTERNA						I
WOTAN DULUX® L 36W/21	21		MAXILUX® White						I
WOTAN DULUX® L 36W/31	31		MAXILUX® Warm White	2900	2650	81	415		W
WOTAN DULUX® L 36W/41	41		MAXILUX® INTERNA						I



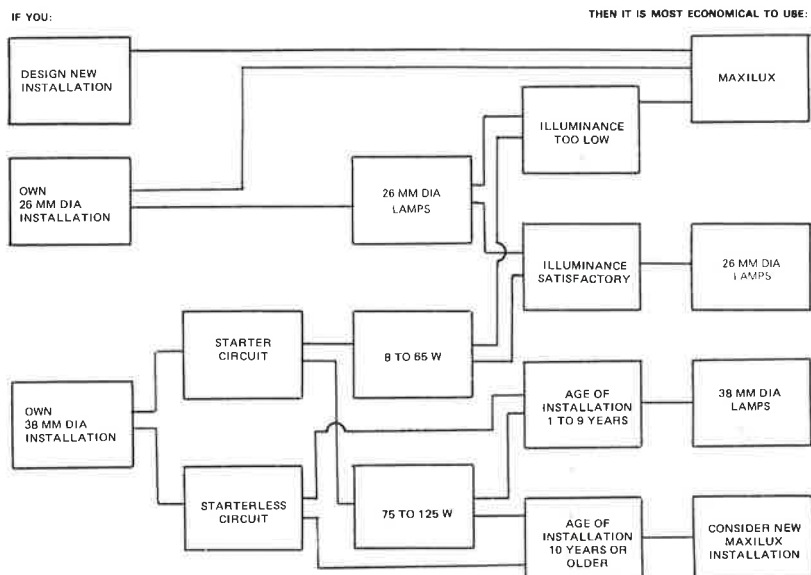
2

Standard Lamps

First choice lamps are printed in bold letters

Lamp wattage	Ballast rating	Nominal dimensions length x diameter mm	Colour	Lamp reference	Luminous flux		Luminous efficacy lm/W	CIE Colour rendering group (1)	CIE Colour appearance group (2)
					Initial lm	Lighting design lm			
4		150 x 16	20 Cool White	L 4/20	140	110	35	2	
			23 White	L 4/23	130	100	32	3	
6		225 x 16	20 Cool White	L 6/20	275	240	48	2	
			23 White	L 6/23	300	250	50	3	
8		300 x 16	41 MAXILUX® INTERNA®	L 8/41	430	400	54	1 B	W
			20 Cool White	L 8/20	400	360	50	2	
			23 White	L 8/23	480	420	60	3	
10		470 x 26	41 MAXILUX® INTERNA®	L 10/41	630	580	63	1 B	W
			41 MAXILUX® INTERNA®	L 13/41	950	875	63	1 B	W
13		525 x 16	20 Cool White	L 13/20	800	700	62	2	
			23 White	L 13/23	850	750	65	3	
15	20	450 x 26	21 MAXILUX® White	L 15/21	1000	920	67	1 B	
			41 MAXILUX® INTERNA®	L 15/41	950	875	63	1 B	W
			23 White	L 15/23	950	800	63	3	
			21 MAXILUX® White	L 16/21	1300	1200	81	1 B	
16	13	720 x 26	41 MAXILUX® INTERNA®	L 16/41	1200	1100	75	1 B	W
			25 Natural	L 16/25	950	800	59		
			11 MAXILUX® Daylight	L 18/11	1300	1200	72		C
			21 MAXILUX® White	L 18/21	1450	1350	81	1 B	
18	20	600 x 26	31 MAXILUX® Warm White	L 18/31					W
			41 MAXILUX® INTERNA®	L 18/41	1300	1200	72		
			20 Cool White	L 18/20	1150	1050	64	2	
			23 White	L 18/23	1200	1100	67		
			30 Warm White	L 18/30				3	W
			20 Cool White	L 20/20	1150	1050	64	2	
20		600 x 38	23 White	L 20/23	1225	1100	61	3	
			11 MAXILUX® Daylight	L 30/11	2300	2100	70		C
30		900 x 26	21 MAXILUX® White	L 30/21	2400	2200	80	1 B	
			41 MAXILUX® INTERNA®	L 30/41	2300	2100	70	1 B	W
			23 White	L 30/23	2400	2150	80	3	

MOST ECONOMICAL TYPE SELECTOR

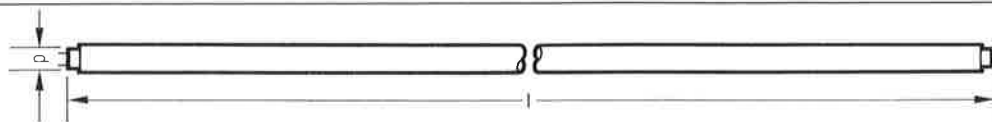


Standard Lamps

2

First choice lamps are printed in bold letters

Lamp wattage	Ballast rating	Nominal dimensions: length x diameter mm	Colour	Lamp reference	Luminous flux		Luminous efficacy lm/W	CIE colour rendering group (1)	CIE colour appearance group (2)
					Initial lm	Lighting design lm			
36	40	970 x 26	21 MAXILUX® White	L 36/21-1	3200	2950	89	1 B	I
			41 MAXILUX® INTERNA	L 36/41-1	3100	2850	86		W
			11 MAXILUX® Daylight	L 36/11	3250	3000	90		C
			21 MAXILUX® White	L 36/21	3450	3200	96		I
		1200 x 26	31 MAXILUX® Warm White	L 36/31	3250	3000	90	2	W
			41 MAXILUX® INTERNA®	L 36/41	3250	3000	90		
			20 Cool White	L 36/20	3000	2750	83		I
			23 White	L 36/23	3050	2800	85		
			30 Warm White	L 36/30	3000	2750	83		W
		1050 x 26	21 MAXILUX® White	L 38/21	3200	2950	84	1 B	I
			31 MAXILUX® Warm White	L 38/31	3200	2950	84		W
40		1200 x 38	20 Cool White	L 40/20	3000	2750	75	2	I
			23 White	L 40/23	3050	2800	76	3	
58	65	1500 x 26	11 MAXILUX® Daylight	L 58/11	5200	4800	90	1 B	C
			21 MAXILUX® White	L 58/21	5400	5000	93		I
			31 MAXILUX® Warm White	L 58/31	5200	4800	90		W
			41 MAXILUX® INTERNA®	L 58/41	5200	4800	90		
			20 Cool White	L 58/20	4800	4400	83		I
			23 White	L 58/23	5000	4500	86		
			30 Warm White	L 58/30	4800	4400	83		W
			20 Cool White	L 65-80/20	5750	5200	72		
			23 White	L 65-80/23	5100	4750	78		
			20 Cool White	L 75-85/20	6250	5800	74		
75-85	85	1800 x 38	23 White	L 75-85/23	6050	5750	81	3	
			20 Cool White	L 100/23	8500	8000	85		
			20 Cool White	L 125/20	9000	8500	72		2
			23 White	L 125/23	9500	8900	76		3
			20 Cool White	L 125/20	9000	8500	72		2
			23 White	L 125/23	9500	8900	76		3



Dimensions L and d are listed on page 31.

MAXILUX and 26 mm diameter lamps must be operated on switch start or QUICKTRONIC (see pages 32–33) circuits.

Some lamps may be subject to minimum ordering quantities.

(1) Colour rendering groups:

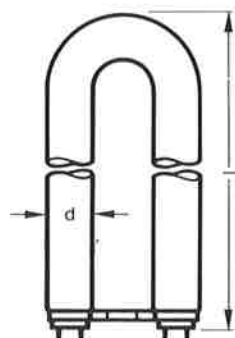
- 1A ($R_a \geq 90$) Wherever accurate colour matching is required, e.g. colour printing inspection
- 1B ($80 \leq R_a < 90$) Wherever accurate colour judgements are necessary and/or good colour rendering is required for reasons of appearance, e.g. shops and other commercial premises
- 2 ($60 \leq R_a < 80$) Wherever moderate colour rendering is required
- 3 ($40 \leq R_a < 60$) Wherever colour rendering is of little significance but marked distortion of colour is unacceptable
- 4 ($20 \leq R_a < 40$) Wherever colour rendering is of no importance at all and marked distortion of colour is acceptable.

(2) Correlated colour temperatures:

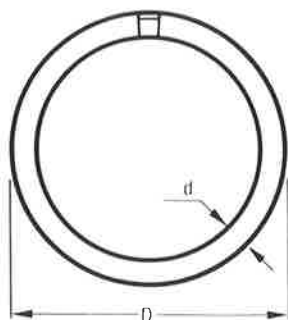
- W (CCT ≤ 3300 K) Warm
- I (3300 K \leq CCT \leq 5300 K) Intermediate
- C (5300 K $<$ CCT) Cold

2

U-Lamps Circular Lamps



U-Lamps



Circular

Lamp wattage	Nom. dimensions		Colour	Lamp reference	Luminous flux			CIE Colour rendering group (1)	CIE Colour appearance group (2)
	Length (l) mm	Diam. (d) mm			Initial lm	Lighting design lm	Luminous efficacy lm/W		
U-lamps (4)									
40	570	38	21 MAXILUX [®] White	L 40/21 UK	3000	2750	75	1 B	I
			25 Natural	L 40/25 UK	2400	2200	60		
65			21 MAXILUX [®] White	L 65/21 UK	4500	4150	69		
			25 Natural Amalgam	L 65/25 UK In	3500	3200	54		
Distance between tube axes = 92 mm									
Circular lamps									
32	300 (3)	33	30 Warm White	L 32/30 C	2000	1800	62	3	W
			30 Warm White	L 40/30 C	2800	2500	70		
40	400 (3)		21 MAXILUX [®] White	L 40/21 C	3000	2750	75	1 B	I
60			30 Warm White	L 60/30 C	3800	3400	63	3	W

(1) Colour rendering groups:

1A ($R_a \geq 90$) Wherever accurate colour matching is required, e.g. colour printing inspection

1B ($80 \leq R_a < 90$) Wherever accurate colour judgements are necessary and/or good colour rendering is required for reasons of appearance, e.g. shops and other commercial premises

2 ($60 \leq R_a < 80$) Wherever moderate colour rendering is required

3 ($40 \leq R_a < 60$) Wherever colour rendering is of little significance but marked distortion of colour is unacceptable

4 ($20 \leq R_a < 40$) Wherever colour rendering is of no importance at all and marked distortion of colour is acceptable.

(2) Correlated colour temperatures:

W (CCT ≤ 3300 K) Warm

I (3300 K \leq CCT \leq 5300 K) Intermediate

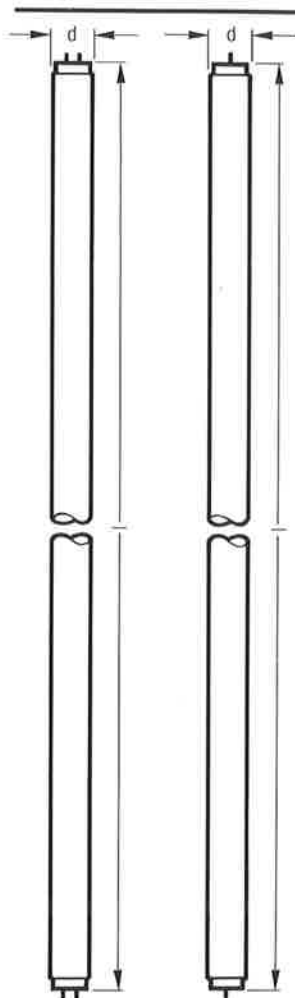
C (5300 K < CCT) Cold

(3) Diameter (D)

(4) See "Selection of Ballasts and Starters", page 34.

Special Types

2



12 DE LUXE Daylight

Applications: Graphic arts, colour matching etc. 5400 K $R_a = 98$

Lamp reference	Lamp wattage W	Nominal dimensions length (l) x diameter (d) mm	Initial luminous flux lm	Lighting design lumen lm	Luminous efficacy lm/W	CIE colour rendering group	CIE colour appearance group
L8/12	8	300 x 16	300	260	38	1A	C
L15/12	15	450 x 26	650	570	43		
L18/12	18	600 x 26	1000	850	56		
L36/12-1	36	970 x 26	2100	1830	60		
L36/12		1200 x 26	2350	2050	65		
L58/12	58	1500 x 26	3750	3250	65		

22 MAXILUX DE LUXE White

Applications: Hospitals, museums etc. 3800 K $R_a = 96$

Lamp reference	Lamp wattage W	Nominal dimensions length (l) x diameter (d) mm	Initial luminous flux lm	Lighting design lumen lm	Luminous efficacy lm/W	CIE colour rendering group	CIE colour appearance group
L18/22	18	600 x 26	1000	850	56	1A	I
L36/22	36	1200 x 26	2350	2050	65		
L58/22	58	1500 x 26	3750	3250	65		

32 MAXILUX DE LUXE Warm White

Applications: Textile industry etc. 3000 K $R_a = 93$

Lamp reference	Lamp wattage W	Nominal dimensions length (l) x diameter (d) mm	Initial luminous flux lm	Lighting design lumen lm	Luminous efficacy lm/W	CIE colour rendering group	CIE colour appearance group
L6/32	6	225 x 16	215	190	36	1A	W
L8/32	8	300 x 16	300	260	38		
L13/32	13	525 x 16	580	590	52		
L15/32	15	450 x 26	650	565	43		
L16/32	16	720 x 26	850	750	53		
L18/32	18	600 x 26	1000	850	56		
L30/32	30	900 x 26	1600	1400	53		
L36/32	36	1200 x 26	2350	2050	65		
L58/32	58	1500 x 26	3750	3250	65		

76 DE LUXE NATURA

Applications: Food display etc. 3700 K $R_a = 80$

Lamp reference	Lamp wattage W	Nominal dimensions length (l) x diameter (d) mm	Initial luminous flux lm	Lighting design lumen lm	Luminous efficacy lm/W	CIE colour rendering group	CIE colour appearance group
L15/76	15	450 x 26	520	450	35	1B	I
L18/76	18	600 x 26	760	700	42		
L30/76	30	900 x 26	1300	1150	43		
L36/76-1	36	970 x 26	1650	1500	46		
L36/76		1200 x 26	1800	1600	50		
L58/76	58	1500 x 26	2880	2600	50		

77 FLUORA

Applications: Plant growth, aquaria etc. Luminous fluxes, colour rendering group and colour appearance group are not significant because of the special application of this lamp type

Lamp reference	Lamp wattage W	Nominal dimensions length (l) x diameter (d) mm	Initial luminous flux lm	Lighting design lumen lm	Luminous efficacy lm/W	CIE colour rendering group	CIE colour appearance group
L15/77	15	450 x 26	250	225	17	3	W
L18/77	18	600 x 26	350	300	19		
L30/77	30	900 x 26	600	550	20		
L36/77	36	1200 x 26	850	750	24		
L58/77	58	1500 x 26	1350	1200	23		

Fluorescent lamps for explosion-proof fittings single pin

Fluorescent lamps with Fa 6 at each end.

Lamp reference	Lamp wattage W	Nominal dimensions length (l) x diameter (d) mm	Initial luminous flux lm	Lighting design lumen lm	Luminous efficacy lm/W	CIE colour rendering group	CIE colour appearance group
L20/20X	20	600 x 38	1000	900	50	1B	I
L20/25X			750	675	38		
L40/20X	40	1200 x 38	2500	2250	62		
L40/25X			1800	1620	45		
L65/20X	65	1500 x 38	4800	4320	74		

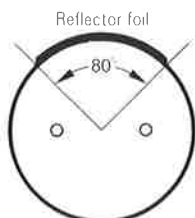
Fluorescent lamps with aluminium reflector foil for dimming circuits

In order to achieve good ignition and control qualities, the reflector foil should be earthed or, if recommended by the manufacturer of the ballast, connected to a special auxiliary ignitor. Rated pre-heat voltage is 6.5 volt for L40/.. DS and L65/.. DS.

MAXILUX

Lamp reference	Lamp wattage W	Nominal dimensions length (l) x diameter (d) mm	Initial luminous flux lm	Lighting design lumen lm	Luminous efficacy lm/W	CIE colour rendering group	CIE colour appearance group
L40/21 DS	40	1200 x 38	3000	2760	75	1B	I
L40/31 DS							W
L65/21 DS	65	1500 x 38	5000	4600	77		I
L65/31 DS							W

At the present some of these lamps are not stock items and subject to minimum ordering quantities.



Switch start operation

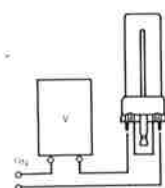


Fig. 1

Single lamp with ballast
WOTAN DULUX[®] D: 10 W, 13 W,
18 W, 26 W
WOTAN DULUX[®] S: 5 W, 7 W,
9 W, 11 W

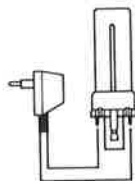


Fig. 2

Single lamp with plug ballast
WOTAN DULUX[®] D: 10 W, 13 W
WOTAN DULUX[®] S: 5 W, 7 W, 9 W,
11 W

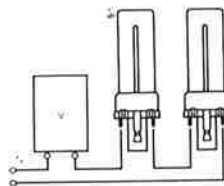


Fig. 3

Series pair with ballast
WOTAN DULUX[®] S: 5 W, 7 W, 9 W

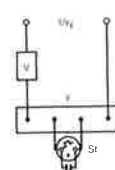


Fig. 4

Single lamp starter St 111 or DEOS[®]
St 171
WOTAN DULUX[®] L: 18 W, 24 W,
36 W

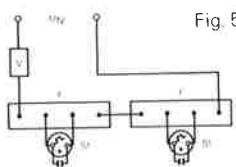


Fig. 5

Series pair on 240 V only with
starter St 151
WOTAN DULUX[®] L: 18 W

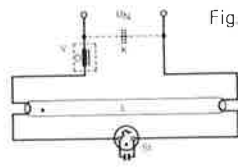


Fig. 6

Single lamp

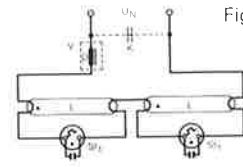


Fig. 7

Series pair for two lamps 4 W, 6 W,
8 W, 15 W, 18 W, 20 W and 22 W on
240 V ~ only with starter St 151

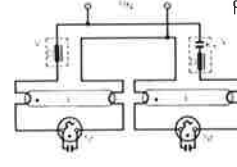


Fig. 8

Lead-lag

D, V = ballast
F = four pin lamp holder
H = cathode heating transformer
K = PFC capacitor (if required)
K₁ = series capacitor
K₂ = capacitor

K_L = RI suppression capacitor 10
nF
L = lamp
NL = neutral, phase
St = starter

St₁ = starter (excessive ignition
times especially at low
voltage can be shortened by
rotating one of the two
starters 180°)

U_N = supply voltage
Z = starting aid

Electronic HF operation

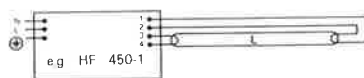


Fig. 9
QUICKTRONIC DE LUXE for use
with one MAXILUX[®] lamp

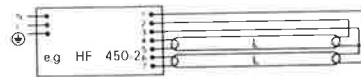


Fig. 10
QUICKTRONIC DE LUXE for use
with two MAXILUX[®] lamps

Starterless operation

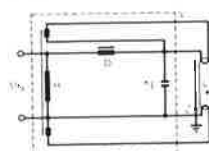


Fig. 11
Quickstart

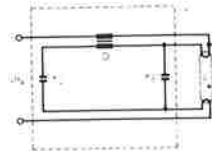


Fig. 12
Semi-resonant

WOTAN's parent company introduced the world's first fluorescent lamp to the public at the Paris World Fair in 1936.

Lamp circuits

The table, "Selection of Ballasts and Starters", on page 34, shows the ballasts and starter types for the various fluorescent lamps. Other types must not be used.

The ballast must be wired to the phase.

Energy conservation

With escalating energy costs it becomes more and more important to save energy. This can be achieved by using starter circuits, they absorb the least power. Starterless semi-resonant circuits absorb about 5% and quickstart circuits about 10% more energy. If the convenience of a starterless circuit is required, DEOS[®] St 171 Electronic Instant Safety Starters can be used in the majority of cases.

Colour designation

Various colour designations are available, see page 30, and "Spectral Power Distribution", page 74.

Luminance

Similar to stearin candles, e.g. L 58 W/21 = 15 kcd/m².

Luminous flux

Depends on colour designation, see pages 18 to 26. Up to 8 times higher than that of a tungsten filament lamp of the same input power. Lumen Maintenance see page 29.

Burning position

Universal

Generation of heat

10% of that of a standard incandescent lamp of the same luminous flux.

Temperature characteristics

Maximum luminous flux at an ambient of about 20°C. The luminous flux of standard fluorescent lamps decreases at higher and lower temperatures.

Switch-start circuits are better than quickstart in temperatures below 5°C. If starterless operation is specified SRS circuits should be used. WOTAN DEOS® St 171 starters operate from 18–30 W: +5 to +80°C, 32–65 W: –20 to +80°C. They assure fast starting times and prevent premature failure of cathodes at low temperatures.

For external ambients below –5°C the running-up time can be shortened by enclosing both ends of the lamp. For ambients down to –10°C the whole lamp should be enclosed. For ambients below –10°C a double sleeve will enable the tube to run up to about normal efficiency in the minimum of time.

Lamp life

Lamp life depends very much on how often the lamp is switched on and off, as is the case with all discharge lamps. Rated lives are listed on page 31 for a switching cycle of 3 hours. The Mortality curve for this switching cycle is shown in the margin. Approximate lamp lives at other switching cycles compared with rated life are about:

Switching cycle	Approx. lamp life
Continuous operation	Above 150%
24 h	150%
8 h	125%
3 h	100%
1 h	65%
45 min	45%
5 min	20%

Vibrations and resistance to shock

Similar to rough service incandescent lamps.

Voltage characteristics

Lamp life and luminous flux of fluorescent lamps depend less on the supply voltage than those of incandescent.

Ballast

In general fluorescent lamps are operated on 240 V with a ballast. Because the supply voltage influences the lamp operation and life considerably, a voltage tolerance of max. ±10% must be maintained. Select correct ballast for each wattage and supply voltage according to table "Selection of Ballasts and Starters", page 34. Some lamps can also be operated in series pair operation on 240 V or one lamp on 120 V.

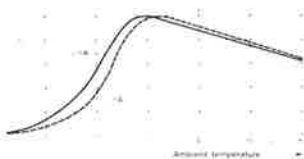
Power factor

Fluorescent lamps without capacitors have a power factor of about 0.5. An improved power factor of up to about 1 can be obtained when using a power factor correction capacitor, see "Technical Lamp Data", page 31. Group power factor correction is also possible. In lead-lag circuits the power factor remains practically 1 without correction.

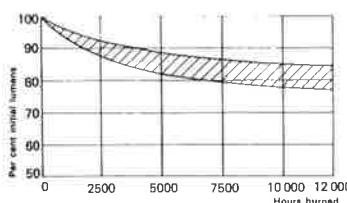
Starter

To ignite a fluorescent lamp a starter is required, unless a starterless circuit is used, see "Selection of Ballasts and Starter", page 34.

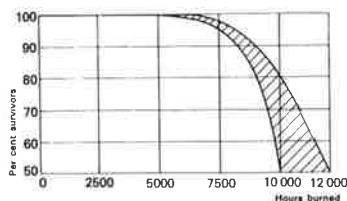
Interdependence of luminous flux and ambient luminaire temperature of free burning L 36 W/.. and L 58 W/..



Lumen Maintenance L 18 to 65 W 26 and 38mm dia.



Mortality L 18 to 65 W 26 and 38mm dia.



Lumen Maintenance and Mortality curves are shown for a 3 hour switching cycle.

Colour rendering and colour appearance

CIE Colour Rendering Groups				
CIE Colour Appearance Groups	1 (Very Good)		2 (Good)	3 (Acceptable)
	1A ($R_a = 90$ to 100)	1B ($R_a = 80$ to 89)	($R_a = 60$ to 79)	($R_a = 40$ to 59)
Cold Above 5300 K	12 MAXILUX DL Daylight $T_n = 5400$ K $R_a = 98$ $\eta = 65$ lm/W (colour matching)	11 MAXILUX Daylight $T_n = 6300$ K $R_a = 85$ $\eta = 90$ lm/W	—	—
		21 MAXILUX White $T_n = 4000$ K $R_a = 85$ $\eta = 96$ lm/W		
Intermediate 3300 to 5300 K	22 MAXILUX DL White $T_n = 3800$ K $R_a = 96$ $\eta = 65$ lm/W (museums, hospitals)	25 Natural $T_n = 4000$ K $R_a = 85$ $\eta = 69$ lm/W	20 Cool White $T_n = 4000$ K $R_a = 67$ $\eta = 83$ lm/W	23 White $T_n = 3500$ K $R_a = 58$ $\eta = 85$ lm/W
		76 DL NATURA $T_n = 3700$ K $R_a = 80$ $\eta = 50$ lm/W (food display)		
Warm Below 3300 K	32 MAXILUX DL Warm White $T_n = 3000$ K $R_a = 93$ $\eta = 65$ lm/W (textiles)	31 MAXILUX Warm White $T_n = 3000$ K $R_a = 85$ $\eta = 96$ lm/W	—	30 Warm White $T_n = 3000$ K $R_a = 54$ $\eta = 83$ lm/W
		41 MAXILUX INTERNA $T_n = 2700$ K $R_a = 85$ $\eta = 90$ lm/W (similar to incandescent)		77 FLUORA $\eta = 24$ lm/W (aquaria)

Luminous efficacy based on 36 W

Some colours may be subject to minimum ordering quantities

Cathode shields

Cathode shields are included in high loading lamps. These shields trap evaporation from the cathodes during life, preventing black deposits at the lamp ends. Cathode shields also reduce flicker.

All L 65–80, L 75–85 and L 125 standard and all wattages of MAXILUX®, 26 mm diameter, U- and circular lamps contain cathode shields.

Flicker

Extremely low flicker, max. 0.2%.

Stroboscopic effects

If stroboscopic effects from rotating parts are expected to cause problems use lead-lag switch start circuit, see "Lamp Circuits", page 28.

Standards

WOTAN Fluorescent Lamps comply with the following International and British Standards, where applicable:

IEC 61	Lamp Caps and Holders
IEC 81	Fluorescent Lamps
BS 1853	Tubular Fluorescent Lamps for General Lighting Service
BS 5101	Lamp Caps and Holders

Technical Lamp Data

2

Lamp reference	Max. length base face to base face (l) mm	Max. lamp dia. (d) mm	Lamp voltage V	Lamp current A	Max. preheat voltage (starterless operation) V	Base	Approx. PFC capacitor (4) μF	Approx. circuit power input		Rated life (3) h		
								Switch start W	Starterless W			
WOTAN DULUX S 5	82 (5)	27 × 12	40	0.180	—	G 23	2	10	—	5000		
WOTAN DULUX S 7	112 (5)		45	0.175				11				
WOTAN DULUX S 9	144 (5)		60	0.170				13				
WOTAN DULUX S 11	213 (5)		90	0.155				15				
WOTAN DULUX D 10	95 (5)	34 × 34	67	0.190	—	G24d-1	3.2	—	—	5000		
WOTAN DULUX D 13	130 (5)		100	0.165				17				
WOTAN DULUX D 18	150 (5)		105	0.220				24				
WOTAN DULUX D 26	170 (5)		110	0.315				34				
WOTAN DULUX L 18	220 (5)	38 × 18	60	0.365	6.5	2G 11	4.5	30	(6)	7500		
WOTAN DULUX L 24	315 (5)		91	0.340			3.6	35				
WOTAN DULUX L 36	410 (5)		110	0.425			4.5	46				
L 4	136	16	29	0.17	—	G 5	2	10	—	5000		
L 6	212		42	0.16				12				
L 8	288		57	0.145				14				
L 10	470		68	0.17				G 13			19	
L 13	517	16	95	0.165	6.5	G 5	4	—	—	5000		
L 15	438	26	53	0.33				25			30	
L 16	720		95	0.20				2.5			21	—
L 18	590		56	0.37				30			—	
L 20	—	38	57	—	6.5	—	—	32	30	7500		
L 30	895	26	96	0.365				40	42			
L 36	1200		104	—				46	—			
L 38	1047		108	0.43				50	—			
L 40	1200	38	103	—	6.5	—	—	55	5000			
L 40K	590		47	0.88				11		58		
L 58	—		—	—				71		—		
L 65–80	—		110	0.67				5.5		—		
at 65 W	1500	38	—	—	6.5	G 13	—	78	85	7500		
at 80 W	—		99	0.87				8	93		—	
L 70	—		128	0.7				80	—			
L 75–85	—		—	—				—	—			
at 75 W	1764	38	130	0.67	6.5	—	—	5	87	7500		
at 85 W	—		120	0.80				6	96		103	
L 100/79	—		107	1.0				10	125		—	
L 100/23	—		125	0.96				7.2	117		—	
L 125	2375	38	148	0.94	6.5	—	—	138	154	5000		
L 20 U	310		57	0.37				4.5	25		—	
L 40 UK	—		103	0.43				49	55		—	
L 65 UK	570		90	0.84				10	85		—	
L 65 UKIn	—	32 (2)	—	—	—	G 10q	—	9	—	5000		
L 32 C	311 (1)		81	0.45				5			43	—
L 40 C	—		103	0.43				4.5			49	—
L 60 C	413 (1)		91	0.75				5			71	—

(1) Outside diameter (D), page 26

(2) Tube diameter (d), page 26

(3) Switching cycle 3 hours, see "Lamp Life", page 29

(4) For single lamps or series pair switch start as shown on page 28, $\cos \phi = 0.9$ at 50 Hz

(5) Base plate to top

(6) Depending on circuit

Dimensions d, D and l are illustrated on pages 24 and 26.

Electronic High-frequency Ballast QUICKTRONIC® DE LUXE

QUICKTRONIC® DE LUXE

increases the luminous efficacy of MAXILUX® fluorescent lamps

WOTAN high-frequency ballasts QUICKTRONIC® DE LUXE are advanced electronic systems for economical operation of fluorescent lamps.

Ballast losses are 62% lower than those of conventional ballasts.

The power consumption eg of a MAXILUX® L 58 W is reduced to only 50 W, and of a MAXILUX® 36 W or WOTAN DULUX® L 36 W to only 32 W.

While the lamp wattage is reduced by 14 % the luminous flux drops only 4 %. At the same time the small loss of the electronic HF ballast improves the circuit efficacy significantly.

Example L 58 W MAXILUX®

Ballast type		Conventional switchstart	Electronic HF
Ballast frequency	Hz	50	30,000
Lamp wattage	W	58	50
Luminous efficacy	lm/W	93	104
Circuit wattage	W	71	55
Circuit efficacy	lm/W	76	94

Increase in circuit efficacy

18 lm/W = 24 %

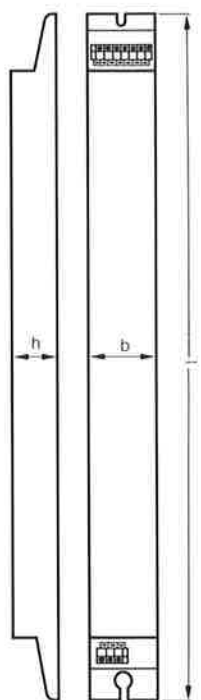
The essential tasks of an electronic HF ballast are:

- maintaining the lamp current with the lowest possible ballast loss
- igniting the lamp without flicker and instantly (<0.1 s)
- cutting off the ballast automatically after lamp failure
- PF correction of the lighting installation
- ensuring its operation also in DC emergency installations
- better lumen maintenance than with conventional ballasts

Electronic HF ballasts replace conventional ballasts, starters, PFC and RF suppression capacitors, their holders and wiring. They save space and make installation easier.

Electronic High-frequency Ballasts QUICKTRONIC® DE LUXE

2



QUICKTRONIC® DE LUXE

QUICKTRONIC® DE LUXE

is a fully electronic high frequency ballast for fluorescent lamps.

Additional advantages for the user are:

- lightweight one-part ballast due to fully electronic filter
- small dimensions
- wide voltage range: 198 to 255 V~/=
- automatic control for constant illuminance
- in emergency installations luminous flux is maintained when switching over to DC as per VDE 0108 (IEC equivalent in preparation)
- flickerfree operation without stroboscopic effect
- no interference and absolute silence. Suitable for use in medicine, EDP, sound recording etc.
- no hum because of fully electronic design
- great convenience by automatic restart after lamp replacement

QUICKTRONIC® DE LUXE for two MAXILUX® fluorescent lamps:

Ballast reference	HF 462-2	HF 450-2	HF 434-2	HF 432-2	HF 416-2
for MAXILUX® ¹⁾	2 × L 70	2 × L 58	2 × L 38	2 × L 36 ¹⁾	2 × L 18
Supply voltage V	220-240				
Ballast frequency kHz	30				
Supply frequency Hz	0/50...60				
Lamp wattage W	62	50	34	32	16
Length l mm	423				
Width b mm	42				
Height h mm	28				
Weight g	480				

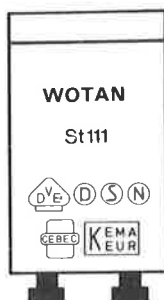
QUICKTRONIC® DE LUXE for one MAXILUX® fluorescent lamp:

Ballast reference	HF 462-1	HF 450-1	HF 434-1	HF 432-1	HF 416-1
for MAXILUX® ¹⁾	1 × L 70	1 × L 58	1 × L 38	1 × L 36 ¹⁾	1 × L 18
Supply voltage V	220-240				
Ballast frequency kHz	30				
Supply frequency Hz	0/50...60				
Lamp wattage W	62	50	34	32	16
Length l mm	357				
Width b mm	29.5				
Height h mm	28				
Weight g	340				

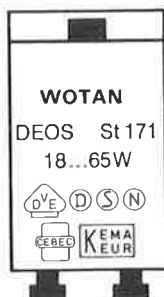
¹⁾ Also for WOTAN DULUX® L 36 W.

Circuit diagrams on p. 28.

Selection of Ballasts and Starters



Starter
St 111
St 151
St 196



DEOS® Starter
St 171

Lamp reference	Ballast	Starter operation		Starterless operation	
		Starter		QUICKTRONIC electronic HF	Conventional ballast
		One lamp at 240 V	Two lamps in series at 240 V or one lamp at 120 V		
WOTAN DULUX S 5			built-in		
WOTAN DULUX S 7			built-in		
WOTAN DULUX S 9	5/7/9/11 W SS	built-in			
WOTAN DULUX S 11					
WOTAN DULUX D 10	13 W SS				
WOTAN DULUX D 13		built-in (2)			
WOTAN DULUX D 18	W DULUX 18 SS				
WOTAN DULUX D 26					
WOTAN DULUX L 18	20 W SS		St 151	HF 516 (1)	
WOTAN DULUX L 24		St 171, St 111		HF 522 (1)	
WOTAN DULUX L 36	40 W SS			HF 532 (1), HF 432	
4			St 151		
6	4/6/8/W SS				
8					
10	10 W SS	St 111			
13	13 W SS				
15	20 W SS		St 151		
16	13 W SS				
18				HF 416	
20	20 W SS		St 151		20 W QS
20 /...U					
30	30 W SS				30 W QS
32		St 171, St 111			
36				HF 432	
38	40 W SS			HF 438	
40					40 W QS + SRS
40 /79 K one lamp	2 x 20 W SS parallel				
two lamps series pair	80 W SS		St 151		
40 /...UK	40 W SS				40 W SRS
40 /...C					
58		St 171, St 111		HF 450	
60	65 W SS				
65-80 at 65 W					65 W SRS
at 80 W	80 W SS	St 196			
65 /...UKIn	65 W/UK SS	St 111			
70				HF 462	
75-85 at 75 W	75 W SS				75 W SRS
at 85 W	85 W SS	St 196			85 W SRS
100	100 W SS				
125 /...	125 W SS				125 W QS

(1) In preparation QS = Quickstart SRS = Semi-resonant start
(2) Four pin version WOTAN DULUX D/E for use without integral starter available

Ballasts

Ballasts are available from electrical wholesalers and should correspond with IEC Publ. 82 and BS 2818.

Starters

St 111
St 151
DEOS® St 171
St 196

Most WOTAN starters are approved by
British Standards
Cebec (Belgium)
Demko (Denmark)
Kema (Netherlands)

Nemko (Norway)
Semko (Sweden) or
VDE (Germany)

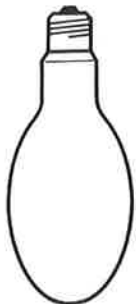
For details contact WOTAN Lamps Limited.

Standards

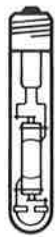
WOTAN fluorescent starters comply with the following international and British standards, where applicable:
IEC 82 Ballasts for tubular fluorescent lamps BS 2818 Ballasts for tubular fluorescent lamps
IEC 155 Starters for tubular fluorescent lamps BS 3772 Starters for fluorescent lamps
BS 5717 Transistorized ballasts for tubular fluorescent lamps
IEC 458 Transistorized ballasts for tubular fluorescent lamps

POWER STAR HQI Metal Halide Lamps Benefits and Operation

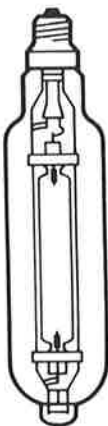
3



HQI-E



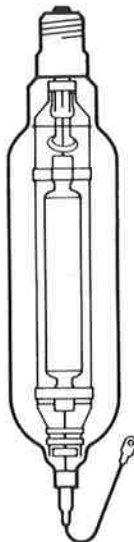
HQI-T
250-400



HQI-T
1000-3500



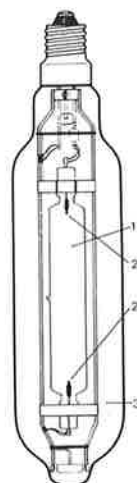
HQI-TS
250-400



HQI-TS
2000-3500



HQI-R



WOTAN POWER STAR are an important improvement on mercury lamps. Rare earth metals are added to the discharge gas resulting in:

Optimum economy and low operating cost, the lamps give more lumen per watt.

WOTAN uses rare earths additives (HQI/D, HQI/NDL and HQI/WDL) for installations where accurate colour rendering is required, and sodium iodides (HQI/N) for industrial and floodlighting installations where high light output is considered more important than accurate colour rendering. One of the four types is always suitable where low-cost, high-quality lighting is required.

Large range of types and wattages available:

HQI-E

In coated elliptical bulbs for uniform surface luminance.

HQI-T

In clear tubular bulbs for luminaires with a precise light distribution

HQI-TS

In double based clear tubular bulbs for floodlights.

This type is also suitable for instant restart of the hot lamp when used with a high voltage ignitor.

HQI-R

Reflector lamps.

The dimensions correspond with those of WOTAN HQL mercury and NAV-E VIALOX® high pressure sodium lamps of the same wattage. Existing luminaires can be used for all three lamp types thus increasing flexibility and reducing stock keeping. Some are also electrically interchangeable with NAV lamps (ballast and ignitor controlling both lamp types available).

Over a century ago Sheffield United Football Club asked WOTAN's parent company to build the World's first electrical football floodlighting installation. 20000 awed spectators watched the first match at Bramall Lane on 14th October 1878. Today WOTAN are still leading and illuminate such installations as the stadia for the Olympic Games, the Football World Cup and over 80 important stadia in the UK. But today we use WOTAN POWER STAR.

Metal halide lamps do not contain starting electrodes, because the halide additives require a high ignition voltage. An external ignitor is required (except HQI-T 2000). Immediately after switching the lamps on, a discharge starts between the electrodes in the argon starting gas. The temperature in the discharge tube rises to a few hundred degrees and the pressure increases to several atmospheres. The mercury and metal halide vapours become active. Now the proper discharge starts and forms a continuous radiation in all wavelengths of the visible spectrum.

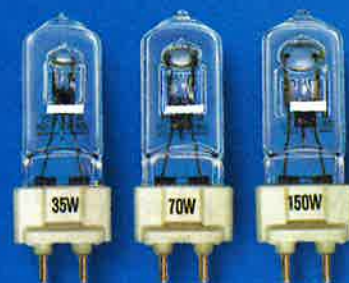
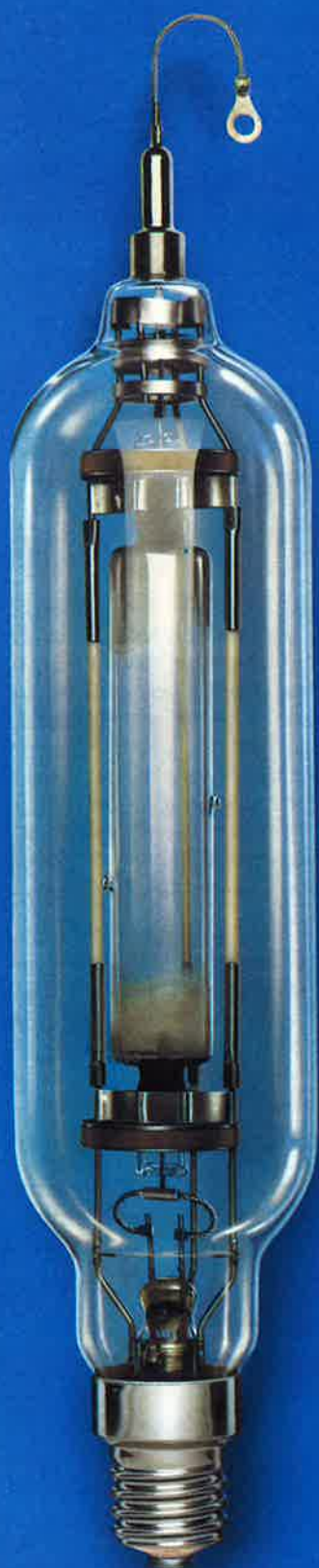
Luminous efficacy varies between 67 and 95 lumen per watt, depending on wattage. WOTAN uses rare earths iodides for all POWER STAR HQI/D, NDL and WDL lamps. Rare earths iodides make it possible to attain a much more uniform spectral power distribution with a much better colour quality and colour rendering than sodium iodide (HQI/N).

WOTAN HQI POWER STAR Metal Halide Lamps consist of:

1. Discharge tube, normally made of quartz, filled with argon starting and mercury discharge gases with several special metal halide additives.
2. Main electrodes, made of tungsten, at each end of the discharge tube contain emissive material.
3. Bulb, either coated elliptical, clear tubular, or reflectorized. A double-based version in a clear quartz tube is also available for instant restart of the hot lamp. The phosphor coating does not serve the same purpose as that of mercury lamps. It is mainly a diffuser ensuring equal brightness over the whole bulb surface.

3

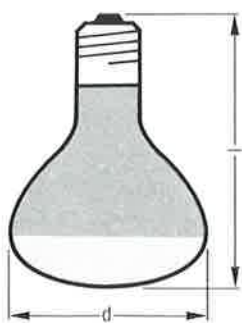
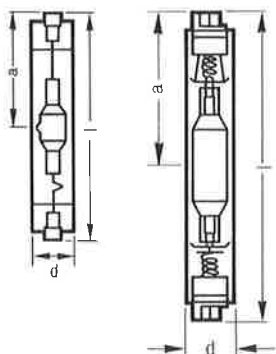
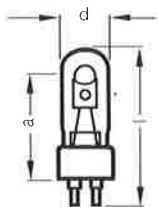
High Intensity Discharge Lamps





3

POWER STAR HQI Metal Halide Lamps Lamp Types



Lamp reference	Lamp wattage W	Luminous flux		Dimensions			Base	Luminous efficacy lm/W	CIE Colour rendering group (4)	CIE Colour appearance group (5)
		Initial lm	Lighting design lm	Dia. (d) mm	Max. length (l) mm	Light centre length (a) mm				

POWER STAR HQI

POWER STAR metal halide lamps excel with their high luminous efficacy and excellent colour rendering qualities. They are available in the colour appearances DE LUXE Cold, DE LUXE Intermediate, Intermediate and DE LUXE Warm.

Applications:

In interior lighting, such as factories, stores, show windows, foyers, hotels, restaurants, exhibition halls, offices, schools, sports halls and for plant growth.

In outdoor lighting, such as floodlighting, representative streets, parks and lighting of buildings and monuments.

Compact POWER STAR® HQI-T® and HQI-TS (MBI)

WOTAN POWER STAR® HQI®-T 35 W to 250 W are the smallest metal halide lamps in the world. Their long life, high lumen package and low heat radiation make them ideal for indoor lighting, stores, exhibitions where higher light quality is demanded, but also for exacting light architecture in foyers, lobbies and malls.

The colours WDL (DE LUXE Warm) and NDL (DE LUXE Intermediate) are suitable for use with HALO STAR tungsten-halogen.

Clear tubular bulb.

Ignitor required.

HQI-T 35/WDL	39	2400	2000					62		
HQI-T 70/WDL	75	5200	4250	25	84	56	G12	69	1B	W
HQI-T 150/WDL	150	12000	9850					80		

TS double-based clear tubular bulb. Hot HQI-TS lamps can be instantly restarted when using a special high voltage ignitor.

Ignitor required.

HQI-TS 70/NDL	75	5500	4700	20	114.2 (6)	57		73		I
HQI-TS 70/WDL		5000	4250				R7s	67	1B	W
HQI-TS 150/NDL	150	11250	9600	23	132 (6)	60		75		
HQI-TS 250/NDL	250	20000	17000	25	163	81	Fc2	80		

POWER STAR HQI-R (MBI-R)

Reflector bulb.

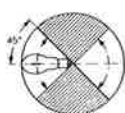
Ignitor required.

HQI-R 250/NDL	250	13500 (1)	11500 (1)	125	180	—	E40	54	1A	I
---------------	-----	-----------	-----------	-----	-----	---	-----	----	----	---

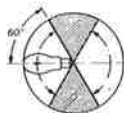
Burning position

□ Permissible

▨ Not permissible



HQI - TS 70/NDL
HQI - TS 70/WDL
HQI - TS 150/NDL
HQI - TS 250/D
HQI - TS 250/NDL
HQI - E 400/DH
HQI - T 400/DH
HQI - TS 400/D



HQI - T 1000/D
HQI - T 2000/D/I
HQI - TS 2000/D
HQI - T 3500/D
HQI - TS 3500/D



HQI - E 400/DV
HQI - T 400/DV
HQI - E 1000/N



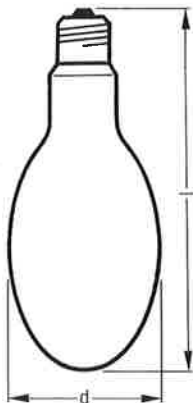
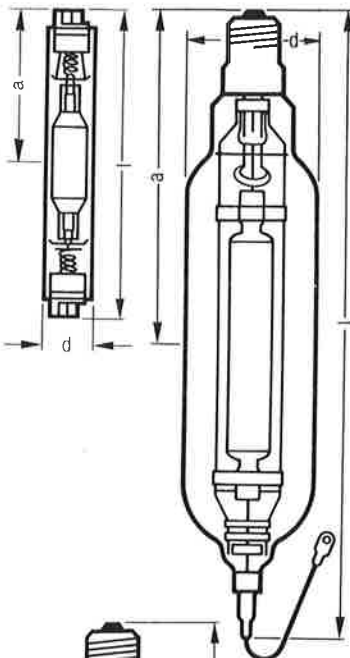
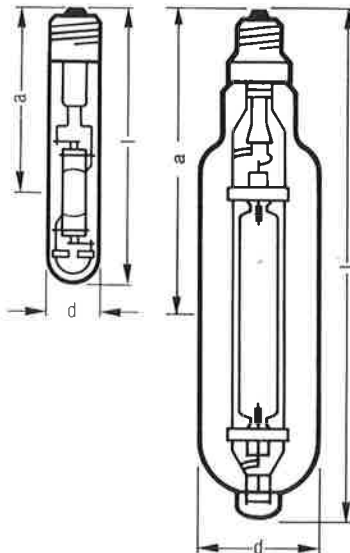
HQI - R 250/NDL



HQI - T 35/WDL
HQI - T 70/WDL
HQI - T 150/WDL
HQI - E 250/D (8)
HQI - T 250/D (8)
HQI - E 400/D
HQI - T 400/D
HQI - T 2000/N

POWER STAR HQI Metal Halide Lamps Lamp Types

3



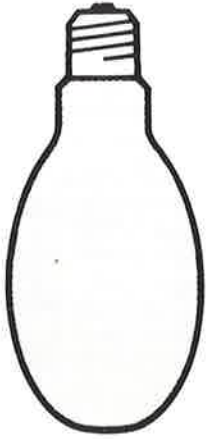
Lamp reference	Lamp wattage W	Luminous flux		Dimensions			Base	Luminous efficacy lm/W	CIE Colour rendering group (4)	CIE Colour appearance group (5)
		Initial lm	Lighting design lm	Dia (d) mm	Max length (l) mm	Light centre length (a) mm				
POWER STAR HQI-T (MBI)										
Clear tubular bulb. Ignitor required.										
HQI-T 250/D	250	19000	15500	46	220	150	E40	76	1A	C
HQI-T 400/D (7)	390	32000	25600		285	175		82		
HQI-T 400/DH (9)	360	25000	20000					70		
HQI-T 400/DV (9)		28000	22500					78		
HQI-T 1000/D	1000	80000	60000	76	340	220		80	1A	
HQI-T 3500/D	3500	300000	n.a.	100	430	265		86		
Clear tubular bulb. No ignitor required.										
HQI-T 2000/D/I	2000	170000	119000	100	430	265	E40	85	1A	C
HQI-T 2000/N		190000 (2)	143000 (2)					95	2	I
POWER STAR HQI-TS (MBI-L)										
TS double-based clear tubular bulb. Hot HQI-TS lamps can be instantly restarted when using a special high voltage ignitor. Ignitor required.										
HQI-TS 250/D	250	19000	15500	25	163	81	Fc2	76		I
HQI-TS 400/D	360	25000	20000	31	206	103		69	1A	C
HQI-TS 2000/D	2000	170000	120000				85			
HQI-TS 3500/D	3500	300000	n.a.	100	490	265	E40	86		
Operate HQI-TS 70 to 400 W only in luminaires with a boro-silicate protective cover. When used with photo-sensitive materials, a UV filter is recommended. It is recommended that the exhaust tip of HQI-TS 70 to 150 W lamps face the reflector, where applicable.										
POWER STAR HQI-E (MBI-F)										
Coated elliptical bulb. Ignitor required.										
HQI-E 250 W/D	250	17000	14000	90	226		E40	68		I
HQI-E 400/D (7)	390	30000	24000	120	290	—		77	1A	C
HQI-E 400/DH (9)		24000	19500					67		
HQI-E 400/DV (9)	360	26000	21000					72		
HQI-E 1000/N	1000	80000	60000	165	380			80	2	I

Codes

.../D	= DE LUXE Cold. Colour rendering group 1A	.../NDL	= DE LUXE Intermediate. Colour rendering group 1B
.../DH	= DE LUXE Cold, horizontal burning position. Colour rendering group 1B	.../N	= Intermediate. Colour rendering group 2
.../DV	= DE LUXE Cold, vertical burning position. Colour rendering group 1B	.../WDL	= DE LUXE Warm. Colour rendering group 1B

- Luminous intensity distribution on page 47
- In horizontal burning position 170,000 lm initial and 120,800 LDL
- Preliminary data
- Colour rendering groups:
 - ($R_a \geq 90$) Wherever accurate colour matching is required, e.g. colour printing inspection
 - ($80 \leq R_a < 90$) Wherever accurate colour judgements are necessary and/or good colour rendering is required for reasons of appearance, e.g. shops and other commercial premises
 - ($60 \leq R_a < 80$) Wherever moderate colour rendering is required
 - ($40 \leq R_a < 60$) Wherever colour rendering is of little significance but marked distortion of colour is unacceptable
 - ($20 \leq R_a < 40$) Wherever colour rendering is of no importance at all and marked distortion of colour is acceptable
- Correlated colour temperatures:
 - W ($CCT \leq 3300$ K) Warm
 - I ($3300 \text{ K} \leq CCT \leq 5300$ K) Intermediate
 - C ($5300 \text{ K} < CCT$) Cold
- Distance between contacts
- Optimum luminous flux with NAV 400 W ballast
- In base down burning position, non uniform colour appearance is possible
- Run-down type

HQL Mercury Lamps Benefits



HQL DE LUXE
HQL

HQL DE LUXE mercury lamps (DE LUXE MBF)

Mercury fluorescent lamp with better colour rendering, particularly of human complexion.

Ideal for improving existing MBF installations where the requirements are:

- Higher luminous flux

- Low wattage

- Long life

- Natural rendering of human complexion

Coated elliptical or reflector bulbs

Reflector lamps have same dimensions as incandescent internally silvered reflector lamps

Colour improved with *special* yttrium vanadate

Low flicker factor

The dimensions correspond with those of WOTAN HQI-E POWER STAR metal halide and NAV E VIALOX® high pressure sodium lamps of the same wattage. Existing luminaires can be used for all three lamp types, thus increasing flexibility and reducing stock keeping.

WOTAN introduced high intensity discharge lamps in 1931 and POWER STARS in 1965. This proves that WOTAN was always at the forefront of high efficiency lamp development.

HQL SUPER DE LUXE mercury lamps (SUPER DE LUXE MBF)

Mercury fluorescent lamps with the colour appearance of incandescent lamps.

- Pedestrian precincts

- Hotel lobbies

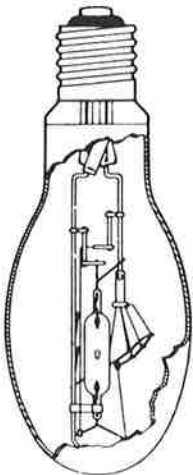
HQL mercury lamps (MBF)

- Long life

- Coated elliptical bulb

- Colour improved with standard yttrium vanadate

- Low flicker factor



HWL

HWL DE LUXE mercury tungsten blended lamps (DE LUXE MBTF)

Mercury tungsten blended reflector lamp with better colour rendering, particularly of human complexion.

Reflector lamps are *directly interchangeable* with incandescent internally silvered reflector or PAR 38 lamps. If feasible use HQLR DE LUXE lamps with ballast because of their considerably higher efficacy.

HWL mercury tungsten blended lamps (MBTF)

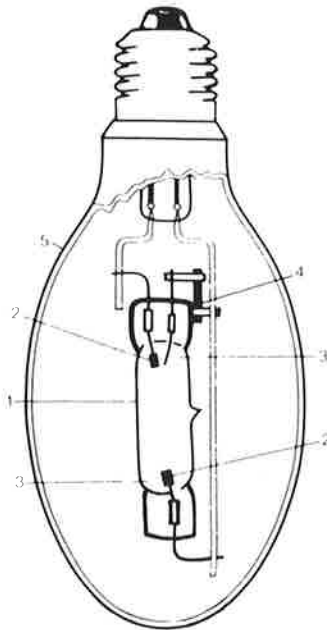
Longer life than incandescent lamps. Particularly suited for temporary replacement of GLS lamps where immediate capital investment is a problem and location access is difficult.

- Coated elliptical bulb.

A tungsten filament series connected to the discharge tube serving mainly as current limiter but also as light source. No need for a ballast, it can be operated directly on the power supply. If feasible, use HQL DE LUXE lamps with ballast because of their considerably higher efficacy.

HQL Mercury Lamps Operation

3



When switching the lamp on, a discharge starts between the main and starting electrodes. The argon starting gas ionizes and then initiates the arc between the main electrodes. Soon the temperature in the discharge tube rises to a few hundred degrees and the pressure increases to about four atmospheres (400000 N/m^2). Then the radiation in the invisible, long wave ultraviolet starts. Some light is also radiated in the visible part of the spectrum, but none in the red. The phosphor coating inside the bulb transforms the ultraviolet radiation into visible light, increases the luminous efficacy and improves colour appearance (red). Luminous efficacy of mercury lamps varies between 32 and 60 lumen per watt, depending on the lamp wattage and phosphor.

WOTAN HQL mercury lamps consist of:

1. Discharge tube, normally made of quartz glass, filled with argon starting and mercury discharge gases.
2. Main electrodes, made of tungsten, at each end of the discharge tube containing emissive material.
3. Starting electrode, made of molybdenum, adjacent to the main electrode.
4. High-ohm resistor connecting main and starting electrode, no bimetal switch, resulting in higher reliability.
5. Elliptical bulb provides uniform operating temperature and light distribution. The bulb is coated with phosphor containing yttrium vanadate, the HQL DE LUXE and SUPER DE LUXE lamps in addition contain other high-quality phosphors.

3

HQL DE LUXE HQL Mercury Lamps Lamp Types

Lamp reference	Lamp wattage W	Luminous flux		Dimensions		Base	Luminous efficacy lm/W	CIE Colour rendering group (3)	CIE Colour appearance group (4)
		Initial lm	Lighting design lm	Diameter (d) mm	Max. length (l) mm				

DE LUXE HQL mercury lamps

High pressure mercury lamps with yttrium vanadate DE LUXE phosphor. The pleasant, warm colour appearance opens new fields of indoor applications for DE LUXE HQL lamps. They follow the trend of point light sources, e.g. in display and effect lighting in downlighters, wallwashers and for outdoor lighting in pedestrian areas and representative streets.

HQL DE LUXE (DE LUXE MBF)

Coated elliptical bulb.
Higher luminous flux.
Better colour rendering, especially of human complexion.

HQL 50 DE LUXE	50	2000	1900	55	130		40	3	W
HQL 80 DE LUXE	80	4000	3800	70	156	E27	50		
HQL 125 DE LUXE	125	6500	6200	75	170		52		
HQL 250 DE LUXE	250	14000	13300	90	226	E40	56		
HQL 400 DE LUXE	400	24000	22800	120	290		60		

HQLR DE LUXE (DE LUXE MBFR)

Reflector bulb.

HQLR 80 DE LUXE	80	3000 (1)	2850 (1)	125	168	E27	38	3	I
HQLR 125 DE LUXE	125	5000 (1)	4750 (1)				40		

HQLR DE LUXE is also used in the FLORA Set for plant display and aquaria.

HQL mercury lamps

High pressure mercury lamps with yttrium vanadate phosphor. For general use in road and factory lighting.

HQL (MBF)

Coated elliptical bulb.

HQL 50	50	1800	1700	55	130	E27	36	3	I
HQL 80	80	3800	3600	70	156	E27 (2)	48		
HQL 125	125	6300	6000	75	170		50		
HQL 250	250	13000	12300	90	226		52		
HQL 400	400	22000	21000	120	290	E40	55		
HQL 700	700	40000	38000	140	330		57		
HQL 1000	1000	58000	55000	165	390		58		



HQL SUPER DE LUXE
HQL DE LUXE
HQLB SUPER DE LUXE
HQLR DE LUXE
HQL
HWLR DE LUXE

HWL

Burning position

- ☐ permissible
- ☐ not permissible

HQL SUPER DE LUXE

HWL

Mercury Lamps

Lamp Types

3

Lamp reference	Lamp wattage W	Luminous flux		Dimensions		Base	Luminous efficacy lm/W	CIE Colour rendering group (4)	CIE Colour appearance group (5)
		Initial lm	Lighting design lm	Diameter (d) mm	Max. length (l) mm				

HQL SUPER DE LUXE (SUPER DE LUXE MBF)

Decorative elliptical bulb with golden filter layer for interior and outdoor lighting. Incandescent like colour appearance (3000 K) with the advantages of HQL mercury lamps.

HQL SUPER DE LUXE are used in pedestrian precincts, gardens, parks, foyers, shopping malls and other public areas.

Coated elliptical bulb.

HQL 50 SUPER DE LUXE	50	1600	1500	55	130		32		
HQL 80 SUPER DE LUXE	80	3400	3200	70	156	E27	42	2	W
HQL 125 SUPER DE LUXE	125	5700	5350	75	170		46		

HQLB SUPER DE LUXE (SUPER DE LUXE MBFG)

Decorative globe bulb with golden filter layer for interior and outdoor lighting. Low luminance and splash resistant due to its large bulb surface. Pleasant incandescent like colour appearance (2900 K). Long service life.

HQL-B SUPER DE LUXE are particularly suited for foyers, malls, pedestrian precincts, parks, gardens and other lighting schemes requiring long service life.

Coated globe bulb.

HQLB 50 SUPER DE LUXE	50	1600	1500	126	190	E27	32	2	W
HQLB 80 SUPER DE LUXE	80	3000	2800				38		

HWL mercury tungsten blended lamps (MBTF)

With yttrium vanadate phosphor. Directly interchangeable with incandescent lamps.

Coated elliptical bulb.

240 to 250 V, no ballast required.

HWL 160 245 V	160	3100	2600	75	177	E27 (3)	19	2	I
---------------	-----	------	------	----	-----	---------	----	---	---

HWLR DE LUXE (DE LUXE MBTFR)

Tungsten blended lamps with yttrium vanadate phosphor.

Reflector bulb.

240 to 250 V, no ballast required.

HWLR 160 DE LUXE	160	2500 (1)	2125 (1)	125	168	E27	16	2	W
------------------	-----	----------	----------	-----	-----	-----	----	---	---

(1) Luminous intensity distribution on page 47

(2) Also available with base B 22 d-3

(3) Also available with base B 22 d

(4) Colour rendering groups:

1A ($R_a \geq 90$) Wherever accurate colour matching is required, e.g. colour printing inspection

1B ($80 \leq R_a < 90$) Wherever accurate colour judgements are necessary and/or good colour rendering is required for reasons of appearance, e.g. shops and other commercial premises

2 ($60 \leq R_a < 80$) Wherever moderate colour rendering is required

3 ($40 \leq R_a < 60$) Wherever colour rendering is of little significance but marked distortion of colour is unacceptable

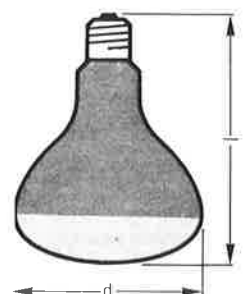
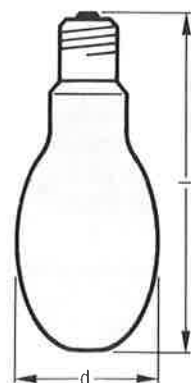
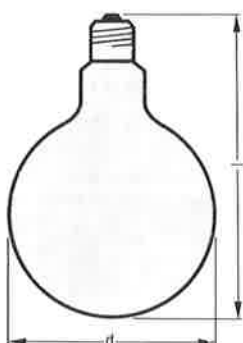
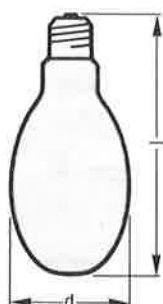
4 ($20 \leq R_a < 40$) Wherever colour rendering is of no importance at all and marked distortion of colour is acceptable.

(5) Correlated colour temperatures:

W ($CCT \leq 3300$ K) Warm

I (3300 K \leq $CCT \leq 5300$ K) Intermediate

C (5300 K $<$ CCT) Cold



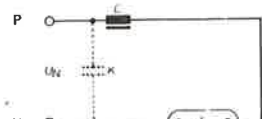


Fig. 1

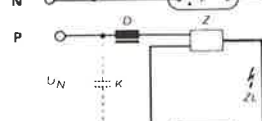


Fig. 2

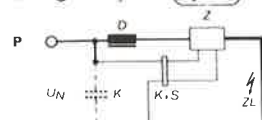


Fig. 3

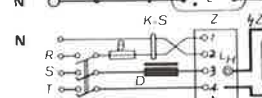


Fig. 4



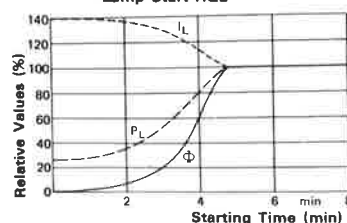
Fig. 5



Fig. 6

- B = Fuse (IEC 127, BS 4265 T 6.3)
 D = Ballast
 D¹ = Tapped ballast
 K¹ = Capacitor for power factor correction
 K₁ = Capacitor for power factor correction and lamp start
 K + S = Make-and-break switch with relay
 L = Lamp
 LH = High voltage terminal
 N = Neutral
 P = Phase
 R, S, T = Three phase leads
 Sch = On-off switch
 St1 = Leakage field transformer
 Un = Supply voltage = 240 V a.c. (for 2000 W and 3500 W) = 415 V a.c.
 Z = Ignitor to be installed near the lamp
 ZL = High voltage ignitor lead to centre contact of lamp
 I_L = Lamp current (A)
 P_L = Lamp power (W)
 U_L = Lamp voltage (V)
 Φ = Luminous flux (lm)

Lamp Start HQL



Lamp circuits

All discharge lamps must be connected to a current limiter. For mercury and metal halide lamps in general a ballast is used. Connection of a discharge lamp directly to the power supply without current limiter will destroy the lamp. Proper operation of lamps can only be guaranteed if approved ballasts and ignitors are used. Operation of damaged lamps, or lamps without outer bulbs, is dangerous and must be avoided.

HWL mercury tungsten blended lamps are an exception in which the discharge tube is connected to a tungsten filament. This serves as current limiter and also radiates light.

For proper operation of the lamp select correct ballast suitable for the lamp type, wattage and supply voltage. See list, "Selection of Ballasts and Ignitors", page 57. Incorrect ballasts can lead to improper colour appearance and a reduction in lamp life.

HQI metal halide lamps also require an ignitor in addition to a ballast. An exception are the HQI-T 2000 W, which have built-in starting electrodes and therefore do not require an external ignitor.

Lamp circuits suitable for each lamp are listed under "Circuit Diagram" on pages 48 and 54.

Power factor correction

Discharge lamp circuits with a ballast have an inductive load and a power factor of about 0.5 to 0.7. To improve the power factor a capacitor can be added, usually one for each lamp. PFC capacitors must always be connected in parallel, see "Lamp Circuits" above. Other connections result in improper operation. It is important to select the capacitor value recommended by the lamp manufacturer. Incorrect capacitor values can result in improper lamp operation.

Mercury tungsten blended lamps HWL are an exception. They do not require a PFC capacitor, because their power factor is almost 1.

Lamp start

HQL lamps take about 4 to 5 minutes before 90% of the maximum luminous flux are reached. In HQI lamps this takes about 2 to 3 minutes. In HWL lamps the full flux is reached instantly, the lamp then stabilizes for normal operation. The diagram shows the typical starting characteristic of a discharge lamp in inductive operation without PFC correction.

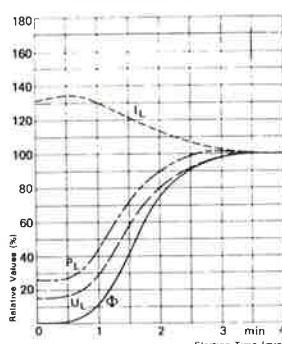
In uncompensated circuits starting currents are 1-2 times higher than lamp currents.

Restart of hot lamp

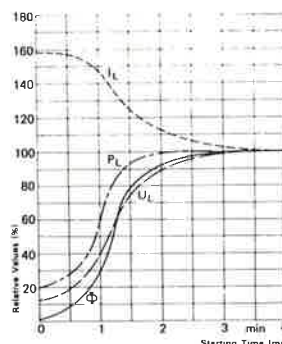
All high pressure discharge lamps need a certain cooling time before they can be restarted, except those which are built for instant restart by means of a high voltage ignitor.

Mercury and metal halide lamps require between 2 to 10 minutes to cool, depending on luminaire design, before they are ready to restart. This is because the pressure in the discharge tube must sink to a level where the discharge can recommence. Metal halide lamps are also available in a TS version for instant restart. A high voltage ignitor (25 to 60 kVp) can restart this lamp *instantly* after extinction. Starting of cold lamps, however, takes the same time as with standard ignitors.

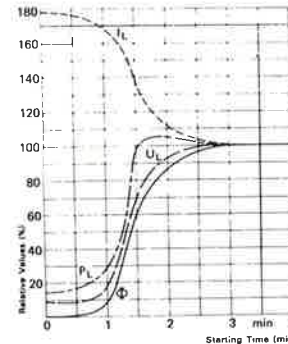
Lamp Start
HQI 70-1000/D,
NDL and WDL



Lamp Start
HQI/N



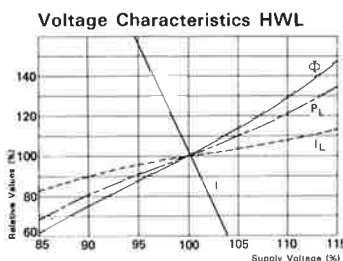
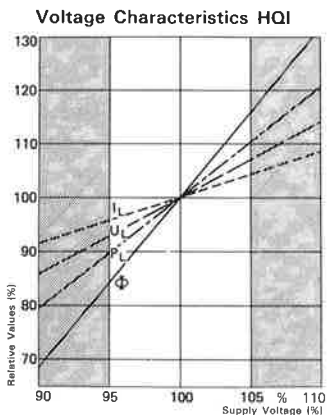
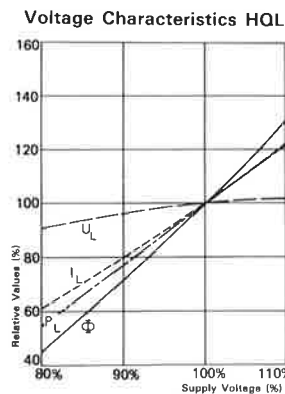
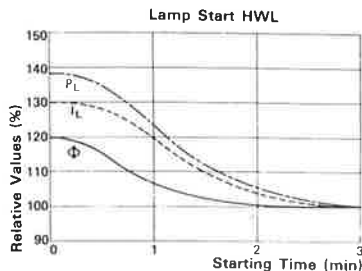
Lamp Start
HQI 2000-3500/D



Metal Halide and Mercury Lamps

Technical Information

3



Φ = Luminous flux (lm)
 P_L = Lamp power (W)
 U_L = Lamp voltage (V)
 I_L = Lamp current (A)
 T_n = Correlated colour temperature (K)
 L = Rated life

Voltage characteristic

The voltage characteristics of HQL and HQI lamps are somewhat different from each other. The diagrams in the margin show the electrical and light data as a function of the supply voltage. The permissible **short time** supply voltage variations for stable operation and long lamp life are as follows:

- HQL lamps $\pm 10\%$
- HQI lamps $\pm 5\%$
- HWL lamps $\pm 3\%$

If the supply voltage of HQI lamps is for a longer time above or below the rated voltage a tapped ballast must be used. The permissible frequency variation is $\pm 2\%$.

If occasional voltage variations in HWL installations are over 3%, HWL lamps should be operated in vertical burning position only.

Overrunning or underrunning the lamp will exceed the tolerance of arc temperature and pressure and result in lamp damage.

Temperature characteristics

Lamps ignite and burn normally at the rated supply voltage down to an ambient temperature of -30°C . At lower temperatures than this is a higher starting voltage is required.

The ambient temperature has a negligible influence on the luminous flux, because the temperature in the discharge tube is 600 to 1000°C .

Maximum permissible base temperatures are:

HQI, HQL and HWL 250°C

Maximum permissible bulb temperature 350 to 550°C (HQI-TS 70: 500°C , HQI-TS 150 and 250: 650°C) depending on lamp wattage. Proper operation at the correct temperatures in the luminaires can also be checked by measuring the corresponding lamp currents and voltages.

Lamp life

The lamp life depends on the way the lamp is operated. The following points are important:

Select correct circuit components for supply voltage lamp, type and wattage. Circuit must be wired correctly, use only components approved by WOTAN.

Excessive switching shortens lamp life as is the case with all discharge lamps. Variations in the supply voltage will cause anomalous operating conditions and shorten lamp life. This happens often while a building is under construction (heavy loads due to building machinery, welding machines etc.).

Lamp quality is of course also of importance, WOTAN with its vast experience, its well equipped research and development facilities and its modern manufacturing plants guarantees high quality lamps. Most light sources, however, are automatically mass produced items. The lumen maintenance and mortality curves therefore indicate average values.

Service life

Rated Life is the optimum point in time for lamp replacement where the operating costs are at a minimum. Operating costs do by necessity include all factors such as electricity and replacement labour cost, lumen maintenance, mortality and lamp price. The indicated rated life is based on a switch-on/switch-off cycle of 8 hours (except HQI $\geq 1000\text{ W} = 3\text{ h}$). About 5% HQL, 8% NAV or 10% HQI lamps will fail before the rated life is reached (for HQI-TS 70 and 150 consult curves on page 46). The rated lives are listed under "Technical Lamp Data", pages 48 and 54.

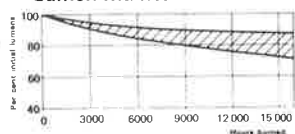
For HQL and NAV roadway installations the most economical replacement cycle is 8000 hours, because of the longer journeys involved and the higher maintenance cost for individual lamp replacement.

Rated Average Life is normally given for a switching cycle of 10 hours and a failure rate of 50%. It can be 20000 hours or more, but obviously the annual operating costs would reach completely uneconomical levels and the resulting illuminance levels would be much too low.

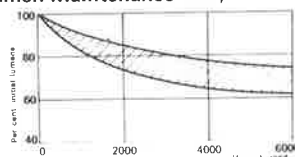
Metal Halide and Mercury Lamps

Technical Information

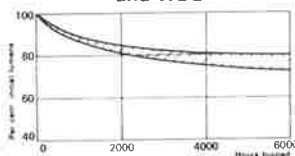
Lumen Maintenance HQL



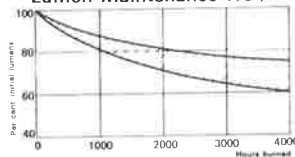
Lumen Maintenance HQI/D 250-400



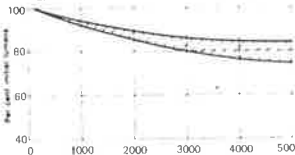
Lumen Maintenance HQI/NDL and WDL



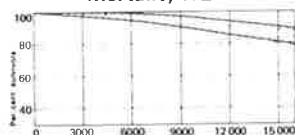
Lumen Maintenance HQI/N



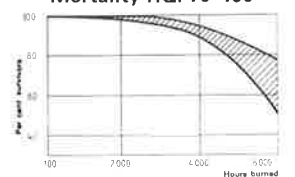
Lumen Maintenance HWL



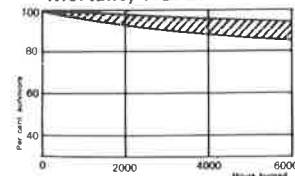
Mortality HQL



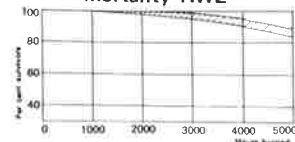
Mortality HQI 70-150



Mortality HQI 250-400



Mortality HWL



Luminous flux

Luminous fluxes are listed in the tables on pages 38, 39, 42 and 43. Initial lumens are given for 100 hours, lighting design lumens for 2000 burning hours. Mean lumens during rated life may be higher than lighting design lumens.

The luminous flux varies with the burning position of the lamp. A vertically burning lamp gives about 5 to 10% more light than one in horizontal burning position. The luminous flux of lamps with universal burning position is given for vertical operation.

The luminous intensity distributions of reflector lamps are shown in the polar diagrams on page 47.

Lumen maintenance

The luminous flux of most lamps decreases during their rated life. The decrease is caused among other things by electrode wear, blackening and ageing of the phosphor coating. The fastest decrease in luminous flux occurs during the first 100 burning hours, afterwards it slows down. Variations exist for the different wattages, the decrease in lower wattage lamps is slower than in higher wattages.

Burning position

The permissible burning positions for the various lamps are listed under "Lamp Types", pages 38 and 42.

Colour appearance and colour rendering

Both mercury and POWER STAR metal halide lamps have a white light colour. Their spectral power distribution, however, differs considerably, see "Spectral Power Distribution", page 75. This is also true for the light quality and therefore colour rendering which are quite different.

The light quality of HQL mercury lamps is not particularly good and this lamp type is not well suited where good colour rendering is required.

DE LUXE HQL lamps are better, particularly where good colour rendering of the human skin is desirable.

SUPER DE LUXE HQL lamps have the colour appearance of incandescent lamps.

POWER STAR HQI metal halide lamps give a very much better light quality and colour rendering. They are available in three colour appearances and are a very suitable light source where good colour rendering is required. In addition they give optimum seeing conditions for the human eye.

If good uniformity in colour appearance is important use HQI/NDL or HQI/WDL, their tolerance is ± 300 K. The tolerance in colour temperature of HQI/D is ± 500 K.

CIE Colour Rendering Groups

	1 (Very good)		2	3	4
	1A $R_a = 90$ to 100	1B $R_a = 80$ to 89	$R_a = 60$ to 79 (Good)	$R_a = 40$ to 59 (Acceptable)	$R_a = 20$ to 39 (Unusual)
Cold Above 5300 K	HQI/D $T_n = 5200$ to 6000 K $R_a = 90$ to 93		—	—	—
Intermediate 3300 to 5300 K	—	HQI/NDL $T_n = 4300$ to 4500 K $R_a = 85$	HQI/N $T_n = 4500$ K $R_a = 60$	HQL $T_n = 3550$ to 4200 K $R_a = 43$ to 50	—
			HWL $T_n = 3600$ K $R_a = 65$	HQLR DL $T_n = 3400$ to 3500 K $R_a = 56$	
			HWL DL $T_n = 3200$ K $R_a = 71$		
Warm Below 3300 K	—	HQI/WDL $T_n = 3000$ K $R_a = 80$	HQL SDL $T_n = 2900$ to 3000 K $R_a = 60$	HQL DL $T_n = 3000$ to 3200 K $R_a = 50$ to 57	NAV $T_n = 2000$ K $R_a = 20$
			NAV DL $T_n = 2200$ K $R_a = 65$		

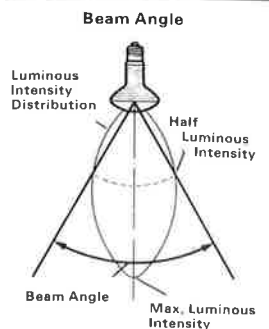
Correlated colour temperatures for each lamp type are listed on page 48. Luminous efficacies can be found on pages 38, 39, 42, 43, 50 and 51.

Lumen maintenance and mortality curves are shown for an 8 hour switching cycle.

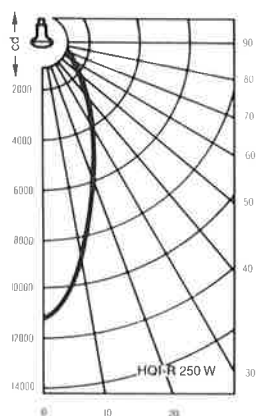
Metal Halide and Mercury Lamps

Technical Information

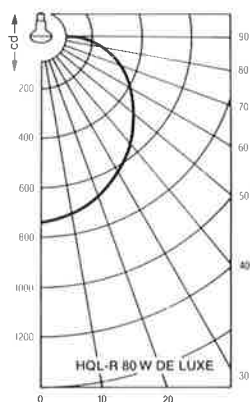
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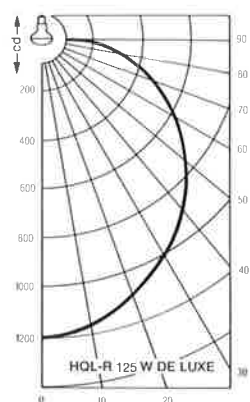
Luminous Intensity Distributions



HQI-R 250 W/NDL



HQL-R 80 W DE LUXE



HQL-R 125 W DE LUXE

Illuminance of HID reflector lamps

Lamp reference	Beam angle	Max illuminance (lux) at a distance from the lamp of				
		1.5 m	2.5 m	3.5 m	4.5 m	6 m
HQI-R 250 W/NDL	50°	4500	1700	900	560	310
HQL-R 80 W DE LUXE		330	120	60	40	20
HQL-R 125 W DE LUXE	120°	530	190	100	60	30
HWL-R 160 W DE LUXE		265	95	50	30	15

Luminaire design

Luminaires for HQI 1000 to 3500 and -TS lamps should be designed with a pressure-free lamp support at the end opposite the lamp base in order to minimize the influence of vibration.

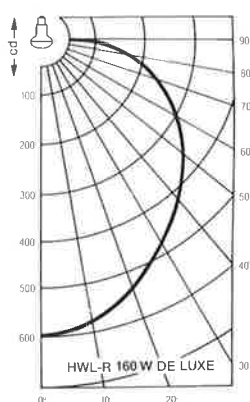
Flicker

Very low flicker factor, HQL max. 2%, HQI max. 2.4%.

Standards

WOTAN Mercury and Metal Halide Lamps comply with the following International and British Standards, where applicable:

IEC 61	Lamp Caps and Holders
IEC 188	High Pressure Mercury Vapour Lamps
BS 3677	High Pressure Mercury Vapour Lamps
BS 5101	Lamp Caps and Holders



HWL-R 160 W DE LUXE

Metal Halide and Mercury Lamps

Technical Lamp Data

LIF reference	Lamp reference	Supply voltage V	Lamp current (3) A	Approx. corrected lamp current (5) A	Approx. starting current (3) A	Lamp voltage V	Min. ignition voltage	Normal restart kVp	Instant restart kVp	Approx. circuit power W	Correl. colour temp. K	Avg. luminance kcd/m ²	Rated life (4) h	Approx. PFC capacitor (5) μ F	Circuit diagram (6)	Time lag fuse recommended (3) A
MBI-F	HQIE 250/D		3.0	1.5	4.2	100				275	5200	150		32		6
	HQIE 400/D (1)		4.5	2.5	6.5					440	5000	130		45		
	HQIE 400/DV		3.5	2.0	5.0					385	5600	110		35		10
	HQIE 400/DH					120						100				
	HQIE 1000/N		9.5	6.0	14.0		3			1050	4500	230		85	2	20
MBI-R	HQIR 250/NDL		3.0	1.5	4.2	100				275		800 (7)		32		6
	HQIT 35/WDL	240	0.5	0.3	0.7	90				48		35000	6000	6		2
	HQIT 70/WDL		1.0	0.5	1.4		3.5	Not possible		88	3000	50000		12		
	HQIT 150/WDL		1.8	1.0	2.5	95				170		80000		20		4
	HQIT 250/D		3.0	1.5	4.2	100				275	5400	11000		32		6
MBI	HQIT 400/D (1)		4.5	2.5	6.5		3			440	5200	8000		45		
	HQIT 400/DV		3.5	2.0	5.0	120				385	5900	7000		35		10
	HQIT 400/DH											6500				
	HQIT 1000/D		9.5	6.0	14.0		4			1050	6000	8100	4000	85		20
	HQIT 2000/D/I	415	10.3	5.5	16.5	230	No ignitor required			2080		9200	(8)	60	1	25
MBI-L	HQIT 2000/N		8.8	6.5	15.5	245				2070	4500	5300		37		20
	HQIT 3500/D		18.0	9.8	29.0	220	4			3650	6000	8800	1000	100	2	50
	HQITS 70/NDL		1.0	0.5	1.4			25		88		4300		12		2
	HQITS 70/WDL					95	3.5				3000	15000				
	HQITS 150/NDL	240	1.8	1.0	2.5					170		4300	6000	20	2/3	4
MBF	HQITS 250/NDL		3.0	1.5	4.2	100		35		275		16000		32		6
	HQITS 250/D		3.5	2.0	5.0	120	3			385	5600	7600		35		10
	HQITS 400/D															
	HQITS 2000/D	415	10.3	5.5	16.5	230	4	60		2080	6000	9200	4000 (8)	60	2/4	25
	HQITS 3500/D		18.0	9.8	29.0	220				3650		8800	1000	100		50
MBF	HQL 50 SUPER DE LUXE		0.6	0.35	0.85	95				59		30		7		2
	HQL 80 SUPER DE LUXE		0.8	0.5	1.2	115				89	3000	40		8		
	HQL 125 SUPER DE LUXE		1.15	0.7	1.8	125				137		60		10		4
	HQL 50 DE LUXE		0.6	0.35	0.85	95				59	3300	40		7		2
	HQL 80 DE LUXE		0.8	0.5	1.2	115				89	3200	50		8		
	HQL 125 DE LUXE		1.15	0.7	1.8	125				137		70		10		4
	HQL 250 DE LUXE		2.15	1.5	3.2	130				266	3100	100		18		6
	HQL 400 DE LUXE		3.25	2.4	5.4	135				425	3000	105		25		10
	HQL 50	240	0.6	0.35	0.85	95	No ignitor required	Not possible		59	4200	40	9000	7	1	2
	HQL 80		0.8	0.5	1.2	115				89	4100	50		8		
	HQL 125		1.15	0.7	1.8	125				137	4000	70		10		4
	HQL 250		2.15	1.5	3.2	130				266	3900	100		18		6
	HQL 400		3.25	2.4	5.4	135				425	3800	105		25		10
	HQL 700		5.4	4.0	9.0	140				735	3550	130		40		10
	HQL 1000		7.5	5.7	13.0	145				1045		160		60		20
MBF-G	HQLB 50 SUPER DE LUXE		0.6	0.35	0.85	95				59		<11		7		2
	HQLB 80 SUPER DE LUXE		0.8	0.5	1.2	115				89	3500	60 (7)		8		
MBF-R	HQLR 80 DE LUXE															
	HQLR 125 DE LUXE		1.15	0.7	1.8	125				137	3400	100 (7)		10		4
MBTF	HWL 160		0.8		1.1	92				160 (2)	3600	30	5000	No capacitor nor ballast required		2
MBTF-R	HWLR 160 DE LUXE		0.75		1.1	92				160 (2)	3200	50 (7)	6000			

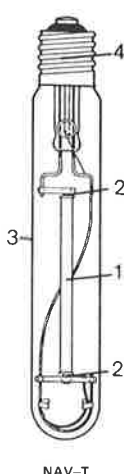
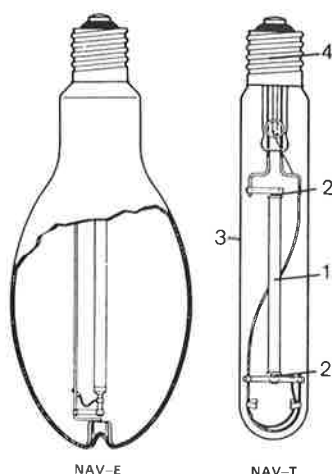
- (1) Preliminary data.
 (2) Neither ballast nor ignitor required.
 (3) Inductive operation, no power factor correction.
 (4) Switching cycle 8 hours except HQI \geq 1000 W = 3 h, see "Rated Life", page 43.
 (5) $\cos \phi = 0.9$ at 50 Hz.
 (6) See "Lamp Circuits", page 44.
 (7) See "Luminous Intensity Distributions", page 47.
 (8) Service life 4000 h at a switching cycle of 3 h, 9000 h at a switching cycle of 8 h.

Sodium Lamps

Benefits

Operation

3



Sodium lamps are made in two types, the older SOX low pressure and the newer NAV high pressure sodium lamps.

High pressure sodium lamps VIALOX® NAV (SON)

High light output.
The appearance is golden, but colour vision is possible.
Long life.
Small decrease in light output during life.
Larger range of types and wattages available:

NAV-E

In coated elliptical bulbs for uniform surface luminance. The dimensions correspond with those of WOTAN HQL mercury and POWER STARS HQL metal halide lamps of the same wattage thus increasing flexibility and reducing stock keeping. Existing luminaires can be used for all three lamp types. Most are also electrically interchangeable with HQL lamps (ballast and ignitor controlling both lamp types available).

NAV-T

In tubular clear bulbs for luminaires with precise light distribution.

NAV-TS

In double-based clear tubular bulbs for floodlights. This type is also suitable for instant restart of the hot lamp when used with a high voltage ignitor.

Operation

When switching the lamp on, a discharge starts in the inert igniting gas in the discharge tube. The pressure in the discharge tube rises then to about one atmosphere (100000 N/m^2) and the sodium-mercury discharge gas becomes active and radiates light. Luminous efficacy varies between 70 and 130 lumen per watt, depending on lamp type and wattage.

WOTAN VIALOX® NAV High Pressure Sodium Lamps consist of:

1. Discharge tube made of material resistant to the chemically active sodium. The discharge tube is filled with an inert starting gas, mostly xenon, and a sodium-mercury discharge gas.
2. Electrodes are made of tungsten and contain emissive material.
3. Bulb in clear tubular or coated elliptical shape.
4. Edison screw base E 40, except 50, 70 and 110 which have E 27 and NAV-TS which have Fc 2 bases, one at each end.

Low pressure sodium lamps SOX

Highest efficacy of all lamps.

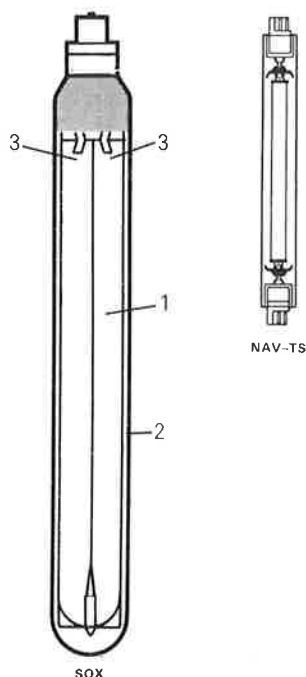
Give yellow light which is monochromatic (unicoloured). Colours cannot be distinguished.

Operation

Tubular outer bulb houses a U-shaped discharge tube and has a BY 22 d bayonet base. Under normal operating conditions the discharge tube has a pressure of 7×10^{-5} atmosphere (0.7 N/m^2). Luminous efficacy varies between 100 and 183 lumen per watt, depending on lamp type and wattage.

SOX Low Pressure Sodium Lamps consist of:

1. Discharge tube made of special glass is protected on the inside against chemical attack by sodium vapour. It is filled with an inert starting gas, mostly neon, and the sodium discharge gas.
2. Bulb made of clear glass is covered on the inside with a transparent reflector, the purpose of which is to reflect infrared heat radiation. Vacuum between bulb and discharge tube together with the heat reflector insulate discharge and maintain the required 270°C .
3. Two electrodes made of tungsten at both ends of discharge tube.

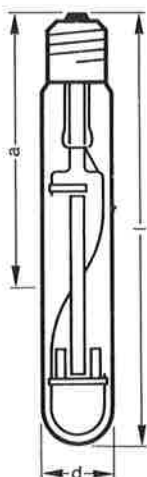
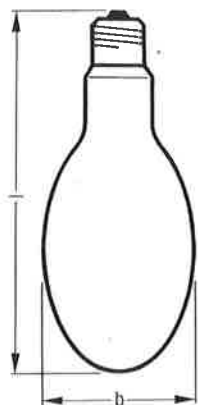


VIALOX® NAV DE LUXE

VIALOX® NAV SUPER

High Pressure Sodium Lamps

Lamp Types



Lamp reference	Luminous flux			Dimensions			Base	Luminous efficacy lm/W	CIE colour rendering group (2)	CIE colour appearance group (3)
	Lamp wattage W	Initial lm	Lighting design lm	Dia. (d) mm	Max. length (l) mm	Light centre length (a) mm				

VIALOX® NAV

Very high luminous efficacy, up to 130 lm/W, and long life result in longer replacement cycles and high economy. A full range guarantees the suitable type for each application.

NAV DE LUXE (SON DE LUXE)

High pressure sodium lamps with improved colour rendering. Main applications are interior industrial and commercial installations, as well as prestigious street and flood lighting.

Coated elliptical bulb.
Ignitor required.

NAV E 150 DE LUXE	150	12000	11900	90	226	—	E40	80	3	W
NAV E 250 DE LUXE	250	22000	21800					88		
NAV E 400 DE LUXE	400	36000	35650	120	285			90		

Clear tubular bulb.
Ignitor required.

NAV T 150 DE LUXE	150	12500	12400	46	211	132	E40	83	3	W
NAV T 250 DE LUXE	250	23000	22750	52	257	158		92		
NAV T 400 DE LUXE	400	38000	37600		285	175		95		

NAV SUPER (SON PLUS)

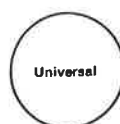
High pressure sodium lamps with increased luminous efficacy.

Coated elliptical bulb.
Ignitor required.

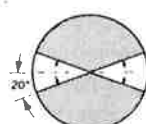
NAV E 100	100	9500	9400	75	186		E40	95	4	W
NAV E 150 SUPER	150	15500	15350	90	226	—		103		
NAV E 250 SUPER	250	30000	29700					120		
NAV E 400 SUPER	400	51500	51000	120				129		

Clear tubular bulb.
Ignitor required.

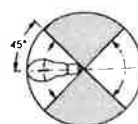
NAV T 50/E	50	4000	3950	37	156	104	E27	80	4	W
NAV T 70/E	70	6500	6400					93		
NAV T 100	100	10000	9900	46	211	132		100		
NAV T 150 SUPER	150	17000	16850	52	257	158	E40	113		
NAV T 250 SUPER	250	33000	32650		285	175		132		
NAV T 400 SUPER	400	55500	54950					139		



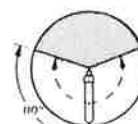
NAV-E
NAV-T



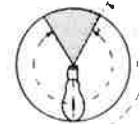
SOX 90 W to
SOX 180 W



NAV-TS



SOX 35 W to
SOX 55 W



SOX 18 W

Burning position



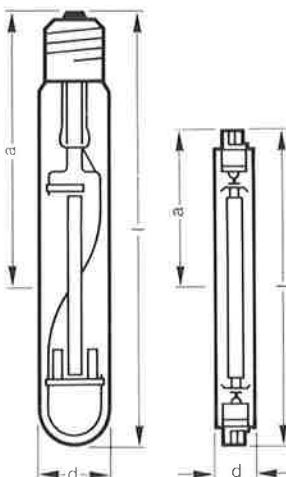
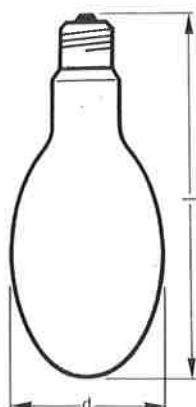
permissible



not permissible

VIALOX® NAV High Pressure SOX Low Pressure Sodium Lamps Lamp Types

3



Lamp reference	Luminous flux			Dimensions			Base	Luminous efficacy lm/W	CIE colour rendering group (2)	CIE colour appearance group (3)
	Rated power W	Initial lm	Lighting design lm	Dia (d) mm	Max length (l) mm	Light centre length (a) mm				

VIALOX® NAV Standard High Pressure Sodium Lamps

Main applications are outdoor traffic and industrial lighting as well as industrial interior lighting where requirements are not so stringent.

VIALOX® NAV-E (SON)

Coated elliptical bulb.
Ignitor required.

NAV E 50/E	50	3500	3450	70	156		E27	70		
NAV E 70/E	70	5600	5500					80		
NAV E 150	150	14000	13850	90	226			93	4	W
NAV E 250	250	25000	24800				E40	100		
NAV E 400	400	47000	46500	120	290			118		
NAV E 1000	1000	120000	119000	165	400			120		

NAV E 100 see NAV SUPER page 50.

Coated elliptical bulb.
No ignitor required.

NAV E 50/I	50	3500	3450				E27	70		
NAV E 70/I	70	5600	5550	70	156			80		
NAV E 110 (1, 4)	110	8000	7900	75	175			73	4	W
NAV E 210 (4)	210	18000	17800	90	226		E40	86		
NAV E 350 (4)	350	34000	33600	120	290			97		

VIALOX® NAV-T (SON-T)

Clear tubular bulb.
Ignitor required.

NAV T 150 W	150	14500	14350		211	132		97		
NAV T 250 W	250	27000	26700	46	257	158	E40	108	4	W
NAV T 400 W	400	48000	47500		285	175		120		
NAV-T 1000 W	1000	130000	129000	65	400	240		130		

NAV T 50/E, NAV T 70/E, NAV T 100 see NAV SUPER page 50.

VIALOX® NAV-TS (SON-L)

TS double-based clear tubular bulb.
Hot NAV-TS lamps can be instantly restarted when using a special high voltage ignitor.
Ignitor required.

NAV-TS 70 W (1)	70	7000	6950	20	114.2 (5)	57	R7s	100		
NAV-TS 250 W	250	25500	25200	23	206	103	Fc 2	102	4	W
NAV-TS 400 W	400	48000	45500					120		

SOX Low Pressure Sodium Lamp

Low pressure sodium lamps have a luminous efficacy up to 183 lm/W. The light is monochromatic yellow.

Application: Road Lighting with low colour requirements, for tunnels, canals and locks.

Clear tubular with infrared reflecting coating.

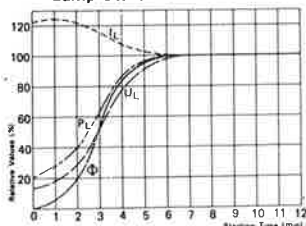
SOX 18 W	18	1800	1750	53	216			100		
SOX 35 W	35	4800	4700	52	310			137		
SOX 55 W	55	8000	7850		425		BY22d	145		W
SOX 90 W	90	13500	13250		528			150		
SOX 135 W	135	22500	22000	66	775			166		
SOX 180 W	180	33000	32300		1120			183		

- (1) Preliminary data
- (2) Colour rendering groups:
 - 1A ($R_a \geq 90$) Wherever accurate colour matching is required, e.g. colour printing inspection
 - 1B ($80 \leq R_a < 90$) Wherever accurate colour judgements are necessary and/or good colour rendering is required for reasons of appearance, e.g. shops and other commercial premises
 - 2 ($60 \leq R_a < 80$) Wherever moderate colour rendering is required
 - 3 ($40 \leq R_a < 60$) Wherever colour rendering is of little significance but marked distortion of colour is unacceptable
 - 4 ($20 \leq R_a < 40$) Wherever colour rendering is of no importance at all and marked distortion of colour is acceptable
- (3) Correlated colour temperatures:
 - W (CCT ≤ 3300 K) Warm
 - I (3300 K \leq CCT \leq 5300 K) Intermediate
 - C (5300 K $<$ CCT) Cold
- (4) Lamps can be used in luminaires made for 125, 250 or 400 W mercury lamps respectively, if the ballasts are also suitable for the higher lamp current of high pressure sodium lamps. Check if the IEC specifications for maximum permissible winding temperatures are observed. In case of doubt consult with luminaire manufacturer before lamp change
- (5) Distance between contacts

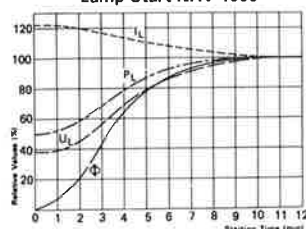
Sodium Lamps

Technical Information

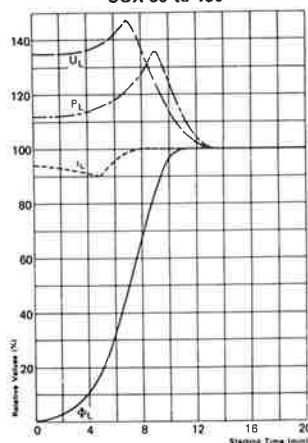
Lamp Start NAV 50 to 400



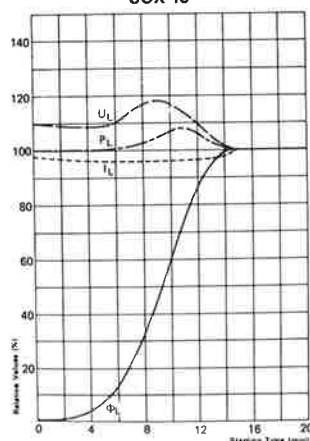
Lamp Start NAV 1000



Lamp Start
SOX 35 to 180



Lamp Start
SOX 18



Ballast and circuit diagram

Like all other discharge lamps, sodium lamps must be series connected to a current limiter and have an ignitor. The correct circuit components must be selected for each lamp type, power rating and supply voltage to guarantee proper lamp operation, see "Selection of Ballasts and Ignitors", page 57.

NAV high pressure sodium lamps must be series connected with a ballast as current limiter. An external ignitor is normally necessary because of the high starting voltage required (except NAV plug-in lamps).

SOX low pressure sodium lamps require a starting voltage of 400–600 V. Normally control components are used which serve as current limiter as well as ignitor.

Power factor correction

The uncorrected power factors are:

NAV with ballast abt. 0.5–0.7

SOX with control components abt. 0.3

For proper power factor correction:

The correct capacitor must be selected for lamp type and wattage. They are listed under "Technical Lamp Data", page 54.

Capacitors must be correctly connected, see "Lamp Circuits", page 44.

Lamp start

An inert starting gas starts the discharge in the discharge tube which then ignites the lamp. The temperature in the discharge tube and the pressure of the sodium vapour then increases gradually. In high pressure sodium lamps it takes about 4 minutes until 90% of the maximum luminous flux is reached. In low pressure lamps this takes about 9 minutes.

In uncompensated NAV circuits starting currents are about 1–2 times higher than lamp currents.

For SOX lamps the starting voltages are about 1.5 times higher than the lamp voltages.

Restart of hot lamps

NAV-E and NAV-T high pressure sodium lamps with an external ignitor require about 1 minute to restart when they are hot.

NAV-E plug-in lamps about 5–7 minutes because they use starting electrodes, no ignitor. The exact time depends on luminaire design.

NAV-TS lamps can be restarted instantly. For this a special ignitor with starting voltage of about 25 kVp is required.

Low pressure sodium lamp SOX can be restarted instantly when hot.

Voltage characteristics

The diagrams on page 53 show how the technical data changes with supply voltage variations. The lamp voltage varies to a larger degree than the supply voltage. Overrunning and underrunning will result in unstable operation or extinction of the lamp. The maximum permissible short time supply voltage variation for high pressure sodium lamps NAV is $\pm 5\%$. For constant supply voltages variations a tapped ballast is required. Permissible frequency variation is $\pm 2\%$. Therefore it is important to select a ballast for the correct supply voltage. For low pressure sodium lamps SOX the maximum permissible supply voltage variation is $\pm 10\%$. This has no major influence on the luminous flux; however, constant overrunning will shorten the lamp life.

Power reduction

The power of NAV 100, 150, 250 and 400 lamps can be reduced to 50% of the nominal power by means of:

Sequence switching to ballast of lower rating or

Sequence switching with additional inductance.

At reduced power the luminous efficacy is only slightly reduced. The light colour becomes more yellow and the colour rendering less favourable.

Radio interference

After ignition, radio interference does not normally occur.

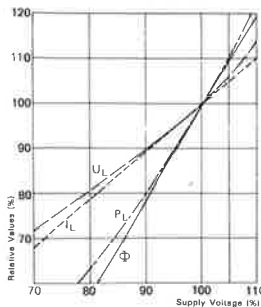
I_L = Lamp Current (A)
 P_L = Lamp Power (W)
 U_L = Lamp Voltage (V)
 Φ_L = Luminous Flux (lm)

Sodium Lamps

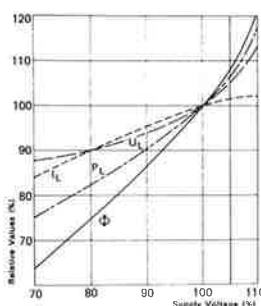
Technical Information

3

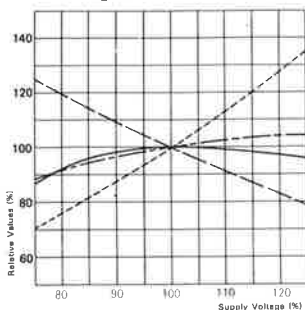
Voltage Characteristics
NAV 50 to 70



Voltage Characteristics
NAV 100 to 1000



Voltage Characteristics SOX



I_L = Lamp Current (A)
 P_L = Lamp Power (W)
 U_L = Lamp Voltage (V)
 Φ_L = Luminous Flux (lm)

Temperature characteristics

High pressure sodium lamps NAV burn correctly between temperatures of -30 and $+100^\circ\text{C}$. The luminous flux does not vary appreciably between these temperatures. The luminous flux of low pressure sodium lamps SOX, however, depends more on temperature. At an ambient temperature of $+20^\circ\text{C}$ it is at a maximum. At 0°C it decreases by 3%, at -20°C by 8% and at -30°C by 12%.

Luminous flux

Luminous fluxes are listed in the tables on pages 50 and 51. Initial lumen is given for 100 burning hours. Lighting design lumen of NAV lamps for 2000 hours and SOX lamps for 3000 hours. Mean lumen during rated life of NAV lamps may be higher than lighting design lumen.

For lamps which can burn horizontally and vertically, fluxes are given for vertical burning position; in horizontal burning position they decrease by about 3%.

Lumen maintenance

The light output decreases during the lives of most light sources. The decrease in luminous flux of sodium lamps is caused by electrode deposits on the inside of the discharge tube which reduces transmission of light. The decrease in luminous flux is small for both high and low pressure sodium lamps. The diagrams on page 54 show average lumen maintenance and mortality during life at a switching cycle of 8 hours.

Lamp life

Similar conditions exist for sodium lamps as described for mercury lamps, see "Rated Life", pages 45 and 54.

Burning position

NAV-E and NAV-T lamps have universal burning positions. NAV-TS and SOX lamps are restricted. Details are given on page 50.

Light colour and colour rendering

NAV lamps radiate light in all wavelengths of the spectrum. The main radiation, however, is in the yellow and orange range, see "Spectral Power Distribution", page 75. This results in a pronounced golden colour appearance. A certain colour rendering can be obtained, but it is not particularly good. Neither type of sodium lamps can be used where good colour rendering is required.

The light from SOX lamps is a strong yellow. It is monochromatic (unicoloured) with radiation in only one wavelength. No other colours can be distinguished. All different colours appear as different shades of yellow.

High pressure sodium lamps have a colour rendering index $R_a = 20$ and a colour temperature of 2000 K.

Low pressure sodium lamps are monochromatic and therefore a colour rendering index is not very useful. The colour temperature is 1800 K.

Luminaire design

luminaires for all SOX lamps should be designed with a pressure-free lamp support at the end opposite the lamp base in order to minimize the influence of vibration.

Flicker

NAV: Extremely low flicker factor, max. 0.5%.

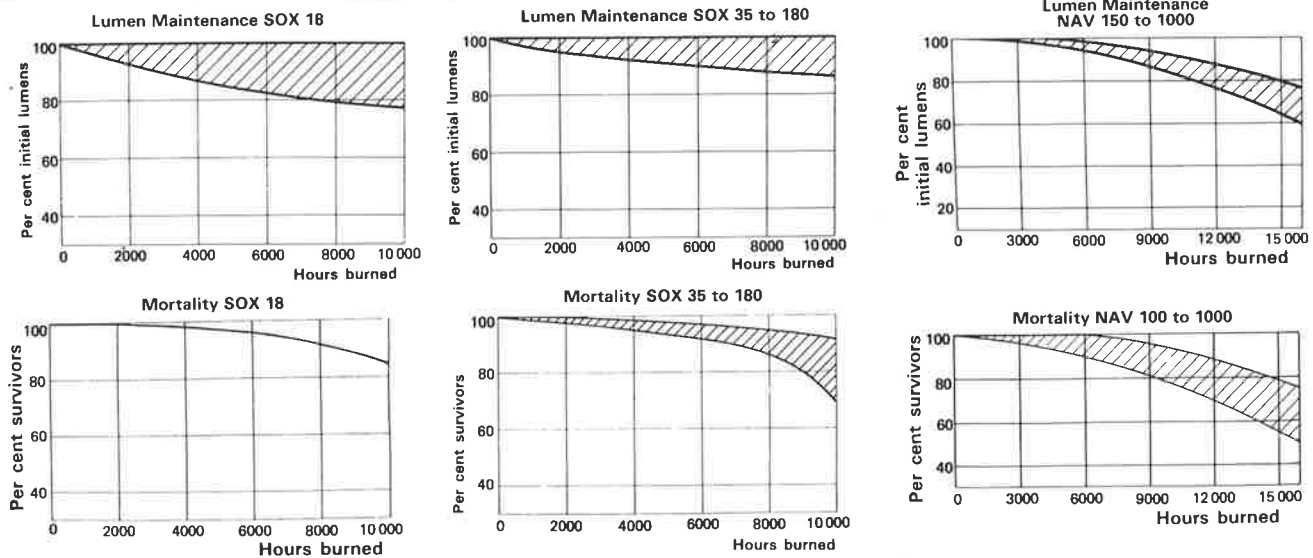
Standards

WOTAN Sodium Lamps comply with the following International and British Standards, where applicable:

IEC	61	Lamp Caps and Holders
IEC	192	Low Pressure Sodium Vapour Lamps
IEC	662	High Pressure Sodium Vapour Lamps
BS	3767	Low Pressure Sodium Vapour Lamps
BS	5101	Lamp Caps and Holders

Sodium Lamps

Technical Lamp Data



Lumen Maintenance and Mortality curves are shown for an 8 hour switching cycle.

LIF reference	Lamp reference	Supply voltage V	Lamp current (2) A	Starting current (2) A	Approx. connected lamp current (4) A	Lamp voltage V	Normal restart kVp	Instant restart kVp	Approx. circuit power W	Avg. luminance kcd/m ²	Rated life (3) h	Approx. PFC capacitor (4) μ F	Circuit diagram (5)	Time lag fuse recommended (2) A
SON DE LUXE	NAV E 150 DE LUXE (6)	240	1.8	2.6	1.0	100	2.8	4	170	80	9000	20	2	4
	NAV E 250 DE LUXE (6)		3.0	4.5	1.5	105			275	170		36		6
	NAV E 400 DE LUXE (6)		4.4	6.5	2.5	105			450	190		45		10
	NAV E 100		1.2	1.8	0.7	85			115	150		12		4
SON PLUS	NAV E 150 SUPER	240	1.8	2.6	1.0	100	3.5	1.8	170	110	9000	20	2	6
	NAV E 250 SUPER (6)		3.0	4.5	1.5	105			275	230		36		10
	NAV E 400 SUPER (6)		4.4	6.5	2.5	105			450	240		45		10
	NAV E 50/E		0.77	1.2	0.45	85			62	40		10		2
SON	NAV E 70/E	240	1.0	1.5	0.6	90	2.8	Not possible	83	70	9000	12	1	4
	NAV E 150		1.8	2.6	1.0	100			170	100		20		6
	NAV E 250		3.0	4.5	1.5	105			275	190		36		10
	NAV E 400		4.4	6.5	2.5	105			450	220		45		25
SON Plug-in	NAV E 1000	240	10.3	16.0	6.0	110	3.5	Not possible	1090	300	9000	100	2/3	25
	NAV E 50/I		0.77	1.2	0.45	85			62	40		10		2
	NAV E 70/I		1.0	1.5	0.6	90			83	70		12		4
	NAV E 110		1.15	1.7	0.7	125			122	110		10		6
SON-T DE LUXE	NAV E 210	240	2.25	3.4	1.4	117	2.8	20	232	130	9000	18	2	10
	NAV E 350		3.45	5.2	2.1	125			385	160		25		4
	NAV T 150 DE LUXE (6)		1.8	2.6	1.0	100			170	2500		20		6
	NAV T 250 DE LUXE (6)		3.0	4.5	1.5	105			275	3500		36		10
SON-T PLUS	NAV T 400 DE LUXE (6)	240	4.4	6.5	2.5	105	1.8	Not possible	450	4000	9000	45	2	2
	NAV T 50/E (6)		0.77	1.2	0.45	85			62	2500		10		4
	NAV T 70/E		1.0	1.5	0.6	90			83	4000		12		6
	NAV T 100		1.2	1.8	0.7	100			115	3000		20		10
SON-T	NAV T 150 SUPER	240	1.8	2.6	1.0	100	3.5	Not possible	170	3500	9000	20	2/3	4
	NAV T 250 SUPER (6)		3.0	4.5	1.5	105			275	5000		36		6
	NAV T 400 SUPER (6)		4.4	6.5	2.5	105			450	6000		45		10
	NAV T 150		1.8	2.6	1.0	100			170	3000		20		25
SON-L	NAV T 250	240	3.0	4.5	1.5	105	2.8	20	275	4000	9000	36	5	6
	NAV T 400		4.4	6.5	2.5	105			450	5000		45		10
	NAV T 1000		10.3	16.0	6.0	110			1090	6000		100		2
	NAV TS 70 (6)		1.0	1.5	0.6	90			83	4000		12		6
SONX	NAV TS 250	240	3.0	4.5	1.5	100	2.8	Not possible	275	5500	10000	36	6	10
	NAV TS 400		4.4	6.5	2.5	105			450	5500		45		2
	SOX 18		0.35	—	—	57			25	—		5 (1)		4
	SOX 35		1.4	0.6	—	70			56	—		20		6
SONX	SOX 55	240	—	—	—	105	No ignitor required	Not possible	76	—	10000	26	5	10
	SOX 90		2.1	—	—	115			113	—		45		2
	SOX 135		3.1	0.9	—	160			175	—		40		6
	SOX 180		—	—	—	245			220	—		—		10

- (1) Capacitor essential.
- (2) Inductive operation, no power factor correction.
- (3) Switching cycle 8 hours, see "Rated Life", pages 45 and 53.
- (4) $\cos \phi = 0.9$ at 50 Hz.
- (5) See "Lamp Circuits", page 44.
- (6) Preliminary data.

High Intensity Discharge Lamps Ballasts

3

All discharge lamps require a current limiter. In most cases this is a ballast. It must be series connected to line, ignitor and lamp and serves as an inductive resistance. It restricts the current from the power supply to that needed by the lamp. A lamp operated without ballast would be destroyed. Because it has to supply the exact current to the lamp, it is important to select the correct ballast for the supply voltage, lamp type and wattage. Improper selection or low quality ballasts can result in improper lamp operation or short life. Proper operation and long lamp life depend very much on the correct selection of the ballast.

Discharge lamp types (except HWL) need the correct ballast type, one for each lamp. Some WOTAN ballasts and ignitors are unique in that they can accommodate HQI metal halide as well as NAV high pressure sodium lamps, thus increasing flexibility and reducing stock keeping.

Most ballasts are designed for 240 or 415 V. Because the supply voltage influences the lamp operation and life considerably, the following maximum short time voltage variations must not be exceeded:

Mercury (HQL)	$\pm 10\%$	High Pressure Sodium (NAV)	$\pm 5\%$
Metal Halide (HQI)	$\pm 5\%$	Low Pressure Sodium (SOX)	$\pm 10\%$

For continuous operation at such voltages, or if frequent peaks within these tolerances are expected, tapped ballasts must be used in order to ensure proper operation and full lamp life, e.g. 230/240/250 V. This means that, e.g. if the supply voltage is below 235 V or above 245 V, the 230 V or the 250 V tapping respectively must be used.

An amendment to IEC Publication 662 "High Pressure Sodium Lamps" determines that considerable life shortening also of HPS lamps must be expected if they are continuously operated at a supply voltage which is more than 7 V (for ≤ 150 W), respectively more than 10 V (for > 150 W) higher than the rated supply voltage of the ballast used. It is therefore recommended to use also tapped ballasts for HPS lamps. They will allow proper adaptation to existing supply voltage conditions.

Ballasts must not be overheated because this would change the current supply resulting in faulty operation and reduced lamp and ballast lives. A ballast temperature exceeding the maximum permissible ambient by 10°C reduces the ballast life by one half. Ballasts have a rated life of 10 years at the maximum winding temperature $t_w = 130^{\circ}\text{C}$.

The distance between ballast and lamp can exceed 50 m, if adequate cross section of cable is used.

WOTAN has an approval system for ballasts and ignitors. Any manufacturer can submit his circuit components and obtain a WOTAN approval number, if they fulfil the requirements and are of the required quality. Lists of different manufacturers are available from WOTAN Lamps Ltd on request.

This approval number, however, is not an electrical safety approval. Ballasts and ignitors not having WOTAN approval numbers could cause problems.

Ballasts for mercury lamps

Available from electrical wholesalers. They should correspond with IEC Publ. 459 and BS 4782 "Ballasts for discharge lamps (excluding ballasts for tubular fluorescent lamps)".

Standards

IEC 262	Ballasts for high pressure mercury vapour lamps.
IEC 459	Ballasts for low pressure sodium lamps.
BS 4782	Ballasts for discharge lamps (excl. ballasts for tubular fluorescent lamps).

3

High Intensity Discharge Lamps Ignitors

For reliable ignition and optimum life of most discharge lamps a properly selected ignitor is required. Excessive switching of all discharge lamps results in a shorter lamp life. Improper selection or low quality ignitors can result in improper lamp operation or short life.

Most discharge lamps do not ignite on the supply voltage and require an external ignitor. Exceptions are HQL, HWL, HQI-T 2000 and certain NAV lamps, which have built-in ignitors.

Three main ignitor systems are available which have certain advantages and disadvantages for particular applications:

(1) Electronic superimposed ignitors

Series connected to line with ballast and lamp. Can be used for most high pressure sodium and metal halide lamps. Give a starting voltage of up to 5 kVp. Superimposed ignitors should be mounted in the vicinity of the lamp. Advantages: Electrical safety, low radio interference. Restart time of hot HQI 5–10 minutes, of NAV 0.5–1 minute. Maximum distance between ignitor and lamp 3 m.

(2) High voltage ignitors for instant restart of hot TS-lamps

Hot HQI-TS and NAV-TS lamps can be instantly restarted when using a special high voltage ignitor. The starting voltage for 70–1000 W lamps is 25–35 kVp, for 2000 and 3500 W 60 kVp. Medium radio interference. The distance between ignitor and lamp must be as short as possible (0.3 to 0.6 m).

(3) Control components for SOX lamps

Are available from electrical wholesalers. Application details are available from them or the manufacturers. They should correspond with

IEC Publ. 459 Ballasts for low-pressure sodium vapour lamps and

BS 4782 Ballasts for discharge lamps (excluding ballast for tubular fluorescent lamps).

Silicone high voltage cables

Because of the high ignition voltage required for normal and instant restart, special silicone high voltage cable must be used between ignitor and lamp.

Degree of protection	Normal restart		Instant restart	
	50–1000 W	2000–3500 W	70–1000 W	2000–3500 W
IP20	9-1000-KA-901-7	—	9-1000-KA-901-8	—
IP65	9-1000-KA-902-0	9-1000-KA-901-1	—	9-1000-KA-901-8

High Intensity Discharge Lamps Selection of Ballasts and Ignitors



		Ignitor	
	Ballast	Normal restart	Instant restart
HQI T 35/WDL	OMBIS 35	ZRM 1,8-ES	Not possible
HQI T 70/WDL	OMBIS 70		
HQI TS 70/(NDL, WDL)		240 SMZ 6	
HQI T 150/WDL	OMBIS 150		Not possible
HQI TS 150/NDL		240 Z 6 .s	
HQI TS 250/NDL	OGLIS 250	ZRM 6-ES	Not possible
HQI (E, R, T) 250/(D, NDL)		240 Z 6 .s	
HQI TS 250/D	OGLS 400		Not possible
HQI (E, T) 400/D		240 Z 6 .s	
HQI (E, T) 400/D (H, V)	OGLI 400		Not possible
HQI TS 400/D		240 Z 6 .s	
HQI (E, T) 1000/(D, N)	OGLIS 1000	ZRM 12-ES	
HQI T 2000/D/I	2 × OGLI $\frac{1}{2}$ 2000	None required	Not possible
HQI T 2000/N	OGLI 2000		
HQI TS 2000/D	2 × OGLI $\frac{1}{2}$ 2000	ZRM 12-ES 400	420 Z 4 B/D2
HQI T 3500/D	3 × OGLI $\frac{1}{3}$ 3500	ZRM 20-ES 400	Not possible
HQI TS 3500/D			420 Z 4 B/D2
NAV (E, T) 50/E	OMBS 50	ZRM 2-ES	Not possible
NAV E 50/I		None required	
NAV (E, T) 70/E	OMBIS 70	ZRM 2-ES	
NAV E 70/I		None required	
NAV TS 70		ZRM 2-ES	240 SMZ 6
NAV (E, T) 100	OMBS 100	ZRM 6-ES	
NAV E 110	Standard MBF 125 W	None required	
NAV (E, T) 150 (DE LUXE, SUPER)	OMBIS 150	ZRM 6-ES	Not possible
NAV E 210	Standard MBF 250 W	None required	
NAV (E, T) 250 (DE LUXE, SUPER)	OGLIS 250	ZRM 6-ES	
NAV TS 250			240 Z 6 .s
NAV E 350	Standard MBF 400 W	None required	Not possible
NAV (E, T) 400 (DE LUXE, SUPER)			
NAV TS 400	OGLS 400	ZRM 6-ES	240 Z 6 .s
NAV (E, T) 1000	OGLIS 1000	ZRM 12-ES	Not possible
ULTRAMED 400	OGLS 400	ZRM 6-ES	240 Z 6 .s
ULTRAMED 1000	OGLIS 1000	ZRM 12-ES	240 Z 6 .s
ULTRAMED 2000	2 × OGLI $\frac{1}{2}$ 2000	ZRM 20-ES 400	420 Z 4 B/D2
ULTRAMED 4000	3 × OGLI $\frac{1}{3}$ 3500	ZRM 20-ES 400	420 Z 4 B/D2

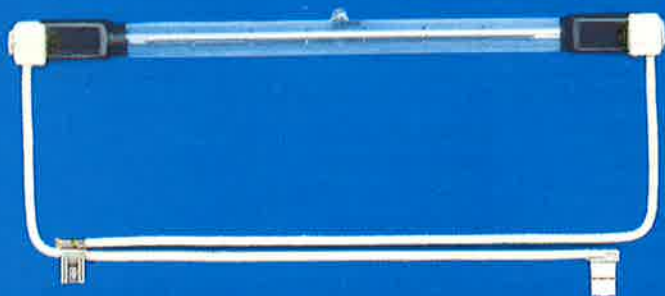
Most WOTAN ballast and ignitors are approved by:

BSI (Great Britain)	Nemko (Norway)
Cebec (Belgium)	Semko (Sweden)
Demko (Denmark)	SEV (Switzerland) or
EIRF (Finland)	VDE (Germany)
KEMA (Netherlands)	

For details and lists of approved ballasts and ignitors made by **other manufacturers**, please contact WOTAN Lamps Limited.

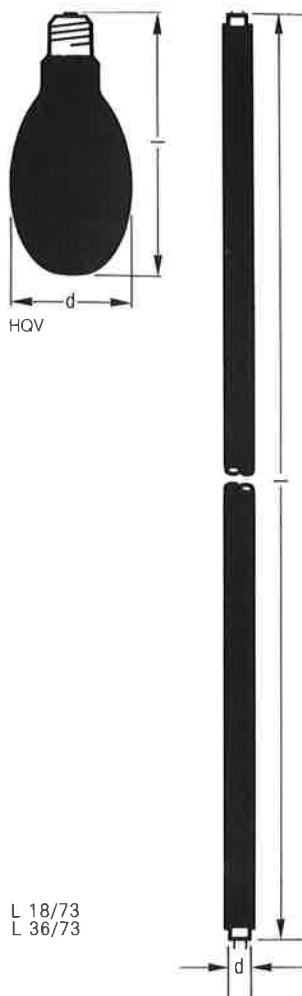
4

Special Lamps



HQV and L.../73 Black Light Lamps

4



Some materials possess the property to convert invisible UV radiation into light (fluorescence). HQV and L.../73 are lamps emitting long wave UV and thus creating fluorescence. They are, therefore, the ideal source for research work requiring fluorescence analysis. Beyond this they can be used for special luminous effects in theatres and nightclubs.

WOTAN mercury high pressure lamps with elliptical or tubular bulbs made of Woods glass (HQV and L.../73) generate rays only in the long UV between 300 nm and 400 nm. They are invisible to the eye and absolutely harmless. The visible radiation is absorbed almost completely.

The irradiance is measured at a distance of 1 meter at mid-lamp level and for the HQV 125 amounts to approximately 150 mW/m². The irradiance of the L 18/73 amounts to approx. 0.5 W/m² and of the L 36/73 to 1 W/m².

Application

Material research

Tests by means of fluorescent solutions, e.g. for the detection of hair cracks in engine shafts.

Textile industry

Material analysis, e.g. the composition and nature of material consisting of wool and synthetics. Detection of otherwise invisible and possible dry-cleaning stains.

Foodstuffs industry

Detection of adulterated foodstuffs, decayed fruit (especially oranges), meat, fish, etc.

Criminal investigation

Detection of forged banknotes, cheques, documents or subsequent alterations of same, removed blood stains, counterfeit paintings etc.

Mail service.

Efficient operation of automatic letter stamping machines, detection of forged postage stamps.

Special illumination effects

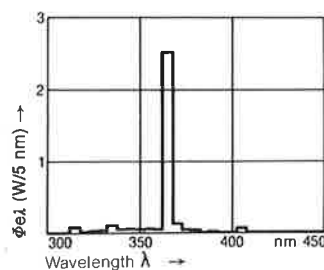
e.g. on theatre and operatic stages, in nightclubs, discotheques, bars, etc.

Further fields of application:

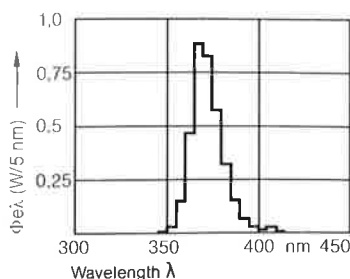
advertising; shop windows; agriculture (e.g. examination of seed corn); mineralogy.

Examination of gemstones; art historical tests; paleography; diagnostics.

The operation of damaged HQV lamps or without an outer bulb is dangerous and not allowed.



**Spectral Power Distribution
HQV 125**

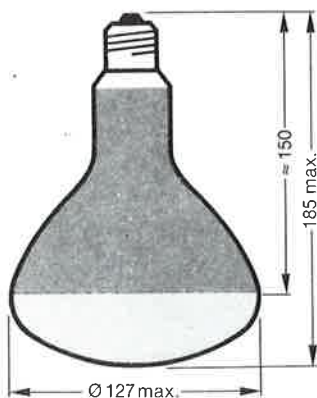


**Spectral Power Distribution
L 18/73**

Lamp reference	HQV 125	L 18/73	L 36/73
Lamp current A	1.15	0.37	0.44
Lamp power W	125	18	36
Diameter d mm	75	26	26
Length l mm	170	590	1200
Base	E 27	G 13	G 13
Ballast	Standard MBF 125 W	20 W SS	40 W SS
Starter	—	St 171, St 111	

ULTRA-VITALUX®

UV Lamps for Technical Applications



ULTRA-VITALUX

Because of their sunlike radiation and simple installation ULTRA-VITALUX lamps are particularly well suited for testing of materials and instruments used in different environments eg in the tropics, for artificial ageing, weathering, establishment of changes in materials, operational safety or life in special climates.

The total irradiance of the sun at noon on a sunny June day is in the average 1 kW/m^2 (annual avg. solar radiation at 50°N latitude: 200 W/m^2). An array of 16 UV lamps per square metre with a distance of 50 cm between lamp crown and irradiated object represents a similar irradiance.

For curing of plastics

Modern plastics can be cured with UV. Special photo initiators cause polymerization in plastics when exposed to UV.

The advantages of this process are: Only one substance is needed. No need for mixing and measuring. Almost unlimited processing times are possible under normal indoor lighting. Pot time is no problem. Fast curing by UV. Clean processing in the trade, in workshops and as a hobby.

For exposure of photoresists

In electronics the pattern of printed circuits is transferred by means of UV onto photoresists. After development the printed circuit can be etched, whereby only the desired conductors remain.

Simple handling and high UV content distinguish ULTRA-VITALUX® also for this application.

Mushroom shaped reflector bulb of special hard glass.

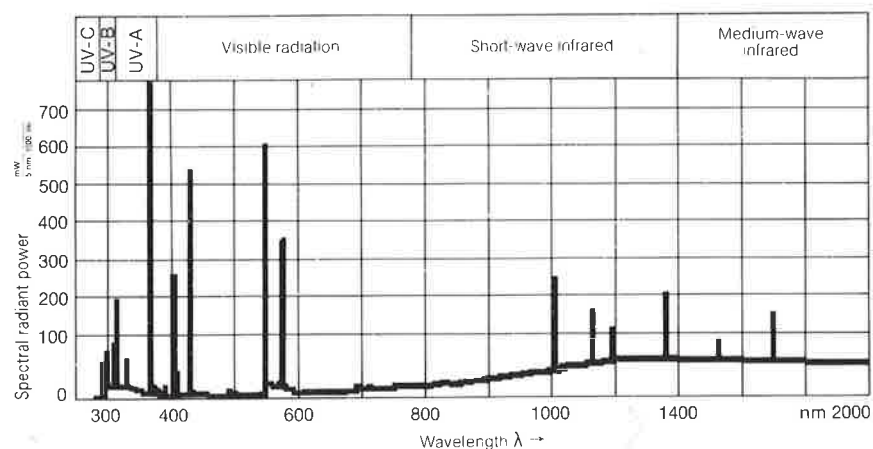
Base E 27.

Universal burning position.

Lamp reference	Lamp voltage V	Lamp wattage W	Run-up time \approx min	Service life (1) h
ULTRAVITALUX®	240	300	2	1000

(1) Time during which the UV radiant power decreases to 50% of the radiant power of a new ULTRA-VITALUX® lamp.

Spectral Power Distribution



ULTRA-VITALUX® Sunlamps

4

Before treatment of diseases consult your physician regarding optimum treatment.



The radiation of this well proven sunlamp for partial exposure of the body closely resembles the radiation of the sun and has the same large share of the biologically useful effect of the sun. Regular exposures increase the feeling of well-being, improve the resistance against diseases and give the skin a healthy sun tan. Simple installation and operation on 240 V ~ supply voltage.

Properties:

The ULTRA-VITALUX® lamp emits a blended radiation which closely resembles the radiation of the sun in high mountain areas and has the same vital biological effect on the organism. This blended radiation is generated by a quartz discharge tube and a tungsten filament. The bulb of this sunlamp is of special glass which transmits only that part of the radiation which is also part of the solar radiation.

Biological effects:

Many medical publications have dealt with the biological effects of the ULTRA-VITALUX® sunlamps, e.g.

Better blood circulation of the skin which becomes more elastic and smoother, whilst a healthy suntan is obtained as a cosmetic side effect.

Regulative effect on the vegetative nervous system. For the organism this means preservation of its resilience and efficiency or improvement of its capability to regenerate after hard work or illness.

Reduction of SH-groups, a result of which stimulates many bio-catalysts, e.g. enzymes, ferments, vitamins etc., to more intensive activity.

Raising, or regulation of the calcium level.

Prevention of infectional diseases on account of the bactericidal effects.

Excellent results in the treatment of acne, furuncles etc.

The effects of ultraviolet radiation can be intensified by simultaneous infrared radiation.

The UV irradiance at a distance of 1 m is:

UV-A approx. 5 W/m²

UV-B approx. 2 W/m².

Mushroom shaped hard glass reflector bulb

Base E27

Universal burning position

Lamp reference	Lamp voltage V	Lamp wattage W	Approx. run up time min.	Service life (1) h
ULTRA VITALUX®	240	300	2	1000

(1) Time during which the UV radiant power decreases to 50% of the radiant power of a new ULTRA-VITALUX® lamp.

4

EVERSUN UV-A Fluorescent Lamps for Solaria and Sun Beds

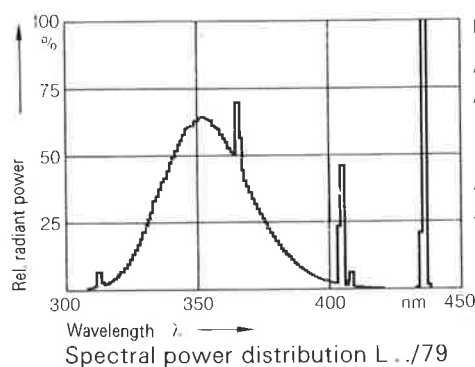
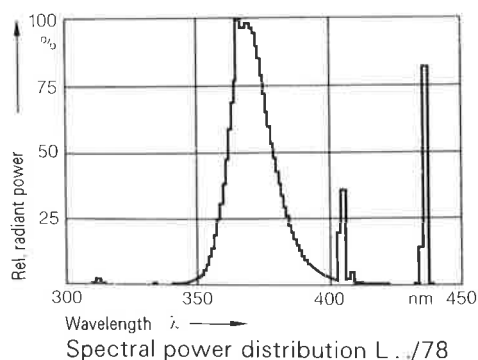
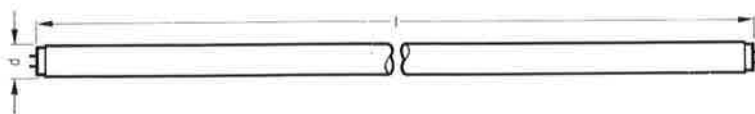
A special phosphor is used for the manufacture of the UV-A fluorescent lamps. This phosphor effectively transforms the shortwave UV radiation of the low pressure mercury discharge into a longwave UV-A radiation. On account of the filtering effect of the special glass of which the tube is made the amount of UV-B radiation is kept to a minimum. UV-A fluorescent lamps are particularly suited for solaria and sun beds. The high UV-A output guarantees a quick sun tan by direct pigmentation without negative effects for the skin. The small share of UV-B radiation allows long exposure times without danger of sunburn and is sufficient to stimulate the formation of pigments which are necessary for obtaining a sun tan.

Lamp reference	L 20/79			L 40/79 K		L 40/78 KR		L 80/79	L 80/78-R	L 100/79	L 100/79-B	L 100/78-R
Lamp watt	W	20		40		40		80		100		
Circuit watt approx.		30	50	55	92	55		92	119			
Lamp voltage	V	48		47		47		99		107		
Lamp current	A	0.46		0.88		0.88		0.87		1.0		
Switch start circuit		sgl lamp	series pair	sgl lamp	series pair	sgl lamp	series pair	single lamp				
Ballast	—	30 W	40 W	2 × 20 W	80 W	2 × 20 W		80 W		100 W 2400 mm		
Starter		St 111	2 × St 151	St 111	2 × St 151	St 111	2 × St 151	St 111		St 191 or St 196		
PFC capacitor	μF	5	4.5	11	9	11		9		10		
UV-A rad. flux (315–400 nm) 100 h		3.5		8		7		19	18	23		
UV-B rad. flux (280–315 nm) 100 h	W	0.02		0.04		0.01		0.1	0.02	0.12	0.16	0.03
UV-C rad. flux (below 280 nm) 100 h		0										
UV-A maintenance after 1000 h compared with 100 h	%	75		79		80		79	80	72		80
Safety factor (1)		4		5		>50		4	>50	5	3	>50
Base	—	G13										
Burning position		universal										
Length l	mm	438		590		1500		1764				
Diameter d		26				38						
Version	—	no reflector			reflector			no reflector	reflector	no reflector		reflector

(1) Threshold ratio erythema: direct pigmentation. The higher the Safety Factor, the lower the danger of sun burn (see DIN 5031 Pt. 10).

Caution:

Safe operation of these lamps is only warranted if used in purpose designed equipment. In case of questions contact your equipment manufacturer.



References:

- /79 Standard
- /79B With higher UV-B radiation resulting in shorter tanning times of previously tanned skin.
- /79K Standard lamp, shortened version.
- /78R With reflector resulting in higher, more directional radiant intensity and more intensive tanning.

ULTRAMED® Metal Halide Lamps

4

UV lamp for photochemical therapy, phototherapy of skin diseases and sun-tanning through direct pigmentation. With this UV lamp, which is particularly intensive in the ultraviolet range from 250 to 400 nm, it is possible to treat people suffering from psoriasis vulgaris, parapsoriasis, acne vulgaris etc. with photochemo-therapy, photo-therapy or selective photo-therapy.

In addition the high radiant flux in the UV range enables the use of this lamp for cosmetic purposes, e.g. suntanning through direct pigmentation. For this type of treatment, however, the radiant flux of the ULTRAMED® lamp in the UV B range must be reduced by using supplementary filters in order to decrease the danger of sunburn.

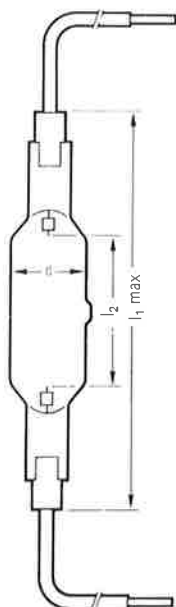
Industrial applications include the printing trade, varnish drying, hardening and polymerization of plastics, paints and resin, as well as reprographic use.

Lamp reference		ULTRAMED® 400	ULTRAMED® 1000	ULTRAMED® 2000	ULTRAMED® 4000
Supply voltage	V~	240	240	415	415
Lamp wattage	W	420	1000	2000	4000
Lamp voltage	V	125	130	250	250
Lamp current	A	4	9	9	18
UV A radiant flux (315–400 nm) (1)	W	80	200	450	800
UV B radiant flux (280–315 nm) (1)	W	16	40	100	160
Service life (2)	approx. h	1000	1000	800	500
Burning position		horizontal ± 30°			
Overall length	l_1	104	141	196	215
Arc gap	l_2	35	53	106	115
Overall diameter d	mm	16	28	30	34
Base		R7s	KY10s	KY10s	KY10s

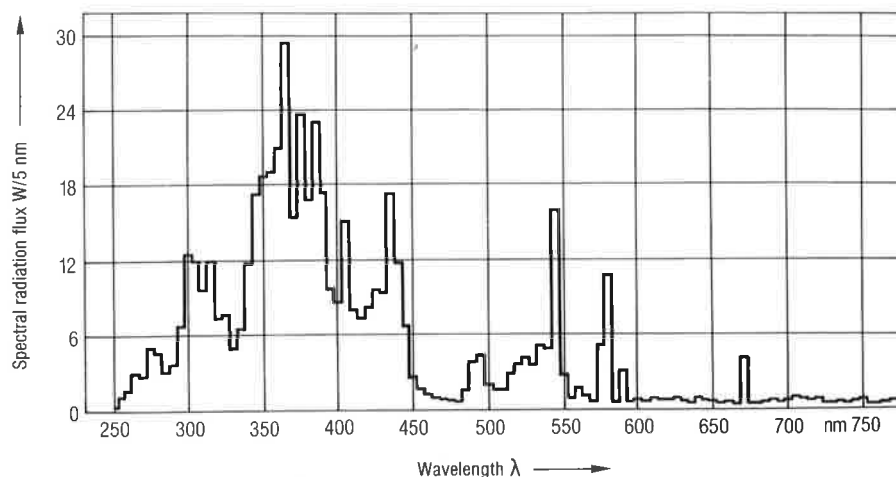
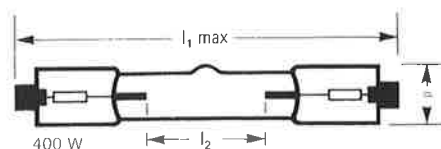
(1) After 20 h

(2) Cycle 60 min, on–15 min, off, 75% initial flux

Safe operation of these lamps is only warranted if used in purpose designed equipment. In case of questions, contact your equipment manufacturer.

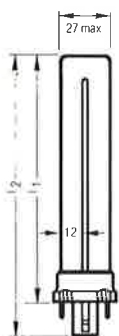


1000 W, 2000 W,
4000 W



4

WOTAN DULUX® S in Special Colours



WOTAN DULUX® S in special colours are compact fluorescent lamps. Their electrical and geometrical data correspond with those of the WOTAN DULUX® S lamps for general lighting and, therefore, can be operated with the same ballasts and lampholders (circuit diagram see page 28).

The difference lies in the use of special phosphors which transform the short wave UV radiation of low pressure mercury lamps quite efficiently into radiation in the blue or long-wave long wavelength UV range.

Applications

For polymerization of plastics, adhesives, varnishes and paints, depending on the thickness of the material, colour 71 is particularly suited for thickness over 5mm, colour 72 for 1–5 mm and colour 78 for < 1 mm. This rule of thumb can be influenced by colour or material.

For the exposure of diazo film colour 72 is recommended.

In medicine, for the treatment of hyperbilirubinaemia colour 71 is optimum, and for the photo-chemical treatment of psoriasis (PUVA) colour 78.

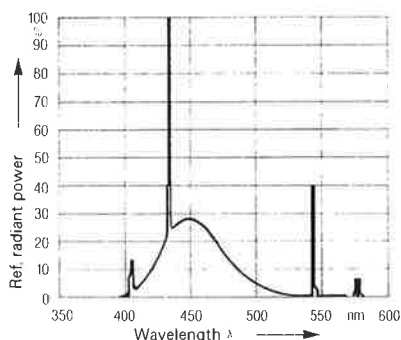
As insect trap colour 78 is suitable.

Lamp Reference		WOTAN DULUX S 7/78	WOTAN DULUX S 9/71	WOTAN DULUX S 9/78	WOTAN DULUX S 11/72	WOTAN DULUX S 11/78
Lamp wattage	W	7		9		11
Lamp current	A	0.175		0.17		0.155
Lamp voltage	V	45		60		90
Radiant power after 100 h	W	1.4 (1)	2.3 (2)	1.7 (1)	2.9 (3)	2.6 (1)
Length l_1	mm	115		145		215
Length l_2 (max.)	mm	138		168		238
Burning position				universal		
Base				G 23		
Starter				integral		

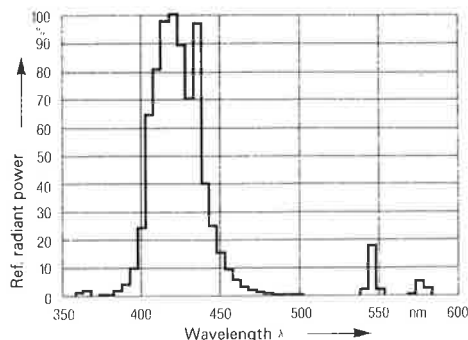
1) In the range of 350–400 nm.

2) In the range of 400–550 nm.

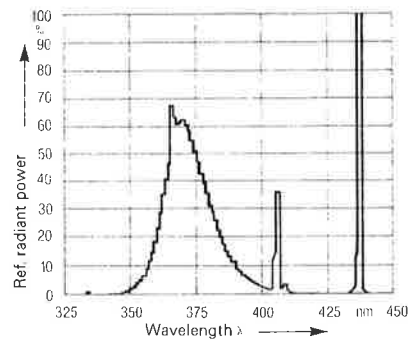
3) In the range of 380–480 nm.



Spectral power distribution
WOTAN DULUX® S 9/71



Spectral power distribution
WOTAN DULUX® S 9/78



Spectral power distribution
WOTAN DULUX® S 11/72

HNS Germicidal and Ozone Generating UV Lamps

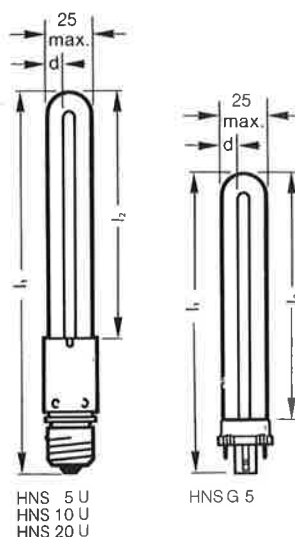
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Caution:
Safe operation of these lamps is only warranted if used in purpose designed equipment. In case of questions, contact your equipment manufacturer.

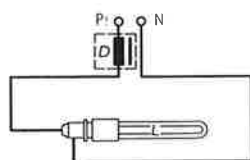
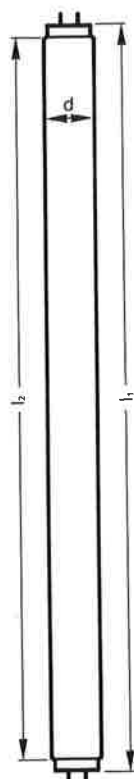
HNS germicidal and ozone generating UV lamps save costs because of their low power consumption, clean operation and long service life. They prevent losses resulting from decayed goods and provide at the same time a healthier environment. Their disinfecting effect is equal to a 100 fold air circulation per hour, compared with a 10 fold air circulation in conventional air conditioning plants. Their radiation peaks at 253.7 nm.

The disinfection of water by shortwave UV radiation is superior to all chemical treatments, as far as water quality and costs are concerned.

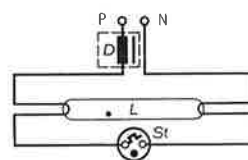
HNS UV lamps are also suitable for the erasion of microelectronic memories (EPROM). The compact UV lamp HNS 10 and 20 W/U are particularly suitable for this purpose.



Lamp reference		HNS 10/UOZ (1)					
		HNS G5OFR (1)	HNS 5/UOZ (1)	HNS 10/UOFR (2)	HNS 15/OFR (2)	HNS 20/UOZ (1)	HNS 30/OFR (2)
Lamp current max.	mA		150	170	330	500	370
Lamp wattage	W		5	10	15	20	30
Irradiance (3)	$\mu\text{W}/\text{cm}^2$		18	50	40	80	90
UV radiant power	W		1.5	4	3.5	7	8
Tube diameter d avg.	mm		10	10	26	10	26
Length l ₁ max.	mm	120	146	221	438	221	895
Length l ₂ max.	mm	79	68	142	378	142	835
Service life (60% of initial UV radiant power)	h			6000			3000
Base		G23		E 27		E 27	G 13 (4)
Ballast		5/7/9/11 W SS		10 W SS		20 W SS	30 W-T8 SS
Starter (see page 34)			built-in		St 111	built-in	St 111

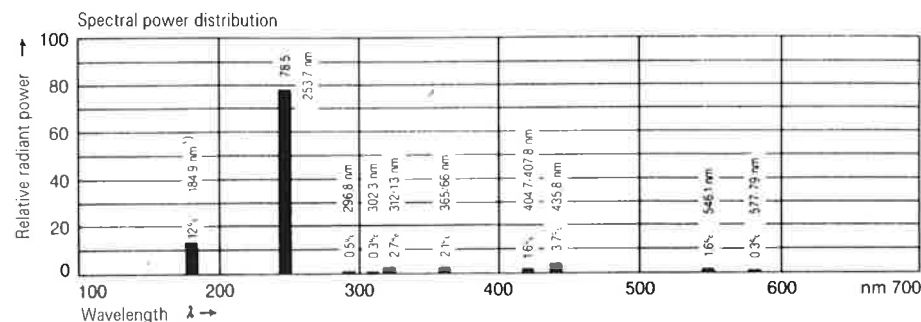


Circuit HNS G5
HNS 5/U
HNS 10/U
HNS 20/U



Circuit
HNS 15
HNS 30
HNS 55

D = ballast
L = lamp
N = neutral
P = phase
St = starter



¹⁾ HNS 10 and 20 W/U oz only

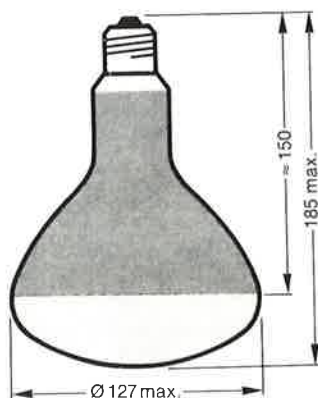
- (1) Germicidal and ozone generating lamp.
- (2) Ozone free germicidal lamp.
- (3) UV irradiance 253.7 nm measured at a distance of 1 m, at the lamp centre, at 20°C ambient temperature, free burning. Between distances of 0.3 and 3.0 m, the irradiance is proportional to the inverse value of the square distance. The legs of lamp HNS 10 and 20/U point towards the irradiated object.
- (4) As fluorescent lamps L 15/- and L 30/-.
- (5) Minimum ordering quantities.

4

SICCATHERM® HALOTHERM® Infrared Lamps



SICCATHERM®
100 W, 175 W



SICCATHERM®

SICCATHERM® infrared lamp for agriculture, industry, research and trade

SICCATHERM® are quality infrared lamps. The maximum of their radiation is in the infrared (heat), the visible portion (light) is small.

SICCATHERM® PAR, compared with conventional infrared lamps, are particularly economical: up to 30% lower power consumption at the same intensity are achieved by its optimized reflector design for a narrower beam and its computer calculated diffuser for uniform irradiance.

Applications

- in animal breeding of poultry, pigs, calves, foals.

Function when used for animals: Faster growth rate due to greater appetite and improved utilization of fodder. Increased resistance against diseases. No crowding of the young animals due to lack of warmth, therefore lower breeding losses. Clean hygienic stables because of dry litter. Increased efficiency.

- in food processing for pasteurizing and drying.

- in industry for varnish and paint curing, for enamelling processes and for distilling.

Function when drying: The infrared radiation generated by the SICCATHERM® lamp penetrates the material to be dried and is absorbed in its interior. Thus considerable heat exchange with the surrounding air can be avoided. It is advantageous that not only the surface is dried, but the entire substance is heated. The drying process is accomplished as if the evaporation surface were enlarged several times.

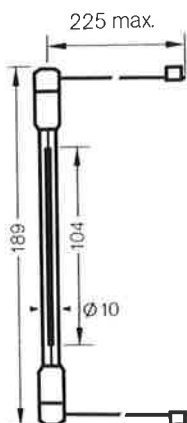
Base E 27

Lamp reference	Watt	Crown	Average service life h	Burning position
100 SICCA LR	100	red filter	5000	BU ± 90
150 SICCA LR	150	red filter	5000	universal
175 SICCA LR	175	red filter	5000	BU ± 90
250 SICCA LR	250	red filter	5000	universal
250 SICCA L	250	clear	5000	universal
250 SICCA I	250	frosted	5000	universal
375 SICCA I	375	clear	5000	universal

HALOTHERM® tungsten-halogen infrared lamps for today's hobs.

Today's kitchen-ranges with ceramic hobs use not only conventional heating elements, but also HALOTHERM® tungsten-halogen infrared lamps. The full radiant power is instantly available after switching on. The heat can be used for a specific task more quickly and more discriminately.

Lamp reference	Lamp wattage W	Lamp voltage V	Burning position
HALOTHERM 500	500	110	H ± 15°

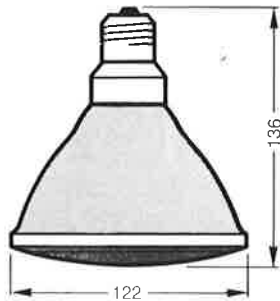


HALOTHERM®

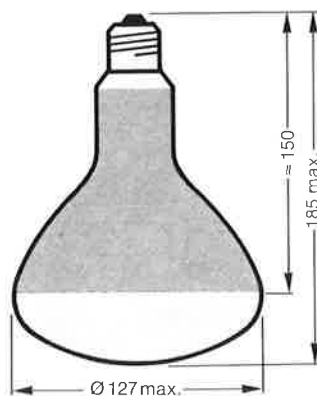
THERATHERM® Infrared Lamps

4

Caution:
Before treatment of diseases consult your physician regarding optimum treatment.



THERATHERM® DE LUXE



THERATHERM®

THERATHERM® infrared lamps emit in the therapeutical effective range of short wave infrared. The specially pigmented red filter provides an agreeable, uniform colour. The parabolic reflector beams the radiation to high irradiance. THERATHERM® infrared lamps radiate the full radiant energy immediately after switch-on. They excell by a very long lamp life.

Biological effects:

THERATHERM® are infrared lamps of high biological value, mainly because of their great translaminar, as well as thermal effects in the organism. The cells and organs exposed to the thermal radiation are activated and the blood circulation is improved on account of the widening of the blood vessels. This makes possible an accelerated reduction of metabolites and mobilisation of antigens in the body. The result is a palliation of pains with pathological symptoms such as rheumatism, muscular pains, sciatica, arthritis, lumbago, face neuralgia, influenza, sinusitis and bronchial catarrhs, inflammation of the throat and middle ear, abrasions, cuts and grazes, fresh scars, other minor injuries, contusions, sprains, stains, bruises, effusions of blood, toothache following dental treatment etc. The absorbed heat is physiologically distributed through the body by the blood circulation.

Since the main part of the radiation penetrates the skin and stratum germinativum without being absorbed, the skin is not affected so that no local burns will occur, provided the directions for use are followed.

Applications:

THERMATHERM® are recommended for therapeutical applications:

- in private houses
- in practices of doctors, physiotherapists, or masseurs.
- in hospitals and nursing-homes
- for face and beauty treatment
- as additional infrared lamps in solaria systems WOTAN ULTRA-VITALUX®

THERATHERM® DE LUXE: Pressed glass reflector bulb

THERATHERM®: Hard glass reflector bulb

Base E27

Universal burning position

Lamp reference	Lamp voltage V	Lamp wattage W	Service life h	Weight g
THERATHERM® DE LUXE	240	150	5000	400
THERATHERM®	240	250	5000	150

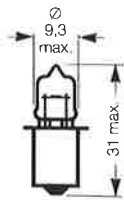
5

Miniature Lamps

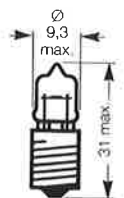


MINIWATT® Tungsten-halogen Miniature Lamps

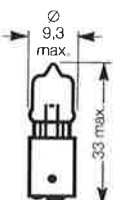
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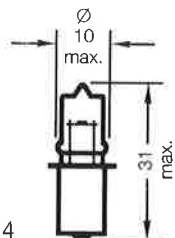
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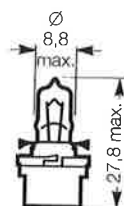
2



3



4



5

MINIWATT®
lamp reference

Lamp
voltage
V

Lamp
wattage
W

Lamp
current
mA

Luminous
flux
lm

Average
life
h

Fig.
no.

MINIWATT® tungsten-halogen lamps for battery use Base P 13.5s

6405310 (HPR52)	2.8	2.4	850	35	10	1
6405710	4	2	500	33	15	1
6405910 (HPR53)	4	3.4	850	60	25	1
6406310	5.2	2.6	500	48	15	1
6406510 (HPR50)	5.2	4.4	850	85	25	1
6407210 (HPR51)	6.5	4.5	700	90	25	1

Base E10

6405330	2.8	2.4	850	36	10	2
6405730	4	2	500	34	15	2
6405930	4	3.4	850	62	25	2
6406330	5.2	2.6	500	50	15	2
6406530	5.2	4.4	850	90	25	2

MINIWATT® tungsten-halogen lamps long life

Base P 13.5s

6404010	4	4	1000	50	300	1
6404110	4	4	1000	50	600	1

Base BA 9s

6404036	4	4	1000	60	300	3
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Tungsten-halogen vehicle lamps

Base PX 13.5s

64100 HS3	6	2.4	400	36	100	4
64130	6	15	2500	320	200	4
64131	12	15	1250	320	200	4

Base BA 15s

64170	12.8	50	3900	1250	200	—
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Base BA 9s

64111	13.5	5	370	80	240	3
64113	13.5	10	740	200	240	3
64115	13.5	20	1480	450	240	3

MINIWATT® tungsten-halogen lamps for LCD illumination

Tungsten-halogen lamps have important advantages:

- higher and constant luminous flux throughout lamp life
- higher colour temperature (approx. 3000 K)—white light
- unchanging, very good colour rendering properties throughout life
- long life

and, therefore, are particularly suited for LCD illumination, resp. coupling with fiber optics

Plastic holder MF for printed circuit boards with a thickness of 2 mm.

Plastic holder MFX for printed circuit boards with a thickness of 1.6 mm.

Wire ended on request.

64122 MF	12	3	250	26 (1)	2000	5
64122 MFX	12	3	250	26 (1)	2000	5
64124 MF	12	5	415	50 (1)	2000	5
64124 MFX	12	5	415	50 (1)	2000	5

Tungsten-halogen navigation lamp

Base BA 9s

64022	12	5		75	400	3 (2)
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(1) Measured with plastic holder.

(2) Similar to Fig. 3, but with vertical filament.

5

Miniature Lamps Lamp Types

ERG lamp reference

MINIWATT®
lamp
reference

Lamp
voltage
V

Lamp
wattage
W

Lamp
current
mA

Luminous
flux
lm

Bulb
size

MINIWATT® lamps are used as indicator lamps, e.g. in domestic appliances, switch gear and office machines as well as in entertainment electronics, electronic data processing equipment and medicinal appliances.

Benefits

WOTAN MINIWATT® and ERG Lamps offer these advantages:

Long life: 10,000–1000 h. (The first values listed below refer to 10,000 h, the second values to 1000 h, unless otherwise stated.)

Internationally standardized

B22d

Pygmy sign	—	200–250	10–15	50–56	40–100	S25
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E14

—	6514	19–24	6–10	355–400	(1)	S25
Pygmy sign	—	—	10–15	560–630	40–100	
—	6522	110–140	6–10	63–70	(1)	

—	6524	210–260	—	32–36	(1)	T16
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RL 24V 5W E14	—	19–24	3.5–5	180–200	(1)
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RL 30V 5W E14	—	24–30	—	140–160	—
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RL 24–30V 6–10W E14	6814	—	7–10	250–280	25–63
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RL 42V 5W E14	—	34–42	3.5–5	100–110	(1)
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RL 36–45V 6–8W E14	6816	36–45	7–10	200–220	25–63
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RL 60V 5W E14	—	45–60	3.5–5	70–80	(1)
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RL 48–60V 6–10W E14	6818	—	7–10	140–160	25–63
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RL 110–130V 5–7W E14	—	105–130	5–7	45–50	(1)
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RL 110–140V 6–10W E14	6822	110–140	7–10	63–70	25–63
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RL 220–250V 6–10W E14	6824	200–250	7–10	36–40	25–63
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RL 220–260V 5–7W E14	—	210–260	5–7	22–25	—
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RL/I 24V 5W E14	—	19–24	—	180–200	—
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RL/I 30V 5W E14	—	24–30	—	140–160	—
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RL/I 48V 5W E14	—	38–48	3.5–5	90–100	(1)
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RL/I 60V 5W E14	—	48–60	—	70–80	—
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RL/I 130V 5W E14	—	105–130	—	32–36	—
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RL/I 220–260V 5–7W E14	—	210–260	5–7	25–28	—
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BA15d

RL 24V 5W BA15d	—	19–24	3.5–5	180–200	(1)	T17
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RL 30V 5W BA15d	—	24–30	—	140–160	—
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RL 24–30V 6–10W BA15d	6815	—	7–10	250–280	25–63
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RL 42V 5W BA15d	—	34–42	3.5–5	100–110	(1)
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RL 36–45V 6–10W BA15d	6817	36–45	7–10	200–220	25–63
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RL 60V 5W BA15d	—	45–60	3.5–5	70–80	(1)
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RL 48–60V 6–10W BA15d	6819	—	7–10	140–160	25–63
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RL 110–130V 5–7W BA15d	—	105–130	5–7	45–50	(1)
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RL 110–140V 6–10W BA15d	6823	110–140	7–10	63–70	25–63
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RL 220–250V 6–10W BA15d	6825	200–250	7–10	36–40	25–63
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RL 220–260V 5–7W BA15d	—	210–260	5–7	22–25	—
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RL/I 24V 5W BA15d	—	19–24	—	180–200	—
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RL/I 30V 5W BA15d	—	24–30	—	140–160	—
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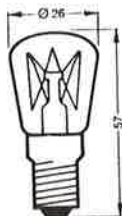
RL/I 48V 5W BA15d	—	38–48	3.5–5	90–100	(1)
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RL/I 60V 5W BA15d	—	48–60	—	70–80	—
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RL/I 130V 5W BA15d	—	105–130	—	32–36	—
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RL/I 220–260V 5–7W BA15d	—	210–260	5–7	25–28	—
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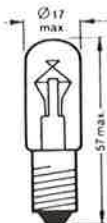
(1) On request.



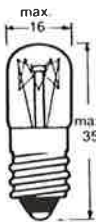
MINIWATT
6500 series



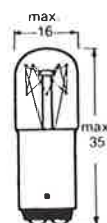
ERG
RL



MINIWATT
6800 series
E14



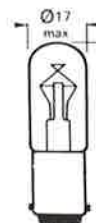
ERG
RL/I



ERG
RL/I



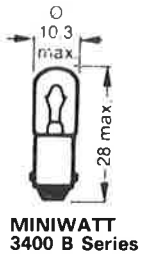
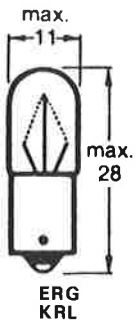
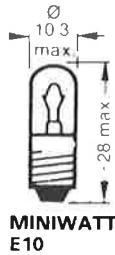
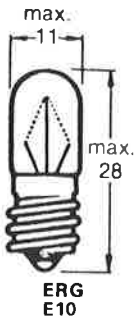
ERG
RL



MINIWATT
6800 series
BA 15d

Miniature Lamps Lamp Types

5

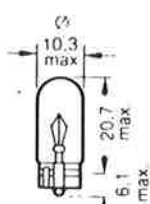


ERG lamp reference	MINIWATT ^R lamp reference	Lamp voltage V	Lamp wattage W	Lamp current mA	Luminous flux lm	Bulb size
E10						
KRL 6V 3W E10	—	4-6	2.2-3	450-500		
—	3450	6-7	1.8-2.5	315-355		
—	3353	10-12	0.8-1.1	90-100		
KRL 12V 3W E10	—	—	2.2-3	220-250		
—	3453	12-16	2-2.8	160-180	(1)	
—	3361	14-18	1.2-1.8	90-100		
—	70205	—	0.8-1.1	45-50		
KRL 24V 0.08A E10	—	19-24	1.2-1.8	70-80		
KRL 24V 3W E10	—	—	2.2-3	110-125		
KRL 30V 0.07A E10	—	24-30	1.4-2	63-70		
KRL 30V 3W E10	3456	—	—	90-100	6-16	T10
KRL 36V 3W E10	—	28-36	2.2-3	70-80		
KRL 42V 3W E10	—	34-42	—	63-70	(1)	
—	3459	36-45	2-2.8	56-63		
KRL 48V 3W E10	—	38-48	2.2-3	—		
—	3462	45-60	2-2.8	40-45	4-10	
—	3482	—	4-5.5	80-90		
KRL 60V 3W E10	—	48-60	2.2-3	45-50	(1)	
KRL 130V 0.02A E10	—	105-130	1.8-2.5	18-20		
BA9s						
KRL 6V 3W BA9s	—	4-6	2.2-3	450-500		
—	3450 B	6-7	1.8-2.5	315-355		
KRL 12V 3W BA9s	—	10-12	2.2-3	220-250		
—	3453 B	12-16	2-2.8	160-180	(1)	
—	3473 B	—	4-5.5	315-355		
KRL 24V 0.08A BA9s	—	19-24	1.2-1.8	70-80		
KRL 24V 3W BA9s	—	—	2.2-3	110-125		
KRL 30V 0.07A BA9s	—	—	1.4-2	63-70		
KRL 30V 3W BA9s	3456 B	24-30	2.2-3	90-100	6-16	T10
—	3476 B	—	4-5.5	160-180		
KRL 36V 3W BA9s	—	28-36	—	70-80	(1)	
KRL 42V 3W BA9s	—	34-42	2.2-3	63-70		
KRL 48V 3W BA9s	—	38-48	—	56-63		
KRL 60V 3W BA9s	3462 B	48-60	—	45-50	4-10	
—	3482 B	—	4-5.5	80-90	(1)	
KRL 130V 0.02A BA9s	—	105-130	1.8-2.5	18-20		

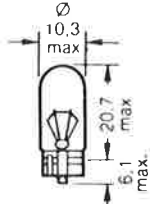
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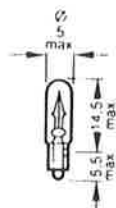
Miniature Lamps Lamp Types



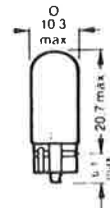
2500 Series



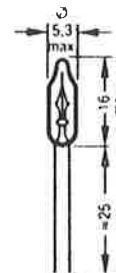
62150 Series



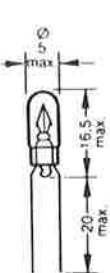
2300 Series



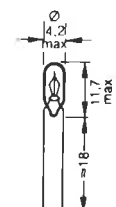
2500/1 Series



2200U Series



**2300K
2700K Series**



3200U Series

ERG lamp reference	MINIWATT® lamp reference	Lamp voltage V	Lamp wattage W	Lamp current mA	Luminous flux lm	Bulb size
Wedge base						
(1)	2501	6-7	1.8-2.5	315-355	(7)	T10
	2521	12-16	2-2.8	160-180	5-12	
	2541	24-30	2-2.8	80-90	(7)	
	2581	48-60		40-45		
—	2306	6-7	0.16-0.22	28-32	0.4-1	T5
	2307		0.4-0.55	80-90	1.6-4	
	2305		0.8-1.1	160-180	3-8	
	2322	12-16	0.3-0.45	32-36	1-2.5	
	2321		1-1.4	80-90	4-10	
	2342	24-30	0.6-0.9	32-36	2-5	
	2341		1-1.4	45-50	3-8	
(2)	2506/1	12	1.2	100	(7)	T10
(3)	2509/1	6	1.8	300		
Wire Ended						
—	2205 U	6-10	0.2-0.28	40-45	0.6-1.6	
	2206 U		0.4-0.55	80-90	1.2-3	
	2209 U	12-16	0.5-0.7	40-45	(7)	
	2211 U		1-1.4	80-90		
(5)	2202 U	24-30	1.2-1.8	50-56		T5
	2306 K	6-7	0.16-0.22	28-32	0.4-1	
	2307 K		0.4-0.55	80-90	1.6-4	
	2305 K		0.8-1.1	60-180	3-8	
	2721 K	11-14		80-90	(7)	
	2722 K		1.4-2	12-14		
	2322 K	12-16	0.3-0.45	28-32	1-2.5	
	2321 K		1-1.4	80-90	4-10	
	(6)	3200 U	5-6	0.1-0.14	20-22	
3201 U		0.2-0.28		40-45		
3204 U		12-16	0.25-0.35	20-22		
3205 U			0.5-0.7	40-45		
3206 U			1-1.4	80-90		

- (1) Also available frosted.
 (2) Possibly subject to minimum ordering quantity.
 (3) Frosted radio panel lamps, rated life 5000 h.
 (4) Frosted radio panel lamps, rated life 10,000 h.
 (5) Wire ends can be soldered and welded, they are not straightened when delivered. If dip solder wire ends (IEC Pub. 68-2-20) are required, add . . . UK to lamp reference.
 (6) Wire ends can be dip soldered (IEC Publ. 69-2-20).
 (7) On request.

Miniature Lamps

Technical Information

5

Voltage characteristics

The diagram shows the interdependence between voltage variation and luminous flux, wattage, current and life.

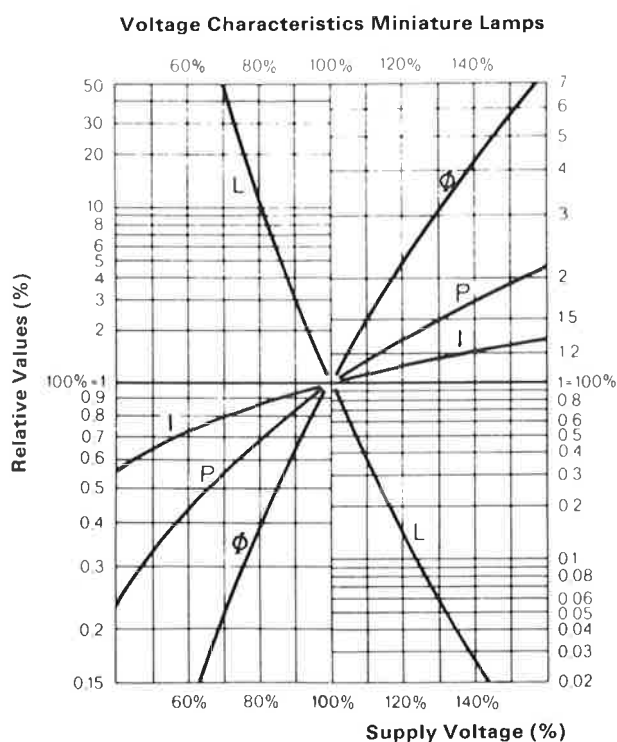
Burning position

Universal.

Lamp bases

The IEC Lamp Base Code (IEC Publ. 61, BS 5101) indicates, first by upper case letter, the type of base. The figures following indicate the nominal outer diameter of the base barrel or screw thread in mm. The last lower case letter describes the number of contacts (s = single, d = double).

Withdrawn lamp base and bulb size designations should not be used any longer. Some commonly used abbreviations were:



Φ = Luminous Flux (lm)
 P = Input Power (W)
 I = Current (A)
 L = Life (h)

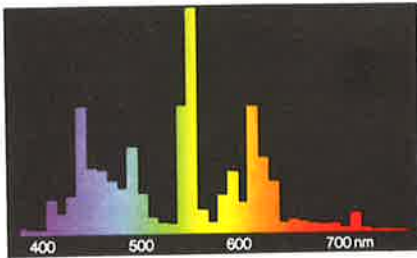
IEC and BS bases	Withdrawn bases
BA9s	MCC
B15s or BA15s	SCC
B15d or BA15d	SBC
B22d	BC
B22d-3	3-pin BC
E5	LES
E10	MES
E14	SES
E27	ES
E40	GES

Metric bulb sizes	Withdrawn Imperial bulb sizes
T17	T5 $\frac{1}{4}$
16	5
14	4 $\frac{1}{2}$
11	3 $\frac{1}{2}$
10	3 $\frac{1}{4}$
6	2
5	1 $\frac{1}{2}$
4	1 $\frac{1}{4}$

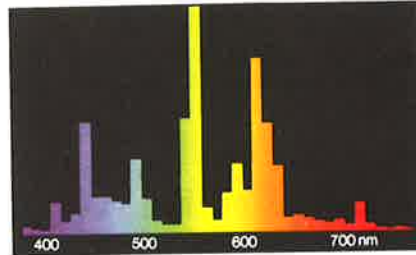
Spectral Power Distribution of Fluorescent Lamps

Visible range from 380 to 780 nm

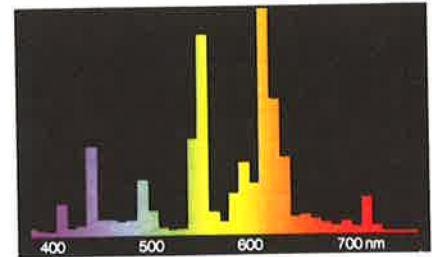
Height of illustration corresponds with $\frac{200 \text{ mW}}{1000 \text{ lm} \cdot 10 \text{ nm}}$



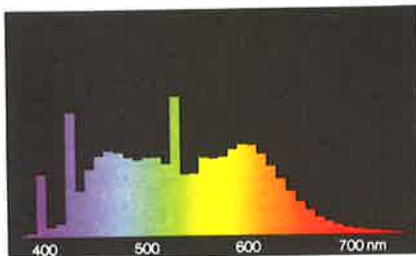
11 MAXILUX® Daylight



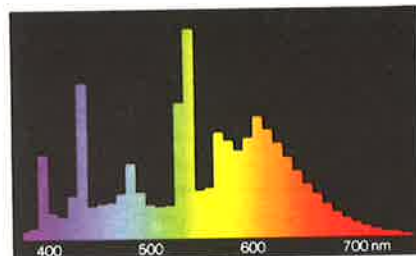
21 MAXILUX® White



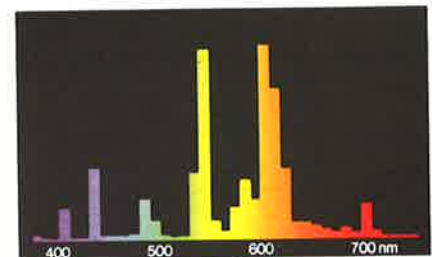
31 MAXILUX® Warm White



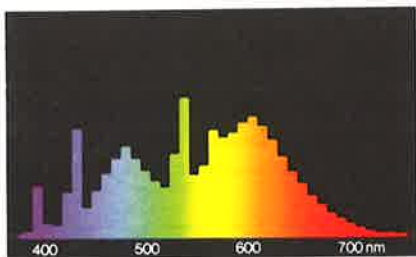
12 MAXILUX® DE LUXE Daylight



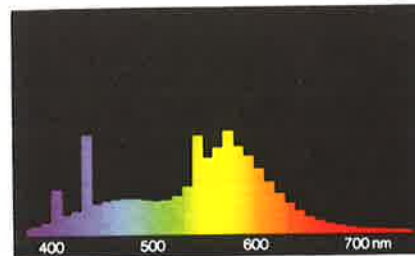
32 MAXILUX® DE LUXE Warm White



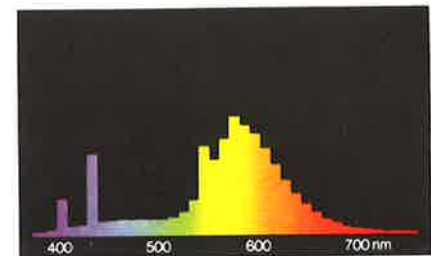
41 MAXILUX® INTERNA®



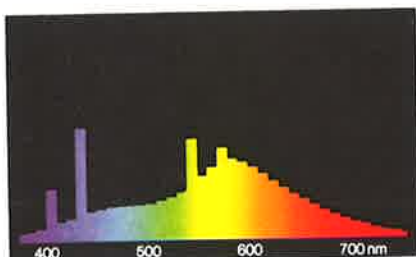
22 MAXILUX® DE LUXE White



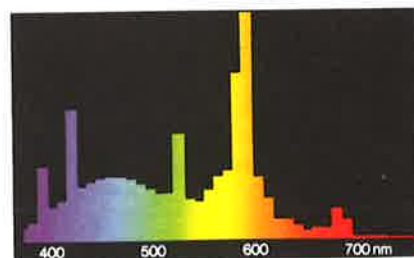
20 Cool White



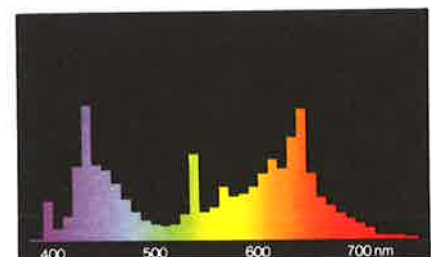
30 Warm White



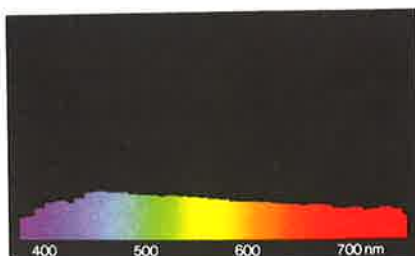
25 Neutral



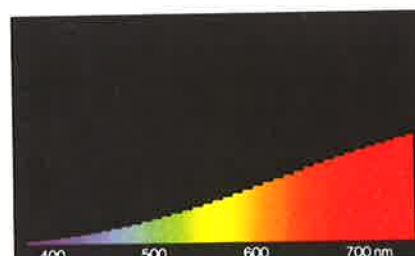
76 DE LUXE NATURA



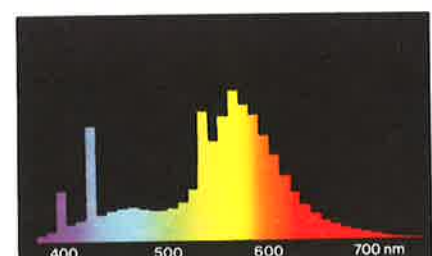
77 FLUORA®



Natural daylight (D 65)



Incandescent lamp



23 White

Height of illustration corresponds with $\frac{200 \text{ mW}}{\text{m}^2 1000 \text{ lx} 10 \text{ nm}}$

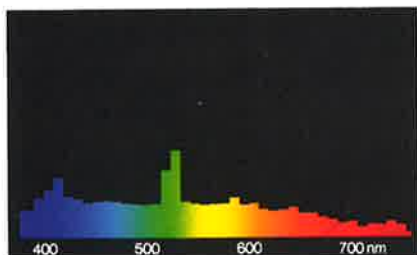
Spectral Power Distribution of Discharge Lamps

Visible range from 380 to 780 nm

Height of illustration corresponds with $\frac{200 \text{ mW}}{1000 \text{ lm} \cdot 10 \text{ nm}}$

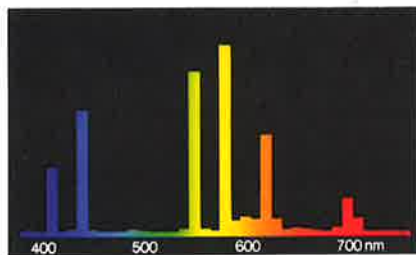
6

POWER STAR HQI®



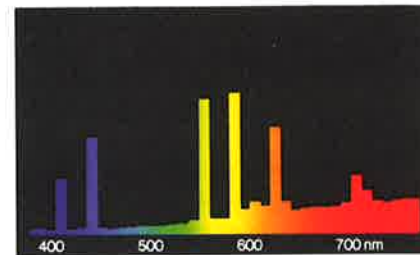
HQI.../D

HQL lamps

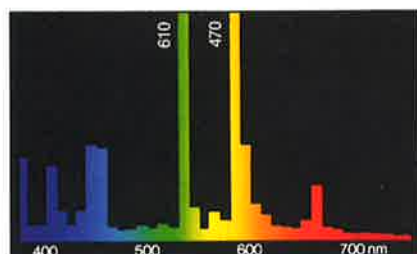


HQL

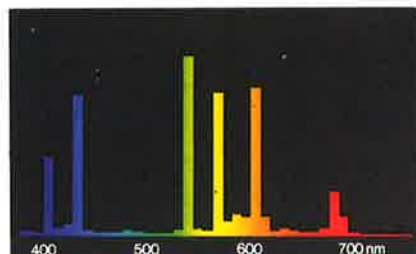
HWL lamps SODIUM lamps



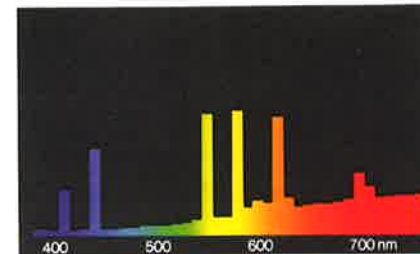
HWL



HQI.../N



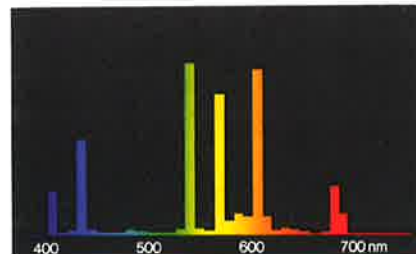
HQL DE LUXE



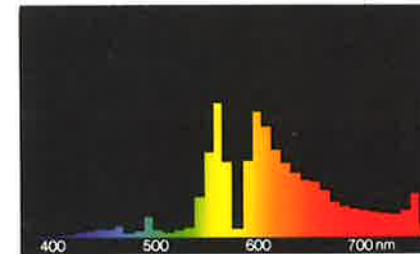
HWL-R DE LUXE



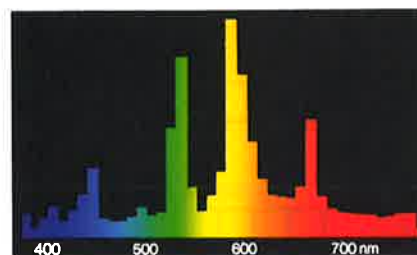
HQI.../NDL



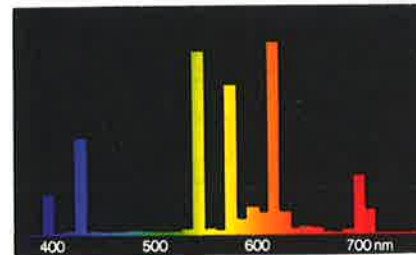
HQL SUPER DE LUXE



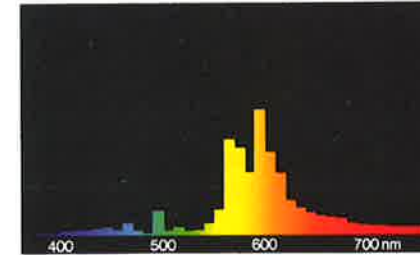
VIALOX® NAV DE LUXE



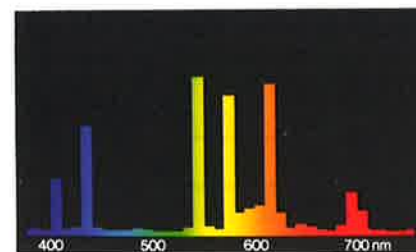
HQI-TS.../WDL



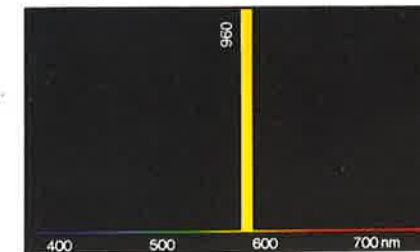
HQL-B SUPER DE LUXE



VIALOX® NAV



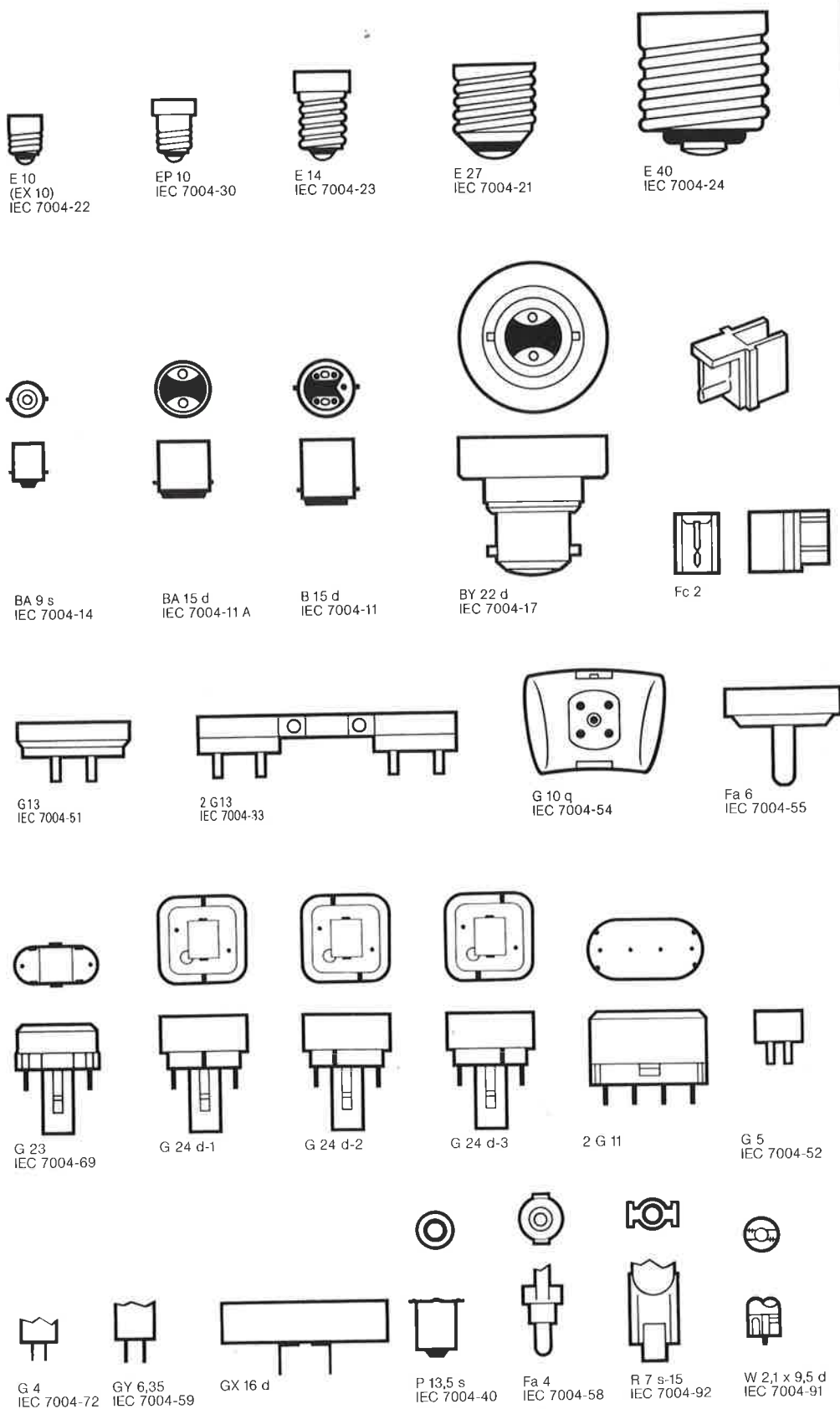
HQL-R DE LUXE



SOX

6

Lamp Base Comparison



The IEC numbers refer to IEC Publ. 61 = BS 5101

Sales Programme

Indoor and Outdoor Lighting

General lighting service lamps
Fluorescent lamps
Discharge lamps
Miniature lamps
Special lamps

Illuminating Ideas

Luminaires with fluorescent,
MAXILUX® and compact fluorescent lamps
Luminaires for tungsten-halogen lamps
Plant display luminaires
Luminaires for special applications

Vehicle Lamps

Automobile lamps
Motorcycle lamps
Moped lamps
Bicycle lamps
Automobile spare lamp boxes
Sales aids

Indicator and Signal Lamps

MINIWATT® lamps
Tungsten-halogen lamps for pocket and LCD lights
Telephone lamps
Radio panel lamps
Aircraft lamps
Neon glow lamps
Miniature lamps

Traffic Light Lamps

Light for Photo, Studio and Theatre

FlipFlash, FlashBar, flashcube, VACUBLITZ®
SUPERPHOT® and NITRAPHOT® photographic lamps
XENOPHOT® HLX tungsten-halogen projector lamps
BELLAPHOT® lamps for slide and cine projection
Projector lamps
Cinema and episcopes lamps
Enlarger lamps
Darkroom lamps
Tungsten-halogen for overhead and advertising
projectors, microfilm readers and microscopes
HALOS HCI metal halide lamps for overhead
projectors
HALOMET HTI metal halide lamps with reflector
lamps for film, TV and photo studios
Theatre lamps
Floodlighting lamps
METALLOGEN HMI metal halide lamps

Photo, Video and Film Equipment for Perfect Lighting

Electronic flash units
Video and film lights
Slide viewers
Darkroom safety lights

Light for Cine Projection, Technology and Science

HBO short-arc mercury lamps
XBO short-arc xenon projector lamps
XBF water cooled xenon lamps
KBF water cooled krypton lamps
EURAM® electronic flashtubes
Spectral lamps
Tungsten-halogen airport lamps
Tungsten-halogen infrared reflector lamps
Scientific lamps

Please request catalogues covering the above subjects by asking for the boldly printed titles.



Registered Trade Marks General Information

Registered trade marks

ARAM®	HALOS®	OVISIL®	WOTAN HALOTUBE®
AS®	HALOTHERM®	POWERTRONIC®	WOTAN HBO®
BELLALUX®	HALOTRONIC®	QUICKTRONIC®	WOTAN HLX®
BELLAPHOT®	JOGGILUX®	RAM®	WOTAN HMI®
BILUX®	LINESTRA®	SICCATHERM®	WOTAN HQI®
CENTRA®	LUMILUX®	SUPERLUX®	WOTAN HQL®
CENTRALUX®	LUMINESTRA®	SUPERPHOT®	WOTAN HTI®
CENTRONIC®	LUMIPHOT®	THERATHERM®	WOTAN L-INTERNA®
CIRCOLUX®	MAXILUX®	ULTRA-VITALUX®	WOTAN LONGLIFE®
COMBILUX®	MAXILUX INTERNA®	URDOX®	WOTAN NAV®
CONCENTRA®	METALLOGEN®	VACUBLITZ®	WOTAN POWER STAR®
DEKOLUX®	MINIWATT®	VIALOX®	WOTAN SOLARCA®
DEOS®	MONTASOL®	WOTAN®	WOTAN ULTRAMED®
DIADEM®	NERON®	WOTAN BELCOLOR®	WOTAN ULTRATECH®
EURAM®	NITRA®	WOTAN COMPACTA®	WOTAN UVISTRA®
FLUORA®	NITRAPHOT®	WOTAN DULUX®	WOTAN XBF®
GIGANT®	OPALINA®	WOTAN EVERSUN®	WOTAN XBO®
HALOFLOOD®	OS®	WOTAN HALOCENT®	XENOPHOT®
HALOMET®	OSA®	WOTAN HALO STAR®	

General Information

The technical data are in accordance with BS (British Standards) and IEC (International Electrotechnical Commission) where applicable.

All lamps, with the exception of those marked otherwise, are designed for supply voltages of 240 V.

The supply of lamps not listed, including those with different lamp bases and voltages, will be investigated upon request.

Sales and delivery are subject to the WOTAN Conditions of Sale valid on the day the sales contract was effected.

Operating data and dimensions are subject to the usual tolerances.

Technical modifications are reserved and supply is

subject to availability.

Lamps are wrapped in the original white-blue folding box. Standard packs differ depending on the size and shape of the lamps.

Standard packs enjoy important advantages:

Prompt delivery

Simple and cost saving warehouse handling

No time consuming individual count on arrival of the goods

Exact contents description on each stacked carton

No danger of wrong type identification

Less breakage.

WOTAN Lamps Ltd. is constantly developing and improving its products. The right is reserved to change specifications given in this catalogue without notice.

Every effort has been made to make the information as useful and accurate as possible, but the customer must regard this information as being by way of general guidance only and WOTAN Lamps Ltd. can accept no liability in connection therewith.

The Health and Safety at Work etc. Act 1974

Essential guidance for safe installation, maintenance and disposal of WOTAN lamps is provided with the product.

More detailed information is given in the relevant Product Information available free on request.



WOTAN advertising board 1910

The Museum of London

WHO IS WOTAN?

WOTAN Lamps Limited is a UK subsidiary of OSRAM GmbH and wholly owned by SIEMENS AG.

Sir William Siemens was not only one of the founders of SIEMENS, but also the first president of what is today the Institution of Electrical Engineers in London. In 1883 he was knighted by Queen Victoria for his services to the British electrical industry.

The SIEMENS group today achieves sales of over £17 billion, and more than 360,000 employees manufacture electrical equipment from the smallest microcomputer components to the largest nuclear power plants.

OSRAM GmbH is the second largest lamp manufacturer in Europe and the fourth largest in the world. As specialists OSRAM GmbH manufacture only lamps, in 30 factories worldwide.

The trademark WOTAN is derived from the words WOLfram (tungsten) and TANTalum, metals used in lamp making. Lamps branded WOTAN have been sold in the United Kingdom for over three quarters of a century.

WOTAN represents technical progress and high quality achieved by worldwide teamwork. This is and will always be the aim of WOTAN.

WOTAN

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