Biax™ 2D™

Biax™ 2D™ Compact Fluorescent Lamps 10W, 16W, 21W, 28W, 38W, 55W

Biax™ 2D™ lamps are energy saving compact fluorescent tubes formed into a "2D" shape. All types are available with a 4pin cap which permits use with conventional or electronic (high frequency) control gear, dimming circuits and emergency lighting circuits.
The 16W and 28W types are available also with 2pin cap which contains a starter switch and a r.i.s. capacitor. All lamps use rare earth triphosphors to give high efficacy with good colour rendering properties.
In response to the demand from the market for a higher light output version of the 2D™ lamp, GE offers the 55W using the 28W/38W envelope size. The high luminous efficacy has been retained in the 55W by incorporating an amalgam which overcomes the fall in efficacy that occurs with increased lamp loading. The 55W lamp has a cap which uses an upgraded material and has a dedicated key. The cap material withstands the higher temperatures generated by the increased lamp power while the modified holder key for the 55W 2D™ will prevent accidental insertion of any lower rated 2D™ lamp into a 55W socket.

APPLICATION AREAS

- Residential
- Domestic
- Hotels/motels/restaurants
- Utility areas
- Task lighting
- Emergency lighting

The flat profile makes the 2D™ an ideal choice for building into slim, attractive luminaires. Its two dimensional shape is suitable for both uplighting and downlighting applications, where directional lighting is required. Due to its shallow, broad configuration, it spreads light over a large area without the need for expensive optics.

STARCOAT™ 2D™ T5 LAMPS

After more than 20 years of success in manufacturing the famous energy saving Biax™ 2D™ compact fluorescent lamps, GE introduced the next generation of lamps under the name of Starcoat™ Biax™ 2D™ T5. Available in 28 and 38 Watt with a wide choice of colour temperatures, these new lamps directly replace current wattage equivalent Biax™ 2D™ products delivering enhanced life and energy saving performance, offering an outstanding 50% improvement in life to 15000 hours and 10% higher lumen output. These new products benefit from the advanced T5 Starcoat™ technology already used in the latest 16mm (5/8 inch) linear fluorescent range to deliver an excellent colour rendering, enhanced lumen maintenance, and improved light output due to better reflection of the UV emission to be transformed in visible light.
The slimmer size (14% smaller overall diameter) will allow luminaire manufacturers to design new fittings with improved optical control in addition to the well-known uniformity of light of the Biax™ 2D™ concept.

- 28W lamp available in 2 & 4-pin versions
  - 2-pin design with internal starter
  - 4-pin design optimised for high frequency operation and also suitable for emergency lighting
- 38W lamp available in 4-pin version
  - also available with amalgam technology for improved lumen output at extremes of temperature
  - Superior lumen maintenance - over 80% of the initial lumen output at 15000 hours
- Excellent colour rendering - CRI Ra 82
- Compatible with existing ballasts and fittings

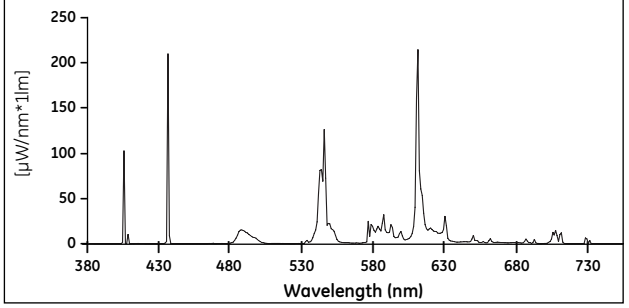
Ordering information Description		Product code OEM pack	 Blister pack	Wattage	CCT	Colour
F102D/827/4P	4 pin	32414	29433	10	2700K	Extra Warm White
F102D/835/4P	4 pin		28366	10	3500K	White
F162D/827/2P	2 pin	36885	32416	16	2700K	Extra Warm White
F162D/835/2P	2 pin	37458	32419	16	3500K	White
F162D/860/2P	2 pin		32454	16	6000K	Daylight
F162D/827/4P	4 pin	37457	32422	16	2700K	Extra Warm White
F162D/830/4P	4 pin	92480	expected in Q2 05	16	3000K	Warm White
F162D/835/4P	4 pin	37459	32425	16	3500K	White
F212D/827/4P	4 pin	37464	32430	21	2700K	Extra Warm White
F212D/835/4P	4 pin	37467	32431	21	3500K	White
F212D/860/4P	4 pin		32453	21	6000K	Daylight
F282DT5/827/2P	2 pin	10511	10546	28	2700K	Extra Warm White
F282DT5/835/2P	2 pin	10532		28	3500K	White
F282DT5/827/4P	4 pin	10529	10547	28	2700K	Extra Warm White
F282DT5/830/4P	4 pin	21526	expected in Q2 05	28	3000K	Warm White
F282DT5/835/4P	4 pin	10534	10567	28	3500K	White
F282DT5/840/4P	4 pin	23055	10548	28	4000K	Cool White
F382DT5/827/4P	4 pin	10538	10550	38	2700K	Extra Warm White
F382DT5/830/4P	4 pin	21556	expected in Q2 05	38	3000K	Warm White
F382DT5/835/4P	4 pin	10544	10566	38	3500K	White
F382DT5/835/A/4P	4 pin	10543		38	3500K	White
F552D/827/A/4P	4 pin	37525	37523	55	2700K	Extra Warm White
F552D/830/A/4P	4 pin	10764	expected in Q2 05	55	3000K	Warm White
F552D/835/A/4P	4 pin	37529	37528	55	3500K	White
F552D/840/A/4P	4 pin	12382		55	4000K	Cool White
F552D/860/A/4P	4 pin	92430		55	6000K	Daylight

LAMP COLOUR

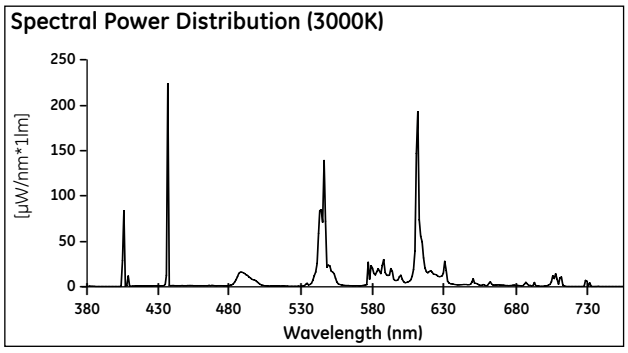
Colour coordinates

CCT (K)	x	y	CRI
2700	0.463	0.420	82
3000	0.440	0.402	82
3500	0.415	0.402	82
4000	0.380	0.377	82
6000	0.316	0.336	82

Spectral Power Distribution (2700K)



Spectral Power Distribution (3000K)



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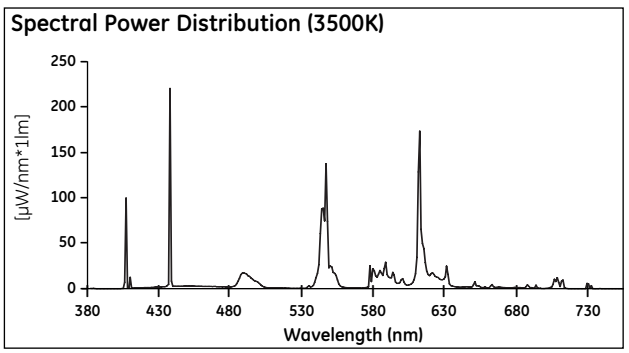

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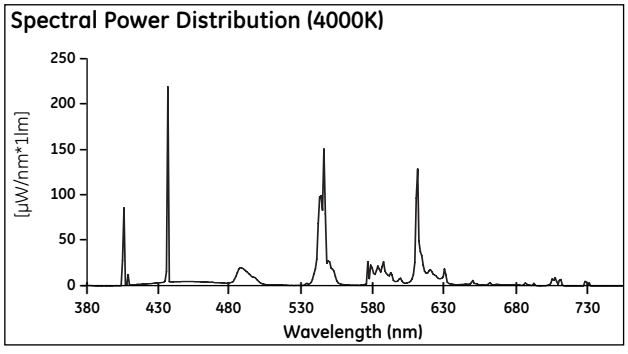
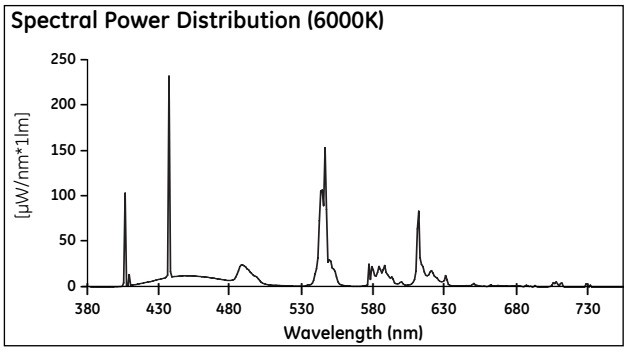


Spectral Power Distribution (6000K)



LAMP DIMENSION

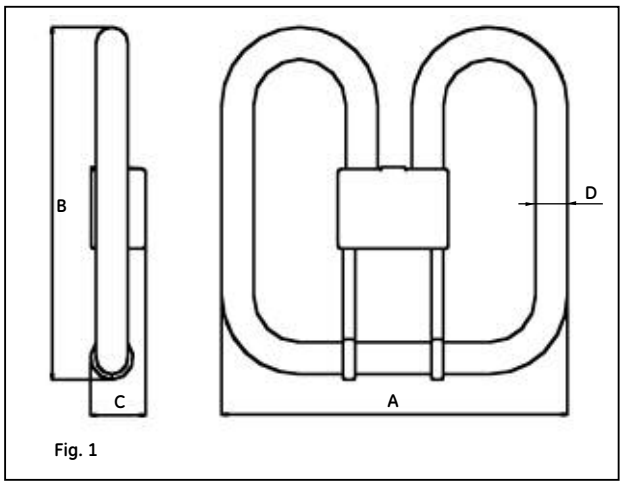


Fig. 1

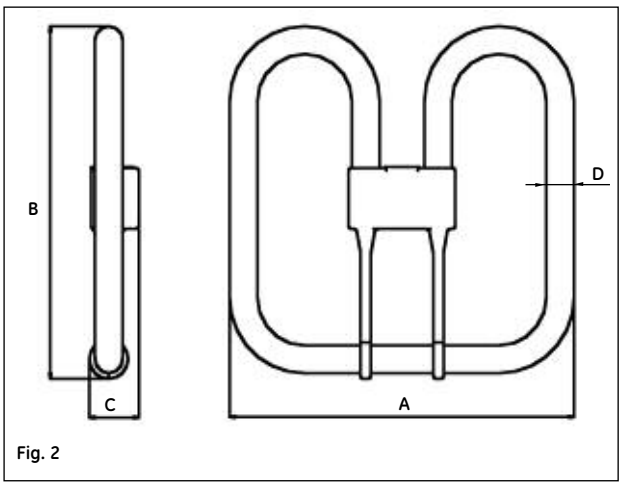
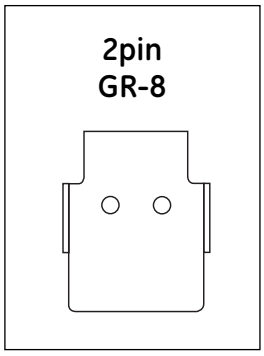


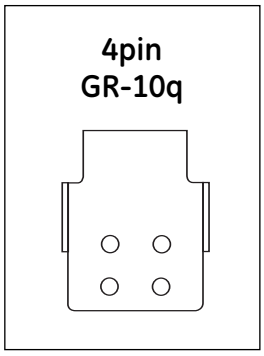
Fig. 2

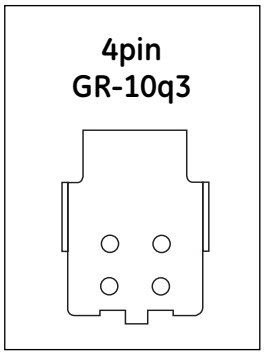
DIMENSIONS (mm)

	A	B	C	D	Fig.no
10W	92	94	33	12.5	1
16W, 21W	138	141	27.2	13	1
28W, 38W	202	204	28.6	16	2
55W	202	206	28.6	18.5	1

CAPS







General information	Unit	10W 4pin	16W 2pin	16W 4pin	21W 4pin
Nominal wattage	W	10	16	16	21
Cap		GR-10q	GR-8	GR-10q	GR-10q
Burning position			see page 11		

Lifetime performance	Unit	10W 4pin	16W 2pin	16W 4pin	21W 4pin
Rated median life	h	10000	15000	15000	15000
Average survival rate					
@ 5000 h		99%	99%	99%	99%
@ 10000 h		51%	79%	79%	83%
@ 15000 h			51%	51%	51%
Average lumen maintenance					
@ 5000 h		80%	85%	85%	82%
@ 10000 h		70%	75%	75%	72%
@ 15000 h			70%	70%	68%

Photometric data	Unit	10W 4pin	16W 2pin	16W 4pin	21W 4pin
Initial luminous flux	Lm	650	1050	1050	1350
Colour rendering index	R_a	82	82	82	82
UV PET	h	>2000	>2000	>2000	>2000
Run up time	s	20	20	20	20

Operation with electromagnetic ballast	Unit	10W 4pin	16W 2pin	16W 4pin	21W 4pin
Lamp wattage	W	10	16	28	28
Lamp current	mA	180	195	195	260
Lamp voltage	V	72	103	103	102
Luminous efficacy	Lm/W	65	65	65	64
Recommended starter		GE 155/500	-	GE 155/500	GE 155/500

Operation with electronic ballast	Unit	10W 4pin	16W 2pin	16W 4pin	21W 4pin
Lamp wattage	W	9.5	-	15	19
Lamp current	mA	160	-	165	220
Lamp voltage	V	60	-	92	85
Luminous efficacy	Lm/W	68	-	70	71
Max. current in any lead to cathodes	mA	210	-	195	260
Operating current range	mA	120...185	-	110...195	145...260
Dimming			-		
I_D	mA	15...120	-	15...110	20...145
X	A^2	0.038	-	0.033	0.058
Y	A	0.27	-	0.25	0.33
Min. ballast OCV @ -15°C	V	550	-	550	550
Cold cathode resistance	Ohms	10.8	-	13.5	6.5
Max. cathode voltage during preheat	V (rms)	11	-	11	11
R_h/R_c cathode resistance ratio		425...6.5	-	4.25 ... 6.5	4.25 ... 6.5

General information	Unit	28W 2pin	28W 4pin	38W 4pin	38W 4pin Amalgam	55W 4pin Amalgam
Nominal wattage	W	28	28	38	38	55
Cap		GR-8	GR-10q	GR-10q	GR-10q	GRY-10q3
Burning position				see page 11		

Lifetime performance	Unit	28W 2pin	28W 4pin	38W 4pin	38W 4pin Amalgam	55W 4pin Amalgam
Rated median life	h	15000	15000	15000	15000	10000
Average survival rate						
@ 5000 h		99%	99%	99%	99%	92%
@ 10000 h		92%	92%	92%	92%	87%
@ 15000 h		51%	51%	51%	51%	
Average lumen maintenance						
@ 5000 h		85%	85%	85%	85%	79%
@ 10000 h		84%	84%	84%	84%	70%
@ 15000 h		83%	83%	83%	83%	

Photometric data	Unit	28W 2pin	28W 4pin	38W 4pin	38W 4pin Amalgam	55W 4pin Amalgam
Initial luminous flux	Lm	2250	2250	3000	3000	3900*
Colour rendering index	R_a	82	82	82	82	82
UV PET	h	>2000	>2000	>2000	>2000	>2000
Run up time	s	30	30	40	50	50

*Optimum light output reached at 35 ˚C within fittings. Lumen rate at 25 ˚C: 3200

Operation with electromagnetic ballast	Unit	28W 2pin	28W 4pin	38W 4pin	38W 4pin Amalgam	55W 4pin Amalgam
Lamp wattage	W	28	28	38.5	38.5	56
Lamp current	mA	320	320	410	410	740
Lamp voltage	V	115	115	117	117	98
Luminous efficacy	Lm/W	80.4	80.4	77.9	77.9	66
Recommended starter		-	GE 155/400	GE 155/400	GE 155/400	GE 155/500

Operation with electronic ballast	Unit	28W 2pin	28W 4pin	38W 4pin	38W 4pin Amalgam	55W 4pin Amalgam
Lamp wattage	W	-	26	36	36	55
Lamp current	mA	-	260	355	355	700
Lamp voltage	V	-	101	101	101	78
Luminous efficacy	Lm/W	-	85.9	83.3	83.3	70.9
Max. current in any lead to cathodes	mA	-	360	500	500	770
Operating current range	mA	-	220 ... 320	300 ... 435	300 ... 435	500 ... 770
Dimming		-				
I_D	mA	-	30 ... 220	40 ... 280	40 ... 280	70...560
X	A^2	-	0.14	0.37	0.37	0.43
Y	A	-	0.52	0.83	0.83	0.91
Min. ballast OCV @ -15°C	V	-	550	550	550	550
Cold cathode resistance	Ohms	-	3.65	2.05	2.05	1.6
Max. cathode voltage during preheat	V (rms)	-	11	11	11	11
R_h/R_c cathode resistance ratio		-	4.25 ... 6.5	4.25 ... 6.5	4.25 ... 6.5	4.25 ... 6.5

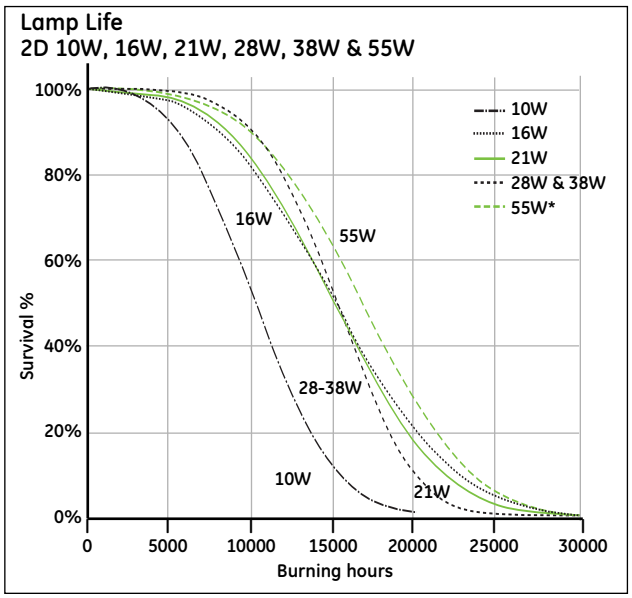
LAMP LIFE

Cathodes of a fluorescent lamp lose their electron-emissivity during life due to the evaporation of emission mixture. When the deterioration reaches a certain level, the cathode breaks. Typical lifetime characteristics are based on GE Lighting's measurements according to the relevant IEC standards. The declared lamp life is the median life, which is when 50% of the lamps from a large sample batch would have failed. Real lifetime figures may depend on actual application. For instance improper cathode preheat, too high operating current, or too low operating current without additional cathode heating reduces the expected life.

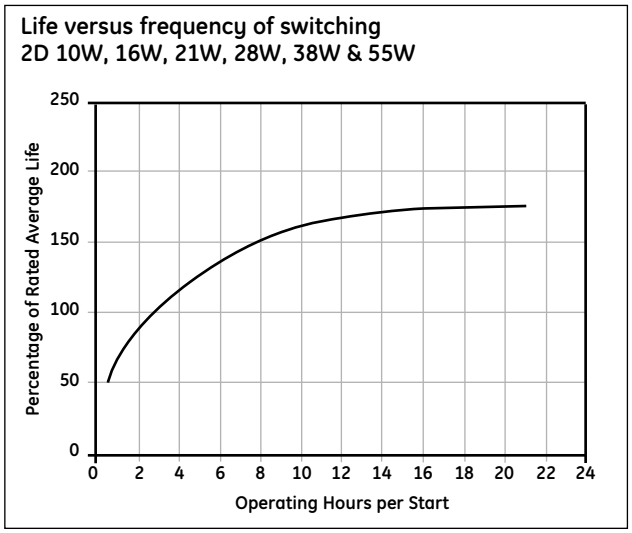
After incorporating latest technical improvements the 16W, 21W, 28W and 38W Biax™ 2D™ lamps have a median life of 15,000 hours, 10W and 55W types have a median life of 10,000 hours when tested under the conditions shown below.

Test conditions:
- Photometric sphere
- Horizontal burning position
- Switching cycle: 165 minutes On – 15 minutes Off
- 50Hz line frequency operation
- High frequency operation for Biax™ 2D™ 55W
- 25°C ambient temperature

Presented median life of Biax™ 2D™ lamps is tested on a standard switching cycle of 3 hours (2.75 hours on, 0.25 hours off). The impact on life of alternative switching cycles is shown in the graph "Life versus Frequency of Switching". For very frequent switching applications it is possible to minimise the adverse effect of short on periods with the use of a suitable electronic starter. For lamps with an integral starter switch (2pin), the switch is designed to give approximately 20,000 starts which may be of more relevance than rated lamp life in a frequently switched situation.
To achieve claimed life for high frequency operation a preheated start is recommended.



* For 55W type lamp life claim is only 10,000 hours due to limitations in lumen maintenance performance

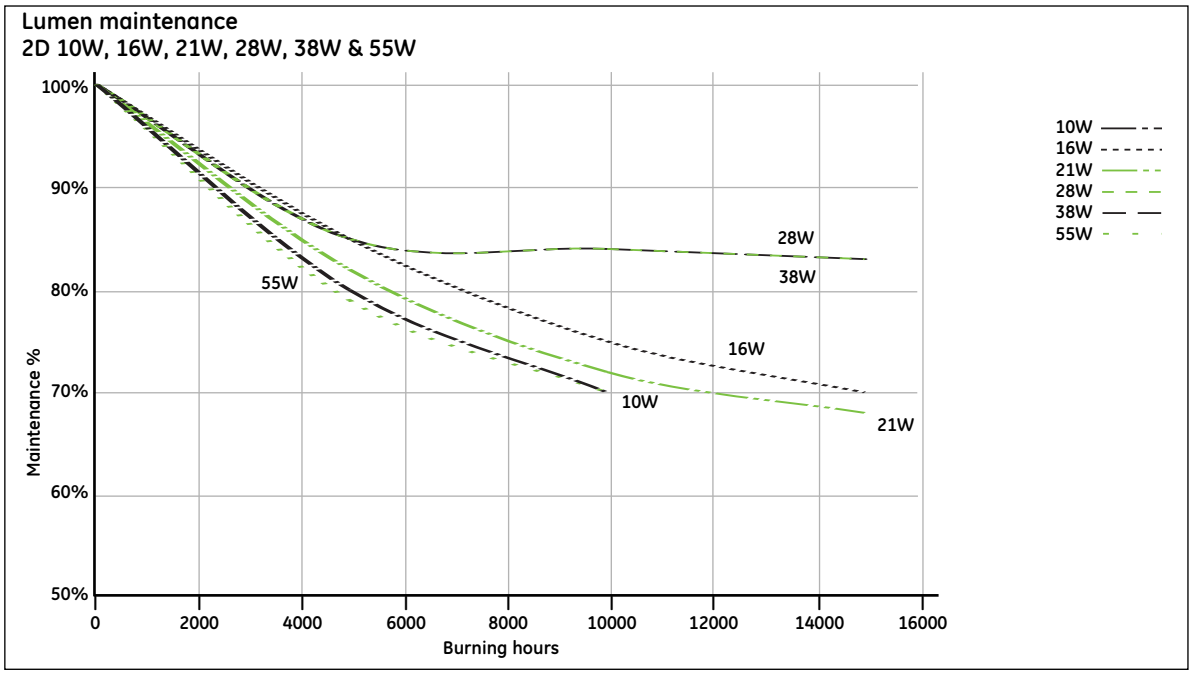


LUMEN MAINTENANCE

The lumen maintenance graph shows how the light output decreases throughout life. The main causes of the light depreciation are the deterioration of phosphor coating and end blackening due to the deposition of evaporated emission mixture on the glass tube. These effects are normal and unavoidable. The lumen maintenance curve given below for Biax™ 2D™ lamps is based on lumen readings under laboratory conditions.

Test conditions:
- Photometric sphere
- Horizontal burning position
- Switching cycle: 165 minutes On – 15 minutes Off
- 50Hz line frequency operation
- High frequency operation for Biax™ 2D™ 55W
- 25°C ambient temperature

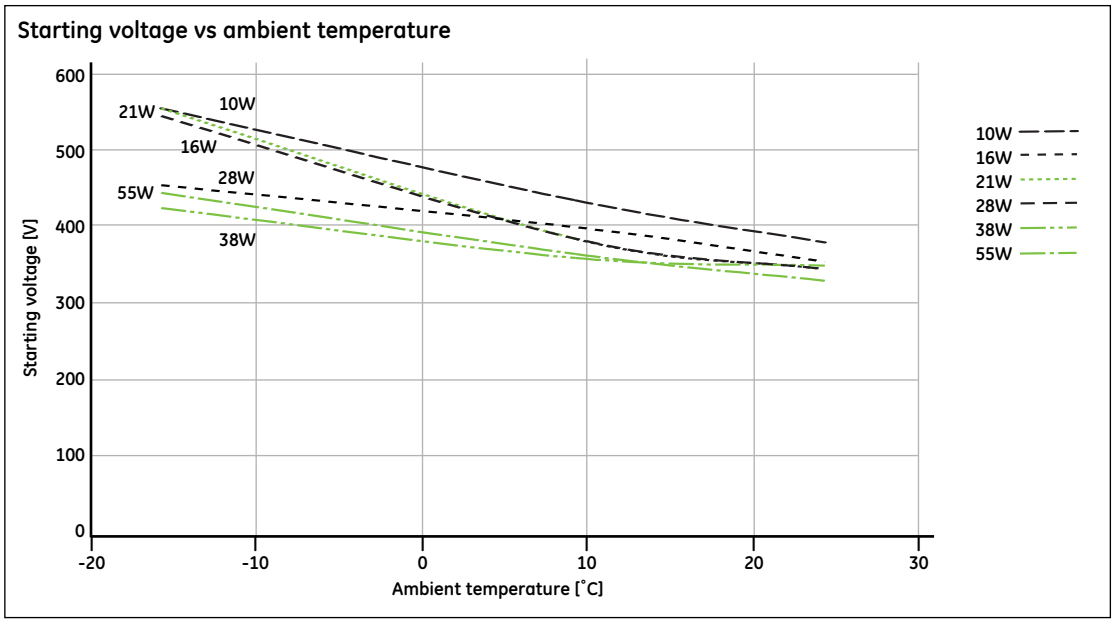
	10W 4pin	16W 2pin 16W 4pin	21W 4pin	28W 2pin 28W 4pin 38W 4pin	55W 4pin Amalgam
Average lumen maintenance					
@ 5000 h	80%	85%	82%	85%	79%
@ 10000 h	70%	75%	72%	84%	70%
@ 15000 h		70%	68%	83%	



LAMP STARTING

The graph Starting Voltage vs. Ambient Temperature shows electronic ballast open circuit voltage required for starting as a function of ambient air temperature. Data is based on measurements carried out by GE Lighting under controlled test conditions. Actual lamp starting voltage figures depend on the overall characteristics of electronic ballast. Appropriate preheating of cathodes is necessary in order to achieve low starting voltage and long lamp life.

Test conditions:
- horizontal lamp position
- thermal chamber providing ±2°C accuracy
- 2 s current controlled preheat
- sufficient preheat current
- voltage ramp-up until ignition



Ambient temperature	Starting voltage V_{eff}					
[˚C]	10W	16W	21W	28W	38W	55W
-15	550	540	550	450	420	440
10	530	380	380	395	355	360
20	375	340	340	350	345	325

Minimum Staring Temperature

Lamp starting at low ambient temperatures can be successfully achieved, however light output during initial warm-up will be considerably reduced, but will gradually increase as lamp temperature rises. Use of an electronic starter or electronic ballast is recommended for lower ambient temperature applications. Satisfactory starting at lower ambient temperatures requires a close proximity earth (ground) plate.
Use of an electromagnetic ballast and glow starter is not recommended for applications below -10 °C.

Run-Up Time

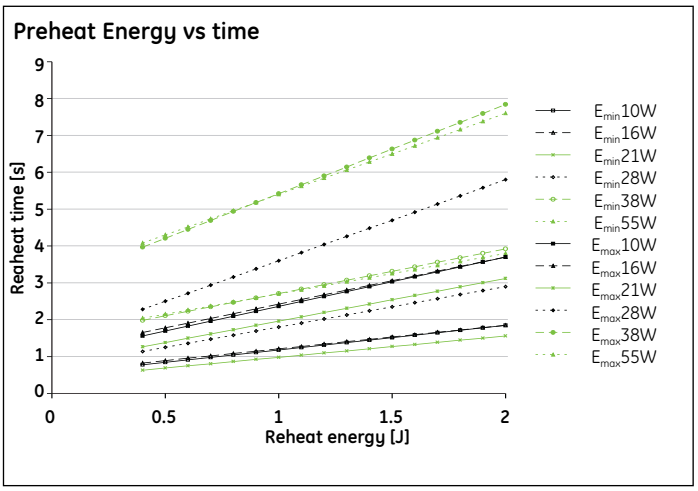
When a fluorescent tube is switched on light output rises during the first few minutes until the optimum temperature is reached, but then falls if the temperature continues to rise.
Amalgam lamp technology provides maximum light output at a higher lamp operating temperature than standard liquid mercury dose technology, but warm-up time is longer. However the slower fall-off in light output at higher ambient/operating temperatures allows greater flexibility in luminaire design.
As a consequence of the “slower” run-up characteristic amalgam lamps are not considered suitable for applications involving severe under-running associated with emergency lighting applications; where very short on-periods are likely or where low ambient temperatures are encountered, unless the fitting is fully enclosed.

PREHEATING REQUIREMENTS

Suitable preheating of cathodes prior to ignition is essential for long lamp life. The preheating requirement can be given by the following formula:

E = Q+P•t
This energy is measured on a substitution resistor

Q stands for the necessary thermal energy. P represents the power loss due to the heat transmission from the cathode. The longer the preheating, the more the power loss. The two basic preheating modes, the current controlled and the voltage controlled modes, can be derived from the formula.

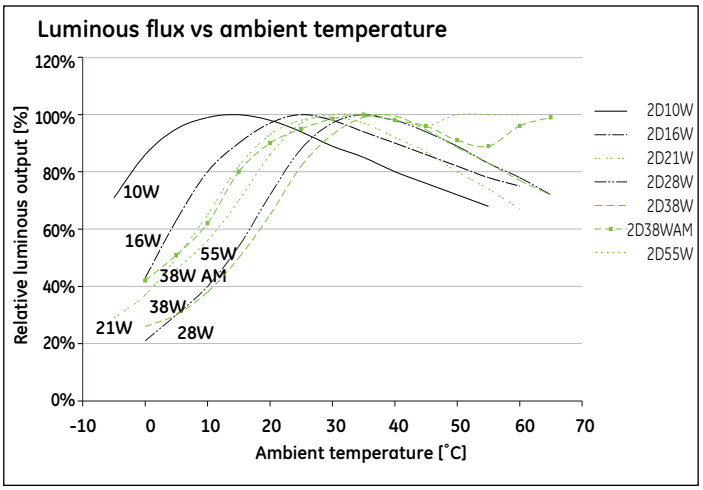


	Minimum energy			Maximum energy		
	Q	P	R_{sub}	Q	P	R_{sub}
10W	0.51	0.67	34.0	1.02	1.34	45.0
16W	0.57	0.64	42.0	1.14	1.28	56.0
21W	0.40	0.58	18.0	0.80	1.16	27.0
28W	0.70	1.10	11.5	1.40	2.20	17.5
38W	1.50	1.21	6.5	3.00	2.42	8.5
55W	1.60	1.10	5.0	3.20	2.20	7.0

INFLUENCE OF AMBIENT TEMPERATURE

Lamp performance

The lamp performance parameters, such as luminous output, lamp voltage and power depend on the mercury vapour pressure in the discharge tube. The mercury vapour pressure is a function of the thermal conditions around the lamp. The burning position, air flow, and radiated heat have an effect on these conditions. The curve shows the relative luminous output as function of the ambient temperature in horizontal burning positions. Tests were performed in draught-free air under thermally controlled conditions.



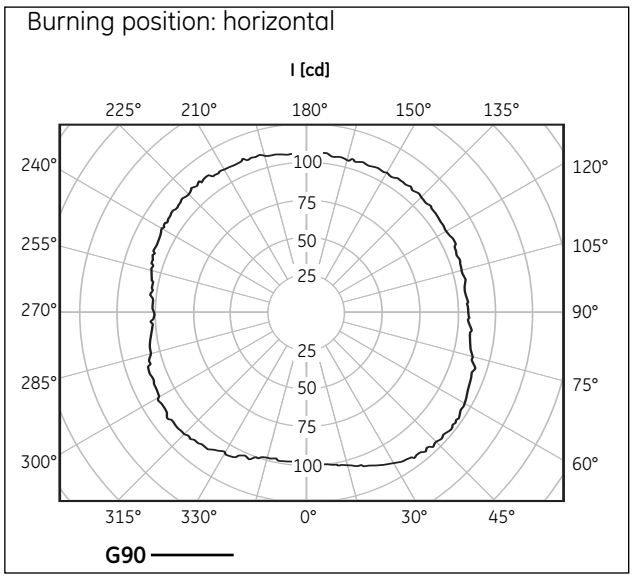
Test conditions:
- thermal chamber with ±2°C accuracy
- draught-free air

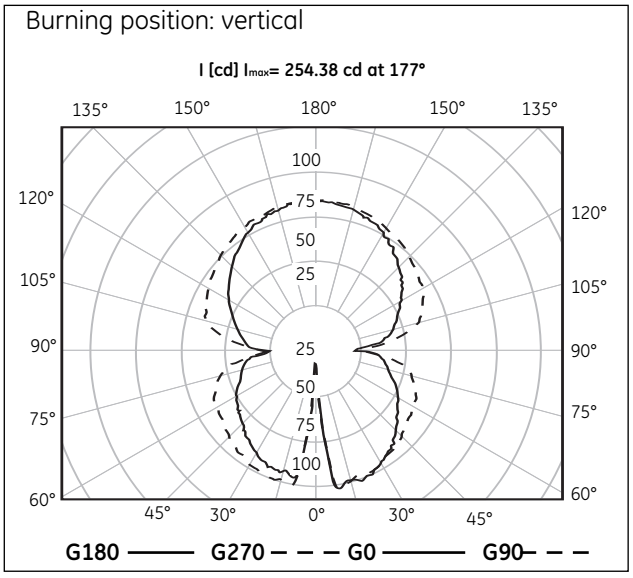
Operating Note

The ambient temperature at which maximum light output of Biax™ 2D™ 55W occurs is 30°C. For optimum performance in a fitting, consideration must be given to the likely temperature rise within the fitting due to the heating effect of the lamp.

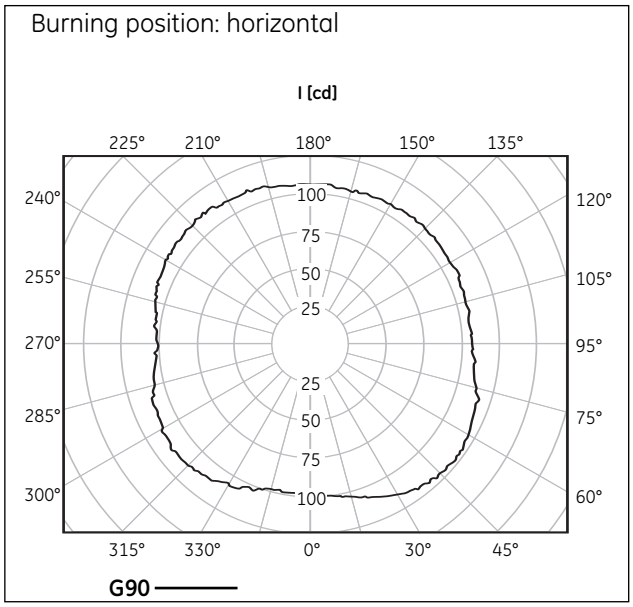
LUMINOUS INTENSITY DISTRIBUTION

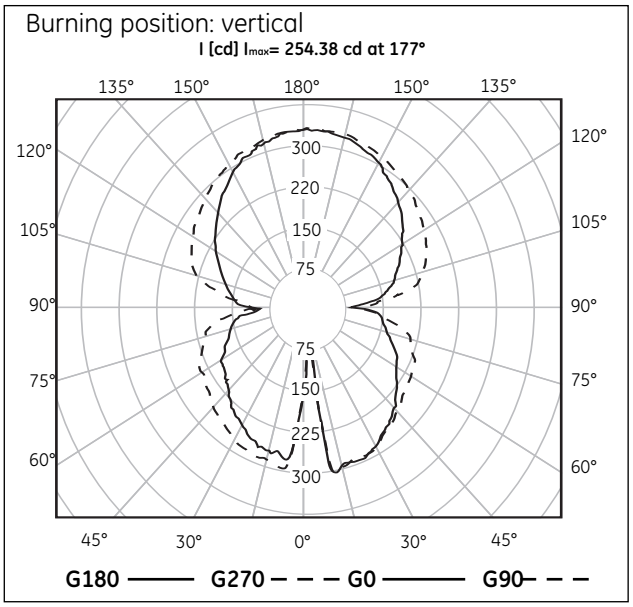
The following diagrams show the polar light intensity distribution of the 2D™ 28W lamp.





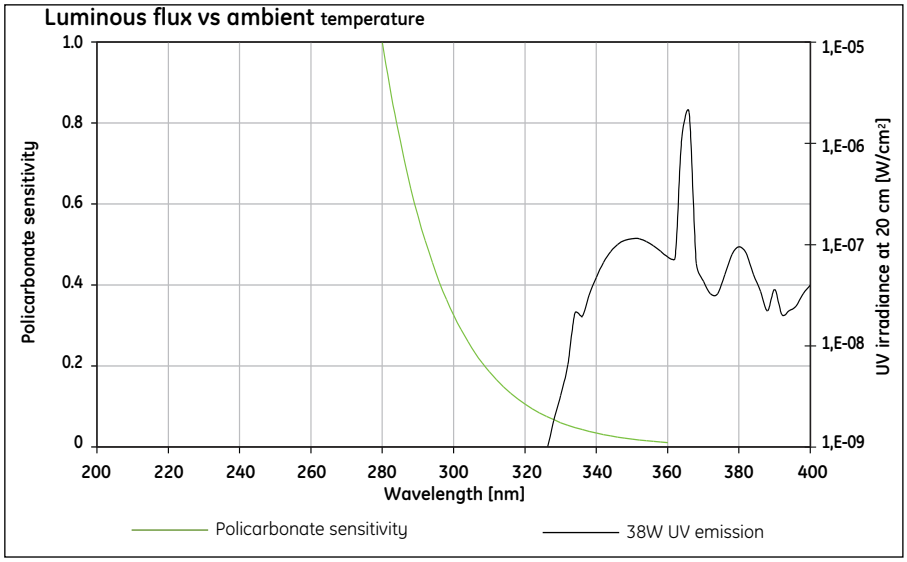
The following diagrams show the polar light intensity distribution of the 2D™ 38W lamp.





The shape of polar light intensity distribution of the other 2D™ lamps follow the above examples due to the similar lamp shape

ULTRAVIOLET SPECTRAL DISTRIBUTION

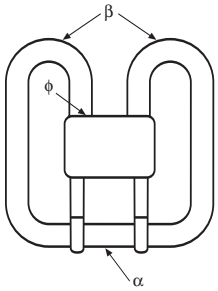


The UV output of 2D™ lamps is minimised by using special glass for the body tube. This glass able to cut totally UV C and almost totally UV B so that specially suitable for any application where Polycarbonate fittings are applied. Since Polycarbonate material has some sensitivity in the UV A range, some discoloration can be seen after a long time period. (15 000-20 000 hours).

OPERATING NOTES

2 pin Biax™ 2D™ lamps are unsuitable for use in dimming circuits or from an electronic ballast and should not be used for these applications.
The 4pin Biax™ 2D™ lamps can be operated from electronic control gear and dimmed using appropriate control gear.
The Biax™ 2D™ lamps can be operated in any position except where leg "a" is higher than bends b in case of 21W and 38W types. This limitation is necessary to ensure that region Ø of cap is kept as cool as possible.
Do not use a Biax™ 2D™ lamp to replace any other rating or in luminaires or circuits designed for other ratings of Biax™ 2D™ lamp, as poor lamp performance and short lamp life will result.

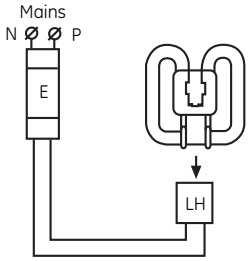
Operating position



CIRCUIT DIAGRAMS

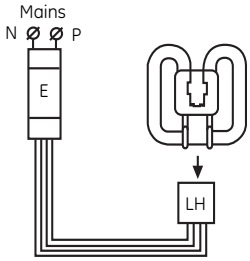
2-pin, electromagnetic ballast (single lamp)

LH = Lamp Holder
E = Electronic Gear



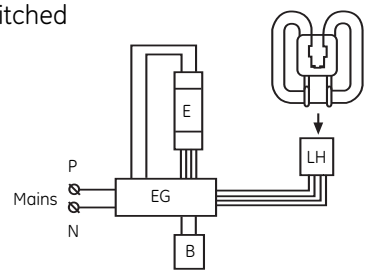
4-pin, electronic ballast (single lamp)

LH = Lamp Holder
E = Electronic Gear



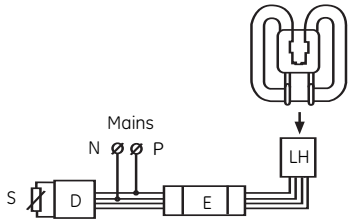
4-pin, automatically switched emergency lighting

LH = Lamp Holder
E = Electronic Gear
EG = Emergency Gear
B = Battery



4-pin, electronic dimming ballast

LH = Lamp Holder
E = Electronic Gear
D = Dimmer
S = Sensor or control



Control Gear - Mains Frequency

Watt	Volt	Manufacturer	Catalogue code
10	240	Helvar	L13D/DL
16	240	Helvar	L16D/DL
21	240	Helvar	L21 TL2-100mm
28	230	Tridonic	EC20
28	230	ERC	MEC86
28	230	Vossloh-Schwabe	L18, LN 18
28	240	Vossloh-Schwabe	L20
28	240	Vossloh Schwabe	LNN65.166
38	240	Atlas	405069545.4P
38	230	ERC	MEC86
38	240	Helvar	L36TL2 230
38	230	Helvar	L36TL2 230
38	230	Tridonic	EC40
38	230	Vossloh-Schwabe	L36
38	240	Vossloh-Schwabe	L40

Control Gear - Dimming

Watt	Manufacturer	Catalogue code
10	Tridonic	PC 11/13 TCD A111
16	Tridonic	PC 16 A011; DSI 011
16	HÜCO	O9 6592
28	HÜCO	O9 6976 TC-DEL/TEL 26W
28	HÜCO	O9 7476 TC-DD 28W
28	HÜCO	O9 6506
38	Magnetek Ltd	DBT-136
38	Tridonic	PC1/55 DD ECO
55	Tridonic	PC 2x55 TCL A011; DSI 011
55	Philips	HF-R155PLL
55	Philips	HF-R255PLL

Control Gear - High Frequency

Watt	Manufacturer	Catalogue code
10	Tridonic	PC PRO 9/11 FSD b101
16	Tridonic	PC PRO 11/13 FSQ b101
21	Tridonic	PC PRO 18 FSQb101
21	Magnetek Ltd	CBC-118
21	Helvar Ltd	EL1x18HF
28	HÜCO	O9 7435 TC-DD28W
28	Magnetek Ltd	Continua 2D 28W
28	Magnetek Ltd	CBC-126 DE
28	Atlas	GTC126
28	Energy Savings	ES-1-CFQ-26-230-Z
28	Quantic	U2D-1-28W
28	Arlen	PL26R-D
28	Arlen	PL32R-T
38	Magnetek Ltd	BBT-136
38	Hüco	O9 6595
38	Tridonic	PC PRO 36 FSD a101
38	Tridonic	PC1x38DD PRO
55	Tridonic	PC1/55
55	Tridonic	PC 2x55TCL A011
55	Magnetek Ltd	CBC-155L
55	Magnetek Ltd	EET-158
55	Helvar Ltd	EL1x55HF2HF
55	Helvar Ltd	EL2x55HF2HF
55	Hüco	09 7438 TC-DD 55W

ADDITIONAL NOTES

The 16W, 21W, 28W and 38W lamps have a long tip-off tube which acts as a cool spot into which the liquid mercury reservoir (required by all fluorescent lamps) migrates during early lamp operation. In relation to circuit or fittings design or ballast evaluation, tests should be conducted with lamps aged to a minimum of 500 hours with care being taken to keep the mercury in this "cool spot". In practice this means either the lamp should be left undisturbed in the ageing position or if the lamp is moved avoid mechanical shock. The 2D "loops" should be kept above the straight lamp region (90° bends). This procedure is recommended to ensure that liquid mercury is fully retained in the cool spot tip-off tube.

4 pin lamps can be operated directly from 220/250V 50/60Hz mains supplies using an electromagnetic ballast and external glow or electronic starter. Recommended GE glow starters are 155/500 and 155/400. T5 28 and 38W lamps operate flicker-free only with GE 155/400 starters. For supply voltages above or below the range 220/250V, a transformer or other suitable means of adjusting the supply voltage is necessary. Operation from an electronic ballast maximises lamp photometric and survival performance.

Biax™ 2D™ lamps are standardised internationally through the International Electrotechnical Commission (IEC). For lamp performance the relevant data sheets in IEC 60901 (EN 60901) apply and for lamp safety the relevant clauses in IEC 61199 apply.

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