High Pressure
Sodium Lamps

SOLARCOLOUR & SOLARSTREAM L1

information and data

GEC

High Pressure Sodium Lamps

SOLARCOLOUR & SOLARSTREAM

L1

COMPANION BOOKLETS

L2 Mercury Lamps

L3 Planned Lighting Maintenance

L4 Low Pressure Sodium Lamps

L5 Infra-Red Heaters

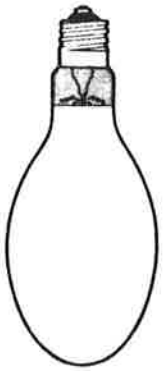
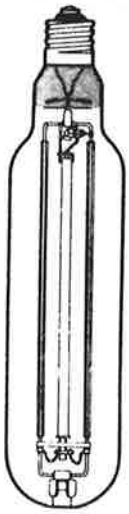
L6 Fluorescent Tubes

L7 Laboratory Lamps

L18 Photoprint Lamps and Gear.

Ref: L1/4 HT/EX/1976

SOLARCOLOUR

SON-R	SON	SON-T	SON-T	SON-T
				
250W 310W & 400W	120W 220W 250W 310W 360W & 400W	220W 250W 310W 360W & 400W	600W	1000W

SOLARSTREAM

SON-L

250W 310W 400W & 1000W

(Not to scale)

Ref: L1/4 HT EX

HIGH PRESSURE SODIUM LAMPS

G.E.C. SOLARCOLOUR AND SOLARSTREAM

I N D E X

HIGH PRESSURE SODIUM LAMPS

G.E.C. SOLARCOLOUR AND SOLARSTREAM

I. SOURCE OF RADIATION

The G.E.C. Solarcolour and Solarstream Lamps are electrical discharge devices and produce most of their visible radiation from energised sodium atoms.

II. APPLICATION

(a) General

The colour appearance and rendition of the Solarcolour and Solarstream lamps enable the lamps to be used in most lighting installations and especially for the following applications:-

Industrial
Commercial
Street Lighting
Floodlighting

When used in situations where a high colour temperature with very accurate colour rendition is required, the addition of mercury lighting is recommended.

The various wattages have been designed with the following objectives:-

(b) Solarcolour (SON, SON-T, SON-R)

(i) 120W

A newly developed low wattage lamp for 'Group B' street lighting particularly for Conservation Areas, Shopping Precincts, historic towns, etc. Also suitable for commercial and industrial lighting where low mounting height rules out use of the higher wattage lamps.

(ii) 220W

A plug-in replacement for 250W MBF/U giving nearly 1½ times the light for less power. No change in control gear or circuit is necessary but the value of power factor correction capacitance may have to be adjusted (usually to about 30 mfd) if a power factor of 0.85 is to be maintained. As the running current of the 220W Solarcolour SON lamp is higher than that of the 250W H.P.M.V. lamp, the choke will run hotter. It is recommended that the suitability of the choke to be used is checked. The older designs of large chokes are in general capable of operating satisfactorily at these higher currents, but as these are no longer available, the 220W Solarcolour lamp is not recommended for new installations; the 250W lamp should be used in such cases. Cable insulation should also be checked (See Section V.Cable, Page 7).

(iii) 250W

For new installations using specially designed control gear. Recommended for street lighting, industrial and commercial lighting and horticulture. The 250W reflector lamp is particularly suitable for interior lighting and horticulture.

(iv) 310W.

Designed to be operated in existing mercury lamp installations where the maximum reduction in running costs, without changing control gear, is the first consideration. For conversion from 400W mercury lamps, the choke tapping should be set 10v above the average actual supply voltage. There will be an increase in light output of approximately 50% compared with mercury.

To achieve .85 p.f., it may be necessary to add a small additional capacitor to bring the total value up to 30 mfd. Cable insulation should also be checked. (see Section V. Cable, Page 7).

(v) 360W.

A 'plug-in' replacement for a 400W mercury lamp where a 'tapped' choke is not being used, or where a higher light output than that obtained from a 400W MBF lamp with improved colour and 10% lower wattage is required. No change in control gear or circuit is necessary but the value of power factor correction capacitance may have to be adjusted (usually to about 30 mfd) if a power factor of 0.85 is to be maintained. As the running current of the 360W Solarcolour SON lamp is higher than that of the 400W H.P.M.V. lamp, the choke will run hotter. It is recommended that the suitability of the choke to be used is checked. The older designs of large chokes are in general capable of operating satisfactorily at these higher currents, but as these are no longer available, the 360W Solarcolour lamp is not recommended for new installations; either the 310W or 400W lamp should be used in such cases with appropriate control gear. Cable insulation should be checked (see Section V. Cable, page 7)

(vi) 400W.

For new installations using specially designed control gear. Suitable for street lighting (major roads), industrial lighting (high bay), area and building floodlighting, football floodlighting, security areas.

(vii) 600W.

For new installations where mounting heights are higher than for the 400W lamp. Suitable for motorway lighting, multilevel road intersections (high mast), very high bay lighting in industry (power stations), floodlighting (area and building), security. These lamps are normally operated on circuits for three phase mains supply. (See Installation & Maintenance booklet M1 concerning loss of one phase).

(viii) 1000W.

Particularly recommended for very high bay, motorway, area lighting, floodlighting and other applications where higher lumen output units are required. These lamps are also normally operated on circuits for three phase mains supply. (See Installation and Maintenance booklet M1 concerning loss of one phase).

(c) Solarstream

(i) 250W.

The lowest wattage in the range, used in converted 750W or 1000W Tungsten Halogen fittings or for use in new fittings where low running costs and long life are required.

(ii) 310W.

A lamp designed for use in converted 1500W Tungsten Halogen fittings, where a similar lumen output is required with the benefits of a 75% saving in power consumption and increased life.

(iii) 400W.

Designed for use in a specially developed fitting and as an alternative to 1500W Tungsten Halogen.

(iv) 1000W.

For floodlighting of large areas where suitable mounting positions are available (tall buildings,etc.).

III. ARC TUBE CHARACTERISTICS

The sodium vapour pressure when the lamp is fully run up is of the order of 250mm. Hg. Although this appears to be low in comparison with the high pressure mercury vapour lamp, it is 50,000 times greater than the original monochromatic low pressure sodium lamp.

The use of crystalline alumina (in the manufacture of the arc tube) is necessary to withstand the corrosive properties of sodium at the high temperature at which the arc tube has to run (1300^{o}C.).

IV. CONTROL GEAR AND CIRCUIT

As with all discharge lamps, the Solarcolour and Solarstream lamps have to be used with approved control gear to ensure the lamps run at correct wattage and current.

Typical circuits are shown in FIG.2.

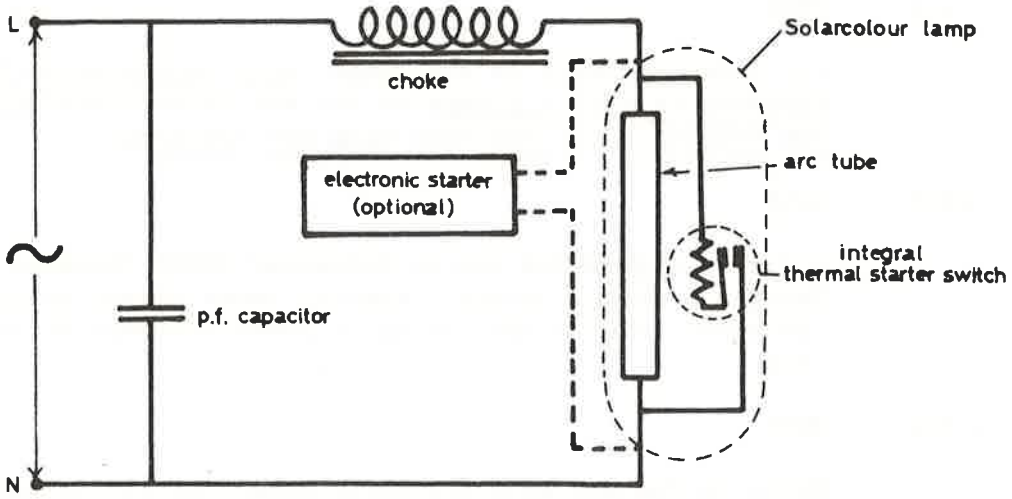


FIG.2a. Typical circuit for SOLARCOLOUR lamps.

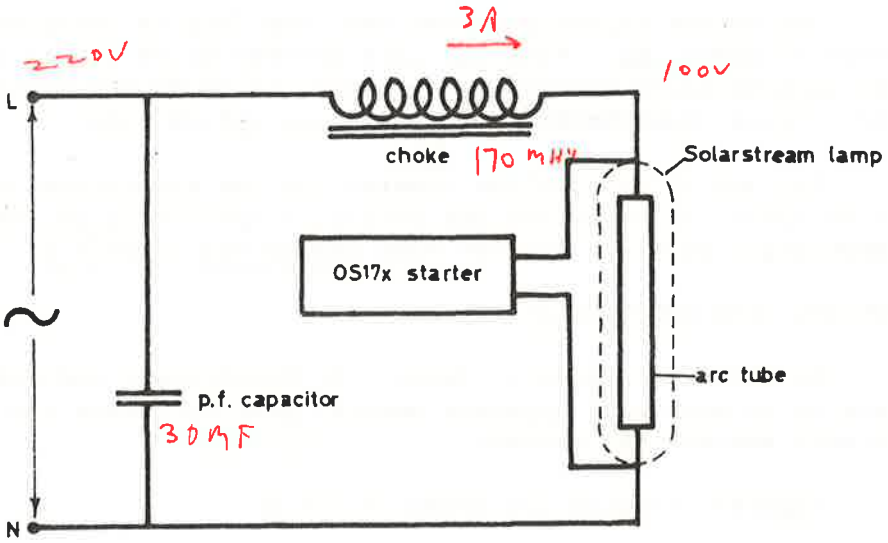


FIG.2b. Typical circuit for SOLARSTREAM lamps

NOTE: The Power Factor Correction Capacitors are an essential part of the circuits and must not be omitted.

V. CABLE

In order to strike the lamp, a high voltage pulse is necessary (see 'Striking Mechanism'). This high voltage must be catered for with the insulation of the cable between the control gear and the lamp. P.V.C. insulation is recommended. Where high temperatures are involved insulation should be either Butyl or Silicone rubber.

VI. POWER FACTOR

The power factor of the circuit depends upon the type of control gear employed. It should be of the order of 0.85 - 0.95.

VII. OVERALL WATTAGE

The wattage lost in control gear will depend upon the design of the choke in use. For purposes of calculating cable sizes etc., a figure of 10% of lamp wattage can be used.

VIII. STRIKING MECHANISM

The Solarcolour and Solarstream lamps differ from most other discharge lamps in that no starting aids such as pre-heated cathodes or auxiliary electrodes are employed. They start cold using a high voltage pulse.

(a) Solarcolour

A thermal starting switch is incorporated inside the Solarcolour lamp (FIG.2a). When the lamp is not functioning, the contacts of the bi-metal switch are closed. The switch is in series with the heater coil and the whole device short circuits the lamp arc tube.

On switching on, the heater coil warms up until the bi-metal switch snaps open. In doing so, an inductive circuit is broken and a high voltage is induced across the arc tube causing it to strike.

Generally 1000 volts are necessary to strike the lamp and the peak voltage obtainable when the switch opens, is in the order of 4000 volts. When, however, the switch opens at certain parts of the sine wave cycle where the current is around zero, the induced voltage is less than the required 1000 volts. Under these conditions the lamp will not strike and it is necessary to allow the heater coil to cool down and the contacts to close after which the lamp starting cycle will recommence, which will take 2 - 4 minutes.

(b) Solarstream

The Solarstream lamp does not incorporate an internal starter switch, and an external starter (OS17X or OS19X) must be used.

IX. STARTING TIME

(a) Solarcolour

The internal thermal switch will open approximately 30 seconds after the mains supply is switched on. If, for the reason explained in viii above, the lamp does not strike when the switch opens, it is necessary to allow the bi-metal strip to cool and the contacts to re-close. This re-closure time is approximately 2 - 4 minutes according to the condition in which the lamp is operating. More than 90% of lamps strike first time.

NOTE: The heat radiated from the arc tube when the lamp is burning is used to keep the bi-metal switch open.

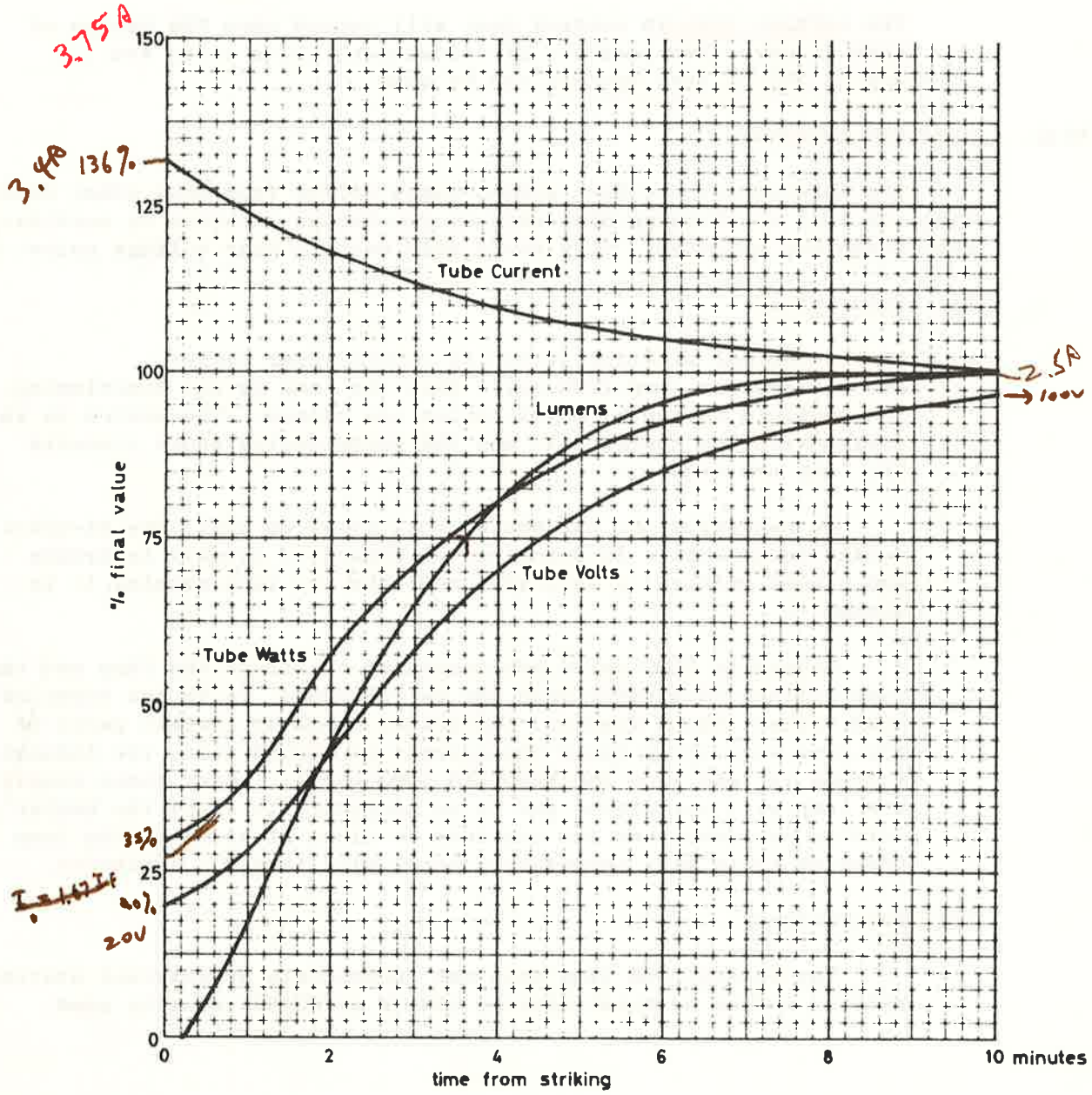


FIG 3. Typical starting characteristics of 400W SOLARCOLOUR and SOLARSTREAM lamps (measured on a 240v supply).

Ref: L1/4 HT EX

(b) Solarstream

The starting time of the Solarstream lamp depends on the starter used. With OS17X or OS19X the lamp starting time is about 1 second

Both Solarcolour and Solarstream lamps have acceptable light output within two minutes of striking. (see FIG.3.)

X. EXTERNAL STARTING DEVICE FOR IMMEDIATE STRIKING OF SOLARCOLOUR LAMPS

In circumstances where the possibility of starting delays are completely unacceptable, an electronic starting device can be incorporated in the circuit. This ensures immediate starting after the internal starting switch has opened and is usually sufficient on a few strategic lamps.

The functioning of the external starter is dependent upon the internal switch contacts being open. A delay of up to 30 seconds is necessary for the heating of the switch.

The nominal dimensions of these starters are:-

	OS17X & OS19X
Overall length	114mm.
Diameter	38mm.

XI. RE-STRIKING TIME

(a) Solarcolour

In common with other high pressure discharge lamps, if a Solarcolour lamp is switched off while hot, it will not restrike immediately. The time to restrike is dependent on the time taken for the switch to reclose; an average time is 15 - 20 minutes, but this varies according to surrounding conditions.

The use of an external starter can reduce this delay in re-striking to approximately 90 seconds, depending upon the running conditions of the lamp. After hot re-start, the lamp can be expected to attain 80% light output in a further 90 seconds and full output after about 10 minutes.

(b) Solarstream

If the supply is interrupted, the re-striking time of the lamp will depend on the characteristics of the starter. The re-striking time with the OS17X or OS19X will generally be less than two minutes.

XII. OPERATING CONDITIONS

(a) Low Temperature

Low temperature conditions have no adverse effect on Solarcolour or Solarstream lamps.

(b) High Temperature (see also High Voltage)

High Pressure Sodium lamps are perfectly satisfactory at normal temperatures. Any abnormal increase in the operating temperature of the arc tube will increase the voltage across the lamp; if this is too high, the lamp will extinguish. Should a lamp extinguish, it will cool down, re-start, run-up and again extinguish when it becomes overheated. The total cycle time for this type of problem is in the order of one hour.

NOTE: It should be noted that ambient temperatures within the range -40°C. to +100°C. will not have this effect on a lamp. The circumstances where conditions exist that will cause over-heating are in fittings or lanterns where heat and light are reflected or re-radiated back into the lamp. Such fittings or lanterns are not suitable for Solarcolour or Solarstream lamps and require modification.

G.E.C. will be pleased to give help in fittings design.

(c) Voltage Variation

Solarcolour and Solarstream lamps are suitable for nominal mains voltages of 220v and above. They will function at voltages within the statutory variations and will usually accept a 40v drop provided the actual voltage is not below 200v.

High voltage, whilst slightly improving the colour, can (for reasons described under 'High Temperature') cause the lamp to 'overwatt' and extinguish. It is essential that control gear tappings are adjusted for the actual mains voltage applied.

The effect of variation of mains voltage on arc tube voltage, arc tube current, arc tube watts and lumen output, is shown in FIG.4.

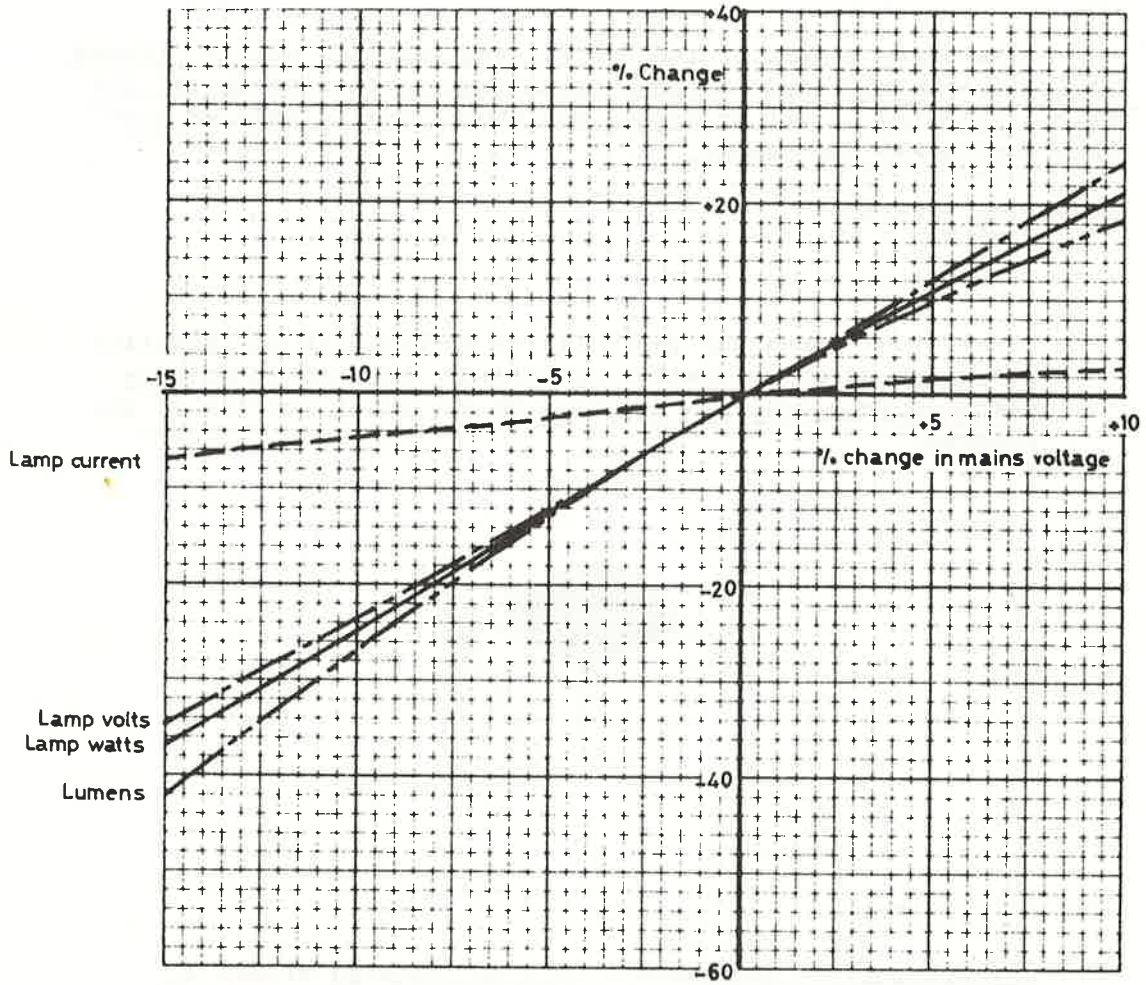


FIG.4. Effect of mains voltage variation on SOLARCOLOUR and SOLARSTREAM lamp characteristics.

(d) Vibration

The mechanical assembly of the Solarcolour lamps has been designed in order that it may be operated under the most arduous conditions so far as vibration is concerned.

Ref: L1/4 HT EX

There is one important condition. It is essential that the sodium from the reservoir inside the arc tube is not allowed to enter the arc stream, as the arc voltage will increase and the lamp extinguish. In conditions of severe vibration, the lamp should be operated vertically - cap up.

The Solarstream lamp should not be used in situations subject to any severe vibration.

(e) Unprotected lamps

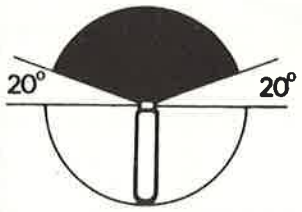
The outer bulb of the Solarcolour lamps runs at 300-320°C., but being made of glass with a low co-efficient of expansion (hard glass) it will withstand rain splashes and is suitable for operation in open lanterns or fittings.

* The outer jacket of the Solarstream lamp is "quartz" (fused silica), this material, although resistant to thermal shock, can be contaminated by oil or grease and should not be handled more than absolutely necessary.

(f) Operating Position

(i) Solarcolour

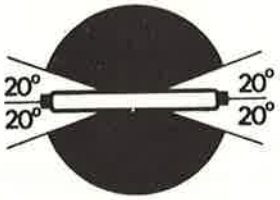
Solarcolour lamps may generally be operated in any position but under severe vibration conditions they should only be operated in a position as shown in the clear portion of the diagram.



(ii) Solarstream

The Solarstream lamp should only be operated within 20° of horizontal.

OSRAM: 45°



XIII. ELECTRICAL CHARACTERISTICS

Lamp Wattage	Minimum Nominal Supply Voltage	MAINS			ARC TUBE			Typical Circuit Watts
		Nominal Supply Voltage	Starting Current Amps	Running Current Amps	Voltage	Starting Current Amps	Running Current Amps	
120	220	240	1.1	0.7	100 + 20 - 15	1.8	1.4	140
220	220	240	1.9	1.4	105 + 20 - 15	3.3	2.7	250
250	220	240	2.0	1.5	100 + 15 - 15	3.6	3.0	280
310	220	240	2.0	1.6	110 + 20 - 15	4.4	3.2	345
360	220	240	2.7	2.0	110 + 20 - 15	5.0	3.7	400
400	220	240	3.5	2.3	105 + 15 - 15	5.8	4.45	445
600	380	415	2.5	1.8	200 + 30 - 30	5.0	3.7	685
1000	380	415	4.0	3.0	200 + 30 - 30	8.0	5.7	1120

NOTE: The characteristics given in the above table have been measured with power factor correction in a typical luminaire. In free air the arc tube voltage of clear lamps will be approximately 5% lower (Solarstream 20% lower).

XIV. COLOUR CHARACTERISTICS

(a) Chromaticity

x = .526 y = .418

(b) Luminosity (8 bands)

1 380-420 nm	2 420-440 nm	3 440-460 nm	4 460-510 nm	5 510-560 nm	6 560-610 nm	7 610-660 nm	8 660-760 nm
0.0002	0.026	0.090	2.3	11.4	72.8	13.0	0.38

Ref: L1/4 HT EX

(c) Spectral Energy Distribution

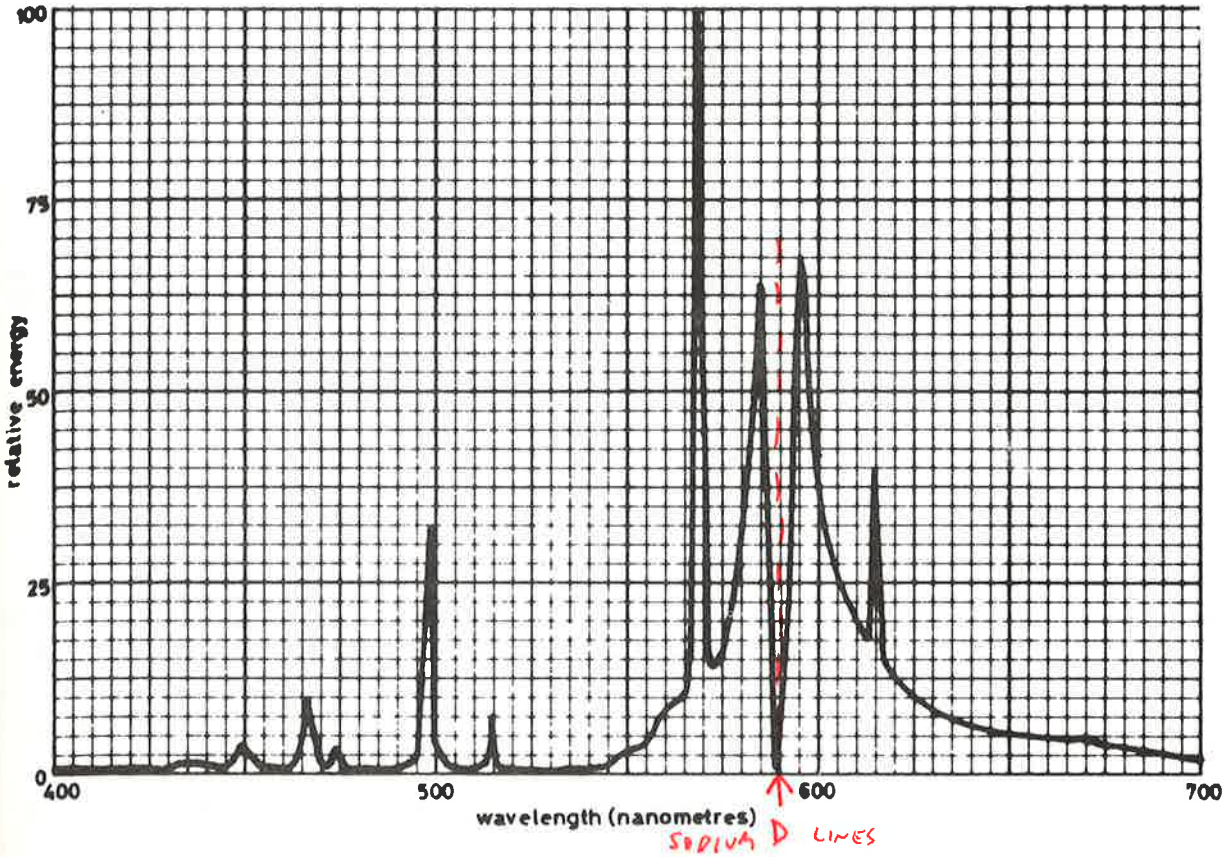


FIG.5. Typical spectral energy distribution

XV. LIFE AND LUMEN MAINTENANCE

(a) Life

The survivor rate of a typical batch of lamps is shown in FIG.6. Where 50% survivors remain is known as the average life.

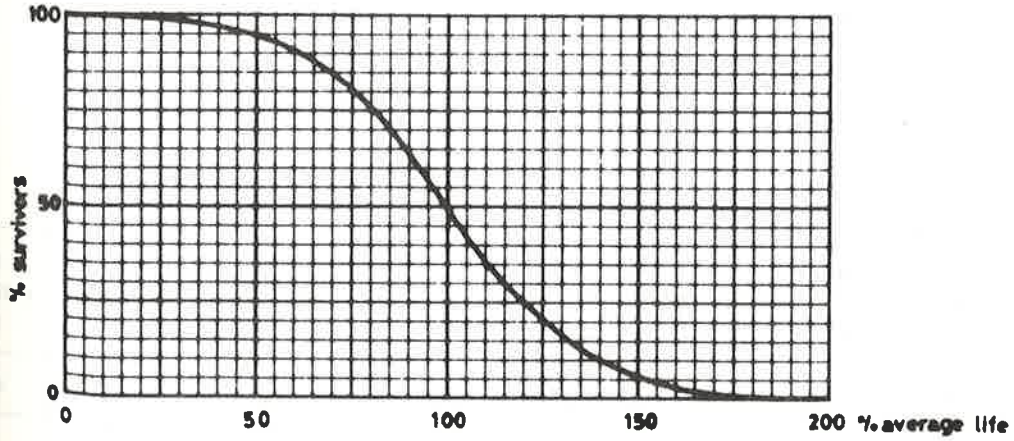


FIG.6. Typical survivor curve of Solarcolour and Solarstream lamps

Continued improvements in lamp technology means that life expectancy can increase year by year, check with GEC for latest figures.

Ref: L1/4 HT EX

(b) Lumen Maintenance

The lumen maintenance over the first 6000 hours is approximately 90%

XVI. SERVICING OF LAMPS WHICH ARE NOT OPERATING SATISFACTORILY

To be carried out by competent personnel only.

(a) Lamp does not start

1. Check mains supply between choke and neutral.

2. In the case of lamps with internal starters, check current in lamp leads (this should be between 100% and 170% of nominal value shown in table in Para. XIII. This test should be carried out several times over a period of five minutes because of the possibility of testing while the starting switch is open. If no current, check continuity of:-

   (a) choke

   (b) wiring and lampholder

   (c) lamp (a cold lamp should show a short circuit)

   If the heater coil has fused, check choke and wiring for insulation failure.

3. If checks in 1. and 2. are satisfactory, replace lamp. If starting is still not achieved, check for surge breakdown in wiring, lampholder or choke.

4. The power factor capacitor also forms an essential part of the starting circuit (internal or electronic) and should be replaced if starting difficulties persist.

(b) Lamp starts and goes out after running up

As previously inferred, this phenomena occurs as the result of the lamp operating with too high an arc tube voltage. This can be due to an unsuitable fitting or incorrect control gear characteristics at the particular choke tapping or very high mains voltage.

In order to check on the fitting, measure the voltage across the lamp when it is run up, but before extinction. Measure again with a new lamp operating outside the lantern. If the voltage of the lamp in the lantern is more than 15% above that with the lamp operating outside, then the design of the fitting is unsuitable for use with the particular wattage of Solarcolour lamp. For Solarstream lamps, the fitting should raise the tube voltage by between 20 and 35v.

If the cause of the trouble cannot be related to the lantern, the running arc tube voltage and current should be measured. At the point where the voltage given in Section XIII is achieved, the current should be reasonably near the objective given in the same table. If this is not the case, the choke tapping should be adjusted- this is in spite of the fact that the choke may already be set for the actual voltage applied. Variations in choke characteristics can result in incorrect lamp performance.

XVII. LUMINAIRES

Whilst Solarcolour and Solarstream lamps can be used in luminaires of standard design appropriate to the particular wattage, care should be taken to ensure that they do not cause an excessive rise in lamp tube voltage, as this may result in the lamps self-extinguishing.

XVIII. DISPOSAL OF LAMPS

The High Pressure Sodium lamp does not contain harmful quantities of dangerous chemicals, but as the outer bulb has been evacuated, protective glasses and gloves should be worn when breaking open the lamp.

All lamps should be broken into pieces and disposed of in accordance with local safety regulations

XIX. TUBULAR SOLARCOLOUR LAMPS SON-T - DIMENSIONS AND LIGHT OUTPUT

All tubular Solarcolour lamps have clear bulbs and E40 (G.E.S.) caps

(a) Dimensions (millimetres)

Wattage	Diameter	Maximum Overall Length	Nominal Light Centre Length	Nominal Arc Length
220	52	257	158	75
250	52	257	158	75
310	52	285	175	90
360	52	285	175	90
400	52	285	175	90
600	65	340	200	135
1000	90	405	240	200

(b) Light Output (check with current publication for latest lumen figures)

Wattage	Initial Lumen Output	Lighting Design Lumens	Luminance 2000 Hours Kcd/m^2
220	22,000	20,000	5,650
250	25,000	24,000	6,800
310	36,500	34,500	8,300
360	40,000	38,000	8,700
400	50,000	47,500	10,000
600	70,000	65,000	10,000
1000	130,000	125,000	12,500

Ref: L1/4 HT EX

XX. ELLIPTICAL SOLARCOLOUR LAMPS SON - DIMENSIONS AND LIGHT OUTPUT

Elliptical Solarcolour lamps have clear or internally diffused bulbs and E27 (ES) or E40 (GES) caps.

(a) Dimensions (millimetres)

Wattage	Maximum Diameter	Maximum Overall Length	Finish	Cap
120	76	178	Clear	E.S.
220	91	227	Diffused	G.E.S.
250	91	227	Diffused	G.E.S.
310	121	285	Diffused	G.E.S.
360	121	285	Diffused	G.E.S.
400	121	285	Diffused	G.E.S.

(b) Light Output (check with current publication for latest lumen figures)

Wattage	Initial Lumen Output	Lighting Design Lumens
120	8,600	8,000
220	19,000	18,000
250	23,000	22,000
310	34,000	33,000
360	38,000	36,000
400	44,500	42,500

XXI. REFLECTOR SOLARCOLOUR LAMPS SON-R - DIMENSIONS AND POLAR DIAGRAM

Reflector Solarcolour lamps have a specially shaped bulb with a titania reflector.

(a) Dimensions (millimetres)

Wattage	Maximum Diameter	Maximum Overall Length
250	167	260
310	167	260
400	167	260

(b) Polar Diagram

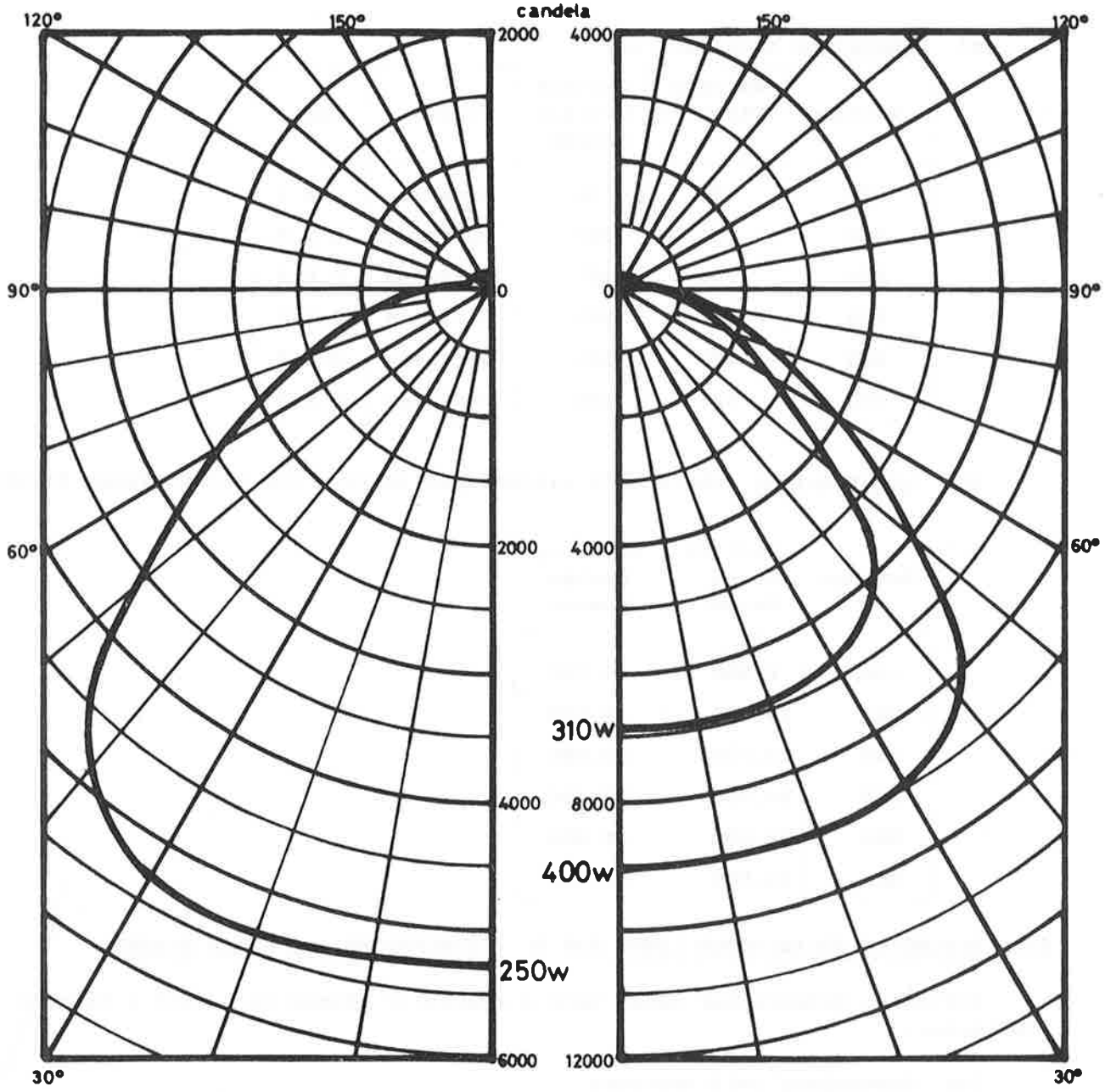


FIG.7. Polar diagram for 250W 310W & 400W Reflector Solarcolour (SON-R) Lamps

Ref: L1/4 HT EX

XXII. SOLARSTREAM LAMPS SON-L - DIMENSIONS AND LIGHT OUTPUT

Solarstream lamps have clear fused silica bulbs and R12.5s caps.

(a) Dimensions (millimetres)

Wattage	Maximum Radius Incl.Pip	Maximum Overall Length
250	18	273
310	18	273
400	18	273
1000	18	405

(b) Light Output

Wattage	Initial Lumen Output	Lighting Design Lumens	Luminance 2,000 hours Kcd/m^2
250	25,000	24,000	6,800
310	36,000	34,500	8,300
400	50,000	47,500	10,000
1000	130,000	125,000	12,500

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