THORN LIGHTING

CfSB | | 63.9 | | |

Publication No. 44748

DISCHARGE LAMPS

Sydney Opera House

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Bottled Lightning

In electric discharge lamps, light is produced in a more complex manner than in incandescent filament lamps. Hence a comparison with a miniature "flash of lightning" is valid, but instead of lasting for a brief period it is sustained. All discharge lamps consist of a sealed arc tube with two electrodes and some form of metal which can be vaporised and ionised to conduct current as an arc from one electrode to the other.

For high intensity discharge lamps there is also a starting gas which ionises readily. During this initial stage it is the heat generated by the flow of gas particles which causes the basic metal material to evaporate. This in turn becomes ionised and the resistance between the electrodes continues to fall until the arc current reaches the rating for the lamp.

This "run-up" period can take several minutes before the lamp has stabilized and is radiating the correct amount of light at the right colour.

Light is generated from the collisions between electrons and ions. The kinetic energy of these collisions is absorbed by elevating the orbital path of some electrons within the atoms of the metal.

This condition cannot be sustained and the electrons fall back to their stable orbit. In doing so they release energy of a specific wavelength which is determined by the distance of the "fall". Because there are specific orbital paths the radiation occurs only at individual wavelengths and these are characteristic to each metallic element. However by changing the pressure of the lamp the number of collisions increase so that the complete arc is continuously generating radiation.

Discharge lamps use one of two metallic elements – mercury or sodium. The latter is particularly interesting because at a low arc tube pressure the radiation appears as a monochromatic yellow. Increasing the pressure broadens the radiation band to a golden colour. Thus the fundamental difference between the various sodium lamps is arc tube pressure increasing from SOX to SON to SONDL. Details of the standard lamp abbreviations are given on page 7.

With mercury discharge lamps the basic visible radiation comes from wavelengths in the blue/green region of the spectrum. Unlike sodium lamps there is also radiation in the ultra violet region. This invisible radiation can be converted into useful visible light by coating the inside of the outer lamp envelope with a phosphor material. Phosphors have the property of absorbing radiation at one wavelength and transmitting it at a different wavelength. By selecting the right phosphors it is possible to absorb the UV radiation and to transmit the energy in the colour bands in which the mercury metal is deficient. There has been considerable phosphor development over the past 30 years for fluorescent tubes, which are one form of low pressure mercury lamp, and for colour television screens.

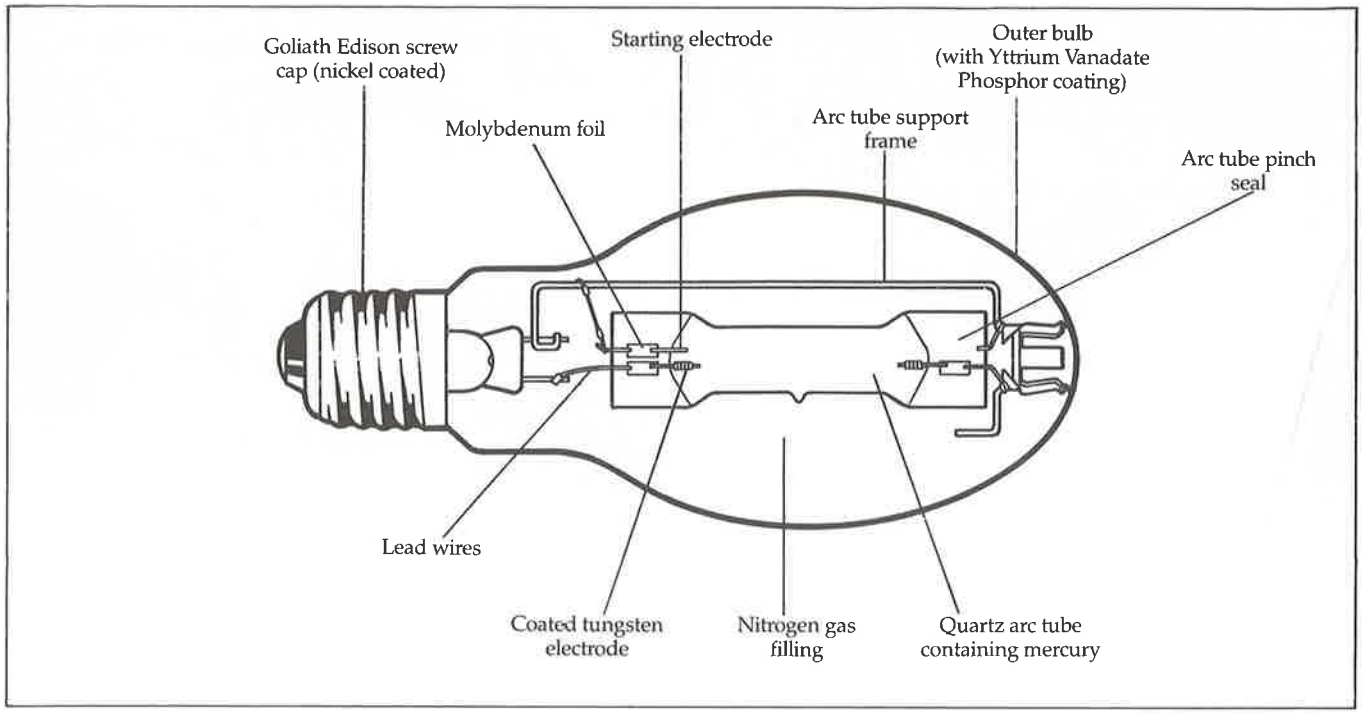
A second way of improving the colour of mercury lamps has been available since the sixties and is by adding other metals into the arc tube. As each metal has its own colour characteristics it is possible to produce a wide range of lamps with differing colour appearance and colour rendering properties. The amounts of metal required to make the correct dose for a lamp are very minute and the proportions highly critical. It was found more convenient and accurate to use metal halides during manufacture and thus they have become known as metal halide lamps, when multi-metal discharge lamps would be a truer description.

A high intensity discharge lamp will only operate at its nominal wattage if the lamp voltage and the supply voltages are also nominal. For mercury and metal halide lamps the lamp voltage remains about the same through life. However because of manufacturing tolerances there will be a variation for individual lamps.

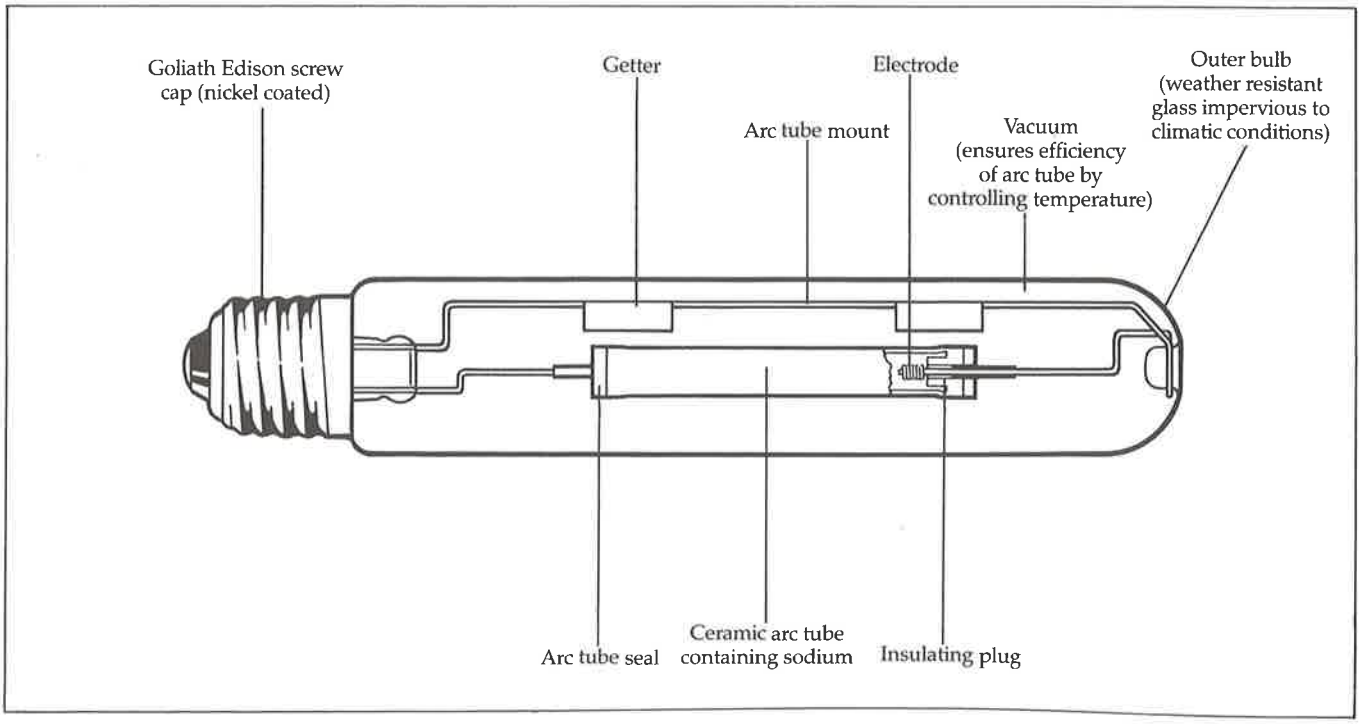
With high pressure sodium lamps the lamp voltage rises through life and the control gear should be such as to minimise the change in lamp watts.

The characteristics of a discharge lamp are related to the arc tube vapour pressure. High intensity discharge lamps are contained within an outer bulb which ensures thermal stability of the arc tube. For this reason the lamps will operate over a wide ambient temperature range without significant performance variation.

Typical mercury lamp construction (elliptical)



Typical sodium lamp construction (tubular)



Discharge Lamp Designations

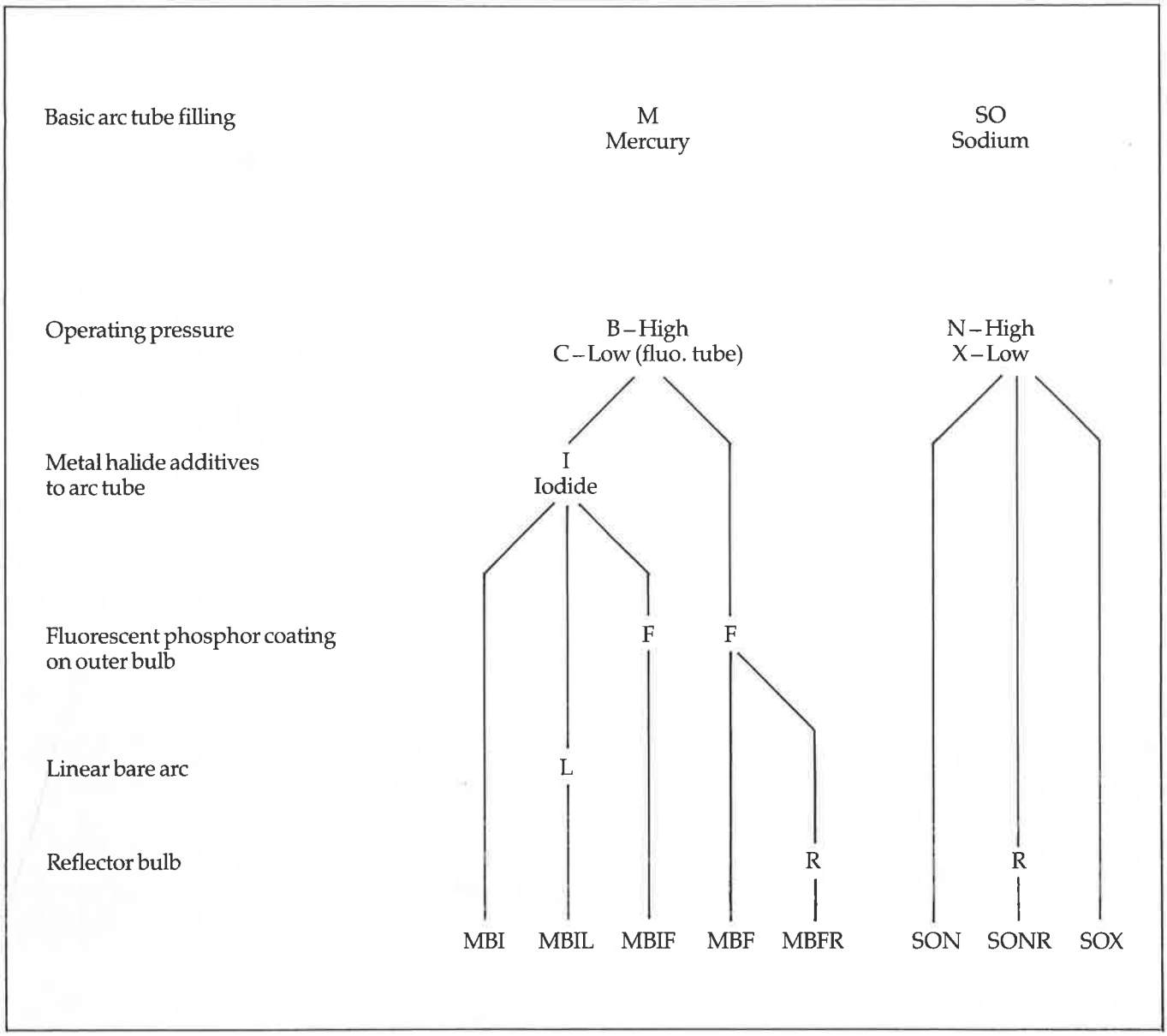
What do the names of discharge lamps mean?

UK designations of discharge lamps are built up from the components of the lamp and examples are shown below.

In addition to these designations, further suffixes denote restrictions in operating position.

Restrictions are indicated on the product pages and explained under "physical characteristics". Where no restriction is shown the lamp may be operated in any position.

e.g. MBF which should strictly be designated MBF/U "UNIVERSAL".



Suffixes Denoting Bulb Shape

Elliptical		SON-E
Tubular	MBI-T	SON-T
Tubular double cap		SON-TD

Economic Story

Economically, discharge lamps have two major qualities which make them a really cost-effective choice. Firstly they are efficient – for each watt of energy, they give out more light than most other light sources. Secondly their characteristic long life means that not only can this efficiency be relied on for thousands of operating hours, but operating costs are also lower as the need for maintenance/replacement is reduced.

In floodlighting situations where long operating hours are required, discharge lamps, as an alternative to Tungsten Halogen, offer the right combination – performance with economy. In fact 70–80 per cent savings on power costs can be achieved and pay backs on capital costs should be anticipated within one year. For display lighting, the new, low wattage metal halide lamp – Arcstream – represents a considerable breakthrough. Efficiency and quality light are combined to form a light source that offers five times the light output of a PAR Lamp of the same wattage but which will last three times as long.

The message is borne out by the dominance of Thorn discharge lamps in the Energy Management in Lighting Award Scheme (EMILAS) and the National Lighting Awards (NLA). In 1987 eight of the 13 EMILAS award winners used Thorn discharge lamps, showing that where energy management was important these lamps were supreme. In the NLA – which requires a combination of aesthetic lighting design with economy of operation – three out of the four winners and nine of the total 12 entrants who received commendation had used discharge lamps in their schemes.

M4 Motorway

But it is road-lighting which is probably the essence of the economic story where discharge lamps are concerned. The thousands of operating hours which road-lighting uses requires extremely efficient lighting as cheaply as possible. Thorn Lighting has responded to this need by offering three solutions: SOX, or low pressure sodium lamps are the most efficient light sources in terms of converting electrical energy into visible light. In other words SOX lamps produce the highest lumen output for each watt of energy used than any other light source available. Further savings made by using the newly developed SOX-E lamp with special control gear. The third option is SON, or high pressure sodium, which offers far better quality light than SOX. Although the efficacy of SON is lower than SOX, the life of the lamps is almost twice as long so that drastic savings can be made on maintenance and replacement costs. In addition, SON lamps are far more robust and less sensitive to vibration than SOX lamps so that in arduous situations such as motorways, SON should be used.

Discharge Lighting cannot be ignored because wherever it is used it saves money. Whether these savings are made in the amount of power consumed or the amount of money spent on maintaining your lighting installation, discharge lighting provides an economical alternative for an increasingly diverse variety of applications – interior and exterior, industrial, commercial or display, road-lighting and so on.

Municipality Planning Building, Abu Dhabi

Light Output Comparison

The histogram shows the relative light outputs available from lamp types in general use.

It can be seen that discharge lamps offer efficacies and a range of outputs unmatched by any other lamp type.

With long lamp life and good lumen maintenance, discharge lamps provide the most economical lighting for many applications.

The meaning of discharge lamp names is given on page 7.

Light Output Comparison Initial Lumens

White Pluslux Fluorescent Tube	
36W	3140
58W	5000
100W	8800

GLS	
150W	2140
300W	4550
500W	8200
750W	13100
1000W	18400

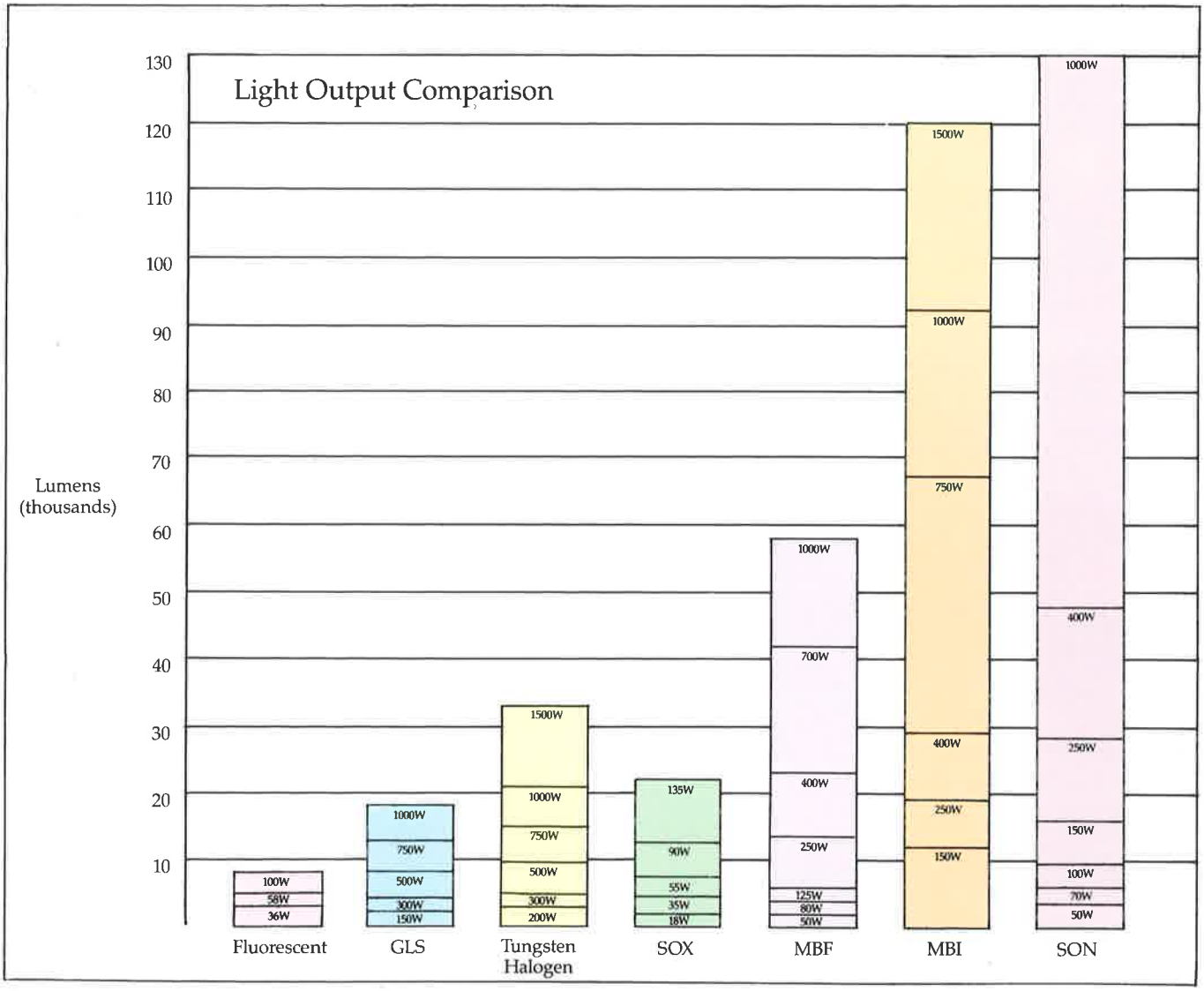
Tungsten Halogen	
200W	3100
300W	5000
500W	9500
750W	15000
1000W	21000
1500W	33000

SOX	
18W	1800
35W	4600
55W	7650
90W	12750
135W	22000

MBF	
50W	2000
80W	3850
125W	6300
250W	13500
400W	23000
700W	42000
1000W	58000

MBI	
150W	12000
250W	19000
400W	29000
750W	67000
1000W	92000
1500W	120000

SON	
50W	3500
70W	6000
100W	9600
150W	16000
250W	28500
400W	48000
1000W	130000



Starting

When a discharge lamp is switched on, current first flows through the starting gas of the arc tube. The heat generated vapourises the mercury, sodium or halide filling until the operating conditions are achieved.

Typical run-up characteristics are shown on the graph.

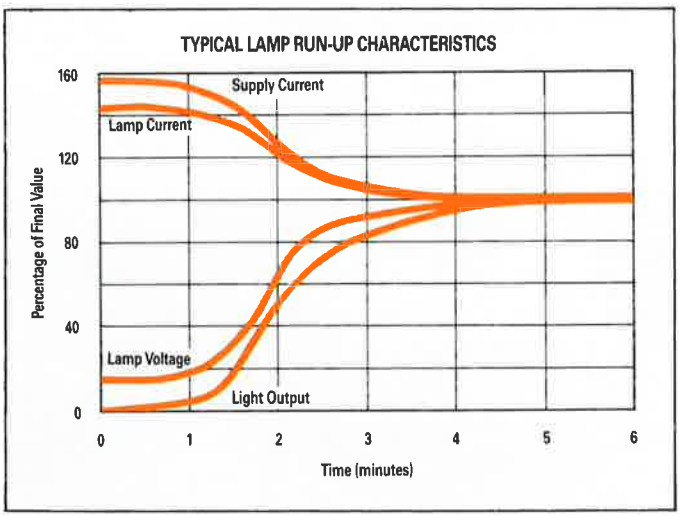
If there is a momentary interruption to the supply voltage most lamps need to cool before they will restrike.

The following table shows typical times for both these characteristics. Run-up times are for the time to 90 per cent nominal light output. Times for individual lamps will vary according to location and luminaire.

Lamp type	Rating Watts	Run-up time mins.	Re-strike time mins.
SOX & SOX-E	18	12	Instant
	35	9	Instant
	55	9	Instant
	90	9	10
	135	8	10
SON, SONR & SON-TD	50	3	less than 1
	70	3	less than 1
	100	4	less than 1
	150	6	less than 1
	250	6	less than 1
	400	4	less than 1
	1000	6	3
SONDL	150	8	less than 1
	250	8	less than 1
	400	8	less than 1
MBI	250	2	7
	400	2	7
	1000	2	7
MBI-T Arcstream 3000/4000	150	1	4
MBF, MBFSD & MBFR	50	5	4
	80	3	4
	125	3	4
	250	4	4
	400	4	4
	700	3	6
	1000	2	7
MBIL	750	2	8–12†
	1500	2	15–20†
CSI	1000	1	10*

† In floodlight

* Hot re-strike version also available



Quality Story

Quality control and quality assurance play an increasingly vital role in modern manufacturing and development techniques and Thorn Lighting continues to uphold its commitment to its customers to provide them with high quality, high performance products – products which, satisfy and fulfil all their lighting requirements.

All of Thorn's discharge lamps are manufactured to both the relevant British Standards and the agreed standards of the International Electrotechnical Commission (IEC). The lamps are also monitored for quality at each stage in their production – from component parts to finished lamps – using methods and procedures which are also laid down by the British Standards Institute and the IEC.

Thorn is also dedicated to improving the quality of its existing products and introducing new, high quality products through research and development which is carried out at Thorn's laboratories at Leicester. SON lamps which, despite being well established high quality, high performance products are still the subject of research and development. In recent months improvements to the arc tube have increased the light output of SON lamps and made starting easier and more reliable throughout their life. The introduction of new, hi-tech machinery which uses lasers to weld the arc tube framework has made it a more robust structure and even better able to cope with arduous operating conditions.

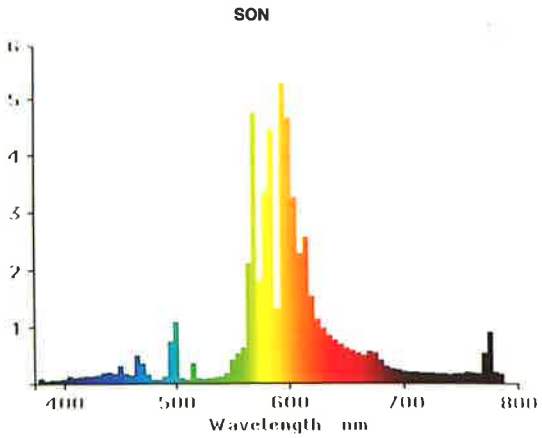
Research and development has also led to the introduction of new lamps which, in particular, offer high quality white light. Phosphor development has enabled Thorn to introduce the new Super Deluxe mercury lamp with higher output and a colour rendering which is good enough for internal commercial use (see page 36/37). The new Arcstream lamp (see page 32/33) extends the benefits of metal halide technology into a highly compact, flexible light source. With the already established SON Deluxe, Thorn are now able to offer a range of lamps which offer white light and good colour rendering and combine this with high performance and long life.

Through their commitment to quality, Thorn has produced a range of discharge lamps which are being used in increasingly diverse applications and by improving the quality of lighting for leisure, industry, commerce and streets, Thorn is able to improve the quality of life for all of us.

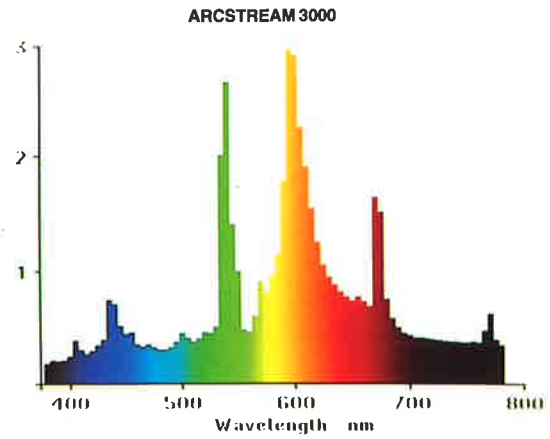
Colour Story

Introduction

The colour of an object is not a physical characteristic of that object. The colour we see is dependent on the light source that illuminates the object and how the object reflects, transmits or absorbs that light. For example, a tomato appears red because it reflects red light, but it only appears red if red is contained in the light that illuminates it.



SON SPD



Arcstream SPD

Spectral Power Distribution Diagrams

Light is a form of electromagnetic radiation and visible light is only a small proportion of that radiation. Each wavelength of electromagnetic radiation corresponds to a colour and the light given off by most light sources is a blend of various different colours. A spectral power distribution diagram (SPD) shows which colours are contained in the light source. The height of a particular colour on an SPD shows the relative ability of that light source to render that colour.

Discharge lamps can have markedly different SPD's and hence different abilities to render certain colours and this is due to the materials used in the construction of the lamp.

Colour Rendering

It is important to appreciate these different qualities and the implications of the way coloured objects appear under these light sources but as a general guide, use can be made of an R_a index. This is simply an indication of the average ability of a light source to render colour. An index of 100 is the best possible number to achieve. A conventional White fluorescent lamp has an index of R_a 54 while discharge lamps can vary enormously from a high pressure sodium lamp with an index of R_a 25 to an Arcstream metal halide lamp with an index of R_a 80.

Two light sources with the same R_a index can have completely different colour rendering properties.

For example, both SON-DL and the Kolorarc MBIF lamps have a R_a index of 70 but they render colours in different ways. The SON-DL is much better at rendering orange and red but worse at rendering blues and greens than MBIF. This is why it is important to consult the SPD. This however is only a very general comparison and the visual effect is a complex inter-reaction between the light source and illuminated object. A detailed study would require examination of the reflective properties of the object and the effect that the light source has on these properties or alternatively a site trial.

Colour Appearance

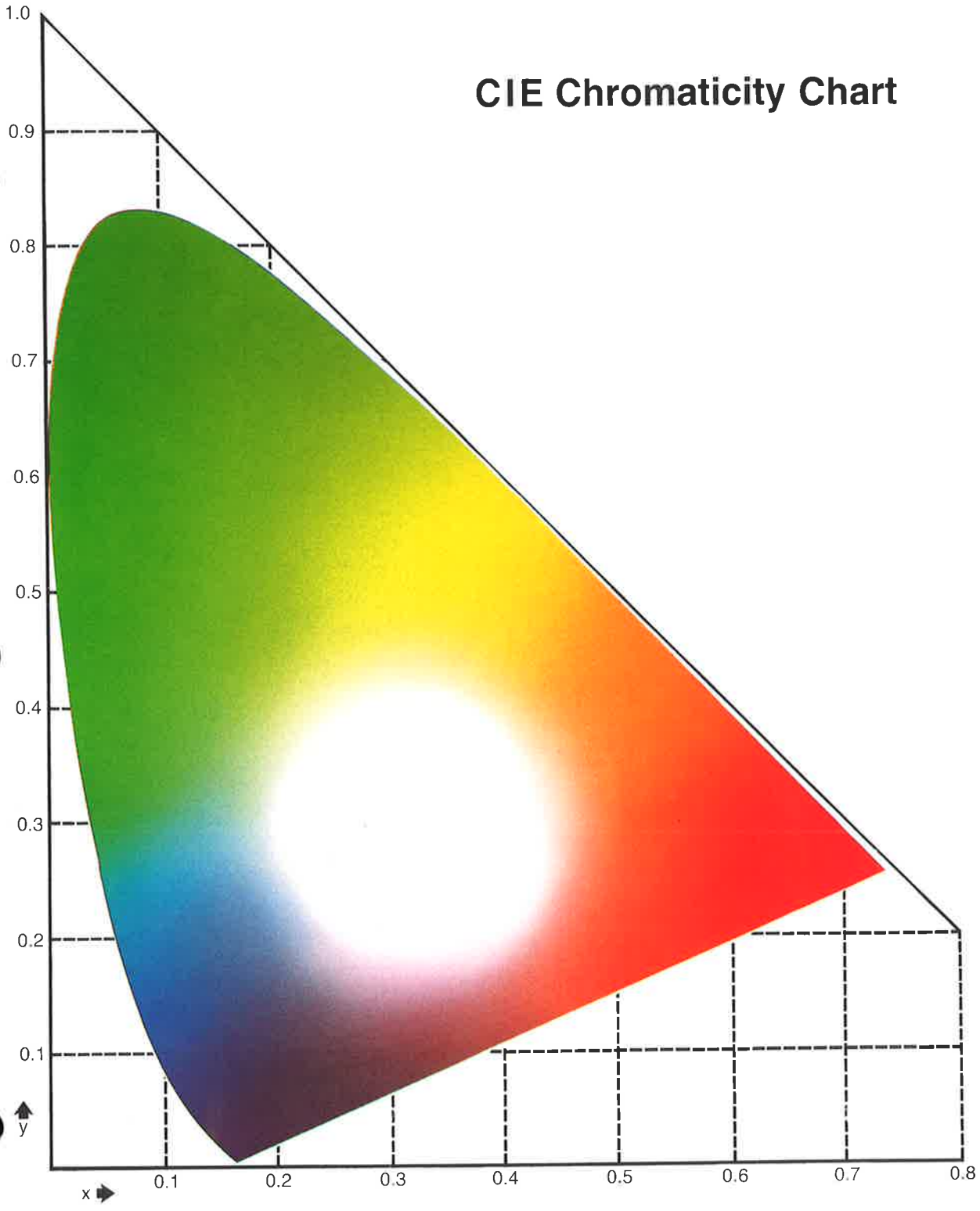
Whether a light source will appear cool (like an overcast day) or warm (like a summer sunset) can be determined from its colour temperature given in degrees Kelvin (K). The lower the figure, the warmer the light source appears. For example, a SON lamp has a colour temperature of 2000K and appears very warm while an MBF lamp with a colour temperature of 3800K appears very cool in comparison (most White fluorescent tubes are 3500K).

The actual colour that a light source appears ie a yellow tinge or pink tinge is given by chromaticity co-ordinates. These co-ordinates are simply a way of specifying a colour numerically. Once the co-ordinates are known, reference to the CIE Colour Triangle shows the colour that the light source will appear.

Correlated Colour Temperature (CCT)	CCT Class
CCT≤3300K	Warm
3300K<CCT≤5300K	Intermediate
5300K<CCT	Cold

Colour rendering groups	CIE general colour rendering index (R_a)	Typical application
1A	$R_a \geq 90$	Wherever accurate colour matching is required, eg 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, eg 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.

CIE Chromaticity Chart



Lumen Maintenance and Life Survival

It is not possible to guarantee the performance of an individual lamp but that of a representative group can be predicted from field and laboratory testing.

The graphs indicate the depreciation to be expected through life of a representative batch of lamps operating under optimum conditions on a 10-hour switching cycle. (Five-hour cycle for MBIL and CSI Sealed Beam.)

Adverse field conditions such as supply voltage variations or vibration will have a detrimental effect on performance.

The lumen maintenance curves indicate typical performance during lamp life ignoring the effects of dirt accumulation and corrosion on the lamp and luminaire.

Assessments can be made from the curves of:

(a) Lumen depreciation over a given lamp life.

(b) Lamp life corresponding to an acceptable lumen depreciation.

The life survival curves enable a group replacement period appropriate to the application to be chosen in conjuction with the lumen maintenance curve.

With the aid of these graphs the relative merits of different lamp types can be assessed by comparing lumen maintenance and survival figures after the same operating period.

For example:-

The lumen depreciation of SON is only half that of MBF. The failure rate of SON is less than half that of SOX.

Supply Voltage

Both lumen maintenance and survival will be adversely affected by variation in the supply voltage from the nominal value.

It is important therefore to ensure that the ballast tapping corresponds to the actual supply voltage at the luminaire. In order to achieve optimum performance the supply voltage and the ballast design voltage should be within ± 3%.

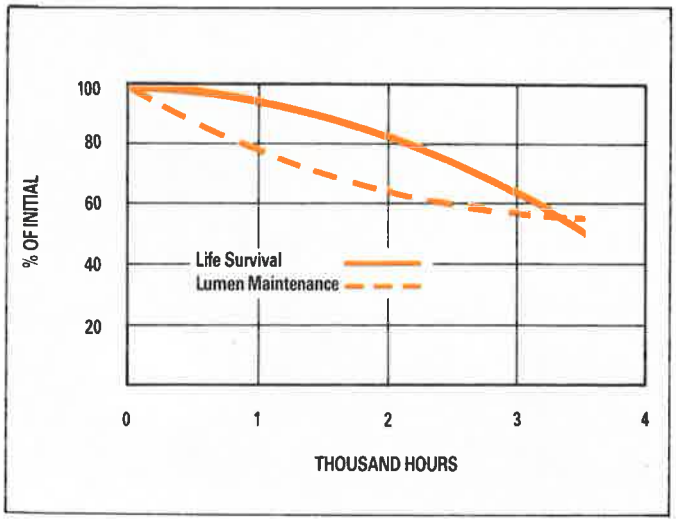
Supply voltage excursions of ± 5% from normal will not be detrimental provided that for most of the time the variation is within ± 3%

MBIL Life Survival

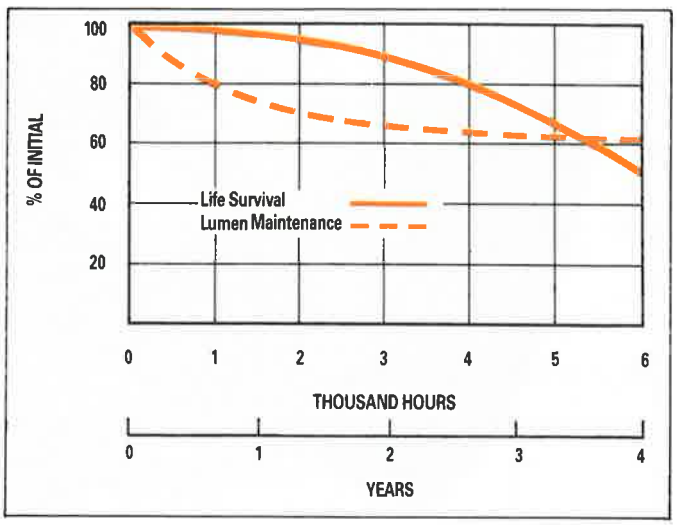
For regular use, eg a five-hour cycle every day, the "THOUSAND HOURS" scale should be used.

For intermittent use, eg once or twice a week during the winter months, life is determined more by installation time than usage. Under such conditions, the "YEARS" scale should be used.

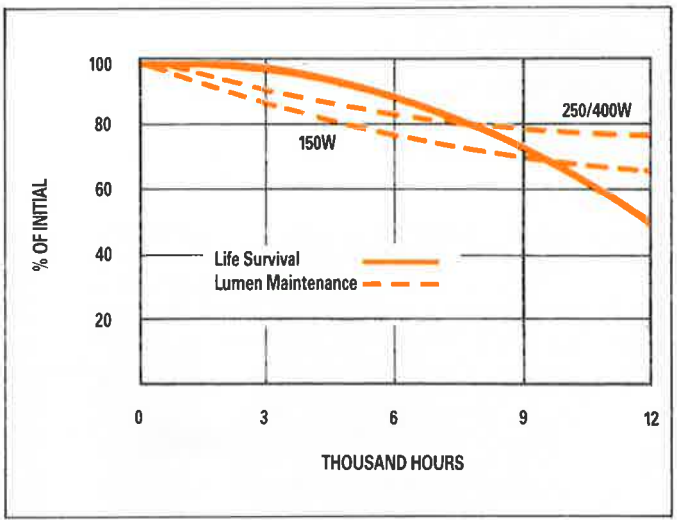
CSI



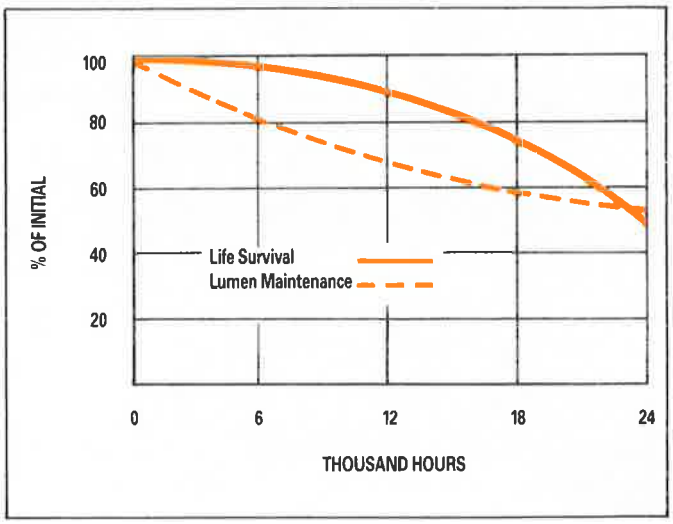
MBIL



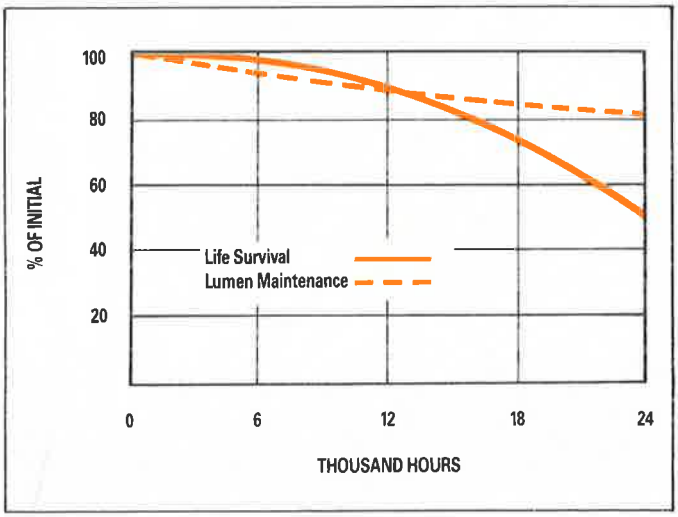
SONDL



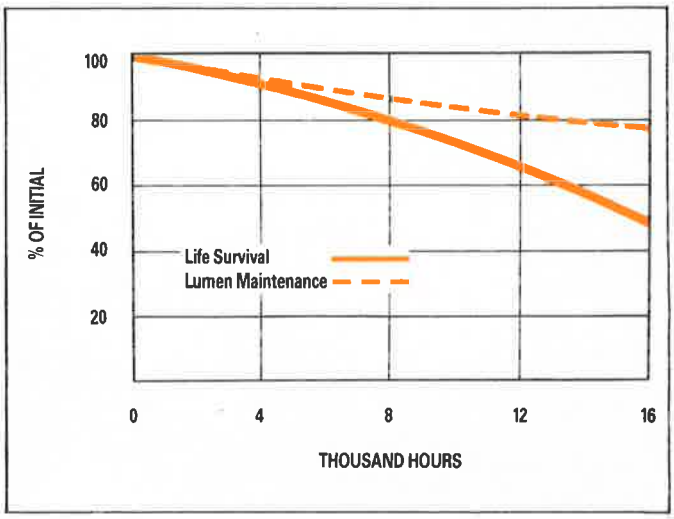
MBF, MBFSD, MBFR



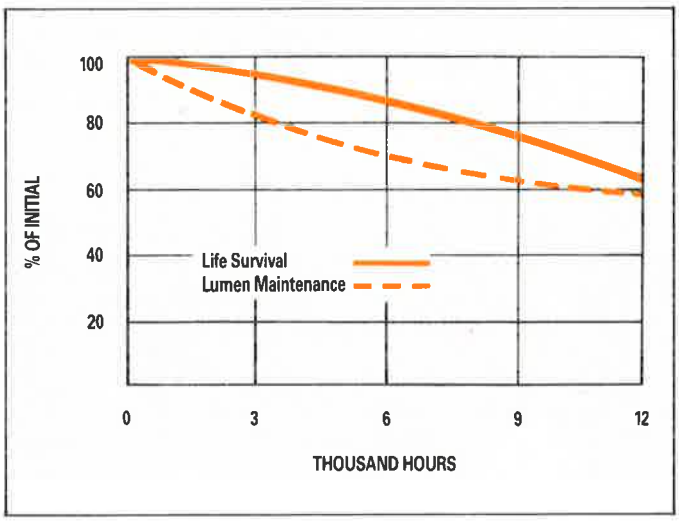
SON, SON-R, SON-TD



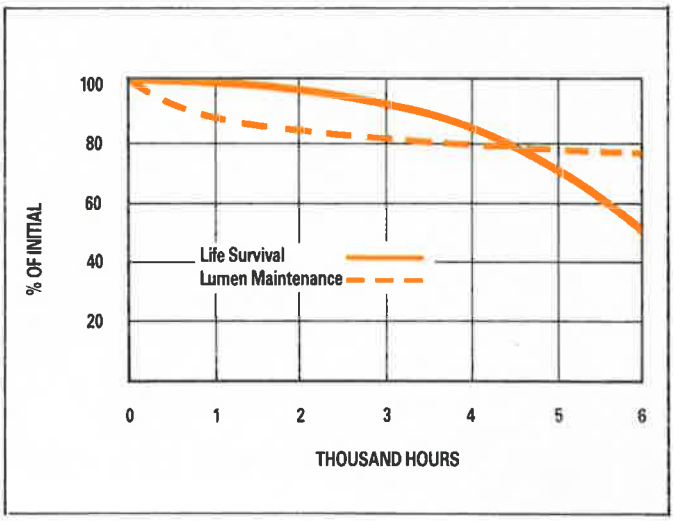
SOX, SOX-E



MBI, MBIF

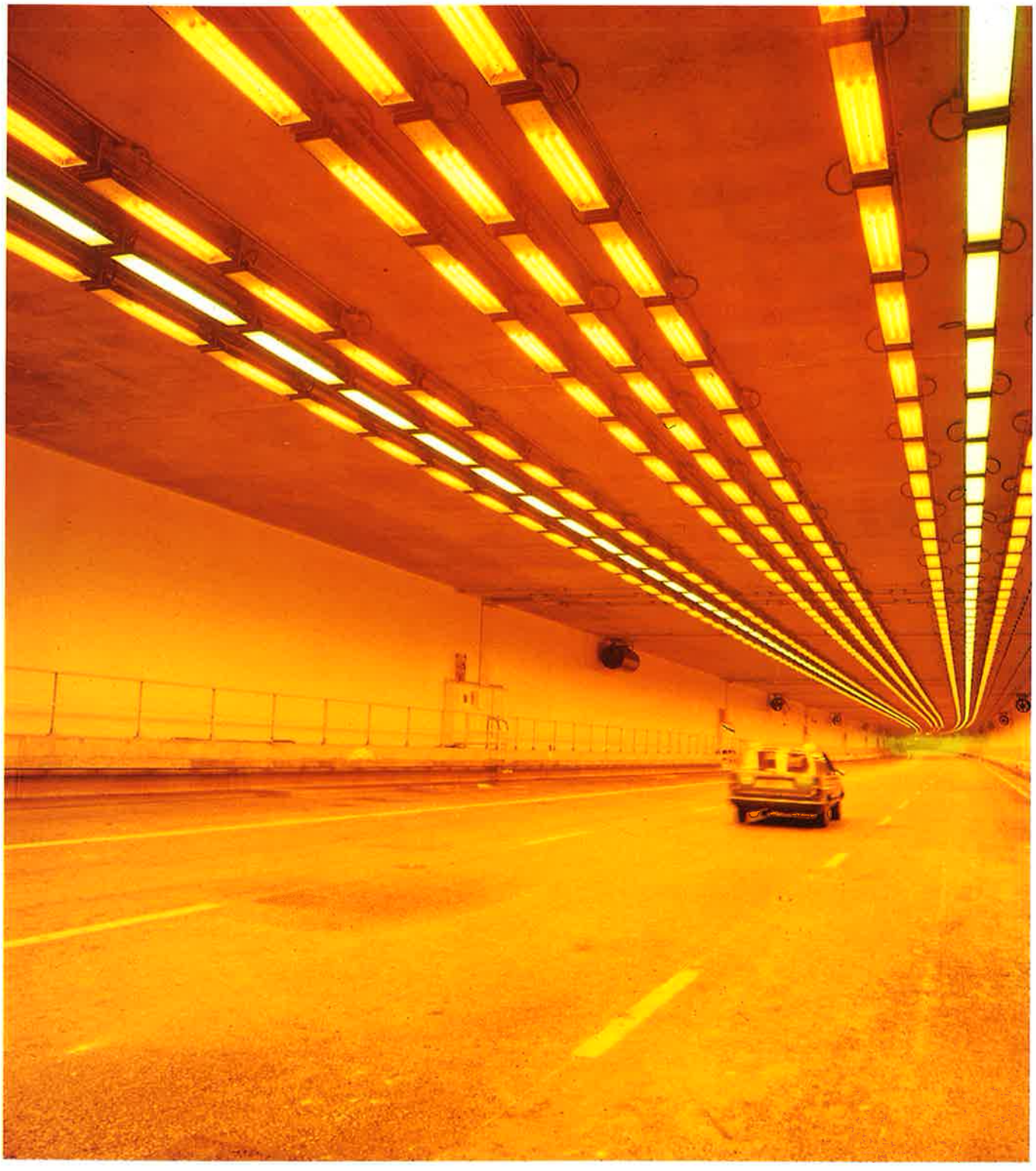


ARCSTREAM



SOX/SOX-E

low pressure sodium lamps



A1(M) Hatfield Tunnel

Low Pressure Sodium Lamps – SOX

SOX lamps consist of a sodium discharge which operates at low pressure within a U-shaped arc tube. The arc tube is enclosed in a clear tubular bulb which is coated internally with a transparent infra-red reflecting medium. This treatment thermally insulates the arc tube, keeping it at the right temperature for optimum operating efficiency. The great benefit of SOX is its extremely high efficacy, a direct result of the characteristic yellow coloured light which the low pressure discharge emits. This monochromatic light is concentrated at wavelengths of 589 and 589.6 nanometers (see spectral distribution histogram) and this radiation is very close to the wavelength at which the human eye is most receptive – 555 nanometers.

The high efficacy results in very low power costs and makes SOX particularly suitable for use where long operating hours are required. SOX is therefore traditionally associated with, and eminently useful for road-lighting but it is also economic for security lighting of car parks and storage areas; marshalling yards and harbours; public and amenity lighting; construction sites and other external industrial uses. However, the monochromatic light which SOX emits makes colour discrimination impossible so the lamps should not be used where colour judgement is required. On the other hand, this radiation is useful for scientific and graphic arts purposes.

Low Pressure Sodium Lamps – SOX-E

The construction of SOX-E lamps is similar to standard SOX except that by improving the thermal insulation, higher efficacies can be achieved. By operating lamps at lower wattages significant power savings can be achieved with only a small reduction in light output. This accounts for the "E" suffix which stands for ECONOMY.

SOX-E lamps are interchangeable with standard SOX lamps in the following way:

Equivalent Ratings

SOX	SOX-E
35W	26W
55W	36W
90W	66W
135W	91W

Note

Although significant power savings can be achieved by substituting SOX-E lamps for SOX, the rated wattage figures for SOX-E will only be achieved when they are operated on control gear designed specifically for SOX-E.

The electrical characteristics of SOX-E lamps operated on SOX control gear are given on page 40.

Colour

Due to the monochromatic nature of the light output, colour temperature and colour rendering figures are not applicable.

SOX lamps should not be used where colour discrimination is required.

Range

Rating Watts	Lamp type	Lumen output 100 hrs.	Lumen output 2000 hrs.
18	SOX	1800	1750
35	SOX	4600	4500
55	SOX	7650	7500
90	SOX	12750	12500
135	SOX	22000	21500
26	SOX-E	3950	3800
36	SOX-E	5950	5750
66	SOX-E	10500	10000
91	SOX-E	16800	16300

SOX-E lumens apply to operation on standard SOX control gear.

SON
high pressure sodium lamps

British Steel Corporation, Workington

One of the most important developments in the discharge lamp story has been the progression from low pressure to high pressure sodium lamps. These lamps from Thorn Lighting are known as SON and the great benefits which are derived from them are achieved as a result of developments in modern technology – primarily to the arc tube.

Thorn's SON lamps consist of a sodium discharge operating at higher pressure than that which occurs in SOX lamps. This discharge operates within a sintered alumina arc tube – a ceramic material which was developed to cope with the special requirements of SON operation. This arc tube is mounted in either an elliptical bulb (SON-E) which is treated with a light-diffusing coating or a clear, tubular bulb (SON-T) which gives excellent optical control when used in a suitably enclosed luminaire. The lamp is also available in double-ended and reflector versions (see pages 24/25).

The operation of the sodium discharge at a higher pressure has two advantages. Firstly, the lamps emit a pleasant golden-white light with adequate colour rendering for colour discrimination purposes. Secondly, the lamps demonstrate exceedingly good lumen maintenance and long life.

Edmonton Green

This, of course, means that Thorn's SON is highly suitable for a wide variety of uses. It can be used for road-lighting and security and amenity lighting as an alternative to SOX. The superior quality of light and the ability to distinguish colours is an advantage acknowledged by drivers and pedestrians alike and SON's ability to maintain its high lumens means that economically, too, it is a viable alternative to low pressure sodium and high pressure mercury lamps.

Thorn Lighting's SON is used for many internal applications also – in factories and warehouses, loading bays, workshops and garages and both large and small installations. In fact SON is now first choice for exterior and industrial lighting.

Choose Thorn's SON and you choose reliability, quality performance and value for money. And that means peace of mind.

SON

Rating		50–70W	100W	150–400W	1000W
Correlated colour temperature (K)		1900	1950	2000	2050
Colour co-ordinates	x	0.542	0.530	0.530	0.520
	y	0.415	0.418	0.415	0.415
General colour rendering index (R_a)		35	25	25	20
Colour rendering group		4	4	4	4

Range

Rating Watts	Lamp type	Lumen output 100 hrs	Lumen output 2000 hrs.
50	SON-E	3500	3100
70	SON-E	5800	5300
100	SON-E	9200	8800
150	SON-E	15500	15000
250	SON-E	26500	25500
400	SON-E	46000	45000
1000	SON-E	120000	110000
50	SON-T	3500	3100
70	SON-T	6000	5500
100	SON-T	9600	9200
150	SON-T	16000	15500
250	SON-T	28500	28000
400	SON-T	48000	47000
1000	SON-T	130000	120000

Rea Point, Canada

SONDL
high pressure sodium lamps – deluxe

Gloucester Cathedral

As we have seen on the previous page, the progression from low pressure sodium (SOX), to high pressure sodium (SON) lamps was made possible thanks to advances in modern technology. Things of course do not stand still and these developments have been pushed along still further. By increasing the arc tube pressure of SON lamps even more, several advantages can be achieved. The resulting lamp is called SON Deluxe.

The construction of SONDL is virtually the same as standard SON and, like SON is available in diffused elliptical and clear tubular bulb versions. However, just as the operation of SON required arc tube development, so too, did SON Deluxe and the main difference between the lamps is in this area.

Thorn are world leaders in the development and production of SON Deluxe and the lamp has several important advantages. Thorn's SONDL combines the energy saving benefits associated with SON, but the colour appearance is whiter with a rise in colour temperature from 2000K to 2200K. The colour rendering improves also, with a dramatic leap to R_a 65 on the colour rendering index.

The result of this improved colour means that SONDL is ideal for commercial interior use – in offices, entrance foyers and institutional and social areas. SONDL is also highly suited to industrial interiors and for decorative floodlighting and amenity lighting.

SONDL

Rating		150–400W
Correlated colour temperature (K)		2200
Colour co-ordinates	x	0.504
	y	0.411
General colour rendering index (R_a)		65
Colour rendering group		2

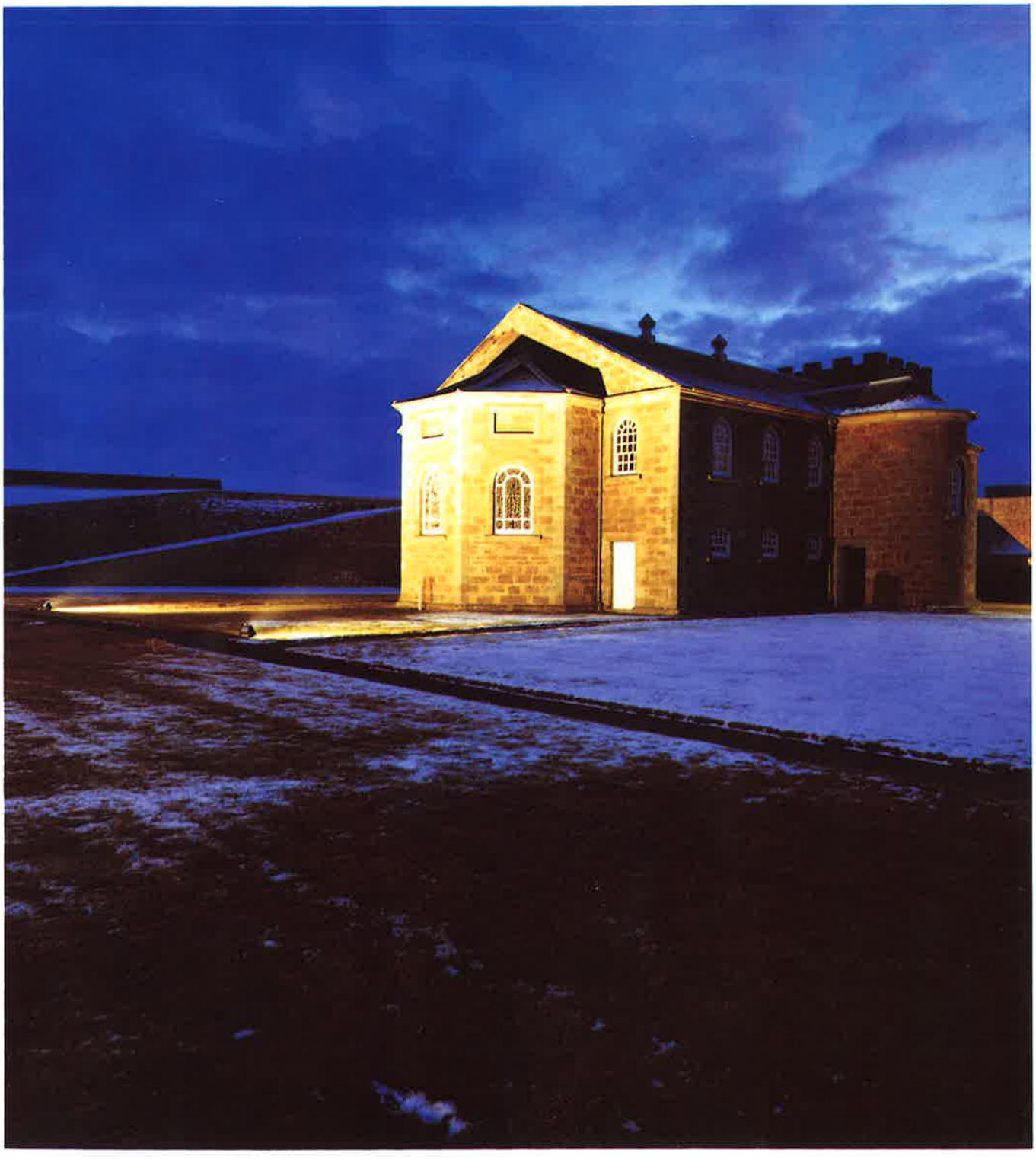
Range

Rating Watts	Lamp type	Lumen output 100 hrs.	Lumen output 2000 hrs.
150	SONDL-E	11500	11000
250	SONDL-E	20000	19000
400	SONDL-E	34000	33000
150	SONDL-T	12000	11500
250	SONDL-T	21000	20500
400	SONDL-T	35000	34000

Swimming Pool, Lyon

SON-R/SON-TD

high pressure sodium reflector lamp



Fort George, Ardersier

High Pressure Sodium Reflector Lamp – SON-R

SON-R from Thorn Lighting operates in the same manner as standard SON (see pages 20/21). The high pressure sodium discharge operates in a sintered alumina arc tube which is mounted in a shaped glass bulb. This bulb incorporates an internal reflector which allows good optical control.

Thorn's SON-R can be used in areas where the warm, golden light which is typical of SON is useful for decorative purposes in, for example, foyers, stairwells, for canopy lighting – or any application where precise colour rendering is not required. In addition, the accurate optical control which is inherent in SON-R is useful for display purposes of plant and floral displays for example.

Finally, there are two important factors which make SON-R a very economic choice. Firstly, the high efficiency, long life and reliability, which is a characterstic of high pressure sodium lamps, is found in SON-R, and secondly, the internal reflector reduces the need for expensive luminaires and also means low maintenance – especially cleaning – costs.

High Pressure Sodium Discharge Lamp – SON-TD

Market leaders, Thorn Lighting's SON-TD operates in the same manner as standard SON (see pages 20/21). The construction of the lamp is similar, also, in that the same sintered alumina arc tube is used but it is mounted in a clear tubular quartz bulb which is double-ended for use in specially designed luminaires.

All the advantages of SON are inherent in SON-TD and the lamp combines economy of operation and high performance with excellent optical control when used in conjunction with Thorn's specially designed floodlights.

SON-TD is ideal for floodlighting applications where long operating hours are required and the lamp is used in widely differing situations from outdoor sports arenas, ski slopes etc, decorative lighting of public buildings, security lighting of small industrial units to floodlighting in hazardous areas and so on.

Choose SON-TD for high efficiency and low operating costs, precision performance and dramatic lighting. Choose SON-TD and choose Thorn!

SON-R and SON-TD

Rating		70W SON-R	250–400W SON-TD
Correlated colour temperature (K)		1900	2000
Colour co-ordinates	x	0.542	0.530
	y	0.415	0.415
General colour rendering index (R_a)		35	25
Colour rendering group		4	4

Range

Rating Watts	Lamp type	Lumen output 100 hrs.	Lumen output 2000 hrs.
70	SON-R	4800	4500
250	SON-TD	26000	25000
400	SON-TD	48000	46000

Beam information for SON-R

Rating	70W
Peak intensity (kcd)	8.4
½ peak beam angle	18°
1/10 peak beam angle	70°

MBI/MBIF
metal halide lamps

Globe, Stockholm

KOLORARC

KOLORARC lamps consist of a high pressure discharge with metal halide additives operating in a quartz arc tube. This arc tube is mounted in an elliptical glass bulb which is coated internally with fluorescent phosphor for the MBIF version and is clear for the MBI lamp.

KOLORARC lamps have excellent colour rendering properties – a direct result of the use of the metallic additives which improve the spectral distribution.

In terms of development, metal halide lamps are a progression from standard mercury lamps and the luminous efficacy of KOLORARC lamps is almost 25 per cent higher.

KOLORARC lamps are, therefore, ideally suited to applications where good quality white light is required. They are used in uplights in commercial environments, in industrial workshops, in exhibition areas, in sports halls and wherever television cameras are used or where filming is likely to take place. Finally, the MBI version lends itself to floodlighting as the lamp allows good optical control when used in suitable luminaires.

Texas Homecare, Hemel Hempstead

KOLORARC

Rating		250–1000W Coated	Clear
Correlated colour temperature (K)		3800	4100
Colour co-ordinates	x	0.395	0.380
	y	0.395	0.385
General colour rendering index (R_a)		70	65
Colour rendering group		2	2

Range

Rating Watts	Lamp type	Lumen output 100 hrs.	Lumen output 2000 hrs.
250	MBIF/BUH	19000	16000
400*	MBIF/BU	29000	24000
400*	MBIF/H	29000	24000
1000	MBIF/U	92000†	85000†
400*	MBI/BU	29000	24000
1000	MBI/U	92000†	85000†

* When operated with Thorn control gear, lamp operates at 375W. Lumen outputs quoted for this condition.

† Applies to vertical position; when operated horizontally, reduce by 10 per cent.

Ipswich Co-Operative Store

MBIL
metal halide lamps – linear

Kew Gardens

Exclusive to Thorn Lighting, MBIL lamps are the highly powerful metal halide lamps which have dramatically changed floodlighting systems over recent years.

MBIL lamps consist of a high pressure discharge with metal halide additives operating in a double-ended quartz arc tube. This arc tube is not mounted in a conventional outer envelope but is used as a bare arc tube lamp in conjunction with a suitably designed luminaire like Thorn Lighting's OW 1500.

MBIL lamps have several very important features. As a bare arc tube lamp it is extremely slim and being double-ended in design, the lamp can be positively positioned within its luminaire ensuring that focussing is extremely accurate. The use of metallic additives in the discharge means that MBIL has a wide spectral distribution and therefore has good colour rendering properties. The lamp also emits light with a colour temperature of 5200K – white light which blends well with natural daylight. Finally, despite its compact size, MBIL has an extremely high lumen output and a long life achieving lower

operating costs than would be expected from conventional floodlighting lamps.

When MBIL is used in specially designed luminaires the results are impressive. By producing an asymmetric beam with a sharp cut-off, even illumination can be achieved without causing uncomfortable glare as a result of light-spillage which often occurs with other, less precisely controlled, alternatives. As a result of this, spectators can watch a game of floodlit football from one stand without being blinded by the light from the opposite stand, or people can live and work comfortably in offices or flats on the same level as luminaires which are floodlighting a nearby car park or loading bay. In addition, because the lamp is slim, the luminaire is compact which means that the whole package is lighter and the effect of windage on towers can be substantially reduced. In fact, mounting towers could be cheaper to install where they carry less weight.

MBIL is, therefore a highly flexible light source. With its high quality white light it is extremely useful for stadia lighting where television cameras are used but it is also important for other sports lighting – indoors or outdoors – for tennis courts, ski slopes or riding schools. However, it is also very suitable for floodlighting public buildings, public areas, building sites, marshalling yards or car parks without causing danger or discomfort to surrounding activities.

In short, whatever floodlighting scheme you are designing, whether it's for sports lighting or not, it will always be a first division installation when you choose MBIL.

MBIL

Rating		750 and 1500W
Correlated colour temperature (K)		5200
Colour co-ordinates	x	0.340
	y	0.360
General colour rendering index (R_a)		65
Colour rendering group		2

Range

Rating Watts	Lamp type	Lumen output 100 hrs.	Lumen output 2000 hrs.
750	MBIL-H	67000	58500
1500	MBIL-H	120000	110000

Olympic Games, Calgary

CSI
metal halide lamps – compact source, sealed beam

Sydney Opera House

On pages 28/29 we saw how MBIL lamps have been designed specifically for floodlighting purposes. Thorn Lighting also manufacture the CSI Sealed Beam Lamp – a light source which extends the possibilities for the design of floodlighting systems by providing a projector or spotlight rather than a wide beam flood.

The CSI Sealed Beam Lamp consists of a high pressure discharge with metal halide additives operating in a quartz arc tube. The technology of the CSI lamp centres around this arc tube which is highly compact but extremely robust. The arc tube is mounted in a PAR 64 sealed beam unit with a clear front glass. This not only provides thermal and physical protection for the arc tube but is also an integral precision reflector system.

By using metal halide additives, CSI lamps produce a broad spectral distribution so the colour rendering properties are excellent. With their own in-built reflector system, CSI lamps can be used in luminaires like Thorn's OQ1000 to give accurate optical control and, because CSI lamps emit light with a colour temperature of 4000K, a precise beam of cool, crisp white light is always thrown onto its subject. CSI lamps are also available in a hot

restrike version so that in the event of an interruption to the power supply, the lamp will restart immediately. Finally, as an alternative to traditional tungsten light sources CSI lamps, being discharge lamps, offer a real economic story. With an efficacy which is better than many other conventional lamps and a life which is longer, too, CSI can reduce operating costs dramatically.

As spotlights, CSI lamps are ideal for the long range projection of light from high towers and because of their excellent colour rendering and white colour appearance are an excellent choice where television cameras are being used. CSI lamps are, therefore, most frequently used for major sporting stadia and many of the world's most memorable sporting moments have been televised under Thorn's CSI spotlights. However, CSI lamps, with their economy of operation combined with their superb performance can be used for many other applications. Anywhere where a high powered, long range, narrow beam spotlight is required to light a feature of a building, monument, column, atrium, then Thorn CSI Sealed Beam lamps provide an effective, economic answer.

CSI

Rating		1000W
Correlated colour temperature (K)		4000
Colour co-ordinates	x	0.395
	y	0.395
General colour rendering index (R_a)		80
Colour rendering group		1B

Range

Rating Watts	Lamp type	Lumen output 100 hrs.	Lumen output 2000 hrs.
1000	CSI	76000	67000

Beam information

Rating	1000W
Peak intensity (kcd)	1500
½ peak beam angle	6°
1/10 peak beam angle	18°

Ski Slope, Sweden

MBI-T/BDH
metal halide lamps

Royal Museum of Scotland, Edinburgh

ARCSTREAM 3000 or 4000

Thorn Lighting's Arcstream is the very latest in the metal halide development story and is a lamp which, it is widely believed, will lead us into a new generation of light sources.

Arcstream consists of a high pressure metal halide discharge operating in a quartz arc tube. This arc is mounted in an outer quartz bulb which provides thermal and physical protection for the arc tube.

The innovation of Arcstream has been achieved as a result of the knowledge and experience which has been gained from the development and manufacture of Thorn compact source lamps which are used for floodlighting and studio and theatre lighting. The main feature of these lamps is their extremely compact size and Arcstream is a perfect example. The electrodes within the arc tube are only 6mm apart which allows the lamp itself to measure only 76mm in length and 21.5mm in diameter.

Despite its featherweight appearance, Arcstream has a heavyweight nature when it comes to saving money. It is extremely efficient – providing the user with high lumen output for low watts – and has a long life. These factors are a winning combination because the result is low operating costs and reduced maintenance costs. Also, with an R_a of 80, Arcstream's colour rendering is excellent and with a choice of colour temperatures at 3000K (Warm White) and 4000K (Cool White), the lamp emits a high quality white light which is sure to match any lighting installation – particularly Lightstream and fluorescent.

The lamp is fitted with a single cap which means that installation and maintenance is easier than for double ended lamps. The cap is a G12 and has been standardised in Europe.

Finally, being such a small point-like source, precise optical control can be achieved in luminaires which are equally compact.

The benefits and features of Arcstream mean that it is a highly versatile light source. It is particularly useful for display lighting where the quality of light is important and because the light can be controlled so accurately, it is an excellent choice. Arcstream is, however, an equally natural choice for commercial lighting because of its ability to blend with other lighting and because of the new range of slim, designer uplights which will house the lamp. Finally Arcstream floodlights buildings, statues and monuments most powerfully and dramatically – an excellent way to highlight our heritage.

This, then, is Arcstream and in all senses it really does reflect the old saying that "small is beautiful".

ARCSTREAM

Rating		150W	
Correlated colour temperature (K)		3000	4000
Colour co-ordinates	x	0.434	0.380
	y	0.402	0.377
General colour rendering index (R_a)		80	85
Colour rendering group		1B	1B

Range

Rating Watts	Lamp type	Lumen output 100 hrs.	Lumen output 2000 hrs.
150	MBI-T/BDH 3000K	12000	10000
150	MBI-T/BDH 4000K	12000	10000

MBF/U & MBFR

high pressure mercury lamps

Rissne, Sweden

KOLORLUX – MBF

Standard Thorn KOLORLUX lamps consist of a mercury discharge operating at high pressure within a fused silica, or quartz, arc tube. The arc tube is mounted in an elliptical glass bulb which is coated internally with a fluorescent phosphor. This phosphor both improves the colour emitted from the bare arc-tube and diffuses the light.

Introduced before World War Two, Thorn's MBF lamp has, over the years proved itself to be a highly reliable light source and still offers the typical benefits expected from a high intensity discharge lamp – high output, long life and low operating costs. One of the great features of the lamp is its emission of cool, white light with reasonable colour rendering properties which makes it suitable for internal use where some colour judgement is required. MBF is, however, more frequently used outdoors – for road-lighting, floodlighting, security and amenity lighting, in car parks and walkways, forecourts and railway stations.

Finally, because the lamps operate on a basic choke circuit, the KOLORLUX package is not only simple but incurs low initial capital costs.

Rissne, Sweden

KOLORLUX REFLECTOR – MBFR

MBFR lamps consist of a mercury discharge operating at high pressure within a fused silica, or quartz, arc tube. The arc tube is mounted in a shaped, hard glass bulb which is coated with a colour-improving phosphor and a reflecting layer.

The lamp provides excellent optical control. Being internal, the performance of the reflector is not affected by the build-up of dirt or corrosion on reflecting surfaces as is the case with conventional luminaires. Capital costs are lower, also, as expensive luminaires are unnecessary.

MBFR lamps are, therefore, highly suited to operation in dirty industrial environments such as foundries, dust laden atmospheres or high, inaccessible areas – in fact any application where minimum maintenance, especially in respect of cleaning costs is valued.

In addition, as the bulb is shaped from hard glass, MBFR lamps can be used externally.

MBF and MBFR

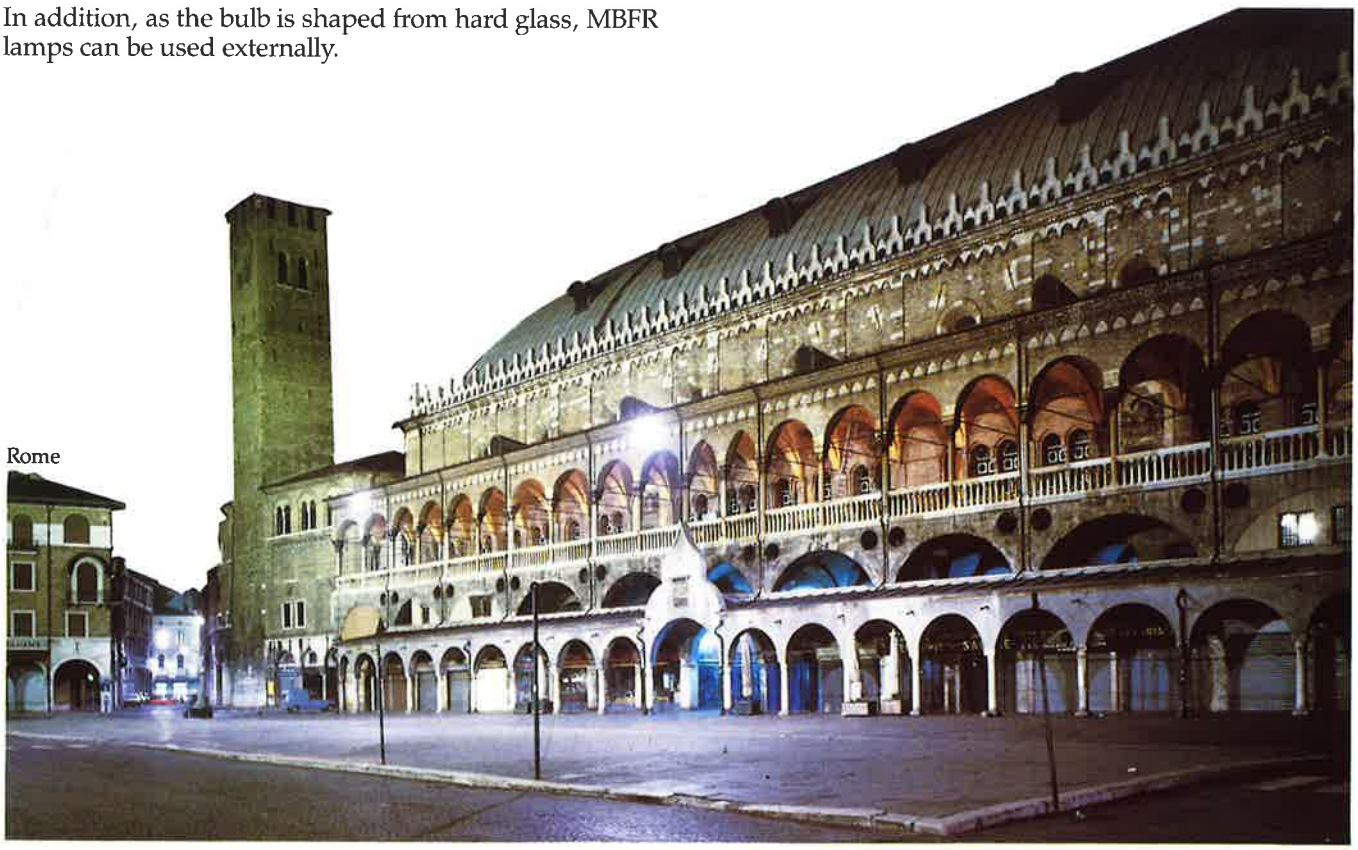
Rating		MBF (all ratings)	MBFR (all ratings)
Correlated colour temperature (K)		3800	3800
Colour co-ordinates	x	0.390	0.395
	y	0.385	0.400
General colour rendering index (R_a)		45	35
Colour rendering group		3	4

Range

Rating Watts	Lamp type	Lumen output 100 hrs.	Lumen output 2000 hrs.
50	MBF	2000	1900
80	MBF	3850	3650
125	MBF	6300	5800
250	MBF	13500	12500
400	MBF	23000	21500
700	MBF	42000	38000
1000	MBF	58000	55000
250	MBFR	11500	10500
400	MBFR	20500	18000
700	MBFR	35000	32500
1000	MBFR	52000	48000

Beam information for MBFR

Rating	250W	400W	700W	1000W
Peak intensity (kcd)	3.1	5.1	9.1	13.5
½ peak beam angle	120°	120°	112°	112°
1/10 peak beam angle	150°	160°	160°	160°



Rome

MBFSD
high pressure mercury lamp – super deluxe

W. H. Smith's Do-It-All, Ashford, Kent

KOLORLUX SUPER DELUXE

These lamps are the same as the standard MBF lamps in terms of construction and design, the only difference being that a special phosphor which improves the colour of the lamp has been developed. This phosphor converts more of the ultra-violet light into the "redder" area of the spectrum and as a result the colour appearance becomes warmer at 3300K and the colour rendering properties improve. This means that Thorn's MBFSD can be used for commercial and office interiors or anywhere where colour rendering is required. In fact MBFSD can be used for the same applications as standard MBF but their warmer light will add a touch of atmosphere.

In addition, the lumen output for most ratings of MBFSD is five per cent higher and lumen maintenance is equally good.

Finally, MBFSD is electrically and dimensionally the same as MBF of the same wattage. They can, therefore be used as direct replacements to improve the quality of lighting.

KOLORLUX SUPER DELUXE

Rating		MBFSD
Correlated colour temperature (K)		3300
Colour co-ordinates	x	0.420
	y	0.395
General colour rendering index (R_a)		55
Colour rendering group		3

Range

Rating Watts	Lamp type	Lumen output 100 hrs.	Lumen output 2000 hrs.
50	MBFSD	2000	1900
80	MBFSD	3850	3650
125	MBFSD	6500	6200
250	MBFSD	14000	13300
400	MBFSD	24000	22800

Texas Instruments Office, Bedford

Discharge Lamps for Special Applications

Wembley Arena

Thorn Lighting are pleased to advise on the application of their standard discharge sources for special situations. A typical example of this is in the use of Thorn MBI lamps by Trinity House in unmanned lighthouses, an application which makes full use of their long life, good maintenance and white light characteristics. The lamps directly replace incandescent lamps in optics of the rotating lens type.

Special discharge lamps have been made by Thorn for many specific and diverse applications. Typical examples are disco lighting, criminal forensic work, water sterilisation, plant growth and a multitude of applications in the graphic arts industry.

Thorn are the world's recognised leaders in the development of short arc metal halide lamps. Such types as their CSI and CID range are used all over the world for lighting in the film and television industry. Sealed beam (PAR 64) types are used for sports fields' floodlighting, especially where illumination is required to television standards (see pages 30/31).

A range of Xenon lamps, of the short arc high brightness, high pressure type typically used in film projection and optical and laboratory applications, is also available.

If you require assistance in the application of standard discharge lamps for special applications or for special discharge lamps for a new application, please contact the specialists:-

THORN EMI Lamps and
Components Limited

Miles Road
MITCHAM
Surrey
CR4 3YX

Telephone No. 01-640 1221
Telex No. 25534 TELC G
Fax No. 01-685 9625

Eddystone Lighthouse

Electrical Data

Lamp				Circuit					
Lamp Type[1]	Nominal Watts	Lamp Volts	Lamp Current (Amps)	Objective Lamp Watts	Total[2] Circuit Watts	Circuit Current (Amps)[3] Start	Run	Cap	Fuse[4] Rating HBC or MCB (Amps)
Mercury									
MBF Kolorlux	50	95	0.61	50	62	0.32	0.3	0.45	4
50–1000W	80	115	0.8	80	94	0.5	0.4	0.6	4
MBFSD Kolorlux Super Deluxe	125	125	1.15	125	142	1.1	0.7	0.6	4
50–400W	250	130	2.13	250	275	2.2	1.33	0.98	10
MBFR Kolorlux Reflector	400	135	3.25	400	430	4.0	2.2	1.5	16
250–1000W	700	140	5.2	670	720	6.5	3.5	2.3	16
	1000	145	7.5	1000	1040	9.0	5.0	3.8	20
Metal Halide									
MBI-T Arcstream	150	95	1.8	150	172	0.76	0.76	1.5	4
MBI/MBIF Kolorarc	250	100	2.9	258	288	1.5	1.3	2.3	10
	400	120	3.5	380	410	3.5	2.0	1.9	16
	1000	250	4.2	1000**	1050	5.2	3.1	2.0	16
MBIL Tubular Double Cap	750	500	1.75	805	915	6.0	4.2	5.7	16
	1500	250	6.7	1500**	1580	6.0	4.2	3.9	16
CSI Sealed Beam	1000	77	15	1000	1120	3.5	5.0	13.5	20
Low Pressure Sodium									
SOX	18	56	0.35	18	26	0.16	0.13	0.45	3
	35	70	0.6	37	52	0.27	0.26	0.46	4
	55	107	0.59	56	68	0.31	0.32	0.46	4
	90	112	0.94	91	105	0.52	0.50	0.61	4
	135	164	0.95	135	175	0.83	0.87	2.3	4
SOX-E‡	26	60	0.62	30	44	0.27	0.25	0.46	4
	36	82	0.61	39	53	0.31	0.32	0.46	4
	66	88	0.97	68	89	0.52	0.49	0.61	4
	91	140	0.94	103	140	0.83	0.85	2.3	4
High Pressure Sodium									
SON-E Elliptical Diffuse	50	85	0.76	50	62	0.35	0.3	0.6	4
SON-T Tubular Clear	70	90	0.98	70	86	0.55	0.4	0.76	4
SONDL-E Ellipt. Diff. Deluxe	100	100	1.2	100	114	0.7	0.52	0.91	4
150–400W	150	100	1.8	150	172	0.7	0.8	1.5	4
SONDL-T Tub. Clear Deluxe	250	100	3.0	250	280	1.5	1.3	2.3	10
150–400W	400	105*	4.4†	400	432	3.0	2.15	3.0	16
SON-TD Tubular Double Cap	1000	110	10.3	1000	1090	6.0	5.4	6.4	20
250–400W									
SON-R Reflector 70W									

‡ Operated on standard SOX control gear. * SON-T and SONDL-T 100V. † SON-T and SONDL-T 4.6A ** On 415V supply.

The following notes refer to the column headings on the table.

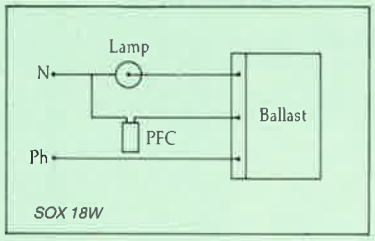
1. Where lamp types are bracketed, lamps of the same wattage have the same characteristics and operate from the same control gear.

2. The figures quoted apply to current Thorn control gear and are dependent upon the operating temperatures of the circuit components. Some variation may be experienced in practice.

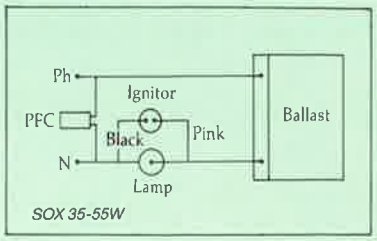
3. This figure is the maximum circuit current with a failed lamp or with no lamp installed.

4. Fusing
At switch-on, a high charging current will flow into the PF correction capacitor, also for a short time the lamp may act as a rectifier and as a result the ballast may allow several times the normal circuit current to flow. To avoid fuse failures the ratings shown should be used. For further information refer to Data Sheet 4:90.2. To prevent rectification occurring at end of life continuous burning of discharge lamps should be avoided and a switch off introduced at least once every 24 hours.

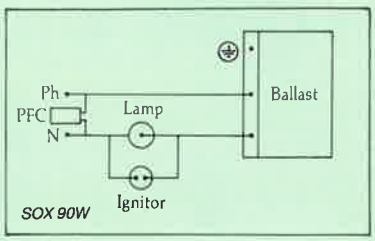
Circuit Diagrams



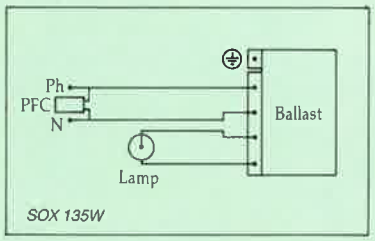
SOX 18W



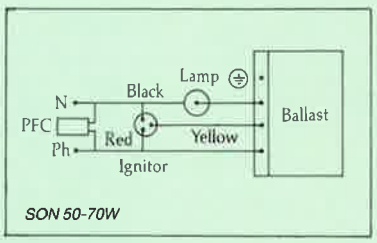
SOX 35-55W



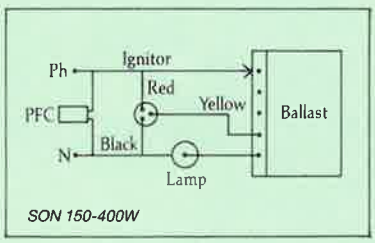
SOX 90W



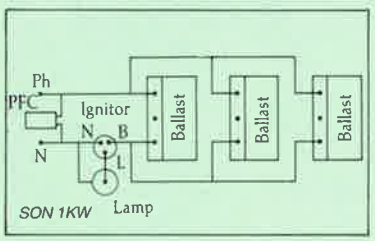
SOX 135W

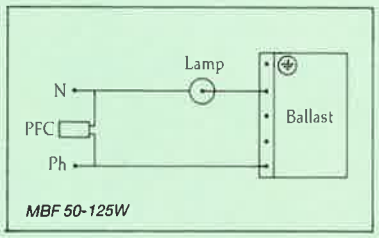


SON 50-70W

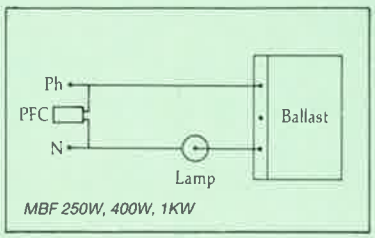


SON 150-400W

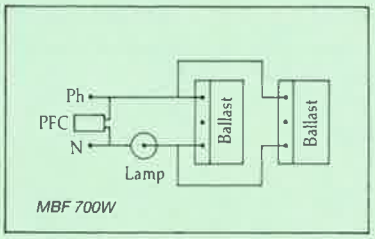




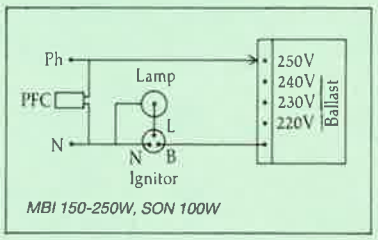
MBF 50-125W



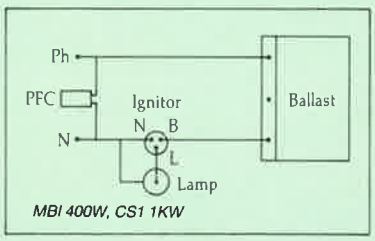
MBF 250W, 400W, 1KW



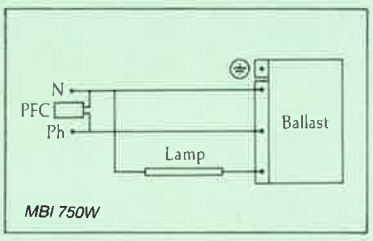
MBF 700W



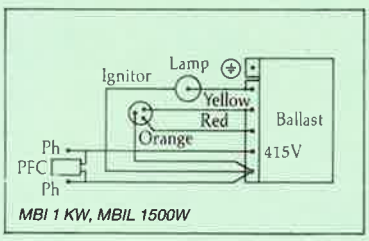
MBI 150-250W, SON 100W



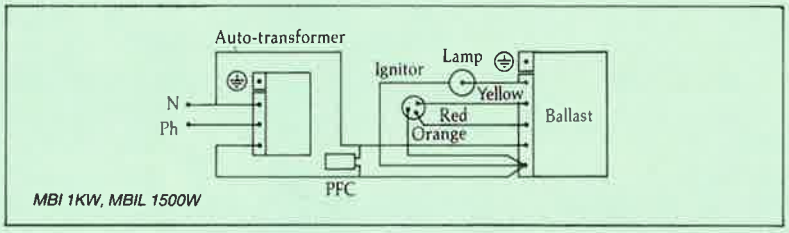
MBI 400W, CS1 1KW



MBI 750W



MBI 1 KW, MBIL 1500W



MBI 1KW, MBIL 1500W

Physical Characteristics

Lamp Type	Wattage Range	Dimensions Overall Length (mm max.)	Dimensions Diameter (mm max.)
SON-E SONDL-E (150–400W)	50	154	71
	70	154	71
	100	186	76
	150	227	91
	250	227	91
	400	286	122
	1000	410	167
SON-T SONDL-T (150–400W)	50	154	38.5
	70	154	38.5
	100	210	47
	150	210	47
	250	257	47
	400	285	47
	1000	380	67
SON-TD	250	189	22.4
	400	254	22.4
SON-R	70	144	96
MBI-T ARCSTREAM	150	76	21.5
MBIF MBI (400W BU & 1000W)	250	227	91
	400	286	122
	1000	410	167
MBIL	750	254	21.3
	1500	254	21.3
CSI	1000	175	205
MBF MBFSD (50–400W)	50	129	56
	80	154	71
	125	175	76
	250	227	91
	400	286	122
	700	328	143
	1000	410	167
MBFR	250	260	166
	400	300	181
	700	328	202
	1000	380	221
SOX SOX-E	SOX	SOX-E	
	18		216	53
	35	26	311	53
	55	36	425	53
	90	66	528	67
	135	91	775	67

Cap	Average Weight g	Operating Position	Min. Starting Temp. °C
E27	55	U	
E27	55	U	
E40	140	U	
E40	175	U	−40
E40	190	U	
E40	250	U	
E40	445	U	
E27	55	U	
E27	55	U	
E40	140	U	
E40	150	U	−40
E40	180	U	
E40	200	U	
E40	445	U	
Rx7s	85	H	−40
Rx7s	100	H	
E27	65	U	−40
G12	35	BDH	−20
E40	190	BUH	
E40	250	BU, H	−20
E40	430	U	
Rx7s	30	H	−20
Rx7s	45	H	
G38	860	U	−20
E27	50	U	
E27	60	U	
E27	75	U	
E40	190	U	−20
E40	250	U	
E40	310	U	
E40	430	U	
E40	360	U	
E40	390	U	−20
E40	430	U	
E40	450	U	
BY22d	150	BUH	
BY22d	245	BUH	
BY22d	330	BUH	−20
BY22d	500	H	
BY22d	750	H	

Operating Positions

U – Universal

Lamp may be operated in any position.

H – Horizontal

Lamp must be operated within ± 20° of the horizontal.

MBI/MBIF lamps have been designed to operate within ± 15° of horizontal for best colour uniformity but may be used up to ± 60° of horizontal.

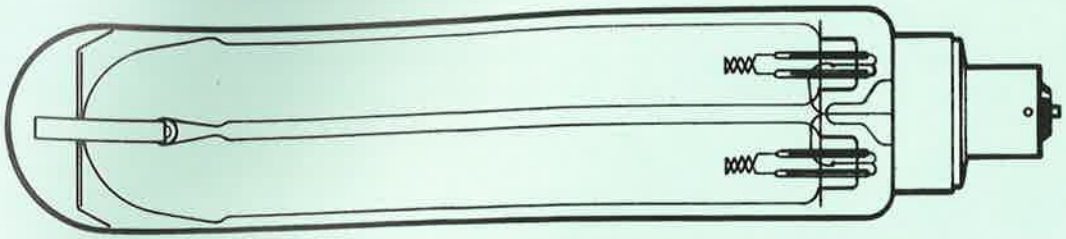
BU – Base Up

Lamp must be operated base up within ± 30° of vertical.

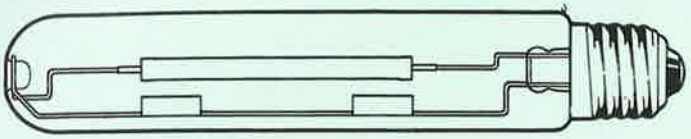
BUH – Base Up to Horizontal Lamp must be operated between base up and base 15° below horizontal.

BDH – Base Down to Horizontal Lamp must be operated between base down and base 15° above horizontal.

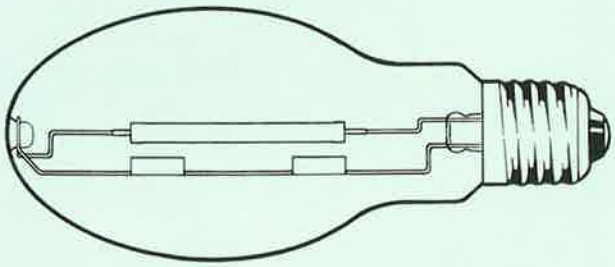
Lamp diagrams on pages 44/45.



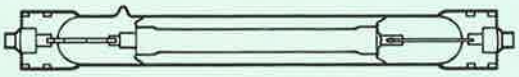
SOX/SOX-E



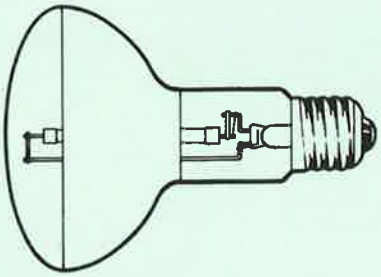
SON-T + SONDL-T



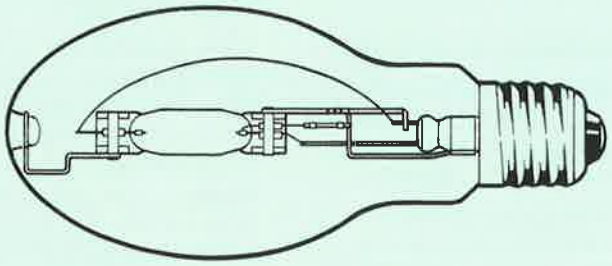
SON-E + SONDL-E



SON-TD

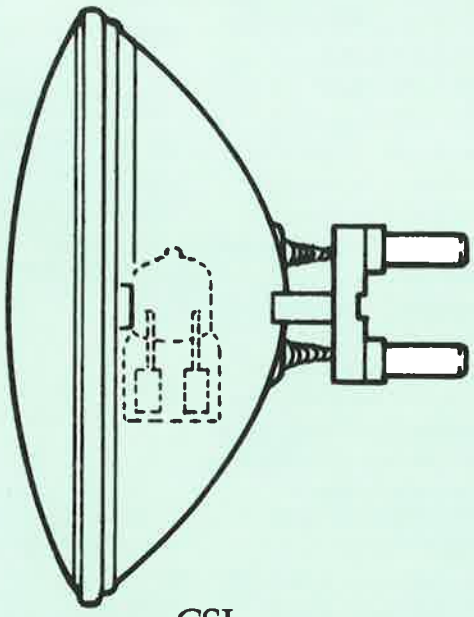


SON-R

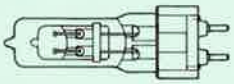


MBI/MBIF

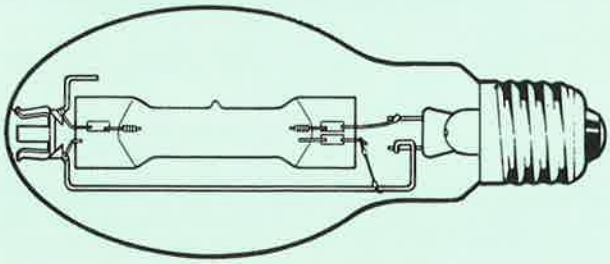
MBIL



CSI



MBI-T (Arcstream)



MBF + MBFSD

Temperature Limits

The following maximum temperatures must not be exceeded.

	Bulb °C	Cap./Bulb interface °C
SON-TD	750	350
All other SON types		
50–70W	375	210
100–1000W	450	250
All MBF types		
50–125W	375	210
250–1000W	450	250
MBI & MBIF		
250–1000W	450	250
SOX	150	150
MBIL	850	350
CSI Sealed Beam	500	280
Arcstream	600	150

Lamp Enclosure

Mercury and metal halide lamps with outer bulbs made of quartz emit UVA and UVB radiation.

Such lamps should always be operated in enclosed luminaires with UV absorbent cover glasses and personnel should never be exposed to radiation from a bare lamp.

There is a very minor risk of the envelope of MBI, MBIF and MBI-T lamps shattering on failure and full enclosure is essential to retain the fragments under such circumstances.

SON Lamps

It is a characteristic of high pressure sodium lamps that there is a rise in arc voltage when run in an enclosure compared with that obtained when running in free air. It is important that for maximum life the luminaire is so designed that this arc voltage rise is limited to the value shown in the table below. It is the change in voltage that is important, not the absolute magnitude, as with all lamps there is an allowable manufacturing tolerance in their electrical characteristics. A true RMS reading instrument should be used to measure the voltage.

Rating	Max. Permissable Voltage Rise
50–150W	5 volts
250W	10 volts
400W	7 volts
1000W	10 volts

Linear Lamps

SON-TD and MBIL lamps are specifically designed for operation in suitable floodlights.

The lumen output and electrical characteristics are quoted for optimum performance in luminaires and will not be achieved in free air.

Guide for Installation, Operation and Disposal of Discharge Lamps

Before Use

(All lamps should be installed and replaced by a competent electrician or suitably qualified person.)

(1) Isolate equipment before inserting/removing lamp. Ensure lamp is cool before touching.

(2) Ensure that lamp is correct type for application including operating position, voltage, wattage, cap and control gear. Incompatible equipment can damage lamp.

(3) Lamps are made from glass and quartz which are inherently fragile and may implode if broken – protect personnel, equipment and property from lamp breakage.

(4) Ensure correct location of lamp in lampholder. Tighten firmly but do not overtighten. Ensure lamp is not scratched or cracked before or during insertion.

(5) Instructions for specific lamp types.

(a) Handling

Do not touch MBIL, SON-TD, Arcstream, CSI, CID, or other quartz jacketed lamps with bare hands. If touched wipe with clean cloth soaked in methylated spirit.

(b) Enclosure:

i Operate lamps with quartz envelope eg SON-TD, MBIL, Arcstream, CSI, CID etc only in suitably enclosed fittings.

ii Harmful UV radiation is emitted by MBIL, Arcstream, CSI and CID lamps so do not operate without UV absorbing glass in enclosed fitting.

iii There is a minor risk of Arcstream, MBIF/MBI lamp envelopes shattering on failure and full enclosure is essential to retain the hot fragments under such circumstances.

During Use

(1) Discharge lamps can take several minutes to warm up and also to restrike in the event of a momentary supply failure.

(2) Prevent water or moisture coming into contact with lamp or shattering could occur.

(3) Serious skin burn and eye inflammation can result from short wave ultra violet radiation if the outer envelope of CSI, mercury or metal halide lamps is broken or punctured. Do not use where people will remain for more than a few minutes unless adequate shielding (eg tempered glass or other suitable enclosure materials), or other safety precautions are used.

(4) Mercury and metal halide lamps emit low level ultra violet radiation. This is harmless unless used for prolonged periods in close proximity to eyes, skin and materials. Employ suitable protection in this event.

(5) In order to maximise lamp survival, lumen maintenance and colour uniformity, the supply voltage and ballast design voltage should be within ± 3%. Variations of ± 5% are permissible for short periods only.

(6) It is an inherent characteristic of all discharge lamps that colour may vary from lamp to lamp and that colour will change slightly with age.

Disposal

(1) It is not necessary to break quartz jacketed lamps, eg Arcstream, MBIL, SON-TD, CSI, CID etc – put into pack or similar before disposal.

(2) Break the outer jacket of other lamps in a container outdoors or in a well ventilated area. The arc tubes should not be broken.

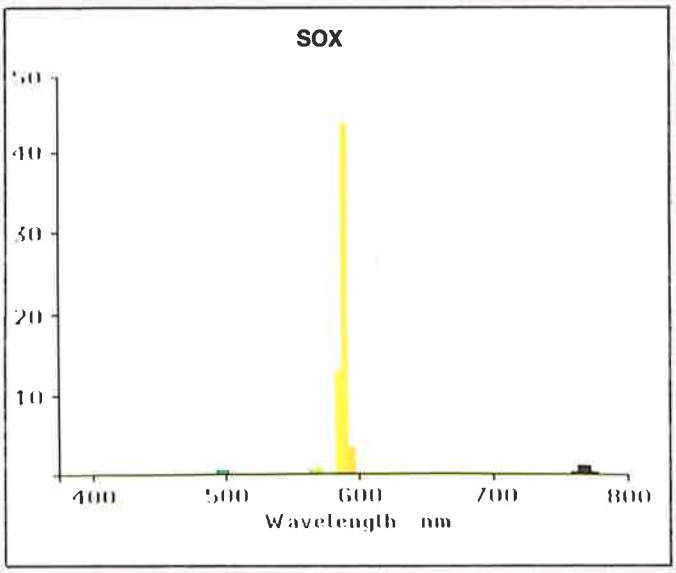
(3) Low pressure sodium lamps (SOX) shold be broken into small pieces within a large dry container outdoors in a dry atmosphere. Precautions must be taken against the risk of fire (from the reaction of sodium with water), flying glass and other fragments. No more than 20 lamps should be broken into the same container at one time. When the container is no more than one-quarter full, the operator should use a hose at a safe distance to fill the container with water. The liquid may then be disposed of as a very weak solution of caustic soda and the debris as glass.

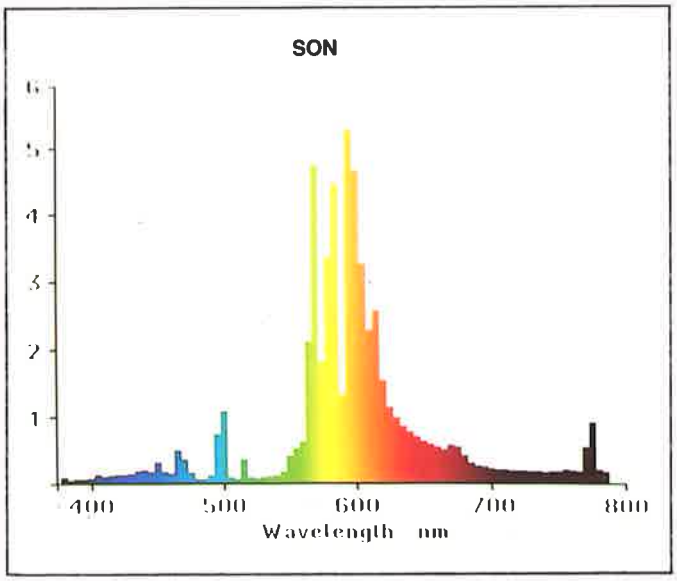
(4) Large quantities of lamps must be disposed of in accordance with the rules of the local authority.

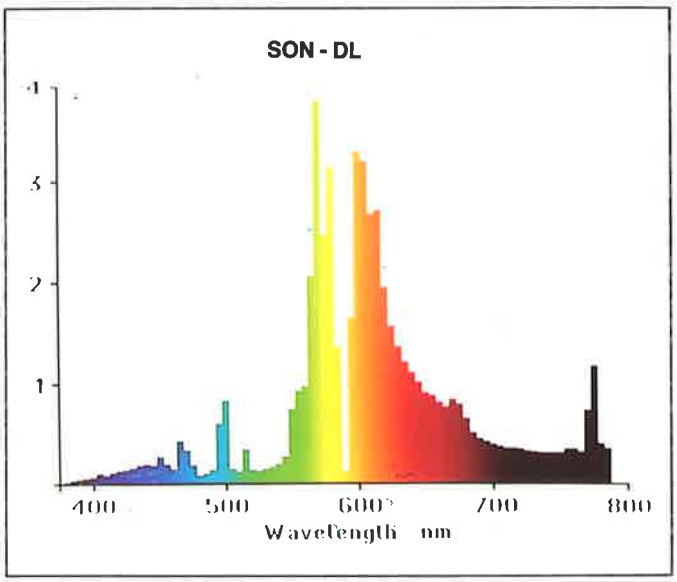
Spectral Power Distribution

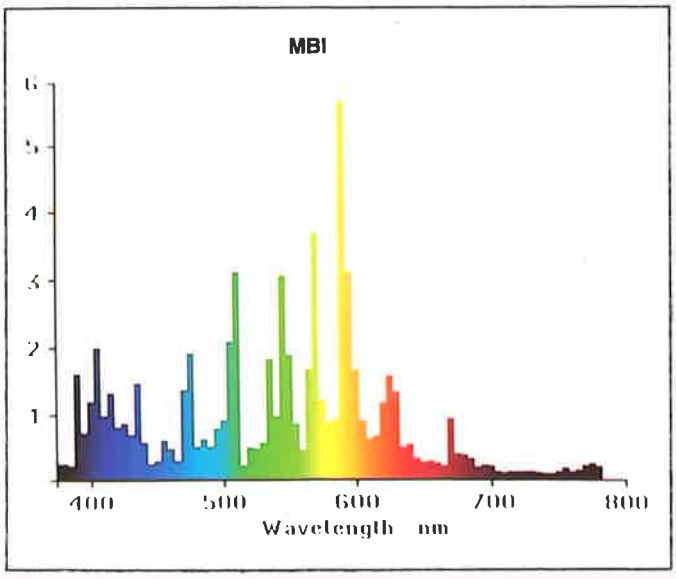
These Spectral Power Distribution histograms (SPDs) can be used to identify and compare the colour performance of different discharge lamps.

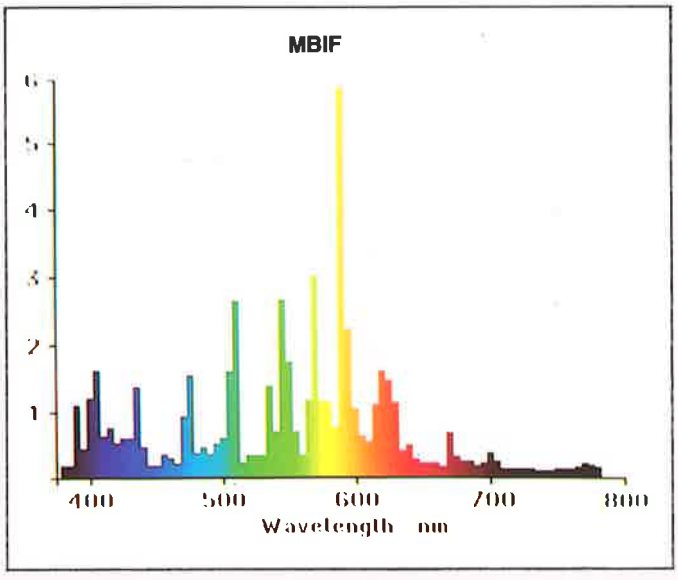
For further information on colour performance, please turn to page 13.

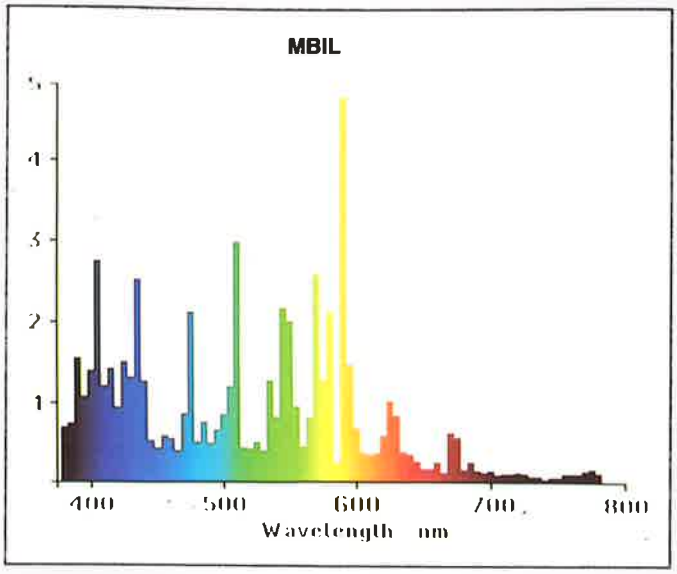


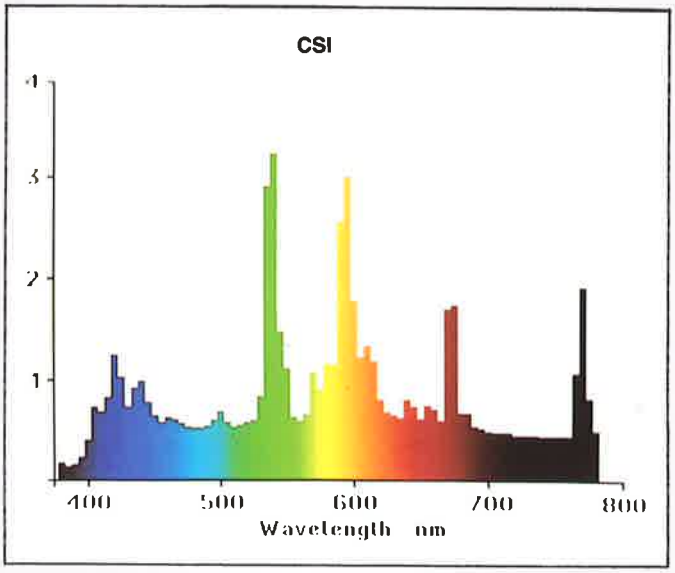


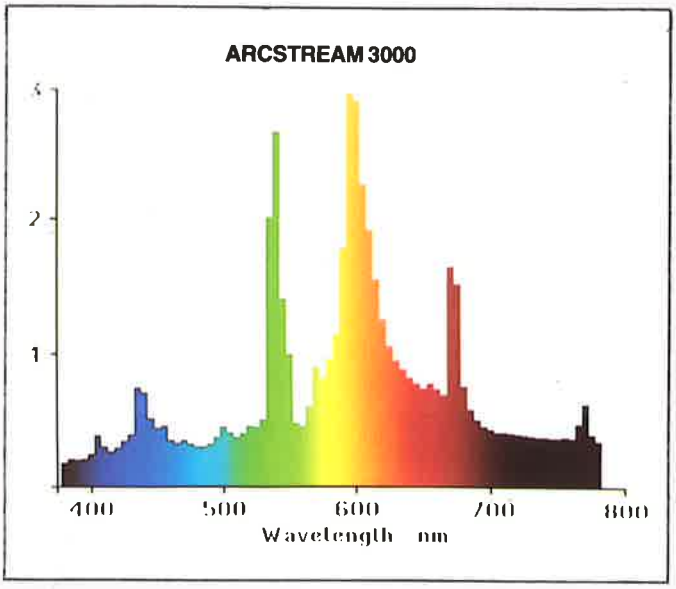


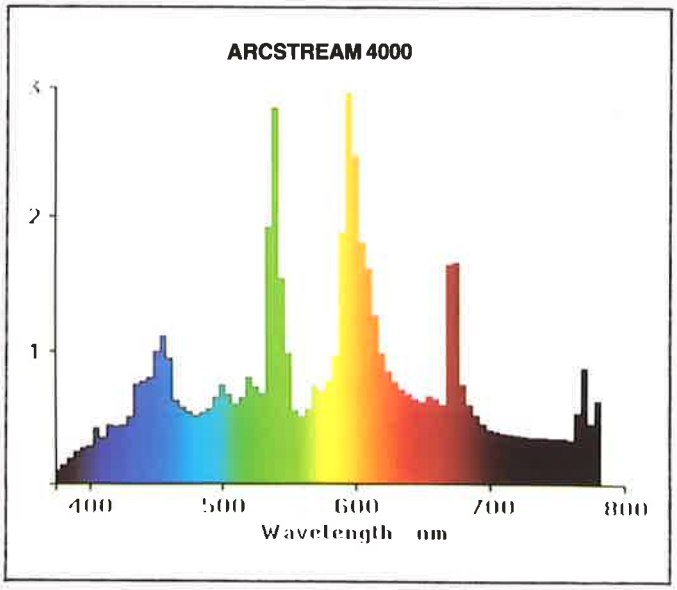


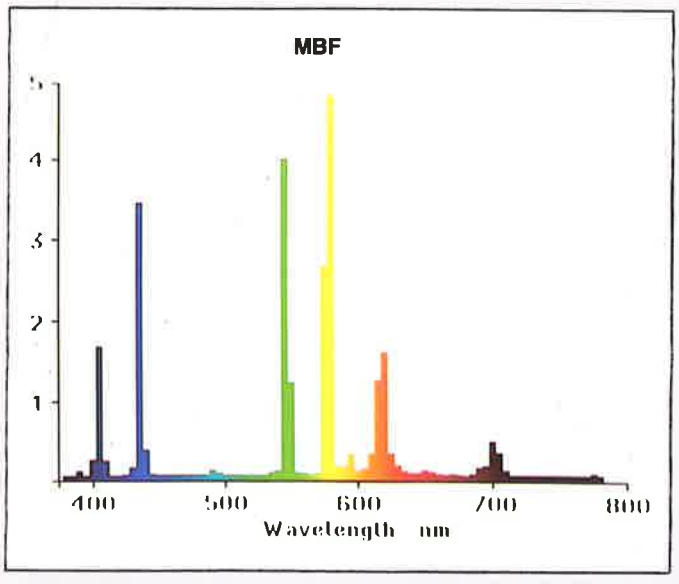


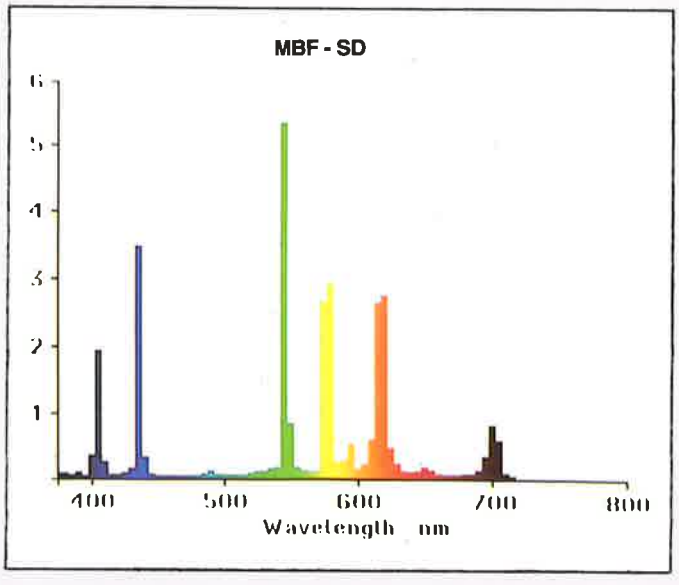

MBIL
400
500
600
700
800
Wavelength nm


CSI
400
500
600
700
800
Wavelength nm


ARCSTREAM 3000
400
500
600
700
800
Wavelength nm


ARCSTREAM 4000
400
500
600
700
800
Wavelength nm


MBF
400
500
600
700
800
Wavelength nm


MBF - SD
400
500
600
700
800
Wavelength nm

Discharge Lamp Data Sheets

The following Thorn Lighting Data Sheets contain technical information on specific subjects and lamp types and are available on request.

4:90 Series – General Information

4:90.1 Lumen Outputs of Discharge Lamps
4:90.2 Fuse Ratings for Discharge Lamps
4:90.3 Electrical Characteristics of Discharge Lamps

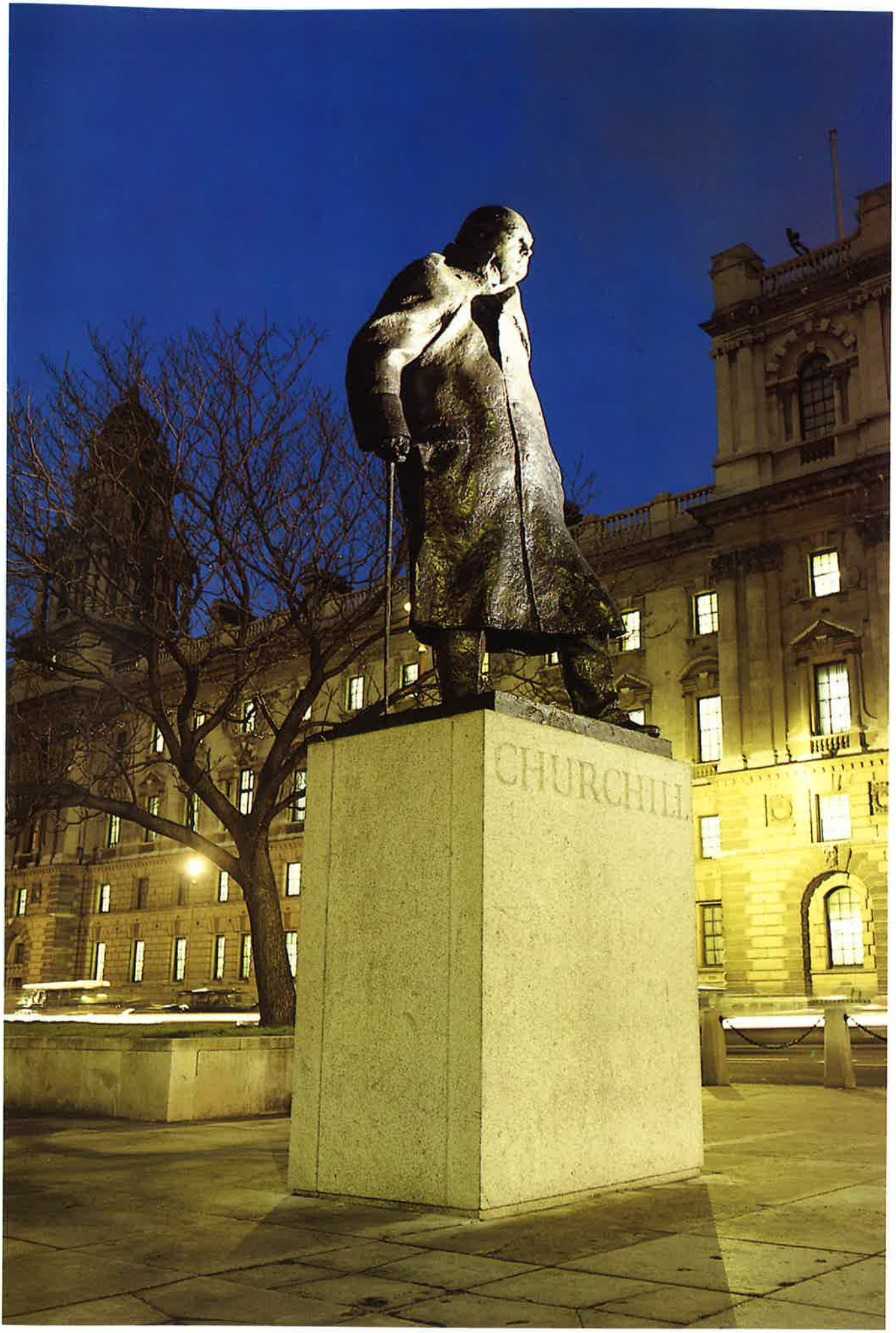
4:91 Series – Mercury and Metal Halide Lamps

4:91.2 MBF KOLORLUX
4:91.5 MBFR
4:91.6 MBI/MBIF KOLORARC
4:91.7 ARCSTREAM
4:91.11 MBIL
4:91.12 MBF Super Deluxe
4:99.7 1kW CSI Sealed Beam

4:96 Series – High and Low Pressure Sodium Lamps

4:96.1 SON-E
4:96.2 SON-T
4:96.3 SONDL-E
4:96.4 SONDL-T
4:96.5 SON-TD
4:96.6 SON-R
4:96.7 SOX

See pages 38/39 for information on discharge lamps for special purposes.



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