

# Discharge Lamps

**GTE SYLVANIA**

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## GTE Sylvania

Throughout the world, the word "Sylvania" has the same meaning... Sylvania means light.

Sylvania means light to live by, light to work by, light to play by. People everywhere recognise the Sylvania brand because they use so many Sylvania products in their everyday lives. They work under Sylvania fluorescent lamps, drive home at night along roads illuminated by Sylvania discharge lamps, admire monuments floodlit with Sylvania tungsten-halogen lamps, stop at Sylvania traffic lights, read the evening paper by Sylvania incandescent bulbs and even take pictures with Sylvania flashbulbs.

Light from Sylvania means a choice of more than 6,000 different lamp types.

**Incandescent Lamps** – Household bulbs, candles, round bulbs, coloured lamps, industrial lamps... in innumerable finishes, voltages and caps;

**Display Lamps** – Reflector lamps, crown-silvered lamps, globe lamps... for exciting and dramatic lighting effects in shops, department stores or in the home;

**Tungsten-Halogen Lamps** – Powerful lamps for flood-lighting, small lamps for projectors, special lamps for photocopying machines, airports... in a large variety of wattages, voltages, bulb shapes and sizes;

**Fluorescent Lamps** – As short as 6 inches, as long as 8 feet, from 4 watts to 215 watts, in over a dozen different colours and in various shapes;

**Discharge Lamps** – For street lighting, industrial lighting, stadium lighting... an extensive range of mercury lamps, space-age high pressure sodium lamps, energy-saving low pressure sodium lamps;

**Flashbulbs** – From the inventor of the Flashcube and the Magicube and the world's largest manufacturer of flashbulbs;

**Projector Lamps** – The most complete range of projector lamps from the world's market leader;

**Advanced Technology Lamps** – Highly technical light sources, including tubular metal halide lamps for print curing, pulsed xenon arc tubes, ultra-violet cells and many more... for applications extending from medicine to space ships.

Sylvania is a pioneer and innovator in lighting. Scientists and engineers at the central research establishment and manufacturing companies throughout the world are constantly working on new innovations and product improvements. Long before the "energy crisis", Sylvania's engineers were concerned with energy conservation. High efficacy Sylvania sodium and metal halide lamps are proof of Sylvania's far-sighted and innovative approach to lamp development.

Some 90% of the Sylvania lamps sold in Europe are made in Europe in our own factories. Sylvania's capability in designing and building high-speed, automatic lamp-



making machines has been of fundamental importance to its success in the lighting business. To illustrate: at our 400,000 square foot plant in Erlangen, West Germany, each one of our "horizontal" fluorescent machines produces lamps at a rate faster than one per second – more than 3,600 lamps per hour.

The total production process of the 250 foot long machines, including a quality test after every stage of production, is monitored and controlled electronically using computer-type techniques.

Also at Erlangen are the most up-to-date, rotating-bending and exhaust machines for circular fluorescent lamps and equipment for making small diameter fluorescent lamps, IRS lamps, tungsten-halogen lamps and discharge lamps.

Flashcubes and Magicubes are produced at our factory in Tienen, Belgium. In Leeds, England, the company has two plants manufacturing lamps in major expanding product areas, such as, miniature fluorescent and display lamps.

The large-volume household incandescent lamps are produced on new, high-speed "Twin-Head" machines in the Sylvania incandescent lamp factory in Belgium, while millions of other incandescent lamp types are made in Vicenza, Italy.

Sylvania's efforts in research and development, investments in modern manufacturing plants and wide range of products all have one aim – to serve our customers. To Sylvania, service means... a local company with local people in each country... dozens of fully-stocked warehouses throughout Europe... sales offices... technical advisors... a fleet of delivery vans... and, most important of all, the spirit and enthusiasm which puts Sylvania service into action!



GTE Sylvania is a part of the General Telephone and Electronics group, one of the largest industrial companies in the world with sales exceeding 6 billion dollars.

The wide range of GTE's business interests includes lamps and lighting products, radio and television sets, colour and black-and-white picture tubes, telephone exchanges, switchboards, telephones, microwave and data transmission systems, satellite communications systems, data processing and telephone operating companies serving some 13 million telephones.

Almost 200,000 people throughout the world are making lamps... building communications systems... working in laboratories to develop new light sources... designing new, high-quality home entertainment products... probing the unknown in research centres to discover new products and techniques for the future. GTE is an organisation dedicated to providing advanced products and unrivalled service to the most important people of all... our customers.

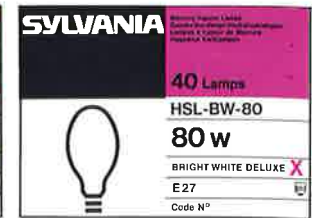
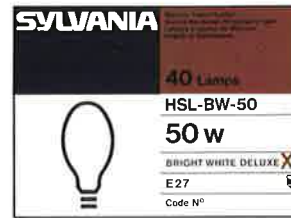
## Product Identification

Sylvania Discharge lamps are easier to handle. Colour-coded packaging saves time in the warehouse and helps to avoid errors.

Discharge lamps are often used in inaccessible locations... along narrow reservations on motorways... in high-bay industrial installations. Replacing a lamp involves the use of special vehicles with hydraulic platforms; the job is time-consuming; labour charges are higher than the cost of the lamp. Picking up the wrong lamp in a hurry at the maintenance depot becomes a disastrously expensive mistake when discovered miles away on top of a street lighting pole.

Sylvania have eliminated the problem of misplaced or incorrect lamps. Each carton is clearly identified with a colour-coded label. Every wattage has its own colour. A clear drawing shows the type of lamp at a glance. When a carton of Sylvania Discharge lamps is opened, each individual lamp box bears the same colour-coded label. So the lamp is clearly marked until it is actually being installed.

### Mercury Lamps



### High Pressure Sodium Lamps



### Low Pressure Sodium Lamps



## Quality First

Sylvania Discharge lamps – in common with all other Sylvania lamps – comply with the requirements of the International Electrotechnical Commission (IEC) and in many aspects far exceed the international standards.

The outstanding quality of Sylvania Discharge lamps rests on three pillars ... quality lamp materials, quality manufacturing techniques and quality control. When we make lamps, we don't just use glass. We use half a dozen specialised materials, ranging from high-resistance lead-alkali silicate to sodium-resistant ceramic alumina. More than a dozen different metals and alloys are tailor-made for specific components: tungsten

with a melting point higher than 3400 °C is used for long life electrodes; niobium with an expansion co-efficient close to alumina makes the dependable seal in our High Pressure Sodium lamps. Some of the gases used in Sylvania Discharge lamps are so rare that out of every million parts of air distilled, only nine parts of filling gas can be extracted.

Sylvania's sophisticated lamp-making machines automatically test lamps during each stage of production. The finished lamps are re-tested and inspected in our quality control departments. That is why customers throughout Europe find that they can depend on Sylvania lamps for performance and reliability.

## Lamp Type Comparison

### Mercury Lamps

- The universal discharge lamp combining excellent colour rendering with good efficacy.
- Available in numerous bulb shapes and sizes.
- In Sylvania Mercury lamps, light is produced by a combination of "excitation" and "fluorescence". The mercury discharge tube emits a cool white light and some ultra-violet. The phosphor on the bulb converts the ultra-violet to visible light in the red range. The combined light output is of excellent colour.
- Efficacies up to 60 lm/W are achieved.

### Blended Lamps

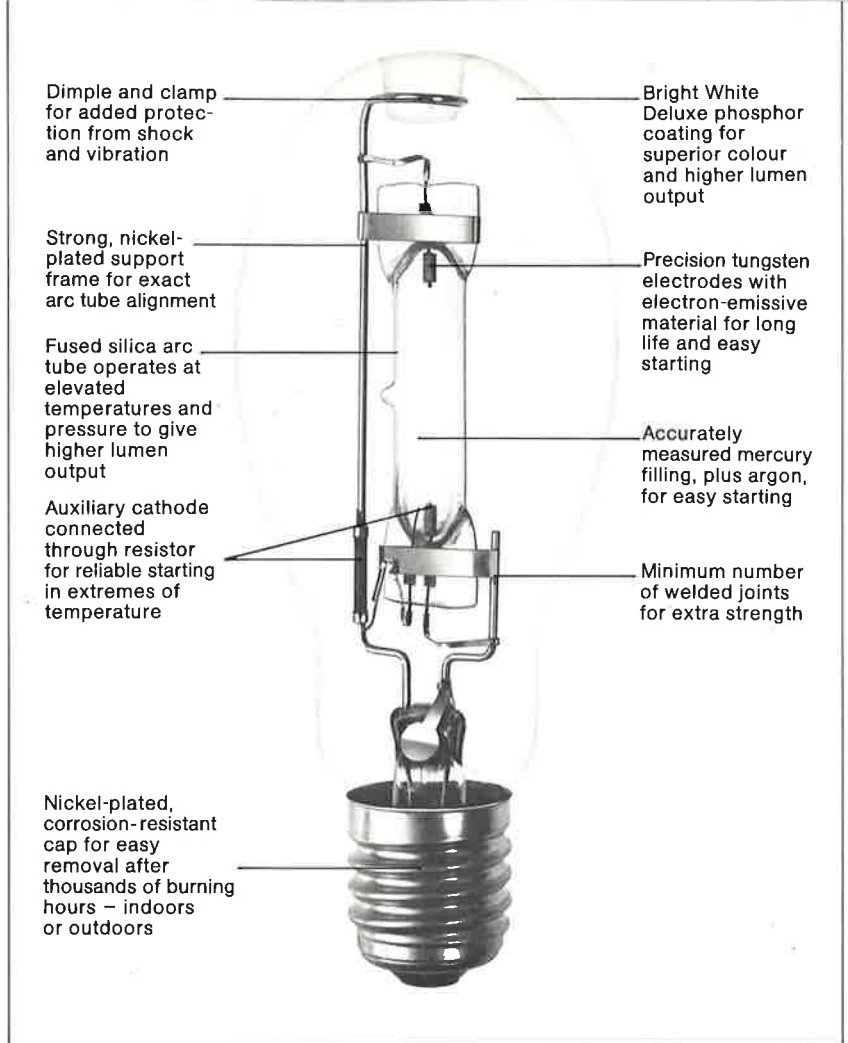
- A discharge lamp which can directly replace incandescent lamps.
- Gives more light and lasts six times as long as an incandescent lamp.
- Requires no control gear; simply screws into incandescent lamp holder.
- In Sylvania Blended lamps, a mercury discharge arc tube and an incandescent filament operate in the same bulb. The filament controls the arc tube current and at the same time contributes light. The combination of mercury radiation, phosphor radiation and incandescent radiation produces a very pleasant white light.
- The efficacy is around 19 to 22 lm/W.

### High Pressure Sodium Lamps

- Unique combination of good colour appearance and very high efficacy.
- Pleasant golden-white colour enhances environment.
- Sylvania High Pressure Sodium lamps have arc tubes made of high-purity aluminium-oxide ceramic which are able to withstand the severe chemical attacks of sodium at over 1300 °C. Light is produced by excitation of sodium atoms coupled with complex processes of absorption and re-radiation at different wavelengths. This results in a pleasant, warm, golden-white light colour.
- Efficacies up to 120 lm/W are obtained.

### Low Pressure Sodium Lamps

- The most efficient light source commercially available.
- Yellow light colour coincides with maximum spectral sensitivity of the eye; provides good perception and contrast.
- Provides safety and security at lowest running cost.
- Sylvania Low Pressure Sodium lamps are a typical single energy conversion lamp in which light is generated by exciting sodium atoms to resonance radiation. The crucial lamp pressure and temperature are controlled by advanced indium-oxide film technology.
- With efficacies up to 183 lm/W, this is the most efficient lamp.



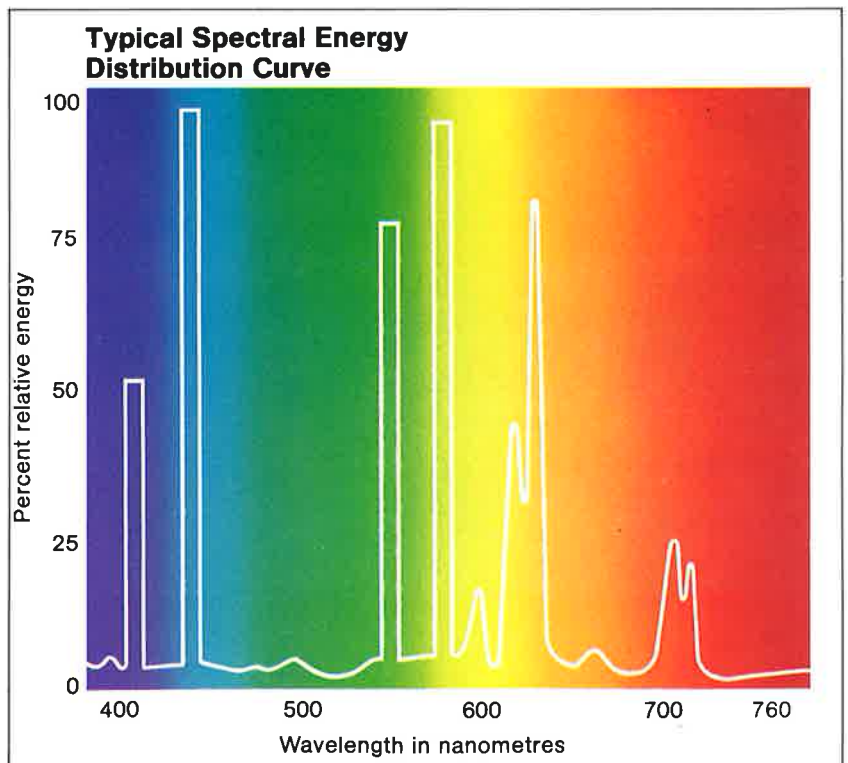
**Typical Mercury Lamp Construction**

## Sylvania Bright White Deluxe Mercury Lamps – The choice of lighting professionals

There are good reasons why Sylvania Bright White Deluxe Mercury lamps are being installed in increasing numbers. They are four times more efficient than incandescent lamps and thanks to Sylvania's phosphor technology, the light they emit appears more natural. The spectral energy distribution curve illustrates how the Bright White Deluxe phosphor peaks in the red area of the spectrum, resulting in excellent overall colour rendering.

Sylvania Bright White Deluxe Mercury lamps are most commonly used for street lighting. However, because of the wide range of wattages available – from 50 to 1000 watts – they are increasingly used in such diverse applications as shop window lighting and factory lighting. They operate reliably on simple control gear and are not greatly affected by voltage variations or extremes of temperature. As a result they are suitable for application indoors or outdoors.

As shown in the lamp construction photograph, an interesting feature of Sylvania Bright White Deluxe Mercury lamps is the incorporation of an auxiliary starting cathode and resistor. This ensures reliable starting in temperatures well below 0 °C.



### Sylvania Bright White Deluxe Mercury Lamps

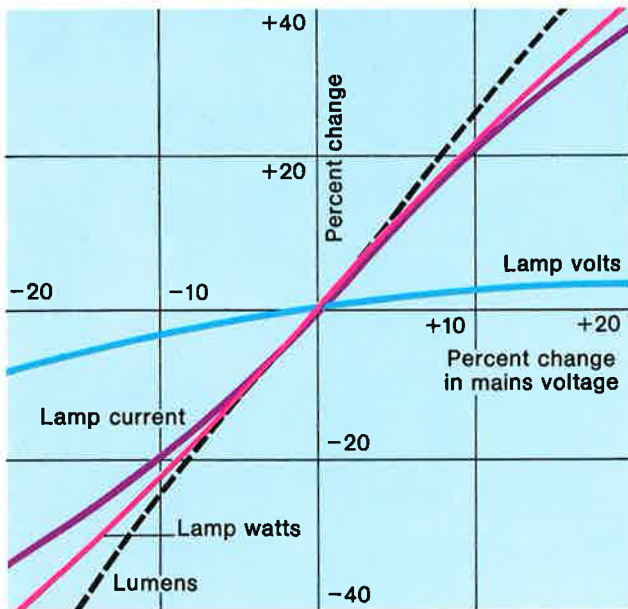
- Excellent colour rendering – pleasant environment
- Efficacies up to 60 lm/W – low running costs
- Range from 50–1000 watts – large or small installations



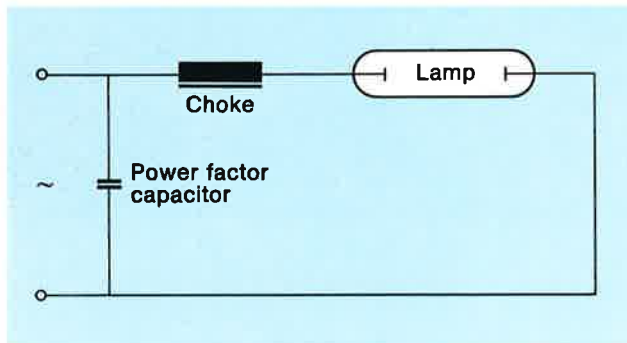
<b>Technical Data HSL-BW</b>								
<b>General Information</b>								
Lamp Rating	W	50	80	125	250	400	700	1000
Type Description		HSL-BW-50	HSL-BW-80	HSL-BW-125	HSL-BW-250	HSL-BW-400	HSL-BW-700	HSL-BW-1000
Ordering Code		20405	20406	20407	20408	20409	20410	20411
Std. Packing Quantity		40	40	40	12	12	6	6
<b>Mechanical Data</b>								
Bulb Shape		Ellipsoidal	Ellipsoidal	Ellipsoidal	Ellipsoidal	Ellipsoidal	Ellipsoidal	Ellipsoidal
Bulb Finish		Phosphor coated	Phosphor coated	Phosphor coated	Phosphor coated	Phosphor coated	Phosphor coated	Phosphor coated
Bulb Diameter	mm	56	71	76	91	122	152	167
Overall Length	mm	130	156	170	226	292	343	380
Cap		E 27	E 27	E 27	E 40	E 40	E 40	E 40
<b>Illumination Characteristics</b>								
Light Output	lm	2000	3800	6300	13 500	23 000	42 000	60 000
Efficacy	lm/W	40	48	50	54	58	60	60
<b>Electrical Characteristics</b>								
Arc Tube Voltage	V	95	115	125	130	135	140	145
Arc Tube Current	A	0.61	0.80	1.15	2.15	3.25	5.40	7.50
<b>Control Gear</b>								
Rec. PF Capacitor	mfd	7	8	10	18	25	40	60

The information given is typical and must not be considered a guarantee of individual performance and/or characteristics.

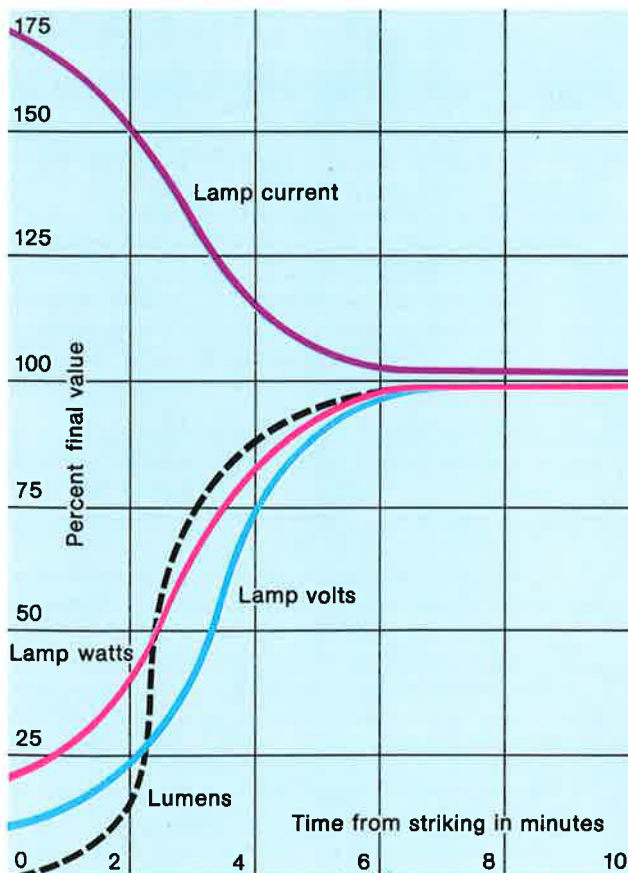
## Operating Characteristics of Mercury Lamps



Typical Effect of Mains Voltage Variations



Typical Operating Circuit



Typical Starting Characteristics



## Sylvania Reflector Mercury Lamps – The perfect lamps for heavy industry

Sylvania Reflector Mercury lamps help to overcome one of industry's most costly problems... dirt.

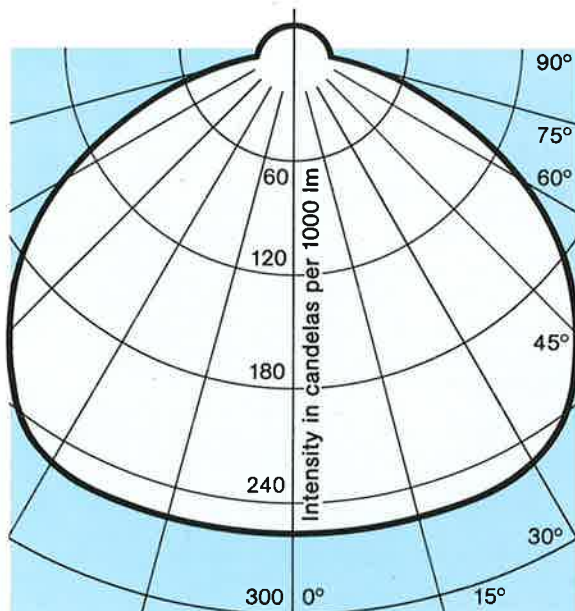
Maintenance engineers in steel mills, mining, foundries, welding shops, etc. know that dirt, dust and soot settling on lamps and fittings can reduce lighting levels by as much as 50%, resulting in reduced productivity and increased risk of accidents. Cleaning dirty lamps and fittings, particularly in inaccessible high-bay installations, is time-consuming and expensive.

To overcome these problems, Sylvania Reflector Mercury lamps have a specially-shaped bulb with an internal reflector. The reflector, which is protected inside the bulb, directs the light downwards. Thus, dust or soot settling on top of the bulb cannot affect the light output of the lamp and excellent lumen maintenance is assured, even in dirty environments.

The bulb shape gives a carefully-controlled light distribution pattern. Therefore, no fittings are required and economies can be achieved in lighting installations using Sylvania Reflector Mercury lamps.

### Sylvania Reflector Mercury Lamps

- Internal reflector impervious to dirt – better lumen maintenance
- Closely-controlled polar distribution – directs light where it is needed
- Tough glass bulb – indoor/outdoor operation without extra protection
- Bright White Deluxe colour – matches other Sylvania Mercury lamps



**Typical Polar Intensity Curve**

The combination of bulb shape and titanium-dioxide reflector employed in Sylvania Mercury Reflector lamps gives the polar intensities shown in the diagram. The light output from the lamp is directed below the horizontal, resulting in very high peak intensities.

### Technical Data HSR-BW

#### General Information

Lamp Rating	W	250	400
Type Description		HSR-BW-250	HSR-BW-400
Ordering Code		20412	20413
Std Packing Quantity		6	6

#### Mechanical Data

Bulb Shape		Reflector, internal coating	Reflector, internal coating
Bulb Finish		Phosphor coated	Phosphor coated
Bulb Diameter	mm	165	180
Overall Length	mm	260	300
Cap		E 40	E 40

#### Illumination Characteristics

Light Output	lm	11 500	20 500
Efficacy	lm/W	46	51

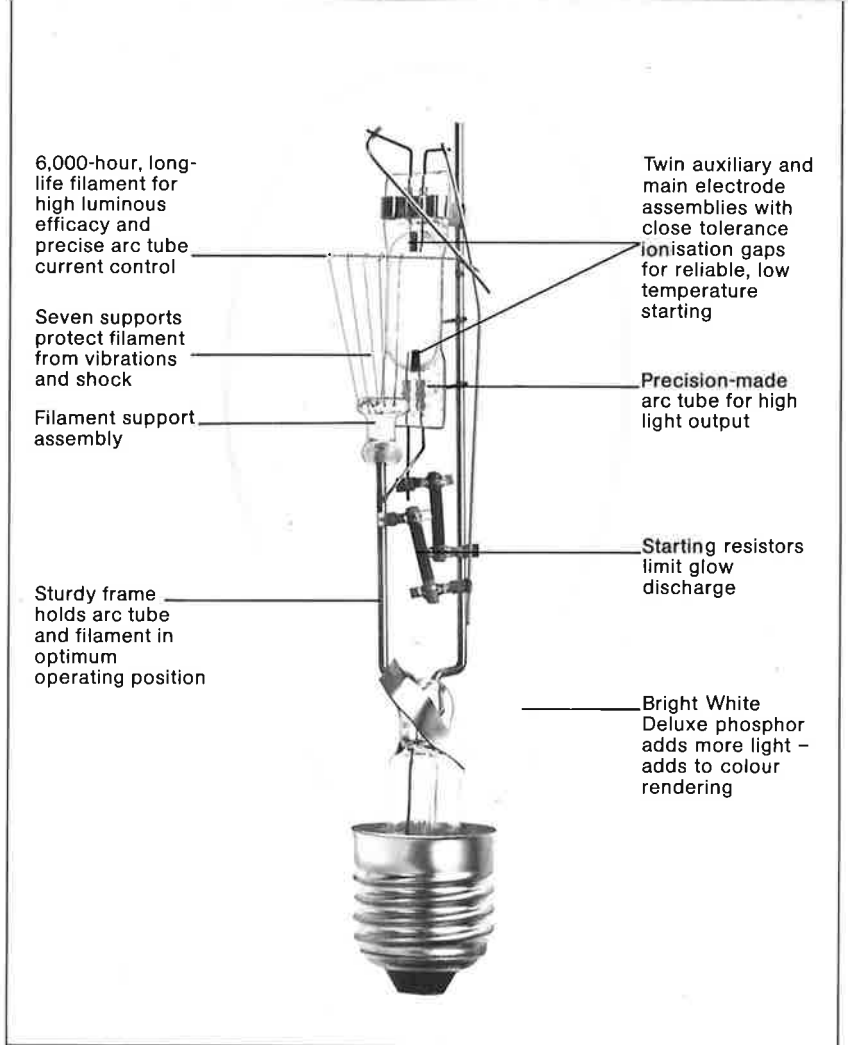
#### Electrical Characteristics

Arc Tube Voltage	V	130	135
Arc Tube Current	A	2.15	3.25

#### Control Gear

Rec. PF Capacitor	mfd	18	25
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**Typical Blended Lamp Construction**

## Sylvania Blended Lamps – The modern alternative to incandescent lamps

The charm of historic cities, streets and parks is often enhanced by the beauty of their traditional street lighting poles and lanterns. Although such lighting is aesthetically pleasing, the incandescent lamps which are commonly used as the light source are not sufficiently powerful to meet the higher levels of illumination demanded by modern-day traffic. This can lead to conflicts between preserving architectural heritage and meeting the safety requirements of today.

Sylvania Blended lamps are the answer. They are as simple to install as incandescent lamps, yet they have the high light output of discharge lamps. No external control gear is required and therefore, there are no additional installation costs.

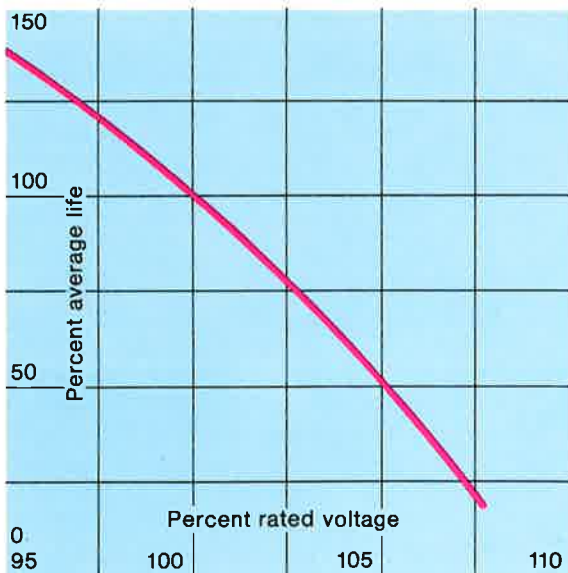
Maintenance costs, too, are dramatically reduced because Sylvania have designed their Blended lamps to last six times as long as incandescent lamps. This makes them an attractive replacement in many industrial and commercial incandescent installations.

As shown in the lamp construction photograph, in Sylvania Blended lamps, a mercury discharge tube and an incandescent filament operate inside a phosphor-coated bulb. The combination of light from the filament, the mercury arc and the phosphor coating results in a warm and pleasant colour.

The tungsten filament performs the dual function of contributing about 20% of the total light output and acting as a series current limiting device for the mercury arc tube, obviating the need for a choke.

### Sylvania Blended Lamps

- Direct plug-in replacement for incandescent lamps
- Six times the life of incandescent lamps – cuts maintenance costs
- 40% more light – lower running costs
- Low initial cost – no control gear needed
- Pleasant white colour



**Typical Relationship of Blended Lamp Life and Mains Voltage**

The operating parameters of Sylvania Blended lamps are so determined that optimum light and life are obtained at the specified mains voltage. Changes in the supply voltage can influence the lamp's characteristics. The relationship between lamp life and mains voltage is illustrated in the graph.

### Technical Data HSB-BW

#### General Information

Lamp Rating	W	160	250
Type Description		HSB-BW-160	HSB-BW-250
Mains Voltage	V	220-230	220-230
Ordering Code		20 414	20 415
Std. Packing Quantity		40	12

#### Mechanical Data

Bulb Shape		Ellipsoidal	Ellipsoidal
Bulb Finish		Phosphor coated	Phosphor coated
Bulb Diameter	mm	76	91
Overall Length	mm	170	226
Cap		E 27	E 40

#### Illumination Characteristics

Light Output	lm	3100	5600
Efficacy	lm/W	19	22

#### Electrical Characteristics

Lamp Current	nom. A	0.71	1.11
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#### Control Gear

Rec. PF Capacitor.	mfd	None	None
Choke		None	None

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**Sylvania  
“Lifeline” Mercury Lamps  
– Total reliability  
under shock and vibration**

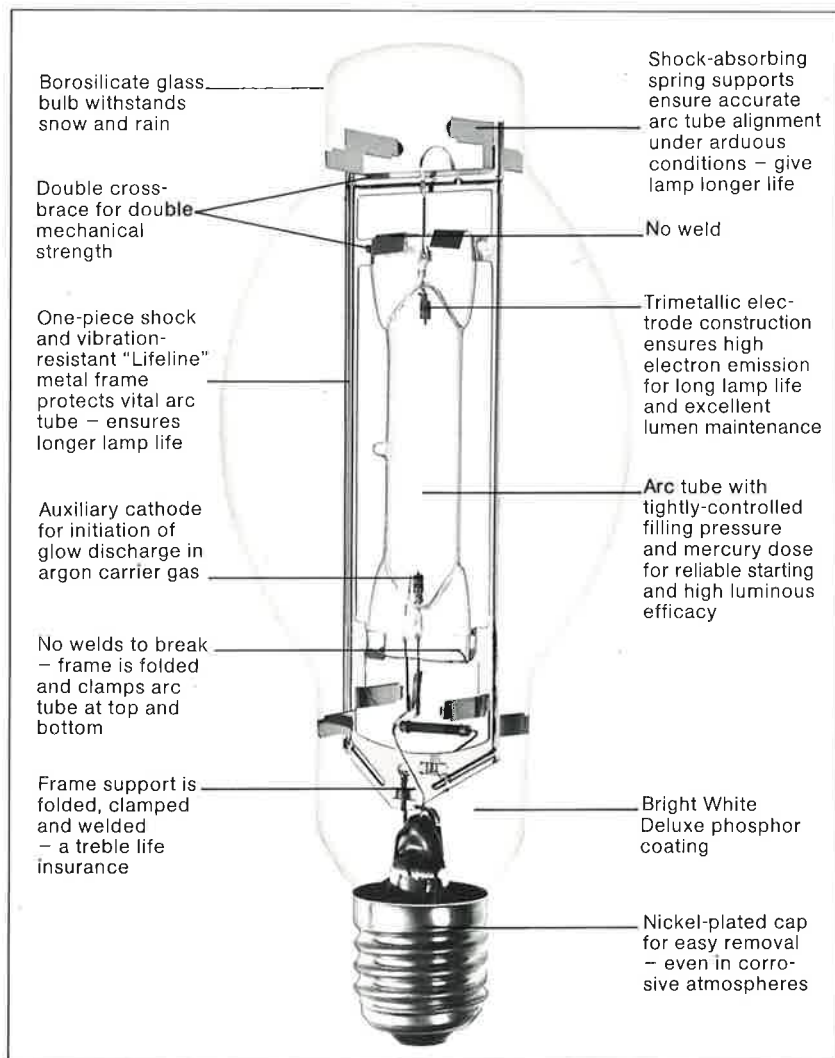
In street lighting installations, particularly on motorways, bridges and trunk roads, lamps are constantly exposed to the vibrations caused by the steady stream of cars and lorries. The combined effects of these vibrations and the shocks from wind and storms can be devastating for both lanterns and lamps.

In industrial high-bay fittings, lamps are subjected to sudden shocks from press brakes, vibrations in steel mills...destructive conditions for most lamps.

Sylvania “Lifeline” Mercury lamps shrug off shock and vibrations. They go on, where other lamps fail. Because the heart of the lamp – the mercury arc tube – is uniquely protected by the “Lifeline” metal frame.

Ordinary lamp frames are made of wire and spot-weld assembled. These welds are the weak points, most likely to break under shock or vibration. When a weld breaks, the lamp fails...often thousands of hours before the end of its rated life.

**Typical “Lifeline” Lamp Construction**





As illustrated in the construction photograph, the Sylvania "Lifeline" lamp frame needs no welds – it is made of a single piece of strong, nickel-plated steel. The frame is folded and has clamps to hold the arc tube firmly in position. Shock-absorbing spring supports protect the vital arc tube and ensure accurate alignment, even under arduous conditions.

This rough-service, one-piece frame construction gives Sylvania "Lifeline" lamps their superior shock and vibration-resistance, ensuring longer life. Advanced discharge lamp technology, including trimetallic electrodes, close tolerance arc tube construction and Bright White Deluxe colour rendering, ensure that "Lifeline" lamps have high light output and excellent lumen maintenance throughout their extended life.

Sylvania "Lifeline" Mercury lamps mean total reliability as a result of trend-setting lamp development and advanced production techniques

#### Sylvania "Lifeline" Mercury Lamps

- Longer life under shock and vibration
- Lower maintenance costs thanks to stronger construction

<b>Technical Data HSSL-BW</b>			
<b>General Information</b>			
Lamp Rating	W	250	400
Type Description		HSSL-BW-250	HSSL-BW-400
Ordering Code		20416	20417
Std. Packing Quantity		12	6
<b>Mechanical Data</b>			
Bulb Shape		Ellipsoidal with dome	Ellipsoidal with dome
Bulb Finish		Phosphor coated	Phosphor coated
Bulb Diameter	mm	91	122
Overall Length	mm	226	292
Cap		E 40	E 40
<b>Illumination Characteristics</b>			
Light Output	lm	13 500	23 000
Efficacy	lm/W	54	58
<b>Electrical Characteristics</b>			
Arc Tube Voltage	V	130	135
Arc Tube Current	A	2.15	3.25
<b>Control Gear</b>			
Rec. PF Capacitor	mfd	18	25

The information given is typical and must not be considered a guarantee of individual performance and/or characteristics.



**Sylvania  
High Pressure Sodium Lamps –  
Sunlight by night**

Sylvania High Pressure Sodium lamps uniquely combine superb colour, high efficacy, low running costs and long life.

Motorways, bridges and complex road intersections become safer under the 'sunlight look' of Sylvania High Pressure Sodium lamps. City centres, shopping areas and residential districts spring to new life at nightfall. Efficiency and security increase at bus and railway terminals, airports, dock installations and industrial premises. Sports stadiums are brighter and attract more spectators. Ancient monuments show their splendour under the 'sunlight look' of Sylvania High Pressure Sodium floodlighting; modern buildings appear warm and pleasant.

Colour, with efficacy as never before... that's High Pressure Sodium lighting by Sylvania... ready to put its



'sunlight look' on the healthy and successful growth of Europe's cities.

Sylvania High Pressure Sodium lamps are literally a product of the space age. Scientists working on space projects had been searching for materials to protect the astronauts' capsule against the tremendous heat it would encounter on re-entry into the earth's atmosphere. In the process, they developed a high-purity, heat-resistant ceramic with light transmitting properties. Lighting research laboratories took this ceramic and after months of technological analysis, developed High Pressure Sodium lamps of high efficacy and colour rendering properties which allow easy identification of colours.

Space-age Sylvania High Pressure Sodium lamps make an important contribution to modern lighting technology

and enhance the quality of our lives and environment.

In Sylvania High Pressure Sodium lamps, the surprising efficiency of converting electricity into light is achieved through a process of excitation and de-excitation of atoms. Sodium is vapourised and partially ionised to establish an electrical discharge. Ions colliding with atoms temporarily displace electrons out of their normal orbit into a higher state. On returning to their normal orbit, these "excited" electrons release the extra energy in the form of radiation. The wavelength of this radiation is largely determined by the vapourised sodium. As the temperature and pressure of the discharge are increased, the resonance radiation is absorbed and subsequently re-radiated in other wavelengths which cover a wide spectral band.

## Sylvania High Pressure Sodium Lamps

Sylvania High Pressure Sodium lamps are available in a variety of wattages, bulb shapes and finishes. Factors such as the level of illumination required, the design of the fitting, light distribution, visual comfort, mounting height and operational economics influence the final choice.



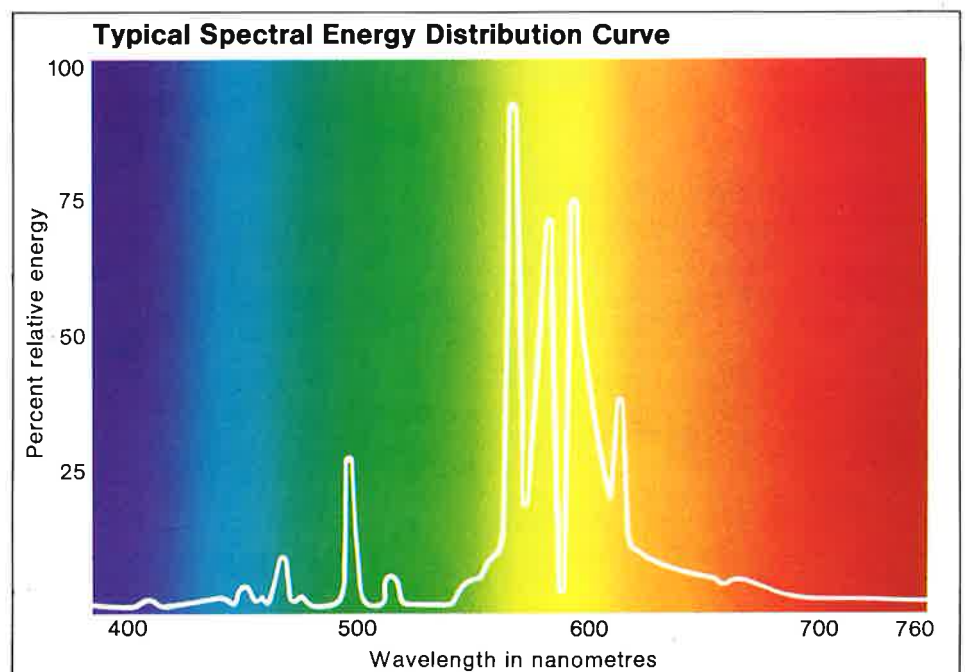
### Ellipsoidal Lamps with Diffusing Finish

The ellipsoidal version is a general purpose lamp, primarily for use in fittings with conventional optical systems. Frequently used in street lighting installations, ellipsoidal lamps are equally suitable for industrial and commercial lighting.

### Clear Tubular Lamps

The compact linear light source of the tubular lamp lends itself to accurate optical control. Incorporated in fittings specifically designed for linear light sources, they are often used for floodlighting, in high-bay industrial installations and street lighting.

The spectral energy distribution curve illustrates the broad range of the spectrum covered by the radiations produced in the high pressure sodium discharge, resulting in the pleasant, golden-white colour characteristic of all Sylvania High Pressure Sodium lamps. The colour appearance is close to that of a black body at 2100° K. The CIE chromaticity coordinates are  $x = .512$  and  $y = .420$ .





### Reflector Lamps

The deterioration in levels of illumination in many industrial installations due to dust or soot settling on the lamps has been overcome by the use of a specially-shaped outer bulb with an internal reflective coating. The rugged construction ensures a long, dependable working life. Maintenance costs are considerably reduced.

The heart of the Sylvania High Pressure Sodium lamp is the arc tube. It is made of a high-purity aluminium-oxide ceramic with excellent light transmitting properties. This ceramic – the result of space research – is able to withstand the severe chemical attacks of sodium vapour at high temperatures. Sylvania technology has produced a ceramic arc tube assembly which operates at efficacies up to 120 lm/W and has outstanding lumen maintenance characteristics.

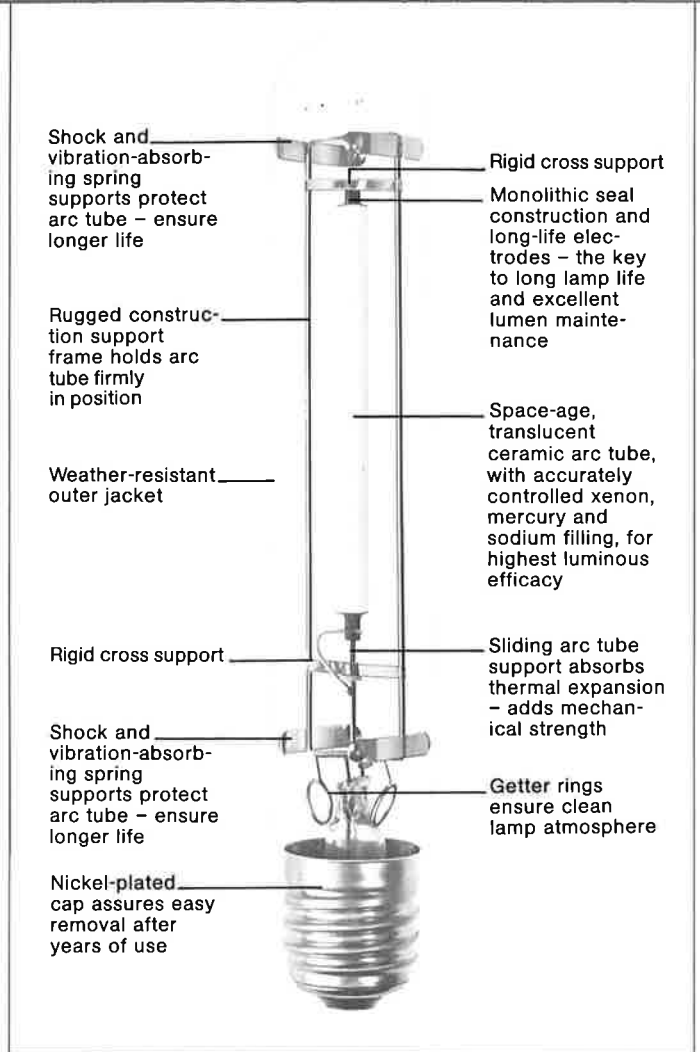
The arc tube contains a controlled amount of sodium whose atoms are excited in the discharge, converting electrical energy directly and efficiently into light. In addition, some mercury is added to increase the impedance and xenon filling facilitates lamp starting.

The arc tube operates at some 1300°C and this temperature is critical to the

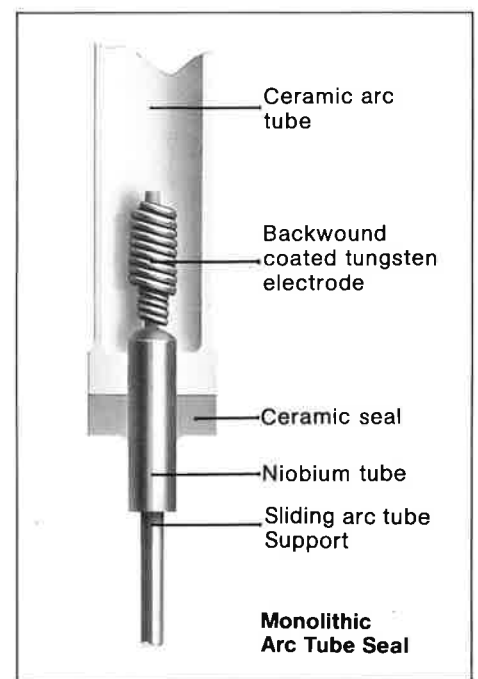
lamp's operating efficacy. In Sylvania High Pressure Sodium lamps the temperature and vapour pressure are accurately controlled by the strategic location of the cold spot and the high vacuum in the lamp jacket which is maintained by the barium getter.

### Monolithic Arc Tube Seal

A major technological factor affecting lamp life and lumen maintenance is the construction of the seals and electrodes at the ends of the arc tube. Sylvania High Pressure Sodium lamps have monolithic seals in which the electrode assembly and a ceramic sealing button are fused to the arc tube under tremendous heat. Thanks to this seal construction, Sylvania High Pressure Sodium lamps may be operated in any burning position. The sliding arc tube support absorbs thermal expansion and maintains exact arc tube alignment.



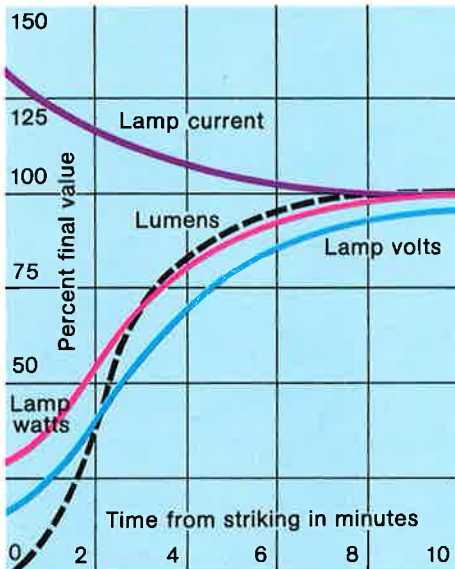
Typical High Pressure Sodium Lamp Construction



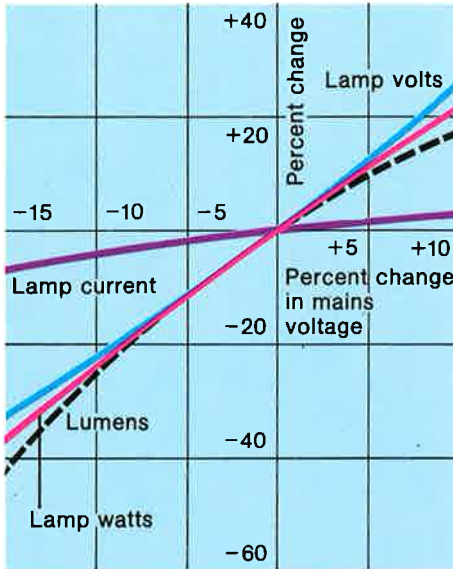
The normal mains voltage is not sufficient to cause a Sylvania High Pressure Sodium lamp to strike. When a lamp circuit is first switched on, an electronic starter applies short bursts of high voltage pulses in the region of 4000 volts across the lamp. This initiates the xenon arc which is fol-

lowed by a mercury vapour discharge and then the sodium discharge. Sylvania High Pressure Sodium lamps deliver an acceptable light output within two minutes from striking and 80% within four minutes. During this time, the tube voltage rises while the tube current diminishes.

If switched off, Sylvania High Pressure Sodium lamps cool rapidly and the internal pressure is quickly reduced to a level where the arc strikes again. The re-strike time after a momentary interruption is less than one minute.



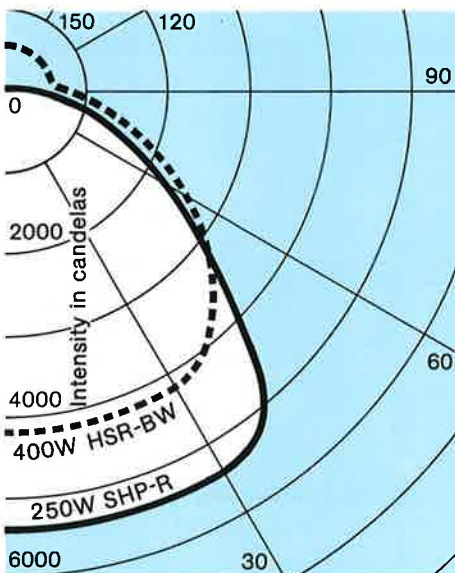
Typical Starting Characteristics



Typical Effect of Mains Voltage Variations

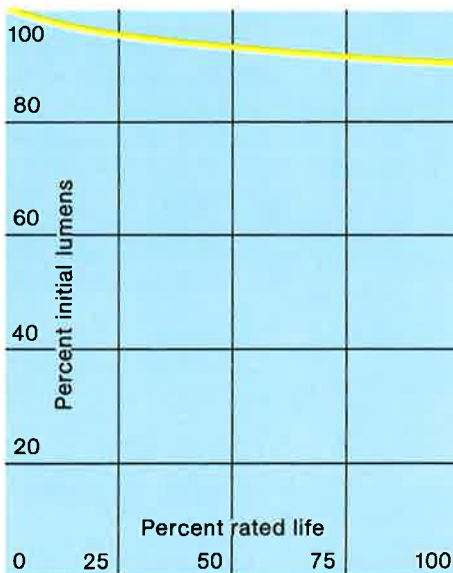
The operational parameters of High Pressure Sodium lamps are affected by changes in supply voltage. An increase in mains voltage will lead to a rise in lamp voltage, which in turn will increase the arc tube voltage. The changes are to some extent dependent on the control gear used. Typical variations in lamp current, voltage, wattage and light output which result from mains voltage variations are illustrated.

The starting voltage required is largely independent of the ambient temperature and lamp operation will not be seriously affected within a range of -40° to +70°C.



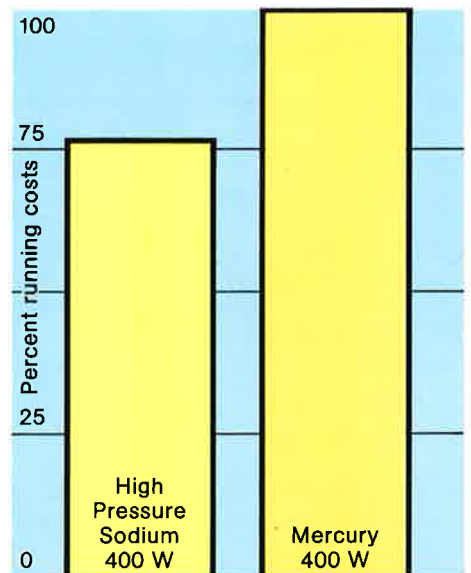
Typical Polar Intensity Curve

The Sylvania Reflector High Pressure Sodium lamp gives a closely-controlled polar distribution, similar to that of a standard lamp with a reflector fitting. The illustration shows the light distribution and comparative intensity of a 250 W Sylvania Reflector High Pressure Sodium lamp and a 400 W Reflector Mercury lamp. Although consuming 37% less energy, the High Pressure Sodium lamp has a much higher peak intensity, reflecting the considerable economies which are possible in capital investment.



Typical Lumen Maintenance Curve

The design principles of Sylvania High Pressure Sodium lamps, incorporating the most advanced technology, result in outstanding maintenance of efficacy throughout life. This is dramatically illustrated in the typical lumen maintenance curve. The high lumen maintenance ensures that the lighting level of an installation will essentially remain at the design value.



Comparison of Typical Running Costs

More than ever before, economic considerations play an important role in the choice of a lighting installation. In Sylvania High Pressure Sodium lamps, low capital and running costs are uniquely combined with lighting engineering and environmental advantages. A typical comparison between the running costs of a Sylvania High Pressure Sodium lamp installation and a Mercury installation is shown. The savings are significantly in favour of High Pressure Sodium lamps. The trend to higher electricity costs will widen the gap still further. Not included in the comparison are the savings from lower kVA demand and smaller-sized cabling.

# Sylvania High Pressure Sodium Lamps

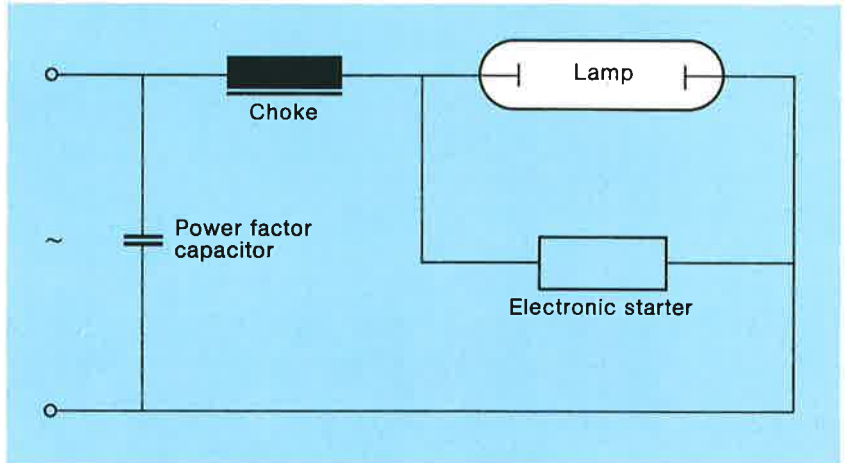
The Sylvania Electronic Starter SHP-1 generates the high-voltage pulses required to strike a High Pressure Sodium lamp. Employing advanced, solid-state circuitry, short high-voltage bursts of low energy are delivered at a low repetition rate. This ensures immediate lamp starting and provides maximum electrical safety and minimises radio interference.

The SHP-1 offers the major safety advantage of sensing a faulty or missing lamp and switching itself off automatically after less than three minutes. Installation is extremely simple – only two connections across the lamp are required – obviating the need for tapped chokes.

In common with all discharge lamps, Sylvania High Pressure Sodium lamps have a negative resistance characteristic and must be operated in conjunction with suitable control gear. As shown in the circuit diagram the arc tube current is generally controlled by a series choke.



**Electronic Starter**



**Typical Operating Circuit**

<b>Technical Data</b>						
<b>General Information</b>						
Lamp Rating	W	250	250	250	400	400
Type Description		SHP-250	SHP-T-250	SHP-R-250	SHP-400	SHP-T-400
Ordering Code		20 481	20 482	20 483	20 484	20 485
Std. Packing Quantity		10	10	1	10	10
<b>Mechanical Data</b>						
Bulb Shape		Ellipsoidal	Tubular	Reflector	Ellipsoidal	Tubular
Bulb Finish		Diffusing	Clear	Internal reflective coating – clear lens	Diffusing	Clear
Bulb Diameter	mm	91	48	165	122	48
Overall Length	mm	226	257	260	292	285
Light Centre Length	mm	–	158	–	–	175
Arc Length	mm	75	75	75	90	90
Cap		E 40	E 40	E 40	E 40	E 40
<b>Illumination Characteristics</b>						
Light Output	lm	25 000	25 500	21 500	47 000	48 000
Efficacy	lm/W	100	102	86	118	120
<b>Electrical Characteristics</b>						
Arc Tube Voltage	V	100	100	100	105	105
Arc Tube Current	A	3.00	3.00	3.00	4.45	4.45
<b>Control Gear</b>						
Rec. Electronic Starter		SHP-1	SHP-1	SHP-1	SHP-1	SHP-1
Rec. PF Capacitor	mfd	40	40	40	45	45

The information given is typical and must not be considered a guarantee of individual performance and/or characteristics.



## **Sylvania Low Pressure Sodium Lamps – The energy savers**

Statistics prove that good street lighting substantially increases road safety and saves human lives. Other reports show that for economical and ecological reasons, energy consumption – including electricity – should be reduced.

Sylvania have the answer to this rather contradictory situation: Sylvania Low Pressure Sodium lamps, the most efficient light source commercially available.

With Sylvania Low Pressure Sodium lamps, it is possible to provide good street lighting for the fast, accurate and easy vision required on motorways, in tunnels, at intersections, while conserving electricity. With efficacies up to 183 lm/W, these lamps give fourteen times more light for the power consumed than incandescent lamps.

Sylvania engineers have always had the basic aim of developing lamps which use energy efficiently. Low Pressure Sodium lamps are not an instant discovery in response to the 'energy crisis'; they are the result of years of research into sodium lamp technology.

For efficient operation of the low pressure sodium discharge, the arc tube voltage must be kept relatively low in comparison to the length of the arc tube. In Sylvania Low Pressure Sodium lamps the long, thin arc tubes are bent into a U-shape. This results in a compact lamp with a simple bayonet cap for the electrical connections.

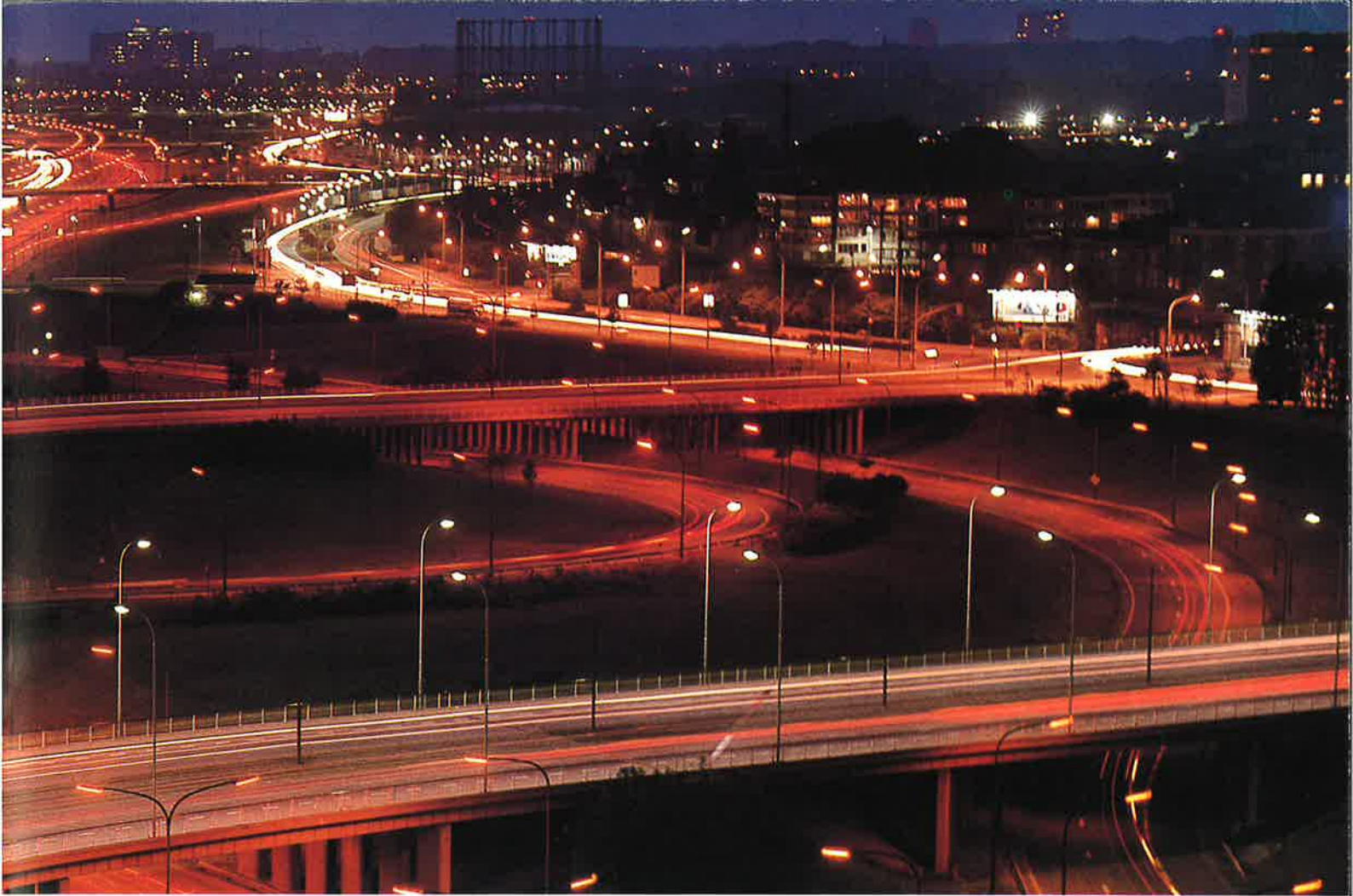
Sodium vapour is chemically very active and destroys most types of glass. The arc tubes of Sylvania Low Pressure Sodium lamps are made of a two-ply material with an internal sodium-resistant layer, which resists discolouration and therefore, ensures long lamp life and good lumen maintenance.

Long life, triple-coil tungsten electrodes are employed and the joints between the electrodes and the lead-in wires are protected from sodium attacks by ceramic beads.

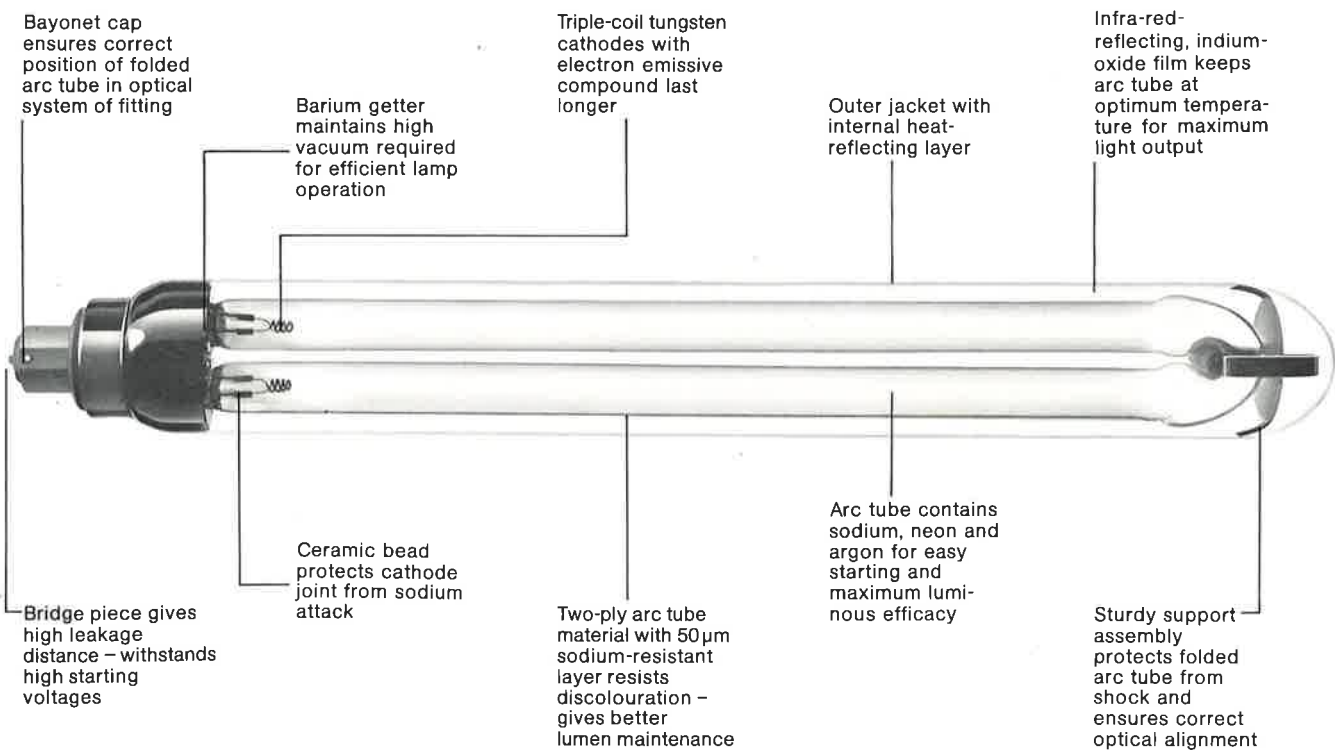
The arc tube contains a small amount of sodium which, by careful control of temperature and pressure, is operated at resonance radiation, producing the characteristic yellow-coloured light. Argon is added for easy starting and neon is used as a filler gas.

The heat generated by a low pressure sodium discharge is not sufficient to bring the vapour pressure to the optimum value. The arc tube is, therefore, sealed into a high-vacuum jacket with an internal infra-red-reflecting, indium-oxide film which reduces heat-radiation losses and ensures lamp operation at maximum efficacy.

Sylvania Low Pressure Sodium lamps are available in a wide range of wattages – from 35W to 180W. The energy savings possible make them attractive, not only for street lighting but for many types of installations where safety and security are important... in industry, docks, harbours, storage areas, etc.



### Typical Low Pressure Sodium Lamp Construction



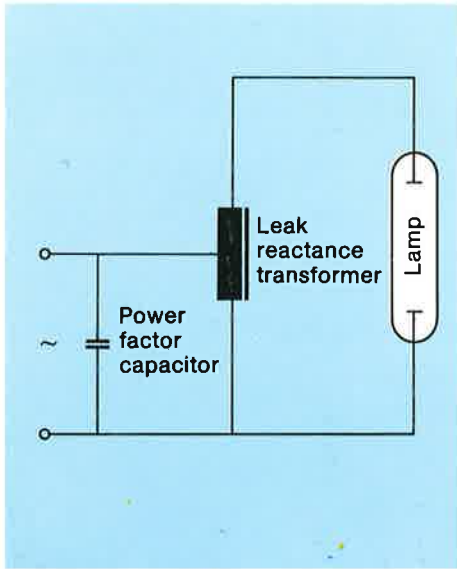
Sylvania Low Pressure Sodium lamps are cold started. They are generally operated in conjunction with leak reactance transformers which step-up the mains voltage to provide the high lamp starting voltage required. The impedance required to control the arc tube current is obtained from the same transformer by introducing leakage reactance.

The high starting voltage available and the low lamp operating pressure ensure quick re-striking of a lamp after a momentary power cut.

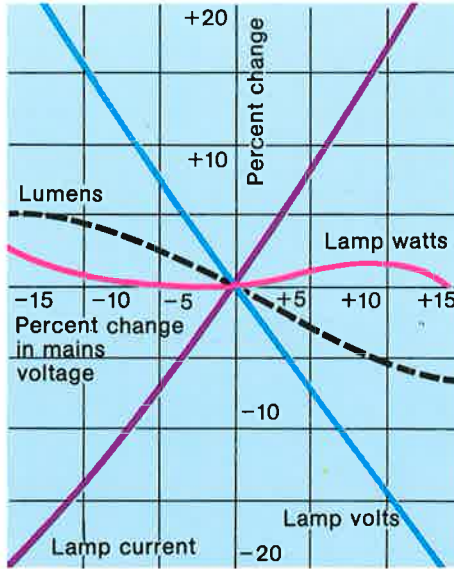
The effect of mains voltage variations on the operating characteristics of Sylvania Low Pressure Sodium lamps is illustrated in the graph. Increases in mains voltage influence the vapour pressure which is critical for the maintenance of optimum resonance radiation.

Sylvania Low Pressure Sodium lamps require a starting voltage roughly twice that of the stabilised arc tube voltage. The initial arc is struck in argon gas, initiating a discharge in the neon gas filling. The heat developed vapourises the sodium. As illustrated, Sylvania lamps reach about 80% light output within ten minutes from striking.

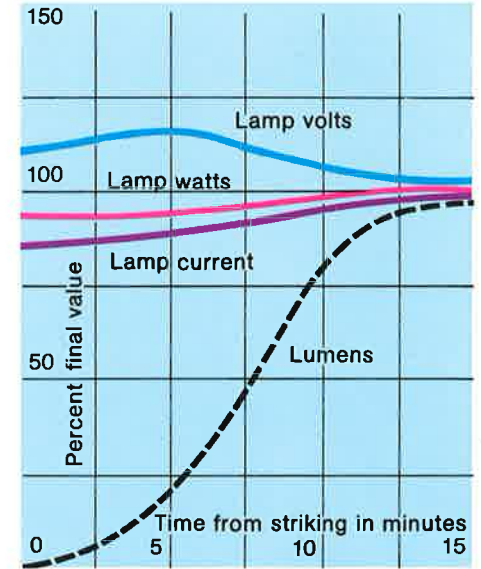
The starting voltage is hardly influenced by the ambient temperature, ensuring dependable starting even under adverse conditions.



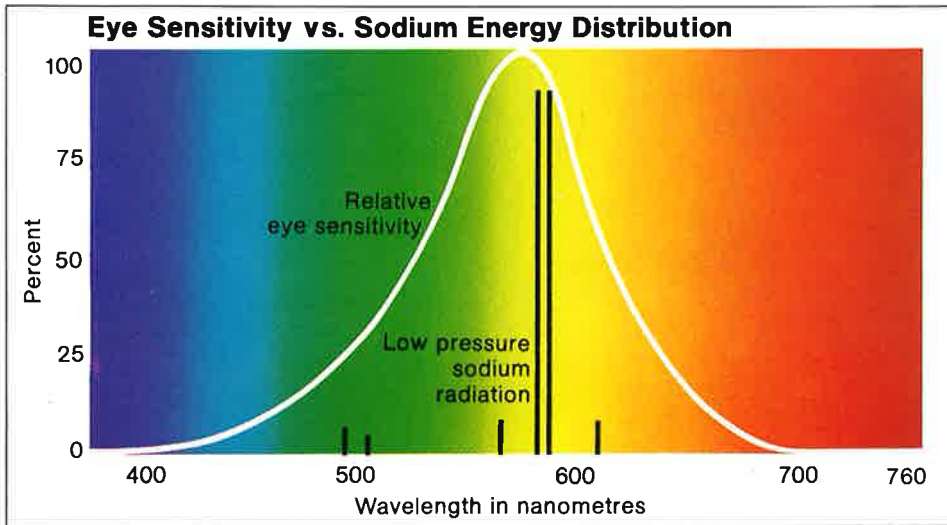
Typical Operating Circuit



Typical Effect of Mains Voltage Variations



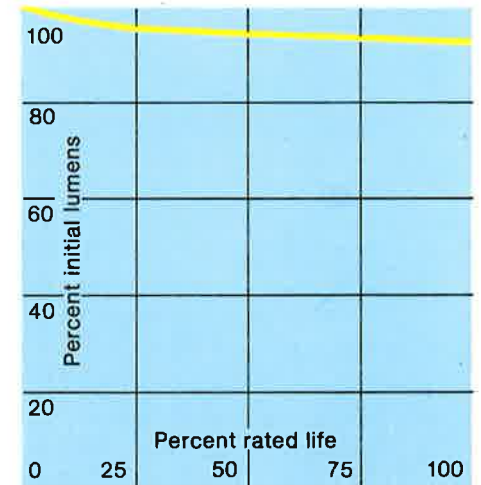
Typical Starting Characteristics



The sensitivity of the human eye varies with the wavelengths of the spectrum. As shown in the diagram, the eye responds most strongly to yellow-green radiations, with a gradual decline towards the violet and red colours.

The almost monochromatic radiation of a Low Pressure Sodium lamp stems from a double line at a wavelength of 589 and 589.6 nm.

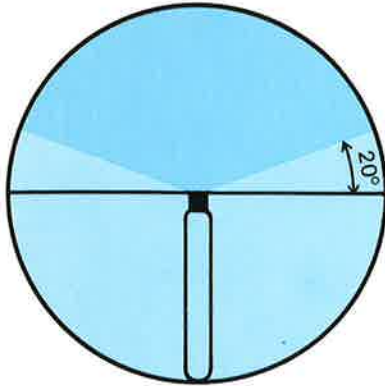
As illustrated, the sodium radiation almost coincides with the maximum sensitivity of the eye. This gives the Low Pressure Sodium lamp its extremely high luminous efficacy.



Typical Lumen Maintenance Curve

Excellent lumen maintenance is a key feature of Sylvania Low Pressure Sodium lamps. Discolouration of the arc tube is kept to a minimum and the lamps continue to deliver their remarkably high light output throughout the rated life, ensuring a most economical use of electrical energy.

# Low Pressure Sodium Lamps

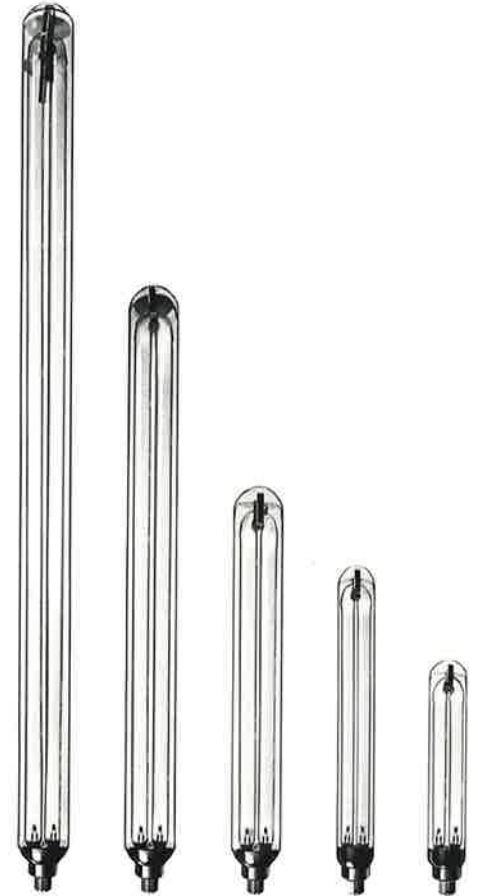


Operating Position

## Economic Considerations

The major cost factor in operating a lighting installation is the electricity consumption. Low Pressure Sodium lamps can reduce these electricity costs considerably. For example: 135W Low Pressure Sodium lamps and 400W Mercury lamps have about the same light output and both are suitable for street lighting. A comparison shows that to light one

mile of motorway with lanterns mounted on 25-foot columns and spaced 120 feet apart, 400W Mercury lamps would consume 70,400 kWh per annum. For the same mile of motorway fitted with Sylvania Low Pressure Sodium lamps, the corresponding power consumption would be only 23,800 kWh.



<b>Technical Data</b>						
<b>General Information</b>						
Lamp Rating	W	35	55	90	135	180
Type Description		SLP-35	SLP-55	SLP-90	SLP-135	SLP-180
Ordering Code		20 495	20 496	20 497	20 498	20 499
Std. Packing Quantity		12	12	6	1	1
<b>Mechanical Data</b>						
Bulb Shape		Tubular	Tubular	Tubular	Tubular	Tubular
Bulb Finish		Indium-oxide coated	Indium-oxide coated	Indium-oxide coated	Indium-oxide coated	Indium-oxide coated
Bulb Diameter	mm	51	51	65	65	65
Overall Length	mm	310	425	528	775	1120
Light Centre Length	mm	170	230	280	405	575
Arc Length	Folded Tube mm	196	311	408	659	1004
Cap		BY22d	BY22d	BY22d	BY22d	BY22d
<b>Illumination Characteristics</b>						
Light Output	lm	4800	8000	13 500	22 500	33 500
Efficacy	lm/W	137	145	150	167	183
<b>Electrical Characteristics</b>						
Arc Tube Voltage	V	70	109	112	164	240
Arc Tube Current	A	0.60	0.60	0.95	0.95	0.91
<b>Control Gear</b>						
Rec. PF Capacitor	mfd	20	20	26	45	40

The information given is typical and must not be considered a guarantee of individual performance and/or characteristics.

# Sylvania

15.

	4	20
	14500	13000
Ra	20	55
CCT		2200

# Philips

15w	Elliptical	Tubular
Standard	14000	14500
S	16000	17000



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