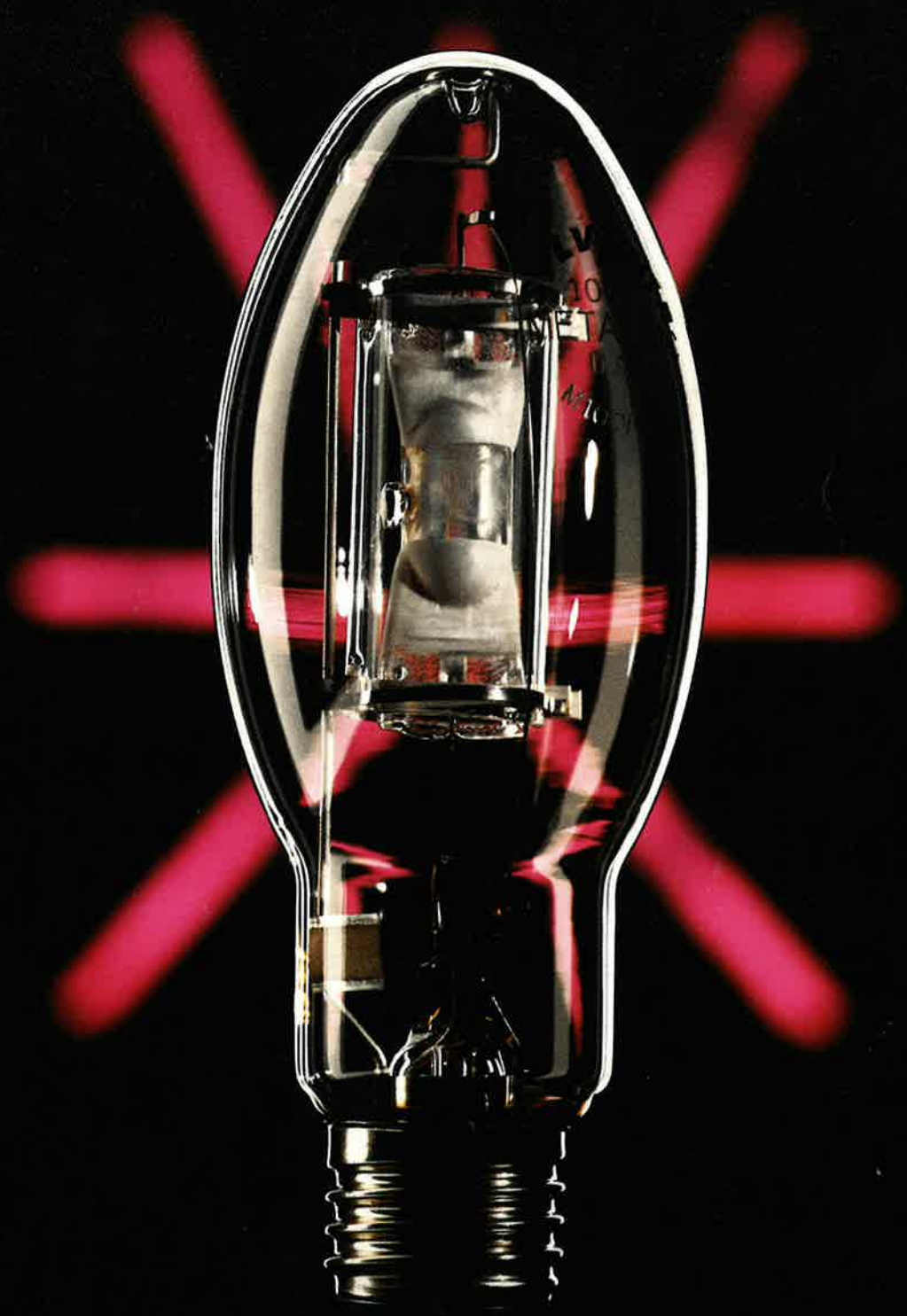
M75/M100/M150

MetalArc Lamps



Technical Manual

SYLVANIA GTE

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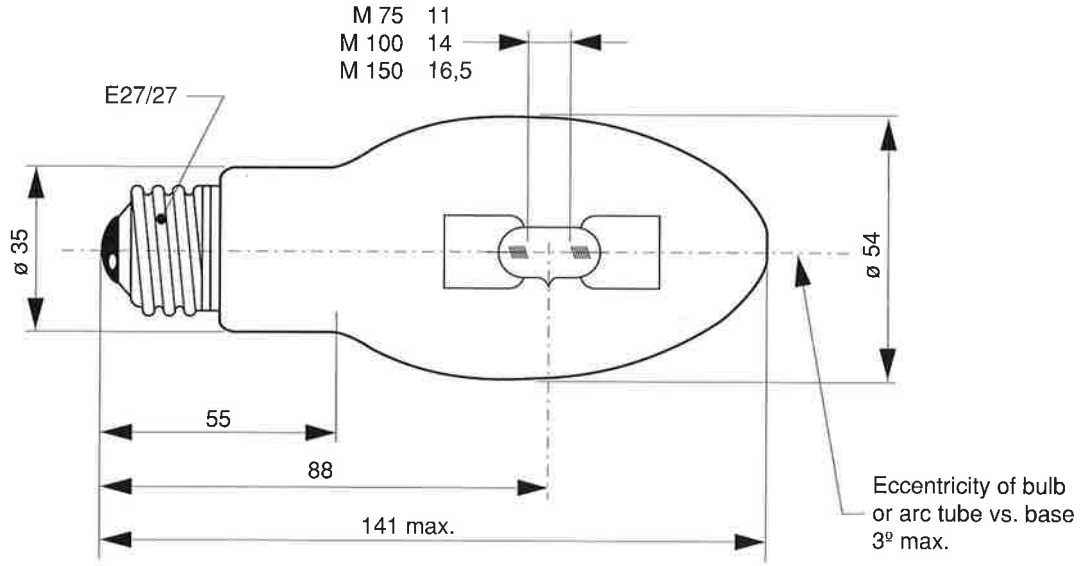
Technical Manual M75/M100/M150

This manual contains the following information :

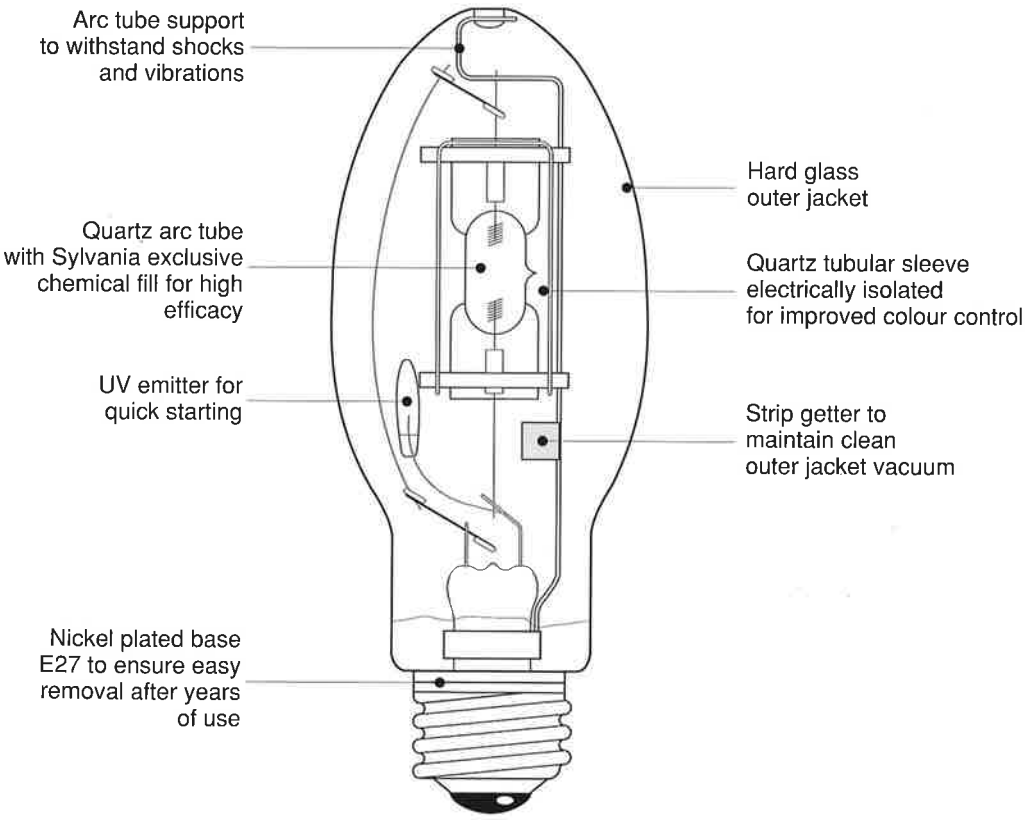
1. Product Description and Data

	M75		M100		M150	
Product designation	M75/CL/BU	M75/CO/B	M100/CL	M100/CO	M150/CL	M150/CO
Code Nr.	20680	20681	20637	20638	20682	20683
Bulb finish	Clear	Coated	Clear	Coated	Clear	Coated
Operating position	Base Up	Base Up	Universal	Universal	Universal	Universal
Outer bulb	ED 54 Borosilicate (hard) glass					
Lamp cap	E 27/27 Ceramic					
Dimensions	See drawing					
Lamp Wattage (W)	75	75	100	100	150	150
Circuit Wattage appr. (W)	86	86	115	115	172	172
Lamp voltage (V)	95	95	95	95	95	95
Lamp current (A)	0.95	0.95	1.1	1.1	1.8	1.8
Peak starting voltage min./max. (V)	3.3/4.5	3.3/4.5	3.3/4.5	3.3/4.5	3.3/4.5	3.3/4.5
Pulses/half cycle	3					
Pulse position	60-90° of half cycle					
Pulse width min. (micro-sec) at 2300 V	0.6		0.6		0.8	
Open circuit voltage (OCV) min (V)	208					
Mains voltage variation max.	±5 %					
Choke current tolerance max.	±3 %					
Light Output (lm)	5600	5200	8500	8000	13500	12700
Lamp Efficacy (lm/W)	75	69	85	80	90	85
Colour temperature (K)	3200					
Colour rendering class (DIN 5035)	2					
Average luminance (cd/cm²)	1500					
Run-up time for 90% light output (min.)	2-3					
Minimum starting temperature	-30°C					
Cap temperature max.	190°C					
Bulb temperature max.	275°C					
Switch cycle for life test	11 h ON / 1 h OFF					

All data at 100h, measured in base-up position



Dimensions in mm



Physical characteristics

Material	*Function*	*Property*
Hard glass (borosilicate)	Outer jacket	Transparent Thermal shock resistant UV absorbing
Quartz glass	Arc tube	Transparent Refractory Strength Chemical stability
Tungsten	Electrodes	Electron emission High melting point Low evaporation rate Chemical stability
Molybdenum	Seals Lead Wires	High melting point Ductile Electrically conductive Chemical stability Strength

2. Photometric and Colorimetric Performance (over life)

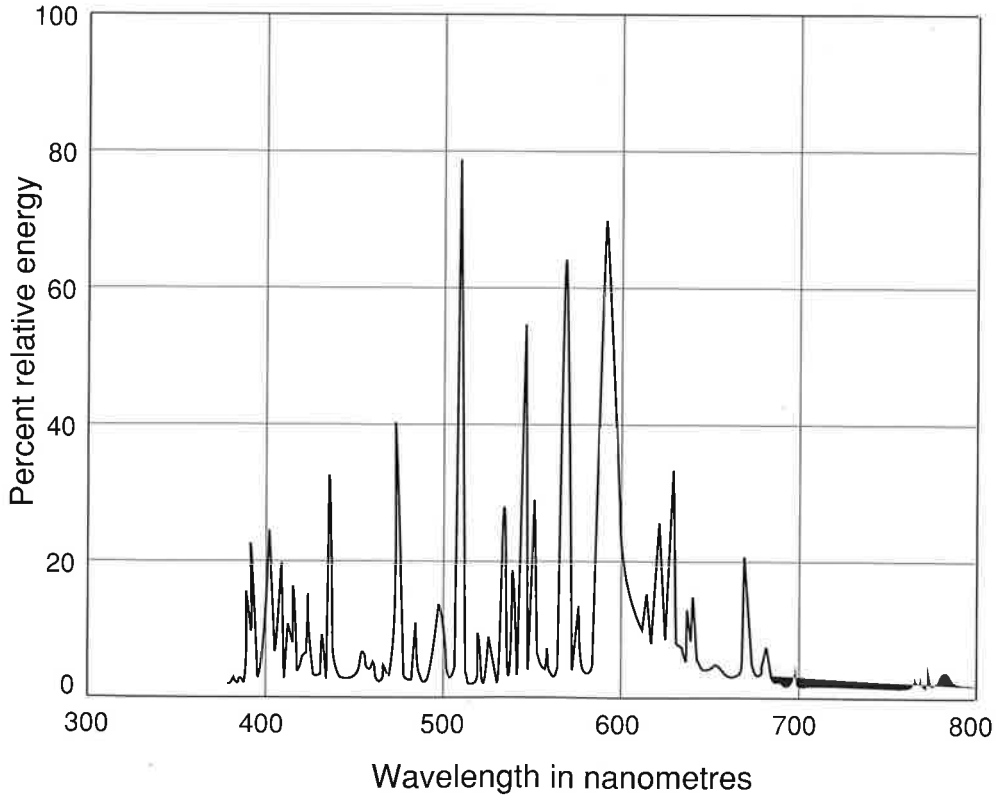
The following diagrams are valid for lamps operated to specified mains voltage and choke tolerance, as well as in a fixture which corresponds to the established recommendations.

1. The light output performance is as indicated in the data table.

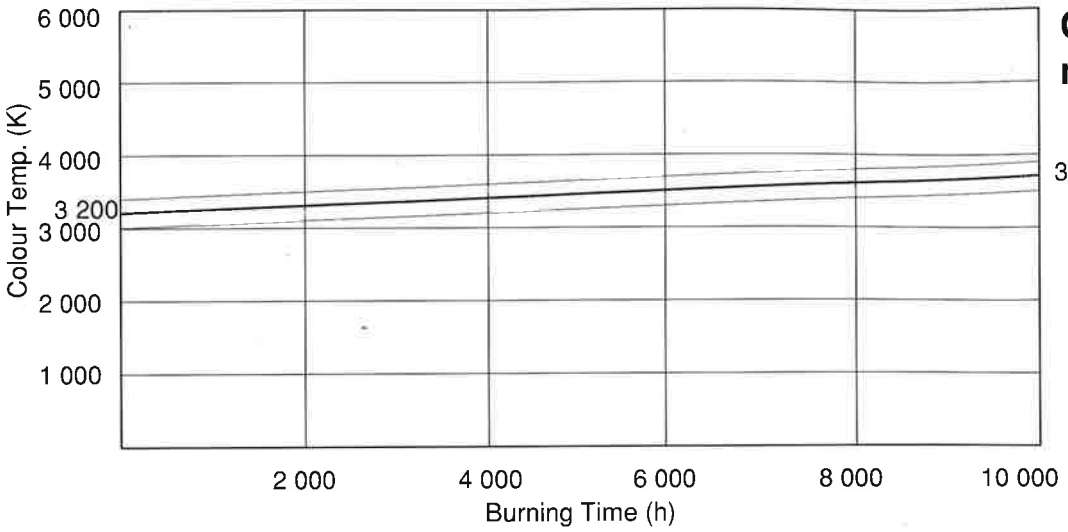
2. The colour temperature under above conditions at 100 hours is
   - nom. 3200 Kelvin (K)
   - tolerance ± 200 K
   - colour shift during life less than + 500 K

If colour uniformity is important for an installation, it is recommended to group-replace lamps. For colour uniformity it is also important to consider the colours as used in a room (reflective surfaces) which may cause appearance differences for which the light source is not responsible.

Relative spectral power distribution

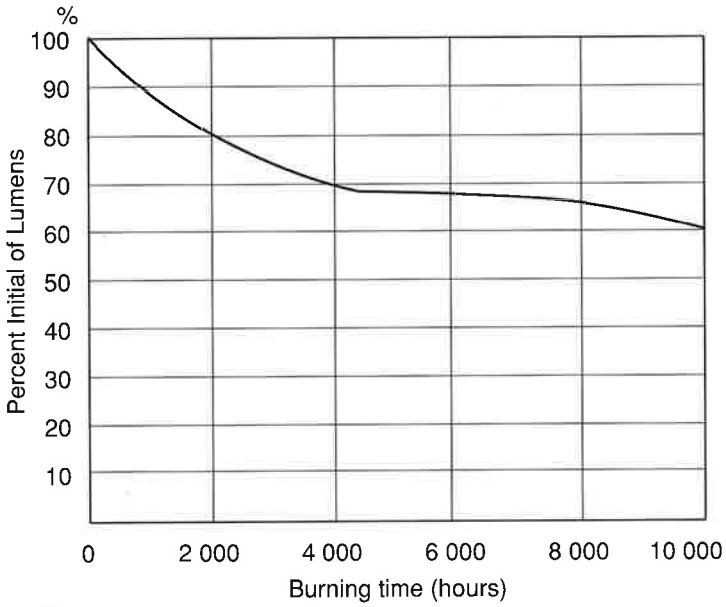


Colour maintenance

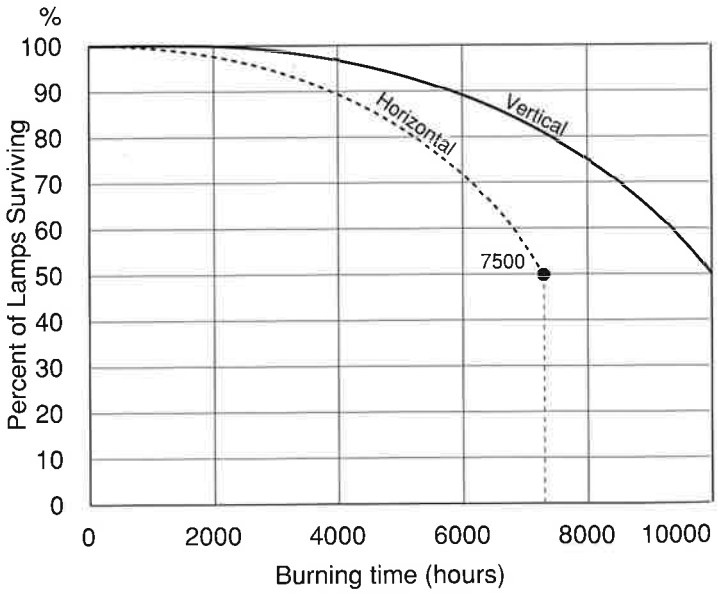


3700 K ± 200K

Lumen maintenance



Lamp mortality



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3. Principles of operation

These lamps are part of the metal halide lamp family, using a multitude of metal additives in the form of halides in the discharge mechanism.

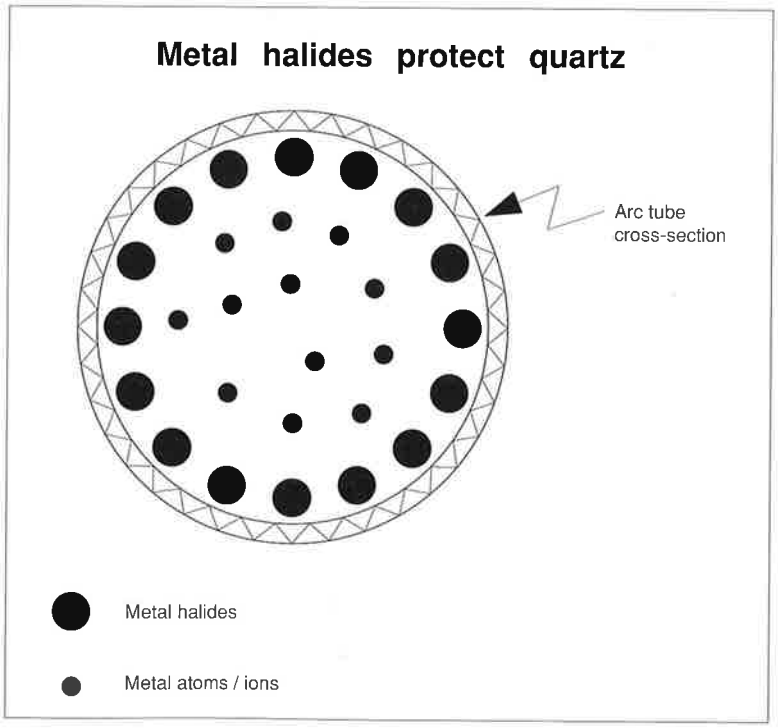
The arc tube contains :

1) Argon gas, which is required to start the discharge of the arc tube.
2) Mercury, which is acting as a discharge basis, and is regulating the electrical properties (lamp power, lamp voltage and current)
3) Various metals in chemical combination with iodine. These iodides dissociate into metal atoms and free iodine at the temperatures in the core of the discharge.

The free metals then actively take part in the discharge, are excited and radiate with their particular spectrum.

In the lower temperature zone towards the arc tube wall, the metals recombine with the iodine, and the quartz glass of the arc tube is not chemically attacked by them.

Metal halide lamps require more attention in the design of the fixture and the choke, to match the operating conditions and tolerances, in order to perform according to their specified data.



In the following is a listing of the various elements which play a role in the discharge of these lamps The effect of the single element radiations as they are indicated can be observed in the spectral power distribution diagram of the lamp.

Which metals as additives ?

When we look at the spectra of the various metals and select those which may be useful with respect to their radiation in the visible spectrum, then there are still 50 elements available.

But there are other necessary properties which these elements must have, particularly when they are in chemical combination with a iodine. These properties are :

1) the elements must not be highly toxic.
2) at room temperature the vapour pressure of the iodide must be low, so as not to affect the starting properties of the arc tube.
3) at high temperatures in the discharge column the iodide must be unstable so that the metal can freely participate in the discharge.
4) the iodide must not react with the quartz glass of the arc tube.
5) at arc tube temperatures the iodide must go into vapour form, and its vapour pressure must match the conditions created by the other additives.

Chemical fill

Element	*Purpose*
Scandium	Large band of blue and green radiation
Sodium	Narrowband yellow-orange radiation
Iodine	In combination with metals
Mercury	Power loading
Argon	Buffer starting gas

4. Electrical parameters, equipment and lamp testing

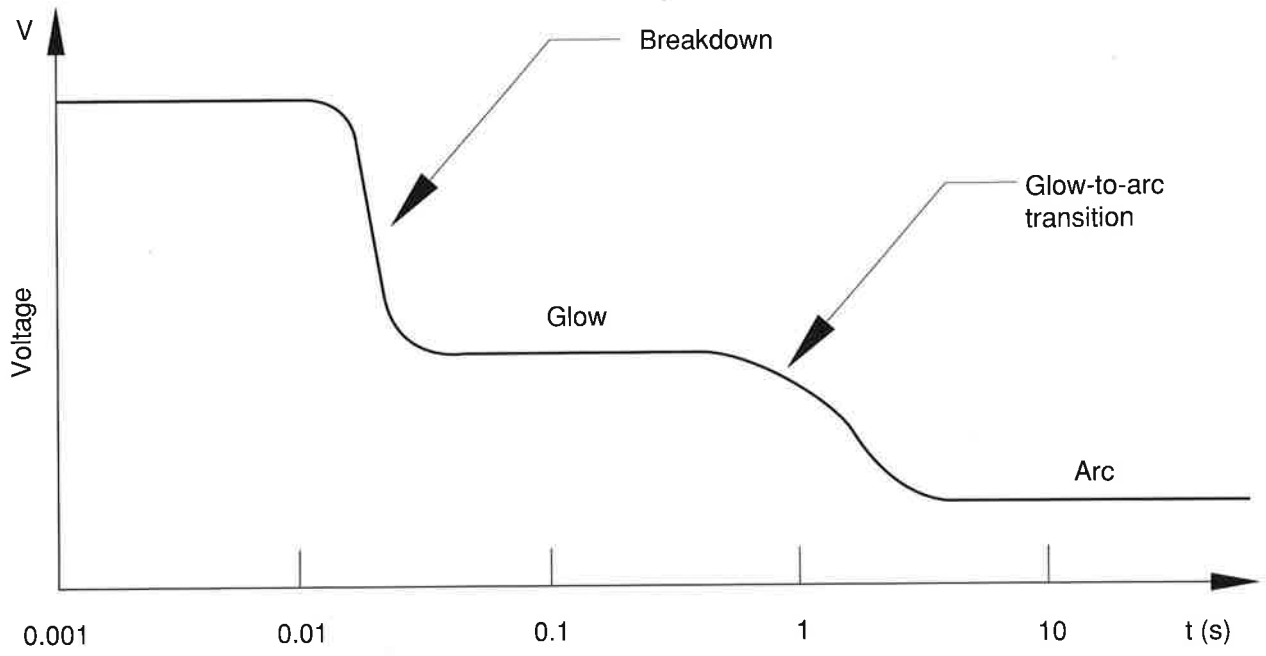
The ignition of M75/M100/M150 lamps

We need an ignitor to start the discharge in the arc tube. The ignitor must provide a minimum of three high voltage spikes with a minimum of 3.3 kV and maximum of 4.5 kV. They must have a pulse width of 0.6 - 0.8 microseconds at 2300 volts and must be located between 60 and 90 degrees of the half wave of open circuit voltage.

The starting phases are shown in the following diagram. The high voltage pulses cause the breakdown (ionisation) of the low pressure argon/mercury atmosphere in the arc tube. During a short time the discharge goes through a glow stage until the arc is firmly established in the mercury vapour. At this moment we have a low pressure mercury vapour discharge which mainly produces UVC radiation (as in a fluorescent lamp). This radiation is, however, absorbed by the hard glass of the outer bulb (borosilicate glass).

The heat which is developed by the discharge will now evaporate all the mercury, which means an increase of mercury vapour pressure and temperature, as shown in the table.
From about 400 °C on, the metal halides start to evaporate. Stable conditions are reached with an arc tube temperature of about 800 °C and a total pressure of about 9 bar.
Once the arc tube has reached these operating conditions the initial UVC radiation is fully absorbed in the plasma.

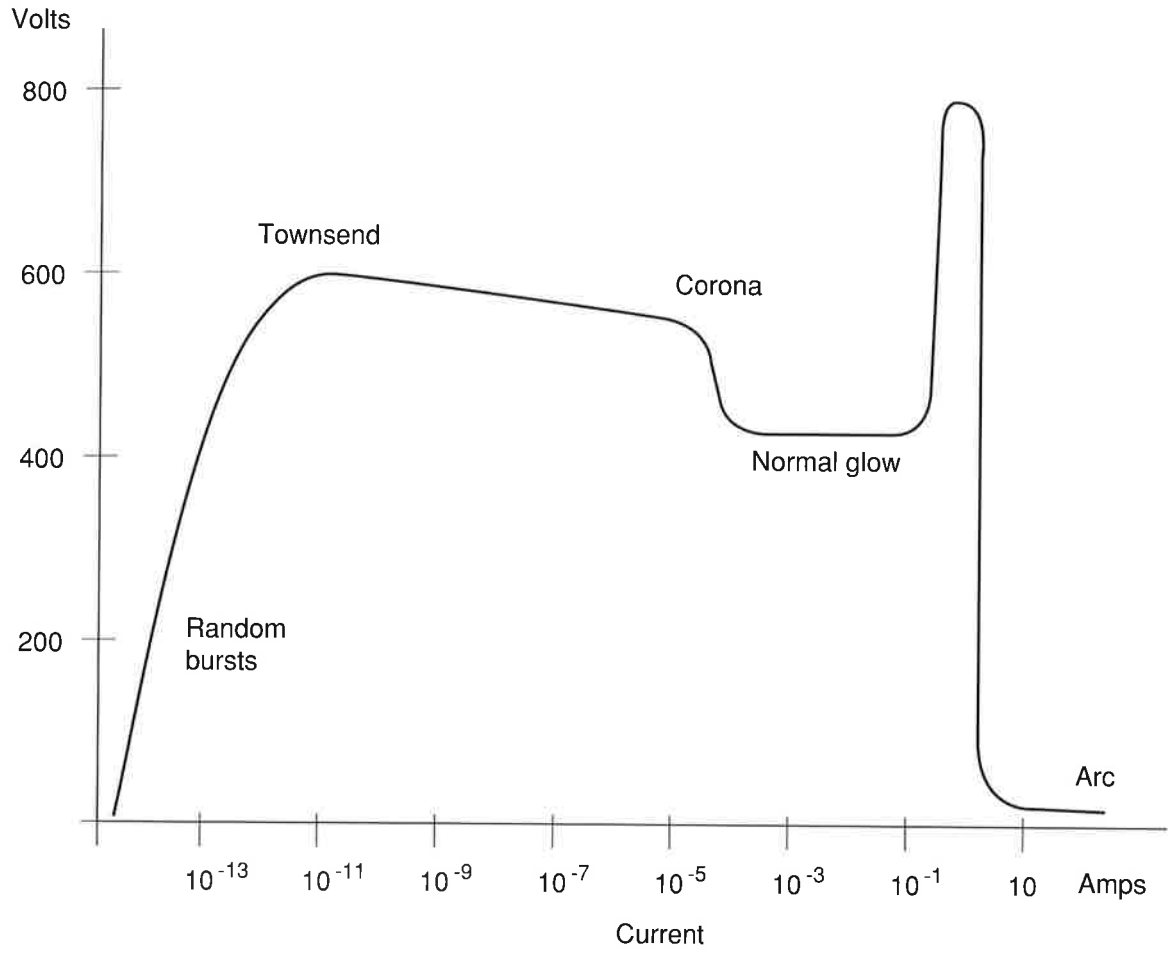
Lamp starting phases



Characteristic pressure

Phase	*Time*	*Temp.*	*Pressure*		
			Ar	Hg	Metal Halides
Ignition	0	25 °C	133 mbar	0.003 mbar	0
Initial	5s	50 °C	145 mbar	0.02 mbar	0
Warm up	75s	400 °C	300 mbar	1 bar	1 mbar
Operation	200s	800 °C	0.5 bar	8.8 bar	10-20 mbar

Voltage-Current discharge characteristic

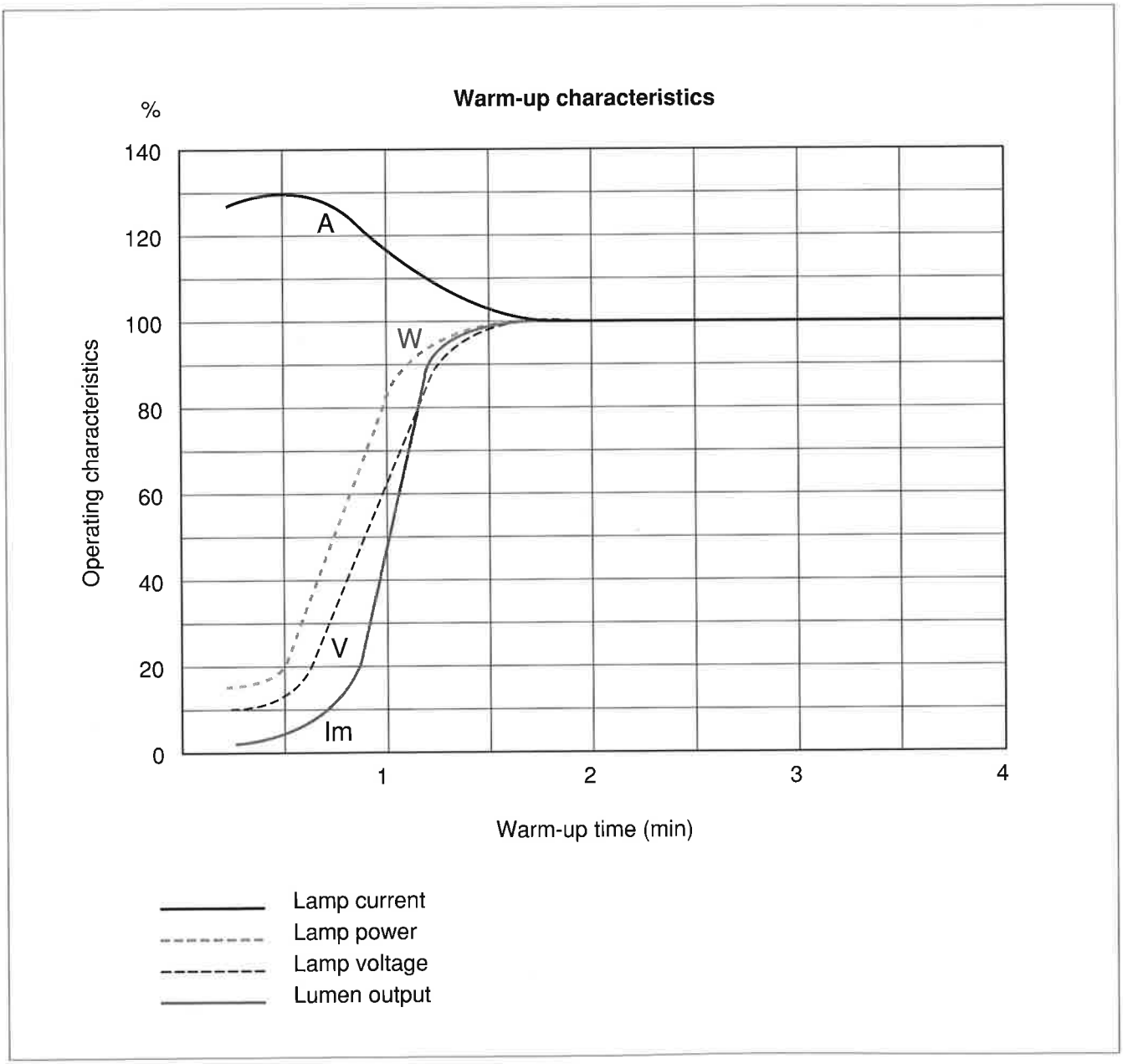


This curve shows the principle of the relation between voltage and current of a gas discharge.

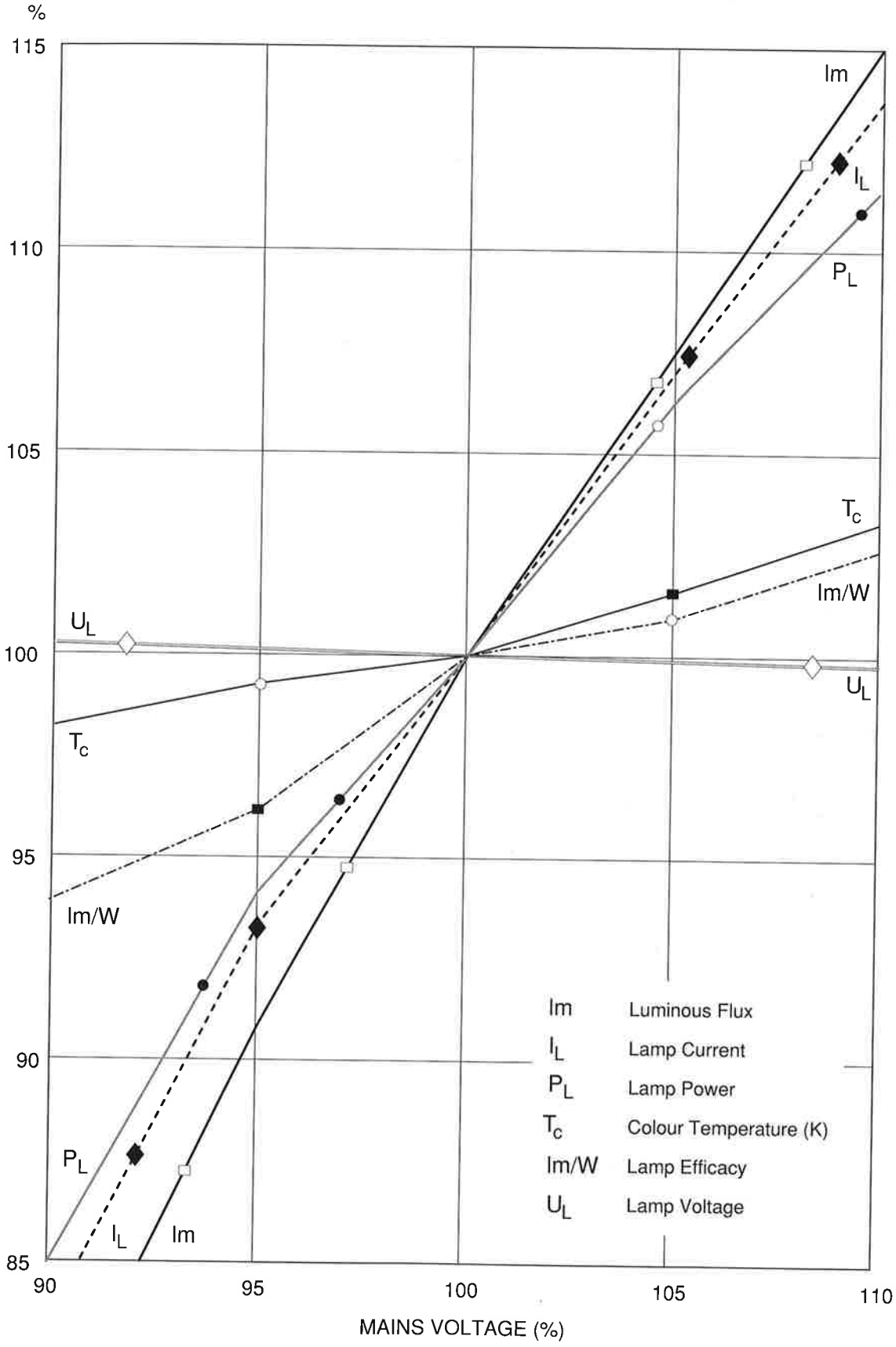
Run-up conditions

The current at the beginning of the run-up time is about 40% higher than the nominal operating current.

It is recommended that a slow acting fuse is used for the protection of the installation . Fuse rating : M75 ... 2.5A, M100 ... 2.5A, M150 ... 4A.



M75/M100/M150 Lamp Performance vs. Mains Voltage Variation



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Influence of Supply Voltage on Lamp Performance

The influence of supply voltage is less critical to colour temperature variation due to the exclusive Sylvania lamp design features. Overwattage operation, of course, will shorten the lamp life.

Mains Voltage and Harmonics

The maximum lamp operating voltage was chosen in such a way that the lamp will not extinguish with a mains voltage reduction of -10%, however the flickering may be objectable.
According to IEC specifications this test is done under the condition that the mains voltage does not contain more than 3% harmonics.

3-Phase Systems

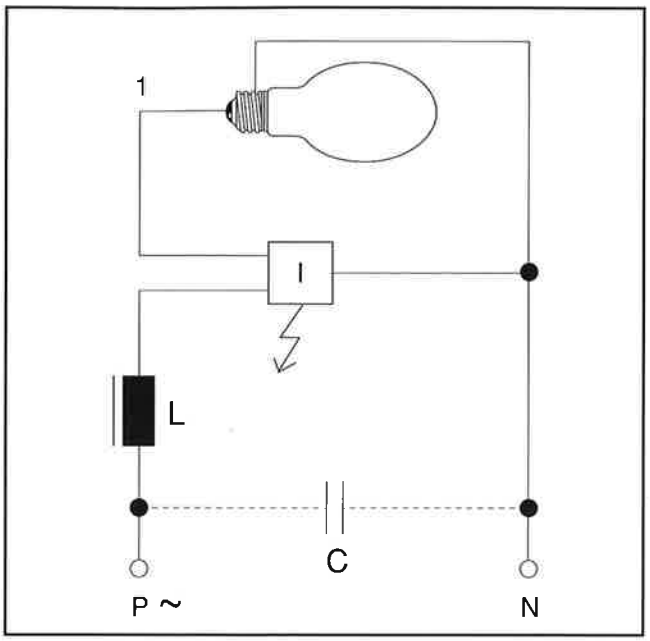
1) 127 V / 220 V System

If parallel compensated circuits are connected to such a system then resonance conditions can occur if one of the phases (each one equipped with a separate fuse) are disconnected. The increased current can then endanger the lamp, the choke and the capacitor.
It is therefore recommended that a circuit breaker is used which always cuts out all 3 phases together for a group of fixtures.

2) 220 V / 380 V System

Similar conditions may develop on this type of system when the neutral conductor is disconnected.

Ignitor/Control gear circuit



The M75/M100/M150 lamps were designed to operate on a standard choke, the same type as used for 70/100/150W high pressure sodium lamp. See listing of chokes and ignitors.

The circuit diagram shows the recommended wiring of the ignitor type.

For ignition, the ignitor should comply with following specification:

- Peak voltage min. 3.3 kV, max. 4.5 kV
- Pulse width at 2.3 kV min. 0.6 - 0.8 micro-sec
- Pulse repetition rate min. 3 pulses/half cycle

Peak voltage limitation

The lamps are equipped with an E27 base with a ceramic insulator, which is rated for a max. peak voltage of 4.5 kV. - For the selection of the ignitor care must be taken, that this peak voltage is not exceeded.

Only E27 lamp holders rated for 4.5 kV must be used. In the following are listed high-volt lamp holders which are suitable:

- Bender & Wirth	Type 10064Z
- A.G. Hackney	Type 138830 Mark 2
- Vossloh	Type 626

Choke tolerance and tapping

To obtain the specified lamp performance chokes with a tolerance of +- 3 % should be used.

Chokes should also be equipped with at least 2 tappings for mains voltage connection, to connect the circuit to the prevailing supply voltage.

Thermal protection of the choke

At the end of life the lamps can develop anomalous operating mode characterised by a higher current flow. This may cause damage to the choke by overheating.

It is therefore recommended to use chokes which are equipped with a thermal protection of the reset type.

Chokes for M150

ABB (BBC)		
1. SOH/DJ 150/2 KU-K-V551/552*	with thermo-protection	220/230V
2. SOH/DJ 150/2KU-K-70-V551/552		220/230V
3. SOH/DJ 150/23KU-K-V551/552*	with thermo-protection	230/240V
May and Christe		
1. NQI 150 -24.2- 23T SW*	with thermo-protection	220/230V
2. NQI 150 -24.2 K38T SW*	with thermo-protection	230/240/250V
3. NQI 150 -24.2- 23		220/230V
4. NQI 150 -0.3.2 H23		220/230V
Schwabe		
1. NAHJ 150.526*	with thermo-protection	230/240/252V
2. NAHJ 150.489		220/230/240V
Zumtobel		
1. OMBIS 150W B105 (TP)*	with thermo-protection	230/240/250V
2. OMBIS 150W B105		230/240/250V
3. OMBIS 150W		220/240V
Leuenberger		
1. XI/XHp*	with thermo-protection	220/230V
2. XI/XHv		220/230V
3. XI/XHo		220/230V
W.J. Parry (Nottingham)		
1. HSV 163 212 B3	with thermo-protection	210/220/230V
2. HSV 163 222 B3*	" " "	220/230/240V
3. HSV 163 232 B3*	" " "	230/240/250V

Chokes for M75

BBC	SOH/DJ 70/2	220/230 V ± 5%
GERMANN	GQI 70 S	- " -
HELVAR	NK 70 L	- " -
LEUENBERGER	AA/VHn	- " -
MAY & CHRISTE	QI 70 WDL 24.2	- " -
SCHWABE	NAHI 70.252	220/240 V ± 5%
HELVAR	NK 70 L	- " -
PARRY	HSV 073	220/230/240/250 V ± 5%
ZUMTOBEL	OMB S 70 W	230/240/250 V ± 5%
HELVAR	NK 70 L	240/250 V ± 5%
BBC	SOH/DJ 70/2-V.12	240/250 V ± 5%

Chokes for M100

LEUENBERGER	220/230 WHn
ZUMTOBEL	0 MBS 100 K75
MAY & CHRISTE	N 100 - 02.2H
SCHWABE	NaH 100. 354
PARRY	HSG 102 220/240
	HSV 102 220/240

Ignitors for M75 and M100

MAY & CHRISTE	ZG 70 SE
TRIDONIC	ZRM 2
PARRY	PBE 100
ERC	640006

Ignitors for M150

BAG - TURGI	MZN 150 S
	MZN 250 SE
MAY & CHRISTE	ZG 4.5 SE
ZUMTOBEL	ZRM 6 ES
	ZRM 1.8 ES/2
PARRY	PWE 400255

Power Factor Correction

On the basis of indicated lamp and circuit data the capacitance for the power factor (parallel) capacitor can be calculated with the following formular.

Capacitor tolerances and actual choke losses have to be considered and may require an increase above of the calculated values.

$$C = \frac{1}{2\pi \times f \times U_N^2} \times \left[\sqrt{(U_N^2 \times I_L^2) - P^2} - (P \times tg\varphi) \right]$$

C	capacitance
U_N	Mains Voltage
f	Mains frequency
I_L	Lamp Current
P	Circuit Power (Lamp+ Choke)

$tg\varphi$ =	0.75	for $\cos\varphi$ =	0.8
	0.62		0.85
	0.49		0.9
	0.33		0.95

Radio Interference

Parallel compensated circuits with superimposed pulse ignitors will operate within the recommendations for radio interference suppression. It is recommended that ignitors are used which have been approved for this issue.

Dimming

We do not recommend that these lamps are dimmed because of the strong change in colour temperature, colour rendition and a reduction of lamp life.

Lamp testing
Electrical, photometric and colorimetric data

Test equipment

Measurements are made in an integration sphere with a diameter of 1.5 m. The room temperature is controlled to 25 °C ± 1 °C.

For measurements the lamps are operated on a reference ballast with the input voltage to the circuit being controlled to ± 0.1% of the nominal voltage.

Measuring equipment

For electrical measurements only "true RMS" instruments are suitable because of the non-sinoidal voltage and current wave forms. The crest factor capability should be better than 2.5.

The instrument has to be protected from high voltage spikes from the ignitor when lamp voltage is measured (these spikes may be as high as 4.5 kV).

The apparent lamp power factor is about 0.90

Lamp ageing

The lamps have to be aged for 100h before measurement. Nominal lamp data are referred to at 100 hours

The switch cycle for ageing is 11 hours on, 1 hour off.

Lamp Operating Position

The factory procedure is to age and test/measure lamp in base up operation position. When lamps (after allowing them to cool down for 15 min.) are taken from the ageing racks to the measurement station they are maintained in the same base up position to avoid any changes with respect to iodide condensation.

Lamp stabilisation before measurement

Light output and lamp voltage must be stable. In general 15 minutes are sufficient to achieve this.

5. Utilisation and application

Warning

I. Operate in Enclosed Fixtures only

The Sylvania Metalarc lamps must be operated only in closed fixtures. Although the risk is extremely low, these lamps may be subject to a type of failure in which the arc tube, operating at a pressure of approximately 9 bar, bursts and shatters the outer jacket resulting in the discharge of hot quartz arc tube particles (as high as 1832° F, 1000° C). **In the event of such a failure, there is a risk of personal injury and property damage from hot quartz arc tube particles, shattered glass, burns and fire. Enclosure material must withstand this risk.**

2. Ultraviolet Radiation Exposure

This lamp can cause serious skin burn and eye inflammation from short-wave ultraviolet radiation if outer jacket or envelope of the lamp is broken or punctured.
Do not use where people will remain for more than a few minutes unless adequate shielding or other safety precautions are used.

3.Electrical Shock Hazard

Do not remove or insert lamp when power is on. If outer jacket is broken, shut off power immediately and remove lamp after it has cooled.

4 .Proper Care and Maintenance

To minimize the hazards described above:
1) Operate lamps only in compatible fixtures and on circuits wired with appropriate auxiliary equipment (see operating instructions below);
2) Do not expose lamp to moisture;
3) Replace lamp if outer bulb is scratched, cracked or damaged in any way;
4) Replace lamp at or before the end of rated life as specified in the GTE Sylvania Product Bulletins for each lamp type;
5) Turn lamp off for at least fifteen minutes at least once a week;
6) Electrically insulate any metal support in contact with outer jacket to avoid glass decomposition.

Installation and Operating Instructions

Metalarc Lamps will operate satisfactorily only if the control gear (e.g. choke, starter, capacitor & socket) conforms to given electrical specifications.

Lamps should be screwed into the socket firmly without using undue pressure.

Operating position

Consult data table on Page 2 for permissible operating position.

Radiation and colour fading

Any radiation (ultraviolet, visible or infrared) from a light source, artificial or natural light will cause changes in colours. The principle criteria for such changes are:

1. The resistance of the pigment or dye to radiation.
2. The radiation intensity in Lux or Watt/m^2
3. The type of radiation, see spectral power distribution
4. The exposure time

Additional influences which may accelerate colour fading come from environmental conditions like moisture, vapours, etc.

The lamps radiate some UV-A (315-400 nm) but practically no UV-B (280-315 nm). In the following list we indicate typical UV radiation values which show little difference with fluorescent lamps.

Lamp type	**Total UV radiation** (Watt/1000 lm)
M100	0.21
F40W/CWX	0.33
F40W/WWX	0.124
F36W/UW	0.126
F36W/WW	0.089
F36W/CW	0.148
F36W/D	0.164

As we recommend to operate the lamps in fixtures with protection glass it may be useful in critical cases to utilise a filter glass like the UVILEX 390.

Exposure Time

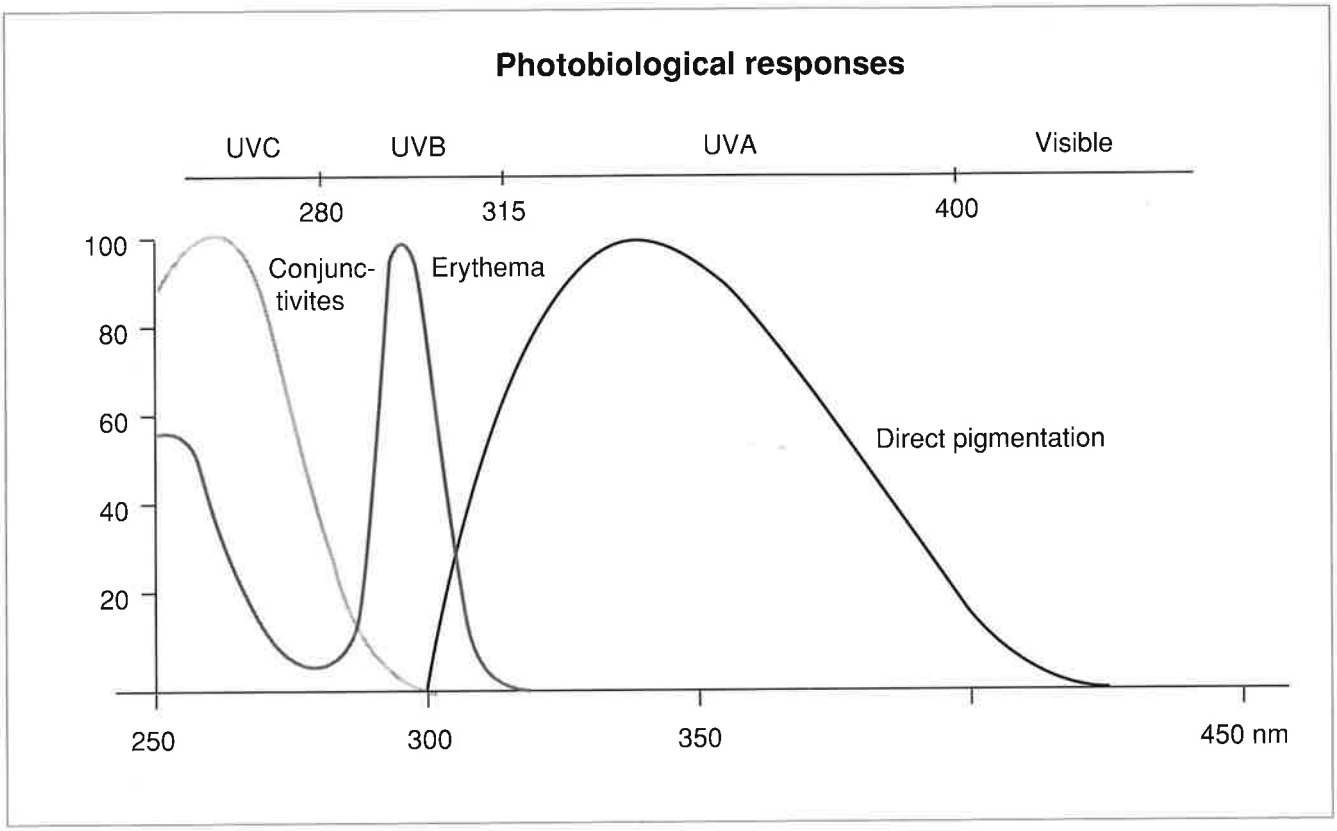
The following tables indicate permissible exposure times for 1000 lux natural daylight and various categories of pigment/dye resistance. The information is by DESAG with the UVILEX 390 filter glass.

Resistance to fading categories	Permissible exposure to daylight (1000) Lux	
1	very light sensitive	70 hours
2		150 hours
3	↑	300 hours
4	↓	600 hours
5		1200 hours
6		2500 hours
7		5000 hours
8	less light sensitive	10000 hours

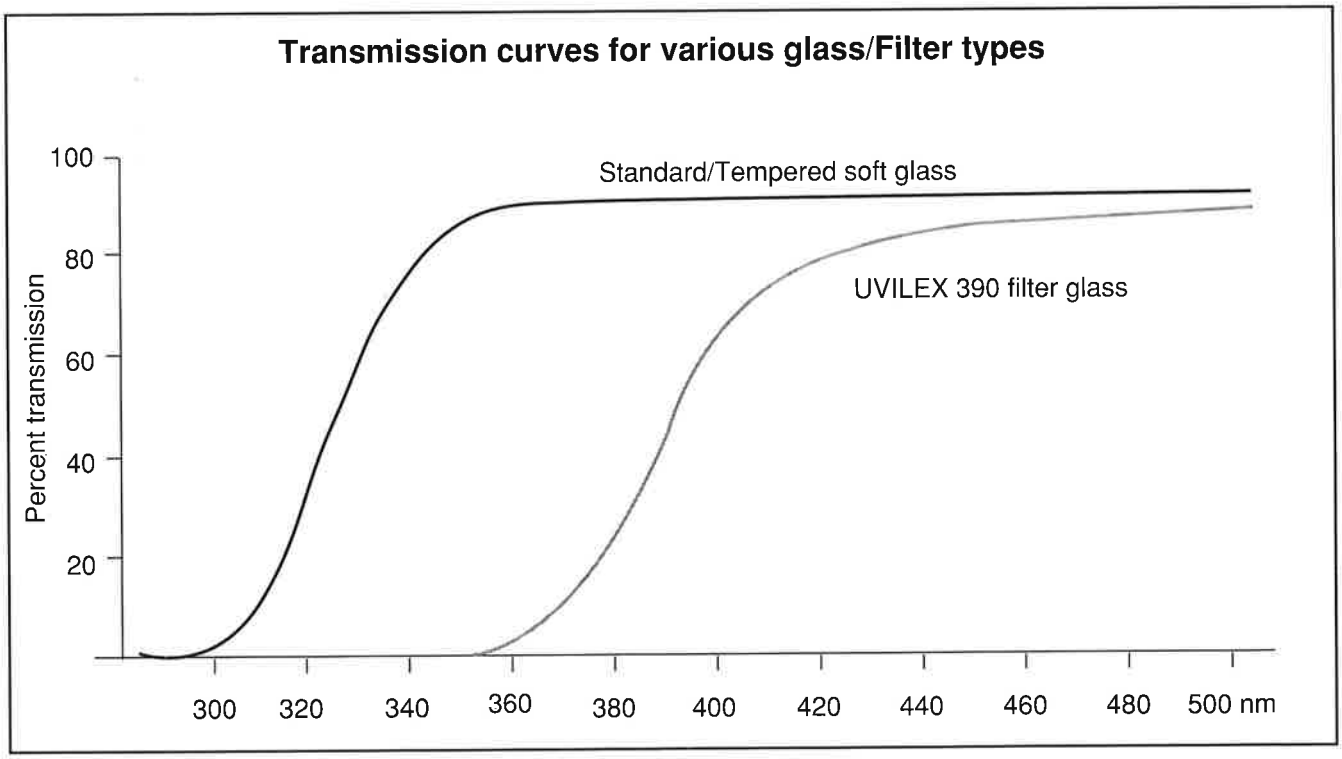
Table 1 : Permissible exposure time for various resistance to fading categories

Light source	Multiplication factors compared with daylight	
	without UV filter	with DESAG-UV-barrier filter
Halogen and fluorescent lamps	2	4
Metal halide lamps	1.5	2.5

Table 2 : Multiplication factors for different types of lamp compared with daylight

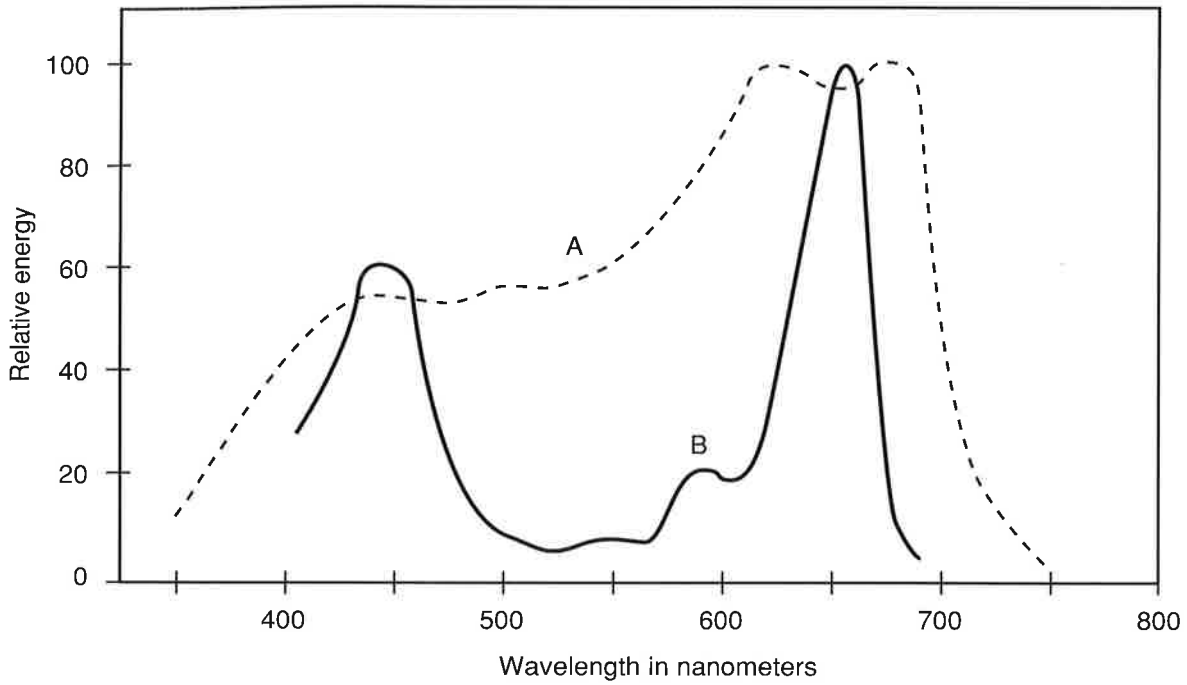


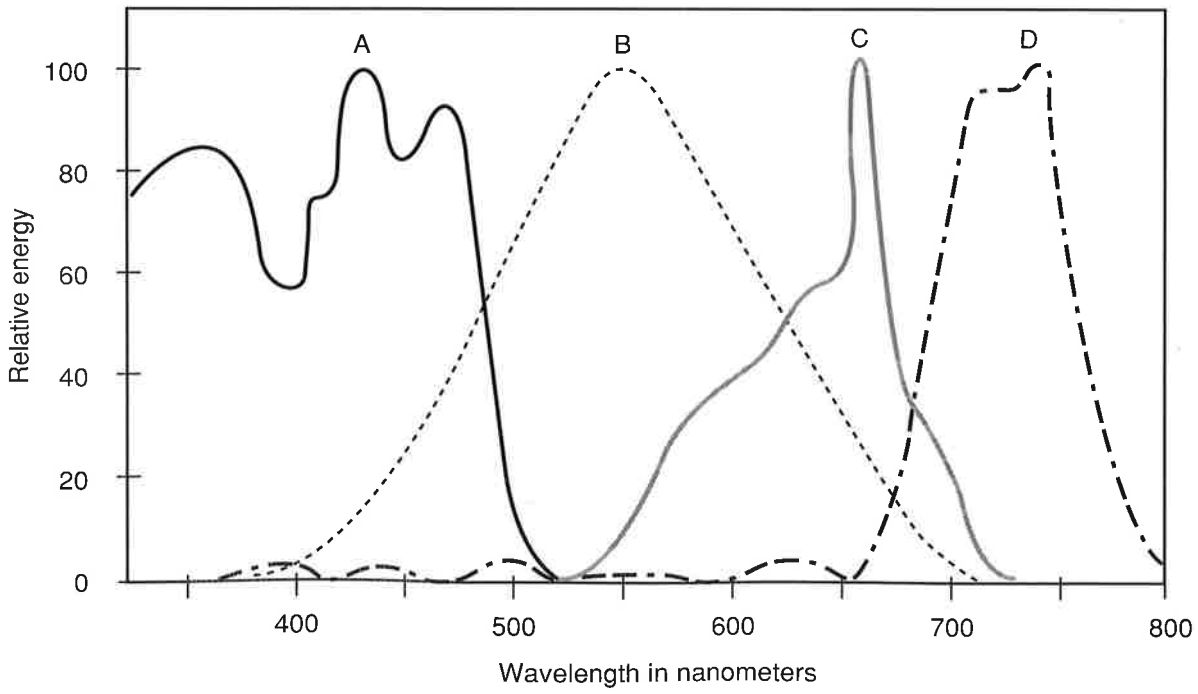
The above are presented for information purposes only. Care should be taken to protect skin and eyes from prolonged direct radiation from the lamp or a protective glass used (see below and Page 25).



Special Application : Horticultural application data

(A) Photosynthetic response
(B) Chorophyll synthesis





Action spectrum of:

(A) Phototropic response
(B) Photopic vision (Eye sensitivity curve)
(C) Photomorphogenic induction (Pr)
(D) Photomorphogenic reversal (Pfr)

For information purposes only

6. Recommendations for fixture design

The general rules as outlined in IEC standard Nr. 598 with its amendments apply, or the EEC standard EN 60-598.

Thermal considerations

The following recommendations are valid for fixture operation at + 5% of nominal mains voltage and for a choke with +- 3% maximum current tolerance. Furthermore for a lamp with nominal operating voltage (95 V).

The fixture design should be such, that following temperature limits are not exceeded:

- max. bulb temperature 275°C
- max. base temperature 190°C

These temperature limits should be controlled in the most unfavourable operating position.

Lamp holders

E27 high volt rated (4.5 kV) lamp holders must be used to withstand the starting peak pulses.
See also page 15.

Reflector design/materials

The arc discharge of metal halide lamps can be colour structured. It is therefore recommended that a material surface is used for the reflector which mixes these colour zones.
To avoid any back radiation of infrared from the reflector on to the arc tube (which will cause operating voltage increase) the recommendations as per the following drawings should be followed.

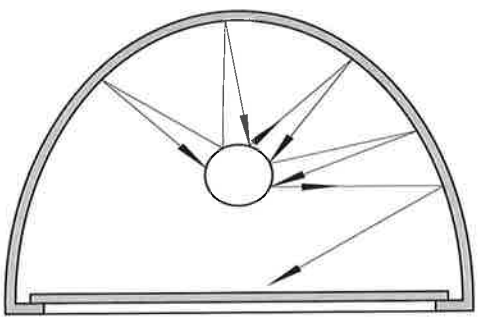


Fig.1 Reflector with inadmissible infrared reflection to the arc tube

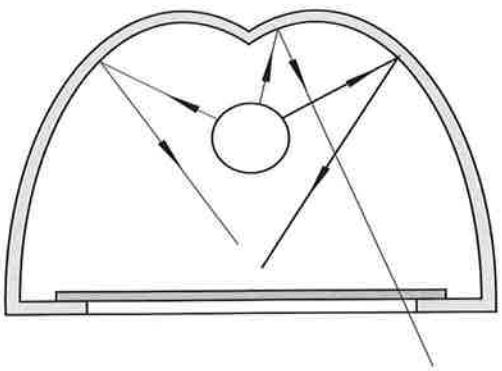


Fig.2. Reflector with reduced infrared reflection to the arc tube

Fixture influence on lamp operating voltage

The fixture design (temperatures on the lamp) and the shape of the reflector (back radiation on the arc tube) will influence the lamp operating voltage.
An increase in lamp operating voltage causes an increase in lamp wattage and consequently a change in the photometric and colorimetric performance. The lamp life is negatively affected

The reflector and fixture design should be such that the lamp voltage does not increase more than 5 volts compared to operating in free air.

Magnetic fields

For both, ignitors and chokes, care should be taken that stray magnetic fields do not influence the arc discharge of the lamp.

Fixture materials

Because of the relatively high temperatures and the radiation present, plastic materials, varnish and insulation products have to be resistant to these conditions. They should not give off harmful vapours to other components of the fixture.

7. Trouble Shooting

1. *Lamp shows bright flash, and does not ignite again. (Strong overload and destruction of lamp.)*

   - no choke or incorrect choke
   - choke short circuited (insulation break down)
   - choke wrongly connected
   - capacitor wrongly connected (lamp parallel not circuit parallel)

2. *Lamp does not ignite*

   - ignitor defect
   - ignitor wrongly connected
   - wrong ignitor (not as specified for the lamp)
   - bad lamp holder or circuit contact
   - electrical supply voltage too low, circuit wrongly connected
   - lamp defect or end of life
   - lamp has not cooled down after current interruption

3. *Lamp does not ignite properly, stays in glow stage*

   - lamp was damaged in previous overload
   - ignitor defect
   - low open circuit voltage

4. *Lamp ignites but extinguishes again (immediately or cyclic)*

   - lamp overload conditions because of too high mains voltage, wrong choke connection, defect or wrong choke, capacitor parallel to lamp
   - lamp at end of life.
   - fixture design problem, too high lamp temperature, reflector back radiation on are tube
   - mains voltage irregular, nearby high power equipment switched on - off.

5. *Lamp flickers, discharge spirals*

- lamp operating voltage too high / low. Check choke connection.
- low supply voltage.

6. *Strong blackening of arc-tube, light output reduction*

- overload operation
- wrong or defect choke
- capacitor and lamp are in parallel
- low supply voltage.

7. *Fuse is acting immediately or shortly after switch-on*

- overload conditions
- wiring defect
- fuse rating too low. Should be 2x nominal lamp operating current.

8. *Lamp extinguishes, arc-tube is expanded*

- overload conditions

9. *Lamp operates with rather greenish light or other abnormal colour, colour differences*

- underload (current /voltage) condition.
- strongly varying operating positions in an installation
- lamps of different operating age

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