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DATA SHEET

Ceramic Metal Halide Lamp Dimmable

Tubular 150W

Product information

CMH lamps combine the HPS technology (providing stability, efficiency & uniformity) and the Metal Halide Technology (providing bright white quality light) to produce highly efficient light sources with good colour rendering and consistent colour performance through life. This is achieved by using the ceramic arc tube material from the Lucalox lamp, which minimises the chemical changes inside the lamp through life. When combined with the halide doses used in Metal Halide lamps then the quality and stability of the dose maintains the colour consistency. Hence the name CMH. Metal halide lamps, traditionally made with quartz arc tubes, are prone to colour shift through life and lamp-to-lamp colour variation. Some of the dose, e.g. sodium, (an important component of metal halide lamps), can migrate through quartz to cause colour shift and loss of light through life. The ceramic arc tube resists this material loss, can be manufactured to tighter tolerances and withstands a higher temperature to provide a more constant colour.

Features

- Consistent colour over life
- Colour uniformity lamp to lamp
- Energy saving installation
- Dimmable – better color control on electronic ballast
- Operates on either electronic or electro-magnetic ballasts
- Up to 15,000 Hr life
- UV control
- Easy retrofit for High Pressure Sodium lamps

Tubular formats

Conventional lamp shapes with a screw-type base enables existing luminaire designs to use CMH lamps with little or no modification to the optical system.

Application Areas

Street Lighting

Architectural floodlighting, city beautification

Mesopic lighting

The human eye sensitivity curve maximum is different for daylight and, for example, for night driving levels. The more overlap a light source spectrum has with this eye sensitivity curve, the higher the illumination level we perceive. Research has been conducted to find an optimal lamp spectral fit for night roadway illumination, which we call mesopic illumination. The lamp developed enhances visibility of objects and shortens reaction time. While keeping the same illumination level, this CMH lamp can replace a higher wattage HPS lamp.

Basic data

Description	Product Code	Wattage	Colour	Format
CMH150/TT/UVC/U/842/E40 TU	93102170	150	4000K	Tubular

Specification summary[1]

General	Units	
Product Code		93102170
Nominal Wattage	[W]	150
Rated Wattage	[W]	150
Weighted Energy Consumption	[kWh/1000 hrs]	165
Bulb Format		Tubular
Bulb Material		Heat resistant/hard glass
Bulb Finish		Clear
Arc Gap	[mm]	10
Bulb Designation		T15
Base		E40
Mercury Content	[mg]	17.0
Ambient Temperature	[°C]	25
Operating Conditions		
Burning Position		Universal
Luminaire Characteristics		Enclosed

Electrical Characteristics	Units	Electromagnetic Ballast Horizontal	Electronic Ballast	
			Horizontal	Vertical
Lamp Power (rated)	[W]	150	147	147
Lamp Voltage	[V]	95	90	90
Lamp Volts min.	[V]	85	85	85
Lamp Volts max.	[V]	115	115	115
Lamp Current	[A]	1.8	1.6	1.6
Min. Ignition Voltage	[kV]	2.7	3	3
Max. Ignition Voltage	[kV]	5	5	5
Ballast Required		HPS or MH compatible		
Ballast Impedance at 230V	[V/A]	106	N/A	N/A
Power Factor Correction Capacitor	[µF]	20	N/A	N/A

[1] The specification contains data about lamp operated on a typical electromagnetic or on a typical electronic ballast. Actual values may depend on ballast and application. Optimized for horizontal operation. In vertical orientation best performance achieved by electronic ballast. Note that the lamp voltage inside the luminaire should not deviate by more than 10V from the bare lamp voltage in free air. Thermal protection recommended.

Photometric Characteristics	Units	Electromagnetic Ballast Horizontal	Electronic Ballast	
			Horizontal	Vertical
100 Hour Initial Lumens	[lm]	14,500	14,500	14,500
Rated Lumens	[lm]	15,300	15,000	-
Correlated Colour Temperature Vertical	[K]	4,100	3,850	4,450
Chromaticity X		0.377	0.386	0.376
Chromaticity Y		0.376	0.378	0.394
Colour Rendering Index Horizontal	[Ra]	89	88	80
Luminous Efficacy	[lm/W]	97	98	-
Rated Lamp Efficacy	[lm/W]	102	102	-
Energy Efficiency Class	[EEC]	A+	A+	A+

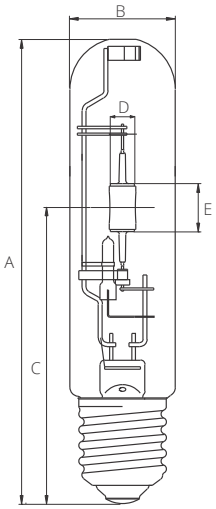
Operating Conditions		
Time to Start (at 25°C)	s	< 10
Time to Start – Cold Box Test at -30°C	s	< 30
Warm-up Time (for 90% lumens)	min	3
Hot Restart Time	min	15

Through Life Performance[2]		
Lumen Maintenance at 40% Rated Life (mean lumens)	lm	11,000
Average Rated Life	h	15,000

Safety Requirements		
Maximum Allowed Bulb Temperature Under Abnormal Conditions[3]	°C	310 (based on IEC)
Maximum Base Temperature[3]	°C	210 (based on IEC)

[1] The specification contains data about typical performance (50 Hz sine wave at nominal W). Actual values may depend on ballast and application.
[2] Life data measured in Horizontal position.
[3] For a bare lamp running at 1.25 x normal operating power to simulate the most unfavourable conditions of high line voltage and low ballast impedance in a fixture environment.

Dimensions

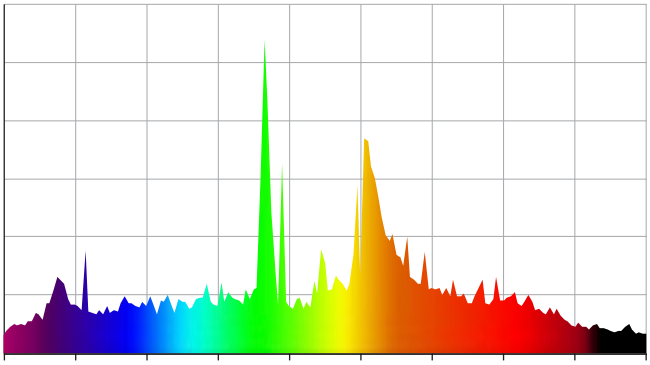


Dimensions		
A	[mm]	207
B	[mm]	48
C	[mm]	132
D – Burner Width	[mm]	12
E – Burner Height	[mm]	21.2

Spectral power distribution

Representative spectral power distribution curve is provided in the following diagram.

Spectral power distribution 4000K

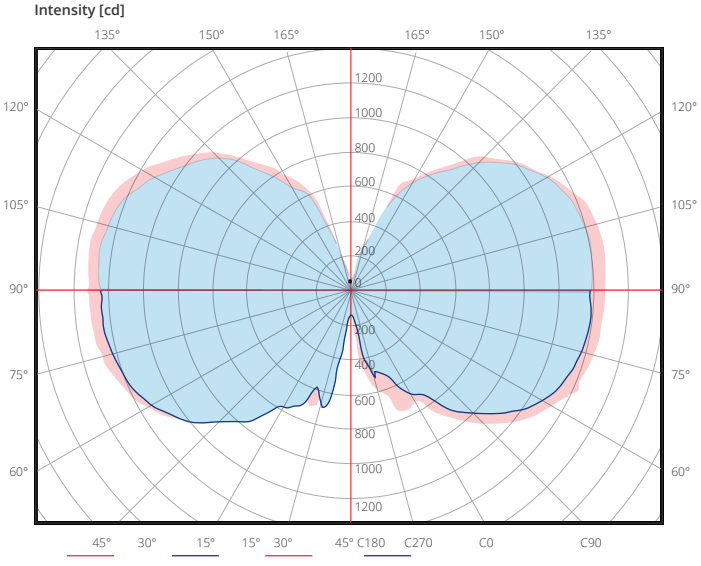


Wavelength [nm]

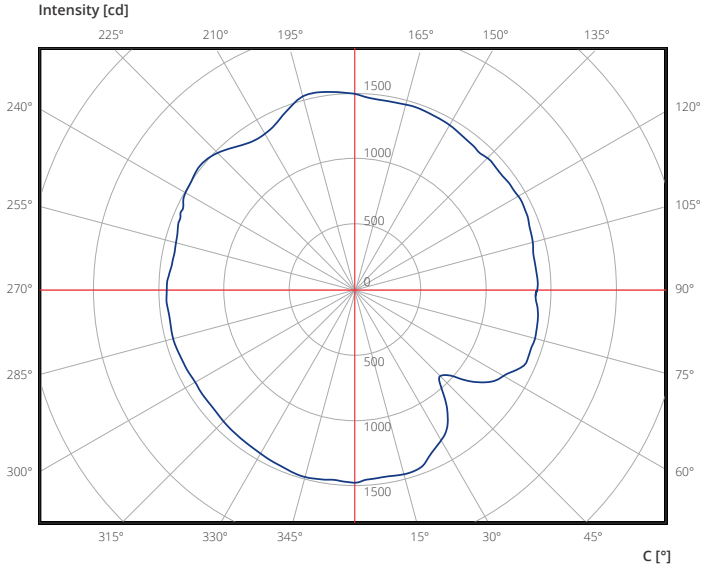
Distribution of luminous intensity

The following diagrams show typical polar light intensity curves of the lamp.

Vertical plane polar intensity curve 150W



Horizontal plane polar intensity curve 150W



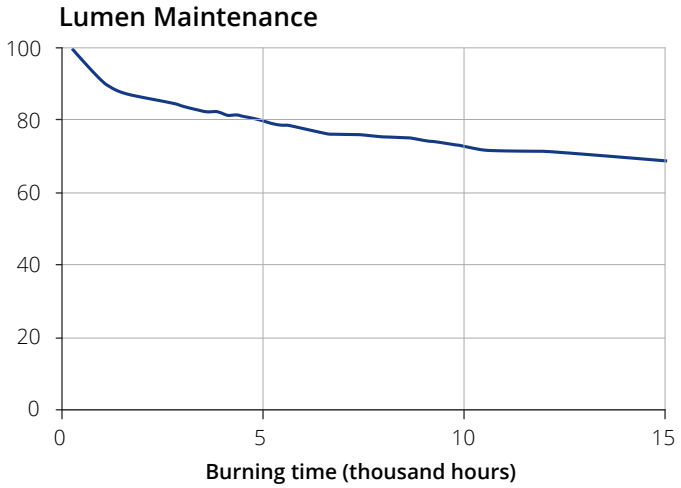
Gamma [°]

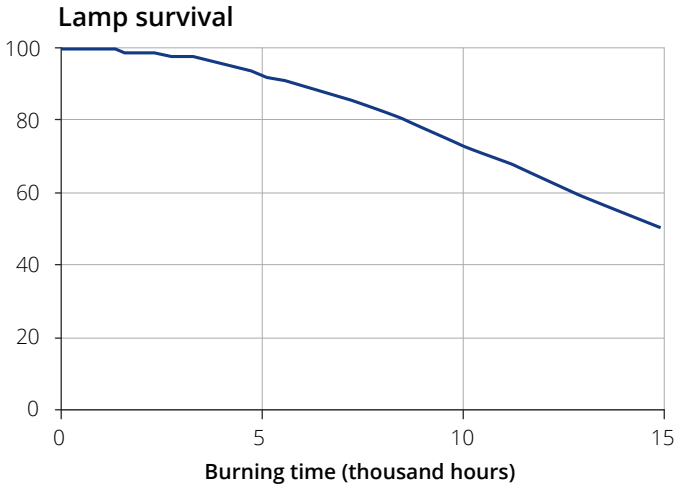
Lamp life

Life survival graphs are shown for statistically representative batches of lamps operated under controlled nominal conditions with an 11 hours per start switching cycle. The declared lamp life is the median life, which is when 50% of the lamps from a large sample batch would have failed. Lamp life in service will be affected by a number of parameters, such as supply voltage variation, switching cycle, operating position, mechanical vibration, luminaire design and control gear. The information is intended to be a practical guide for comparison with other lamp types. The determination of lamp replacement schedules will depend upon the acceptable reduction in illuminance and the relative costs of spot and group replacement.

Lumen maintenance

The lumen maintenance graph shows light output performance through life for statistically representative batches of lamps operated under controlled conditions with an 11 hours per start switching cycle. A common characteristic for all metal halide lamps is a reduction in light output and a slight increase in power consumption through life. Consequently there is an economic life at which lamp efficacy falls to a level when lamps should be replaced to restore design illumination levels. In areas where multiple lamps are installed, consideration should be given to a group lamp replacement programme to maintain uniform illumination levels. Curves represent operating conditions for an 11 hours per start switching cycle, but less frequent switching will improve lumen maintenance.





End of life conditions

The principal end of life failure mechanism for CMH lamps is arc tube leakage into the outer jacket. At the high operating temperatures inside the arc tube, the corrosive dose material can eventually cause leakage after a long period of time. Arc tube leakage into the outer jacket can be noticed by a sudden significant lumen drop and a perceptible color change (the color usually turns green). IEC 60662 and IEC 62035 warn that there is a risk that at the end of lamp life a number of lamps may exhibit a rectifying effect. Thermally protected ballasts or ballasts resistant to rectification are recommended by GE Lighting.

End of life cycling

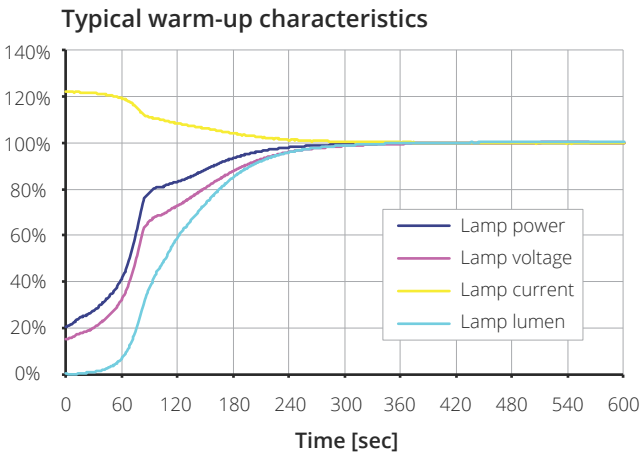
A condition can exist at end-of-life whereby lamp voltage rises to a value exceeding the voltage supplied by the control gear. In such a case the lamp extinguishes and on cooling restarts when the required ignition voltage falls to the actual pulse voltage provided by the ignitor. During subsequent warm-up the lamp voltage will again increase, causing extinction. This condition is known as end-of-life cycling. Normally cycling is an indication that lamp end-of-life has been reached, but it can also occur when lamps are operated above their recommended temperature. Lamp voltage at 100 hours life should not increase by more than 5V when operating in the luminaire, when compared to the same lamp operating in free-air. A good luminaire design will limit lamp voltage rise to 3V.

It is good practice to replace lamps that have reached end-of-life as soon as possible after failure, to minimise electrical and thermal stress on ignitor internal components. The use of a 'timed' or 'cut-out' ignitor is not a specific requirement for CMH lamps, but is worth considering as a good optional safety feature which also prolongs the life of ignitor internal components, lamp holder contact surfaces and fixture wiring.

The operating period of a timed/cut-out ignitor must be adequate to allow lamps to cool and restart. A period of 10 to 15 minutes continuous or intermittent operation is recommended before the ignitor automatically switches off. Timed/cut-out ignitors specifically offered for High-Pressure Sodium lamps, where the period of operation is less than 5 minutes, are not suitable for CMH lamps.

Warm-up characteristics

During the warm-up period immediately after starting, lamp temperature increases rapidly evaporating mercury and metal halide dose in the arc-tube. Lamp electrical characteristics and light output stabilise in less than 4 minutes. During this period light output increases from zero to full output and colour approaches the final visual effect as each metallic element becomes vaporised.



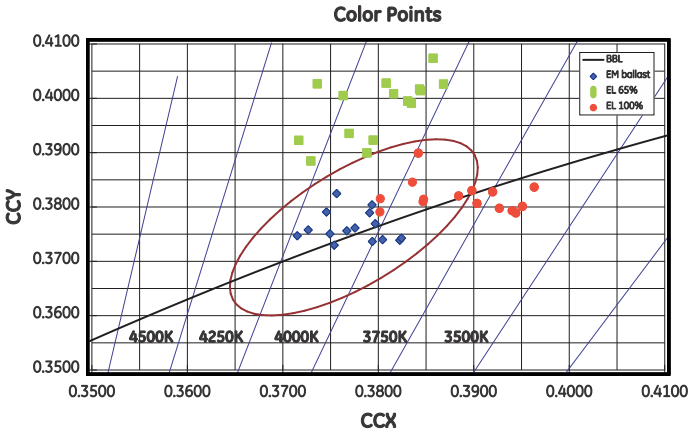
Supply voltage sensitivity

The line supply voltage applied to the control gear should be as close to rated nominal as possible. Lamps will start and operate at 10% below rated supply voltage but this should not be considered as a normal operating condition. In order to maximise lamp survival, lumen maintenance and colour uniformity, supply voltage and rated ballast voltage should be within ±3%. Supply variations of ±5% are permissible for short periods only. Where supply voltage variation is likely to occur the use of electronic control gear should be considered as this type of equipment is normally designed to functioncorrectly for a voltage range of 200-240V.

Dimming

On ballasts specifically designed to operate lamps at reduced power dimming is possible with this product. Dimming to 70% does not affect the lamp performance significantly. Dimming to 50% provides reliable operation. Results may vary with ballast type.

The diagram below illustrates the colour coordinates in horizontal operation on a typical electromagnetic ballast (blue), on a typical electronic ballast (red) and on a typical electromagnetic ballast dimmed to 65% power (green). The 6 mpcd ellipse is indicated on the figure.



Flicker

With conventional ballasts there will be a line frequency (50 Hz) flicker from CMH lamps as with all other discharge lamps. For example a 150W single ended lamp has a flicker value of approximately <0.5 %. Normally this is not of concern, but, where visual comfort and performance is critical, the use of electronic control gear should be considered.

UV and damage to sensitive materials

The wall of the bulb, which is produced with specially developed 'UV Control' material, absorbs potentially harmful high energy UV radiation emitted by the ceramic arc tube. This technology allows the lamp to significantly reduce the risk of discolouration or fading of products. When illuminating light-sensitive materials or at high light levels, additional UV filtration is recommended. These luminaries are allowed to be used without front glass.

Although PET determines limits of human exposure to lamp UV, the risk of fading of mechanise due to UV can be quantified by a damage factor and a risk of fading. The risk of fading is simply the numerical product of the illuminance, exposure time and damage factor due to the light source.

Lamp type		**150W**
UV-PET Performance µW / (cm2) UX / 500 LUX		
UV C	220-280nm	0.0000
UV B	280-315nm	0.0000
UV A	315-400nm	5.7029
UVC/UVB		0.0000
UVB/UVA		0.0000
E_{eff}		0.0004
PET (h)±10%		1898
Risk Group	IESNA RP-27.3-96	Exempt

Finally the selection of luminaire materials should take into consideration the UV emission. Current UV reduction types on the market are optimised for UV safety of human eye and skin exposure. However, luminaire materials may have different wavelength dependent response functions. Designers must take account of emission in each of the UV-A, UV-B and UV-C spectral ranges as well as material temperatures when designing luminaires.
Typical values for UV-A, UV-B and UV-C range radiation can be found in the table above.

Information on luminaire design

Ballasts

CMH lamps in this datasheet are designed to operate from the same ballast impedance as conventional High Pressure Sodium systems. The use of thermal protection or ballast protection is good practice for these lamps. This safety device will protect the circuit at end of lamp life should partial rectification occur due to electrode imbalance or arc tube failure. This requirement applies to both ceramic and quartz arc tube metal halide lamps as well as high performance High Pressure Sodium Lamps.

Stray magnetic field of conventional ballast

At the design stage for fixtures incorporating the control gear, careful consideration should be given to the physical layout of the lamp and ballast. The relative positions and distance between lamp and ballast can adversely affect lamp performance and drastically reduce lamp life survival.

Conventional magnetic ballasts can produce a stray magnetic field and if the lamp is placed within this field, "bowing" of the arc in the discharge tube can occur. Since ceramic is a very rigid material severe arc bowing can cause high thermal stress leading to cracking or rupture of the arc-tube resulting in failure of the lamp early in life.

Such bowing of the arc can also affect the quartz arc-tube in conventional metal halide lamps, but cracking or rupture failure is less likely since quartz softens at the resulting higher wall temperature causing the arc-tube to become swollen. Excessive swelling of a quartz arc-tube can however also result in cracking or rupture failure.

In fixtures where the ballast is necessarily placed close to the lamp, use of magnetic shielding is essential. Another solution is to use an electronic ballast, which eliminates the need for an ignitor, simplifies wiring, reduces the risk of stray magnetic field and eliminates light output flicker.

Containment requirement

CMH lamps operate above atmospheric pressure, therefore a very small risk exists that the lamp may shatter when the end of life is reached. Though this failure mode is unlikely, containment of shattered particles is required as prescribed by IEC 62035.

Single-ended lamp should only be used in a suitable enclosed luminaire with front cover glass capable of containing the fragments of a lamp should it shatter.

Control gear and accessories

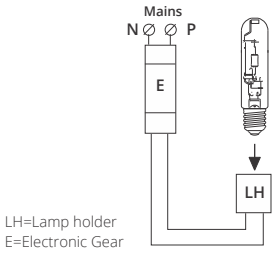
Electronic ballasts

New power controlled electronic ballasts are made by various gear manufacturers for Ceramic Metal Halide lamps.

Their advantages are:

- Supply voltage regulation
- Greater lamp colour consistency
- Reduced noise
- Elimination of lamp flicker when ballast frequency is higher than 70 Hz
- Lightweight
- Lower electrical losses
- Single piece compact unit
- Reduced wiring in luminaire

Electronic ballast circuit diagram



Note: Tungsram Lighting is glad to test electronic gears for compatibility. For specific requests please contact your local representative or visit www.tungsram.com

Standards

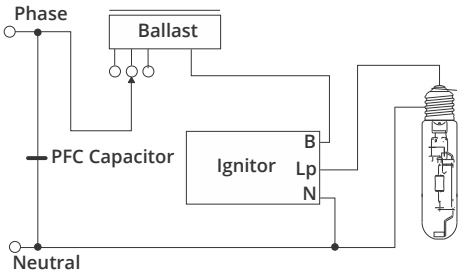
The ballasts should comply with the relevant parts of the following standards:

- RFI suppression EN 55015
- Harmonics EN 61000-3-2
- Immunity EN 61547
- Safety EN 60926/EN 60928/EN 61347
- Performance EN 60927/EN 60929

Superimposed ignitors

In many installations Ceramic Metal Halide lamps are operated from a conventional magnetic ballast in conjunction with a superimposed ignitor. These ignitors generate starting pulses independently from the ballast and should be placed close to the lamp, preferably within the luminaire. Wiring between ignitor and lamp should have a maximum capacitance to earth of 100pF (length equivalent to less than 1 Metre) - contact ignitor manufacturer for details of specific ignitor types. A typical circuit diagram is shown:

Typical superimposed ignitor circuit



Suitable ignitors

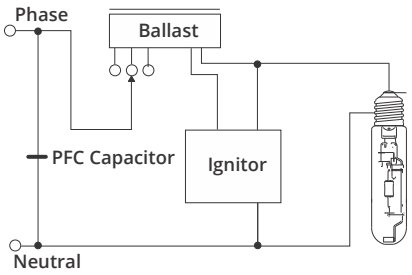
Suitable high-energy (superimposed) ignitors are listed below recommended by gear manufacturers. Check with your supplier for their current range of ignitors. Lamp re-starting under warm lamp conditions can take up to 15 minutes. Suitable ignitors with a warm restart of less than 15 minutes include the following, with the list not being fully inclusive:

General Information	Products				
BAG Turgi	NI 400/LE	NI 400 LE/3.5A	NI 400 LE/3.5A-TM20		
ERC	640006	640106	640216	640155	640305
Helvar	L-250	LSI-400			
Tridonic	ZRM 6-ES/B	ZRM 8-ES/D	ZRM 4.5-ES/B	ZRM 6-ES/B	ZRM 2.5-ES/D
Vossloh-Schwabe	Z 400	Z 400 S	Z 400 M	Z 400 M A20	Z 400 MK A20

Impulser ignitors

Impulser type ignitors use the ballast winding as a pulse transformer and can only be used with a matched ballast. Always check with the ballast and ignitor supplier that components are compatible. Longer cable lengths between ballast & ignitor and the lamp are possible due to the lower pulse frequency generated, giving greater flexibility for remote control gear applications. Ignitor pulse characteristics at the lamp must however comply with specified minimum values for CMH lamps under all conditions.

Typical impulser ignitor circuit



Timed or cut-out ignitors

The use of a 'timed' or 'cut-out' ignitor is not a specific requirement for CMH lamps but it is a good optional safety feature worth considering to protect the ignitor from overheating and to prolong its life. If used, the timed period must be adequate to allow lamps to cool and restart as described in the previous section. A period of 10-15 minutes continuous or intermittent operation is recommended before the ignitor automatically switches off. Timed ignitors specifically offered for High-Pressure Sodium lamps where the period of operation is only about 5 minutes are not suitable for CMH lamps.

Hot re-strike

All ratings re-strike within 15 minutes following a short interruption in the supply. Hot re-strike may be achieved using a suitable ignitor. Actual re-strike time is determined by the ignitor type, pulse voltage and cooling rate of the lamp.

Warm re-starting

The combined characteristics of ceramic arc tube material and vacuum outer jacket result in CMH lamps cooling relatively slowly. It is possible with low energy ignitors to reach the required breakdown voltage but not create a full thermionic discharge. Under these conditions the lamp can remain very warm and be prevented from cooling to a tempera-ture at which the arc can be re-established. To avoid this, turn off the power supply for approximately fifteen minutes or change to a suitable high energy ignitor from the list given in the superimposed ignitor section.

Fusing recommendations

For a very short period immediately after switch-on, all discharge lamps can act as a partial rectifier and the ballast may allow higher than the normal current to flow. In order to prevent nuisance fuse failure the fuse ratings must take account of this.

See relevant information on national installation requirements for High Intensity Discharge lighting circuits. Single fusing is recommended which gives added protection for the end-of-life condition when partial rectification can also occur.

Number of lamps	1	2	3	4	5	6
150W fuse rating (A)	4	6	10	10	16	16

Safety warnings

The use of these products requires awareness of the following safety issues:

Warning

- Risk of electric shock - isolate from power supply before changing lamp
- Strong magnetic fields may impair lamp performance, and in the worst case could lead to lamp shattering.

Use in enclosed fixtures to avoid the following:

- Risk of fire
- A damaged lamp emits UV radiation which may cause eye/skin injury
- Unexpected lamp shattering may cause injury, fire or property damage

Caution

- Risk of burn when handling hot lamp
- Lamp may shatter and cause injury if broken

Always follow the supplied lamp operation and handling instructions.