TUNGSRAM™

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DATA SHEET

Ceramic Metal Halide Lamp

High Wattages

250W and 400W

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
- Excellent colour rendition (CRI: 80+)
- Up to 24% higher efficacy than Quartz Metal Halide
- Up to 24,000 hours life
- UV control
- Easy retrofit for High Pressure Sodium and High Pressure Mercury lamps

Elliptical and 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.

Coated and clear versions enable close matching to the lamp types previously used.

Application areas

Commercial areas/city beautification/architectural

Street and Pedestrian

Showbiz

Car Park

Specification summary

Description	Product Code	Wattage	Colour	Format
CMH250/E/UVC/U/830/E40/D TU	93102160	250	3000K	Elliptical
CMH250/TT/UVC/U/830/E40 TU	93102159	250	3000K	Tubular
CMH250/TT/UVC/H/830/E40 TU	93102169	250	3000K	Tubular
CMH250/TT/UVC/U/942/E40 TU	93102206	250	4200K	Tubular
CMH400/TT/UVC/U/830/E40	93102166	400	3000K	Tubular

General	Units	250W				400W
		Tubular	Tubular	Elliptical	Tubular	Tubular
Product Code		93102206	93102159	93102160	93102169	93102166
Nominal Wattage	[W]	250	250	250	250	400
Bulb Format		Tubular	Tubular	Elliptical	Tubular	Tubular
Bulb Material		Heat resistant / Hard Glass				
Bulb Finish		Clear	Clear	Diffuse	Clear	Clear
Arc Gap	[mm]	16.5	16.5	N/A	16.5	21.5
Bulb Designation		T15	T15	ED28	T15	ED18
Base		E40	E40	E40	E40	E40
Mercury Content	[mg]	29.0	29.0	29.0	29.0	37.5
Ambient Temperature	[°C]	25	25	25	25.0	25

Operating Conditions**

Operating Position		Universal	Universal	Universal	Universal	Universal
Luminaire Characteristics		Enclosed	Enclosed	Enclosed	Enclosed	Enclosed

Electrical Characteristics***		250W				400W	
		Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
Product Code		93102206		93102159 / 93102160		93102169	93102166
Rated Power	[W]	260	252	265	264	220	408	398
Weighted Energy Consumption	[kWh/1000hrs]	286	277.2	291.5	290.4	242	448.8	437.8
Lamp Voltage	[V]	107	90	117	108	110	110	100
Typical Voltage Change with Burning Position – Vertical to Horizontal	[V]	+17		+9		N/A	+10	
Lamp Volts Max	[V]	117	100	125	120	120	120	110
Lamp Volts Min	[V]	97	80	100	100	105	100	90
Lamp Current	[A]	2.9	3.1	2.7	2.6	2.3	4.3	4.5
Max. Ignition Voltage	[kV]	5		5		5	5	
Min. Ignition Voltage	[kV]	2.8		2.8		2.8	2.8	
Conventional Ballast Required		HPS compatible		HPS compatible		Hg	HPS compatible	
Ballast Impedance at 230V	[V/A]	63		63		74.6	40.9	
Power Factor Correction Capacitor	[mF]	35		35		35	45	

* Thermal protection required
** Note that the lamp voltage inside the luminaire should not deviate by more than 10V from the bare lamp voltage in free air.
*** The specification contains data about typical performance on a 50 Hz sine wave ballast at rated power. Actual values may depend on ballast and application.

Photometric Characteristic	Units	250W				400W	
Product Code		93102206	93102159	93102160	93102169	93102166	
Initial Lumens (100 hrs)	[lm]	25000	25000	23500	20000	HOR 40500 / VBU 39500	
Rated Lumens	[lm]	26100	25800	23900	20000	HOR 40800 / VBU 39800	
Correlated Colour Temperature V	[K]	5000	3600*	3600*	N/A	3600*	
Correlated Colour Temperature H	[K]	4200	2900	2900	3000	3050	
Chromaticity X Vertical		0.35	0.41	0.40	N/A	0.40	
Chromaticity Y Vertical		0.37	0.39	0.39	N/A	0.40	
Chromaticity X Horizontal		0.374	0.43	0.43	0.43	0.43	
Chromaticity Y Horizontal		0.371	0.38	0.39	0.39	0.39	
Colour Rendering Index VBU	[Ra]	80	81	80	N/A	80	
Colour Rendering Index HOR	[Ra]	90	86	85	80	84	
Luminous Efficacy VBU	[lm/W]	94	95	89	N/A	100	
Luminous Efficacy HOR	[lm/W]	97	97	90	92	100	
Energy Efficiency Class	[EEC]	A+	A+	A+	A+	A+	

* 3300K at 1000hrs & beyond

Starting Characteristics*							
Time to Start (at 25°C)	[s]	<10	<10	<10	<10	<10	
Time to Start – Cold Box Test at -30°C	[s]	<30	<30	<30	<30	<30	
Warm-up Time (for 90% lumens)	[min]	5	5	5	5	3	
Starting Current – Minimum	[A]	2.8	2.7	2.7	2.1	4.2	
Starting Current – Maximum	[A]	3.1	4.5	4.5	4.5	7.5	
Pulse Peak Voltage – Minimum	[kV]	2.8	2.8	2.8	2.8	2.8	
Pulse Peak Voltage – Maximum	[kV]	5	5	5	5	5	
Pulse Width @ 90% of Min. Pulse Peak Voltage	[µs]	2	2	2	2	2	
Pulse Repetition Rate @ 60-90° or 240-270°				1 per cy	cle min.		
Hot Restart Time	[min]	15	15	15	15	15	

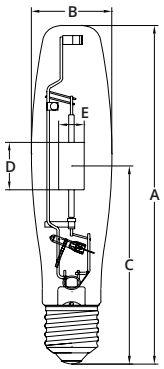
* Typical values (actual values are ballast and ignitor dependent)

Through Life Performance							
Lumen Maintenanceat 40% Rated Life (mean lumens)	[lm]	21600	21000	18800	17000	HOR VBU 3	35800 2865
Average Rated Life	[h]	24000	24000	24000	24000	24	000
Safety Requirements							
Maximum Allowed Bulb Temperature Under Abnormal Conditions*	[°C]	400	400	400	400	400	
Maximum Base Temperature*	[°C]	250	250	250	250	250	

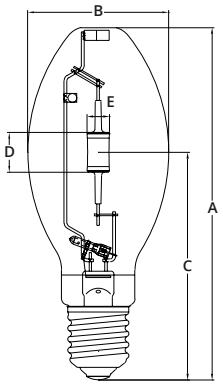
* For a bare lamp running at 1.25 x normal operating power to simulate the most unfavourable conditions of high line voltage and low ballast impedance in a fixture environment.

Dimensions

Tubular



Elliptical



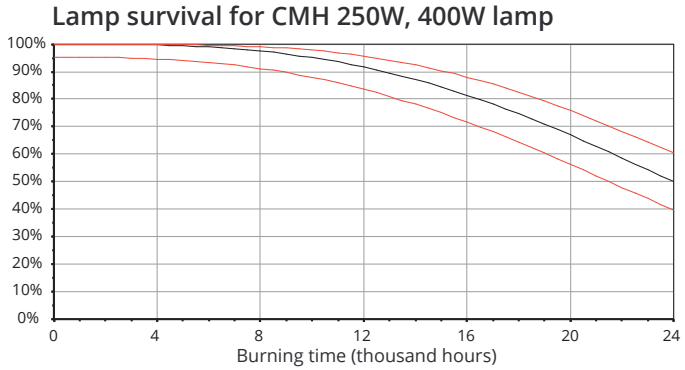
		250W		400W	
Dimensions		**Tubular**	**Eliptical**	**Tubular**	**Tubular**
Product code		93102206	93102160	93102169	93102166
A	[mm]	251	270	251	270
B	[mm]	48	59	91	59
C	[mm]	153,5	175	133,5	175
D - Bruner Height	[mm]	25,5	25,5	25,5	34,4
E - Bruner Width	[mm]	14,4	18,7	14,4	18,7

Note: the elliptical product drawing is made transparent for illustration only. In actuality the arc-tube cannot be seen, due to the coated outer bulb.

Lamp life

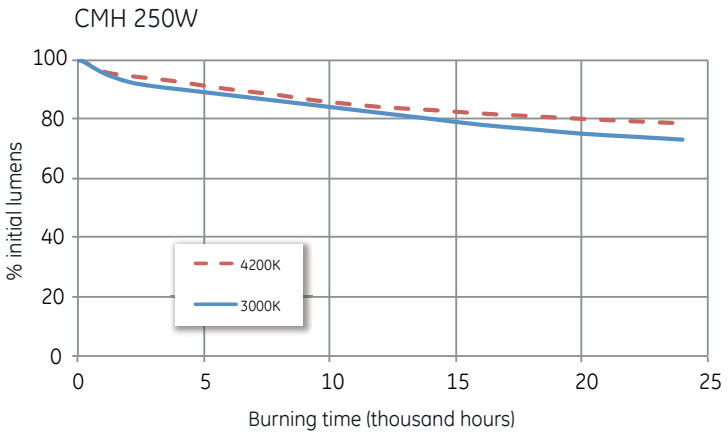
The graphs below show the mortality curves of statistically representative batches of lamps operated under controlled conditions of 11 hours per start. The declared lamp life is the median life, which is when 50% of the lamps from a large sample batch would have failed. Lamp life in service will be affected 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.

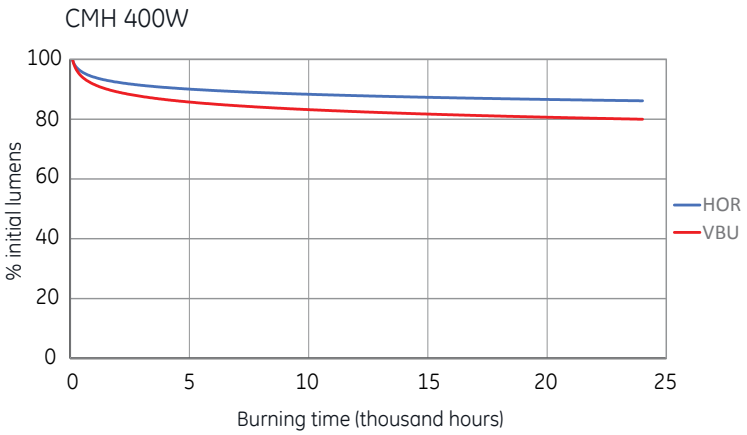
Note: The representative curves are for both Vertical Base Up and Horizontal burn position.



Lumen maintenance

The lumen maintenance graphs show 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.

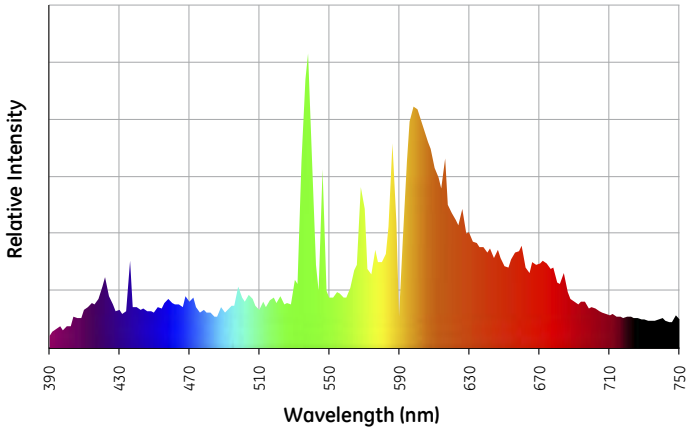




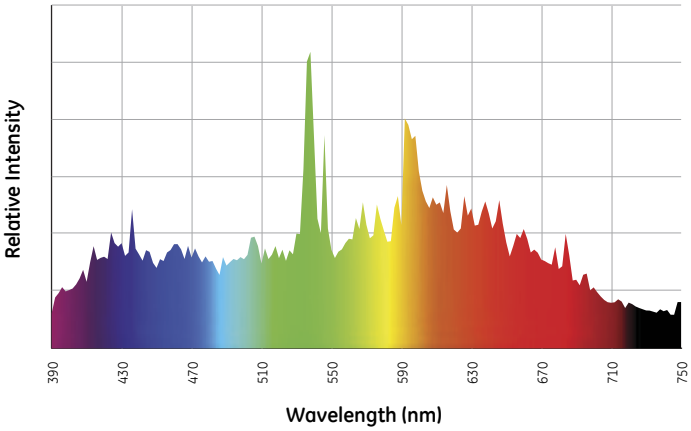
Spectral power distribution

Spectral power distribution curve is given in the following diagram

Spectral power distribution 3000K



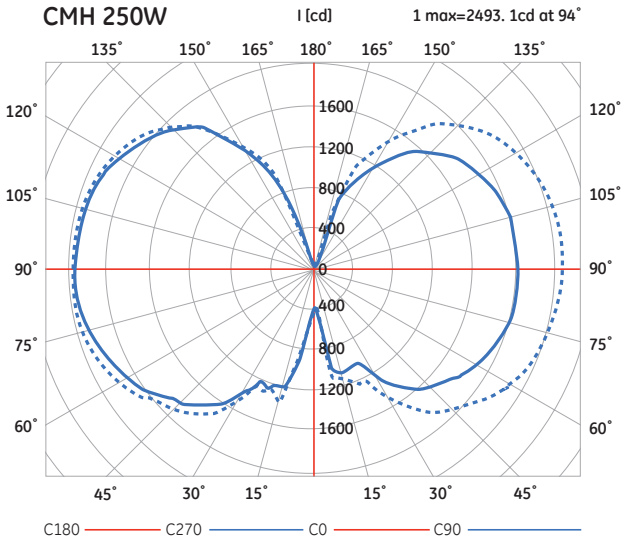
Spectral power distribution 4200K



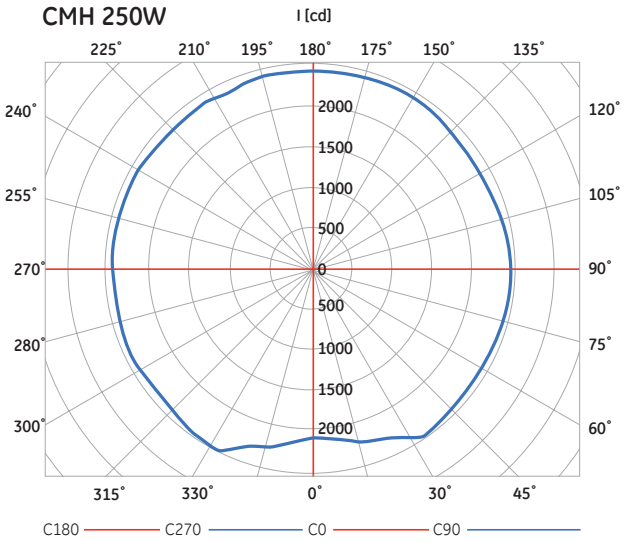
Distribution of luminous intensity

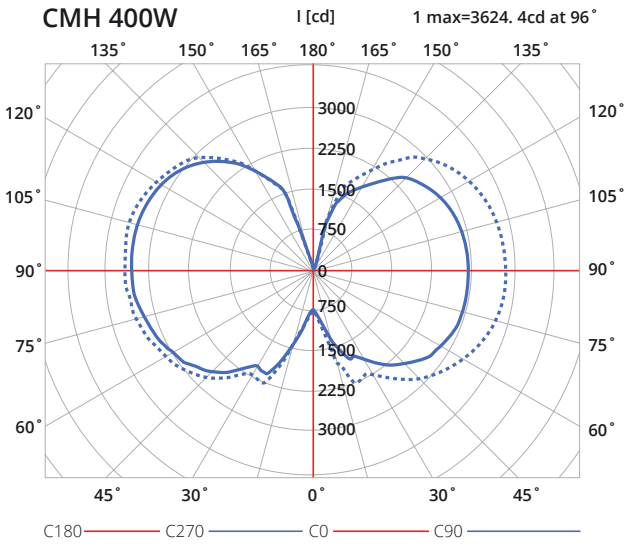
The following diagrams show the polar light intensity curves of the lamp in vertical base-up position

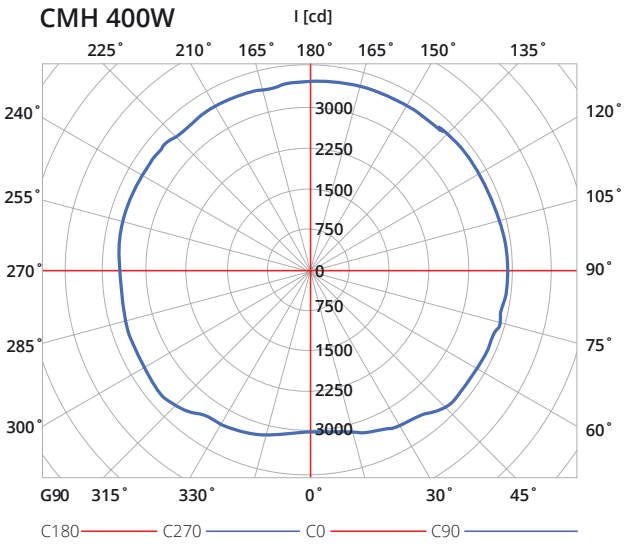
Vertical plane polar intensity curve



Horizontal plane polar intensity curve



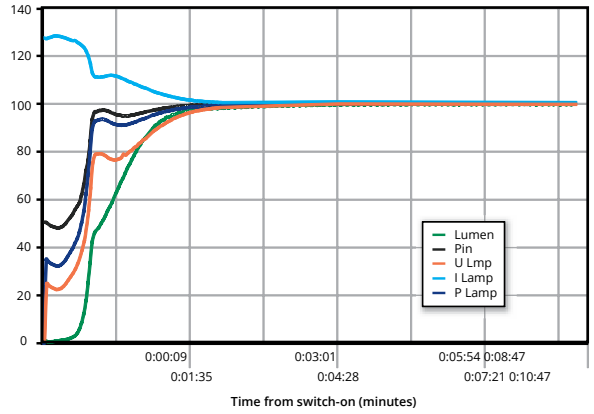




Warm-up characteristics

During the warm-up period immediately after starting, lamp temperature increases rapidly and mercury and the metal halides evaporate within the arc-tube. The lamp current and voltage will stabilise in less than 4 minutes. During this period the light output will increase from zero and the colour will approach the correct visual effect as each metallic element becomes vaporised.

Typical Warm-up Characteristics



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 function correctly for a voltage range of 200-240V.

Dimming

These 250w and 400w CMH lamps may be dimmed to 50% power level, after operation in full-power mode for a minimum of 15 minutes. With dimming, the color shifts toward higher color temperature with lower color rendering. Lumen maintenance may vary from specification when lamps are used a lower than full-wattage mode. Rated lamp life is the total burning time in dimmed and full-power modes.

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 250W 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.

End-of-life conditions

The principal end-of-life failure mechanism for CMH lamps is arc tube leakage into the outer jacket. High operating temperature inside the arc tube causes metal halide dose material to gradually corrode through the ceramic arc tube wall, eventually resulting at normal end-of-life in leakage of the filling gas and dose. Arc tube leakage into the outer jacket can be observed by a sudden and significant lumen drop and a perceptible colour change (usually towards green). The above situation is often accompanied by the so-called rectification phenomena. This occurs where a discharge is established between two mount-frame parts of different material and/or mass, causing asymmetry in the electrical characteristic of the resulting discharge current. Rectification can lead to overheating of the ballast, therefore conventional magnetic ballasts must conform to requirements of the IEC60662 and IEC62035 lamp standards by incorporating protection to maintain safety and prevent damage. Lamps designated as CMH250, KRC250, and CMH400/E do not require thermally protected ballasts.

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 extinguished 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 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.

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.

The use of UV control material together with an optically neutral front glass cover 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. Luminaires should not be used if the front glass is broken or missing. It is recommended that a safety interlock switch is incorporated into the luminaire to prevent operation when the luminaire is opened.

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.

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 below.

Lamp type		250W	400W
UV-PET Performance			
UV-C[1]	220-280nm	0.00008	0.0000
UV-B[1]	280-315nm	0.00002	0.0000
UV-A[1]	315-400nm	0.00082	0.0005
UVC/UVB		4.1	0.0000
UVB/UVA		0.025	0.0000
E_{eff}[2]		0.0204	0.0005
PET (h)±10%		885	1798
Risk Group	IESNA RP-27.3-96	Exempt	Exempt

[1] µW / (cm_2) / 500 Lux
[2] mW / klm

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 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

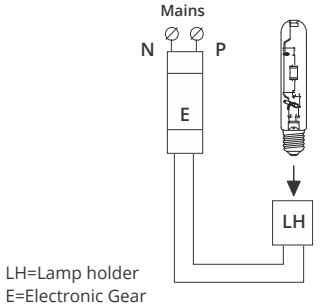
Electronic ballasts

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



LH=Lamp holder
E=Electronic Gear

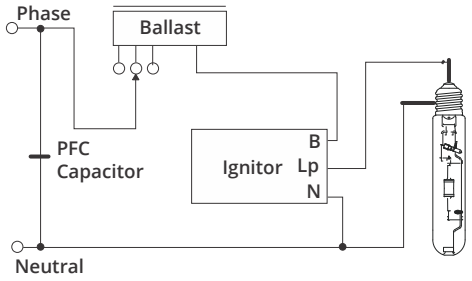
Note: Tungsram Lighting is glad to test electronic gears for compatibility. For specific requests please contact your local representative or visit www.tungsram.com.

* Currently, product code 93102206 is still under testing for ballast compatibility.

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

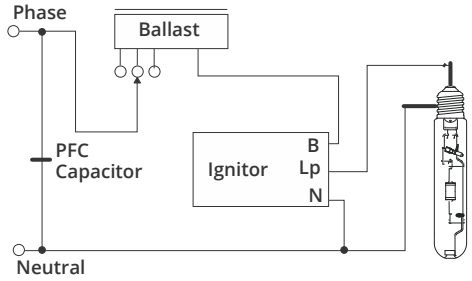
Suitable high-energy (superimposed) ignitors recommended by control gear manufacturers are listed below. Check with suppliers for their current range of ignitors. Lamp re-starting under warm lamp conditions can take up to 15 minutes. Suitable ignitors to achieve a warm restart of less than 15 minutes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

Maker	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/CT	ZRM 8-ES/CT	ZRM 4.5-ES/CT	ZRM 6-ES/CT	ZRM 2.5-ES/CT
Vossloh-Schwabe	Z 400	Z 400 S	Z 400 M	Z 400 M A20	Z 400 M 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 superimposed ignitor circuit



Other ignitor related considerations

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. Tungsram Lighting should be consulted when considering use of an instant hot re-striking system.

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 temperature 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. HBC or MCB (type 3 or 4) fuse ratings for single and multiple lamp installations

Number of Lamps	1	2	3	4	5	6
250W Fuse Rating (A)	10	16	16	20	20	20
400W Fuse Rating (A)	16	20	20	25	25	32

Safety warnings

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

Warning

Risk of electric shock
- Turn power off before inspection, installation or removal
- Do not use where directly exposed to water or outdoors without an enclosed fixture

Risk of fire
- Keep combustible materials away from lamp
- Use in luminaire rated for this product which complies with UL1598 or IEC 60598
- Use thermally protected ballast in accordance with IEC 61167 and IEC62035

Unexpected lamp rupture may cause injury, fire, or property damage
- Open rated (/O) lamps: Do not use where directly exposed to water or outdoors without an enclosed luminaire.
- Other lamps: Use in ENCLOSED luminaire with front cover made of glass capable of containing the fragments of a lamp should it shatter, to avoid risk of fire.
- DO NOT operate lamp in a luminaire with a missing or broken lens diffuser
- Do not exceed rated voltage
- Do not use lamp if outer glass is scratched or broken
- Use only properly rated ballast and ignitor
- Operate lamp only in specified position
- Turn quartz metal halide lamp off at least once for 15 minutes per week. FAILURE TO COMPLY INCREASES THE RISK OF RUPTURE
- Do not use beyond rated life
- Do not turn on lamp until fully installed

A damaged lamp emits UV radiation which may cause eye/skin injury

IEC 60662 (HPS 1997) 9.4 - Possible conditions at end of lamp life

- A risk exists that at the end of life a number of lamps exhibit a rectifying effect. This can lead to ballast, transformer or starting device overloading. Suitable protective measures should be taken to ensure that safety is maintained under this condition.

Cautions

Risk of burn
- Allow lamp to cool before handling

Lamp may shatter and cause injury if broken
- Wear safety glasses and gloves when handling lamp
- Do not use excessive force when installing lamp
- Do not stare at light source. May be harmful to the eyes. Not applicable to diffuse coated bulbs.
- Dispose of lamp in a closed container
- Quartz metal halide lamp arc tube fill gas contains Kr-85
- For operating instructions see electronic catlog / data sheet at www.tungsram.com
- GE Lighting accepts no liability for injury or damage resulting from incorrect use of the lamp, or from use of the lamp in combination with inappropriate equipment.
- Consult your supplier if you have any questions or concerns.

Always follow the supplied lamp operation and handling instructions.