

## INTRODUCTION

Cathodeon has designed a range of high quality rugged low pressure gas discharge lamps primarily for use in photoionisation detectors (PID).

**DC lamps** are available in a 35mm diameter mainly for use in equipment manufactured by HNu, and in a 20mm diameter suitable for use in all other applications of DC photoionisation lamps.

Fig 7a PKS Lamp

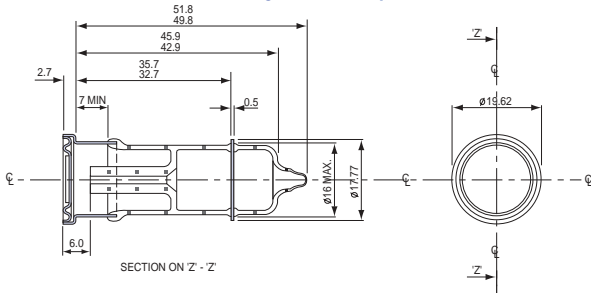
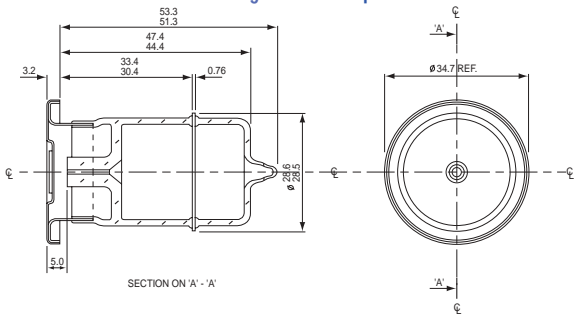
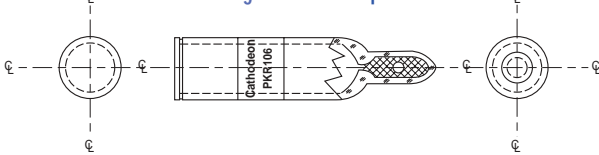


Fig 7b PKL Lamp



In addition, Cathodeon offers **RF excited** photoionisation lamps of 1/2 inch diameter providing a lower cost source of ionising energy of comparable output depending on operating conditions. At 250mW input power, the RF PID lamp has a threefold increase in efficiency over a DC lamp.

Fig 8 RF PID Lamp



## GENERAL CONSTRUCTION

**DC lamps:** In DC PID lamps the gas discharge is initiated by the application of 1500V between the anode and cathode and is confined to a capillary of 1.5mm diameter within the glass envelope and excites the natural resonance frequencies of the gas. Operating currents for the lamp are in the area of 0.1mA to 2.0mA.

Cathodeon's 20mm diameter photoionisation lamps with the S type window flange are designed to be compatible with virtually all photoionisation instruments except those supplied by HNu. This flange has an outer lip that facilitates sealing to the cell surface with a viton O ring.

In addition, Cathodeon offers its A type window flange which has an exceptionally smooth front face to minimise band broadening effects in the analytical cell.

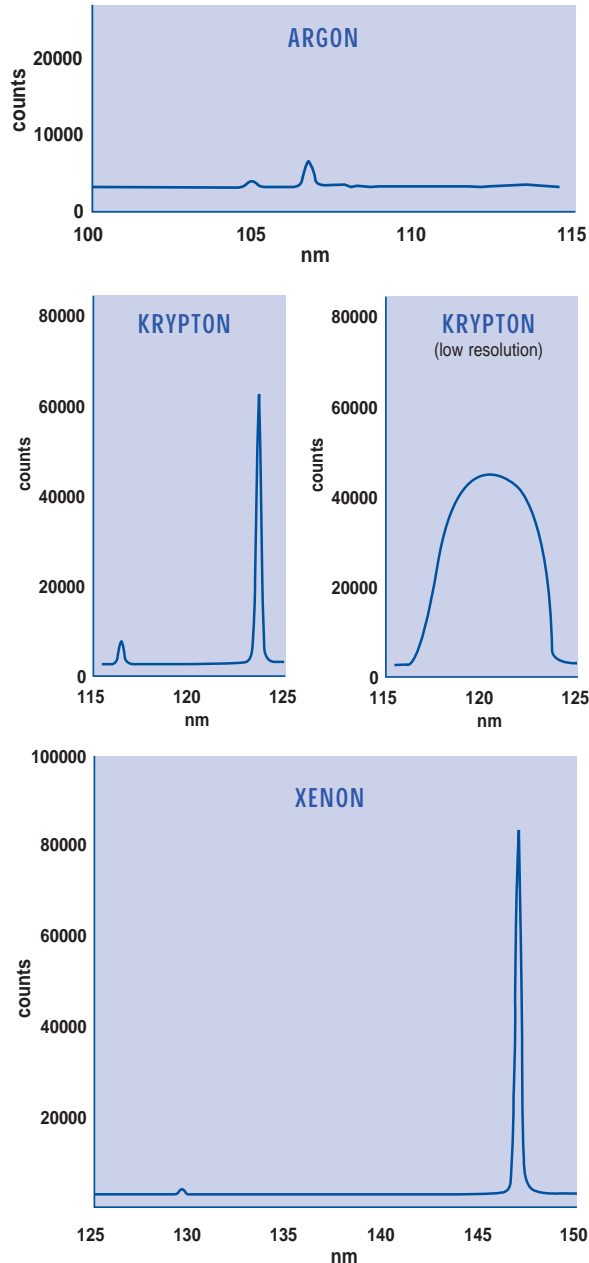
**RF lamps:** These lamps consist of a glass envelope and an appropriate hard sealed window. They may be energised by subjecting them to low energy (typically in the 100mW

region) electromagnetic fields in the frequency range 200kHz to 14MHz and above. Nominal performance occurs using a 10mm diameter antenna of Eu-Cu wire close wound around the glass envelope energised with a 13MHz frequency source.

## GAS FILL

Cathodeon photoionisation lamps are available with a variety of gas fills including argon, krypton, xenon and deuterium gases. When used with the windows detailed below, outputs are equivalent to the photon energies quoted.

Fig 9 Relative Spectral Output - Argon/Krypton/Xenon



Earlier research has suggested that a krypton gas fill when combined with a magnesium fluoride window creates a lamp with an output of 10.2eV. However, recent use of vacuum monochromators with superior resolution have shown the output of krypton to be two lines 116.5 and 123.6nm equivalent to 10.0 and 10.6eV respectively. When following methodologies in published papers it should be noted that any photoionisation lamp filled with krypton will have given both 10.0 and 10.6eV whilst any reference to 10.2eV will refer either to erroneous results from a krypton filled lamp or to a

# PHOTOIONISATION LAMPS

## APPLICATIONS

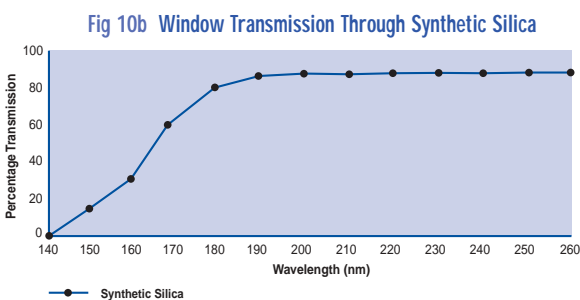
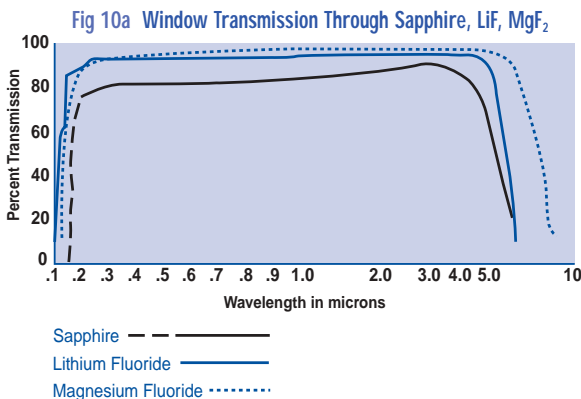
Photoionisation lamps are most commonly used in gas chromatography, trace gas monitoring, portable gas analysis and mass spectrometry sample ionisation. With new applications constantly developing in volatile gas analysis, Cathodeon is both willing and able to collaborate with instrument design engineers on novel products based on our low pressure gas discharge and RF excited technologies

# PHOTOIONISATION LAMPS

deuterium filled lamp that does give a genuine output at this photon energy, albeit at a substantially lower energy.

## WINDOWS

All Cathodeon PID lamps are available with magnesium fluoride, lithium fluoride, sapphire and Spectrosil windows. Magnesium fluoride is the most common window material, providing excellent deep ultra violet transmission with reasonable lifetime.



Cathodeon's unique processing technique allows the use of a thinner magnesium fluoride window improving transmission and therefore improving life due to a reduction in the density of light absorbing colour centres. Lithium fluoride is used in combination with an argon gas fill to provide an 11.8eV photon energy lamp. However, there are severe restrictions to the use of such lamps from the hygroscopic nature of the crystal itself and the available sealing technologies. These restraints combined limit the lamp to operating at room temperature, and operating current of no more than 0.2mA, an expected life of less than 200 hours and a limited shelf life of a few weeks.

Sapphire is available in combination with a xenon gas fill to selectively provide the 8.4eV line, whilst attenuating the stronger 9.6eV line. Whilst not normally used in photoionisation lamps, applications requiring only low photon energies (below 6.9eV) are possible with Spectrosil windows.

## PROCESSING

**DC lamps:** Through Cathodeon's unique sealing and high temperature processing regimes, the lamps have high energy, whilst precise electrode alignment ensures high stability.

Cathodeon has specifically developed its own high temperature seal for this window material, enabling the use of higher temperature processing during the manufacture of the lamp leading to a cleaner lamp, improving both output and lifetime.

Cathodeon 35mm PID lamps combine all the features of the smaller lamp described above in a physical size comparable to instruments manufactured by HNu and others using the same sized lamp.

## TESTING

**DC lamps:** All lamps are leak tested prior to gas filling, together with a close visual inspection of the envelope and window. They are then exposed to a 23 hour preliminary aging cycle to remove oxidised layers from metal surfaces, before being put through a simulated gas chromatograph to check the minimum sensitivity. Failure to reach expected standards in any test leads to rejection of the lamp.

**RF lamps:** Again, leak testing and visual inspections are carried out to check the integrity of each lamp. To ensure a high output against background noise, a spectral purity test is carried out using a vacuum monochromator.

## SPECIFICATIONS

### DC lamps

For practical convenience of electrical operation, the DC PID lamp window flange (anode) is held at Earth potential whilst the cathode ring is supplied with a negative ignition and operating potential.

Ignition voltage: **1500V**

Maximum operating current: **2mA**

Minimum operating current: **0.2mA**

Typical operating voltage at maximum current: **320V to 370V DC**

Maximum operating temperature: **350°C**

Ignition time: **1-2 Sec**

### RF lamps

When operated with a power supply at a 13MHz operating frequency (as described below).

Range of operating current: **80-150mA**

Range of operating voltage: **15-24V DC**

Maximum operating temperature: **350°C**

Ignition time: **100mSec**

## POWER SUPPLY

**DC lamps:** The C200 1500V power supply combined with a series resistor of 0.8-5.0MΩ is sufficient to power the lamp. The series resistor (usually 3.5MΩ) reduces the current of the lamp to a reasonable operating level of about 0.5mA

**RF lamps:** The C210 power supply is a PCB mounted system operating nominally at 13MHz at a power level of approximately 0.5W. The power supply is coupled to the lamp by means of a closely coupled, screened antenna.

Fig 11 RF Power Supply C210



## APPLICATIONS

Cathodeon's unique processing technique allows the use of a thinner magnesium fluoride window improving transmission and therefore improving life due to a reduction in the density of light absorbing colour centres.

**WARRANTY**

**DC lamps:** For the same window material the lifetime of both 20 and 35mm diameter lamps is, in practice, the same although the larger gas volume should in theory extend the period before gas clean up limits the performance of the lamp. Lifetime is impacted by both operating current and temperature, as current increases the increased level of deep ultra violet radiation accelerates the formation of colour centres in the window which in turn reduces its transmission and the output drops. Increased window temperature also has a negative impact on life.

**RF Lamps:** With no metal surfaces to contaminate the gas, Cathodeon RF photoionisation lamps are less susceptible to lifetime limiting gas clean up phenomena. However, these lamps do have a limited gas volume so in addition to our unique high temperature processing Cathodeon uses a getter held in the pump stem to ensure maximum gas purity throughout the life of the lamp. These lamps have been operated in excess of 3000 hrs with no serious degradation. Output at 3000 hrs is approximately 80% of 130 hr output.

Fig 12 DC Lamp Lifetime

CURRENT	TEMPERATURE	LIFE
0.2mA	ambient	>3000 hours
0.5mA	ambient	>2000 hours
0.5mA	300°C	>500 hours

**ORDERING CODES****DC LAMPS**

LAMP TYPE	FILL GAS	PHOTON ENERGY (eV)	ORDERING CODE
20mm	Xenon	8.4	PXS 084
20mm	Xenon	9.6	PXS 096
20mm	Krypton	10.6	PKS 106
20mm	Argon	11.8	PAS 118
35mm	Xenon	8.4	PXL 084
35mm	Krypton	10.6	PKL 102
35mm	Argon	11.8	PAL 118

**RF LAMPS**

FILL GAS	PHOTON ENERGY (eV)	ORDERING CODE
Xenon	8.4	PXR 084
Xenon	9.6	PXR 096
Krypton	10.0	PKR 100
Deuterium	10.2	PDR 102
Krypton	10.6	PKR 106
Argon	11.8	PAR 118

Please note that all 11.8eV lamps (both DC and RF), are constructed using a lithium fluoride window in place of magnesium fluoride.

**POWER SUPPLIES**

POWER SUPPLY	ORDERING CODE
DC lamp power supply	C200
RF lamp power supply	C210

**hi-Tech lamps**  
 800-229-6509  
 info@hi-techlamps.com

**PHOTOIONISATION LAMPS****APPLICATIONS**

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