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# Product Guide

## TLS120Xe

High Power Tuneable  
Light Source  
(280-1100nm)



## Guide Overview

This product guide is intended to provide functional, operational, installation and safety information for the TLS120Xe tuneable light source. This guide is divided into four sections:

- ▶ **Regulatory & warranty information-** includes pertinent regulatory and commercial information.
- ▶ **TLS120Xe description-** introduces the design and functionality of this tuneable light source.
- ▶ **Operating the TLS120Xe-** provides information and procedures on how to setup and use the unit.
- ▶ **Servicing and re-configuration-** includes information on lamp and slit changing.

## Safety Notices

In normal use, the TLS120Xe poses a potential optical radiation hazard.



Non-coherent optical radiation (280 nm-1100 nm) emitted from the output aperture.

WARNING. Possibly hazardous UV and visible optical radiation emitted from this product. Avoid eye and skin exposure to unshielded product. Do not look at operating lamp. Eye injury may result.



For further information please read section 3.1 and consult the TLS120Xe photobiological safety report.

In order to change the lamp of the TLS120Xe, the user or service personnel must open the top access panel. In so doing, one is exposed to additional risks.



Please ensure all service personnel review sections 4.1.1 and 4.2.1 before servicing or re-configuring the TLS120Xe.



Do not use this equipment other than in the manner specified in section 1.1 of this product guide. If the equipment is used in a manner other than specified by the manufacturer, safety protections may be impaired.



Do not position equipment in a manner which may prevent access to power disconnection.



Clean outside of product only with damp cloth when unit powered-off and disconnected from the mains supply.



Always keep liquids away from the TLS120Xe.



Do not subject the TLS120Xe to violent physical shock.  
This may cause the lamp to explode.

## Revision

This section records the document revision details.

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Date	Version	Notes
January 2020	1.1	First release
June 2020	1.2	Update safety information
January 2021	1.3	Updated safety warning

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## Regulatory & Warranty Information

### 1.1 Intended Use

The TLS120Xe is an ultraviolet- visible- near infrared monochromatic tuneable light source (280 nm – 1100 nm) intended for laboratory (indoor) use in the physical and life sciences.

### 1.2 Regulatory Compliance

CE Marking

*\*To be included in final version\**

### 1.3 Contact Bentham

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### 1.4 Notice for clients in the EU



This product is designated for separate collection at an appropriate collection point in accordance with European Community Directive 2012/19/EU.

Do not dispose of as household waste. Bentham are fully WEEE compliant, our registration number is WEE/CB0003ZR.

Should you need to dispose of our equipment please telephone +44 (0) 113 385 4352/4356, quoting account number 135419

## 1.5 Guarantee

Bentham Instruments warrants each instrument to be free of defects in material and workmanship for a period of one year after shipment to the original purchaser. Liability under this warranty is limited to repairing or adjusting any instrument returned to the factory for that purpose. The warranty of this instrument is void if the instrument has been modified other than in accordance with written instructions from Bentham, or if defect or failure is judged by Bentham to be caused by abnormal conditions of operation, storage or transportation.

This warranty is subject to verification by Bentham, that a defect or failure exists, and to compliance by the original purchaser with the following instructions.

Before returning the instrument, notify Bentham with full details of the problem, including model number and serial number of the instrument involved. After receiving the above information, Bentham will issue an RMA reference number and provide shipping instructions.

After receipt of Shipping instructions, ship the instrument "carriage paid" to Bentham. Full liability for damage during shipment is borne by the purchaser. It is recommended that instruments shipped to us be fully insured and packed surrounded by at least two inches of shock-absorbing material. Specific transit packaging as used in Monochromators etc. must be installed.

Bentham reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This warranty is expressly in lieu of all other obligations or liabilities on the part of Bentham, and Bentham neither assumes, nor authorises any other person to assume for it, any liability in connection with the sales of Bentham's products.

Nothing in this guarantee affects your statutory rights.

## 2. TLS120Xe Description

### 2.1 Features Overview

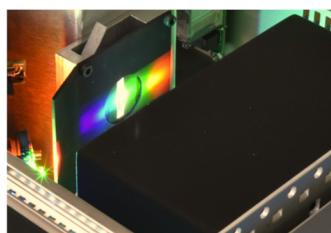


#### A multitude of applications

The TLS120Xe easily fits into a wide range of applications in spectroscopy and spectrophotometry to access the optical properties of components, materials and photodetectors.

#### High optical power

Efficient coupling and optimised operation of short arc xenon lamp ensures high beam power.



#### Continuous tuning

A concave grating monochromator provides narrow bandwidth and high wavelength agility, giving you the freedom to select the wavelength you require.

#### Monitor source parameters

An OLED display reports wavelength, bandwidth, burn time and stability in real-time.



#### Monochromatic light at your fingertips

Choose the wavelength you want, with direct front panel control or automation over USB.

#### Range of fibre output options

A range of fibre and light guides are on offer to adapt to your application.





## 2.2 Optical Design Overview

The TLS120Xe is a tuneable light source operating over the spectral range 280 nm to 1100 nm. It houses an ultra-quiet short-arc xenon light source, starter and constant current power supply with a 120mm focal length concave grating monochromator in a single 19" rack (4U) unit. With a single mains power input, the TLS120Xe offers plug and play functionality, with direct front panel control or automation over USB.

The arc of a short arc xenon lamp is placed at the primary focal point of an AlMgF<sub>2</sub> coated ellipsoidal reflector. At the secondary focal point of the ellipsoidal reflector is located the rectangular entrance slit of a concave grating constant deviation monochromator. A four-position filter wheel is located behind the entrance slit, fitted with a shutter and two long pass filters (OS400 and OS700) to suppress diffraction orders other than the first diffraction order.

A 1200 g/mm, ruled concave diffraction grating (380 nm blaze wavelength) is mounted on an on-axis rotating turret driven by stepper motor having a drive resolution of 0.5 arcsec per step.

The grating spectrally disperses the broadband optical input light and re-focuses the dispersed light onto a rectangular exit slit, transmitting a narrow band of wavelengths defined by the largest width of the entrance and exit slits. Rotating the diffraction grating allows selection of the transmitted wavelength over the range 280nm to 1100nm.

A pair of biconvex lenses focus light transmitted through the slit onto the optical fibre/ liquid light guide of choice. An iris diaphragm allows control of the level of illumination.

The xenon lamp should be changed if it has failed or if the power output has fallen below the recommended level of 87.5% of the initial output (nominally 2000 hours). The TLS120Xe includes a monitor photodiode and amplifier to enable output monitoring during lamp alignment.



Please read section 1.6 for recommended replacement lamps and section 3.2 for the lamp replacement procedure.

The bandwidth of the TLS120Xe is defined by the width of the entrance and exit slits as shown in table 1.



Please read section 3.1 for the procedure to change slits.

<b>Grating line density (g/mm)</b>	1200
<b>Reciprocal Dispersion (nm/mm)</b>	2.70
<b>Slit Width (mm)</b>	<b>Bandwidth (nm)</b>
0.74	5
1.48	10
2.96	20
5.92	40

Table 1: Bandwidth of TLS120Xe

## 2.3 Description of Features



- 1 TLS120Xe
- 2 Main switch
- 3 Wavelength selection switch
- 4 Display
- 5 Output port
- 6 Iris diaphragm
- 7 Lamp power switch
- 8 Monitor port
- 9 USB 2.0 port

Figure 1: TLS120Xe features

## 2.4 Installation Requirements

<b>Overall dimensions (mm)</b>	300L x 462W x 184H
<b>Weight (kg)</b>	8.8
<b>Power supply</b>	100-240V AC, 50-60 Hz
<b>Unit orientation</b>	Horizontal mount only
<b>Computer interface</b>	USB 2.0
<b>Electrical consumption</b>	300 W

Table 2: TLS120Xe installation requirements

## 2.5 Shipped Components

Component	Part no	Description
Main unit	TLS120Xe	High Power Tuneable Light Source
Lamps	19719	100W short-arc xenon lamp
	19583	75W short-arc xenon lamp
Slit	SA-FSP(0.74)	Slit pair (5nm bandwidth)
	SA-FSP(1.48)	Slit pair (10nm bandwidth)
	SA-FSP(2.96)	Slit pair (20nm bandwidth)
	SA-FSP(5.92)	Slit pair (40nm bandwidth)
Fibres	SMA-1500-1000 & adaptor 45937	SMA fibre, 1m long. 1.5mm dia.
	FIBRE-UV-4-4-1000 & adaptors 45936 & 46888	UV fused silica fibre bundle, 1m long. 4mm dia.
	LLG-3-1000 & adaptors 45935 & 46915	Liquid light guide, 1m long. 3mm dia.
Cables	-	Mains power cord
	CAB-USB	USB 2.0 cable

Table 3: TLS120Xe shipped components

## 2.6 Chassis Labels


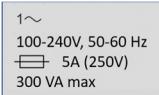



Label	Panel	Description
	Front	Optical radiation hazard label alerting to potential hazards due to non-coherent optical radiation (280 nm-1100 nm) emitted from the output aperture.
	Rear	Safety label stating the AC voltage and current ratings of the TLS120Xe.
	Rear	Environmental label indicating that the TLS120Xe can be disposed of following European Community Directive 2012/19/EU regulations.
	Sides (under cover)	Removal not intended during normal use. Servicing to be undertaken by qualified personnel having read the appropriate sections of this document.
	Rear	Manufacturing information including address, part and serial number, date manufactured and regulatory compliance.

Table 4: Chassis labels

## 2.7 Consumables

Part no	Description
19719	100W short-arc xenon lamp, nominal 500 hours lifetime
19583	75W short-arc xenon lamp, nominal 2000 hours lifetime

Table 5: TLS120Xe consumables

## 2.8 Specifications

### Light Source

Lamp type	Short-arc OFR xenon lamp
Operating Current	Constant current
Coupling	Ellipsoidal reflector, 60mm diameter

### 75W Lamp Option

Operating Current	5.4A
Nominal lamp power and voltage	75W, 15V
Nominal lifetime	2000 hours

### 100W Lamp Option

Lamp type	7.2A
Operating Current	100W, 14V
Nominal lamp power and voltage	500 hours

### Optical Layout

Configuration	Constant Deviation Angle
Focal length	120mm effective

### Opto-Mechanical

Grating mount	Single grating on-axis turret
Grating type	Concave blazed holographic
Grating line density	1200
Nominal blaze wavelength	380nm
Slit type	Fixed Slit
Drive type	Stepper motor
Wavelength accuracy	±0.1nm.
Drive resolution	0.5 arcsec per step
Maximum drive speed	115° per sec
Switching speed	<10ms for 100nm

### Optical Performance

Wavelength range	280nm – 1100nm
Wavelength step	0.0035nm
Bandwidth at FWHM with 0.74mm slit	5nm
Bandwidth at FWHM with 1.48mm slit	10nm
Bandwidth at FWHM with 2.96mm slit	20nm
Bandwidth at FWHM with 5.92mm slit	40nm

### Control

Interface	USB2.0
Software control	BenWin+ spectral acquisition application, SCPI

### Electrical/ Mechanical

Overall dimensions	300L x 460W x 185H (mm)
Weight	8.8 kg
Power supply	100-240V AC 50-60 Hz
Line fuse	5A slow blow (rated 250 VAC)
Mains supply voltage fluctuations	Up to $\pm 10$ % of the nominal voltage
Transient voltages	Up to overvoltage category 2
Orientation	Horizontal only

### Environmental

Operating temperature range	5-40°C
Operating humidity range	Maximum relative humidity 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C
Altitude	< 2000m above sea level
Environment pollution category	Category 2

Table 6: TLS120Xe specifications

## 3. Operating the TLS120Xe

### 3.1 Safety Notices

The optical radiation emitted from the aperture of the TLS120Xe poses a potential optical radiation hazard.



**Optical radiation hazard:** Non-coherent optical radiation (280 nm-1100 nm) emitted from the output aperture.

#### Optical Radiation Safety Information

Hazard Designation	Warning	User Information
Actinic UV	WARNING UV emitted from this product.	Avoid eye and skin exposure to unshielded product
Near UV	NOTICE UV emitted from this product.	Minimise exposure to eyes. Use appropriate shielding
Blue light	CAUTION Possibly hazardous optical radiation emitted from this product.	Do not stare at operating lamp. May be harmful to the eye.
Retinal thermal	-	-
Infrared eye	NOTICE IR emitted from this product.	Use appropriate shielding or eye protection.

Table 7: TLS120Xe optical radiation safety information

In deploying the TLS120Xe in an experimental setup, safety measures should be implemented in the following order:

1. Engineering controls (e.g., filters, shielding, etc)
2. Administrative measures (such as warnings and labels)
3. Personal protective equipment (eye and skin protection)



For further information please read the TLS120Xe photobiological safety report for further guidance on the risk assessment given the various configuration parameters that may impact the accessible emission.

### 3.2 Setting up the TLS120Xe

The TLS120Xe is designed to be bench mounted. Locate the TLS120Xe on a stable surface with enough space around the unit to ensure air flow.



The lamp in the TLS120Xe can be operated horizontally or vertically with the anode above the cathode. Running the lamp with the cathode in the uppermost position will permanently damage the lamp and lead to failure within a few hours.



Ensure that the TLS120Xe is located in such a manner to ensure that the fans to the rear of the unit are not blocked.



Only use if connected to a safety earth, do not connect using two-pin only connectors. Only use a cable rated for the product.



Ensure that the TLS120Xe is located on a stable surface.



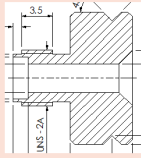
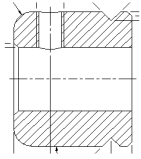
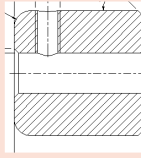
Allow to reach room temperature before using to avoid condensation.



Figure 2: TLS120Xe with fibre optic attached

The TLS120Xe is supplied with an output port adaptor according to the output fibre purchased with the TLS120Xe, attached to the fibre as described in table 8.

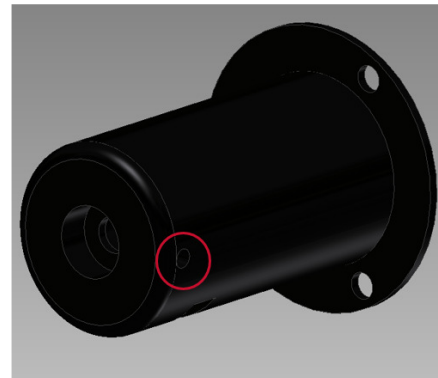


Fibre	Adaptor	Connection	Drawing
SMA-1500-1000	45937	SMA bulkhead	
FIBRE-UV-4-4-1000	45936	Radial grub screw (M3)	
LLG-3-1000	45935	Radial grub screw (M3)	

**Table 8: TLS120Xe output fibre adaptor**

The adaptor is held at the TLS120Xe output port using a radial M3 grub screw indicated in figure 4.

The TLS120Xe is now ready to use.



**Figure 3: Location of attachment screw to fibre adaptor**

### 3.3 Powering on/ off the TLS120Xe

Upon powering on the TLS120Xe, the user will be presented with the following splash screen showing the product ID, serial number and firmware version.

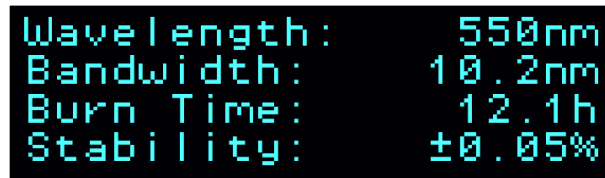
```

Bentham Instruments
Product    TLS120Xe
Serial No. 12345/6
Firmware   v1.3.0
  
```

**Figure 4: Splash screen at initial boot of TLS120Xe**

Upon finishing the boot sequence, the xenon lamp will automatically be struck by default. The “output” LED should turn from red to green to indicate that the lamp has been ignited. If the unit has not been set to ignite the lamp at start up, then pressing the output button will turn the lamp on.

The display will indicate the current wavelength, calculated bandwidth (given the slits installed), the burn time of the lamp and its stability.



Wavelength:	550nm
Bandwidth:	10.2nm
Burn Time:	12.1h
Stability:	±0.05%

Figure 5: Display during normal operation

It is recommended to give the unit a ten-minute warm-up time to allow the lamp output to stabilise.

To power off the TLS120Xe, switch off directly from the left-hand power on switch.

### 3.4 Manual Control

Having powered on the TLS120Xe, the user can directly use the wavelength rotary switch to select wavelength with a resolution of 1nm.



Figure 6: Manual control of the TLS120Xe

The output button can be depressed momentarily to open/ close the shutter as required.

### 3.5 Computer Control

The TLS120Xe wavelength selection can be fully controlled, with a wavelength resolution of 0.1nm, over the USB 2.0 interface using the SCPI protocol.

The USB IDs of the TLS120Xe are VID 04D8, PID 1705.

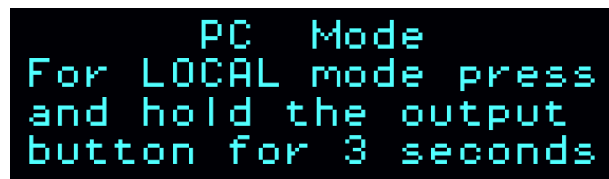
Upon finishing the boot up sequence, the user can control the unit remotely. In the following example the TLS120Xe is set to remote mode, the target wavelength is set to 500nm, the target filter set to the appropriate filter for 500nm and the monochromator moved to the target wavelength:

```
:SYST:REM  
:MONO 500  
:MONO:FILT:WAVE 500  
:MONO:MOVE
```



Please see the TLS120Xe communications manual for further information.

To revert to local mode after computer control, hold the output button for 3 seconds.

A black rectangular LCD display with green pixelated text. The text reads: "PC Mode" on the first line, "For LOCAL mode press" on the second line, "and hold the output" on the third line, and "button for 3 seconds" on the fourth line.

PC Mode  
For LOCAL mode press  
and hold the output  
button for 3 seconds

Figure 7: Display shown when initiating remote mode

## 4. Servicing and Re-configuration

### 4.1 Changing slits

#### 4.1.1 Safety Notices



**Power off:** Switch off and disconnect the TLS120Xe from the mains before proceeding to change slits.



**Mechanical Hazard:** Ensure unit is powered off before accessing.



**Burn hazard:** Internal surfaces get hot during use, allow to cool before opening



**Notice:** Do not touch the diffraction grating of the TLS120Xe. If gratings inadvertently touched, do not attempt to clean, only further damage can result.



**Notice:** To avoid contamination of the inside of the unit, perform this operation in a dust-free environment.

#### 4.1.2 Overview

The bandwidth of the TLS120Xe is set by a pair of rectangular slits as detailed in table1, requiring access to the monochromator compartment of the TLS120Xe.

The side panels of the TLS120Xe should be removed to allow removal of the top cover and gain access to the slits.



**Tools required:** Flat-bladed screwdriver to remove side panels. Torx T20 screwdriver to remove lid. Pliers to remove installed slits

#### 4.1.3 Procedure



Ensure you read section 3.1.1 before following the procedure below.

1

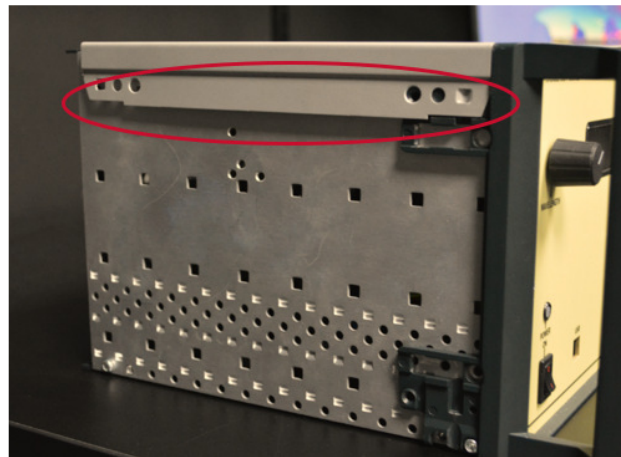
Power off and disconnect the TLS120Xe from the mains power supply.

2

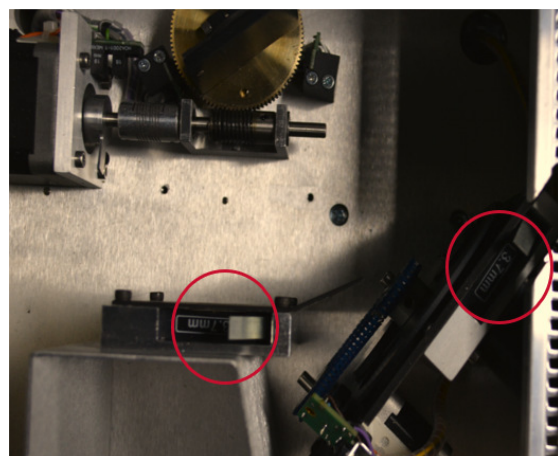
Insert a flat-bladed screwdriver into the two notches of each side panel to remove that panel.



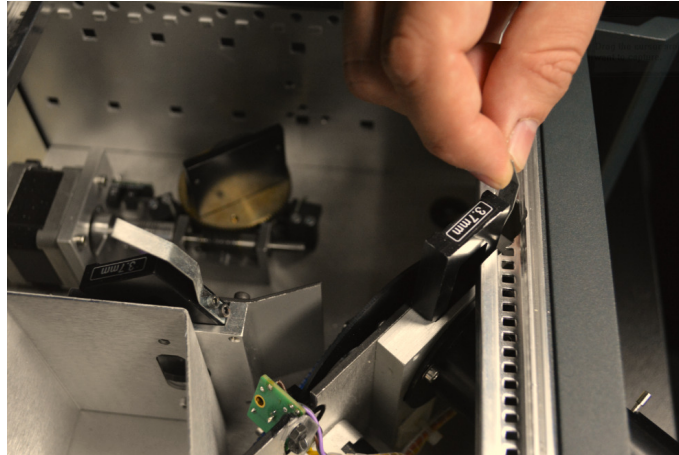
- 3** Remove the two Torx TX 20 screws either side of the lid and use a flat-bladed screwdriver to help prise off the lid and remove.



- 4** The entrance slit can be seen toward the lamp and the exit slit toward the output port.



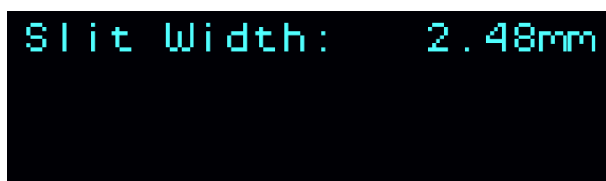
- 5 Using a pair of pliers to catch the silver leaf of the slits, pull the slits up and out, noting the orientation.



It is important to ensure the correct orientation of the slits otherwise a wavelength error will result.

The cut metal aperture of the slit should face toward the diffraction grating for both entrance and exit slits.

- 6 Insert new slits in correct orientation and push firmly down in slit housing.
- 7 Replace cover then side panels, re-connect the TLS120Xe to mains power.
- 8 Turn on the TLS120Xe and the lamp if not already on.
- 9 Briefly press the output button while the lamp is striking to enter slit setup mode.



- 10 Use the wavelength knob to set the slit width. Press the output button again to exit

## 4.2 Changing lamp

### 4.2.1 Safety Notices



**Power off:** Switch off and disconnect the TLS120Xe from the mains before proceeding to change the lamp.



**Electric shock hazard:** Mains voltage and 30kV arc lamp ignition circuits are present inside the enclosure. Disconnect mains prior to opening.



**Explosion risk:** Xenon arc lamps could explode when not in operation causing serious injuries. It is critical to follow safety instructions carefully.



**Hot surface:** Never touch the lamp when it is on, or soon after it has been turned off, as it is hot and will cause serious burns. Lamps should be allowed to cool for a minimum of ten minutes after the lamp is turned off.



**Mechanical Hazard:** Ensure unit is powered off before accessing.



**Face mask:** Explosion risk, wear full face mask throughout lamp change procedure.



**Protective gloves:** Explosion risk, wear gloves and cover sleeves throughout lamp change procedure.



**Protective apron:** Explosion risk, wear protective apron throughout lamp change procedure.



**Notice:** To avoid risk of explosion, xenon arc lamps should not be used beyond their rated service life.



**Caution:** Always transport the lamp in the provided protective case or cover until installation.



**Caution:** Ensure correct lamp used in accordance with consumables listed in section 2.7. Using a lamp above or below its rated current or voltage may cause the lamp to leak or burst.



**Caution:** Install the lamp properly in the equipment, without twisting, bending or otherwise applying excessive stress to the lamp to avoid explosion or lamp degradation.



**Caution:** Save the protective case or cover and packaging materials (box) for lamps that have been used to their rated service life. Use the protective case when disposing of the lamps.



**Caution:** Affix the lamp in the correct polarity according to the lamp and fixture design.



**Caution:** Place the protective cover if attached, on the lamp immediately before or after removal of the lamp.



**Caution:** On disposal, inform the recycler that the lamp is filled with high pressure gas.



**Notice:** Do not touch the diffraction grating of the TLS120Xe. If gratings inadvertently touched, do not attempt to clean, only further damage can result.



**Notice:** To avoid contamination of the inside of the unit, perform this operation in a dust-free environment.



**Notice:** Do not touch quartz envelope with bare hands. If quartz envelope is dirty, wipe with alcohol-soaked clean cloth.

#### 4.2.2 Overview

The xenon lamp should be changed if it has failed or if the power output has fallen below the recommended level of 87.5% of the initial output. The nominal lifetime is around 2000 hours.



Please see section 2.7 for replacement lamps.

To access the lamp, the side panels, top panel and lamp cover should be removed.



**Tools required:** Flat-bladed screwdriver to remove side panels. Torx TX20 screwdriver to remove lid. 0.87mm AF and 1.5mm AF hex keys to remove the lamp. 2mm AF hex key to align the lamp.

#### 4.2.3 Lamp Replacement



Ensure you read section 4.2.1 before following the procedure below.



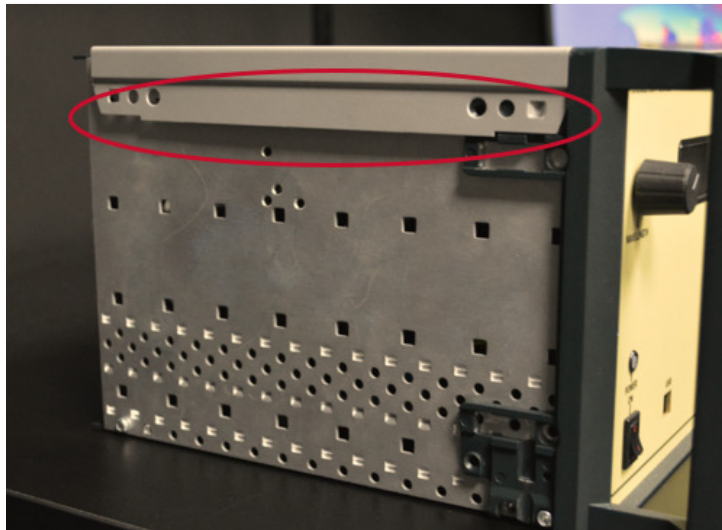
Ensure the following steps are reproduced in the correct order to avoid excessive mechanical strain on the lamp.



- 1 Power off and disconnect the TLS120Xe from the mains.
- 2 If the unit has been running, leave at least ten minutes to allow the lamp to cool down
- 3 Insert a flat-bladed screwdriver into the two notches of each side panel to remove that panel.

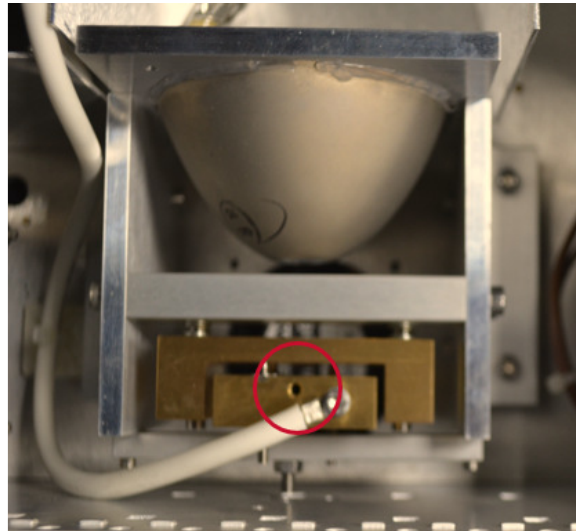


- 4 Remove the two Torx TX 20 screws either side of the lid and use a flat-bladed screwdriver to help prise off the lid and remove.

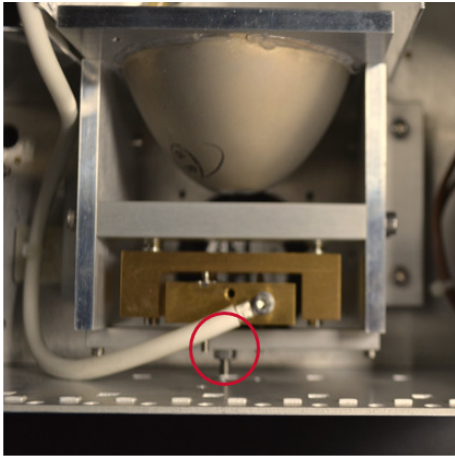


- 5 Unplug the lamp shield safety switch, undo the screws holding the safety shield and then remove the lamp shield
- 6 The anode end of the lamp is the larger ferrule which is clamped into the brass block which has the red wire connected to it. The cathode end is the smaller ferrule which is connected to the bare flying lead by the small brass cylinder.

- 7 Using a 0.87mm AF hex key, loosen the screw on the wire connected to the tip of the lamp
- 8 Using a 1.5mm AF hex key, loosen the screw holding the base of the lamp



- 9 Take the new lamp out of its box. Remove the plastic safety cover from the new lamp and fit it to the old lamp. Place the old lamp in the packaging for disposal
- 10 Noting the cut out in the parabolic mirror and the seal protruding from the side of the xenon lamp, attach the screw terminal to the tip of the lamp (opposite end to the lamp seal) taking care that it sits flush with the lamp
- 11 Place the lamp into the receptacle aligning the lamp seal with the cut out in the parabolic mirror
- 12 Tighten the screws on the lamp base (using a 1.5mm AF hex key)
- 13 Loosen screws on the wire connected to the tip of the lamp (using a 0.87mm AF hex key)
- 14 Replace the lamp cover and secure in place with the screws
- 15 Plug in the safety shield switch
- 16 Loosen the nut on the focus screw of the xenon lamp mount in preparation for the next stage.



- 17** Replace top cover (replacing Torx screws but leave the left-hand side panel off for the optimisation procedure described in the next section.

4.2.4 Optimising Lamp Position

The monitor port is fitted with an SMA bulkhead. For other fibre than SMA, adaptors are described in table 5.

Fibre	Adaptor	Connection	Drawing
FIBRE-UV-4-4-1000	46888	Radial grub screw (M3)	
LLG-3-1000	46915	Radial grub screw (M3)	

Table 9: TLS120Xe monitor port fibre adaptors

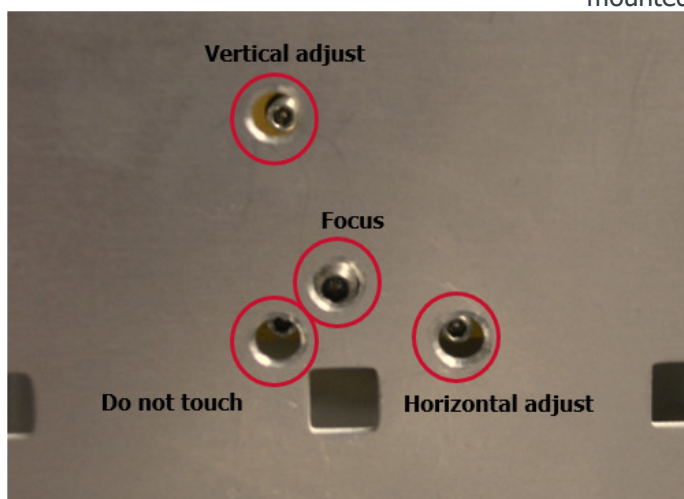
- 1** Connect the fibre or liquid light guide to the monitor port of the TLS120Xe, using the adaptors below
- 2** Switch the TLS120Xe on, as well as the lamp if the lamp doesn't automatically switch on
- 3** Hold the output button for 3 seconds to enter the optimisation mode
- 4** White light should be emitted, and the sensor information is displayed. The user can use the wavelength knob to change the target wavelength

```

Optimization Mode
Current:      0.246mA
Session Max: 0.123mA
---
```

Figure 2: Front panel display during optimisation mode

- 5 To the left-hand side of the unit, access can be gained to the setting screws of the kinematic mount in which the xenon lamp is mounted.



- 6 To the left-hand side of the unit, access can be gained to the setting screws of the kinematic mount in which the xenon lamp is mounted. Iteratively follow steps 6 and 7 until a maximum signal found
- 7 Focus adjust: Use an 2mm AF Allen key to turn 1/4 turn at a time
- 8 Horizontal/ vertical tilt: Use a 1.5mm AF Allen key to turn 1/4 turn at a time
- 9 When a maximum signal is achieved, switch unit off, remove mains connector and top cover
- 10 Tighten set screw lock screws
- 11 Replace top cover (replacing Torx screws) and side cover. Insert mains cable