RESONANCE LTD
Optical Solutions & Technologies

High-Power, RF-Excited EUV Flow Light Source EUV-X-LHP500FL

Operating Manual

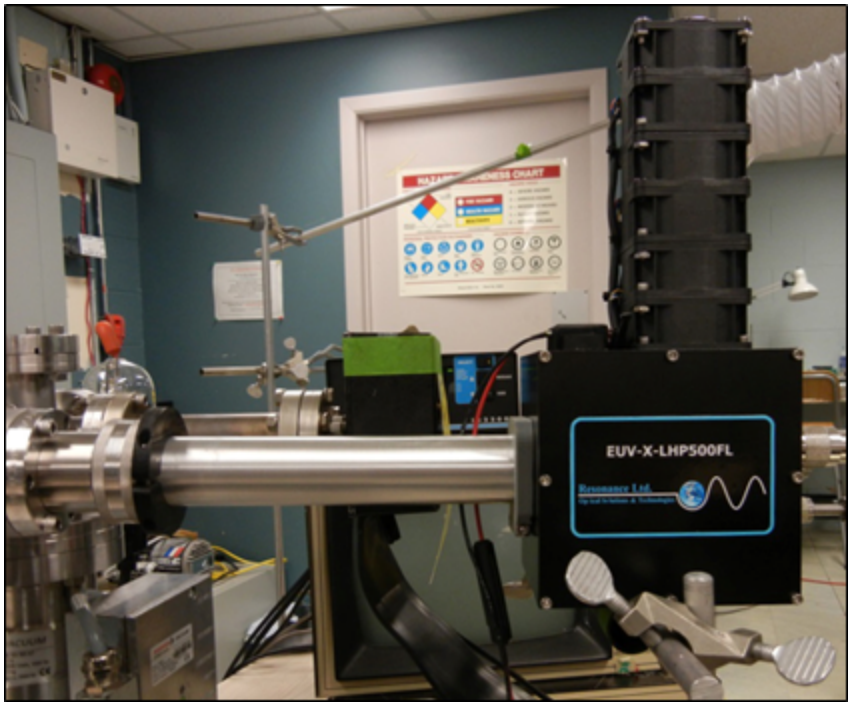


Table of Contents

Overview

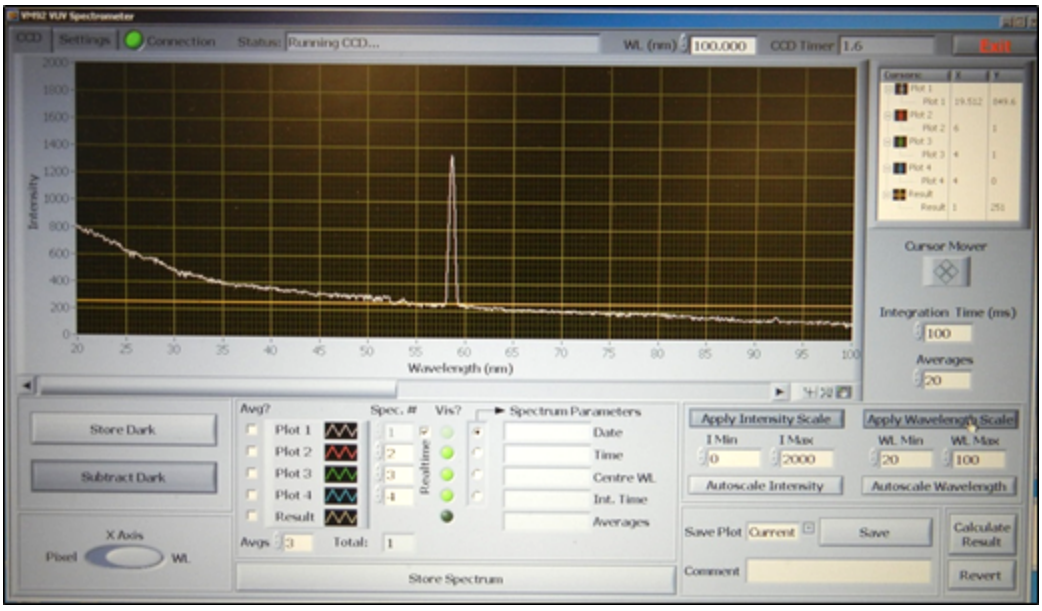
The Resonance Ltd. EUV-X-LHP500FL is an RF-excited flow lamp with a capillary bore. The system includes a reverse-flow nozzle, an interchangeable flow lamp tube with gate and metering valves, a bulb impedance matching circuit, RF coupler and an air cooling system in an RF enclosure. It also includes a 500 W 13.56 MHz. RF generator and RF tuner. This 30 to 7,000 NM RF lamp system strong source of EUV/VUV/VIS/IR emissions. This source mounts to a 4.5 inch CF (other flanges on request) for convenient connection to a HV system. The re-entrant design facilitates control of the flux-coverage area and irradiance on the target. This system employs a reverse flow to sweep active gas species away from to the target region. The 0-500 W power supply works at 13.5 MHz with a matching network to optimize coupling to the lamp. Versions with windows. automated gas manifolds, EUV monitors, differential pumping systems, and focusing mirror available as custom systems.

This light source mounts to a 4.5 inch or larger CF type flange. The light source includes everything required to produce EUV emissions except the vacuum system and can operate off of 100 to 240 V 50 or 60 hz.

Electrical/Optical/General Specifications				
Specification	Minimum	Typical	Maximum	Units
Flow Gas User Selected		Helium		
Peak Wavelengths	-	30, 58	-	Nm
Full Spectral Range	-	28 – 7000	-	Nm
VUV Intensity	2×10^{15}	10^{16} @ 58nm	2×10^{17}	Photons/sec/steradian
Full Angle Output Cone	15	28	35	Degrees
Clear Aperture (Standard Tube)	0.35	0.45	0.5	CM.
Certification	Calibration of Irradiance in Vacuum			
Input Power	25	100	500	Watts
Input Voltage	70	115	260	VAC
Mounting Flange	4.5inch CF is standard, lamp can be sealed to HV system			
Cooling	Forced air cooling with 6-stage fan			
Major Spectral Outputs (nm)				
He: 58.4334 He II: 30.4	N: 120			
Ne: 73.5895 and 74.3718	Cl: 118			
Ar: 104.8219 and 106.6659	N2: LBH bands			
H: 121.57 and 102.572	H2: numerous lines in 80 to 200nm region			
O: 130.22, 130.48 and 130.61	Air: numerous lines and bands from 80 to 1000nm			
CO: 4^{th} positive bands 100 to 200	Ar, Kr, Xe: 104 to 190nm Excimer emissions			

Calibration

Calibration		
Calibration Standard	Kr VUV Light Source KrLM-LQD12	
Parameter	Value	Units
Gas	Helium	
Wavelength	58.4	Nm
Flow Rate	240	SCCM
Forward Power	100	Watts
Reflected Power	0	Watts
Distance En. Slit to Lamp	12.5	Cm
Spectrometer Calibration	1.42E + 12	Ph/sec/steradian per ct. per sec.
Measured Counts	11,200	Counts/second
Measured Intensity	1.60E + 16	Ph/sec/steradian
Ultimate Vacuum	<2e – 7	Torr



Calibration Spectrum with VM92

System Diagram

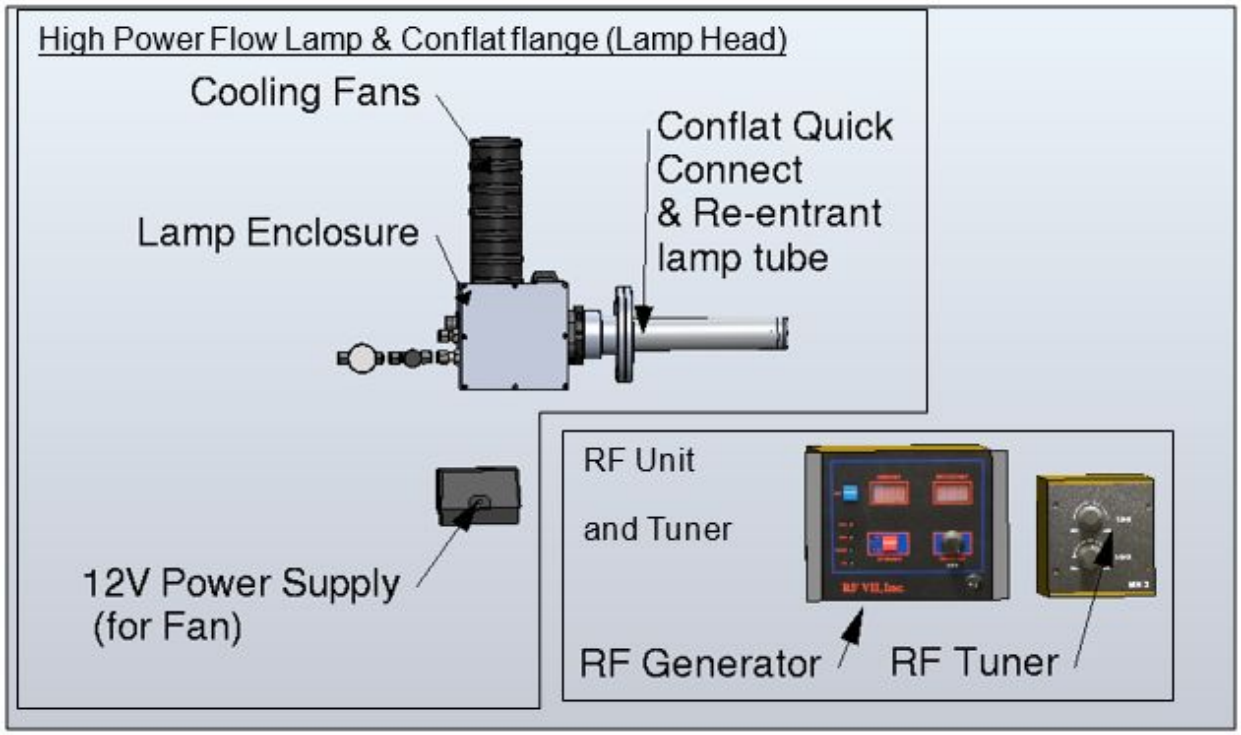
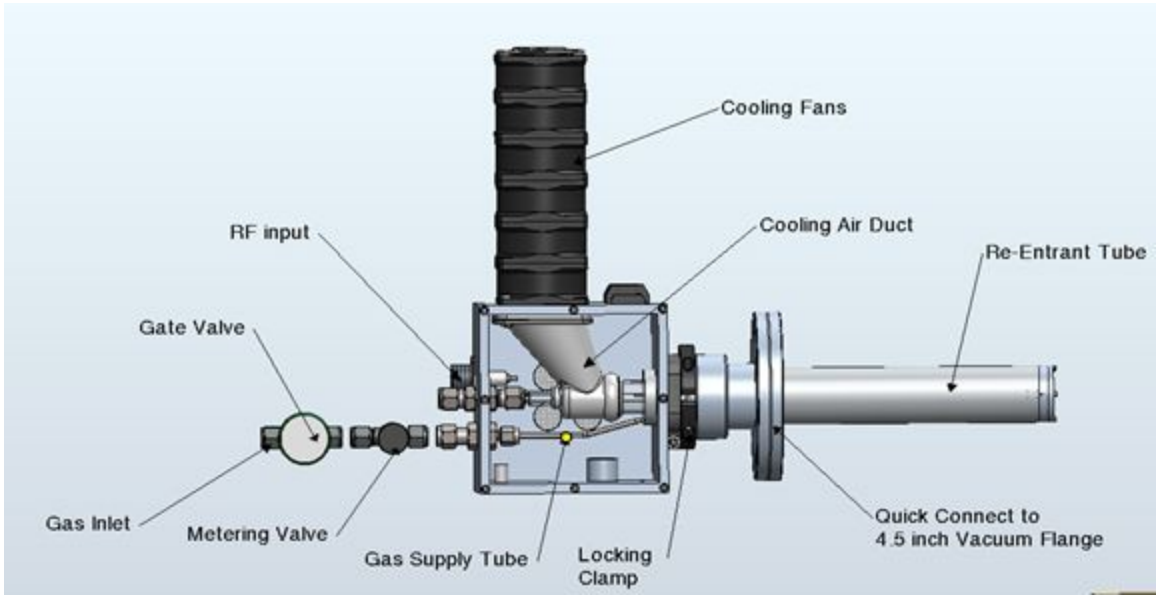
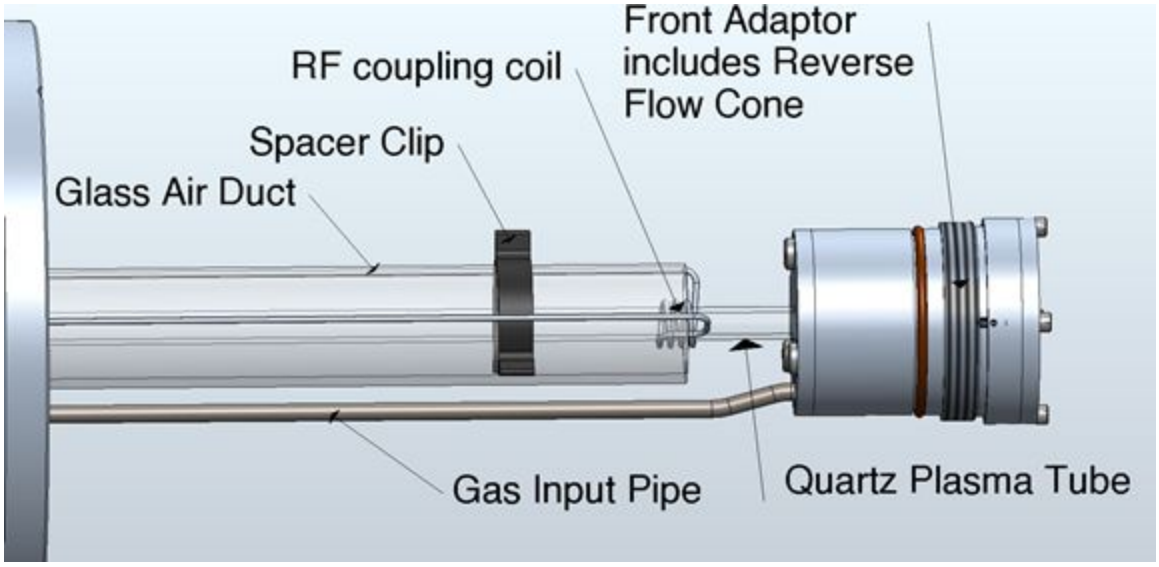


Figure 2: Lamp System

Flow Lamp Configuration





Packing List

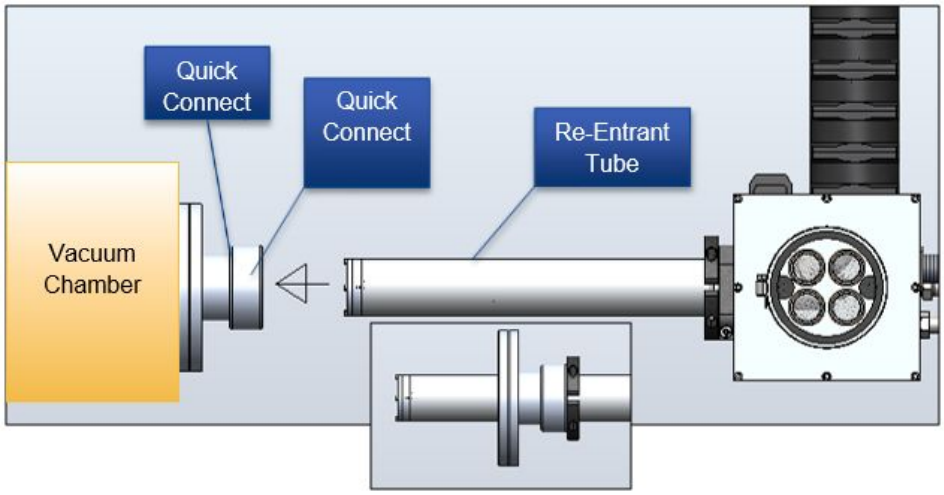
Item	Description	Qty.	Model	Serial
1	High Power Flow Lamp & Conflat Flange		EUV-X-LHP500FL	
2	Spare O-ring Kit			
3	Exhaust Tubing			
4	12V Power Supply			
5	Template for Cone Angle Adjust			
6	Manual			
7	RF Unit and Tuner			
8	RF Unit Output N Connecting Cable			
9	Tuner Input N Connector Cable			
10	RF Unit Power Cable			
11	RF Power Unit Manuals			

Operating Procedure

The flow lamp can be operated with any non-corrosive gas to obtain EUV spectra. Typically, the supply line is pressurized to a few PSI above ambient pressure (10 to 50 PSI or 70 to 340 KPa). To operate:

1. Connect lamp head to Vacuum Chamber with 4.5 inch compression coupling

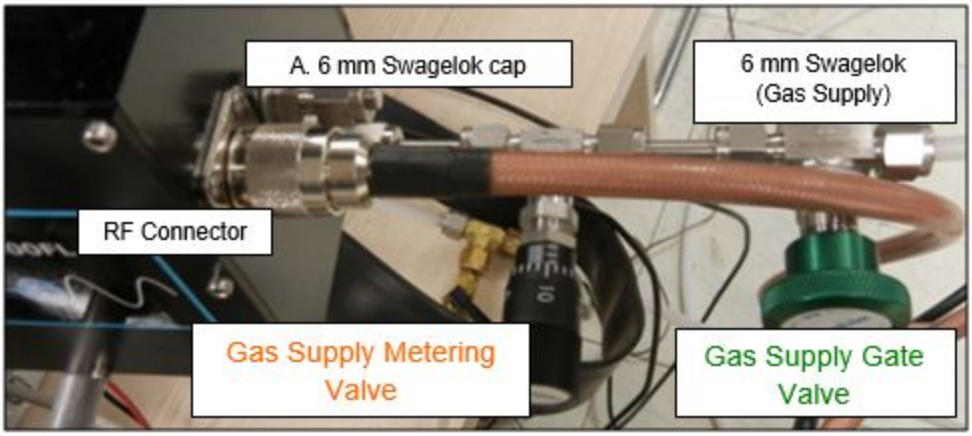
2. Slide Locking Clamp up to Quick connect cap and tighten



3. Ensure that the ¼" Swagelok cap is connected to the rear of the lamp housing.

4. Attach a gas supply line to the Gas Supply Gate Valve.

5. Connect the RF connector from the RF tuner box.



6. Pump out flow lamp to green gate valve (**gate valve closed** and **meter valve set to 10 turns** on coarse scale open). Ensure system pumps down with green valve closed to better than 2e-5 torr.

7. Open green valve with main cylinder valve on gas supply closed. Pump out supply line to <1e-2 torr. Then close gate valve and pressurize line.

8. Set flow to 1 turn (or 25 on fine scale) with He at 40psi (276 KPa).

9. Turn on FAN by plugging it in.
   IMPORTANT FAN MUST BE ON BEFORE TURNING ON RF!

10. Turn RF power up to 10 W.

11. Adjust load and tune until Reflected power goes to 0 to 2 W.

12. Increase RF to 50 W.

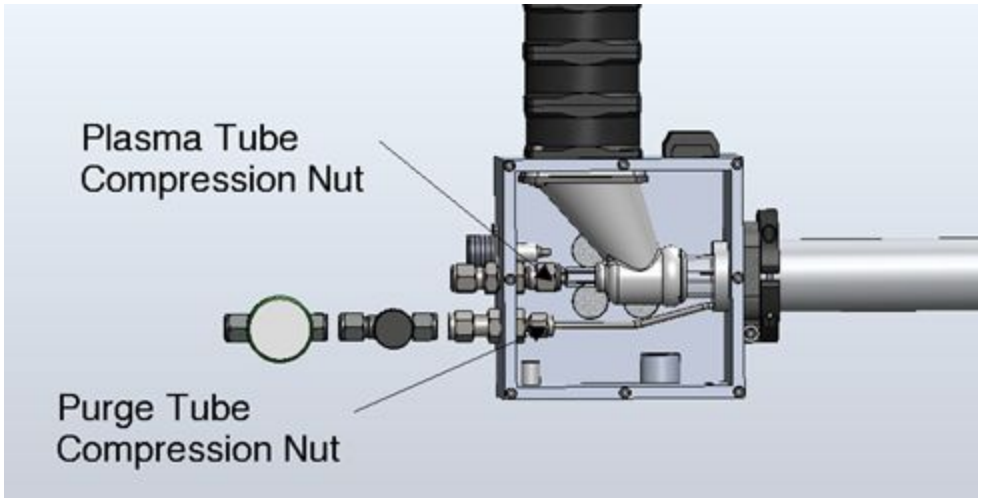
13. Repeat step 7. Slowly increase RF to 100W or higher.
    OPERATE AT LOWEST RF POWER FOR MAX LIFE

14. Note that lamp intensity at He 58nm will saturate (not increase with power) between 100 and 250W with most He pressures.

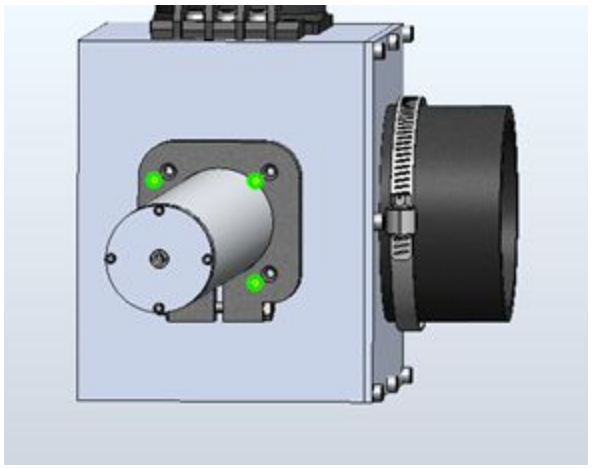
15. Adjust the flow of gas. In normal operation (with Ar, Xe, Kr, Ne, He, or N2) the shut-off valve should be opened and the metering valve set so that the flow of gas is quite small. This will maintain pressure at a few Torr in the flow lamp and less that 10^-1 Torr in the mono/spectrometer.

Removing and Replacing Plasma Tube

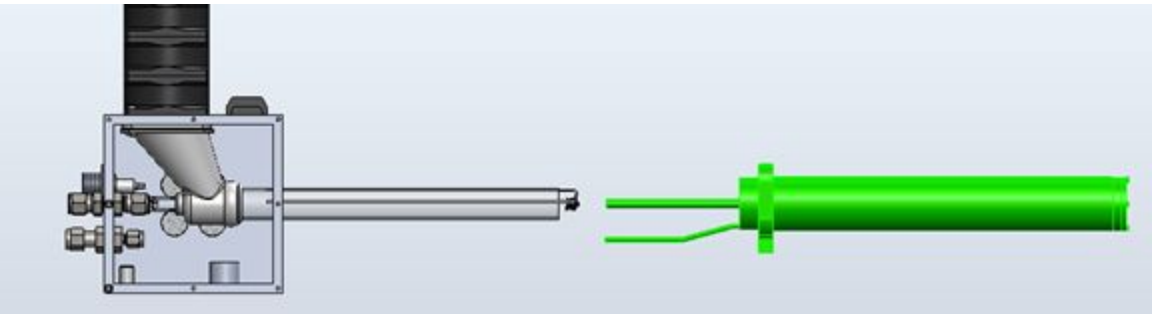
1. Remove cover and loosen plasma tube and purge tube compression fittings.



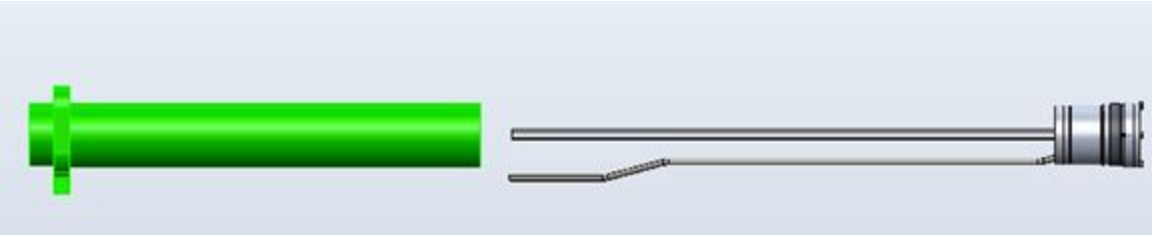
2. Remove 3 screws holding tube locking ring to housing.



3. Slide re-entrant tube assembly out of housing.

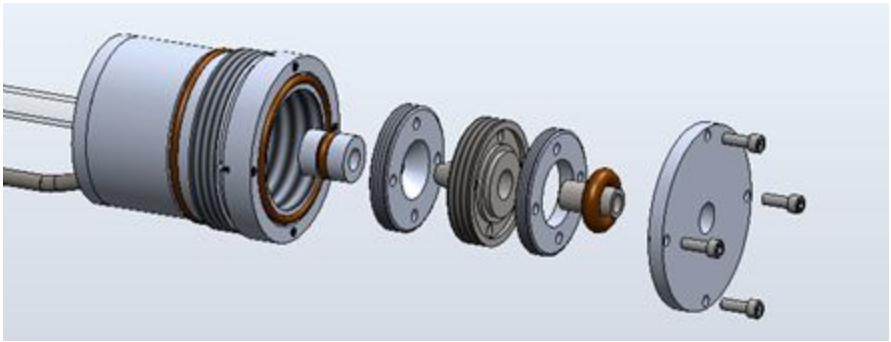


4. Unscrew re-entrant tube from front of assembly.

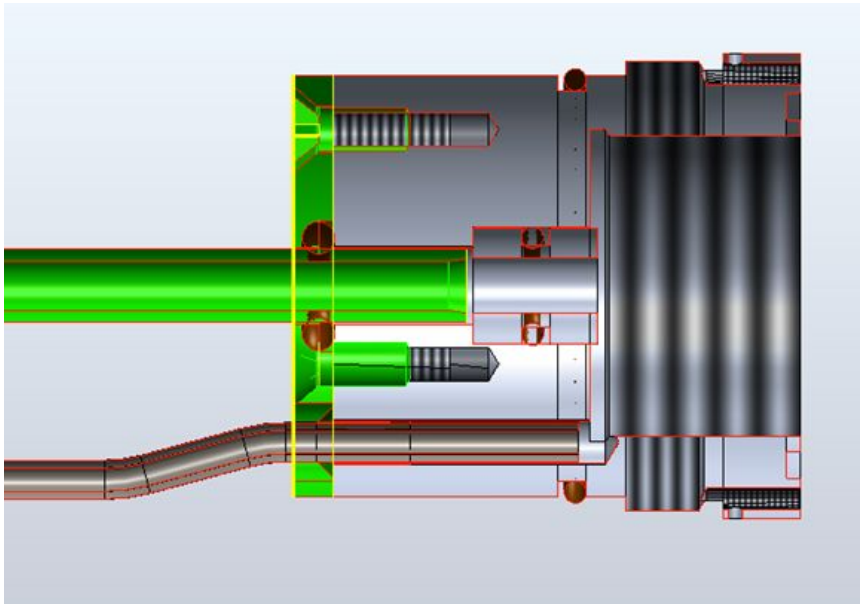


5. Unscrew 3 flat head screws on plasma tube retainer plate and slide plasma tube assembly off of front assembly.

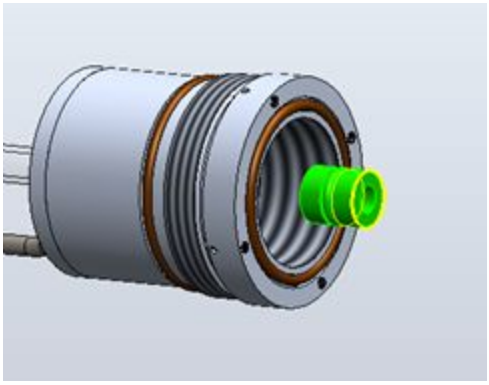
6. Remove entire reverse flow assembly from front adapter.



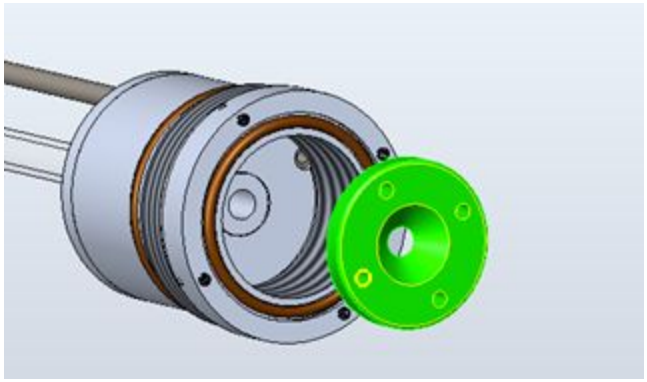
7. Clamp replacement plasma tube into front adapter and adjust to insure there is a 0.1 to 0.5mm gap between the tube end with the taper and the bottom of the wall. This prevents cracking of the plasma tube when the reverse flow assembly is installed.



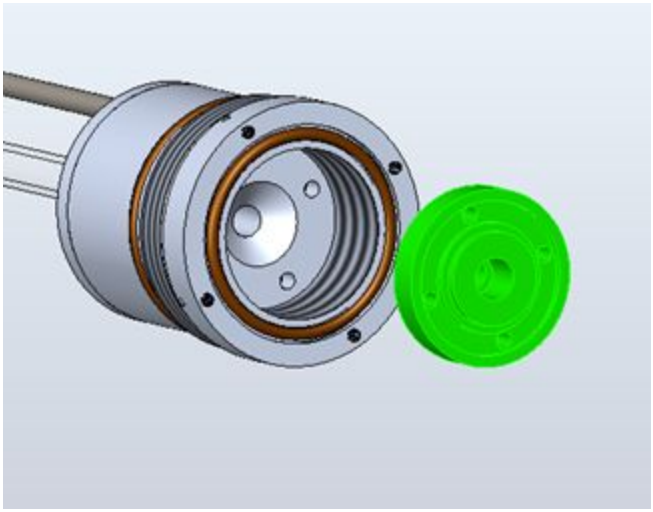
8. Insert shut-off-bushing with its o-ring into front adapter. Make sure it does not hit plasma tube.



9. Screw locking ring into adapter and tighten it to secure shut-off-bushing.

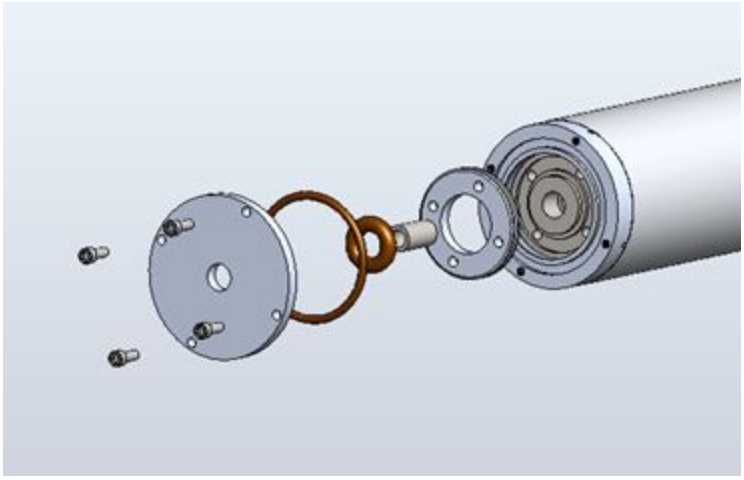


10. Screw cone into front adapter and adjust angle (see Adjust reverse flow nozzle gap procedure, step 4).

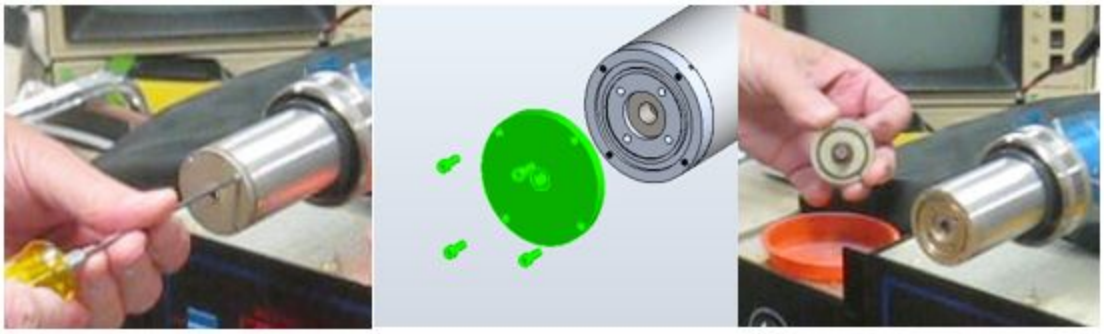


Adjusting Reverse Flow Nozzle Cap

1. Unscrew clamp ring.



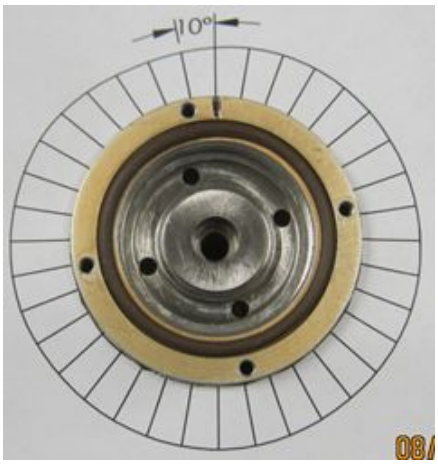
2. Extract clamp ring plus extension tube and o-ring.



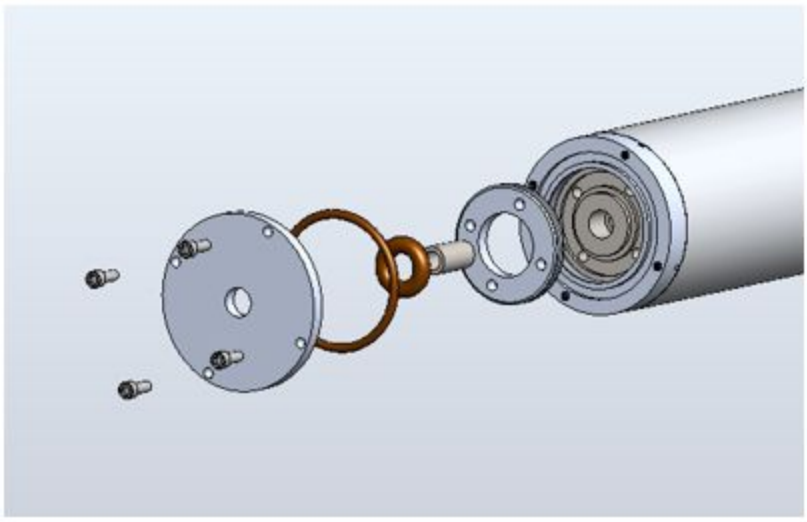
3. Unscrew and remove locking ring.

4. Set to zero gap (gently) and adjust gap to angle.

5. Use template to check angle.



6. Re-assemble locking ring, extension tube an o-ring and clamping plate.



Mounting the Lamp

Refer to the lamp configuration drawings (in this manual). The standard way to mount the lamp is with a 4.5" inch Conflat type flange. When the lamp is attached to the Conflat adaptor it is important to use the Clamping Ring to prevent the lamp from being sucked into the vacuum chamber. The Compression ring by itself is insufficient to prevent the lamp from sliding into the chamber.

The lamp has been vacuum tested and should bolt onto a standard flange or adapter. The lamp is designed to operate on High Vacuum equipment at pressures less than 10^{-7} Torr. The seals in the mounting adapters are viton and should operate to vacuum levels below 10^{-9} Torr.

Caution

- To maximize the life of the electronics avoid running the lamp without generating a plasma.
- The lamp is not designed to be bakable to more than 150°C (non-operational). Precautions should be taken to insure the lamp does not get heated above this temperature during system bake-outs. Additionally, the lamp should not be operated during system bake-outs.

Contact

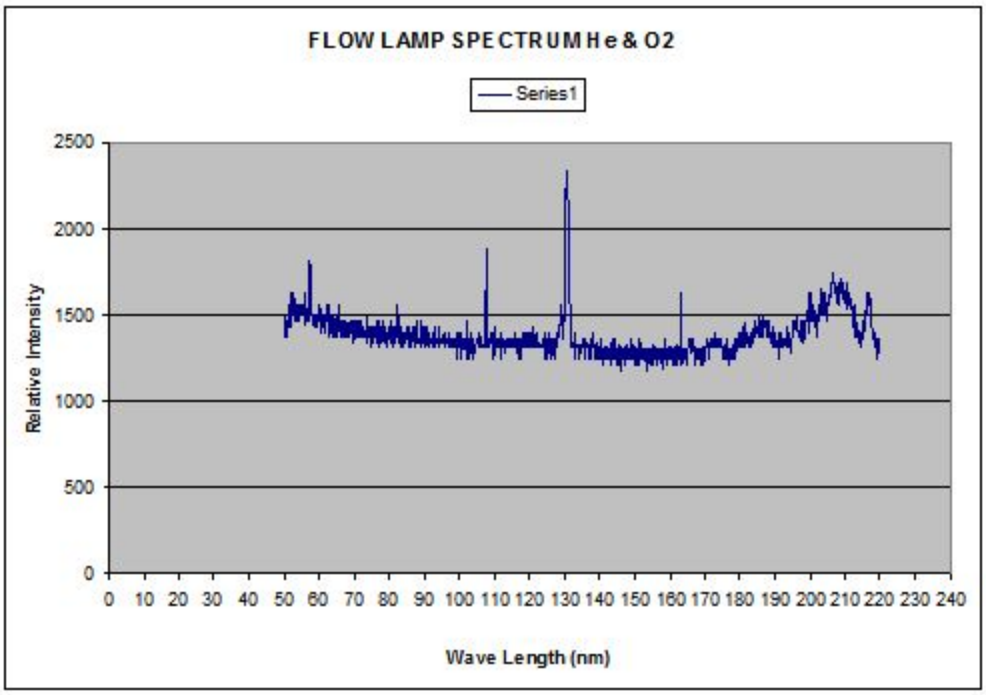
Resonance Ltd. stands behind every product we sell. We welcome feedback and encourage any of our customers to contact us with questions, or concerns. You may contact us through e-mail, our website, telephone, or fax!

Resonance Ltd.
143 Ferndale Drive North
Barrie, ON
L4N 9V9

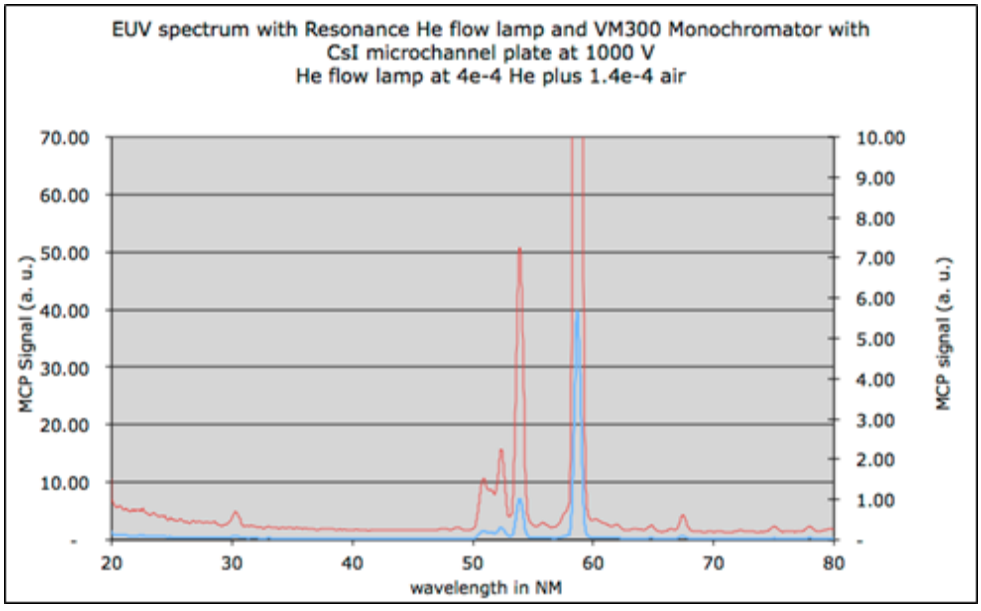
Tel: 705-733-3633
Fax: 705-733-1388
Email: res@resonance.on.ca
Web: www.resonance.on.ca

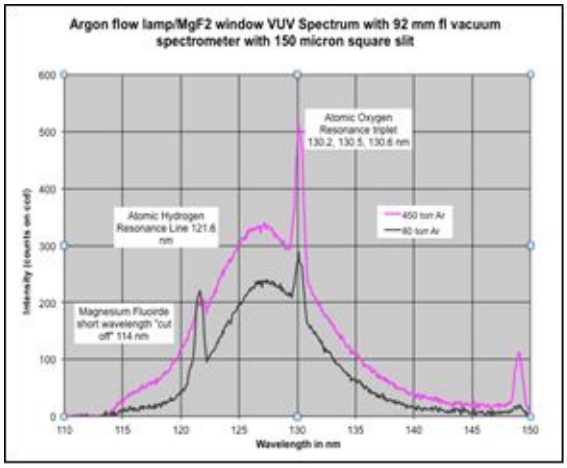
Appendix

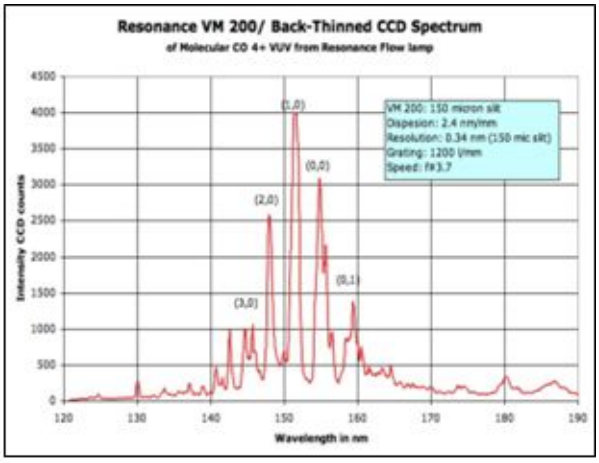
Example spectrum of each lamp supplied using He.

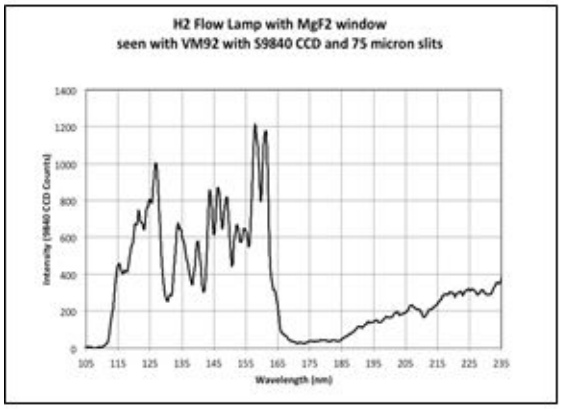


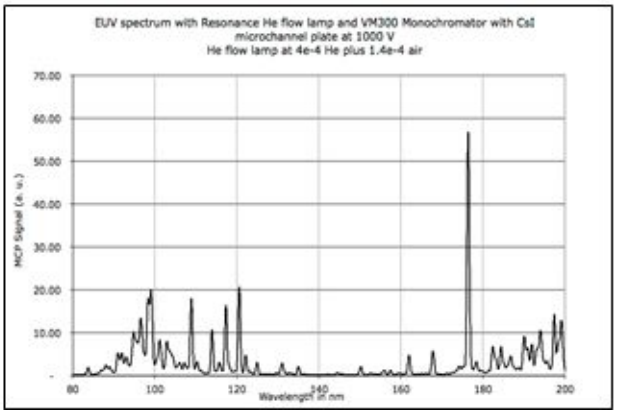
Spectra taken with Resonance VM92, VM200 or VM300 Spectrometers




Argon flow lamp/MgF2 window VUV Spectrum with 92 mm fl vacuum spectrometer with 150 micron square slit
Atomic Oxygen Resonance triplet 130.2, 130.5, 130.6 nm
Atomic Hydrogen Resonance Line 121.6 nm
Magnesium Fluoride short wavelength "cut off" 514 nm
450 torr Ar
80 torr Ar
Intensity (counts on ccd)
Wavelength in nm


Resonance VM 200/ Back-Thinned CCD Spectrum
of Molecular CO 4+ VUV from Resonance Flow lamp
VM 200: 150 micron slit
Dispesion: 2.4 nm/mm
Resolution: 0.34 nm (150 mic slit)
Grating: 1200 l/mm
Speed: f#3.7
(1,0)
(0,0)
(2,0)
(0,1)
(3,0)
Intensity CCD counts
Wavelength in nm


H2 Flow Lamp with MgF2 window
seen with VM92 with S9840 CCD and 75 micron slits
Intensity (9840 CCD Counts)
Wavelength (nm)


EUV spectrum with Resonance He flow lamp and VM300 Monochromator with CsI microchannel plate at 1000 V
He flow lamp at 4e-4 He plus 1.4e-4 air
MCP Signal (a. u.)
Wavelength in nm