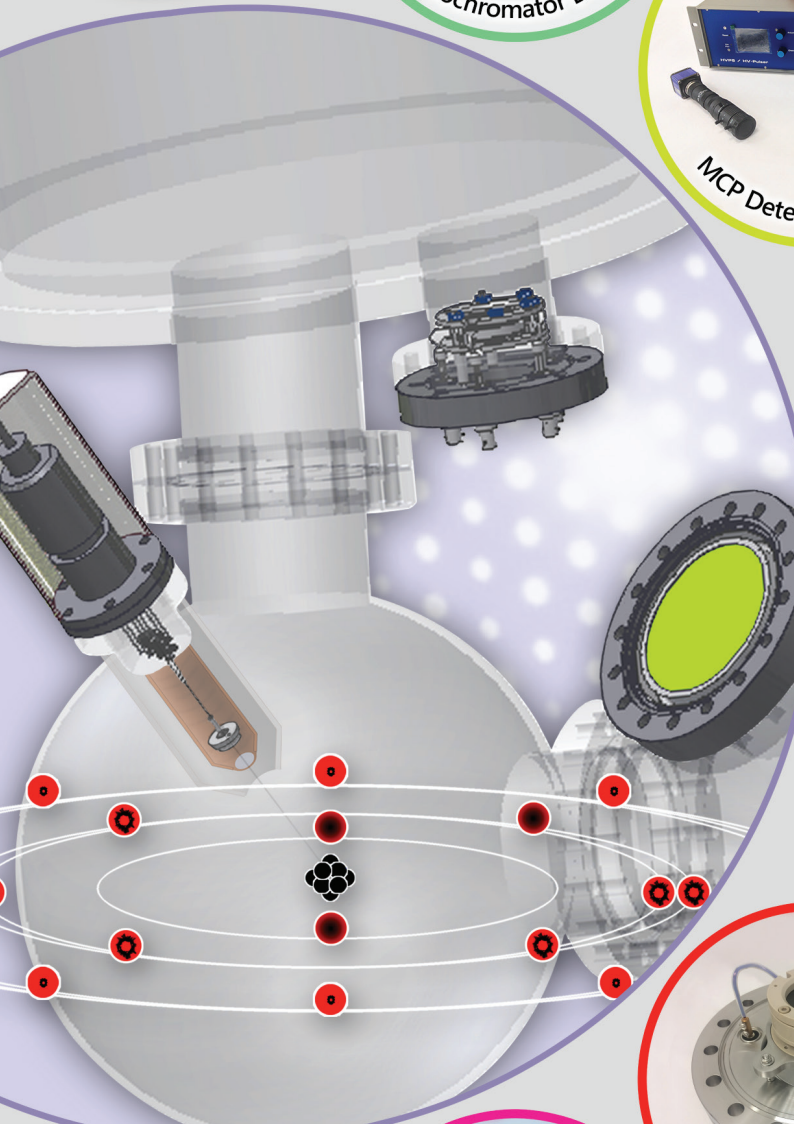
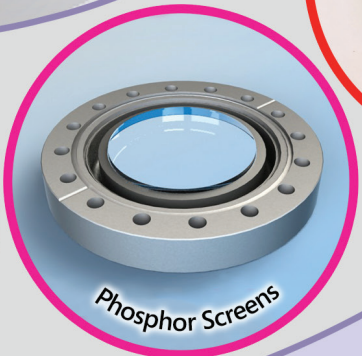
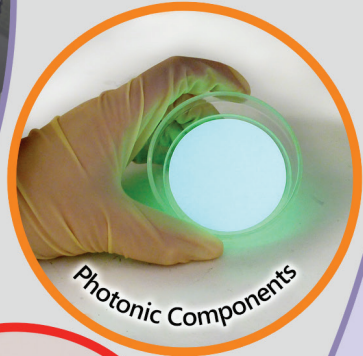
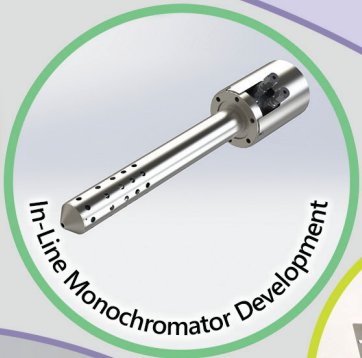




Torr Scientific Ltd.

X-ray and Electron-Optical Components (XEO)

www.torrscientific.co.uk

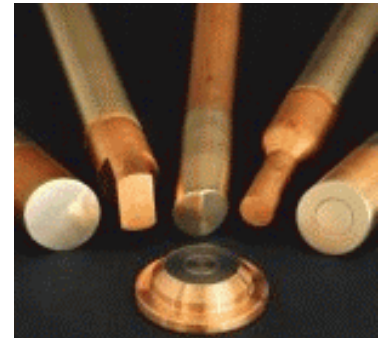


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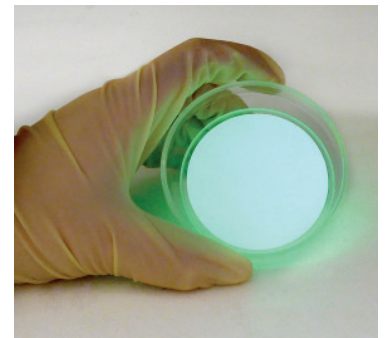
Torr Scientific Ltd.

Specialists in UHV, Optical and X-ray Components



“Welcome to Torr Scientific’s XEO Division”

Welcome to the XEO Division of Torr Scientific which focuses on X-ray and Electron-Optical products. The newly built clean production facility is dedicated to production of X-Ray Anodes and Sources, Electron Sources, Phosphor Screens, Microchannel Plate Assemblies and Torr’s development, The In-Line Monochromator. For further details please use the Products and Services menu.



FS 585099

The company registration number is 3622909

The company VAT number is 702 9779 14



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SECTION 2

CVD DIAMOND

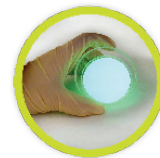
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Torr Scientific relocated to a modern 410 m² factory in Bexhill-on-Sea, East Sussex in August 2009. A 270 m² first floor extension was completed in October 2011 increasing floor space at the Sussex manufacturing site to 690 m². A second adjoining factory and cleanroom was built in 2015 expanding floor space to over 1200 m²

In response to demand from customers requiring contamination free products for UHV applications, the company invested in a new 110 m² cleanroom to provide a laboratory manufacturing facility in which thin-film coatings and hermetic seals are processed. An additional newly commissioned second cleanroom is dedicated to the coating of X-ray source anode components.



Torr Scientific's vacuum furnace has a hot zone four times larger than previous furnaces at TSL. The system incorporates a Microlink control system with data management and logging. The furnace brazes fused silica, sapphire UHV viewports, plus X-ray anode bodies and heatsinks.

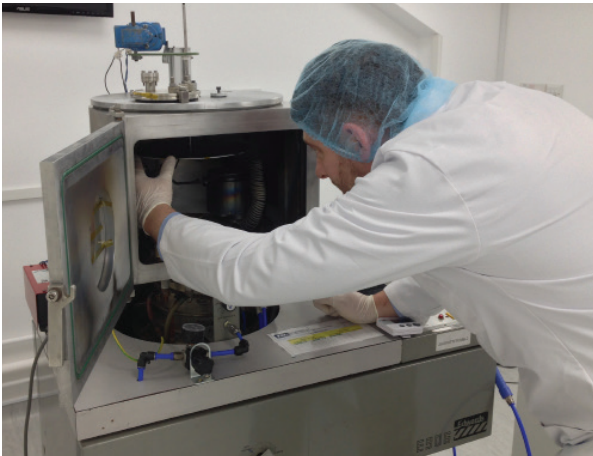
A turntable and TIG welding equipment has been set up at Torr Scientific and products are welded within the company allowing full quality control over the complete manufacturing process. X-ray anode assemblies are welded by highly experienced engineers.



All brazed and welded components are leak tested using TSL's mass spectrometer helium leak testers.

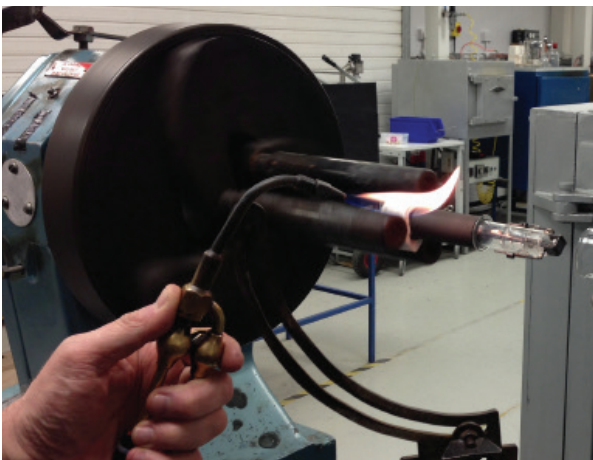
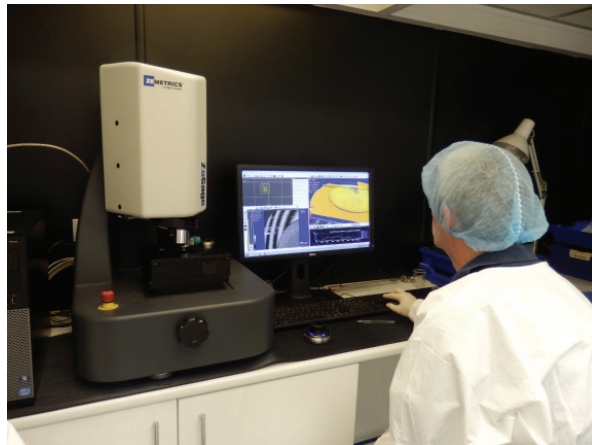
Cleaning and assembly of UHV instrumentation takes place in laminar flow cabinets in cleanroom conditions.





The newly commissioned second cleanroom at Torr Scientific is dedicated to the coating and assembly of X-ray source anode components. The anodes are sputter coated with a metallic anode film to customer requirements, typically being tungsten, aluminium and magnesium. Sputtering can provide a dense well-adhered film if the correct conditions are employed. We optimise our sputter processes by examining fracture cross sections of the coatings in our scanning electron microscope.

Torr Scientific's optical inspection capability includes a Zygo interferometer surface profiler. The profiler enables highly accurate non-destructive examination of surfaces to check thicknesses and uniformity of X-ray anode coatings and optical flatness and seal structure of hermetic seals manufactured at the company. The interferometer brings a greater level of quality control and alongside the existing UV-Vis-IR spectrophotometer strengthens the company's optical and coating test facilities.



Torr Scientific has extended its processing capabilities to include production of glass to metal seals. The facility will also allow further development of the wide range of vacuum optical components offered by the company. OEM and non-standard enquiries are also welcome. A new induction heater has been added to the glass shop and will enable the company to develop its range of glass vacuum windows, feedthroughs and OEM requirements for encapsulation of X-ray and photonic components. The induction heater adds to the current vacuum brazing techniques applied for production of the hermetic seals.

X-Ray Anodes and Sources

Torr Scientific manufactures and refurbishes X-Ray anodes and sources. The anodes emit X-rays in response to an incoming high energy electron beam. When sealed into vacuum devices they become the heart of X-ray tubes which are used in numerous medical, industrial and scientific applications. When incorporated with a vacuum flange, they become the source of X-Rays for analytical instruments used for X-Ray spectrometry, typically in X-Ray Photoelectron Spectroscopy (XPS) UHV surface science systems. TSL manufactures anodes to customer specifications. The devices are manufactured in cleanroom conditions and key processes such as brazing, helium leak testing and thin film coating are all carried out at the company. The company also offers a recoating and refurbishment service for X-Ray anodes on the major surface analysis instruments.



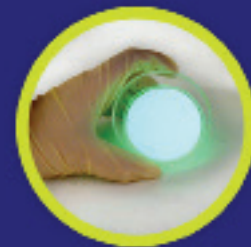
CVD Diamond

Torr Scientific is the European agent for optical and thermal CVD diamond processed at The Plasma Laboratory, Hebei Institute of Laser in China. Natural diamond has always been of extreme scientific interest due to its unmatched properties including hardness, thermal conductivity, broadband transparency, chemical inertness and high temperature stability. However, the cost of natural diamond substrates is prohibitive in most cases. CVD processes have been developed to the point where economical artificial diamond substrates are now readily available. Torr Scientific is offering CVD diamond substrates in various shapes for use in applications such as thermal mounts and laser windows as well as sealed into vacuum viewport assemblies for high vacuum applications. The CVD diamond performance is very close to that of natural diamond, so our customers can take advantage of thermal conductivity that is five times that of copper and high transparency for optical wavelengths that range from 225 nanometers to beyond 100 microns.



Photonic Components

Engineers at Torr Scientific have considerable experience in design, engineering, manufacturing and handling of electro-optical components. This includes hermetic seal know-how, processing of thin films and vacuum technology. Products incorporating fibre optic bundles and micro-channel plates have been manufactured. Phosphor screens are processed for imaging devices and micro-channel plate assemblies can be manufactured in cleanroom conditions for open faced and time of flight detectors.



Chambers, Viewport Accessories and Construction Hardware

A complimentary range of CF viewport shutters is also offered by Torr Scientific. Sealing components such as KF and ISO centering rings, plus CF copper gaskets are also available. Construction components such as KF swing clamps, ISO claw clamps, nuts, bolts and washers and blank flanges can also be found in this catalogue. Torr Scientific is designing and manufacturing UHV chambers for a variety of research applications. The chambers can be quoted to customer specifications and can be offered in 304L, 316L and 316LN stainless steel. All vacuum fabrications are inspected, helium leak tested and cleaned to UHV standards. Pumps, pumping trolleys and assembly packages can also be supplied.





X-Ray Anodes and Sources

SECTION 1

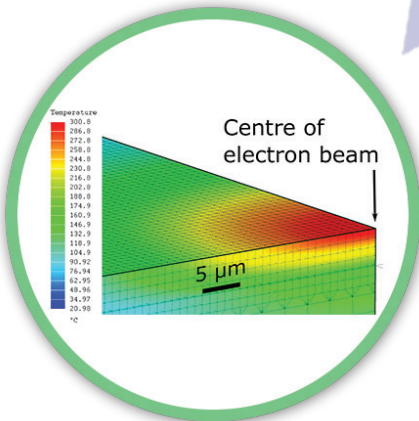
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Brazing of Anode Bodies

X-ray anode bodies and heatsinks are brazed in the vacuum furnace at Torr Scientific. Capabilities include joining various materials including stainless steel to copper and copper to silver and assembly of water-cooled configurations. CVD diamond wafers can be incorporated for customers requiring highly efficient cooling for small spot or high power X-ray applications.



Finite Element Analysis – of CVD diamond heat spreaders for more power

Diamond has thermal conductivity up to 5 times that of copper. CVD (chemical vapour deposited) diamond is grown in a reactor, and is more affordable than gemstone diamonds.

FEA has been used at Torr Scientific to model the complex effects that microstructure can have on the thermal properties of CVD diamond, and how to best deploy CVD-diamond as a heat spreader in X-ray anodes.

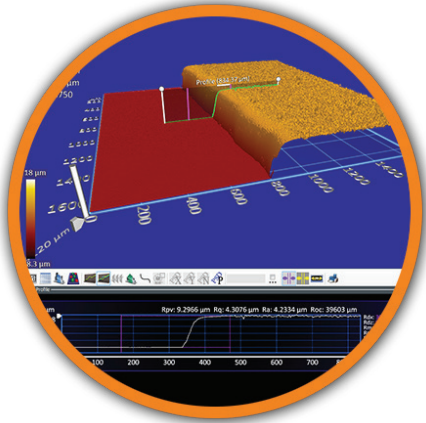
Welding and Leak-Testing

The anode assemblies are TIG (tungsten inert gas) welded by our highly experienced engineers. The assemblies are then cleaned, inspected, and helium leak tested. Helium, being one of the very smallest gas species, makes the leak test highly sensitive and ensures UHV (ultra-high vacuum) performance. Water cooled anodes are additionally tested for water flow.



Sputter Coating of X-ray Anodes

The newly commissioned second cleanroom at Torr Scientific is dedicated to the coating and assembly of X-ray source anode components. The anodes are sputter coated with a metallic anode film to customer requirements, typically being tungsten, aluminium and magnesium. Sputtering can provide a dense well-adhered film if the correct conditions are employed. We optimise our sputter processes by examining fracture cross sections of the coatings in our scanning electron microscope.

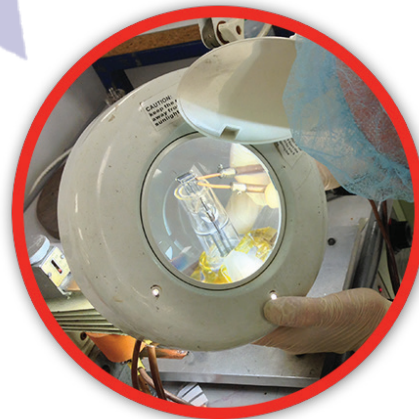


White Light Interferometer – inspection of thickness and finish

Torr Scientific use a Zygo ZeGage white light interferometer for precise assessment of coating thicknesses, surface finish and grain size. The technique requires little or no sample preparation and is non-destructive. Advanced data processing software allows filtering of curvature for quantitative assessment of surface roughness, or filtering of fine details to allow more precise measurements of overall form. Data stitching allows measurements of larger areas covering tens or even hundreds of millimetres.

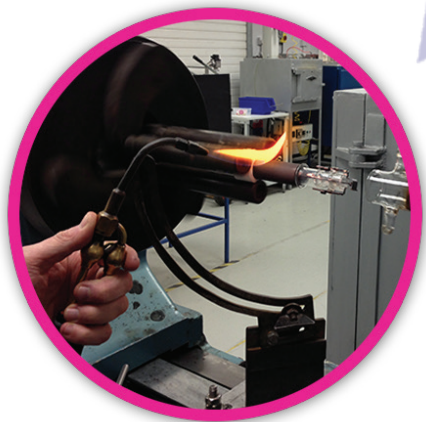
Filament Assembly

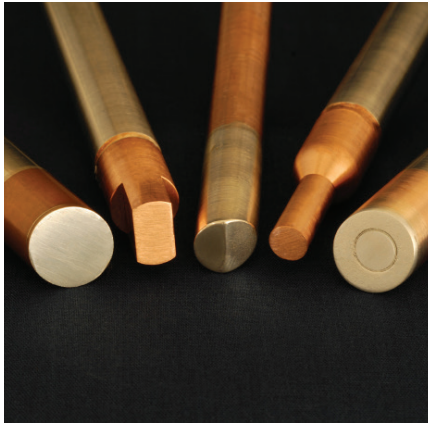
Cathode filaments are formed and assembled in cleanroom conditions, prior to incorporation into X-ray source assemblies. For higher electron emission, thoriated tungsten may be used. Alternatively, Torr Scientific can apply a thoria coating to a formed filament.



Glass Shop

The glass shop at Torr Scientific manufactures housings for vacuum and X-ray devices, feedthrough bases incorporating glass-to-metal seals and glass vacuum optics sealed into metal holders. Glass-to-metal seals may incorporate regions of grading from one glass to another, to reduce thermal expansion mismatch. Our glasswork is used in high power X-ray devices, ionising radiation detectors and vacuum gauges.

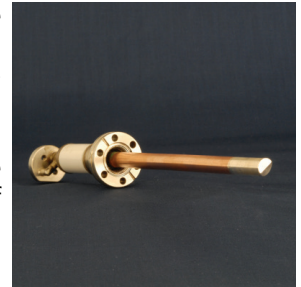




Torr Scientific manufactures and refurbishes X-Ray anodes and sources. The anodes emit X-rays in response to an incoming high energy electron beam. When sealed into vacuum devices they become the heart of X-ray tubes which are used in numerous medical, industrial and scientific applications. When incorporated with a vacuum flange, they become the source of X-Rays for analytical instruments used for X-Ray spectrometry, typically in X-Ray Photoelectron Spectroscopy (XPS) UHV surface science systems. TSL manufactures anodes to customer specifications. The devices are manufactured in cleanroom conditions and key processes, such as brazing, helium leak testing and thin film coating are all carried out at the company. Torr Scientific also offers a recoating and refurbishment service for X-Ray anodes on the major surface analysis instruments.

X-Ray Anode Recoating and X-Ray Source Refurbishment Service

Torr Scientific offers a recoating service for x-ray anodes used on all the major surface analysis instruments. The company can coat both twin and monochromator anodes using the usual materials, magnesium and aluminium, plus the more exotic such as silver, zirconium, yttrium and titanium. All work is conducted to the highest standards in an ISO9001:2015 approved company by people who have a strong background in surface analysis related instrumentation and therefore understand the issues of cleanliness and contamination. The latest sputter coating technologies are used to produce clean, pure, strongly adhering coatings, which are very rugged.



The company offers several different levels of service:

- A mechanical and chemical clean and sputter coating with magnesium and aluminium typically 10µm thick. Recoating of both mono and twin anodes is offered and includes coating with zirconium, yttrium and titanium.

- A more specialist re-coat including a proprietary barrier layer for more recent instruments using higher powered and stressed anodes, or simply for older instruments to enhance anode lifetime. The barrier layer prevents lower melting point Al/Cu or Mg/Cu eutectics forming which limit power and lifetime.

- A full re-tip, cathode replacement and re-build can be quoted on an individual basis, including silver or copper tips, plus diamond and longer life tips

Anodes should be sent to Torr Scientific in transit tubes and with a health and safety statement confirming that the item is free from hazardous materials. Exposure of magnesium anodes to air should be kept to a minimum. The anodes will therefore be shipped to you in the transit tubes filled with an inert gas. The transit tube can also be provided on request.

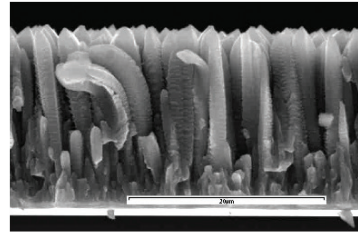
Diamond Tipped X-Ray Anodes

Torr Scientific has advanced its ability to produce ever higher performance capability for X-ray anodes. The company has developed an in-house process that adds a single crystal CVD diamond layer between the copper heat sink and the target material. The unmatched thermal conductivity of diamond enables far greater heat transfer from the target material to the copper heat sink. Torr uses advanced brazing techniques to vacuum seal the diamond to the heat-sink and applies new sputter coating technology to apply thick layers of anode materials with outstanding adhesion and surface finish qualities. This advance is particularly important where the highest possible X-Ray energy and power density is desired. Power densities have tripled as a result. Torr Scientific now offers these advanced technologies in everything from the refurbishing and recoating of existing X-Ray anodes to the manufacturing of complete X-Ray anode assemblies to customer specifications.

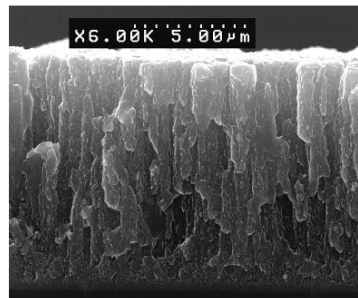


Coherent Anode Coatings

As part of Torr Scientific's X-Ray Source development project, the company has been working with the Faculty of Engineering and Physical Sciences at The University of Surrey to maximise the adhesion, thermal conduction and X-ray yield of anode coatings. Images viewed on a scanning tunneling microscope of a cross section of typical sputtered aluminium coating showed poor surface integrity with many voids in the structure. The optimum sputter coating conditions were researched and the coating control procedure reviewed to deliver the optimum process conditions which has resulted in denser, more coherent films. Finite element analysis and Monte Carlo simulation of electron interactions has also been carried out to study the performance of diamond tipped anodes, brazed in the Torr Scientific vacuum furnace. The company offers an X-ray anode refurbishment and recoating service and also welcomes enquiries for customer specific thin film coating and vacuum brazing requirements.



Before and after. Above, the cross section of a typical aluminium sputter coating compared to below, the improved dense film after the optimum process conditions have been applied.



X-ray Anodes and Sources



Torr Scientific is developing an In-Line Monochromator for surface analysis applications. Please contact Torr Scientific if you would like to be updated regarding this project.

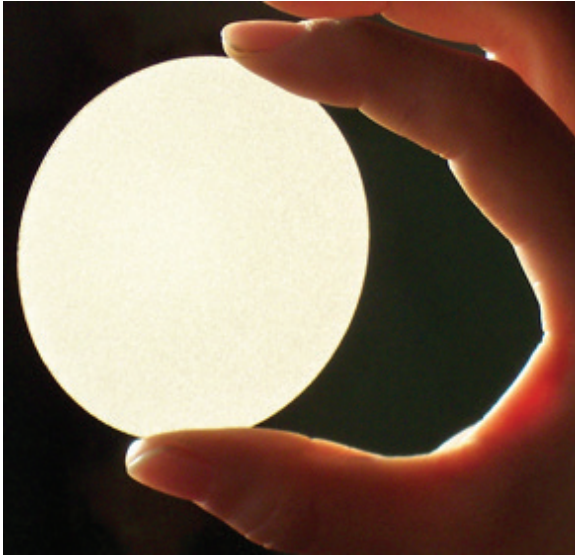
CVD Diamond

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CVD DIAMOND

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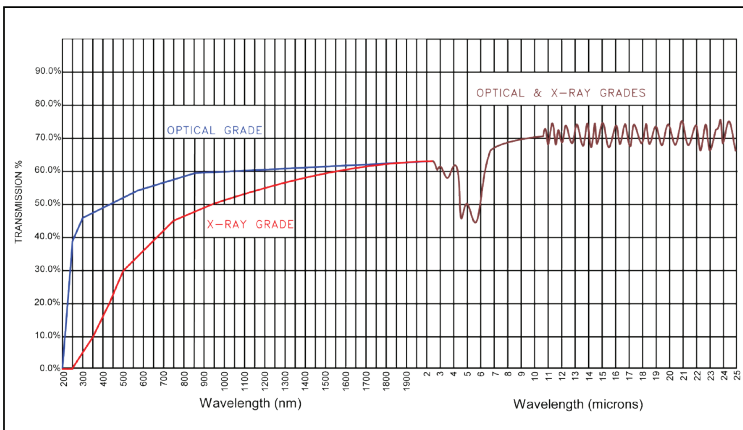
Specification	
Tolerance of Thickness:	±25 µm
Flatness:	<4 µm/cm
Thermal Conductivity:	Up to 1800 W/mK (1000 - 1500 W/mK typical)
Density:	3.5 g/cm ³
Young's Modulus:	1220 GPa
Growth Side Surface Finish:	<100 nm R _a
Nucleation Side Surface Finish:	<30 nm R _a

Synchrotrons are capable of generating beams over a wide spectral range and therefore optical components should exhibit high transparency to accommodate such wavelengths. Diamond is unique among all known materials due to its wide spectral transparency but is not a cost-effective solution in its natural form. Synthetic diamond, however, produced in the laboratory by chemical vapour deposition (CVD) techniques at a fraction of the cost, has very similar properties to natural diamond. This includes extreme hardness, high thermal conductivity and the necessary transparency for optical wavelengths that range from 220 nanometres to beyond 100 microns, making CVD diamond an ideal choice for synchrotron applications.

CVD diamond benefits include:

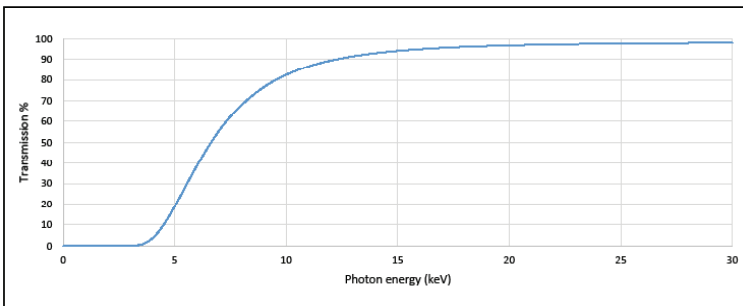
- **Exceptional broadband infrared transparency**
- **Excellent thermal conductivity**
- **High fracture strength**
- **Transparency in the optical and ultraviolet spectrum**
- **Low scatter in infrared**
- **Low thermal expansion coefficient**

Transmission Curve - CVD Diamond



Optical transmission for CVD diamond showing good transparency from UV through to IR (note the varying horizontal scale). The low optical absorption, high thermal conductivity and physical and chemical ruggedness of the diamond, mean that it can tolerate high radiation flux for extended periods compared with other window materials.

Please note that the optical transmission curves are approximations and should be used for reference only



The transmission of X-rays through 250 µm thick CVD diamond as a function of photon energy, showing around 15% attenuation at 10 keV, and less than 5% attenuation above 15 keV.

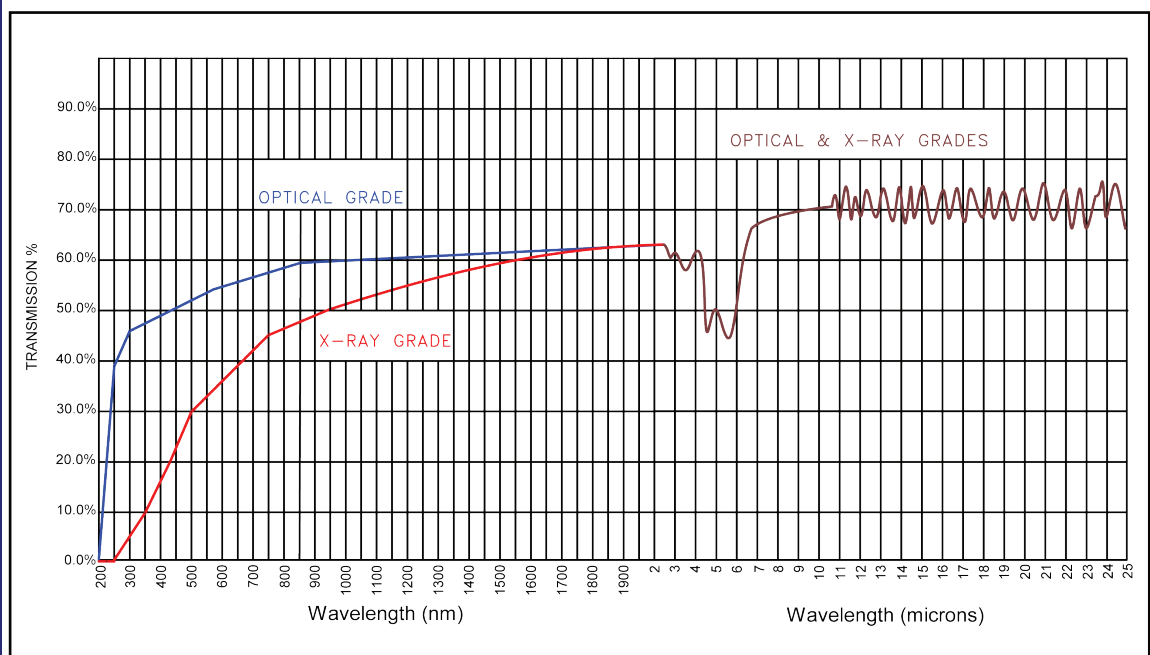




Specification	
Seal Type	Braze
Maximum Temperature	450 °C 304L, 600 °C 316LN
Minimum Temperature	minus 20 °C
Maximum Rate of Temperature Change	3 °C per minute
Window Roughness	30nm Ra
Leak Rate	<1x10 ⁻¹⁰ atm-cc/sec (He)
Pressure Range	1 bar to 1x10 ⁻¹¹ mbar

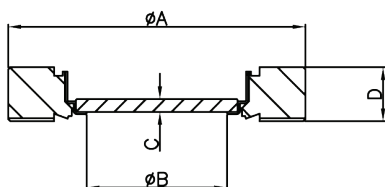
Torr Scientific CVD Diamond UHV Viewports are offered as standard in CF flanges, but can be supplied in ISO, KF or custom designed flanges on request. The viewports comprise a diamond window which is synthetically produced by a chemical vapour deposition (CVD) process. The ultra high vacuum (UHV) CF versions are offered using high grade 304L or 316LN stainless steel flanges. TSL viewports are manufactured in cleanroom conditions and helium leak tested, cleaned and packed to UHV standards. The rugged construction of the CVD Diamond viewports allows repeated bake-out with UHV performance. The transmission properties of the CVD Diamond extend from visible through FIR to beyond 100 microns. The window is polished to a surface roughness of 30nm Ra, has high thermal conductivity and good bio compatibility. Various anti-reflective coatings to match customer reflectance requirements are also processed at TSL. Non-standard viewports can be manufactured on request, including re-entrant style microscope/camera viewports. Annealed copper gaskets and other component accessories are also supplied by TSL.

Transmission Curve - CVD Diamond

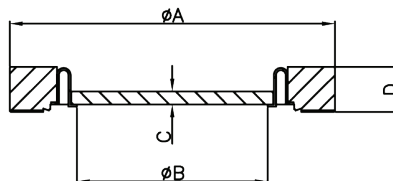


Please note that the optical transmission curves are approximations and should be used for reference only

CF-1



CF-2



CVD Diamond
UHV Viewports

Part Number	Flange Type	A (mm)	B (mm)	C (mm)	D (mm)	Dia-gram	Flange Material	Weld Ring Material	Window Grade
VPZ16CVDDX	NW16CF	34	15	0.5	12.7	CF-1	304L	Kovar	X-ray
VPZ16CVDD	NW16CF	34	15	0.5	12.7	CF-1	304L	Kovar	Optical
VPZ16CVDDX-LN	NW16CF	34	15	0.5	12.7	CF-1	316LN	Kovar	X-ray
VPZ16CVDD-LN	NW16CF	34	15	0.5	12.7	CF-1	316LN	Kovar	Optical
VPZ38-15CVDDX	NW35CF	70	15	0.5	12.7	CF-1	304L	Kovar	X-ray
VPZ38-15CVDD	NW35CF	70	15	0.5	12.7	CF-1	304L	Kovar	Optical
VPZ38-15CVDDX-LN	NW35CF	70	15	0.5	12.7	CF-1	316LN	Kovar	X-ray
VPZ38-15CVDD-LN	NW35CF	70	15	0.5	12.7	CF-1	316LN	Kovar	Optical
VPZ38-20CVDDX	NW35CF	70	20	1	12.7	CF-2	304L	Kovar	X-ray
VPZ38-20CVDD	NW35CF	70	20	0.5	12.7	CF-2	304L	Kovar	Optical
VPZ38-20CVDDX-LN	NW35CF	70	20	1	12.7	CF-2	316LN	Kovar	X-ray
VPZ38-20CVDD-LN	NW35CF	70	20	0.5	12.7	CF-2	316LN	Kovar	Optical

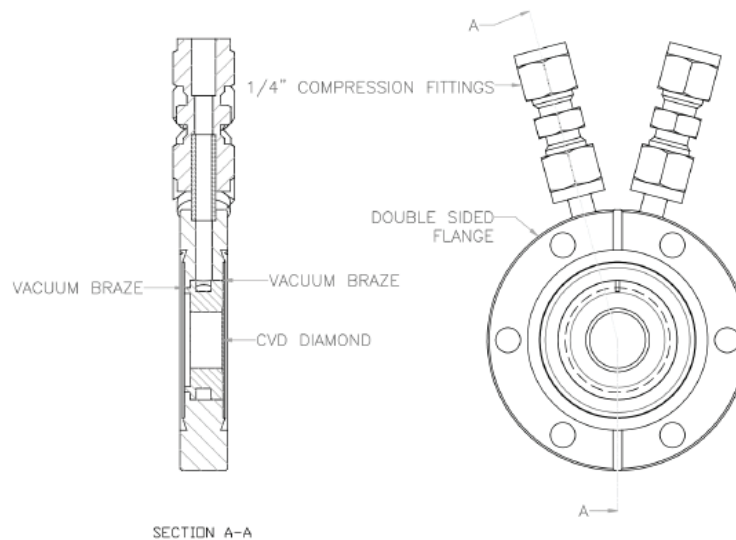
Water Cooled X-Ray UHV Windows



Specification	
Seal Type	Braze
Maximum Temperature	200 °C
Minimum Temperature	-20 °C
Maximum Rate of Temperature Change	3 °C per minute
Window Roughness	30 nm R _a
Leak Rate	<1x10 ⁻¹⁰ atm-cc/sec (He)
Pressure Range	1 bar to 1x10 ⁻¹¹ mbar

High Thermal Conductivity

CVD diamond windows used in synchrotron applications can be subjected to high thermal loads due to the absorption of low-energy X-rays. Since CVD diamond possesses excellent thermal conductivity, the absorbed energy is quickly dissipated to the edge of the diamond window where it can be removed by a simple and efficient cooling technique. Water-cooled CVD diamond windows are therefore ideal in applications which involve higher frequencies or higher power. Torr Scientific manufactures a standard range of water-cooled CVD diamond windows, supplied in either 304L or high-grade 316LN CF flanges. Bespoke windows are also available on request.



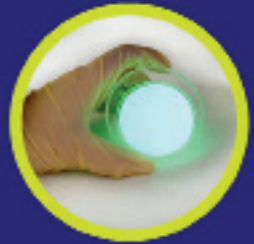
Part Number	Flange Type	OD (mm)	View Diameter (mm)	Optic Thickness (mm)	Flange Thickness (mm)	Flange Material	Window Grade
VPZ38-15CVDDX-WC	NW35CF Double sided	70	15	0.5	12.7	304L	X-ray
VPZ38-15CVDD-WC	NW35CF Double sided	70	15	0.5	12.7	304L	Optical
VPZ38-15CVDDX-LN-WC	NW35CF Double sided	70	15	0.5	12.7	316LN	X-ray
VPZ38-15CVDD-LN-WC	NW35CF Double sided	70	15	0.5	12.7	316LN	Optical
VPZ38-20CVDDX-WC	NW35CF Double sided	70	20	0.5	12.7	304L	X-ray
VPZ38-20CVDD-WC	NW35CF Double sided	70	20	0.5	12.7	304L	Optical
VPZ38-20CVDDX-LN-WC	NW35CF Double sided	70	20	0.5	12.7	316LN	X-ray
VPZ38-20CVDD-LN-WC	NW35CF Double sided	70	20	0.5	12.7	316LN	Optical

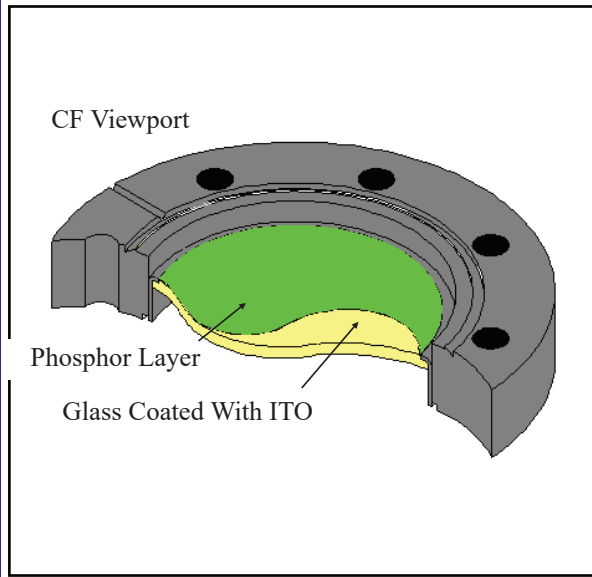
Photonic Components

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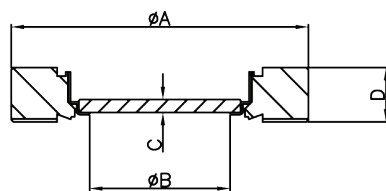




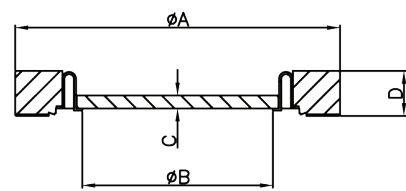
Specification	
Seal Type	Induction
Weld Ring	Kovar
Standard Phosphor	P22 yellow/green
Coating	Indium Tin Oxide (ITO) conducting underlayer on vacuum face of window
Maximum Temperature	350 °C
Minimum Temperature	minus 20 °C
Maximum Rate of Temperature Change	3 °C per minute
Leak Rate	1×10^{-10} atm-cc/sec (He)
Pressure Range	1 bar to 10^{-11} mbar

Torr Scientific produces a range of RHEED screens which are processed using kodial glass zero length viewports with kovar weld rings and options of 304L or 316LN CF flanges. P22 yellow green phosphor is supplied as standard and other phosphors including P11, P43 and P46 can be supplied on request. Options with additional 6mm thick lead glass discs for X-Ray protection are also offered. Screens can be prepared to customer design including phosphor layers directly on to lead glass windows. RHEED, Reflection High Energy Electron Diffraction, is a typical application used as a structural probe during material growth and deposition in Molecular Beam Epitaxy. Torr Scientific also refurbishes LEED screens and processes custom specific phosphor screens on various substrates, typically glass and lead glass.

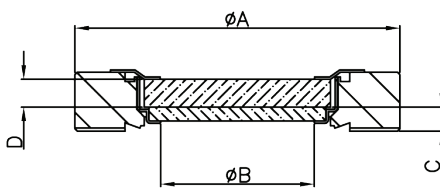
CF-1



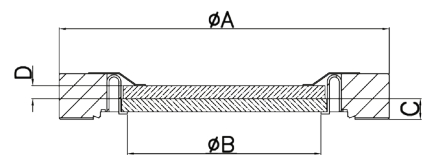
CF-2



CF-3



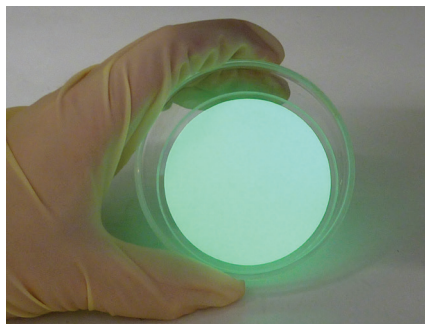
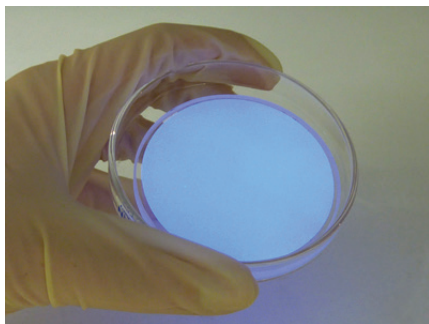
CF-4



Part Number	Flange Type	A (mm)	B (mm)	C (mm)	D (mm)	Dia-gram	Flange Material	X-ray protection lead glass (6mm thick)
VPZ16ITOP22	NW16CF	34	15	1	12.7	CF-1	304L	
VPZ16ITOP22LG	NW16CF	34	15	1	12.7	CF-3	304L	Yes
VPZ16ITOP22-LN	NW16CF	34	15	1	12.7	CF-1	316LN	
VPZ16ITOP22LG-LN	NW16CF	34	15	1	12.7	CF-3	316LN	Yes
VPZ38ITOP22	NW35CF	70	32	2.5	12.7	CF-1	304L	
VPZ38ITOP22LG	NW35CF	70	32	2.5	12.7	CF-3	304L	Yes
VPZ38ITOP22-LN	NW35CF	70	32	2.5	12.7	CF-1	316LN	
VPZ38ITOP22LG-LN	NW35CF	70	32	2.5	12.7	CF-3	316LN	Yes
VPZ64ITOP22	NW63CF	114	63	3	17.4	CF-1	304L	
VPZ64ITOP22LG	NW63CF	114	63	3	17.4	CF-3	304L	Yes
VPZ64ITOP22-LN	NW63CF	114	63	3	17.4	CF-1	316LN	
VPZ64ITOP22LG-LN	NW63CF	114	63	3	17.4	CF-3	316LN	Yes
VPZ100ITOP22	NW100CF	152	89	4	19.9	CF-2	304L	
VPZ100ITOP22LG	NW100CF	152	89	4	19.9	CF-4	304L	Yes
VPZ100ITOP22-LN	NW100CF	152	89	4	19.9	CF-2	316LN	
VPZ100ITOP22LG-LN	NW100CF	152	89	4	19.9	CF-4	316LN	Yes
VPZ150ITOP22	NW150CF	203	136	6.5	22.3	CF-2	304L	
VPZ150ITOP22LG	NW150CF	203	136	6.5	22.3	CF-4	304L	Yes
VPZ150ITOP22-LN	NW150CF	203	136	6.5	22.3	CF-2	3016LN	
VPZ150ITOP22LG-LN	NW150CF	203	136	6.5	22.3	CF-4	316LN	Yes

For alternative phosphor types please replace 'P22' in the part code with P11, P43 or P46.

Phosphor Type	Chemical Composition	Typical Peak Wavelength	Fluorescent Colour	Chromaticity Coordinates (X,Y)	Decay Time	Information
P11	ZnS:Ag	460 nm	Blue	0.139, 0.148	34µs	Good energy conversion (efficiency) for blue light
P22	ZnS:Cu, Al	-	Yellowish-green	0.281, 0.621	1-100ms	Used in colour televisions
P43	Gd2O2S:Tb3+	545 nm	Green	0.344, 0.568	1ms	Excellent scintillator for x-rays < 250nm
P46	Y3Al5O12:Ce3+	530nm	Yellow-green	0.294, 0.532	300ns	Flying-spot equipment



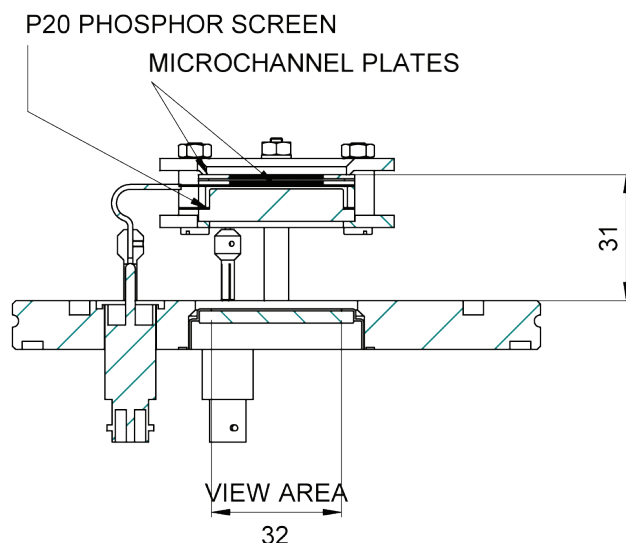
UHV CF RHEED Screens



Specification	
MCP Type	MCP Hard Edge
Open Area Ratio	60%
Gain	10^{-6} - 10^{-7} typical
PHD	FWHM/A < 120%
Output	P22G (Green) High Resolution Al backed
Strip Current	< 20 μ A
Mounting	Detector is mounted on standard ISO100 or CF100
Feedthrough Type	SHV

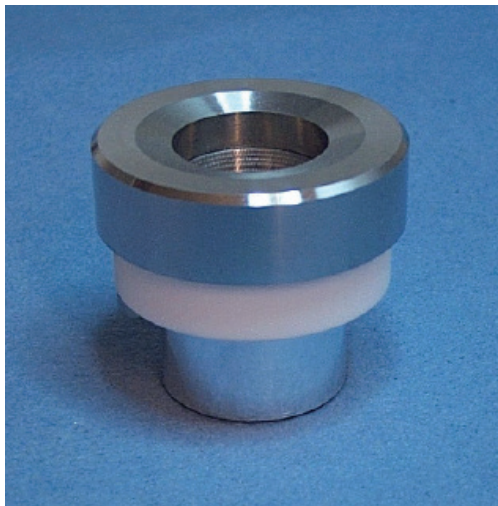
Application	Options
• Mass Spectrometry	• \varnothing 18 mm, \varnothing 25 mm, \varnothing 40 mm & \varnothing 50mm
• Electron Detection	• Single, double and triple MCP versions
• X-ray Detection	• High Resolution Screens with P20,P22, P43, P46, P47. Others available on request
• UV Detection	• Fiber optic or glass output window
• Ion Detection	• Anti Reflective Coating for High efficiency light output
• Time-of-Flight Measurements	• Magnetic free MCP detectors available
• Short time particle beam adjustments	• Taper coupling to CCD possible

MCP detectors are used in a variety of applications including UV, VUV and EUV spectroscopy, atomic and molecular physics, TOF mass-spectrometry of clusters and biomolecules, surface studies and space research. These vacuum imaging detectors can be supplied as a totally assembled unit that can be easily mounted on any support substrate or directly on a vacuum flange. They also can be supplied pre-mounted on a standard CF flanges or ISO Vacuum flange. As the MCP is operated with a high voltage of about 1 kV per stage, a relatively high degree of vacuum must be required. If the MCP is operated at a deficient vacuum, not only the noise increases due to the ion generation in the channels, but also the lifetime may be shortened and, in the worst case, the MCP may be damaged by discharge. It is therefore recommended that the MCP be operated at the highest possible level of vacuum. When using a new MCP, it is recommended that before applying a voltage to it the system be evacuated at a pressure of 5×10^{-6} torr or below for more than 24 hours. If the evacuation time is short or the degree of vacuum is deficient a discharge may occur.



The part numbers listed below all assume either a CF100 or ISO100 flange, a glass window and a P20 yellow/green phosphor screen. Alternative designs incorporating different MCPs, flanges and screens can be quoted on request. Versions with fibre optic outputs for coupling to CCD cameras can also be manufactured.

Part Number	Flange Type	No. of MCPs	MCP OD (mm)	MCP Effective Dia (mm)	MCP Pore Size (μ)	Window/Screen
TSCF100118OFD	NW100CF 154mm OD	1	18	14.5	4	Glass/P20
TSCF100218OFD	NW100CF 154mm OD	2	18	14.5	4	Glass/P20
TSIS100118OFD	ISO100 130mm OD	1	18	14.5	4	Glass/P20
TSIS100218OFD	ISO100 130mm OD	2	18	14.5	4	Glass/P20
TSCF100125OFD	NW100CF 154mm OD	1	25	20	12	Glass/P20
TSCF100225OFD	NW100CF 154mm OD	2	25	20	12	Glass/P20
TSIS100125OFD	ISO100 130mm OD	1	25	20	12	Glass/P20
TSIS100225OFD	ISO100 130mm OD	2	25	20	12	Glass/P20
TSCF100133OFD	NW100CF 154mm OD	1	32.8	27	12	Glass/P20
TSCF100233OFD	NW100CF 154mm OD	2	32.8	27	12	Glass/P20
TSIS100133OFD	ISO100 130mm OD	1	32.8	27	12	Glass/P20
TSIS100233OFD	ISO100 130mm OD	2	32.8	27	12	Glass/P20
TSCF100138OFD	NW100CF 154mm OD	1	38.5	32	12	Glass/P20
TSCF100238OFD	NW100CF 154mm OD	2	38.5	32	12	Glass/P20
TSIS100138OFD	ISO100 130mm OD	1	38.5	32	12	Glass/P20
TSIS100238OFD	ISO100 130mm OD	2	38.5	32	12	Glass/P20
TSCF100150OFD	NW100CF 154mm OD	1	50	42	12	Glass/P20
TSCF100250OFD	NW100CF 154mm OD	2	50	42	12	Glass/P20
TSIS100150OFD	ISO100 130mm OD	1	50	42	12	Glass/P20
TSIS100250OFD	ISO100 130mm OD	2	50	42	12	Glass/P20



Torr Scientific designed a range of Ion Time-of-Flight Detectors for use, for example, in time-of-flight mass spectrometers such as MALDI-TOF instruments. The detector can use a number of different manufacturers micro-channel plates. To obtain the fastest pulse rise times the smallest pore sizes are necessary. The detector envelope has been designed to be within the space envelope of current detectors on the market, although through a novel design and clever use of machineable glass ceramics the component count has been reduced substantially such that the detector can be offered at competitive prices. The ingenious use of MGC has also made it possible to design the detector with very large high voltage and vacuum outgassing clearances so that the detector can be installed and run in a very short time without concerns over damaging internal flash-overs that could ruin a channelplate. The conical anode and concentric body have been designed to give optimum 50 Ω matching to get fastest rise times and minimum ringing from reflections.

There are currently three models available. The parts below are unmounted. Please specify preferred flange type and size and any other important dimensions or specifications and we will be pleased to quote for an assembly to suit your application. Good detector performance in terms of rise time and pulse shape is just part of the problem. For very high speed detectors the detection 'system' must be dealt with holistically as the cabling, detector and connectors must perform well as a transmission line. Typical co-axial connectors have a VSWR (voltage standing wave ratio) of 1.05 meaning 5% of the energy in the 'wave' gets reflected at each connector. This not only reduces the peak height, but also broadens the peak, and results in ringing tails, so you want to minimise the number of connections. For this reason TSL can also provide a connection kit comprising the very best solid coaxial cable matched to the detector, with a vacuum flange brazed at an appropriate distance, and terminated with an SMA/B/C, or BNC connector which can be plugged directly into your pre-amp, TDC, or transient recorder - i.e. the minimum number of connections. (see Figs 1 & 2 below)

For very high speed detectors the detection 'system' must be dealt with holistically as the cabling, detector and connectors must perform well as a transmission line. Typical co-axial connectors have a VSWR (voltage standing wave ratio) of 1.05 meaning 5% of the energy in the 'wave' gets reflected at each connector. This not only reduces the peak height, but also broadens the peak, and results in ringing tails, so you want to minimise the number of connections. For this reason TSL can also provide a connection kit comprising the very best solid coaxial cable matched to the detector, with a vacuum flange brazed at an appropriate distance, and terminated with an SMA/B/C, or BNC connector which can be plugged directly into your pre-amp, TDC, or transient recorder - i.e. the minimum number of connections. (see Figs 1 & 2 below)

Ion Time-of-Flight Detector

Part Number	MCP OD (mm)	MCP Effective Dia (mm)	MCP Pore Size (μ)
TSUF000018TOF	18	14.5	4
TSUF000025TOF	25	20	12
TSUF000038TOF	38.5	32	12

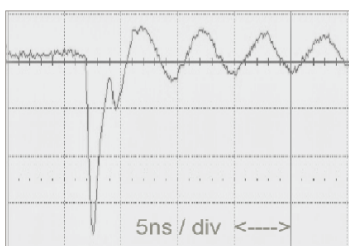


Figure 1: Example of a badly terminated detector

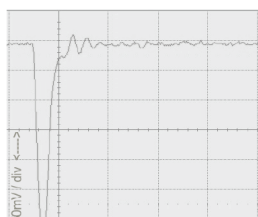
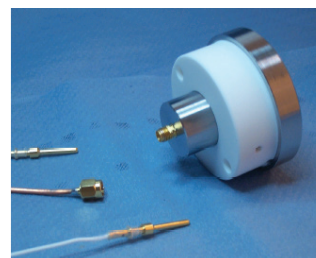
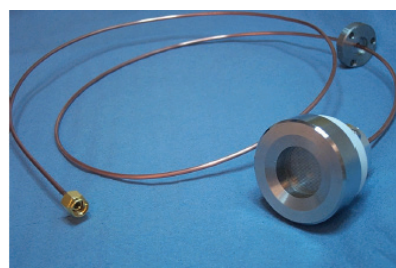
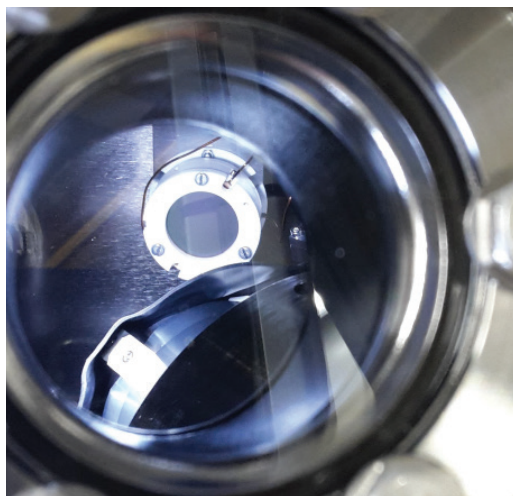


Figure 2: Example of data taken with connection kit showing sub-nanosecond FWHM



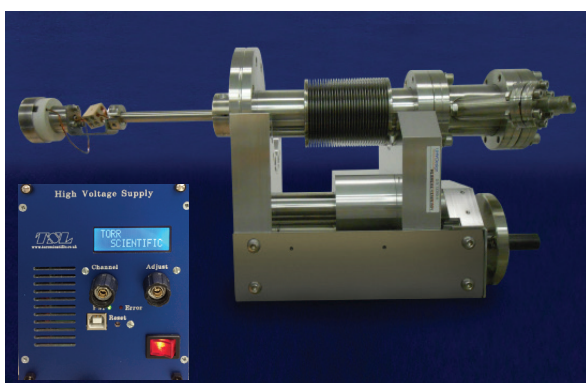
MCP Manipulators for Beam Visualisation & Secondary Electron Detection



Specification	
Plate Outer Diameter	24.8 mm or 38.4 mm
Effective Area	20 mm or 32 mm diameter
Thickness	0.48 mm
Channel Diameter	12 μm
Channel Pitch	15 μm
Bias Angle	8 $^{\circ}$
Open Area Ratio	60%
Gain per Plate (min)	10 4
Plate Configuration	Single or matched pair chevron stack
Output Options	Phosphor screen or anode
Manipulator Linear Travel	50 mm or 100 mm (longer travels available on request)

Reliable Beamline Measurements

MCP Manipulators are ideal instruments for beam visualisation and secondary electron detection at synchrotron facilities. The MCP detector can be customised according to the application in question, and are mounted on to a smooth and precise linear shift mechanism (typically offering up to 100 mm linear travel, with longer travels available on request) so it can be moved in and out of the detection zone. Electrical feedthroughs are positioned at the end of the MCP Manipulator, fitted with SHV connectors as standard, with in-vacuum UHV compatible Kapton wire being used throughout for electrical insulation. An optional 3U rack-mounted, high voltage power supply, complete with digital readout is also available.



Smooth & Precise Linear Motion

At the heart of the MCP Manipulator is a unique linear shift mechanism (LSM) that provides smooth, precise linear motion along the z-axis. Each LSM incorporates a unique kinematically designed external leadscrew mechanism, complete with anti-rotation and anti-deflection systems. Their true UHV performance, precise motion and robust design make them ideally suited for the positioning and manipulation of beam line diagnostics.

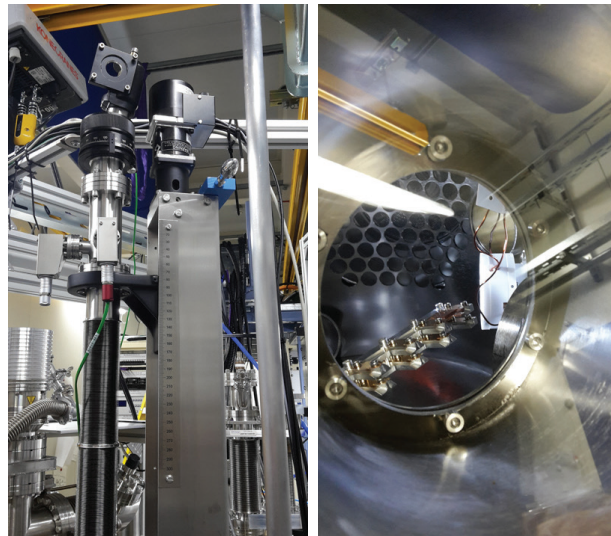
- 2x flange parallelism of conventional designs
- 2x load-carrying capability of conventional designs
- Smooth kinematic motion
- 10,000 cycle lifetime guarantee (3 million cycle option)
- Demountable bellows assembly
- Reliable and rigid construction

MCP Manipulators installed at the Diamond Light Source

Two MCP Manipulators are installed on the end station of the second branch of the IO5-ARPES beamline. The branch will measure the angular-resolved photoemission from the spot of VUV light (50-100eV), focused using a Fresnel zone plate into a spot with size <1 micron.

The first MCP Manipulator is used as an auxiliary photoemission detector, adding measure of photoemission integrated in both electron energy and angle. This detector provides a high level count rate which is suitable for fast scanning mapping of sample topography.

The second MCP Manipulator is placed behind the zone plate optics and sample, providing the beam visualisation behind the zone plate focus, and is used for alignment of the zone plate relative to the required aperture.



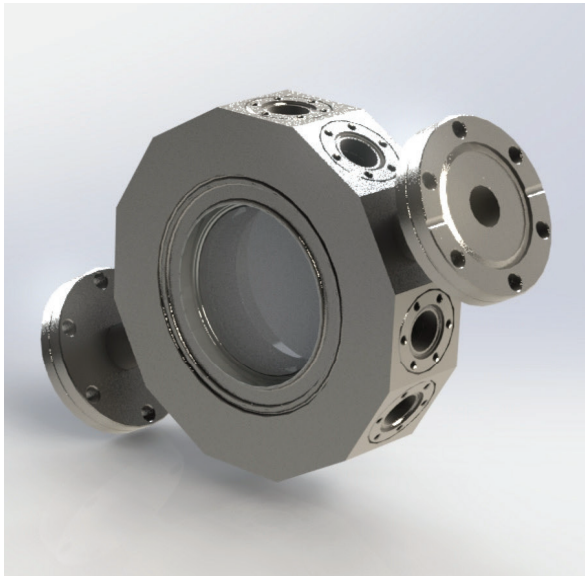
Atom Trap Chambers

SECTION 4

ATOM TRAP CHAMBERS

Atom Trap Chambers.....36

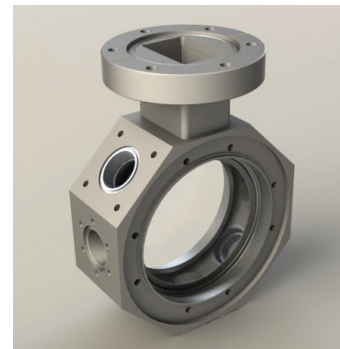




Specification	
Body Material	316LN (316L / 304L options)
Maximum Temperature	200 °C
Flange Material	316LN (option 304L)
Number of Horizontal Ports	Up to 14
Leak Rate	<1x10 ⁻¹⁰ atm-cc/sec (He)
Pressure Range	1 bar to 1x10 ⁻¹¹ mbar
Surface Quality	20/10 scratch/dig
Optic Material	Fused Silica with Broadband Coating option
Flatness	< 8λ

Torr Scientific's new range of compact, low-magnetic, chamber modules are used in the research of ultra-cold atoms. New technology, especially semiconductor laser development, has revolutionised atomic physics over the past two decades and scientists are now able to routinely cool certain gases to ultra-low temperatures, very close to absolute zero (~50 Nano-Kelvin). At such low temperatures, it's possible to trap atoms with light, magnetic and / or electric fields and study their behaviour in detail.

The new range of Atom Trap Chambers are manufactured from 316LN stainless steel with 316LN flanges, and contain up to 14 horizontal and two vertical ports, six of which are used to house three pairs of counter-propagating laser beams that perform the 'trapping'. High quality fused silica optics that offer a high threshold to laser damage (complete with non-magnetic weld rings) are welded directly to the chamber body to reduce the overall chamber size, with an option for custom anti-reflective coatings that are optimised to the wavelengths of the lasers being used.



316LN SS low-magnetic body as standard with 316L / 304L options

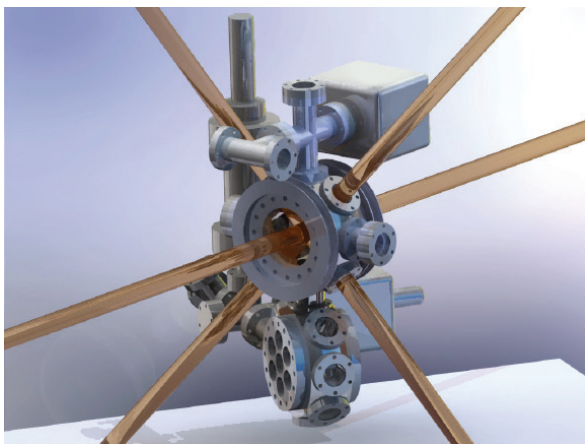


Image courtesy of The Weizmann Institute

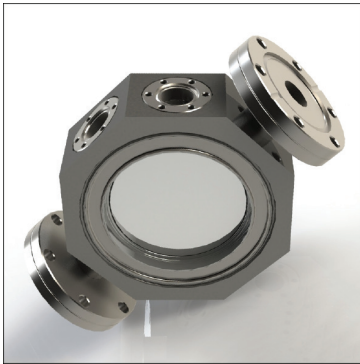
A typical Atom Trap Chamber arrangement with 3 pairs of counter-propagating lasers to 'trap' the atoms

Two vertical 63.5mm diameter fused silica windows are fitted as standard with an option for broadband coating. The greater optical access allows the exploration of different types of optical lattices and the compactness of the chamber makes it possible to generate the magnetic gradients needed by using small coils / currents that do not require active dissipation.

For details on Torr Scientific's range of Anti-Reflective viewports, see page 54



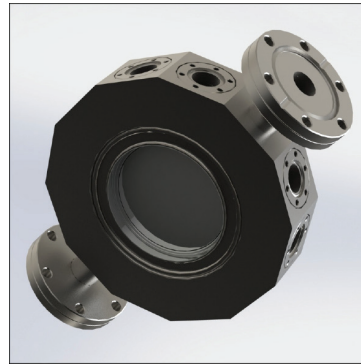
Standard Chamber Design



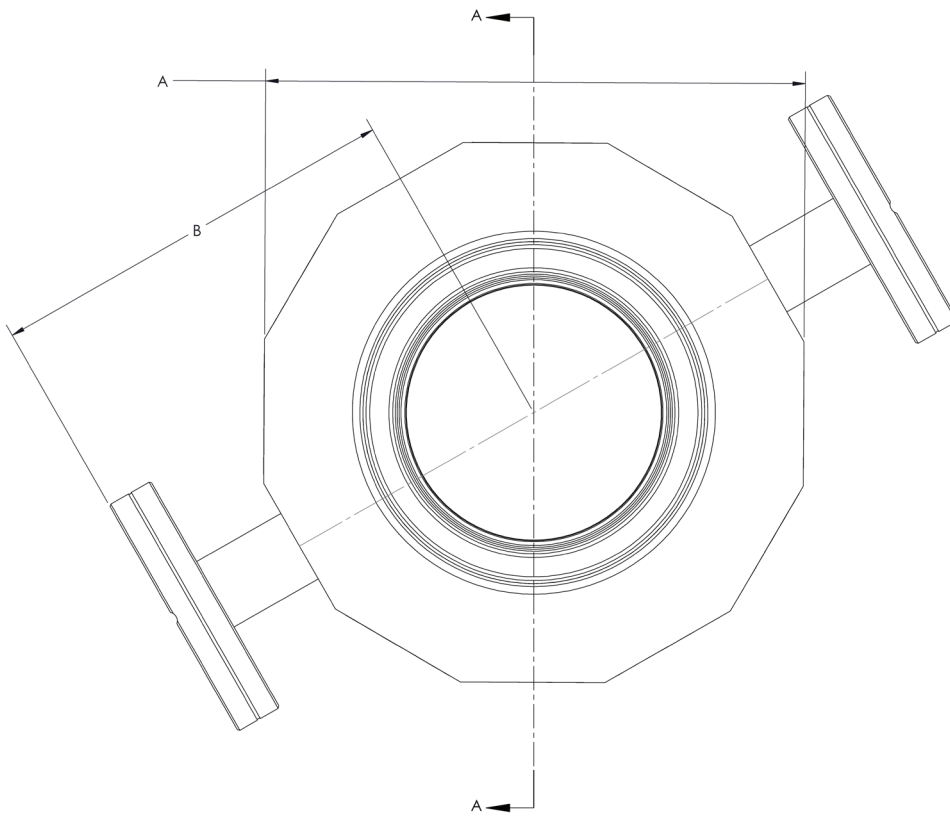
ATC-8P



ATC-10P



ATC-12P



Part Number	Horizontal Ports	Port Length DN16 (A)	Port Length DN35 (B)	Vertical Port Optics	Broadband Coating
ATC-8PC	6 x DN16, 2 x DN35	112mm	81mm	2 x DN64 Fused Silica	YES
ATC-10PC	8 x DN16, 2 x DN35	118mm	94mm	2 x DN64 Fused Silica	YES
ATC-12PC	10 x DN16, 2 x DN35	150mm	110mm	2 x DN64 Fused Silica	YES
ATC-8PU	6 x DN16, 2 x DN35	112mm	81mm	2 x DN64 Fused Silica	NO
ATC-10PU	8 x DN16, 2 x DN35	118mm	94mm	2 x DN64 Fused Silica	NO
ATC-12PU	10 x DN16, 2 x DN35	150mm	110mm	2 x DN64 Fused Silica	NO

Bespoke designs available upon request

Part Number	Page Number
ATC-10PC	37
ATC-10PU	37
ATC-12PC	37
ATC-12PU	37
ATC-8PC	37
ATC-8PU	37
TSCF100118OFD	29
TSCF100125OFD	29
TSCF100133OFD	29
TSCF100138OFD	29
TSCF100150OFD	29
TSCF100218OFD	29
TSCF100225OFD	29
TSCF100233OFD	29
TSCF100238OFD	29
TSCF100250OFD	29
TSIS100118OFD	29
TSIS100125OFD	29
TSIS100133OFD	29
TSIS100138OFD	29
TSIS100150OFD	29
TSIS100218OFD	29
TSIS100225OFD	29
TSIS100233OFD	29
TSIS100238OFD	29
TSIS100250OFD	29
VPZ100ITOP22	27
VPZ100ITOP22LG	27
VPZ100ITOP22LG-LN	27
VPZ100ITOP22-LN	27
VPZ150ITOP22	27
VPZ150ITOP22LG	27
VPZ150ITOP22LG-LN	27

Part Number	Page Number
VPZ150ITOP22-LN	27
VPZ16CVDD	23
VPZ16CVDD-LN	23
VPZ16CVDDX	23
VPZ16CVDDX-LN	23
VPZ16ITOP22	27
VPZ16ITOP22LG	27
VPZ16ITOP22LG-LN	27
VPZ16ITOP22-LN	27
VPZ38-15CVDD	23
VPZ38-15CVDD-LN	23
VPZ38-15CVDD-LN-WC	24
VPZ38-15CVDD-WC	24
VPZ38-15CVDDX	23
VPZ38-15CVDDX-LN	23
VPZ38-15CVDDX-LN-WC	24
VPZ38-15CVDDX-WC	24
VPZ38-20CVDD	23
VPZ38-20CVDD-LN	23
VPZ38-20CVDD-LN-WC	24
VPZ38-20CVDD-WC	24
VPZ38-20CVDDX	23
VPZ38-20CVDDX-LN	23
VPZ38-20CVDDX-LN-WC	24
VPZ38-20CVDDX-WC	24
VPZ38ITOP22	27
VPZ38ITOP22LG	27
VPZ38ITOP22LG-LN	27
VPZ38ITOP22-LN	27
VPZ64ITOP22	27
VPZ64ITOP22LG	27
VPZ64ITOP22LG-LN	27
VPZ64ITOP22-LN	27



Torr Scientific Limited ("The Company")

1. General

In these terms and conditions "Goods" includes the supply of services in accordance with the provisions hereof and "Delivery" includes performance of services as the context may admit. "Order" means an order accepted by the Company and includes contracts to provide services and also authorised amendments to an order. "Price" includes mutatis mutandis payment for Goods and/or services according to time expended, materials used or supplied or on any other basis than fixed price.

1.2 Estimates or quotations are an invitation to treat only and are valid for 30 days unless otherwise stated. No order will become effective until it is accepted or confirmed on behalf of The Company. Such accepted or confirmed Order will then comprise The Company's entire agreement with the buyer and merge all prior discussion quotation offers and understandings.

1.3 These terms and conditions exclude any other terms and conditions inconsistent therewith which a buyer might seek to impose even though such other terms and conditions may be submitted in a later document and/or purport to exclude or supersede any terms or conditions inconsistent with them or may be contained in any offer acceptance or counter offer made by the buyer.

2. Amendments to Order

Save as expressly agreed in writing signed by the Company's duly authorised representative or as provided by clause 5 hereof:-

2.1 If any information supplied by or on behalf of the buyer is insufficient, incorrect, inaccurate, misleading or if the buyer notifies The Company of any changes of requirements in relation to any Order offer or acceptance thereof by the Company The Company shall be entitled to amend the Price, the terms of payment and the delivery date or delivery schedule as in the circumstances The Company shall consider fair and reasonable. The Company shall as soon as practicable notify the buyer in writing of such amendments.

2.2 Any variation or amendments requested by the buyer will only be valid and binding on The Company when subjected to a change order relating to the Order duly placed upon and accepted by The Company in writing signed by a duly authorised representative and subject to appropriate adjustment in price, delivery date and any other matters.

3. Cancellation of Order

3.1 Cancellations of orders confirmed in writing and made before The Company has sent an order acknowledgment to the buyer no cancellation fee will be incurred.

3.2 Cancellation of orders confirmed in writing made after The Company has sent an order acknowledgment to the buyer. The Company reserves the right to apply up to a 100% cancellation fee against the total value of the order.

4. Delivery

Times quoted for delivery are to be treated as estimates only and The Company shall not be liable for failure to deliver within such time. Whether a time for delivery is quoted or not the time for delivery shall be extended by a reasonable period if delay in delivery is caused by anything beyond The Company's control. Any special delivery requirements must be notified to The Company at the time of placing an Order. A charge will be made to cover delivery of Goods unless previously agreed in writing.

5. Amendments to Price

The price, delivery dates or any other terms relating to Goods are based upon The Company's assessment of materials, labour and buy-in prices and are subjected to revisions in respect of any increased cost to The Company in respect thereof.

6. Liability

6.1 All Goods will be carefully inspected before delivery to ensure freedom from defects and general compliance with the Order. The Company undertakes to replace or repair at the option of The Company and to deliver any Goods or part thereof proved to the satisfaction of The Company to have been defective in material or workmanship when originally despatched, if returned to The Company and accompanied by an official Returns Authorisation Number from The Company within Twelve months from date of despatch.

Where The Company has manufactured the Goods to a design of the Buyer no liability is accepted by The Company for design errors, which remains the responsibility of the buyer. The Company shall be entitled to charge for any additional works carried out at the buyer's request.

6.1 The Company has the right to void the warranty if the product: (i) is altered or modified in any way; (ii) is otherwise improperly installed; (iii) has been subjected to improper operation, misuse, abuse, accident or neglect.

6.2 The Buyer must examine the Goods immediately upon delivery and within 7 days thereafter notify The Company in writing of any defects and return any allegedly defective part or parts of the Goods to The Company or as the Company shall direct see 6.1 at the Buyers expense.

6.3 The Company shall not be liable for any Consequential loss or loss of profit howsoever arising (including by negligence) to the buyer the buyer's staff or any other third party.

6.4 The Company shall not be liable for any Consequential for any loss expense or damage howsoever arising (including by negligence) to the buyer the buyer's staff or any other third party.

7. Patents

The buyer covenants with The Company that it shall forthwith notify The Company of any allegation of infringement of any patent registered design trade mark copyright or other intellectual property right enjoyed by The Company or by the manufacture or supplier of the Goods or any part thereof.

8. Payment

8.1 Unless otherwise agreed or notified by The Company payment in full is due 30 days from the date of Invoice and is the essence of the contract.

8.2 The Company reserves the right at any time at its discretion to demand security for payment before continuing with or delivering any order.

8.3 Interest is chargeable at the discretion of The Company at 3% per month or part thereof on any late payment beyond the agreed payment terms.

9. Confidentiality

All information supplied by The Company in any form (other than information in the public domain) is supplied in confidence and must not be used by the buyer for any other purpose that the Order and must not be disclosed to any other party without The Company's express written consent and then only on conditions equivalent to this condition and with an express notification that the information was provided for the buyer only and it is not intended to be relied upon by any other party.

10. Assignment and Sub-Contracting

The Company may assign or sub-contract such part or parts of any Order as it sees fit.

11. Risk

The risk in the Goods shall be passed onto the buyer at the point of delivery.

12. Customers Own Material

Free issued material issued to the Company for processing against an Order is carried out at the Buyers risk of damage or loss to that material.

12.1 It is the Buyers responsibility to notify The Company of any process or materials, which may have a damaging effect on the free issued material.

13. Lien

Until the company has received payment in full for any Goods from the buyer The Company shall have a general and specific lien on all the Buyer's property in the possession or control of The Company for all monies due to The Company from the buyer.

14. Matters Beyond Company's Control

The Company shall not be liable for any loss, damage or expense howsoever arising from any delay or failure of performance arising from circumstance beyond its control including but not limited to earthquakes, flood, storm, force majeure, public enemies, invasion, national emergency, strikes, riots, boycott, interruption of services rendered by any public utility or interference from any government agency or official

15. Law

This agreement shall in all respects be governed by and constructed in accordance with the laws of England. The buyer submits to the jurisdiction of the English courts.

Registered Name & Office: Torr Scientific Limited, Unit 11 Pebsham Rural Business Centre, Pebsham Lane, Bexhill-on-Sea, East Sussex, TN40 2RZ
Registered in England & Wales Number: 3622909 **VAT Registration Number:** 702 9779 14

Represented by:

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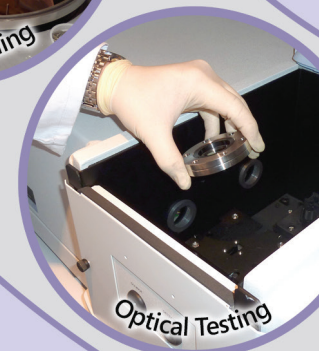
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