Quorum Technologies

SC7680 Large Chamber Auto/Manual High Resolution Sputter Coater

Operating Manual

Document Number OM-SC7680

Issue 1 (09/03)

Polaron

Quorum Technologies

Quorum Technologies Ltd is the owner and manufacturer of the Polaron range of EM preparation equipment.

Unit 15A
Euro Business Park
New Road
Newhaven
East Sussex
U.K.
BN9 0DQ
tel: +44(0) 1273 510535
fax: +44(0) 1273 510536
Email: sales@quorumtech.com
http:///www.quorumtech.com

For further information regarding any of the other products designed and manufactured by Quorum Technologies, contact your local representative or directly to Quorum Technologies at the address above.

- Carbon and Sputter Coaters
- Plasma Reactor for ashing and etching
- High Vacuum Bench Top Evaporators
- Cryo Transfer Systems
- Critical Point Dryers
- Service and Spares

Disclaimer

The components and packages described in this document are mutually compatible and guaranteed to meet or exceed the published performance specifications. No performance guarantees, however, can be given in circumstances where these component packages are used in conjunction with equipment supplied by companies other than Quorum Technologies.

1 Contents

1.1 Manual Layout

This Operating Manual is divided up into the following major sections, each section dealing with specific topics, as follows:

Section 1 - Contents

Section 2 - Health and Safety
General section which applies to all Quorum Technology products detailing the very important issues of Health and Safety applicable when using surface analysis equipment.

Section 3 - Introduction
Introduces this manual.

Section 4 - General Description
Identifies each of the equipment items and provides an overview of their functions and how they work.

Section 5 - Installation
Instructions on how this instrument should be installed and the connections which should be made between the equipment items.

Section 6 - Operation
Instructions on how to start-up and run the instrument.

Section 7 - Maintenance
Instructions on how to check the system is functioning correctly, and how to change consumable items. Details of appropriate spare parts

Section 8 - Fault Finding
Information on how to identify faults in the system and how to rectify these faults.

Section 9 - Agents
List of main agents supporting Quorum Technologies product range

Section 10 - Index

1.2 Section Contents

1.3 List of Figures

1.4 List of Tables

2 Health and Safety

Safety is very important when using any instrumentation and all users of our equipment should read this section.

This section of the Manual applies to all equipment supplied by Quorum Technologies Polaron range of products, not just the particular instrument for which the manual refers.

Included in this section are details on warning notations, good working practices and information on European Community (EC) legislation regarding **"Control Of Substances Hazardous to Health"** (COSHH) and risk analysis.

2.1 Control of Substances Hazardous to Health (COSHH)

The E.C. legislation regarding the "Control of Substances Hazardous to Health" requires Quorum Technologies to monitor and assess every substance entering or leaving their premises. Consequently any returned goods of whatever nature must be accompanied by a declaration form available from Quorum Technologies, reference number SP-100. Without this declaration Quorum Technologies reserves the right not to handle the substance/item. Also in accordance with E.C. regulations we will supply on request hazard data sheets for substances used in our instruments.

2.2 Safety Policy

This section contains important information relating to all health and safety aspects of the equipment. As such it should be read, and understood, by all personnel using the instrument whether as an operator or in a service capacity.

Quorum Technologies is committed to providing a safe working environment for its employees and those that use it's equipment and conducts its business responsibly, and in a manner designed to protect the health and safety of its customers, employees and the public at large. It also seeks to minimise any adverse effects that its activities may have on the environment.

Quorum Technologies regularly reviews its operations to make environmental, health and safety improvements in line with UK and European Community legislation.

The equipment has been designed as a free-standing bench mounted instrument. Quorum Technologies cannot be held responsible for any damage, injury or consequential loss arising from the use of its equipment for any other purposes, or any unauthorised modifications made to the equipment.

All service work carried out on the equipment should only be undertaken by suitably qualified personnel. Quorum Technologies is not liable for any damage, injury or consequential loss resulting from servicing by unqualified personnel. Quorum Technologies will also not be liable for damage, injury or consequential loss resulting from incorrect operation of the instrument or modification of the instrument.

2.3 Conformity

This instrument is supplied in a form that complies with the protection requirements of the EC Electromagnetic Compatibility Directive **89/336/EEC** and the essential health and safety requirements of the low voltage directive **72/23/EEC** both as amended by **92/31/EEC.** Any modifications to the equipment, including electronics or cable layout may affect the compliance with these directives.

2.4 Servicing

2.4.1 Disclaimer

Qualified personnel should carry out all service work on the equipment. Quorum Technologies cannot be liable for damage, injury or consequential loss resulting from servicing from unqualified personnel. Quorum Technologies will also not be liable for damage, injury or consequential loss resulting from incorrect operation of the instrument or modification of the instrument.

2.4.2 Operators and Service Engineers

A normal operator of the equipment will not be trained in, or qualified for service work on the equipment and may cause a hazard to himself/herself or others if such work is attempted. Operators should therefore restrict themselves to the normal operation of the equipment and not by removing covers from the electronic equipment or dismantling of the instruments.

Service Engineers who are suitably trained to assess and isolate electrical, mechanical and vacuum hazards should be the only personnel who access the equipment.

2.5 Hazard Signals and Signs

2.5.1 Hazard Signal Words

The standard three hazard signal words are defined as follows:

- **DANGER** - *imminently* hazardous situation or unsafe practice that, if not avoided, *will* result in death or severe injury.
- **WARNING** - *potentially* hazardous situation or unsafe practice that, if not avoided, *could* result in death or severe injury.
- **CAUTION** - *potentially* hazardous situation or unsafe practice that, if not avoided, *may* result in minor or moderate injury or damage to equipment.

2.5.2 Hazard Labels used on Equipment

Several hazard symbols may be found on the equipment, they are shown below with their meaning:

Caution, risk of electric shock

Caution (refer to accompanying documents)

Easily touched higher temperature parts

Warning, risk of electric shock

Figure 2-1: Hazard Labels

2.5.3 Hazard Warning Labels used in Equipment Manuals

The international warning signs used in equipment manuals as shown in Figure 2-2.

Figure 2-2: International Warning Signs

Where appropriate these are used when a specific identifiable risk is involved in either using or maintaining the instrument. These take the form of warning triangles or signs with a graphical description of the hazard.

2.5.4 Instrument Functionality Signs

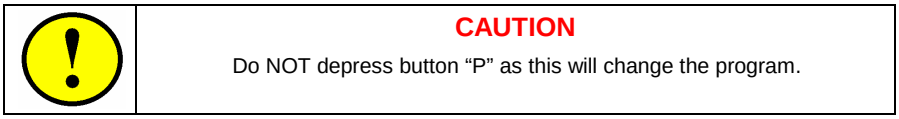


Figure 2-3: Typical Caution Warning as Shown in this Manual

This typical sign applies to cautions where there is a risk to the functionality of equipment due to incorrect operation. These cautions or warnings will be contained in a box and be accompanied by a circular warning symbol as shown in Figure 2-3.

2.5.5 Serious Damage to Instruments

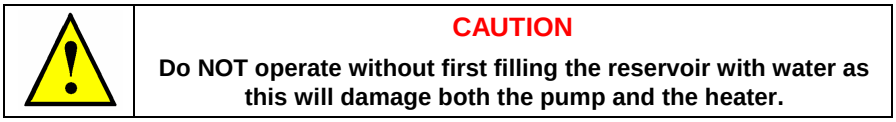


Figure 2-4: Typical Caution Warning as Shown in this Manual

This typical caution sign is used where serious damage will be caused by incorrect operation of instrumentation, they will follow the same form as functionality warnings but with a triangular warning symbol as shown in Figure 2-4.

2.5.6 Hazard to Operator

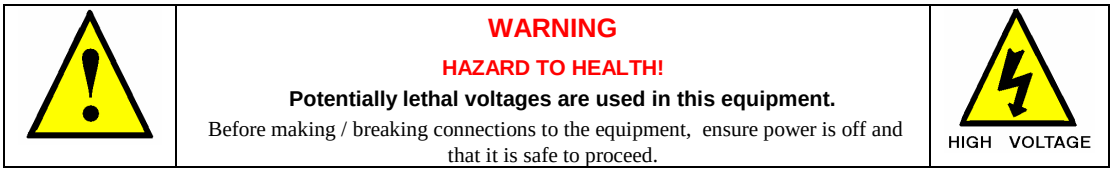


Figure 2-5: Typical Warning as Shown in this Manual

These warnings will generally occur in relevant installation and maintaining sections where there exists a potential hazard to the engineer working on the instrument. They will take the form of the triangular warning symbol accompanied by an international warning sign and bold type lettering beginning with **"WARNING-HAZARD TO HEALTH!"** as shown in Figure 2-5.

2.6 Risk Analysis

2.6.1 Personal Operational Risks

The following is a list of tasks carried out by both the operator and service engineer where recognised risks have been observed, listed is the personnel protection equipment (PPE) which is suggested for use for various tasks on any surface analysis equipment and systems:

Task	Carried out by	Nature of Hazard	Recommended PPE
Cleaning of parts / samples with isopropanol (IPA)	Operator / Service Engineer	Splash hazard to eyes, drying of skin	Protective goggles, protective gloves.
Use of Liquid Nitrogen in sample cooling etc.	Operator / Service Engineer	Burn risk	Thermally protective gloves and goggles should be worn.
Lifting of Heavy Items	Service Engineer	Dropping on foot.	Protective footware.

Table 1- Personal Operational Risks

2.6.2 Hazardous Materials

- **Isopropanol (IPA)**

  For certain service tasks isopropanol is suggested for cleaning components before use in the vacuum system. It should be noted that isopropanol is a flammable liquid and as such should not be used on hot surfaces. In addition it is recommended that protective gloves be worn when using isopropanol.

- **Liquified Gases**

  Instruments may use nitrogen, argon or carbon dioxide in a liquified state. The user is responsible for safe handling of these gases.

- **Nitrogen, Argon and Helium Gas Supplies**

  Instruments may use nitrogen, argon or helium gas supplies for their operation, the customer is responsible for maintaining the supply to the instrument. This supply should be regulated and kept to the lowest pressure and flow rate as is practical to minimise the effects of any leaks.

- **Hazardous Gases**

  Quorum Technologies has no control over the gases used within the system. It is therefore viewed as the customers responsibility to assess the hazards involved and take appropriate precautions when using explosive, toxic or corrosive gases or gases which may result in hazardous products as a result of a chemical reaction.

.

2.7 Good Working Practices

It is essential that good hygienic working practices are adopted at all times especially in an ultra high vacuum or cleanroom environment and are generally of the “Common sense” type Some simple good practice rules are:

- If in doubt don't.
- If in doubt ask.
- When handling solvents wear face mask, gloves, apron and work only in a well ventilated area.
- Mop up any spillage’s immediately.
- When handling or decanting mineral oils wear protective clothing.
- Aerosols of mineral oils, such as that produced by gas ballasting, can prove to be hazardous and an exhaust is recommended.
- Before attempting to service electrical apparatus, isolate from the mains.
- Treat all unknown substances as hazardous.
- Dispose of substances in an appropriate manner.
- Use the correct tool for the job.
- Keep a straight back and bend from the knees when lifting heavy objects.
- Wear protective clothing when using liquid nitrogen.
- Affix pressurised gas cylinders firmly to walls or racks. Use the correct regulating valves on gas cylinders and always transport cylinders using the appropriate specialist trolley.
- Obey safety regulations regarding lifts, hoists and machine tools.
- Always keep protective screens or lead-glass viewports on if using an X-ray source.
- Always make sure you understand a procedure well before attempting it for the first time.

2.8 SC7680 Specific Safety Hazards

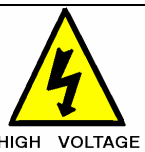
The following Safety Hazards are specific to the SC7680 Sputter Coater.

WARNING

HAZARD TO HEALTH!

The Power Supply used in the Model SC7680 unit can operate at up to 3000V D.C

HAZARDOUS VOLTAGE OUTPUTS of up to 3000V. D.C.



2.8.1 Contamination

Contamination can seriously affect the sputtering process. To reduce the possibility of contamination by airborne particles, minimise the time the vacuum chamber is open to the atmosphere.

3 Introduction

This manual is intended for all users of the **SC7680 Sputter Coater** manufactured by Quorum Technologies from the **POLARON** range and provides information on the installation, operation and maintenance of the instrument. Please note that qualified service personnel should only carry out the servicing and maintenance procedures and it is essential that all users should read the ***Health and Safety*** section of this manual.

3.1 Return of Goods

If goods are to be returned to Quorum Technologies for repair or servicing the customer should contact their local distributor or the factory direct before shipment. A "Returns Authorisation Number" should be obtained in advance of any shipment. This number is to be clearly marked on the outside of the shipment. Complete the returned equipment report form, number **SP106** with as much detail as possible and return with the goods.

All returned goods are to be accompanied by a completed "Returned Goods Health and Safety Clearance" form **SP-100** attached to the outside of the package (to be accessible without opening the package) and a copy of the forms should be faxed in advance to the factory.

When goods are to be returned under warranty refer to the “Warranty Claim, Repair and Returns Procedure” form number **SP-105**

Copies of all these forms can be found in the documentation pack supplied with the instrument or direct from Quorum Technologies, the details can be found on page two of this document.

3.2 Returns Procedure

Warranty Claim

Electronic and basic servicing capabilities exist via the Quorum Technologies distributor network. All components are sold with a **return to factory warranty** (unless otherwise stated) which covers failure during the first 12 months after delivery. In addition to the statutory 12 months warranty this model carries an additional four-year warranty when registered at the time of purchase, for details refer to form SP-105 in the Service Pack.

Returns must be sent carriage paid, Quorum Technologies will cover the return carriage costs. This covers defects which arise as a result of a failure in design or manufacturing. It is a condition of warranty that equipment must be used in accordance with the manufacturers instructions and not have been subjected to misuse. This warranty does not cover consumable items such as sputter coating targets and carbon evaporation material. To make a claim under the terms of this warranty provision contact the Customer Service Department at your local Quorum Technologies Representative in the first instance.

Chargeable Repairs

Always contact your in-country Quorum Technologies Representative in the first instance. They will be pleased to assist you and will be able to provide an estimate of repair costs, many offer local repair facilities.

For routine repairs where down-time is not critical. The target standard return time at Quorum Technologies is 20 working days.

Returns

All returns to Quorum Technologies require the following procedure to be followed:

1. Contact the local Quorum Technologies Representative and request a Returns Authorisation Number.
2. Complete a Returned Goods Health and Safety form and returned equipment fault report form.
3. Attach a copy of the completed form to the outside of the package with the usual shipping documents.

Packaging and Carriage

All goods shipped to the factory **must** be sealed inside a clean plastic bag and packed in a suitable carton. If the original packaging is not available Quorum Technologies should be contacted for advice. Quorum Technologies will not be responsible for damage resulting from inadequate returns packaging or contamination of delicate structures by stray particles under any circumstances. All non-warranty goods returned to the factory must be sent carriage pre-paid, (Free Domicile). They will be returned carriage forward (Ex-Works).

4 Description

4.1 Equipment

Each SC7680 Sputter Coater when supplied as a complete package, includes the basic unit, a Gold Palladium target, a start up kit and operation manual. Items can be ordered as a full package or separately against the following numbers:

SC7680 Sputter Coater 220-240V complete, consisting of the following:

LA768001D	Sputter Coater 220-240V. With Gold/Palladium target
SC7680-STARTUP	Start up Kit
OM-SC7680	Operation Manual

SC7680/110V Sputter Coater 110-120V complete, consisting of the following:

LA768002D	Sputter Coater 110-120V. With Gold/Palladium target
SC7680-STARTUP	Start up Kit
OM-SC7680	Operation Manual

4.1.1 Accessories

The following accessories are available from Quorum Technologies:

E5005G Rotary Pump, 90 L/m, 110/240 Volt, 50/60Hz, fitted with **E5004** rotary pump exhaust filter.

Three carbon-coating accessory packages are also available. These can be used with the SC7680 to carry out Carbon evaporation.

CA078R/1/240 A single source Carbon Rod Head with 240V PSU (CA7625)

CA078R/2/240 A double source Carbon Rod Head with 240V PSU (CA7625)

CA078R/3/240 A triple source Carbon Rod Head with 240V PSU (CA7625)

These accessories make use of the vacuum pump and vacuum control facilities of the SC7680 sputter coater.

A 110 volt version of each is available as part number **CA078R/*/110V**

For further information about the CA7625 carbon coating accessory refer to operating manual OM-CA7625.

4.1.2 Optional items

The following optional items are available from Quorum Technologies:

SC510-314A	Gold Target
SC510-314B	Gold/Palladium Target (1 off supplied with Sputter Coater)
SC510-314C	Platinum Target
SC510-314D	Nickel Target
SC510-314E	Silver Target
SC510-314G	Palladium Target

4.1.3 Optional Accessories

The SC7680 Sputter Coater is available with three optional stage accessories, only one of which may be fitted at a time. These accessories will normally be factory fitted at the time of ordering, the required option must be stated at this time. If more than one of these options are ordered the others will be supplied as kits. Alternatively, the Sputter Coater can be returned to the factory for upgrading. Methods of fitting these units can be found in the Installation Section, Paragraph 5.3.

Film Thickness Monitor

The optional FT7690 Film Thickness Monitor, monitors and controls thickness of the sputtered film by over-riding the timer when plugged into the unit. The deposition thickness is selected and controlled to 0.1 nm with a range of 999.9 nm. The density of the sputtering material is selected and the percentage of the crystal used life can be displayed. The crystal life is typically 2-4 microns for gold. The unit operates using an oscillating 5MHz crystal and monitoring the change of resonant frequency as the crystal becomes loaded with evaporant.

The Film Thickness Monitor may be configured with either a centrally mounted, adjustable height stage or a variable position Crystal holder with separate feedthrough.

FT7690 Film Thickness Monitor complete with Oscillator.

FT7607 Crystal Holder Stage.

FT7687 Adjustable position Crystal Holder with separate feed-through. (can be fitted with **RC7606** or **WS7608**)

Rotary Planetary Stage

The standard stage can be replaced with a rotary planetary stage. This is of particular interest for users with open pore high surface area samples and for carbon evaporation. The power supply for the rotary stage is built into the system as standard.

RC7606 A kit of parts to add a rotary planetary specimen stage to a SC7680 Sputter Coater, the kit contains: Rotary Planetary Stage, Motor, Drive Components and Fixings.

Water Cooled Stage

The standard stage can be replaced with a water-cooled stage. Cooled water can be circulated to lower the stage temperature. This reduced temperature should be kept above the Dew point to avoid condensation of atmospheric moisture whilst the stage is open to the atmosphere. This will result in excessive pump down times on re-evacuation and possible sample damage.

WS7608 A kit of parts to add a water-cooled specimen stage to a SC7680 Sputter Coater, the kit contains: Water Cooled Stage, Inlet and Outlet Connectors, Piping and Fixings.

4.2 Overview

The **SC7680 Sputter Coater** is an extremely versatile large chamber sputter coater, designed to produce fine grain “cool” coatings. At the heart the SC7680 has an advanced annular style magnetron head which is designed to ensure even coatings over a wide area. It is fitted with a simple to replace ring target (gold/palladium is supplied as standard, but others metals are available as options). This enables thin sample coatings of 2-3 nm to be achieved without charging effects being experienced in the SEM. The Sputtering head can be located in one of two positions to enable even coating on substrates upto 200mm (8”) in diameter.

The sputter head when operated at 800V DC gives high-resolution coatings. Alternatively standard coatings with rapid deposition can be achieved at high voltages. Coating time is controlled with a 999 second timer. Pressure levels and plasma currents are monitored by analogue meters.

The standard system has a Rotary Spin Table stage fitted as standard. A Water-Cooled stage, Rotary Planetary stage, or a Film Thickness Monitor stage are optional.

The SC7680 can be used in two modes: automatic for standard coatings or manual operation with complete control of all parameters – essential for the production of high-resolution films.

The 250mm (10") diameter Pyrex cylinder is mounted on an aluminium baseplate and sealed with “L” shaped gaskets. A Large diameter pumping hose means pump down times and cycle times are fast. The SC7680 is fitted with an epicyclical rotary spin table, which is of particular interest for users with semiconductor wafer samples, as the table can be adjusted to accept a range of wafer sizes. The power supply for the rotary stage is built into the system as standard.

When the SC7680 is operated in manual mode, pump down, purge and flush are still carried out automatically, this maintains system versatility but releases the user from time consuming mundane operations. For Field Emission SEM and high-resolution studies, the platinum target (SC510-314C) is recommended.

For SEM X-ray microanalysis, the SC7680 can be simply converted to deposit carbon by the addition of optional, carbon evaporation attachments, consisting of a switchable Voltage power supply (CA7625) and either a single, double or triple Carbon source – **CA078R/1/240**, **CA078R/2/240**, **CA078R/3/240** respectively.

The SC7680 comes complete with a one metre length of 20mm bore vacuum hose and fittings and requires only the addition of a rotary pump with a capacity of 90 litres / minute or greater (see "options and accessories”).

4.3 Technical Specification

4.3.1 SC7680 Sputter Coater Specification

Unit dimensions:	455mm wide x 375mm deep x 395mm high (including vacuum chamber).
Vacuum chamber:	240mm internal diameter x 140mm high.
Weight:	25 kg (55lbs).
Power requirement:	Available for either 230V (13 amp) *or* 110V (20 amp) operation at 50/60Hz.
Target distance:	Normally 53mm (adjustable on standard and FT7607 FTM stages).
Power supply output:	Normal operation is up to 2400V D.C. at 20mA. or 800V D.C at 10mA. Maximum output 2800V D.C.
System control:	Automatic or manually by a 999 second timer with 1 second resolution.
Pumping requirements:	Pump to evacuate $>10^{-3}$ mbar.
Sputtering rates:	Refer to Table 6.1, example with a gold/palladium target and current of 20mA and voltage of 2.5kV a rate of 10nm per minute is achieved.
Coating thickness:	Dependant on time and current, normally between 50 and 300 Angstrom (∑) units for SEM investigations, but will typically be in the region of 1 - 20 nanometers, thin coatings of 2-3 nm can be achieved without charging effects being experienced in the SEM.
Coating uniformity:	Better than 10%. Over 150mm (6”)
Gas medium:	Argon.

4.4 Physical Description

Figure 4-1: SC7680 Sputter Coater

The SC7680 Sputter Coater is a simple to operate magnetron sputtering system designed to be used for coating Scanning Electron Microscopy (SEM) specimens. The system can be operated in manual or automatic mode. In the manual mode, pump down, purge and flush are still carried out automatically. The manual control of sputtering simplifies the control of the parameters essential for the production of high-resolution films.

The SC7680 Sputter Coater is comprised of two main parts:

The Cabinet assembly
The Vacuum chamber

The cabinet assembly, which contains a high voltage power supply, vacuum gauging and manifold, supports the vacuum chamber. Mounted on the front panel of the cabinet are switches and meters, which provide the operator interface to the system. All service connections to the system are made via the rear panel. The cabinet is constructed in a manner to comply with the European EMC regulations.

The vacuum chamber is formed by the top plate assembly, the glass work chamber and the baseplate assembly mounted on the top panel of the cabinet. Circular “L” gaskets at each end of the work chamber maintain the integrity of the vacuum system.

The top plate supports the cathode (target) and magnetic deflection system incorporating a dark space shield, which confines the plasma below the target. Flying leads (secured to the top plate), provide the necessary electrical and gas connections between the top plate and the rear panel connectors of the cabinet. The top plate is supported from a hinged pillar fixed to the rear panel. The hinging facilitates the loading and removal of samples from the work chamber and also aids the changing and replacement of targets.

The Rotary spin Table may be configured for concentric rotation, suitable for up to 8” diameter samples, or, as an offset, dual rotation (epicyclical) for samples up to 6” diameter.

The table itself has two fixed blades and one sprung blade that may be configured to locate and clamp 4”, 6” or 8” semiconductor wafers. Each blade is retained by two screws, which must be removed and re-positioned for the various wafer diameters.

The spin table may be mounted directly on the central spindle for concentric rotation and up to 8” diameter samples. To enable uniform coating over this diameter, the sputtering head must be mounted in the offset position (See section 7.3.3).

The table may also be mounted using the offset geared drive to allow the double or epicyclical rotation, This motion will also allow a more uniform coating with the sputtering head mounted in the offset position (See section 7.3.3)

A smaller SEM stub holder may also be mounted centrally on the spin table platform for holding routine SEM pin stubs. The sputtering head should be mounted in the central position for use with this holder. (See section 7.3.3)

Figure 4-2: Underside View of Spin Table Configured to Hold 8" Dia Wafers

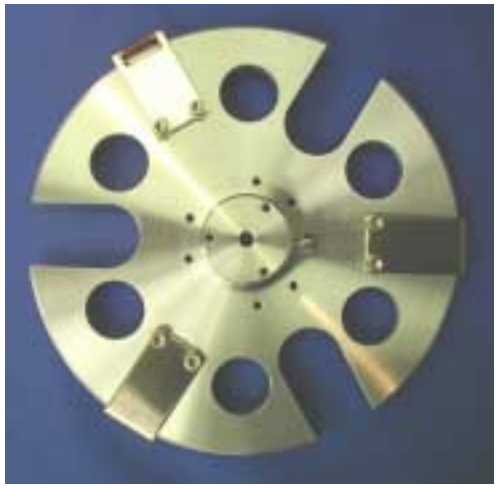


Figure 4-3: Underside View of Spin Table Configured to Hold 6" Dia Wafers

Figure 4-4: Spin Table Shown Mounted Concentrically

Figure 4-5: Spin Table Shown Mounted Eccentrically

The SC7680 Sputter Coater produces fine grain coating with maximum versatility. The annular design of the magnetron sputter head ensures even coating over a wide area, which enables thin coatings of 2-3 nm to be achieved without charging effects being experienced in the SEM. The SC7680 sputter head, when operated at 800V DC gives high-resolution coatings or standard coatings deposited rapidly at 2400V DC. A three digit electronic timer with 1-second resolution controls coating time. Analogue meters monitor the vacuum level and plasma current. An optional Water-Cooled stage (WC7608), a Rotary Planetary stage (RC7606), a FTM stage (FT7607) or Adjustable position Crystal holder (FT7687) can replace the fitted stage. With the optional FTM stage, the coating thickness can be controlled by an optional FTM (FT7690 Film Thickness Monitor/controller)

4.4.1 Operational Description

The SC7680 operates at a potential of up to 3000 Volts DC.

A High Voltage (HV) is applied between the Target (cathode) and Baseplate (anode) which is at earth potential. A pressure interlock ensures that the HV supply cannot be activated until vacuum chamber pressure is reduced to 10^{-1} mbar or better. Low pressure gas (argon is preferred) is leaked into the vacuum chamber to provide a medium for ionisation. Figure 4-6 shows the principles of operation of the SC7680.

Electrons emitted by the cathode, concentrated in the vicinity of the target by the magnetic field, collide with the gas molecules, producing positive ions (due to secondary electron emission). Positive ions attracted by the negative potential of the cathode, bombard the target, causing erosion of the target material. The dislodged target atoms falling toward the sample follow multiple paths due to collisions with the ionized gas, coating the sample on all exposed faces.

A gas discharge glow, centred about the cathode is visible.

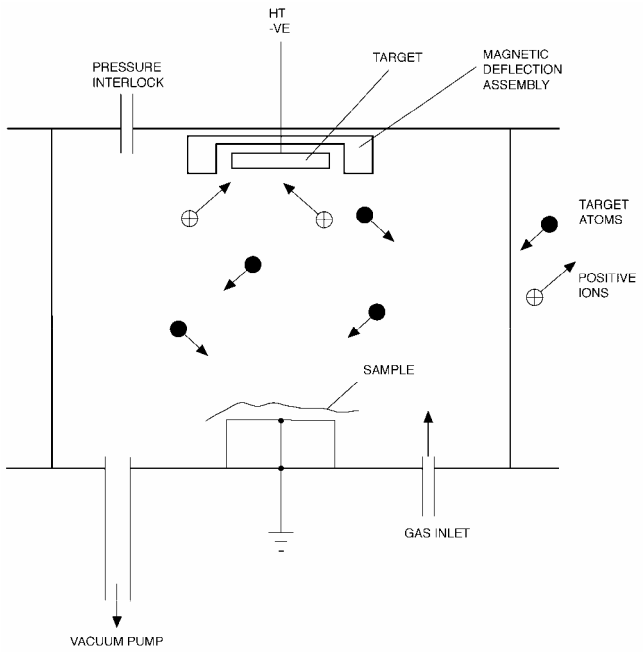


Figure 4-6: Sputter Coater Operation

4.4.2 Pumping Requirements

The work chamber has to be evacuated to <2 x 10^{-2} mbar. This can be achieved in a reasonable time (depending on the cleanliness of the chamber) using a 90 l/m two stage rotary pump, preferably incorporating an anti-suck back device and fitted with an oil mist filter on the exhaust.

4.5 Interlocks

Safety interlocks are incorporated in the SC7680 Sputter Coater to prevent high voltage power being switched on with the chamber top plate not in the closed position. A vacuum switch will also disable the high voltage power should the pressure rise beyond operating parameters.

	**WARNING** **HAZARD TO HEALTH!** **Potentially lethal voltages are used in this equipment.** Under no circumstances should interlock connections be over-ridden.	 HIGH VOLTAGE

4.6 SC7680 Panel Details

The SC7680 Sputter Coater is designed to be bench mounted, it provides 0 - 2.8 kV DC output. Process current of up to 0 - 50 mA is available with a 999 second timer to control the process. The front panel, incorporates the chamber pressure and plasma current analogue meters, the manual/auto select switch, sequence start switch, set HT switch, repeat coating switch, and vent/stop switch. For manual operation, there are timer start and stop switches. The digital timer sets the coating time for both the manual and automatic sequences. The voltage applied to the sputter head is also selected on the front panel. The logic state in the operating sequence is also displayed by a series of LED indicating lamps. The argon leak valve controls the gas pressure.

4.6.1 SC7680 Front Panel Controls

The controls and indicators mounted on the SC7680 Sputter Coater front panel are described below and identified in Figure 4-7 and described in Table 2.

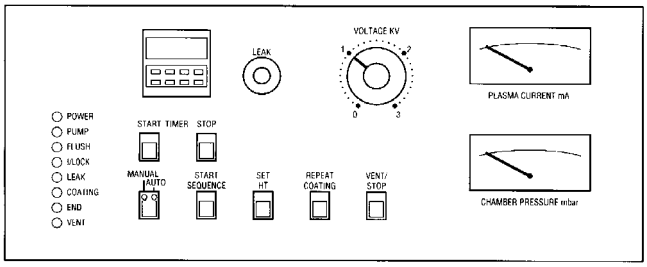


Figure 4-7: SC7680 Sputter Coater, Front Panel Controls

CONTROL or INDICATOR	DESCRIPTION	
TIMER	Multifunctional timer.	
LEAK	This valve leaks gas into the vacuum chamber to control the plasma current. Turn the valve fully clockwise to close the valve.	
VOLTAGE kV	This rotary control adjusts the output voltage of the high voltage power supply in the range, 0 - 3 kV dc.	
INDICATOR LIGHTS	**POWER**	When illuminated (red), indicates mains power is connected to the unit, the system is ON.
	PUMP	When illuminated (red), indicates power is connected to the rotary pump, the system is pumping.
	FLUSH	When illuminated (red), indicates the chamber is being purged with gas.
	I/LOCK	When illuminated (red), indicates that HT power supply has been enabled by the vacuum interlock.
	LEAK	When illuminated (red), indicates that a 30 second delay is taking place. During this delay gas is leaked into the chamber to establish a stable vacuum. If the pressure rises above the safety interlock threshold the indicator is illuminated (flashing) and the delay is reset.
	COATING	When illuminated (red), indicates that the plasma discharge is ON.
	END	When illuminated (red), indicates that the sputtering process is complete.
	VENT	When illuminated (red), indicates that the vacuum chamber is being vented.
TIMER START	This press to operate switch, starts the timer when in manual mode.	
TIMER STOP	This press to operate switch, resets the timer and terminates the sputtering process in both manual and automatic modes.	
MANUAL AUTO	This press to operate switch, controls the mode of operation of the system. The mode selected, Manual or Auto is indicated by the illumination of an integral LED.	
START SEQUENCE	This press to operate switch, starts the sputtering process in both Manual and Auto modes.	
SET HT	This non-latching (press and hold to operate) switch, allows the user to set the sputtering parameters (voltage, current and chamber pressure) in manual mode.	
REPEAT COATING	This press to operate switch, starts the repeat sputtering process.	
VENT/STOP	This press to operate switch, stops the sputtering process and starts to vent the system.	
PLASMA CURRENT mA	This meter provides an indication of plasma current flow. Under the recommended operating conditions: Plasma current approx. 18 mA.	
CHAMBER PRESSURE mbar	This meter provides an indication of pressure within the chamber. The normal readings are: Pressure with no gas input 0.01 mbar or better. Pressure with gas input 0.04 - 0.06 mbar	

Table 2: SC7680 Front Panel Control Descriptions

4.6.2 SC7680 Rear Panel Connections

The connection points and other components mounted on the rear panel of the SC7680 Sputter Coater are described below and identified in Figure 4-8 and described in Table 3.

The rear panel, includes the necessary fuses F1-F4, the HT outlet which is connected to the sputter head, the vacuum interlock socket for the sputter head (which prevent the operation of the HV power supply without vacuum being applied to the head), the Mains ON/OFF switch, the rotary pump socket, argon gas inlet nipple, and the ground (earthing) terminal for the sputter head. There are two 4mm sockets which enables the user to measure the actual voltage being applied to the head using a standard DVM in a ratio of 10,000:1 (i.e. 100mV = 1000V).

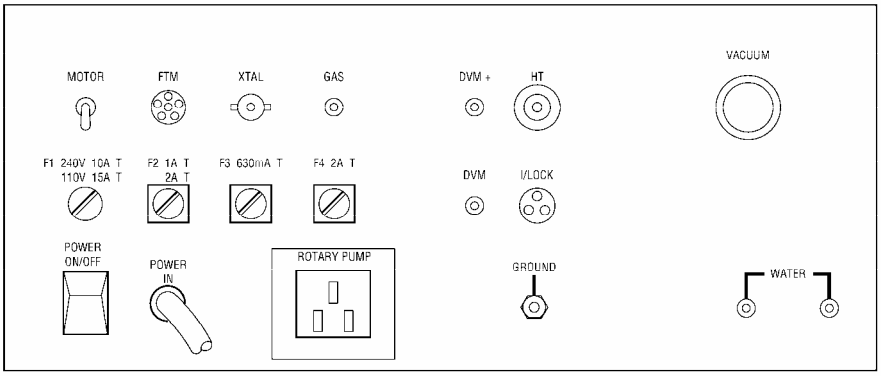


Figure 4-8: SC7680 Sputter Coater, Rear Panel Connections.

CONNECTION	DESCRIPTION
MOTOR	This toggle switch sets the rotating sample stage motor ON/OFF, when set down the motor is ON. On systems not equipped with a Rotary Planetary Stage (RC7606), this switch has no effect. A rotary control below the switch allows the speed of the rotary stage to be adjusted.
FTM	A six way DIN socket provides for the connection of the controlling function of the Film Thickness Monitor (FT7690).
XTAL	This BNC fixed socket provides a connection point to the FTM oscillator and internally to the crystal holder stage (FT7607).
GAS	A 3 mm nipple provides the gas (argon) input connection point.
DVM+/-	Two sockets provide for the connection of a Digital Voltmeter Meter to enable an accurate measurement of the HT voltage. (DVM output 1 volt = 10 kV dc).
HT	High voltage socket, connects a negative supply to the cathode mounted in the top plate assembly.
VACUUM	A 20 mm vacuum hose connection point, connects to the vacuum pump.
F1	Rotary Pump fuse, (240 Volt, 10 Amp), (110 Volt, 15 Amp).
F2	Main supply fuse, (240 Volt, 1 Amp), (110 Volt, 2 Amp).
F3	HT fuse, 630 mA.
F4	Pirani timer supply fuse, 2 Amp.
I/LOCK	A three way socket connects the top plate pressure switch to the control unit.
POWER ON/OFF	A vertically operated rocker switch acts as a mains isolator.
POWER IN	A flying lead provides the connection of power to the system.
ROTARY PUMP	A three way mains outlet socket provides power to the rotary pump.
GROUND	Earth connecting point, from the top plate assembly.
WATER	Inlet and outlet connections for cooling water supplies. On systems not equipped with water cooling, panel cut-outs are fitted with blind grommets.

Table 3: SC7680 Rear Panel Components

5 Installation

Quorum Technologies has carefully packed the **SC7680 Sputter Coater** instrument so that it will reach its destination in perfect operating order. Do NOT discard any packing materials until the unit has been inspected for any transit damage and the instrument has been used to the customers satisfaction.

If any damage is found, notify the carrier and Quorum Technologies (or local agent) immediately. If it is necessary to return the shipment, use the packaging as supplied and follow the instructions in this manual for return of goods paragraph 3.1.

5.1 Unpacking Checklist

The Equipment package will normally be despatched from the factory in one box. Inside the box the following will be found, refer and check each item off against the supplied packing list.

- SC7680 Sputter Coater - packed in its own internal packaging. (Target fitted to the Top Plate).
- SC7680 Glass Cylinder – packed separately.
- SC7680 START-UP kit - packed in a polythene bag.
- Optional Spares - packed individually.
- Documentation - Inserted in a folder, containing the operating manual and a standard forms pack.

5.1.1 Preparation

(a) Ensure that a suitable **mains electricity supply** (110 Vac - 20amps or 240 Vac - 13amps, frequency 50/60 Hz) is available. Check that the voltage label attached to the side of the cabinet is suitable for the local voltage and frequency.

The units are supplied for either 230V or 110V operation at 50/60Hz. The power rating is 250VA excluding the rotary pump. The rotary pump outlet is rated at 230V 10A or 110V at 16A. The 240V pump outlet uses a 3-pin plug (404440310), which is supplied, or 110V standard US plug (not supplied).

(b) Ensure that a suitable **gas supply** is available.

Typically: A commerical cylinder of Argon gas (Zero Grade), fitted with a two stage regulator, in order to deliver gas at a pressure around 5-10 psi (0.7bar).

(c) Ensure that a suitable **cooling water supply** is available if the optional water-cooled stage is fitted. This service is not required, unless the water-cooled stage option is fitted.

Ensure that a suitable supply of cooling water is available, a flow rate of 1 - 3 litres / minute of clean water is required. If a closed circuit recirculating chiller is used, avoid operating below dew point.

(d) Ensure that a suitable **vacuum pump** is available.

Where a rotary pump is used, ensure that the rotary pump has been filled with oil, in accordance with the manufacturers instructions. The exhaust should be filtered or expelled to a safe area. All pumps supplied by Quorum Technologies are fitted with an exhaust filter.

5.2 SC7680 Installation

	**Warning** **Hazard to Health!** Potentially lethal voltages are used in this equipment. Before making / breaking connections to the equipment, ensure power is switched off and that it is safe to proceed.	

	**Warning** **Hazard to Health!** **Precautions to be taken when lifting this equipment.** **Weight of unit is 25 Kilograms (55 lbs)**

(a) Position the Sputter Coater Cabinet on a suitable level working surface, access to both front and rear of the cabinet are required.

(b) Clean the 'L' section gaskets using a cloth moistened with isopropanol Fit to the glass cylinder, and then position the cylinder centrally on the base plate (mounted on top of the cabinet).

(c) Position the top plate assembly on the glass cylinder.

(d) Position the vacuum pump as close as possible to the Sputter Coater.

5.2.1 Connections

The connections to be made are described below and illustrated in Figure 5-1.

(a) Make the following hose connections to the rear panel of the cabinet:

(i) Connect from argon cylinder regulator to **GAS** hose nipple.

(ii) Connect the rotary pump to the (**VACUUM**) connector using 20 mm bore vacuum tubing, secure using hose clips or tie-wraps. Ensure the minimum length of hose is used.

(iii) If the system is fitted with water cooling make connections to the **WATER** hose nipples using 6 mm bore tubing.

(b) Connect the Top Plate assembly to the rear panel of the cabinet using the attached connectors:

(i) Connect the HT cable, to the **HT** socket on rear panel.

(ii) Connect the 3-way connector to the **I/LOCK** connector on the rear panel.

(c) Make the following electrical connections to the rear panel of the cabinet:

(i) Connect **(ROTARY PUMP)** power out to the vacuum pump. If a rotary pump is supplied with the Sputter Coater a suitable connecting cable is supplied with the pump, otherwise a suitable 3-way plug (which can be wired by the user) is supplied.

(ii) Connect the mains **(POWER IN)** cable via a suitable plug to the local supply, in accordance with the cable colour coding:

Brown	-	Live
Blue	-	Neutral
Green/Yellow	-	Earth

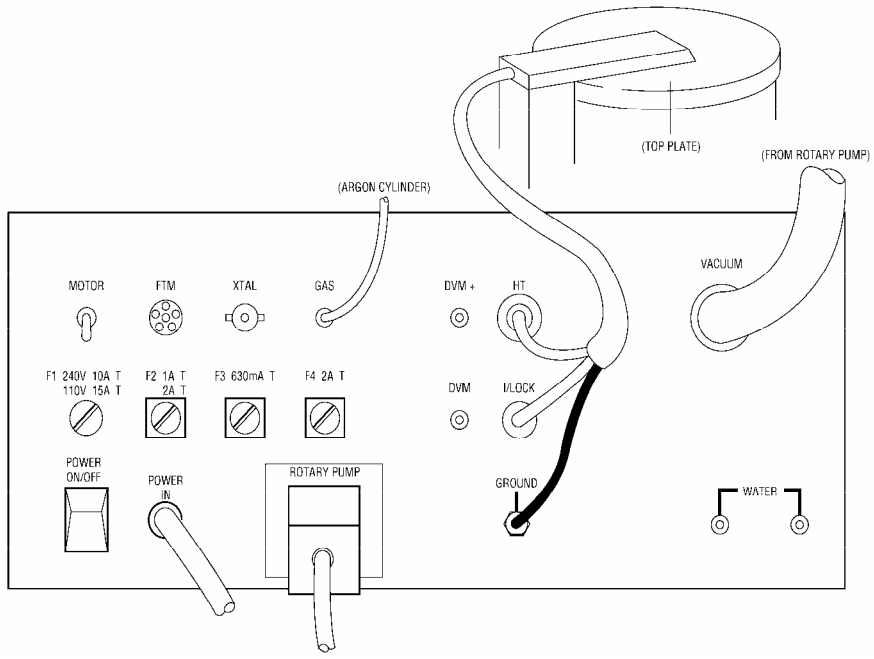


Figure 5-1: SC7680 Connections

5.3 Installation of Optional Accessories

The SC7680 Sputter Coater is available with three optional stage accessories, only one of which may be fitted at a time. These accessories will normally be factory fitted at the time of order in the priority:

(1) FT7607 Crystal Holder stage

(2) RC7606 Rotary Planetary stage

(3) WS7608 Water Cooled stage

A user may retrofit any of the stage options as follows:

(a) Isolate the SC7680 Sputter Coater from the mains power by removing the power lead from the laboratory supply.

(b) Remove all services and connections to the rear panel.

(c) Should you require to remove the front or rear panel, the procedure is as follows:-

Remove the panel by unscrewing 8 x M2.5 captive screws along the top and bottom edges of the panel. Unscrew and remove 4 x M4 screws at the left and right hand edges of the panel. On the rear panel unscrew and remove 2 x M4 screws around the vacuum connection. The rear panel will be captive to the control unit by the wiring loom, move the panel to allow access into the control unit.

On the front panel a rubber hose connected to the needle valve will need to be removed before laying the panel down to gain access.

5.3.1 FT7607 Crystal Holder Stage

(a) Remove the standard adjustable height stage from the base plate by unscrewing and removing 3 x M4 cap head screws. The stage may now be lifted from the base plate, a compressed 'O' ring in the stage flange provides the vacuum seal.

(b) Insert the FT7607 Crystal Holder Stage into the base plate ensuring the 'O' ring seal is clean and lightly greased. Retain the FT7607 stage to the base plate using the 3 x M4 screws provided. Connect the supplied BNC-BNC cable between the stage fitting and the rear panel XTAL fitting.

(c) Re-fit the rear panel and connect all the removed services. The FT7690 Film Thickness Monitor will be required to complete the installation. The FT7690 is fitted external to the SC7680 Sputter Coater and is connected to the FTM socket and a suitable mains supply.

5.3.2 FT7687 Adjustable Position Crystal Holder

(a) Remove the front panel by loosening the four captive screws along the top and bottom edge, and the two screws on either side. The panel should now open but will be restricted by a rubber hose fitted to the Needle valve, remove this tube so the panel can be dropped down.

(b) Locate the blanking plug and remove the two screws & clamps from the underside of the base plate. Ensure the o-ring on the feed-through is lightly greased, insert the feed-through from the bottom and secure with the screws and clamps. Fit the BNC cable to the connector on the back panel and feed-through.

(c) To fit the Crystal holder firstly tighten the hexagon spacer to the base plate, using the screw, secure the arm to the spacer, adjust position as necessary & fit the supplied cable. Refitting the front panel is the reverse of removal.

5.3.3 RC7606 Rotary Planetary Stage

(a) Remove the standard adjustable height stage from the base plate by unscrewing and removing 3 x M4 cap head screws. The stage may now be lifted from the base plate, a compressed 'O' ring in the stage flange provides the vacuum seal.

(b) Insert the RC7606 Rotary Planetary Stage into the base plate ensuring the 'O' ring seal is clean and lightly greased. Retain the RC7606 stage to the base plate using the 3 x M4 screws provided.

(c) Connect the flying lead from the RC7606 motor to the coiled flying lead located on the control unit chassis below the base plate.

(d) Re-fit the rear panel and connect all the removed services. On/off control of the RC7606 stage is provided by the MOTOR switch located on the rear panel.

5.3.4 WS7608 Water Cooled Stage

(a) Remove the standard adjustable height stage from the base plate by unscrewing and removing 3 x M4 cap head screws. The stage may now be lifted from the base plate, a compression 'O' ring in the stage flange provides the vacuum seal.

(b) Insert the WS7608 Water Cooled stage into the base plate ensuring the 'O' ring seal is clean and lightly greased. Retain the WS7608 stage to the base plate using the 3 x M4 screws provided. Remove 2 x blanking covers located on the rear panel 'WATER' legend. Insert the two water fittings into the exposed holes and retain with the nuts provided.

(c) Prior to re-fitting the rear panel and services, test the liquid path of the stage to ensure there are no leaks by connecting the water fittings to a water supply.

(d) Re-fit the rear panel and connect all the removed services.

6 Operation

The SC7680 Sputter Coater is designed to be durable and has a long lifetime. The instrument does contain items, primarily the Target, that has a finite lifetime. In order to sustain optimum performance the Target will need replacing periodically. The lifespan of the Target is dependent on a number of factors, including operating in good vacuum levels, contamination and the purity of the gas being used. The Target should be replaced when it starts to become perforated.

6.1 Test Procedures

CAUTION

Contamination can seriously affect the sputtering process

To reduce the possibility of contamination by airborne particles, minimise the time the vacuum chamber is open to the atmosphere.

This test procedure, which checks the system is operating correctly, should be performed at the following times:

After the installation process has been completed.

After any operation that could lead to contamination of the vacuum chamber.

(a) Preparation

(i) Check that **LEAK** valve is closed, (fully clockwise) do not over-tighten.

(ii) Check the Argon cylinder regulator is open. Set pressure to 0.7 bar (5-10psi).

(iii) Check that mains power is available, set the rear panel mounted **POWER ON/OFF** switch to the down position (ON). The **POWER** indicator and **MANUAL / AUTO** switch indicator will indicate **AUTO**.

(b) Set vacuum pressure.

(i) Operate **MANUAL / AUTO** button, the **MANUAL** indicator will illuminate.

(ii) Set **TIME** control to 10 seconds.

(iii) Set **VOLTAGE** control to 0 volts (fully counter-clockwise).

(iv) Press the **START SEQUENCE** button, The rotary pump will start (the **PUMP** indicator will illuminate), the **CHAMBER PRESSURE** meter will indicate a falling pressure. When pressure falls to 4×10^{-1} mbar (approx.), the flush valve will open (the **FLUSH** indicator will illuminate) for 5 seconds, purging the system with process gas. The system will then continue to pump down. When the pressure falls below $< 10^{-1}$ mbar the **I/LOCK** indicator will illuminate. Wait until the system reaches ultimate pressure, typically $<2 \times 10^{-2}$ mbar.

(c) Set process current

(i) Set the **VOLTAGE** control to 2.2 kV.

(ii) Press and hold the **SET HT** button, no current should be indicated on the **PLASMA CURRENT** meter. If current is indicated (a plasma discharge will be seen in the vacuum chamber), release **SET HT** button, wait for system to pump down further.

(iii) With the **SET HT** button held and no current indicated, slowly open the **LEAK** valve until the chamber pressure begins to rise. Whilst monitoring the **PLASMA CURRENT** meter, adjust the **LEAK** valve for a current of 10 - 20 mA, (a strong plasma discharge will be seen in the chamber). Release the **SET HT** button, the plasma discharge will extinguish.

(d) Timer operation

(i) Operate the timer **START** button, the plasma will strike and the sputtering process will deposit target material on the base plate. The **COATING** indicator will illuminate (flashing).

(ii) After 10 seconds the plasma discharge will terminate, the **COATING** indicator will cease flashing and the **END** indicator will illuminate.

(iii) The rotary vacuum pump will continue to operate maintaining the chamber pressure at the level set by the **LEAK** valve.

(e) Vent system to process gas.

(i) Press and hold the **VENT/STOP** button. The **VENT** indicator will illuminate, the rotary vacuum pump will stop and the chamber will be vented to process gas (argon). All the indicators except **POWER** and **VENT** will be extinguished.

(ii) When sufficient gas has entered the vacuum chamber, positive pressure will 'pop' the vacuum chamber open (typically, after 30 seconds). To close the vent valve, release the **VENT** button.

(iii) Do not disturb the **VOLTAGE** and **LEAK** control settings.

(f) Automatic mode of operation

The automatic mode of operation relies on the settings of **VOLTAGE** and **LEAK** controls set in the manual mode (as above).

(i) Operate the **MANUAL / AUTO** button, the integral **AUTO** indicator will illuminate.

(ii) Operate the **START SEQUENCE** button. An automatic sputtering process will be completed (as tested in the manual mode above), the indicators will mimic the sequence of operations.

(iii) When the sputtering process is complete, (**END** indicator illuminated), vent the system to process gas, see (e) above.

(g) System shut down.

After completion of a work schedule, close down as follows:

(i) Close the **LEAK** valve (turn fully clockwise).

(ii) Turn **POWER** (rear panel of SC7680) to **OFF,** all indicators will extinguish.

(iii) Turn OFF process gas cylinder.

6.2 Coating Process

A metal film of uniform thickness between 50 and 300 Å is generally used for SEM investigations.

Care must be taken to ensure the vacuum chamber is kept clean and free from contamination. Contamination, which can arise from the out-gassing of specimens, adhesives (especially Chlorohydrocarbon based solvents) and rubber gaskets, will adversely affect the quality and rate of sputtering.

A measure of thickness can be obtained using the following equation: **d = KIVt**

d The coating thickness in Angstrom units.

K An experimentally determined constant based on:
The metal being sputtered,
The gas being used,
45 mm (approx.) target to sample distance.
For gold used with argon, K = 0.17 approx.
For gold used with air, K = 0.07 approx.

I is plasma current, in mA.

V is the applied voltage, in kV, (1 kV).

t is the sputtering time, in seconds.

For a typical sputtering, using gold in argon with a plasma current of 18 mA for 120 seconds:

d = KIVt = 0.17 x 18 x 1 x 120
= 367 Å (approx. 3 Å / second)

The uniformity of the coating thickness within the area of the specimen holder is better than 10%.

6.3 Coating Specimens

6.3.1 Coating in Manual Mode – High Resolution

(a) Mount specimens

(i) Prepare specimens on stubs, using an approved method.

(ii) Raise the vacuum chamber Top Plate.

(iii) If necessary adjust the height of the sample stage. Whilst the most suitable height for a particular application can best be established empirically, 50mm between top of the sample and the target provides a satisfactory general purpose setting. Access to the sample stage can be improved by lifting the glass cylinder clear of the system.

(iv) Mount the stubs (with attached samples) on the sample stage.

(v) Lower the hinged top plate to close the vacuum chamber, ensure the surfaces are clean.

(vi) Flick motor switch on rear panel if sample rotation is desired, and adjust the speed using the rotary potentiometer.

(b) Preparation

(i) This procedure assumes that the test procedure (4.1) has been completed and that the **LEAK** valve and **VOLTAGE** controls have been set.

(ii) Check the process gas (argon) cylinder regulator is open. Set pressure to 0.7 bar (5 - 10psi).

(iii) Check that mains power is available, set the rear panel mounted **POWER ON/OFF** switch to the down position (ON). The **POWER** indicator and **MANUAL / AUTO** switch indicator will indicate **AUTO**.

(c) Set vacuum pressure

(i) Operate **MANUAL / AUTO** button, the **MANUAL** indicator will illuminate.

(ii) Press the **START SEQUENCE** button, The rotary pump will start (the **PUMP** indicator will illuminate), the **CHAMBER PRESSURE** meter will indicate a falling pressure. When pressure falls to 4 x 10^{-1} mbar (approx.), the flush valve will open (the **FLUSH** indicator will illuminate) for 5 seconds, purging the system with process gas. The system will then continue to pump down until the lowest pressure is reached.
(If the leak valve is closed the system will reach its lowest pressure, typically <2 x 10^{-2} mbar. Open leak valve and allow pressure to rise to 10^{-1} mbar. Close leak valve and allow system to reach ultimate pressure.

(d) Set process current

(i) Set the **VOLTAGE** control to 800V.

(ii) Press and hold the **SET HT** button, the solenoid operated section of the **LEAK** valve will open allowing system gas to enter the vacuum chamber. Whilst monitoring the **PLASMA CURRENT** meter, adjust the **LEAK** valve for an indicated current of about 5-10 mA, a plasma discharge will just be seen in the chamber. Release the **SET HT** button, the plasma discharge will extinguish.

(e) Sputter coating

(i) Set **TIMER** control to required duration (typically 60 seconds).

(ii) Operate the **START** button. The sputtering process will run for the duration of timer setting, whilst the timer is running the **COATING** indicator will be illuminated flashing. Pressing the STOP button can terminate the process. During the coating process it may be necessary to adjust the leak valve to maintain the 5-10 mA plasma current.

(iii) The process can be repeated by operating either **REPEAT COATING** or by pressing the **START** button again.

(iv) On completion of the sputtering process, the plasma discharge will extinguish and the **END** indicator will illuminate.

(f) Vent system to process gas.

(i) Press and hold the **VENT/STOP** button. The **VENT** indicator will illuminate, the rotary vacuum pump will stop and the chamber will be vented to process gas (argon). All the indicators except **POWER** and **VENT** will be extinguished.

(ii) When sufficient gas has entered the vacuum chamber, positive pressure will 'pop' the vacuum chamber open. Release the **VENT/STOP** button, the vent valve will close and the **VENT** indicator will extinguish.

(iii) Do not disturb the **VOLTAGE** and **LEAK** control settings.

(g) Remove Specimens

(i) Raise the Top Plate to open the vacuum chamber. Remove the coated samples.

(ii) If the system is not to be reused immediately, lower the Top Plate to protect the vacuum chamber against air borne contaminants.

6.3.2 Coating in Manual Mode - Routine

(a) Mount specimens

(i) Prepare specimens on stubs, using an approved method.

(ii) Raise the vacuum chamber Top Plate.

(iii) If necessary adjust the height of the sample stage. Whilst the most suitable height for a particular application can best be established empirically, 50mm between top of the sample and the target provides a satisfactory general purpose setting. Access to the sample stage can be improved by lifting the glass cylinder clear of the system.

(iv) Mount the stubs (with attached samples) on the sample stage.

(v) Lower the hinged top plate to close the vacuum chamber, ensure the surfaces are clean.

(vi) Turn on motor switch located on rear panel, if sample rotation is desired, adjust the speed using the rotary potentiometer.

(b) Preparation

(i) This procedure assumes that the test procedure (4.1) has been completed and that the **LEAK** valve and **VOLTAGE** controls have been set.

(ii) Check the process gas (argon) cylinder regulator is open. Set pressure to 0.7 bar (5 - 10psi).

(iii) Check that mains power is available, set the rear panel mounted **POWER ON/OFF** switch to the down position (ON). The **POWER** indicator and **MANUAL / AUTO** switch indicator will indicate **AUTO**.

(c) Set vacuum pressure

(i) Operate **MANUAL / AUTO** button, the **MANUAL** indicator will illuminate.

(ii) Press the **START SEQUENCE** button, The rotary pump will start (the **PUMP** indicator will illuminate), the **CHAMBER PRESSURE** meter will indicate a falling pressure. When pressure falls to 10^{-1} mbar (approx.), the flush valve will open (the **FLUSH** indicator will illuminate) for 5 seconds, purging the system with process gas. The system will continue to pump down until the lowest pressure is reached. (If the leak valve is closed the system will reach its lowest pressure, typically $<2 \times 10^{-2}$ mbar.

(d) Set process current

(i) Set the **VOLTAGE** control to 2.2 kV.

(ii) Press and hold the **SET HT** button, the solenoid operated section of the **LEAK** valve will open allowing system gas to enter the vacuum chamber. Whilst monitoring the **PLASMA CURRENT** meter, adjust the **LEAK** valve for an indicated current of about 20 mA, a plasma discharge will be seen in the chamber. Release the **SET HT** button, the plasma discharge will extinguish.

(e) Sputter coating

(i) Set **TIMER** control to required duration (typically 60 seconds).

(ii) Operate the **START** button. The sputtering process will run for the duration of timer setting, whilst the timer is running the **COATING** indicator will be illuminated flashing. Pressing the STOP button can terminate the process.

(iii) The process can be repeated by operating either **REPEAT COATING** or by pressing the **START** button again.

(iv) On completion of the sputtering process, the plasma discharge will extinguish and the **END** indicator will illuminate.

(f) Vent system to process gas.

(i) Press and hold the **VENT/STOP** button. The **VENT** indicator will illuminate, the rotary vacuum pump will stop and the chamber will be vented to process gas (argon). All the indicators except **POWER** and **VENT** will be extinguished.

(ii) When sufficient gas has entered the vacuum chamber, positive pressure will 'pop' the vacuum chamber open. Release the **VENT/STOP** button, the vent valve will close and the **VENT** indicator will extinguish.

(iii) Do not disturb the **VOLTAGE** and **LEAK** control settings.

(g) Remove Specimens

(i) Raise the Top Plate to open the vacuum chamber. Remove the coated samples.

(ii) If the system is not to be reused immediately, lower the Top Plate to protect the vacuum chamber against air borne contaminants.

6.3.3 Coating in Automatic Mode

When operating in automatic mode, satisfactory coating will only be achieved if the front panel controls, **LEAK** valve and **VOLTAGE**, are correctly set in manual mode (see above). It is essential that prior to operation in the automatic mode, a single manual process is completed, to ascertain and set suitable settings for the **LEAK** and **VOLTAGE** controls.

(a) Mount specimens.

(i) Prepare specimens on stubs, using an approved method.

(ii) Raise the vacuum chamber Top Plate.

(iii) Mount the stubs (with attached samples) on the sample stage.

(iv) Lower the hinged top plate to close the vacuum chamber, ensure the surfaces are clean.

(v) Turn on motor switch located on rear panel, if sample rotation is desired, adjust the speed using the rotary potentiometer.

(b) Automatic Sputter Coating

(i) Operate the **MANUAL /AUTO** button the integral **AUTO** indicator will illuminate.

(ii) Set the **TIMER** to the required duration, (typically 60 seconds).

(iii) Operate the **START SEQUENCE** button. An automatic sputtering process will be run, the indicators will mimic the sequence of operations. When the sputtering process has been completed the **END** indicator will illuminate.

(iv) If a thicker coating is required, operate the **REPEAT COATING** button, (the timer can be reset if required).

(c) Recover Specimens

(i) Press and hold the **VENT/STOP** button. The **VENT** indicator will illuminate, the rotary vacuum pump will stop and the chamber will be vented to process gas (argon). All the indicators except **POWER** and **VENT** will be extinguished.

(ii) When sufficient gas has entered the vacuum chamber, positive pressure will 'pop' the vacuum chamber open. Release the **VENT/STOP** button, the vent valve will close and the **VENT** indicator will extinguish.

(iii) Raise the Top Plate to open the vacuum chamber. Remove the coated samples.

(iv) If the system is not to be reused immediately, lower the Top Plate to protect the vacuum chamber against air borne contaminants.

6.4 Sputtering Rates

The following curves give experimentally determined sputtering rates for various metals as a function of voltage and current. It is noted that at low voltages and high currents, the rate of coating is lower than that at higher currents. This is as a result of the gas pressure being excessively high to achieve the current at the particular voltage.

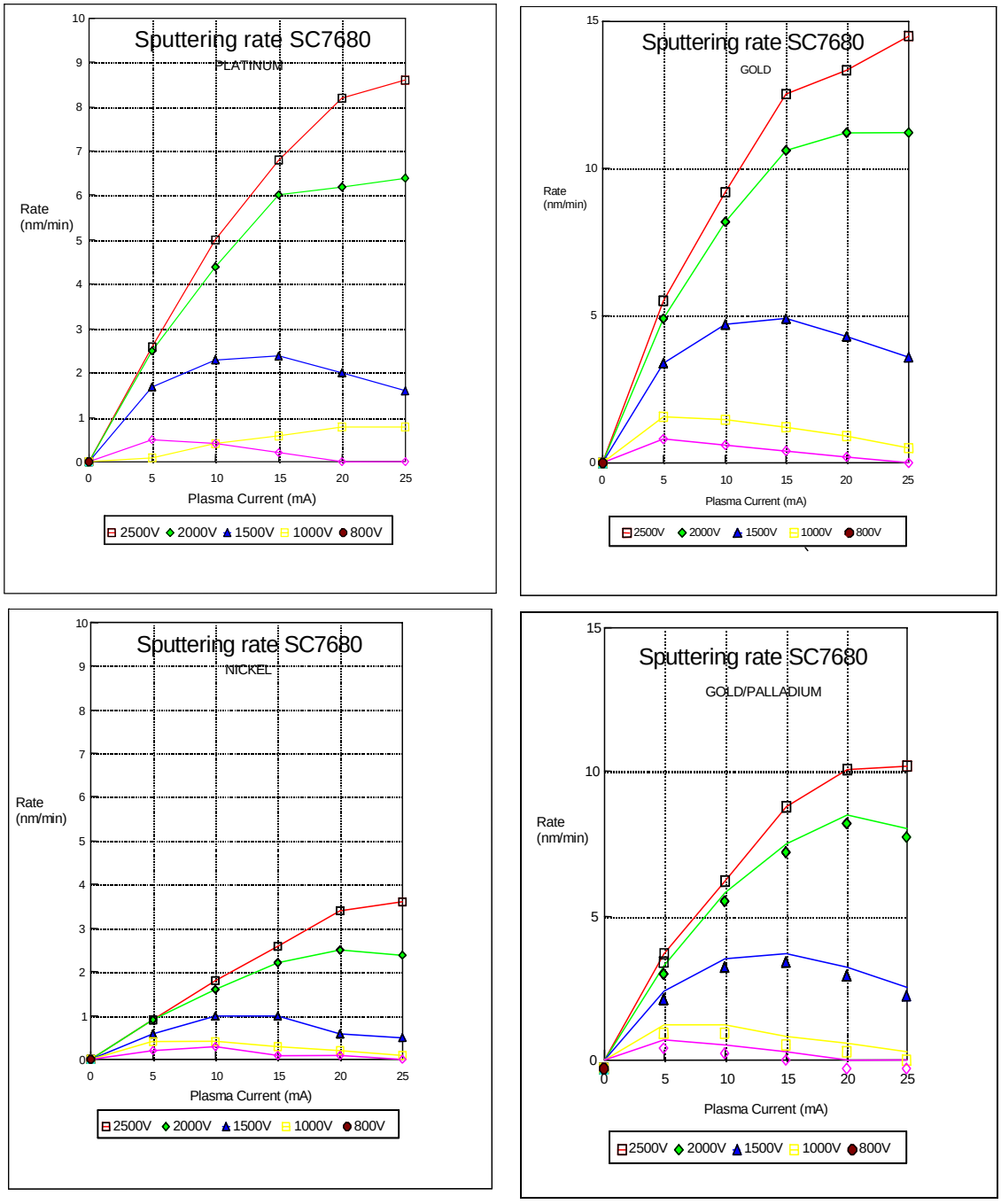


Figure 6-1: SC7680 Sputtering Rates

7 Maintenance

7.1 Maintenance General

WARNING

HAZARD TO HEALTH!

Potentially lethal voltages are used in this equipment.

Before making / breaking connections to the equipment, ensure power is switched off on the the Electronics unit.

(a) The procedures listed in this section should only be done by persons who have had training and who have achieved a satisfactory knowledge of the necessary skills and techniques.

(b) If repairs entail the dismantling of any part of the vacuum system, care must be taken to ensure that it is not contaminated (by dust or fingerprints).

(i) Always wear disposable plastic gloves.

(ii) Do **NOT** handle internal surfaces.

(iii) Whenever possible, cover to protect against dust.

7.2 Cleaning

Use a damp cloth or proprietary equipment cleaner to remove surface grime from the outer surfaces of the cabinet and vacuum chamber. Finish with a dry lint free cloth to remove smearing.

7.2.1 Vacuum Chamber Cleaning

Cleaning of the vacuum chamber is required if the interior of the chamber becomes contaminated, cleaning on a regular basis is unnecessary. The fact that the glass walls of the chamber becomes coated with target material and the sample cannot be seen, should not normally be considered reason to clean the system.

If the system is contaminated by handling or air-bourne pollution, carry out the following procedure.

For cleaning use a nylon abrasive pad (Scotchbrite or similar) and cleaning fluid (Isopropanol or Methyl alchol).

(a) Ensure power, water and gas supplies to the sputter coater are set to **OFF**.

(b) Remove all electrical, gas, water and vacuum connections from the rear of the instrument. Move the sputter coater to a clean working area.

(c) Raise the top plate to expose the target. Disassemble the glass cylinder and ‘L’ gaskets from the cabinet assembly.

(d) Lightly abrade all the accessible interior surfaces of the vacuum chamber to remove any deposits (not the target) and the glass cylinder, to remove any deposits. Finish with a lint free tissue moistened with isopropanol. Cover cleaned components to prevent further contamination.

(e) The target is self-cleaning in use and should not require attention. If the target is damaged, replace the target. See section 7.3.

(f) The vacuum and gas tubing cannot be readily cleaned, if these items are suspect or showing signs of ageing they should be replaced.

(g) Reassemble the vacuum chamber components.

(h) Reconnect the electrical and gas tubing connections from the Top Plate assembly at the rear of the cabinet.

(i) Return the sputter coater to its working position. Reconnect the electrical, vacuum, gas and water connectors to the cabinet rear panel.

(j) When taking the system back into service carry out the Test Procedure (see section 6.1), this will ensure the system is thoroughly dried out.

7.3 Target Replacement

In normal use, erosion of the target will occur. Initially this will be seen as a ring on the surface of the target. With further use, holes will be worn through the target material (generally in a circular pattern) exposing the aluminium. When this occurs the target should be replaced.

7.3.1 Target Removal

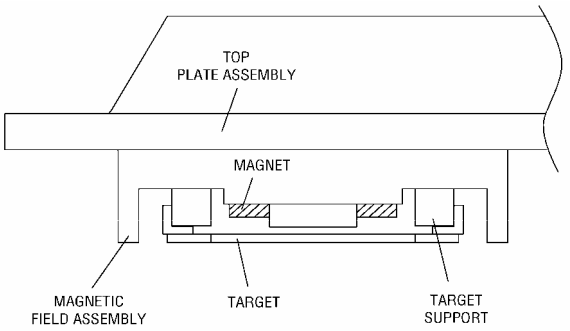


Figure 7-1: Target Replacement

(a) Ensure power supplies to the Sputter Coater are set to OFF.

(b) Open the top plate to obtain access to the target.

(c) Unscrew and discard the old target ring, if the target has seized tight and cannot be unscrewed, lubricate lightly with isopropanol.

(d) If necessary clean vicinity of the target, using a gentle abrasive material (Scotchbrite or similar) and lint free tissue moistened with isopropanol.

Note: In most cases the above removal procedure will be successful. However, if the target will still not unscrew, and target is worn out and is being removed for replacement, the following procedure can be tried:-

Take a look at the surface of the old target. It will be eroded and in places the aluminium backing plate may be exposed. If this is the case you may be able to see two small holes in the surface of the backing plate (if covered by the sputtering metal, then gently press on the surface to find the indent of the holes). Once located you should be able to insert to make shift " turning handles" into the holes (e.g. two small screwdrivers) and use these as levers to turn the target. But as mentioned, proceed **carefully** as the fine threads of the Al backing plate are easily cross-threaded.

7.3.2 Refit New Target

For replacement Target type and number, refer to Spares List Paragraph 7.5

(a) Screw the new target ring onto the target support.

(b) Clean the target and surrounding area using a lint free tissue moistened with isopropanol.

(c) Lower the top plate onto the vacuum chamber and reconnect any services previously removed.

7.3.3 Moving the Sputtering Head

The Sputtering Head has two positions to enable uniform coating of small and large diameter samples.

(a) Remove the two screws and clamps around the Sputtering Head.

(b) Unplug the Sputtering Head and move to the optional position.

(c) Replace the two screws and clamps around the Sputtering Head.

Figure 7-2: Head Central

Figure 7-3: Head Offset

7.4 No Plasma Current

If when **SET HT** is operated and the **VOLTAGE** control is turned clockwise there is no indication on the **PLASMA CURRENT** meter, check the following:

(a) If **I/LOCK** indicator is not illuminated, check the vacuum pressure. Until the vacuum pressure has reduced to 10^{-1} mbar, the interlock will inhibit the **HT**.

(b) If **I/LOCK** indicator is illuminated, check fuse F3 (HT fuse, fitted to Sputter Coater rear panel). If fuse is blown replace with the correct fuse F3, 630mA anti-surge (405020230).

7.5 Spare Parts

Those parts, which due to wear and tear are more commonly required, are listed in the table as follows.

PART NUMBER	DESCRIPTION	QTY
E5004	Oil Mist Filter	1
SC510-314A	Gold Target	1
SC510-314B	Gold/Palladium Target	1
SC510-314C	Platinum Target	1
SC510-314D	Nickel Target	1
SC510-314E	Silver Target	1
SC510-314G	Palladium Target	1
351270380A	Argon Gas Tubing	2 metres
351270320	Vacuum Tubing	1metre
405150320	Fuse – 15A Type T $1^1/_4$" (F1- 110V)	1
405100310	Fuse – 10A Type T $1^1/_4$" (F1- 240V)	1
405010210	Fuse – 1A Type T 20mm (F2, - 110V)	1
405020230	Fuse – 2A Type T 20mm (F2 - 240V, F4)	1
405006210	Fuse – 630mA Type T 20mm (F3)	1

Table 4: Spare Parts

8 Fault Finding

We hope that you experience the minimum of problems throughout the lifespan of the instrument but inevitably problems may occur. Any known problems associated with this type of instrument have been listed below with the possible cause and suggestions of what to do. If problems continue to occur, for example the fuse blows immediately when a new one is fitted, contact the Service Department at Quorum Technologies or your local agent, see Section 9 for list of agents

8.1 Trouble Shooting / Fault Finding

OBSERVATION	POSSIBLE CAUSE	REMEDY	PARA
Unit appears dead	- Cable connections not made	- Check all cable connections	5.2.1
	- Fuse blown (if new fuse blows immediately contact the Service dept at Quorum Technologies)	- Replace fuse (F1) on back panel 10A $1^1/_4$ " Anti-surge. - 240V supply *or* 15A $1^1/_4$ " Anti-surge. - 120V supply	4.6.2
	- Interlock not activating	- Check interlock is operating	-
Rotary Pump not Working When **START SEQUENCE** control is operated, the **PUMP** indicator is illuminated	- Unit not switched on	Check switch on Rotary Pump	-
	- Cable connections not made	- Check all cable connections	5.2.1
When **START SEQUENCE** control is operated, the **PUMP** indicator is not illuminated	- Fuse blown	- Replace fuse (F2) on back panel 1A 20mm Anti-surge. - 240V supply *or* 2A 20mm Anti-surge. - 120V supply	4.6.2
Timer/Controller not working When switching on, **AUTO** indicator is not illuminated	- Fuse blown	- Replace fuse (F4) on back panel 2A 20mm Anti-surge. – 120/240V supply	4.6.2
Ring patterns or holes on Target	- Target at end of life	- Replace Target	7.3
No Plasma Current If **I/LOCK** indicator is not illuminated	- Low or No Vacuum Pressure (Above 10^{-1} the interlock will inhibit HT)	- Leaks in System or Pipework	6.3
		- Vent in Open	4.6.1
If **I/LOCK** indicator is illuminated	- Fuse blown	- Replace fuse (F3) 630mA 20mm Anti-surge.	4.6.2

Table 5: Trouble Shooting

8.2 Fault Prevention

It is assumed that with a system installed in a suitable environment and in regular use, faults will be repaired as they occur. To maintain the equipment to the best operating conditions a maintenance schedule is suggested as part of a fault prevention programme, the following items are suggested to be included in such a programme. The frequency of checking will depend on the usage of the equipment.

ITEM	REGULARLY	OCCASIONALLY
Inspect all connections (vacuum, gas and electric) for signs of wear and that they are securely retained in position.	X	
Check all control knobs are secure and operate correctly		X
Check that the lid interlock is operating correctly	X	
Check all earthing cables and connections are secure	X	
Cleaning	X	

Table 6: Fault Prevention

9 Agents

List of Agents Supporting Quorum Technologies products.

Oxford Instruments Pty. Ltd P O Box 7 Pennant Hills NSW 1715 **AUSTRALIA** Tel: 61 2 9484 6108 Fax: 61 2 9484 1667 Email: keith.murray@oxinst.com.au	Goffin Meyvis P O Box 251, NI-4870 AG ETTEN LEUR **THE NETHERLANDS** **(**Also covers**, BELGIUM & LUXEMBOURG)** Tel: 31 (0)76 508 6000 Fax: 31 (0)76 508 6086 www.goffinmeyvis.com	Hi-Tech Instruments Sdn Bhd 60 Jalan Ind. PBP 3 Taman Ind Pusat, Bandar, Puchong 47100 PUCHONG, Selangor. **MALAYSIA** Tel: 60 3589 11638 Fax: 60 3589 11639	Monocomp Instrumentacion S.A. C/Virgen de la Fuencisla 25 28027 Madrid **SPAIN** Tel: 34 91 326 74 97 Fax: 34 91 326 76 08 Email: Mi@monocomp.jazztel.es
Labco GmbH Dr - Tritemmel - Gasse 8 A3013 PRESSBAUM **AUSTRIA** Tel: 43 2233 53838 Fax: 43 2233 53176 www.jeoleuro.com	OED Technology Limited 15F Beltrade Commercial Building 3 Burrows Street WANCHAI **HONG KONG, CHINA** Tel: 852 2838 2377 Fax: 852 2838 0091 Email:pjcoomb@HK.Super.NET	Ellipsiz Malaysia SDN BHD No.15B/15C Jalan Kenari 8 Puchong Jaya Selangor Darul Ehsan PUCHONG 47100 **MALAYSIA** Tel: 60 3807 52035 Fax: 60 3807 53104	Leica Microsistemas SA Nicaragua 46 BARCELONA 08029 **SPAIN** Tel: 34 93 49 49530 Fax: 34 93 49 49532 Email: ana.alrcon@leica-microsystems.com
Altmann S/A Importação.e Comércio.Av Nacoes Unidas 13771 Bl.1-7°andar 04794-000 Sao Paulo -SP BRAZIL Tel: 55 11 550 73302 Fax: 55 11 550 74196 www.altmann.com.br	Auro-Science Consulting KFT H-1031 Budapest Varosfal Kos 5 Mail:H1300 Budapest PF 234 **HUNGARY** Tel: 361 242 1390 Fax: 361 242 1391 Email dobak@auroscience.hu	Global Science & Technology Ltd PO Box 101253 North Shore Mail Centre Auckland **NEW ZEALAND** Tel: 0800 734 100 Fax: 0800 999 002 Email: jsmall@globalscience.co.nz www.globalscience.co.nz	Aname C/Jose Fernandex Cuevas 14-B-282244 Pozvelo de Alarcon MADRID **SPAIN** Tel: 34 91 352 3084 Fax: 34 91 352 3322 www.aname.org
Soquelec Limited 5757 Cavendish Building Suite 101 MONTREAL QUEBEC H4W 2W8 **CANADA** Tel: 1 514 482 6427 Fax: 1 514 482 1929 www.soquelec.com	Harley Instruments Plot No. 4, Survey No. 47 Poona Satara Road POONA 411009 **INDIA** Tel: 91 2042 20602 Fax: 91 2042 20843 Email: harleyinstruments@vsnt.net	Nerliens Meszansky AS Kampengaten 18 PO Box 2955 Toyen N-0608 OSLO **NORWAY** Tel: 47 2268 5070 Fax: 47 2267 6506 www.nerliens.no	Atema Instrument PO Box 7075 Gillbostraket 8 S-19207 SOLLENTUNA **SWEDEN** Tel : 46 8626 8365 Fax : 46 8626 8355 Email : berndt.holm@atema.se
Edlin s.r.o Kon vova 141 130 83 PRAHA 3 **CZECH REPUBLIC** Tel: 42 2671 08255 Fax: 42 2671 08335 Email:zemek@edlin.cz	AVBA P.O Box 690, Ramat Gabriel Industrial Park, Migdal Haemek, 10500 **ISRAEL** Tel: 972 (0) 4 644 2575 ext.240 Fax: 972 (0) 4 644 2577	ELO SERWIS Grazyna B. Dudzinksa Ul.Sotta K. “Sokola” 7/2A Pl-02-796 Warszawa **POLAND** Tel: 48 004822 649 8690 Fax: 48 (22) 649 11 85 Email: S.Dudzinkski@medianet.pl	HO-CHAN Technologies Ltd N° 19, Lane 43 His-Tsun Road Dai-Li City TAICHUNG **TAIWAN**, ROC Tel: 886 4393 2897 Fax: 886 4393 2401 Email: zenyan@giga.net.tw
Ax Lab A/S Srandboulavarden 64 DK-2100 COPENHAGEN **DENMARK** Tel: 45 3543 1881 Fax: 45 3543 0073 Email:bodil@ax-lab.dk	Eisenberg Brothers 13 Gush Etzion St GIVAT SHUMEL 54030 **ISRAEL** Tel: 972 3 532 1715 Fax: 972 3 532 5696 www.eisenbros.co.il	Labometer Lda Rue Duque de Palmela No. 30-1° 1200 LISBOA **PORTUGAL** Tel: 351 1353 7284 Fax: 351 1332 4304 Email : Labometeri@mail.telepac.pt	Pondpol HTI Co Ltd 82/32 Kanchanapisek Road Talingchan District Bankok 10170 **THAILAND** Tel : 66 (2) 887 8883 Fax : 66 (2) 887 6330 Email : polsin@pondpol.com
Elexience 9 Rue Des Petits-Ruisseaux 91371 VERRIERS-le-BUISSON **FRANCE** Tel: 33 1695 38000 Fax: 33 1601 19809 www.elexience.fr	Jeol (Italia) S.p.A. Centro Direzionale Ripamonti Via Dei Tulipani 1 PIEVE EMANUELE (MI) 20090 **ITALY** Tel: 39 02904 1431 Fax: 39 02904 14303 Email: quill@jeol.it	Ellipsiz Singapore 29 Woodlands Industrial Park E1 #04-01/06 Northtech Lobby 1 **SINGAPORE 757716** Tel: 65 6311 8500 Fax: 65 6269 2628 www.ellipsiz.com	Becthai Bangkok Equip. Co Ltd. 300 Phaholyothin Road Phayathai BANGKOK 10400 **THAILAND** Tel: 66 2615 2929 Fax: 66 2615 2350/2351 www.becthai.th.com
GaLa Instrumente GmbH An der Schalmuch 42 BAD SCHWALBACH D-65307 **GERMANY** Tel: 49 6124 77952 Fax: 49 6124 60274 www.gala-instrumente.de	Nanovision s.r.l Via Santa Margherita, 115 20047 BRUGHERIO **ITALY** Tel: 039 287 8358 Fax: 039 287 2197 Email : nanovision@mclink.it www.nanovision.it	Set-Point Instruments PO Box 11400, VORNA VALLEY Gauteng **SOUTH AFRICA 1686** Tel: 27 11540 6000 Fax: 27 11466 1315 www.setpoint.co.za	Tekser Koll Sti Acibadem Ca. Erdem Sok Baver Apr. No 6/1 Uskudar ISTANBUL 81010 **TURKEY** Tel: 90 216 327 4041 Fax: 90 216 327 4046
Asteriadis S.A 56 - 58 Spirou Trikoupi PO Box 26140 GR-100 22 ATHENS **GREECE** Tel: 30 1 823 5383 Fax: 30 1 823 9567 www.asteriadis.com	Topcon Electron Beam Services Corp 75 - 1 Hasunuma - Cho Itabashi - KU TOKYO 174 **JAPAN** Tel: 813 3558 2588 Fax: 813 5392 4992 www.topcon-ebs.co.jp	DAE IL Commerce 2F Jinsung B/D 326-34 Magoek-dong Kangseo-gu SEOUL **SOUTH KOREA** Tel: 82 2366 58056 Fax: 82 2366 58059 www.daeilcm.co.kr	Energy Beam Sciences PO Box 468 11 Bowles Road AGAWAM MA01001 **UNITED STATES OF AMERICA** Tel: 1 413 786 9322 Fax: 1 413 789 2786 www.ebsciences.com
UNITED KINGDOM Quorum Technologies Ltd, Unit 15a Euro Business Park New Road, NEWHAVEN, East Sussex. England, BN9 0DQ Tel: (0) 1273 510535. Fax: (0)1273 510536 Email: Support@quorumtech.com			

10 Index