

EMS150T S/E/ES Sample Preparation System Instruction Manual



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Health and Safety

Safety is very important when using any instrumentation.

At EMS, we Endeavour to:

- Provide a safe working environment for our employees and customers
- Conduct our business responsibly, in a manner designed to protect the health and safety of customers, employees and the public at large, and to minimize any adverse effects on the environment.
- Review our operations regularly to achieve environmental, health and safety improvements in line with UK and European Community legislation.

All service work carried out on the equipment should only be undertaken by suitably qualified personnel.

EMS is not liable for any damage, injury or consequential loss resulting from servicing by unqualified personnel. EMS will also not be liable for damage, injury or consequential loss resulting from incorrect operation of the instrument or modification of the instrument.

Control of Substances Hazardous to Health (COSHH)

The EC legislation regarding the “Control of Substances Hazardous to Health” requires EMS to monitor and assess every substance entering or leaving their premises. Consequently, a completed Health and Safety Declaration form must accompany any returned goods (see Appendix -9.5.5 on page 67 for the form)

Without this declaration, EMS reserves the right not to handle the substance/item. Also, in accordance with EC regulations, we will supply on request hazard data sheets for substances used in our instruments.

WEEE Compliance



This product is required to comply with the European Union’s Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC.



Conformity



This Equipment of this Design and manufacture and marked CE, conforms with the requirements of the European Directives EMC 89/336/EEC & LVD 73/23/EEC.

Hazard Signal Words

This manual defines hazards using the following key words:

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.

Fail Safe

This Equipment will “fail safe” in the presence of excessive RF, Electrostatic Discharge or Mains Transients. While a loss of function could occur under extreme circumstances, the Equipment’s operation will be fully recoverable under normal operating conditions.

1 Introduction

1.1 General Description

The EMS150T system is a versatile sputter coater/turbo evaporator (see Figure 1-1) for preparing specimens for examination by electron microscopy.

With a comprehensive selection of easily interchanged inserts and sample stages, the EMS150T can be used to:

- Sputter coat samples using targets such as Chromium or Gold.
- Evaporate support films and replicas for TEM and X-Ray analysis and conducting coatings for SEM using 3mm or 6mm carbon rods or cords.
- Evaporate metals upwards or downwards from a wire basket or molybdenum boat arrangement.
- Clean aperture strips. There are three

models in the EMS150T range:

EMS150T S Sputter coater version only.

EMS150T E Carbon/metal evaporation version only.

EMS150T ES Combined system with interchangeable inserts for sputter coating or carbon/metal evaporation.

The instrument is fully adaptable to a wide range of specimens and offers easy loading and unloading of samples. The changeover between sputtering and evaporation inserts is simple. The system is fully automated with a user defined *profile* controlling the pumping sequence, preheating, outgassing, the time and number of evaporation/sputter bursts, and the current used during the process.

The EMS150T can be fitted with a film thickness monitor (FTM), which measures the coating thickness on a crystal in the chamber, to control the coating applied to the sample. For example, the EMS150T can automatically terminate a coating cycle when the required thickness has been achieved.



Figure 1-1. Front view of the EMS150T

The EMS150T features a turbo molecular pump backed by a rotary vacuum pump and controlled by the instrument throughout the fully automatic coating cycle.

The system is fitted with a vacuum shutdown system allowing the instrument to be pumped down and switched off, with the chamber left under vacuum.

1.2 Sputter Coating

Sputter Coaters are used in Scanning Electron Microscopy to provide an electrically conductive thin film representative of the surface topography of the specimen to be viewed, such films inhibit 'charging', reduce thermal damage, and enhance secondary electron emission.

The EMS150T S and EMS150T ES employ a magnetron sputter target assembly. This enhances the efficiency of the process using low voltages and giving a fine-grain (order of 0.5nm Cr grain size), cool sputtering. The unit features a rotating sample table ensuring even depositions (typically 5nm). It uses standard targets, avoiding the necessity of special large profile targets. The instrument is fitted with a 57mm diameter quick-change target (the sample chamber is 165mm in diameter) giving optimum consumable cost performance. Alternative target materials are available.

A shutter assembly is fitted as standard, which allows sputter cleaning of oxidizing targets.

1.3 Carbon Coating

Carbon films, because of their mechanical stability, good electrical conductivity, and low background signal are commonly used to prepare samples for Electron Microscopy (EM).

Thin films of about 5 nm (50Å) are used for particle support and as an isolating layer in autoradiography. Thicker films are used in Scanning Electron Microscopy (SEM) also for support, in addition to coating for X-Ray Microanalysis. In general, there is a need for all these films to be fine grain, even coating, with uniform and reproducible film thickness.

The most common form of deposition is from resistance heated carbon rods. The rods are shaped to achieve high current density with sufficient temperature to cause evaporation. Carbon filaments can also be used, which at high temperature burn quickly, from which has evolved the terminology: Carbon 'Flash' Evaporation. The resulting short coating times and reduced total power input distinguishes it from the somewhat longer process of carbon rod evaporation.

EMS150T E and ES models feature a multi-change head system for Carbon rod, Carbon fibre and metal evaporation.

1.4 Metal Evaporation

By vaporizing a metal film onto a sample, it is possible to enhance the topographic detail for high resolution analyses by TEM or SEM. This technique is particularly useful in the analysis of biological specimens. The metal evaporant, usually a wire of, for example, platinum or gold, is heated and vaporized by a filament (typically made of tungsten).

For downwards evaporation, evaporants usually in the form of wire: e.g gold, platinum, aluminum, etc are placed directly onto the filament. For upwards evaporation, the evaporant is placed in a 'boat' (typically made of molybdenum or tungsten).

The EMS150T E and ES can be configured for metal evaporation in an upwards or downwards direction.

1.5 Aperture Cleaning

In its metal evaporation configuration, you can use a EMS150T E or EMS150T ES to clean aperture strips and other electron microscope components. With the component placed in a molybdenum boat, it can be heated to evaporate contaminants.

2 Installation

It is important that this equipment is installed by skilled personnel in accordance with these instructions. Failure to do so may result in damage or injury. 'If in doubt - ASK'.

2.1 Pre-installation

Identify a suitable location for the unit:

- Mount the unit on a bench or the recommended trolley. The total weight of the system is 33.4 kg.
- The environment should have an ambient temperature range of 15°C to 25°C in a non-condensing relative humidity of not more than 75%.
- Sufficient ventilation is required, and positioning should be out of direct sunlight.

The system is rated for continuous operation.

2.1.1 Required Services


Gas supplies	Argon - Nominal 4 psi Nitrogen - Nominal 4 psi (Argon may be used as common gas)
Electrical supply	90-240V, 50/60Hz, 1350VA, including pump
Vacuum Pump	Pump No 3 complete with Vac. Hose & Oil Mist Filter 35 litre/min 2m ³ /hr

2.2 Unpacking

- 1 Remove the Instrument from its packing and place it in its operational position.

	CAUTION Don't try to lift the unit by yourself: it weighs 33.4kg. Get someone to help you move it.
---	--

2. Carry out a visual inspection to check for any signs of transit damage.
3. Remove the Accessories Pack, and check contents against EMS150T Accessories Pack shipping list.
4. Ensure that all areas of the Instrument are free of loose packaging material. Check specifically the instrument chamber, glass cylinder, and gaskets. (Do not use vacuum grease on gaskets).
5. If your unit includes a vacuum pump, carry out preliminary checks in accordance with the manufacturer's recommendations.

	<i>If you are intending to use an existing or alternative vacuum pump, and have any difficulty with these connections, please contact our technical support.</i>
---	--

2.3 Connections

Installation consists of the following steps:

- Connect gas supplies (see below).
- Make electrical connections (see page 11).
- Connect the vacuum pump (see page 12).
- Install the sample stage (see page 13).

If you want to install a different insert than that supplied with your instrument, please see page 38. If you have ordered a EMS150T ES, the instrument will be fitted with the sputter insert, unless you have specifically requested another configuration.

Figure 2-1 shows the location of connectors and switches on the rear panel of the EMS150T.

POWER INLET	PUMP OUTLET	AUX	GAS INLETS		VACUUM CONNECTION
Power inlet with integral On/Off rocker switch	Power supply for rotary pump allowing control by instrument.	Network connection	Argon 0.3bar (4psi)	Nitrogen 0.3bar (4psi)	Rotary Pump Vacuum connection

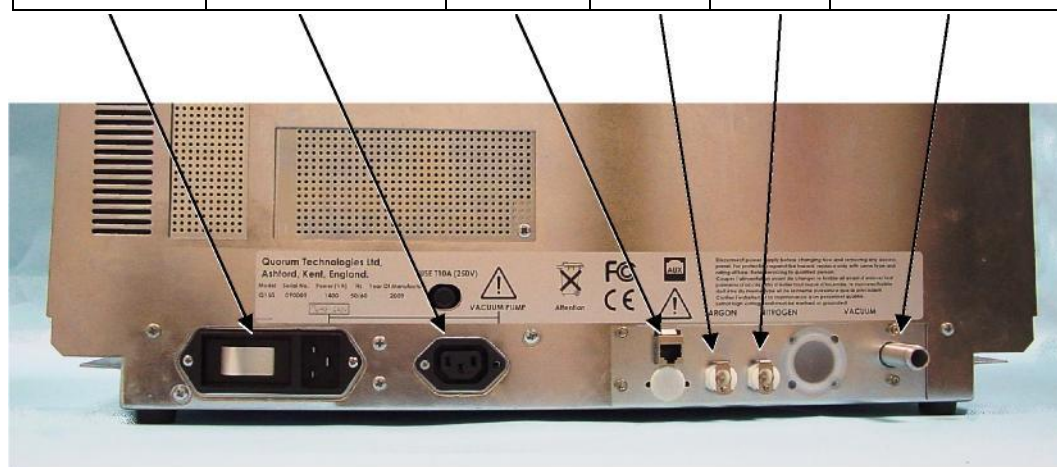


Figure 2-1. EMS150T Rear Panel



WARNING

UNDER NO CIRCUMSTANCES SHOULD ANY OTHER CONNECTIONS OR OUTLETS/INLETS BE USED FOR ANY OTHER EQUIPMENT OR SERVICES.

2.3.1 Gas Connections


1. Connect a suitable argon supply at a regulated input of 0.3bar (4psi) to the quick connect Argon gas connector on the rear panel (see Figure 2-1).
2. Connect a suitable nitrogen supply at a regulated input of 0.3bar (4psi) to the quick connect Nitrogen connector on the rear panel. We do NOT recommend using air as the purge gas.

If you prefer, you can use argon for both process and purge supplies. To do so, install a 'T' piece across both gas inlets.

Connectors are push-fit and will 'snap' into a locked position. To release a connector, depress the metal tongue.

2.3.2 Electrical Connections

1. Connect the instrument to a suitable earthed single-phase ac supply using the supplied cable. The lead should be fitted with the appropriate plug for your country. Ensure the plug is firmly located.




WARNING – EARTH CONNECTION
 This Equipment must be Earthed and fitted with the correct lead for the country of operation. This Equipment is normally supplied from 3 pin supply including Earth.

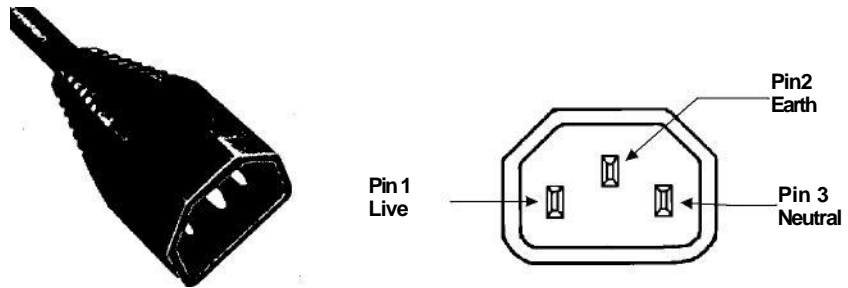


For fuse information, refer to Table 24.

2. Connect the rotary pump power lead to the Pump Output connector on the rear panel (see Figure 2-2). If the rotary pump has its own switch, ensure that this is set to the 'On' position.



WARNING – PUMP OUTPUT
 Check that the Power Output is suitable for the rotary pump. The Pump Output is intended for connection to the pump supply only and provides the electrical supply voltage at a maximum of 4 Amps.



PIN	UK AND EUROPE	U.S.A. AND CANADA
Pin 1 (Live or Hot)	Brown	Black
Pin 2 (Earth)	Green / Yellow	Green
Pin 3 (Neutral)	Blue	White

Figure 2-2. Power outlet lead wiring

2.3.3 Aux Network Connection

To link the EMS150T to your network, use a standard CAT5/5e cable with RJ45 network connectors to connect the AUX Network port directly to your computer's network port or a network hub/switch.

2.3.4 Vacuum Connections

1. If you are using an existing or alternative vacuum pump, and have any difficulty with connections, please ask for advice.
2. If the instrument is NOT going to be vented into an extraction system, fit an Oil Mist Filter with metal adapter to the outlet of the vacuum pump. Please refer to the manufacturer's instructions.
3. Ensure that the vacuum pump is filled with the correct oil.
4. If the vacuum pump is fitted with an on/off switch, ensure that it is set to the 'on' position to allow the instrument to control its power supply.
5. Connect the flexible vacuum hose to the spigot on the rear panel using the hose clip provided. This is a push-on fit to the Instrument. Ensure that this is firmly in place to the full length of the spigot.



A rotating vacuum spigot is available for more convenient hose connection in installations where the instrument is to be located close to a back wall (see page 51).

2.3.5 Fitting the Standard Stage

The EMS150T is supplied with a standard stage (10067). For installation instructions for other stages, see page 38. To install the standard stage:

1. Ensure that the instrument is vented and in standby mode.
2. Open the top cover fully so it rests against its backstop.
3. If there is already a stage in place, remove it by lifting carefully upwards.
4. Fit the standard stage by locating its shaft into the top of the stage rotation drive spigot protruding from the baseplate and with a twisting motion pushing it gently down until the collar around the shaft rests on top of the drive spigot (see below).

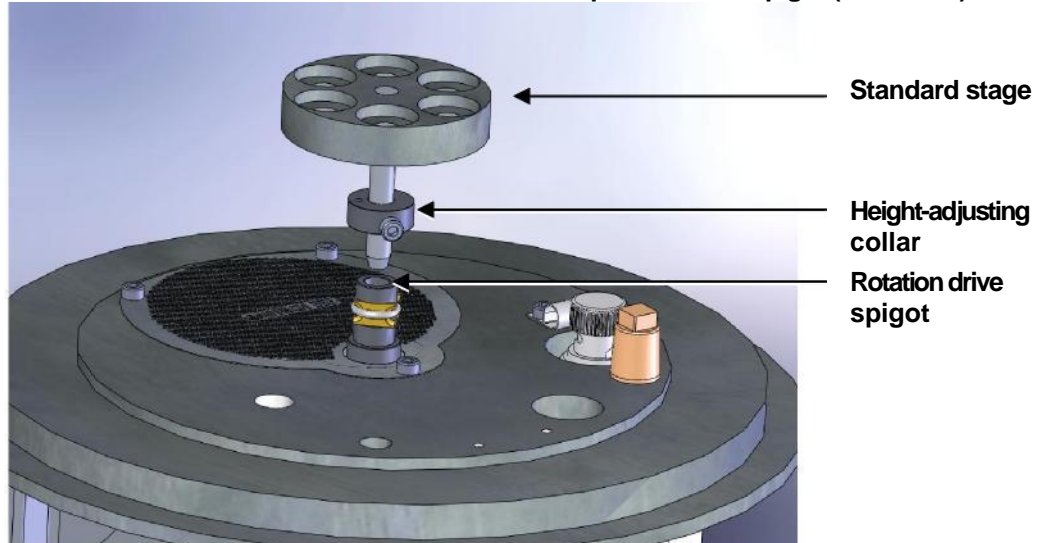


Figure 2-3.

Fitting the standard stage



You can adjust the height of the stage above the base plate by moving the collar up or down the shaft. Unfasten the M3 screw with a hexagonal key, slide the collar to the required position and retighten the M3 screw.

For maximum distance between the stage and the target, remove the collar so that the underside of the stage rests on the top of the drive spigot. To reduce the distance between the stage and target, fit the stage with the alternative long shaft (– supplied with stage).

When using small 1/8" pin stubs, it is advisable to unscrew the stage and fit it upside down for easy access to the stub.

Note that the EMS150T's default tooling factors are based on a stage height of 60mm from the base plate.

2.3.6 Optional Connections

For full connection details of optional units, where provided, please refer to separate instructions. Any other connections on the rear panel not listed are for common manufacturing and are not available for this instrument.

3 Operation

This chapter describes the basic operation of the EMS150T. For more advanced use, please see *Working with Profiles* on page 18 and *Application Guidelines* on page 24.

3.1 Switching On for the First Time

1. Ensure that you have completed the installation as described in the previous sections.
2. Switch the instrument on using the rocker switch located on the rear panel. The front panel LCD display should illuminate and show the initializing message.
3. Once the instrument hardware and software has initialized, the standby screen is displayed (see Figure 3-1).

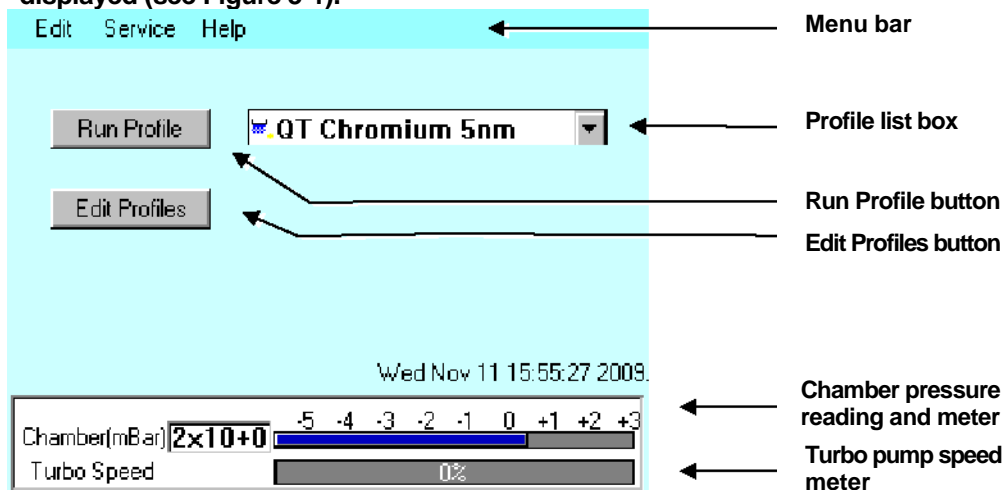


Figure 3-1.

Standby screen

3.1.1 The Standby screen

The Standby screen has three main parts:

- A menu bar with Edit, Service and Help categories (see page 28).
- Run Profile and Edit Profile buttons and a profile selector. Operate the instrument simply by selecting a profile and tapping on the Run Profile button.
- Pumping/vacuum information display: Chamber pressure reading and meter, and a turbo speed indicator.

3.2 Running a Profile

Before you can run a profile, ensure you have:

- Completed the installation as described on page 9.
- Switched on the instrument (see section 14).
- Loaded a sputter/coating target or loaded an evaporation source (see page 38).

To run a profile:

1. Load your sample onto the center of the sample stage.
2. Close the top cover assembly and press it firmly down to secure the latch.
3. Tap on the down arrow button to open the dropdown list of profiles (see Figure 3-2).

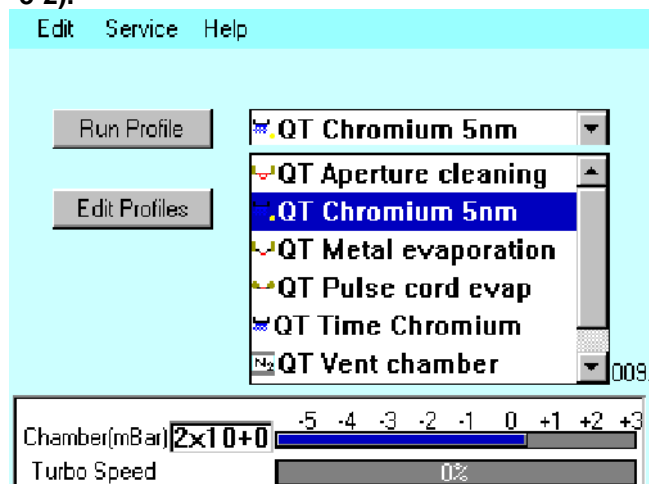


Figure 3-2. Selecting a profile

4. The EMS150T has several default profiles for common tasks as shown in Table 1. Tap on the name of the profile you want to run.

Table 1 EMS150T Default Profiles

PROFILE NAME	PURPOSE
QT Time Chromium	Sputter coating run using Chromium target (see page 24)
QT Chromium 5nm*	Sputter coating run using Chromium target terminated by FTM at a coating thickness of 5nm (see page 24)
QT Metal evaporation	Sputter coating using metal evaporator (see page 26)
QT Aperture cleaning	Default profile for aperture cleaning (see page 25)
QT Pulse rod evap	Evaporation using carbon rods (see page 27)
QT Pulse cord evap	Evaporation using carbon cord (see page 27)
QT Vent chamber	Vent sample chamber
QT Vacuum shutdown	Pumps chamber to 1mBar to allow shutdown under vacuum

* Profile only present on systems equipped with FTM.

5. Tap on the Run Profile button. The EMS150T starts pumping the sample chamber. The progress of the run is shown through a series of on-screen messages (Figure 3-3).

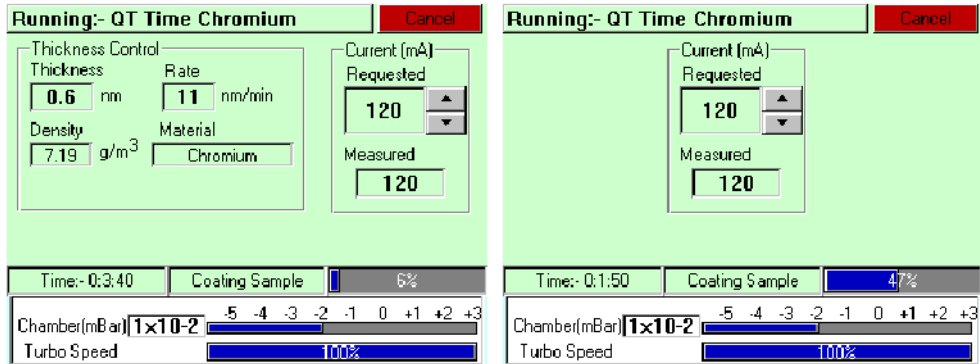



Figure 3-3. A run in progress: with FTM installed (left) and without FTM (right).

6. If you want to stop a run while it is in progress, tap on the Cancel button.
7. At the completion of the run, the EMS150T begins to vent the chamber (see Figure 3-4). If you want to record thickness control or current information, make a note of it now. When the chamber has been vented, the display reverts to the standby screen (see Figure 3-1).

 *Future versions of the EMS150T software will allow logging of thickness control and profile parameters through the instrument's network communication capabilities.*

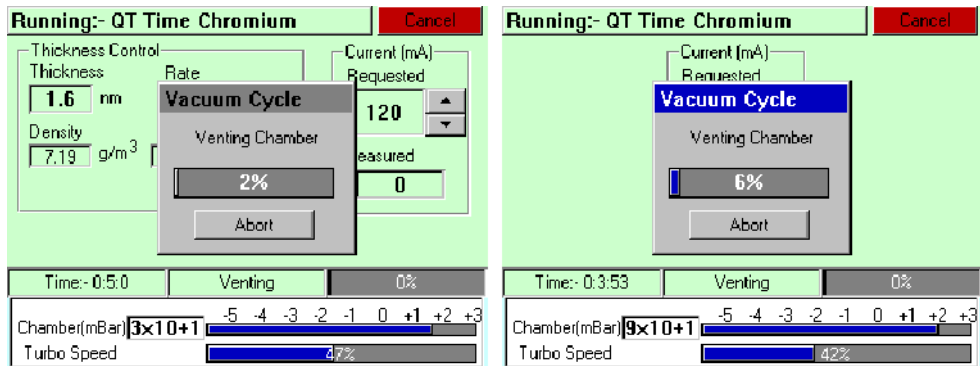


Figure 3-4. Venting the chamber: with FTM installed (left) and without FTM (right).

8. When the chamber has been completely vented, the display reverts to the standby screen. You can now remove your sample and set up another run.

3.3 System Settings

The operation of the EMS150T is controlled by its profile parameters. However, there are several *system parameters*, which can be changed without altering the profile. A system-set parameter overrides the corresponding setting specified in the active profile. You can make the new setting apply just to runs using the active profile or to all runs, irrespective of the choice of profile.

To change a system parameter:

1. Open *Profile Editor*: from the standby screen, tap on the Edit Profile button or choose Edit | Profiles from the menu bar.
2. Tap on the + sign to the left of the currently active profile (see Figure 3-5 - left).

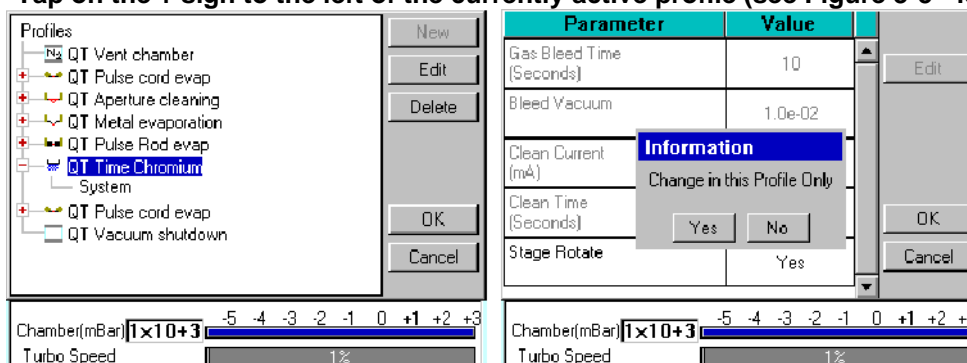


Figure 3-5. Listing system properties for a profile

3. Tap on *System*. *System Property Editor* is displayed (see Figure 3-5 - right).
4. You are prompted to confirm whether the changes are to be applied to runs using this profile only or to all runs. Tap on the Yes button to apply changes to the active profile only, or No to apply the change to all runs.

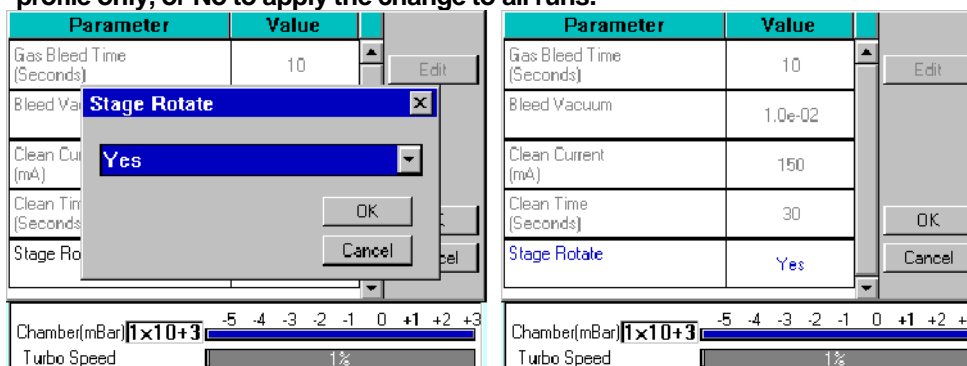


Figure 3-6. Changing the Stage Rotate system property

5. Tap on the value of the system property you want to change (in this case, *Stage Rotate*). Amend the setting as required and confirm the change by tapping on the OK button. Tap on the Cancel button to cancel any change (see Figure 3-6).
6. Altered system parameters are shown with blue text.
7. Tap on the OK button to exit the *System Property Editor*.

4 Working with Profiles

The operation of the EMS150T is controlled by a profile. This describes the sequence of operations in sputter coating or evaporation cycles. You can also create profiles to carry out simple operations such as pumping or venting the sample chamber. Many of the basic operations such as pumping, outgassing or venting the chamber occur automatically as does the sequence in which they occur.

The EMS150T is supplied with several default profiles to perform the basic and most common operations (see Table 1). To make your own profiles, customized for your specific applications, you can:

- Edit an existing default profile
- Create a new profile

4.1 Editing the Active Profile

To edit the profile currently selected on the standby screen, tap on the Edit Profile button. The editable parameters of the selected profile are displayed (see Figure 4-4).

Now refer to the *Editing Profile Parameters* section on page 21.

4.2 Profile Editor

To create, edit or delete any profile:

1. Select Edit | Profiles from the menu bar. *Profile Editor* is displayed (see Figure 4-1).

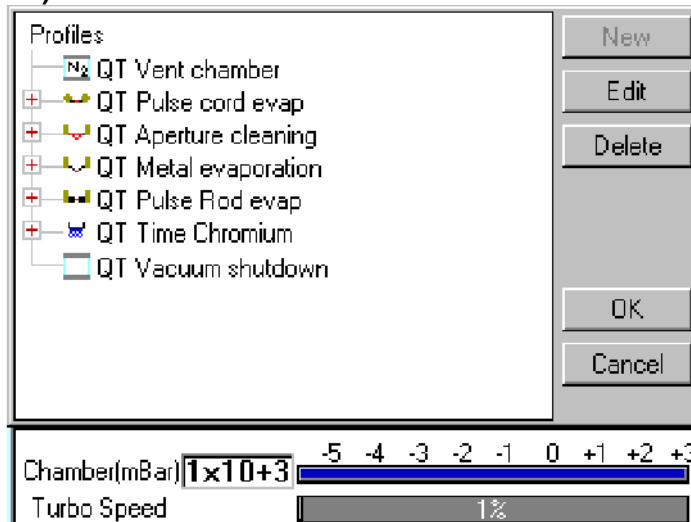










Figure 4-1. Profile Editor

In its main window, Profile Editor lists all existing profiles. To the left of each profile name, an icon denotes the type of profile (see Table 2).

Table 2 Profile icons

Icon	Profile/Process Type
	Timed sputter (see Table 18)
	FTM terminated sputter (see Table 18) Aperture cleaning (see Table 21) Metal evaporation (see Table 20)
	Pulse cord evaporation (see Table 19)
	Pulse rod evaporation (see Table 19) Vacuum shutdown (see Table 22)
	Vent chamber
	
	
	

2. Tap on one of the buttons on the right side of the editor:
 - a. To create a new profile, tap on the New button (see *Creating a new profile*).
 - b. To edit a profile, tap on its name and then tap on the Edit button. The Profile's parameters are displayed (now see *Editing Profile Parameters*).
 - c. To delete a profile, tap on its name and then tap on the Delete button.

4.2.1 Creating a New Profile

To create a new profile:

1. With Profile Editor displayed, tap on the **New** button or tap on *Profiles* at the root of the profile 'tree'.
2. The **New Profile** dialog box is displayed (see Figure 4-2).

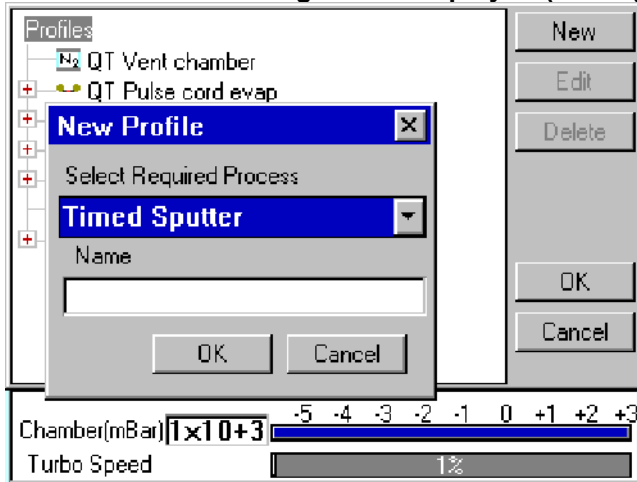


Figure 4-2. Creating a new profile

3. Choose the type of profile you want from the *Select Required Process* drop-down list).



See Table 2 for a list of all the available processes. Note that the processes listed are different for EMS150T E, EMS150T S and EMS150T ES models.

4. Enter a name for the profile: tap in the *Name* field to display the on-screen keyboard (Figure 4-3) in the *Enter Name* dialog box.



Figure 4-3. Entering a new profile name

5. Tap on the **OK** button to confirm the changes to the profile. Alternatively, tap on the **Cancel** button to close the dialog box without creating a new profile.
6. The new profile is created using the default settings for the chosen process type.
7. Now refer to the *Editing Profile Parameters* section, below.

4.2.2 Editing Profile Parameters

1. To edit a profile, tap on its name in *Profile Editor* and then tap on the Edit button. A table showing the profile's parameters is displayed.
2. To edit a parameter, tap on its value (it is then highlighted in blue) and then tap on the Edit button.

 *If a parameter is shown in grey text, you do not have the necessary user privileges to edit it. See page 34 for details.*

3. Change the value as required (see Figure 4-4). The instrument displays a dialog box for editing purposes, with either a numeric keypad or keyboard as required. The dialog box also shows the allowed values for the parameter.
4. Click on the OK button to confirm the change or on the Cancel button to restore the previous value.

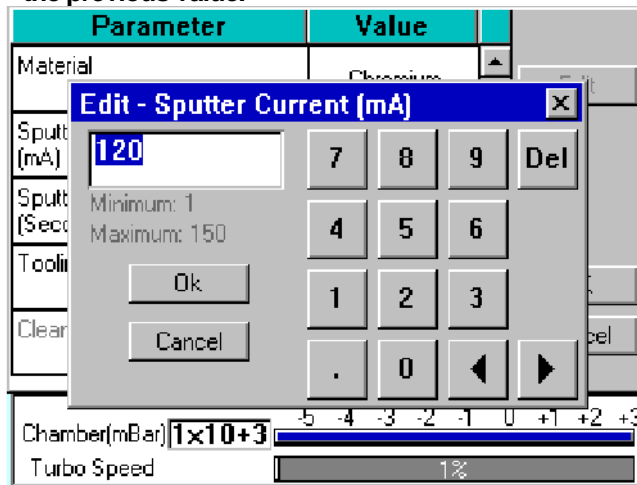


Figure 4-4. Editing Profile Parameters

5. Edit other parameters as required.
6. On the Profile window, click on the OK button to confirm the changes to the profile or on the Cancel button to restore the previous values.

To see a list of the parameters used in profiles see page 58.

Materials

The software contains a database of the most common elements and alloys used in sputtering and evaporation applications (see Table 3). The choice of material is the first parameter in a Sputter Coating profile. The embedded density information is used to calculate film thickness.

Table 3 Materials and their densi

Material	Density g/cm ³
Aluminium	2.70
Carbon	2.25
Titanium	4.54
Chromium	7.19
Nickel	8.90
Copper	8.96
Silver	10.50
Palladium	12.02
Gold / Palladium (Au/Pd) (60:40 mix)	16.40
Tungsten	19.30
Gold	19.32
Platinum / Palladium (Pt/Pd) (60:40 mix)	19.56
Platinum	21.45
Iridium	22.40
User Defined allowable range	1.00 - 23.00

4.3 Creating a New Material

To create a new entry in the material database:

1. Select Edit | Materials from the menu bar. *Materials Editor* is displayed (see Figure 4-5).

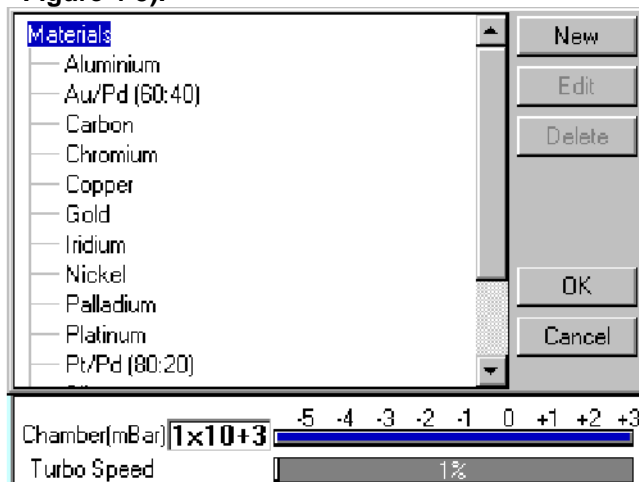


Figure 4-5. Materials Editor

Materials Editor lists all the existing materials.

2. Tap on one of the buttons on the right side of the editor:
 - a. To create a new material, tap on the New button or tap on *Materials* at the root of the materials 'tree' (see *Creating a new material*).
 - b. To edit a material, tap on its name and then tap on the Edit button (see *Editing material parameters*).
 - c. To delete a material, tap on its name and then tap on the Delete button.

4.3.1 Creating a New Material

To create a new profile:

1. Select Edit | Materials from the menu bar. *Material Editor* is displayed (see Figure 4-5).
2. Tap on the New button or tap on *Materials* at the root of the materials 'tree'. The *New Material* dialog box is displayed.
3. Enter a name for the profile: tap in the *Name* field to display the on-screen keyboard (Figure 4-6) in the *Enter Name* dialog box.
4. Tap on the OK button to confirm the changes to the material. Alternatively, tap on the Cancel button to close the dialog box without creating a new material.
5. The new material is created using the default settings for the chosen process type.
6. Now refer to the *Editing Material Parameters* section.

4.3.2 Editing Material Parameters

Each material is defined by the parameters shown in Table 4:

Table 4 Material parameters

Name	Default Value	Minimum Value	Maximum Value	Comment
Density	10	1	30	
Material Type	oxidising	noble	oxidising	
Sputter Current	50	1	150	
Clean Current	150	100	200	
Material Tool		0.1	10	

1. To edit a material, tap on its name and then tap on the Edit button.
2. To edit a parameter, tap on its value (it is then highlighted in blue) and then tap on the Edit button.
3. Change the value as required. The instrument displays a dialog box for editing purposes, with either a numeric keypad or keyboard as required. The dialog box also shows the allowed values for the parameter.
4. When you edit a value, click on the OK button to confirm the change or on the Cancel button to restore the previous value.
5. Edit other parameters as required.
6. Back in the Material Editor, click on the OK button to confirm the changes to the material or on the Cancel button to restore the previous values.

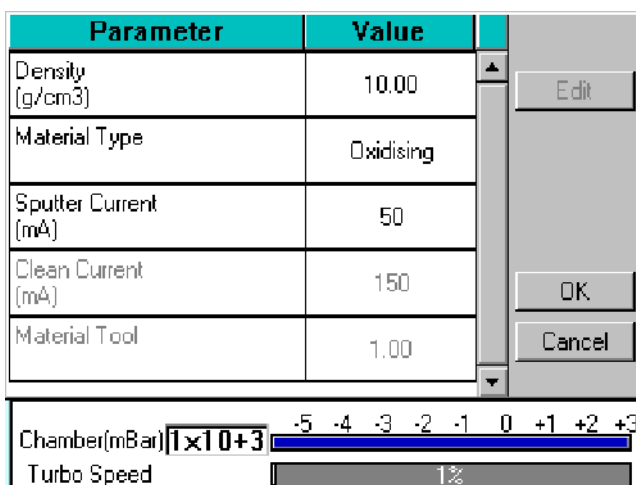


Figure 4-6. Material Parameters

5 Application Guidelines

This section describes the QT processes and their typical applications.

51 QT Timed Sputter

Suitable for the following applications:

- SEM coatings for tungsten emission SEM.
- High resolution SEM coatings for field emission SEM.
- General thin film coatings.
- Target materials: Au, Au/Pd or Pt

5.1.1 Tungsten SEM work

For this type of work, the aim is to achieve a typical thickness of 10-20nm from a gold target. Figure 9-1 shows the deposition graph for gold. With a current of 20mA, a deposition rate of 20nm/minute is typically achieved (assuming that the sample height is set to the default height of 60mm and the vacuum is 1×10^{-2} mBar).

To achieve a gold coating of 10nm create a new profile based on *QT Timed Sputter*: The default *Material setting* is *Au*.

- Edit the current to 25 mA.
- Set the time to 30 seconds.

If necessary adjust the time or current slightly to modify the thickness.

5.1.2 High resolution SEM coatings for field emission SEM

Generally, the recommended target materials are Cr or Ir and the objective is to generate a coating thickness of 5-10 nm.

The deposition graph using a Cr target is shown in Figure 9-2. With a current of 100mA, a deposition rate of 20nm/minute is typically achieved (assuming that the sample height is set to the default height of 60mm and the vacuum is 1×10^{-2} mBar)

To achieve a Cr coating of 10nm, create a new profile based on *QT Timed Sputter*:

- Set the material to Cr.
- Edit the current to 100 mA.
- Set the time to 30 seconds.

If necessary adjust the time or current slightly to modify the thickness.

52 QT FTM Terminated sputter

This process (only available if the FTM is fitted) is suited to the following typical applications:

- SEM coatings for tungsten emission SEM.
- High resolution SEM coatings for field emission FE- SEM.
- General thin film coatings.

5.2.1 High resolution SEM coatings for field emission SEM

For High resolution SEM coatings for field emission SEM, assuming the chosen target material for this application is Cr.

Generally, the recommended target materials are Cr or Ir and the objective is to generate a coating thickness of 5-10nm.

To achieve a Cr coating of 5nm, create a new profile based on *QT FTM Terminated Sputter*:

- Set the material to Cr.
- When prompted, select *use material defaults*. This applies a sputter current of 120mA and automatically sets the clean target current to 150mA and the terminate thickness to 5 nm.

If necessary adjust the thickness if the coating is not sufficient.

5.2.2 General thin film coatings

As an example, to achieve a silver coating of 100nm:

- Create a new profile based on *QT FTM Terminated Sputter*.
- Edit the newly created profile.
- Set the material to *Silver*.
- When prompted, select *use material defaults*. This applies a sputter current of 50mA and a *terminate thickness* to 5nm.
- Edit the *terminate thickness* setting to 100nm.

53 Aperture Cleaning

This process is designed to clean hydrocarbon contamination from SEM apertures. It is only available with EMS150T E/ES models equipped with the optional metal evaporation insert.

1. Fit the molybdenum boat source to the evaporation insert as described on page 43.
2. Load the aperture into the boat.
3. Carefully fit the insert as described on page 43. Select

Aperture cleaning from the process menu and run the process.

The default settings should be sufficient to heat the boat for 1 minute and drive off any contaminants from the aperture. If the cleaning is not sufficient, the current may be increased slightly:

1. Create a new profile from the default aperture cleaning process.
2. Edit the *evaporate current* to a higher value, for example, 35 Amps.

The current may also be increased manually during the process but this setting would not be retained for future runs.

5.4 Metal evaporation

This process is designed for the following applications:

- Alternative coatings methods for SEM samples where sputtering is not available.
- Coating metal films on Non EM substrates.

It is only available with EMS150T E/ES models equipped with the optional metal evaporation insert. To achieve a specific coating depth, the FTM must be installed.

5.4.1 How to achieve a 20nm gold coating

Fit the tungsten filament to the evaporation insert as described on page 43.

Load the filament with a small quantity of the gold to be evaporated. Carefully fit the insert as described on page 43.

1. Create a new profile based on *Metal evaporation*.
2. Edit the new profile:
 - Change the material from *Carbon* to *Gold*.
 - Change *outgas time* to a minimum of 2 seconds
 - Set the *outgas current* to 0 (out gassing is not necessary for this material).
3. Ensure the FTM cover is open
4. Run the new profile.
5. When the *Pump Hold* window is displayed, tap *Continue* when ready to proceed.
6. When the *evaporate* window is displayed use either the right arrows or the slider to increase the requested current gradually until evaporation can be seen on the film thickness monitor display. The measured current may differ from the requested current at this point due to changes in impedance of the source while the metal is melting.

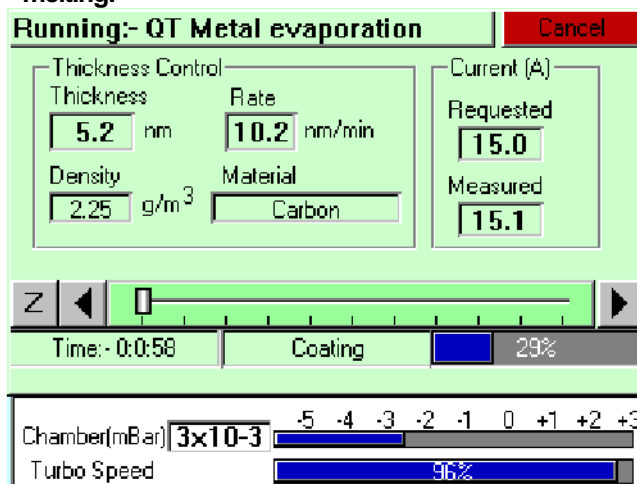


Figure 5-1. QT Metal evaporation process

7. When the required thickness of 20nm is achieved, tap the Z button to the left hand side and the current will immediately reduce to zero.

5.5 Pulsed cord evaporation

This process is designed for preparing conductive carbon coatings for SEM specimens for X-ray microanalysis EDX and WDX. It is only available with EMS150T E/ES models equipped with the carbon cord insert option.

5.5.1 How to create a 20nm carbon coating

1. Install the carbon cord insert as described on page 42.
2. Ensure the stage is fitted with the shorter support shaft to give the maximum source-to-stage distance.
3. Create a new profile based on *QT Pulsed cord evaporation*.
4. Edit the newly created profile setting the parameters as shown in Table 5.
5. Run the new profile.

Table 5 QT Pulsed cord evaporation parameters for 20nm coating.

Parameter	Value
Pulse Current	50A
Pulses Length	3 seconds
Number of Pulses	1
Out Gas Time	60 seconds
Out Gas Current	30A
Pump Hold	Yes

5.6 Pulsed Rod evaporation

Use this process for preparing TEM coatings for applying carbon reinforcement layers onto formvar grids. It is only available with EMS150T E/ES models.

5.6.1 How to create a 5nm carbon support layer

1. Install the carbon insert as described on page 40. Ensure that the carbon rods are prepared correctly as described on page 41.
2. Ensure the stage is fitted with the shorter support shaft to give the maximum source-to-stage distance.
3. Create a new profile based on *QT Pulsed rod evaporation*.
4. Edit the newly created profile setting the parameters as shown in Table 6.
5. Run the new profile.

Table 6 QT Pulsed rod evaporation parameters for 5nm coating.

Parameter	Value
Material	Carbon
Pulse Current	75A
Pulses Length	1.5 seconds
Number of Pulses	2
Out Gas Time	30 seconds
Out Gas Current	50A

6 Instrument Management

The software controls the general operation of the instrument through a system of default settings. This section describes how you can:

- Change general instrument settings
- Define the Network address and set up a connection
- Create user and group accounts
- Monitor the Film Thickness Monitor (FTM)
- Adjust the instrument clock

6.1 The EMS150T Menus

From the standby screen (see page 14), you can control the EMS150T using commands from the menu bar. Use the Edit menu to modify profiles and change the instrument setup; use the Service menu to set the system clock, monitor FTM usage, and connect the EMS150T to a network. The Help menu displays version information about the EMS150T software.

Table 7 EMS150T Menus

Menu	Sub-menu	Command	Purpose
Edit		Profiles	Create, edit or delete profiles (see page 18)
Edit		Materials	Create, edit or delete coating parameters for specific metals or alloys (see page 22)
Edit		System	Change hardware settings in System Editor (see below)
Edit	User	Level	Change user group/login privilege level (see page 34)
Edit	User	Groups	Create, edit or delete user groups and passwords (see page 35)
Service		FTM	Monitor FTM usage (see page 36)
Service		Set Time	Set instrument clock (see page 36)
Service		System	Engineer use only
Service		Connect Network	Connect EMS150T to local network (see page 30)
Help		About	Software version information
Help		Information	

6.2 Instrument Settings

The specific operation of the EMS150T is determined by the settings of the active profile. Default sputter settings and general hardware settings are configured through *System Editor*.

To view the *System Editor*, select Edit | System from the menu bar (see Figure 6-1).

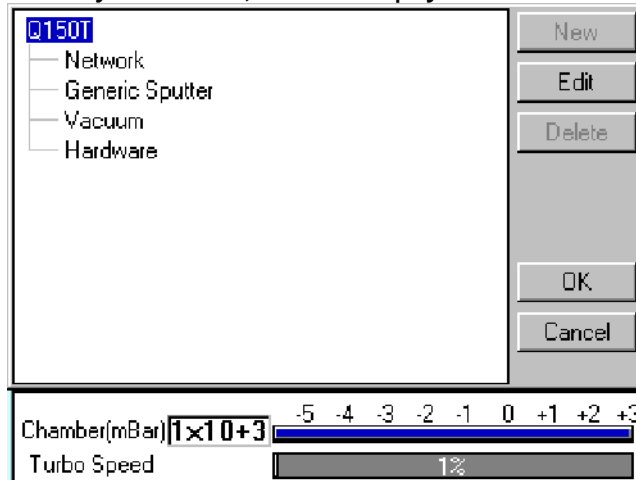


Figure 6-1. System Editor

System Editor arranges settings in four categories:

- Network
- Generic Sputter
- Vacuum
- Hardware

6.21 Network

The Network category determines the IP address used by the instrument for Network connections. To edit network properties, tap on Network and then tap on the Edit button. The Network Properties are displayed (see Figure 6-2).

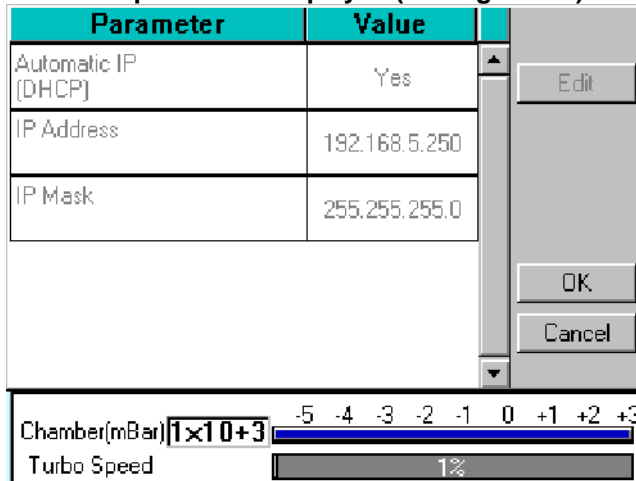


Figure 6-2. Network properties

To set the instrument to use an IP address automatically generated by your DHCP server, ensure that the *Automatic IP (DHCP)* parameter is set to *Yes*. If your network does not have a configured DHCP server, you will need to set the IP address manually.

To set the IP address manually, set *Automatic IP (DHCP)* to *No*, then enter the primary IP address and subnet mask address manually.

6.2.1.1 Connecting to a Network

To connect to a network:

Ensure that you have connected the instrument correctly to your network (see Figure 6-3).

Choose Service | Connect Network on the menu bar. A dialog box confirms that the connection is active and shows its IP address.

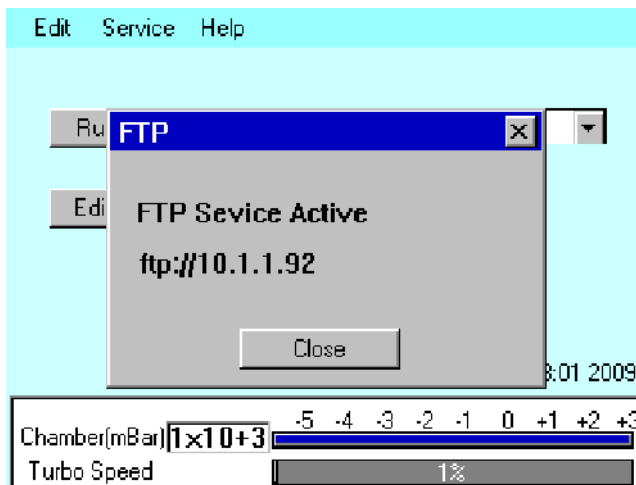


Figure 6-3. Active ftp address

6.2.2 Generic Sputter

This option allows you to change the default settings used during sputter coating sequences. The EMS150T uses these settings in all profiles of type: *Timed Sputter* and *FTM Terminated Sputter* unless overridden in the profile (see page 61).

To change the settings, tap on Generic Sputter and then tap on the Edit button. The *Generic Sputter* properties are displayed (see Figure 6-4 and Table 8).

Parameter	Value
Gas Bleed Time (Seconds)	10
Bleed Vacuum	1.0e-02
Clean Current (mA)	150
Clean Time (Seconds)	30

Chamber(mBar) $1 \times 10^{+3}$

Turbo Speed 1%

Figure 6-4. Generic sputter parameters

Table 8 Generic Sputter parameters

Name	Default Value	Minimum Value	Maximum Value	Comment
Gas Bleed Time (Seconds)*	10	0	20	Time Ar allowed to flow into chamber before plasma started
Bleed Vacuum*	1×10^{-2}	5×10^{-3}	5×10^{-1}	Pressure at which the chamber is maintained at while the plasma is present
Clean Current (mA)*	150	100	200	Current at which the target is cleaned at.
Clean Time (Seconds)*	30	0	60	Time for which the target is cleaned for

* Admin group level required to edit this property

1. To edit a parameter, tap on its value.
2. Change the value as required. The instrument displays a dialog box for editing purposes, with either a numeric keypad or keyboard as required. The dialog box also shows the allowed values for the parameter.
3. When you edit a value, click on the OK button to confirm the change or on the Cancel button to restore the previous value.
4. Edit other parameters as required.
5. Back on the *Generic Sputter* page, click on the OK button to confirm the changes or on the Cancel button to restore the previous values.

6.2.3 Vacuum

This option allows you to change the default settings for pumping/venting cycles used in both sputter coating and evaporation sequences. The EMS150T uses these settings in all profiles.

To change the settings, tap on Vacuum and then tap on the Edit button. The Vacuum properties are displayed (see Figure 6-5 and Table 9).

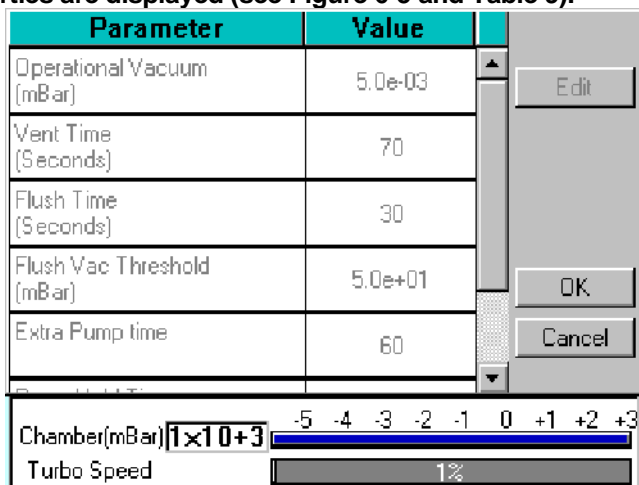


Figure 6-5. Vacuum parameters

Table 9 Vacuum parameters

Name	Default Value	Minimum Value	Maximum Value	Comment
Operational Vacuum (mBar)*	1x10 ⁻³	5x10 ⁻³	1x10 ⁻¹	Time Ar allowed to flow into chamber before plasma started
Vent Time (Seconds)*	70	10	240	Time to vent the chamber after the turbo has reached 50%
Flush Time (Seconds)*	70	10	240	
Flush Vac Threshold (mBar)*	50	0.1	100	Vacuum the system will pump down to before venting with nitrogen during a flush
Extra Pump time*	60	1	240	Time waited after the operational vacuum is achieved
Pump Hold Time (Hours)*	2	0.1	24	The time the system will wait for user input before venting if pump hold enabled
Max Pumpdown Time**	600	60	600	Maximum time the system will wait for the chamber to reach the operational vacuum

* Admin group level required to edit this property

** Engineer group level required to edit this property

1. To edit a parameter, tap on its value.
2. Change the value as required. The instrument displays a dialog box for editing purposes, with either a numeric keypad or keyboard as required. The dialog box also shows the allowed values for the parameter.
3. When you edit a value, click on the OK button to confirm the change or on the Cancel button to restore the previous value.
4. Edit other parameters as required.
5. Back on the Vacuum page, click on the OK button to confirm the changes or on the Cancel button to restore the previous values.

6.2.4 Hardware

This option allows you to change the settings defining the configuration of your instrument. The EMS150T uses these settings in all profiles of type: *Timed Sputter* and *FTM Terminated Sputter*.

To change the settings, tap on Hardware and then tap on the Edit button. The *Hardware* properties are displayed (see Figure 6-6 and Table 10).

Parameter	Value
Target A	Chromium
Vacuum Gauge Type	Pfeiffer TPR28x
Use Turbo Pumping	Yes
Stage Rotate	Yes

Chamber(mBar) $1 \times 10^{+3}$ -5 -4 -3 -2 -1 0 +1 +2 +3

Turbo Speed 1%

Figure 6-6. Hardware settings (single target)

Table 10 Hardware settings

Name	Default Value	Minimum Value	Maximum Value	Comment
Target A				Target material, if installed.
Target B				Target material, if installed.
Target C				Target material, if installed.
Vacuum Gauge Type				Read only: displays gauge type
Use Turbo Pumping*	Yes	No	Yes	If No the turbo pump will not be turned on during the pumping of the chamber
FTM Present	No	No	Yes	
Turbo Present	Yes	No	Yes	
Stage Rotate	Yes	No	Yes	Set the state of the stage unless overridden in the process profile
Stage Rotate Speed				Sets the speed of the stage unless overridden in the process profile
Available Targets*	1	1	3	Sets the number of auxiliary sputter inserts allowing the whole insert to be changed making the use of multiple materials easier

* Admin group level required to edit this property

1. To edit a parameter, tap on its value.
2. Change the value as required. The instrument displays a dialog box for editing purposes, with either a numeric keypad or keyboard as required. The dialog box also shows the allowed values for the parameter.
3. When you edit a value, click on the OK button to confirm the change or on the Cancel button to restore the previous value.
4. Edit other parameters as required.
5. Back on the *Hardware* page, click on the OK button to confirm the changes or on the Cancel button to restore the previous values.

6.3 User Management

The EMS150T software does not employ a user account system with individual login names and passwords. Instead, users are granted access privileges at a *group* level. The lowest security group: *User*, is not password protected. In this mode, a user can run the instrument for sputtering or evaporation and create or edit profiles. The second security group: *Admin*, is password protected. In this level, it is possible to edit a number of hardware settings. It is also possible to create further user groups with customised privileges for instrument use.

6.3.1 Changing User Group

When first switched on, the EMS150T starts in *User* group mode. If you want to change to *Administration* level:

1. Select Edit | User | Level from the menu bar. The *Edit User Level* dialog box is displayed (see Figure 6-7).
2. Select the Administration option button.
3. Tap on the *Access Code* text box. Use the on-screen keyboard (see Figure 4-3) to enter the password.
4. Tap on the OK button. Alternatively, tap on the Cancel button to close the on-screen keyboard without entering the password.
5. Back in the *Edit User Level* dialog box, tap on the OK button. Alternatively, tap on the Cancel button to return to the standby screen without changing the user level.

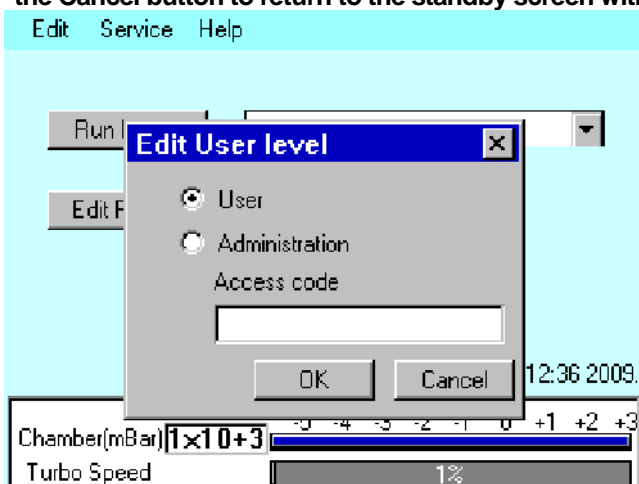


Figure 6-7. Changing the user level

If you want to change back to *User* level:

1. Select Edit | User | Level from the menu bar. The *Edit User Level* dialog box is displayed (see Figure 6-7).
2. Select the User option button.

3. Tap on the OK button. Alternatively, tap on the Cancel button to return to the standby screen without changing the user level.

6.3.2 Managing User Groups

The EMS150T software is set up with User and Administration access levels. There is also the facility for creating new user groups with customised access privileges or for editing or deleting existing groups.

To manage user groups, select Edit | User | Groups from the menu bar. The *Edit User Group* page is displayed (see Figure 6-8).

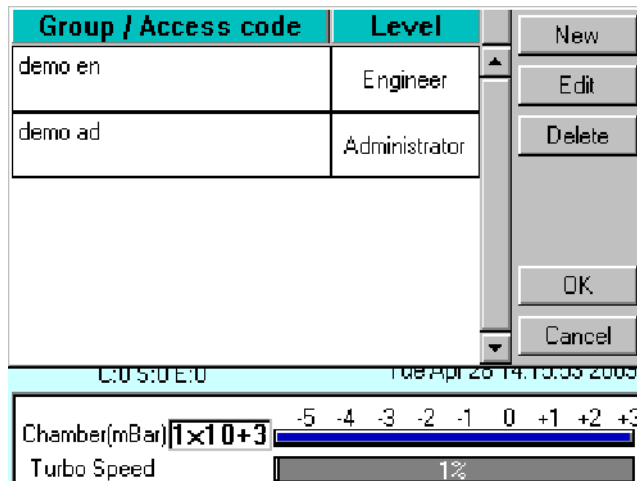
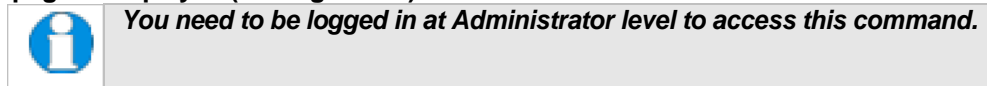


Figure 6-8. Managing user groups

6.3.2.1 Creating a New Group

To create a new user group:

1. Tap on the New button. The *Edit User Group* dialog box is displayed.
2. Tap on the Group Name box. Enter a name using the displayed keyboard dialog box.
3. Select the required privilege level form the *Level* dropdown box.
4. Tap on the OK button to confirm the change or on the Cancel button to exit without creating the new group.

6.3.2.2 Editing a Group

To edit an existing user group, tap on its name and then tap on the Edit button.

1. Tap on the Edit button. The *Edit User Group* dialog box is displayed.
2. To edit the name, tap on the Group Name box. Edit the name using the displayed keyboard dialog box.
3. To change the privilege level, tap on the *Level* dropdown box and select the required level.
4. Tap on the OK button to confirm the change or on the Cancel button to exit without creating the new group.

6.3.2.3 Deleting a Group

To delete a user group:

1. Tap on its name to select it and then tap on the Delete button.
2. Tap on the OK button. Alternatively, tap on the Cancel button to return to the standby screen without changing the user level.

6.4 Film Thickness Monitor

To view the status of the Film Thickness Monitor (FTM), select **Service | FTM** from the menu bar. The FTM Status window is displayed (see Figure 6-9).

This shows the percentage of the crystal used and will help you decide when to replace it (see page 50).

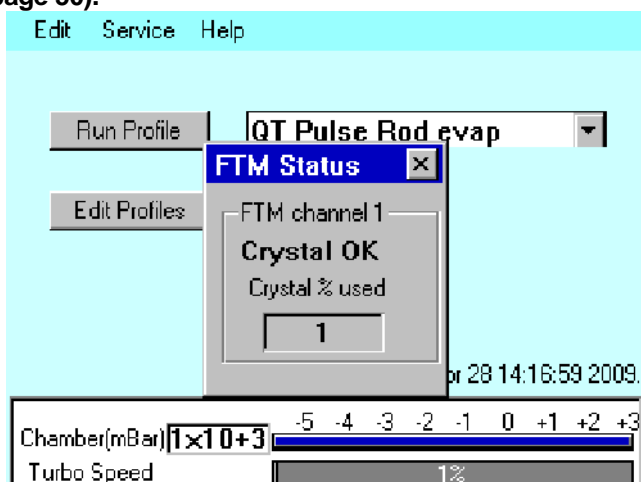


Figure 6-9. FTM Status

6.5 Setting the Date and Time

To adjust the EMS150T's clock, select **Service | Set Time** from the menu bar. The Set Date Time dialog box is displayed (see Figure 6-10).

To change any of the numerical fields, tap in the box and then select the correct value using the displayed keypad. Tap on the OK button to confirm the changes or on the Cancel button to discard them.

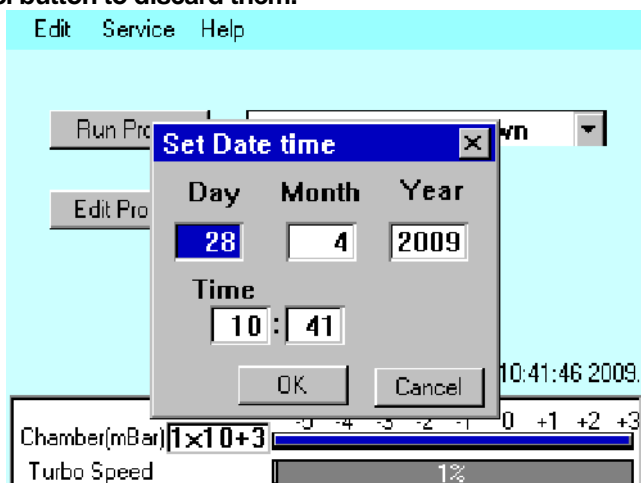


Figure 6-10. Setting the date and time

6.6 Setting up a Network connection

Connect the EMS150T to your network as described on page 11.

You can view data files stored on the EMS150 using Internet Explorer but to be able to have read/write access you will need to use third party FTP software or Windows Explorer. To use Windows Explorer, you will need to set up an exception for it on the firewall (see below).

6.6.1 Configuring a Firewall Exception for Windows Explorer

To set up Windows Explorer:

1. Right click on the network connection in the system tray.
2. Select *Change Windows Firewall settings* from the popup menu.
3. Select the Exceptions tab and click the Add Programs button.
4. From the list select *Windows Explorer*. If this is not in the list, click on the Browse button and navigate to the file *explorer.exe* (this can be found in the *Windows* folder).
5. Click on the Change Scope button.
6. In the dialog select the *My network (subnet) only* option.
7. Confirm your selections by clicking on the OK buttons in the open dialog boxes.

6.6.2 Connecting the EMS150

To connect the EMS150 to the network:

1. From the EMS150's standby page (see Figure 3-1), select Service | Connect Network on the menu bar.
2. A dialog box confirms that the connection to the network is active and shows its IP address (see Figure 6-11).



Figure 6-11. Connecting the Q150 to a network

3. Note the complete address line, for example: <ftp://10.1.1.92>. Type it into the address bar of Windows Explorer on the networked PC. Click on the Go button or press the Return key.
4. The window status bar shows the message *connecting to xx.xx.xx.xx* followed by *getting contents of folder*. Windows Explorer displays a list of files stored on the EMS150.

You can copy files to or from the instrument. Only files supplied by EMS or previously copied or moved from the instrument should be transferred. A file cannot be opened directly from the instrument; copy it to the networked PC before attempting to open it.

6.6.3 Network Troubleshooting

If the connection fails, check that the first three numbers in the IP addresses of the instrument and the computer are the same. Check the firewall settings.

The EMS150 will only support one connection. For example, it will not allow simultaneous connections to Internet Explorer and Windows Explorer.

7 Accessories

The EMS150T can be configured for various sputtering and evaporation applications. This section describes the installation of:

- Sputter insert pre-installed as standard on EMS150T S and EMS150T ES models. Includes instructions for changing the target. Additional sputter insert available .
- Carbon rod insert for 3mm rods pre-installed as standard on EMS150T E models. Carbon rod insert for 6mm rods .
- Metal evaporation insert including its configuration for both downwards and upwards evaporation, and the installation of a wire basket or molybdenum boat).
- Carbon fibre insert
- Rotacota stage
- Slide stage
- Four wafer stage and gear box
- Specimen stage with adjustable tilt
- Film thickness monitor
- Extended height cylinder
- Full range vacuum gauge assembly
- Vacuum spigot

7.1 Installing the Sputter Insert

This section describes the installation of the standard sputter head supplied with EMS150TS and EMS150T ES instruments.

WARNING – HIGH VOLTAGES AND HIGH VACUUM

This equipment produces high voltages and high vacuum in its operation.

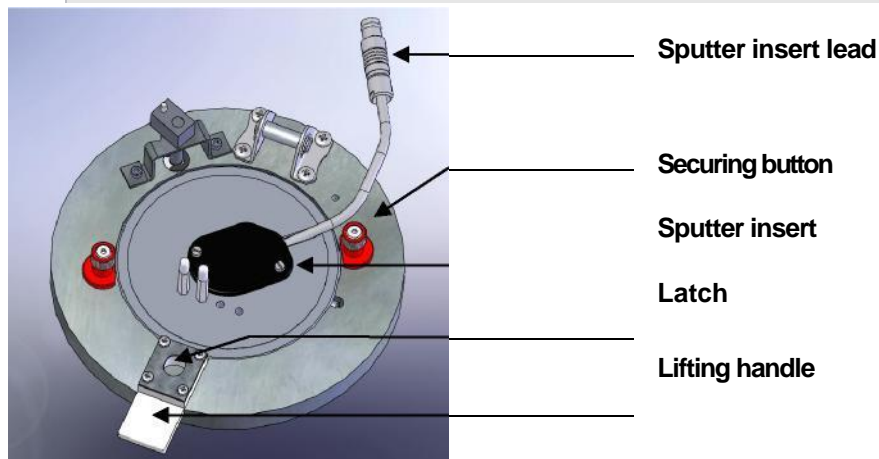


Figure 7-1. Top view of the sputter insert

1. Check the machine is not operating.
2. Press down firmly on the top cover to release the latch.
3. Lift the top cover and rest it against its stop.

4. Turn the two securing buttons to release the installed insert and remove the insert (see Figure 7-1).



EMS150T ES users only: If the insert is a carbon rod type you may have to remove the rods first (see page 40). To do this, check that the securing buttons are restraining the insert and open the lid assembly and rest it against the top cover assembly. Then, using a 2.5mm hex key, release the rod clamping screws and withdraw the rods. Close the lid assembly and release the insert by turning the securing buttons. Now remove the insert.

5. Prepare the sputter insert for installation by removing from any packaging, plastic bags etc. Check the 'O' ring in the outer ring of the lid assembly for damage or debris and clean or replace as required.
6. To fit a target (we recommend you wear latex gloves to do so):
 - a. Unscrew the target clamp ring (see Figure 7-2)
 - b. Place a new target centrally on the holder. Hold it in place with one finger through the clamp ring.
 - c. Screw the clamp ring firmly back in place.
7. Place the insert in position in the outer ring of the lid assembly carefully locating the M3 screw head in the rim of the insert in the slot to the right of the outer ring.
8. Lock the insert in position by turning the securing buttons until their flanges overlap the insert.
9. Plug the sputter insert lead into the socket on the hinge assembly.

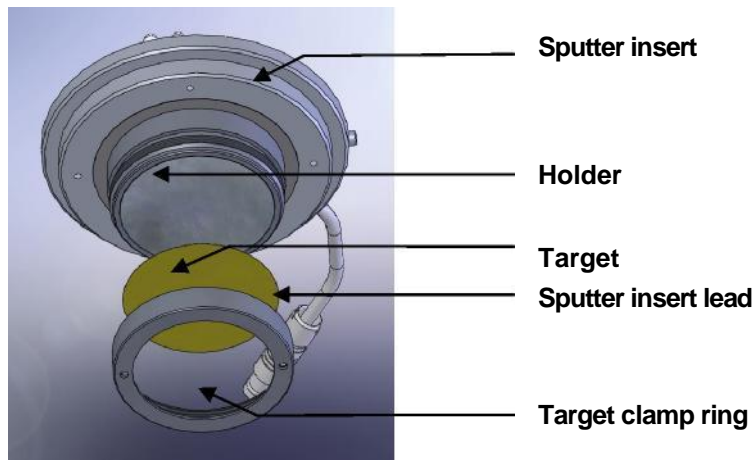


Figure 7-2. Sputter insert and target assembly

7.2 Installing the Carbon Rod Insert

This section describes the installation of the carbon rod insert supplied with EMS150T E and EMS150T ES instruments. There are two inserts designed to accommodate 3mm carbon rods or 6mm rods .

To install the carbon rod insert:

1. Check the machine is not operating.
2. Press down firmly on the top cover to release the latch.
3. Lift the top cover and lay back against its stop.
4. Turn the two securing buttons to release the installed insert and remove the insert.
5. Prepare the carbon rod insert for installation by removing from any packaging, plastic bags etc. Check the 'O' ring in the outer ring of the lid assembly for damage or debris and clean or replace as required.
6. Place the insert in position in the outer ring of the lid assembly carefully locating the M3 screw head in the rim of the insert in the slot to the right of the outer ring. Lock the insert in position by turning the securing buttons until their flanges overlap the insert.
7. Prepare two carbon rods (see page 41).
8. Install the carbon rods (see Figure 7-3):
 - a. Install the flat-ended carbon rod into the fixed terminal.
 - b. Install the sharpened carbon rod into the moveable terminal so that the shaped end touches the other rod.
 - c. Tension the sliding clamp assembly by sliding it to the right to the full extent of the dowels. Tighten the clamp screw to fix the carbon rod in position.
9. Close the lid assembly onto the glass chamber.
10. Check that the copper terminal contacts on the top of the insert and in the underside of the top cover are clean and free from damage and that the top faces are flat for good electrical contact.
11. Close the top cover assembly and press firmly down to secure the latch.

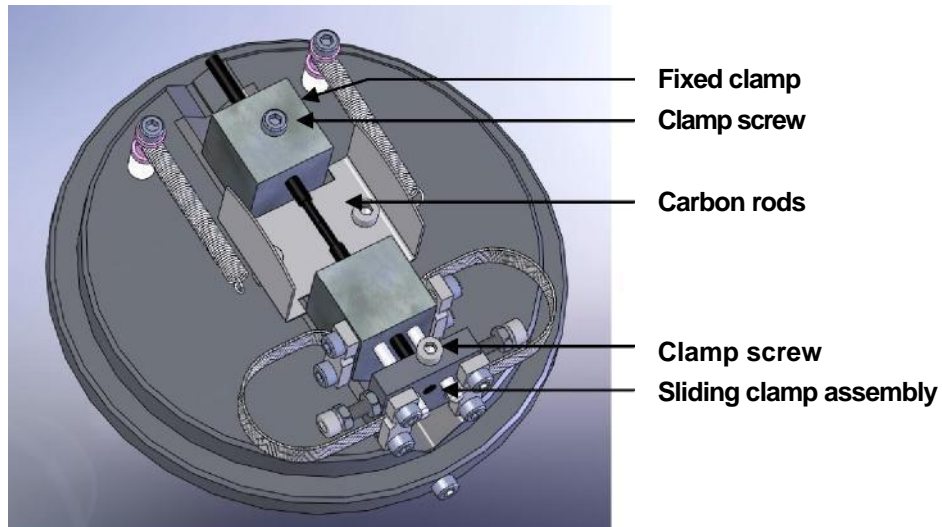


Figure 7-3.

Carbon Rod Insert

7.2.1 Shaping Carbon Rods



WARNING

It is essential that you shape the tips of the carbon rods to the correct profile to minimize the possibility of damage to the instrument due to excessive currents.

We recommend that you shape the rods so that one is sharpened to 1.4mm diameter x 4mm long and the other is flattened as shown in Figure 7-4.

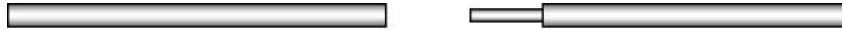
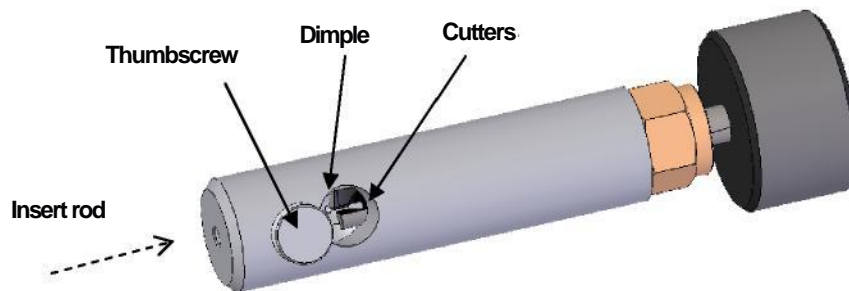


Figure 7-4. Recommended Carbon Rod shapes

The accessory pack contains a rod shaper (see Figure 7-5) that will accept 3mm rods (part no S8651). A rod shaper is also available for 6mm rods .

Figure 7-5. Carbon Rod Shaper (S8650/S8651)



To shape a carbon rod:

1. Cut a 50mm length of rod.



Use only EMS rods due to the varying diameter and quality of other manufacturer's rods. EMS supply rods in two sizes: 3mm) and 6mm (

2. Hold the shaper stationary and insert the carbon rod from the bottom to half way through the window, as indicated by the dimple at the bottom of the hole.
3. Gently tighten the thumb screw to hold the carbon rod in place.
4. Holding the shaper body and, with very little force, gently turn the black knob on the end of the shaper clockwise (when viewed face on).
5. Keep turning the knob until the desired length is achieved, clearing the carbon rod dust as necessary.
6. Undo the thumb screw and withdraw the rod carefully to avoid damaging the newly formed tip.
7. If the rod tip should break in the cutter, it can be removed by unscrewing the brass coupling, removing the cutter and pushing out the broken rod tip, while avoid damaging the teeth of the cutter.



WARNING

TAKE CARE WHEN HANDLING THE CUTTER: IT IS VERY SHARP.

7.3 Fitting the Carbon Fibre Insert

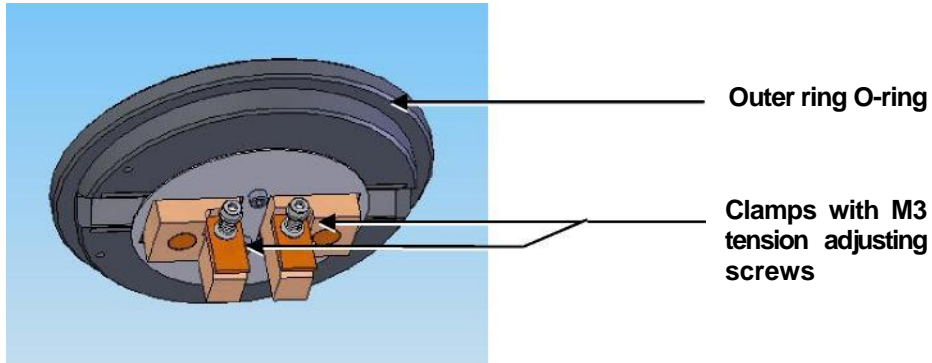


Figure 7-6. Carbon string insert

The carbon fibre insert is designed for carbon evaporation from carbon cords, carbon fibre woven cord and carbon fibre fine strands (see Figure 7-6).

1. Check the machine is not operating.
2. Press down firmly on the top cover to release the latch.
3. Lift the top cover and lay back against its stop.
4. Turn the two securing buttons to release the installed insert and remove the insert.
5. Prepare the carbon fibre insert for installation by removing from any packaging, plastic bags etc. Check the 'O' ring in the outer ring of the lid assembly for damage or debris and clean or replace as required.
6. Place the insert in position in the outer ring of the lid assembly carefully locating the M3 screw head in the rim of the insert in the slot to the right of the outer ring.
7. Lock the insert in position by turning the securing buttons until their flanges overlap the insert.
8. Cut a length of carbon fibre: 35mm if you are using woven cord or 70mm if you are using fine strands
9. Fit the fibre between the two clamps on the insert. If you are using fine strands, fold in half and gently twist together before fitting between the clamps.
10. Adjust the clamp tension by turning the M3 screws on the terminals.
11. Close the lid assembly on to the glass chamber assembly.
12. Check the copper terminal contacts on the top of the insert are clean and free from damage, (They must have a flat top face.) and that the contacts in the underside of the top cover assembly are also clean and flat.

7.4 Fitting the Metal Evaporation Insert

This section describes the installation of the metal evaporation insert designed for downwards evaporation (see Figure 7-7). To install the stage:

1. Check the machine is not operating.
2. Press down firmly on the top cover to release the latch. (See note below.).
3. Lift the top cover and rest it against its stop.
4. Turn the two securing buttons to release the installed insert and remove the insert.
5. Prepare the metal evaporation insert for installation by removing from any packaging, plastic bags etc. Check the 'O' ring in the outer ring of the lid assembly for damage or debris and clean or replace as required.
6. Place the insert in position in the outer ring of the lid assembly. Carefully align the M3 screw head in the rim of the insert with the slot on the right of the outer ring. Lock the insert in position by turning the securing buttons until their flanges overlap the insert.

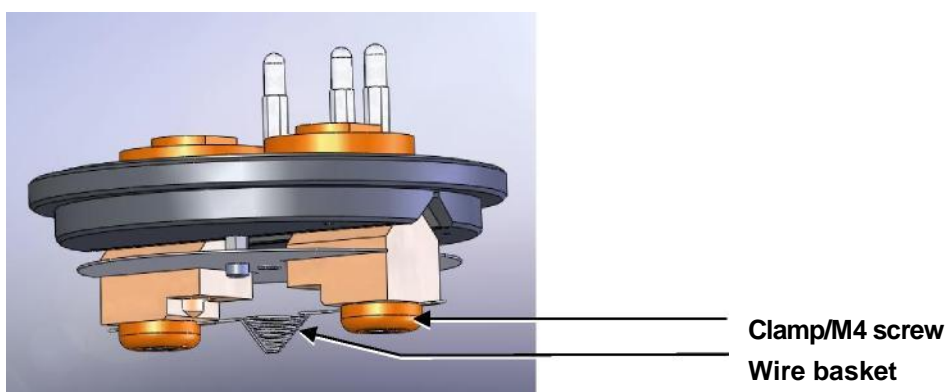


Figure 7-7. Fitting the metal evaporation insert for downwards evaporation

7.4.1 Installing a Wire Basket

To install a wire basket or molybdenum boat:

1. Open the lid assembly and lay back against its stop.
2. Slacken the two M4 socket screws in the terminal clamps.
3. Fit the wire basket so that it lies diagonally across the screws and between the clamps and the terminals (see Figure 7-7).
4. Tighten the two M4 screws.
5. Close the lid assembly on to the glass chamber assembly.
6. Check the copper terminal contacts on the top of the insert are clean and free from damage (they must have a flat top face) and that the contacts in the underside of the top cover assembly are also clean and flat.
7. Close the top cover assembly and press firmly down to secure the latch.

7.4.2 Installing a Molybdenum Boat for Aperture Cleaning

To install a molybdenum boat:

1. Open the lid assembly and lay back against its stop.
2. Slacken the two M4 socket screws in the terminal clamps.
3. Fit the molybdenum boat between the screws and between the clamps and the terminals.
4. Tighten the two M4 screws.
5. Close the lid assembly on to the glass chamber assembly.

6. Check the copper terminal contacts on the top of the insert are clean and free from damage (they must have a flat top face.) and that the contacts in the underside of the top cover assembly are also clean and flat.
7. Close the top cover assembly and press firmly down to secure the latch.

7.4.3 Adapting the Insert for Upwards Evaporation

Install the evaporation insert as described previously. To adapt the insert for upwards evaporation:

1. Remove the two terminal clamps and replace with the electrode extensions (see Figure 7-8).
2. Fit the stage assembly to the hole in the centre of the insert shield.
3. Fit the wire basket or molybdenum boat to the electrode extensions as described above.
4. If an FTM is fitted, you will need to reposition it as described below.
5. Close the lid assembly on to the glass chamber assembly.
6. Check the copper terminal contacts on the top of the insert are clean and free from damage, (They must have a flat top face.) and that the contacts in the underside of the top cover assembly are also clean and flat.
7. Close the top cover assembly and press firmly down to secure the latch.

7.4.3.1 Relocating the FTM

If you want to use an FTM with the metal evaporation insert adapted for upwards evaporation you will need to reposition it as shown in Figure 7-8.

1. Remove the glass chamber assembly.
2. Unplug the FTM's lead from the BNC socket and remove the existing crystal holder from its bracket.
3. Remove the two screws near the inside diameter of the glass chamber holding the turbo shield in place and replace with two M3 x 20 hex spacers.
4. Remove the existing crystal holder bracket.
5. Fit the new crystal holder bracket using two M3x8 socket cap screws.
6. Attach the FTM lead to the BNC connector.
7. Attach the circular heat shield to the two hex spacers fitted previously with two M3x6 socket cap screws having first fed the FTM lead through the hole provided.
8. Pass the FTM lead through the hole in the crystal holder bracket and fix to the crystal holder.
9. Fit the crystal holder to the bracket with two M2.5 x 12 socket cap screws.
10. Refit the glass chamber assembly.

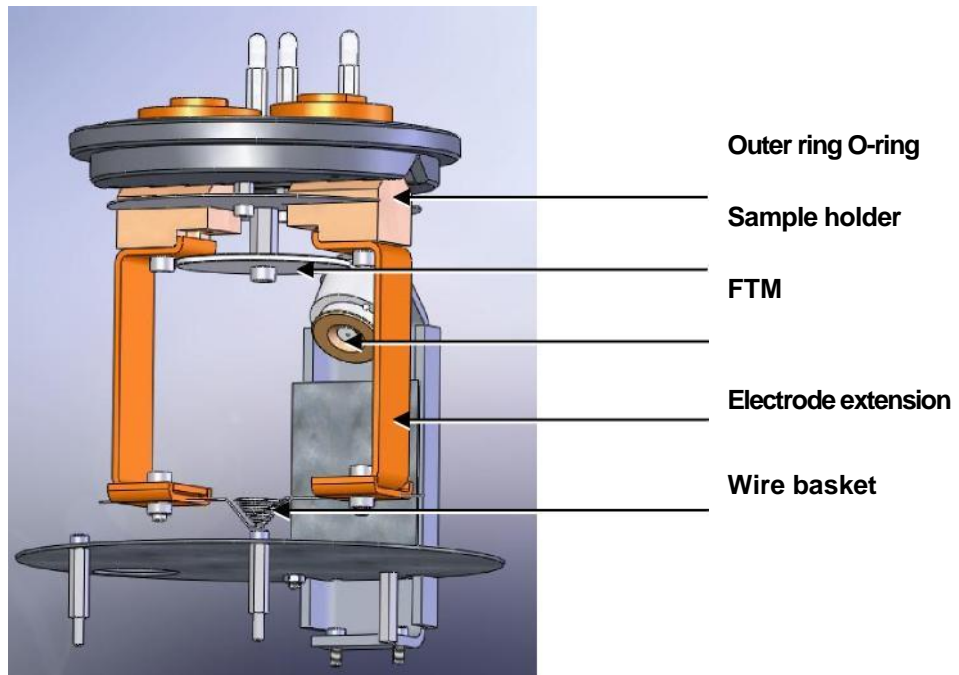


Figure 7-8. Metal evaporation insert adapted for upwards evaporation

7.5 Fitting the Rotacota stage

The Rotacota stage is an offset rotating stage, with tilting sample holder, designed to improve the even distribution of sputtering or evaporation (see Figure 7-9).

- 1 Check the machine is not operating.
- 2 Open the top cover fully so it rests against its backstop.
- 3 Remove any installed sample stage by lifting carefully upwards.
- 4 Fit the RotaCota stage:
 - a. Locate its shaft in the top of the stage rotation drive spigot protruding from the baseplate.
 - b. With a twisting motion, push it gently down until the base collar rests on the baseplate. Locate one of the cut-outs by the shield fixing screw.
- 5 Adjust the angle of the stage (up to 30° from horizontal):
 - a. Slacken the screws in the side of the shield.
 - b. Angle the stage as required.
 - c. Re tighten the screws before use.

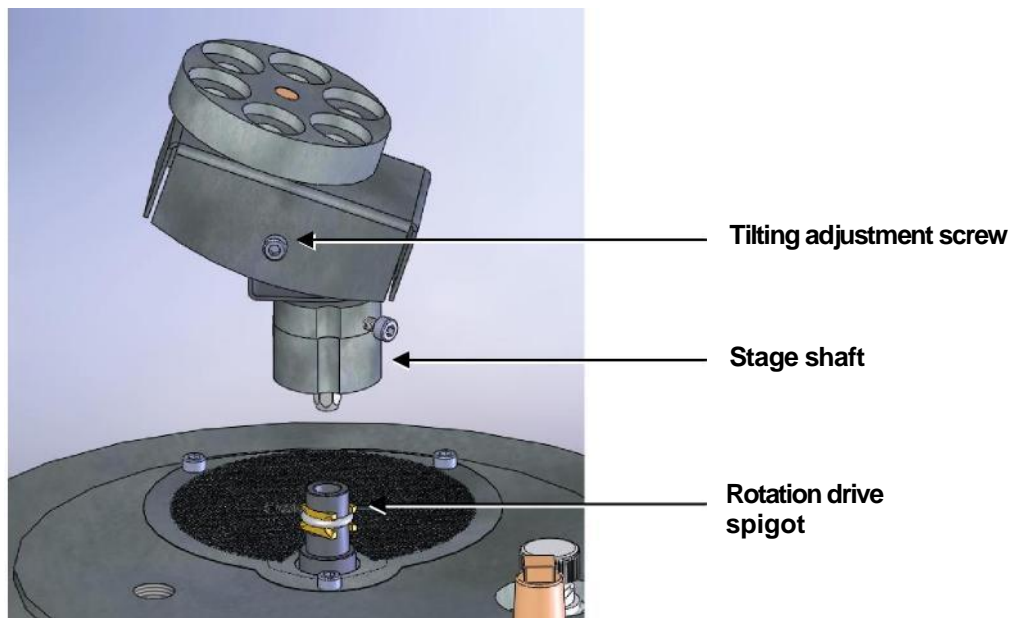


Figure 7-9. Rotacota stage

7.6 Fitting the Slide Stage

4.

To install the slide sample stage :

1. Check the machine is not operating.
2. Open the top cover fully so it rests against its backstop.
3. Remove any installed stage by lifting carefully upwards.

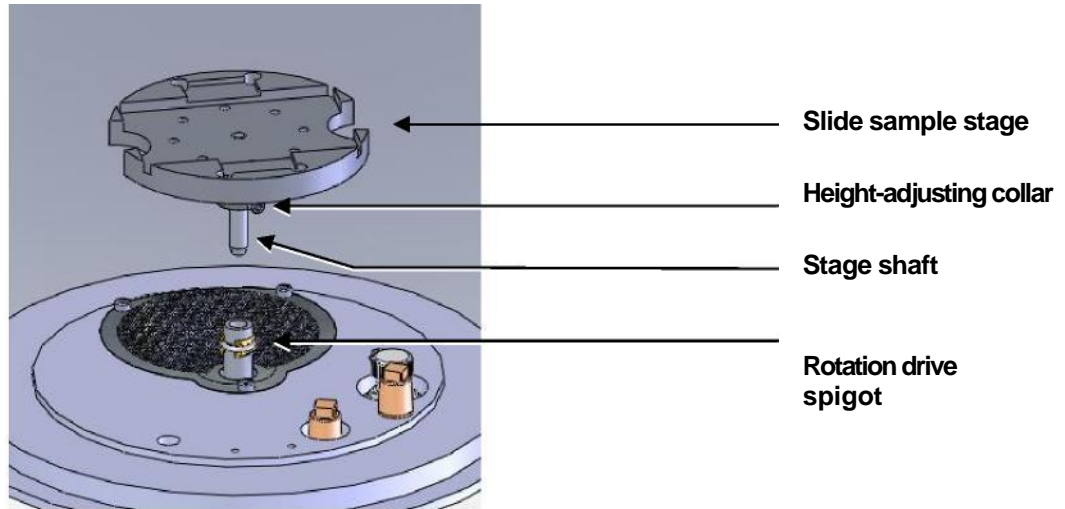


Figure 7-10. Slide stage

4. If necessary, adjust the stage height above the base plate:
 - a. Slacken the M3 screw in the collar with a hexagonal key.
 - b. Slide the collar to the desired position and retighten the M3 screw.

The recommended position for the collar is to achieve a 31.5mm distance between the underside of the collar and the underside of the stage. If you require a greater distance between the stage and the target, the collar can be removed altogether with the underside of the stage therefore resting on the top of the drive spigot.

An alternative shaft is supplied with the stage to further increase the range of stage height adjustment available. To fit, hold the stage firmly and release the M5 nut. Unscrew the shaft, transfer the nut to the new shaft and fit to the stage so that the top is flush with the lower surface of the stage when the nut is tightened.
5. Fit the slide stage:
 - a. Locate its shaft in to the top of the stage rotation drive spigot protruding from the base plate.
 - b. With a twisting motion, push gently down until the collar around the shaft rests on top of the drive spigot (see Figure 7-10).

Remove the collar if you need more distance between the stage and the target: the underside of the stage then rests on the top of the drive spigot.

To maximise the area or achieve more uniform coating on the slide stage, install the stage gearbox assembly – see page 48.

7.7 Fitting the 102mm Stage and Gearbox

The 102mm stage is designed to hold 102mm (4") silicon wafers (see Figure 7-11). If you want to use a FTM with this stage, install the stage gearbox assembly

The sample stage gearbox allows you to install the sample stage in an offset rotating position. To install the 102mm stage and its gearbox:

- 1 Check the machine is not operating.
- 2 Open the top cover fully so it rests against its backstop.
- 3 Remove any installed stage by lifting carefully upwards.
- 4 Remove the M3 socket cap screw securing the turbo mesh (this is the screw nearest to the stage rotation drive spigot).
5. Fit the gearbox:
 - a. Locate its shaft into the top of the stage rotation drive spigot
 - b. With a twisting motion, push it gently down until it sits down on the turbo mesh.
 - c. Secure in place with the M3 x 16 socket cap screw provided.
6. Fit the large stage by locating its shaft in to the top of the stage rotation drive spigot protruding from the base plate and with a twisting motion pushing it gently down until the collar around the shaft rests on top of the drive spigot.
7. Adjust the stage height above the base plate:
 - a. Slacken the M3 screw in the collar with a hexagonal key
 - b. Slide the collar to the desired position and retighten the M3 screw.

Remove the collar if you need more distance between the stage and the target: the underside of the stage then rests on the top of the drive spigot.

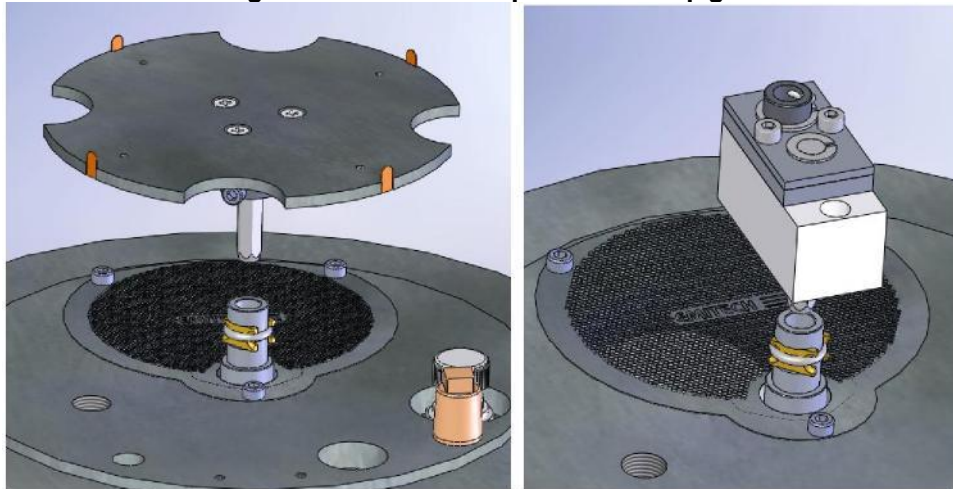


Figure 7-11. Large (102mm) Sample Stage and gearbox

7.8 Installing the Tilt Stage

The tilt stage allows you to vary the sample angle or height (see Figure 7-12). To fit the tilt stage:

- 1 Check the machine is not operating.
- 2 Open the top cover fully so that it rests against its back stop.
- 3 Remove any installed stage by lifting carefully upwards.
- 4 Fit the tilt stage by locating its shaft in to the top of the stage rotation drive spigot protruding from the base plate and with a twisting motion. Push gently down until the collar around the shaft rests on top of the drive spigot.
- 5 Adjust the tilt angle:
 - a. Slacken the M3 screw below the stage with a hexagonal key
 - b. Tilt the stage to the desired angle and retighten the M3 screw.
- 6 Adjust the stage height above the base plate:
 - a. Slacken the M3 screw in the collar with a hexagonal key
 - b. Slide the collar to the desired position and retighten the M3 screw.

Remove the collar if you need more distance between the stage and the target: the underside of the stage then rests on the top of the drive spigot. The recommended position is so that the collar is a distance of 31.5mm below the stage.

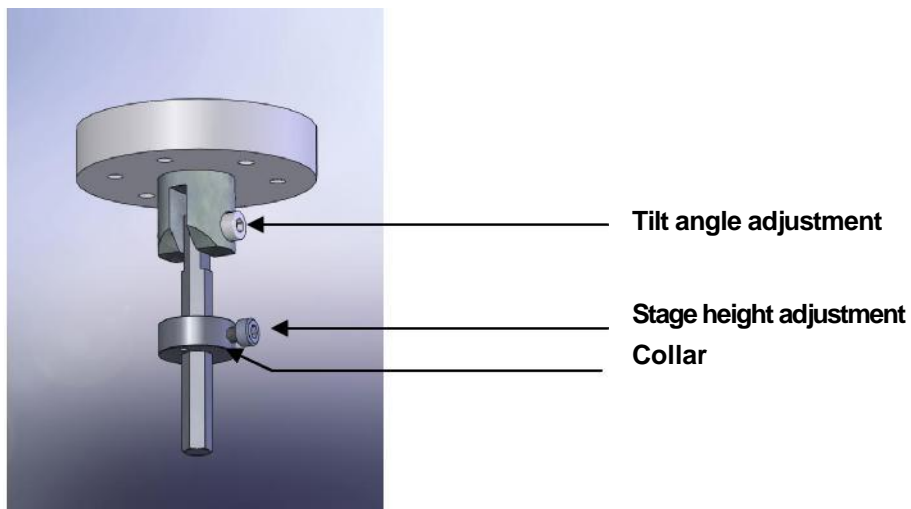


Figure 7-12. Adjustable tilting stage

7.9 Installing the Film Thickness Monitor (FTM)

If you have specified an FTM on the configuration of your EMS150T it will be preinstalled. To install the film thickness monitor :

1. Check the machine is not operating.
2. Open the top cover fully so it rests against its backstop.
3. Remove the glass chamber assembly.
4. Fit the FTM assembly to the base plate with two M3 x 8 socket cap screws (see Figure 7-13).
5. Plug the FTM lead in to the BNC connector on the base plate after removing the dust cap.
6. Refit the glass chamber assembly.
7. Close the top cover assembly and press down firmly to secure the latch.

The crystal cover (see Figure 7-13) may be removed completely for cleaning or if the FTM is in continual use.

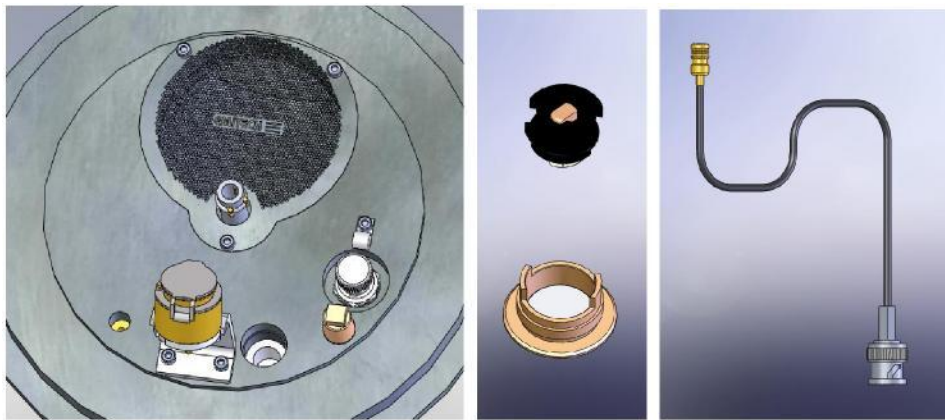


Figure 7-13. FTM (left); replacing the FTM crystal (centre); FTM lead (right)

7.9.1 Replacing the FTM crystal

1. Check the machine is not operating.
2. Press down firmly on the top cover to release the latch.
3. Lift the top cover and rest it against its stop.
4. Remove the glass chamber assembly.
5. Unscrew the top cap of the crystal holder and withdraw (see Figure 7-13).
6. Turn the cap upside down and remove the spring insulator assembly.
7. Tip the old crystal (if fitted) out of the cap and fit the new crystal with the cap inverted.
8. Refit the spring insulator assembly to the cap.
9. Screw the cap assembly back on to the crystal holder body.
10. Refit the glass chamber assembly.
11. Close the top cover assembly and press down firmly to secure the latch.

7.10 Extended height cylinder

1. Check the machine is not operating.
2. Press down firmly on the top cover to release the latch.
3. Lift the top cover and rest it against its stop.
4. Remove the standard glass cylinder assembly .
5. Remove the M6 Cap head screw from the front of the pillar, slide the whole top cover and inner pillar assembly upwards until you see the fourth hole line up and replace the M6 cap head screw.
6. Place the extended glass cylinder assembly in place and close the top cover.



Figure 7-14. The extended height cylinder in position

7.11 Full range vacuum gauge assembly



The instrument must be returned to the factory for fitting this option as the covers need to be removed.

As standard, the EMS150T is fitted with a Pirani gauge with a measurement range of 1000 – 5×10^{-4} mbar. The typical ultimate vacuum of the pumping system in a clean instrument after pre-pumping with dry nitrogen gas is 5×10^{-5} mbar. When the vacuum is better than 5×10^{-4} mbar the instrument simply displays “HiVac”. For users who need an accurate value for the vacuum achieved before and during the coating process (for example, when evaporating carbon it is desirable to achieve as good a vacuum as possible), the Full Range Vacuum Gauge Assembly option extends the accurate measurement range to 1000 – 5×10^{-9} mbar.

Contact EMS for further information.

7.12 Installing the Rotating Vacuum Spigot

The vacuum spigot allows more convenient connection of a vacuum hose to the rear of the EMS150T when the instrument is located close to a wall, bench up stand or other obstruction (see Figure 7-15).

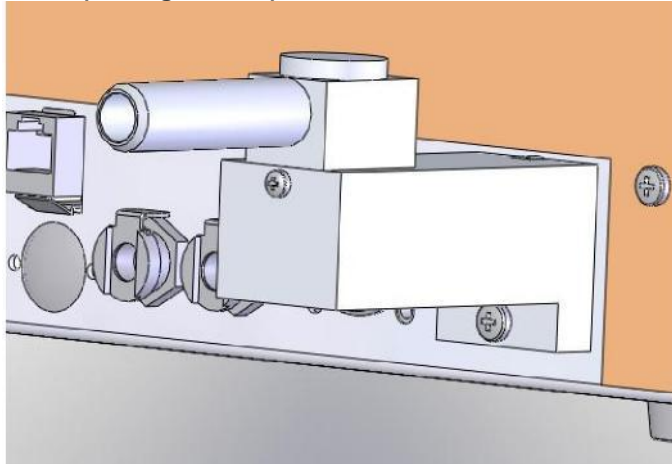


Figure 7-15. Rotating vacuum spigot

To install the spigot:

1. **Shutdown the instrument.**
2. **Remove the lower screw below the protruding vacuum spigot.**
3. **Apply a little vacuum grease to the spigot protruding from the rear of the instrument.**
4. **Take the Rotating Vacuum Spigot assembly and check there is an 'O' ring in the bore.**
5. **Push the Rotating Vacuum Spigot assembly over the protruding spigot until it is completely home against the chassis (a slight twisting motion helps).**
6. **Screw the assembly home using an M4 x 20 pan headed screw underneath the assembly.**
7. **Rotate the spigot to a suitable orientation and attach the hose from the backing pump.**

7.13 Spares

The following are available from EMS, or your local distributor, and are featured in more detail on the EMS website: www.emsdiasum.com.

Table 11 Spare Parts for the EMS150T

SPARES FOR EMS150T	QUANTITY
Carbon rods 3.05mm	Pack of 10
Carbon rods 6mm	Pack of 10
Carbon Fibre	1 Metre
Carbon Cord	1 Metre
Molybdenum Boats	1 x packet 10
Glass Cylinder 6"	Each
'L' Gaskets to suit	Pair
Oil Mist Filter	Each
10A ceramic fuse	Each
Supergrade 'A' Rotary Pump Oil	1 Litre

Table 12 Replacement targets for EMS150T S and EMS150T ES

REPLACEMENT TARGETS
54mm x 0.2mm Chromium Target
57mm x 0.5mm Tungsten Target
57mm Dia x 0.1mm Gold Target
57mm Dia x 0.1mm Au/Pd Target
57mm Dia x 0.1mm Platinum Target
54mm x 1.5mm Chromium Target
57mm x 0.2mm Tungsten Target
54mm x 1.5mm Carbon Target
57mm Dia x 0.1mm Copper Target
57mm Dia x 0.1mm Silver Target
57mm Dia x 0.1mm Nickel Target
57mm Dia x 1.0mm Aluminium Target
57mm Dia x 0.1mm Palladium Target
57mm Dia x 0.1mm Pt/Pd (80/20%) Target
57mm Dia x 1.5mm Titanium Target
57mm Dia x 0.3mm Pt/Pd (80/20%) Target
57mm Dia x 0.3mm Gold Target
57mm Dia x 0.3mm Au/Pd (60/40%) Target
57mm Dia x 0.3mm Platinum Target
57mm Dia x 0.5mm Titanium Target
57mm Dia x 0.1mm Iron Target
57mm Dia x 0.2mm Iridium Target
57mm Dia x 0.1mm Cobalt Target

REPLACEMENT TARGETS
57mm Dia x 0.1mm Tin Target
57mm Dia x 0.1mm Molybdenum Target
57mm Dia x 0.3mm Magnesium Target
57mm Dia x 0.1mm Tantalum Target
57mm Dia x 0.3mm ITO Target



EMS can supply a wider range of target materials and thickness'. Please enquire for details.

7.14 Other Accessories

The following are available from EMS or your local distributor.

Table 13 Accessories for the EMS150T

USEFUL ACCESSORIES FOR EMS150T	QUANTITY
Wenol Polish	100ml. Tube
Amberclens Foam Cleaner	Each
Mini Tork Rolls	Each
Carbon Rod Shaper For 3mm Rods	Each
Carbon Rod Shaper For 6mm Rods	Each

8 Service and Maintenance

For technical and applications advice plus our on-line shop for spares and consumable parts visit www.emsdiasum.com



CAUTION

Ensure mains electrical power is off during any maintenance and service activities.

81 Maintenance

Table 14 Maintenance Tasks

PROCEDURE	FREQUENCY
Inspect electrical power cords and plugs for general condition.	Regularly
FTM users: Check the status of the FTM (see page 28) and replace when necessary (see page 50).	Regularly
Check and clean the glass chamber and the 'L' gaskets as required, using a lint-free tissue and foam cleanser, or similar. Do not use vacuum grease on 'L' gaskets.	Monthly
QT150T S and QT150T ES only: Check the condition of the target material. The wear will depend on use. This is mainly over an outer annulus, accounting for some 70% of the surface area.	Monthly
Check vacuum pump oil level	Monthly
Change oil using 1 litre of supergrade 'A'.	6 Monthly
Check oil mist filter for saturation. This is a disposable plastic filter and cannot be reactivated.	6 Monthly or more regularly as required.



Obtain consumable items from EMS or an approved distributor only. Use only EMS recommended items. For technical assistance and advice - contact EMS.

8.2 Troubleshooting

Routine service should not be necessary. In the event of non-operation, carry out the following checks.



CAUTION

Disconnect the power cord **BEFORE** carrying out any servicing activities.

- Check power to Instrument.
- Check fuse.
- Check vacuum pump local switch should be in 'on' position.
- Check chamber seating for vacuum leaks.
- Check operating conditions of Instrument controls.
- Check target and connections.
- Check correct conditions for sputtering have been set.
- Check all connections.

8.3 Error Messages

Table 15 Error Messages

Error messages	Description of fault
<i>Invalid group name</i>	The name entered is ether to long or the same as a existing group
<i>Maximum groups Reached</i>	Up to 20 groups allowed
<i>Selected material not found in material list cannot continue with coating?</i>	The specified material in the profile has been removed from the material list
<i>Name already exists</i>	The name entered is the same as an existing profile/Material
<i>Name is too long</i>	The name entered is longer than 19 characters
<i>Cannot run process</i>	An unrecoverable undefined error has occurred in starting a process.
<i>This instrument does not support this process</i>	The process run is not able to be run on this instrument
<i>Evaporation PSU not found</i>	A Evaporation process has been run but the PSU is not present or not communicating
<i>Sputter PSU not found</i>	A sputtering process has been run but the PSU is not present or not communicating
<i>FTM crystal not oscillating. Please check or replace</i>	FTM crystal failed and needs to be replaced
<i>FTM Tooling Factor less than 0.1</i>	The Product of the material tooling factor and the profile tooling factor to less than 0.1
<i>FTM Tooling Factor greater than 20</i>	The Product of the material tooling factor and the profile tooling factor to greater than 20
<i>Vacuum interlock not operated. Can not proceed</i>	The operational vacuum as indicated by the gauge has been achieved but vacuum interlock switch has not operated.
<i>Interlock has been activated process stopped</i>	This is most likely caused by the top cover being opened during a cycle
<i>Unable to strike plasma</i>	The required sputter voltage has been applied for 10 second and the plasma has not struck. Check target is connected and that the Argon to turned on
<i>Short on Sputter output. Please</i>	The target shield needs cleaning. As required output

<i>check target</i>	current is seen but the target voltage is less than 80V.
---------------------	--

EMS150T Sample Preparation System

<i>System failed to achieve operational Vacuum</i>	The system has been pumping for the Max pump down time and has not achieved the operation vacuum
<i>Carbon Rod insert not found</i>	A profile has been run that using the Carbon Rod insert and it is not fitted in the chamber lid.
<i>Carbon String insert not found</i>	A profile has been run that using the Carbon String insert and it is not fitted in the chamber lid.
<i>Evaporation insert not found</i>	A profile has been run that using the Evaporation insert and it is not fitted in the chamber lid.
<i>Please contact your supplier a problem has been found with the safety interlock. Continue with coating?</i>	For safety the interlock operates in two ways and it has been detected that one has failed. Please contact your supplier to get it fixed

Table 16 Warning Messages

Warning messages	Description
<i>Please close top cover. Press OK when done</i>	The top cover above the chamber has not been closed on to the chamber lid
<i>Please fit sputter head and close the Top cover. Press Ok when done</i>	The sputter head needs to be fitted

Table 17 Information Messages

Information messages	Description
<i>Change in this Profile Only</i>	This can occur when editing a system level property with in a process profile. Yes: will set the value in this profile. No: will change the value of the system parameter thus changing all process.
<i>Use Materials Defaults</i>	This occurs when the material is changed in a profile. Yes: will copy the relevant properties i.e. oxidizing from the material list to the profile No: will just change the material. This may prevent the clean property being set unless at admin user level.

9 Appendices

9.1 Profile Parameters

Operation of the EMS150T is controlled by a process profile. There are several types of profile as listed in Table 18. Each profile contains a number of adjustable parameters. The following tables list the parameters available in each type of profile, showing their default values and allowed ranges.

Table 18 Pulse/Timed Sputter Coating parameters

Name	Default Value	Minimum Value	Maximum Value	Comment
Material	Gold			Target Material required for this process
Sputter Current (mA)	20	1	50	Coating current Updated from material list
Sputter Time (seconds)	120	1	240	<i>Timed Sputter only</i> Stops sputtering at set time.
Terminate Thickness (nm)		1	2000	<i>FTM Terminated Sputter only</i> Stops sputtering when the FTM reads this thickness
Maximum Sputter Time (minutes)	4.0	0	10.0	<i>FTM Terminated Sputter only</i> Sets upper limit to sputtering if FTM thickness has not been achieved
Tooling Factor	5.0	0.1	10	Tooling factor for this process This is multiplied by that in the material list.
Clean target*	No	No	Yes	Clean target before coating
Flush chamber*	No	No	Yes	Flush chamber with nitrogen before pumping down.

* Admin group level required to edit this property

Table 19 Carbon Pulse/Rod Evaporation profile parameters

Name	Default Value	Minimum Value	Maximum Value	Comment
Material	Carbon			Fixed; read only parameter
Pulse current (A)	60 (cord) 95 (rod)	0	120	Current applied to cord during the evaporation pulse
Max Pulse Voltage (V)*	20	0	20	The voltage across the cord is limited to this value during the evaporation pulse
Pulses Length (s)	1	0.02	3	Time is second that the pulse is applied for
Number of pulses	1	1	5	Number of consecutive pulse cycles
Pulse interval (s)	10	1	30	The time between the start of consecutive pulse cycles. Must exceed pulse length.
Outgas time (s)	10	2	60	Time cord or rod is outgassed before pulse cycle(s).
Outgas current (A)	30 (cord) 20 (rod)	0	40	Current applied at the start of outgas step.
Max Outgas current (A)	40	0	50	Maximum current permitted during outgas.
Max Outgas voltage (V)	10	0	20	Maximum voltage permitted during outgas
Outgas source*	Yes	No	Yes	Include or exclude outgassing step
Tooling factor	5	0.1	10	Tooling factor for this process
Pump hold*	No	No	Yes	If Yes, EMS150T pumps down to outgas-ready state and waits for user input. Note: If hold time (set in <i>System / Vacuum / Pump hold time</i> – see page 32) is exceeded, EMS150T vents chamber.
Flush chamber*	No	No	Yes	Set to Yes to flush chamber with nitrogen before pumping down.

* Admin group level required to edit this property

Table 20 Metal Evaporation profile parameters

Name	Default Value	Minimum Value	Maximum Value	Comment
Material	Carbon			Material to be evaporated in this process
Evaporation Current (A)	0	0	50	Current applied during the evaporation pulse
Evaporation time (Minutes)	1	0.1	4	Duration of evaporation pulse
Out Gas Time (Seconds)	10	2	60	Time source is outgassed before evaporation pulse.
Out Gas Current (A)	20	0	40	Current applied to source at the start of outgas step. Thus allowing automated outgassing. Note the current during the out gas may be adjusted.
Max Out Gas Current (A)	40	0	50	Maximum current that can be set during outgas
Max Out Gas Voltage (V)	10	0	20	The voltage across the rod is limited to this value during Outgas
Outgas source	Yes	No	Yes	Include or exclude outgassing step
Tooling Factor	5	0.1	10	Tooling factor for this process
Pump hold	No	No	Yes	If Yes, EMS150T pumps down to outgas-ready state and waits for user input. Note: If hold time (set in <i>System / Vacuum / Pump hold time</i> – see page 32) is exceeded, EMS150T vents chamber.
Flush chamber	No	No	Yes	Set to Yes to flush chamber with nitrogen before pumping down.

Table 21 Aperture Cleaning profile parameters

Name	Default Value	Minimum Value	Maximum Value	Comment
Evaporation Current (A)	0	0	50	Current applied to evaporation source during the evaporation
Evaporation time (Minutes)	1	0.1	4	Duration of evaporation pulse
Tooling Factor	5	0.1	10	Tooling factor for this process
Pump hold	No	No	Yes	If Yes, EMS150T pumps down to outgas-ready state and waits for user input. Note: If hold time (set in <i>System / Vacuum / Pump hold time</i> – see page 32) is exceeded, EMS150T vents chamber.
Flush chamber	No	No	Yes	Set to Yes to flush chamber with nitrogen before pumping down.

Table 22 Vacuum shutdown properties

Name	Default Value	Minimum Value	Maximum Value	Comment
Shut down Vacuum (mBar)	1	1x10 ⁻²	1x10 ⁺²	Set the Vacuum that the system will pump down to. Note the final vacuum may be different.

9.2 System Overrideable Parameters

If you have Admin group privileges, you can override some of the parameters normally determined by the selected profile.

Table 23 System override properties

Name	Overridden System property	Description
Gas bleed time	System>Generic Sputter> Gas bleed time	Time Ar allowed to flow into chamber before plasma started
Bleed Vacuum	System>Generic Sputter> Bleed Vacuum	Pressure at which the chamber is maintained at while the plasma is present
Clean current	System>Generic Sputter> Clean current	Current at which the target is cleaned at.
Clean time	System>Generic Sputter> Clean time	Time for which the target is cleaned for
Stage rotate	System>Hardware>Stage Rotate	Allow the stage to be turned off for just this cycle
Stage Speed	System>Hardware>Stage Speed	Set the speed of the stage for this process

9.3 Technical Specification

Table 1 lists the technical specification of the EMS150T.

Table 24 Technical Specification

All instruments	
Instrument Case	585mm Wide x 4700mm Deep x 410mm High
Work Chamber	Borosilicate Glass 165mm Dia x 125mm High
Safety Shield	PET
Ultimate vacuum	5×10^{-5} mbar
Turbomolecular Pump	60 litres/sec
Vacuum Gauge Range	1000 - 5×10^{-4} mbar
Fuse	T 10A ceramic (5x20mm); fuse standard IEC60127-2
Weight	33.4 kg
Sputter Coater (EMS150T S and EMS150T ES)	
Target	54mm Dia x 0.2mm Thick (Chromium fitted as Standard)
Specimen Stage	60mm Dia. Rotating Stage
Deposition Current	0-150mA
Deposition Rate	0-20nm/Minute
Sputter Timer	0-10 minutes
Evaporation (EMS150T E and EMS150T ES)	
Evaporation current (rod)	0-90A
Outgas current	0-50A
Carbon source	3.2mm rods or carbon cord

9.4 Sputtering Deposition Rate



These graphs are provided for guidance only and are not to be taken for absolute reference

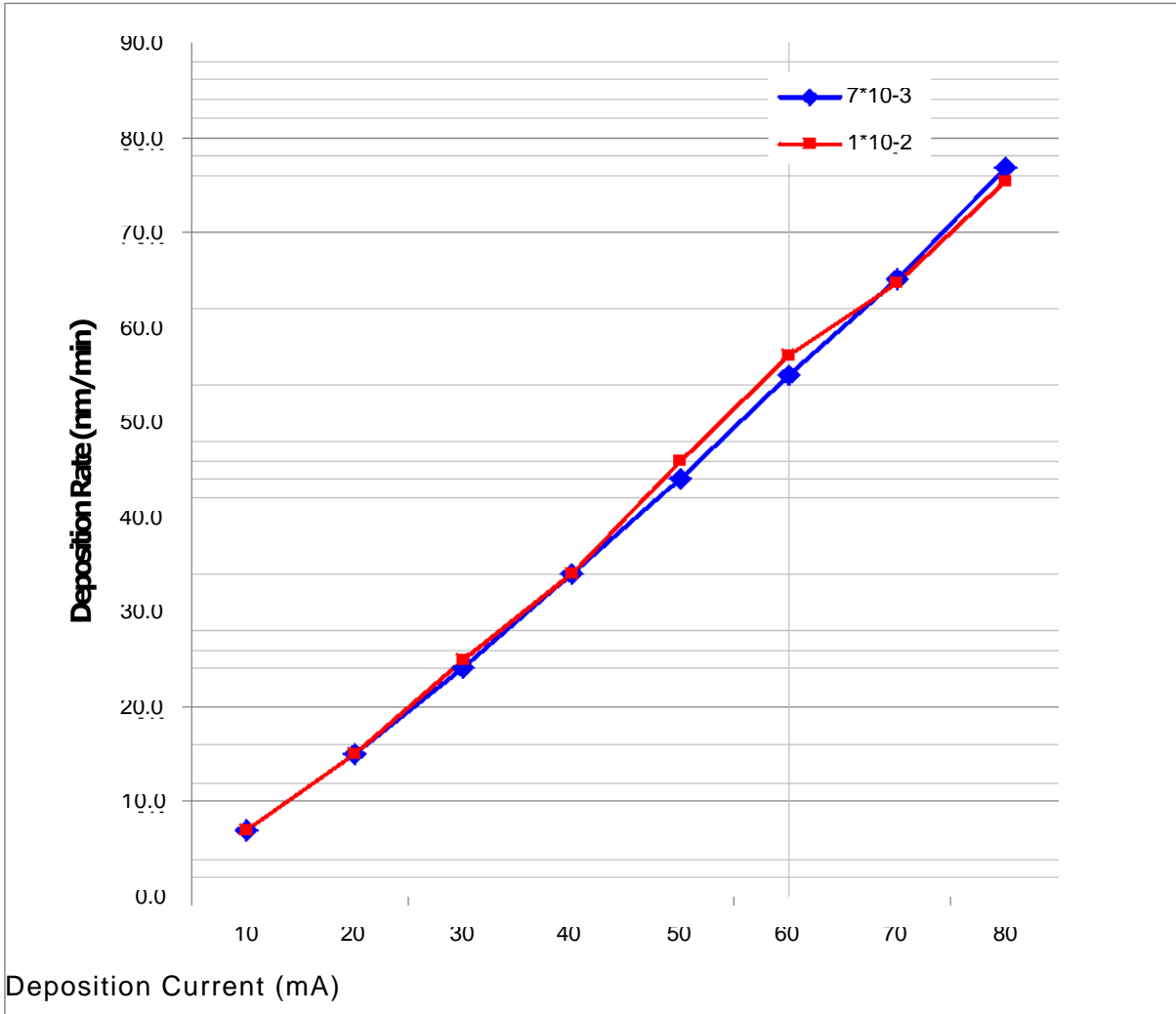


Figure 9-1. Sputtering Deposition Rate using Gold

Gold tooling factor = 2.7

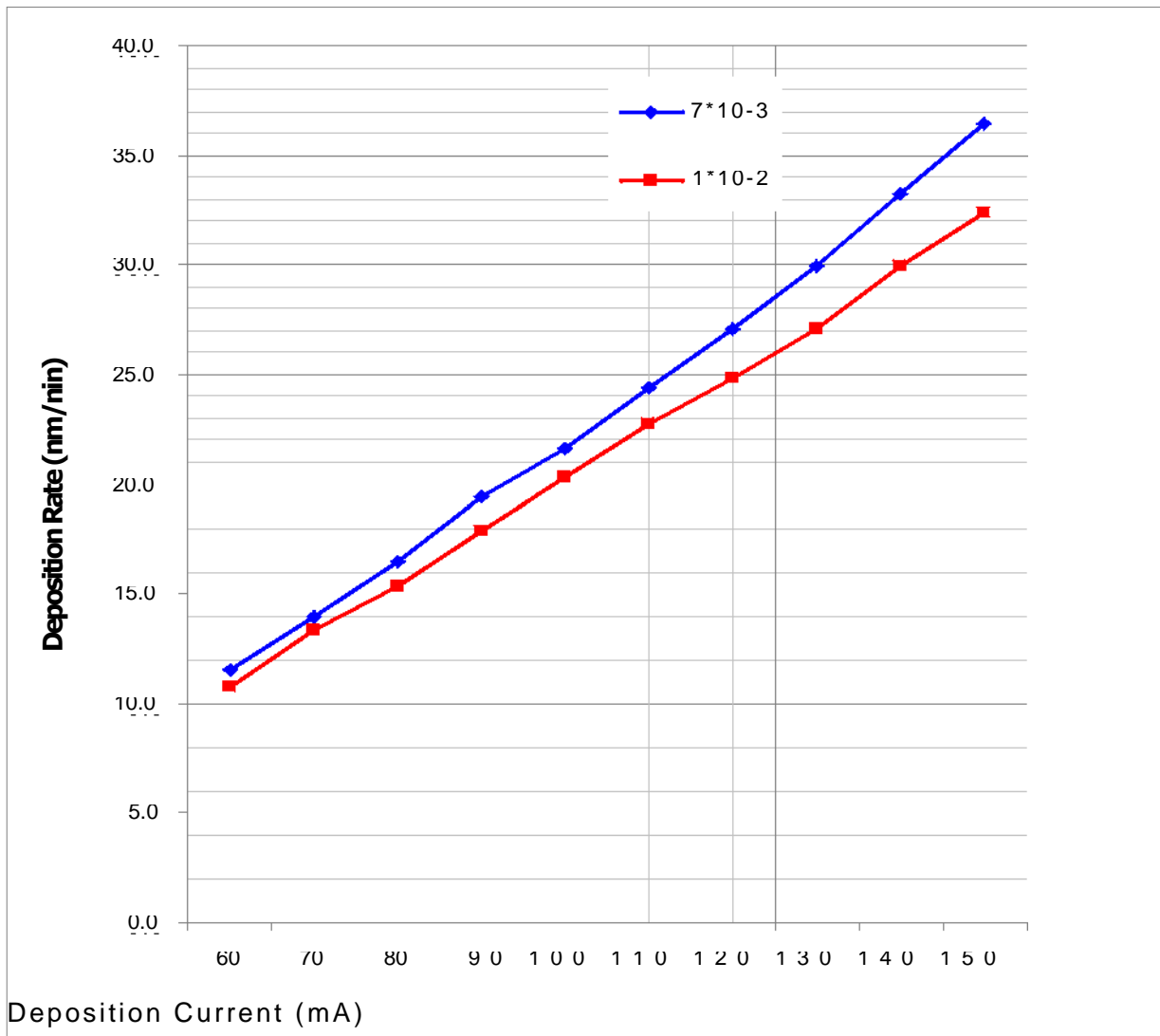


Figure 9-2. Sputtering Deposition Rate using Chromium

Chromium tooling factor = 2.28

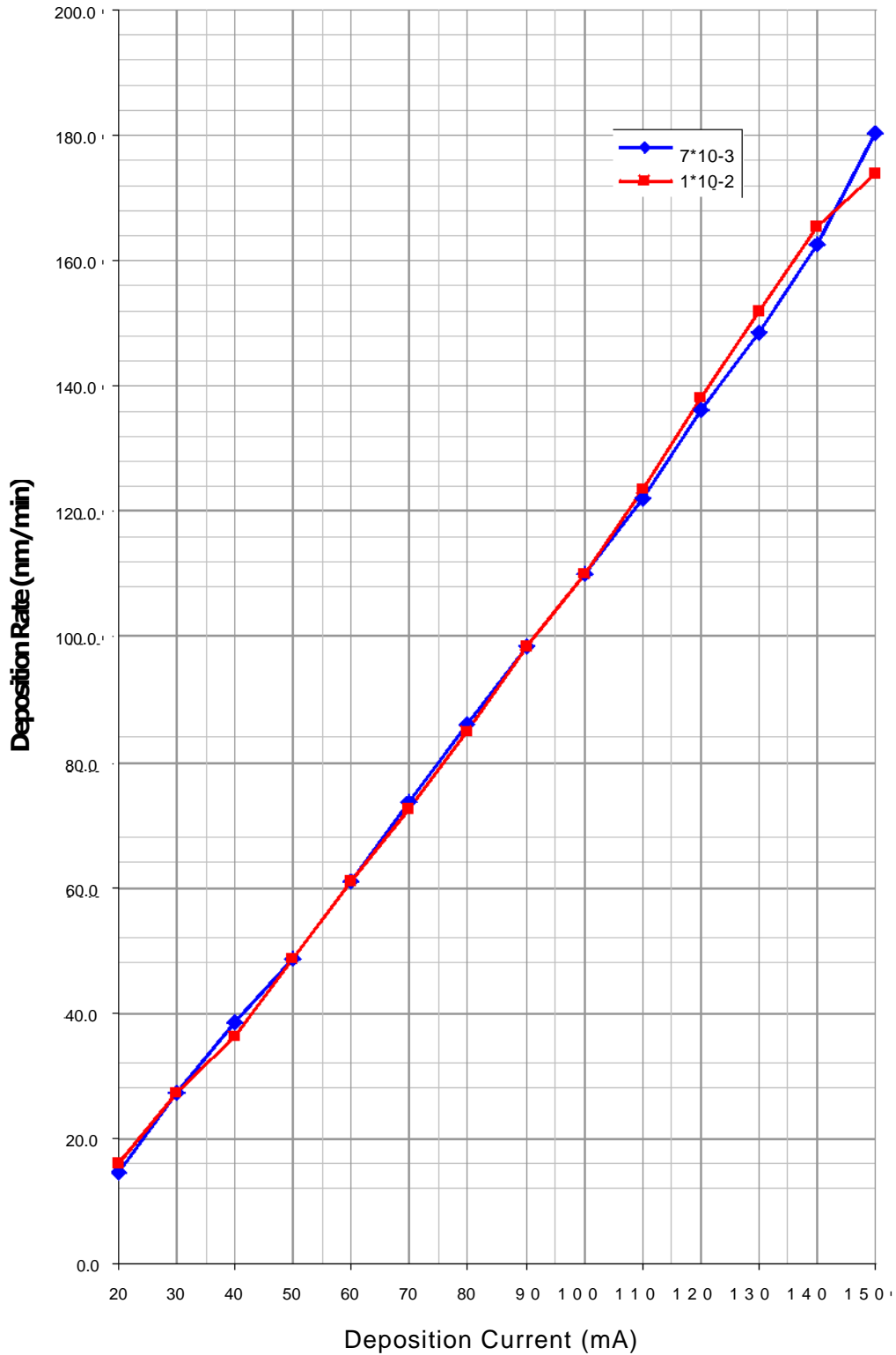


Figure 9-3. Sputtering Deposition Rate using Silver
Silver tooling factor = 2.5

95 Return of Goods

This section contains important safety information regarding the return of Preparation Equipment and Accessories.

9.5.1 General Introduction

The employer (user) is responsible for the health and safety of his employees. This also applies to all those persons who come into contact with the Preparation Equipment and Accessories either at the user's or manufacturer's premises during repair or service. The contamination of Preparation Equipment and Accessories has to be declared and the Health and Safety Declaration form completed. (Appendix -9.5.5 for the form)

9.5.2 Health and Safety Declaration

Those persons carrying out repair or service have to be informed of the condition of the components. This is the purpose of the 'Declaration of Contamination of Preparation Equipment and Accessories'.

9.5.3 Dispatch

When returning equipment the procedures set out in the Operating Instructions must be followed. For example:

- Drain the vacuum pumps.
- Neutralize the flushing with gas.
- Remove filter elements.
- Seal all outlets.
- Pack glass components safely.
- Pack loose attachments securely for example stages.
- Seal in heavy duty polythene or a bag,
- Dispatch in suitable transport container.

9.5.4 Return Address:

F.A.O.: The Service Manager,
EMS
1560 industry Road
Hatfield Pa 19440

9.5.5 Declaration of Contamination Form

Table 25 Declaration of Contamination Form

Declaration of Contamination of Preparation Equipment and Accessories.				
The repair and/or service of Preparation Equipment and Accessories can only be carried out if a correctly completed declaration has been submitted. Non-completion will result in delay. The manufacturer reserves the right to refuse acceptance of consignments submitted for repair or maintenance work where the declaration has been omitted.				
This declaration may only be completed and signed by authorized and qualified staff.				
1. Description of component - Equipment type/model: - Code No.:		2. Reason for return:		
- Serial No.:				
- Invoice No. (if known)				
- Delivery Date.: (if known)_____				
3. Equipment condition		4. Process related contamination of Equipment/ Accessories.		
- Has the equipment been used? Yes/No		- Toxic Yes/No		
- What type of operating medium was used?		- Corrosive Yes/No		
- Is the equipment free from potentially harmful substances? Yes/No		- Explosive* Yes/No		
(If Yes go to Section 5)		- Microbiological* Yes/No		
(If No go to Section 4)		- Radioactive* Yes/No		
		- Other harmful substances Yes/No		
* We will not accept any Equipment/Accessories which have been radioactively, explosively, or microbiologically contaminated without written evidence that such Equipment/Accessories have been decontaminated in the prescribed manner.				
Please list all harmful substances, gases and dangerous by-products, which have come into contact with the Preparation Equipment and Accessories.				
Trade name	Chemical name and symbol	Danger class	Precautions associated with substance.	First aid measures in the event of an accident.
Product name				
Manufacturer				
1.				
2.				
3.				
4.				
5.				
5. Legally Binding Declaration.				
I hereby declare that the information supplied on this form is complete and accurate. The dispatch will be in accordance with the appropriate regulations covering Packaging, Transportation and Labeling of Dangerous Substances.				
Name of Organisation: _____				
Address: _____				
Tel.:		Post Code: _____		
Name:		Fax: _____		
Date:		Job Title: _____		
		Company: _____		

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