

Operator Manual
Version 1.0



DO261734

ABOUT THIS MANUAL

This manual provides guidelines and instructions for operators of the SQM CD/DVD glass mastering system.

The manual is divided into 7 chapters containing the following information:

CHAPTER	TITLE	CONTENTS
1	<i>Safety Information</i>	<i>Important guidelines and information relating to personal and equipment safety. This chapter must be read before attempting to operate the SQM system.</i>
2	<i>Technical Data</i>	<i>Information regarding identification and the environmental aspects of the system.</i>
3	<i>System Description</i>	<i>A general description of the SQM system and an overview of the glass mastering process.</i>
4	<i>Human Machine Interface</i>	<i>An overview of the functionality and facilities provided at the Human Machine Interface used for operation and control of the system.</i>
5	<i>Operating Procedures</i>	<i>Instructions for the correct and safe operation of the system.</i>
6	<i>Chemical Preparation Procedures</i>	<i>Instructions for the mixing of the chemical process solutions used during the mastering process.</i>
7	<i>Routine Maintenance Procedures</i>	<i>Description of the routine maintenance tasks that can be carried out by an operator.</i>

CONVENTIONS USED IN THE MANUAL

The following conventions are used in this manual to highlight important information.

❖ **Warning**

A warning within an instruction is used to indicate that the risk of personal injury exists if the specified precautions are not observed.

For example:



WARNING: Always wear protective clothing, gloves and safety glasses when handling chemicals.

❖ **Caution**

A caution within an instruction is used to indicate that the risk of damaging the machine exists if the specified precautions are not observed.

For example:



CAUTION: Do not over-tighten the connectors as this may result in damage to the threads.

Associated Documentation

The following additional documentation is also provided for use with the SQM system.

- ❖ **SQM Customer Drawings**

Provided for use by suitably qualified technicians. Contains information for the correct ordering of spare parts.

- ❖ **Electrical Schematic Diagrams**

Provided for use by suitably qualified technicians.

- ❖ **User Manual for Media Input System**

Instructions for the use of the system used for the loading and processing of the programs to be mastered in the SQM system.

- ❖ **User Manual for Clean Air Unit**

Instructions for the use and maintenance of the Clean Air Unit used for maintaining the correct environmental conditions within the SQM system

- ❖ **User Manual for Glass Disc Recycling Machine**

Instructions for the use and maintenance of the Glass Disc Recycling machine used for cleaning the glass substrates used in the SQM system (if included in the scope of supply).

- ❖ **SQM Installation Manual**

Provides information regarding the preparation of a mastering system prior to the installation of the SQM system. Also provides instructions for the placement of the machine and connection to the required supplies.

1 SAFETY INFORMATION

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1

SAFETY INFORMATION

1.1 General

This chapter provides important safety information regarding the use and maintenance of the SQM mastering system. The information provided should be carefully read and fully understood before attempting to work with the system. The safety guidelines provided should be observed at all times when operating or maintaining the SQM.



WARNING: Failure to observe the relevant safety precautions may result in serious injury to operating and maintenance personnel.

1.2 Purpose and Limitations of Use

The SQM system is provided for the production of CD and DVD photo-resist masters. The system should be used only for the purpose for which it was intended. Any unauthorised use or modification could present safety risks, and in addition will invalidate the warranty of the equipment.

The system meets the current industrial standards for safety during operation. It has been designed to be easy to operate and requires the minimum of maintenance.

Operators must comply with the safety guidelines provided in this manual. The system should be operated only in a technically perfect condition, by specifically trained staff.

1.3 Definition of User Levels

The following user levels are defined for access to the SQM system:

Table 1.1 Definition of User Levels

USER LEVEL	TASKS
OPERATOR LEVEL	<i>Normal operating procedures, start-up etc. Limited cleaning tasks.</i>
TECHNICIAN LEVEL	<i>Routine maintenance tasks. Adjustment procedures including modification of process parameters. Component replacement.</i>
SERVICE LEVEL	<i>Intended for M2 Engineering personnel. Fault finding and repair tasks.</i>

These user levels are reflected in the access structure of the facilities provided at the Human Machine Interface.

1.4 General Safety Regulations

1.4.1 Technical Standards

The SQM system is manufactured according to the latest technical standards and is designed for safe operation. The system can however present a hazard if operated by untrained personnel or used for purposes other than that for which it was intended.

1.4.2 Adherence to Regulations

Correct use of the system includes conforming to the regulations for correct installation, initial commissioning, application, operation, maintenance and service. M2 Engineering will not accept any responsibility for any damages arising from the incorrect use of the system.

1.4.3 Training of Personnel

Only well trained personnel should be allowed to install, operate (run), maintain or service the SQM system. These personnel must be instructed with respect to the hazards that can be caused by the system.

1.4.4 Cleanliness and Good Housekeeping

It is important that the system and the surrounding area are kept clean and clear of any obstructions which could create a hazard for personnel working in the area of the system.

1.4.5 Access for Authorized Personnel Only

Access to the system must be limited to trained personnel.



WARNING: Persons with cardiac pacemakers must be informed of the hazard presented by the system due to the strong electromagnetic fields produced by the Sputtering module in the system.

1.4.6 Unauthorised Modifications

Any modifications or changes to the system that could affect the safety or reliability of the system are prohibited.

1.4.7 Transportation and Installation

The SQM system must only be transported in its original packing. The system must only be installed or re-located by M2 Engineering personnel or an authorised agent of M2 Engineering. Details for the lifting and positioning of the system are contained in the associated "SQM Installation Manual".

1.4.8 Removal of Safety Features

It is prohibited to remove or override the safety features of the system (interlocks, safety switches etc) unless this is absolutely necessary for service purposes. All safety devices must be re-instated before the system is returned to normal production.

1.4.9 Testing after Maintenance and Service

Following maintenance or service work, the whole safety system of the SQM system must be tested (e.g. interlocks) to ensure it operates faultlessly. Especially after electrical installation or service work the protective measures have to be tested (e.g. protection earth, insulation resistivity etc.). The system may not be operated again until successful tests have been performed.

1.4.10 Supplies

It must be possible to easily isolate all supply lines of compressed air, argon gas as well as the main electrical supply to the system. Supplies must be separately routed and protected against any mechanical damage or stress.

1.4.11 Location of the Operating Instructions

This manual must always be available at the SQM system at a clearly defined place.

1.4.12 Local Regulations

National and local safety regulations must always be observed with respect to the installation and operation of the SQM system.

1.5 Safety Features

The following safety features are incorporated into the design of the SQM system.



WARNING: It is prohibited to remove or override the safety features of the system unless this is absolutely necessary for service purposes. All safety devices must be re-instated before the system is returned to normal production.

1.5.1 Emergency Stop Button



A single Emergency Stop Button is located at the Human Machine Interface. Activating this button results in the immediate stopping of all mechanical movements within the system.

The Emergency Stop button should not be used for a normal production stop as this results in all substrates that were being processed when the button was used being aborted. Additionally, an extended time is required to re-start the system following an emergency stop and this will lead to a loss of production.

1.5.2 Fume Extraction

A fume extraction connection is provided within the system to ensure the safe removal of the potentially dangerous solvent vapours that are produced during the mastering process.

Provision of the extraction fan is the responsibility of the SQM customer. The fan should meet with the following specification.

Capacity: 1200 m3 per Hour
 Static Pressure: 200 pa

A sensor is fitted in the fume extraction pipe and this prevents the system from being used if it is detected that the fume extraction is not operating correctly.

1.5.3 Stack Loader Door Interlock

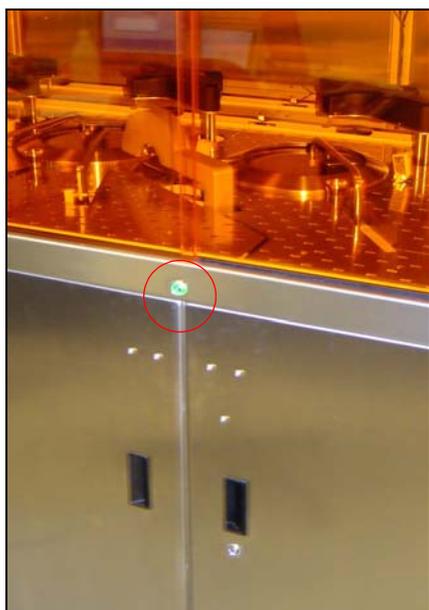


The door to the Stack module is fitted within an interlock device that prevents the door from being opened until the stack lift mechanism has been moved to the default position and has fully stopped. Movement of the stack lift mechanism to the safe default position is activated using the push button located next to the Stack module door.

1.5.4 Door Locks

Mechanical locks are fitted to the lower doors, behind which the power supply modules are located. These doors should be kept locked unless access is specifically required for service purposes. The key used to opening these doors should be held by a person in authority.

1.5.5 Window Interlocks



All windows are fitted with locking devices that prevent them from being opened during operation of the machine. The windows can only be opened following use of the window lock button and after all movements in the machine have stopped.

1.6 Hazardous Areas

The figure below highlights the areas within the SQM system where a potential hazard exists if the safety instructions are not correctly observed. These areas are indicated on the SQM system by the placement of the standard safety labels.



WARNING: These labels must never be removed or covered. The labels should be immediately replaced if they become illegible

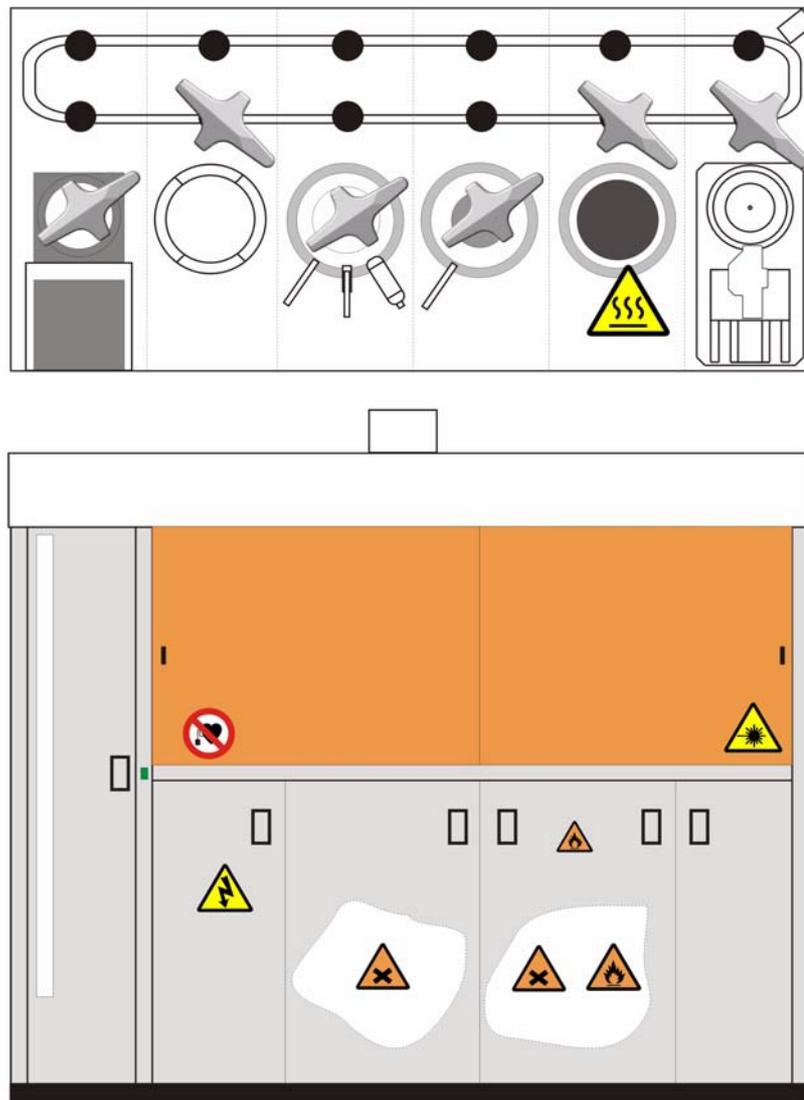


Figure 1.1 SQM System Hazardous Areas

A definition of the warning labels and the hazards indicated by them is provided in Table 1.2.

Table 1.2 Definition of Warning Labels/Hazards

LABEL	HAZARD/PRECAUTIONS
	<p>Potentially lethal electrical power supplies are located behind the panel or door. Access should be restricted to suitably qualified personnel.</p>
	<p>The Sputtering module within the system produces strong electromagnetic fields that can present a hazard to persons with cardiac pacemakers. Any personnel having a pacemaker or other implanted device should keep a safe distance of at least 5 metres from the system when it is in operation.</p>
	<p>The system is fitted with a laser device that can present a hazard to the eyes if the correct precautions are not observed, refer to Paragraph 1.8 "Laser Beam Recorder Air Buffer" on Page 1-11. for more detailed information.</p>
	<p>The Resist Curing module is fitted with a hot plate that gets sufficiently hot to cause injury. The hot plate is always switched on and takes time to cool down after the power is removed from the system. Never place flammable materials on the hot plate.</p>
	<p>The chemical vessel to which the label is affixed contains a flammable solution.</p>
	<p>The chemical vessel to which the label is affixed contains a solution that can be irritating to the skin and eyes.</p>

1.7 Gas Bottles

The Sputtering module uses potentially dangerous Argon Gas. All operating personnel should be aware of the potential hazards involved in the use and handling of the associated gas bottles.



WARNING: Danger of explosion, fire, poisoning and severe damage! Mounting, assembly and handling of the pressure gas bottles and their equipment must be carried out in accordance with national and local regulations. Pressure reducing valves must be installed in the gas supply lines with an adjustable pressure P_{out} for the SQM system of 1.5 bar.

1.8 Laser Beam Recorder Air Buffer

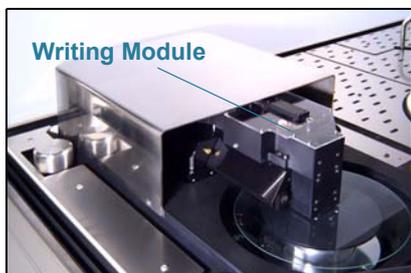
The rotation unit of the Laser Beam Recorder is fitted with an air bearing that has an air buffer tank between the main compressed air supply and the bearing. This tank is provided to protect the bearing against damage in the event of a failure of the main compressed air supply. The tank should be inspected every six months for signs of damage or fatigue. The tank can be accessed from the rear of the machine. If there is no person within the mastering facility that can carry out this inspection then an external authority should be engaged to carry out the inspection.



Figure 1.2 Air Bearing Buffer Tank

1.9 Laser Safety Precautions

The Laser Beam Recorder module is fitted with a laser device of the following type:



Laser Beam Recorder

- ❖ Semi-conductor Diode : Class IIIB Device
- ❖ Maximum Output Power : 5.5 mW
- ❖ Wavelength : 405 nm

The following precautions must be observed at all times:

- ❖ There are no replacement parts within the Laser Beam Recorder. All service should only be carried out by M2 Engineering authorised personnel.
- ❖ The cover of the self-contained writing module should never be removed.
- ❖ Never look directly into the laser light or at the scattering laser light from any reflective surface. Never sight down the beam into the source.
- ❖ The laser warning signs and labels should be maintained at all times.



WARNING: Damage to the eyes caused by laser light is permanent and will not heal.

1.10 Glass Breakage Hazard

The glass substrates used during the mastering process are rotated at extremely high speeds in the Laser Beam Recorder module (6000 RPM). The window of the Laser Beam Recorder must always be closed when a substrate is rotated as this protects against the hazards presented by a glass breakage.

1.11 Chemical Safety

A number of the chemical solutions used during the mastering process and the basic chemicals from which they are mixed are flammable and can cause skin, eye and mucous membrane irritation. Always observe the following precautions:

- ❖ Always prepare all chemicals at the chemical preparation bench with the fume extraction fan switched on. Never prepare the chemicals in the room in which the system is installed.
- ❖ Always wear protective clothing, gloves and safety glasses when handling chemicals.
- ❖ Avoid breathing in fumes, vapours and sprays.
- ❖ Avoid contact with the skin or eyes.
- ❖ Always wash hands thoroughly after working with the chemicals.



1.11.1 Accidents Involving Chemicals

In the event of an accident involving any chemical solution or cleaning agent, reference should be made to the chemical manufacturers Material Safety Data Sheet (MSDS).

In the event of an accident involving the prepared solutions, the following Material Safety Data Sheets are applicable.

Table 1.3 Process Solutions - Safety Details

PROCESS SOLUTION	SAFETY CATEGORY	APPLICABLE MSDS
Adhesive	 Irritant	<i>N-(2-Aminoethyl-3-Aminopropyl) Trimethoxy Silane - A0700CD</i>
Photo-Resist	 Flammable	<i>Microposit (R) EC Solvent</i>
Developer	 Irritant	<i>OCG 809</i>

1.12 General Safety Precautions



- ❖ Do not smoke or use any naked flames in the vicinity of the machine.
- ❖ The hot plate is constantly switched on at a temperature of approximately 90° C (194 °F). Do not touch the hot plate or attempt to handle a glass disc that has recently been heated.
- ❖ Always ensure that the vapour extraction system is switched on as this prevents the build-up of potentially dangerous solvent vapours.
- ❖ Avoid any physical contact with the argon gas used in the system. In the case of inhalation, move the victim into the fresh air and seek immediate medical advice.
- ❖ The process chemicals used in the machine are contained in constant pressure vessels. Always release the pressure using the valve provided before attempting to open any of the vessels.

1.13 Safety Apparatus

Safety apparatus should be provided at the site of the machine in accordance with local regulations. It is recommended that at least the following apparatus is provided in the vicinity of the machine.

- ❖ Fire detection system providing automatic equipment shutdown and acoustic alarms.
- ❖ Smoke detectors.
- ❖ CO₂ fire extinguishers.



WARNING: Never use water for fire extinguishing.

- ❖ Eye flushing equipment.
- ❖ Water spray for dowsing.
- ❖ First aid kit.
- ❖ Protective clothing.

1.14 Precautions to be Taken During Service

The following safety precautions should be taken when carrying out service on the system.

- ❖ Always remove the main power supply to the system when carrying out any maintenance on the electrical system. Lock the main power switch and place a label next to the main power switch indicating that service is being carried out.
- ❖ Disconnect the Uninterruptible Power Supply from the system when carrying out maintenance or service.

2 TECHNICAL DATA

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2

TECHNICAL DATA

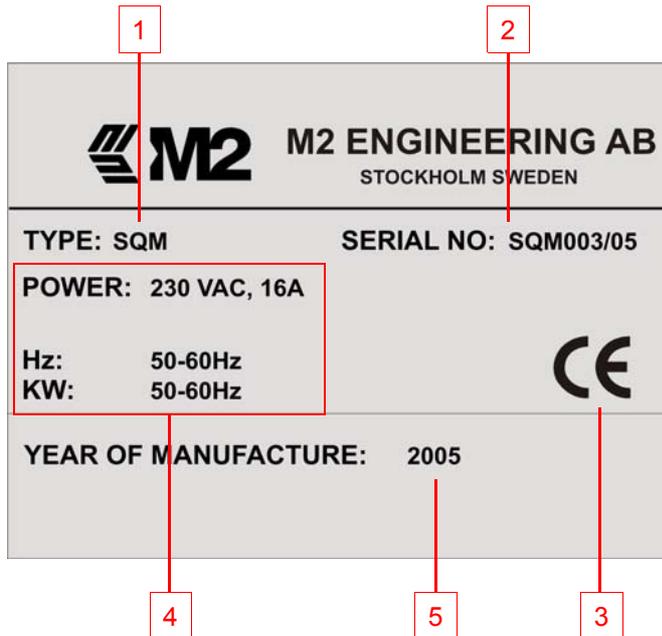
2.1 General

This chapter provides Information regarding the identification, performance and the environmental aspects of the SQM mastering system.

2.2 System Identification

The type plate affixed at the left side of the SQM system provides important information about the machine. The details provided on the type plate should be quoted in all correspondence or other communication with M2 Engineering.

The following information is provided on the type plate:



- 1) Machine type.
- 2) Unique serial number of the machine.
- 3) The CE mark that indicates that the machine conforms to the requirements of the European Machinery Directive with regards to health, safety and environmental aspects.
- 4) Specification of the electrical supply to be connected to the system.
- 5) Year in which the machine was built.

2.3 Conformance to Standards

The SQM system conforms to the following european directives and harmonised standards:

Directives:

- ❖ Machinery Directive (98/37/EC)
- ❖ EMC Directive (89/336/EEC)

Applicable Harmonized Standards:

- ❖ NEN-EN 294

Safety of machinery, safety distances to prevent danger zones being reached by the upper limbs.

- ❖ NEN 1010

Electrical installations

- ❖ NEN-EN 12626:1997

Safety of machinery - Laser processing machines - Safety requirements (ISO 11553:1996, modified)

- ❖ NEN-EN-IEC 60825-4:1998

Safety of Laser Products - Part 1, Laser Guards

2.4 Dimensions and Weight

All dimensions are shown in mm.

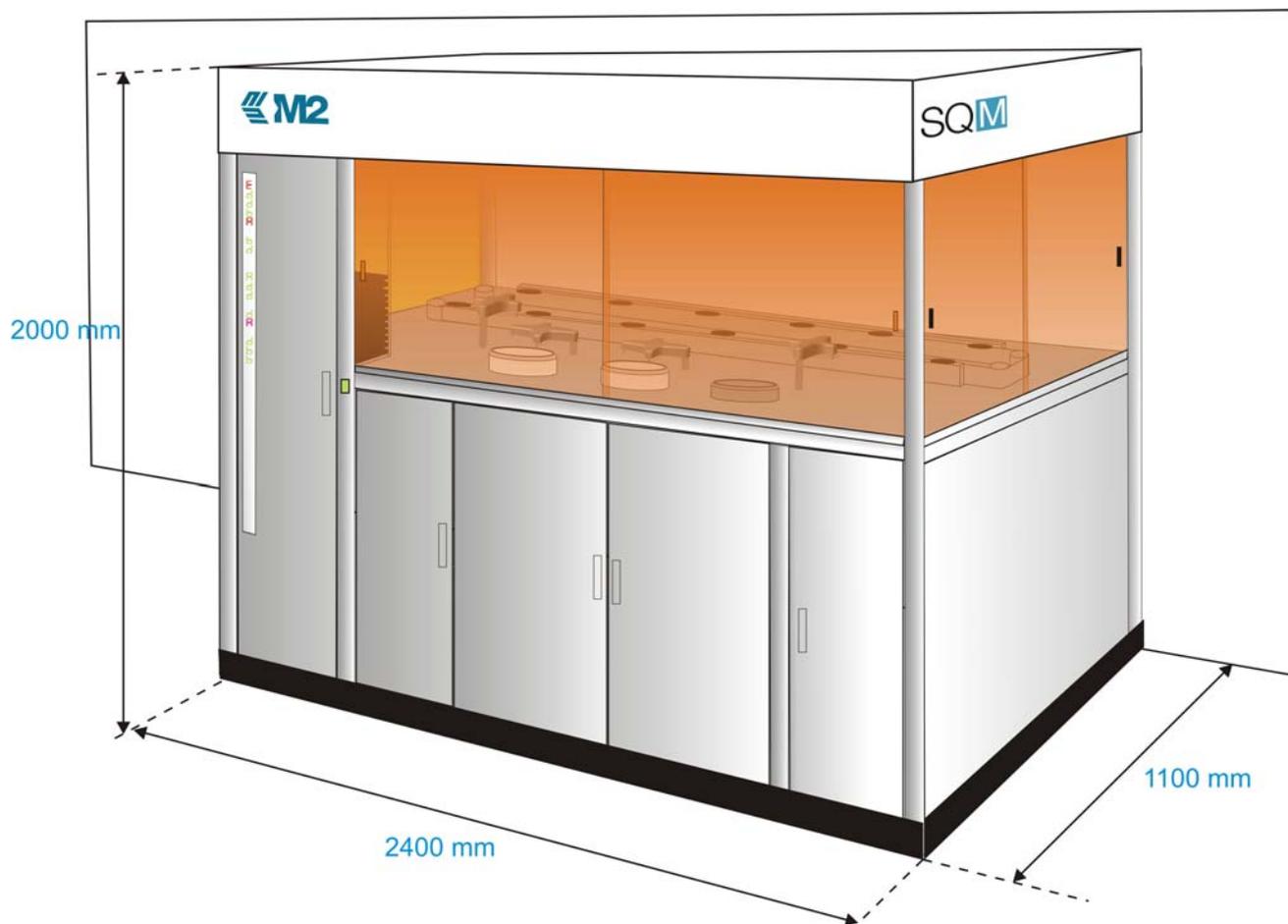


Figure 2.1 Dimensions of the SQM Mastering System

Table 2.1 Weights

ASSEMBLY	WEIGHT
SQM System including LBR	Approximately 1600 kG
SQM Laser Beam Recorder	Approximately 45 kG

2.5 Type Variants

The SQM system can be supplied in the following configurations:

- ❖ CD Only version - Fitted with 10 x Laser Beam Recorder.
- ❖ Entry Level CD/DVD version - Fitted with 6x/2R Laser Beam Recorder.
- ❖ Standard CD/DVD version - Fitted with 10x/4R Laser Beam Recorder.
- ❖ High Volume CD/DVD version - Fitted with 10x/5R Laser Beam Recorder.

2.6 System Performance Data

The output capability of the various configurations is follows:

2.6.1 CD Only Version

- ❖ 135 CD Masters per 24 Hours

2.6.2 Entry Level CD/DVD Version

- ❖ 80 CD Masters per 24 Hours
- ❖ 36 DVD Masters per 24 Hours

2.6.3 Standard CD/DVD Version

- ❖ 135 CD Masters per 24 Hours
- ❖ 70 DVD Masters per 24 Hours

2.6.4 High Volume CD/DVD Version

- ❖ 135 CD Masters per 24 Hours
- ❖ 85DVD Masters per 24 Hours

2.7 Environmental Data

The following paragraphs provide important technical details of the machine when operated under **normal** production conditions.

2.7.1 Machinery Noise

The airborne noise generated by the machine during **normal** operating conditions, does not exceed < 70 dBA and so hearing protection devices are not required.

2.7.2 Machine Vibration

When operated under **normal** operating conditions, the machine complies with the acceptable vibration conditions outlined in Machinery Directive EAC 825/EN 264.

2.7.3 Gas, Vapour and Dust Emissions

The following waste vapour is produced by the system:

- ❖ Vapour: Solvent polluted air.
- ❖ Waste Vapour Pressure: 0,1 bar above atmosphere.



This vapour is safely exhausted to the outside of the building.

2.8 Waste Products

2.8.1 Targets

Spent Nickel Vanadium targets produced by the machine must be disposed of in accordance with local regulations.

2.8.2 Waste Adhesive/Developer

The waste adhesive and developer solution produced by the system are automatically deposited into the waste water treatment system of the associated electroforming system.



2.8.3 Waste Photo-resist

The waste photo-resist produced by the system is collected in a container within the machine. When full, this container should be emptied into a larger sealable container which should in turn be treated as solvent waste in accordance with local regulations.

2.8.4 Cleaning Materials

Waste cleaning materials such as isopropanol and acetone used for machine cleaning must be treated as chemical waste and disposed of in accordance with local regulations.

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3

SYSTEM DESCRIPTION

3.1 General

The SQM from M2 Engineering is an automatic system for the production of photo-resist masters for the following formats of pre-recorded optical media:

- ❖ CD - Audio, ROM, VCD etc.
- ❖ DVD-5
- ❖ DVD-9 - Layer 0 and Layer 1 masters
- ❖ DVD-10
- ❖ DVD-14, 18

3.2 Scope of Supply

The SQM scope of supply comprises the SQM system itself and the associated ancillary equipment as detailed in the sub-paragraphs that follow.

3.2.1 Media Input System

This is the system that is used for the loading and processing of the data to be mastered. The complete media input system consists of an external server to which a CD-ROM, DVD-ROM and DLT drive are connected for the loading of the jobs to be mastered. The encoder that provides the signal to switch the laser in the Laser Beam Recorder (LBR) on and off is built into the SQM system below the LBR. The way in which the media input system is connected to the SQM system is shown in the diagram below.

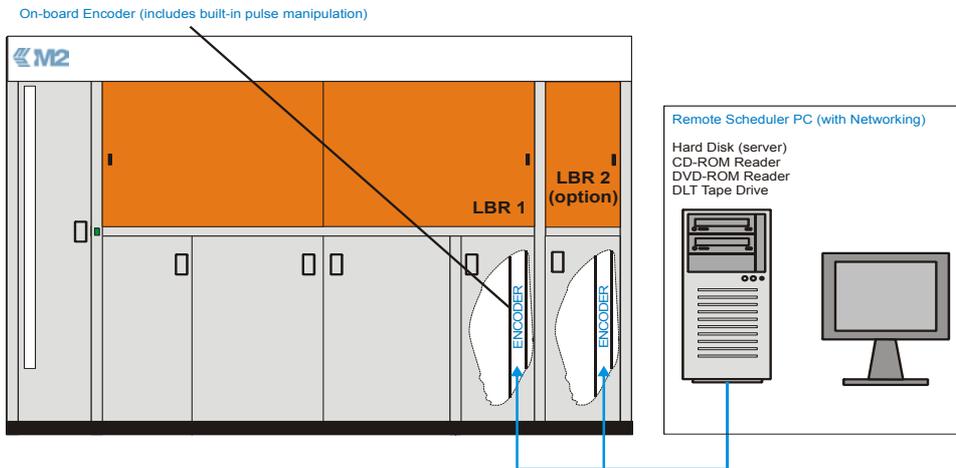


Figure 3.1 Media Input System/SQM Configuration

3.2.2 Clean Air Unit

The SQM is supplied with a self-contained Clean Air Unit that provides a constant supply of conditioned air to the SQM. The air unit provides precise control of the air temperature and humidity and this ensures that the correct environmental conditions within the system are maintained.



 *The technical aspects, operating instructions and maintenance procedures for the Clean Air Unit are contained in the separate Weiss Enet documentation provided with the unit.*

3.3 SQM Technical Description

The SQM system has a modular construction with process modules positioned in-line within a rectangular frame. The system has been designed so that it can be easily expanded by the fitting of additional modules for increased capacity or alternative functionality. The substrates used for the glass mastering process are transported through the system by a central conveyor system. Each process module has a pick and place handler for the transfer of substrates to and from the central conveyor. The general layout of the system is shown in the figure below and the individual modules are described in the sub-paragraphs that follow.

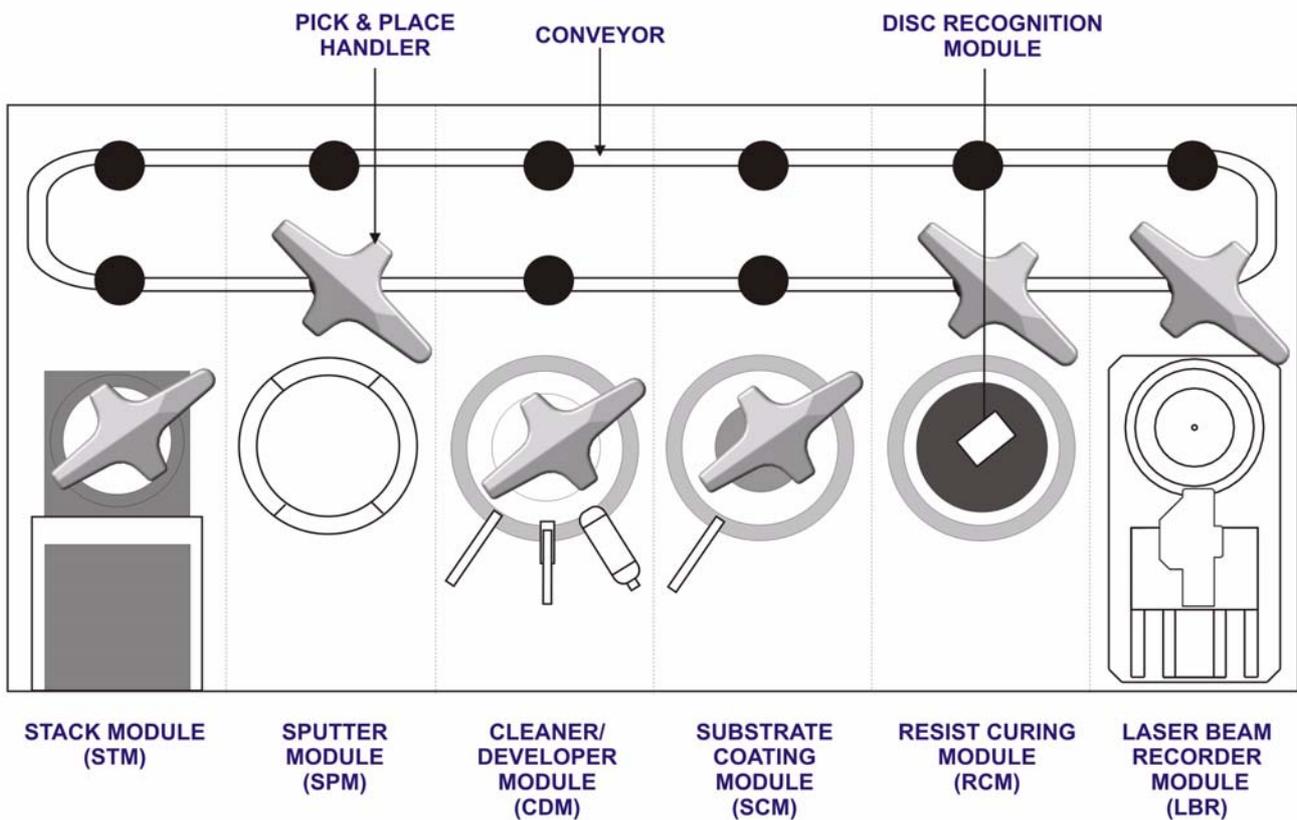


Figure 3.2 SQM System Layout

3.3.1 Stack Module (STM)



The $\varnothing 180$ mm glass substrates used with the SQM system are loaded into the system in individual boxes. These boxes protect the glass substrates from damage and contamination. The Stack Module has the capacity for the simultaneous loading of 20 substrate boxes. Completed masters are returned into a box at the stack module for easy and protected removal from the system. If required, an additional stack loader can be fitted into the system to further reduce the requirement for operator intervention.

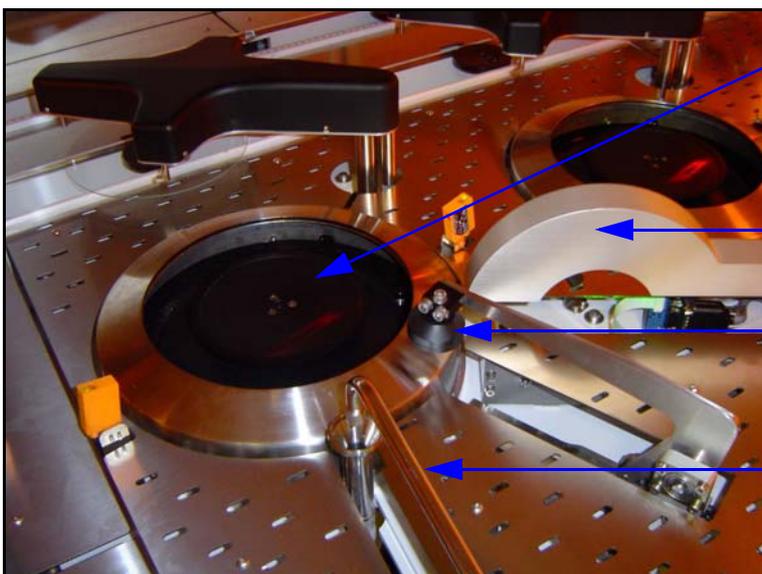
3.3.2 Cleaner Developer Module (CDM)

The cleaner/developer module is used for the initial cleaning of loaded glass substrates, coating of the adhesive layer and the developing of the substrate following recording.

Cleaning is carried out by DI water flushing and the action of a small brush.

The dispensing of the used chemicals is carried out through a single arm having separate tubes for each of the chemical solutions. The dispense arm is driven by a stepper motor that allows programming of the dispense position for each of the chemicals. Each chemical line is fitted with a suck-back valve that prevents the possibility of dripping at the end of the dispense cycle.

The developer module has a quality measurement arm that facilitates the measurement of the asymmetry value over the complete substrate surface following developing. In the event that a correctable change in asymmetry is detected, the system parameters are automatically modified to correct the deviation. This method of feed forward process control ensures maintenance of the process window and makes the system more tolerant to operator errors, environmental changes etc.



Substrate Rotation Table

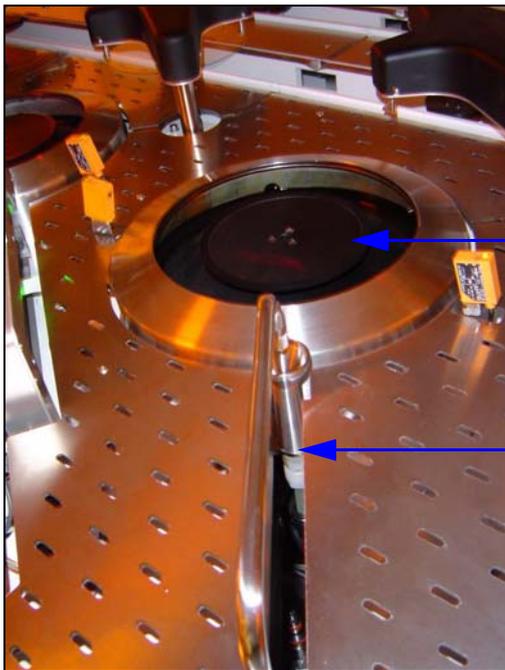
Quality Measurement Arm

Brush Mechanism

Dispense Arm

3.3.3 Resist Coating Module (RCM)

The Resist Coating Module is the module in which the photo-resist layer is applied onto the surface of the glass substrate. The photo-resist layer is applied by first dispensing photo-resist onto the surface and then accelerating the substrate to the correct rotational speed to achieve a layer of the correct thickness and uniformity.

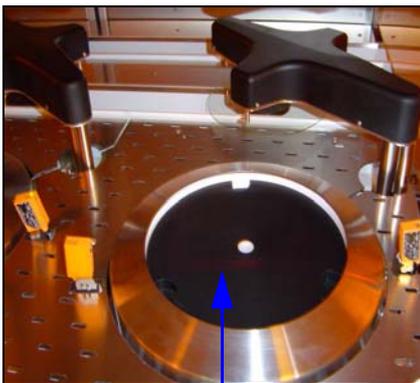


Substrate Rotation Table

Dispense Arm

3.3.4 Resist Curing Module/Disc Recognition Module

This module consists of a hot plate onto which a substrate is placed at various stages during the mastering process to be heated up. The hot plate has the same surface area as the substrate. This ensures an even curing of the entire surface and prevents possibly destructive stresses from occurring in the glass due to uneven heating. A camera (Disc Recognition Module) is positioned above the hot plate for inspection of the glass substrates and reading of the unique serial number that is engraved on each substrate.



Hot Plate

3.3.5 Laser Beam Recorder (LBR)

The Laser Beam Recorder (LBR) is the module where the program or data to be mastered is written onto the glass substrate by exposure of areas of the photoresist using a switched laser beam. The full optical path, including the laser diode, is fitted in a self-contained writing module that can be exchanged as a complete unit, so eliminating the requirement for optical path alignment.



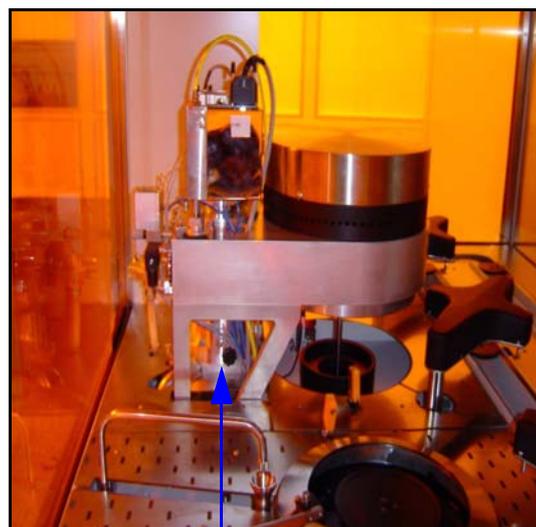
Writing Module

3.3.6 Sputtering Module

The function of the Sputtering Module is to apply a thin layer of Nickel Vanadium onto the surface of the recorded and developed glass master. This metal layer provides the electro-conductive surface required during the subsequent electro-forming process. The vacuum required by the Sputtering Module is developed by the combination of a roughing pump and a turbo-molecular pump.



Roughing Pump
(located in base of machine)



Turbo-molecular Pump

3.3.7 Chemical Compartment

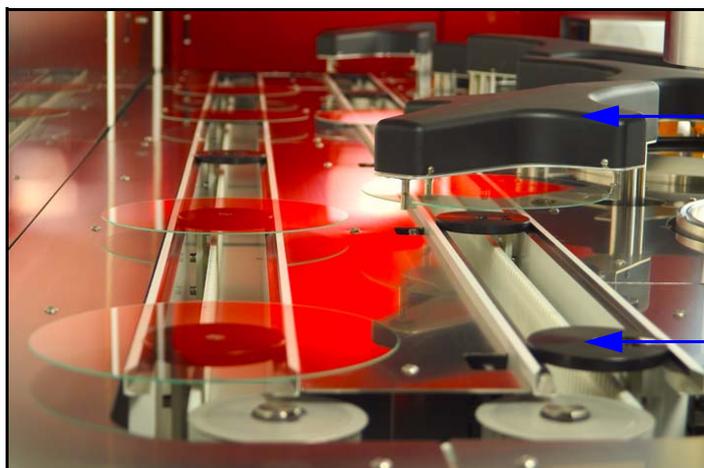
The tanks, filters and other components for the chemical solutions used during the mastering process are located in the chemical compartment in the bottom part of the machine. The tanks are mounted on a drawer that can be pulled out from the machine for easy access.



Chemical Compartment

3.3.8 Conveyor

Glass substrates are transported through the system by the operation of a motor driven conveyor. Substrates are loaded and unloaded from the conveyor by the operation of individual pick and place handlers located at each of the process modules.



Pick and Place Handler

Conveyor

3.3.9 Human Machine Interface



The Human Machine Interface (HMI) for the system is provided by a 15" touch screen. A keyboard with tracker ball is also provided for the entry of data. The touch screen is mounted on a rail that allows the screen to be moved along the length of the system. The facility is provided for the connection of a keyboard and mouse for data entry etc. The interface software provides all of the functions for operation of the system together with comprehensive features for process control and data management. The interface software is implemented on the Windows™ XP platform.

3.4 Mastering Process Description

The process steps carried out during the production of a glass disc master in the SQM system are shown in the figure below and a description of the individual steps is provided in the sub-paragraphs that follow.

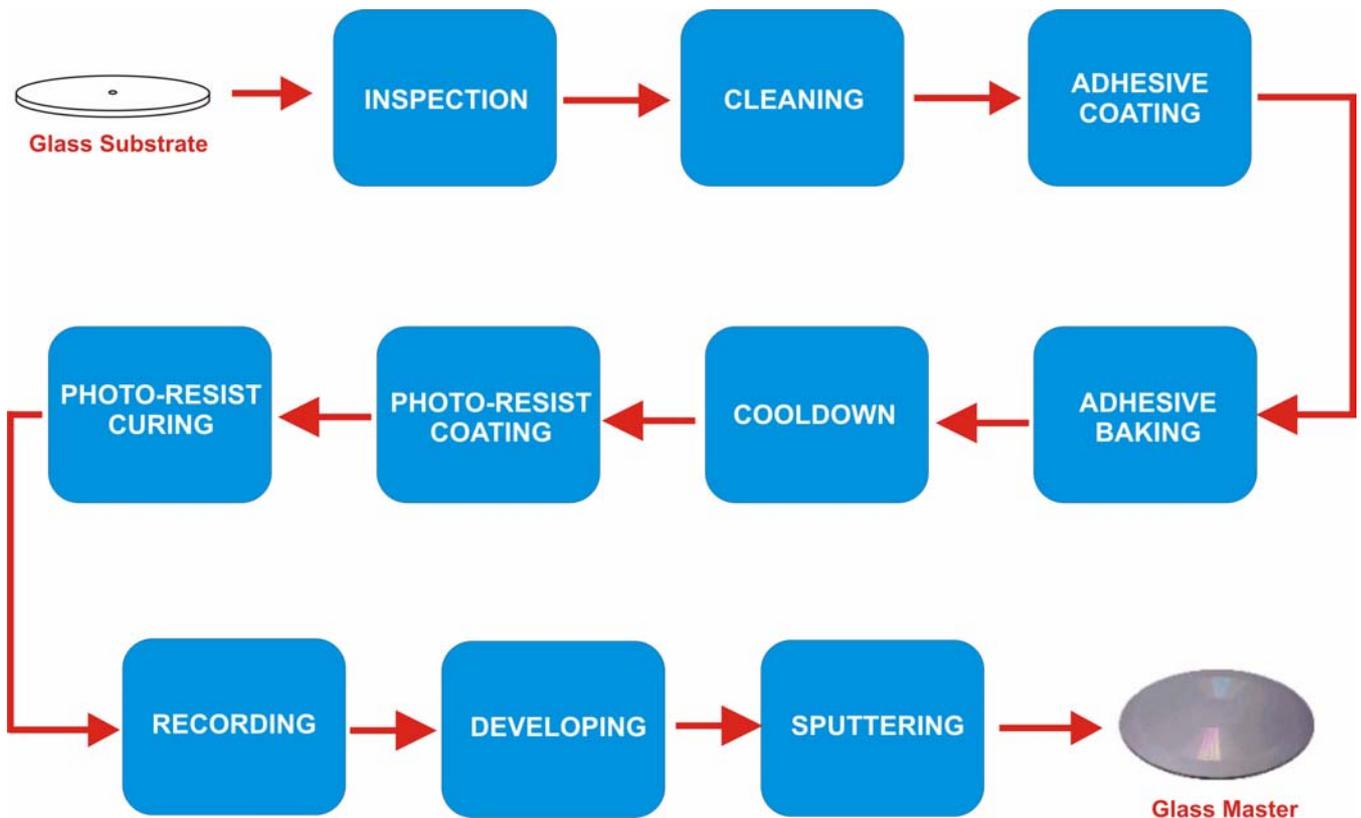


Figure 3.3 SQM Mastering Process Flow Diagram

3.5 Glass Substrates

The input for the glass mastering process is a glass disc substrate. The substrates used in the SQM system have a unique serial number that is used for substrate identification and recognition purposes. The substrates are loaded and unloaded using special protective boxes provided with the system. The general form of the glass substrates is shown in the figure below.

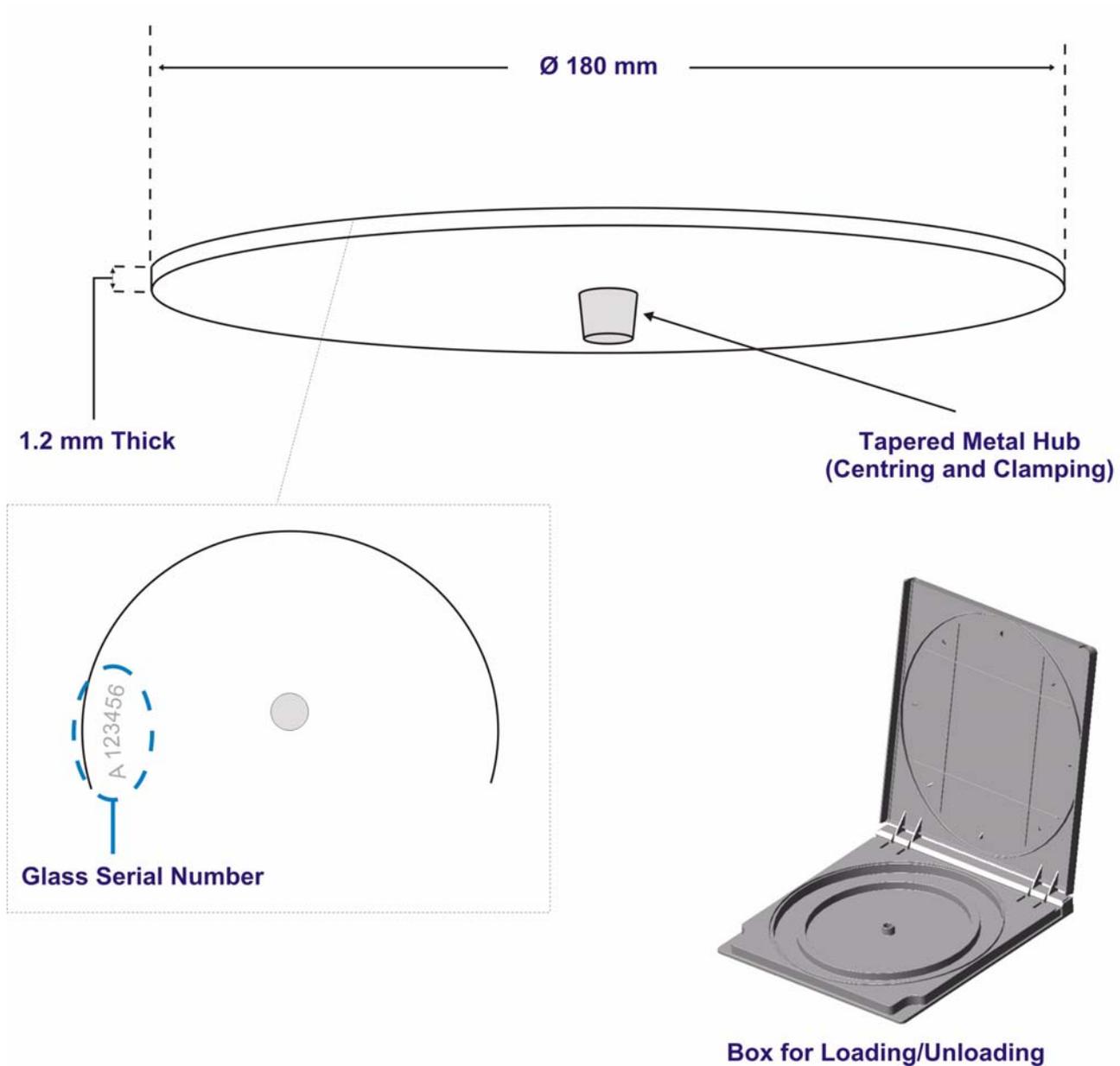


Figure 3.4 SQM Glass Substrate Details

3.5.1 Substrate Inspection

A loaded substrate is first transported to the Resist Coating module where a camera is used to inspect the glass for defects and to read the unique serial number engraved on the substrate. If a defect is detected then the glass will be rejected and automatically returned into the box at the Stack Loader module.

3.5.2 Cleaning

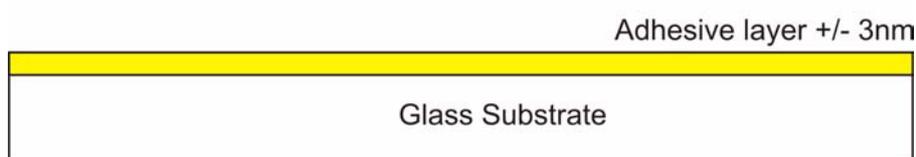
A substrate that passed the inspection is first cleaned in the Cleaner and Developer module. Cleaning is carried out by flushing with DI water and the action of a small brush that sweeps to and from the centre of the substrate.

The cleaning process will only remove dust from the substrate surface and will not remove dirt or finger prints.

3.5.3 Adhesive Coating

The photo-resist used as the recording surface during photo-resist mastering process will not adhere to the surface of the glass substrate and so it is first necessary to apply a thin layer of adhesive to the substrate surface. The adhesive is applied by means of a spin coating process during which a small amount of adhesive is dispensed onto the rotating substrate. The substrate speed is then accelerated to spin off the majority of the adhesive and leave only a very thin layer on the surface.

RESULT:



3.5.4 Adhesive Baking/Cooldown

Following adhesive coating the glass substrate is transported to the Resist Curing module where the adhesive layer is baked to give a flat surface. Following baking the glass substrate remains on the conveyor for a pre-defined period to allow the substrate to cool down.

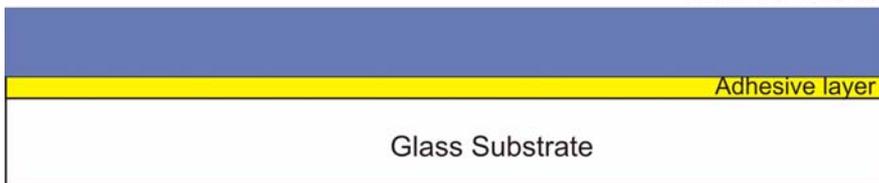
3.5.5 Photo-Resist Coating

The application of the photo-resist layer onto the surface of the glass substrate is carried out in the Substrate Coating module. A small amount of photo-resist is dispensed onto the stationary substrate. The substrate is then rotated so that the photo-resist forms a layer over the complete substrate surface. The rotation speed is then accelerated to the speed required to obtain the correct layer thickness (different speed are used for CD and DVD masters). Finally, the substrate is spun dry.

RESULT:

Photo-resist Layer:

CD +/- 160nm
DVD +/- 130 nm

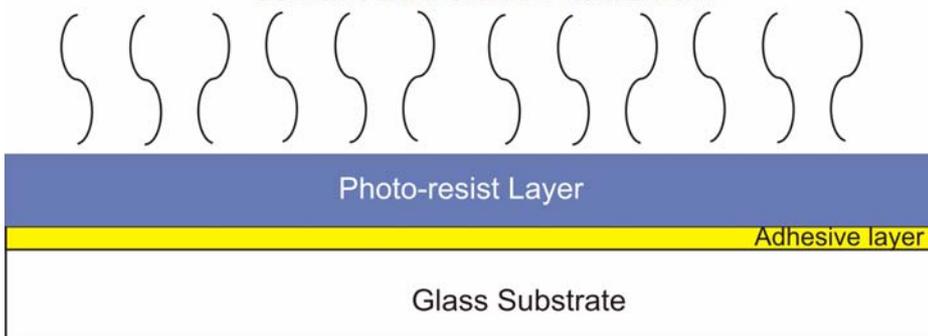


3.5.6 Resist Curing

The resist coated substrate is returned to the Resist Curing module where it is again baked to remove all solvent from the photo-resist layer to produce a stable layer ready for the subsequent recording process step.

RESULT:

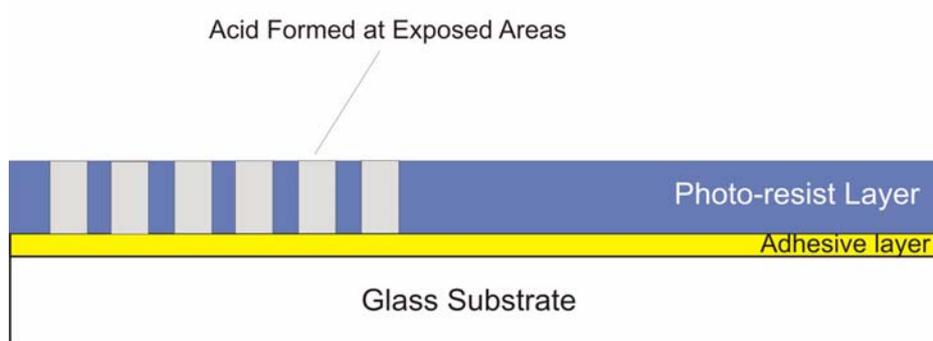
SOLVENT EVAPORTED FROM LAYER



3.5.7 Laser Beam Recording

The program to be mastered is recorded onto the substrate in the Laser Beam Recorder by the exposure of the photo-resist layer by a switched laser beam. Acid is formed at the exposed areas and these areas become more soluble by the developer solution used in the subsequent developing process. The exposed area become the 'pits' in the finished master whereas the unexposed areas are unaffected during developing and become the 'lands' (space between the pits).

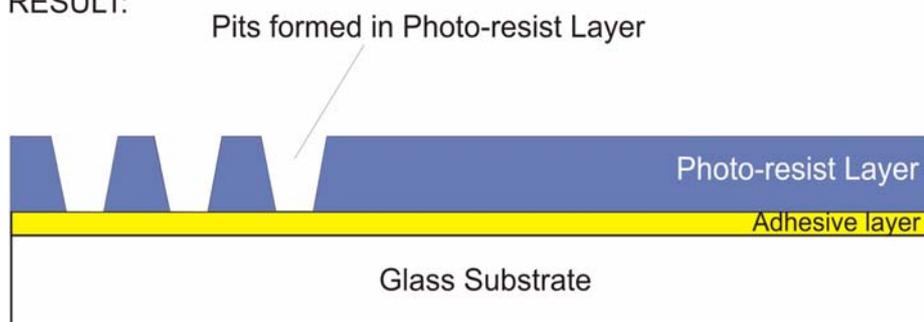
RESULT:



3.5.8 Developing

The developing process is carried out in the Cleaning and Developing module. During developing a chemical is dispensed onto the surface of the rotating substrate. This solution has the effect of dissolving the area of the photo-resist that where exposed in the Laser Beam Recorder to leave pits within the photo-resist layer. The unexposed areas are unaffected and become the 'lands' within the series of pits and lands. Following the formation of the pits a measurement arm is used to scan the surface and to measure the volume of the pits. The measured results are displayed at the Human Machine Interface and, if necessary, the process is automatically adjusted to compensate for any deviations from the pre-defined values.

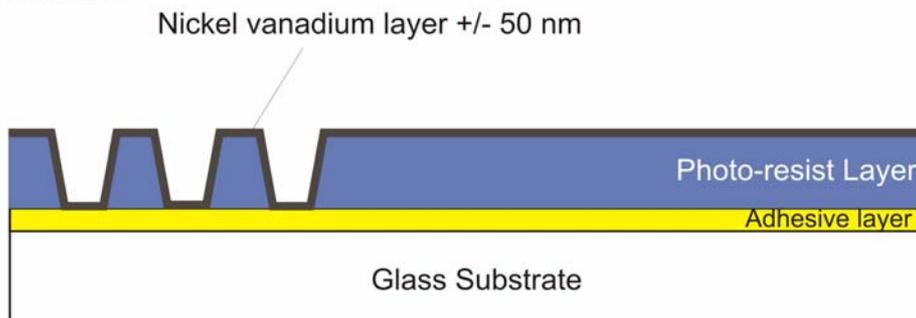
RESULT:



3.5.9 Sputtering

The glass master produced in the SQM system is further processed in an electroforming process to produce the nickel stamper that is subsequently used for the mass production (replication) of CDs or DVDs. The electroforming process requires that the surface of the master is conductive and so it is necessary to apply a thin metal onto the pattern of pits and lands within the photo-resist layer. The metal layer is applied onto the photo-resist in the Sputtering module. During the sputtering process Nickel Vanadium is derived from a source within the module (target) and is deposited onto the photo-resist surface to precisely map the pattern of pits and lands.

RESULT:



Following sputtering, the master is complete and is unloaded from the system for transfer to the electroforming department where the stamper is produced.

4 HUMAN MACHINE INTERFACE

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4

HUMAN MACHINE INTERFACE

4.1 General

This chapter provides a definition of the facilities provided at the Human Machine Interface (HMI) for the operation and control of SQM system.

The description is limited to the features that are intended for use by an operator during normal production with the SQM system. Details of the functions provided for fault diagnosis and process control are provided in the separate SQM Service Manual.

4.2 Human Machine Interface Hardware

The HMI consists of 15" touchscreen that is mounted on a rail to allow it to be moved along the length of the machine. A separate keyboard with trackerball is provided with the system. This keyboard can be connected to system using the USB port located on the touchscreen.



Touchscreen

USB port (for connection of keyboard)

4.2.1 System Status Beacon

A beacon is located on top of the machine to provide an indication of the status of the system as follows:

RED LAMP LIT:

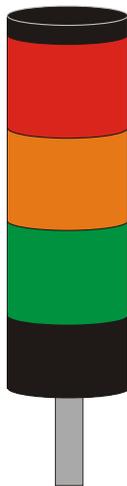
One or more of the system modules is in an alarm condition and can no longer accept glass substrates for processing.

ORANGE LAMP LIT:

The system is able to continue with production but operator intervention is required, for example an empty box should be loaded at the Stack module.

GREEN LAMP LIT:

The system is in normal production without any problems and so no operator intervention is required.



4.3 HMI Menu Structure

The functions, commands and setting that can be selected at the HMI are organised with a menu structure as shown in Figure 4.1. A description of the menus is provided in the paragraphs that follow.

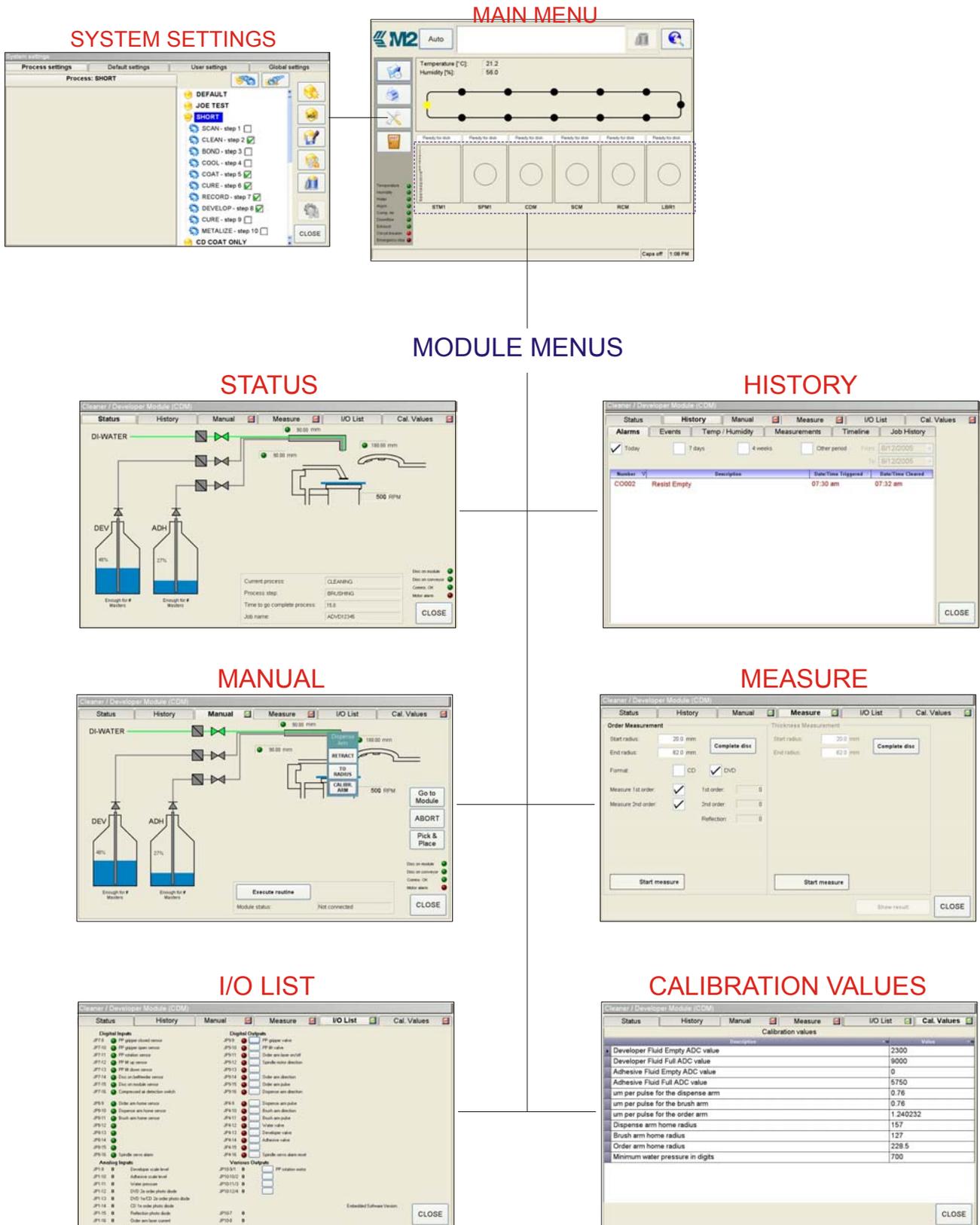


Figure 4.1 HMI General Menu Structure

4.4 Main Menu

The Main Menu provides an overview of the complete system in which the location of the glass substrates and status of the individual processing modules is shown. The layout of the Main Menu is shown below and a description of the displayed items is provided in the sub-paragraphs that follow.

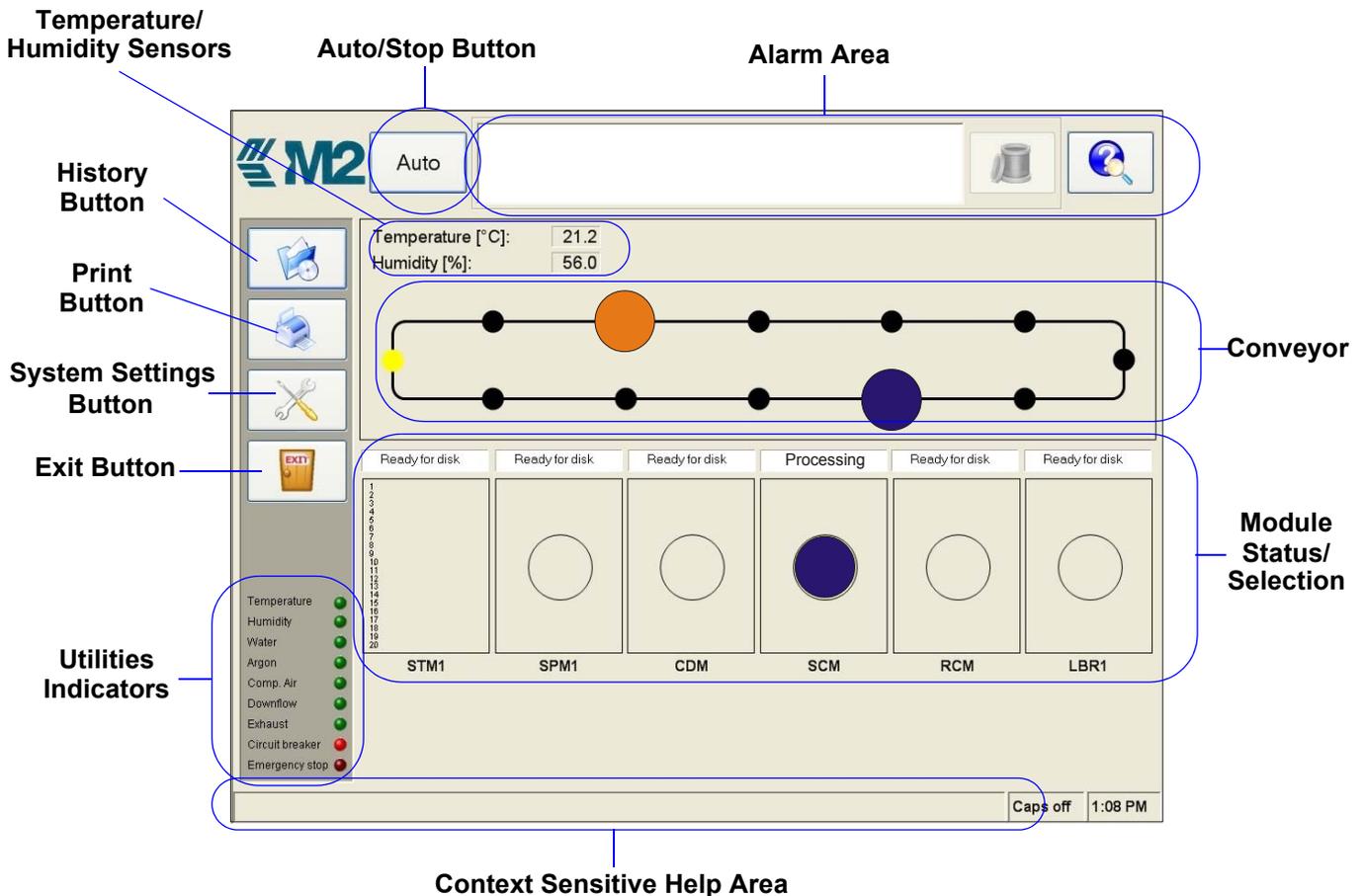
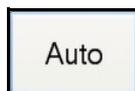


Figure 4.2 Main Menu

4.4.1 Auto/Stop Button



The <Auto/Stop> button is used for starting and stopping the processing of substrates within the system. The button has a toggle function. If the AUTO text is displayed on the button then touching the button will start the automatic production within the system. If the text STOP is displayed on the button then touching the button will stop the production, all modules will complete any process being carried out and then the system will stop.

4.4.2 Alarms Area

The Alarms Area at the top of the screen is used for the display of the alarm messages that are generated in the event of a system error condition.



The messages are categorised as either warnings (**Orange Text**), during which the module continues processing, or as errors (**Red text**) which result in production in the module being suspended until rectification of the error.

If the number of active errors exceeds the display error then a scroll bar is provided to allow movement within the complete alarm list.



When an alarm is highlighted in the list a small amount of help text is displayed in the context sensitive help area at the bottom of the display. More detailed help information can be obtained by touching the *<Alarm Help>* button.

Each alarm message has a unique code where the first two characters indicate the module that generated the alarm as follows:

SL = Stack Module (STM)

CD = Cleaner and Developer Module (CDM)

CO = Resist Coating Module (RCM)

HP = Resist Curing Module (RCM)

LB = Laser Beam Recorder (LBR)

SM = Sputter Module (SPM)

BF = Conveyor



When an alarm condition has been rectified the alarm message can be removed from the displayed list by touching the *<Alarm Clear>* button.

4.4.3 Temperature/Humidity Indicators

Temperature [°C]:	21.2
Humidity [%]:	56.0

This area of the screen provides a constantly updated readout of the temperature and humidity within the system.



The temperature and humidity are measured at the associated clean air unit that provides the conditioned air supply to the SQM system.

4.4.4 History Button



Touching the <History> button results in display of a further menu from which details of the system usage, alarm messages etc. can be accessed.

4.4.5 Reports Button



The <Reports> button allows the definition and printing of a system report.

This feature is not currently implemented.

4.4.6 System Settings Button



The SQM system provides the facility for the specification of scripts that define the way in which a substrate is processed within the system. Touching the <System Settings> button results in the display of a further menu from which these scripts can be created and edited.

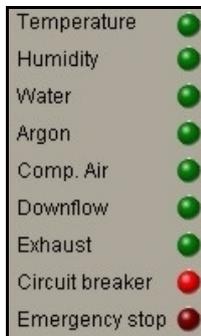
A description of this feature is provided in the SQM Service manual.

4.4.7 Exit Button



Touching the <Exit> button closes the SQM application and returns to the Windows™ desktop.

4.4.8 Utilities Indicators



The utilities required for correct operation of the SQM are continuously monitored and these indicators are used to verify that the correct supplies and services are present (lamp lit). In the event of a failure of any of the utilities or services, the indicator lamp will be extinguished. The Circuit breaker and Emergency stop indicators are lit when the main circuit breakers is tripped or the Emergency Stop Button is activated.

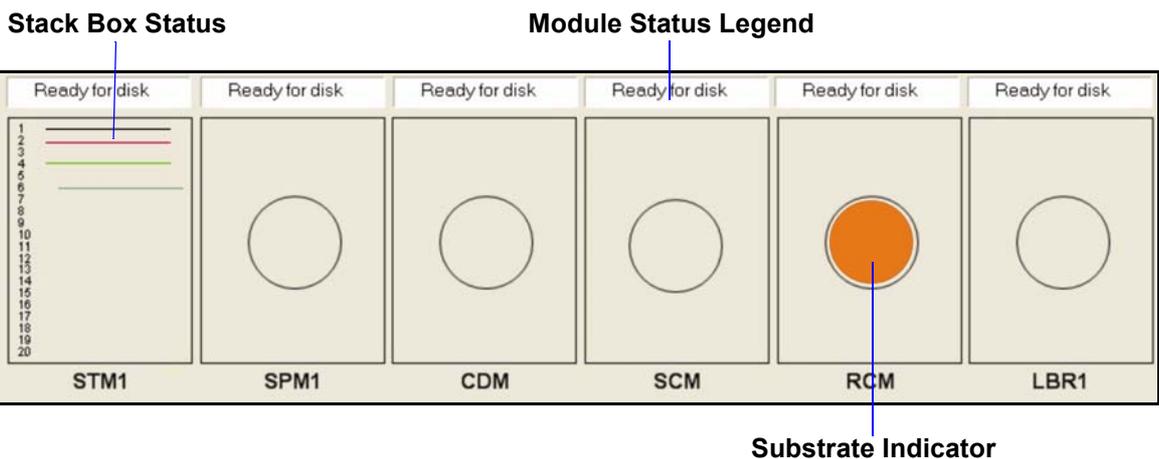
A failure in any of the utilities also results in the display of an alarm message.

4.4.9 Context Sensitive Help Area

This area is used for the display of help text for atrium messages and tips and advice on the use of the functions provided within the control software. When a specific button or function is selected, the text for the button or function is automatically displayed.

4.4.10 Module Status/Selection

The module status selection area allows the menu structure for a particular module to be selected by touching within the module area.



4.4.10.1 Module Status Legend

The status legend above each module provides a constant updated indication of the status of the module as follows:

Ready for disk = The module is inactive but is in the correct state to receive a substrate for processing.

Loading disk = A substrate is being loaded into the module from the conveyor.

Processing disk = A substrate is being processed.

Processing done = Module has finished processing the substrate and the substrate has been positioned over the conveyor by the pick and place robot.

Unloading disk = The module pick and place robot is placing the substrate onto the conveyor.

Not operational = A problem in the module is preventing the module from operating normally.

Aborted = The module was aborted due to a fatal error. The substrate will automatically transported into an empty box at the Stack module.

Not connected = Indicates that there is no TCP/IP connection between the module and the s system controller. Probably due to a disconnected cable or power supply problem.

Waiting for error clear = An error occurred in the module that requires rectification before the module can continue (e.g. an empty chemical tank).

4.4.10.2 Stack Box Status

The status of the substrate boxes present in the stack loader is indicated by the colour in which the box is displayed as follows:

————— Black The box contains a blank substrate ready for processing.

————— Grey The box contains a blank substrate ready for processing.

————— Green The box contains a successfully completed master.

————— Red The box contains a substrate that was aborted (failed).

4.4.10.3 Substrate Indicator

The status of a substrate present on the module is shown as follows:



The status of the substrate changes as soon as the applicable process is started.

Dark Blue		The plain glass substrate has been loaded into the system but has not yet been cleaned.
Light Blue		The substrate has been cleaned and adhesive coated in the Cleaner and Developer module.
Yellow		The substrate has been coated with photo-resist in the Substrate Coating module.
Yellow (spiral)		The substrate has been recorded in the Laser Beam Recorder.
Green (spiral)		The substrate has been developed in the Cleaner and Developer module.
Grey (spiral)		The substrate has been metallised in the Sputtering module.

4.4.11 Conveyor

Screen dumps required (disc details + process routing).

4.5 Module Status Screens

A module status screen can be accessed by touching the appropriate module in the Main Menu. The <Close> button can be used to return to the Main Menu.

A description of the status screens for each of the individual modules is provided in the sub-paragraphs that follow.

4.5.1 Stack Module Status Screen

An example of the status screen for the Stack module (STM) is shown below and a definition of the information given is provided in the table that follows.

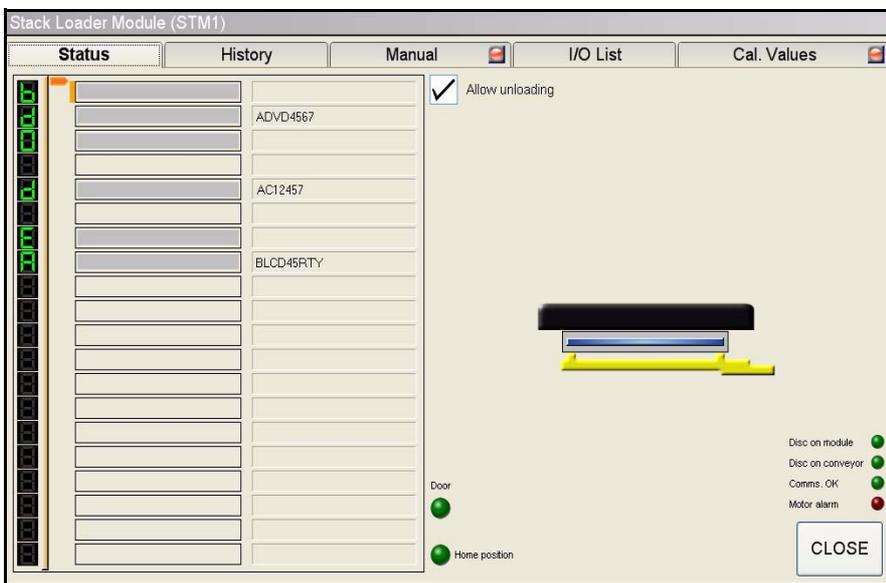
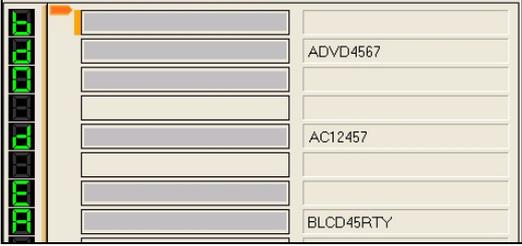
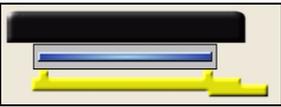
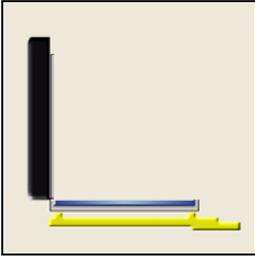
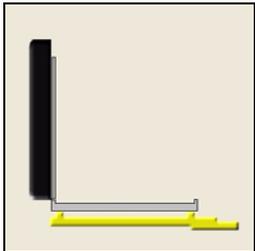
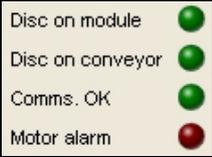


Figure 4.3 Stack Module Status Screen

Table 4.1 Stack Module Status Information

STATUS ITEM	DEFINITION
	<p>Provides an indication of the status of each slot within the stack module. The indicators on the left show the status of each box present in the stack as follows:</p> <p>O = Box contains a blank substrate ready for processing.</p> <p>b = The box is currently being loaded/unloaded or is inside the machine.</p> <p>E = The box is empty.</p> <p>d = The box contains a completed master. The Job name is shown to the right of the box.</p> <p>A = The box contains a substrate that was aborted (failed) during processing.</p>
	<p>There is no box present inside the machine and the fork is in the retracted (default) position. This is the condition when the machine is initially started.</p>
	<p>The fork used to load/unload boxes is inside the stack.</p>
	<p>The fork used to load/unload boxes is inside the stack and a box with blank substrate is present in the machine.</p>
	<p>A box containing a blank substrate has been opened ready for loading of the substrate onto the conveyor.</p>
	<p>An open box is present inside the machine ready for receipt of a completed master.</p>

STATUS ITEM	DENINITION
	<p>Door = Lit to indicate that the stack is in a safe condition for opening of the door.</p> <p>Home position = The stack is at the home (default) position following initialisation.</p>
	<p>Disc on module = A box containing a substrate is present at the load/unload position within the machine.</p> <p>Disc on conveyor = A substrate is present on the conveyor chuck presently located at the stack module position.</p> <p>Comms. ok = The communication between the stack module and the system controller is working correctly.</p> <p>Motor alarm = An error has occurred with the stack lift motor. An appropriate alarm message will also be displayed.</p>
	<p>When checked = The stack module door can be opened for the unloading of completed masters.</p> <p>When unchecked = The stack module door is locked and cannot be opened.</p>

4.5.2 Cleaner and Developer Module Status Screen

An example of the status screen for the Cleaner and Developer Module (CDM) is shown below and a definition of the information given is provided in the table that follows.

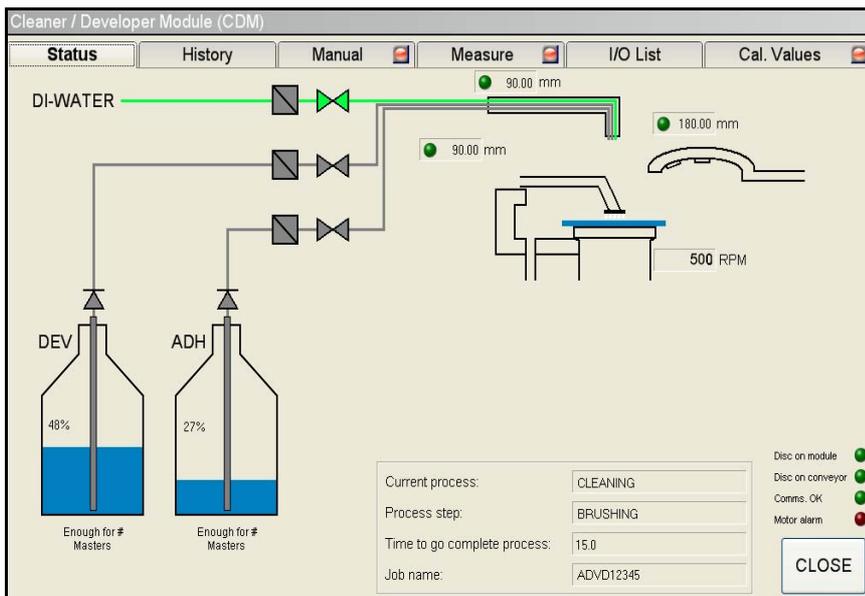
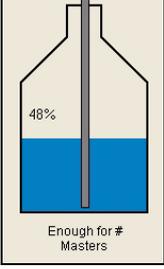
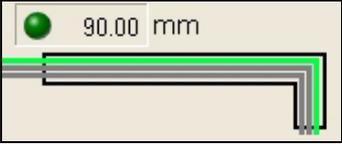
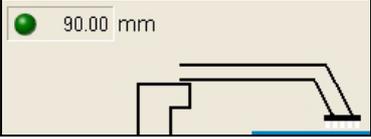
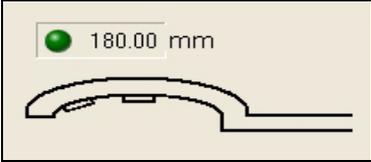
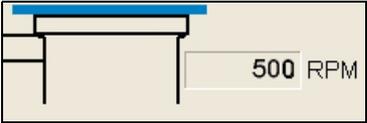


Figure 4.4 Cleaner and Developer Module Status Screen

Table 4.2 Cleaner and Developer Module Status Information

STATUS ITEM	DEFINITION
	<p>Chemical Tanks</p> <p>Shows the level of solution in the tank as a percentage of the full level.</p> <p>The number of masters that can still be produced from the chemical remaining in the tank is also shown.</p>
	<p>Valves</p> <p>Grey = Valve closed.</p> <p>Green = Valve open.</p>
	<p>Dispense Arm</p> <p>Shows the position and movement of the arm used for the dispensing of chemicals. 90 mm is the centre of the substrate, 180 mm is the outside edge of the substrate.</p> <p>The chemical being dispensed is shown by the appropriate tube in the arm being displayed in green.</p>
	<p>Brush</p> <p>Shows the position and movement of the brush used for substrate cleaning. 90 mm is the centre of the substrate, 180 mm is the outside edge of the substrate.</p>
	<p>Quality Measurement Arm</p> <p>Shows the position and movement of the order measurement arm used for quality control. 90 mm is the centre of the substrate, 180 mm is the outside edge of the substrate.</p> <p>When the laser is switched on, this is indicated by the display of the green beams.</p>
	<p>Rotation Table</p> <p>Shows the speed of rotation and the presence of a substrate on the rotation table.</p>

STATUS ITEM	DENINITION
<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Current process: <input type="text" value="CLEANING"/></p> <p>Process step: <input type="text" value="BRUSHING"/></p> <p>Time to go complete process: <input type="text" value="15.0"/></p> <p>Job name: <input type="text" value="ADV12345"/></p> </div> <div style="border: 1px solid black; padding: 5px;"> <p>Disc on module ●</p> <p>Disc on conveyor ●</p> <p>Comms. OK ●</p> <p>Motor alarm ●</p> </div>	<p>Current process = The process being carried out in the module (cleaning, adhesive coating or developing).</p> <p>Process step = The sub-step within the process currently being carried out.</p> <p>Time to go complete process = The remaining time (seconds) until processing of the substrate on the module will be finished.</p> <p>Job name = The name of the job assigned to the substrate by the system scheduler. If no jobs have been started at the Media Input System then the substrate will be shown as unassigned.</p> <p>Disc on module = A substrate is present on the rotation table in the module.</p> <p>Disc on conveyor = A substrate is present on the conveyor chuck presently located at the module position.</p> <p>Comms. ok = The communication between the module and the system controller is working correctly.</p> <p>Motor alarm = An error has occurred with one of the motors within the module. An appropriate alarm message will also be displayed.</p>

4.5.3 Substrate Coating Module Status Screen

An example of the status screen for the Substrate Coating Module (SCM) is shown below and a definition of the information given is provided in the table that follows.

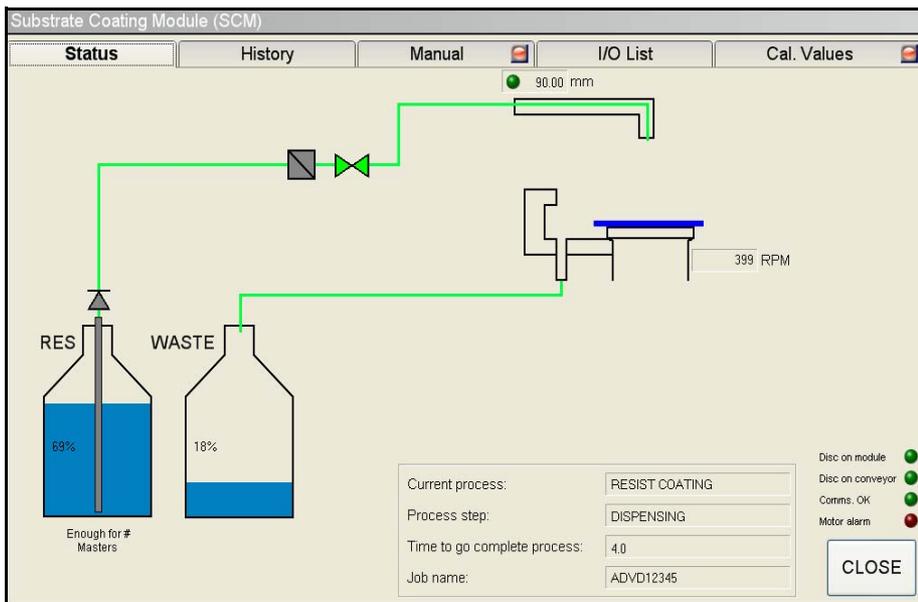
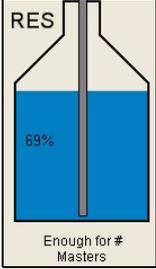
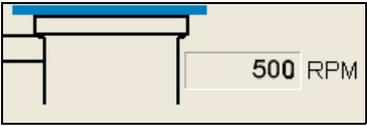
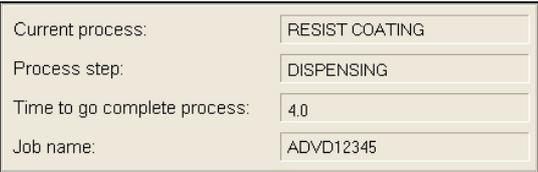


Figure 4.5 Substrate Coating Module Status Screen

Table 4.3 Substrate Coating Module Status Information

STATUS ITEM	DEFINITION
	<p>Photo-resist Tank</p> <p>Shows the level of solution in the tank as a percentage of the full level.</p> <p>The number of masters that can still be produced from the chemical remaining in the tank is also shown.</p>
	<p>Waste Bottle</p> <p>Shows the level of solution in the photo-resist waste bottle tank as percentage of the full level.</p>
	<p>Photo-Resist Valve</p> <p>Grey = Valve closed.</p> <p>Green = Valve open.</p>
	<p>Dispense Arm</p> <p>Shows the position and movement of the arm used for the dispensing of photo-resist. 90 mm is the centre of the substrate, 180 mm is the outside edge of the substrate.</p> <p>Dispensing of photo-resist is shown by the appropriate tube in the arm being displayed in green.</p>
	<p>Rotation Table</p> <p>Shows the speed of rotation and the presence of a substrate on the rotation table.</p>
	<p>Current process = The process being carried out in the module.</p> <p>Process step = The sub-step within the process currently being carried out.</p> <p>Time to go complete process = The remaining time (seconds) until processing of the substrate on the module will be finished.</p> <p>Job name = The name of the job assigned to the substrate by the system scheduler.</p>

STATUS ITEM	DENINITION
	<p>Disc on module = A substrate is present on the rotation table in the module.</p> <p>Disc on conveyor = A substrate is present on the conveyor chuck presently located at the module position.</p> <p>Comms. ok = The communication between the module and the system controller is working correctly.</p> <p>Motor alarm = An error has occurred with one of the motors within the module. An appropriate alarm message will also be displayed.</p>

4.5.4 Resist Curing Module Status Screen

An example of the status screen for the Resist Curing Module (RCM) is shown below and a definition of the information given is provided in the table that follows.

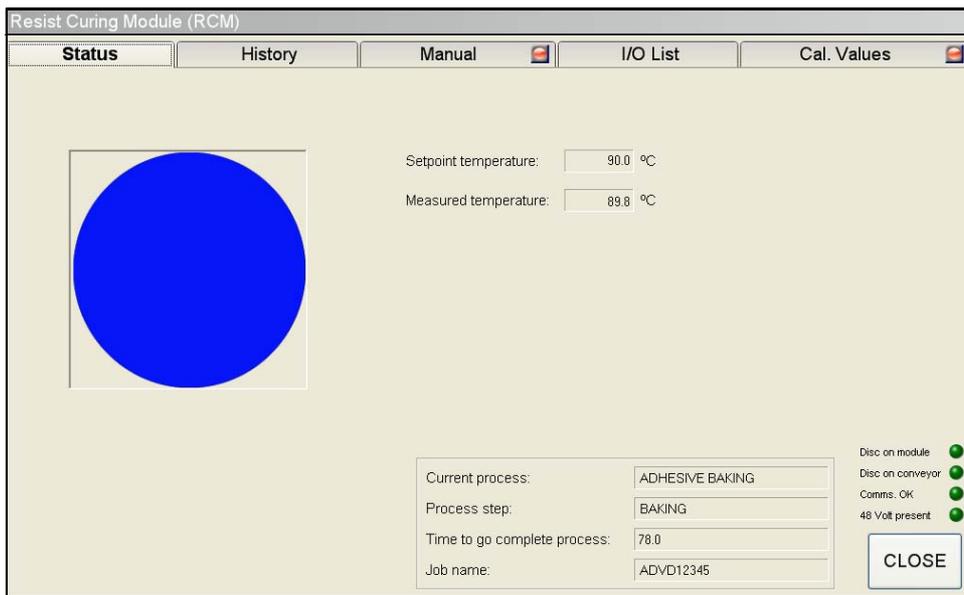
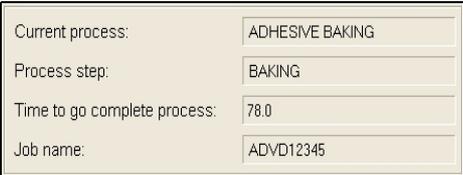
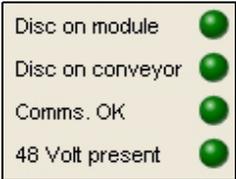


Figure 4.6 Resist Curing Module Status Screen

Table 4.4 Resist Curing Module Status Information

STATUS ITEM	DEFINITION
	<p>Setpoint temperature = The temperature to which the hot plate should be heated in accordance with the system settings.</p> <p>Measured temperature = The measured temperature of the hot plate.</p>
	<p>Current process = The process being carried out in the module.</p> <p>Process step = The sub-step within the process currently being carried out.</p> <p>Time to go complete process = The remaining time (seconds) until processing of the substrate on the module will be finished.</p> <p>Job name = The name of the job assigned to the substrate by the system scheduler.</p>
	<p>Disc on module = A substrate is present on the rotation table in the module.</p> <p>Disc on conveyor = A substrate is present on the conveyor chuck presently located at the module position.</p> <p>Comms. ok = The communication between the module and the system controller is working correctly.</p> <p>48 Volt present = The 48 Volt power supply used by the hot plate is present.</p>

4.5.5 Sputtering Module Status Screen

An example of the status screen for the Sputtering Module (SPM) is shown below and a definition of the information given is provided in the table that follows.

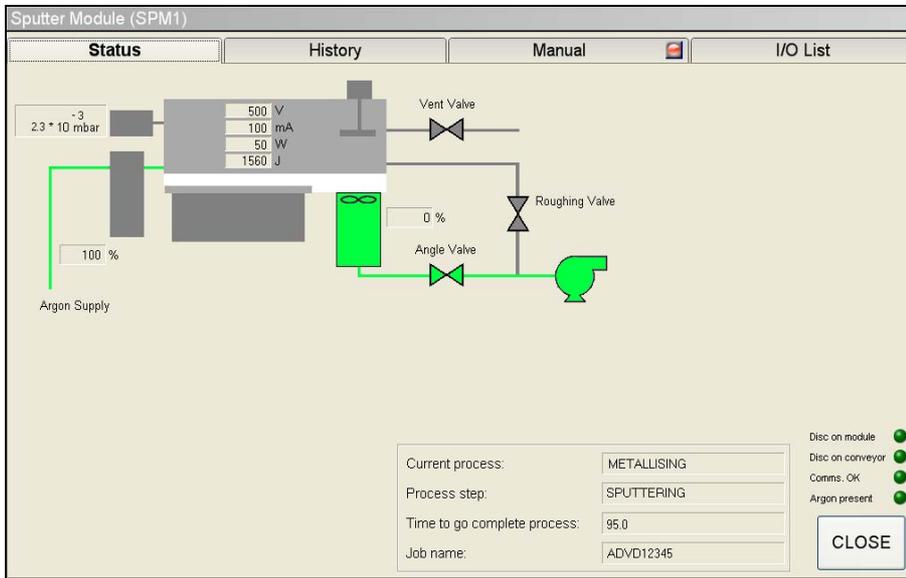
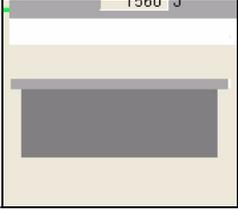
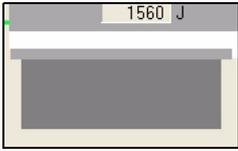
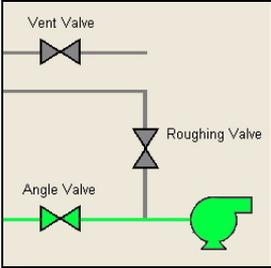
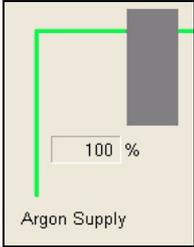
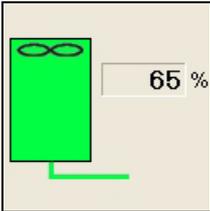
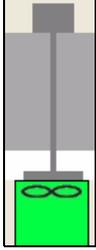
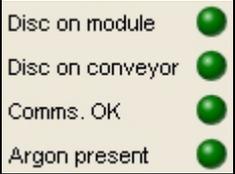


Figure 4.7 Sputtering Module Status Screen

Table 4.5 Sputtering Module Status Information

STATUS ITEM	DEFINITION
	<p>The disc lift is in the lowered position and the sputtering chamber is open.</p>
	<p>The disc lift is in the raised position and the sputtering chamber is closed.</p>
	<p>Details of the sputtering chamber:</p> <p>V = Voltage being used during the process.</p> <p>mA = Current being used during the process.</p> <p>W = Power being used during the process.</p> <p>J = Total energy expended during the process in joules.</p>
	<p>Valves</p> <p>Grey = Valve closed.</p> <p>Green = Valve open.</p>
	<p>Mass Flow Controller</p> <p>Shows the degree to which the mass flow controller used for regulating the argon supply to the chamber is open.</p>
	<p>Turbo Pump</p> <p>Shows the status and speed of the turbo-molecular pump used to develop the vacuum in the sputtering chamber.</p> <p>Pump shown in green = Pump switched on.</p> <p>Pump shown in grey = Pump off.</p> <p>The speed as indicated as a percentage of the maximum pump speed that can be obtained.</p>

STATUS ITEM	DENINITION
	<p>The cylinder (valve) used to isolate the turbo pump from the sputtering chamber is in the closed position. Pump running but isolated from chamber.</p>
	<p>The cylinder (valve) used to isolate the turbo pump from the sputtering chamber is in the open position. Pump running and evacuating the chamber.</p>
	<p>Vacuum Gauge: Shows the current level of vacuum within the sputtering chamber.</p>
	<p>Current process = The process being carried out in the module. Process step = The sub-step within the process currently being carried out. Time to go complete process = The remaining time (seconds) until processing of the substrate on the module will be finished. Job name = The name of the job assigned to the substrate by the system scheduler.</p>
	<p>Disc on module = A substrate is present on the rotation table in the module. Disc on conveyor = A substrate is present on the conveyor chuck presently located at the module position. Comms. ok = The communication between the module and the system controller is working correctly. Argon present = Confirms the presence of the Argon gas supply required for the sputtering process.</p>

4.6 History Screens

Each module has a history section that allows the viewing of the details applicable to the module. The history information is further sub-divided between the separate tabs as described in the sub-paragraphs that follow.



An overall history section providing details of the complete machine can be accessed from the main menu by touching the <History> button.

4.6.1 Alarms Tab

An example of the alarms tab is shown below.

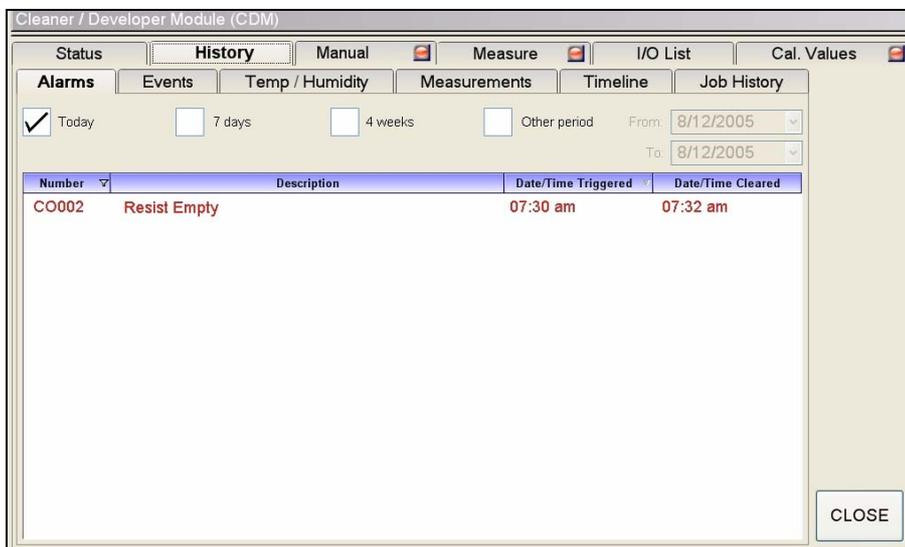


Figure 4.8 Example Alarms Tab

The screen shows all of the alarms generated by the module during the specified period. A different period can be specified by either checking the **Today**, **7 days** or **4 weeks** box or by checking the **Other period** box and selecting the date range.

4.6.2 Events Tab

An example of the events tab is shown below.

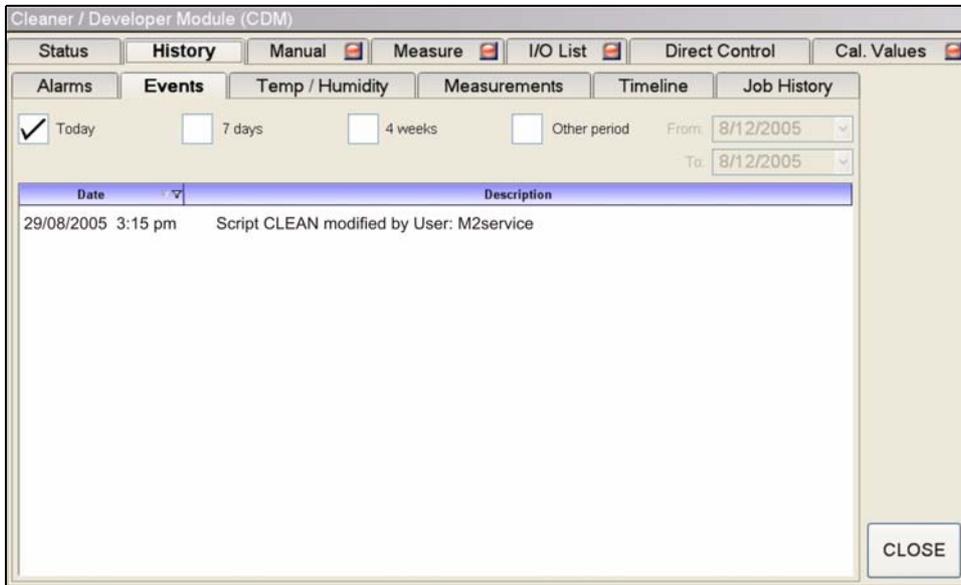


Figure 4.9 Example Alarms Tab

The screen shows all of the events that occurred for module during the specified period. A different period can be specified by either checking the **Today**, **7 days** or **4 weeks** box or by checking the **Other period** box and selecting the date range.

4.6.3 Temperature/Humidity Tab

An example of the temperature/humidity tab is shown below.

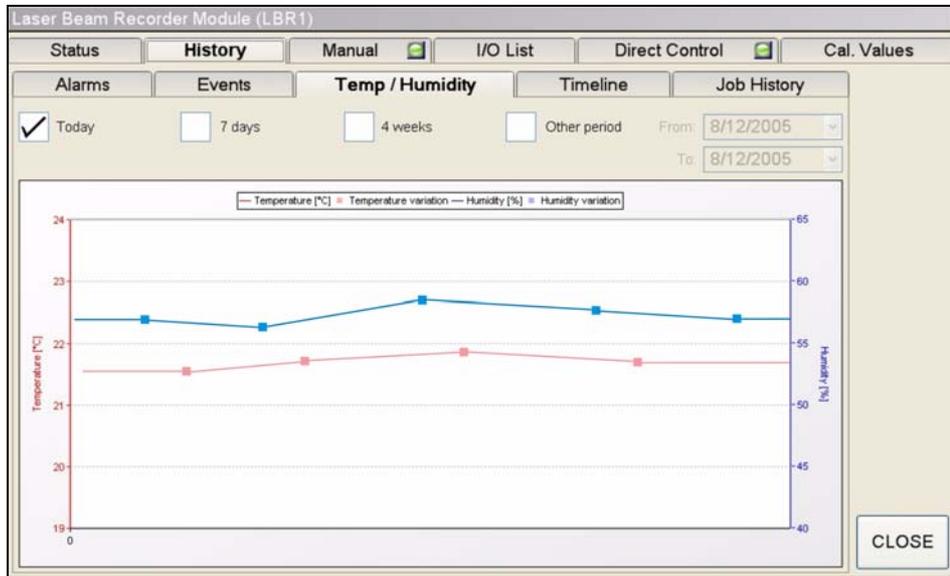


Figure 4.10 Example Temperature/Humidity Tab

The screen shows a plot of the temperature and humidity of the clean air supply to the SQM, measured over the specified period. A different period can be specified by either checking the **Today**, **7 days** or **4 weeks** box or by checking the **Other period** box and selecting the date range.



The sensors used for these measurements are located in the clean air unit that is included in the SQM scope of supply.

4.6.4 Timeline Tab

This function is not currently implemented.

4.6.5 Job History Tab

An example of the Job History tab is shown below.

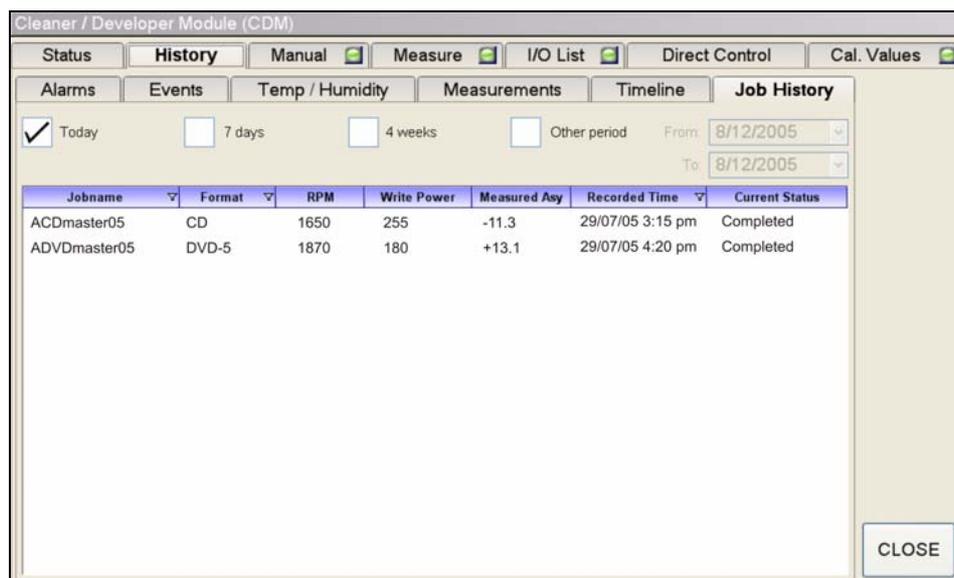


Figure 4.11 Example Job History Tab

This tab provides a listing of all substrates that have been processed in the module during the specified period. A different period can be specified by either checking the **Today**, **7 days** or **4 weeks** box or by checking the **Other period** box and selecting the date range. The following information is provided:

Job Name = The master ID, entered during loading of the job at the media input system.

Format = The type of master, CD, DVD-5 or DVD-9.

RPM = The speed used during the photo-resist coating process to create the correct layer thickness, entered at the media input system.

Write Power = The laser intensity that was used during recording of the master in the Laser Beam Recorder, entered at the media input system.

Measured Assy = The asymmetry that was measured by the quality measurement arm following developing of the substrate.

Recorded Time = The time that the master was recorded in the Laser Beam Recorder.

Current Status = The status of the Job, completed, processing, aborted etc.

5 OPERATING INSTRUCTIONS

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5

OPERATING INSTRUCTIONS

5.1 General

This chapter provides instructions on the general operation of the SQM CD/DVD mastering system. The following standard operator tasks are described:

- ❖ Carrying out the required pre-start checks before beginning with production.
- ❖ Starting-up the system.
- ❖ Loading substrates and removing finished masters
- ❖ Monitoring the system during operation.
- ❖ Responding to alarm messages.
- ❖ Re-filling the process solutions used in the system.
- ❖ Shutting down the system.



WARNING: The system should only be operated by personnel who have attended an official SQM training course and who are familiar with the general safety precautions as detailed in Chapter 1 of this manual.

5.2 Pre-start Checks

This section describes the checks that should be carried out before starting production with the SQM system.

5.2.1 Supplies

The following supplies are required for the correct operation of the system.

ARGON GAS:

The argon supply bottle is located outside of the SQM system. The argon pressure set at the gas bottle should be 1.0 to 2.5 bar.



COMPRESSED AIR:

The connection and pressure gauge for the compressed air supply are located behind the panel on the left-hand side of the machine. The pressure should be set to 5 to 6 bar.



CLEAN AIR:

Check that the associated clean air unit is switched on and set for the correct conditions inside the SQM system. Refer to the Weiss Enet documentation provided with the unit. air system is switched on.

DI WATER:

Check that the external DI water system is switched on.

- ❖ Pressure: 2 to 5 bar
- ❖ Temperature: 20 to 21 °C

EXHAUST

Check that the central exhaust system is switched on.

5.2.2 General Checks before Starting Production

Before starting production, carry out a quick check that there are no tools or other obstructions remaining in the machine and that all doors and windows are closed.

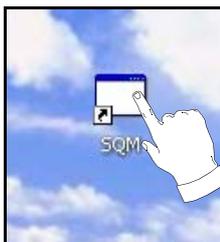
5.3 Start-up Procedures

5.3.1 Power-up Procedure

The procedure that follows is applicable to the starting up of the system following a complete removal of the power.

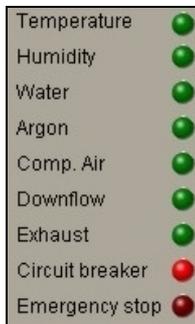
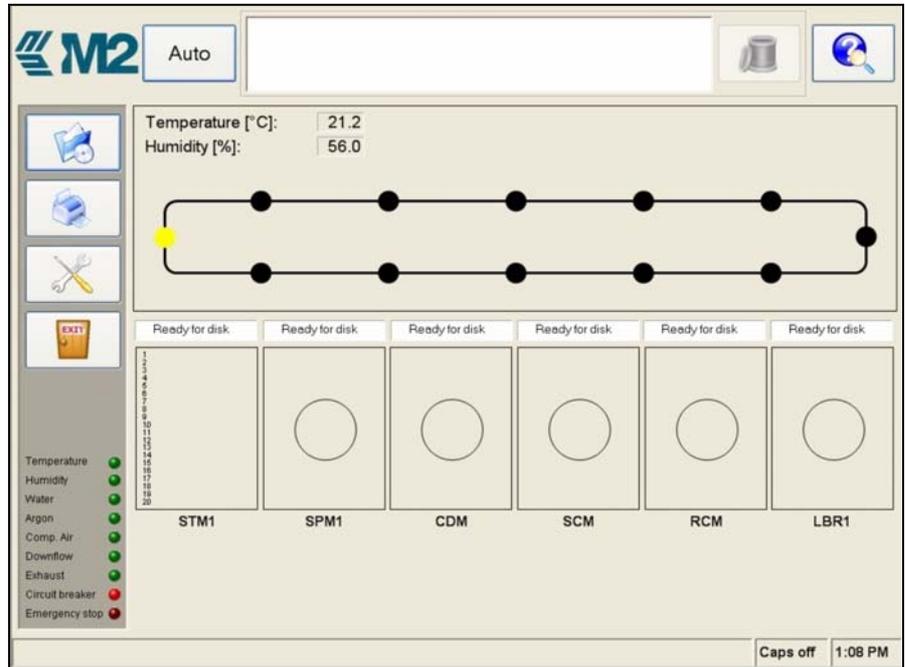


- 6) Switch on the main power switch of the SQM located on the left hand side of the machine.
- 7) Wait for approximately 30 seconds and then press the blue reset button also located on the left hand side panel.

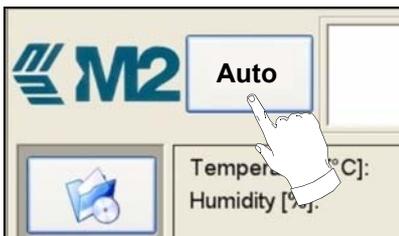


- 8) Switch on the HMI computer located on the top of the machine. The HMI computer will be booted and the Windows™ desktop will be displayed.
- 9) Select the SQM icon to start the SQM control program.

- 10) Confirmation that SQM control software has been successfully started is provided by display of the < Main Menu >.



- 11) Check that there are no alarm messages displayed and that the utilities indicators at the left of the screen are all lit. The <Circuit breaker> and <Emergency stop> indicators should be extinguished.
- 12) Confirmation that all modules are ready for production is provided by display of the text <Ready for disk> above each module. The Stack Module (STM1) will show the text <Waiting>.
- 13) Switch on the external Media Input System computer and start the scheduler program as detailed in the Eclipse documentation provided with the system.
- 14) Load the jobs to be mastered as detailed in the Eclipse documentation.



- 15) The SQM system is now ready to start production and can be set into the automatic mode by selection of the <Auto> button at the top of the screen. After Auto mode has been selected the button text will change to <Stop>.

5.4 Loading/Unloading Substrates

The glass substrates to be used for mastering and the finished masters produced by the SQM system are loaded and unloaded at the Stack Module (STM). The substrates and finished masters are contained in the special boxes provided with the system.

5.4.1 Substrate Loading

To load a box(es) containing a substrate to be used for mastering proceed as follows:



- 1) Press the small button at the Stack module. The indicator in the button will flash slowly while the stack is moved to the correct position for opening of the door.
- 2) When the indicator within the button starts to flash quickly then the door can be opened to gain access to the stack slots.



- 3) Load the box(es) containing the substrates to be used for mastering into the slots. Confirmation that the box contains a blank substrate will be provided by the display of the letter "O" on the indicator to the left of the slot.
- 4) When all of the required substrates have been loaded into the slots, close the stack module door.

- 5) The substrates will be automatically loaded into the system as required by the process. The following general status information is provided by the stack module slot indicators:

O = Box contains a blank substrate ready for processing.

b = The box from the slot is currently being loaded/unloaded or is inside the machine.

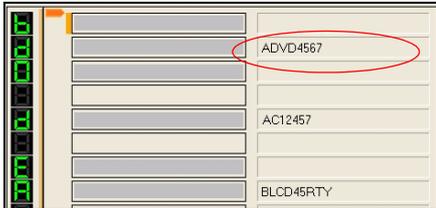
E = The box is empty.

d = The box contains a completed master. The Job name is shown to the right of the box.

A = The box contains a substrate that was aborted (failed) during processing.

5.4.2 Removing Finished Masters

When a master has been completed it will be automatically returned to an empty box at one of the stack slots. Confirmation that the slot contains a completed master is indicated by the display of the letter “d” next to the slot.



The identification (job name) of the completed master(s) is provided on the Stack module status screen at the HMI.

To remove a completed master(s) proceed as follows:



- 1) Press the small button at the Stack module. The indicator in the button will flash slowly while the stack is moved to the correct position for opening of the door.
- 2) When the indicator within the button starts to flash quickly then the door can be opened to gain access to the stack slots.

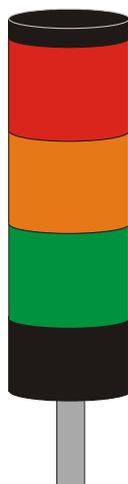


- 3) Unload the box(es) containing the finished masters.

- 4) When all of the required masters have been removed from the slots, close the stack module door.

5.5 Monitoring the System During Production

5.5.1 Status Beacon



The beacon located on top of the machine provides a real-time indication of the status of the system as follows:

RED LAMP LIT:

One or more of the system modules is in an alarm condition and can no longer accept glass substrates for processing.

ORANGE LAMP LIT:

The system is able to continue with production but operator intervention is required, for example an empty box should be loaded at the Stack module.

GREEN LAMP LIT:

The system is in normal production without any problems and so no operator intervention is required.

5.5.2 Monitoring at the HMI

A full description of the screens provided at the HMI for monitoring of the SQM system is provided in Chapter 4 - Human Machine Interface.

5.6 Responding to Alarm Messages

If an error is detected during operation of the system, an alarm message is displayed at the top of the screen.

CO002	Resist Tank Empty	07:45 am	 
CD001	Developer Level Low	07:47 am	
CD012	Water Pressure too low	06:13 pm	
SL021	Alarm on servo	04:45 pm	

The messages are categorised as either warnings (**Orange Text**), during which the module continues processing, or as errors (**Red text**) which result in production in the module being suspended until rectification of the error.

If the number of active errors exceeds the display error then a scroll bar is provided to allow movement within the complete alarm list.



When an alarm is highlighted in the list a small amount of help text is displayed in the context sensitive help area at the bottom of the display. More detailed help information can be obtained by touching the *<Alarm Help>* button.

Each alarm message has a unique code where the first two characters indicate the module that generated the alarm as follows:

SL = Stack Module (STM)

CD = Cleaner and Developer Module (CDM)

CO = Resist Coating Module (RCM)

HP = Resist Curing Module (RCM)

LB = Laser Beam Recorder (LBR)

SM = Sputter Module (SPM)

BF = Conveyor



When the alarm condition has been rectified the alarm message can be removed from the displayed list by touching the *<Alarm Clear>* button.

5.7 Chemical Replenishment/Waste Vessel Emptying

A number of the chemical solutions used during the mastering process and the basic chemicals from which they are mixed are flammable and can cause skin, eye and mucous membrane irritation. Always observe the following precautions:

- ❖ Always prepare all chemicals at the chemical preparation bench with the fume extraction fan switched on. Never prepare the chemicals in the room in which the system is installed.
- ❖ Always wear protective clothing, gloves and safety glasses when handling chemicals.
- ❖ Avoid breathing in fumes, vapours and sprays.
- ❖ Avoid contact with the skin or eyes.
- ❖ Always wash hands thoroughly after working with the chemicals.



The tanks for the process chemicals used during the mastering process and the container for collection of the waste photo-resist are located in a single compartment at the bottom of the machine. The tanks are located on a retractable base plate that can be pulled out of the machine for easy access.



5.7.1 Refilling the Chemical Tanks

An indication that any of the chemical tanks requires refilling is provided by the display of an appropriate alarm message at the HMI. To refill the tank proceed as follows:

- 1) Pull the drawer out of the chemical compartment.
- 2) Identify the correct tank to be refilled by the tags provided on the tank.
- 3) Close off the compressed air supply to the tank at the appropriate regulator.





- 4) Remove the compressed air quick connector from the tank (blue hose).



- 5) Remove the liquid quick connector from the tank (black hose).

- 6) Remove the tank to the electroforming room or other area where the chemical solutions are prepared and add the required quantity of solution into the tank.

The procedures for preparation of the process solutions are contained in Chapter 5, Chemical Preparation.

- 7) Return the tank to the SQM chemical compartment and refit the quick connectors.
- 8) Re-apply the air pressure to the tank to complete the procedure.

In the event of an accident involving the process solutions the following Material Safety Data Sheets are applicable.

Table 5.1 Process Solutions - Safety Details

PROCESS SOLUTION	SAFETY CATEGORY	APPLICABLE MSDS
Adhesive	 Irritant	<i>N-(2-Aminoethyl-3-Aminopropyl) Trimthoxy Silane - A0700CD</i>
Photo-Resist	 Flammable	<i>Microposit (R) EC Solvent</i>
Developer	 Irritant	<i>OCG 809</i>

5.7.2 Emptying the Waste Vessel



The requirement for emptying of the photo-resist waste vessel is provided by the display of an alarm message at the HMI. The waste bottle is fitted into a neck holder that has as shut-off valve to prevent drips and fumes. Remove the waste bottle by tilting it forwards and pulling it away from the neck holder.

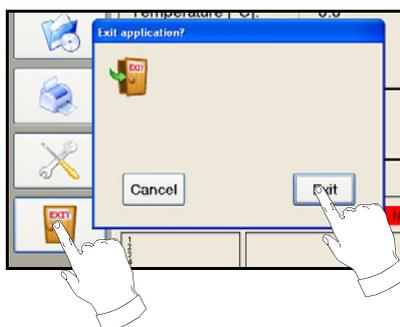
5.8 Shutdown Procedures

5.8.1 Normal Shutdown

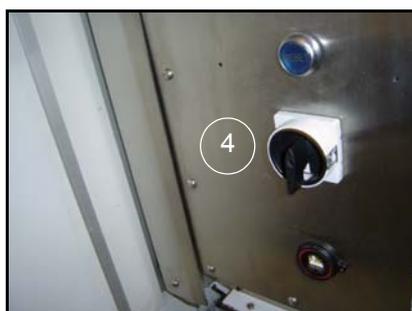
To shutdown the system at the end of a shift or production period proceed as follows:



- 1) At the HMI, select the <Stop> button. All modules will finish process and loaded substrates and the substrates will be unloaded to the conveyor.



- 2) When all substrates have been unloaded to the conveyor, select the <Exit> icon to close down the HMI application. Confirm the request to exit when prompted.
- 3) Close down Windows™ using the normal procedure.



- 4) Remove the power from the SQM using the power switch located on the left-hand side panel of the machine.
- 5) Turn off the DI-water and compressed air supplies to the machine.



- 6) Close off the argon gas supply to the machine.

5.8.2 Longer-term Shutdown

If the system is to be shutdown for a period exceeding 2 days then it is strongly recommended to take precautions to prevent contamination of the chemical circuits due to crystallisation or drying out of the chemicals remaining in the circuits. The chemical tanks should be emptied and then filled with the following cleaning solutions:

- ❖ Adhesive Tank : Demi-water
- ❖ Developer Tank : Demi-water
- ❖ Photo-Resist Tank : Microposit EC Solvent

The tanks should then be re-fitted into the chemical compartment and the manual commands provided at the HMI should be used to thoroughly flush the chemical circuits with the cleaning solutions. The cleaning solutions should be allowed to remain in the circuits during the shutdown period.

When re-starting after a longer shutdown, the cleaning solutions in the circuits should first be flushed out and replaced with the appropriate process solution before re-starting production.

6 CHEMICAL PREPARATION

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6

CHEMICAL PREPARATION

6.1 General

This chapter provides instructions on the preparation of the chemical solutions used in the SQM system. The instructions for the removal and refitting of the SQM chemical tanks are provided in Chapter 5 - Operating Instructions.

6.2 Safety Precautions

A number of the chemical solutions used during the mastering process and the basic chemicals from which they are mixed are flammable and can cause skin, eye and mucous membrane irritation. Always observe the following precautions:

- ❖ Always prepare all chemicals at the chemical preparation bench with the fume extraction fan switched on. Never prepare the chemicals in the room in which the system is installed.
- ❖ Always wear protective clothing, gloves and safety glasses when handling chemicals.
- ❖ Avoid breathing in fumes, vapours and sprays.
- ❖ Avoid contact with the skin or eyes.
- ❖ Always wash hands thoroughly after working with the chemicals.



6.2.1 Accidents Involving Chemicals

In the event of an accident involving any chemical solution or cleaning agent, reference should be made to the chemical manufacturers Material Safety Data Sheet (MSDS).

In the event of an accident involving the prepared solutions the following Material Safety Data Sheets are applicable.

Table 6.1 Process Solutions - Safety Details

PROCESS SOLUTION	SAFETY CATEGORY	APPLICABLE MSDS
Adhesive	 Irritant	<i>N-(2-Aminoethyl-3-Aminopropyl) Trimthoxy Silane - A0700CD</i>
Photo-Resist	 Flammable	<i>Microposit (R) EC Solvent</i>
Developer	 Irritant	<i>OCG 809</i>

6.3 Adhesive Preparation

Special Precautions:

To avoid exposure of the concentrated silane supply to moisture only allow the bottle to be open for as long as is absolutely necessary. The silane bottle should be immediately returned to the refrigerator following preparation of the solution.

Required Chemicals:

10 ml Concentrated Silane

990 ml Demi-water

Required Equipment:

Magnetic Stirrer with Magnet

Erlenmeyer Flask - 1000 ml

Droplet Counter or Pipette

Squeegee Container with Demi-water

Storage after Preparation:

Maximum 2 days at room temperature.

Preparation Procedure:

To prepare 1-liter of the process solution used in the SQM, proceed as follows:

- 1) Remove the remaining solution from the SQM adhesive tank and rinse the tank with DI-water.
- 2) Thoroughly clean the Erlenmeyer flask, the funnel and the stirring magnet with DI-water.





- 3) Add 990 ml of DI-water into the Erlenmeyer flask. The last bit should be carefully added using a squeegee container. Add the stirring magnet.



- 4) Place the Erlenmeyer flask onto the magnetic stirrer. Switch on and adjust the speed to create a vortex of about 1/3 of the water level. No air bubbles should be present.



- 5) Open the silane bottle and extract 5 ml of silane using the droplet counter or pipette. Close the bottle immediately to prevent moisture from entering the bottle.



- 6) Transfer the silane drop by drop into the Erlenmeyer flask. Do not add in large quantities as this will cause a polymer to be formed in the liquid, after which it cannot be used in the system.

- 7) Extract a further 5 ml of silane from the bottle and again add this to the stirring solution drop by drop.



8) Close the silane bottle tightly and immediately return to the refrigerator.



9) Allow the solution in the Erlenmeyer flask to continue stirring for 1 minute.

10) Transfer the prepared solution into the SQM adhesive tank.

11) Repeat the procedure to make any additional solution required.



12) When all required solution has been prepared, thoroughly clean all used glassware and the stirring magnet with DI-water. A small amount of DI-water should be left in the Erlenmeyer flask.

6.4 Photo-Resist Preparation

Special Precautions:

Preparation must be carried out at the chemical bench with the yellow light switched on.



Ensure that the fume extraction for the bench is switched on.

The photo-resist and solvent used must be at room temperature before preparation.

Required Chemicals:

180 ml S1818 Photo-resist (189 grams)

820 ml Microposit EC Solvent (789 grams)

Required Equipment:

Calibrated Measuring Cylinder - 1000 ml

Squeegee Container with Microposit EC Solvent

Storage after Preparation:

Maximum 2 weeks at room temperature.

Preparation Procedure:

To prepare 1-liter of the process solution used in the SQM, proceed as follows:

- 1) Remove the remaining solution from the SQM photo-resist tank and rinse the tank with Microposit EC Solvent.
- 2) Clean the measuring cylinder to be used with Microposit EC solvent.





- 3) Add 820 ml of EC solvent into the measuring cylinder. The last bit should be added using a squeegee container to obtain the required accuracy (the bottom of the meniscus should be used as the reference).



- 4) Shake the photo-resist bottle and add 180 ml into the measuring cylinder to give a total volume of liquid of 1000 ml in the cylinder (the bottom of the meniscus must not deviate more than 2 ml).



- 5) Seal the cylinder using the cap, hold the cap firmly and turn the cylinder upside down and back again slowly about 10 times to thoroughly mix the solution.

- 6) Transfer the prepared solution into the SQM photo-resist tank.
- 7) Repeat the procedure to make any additional solution required.
- 8) When all required solution has been prepared, clean the measuring cylinder and the cap thoroughly with Microposit EC solvent. A small amount of solvent should be left in the measuring cylinder.



6.5 Developer Preparation

Special Precautions:

None.

Required Chemicals:

200 ml OCG 809 LSI Developer 100%

800 ml DI-water

Required Equipment:

Calibrated Measuring Cylinder - 1000 ml

Squeegee Container with DI-water

Storage after Preparation:

1 week at room temperature or 2 weeks if stored in a refrigerator.

Preparation Procedure:

To prepare 1-liter of the process solution used in the SQM, proceed as follows:

- 1) Remove the remaining solution from the SQM developer tank and rinse the tank with DI-water.
- 2) Clean the measuring cylinder to be used with DI-water.



- 3) Pour 800 ml of Demi-water into the clean measuring cylinder. The last bit should be added using a squeegee container (the bottom of the meniscus should be used as the reference).





- 4) Add 200 ml of OCG 809 LSI Developer into the measuring cylinder to give a total volume of liquid of 1000 ml in the cylinder (the bottom of the meniscus must not deviate more than 2 ml).



- 5) Seal the cylinder using the cap, hold the cap firmly and turn the cylinder upside down and back again slowly about 10 times to thoroughly mix the solution.

- 6) Transfer the prepared solution into the SQM developer tank.

- 7) Repeat the procedure to make any additional solution required.



- 8) When all required solution has been prepared, clean the measuring cylinder and the cap thoroughly with DI-water. A small amount of DI-water should be left in the measuring cylinder.

7 ROUTINE MAINTENANCE

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7

ROUTINE MAINTENANCE

7.1 General

This chapter provides instructions for the limited number of routine maintenance tasks that can be carried out by an operator of the SQM system.



WARNING: All other maintenance and repair of the SQM system is considered beyond the scope of a normal operator and should only be carried out by M2 Engineering personnel or personnel who have attended an official SQM service training course.

7.2 Monthly Cleaning Procedures

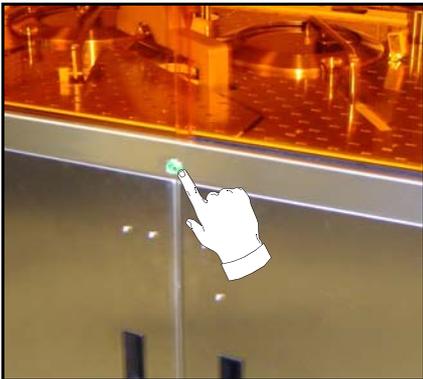
In order to maintain the yield of the system it is very important to keep the machine clean. It is recommended that the following procedures are carried out at least once per month.

7.2.1 General Cleaning

Clean all parts of the machine using a lint-free cloth wetted with DI-water. Any photo-resist stains can be removed using Microposit EC-solvent. The drawer of the chemical compartment should be cleaned of any chemical spillages.

7.2.2 Process Bowl Cleaning

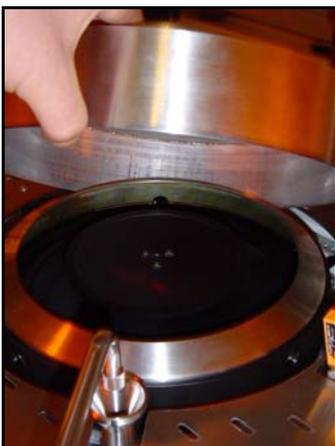
To clean the process bowls of Cleaner and Developer module (CDM) and Resist Coating module (RCM) proceed as follows:



- 1) Press the window release button to allow the windows to be opened. The windows can be opened when the lamp in the button flashed quickly.

- 2) Open the windows to gain access to the process bowls.

- 3) Remove the outer ring of the process bowl.





4) Remove the inner ring of the process bowl.

5) Transfer the rings to the chemical bench and clean as follows:

Cleaner and Developing rings - DI-water and a soft brush.

Resist Coating rings - Microposit EC solvent or Acetone

6) Clean the inside of the process bowls as follows:

Cleaner and Developer bowl - DI-water and a soft brush.

Resist Coating bowl - Microposit EC solvent or Acetone

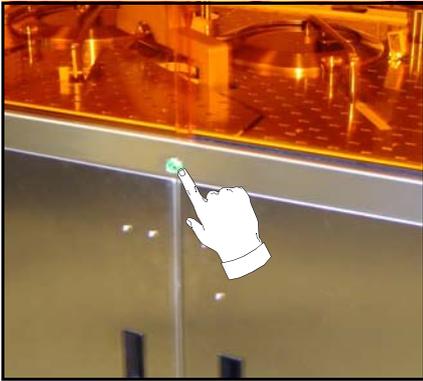
7) Refit the inner and outer rings into the process bowl.

7.2.3 Cleaning the Sputtering Module Masks

To be advised.

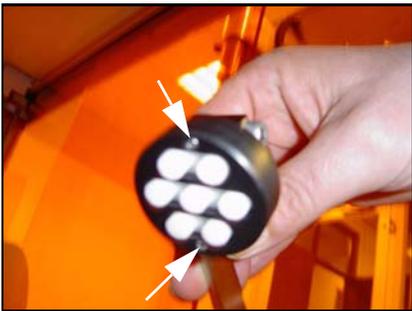
7.3 Brush Replacement

The small foam brush at the Cleaning and Developing module should be replaced at least once every 6 months. Proceed as follows:



- 1) Press the window release button to allow the windows to be opened. The windows can be opened when the lamp in the button flashed quickly.

- 2) Prepare the new brush pad by allowing it to soak in DI-water for 30 minutes.



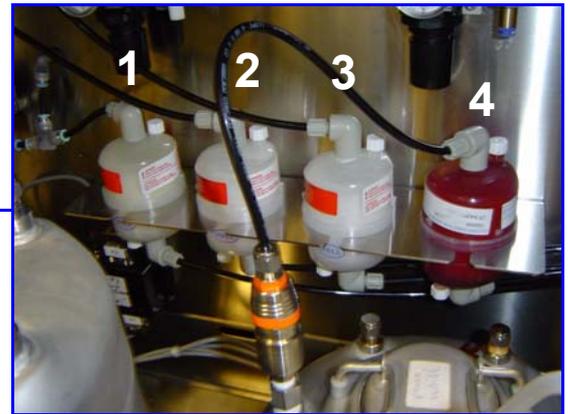
- 3) Lift the brush mechanism and release the 2 screws to remove the pad retaining plate.

- 4) Position the new pad and secure the retaining plate using the 2 screws previously removed.

7.4 Filter Replacement

The chemical filters used in the SQM should be replaced at least once every 6-months. A decrease in the yield of the system due to visual defects or data errors (BLER, E32, PIE, POF etc.) may indicate the requirement for more frequent replacement.

The filters are located in the chemical compartment in the lower part of the machine.



- 1 = DI-water Filter
- 2 = Adhesive Filter
- 3 = Developer Filter
- 4 = Photo-resist Filter

7.4.1 Filter Replacement

To replace each filter proceed as follows:



- 1) Remove the pressure to the appropriate tank (or turn off the DI-water pressure) using the pressure regulators.



- 2) Place a beaker below the lower connection of the filter to be replaced and release the lower tube. Allow the liquid in the filter to drain into the beaker.



- 3) Remove the upper tube from the filter and remove the filter from the mounting bracket.



- 4) Transfer the couplings from the old filter onto the replacement filter.

- 5) Fit the replacement filter into the mounting bracket and re-connect the upper and lower tubes.
- 6) Re-apply pressure to the appropriate tank (or re-apply the DI-water pressure) and check that there are no leakages at the tube connections.
- 7) Unscrew the vent valve at the top of the filter to remove any air trapped in the filter. This completes the procedure.



7.5 Inspection of Laser Beam Recorder Air Buffer

The rotation unit of the Laser Beam Recorder is fitted with an air bearing that has an air buffer tank between the main compressed air supply and the bearing. This tank is provided to protect the bearing against damage in the event of a failure of the main compressed air supply. The tank should be inspected every six months for signs of damage or fatigue. The tank can be accessed from the rear of the machine. If there is no person within the mastering facility that can carry out this inspection then an external authority should be engaged to carry out the inspection.



Figure 7.1 Air Bearing Buffer Tank

7.6 Precautions to be Taken During Service

All other service of the SQM system should only be carried out by an engineer of M2 Engineering or an authorised representative. The following safety precautions should be taken when carrying out service on the system.

- ❖ Always remove the main power supply to the system when carrying out any maintenance on the electrical system. Lock the main power switch and place a label next to the main power switch indicating that service is being carried out.
- ❖ Disconnect the Uninterruptible Power Supply from the system when carrying out maintenance or service.



If carrying out service on the metalliser or laser beam recorder modules then it is advised to remove the door from its hinges to gain better access.

8)

