MULTI-WAY QUARTZ CRYSTAL HEAD AND TEST GLASS CHANGER

IL540.10x6

IL540.10x6 WITNESS PLATE AND QC CHANGER ACCESSORY

Instruction Manual
This documentation is provided as an instruction manual to Intellevation' customers and potential customers only.

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1. Introduction

1.1 Copyright Notice

1.2 Declarations of Conformity/Incorporation

Declaration of Conformity

We, Intellemetrics Ltd,
35 Cable Depot Road,
Riverside Industrial Estate,
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Glasgow, G81 1UY, UK

Declare under our sole responsibility that the product(s)

Witness Piece Changer with optional Crystal Sensor Head
IL540.6X6
IL540.6

to which this declaration relates is in conformity with the following standard(s) or other normative document(s)

EN61326 (Industrial Location, Class A Emissions) — Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements.

following the provisions of

89 / 336 / EEC — Electromagnetic Compatibility Directive.

A. E. Holme
Dr. A.E. Holme, Technical Manager

11th Sept 2002 (Eastbourne)
Date and Place

Intellemetrics Ltd (Part of the BOC Group plc)

The IL540.10x6 has been tested to and meets the machinery directive of 98/37/EC.
The Declaration of Incorporation however confirms that the IL540.10x6 is provided exclusively for use in a vacuum system.

⚠	***Warning***	There is a risk of finger entrapment if the IL540.10x6 test glass changer is indexed during removal/fitting of test glasses

1.3 Warning/Caution symbols on the IL540.10x6

Warning cautions are of the type shown below.

 : *Warning:* *Caution*

1.4 Certification and Compliance

	*Warning*	If this equipment is used in a manner not specified by Intellevation, the protection provided by the equipment may be impaired.

1.5 Scope and Definitions

This manual provides installation, operation and maintenance instructions for the Intellevation IL540.10x6 combined quartz crystal and test glass changer (TGC) accessory, abbreviated to IL540.10x6 of TGC in the remainder of this manual.

Read this manual before you use the IL540.10x6. Important safety information is highlighted as WARNING and CAUTION instructions. You must obey these instructions. The use of WARNINGS and CAUTIONS is defined below.

	Read the manual before fitting or operating the IL540.10x6.

	***Warning***	Warnings are given when failure to observe could result in injury**.**

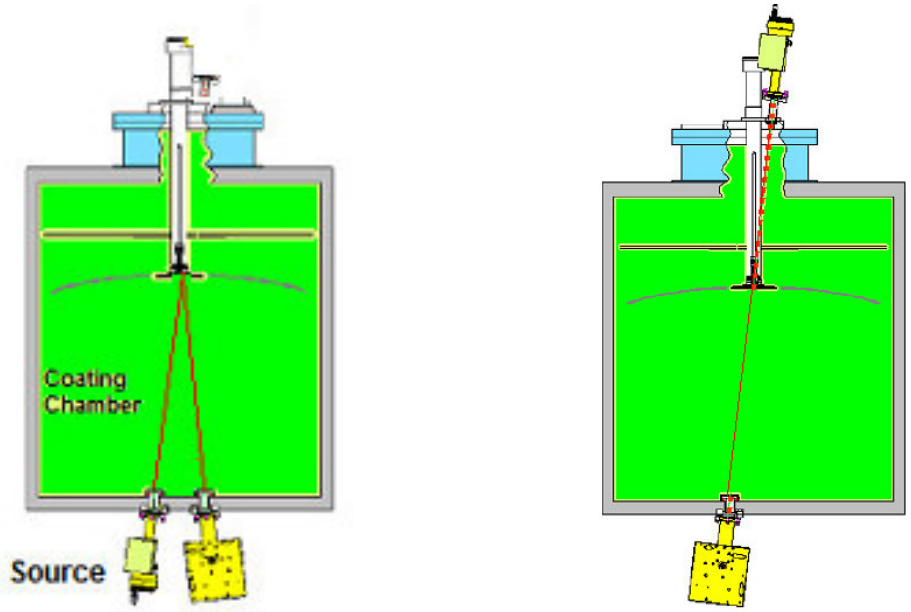
	***Caution***	Cautions are given where failure to observe the instruction could result in damage to the equipment, associated equipment and process

1.6 Description

The IL540.10x6 is an accessory for the Intellevation optical monitor system range that combines a multi position test glass changer with a 6 way quartz crystal head. The test glass changer is of a carousel design, incorporating a number of test glasses individually indexible over a fixed monitor aperture. The Intellevation design of carousel and baseplate ensures the highest precision indexing, and spatial location of the test pieces, which is particularly key for R mode monitoring.

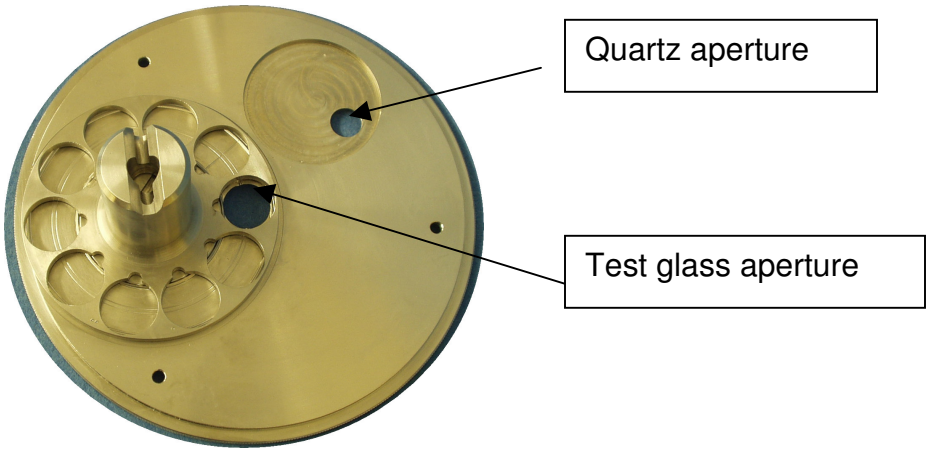
The multiple test glass capacity of the changer enables a range of monitor "schemes" to be evaluated for each film stack (optical filter) thereby enhancing the cut options available and overall filter performance.

The IL540.10x6 has been designed to provide both transmission (T mode) and reflectance (R mode) monitoring paths.

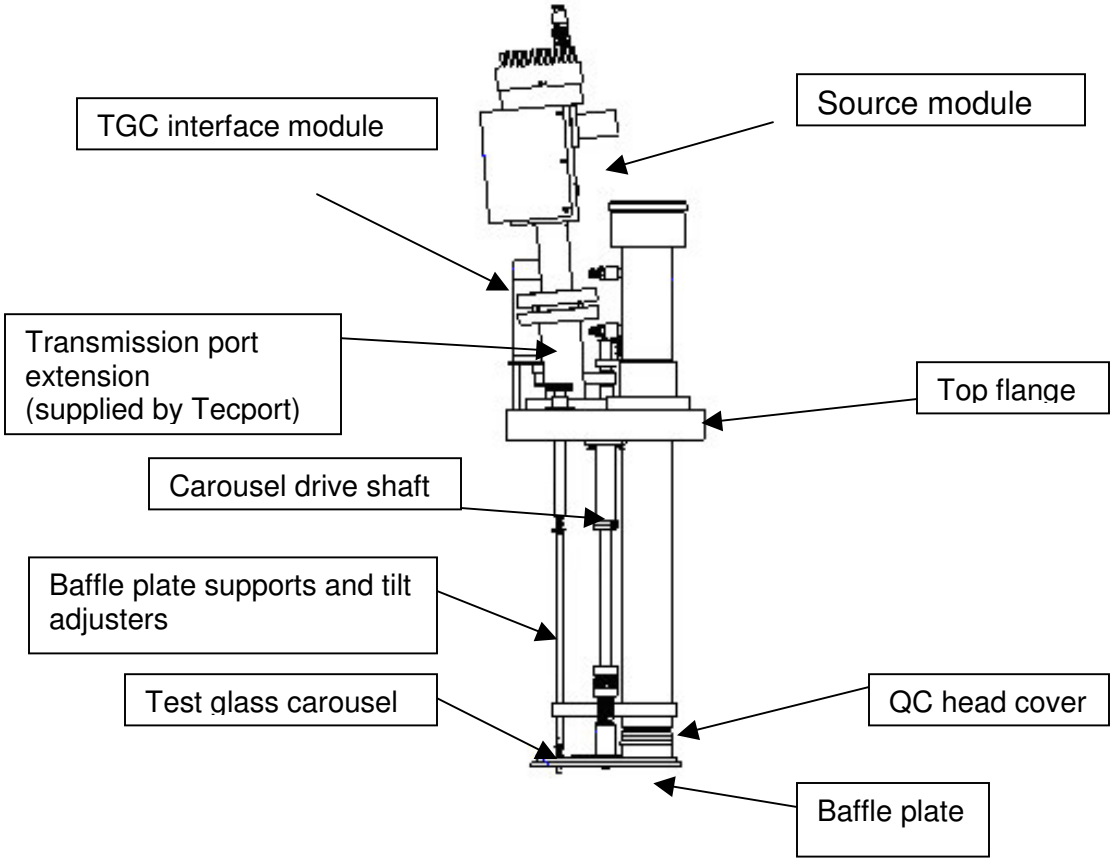


R mode T mode

The 6 position quartz crystal head incorporates 6 quartz crystals in a carousel indexable over a single fixed monitor position, and located in the same plane close to the test piece. This ensures that the deposition rates are very similar for both the test glass and the QC head, which minimises the materials calibrations required. (Note that there is always a requirement when using indirect monitoring with test pieces, to undertake materials distribution calibrations between the test glass/QC and the actual work pieces being coated.)



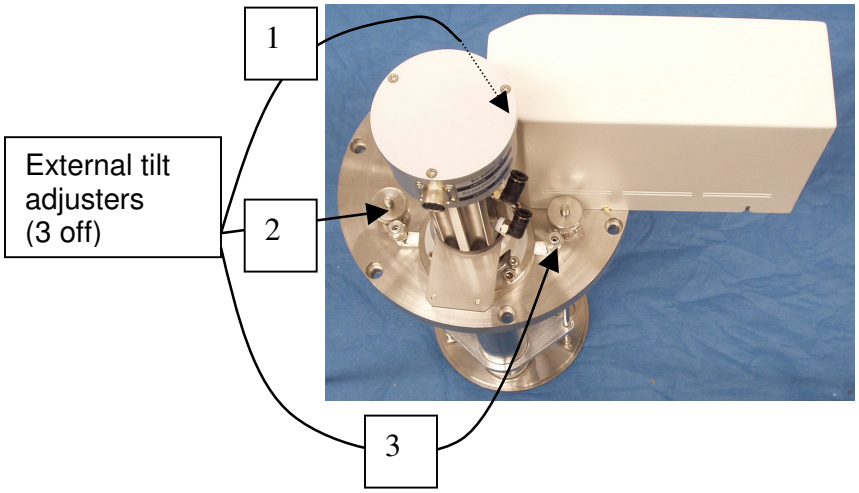
The QC is used to control the deposition rate of the sources, and in some instances of very thin films, which cannot be accurately cut using the optical monitor, the OM can be programmed to defer to QC cut on these films.



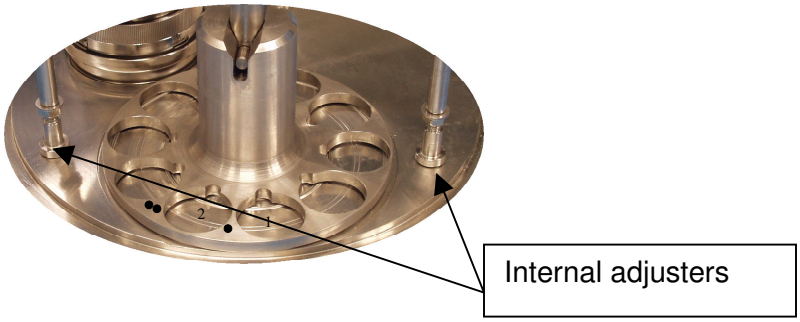
Schematic of the IL540.10x6 with OM source mounted in transmission mode

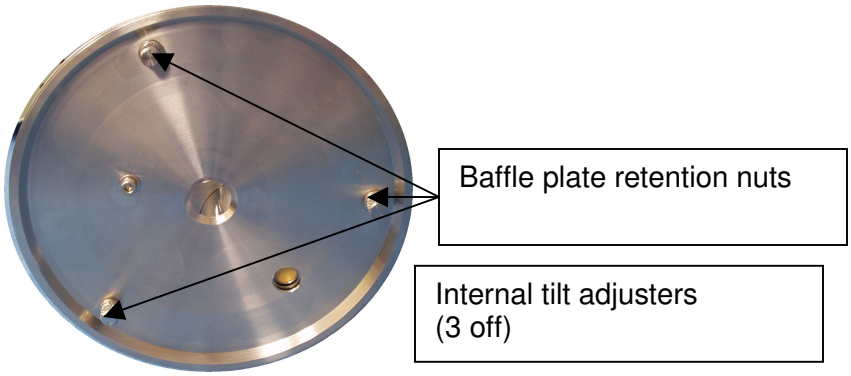
High vacuum compatible grades of stainless steel have been used in the manufacture of all in vacuum components of the IL540.10x6. The IL540.6x6 has been designed to be compatible with in vacuum ambient temperatures up to 250 degrees Centigrade. For the limits associated with the QC changer refer to the manual supplied separately by the manufacturers.

Both internal (in vacuum) and external adjustment of carousel tilt is provided to achieve precise angular alignment of the test glasses with the optical monitor system (OMS).



Number 3 adjuster is slightly smaller in diameter than 1 and 2.





The internal adjusters are provided to allow for initial adjustment of the baffle plate tilt, in air, to align the optical monitor path in R mode operation.
The external adjustment feature is principally to compensate for distortion of the chamber walls under vacuum, affecting the source-witness-detector optical path.

The quartz crystal head is interfaced directly through an oscillator to the quartz crystal monitor/controller (refer to the customer system configuration for details).

The test glass changer is fully automatic and is controlled by software resident on the Intellevation OMS operating through a test glass changer (TGC) interface module mounted on the TGC above the vacuum flange. The interface module comprises a communication PCB, the test glass changer drive motor and drive belt and an optical switch which ensures that the carousel indexes and stops in the correct position for each test glass.

1.7 Controls and Displays

Test Glass Changer

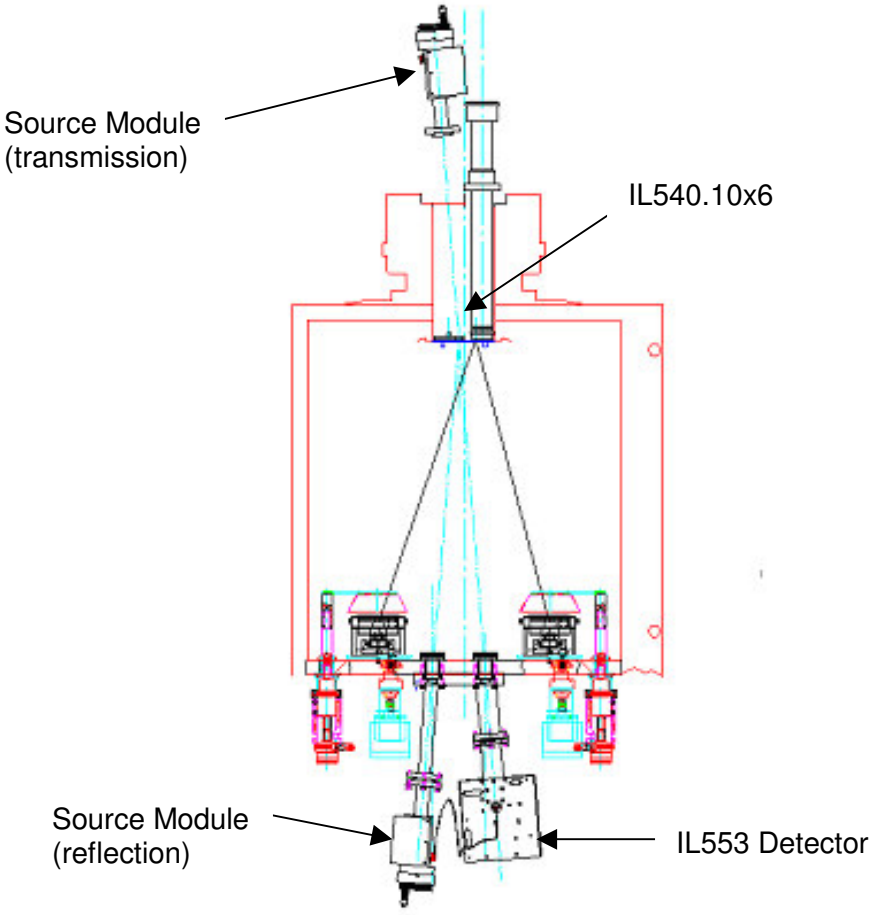
The rotary test glass changer provides for up to 10 test glasses to be used in a deposition. The test glass is selected using Film*Maker* software provided with the Intellevation OMS.

Quartz Crystal Changer
The Jeol quartz crystal changer is easily interfaced to most third party QC controllers and monitor systems. The necessary interface requirements are covered in the Jeol manual.

1.8 Typical Installation

A typical installation is shown below.

- Transmission and reflection mode are shown.
- Electron beam (EB) gun sources.
- Electromagnetic source shutter
- IL540.10x6 combined 10 position test glass changer and 6 ways quartz crystal head.

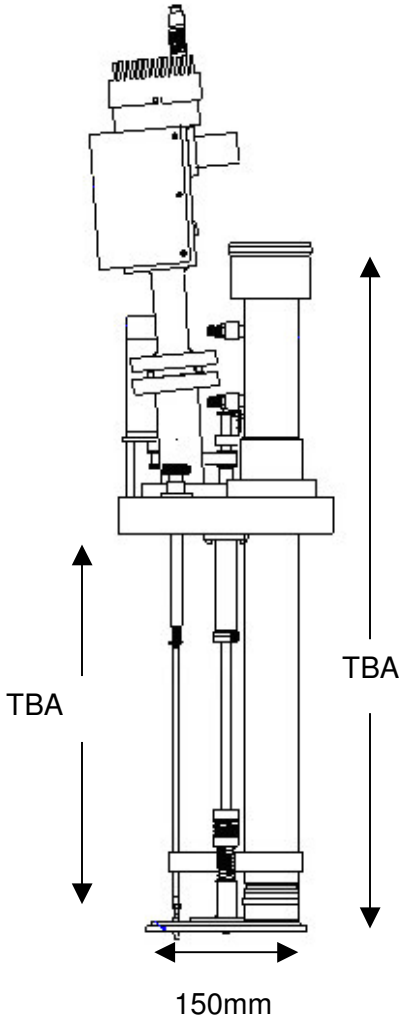


IL540.10x6 (typical layout)

2. Technical

2.1 General

Dimensions	See figure below
Mass	13.45Kg
Operating temperature range	0 to 250°C
Electrical supply	24V DC
Electrical Power rating	1.5A
Pollution Degree	2
Installation category	II



IL540.10x6 dimensions

2.2 Configuration (IL540.10x6)

Customer: Tecport Optics
Customer Order: 2361
Intellevation Job No: Int06/1242

Item	Quantity	S/N
Test Glass Changer and QC changer assembly	1	1,000,242
Cable (TGC to computer) signal	1	N/A
Cable (TGC to computer) power	1	N/A
Test glasses (20mm diameter by 2mm thick)	10	N/A
Manual	1	N/A
Flange O ring Viton	0	N/A
Number of crystals (14mm diameter)	0	N/A
Quartz crystal head Jeol Type BS-04120SSH	1	N/A

2.3 TGC Interface Module

TGC Interface Module

3. Installation

3.1 Unpack and Inspect

Remove all packing materials and protective covers and inspect the IL540.10X6. A packing list is supplied below. Confirm all parts have been received and none are damaged. If there are any physical signs of damage notify Intellevation as soon as possible with a list of the items affected. Retain all packing materials for inspection.

	*Warning*	The IL540.10x6 assembly is heavy, and is a precision-engineered assembly. Take appropriate care during unpacking.

Item	Quantity
IL540.10x6 assembly	1
Flange O ring	0
Cables	2
Test glasses	10
Quartz crystals	0

Packing List

	*Warning*	Do not use IL540.10x6 equipment that is damaged

	*Caution*	Installation can only be carried out by suitably qualified personnel.

3.2 Installing the IL540.6x6

A suitably trained person must complete the installation and commissioning of the IL540.10x6.

Installation Procedure

1. Mount the IL540.10x6 on the vacuum chamber.
2. Connect the TGC module to the OMS computer. (Note: The TGC module is an electronics package mounted within a shielded metal box powered from the computer. To ensure electrical isolation from the system all system inputs/outputs are provided via opto-isolators incorporated into the changer module).
3. Open up Film*Director* followed by the test glass changer server as described in Section 1.7 to allow the test glass changer to operate under manual control.
4. Ensure that the test glass changer is indexing as requested and that the glass is centralised over the coating aperture.
   Note: For safety reasons the test glass is indexed using a low power limited energy stepper motor drive.
   The zero position on the glass indexer (corresponding to *TestGlass* 1 in Film*Maker*) is marked on the back surface of the carousel, as shown below. The test glass changer has been factory set to this value.

5. If the test glass changer is dismantled at any time then the zero index position will need to be reset. This procedure is covered in detail in Section X.

3.3 Specification for test glasses.

1. The clear aperture of the witness must be at least 20mm diameter.
2. The witness must have optically polished parallel-sided surfaces for Transmission mode monitoring.
3. Only the surface receiving coating needs to be polished and flat for Reflectance mode monitoring.
4. The test glasses must be from a reliable quality source and the dispersion of the glass must be well known over the band of operation (550 to 1650nm).

3.4 Connecting the Quartz Crystal changer

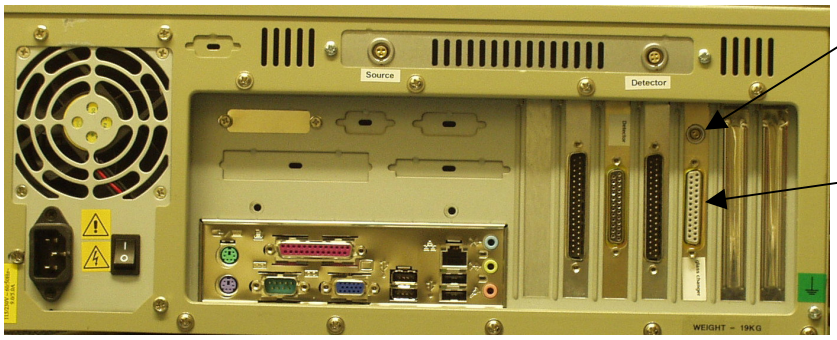
Refer to the Jeol user manual**.**

3.5 Cabling

The electrical cable provided with the IL540.10x6 is: --

Cable TGC-computer	1off

This cable connects the TGC interface module directly to the rear of the Intellevation OMS



TGC power cable

TGC signal cable.

⚠	*Caution*	Only use the cable supplied with the IL540.10X6 as this is specifically manufactured for this application. I/O card.

⚠	*Warning*	Ensure that all of the electrical wiring is secured so that people cannot trip on them. If you do not it may cause injury.

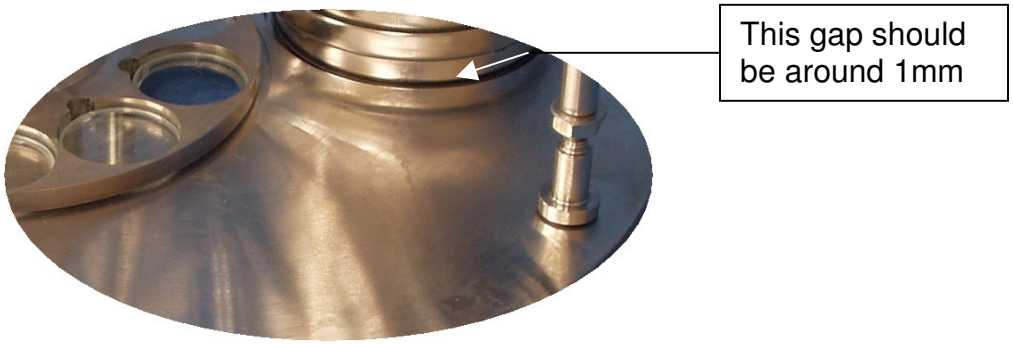
3.4 Optical Alignment of the TGC

This check is undertaken to ensure that the optical path of the Optical Monitor Source Module, TGC and Detector Module are in alignment. The optical alignment procedure will usually be first undertaken by the Intellevation engineer at the time of commissioning.

The most common configuration of the IL540.10X6 is monitoring in the reflection mode, although the IL540.10x6 can be readily configured for transmission mode monitoring also.

Detailed instructions for alignment of both modes are provided in Section 3.10 of the OMS User Manual.

The IL540.10x6 internal adjusters described previously in this manual should be adjusted to their mid point position (to allow for adjustment in either direction). Similarly the external adjusters should be set to their mid point position. Note that there should be a gap of around 1mm between the crystal end cap and the baffle plate as shown below in this neutral starting condition to allow maximum range of tilt of the baffle plate.



1. The Intellevation OMS source module should be powered up by opening Film*Director*.

2. The test glass changer should be set up for **reflectance mode monitoring** (even if initially transmission mode monitoring is to be used). A reflecting flat mirror is placed in the test glass 1 position in the carousel, and the optical path is traced from the source to the witness, using the adjusters provided at the source module flange to achieve the correct path.
3. After the beam has been centralised on the reflector, then remove the reflector and check that the beam is centred in the transmittance mode window also.
4. Replace the reflector.

5. The beam is steered down into the detector window by using the internal adjusters supporting the IL540.10x6 baffle plate to ensure that the light patch is centred in the optical feedthrough.
(Note that if the test glass changer is subsequently used for **transmission mode monitoring** there should be no need to adjust the baffle plate orientation from this optimised position).

6. Connect the QC head via a suitable oscillator to the system QC monitor/controller and connect up the water and compressed air lines. Confirm that the crystals index under software command from the QC controller.

7. Following completion of the OMS alignment procedure as described in the IL553 User Manual, the chamber is pumped down and the test glass changer external adjusters are used to bring the OMS signal back to the original in-air value. At this stage the test glass changer is considered to be aligned.

8. Following this procedure it is valid to check the signal response of an uncoated test glass and compare the results obtained with the factory test results reported at the back of the OMS user manual. If there is a significant variance in the signal path response then this should be investigated, as there is a possible misalignment of the OMS TGC system which needs to be investigated.

4. Software

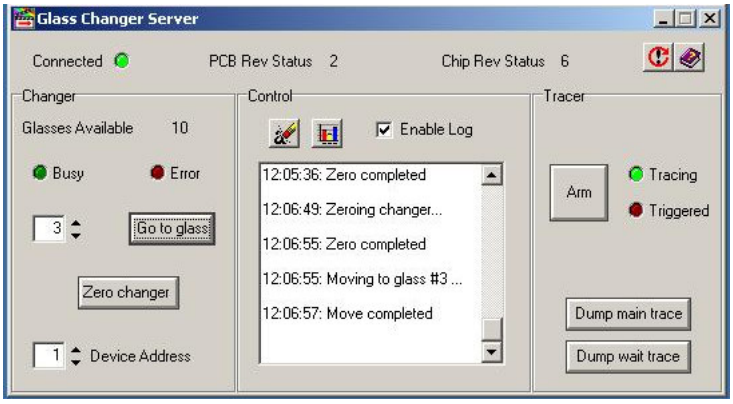
In the deposition process, under auto control, at the start of each film in which there is a pre-programmed test glass change Film*Director* software sends a signal to the test glass changer via the OMS computer I/O and a test glass changer (TGC) interface module requesting the test glass to index.

If manual intervention is required for set up and test for example, this can be done using the ***Test glass changer server.***

The ***Test glass changer server*** is available when Film*Director* is open. The icon automatically minimises to the bottom tray.
Double click on the icon below.

Test glass changer server

The following window will pop up.



The test glass changer will initially zero itself (ie go to test glass position 1), as shown in the ***Control Log*** above.

Under ***Changer*** the glass required 1 to 10 can be changed and then the ***Go to glass*** button pressed.

⚠	***Caution***	The ***Device Address*** must never be changed

4.1 Error Indications

Errors in the operation of the Test glass Changer server are indicated on screen. Where these are not self-explanatory, refer to Intellevation software support in Glasgow.

4.2 Switch ON/OFF the IL540.10x6

If the IL540.10x6 is to be switched off, this should be done only when a deposition is completed. No On/Off switch is provided on the TGC. The TGC is switched off by powering down the OMS computer.

5. Maintenance

The principal factor affecting the need for maintenance is likely to be the accumulation of coating deposits. The IL540.10x6 has been designed to ensure that the critical moving parts are adequately shielded from direct line of sight deposition.

It is strongly recommended that the user provide a tubular shield to prevent non line of sight coating from accumulating internally on the assembly behind the baffle plate. The baffle plate has been designed with an outer landing as shown below to facilitate the fitting of a coating shield.

The IL540.10x6 is mainly fabricated in stainless steel. The baffle plate can be cleaned by bead blasting.

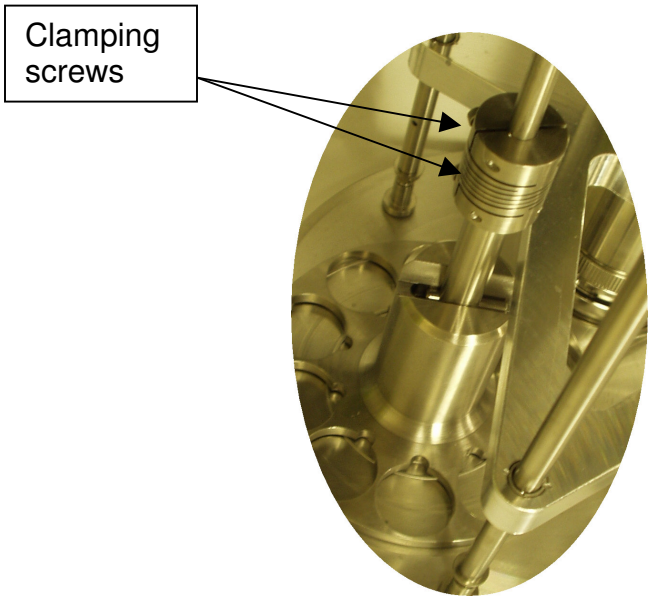
⚠	*Caution*	Do not use highly abrasive materials or corrosive materials to remove coating deposits from the IL540.10x6.

If other assemblies (except for the baffle plate) require cleaning then highly penetrative processes like bead blasting should be avoided as ball bearings are used in various parts of the ssembly. Hand cleaning should only be used and the parts thoroughly cleaned of any abrasive before reassembly.

The test glass aperture in the baffle plate, which will accumulate significant coating, must also be cleaned very carefully to preserve the shape and quality of the landing area in which the test glass sits as this uniquely guarantees repeatable accurate registration of the witness. The IL540.10x6 has been designed to operate without the use of lubricants. However Molybdenum Disulphide can be used sparingly to reduce friction.

If it proves necessary to remove the internal components of the test glass changer for cleaning it is highly likely that the test glass zero position will need to be reset.

To reset the carousel zero position (test glass 1) slacken the allen screws on the drive coupling immediately above the test glass carousel as shown below.



This will allow the lower drive shaft to rotate freely from the upper drive.

Open up the ***Test Glass Changer server*** and this will initialise the system to the zero position.
Rotate the carousel until the zero position, marked with a single indent on the back face of the carousel is centred over the monitor aperture.

Tighten the clamping screws and check the reproducibility of index through all positions, and make any minor adjustments to the carousel as required.

5.1 Test Glass Replacement

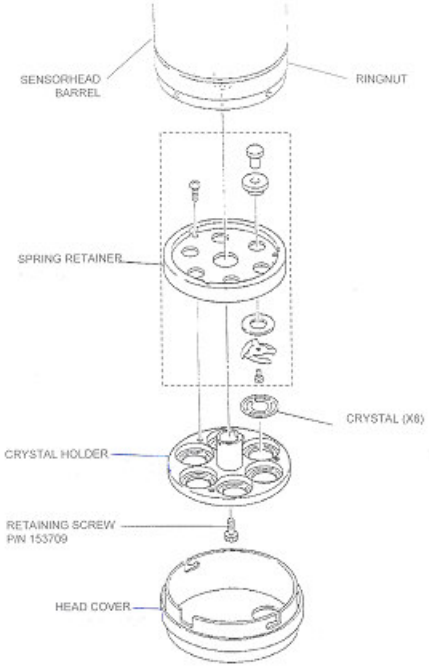
⚠	*Caution*	There is a danger of entrapment if a finger is pushed through the test glass changer coating aperture. Replace test glasses only using the procedure outlined in Section 5.1

To access the test glass carousel, or the QC head, the bottom baffle plate must be removed. The baffle plate is supported on three rods which pass through the top plate and are adjustable external to vacuum to align the test glass under vacuum. The baffle plate can be removed downwards, complete with the carousel by unscrewing the retaining nuts under the baffle plate.

The witness test glasses can now be removed and then replenished with test glasses. Thoroughly clean the test glasses before placing these into the carousel.
The complete baffle plate assembly is then offered up to the three posts and the domed nuts tightened by hand. The bolts should not be over tightened, as the external adjustment may be impaired.
During the process of locating the baffle plate the keyway in the test glass changer drive automatically re-aligns the carousel with the baffle plate aperture.

5.2 Quartz Crystal Replacement

- Remove the bottom baffle plate as described in Section 5.1 above.
- Loosen the retainer ring nut.
- Push the head cover inward while turning it counter clockwise until it stops (1/16 of a turn)
- Pull the head cover outward and remove the head cover from the head barrel
- Loosen the centre screw of the head to release the crystal retainer.
- Remove the remaining three screws (on Teflon side) to separate the head from the spring retainer.
- Remove the used crystals and place fresh crystals into the holder.
- Put the spring retainer and crystal housing back together and tighten the three screws being careful not to deform the crystal springs or break the crystals.
- Place the complete crystal retainer assembly back on the head barrel, observe and line up with the indexed pin. Tighten the screw.
- Put the head cover back on the rotary head.
- Tighten the ring nut to secure the head cover.
- Replace the baffle plate as described in Section 5.1 above.



Schematic of 6 way QC head

6. Storage and Disposal

6.1 Storage

If the IL540.10x6 is to be stored, return it to its protective packaging and store in clean, dry conditions. When required for use, install the IL540.10x6 as described in Section 3.

6.2 Disposal

Dispose of the IL540.10x6 and any components in accordance with all local and national safety and environmental requirements.

7. Spares

Item	Part no
Test glass	SN 131.799
Motor drive belt	SN 131.780
Quartz crystal	SN 66HG