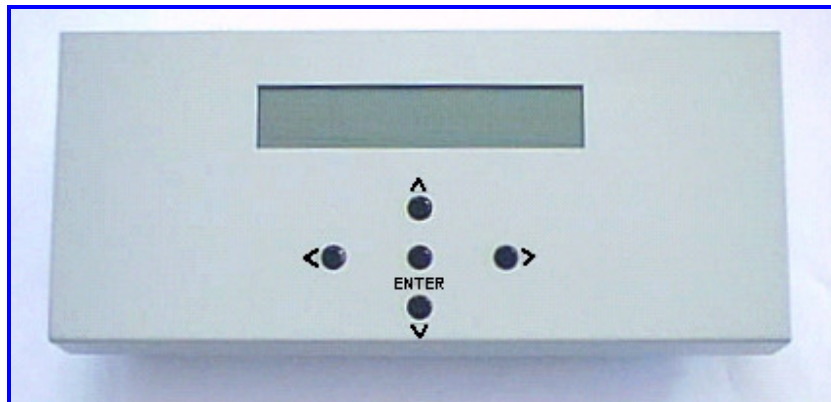




Quorum Technologies

## K150X Film Thickness Monitor Instruction Manual



For technical and applications advice plus our on-line shop  
for spares and consumable parts visit [www.quorumtech.com](http://www.quorumtech.com)

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Issue	Date	Details	Revised By
1	28/04/1999	Initial Issue, applicable to instruments fitted with version 1.04 software or greater	DJR
2	17/11/1999	Update to reflect changes to software (up to version 2.03)	DJR
3	26/06/2007	Company name change, new document layout	JLS

## Disclaimer

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

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## 2 Health and Safety

Safety is very important when using any instrumentation.

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

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

Quorum Technologies cannot be held responsible for any damage, injury or consequential loss arising from the use of its equipment for any other purposes, or any unauthorised modifications made to the equipment.

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

### 2.1 Control of Substances Hazardous to Health (COSHH)

The E.C. legislation regarding the “Control of Substances Hazardous to Health” requires Quorum Technologies to monitor and assess every substance entering or leaving their premises. Consequently any returned goods of whatever nature must be accompanied by a declaration form Health and Safety Declaration form completed. (Appendix 7.3.5 for the form)

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

### 2.2 WEEE Compliance

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



**Figure 2-1: WEEE Directive Symbol**

For full details of our environmental policies including WEEE please visit [http://www.quorumtech.com/environmental\\_policy.htm](http://www.quorumtech.com/environmental_policy.htm)

## 2.3 Conformity

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



## 2.4 Hazard Signal Words

The standard three hazard signal words are defined as follows:

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

## 2.5 Fail Safe

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

## 3 Description

### 3.1 Principle of Operation

The Quorum Technologies Film Thickness Monitor and Controller operates by monitoring the frequency shift of an oscillating quartz crystal as evaporated material is deposited on the crystal. The frequency shift is related to the mass of the deposited material and thus calibration of the thickness depends on the area of crystal exposed (fixed by the design of the crystal holder) and the density of the material being deposited.

When using the equipment, it is always assumed that the source to crystal and source to substrate distances are the same, and it must be remembered that the thickness of coatings (from a point source) will be inversely proportional to the square of the distances. If these distances do differ, a constant factor can be applied to the real density of the material being deposited to compensate accordingly, i.e. the inverse ratio of the distances squared. The deposition thickness can also be calculated from the measured frequency and the programmed density.

$$T_f = D_q \times N_q \times T / \pi \times D \times \arctan(\tan(\pi \times (1 - T_5/T)))$$

where

$T_f$  = Film Thickness

$D_q$  = Density of quartz

$N_q$  = Frequency constant of quartz

$T$  = Period of loaded quartz

$D$  = Density of evaporated material

$T_5$  = Period of 5MHz crystal


A Quartz Crystal is placed in the vacuum work chamber of the coating instrument. One face of this Crystal is exposed towards the deposition source, such that, as material is deposited it will coat the Crystal.


The Crystal is connected via a vacuum feed through to external components, the whole becoming an oscillator whose output is controlled by the frequency of Crystal oscillation.

As material is deposited on the Crystal, so its frequency of oscillation is modified. This 'modification' is used to determine the thickness of material deposited.

## 4 Installation

It is important that this equipment is installed and operated by skilled personnel in accordance with these instructions. Failure to do so may result in damage, and impair protection provided. 'If in doubt - ask'.

	<p style="text-align: center;"><b>WARNING – MAINS LEAD</b></p> <p>This Equipment must be Earthed and fitted with the correct lead for the country of operation. This will normally be achieved from the correct mains supply socket.</p>
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	<p style="text-align: center;"><b>WARNING – EARTH CONNECTOR</b></p> <p>This Equipment is normally supplied from 3 pin supply including Earth. If only 2 pin supply is available a separate Earth must be fitted. The supplementary Earth stud can be used to facilitate this requirement.</p>
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### 4.1 Connections

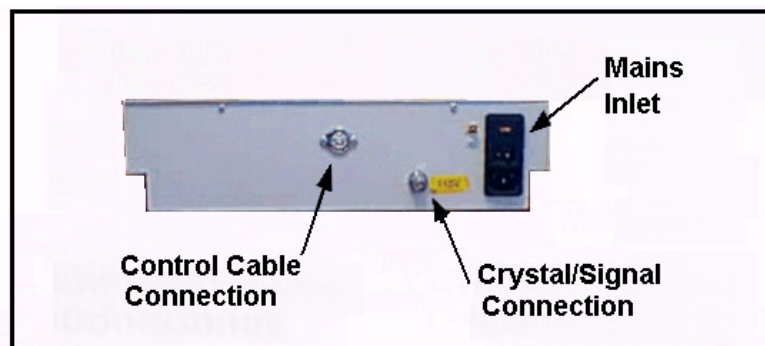


Figure 4-1: K150X Rear Panel Connections

When used in conjunction with the Quorum Technologies range of Sputter Coaters, the F.T.M. must be connected to the Instrument via the interconnecting cable supplied.

**NOTE:** For 'stand alone' operation of the coating instruments without the F.T.M, the 5 Pin DIN override plug supplied should be fitted to the control cable socket in the rear panel of the Coater. The Coater will now operate in the normal manner in isolation.

	<p style="text-align: center;"><b>WARNING – CONTROL CONNECTOR (5 PIN DIN)</b></p> <p>This is for the Control Interconnection Lead between the coating unit and Film Thickness Monitor.</p>
---	--

The external oscillator is connected directly to the Crystal vacuum feed through. The BNC type interconnecting cable is then fitted between the external oscillator and the Film Thickness Monitor main unit.

The F.T.M main unit should now be connected to the mains supply using the lead supplied. If necessary an external earth should be attached to the earth connector at the rear.

## K150X Film Thickness Monitor

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**NOTE:** If the Sputter Coater is fitted with a K125 Etch facility. The K125 Etch facility **MUST NOT** be used when K150X Film Thickness Monitor is switched on, and is in use unless a crystal Cap Cover, Quorum Technologies part number A4120087, is fitted over the crystal holder.

The mains switch is located at the rear of the Instrument. This should now be switched on.

**NOTE:** To prevent spurious operation, the Film Thickness Monitor should always be switched on before the Coating System is switched on.

## 5 Operation

### 5.1 Display

The diagram below shows the layout of the instrument top cover showing the LCD and the data entry keys.

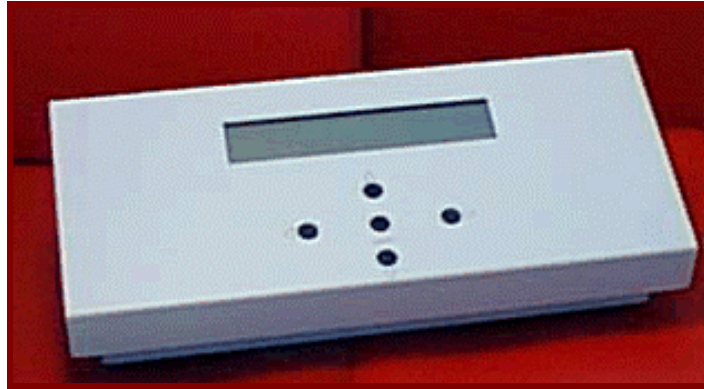


Figure 5-1: K150X Film Thickness Monitor

At switch on, the liquid Crystal display will be as below showing the product title and the software version and issue date

```
***** EMITECH K150X F.T.M. *****
                V2.03 04/11/99
```

After approximately 2 seconds if all is well, the display changes to its normal working state, shown below. The parameters last used are stored internally and restored upon instrument power up. However if these values have become corrupted then the default values are installed. The default values are discussed in the section on changing operating parameters.

```
ENTER-Change Settings, UP-Reset Count
Status   Idle           CRYSTAL FAIL
Terminate Deposition   Density   Mode
005.0 nm 000.0 nm      19.32    Manual
```

**NOTE:** If it is required to reset all parameters to their default values then this can be done by holding the **ENTER** key whilst the unit is powered up.

## 5.2 Display Parameters

### 5.2.1 Terminate

This is the deposition thickness which when exceeded will cause the FTM to assert the coater **STOP** signal, if and only if the FTM is in AUTO, mode.

### 5.2.2 Deposition

This is the current measured deposition thickness. It's value can be reset to 000.0nm whilst the instrument is idle by pressing the ▲ arrow key.

### 5.2.3 Density

This is the density of the coating material being used. It's value is units of  $\text{g cm}^3$ . See the following section on changing the operating parameters for the allowable values for this parameter.

### 5.2.4 Mode

This shows the operating mode and is either **AUTO** or **MANUAL**. In Auto mode the FTM unit will terminate the coating part of the coating instrument's cycle. In manual mode he FTM measures the deposition all the while that the enable signal is active, but the coating cycle is limited the instrument's timer.

### 5.2.5 Status

The FTM has three different status modes, the first is Idle where the user can enter and change operating parameters.

The second, 'Initialising Count' is entered when a change in state of the enable signal is detected. At this point various variables are initialised ready for calculating the deposition thickness.

The final status is Counting where the frequency is measured every 100mS and the deposition thickness calculated. This status remains in manual mode all the time that the enable signal is active, or in auto mode until the terminate thickness has been exceeded.

The **CRYSTAL FAIL** message shown above only appears when the software does not detect any crystal oscillations between measurements. This should not appear when everything has been connected and is working correctly. Refer to section 5.5 Crystal Fail.

### 5.3 Operational Parameters

To change any of the operational parameters press the **ENTER** key whilst the Film Thickness Monitor is in the Idle state. The screen should appear as below.

```

UP/DOWN arrow to Select
Enter Selects
Density
    
```

Using the Up and Down arrow keys page through the different parameters until the parameter it is desired to change is shown, then press the **ENTER** key, to select this parameter.

The screen will then change to show the current value for that parameter. Below is a list of all of the parameters describing each.

#### 5.3.1 Density

This refers to the density of the material being deposited. This figure is obtained by referring to the periodic table supplied. e.g. Gold (Au) is 19.32 g cm<sup>3</sup>, this is the default value for this parameter. The screen should be as below:

```

UP/DOWN arrow to Select
Enter Selects
Density      Gold      19.32 g/cm3
    
```

The densities of popular coating materials are stored in the Film Thickness Monitor program memory. these are:-

Aluminium, Carbon, Titanium, Chromium, Nickel, Copper, Silver, Palladium, Pt/Pd (60:40), Au/Pd (80:20), Tungsten, Gold, and Platinum. To switch between the different materials use the Up and Down arrow keys and when the desired value and material are shown press the **ENTER** key. Aluminium is the first value in the list and User defined is the last. When either end has been reached the selection does not wrap around to the other end.

In addition if the coating material being used is not shown, then any desired value can be entered as a 'User defined' value. If this is required then select user defined value using the **ENTER** key, and the cursor will be then be placed on the most significant digit. Use the ▲ and ▼ arrow keys to set the value of this digit, then use the ► key to move to the next digit. Repeat this until all digits have been entered.

The allowable range of values for the density is from 1.00 g/cm<sup>3</sup> to 23.00 g/cm<sup>3</sup>.

### 5.3.2 Terminate

Selecting the Terminate parameter the screen will look like that below.

UP/DOWN arrow to Select	
Enter Selects	
Terminate	0005.0 nm

As when setting a user defined density the cursor will be then be placed on the most significant digit. Use the ▲ and ▼ arrow keys to set the value of this digit, then use the ► key to move to the next digit. Repeat this until all digits have been entered.

The terminate range may be adjusted from 0.001nm to 999.9nm, The default value for this is 0005.0nm.

**NOTE:** The terminate function is used in conjunction with the automatic function. In the manual mode, this has no effect.

### 5.3.3 Tool Factor

This is a factory set variable that is used to account for the difference in positions from the target between the crystal and the sample, It can be adjusted by the same method as for the terminate values.

The tooling factor now remains as the main display, and flashes. The number may now be changed by entering directly from the front panel key pad.

### 5.3.4 Operating Mode

The operating mode can be changed between Auto where the Film Thickness Monitor stops the coating instrument when the terminate thickness has been exceeded, and Manual mode where the FTM simply measures what has been deposited as previously described. When this parameter is selected the mode is toggled between Auto and Manual using the any of ◀ ▶ ▲ ▼ keys. When the desired mode is shown press the **ENTER** key to accept.

## 5.4 Preparation

### 5.4.1 Manual Operation

Switch on the Film Thickness Monitor Ensure that density figure is correct. If necessary, reset the deposition reading to zero.

Switch on the Sputter Coating Unit. (Refer to Operating Instructions). Operate Sputter Coater in normal manner. As Sputtering continues, the Film Thickness Monitor deposition figure will change.

The Coater will operate in the normal manner, stopping at the end of the timed period. The FTM will display the thickness of the deposited film.

### 5.4.2 Automatic Operation

The Automatic Function can be selected at any stage during cycle, before the FTM has been enabled, usually this is when the coating cycle commences. Ensure that density figure is correct.

Select desired thickness using terminate function. Select Auto mode by pressing Man/Auto button. Press Reset button. The coating unit is now controlled by the Film Thickness Monitor. The coating unit timer is ignored, regardless of its setting.

When the terminate thickness is reached, the coating unit will go to Stop mode.

## 5.5 Crystal Fail

If the Crystal fail message is displayed, it indicates that the chamber Crystal is not oscillating. Carry out the following procedure:-

- Check that the external oscillator and associated lead are connected to the Film Thickness Monitor
- Remove the Crystal from its holder by unscrewing the retaining ring. whilst doing so lightly press against the exposed crystal face with a cotton tip or piece of tissue so that the rotating of the holder does not scratch the crystal surface.
- Clean the Crystal by immersing in 100% alcohol.

**NOTE:** The Crystal should not be handled directly, as this will damage the conductive layers on the Crystal surface.

- Replace the Crystal in its holder. Again lightly pressing against the crystal face so that the holder does not scratch the crystal surface while being tightened.
- If the Crystal fail message continues to read, it is possible that the Crystal is spent.
- A replacement should be fitted. (Quorum Technologies Part No.: C5450)

## 6 Maintenance

### 6.1 Fuse Listings

Fuse listing for 240 Volt K150X

Title	Rating	Function
Fuse 1 (1.25" X 0.25")	T 630mA Ceramic	Electronics Power supply

Table 1: Fuse Listing for the 240 Volt K150X

Fuse listing for 120 Volt K150X

Title	Rating	Function
Fuse 1 (1.25" X 0.25")	T 1A Ceramic	Electronics Power supply

Table 2: Fuse Listing for the 120 Volt K150X

### 6.2 Spares

The following are available from Quorum Technologies, or your local distributor, and are featured in more detail in the current Quorum Technologies Consumables Catalogue. Copies can be sent on request.

Spares For K150X Film Thickness Monitor	Catalogue Number	Quantity
Crystal	C5450	Each
Fuze - T 630mA Ceramic (240v)		Each
Fuze - T 1A Ceramic (120v)		Each

Table 3: Spare Parts for the K150X

## 7 Appendices

### 7.1 Common Coating Material Densities

<b>Material</b>	<b>Density(gm/cm3)</b>
Aluminium	2.70
Carbon	3.51
Titanium	4.54
Chromium	7.19
Nickel	8.90
Copper	8.96
Silver	10.50
Palladium	12.02
Au/Pd (80:20)	17.86
Tungsten	19.30
Gold	19.32
Pt/Pd (80:20)	19.56
Platinum	21.45

**Table 4: Common Coating Material Densities**

## 7.2 Sputtering Deposition Rate

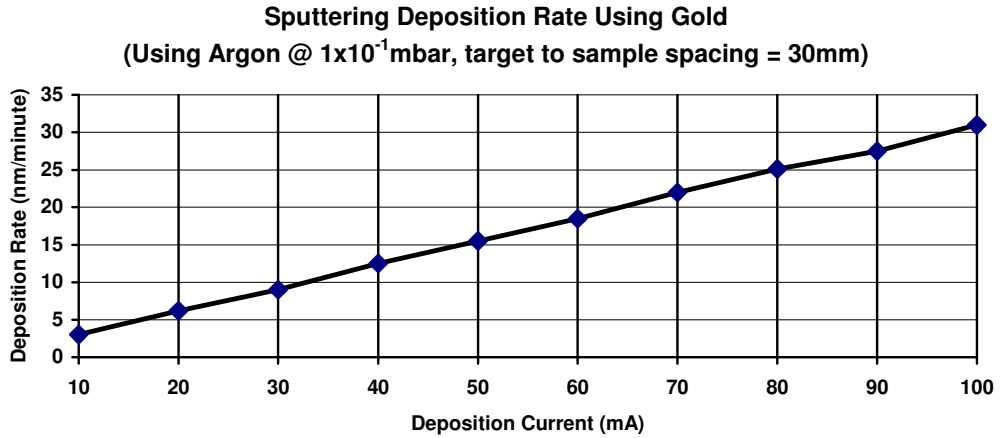


Figure 7-1: Sputtering Deposition Rate using Gold

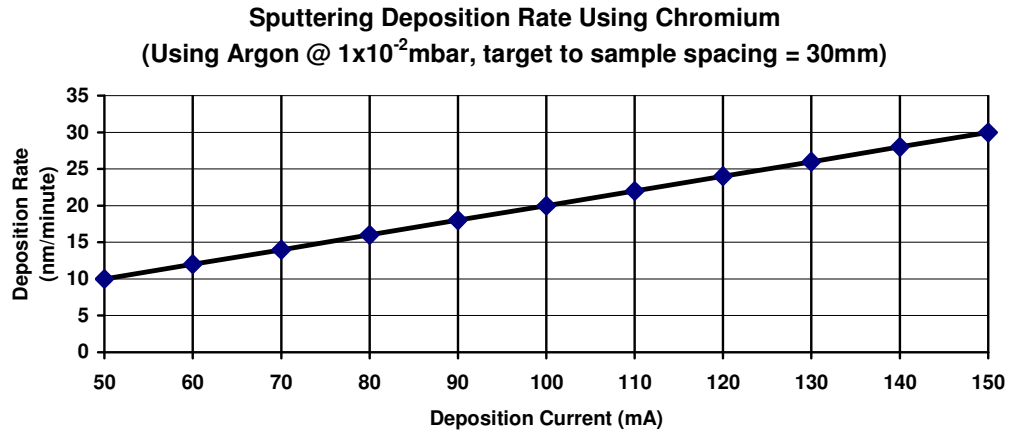


Figure 7-2: Sputtering Deposition Rate using Chromium

## **7.3 Return of Goods**

**Safety information for the return of Preparation Equipment and Accessories.**

### **7.3.1 General Introduction:**

The employer (user) is responsible for the health and safety of his employees. This also applies to all those persons who come into contact with the Preparation Equipment and Accessories either at the user's or manufacturer's premises during repair of service. The contamination of Preparation Equipment and Accessories has to be declared and the Health and Safety Declaration form completed. (Appendix -7.3.5 for the form)

### **7.3.2 Health and Safety Declaration**

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

### **7.3.3 Despatch**

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

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

### **7.3.4 Return Address:**

F.A.O.: The Service Manager,  
QUORUM TECHNOLOGIES,  
Units 1 & 3 Eden Business Centre  
South Stour Avenue,  
ASHFORD,  
Kent. TN23 7RS

**7.3.5 Declaration of Contamination Form**

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

**Table 5: Declaration of Contamination Form**

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