E090-72-880
Issue F

Instruction Manual

AUTO 306 accessories:
EB3 Multihearth Electron Beam Source and accessories

Volume 1 - Installation and Maintenance Instructions

Description	*Item Number*
EB3 Multihearth Electron Beam Source	*E090-72-000*
EB3 Leadthrough Kit	*E090-80-000*
EB3 Water Flow-Switch Kit	*E090-81-000*
EB3 Beam Sweep Unit	*E090-82-000*
EB3 Motorised Turret Drive Kit	*E090-83-000*
EB3 Manual Turret Drive Kit	*E090-84-000*
EB3 3 kW Power Supply, 380/415/440 V, 3 phase 50 Hz	*E090-60-000*
EB3 3 kW Power Supply, 220 V, 3 phase 60 Hz	*E090-61-000*
EB3/FL400 Mounting Kit	*E090-88-000*

BOC EDWARDS

Manor Royal, Crawley, West Sussex, RH10 9LW, UK
Telephone: +44 (0) 1293 528844 Fax: +44 (0) 1293 533453
http://www.bocedwards.com

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Associated publications

Publication title	Publication Number
Vacuum leadthroughs	E090-00-880

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If you change this manual, you must also change E090-72-840 and E090-80-880

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1 INTRODUCTION

1.1 Scope and definitions

This manual is supplied in two volumes; Volume 1 provides installation and maintenance instructions for the EB3 Multihearth Electron Beam Source and its accessories for the AUTO 306, Volume 2 provides operating instructions. You must use the EB3 Multihearth Electron Beam Source and its associated accessories as specified in this manual.

Read this volume of the manual before you install and maintain the EB3 Multihearth Electron Beam Source and its accessories. Important safety information is highlighted as WARNING and CAUTION instructions; you must obey these instructions. The use of WARNINGS and CAUTIONS is defined below.

WARNING

Warnings are given where failure to observe the instruction could result in injury or death to people.

CAUTION

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

The units used throughout this manual conform to the SI international system of units of measurement.

1.2 Safety

Before you install, operate or maintain the equipment, read all of the instruction manuals supplied with the components of the equipment.

When you install, operate and maintain the EB3 equipment, you **must** comply with all of the WARNING safety instructions in this manual. Extremely high voltages are generated and used in the EB3 3 kW Power Supply and EB3 Multihearth Electron Beam Source. Because of this, the EB3 equipment incorporates interlocks which are designed to prevent injury or death to people by electric shock. You must install the interlocks as described in this manual. You must not override or bypass these interlocks.

We recommend that you connect the electrical supply to the EB3 3 kW Power Supply through a lockable electrical supply isolator. Before you maintain the equipment, turn off the electrical supply and lock the isolator; retain the key with you while you maintain the equipment, so that the electrical supply cannot be accidentally switched on.

(Continued on page 2)

In accordance with the requirements of IEC 1010, the following symbols may appear on the EB3 Multihearth Electron Beam Source and accessories:

Caution - refer to accompanying documents.

Caution- risk of electric shock.

Caution - hot surface.

Alternating current.

Earth (ground).

On.

Off.

1.3 Abbreviations and terms used in this manual

Connectors and cables have labels which show the appropriate connector or cable number. The labels may be in the form 'Cx' or 'CONN x', where 'C' and 'CONN' are both abbreviations for 'connector' and 'x' is the actual connector or cable number. Both the 'C' and 'CONN' abbreviations are used throughout this manual.

To make this manual easier to read, the full names of components are sometimes abbreviated. The full names and the corresponding abbreviation(s) used are as follows:

Full name	**Abbreviation(s) used**
EB3 Multihearth Electron Beam Source	Source
EB3 3 kW Power Supply	Power Supply (Unit)
EB3 Source Control	Source Control
EB3 Motorised Turret Drive	Motorised Turret Drive or Turret Drive
EB3 Turret Control	Turret Control
EB3 Manual Turret Drive	Manual Turret Drive or Turret Drive
EB3 Beam Sweep Unit	Beam Sweep Unit
EB3 Sweep Control	Sweep Control
EB3 Water Flow-Switch	Water Flow-Switch

A number of terms are used throughout this manual. To prevent confusion with other terms which are sometimes used to described electron beam source components, these terms are defined below:

Turret	The turret is the rotating part of the Source on which the crucible is mounted.
Crucible	The crucible is an interchangeable component which fits on the turret. The Source is supplied with a four hearth crucible fitted; this crucible can be removed and another type of crucible (with one or more hearths) can be fitted: refer to Section 6.3.1.
Hearth and **hearth liner**	The hearth is the part of the crucible which contains the evaporant (the material to be evaporated by the Source). Alternatively, each hearth can have a hearth liner in which the evaporant is placed: see Section 6.3.2.

1.4 General description

1.4.1 Overview of the EB3 Multihearth Electron Beam Source

The EB3 Multihearth Electron Beam Source and its accessories are designed to be installed in the AUTO 306 and provide the means for electron beam evaporation of materials placed in the hearth(s) in the crucible in the Source. The EB3 components described in this manual are as follows:

EB3 Multihearth Electron Beam Source	The EB3 Multihearth Electron Beam Source is fitted in the AUTO 306 chamber. When operated, the Source generates an electron beam which is used to evaporate materials in the crucible.
EB3 3 kW Power Supply	The EB3 3 kW Power Supply consists of an EB3 Power Supply Unit and an EB3 Source Control. The EB3 Power Supply Unit provides the electrical supplies for the EB3 Multihearth Electron Beam Source. The EB3 Source Control is used to control the operation of the Source.
EB3 Beam Sweep Unit	The EB3 Beam Sweep Unit is used (if required) to scan the electron beam over the evaporant in the crucible: refer to Section 1.9.
EB3 Leadthrough Kit	This kit contains all of the electrical and water leadthroughs and the cooling-water pipelines for the Source.
EB3 Motorised Turret Drive and EB3 Manual Turret Drive Kits	The EB3 Motorised Turret Drive and the EB3 Manual Turret Drive Kits allow you to automatically or manually rotate the crucible in the Source.
EB3 Water Flow-Switch Kit	The EB3 Water Flow-Switch automatically switches off the Source if the cooling-water supply fails.
EB3/FL400 Mounting Kit	This kit enables you to mount the Source in the side evaporation configuration in an FL400 chamber.

In addition to the above components, this manual describes how to change the crucible fitted in the Source. The crucibles available for the Source (and the liners for these crucibles) are listed in Section 6.

The principle of operation of the Source is described in the next section. The components listed above are more fully described in Sections 1.5 to 1.11.

1.4.2 Principle of operation

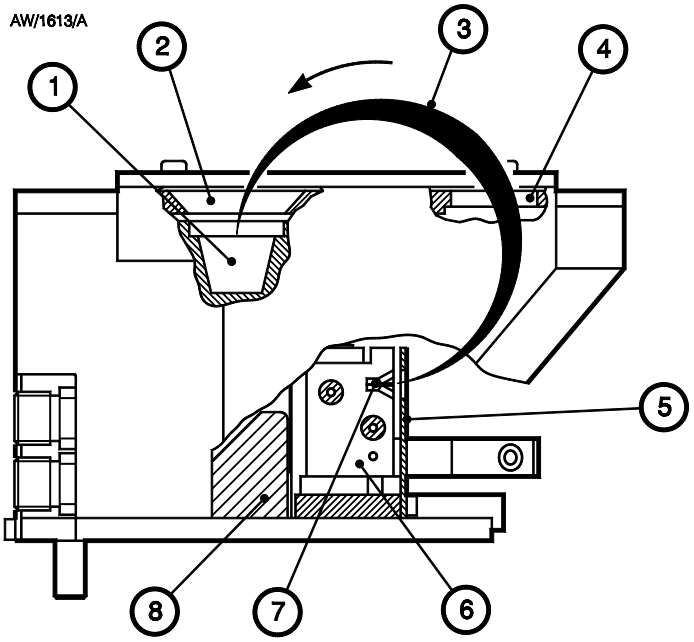
The Source fits in the AUTO 306 vacuum chamber and is operated when the vacuum chamber is at the appropriate pressure for evaporation (see also Section 3.17).

Refer to Figure 1. When the Source is operated, high voltage electrical supplies (provided by the EB3 3 kW Power Supply) heat a tungsten filament (7) until it is incandescent; the filament then spontaneously and randomly emits electrons. The anode plate (5) then collects the electrons and forms them into a beam (3) which is accelerated through the high voltage potential of 5 kV.

Magnetic fields created by a permanent magnet (8) and the pole pieces and pole piece extensions (Figure 20, items 2) deflect the beam through 270^{o} until it impacts on the evaporant in the crucible hearth (1), which is at electrical ground potential.

If the electron beam contains sufficient energy, the evaporant in the crucible is evaporated. For the beam to reach the crucible, it passes through two apertures (2, 4) in the top shield on the Source.

(Continued on page 6)



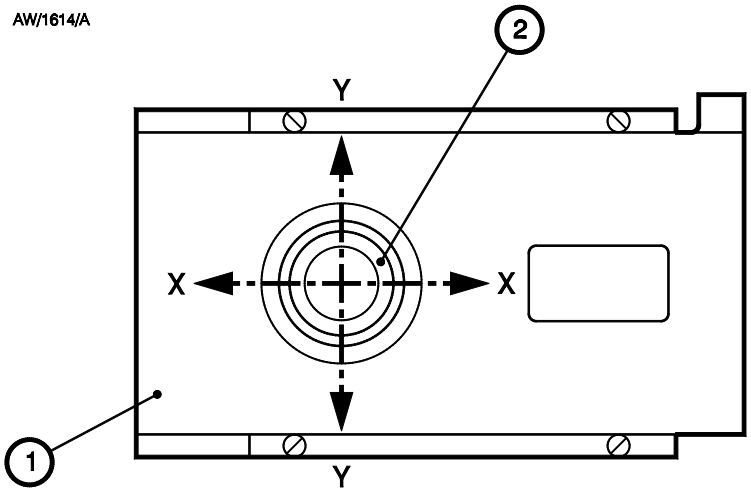
1. Crucible hearth
2. Aperture in top shield
3. Electron beam
4. Aperture in top shield
5. Anode plate
6. Emitter assembly
7. Filament
8. Permanent magnet

Figure 1 - Principle of operation of the Source

The permanent magnet, pole pieces and pole piece extensions direct the beam onto one point on the crucible hearth. However, the Source also has beam sweep coils fitted (Figure 20, item 28). When energised, these coils enable the beam to be scanned across the hearth in one or both of two directions, as shown in Figure 2:

- The X direction: along the length of the Source.
- The Y direction: sideways across the width of the Source.

The EB3 Beam Sweep Unit (see Section 1.9) energises the beam sweep coils and allows you to control the deflection of the electron beam.



1. Top shield
2. Hearth

Figure 2 - Beam sweep operation

1.4.3 Installation configurations

The EB3 Multihearth Electron Beam Source is designed to be installed on a Tripod in the AUTO 306 chamber (that is, in the Bell Jar or in the FL400 chamber). You must fit the Tripod before you fit the Source. To operate the Source, you must install the following:

- EB3 Multihearth Electron Beam Source
- EB3 Leadthrough Kit
- EB3 3 kW Power Supply (and EB3 Source Control)
- EB3 Manual Turret Drive **or** EB3 Motorised Turret Drive

If you want to use the X-Y beam sweep facility, you must also install the EB3 Beam Sweep Unit.

For additional safety, we also recommend that you fit the EB3 Water Flow-Switch, which is used to automatically switch off the EB3 Multihearth Electron Beam Source to prevent overheating if the cooling-water supply fails.

1.5 The EB3 Multihearth Electron Beam Source

The EB3 Multihearth Electron Beam Source is a magnetically focused electron beam source, which operates as described in Section 1.4.2. Refer to Figure 20. The electron beam is deflected through 270^{o} onto the hearth(s) in the crucible (5) by pole pieces, pole piece extensions (2) and a permanent magnet (Figure 1, item 8). The magnet is next to the crucible water-cooling system; this ensures that the magnet is stable and has a long life. The electron beam (when it is on the hearth) has a diameter of approximately 4 mm at 1 kW.

A shield (3) on the top of the Source prevents cross contamination of hearths and the Source by evaporant. The emitter assembly (24) contains the filament and is easy to remove for maintenance.

The crucible is water cooled and is mounted on a rotatable turret (13). The EB3 Multihearth Electron Beam Source is supplied with a four hearth crucible fitted. Other crucibles are also available as accessories: refer to Section 6.3.1.

When the EB3 Manual Turret Drive is used, click-stop positions on the four hearth crucible allow you to determine when a hearth is in the correct position for evaporation.

1.6 The EB3 3 kW Power Supply

Note: The EB3 3 kW Power Supply consists of two electrical units which are supplied together: the EB3 Power Supply Unit and the EB3 Source Control. These units are described separately in the following sections.

1.6.1 The EB3 Power Supply Unit

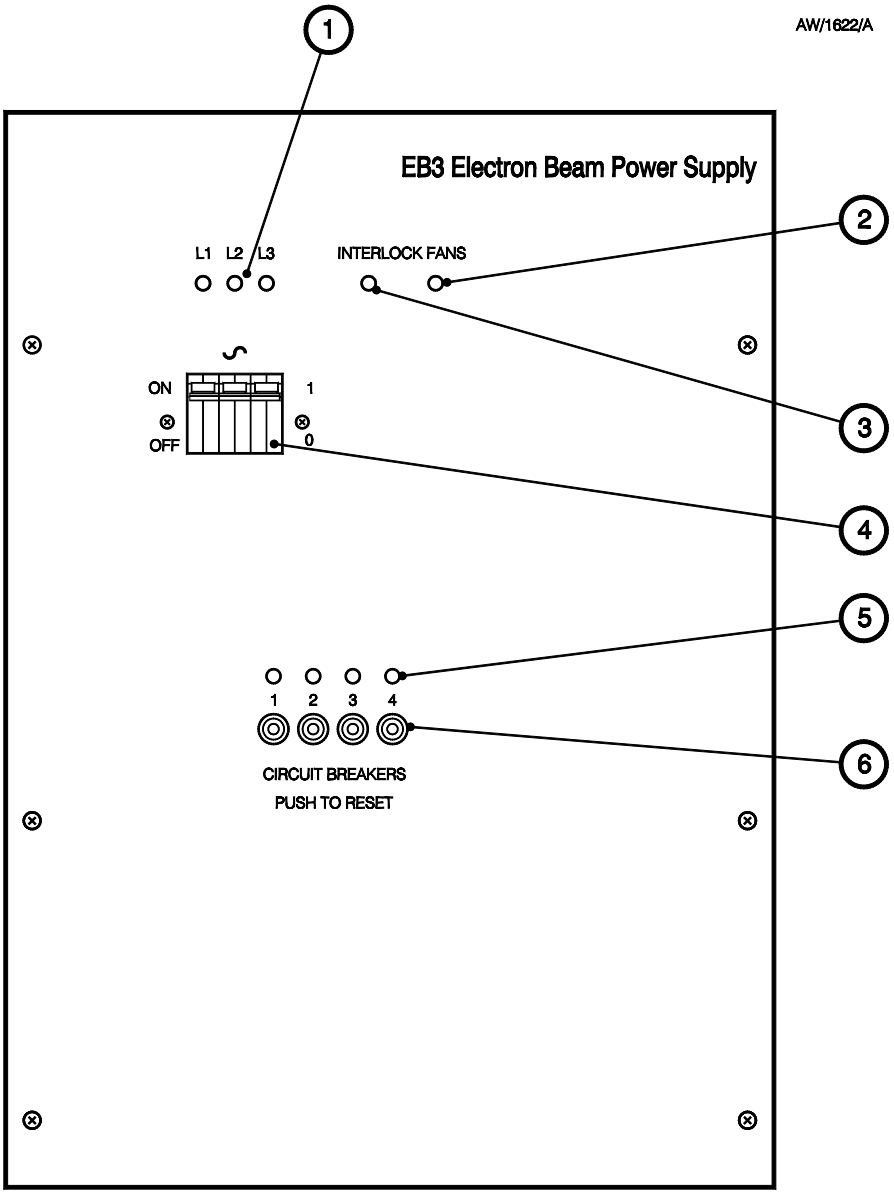
The EB3 Power Supply Unit provides the high and low voltage electrical supplies to the EB3 Multihearth Electron Beam Source. The output cables from the Power Supply Unit enter the AUTO 306 electrical cabinet through a conduit.

The front panel (see Figure 3) has an electrical supply isolator (4), circuit breakers and indicator lamps (1) which show when the electrical supplies to the Power Supply Unit are on. The Power Supply Unit also has indicator lamps (5) which show when a circuit breaker has tripped, and reset buttons (6) to reset a circuit breaker when it has tripped.

Another lamp (3) is on when the interlock signal to the Power Supply Unit is on (see Section 1.12). When the interlock signal is off, the electrical supplies to the Source are switched off.

The electronic valves in the Power Supply Unit are cooled by air from cooling-fans. A lamp (2) is on when the fans are operating.

The Power Supply Unit has a baseframe with castors, for easy movement of the Power Supply Unit. The Power Supply Unit can be located in its operating position on the baseframe or can be rack mounted in a suitable 19 inch rack unit with the rack mounting strips supplied.



1. Phase supply lamps
2. Fan lamp
3. Interlock lamp
4. Electrical supply isolator
5. Circuit breaker indicator lamps
6. Circuit breaker reset buttons

Figure 3 - Front panel of the EB3 Power Supply Unit

1.6.2 The EB3 Source Control

The EB3 Source Control is used to control the operation of the EB3 Multihearth Electron Beam Source.

Refer to Figure 4. The front panel of the Source Control has an on/off switch (11) for the Source Control and an on/off switch for the Source (the gun switch, 10). A voltmeter (1) shows the electrical voltage supplied to the Source. The beam (emission) current or the filament current supplied to the Source are shown on the ammeter (7). The current displayed on the ammeter is selected by the meter switch (6).

The current control (5) allows you to change the current supplied to the filament and so to change the beam (emission) current.

The voltage adjuster (2) allows you to adjust the voltage supplied to the source.

The Source can be controlled either locally by the Source Control or remotely by your own control equipment (for example, a film deposition controller). A switch on the front panel (9) allows you to select local control (through the Source Control) or remote control.

Status LEDs (8) show when the Source Control is on, when the interlocks are on (refer to Section 1.12), when the Source is on and whether the Source is remotely or locally controlled.

A current adjuster on the rear of the Source Control (Figure 37, item 1) allows you to preset the maximum emission current (when the current control on the front of the Source Control is at the maximum setting: see above).

1.7 EB3 Motorised Turret Drive Kit

The EB3 Motorised Turret Drive allows you to automatically rotate the crucible on the EB3 Multihearth Electron Beam Source.

The Source is mounted on a baffle plate (Figure 6, item 7) which fits onto the AUTO 306 Tripod (Figure 6, item 2).

A turret drive passes through a leadthrough in the baseplate of the AUTO 306 and connects to the turret of the Source. The turret is rotated (through the turret drive) by an electric motor. Microswitches on the Motorised Turret Drive detect the position of the turret and stop the turret at the selected position.

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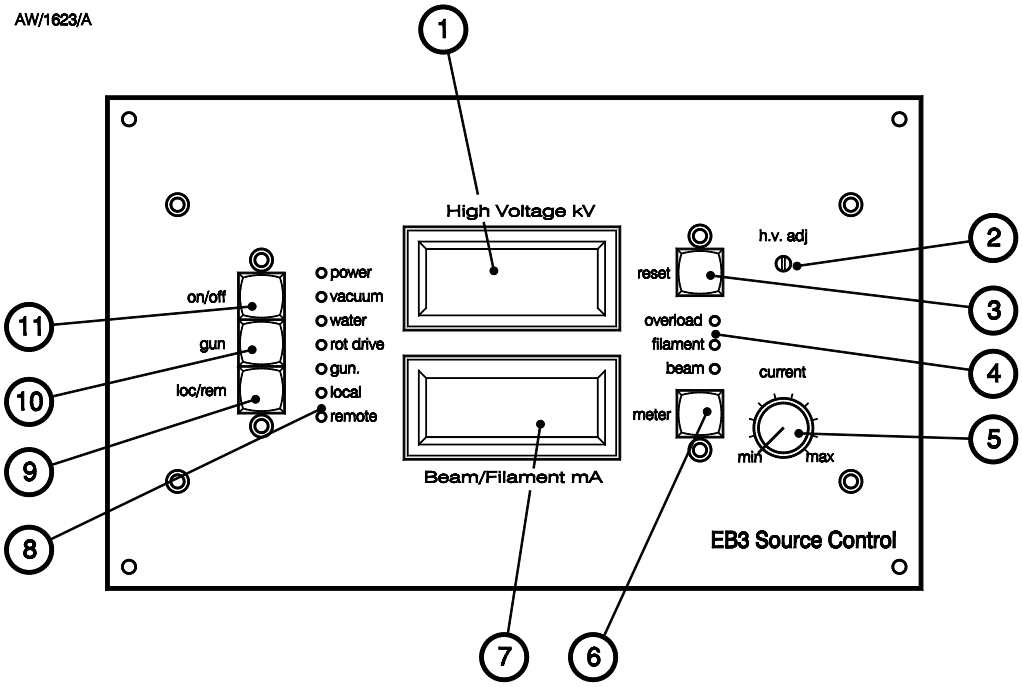


1. Voltmeter
2. Voltage adjuster
3. Overload reset switch
4. LEDs
5. Current control
6. Meter switch
7. Ammeter
8. Status LEDs
9. Local/remote switch
10. Gun switch
11. On/off switch

Figure 4 - Front panel of the EB3 Source Control

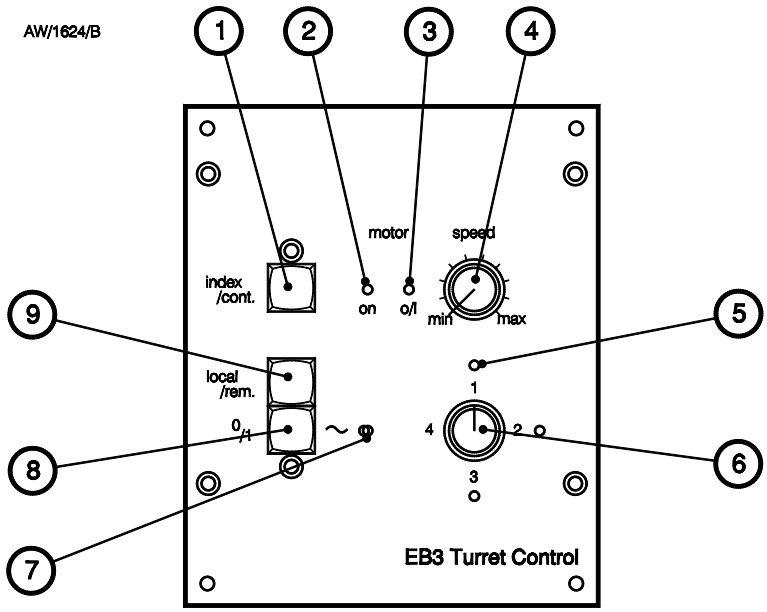
You use the EB3 Turret Control (Figure 5) to control the rotation of the crucible.

- With a four hearth crucible in the Source, you can select one of the four hearths. The turret and crucible will then rotate until the selected hearth is in the evaporation position; this is known as turret indexing.

  When you index the turret, the drive outputs an interlock signal to the Source Control which switches off the electron beam while the crucible is rotating (see Section 1.12). This is to ensure that the electron beam does not strike the crucible between the hearths.

- With another type of crucible in the Source, you can select continuous rotation of the crucible. You can control the speed of rotation between 0.1 and 3 r min^{-1}.

A connector on the Turret Control can be used to remotely select a crucible position; another connector on the Turret Drive can be used to output crucible position information to control equipment. These facilities allow you to use your own control equipment (for example, a film deposition controller) to remotely control the rotation of the crucible.



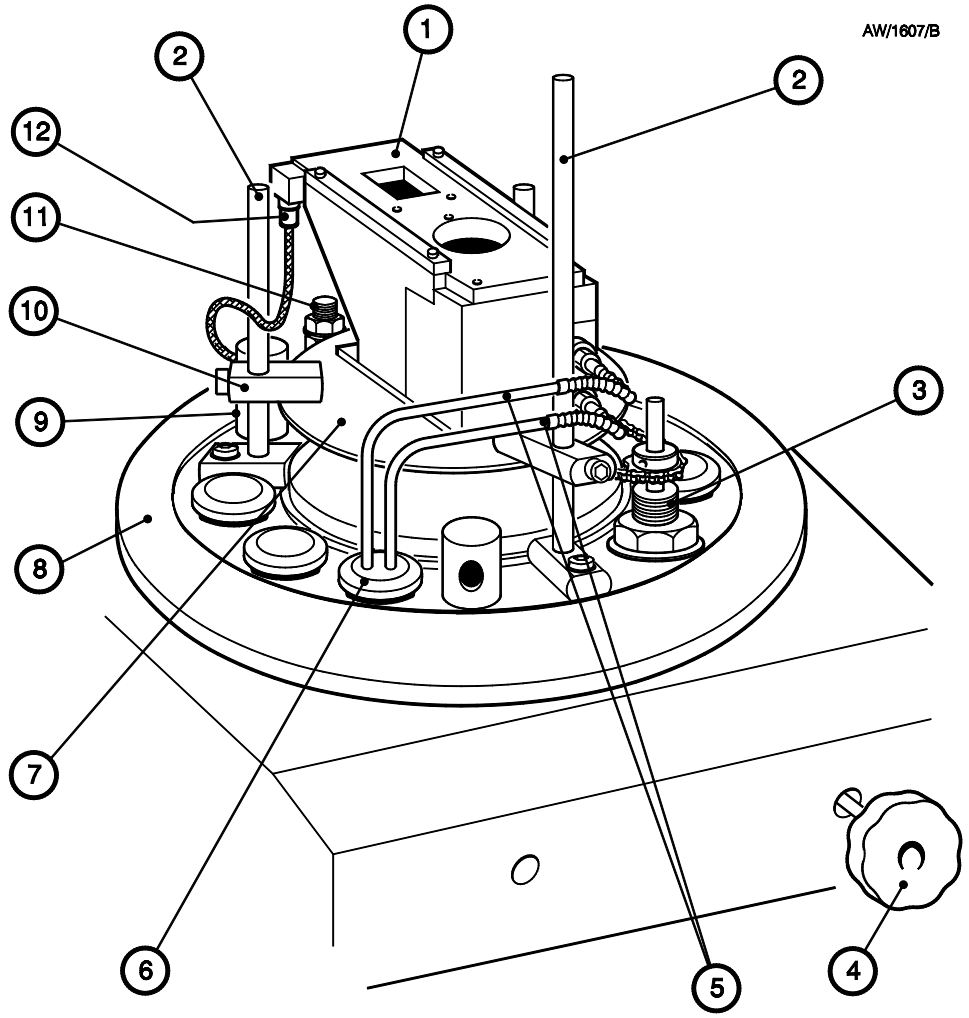
1. Index/continuous rotation switch
2. Motor on LED
3. Motor overload LED
4. Continuous rotation speed control
5. Hearth indicator LEDs
6. Hearth selector switch
7. On/off LED
8. On/off switch
9. Local/remote switch

Figure 5 - Front panel of the EB3 Turret Control

1.8 EB3 Manual Turret Drive Kit

The EB3 Manual Turret Drive allows you to manually rotate the crucible on the EB3 Multihearth Electron Beam Source.

Refer to Figure 6. The Source is mounted on a baffle plate (7) which fits onto the AUTO 306 Tripod (2). A right-angle turret drive (3) passes through a leadthrough in the baseplate of the AUTO 306 (8) and connects to the turret of the Source. When you turn the handwheel (4), the turret drive turns the turret on which the crucible is fitted. The turret has a click-stop, so that you can tell when the crucible is in the correct position for evaporation (refer to Volume 2).



1. EB3 Multihearth Electron Beam Source
2. Tripod leg
3. Turret drive
4. Handwheel
5. Cooling-water pipes
6. Water leadthrough
7. Baffle plate
8. AUTO 306 baseplate
9. Shield (over TL8K25 leadthrough)
10. Baffle plate lug
11. 6EK25 leadthrough
12. Beam sweep connector

Figure 6 - EB3 Multihearth Electron Beam Source mounted on the AUTO 306 baseplate (with Manual Turret Drive)

1.9 EB3 Beam Sweep Unit

The EB3 Beam Sweep Unit allows you to scan the electron beam across the hearth, in the X and Y directions as described in Section 1.4.2. The Beam Sweep Unit has a TL8K25 electrical leadthrough for the beam sweep control electrical supplies and an EB3 Sweep Control to control the operation of the beam sweep. Use beam sweep if you use a disk crucible to evaporate a dielectric material (see Volume 2, Section 2).

The front panel of the Sweep Control (see Figure 7) has: an on/off switch (7); amplitude controls (1, 2) which you use to control the amplitude of the X and Y deflection; frequency controls (4, 10) which select the frequency of the X and Y deflections; and waveform selectors (6, 8) which select the waveform of the deflections. Two sets of LEDs (5, 9) show the deflection schematically.

The offset adjusters (3, 11) allow you to select the static position of the electron beam on the hearth when you have no beam sweep selected. Once you have selected the static position, any beam sweep you select is then relative to the static position.

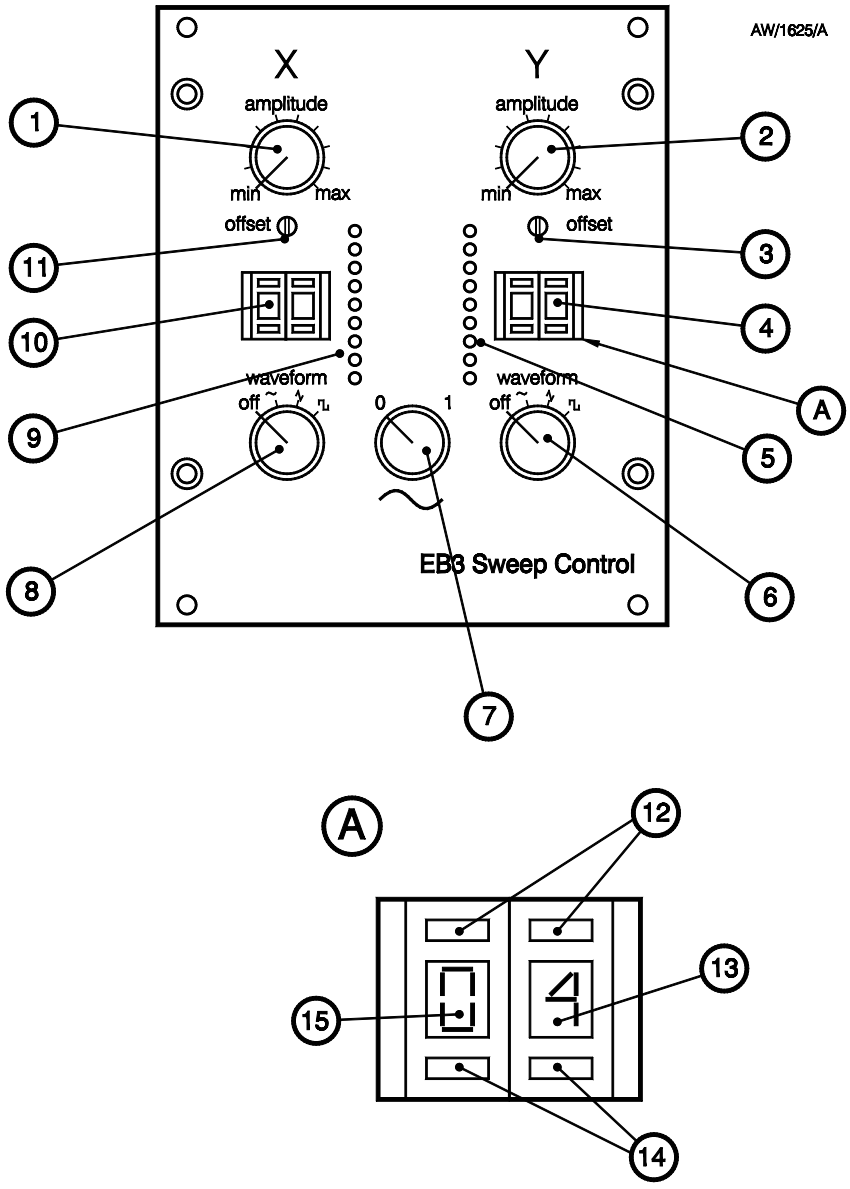
If you select the appropriate settings on the controls described above, the electron beam will move in, for example, a circular path over the hearth. Alternatively, you can select the appropriate settings so that the electron beam 'scans' forwards and backwards over the evaporant; you could use this type of beam sweep with a continually rotating crucible.

1.10 EB3 Leadthrough Kit

This kit contains all of the electrical and water leadthroughs for the AUTO 306 baseplate (except for the beam sweep electrical leadthrough: see Section 1.9) and the cooling-water pipelines for the Source.

The kit components are as follows:

- Two 6EK25 high voltage electrical leadthroughs and earth terminals.
- Emitter wires, to connect the high voltage electrical supplies from the 6EK25 leadthroughs to the emitter assembly on the Source.
- A cooling-water leadthrough, with two flexible cooling-water pipelines and connections to connect the cooling-water pipelines to the cooling-water connections on the Source.
- Two 'T' pieces, reducing connectors and tube to connect the AUTO 306 cooling-water pipelines to the cooling-water pipes on the cooling-water leadthrough.



A Detail of frequency control

1. Amplitude control (X)
2. Amplitude control (Y)
3. Offset adjuster (Y)
4. Frequency control (Y)
5. Scanning LEDs (Y)
6. Waveform selector (Y)
7. On/off switch
8. Waveform selector (X)
9. Scanning LEDs (X)
10. Frequency control (X)
11. Offset adjuster (X)
12. Pushbutton (increase)
13. Frequency indicator (units)
14. Pushbutton (decrease)
15. Frequency indicator (tens)

Figure 7 - Front panel of the EB3 Sweep Control

1.11 EB3 Water Flow-Switch Kit

Note: If you do not fit the EB3 Water Flow-Switch to switch off the EB3 Multihearth Electron Beam Source if the cooling-water supply fails, you must fit an alternative suitable flow-switch. You will damage the Source if you operate it without a suitable flow of cooling-water.

Use the EB3 Water Flow-Switch to protect the EB3 Multihearth Electron Beam Source from overheating if the cooling-water supply fails.

The Water Flow-Switch is fitted in the cooling-water return pipelines and connected to the Source Control. The Water Flow-Switch sends a signal to the Source Control when the cooling-water flow is correct. When the cooling-water flow is too low, the Source is automatically switched off.

1.12 Interlocks

The EB3 Multihearth Electron Beam Source and its accessories have a number of interlocks which prevent operation of the equipment in certain conditions. The interlocks are of two types:

- Safety interlock — This interlock is designed to protect the operator or a maintenance engineer from injury or death.
- Functional interlocks — These interlocks are designed to protect the Source from damage.

The interlocks **must** be installed and used as described in Section 3.

1.12.1 Safety interlock

To ensure operator safety, the Power Supply Unit will only switch on the high voltage electrical supplies to the Source and switch on the power to the Source Control when the safety interlock is closed. The safety interlock is generated by the AUTO 306 and is:

- normally closed when the AUTO 306 is switched on and all of the AUTO 306 panels and doors are closed and the vacuum chamber is under vacuum.
- open when any of the AUTO 306 panels or doors are open or when the vacuum chamber is not under vacuum.

An indicator lamp on the front panel of the Power Supply Unit (Figure 3, item 3) is on when the safety interlock is closed.

1.12.2 Functional interlocks

Note: You cannot determine whether the functional interlocks are closed unless the safety interlock is closed; while the safety interlock is open, the electrical supplies to the EB3 Source Control are off (see Section 1.12.1).

The EB3 Source Control has a number of functional interlocks which are input through connectors on the rear panel of the Source Control. The Source will only operate when all of these interlocks are closed. Status LEDs on the front panel of the Source Control (Figure 4, items 8) are on when the corresponding interlock is closed.

The functional interlocks are:

- Vacuum level — This interlock is generated by the AUTO 306 and is only closed when the pressure in the AUTO 306 chamber is less than a preset pressure: refer to Section 3.17.2. Operation of the Source at high chamber pressures could damage the Source.
- Water — This interlock is closed only when there is an adequate flow of cooling-water through the Source. Operation of the Source when there is no cooling-water flow will cause the Source to overheat and damage the Source.
- Rotary drive — This interlock is closed only when the crucible is not rotating. This interlock signal prevents the electron beam hitting the crucible between the hearths, when you index between hearths on a four hearth crucible.

The Source Control is supplied with two linking connectors which you can fit to the rear panel of the Source Control to ensure that the rotary drive and water interlocks are permanently closed. However:

- If you fit an EB3 Water Flow-Switch, you connect a cable from the Water Flow-Switch to the Source Control. The Water Flow-Switch will close the interlock when the cooling-water flow rate is acceptable.
- You should only fit the rotary drive interlock linking connector if you fit an EB3 Manual Turret Drive. If you fit an EB3 Motorised Turret Drive, you connect a cable from the Turret Drive to the Source Control. The Turret Drive will close the interlock when the crucible is stationary in the selected hearth position.

1.13 Local and remote operation

The EB3 Multihearth Electron Beam Source can be controlled in one of two ways:

- Locally, through the Source Control, the Sweep Control and the Turret Control (if fitted). For local operation, refer to Volume 2 of this instruction manual.
- Remotely, through other control equipment, for example a film deposition controller. Refer to Section 3.19 for the electrical connections for remote control.

1.14 Installation of the EB3 Multihearth Electron Beam Source on other equipment

This manual describes the installation, operation and maintenance of the EB3 Multihearth Electron Beam Source and its accessories in the AUTO 306 coating system. You can install the Source in other systems as long as:

- The system design incorporates safety and functional interlocks equivalent to those described in Sections 1.12 and 3.
- The electrical and cooling-water services comply with the requirements of Section 2.
- Maintenance procedures equivalent to those in Section 4 are complied with.
- The Source is mounted on a non-magnetic base.

Failure to comply with any of the above may invalidate the warranty on your equipment.

If you require further information on the installation of the Source and its accessories in other equipment, please contact your supplier or BOC Edwards.

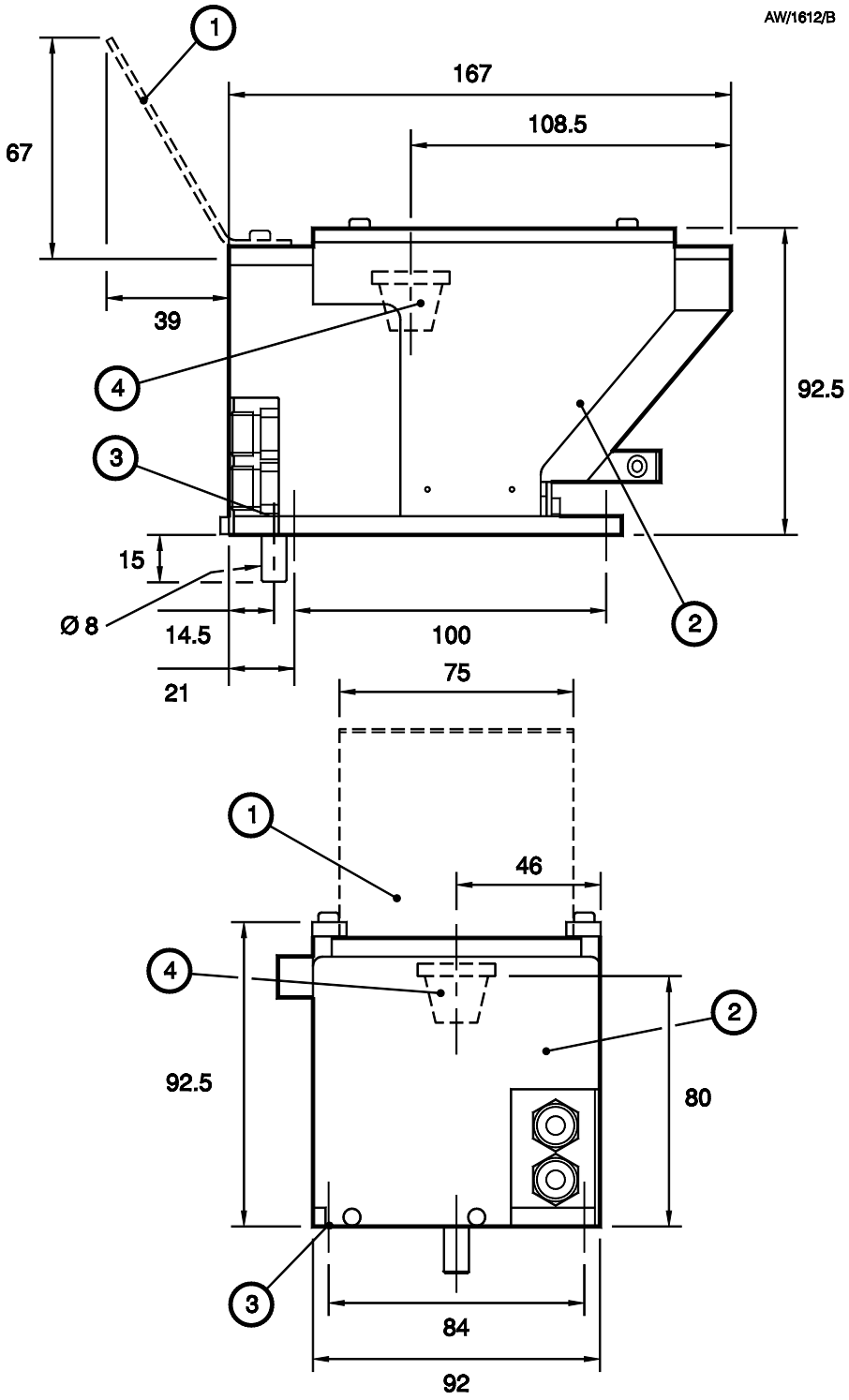
2 TECHNICAL DATA

2.1 General

Maximum operating temperature	5 to 40 ^{o}C
Maximum operating humidity	80 % up to 31 ^{o}C, 50 % up to 40 ^{o}C
Maximum operating altitude	2000 m
Installation category	II
Pollution degree	2
Dimensions	See Figures 8 to 12
Mass	
EB3 Multihearth Electron Beam Source (fitted with a four hearth crucible)	4.9 kg
EB3 Source Control	1.5 kg
EB3 3 kW Power Supply	110 kg
EB3 Turret Control and Motorised Turret Drive	3.46 kg
EB3 Manual Turret Drive	1.53 kg
EB3 Beam Sweep Unit, leadthrough and connections	1.9 kg
EB3 Leadthrough Kit	1.55 kg
EB3 Water Flow-Switch	0.35 kg

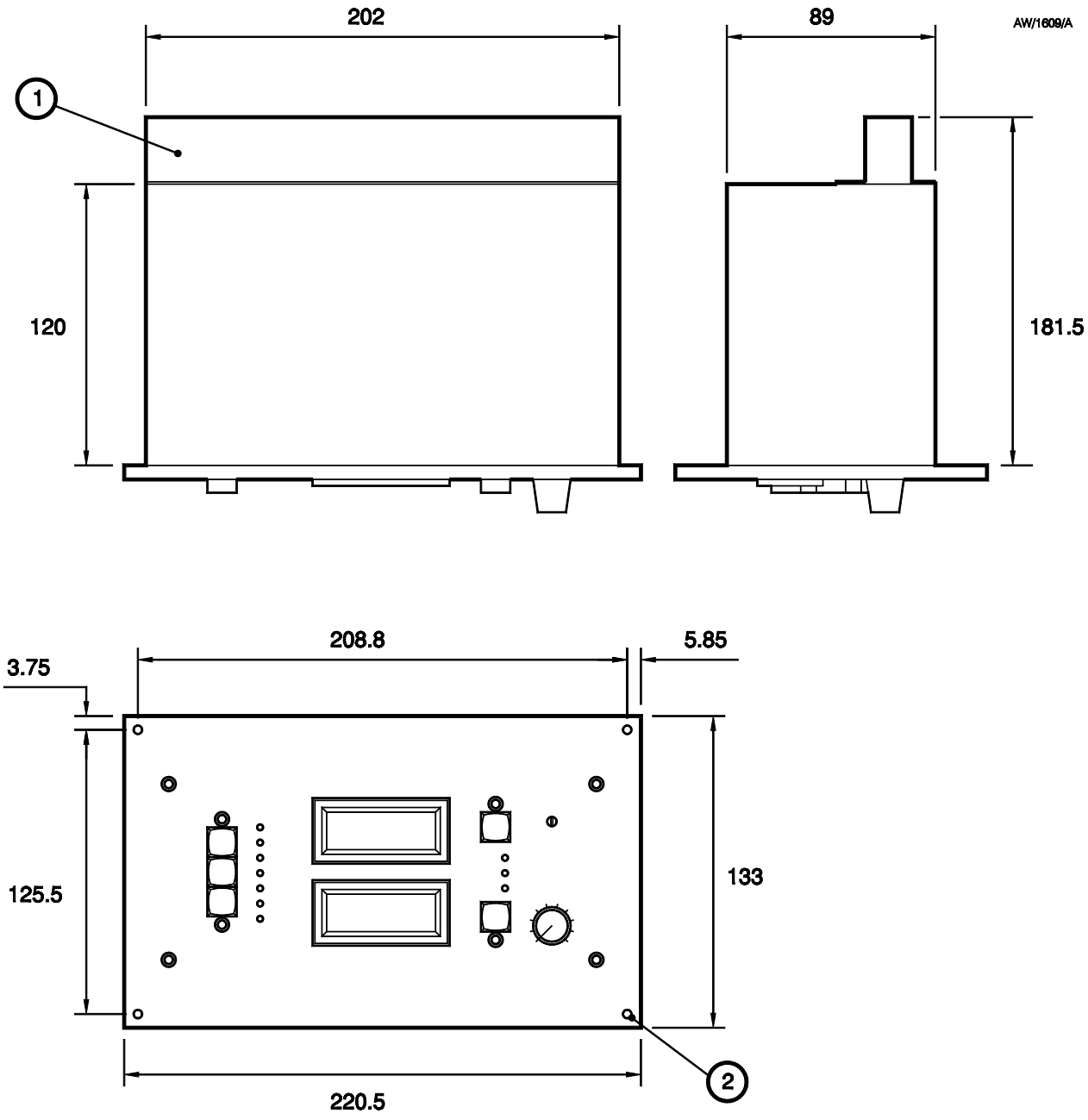
2.2 EB3 Multihearth Electron Beam Source

Operating voltage	5 kV
Filament electrical supply	6 V at 20 A
Emission (beam) current & power	600 mA, 3 kW (maximum)
Magnet type	Permanent Alnico (aluminium, nickel, cobalt) type
Beam diameter (at evaporant)	approx 4 mm (at 1 kW power)
Minimum cooling-water flow rate	3 l min^{-1} at 20 ^{o}C
Cooling-water connections	Cajon VCO $^{1}/_{4}$ inch fittings
Maximum operating time at full power	1 hour



1. Position of the Secondary Electron Absorber (optional accessory)
2. EB3 Multihearth Electron Beam Source
3. Fixing hole: M3 (4 off)
4. Position of the hearth (in a four hearth crucible)

Figure 8 - Dimensions of the EB3 Multihearth Electron Beam Source (mm)



1. Connector cover
2. Fixing hole: M3 (4 off)

Figure 9 - Dimensions of the EB3 Source Control (mm)

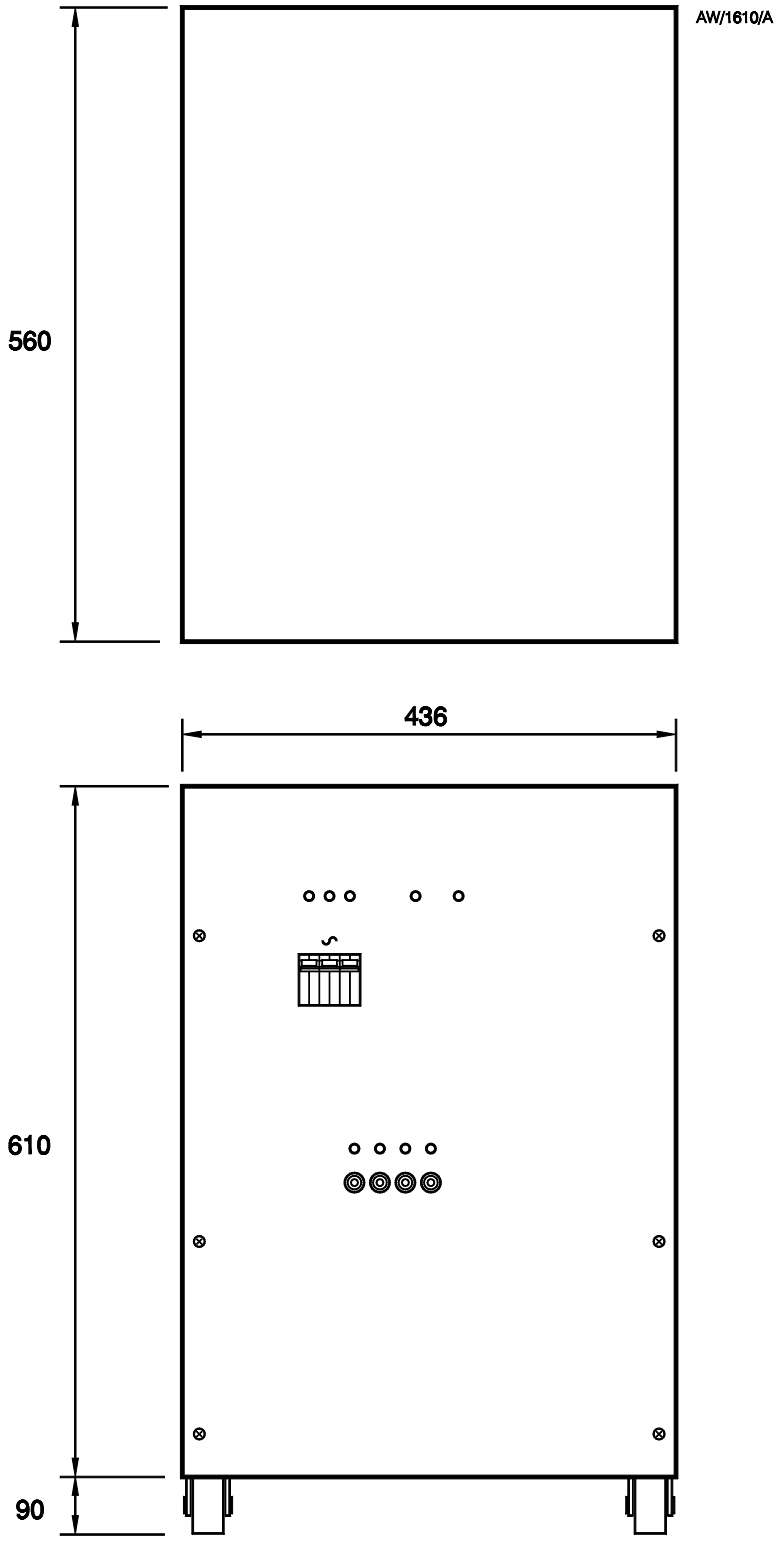
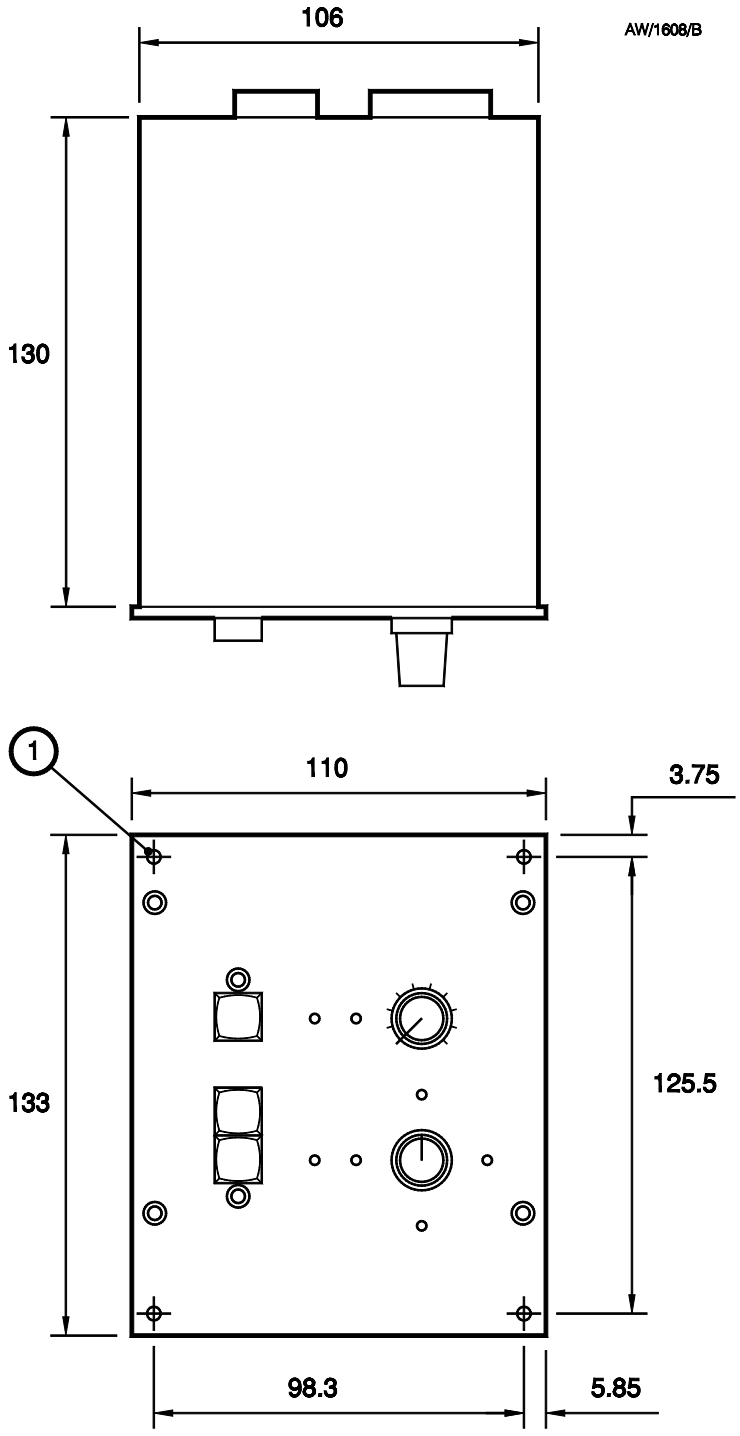
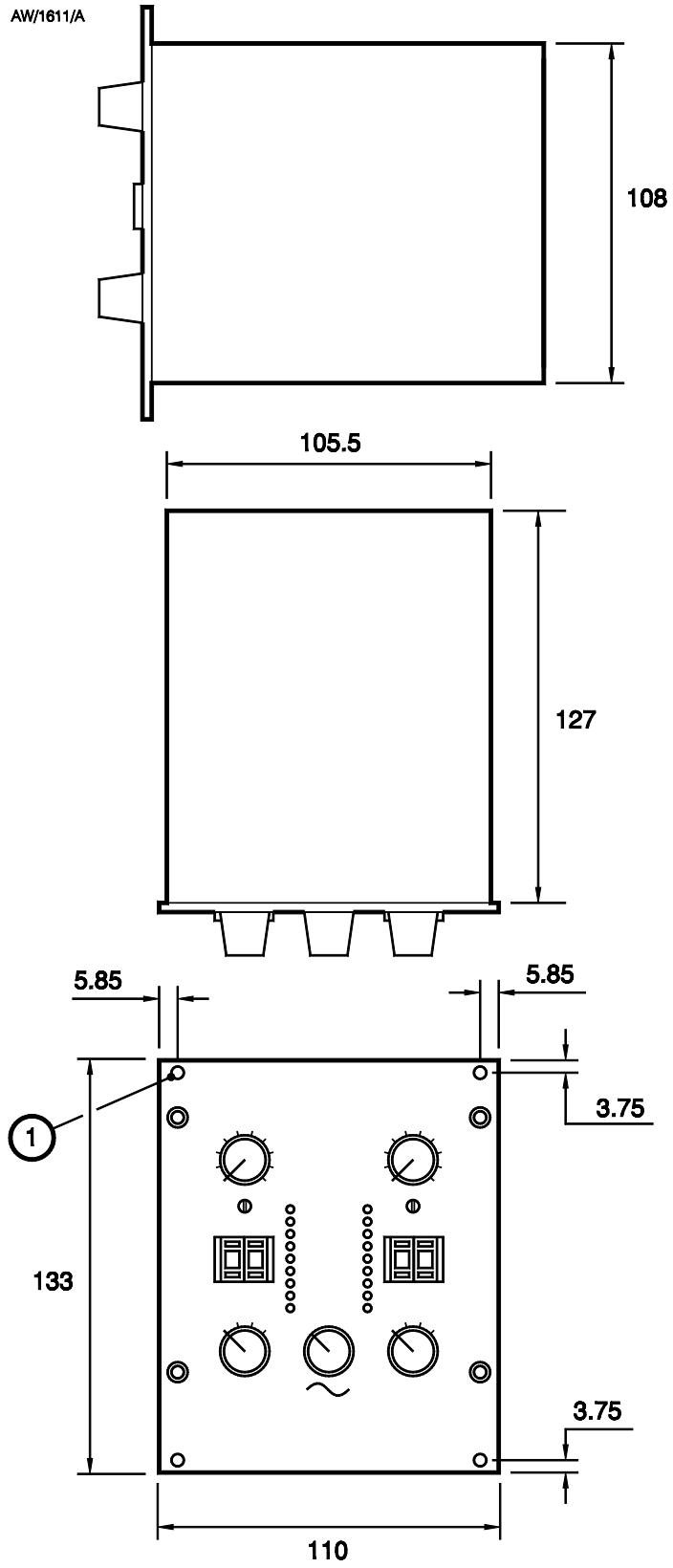


Figure 10 - Dimensions of the EB3 Power Supply Unit (mm)



1. Fixing hole: M3 (4 off)

Figure 11 - Dimensions of the EB3 Turret Control (mm)



1. Fixing hole: M3 (4 off)

Figure 12 - Dimensions of the EB3 Sweep Control (mm)

2.3 EB3 3 kW Power Supply

EB3 Power Supply Unit

Electrical supply	380/415/440 V, 3-phase, 4 wire (for US: 4 wire + neutral), 50 Hz or 220 V, 3-phase, 60 Hz
Electrical supply voltage tolerance	± 10%
Power consumption	6 kVA
High voltage circuit	
Output voltage	4.5 to 5.5 kV d.c. adjustable
Maximum emission current	600 mA
Ripple	0.5% of r.m.s.
Voltage regulation	±1.0%
Overload condition	Output current ≥ 650 mA for 35 ±5 ms
Low voltage circuit	
Filament output	0 to 6 V a.c. at 20 A
Electrical supply socket/plug	CEE 17 (BS4343)
High/low voltage cables	Type UR67

EB3 Source Control

Voltage meter range	0 to 6 kV
Ammeter range	
Emission (beam) current	0 to 600 mA
Filament current	0 to 2000 mA
Remote control signal	0 to ±10 V

2.4 EB3 Motorised Turret Drive

EB3 Turret Control electrical supply	208 to 250 V a.c., 50/60 Hz
Power	10 VA
Turret drive motor voltage	12 V d.c. (approx)
Rotation speed	
Indexing	2 r min^{-1} (approx)
Constant rotation	0.1 to 3 r min^{-1} adjustable

2.5 EB3 Beam Sweep Unit

Electrical supply	208 to 250 V, 50/60 Hz
Power	10 VA
Electrical supply voltage tolerance	±10%
Maximum deflection current	0.05 A
Waveform	Sine, triangular or square (selectable)
Sweep frequency	1 to 99 Hz adjustable
Maximum sweep deflection (in X and Y direction)	± 8 mm (with 4 mm diameter beam)

2.6 EB3 Water Flow-Switch

Minimum water flow rate (for interlock to operate)	3 l min^{-1}
Maximum switched voltage	230 V a.c.
Maximum switched current	3 A

2.7 Fuses

EB3 Sweep Control	20 x 5 mm, 1.0 A, type T
EB3 Turret Control	20 x 5 mm, 100 mA, type F

2.8 Cooling-water supply

Note: In addition to the temperature and pressure stated below, your cooling-water supply must be clean; that is, it should not contain particles which could block the water flow-switch and prevent its correct operation. We recommend that you fit a filter in your cooling-water supply and the maximum acceptable size of particles in your cooling-water supply will depend on the type of filter you fit. The maximum particle size stated below is for correct operation of the EB3 Water Flow-Switch.

Maximum particle size	50 μm (see Note above)
Maximum supply temperature	30 ^{o}C
Maximum supply pressure	7 bar (7 x 10^5 Pa)

2.9 Legislation and standards

The EB3 Multihearth Electron Beam Source and its accessories have been designed in compliance with the following standard:

- IEC 1010-1, 1990 Safety requirements for electrical equipment for measurement, control and laboratory use

3 INSTALLATION

3.1 Unpack and inspect

Note: In the following sections, the horizontal lines in Tables 1 and 2 divide the tables to identify the components which are packed together.

3.1.1 EB3 Multihearth Electron Beam Source

Remove all packing materials and protective covers and check the Source. If the Source is damaged, notify your supplier and the carrier in writing within three days; state the Item Number of the Source together with your order number and your supplier's invoice number. Retain all packing materials for inspection. Do not use the Source if it is damaged.

Check that you have received the items listed in Table 1 below. If any of these items is missing, notify your supplier in writing within three days. If the Source is not to be used immediately, replace the protective covers. Store the Source in suitable conditions, as described in Section 5.

Qty	Description	Check (✓)
1	EB3 Multihearth Electron Beam Source (fitted with four hearth crucible)	❑
1	Hex wrench: 2.5 AF	❑
1	Hex wrench: 3.0 AF	❑
6	Pole piece extensions (3 sets of 2)	❑

Table 1 - Component checklist for the EB3 Multihearth Electron Beam Source

3.1.2 EB3 3 kW Power Supply

WARNING

Use suitable lifting equipment to move the EB3 3 kW Power Supply pallet. Do not try to move the pallet or the Power Supply Unit on your own. The EB3 3 kW Power Supply pallet has a mass of over 100 kg.

Refer to Figure 13 and use the following procedure to unpack and inspect the EB3 3 kW Power Supply.

1. Use a pallet truck or fork-lift truck to move the pallet (7) close to where you will install the equipment.
2. Remove the straps (2) which secure the packaging, lift off the top lid (1), then lift the sleeve (3) off of the pallet.
3. Remove the carton (4) and all remaining packing (5) from the EB3 3 kW Power Supply.

(Continued on page 28)

4. Remove the ramp (9) from the pallet (7), then turn the ramp around and place it at the end of the pallet, as shown in detail B.
5. Remove the conduit (8) from the end of the Power Supply Unit.
6. Get someone to help you to carefully roll the Power Supply Unit (6) down the ramp (9) and off of the pallet (7).
7. Open the carton (4) and remove its contents.
8. Check all the components. If any component is damaged, notify your supplier and the carrier in writing within three days; state the Item Number of the EB3 3 kW Power Supply together with your order number and your supplier's invoice number. Retain all packing materials for inspection. Do not use the EB3 3 kW Power Supply if it is damaged.
9. Check that you have received the items listed in Table 2. If any of these items is missing, notify your supplier in writing within three days.
10. If the EB3 3 kW Power Supply is not to be used immediately, replace the protective covers. Store the accessory in suitable conditions, as described in Section 5.

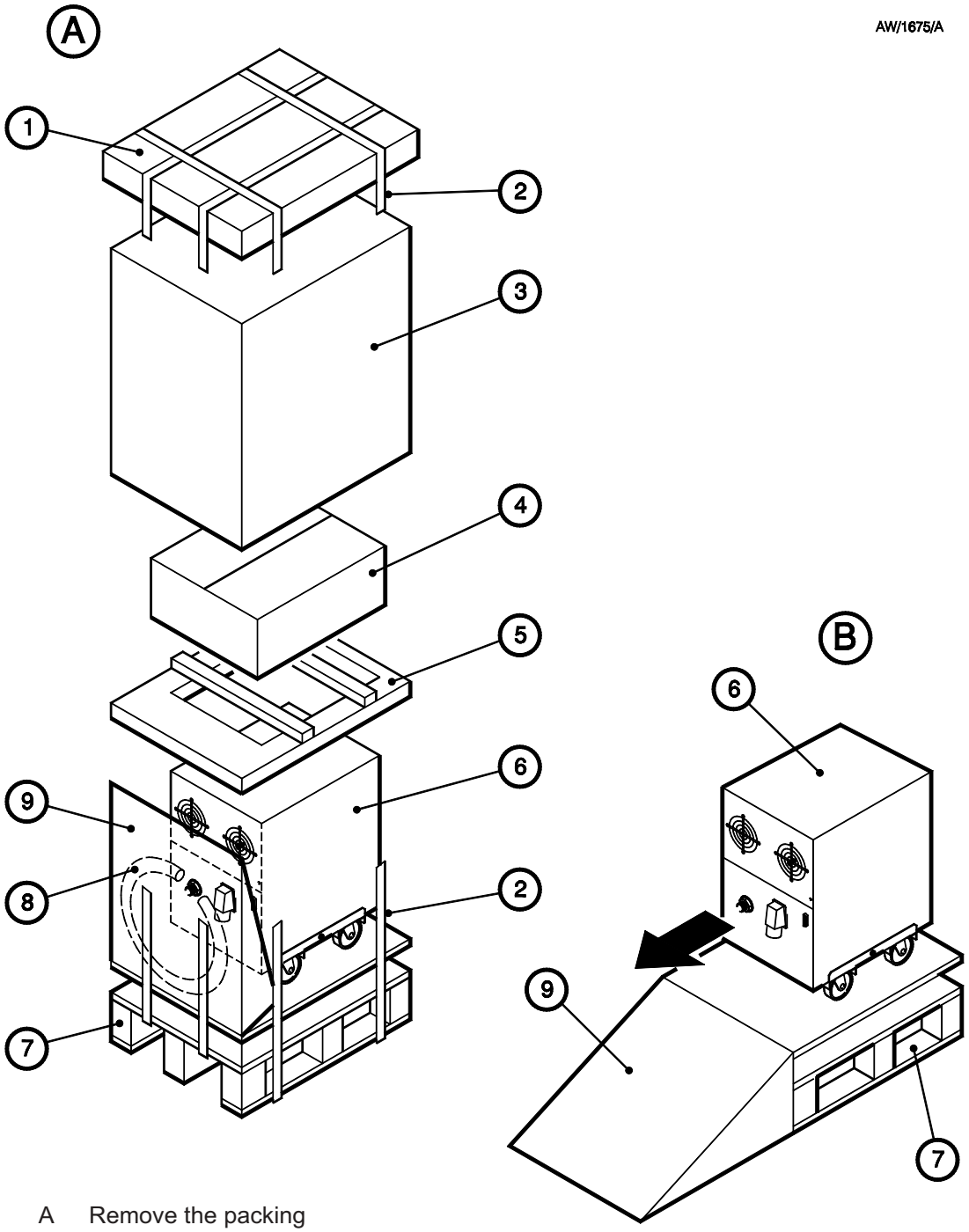
Qty	Description	Check (✓)
1	EB3 Power Supply Unit (with baseframe)	❑
2	Rack mounting strips	❑
1	Electrical supply plug	❑
2	Electronic valves	❑
1	Conduit and couplings	❑
1	Power Supply to Source Control cable	❑
1	EB3 Source Control	❑
1	Water interlock 3-way DIN connector*	❑
1	Vacuum level interlock 4-way DIN connector and cable*	❑
1	Rotary drive interlock 4-way DIN connector*	❑
1	Remote control 6-way DIN connector*	❑
1	Pack of cable ties	❑

* Fitted to the rear panel of the EB3 Source Control.

Table 2 - Component checklist for the EB3 3 kW Power Supply

3.1.3 Other accessories

If you have received other accessories (for example, an EB3 Motorised Turret Drive or an EB3 Beam Sweep Unit), unpack and inspect the accessories as described in the instructions supplied with the accessories.



A Remove the packing

B Roll the unit off of the pallet

1. Top lid
2. Strap
3. Sleeve
4. Carton
5. Packing
6. Power Supply Unit
7. Pallet
8. Conduit (at the end of the Power Supply Unit)
9. Ramp

Figure 13 - Unpack the EB3 3 kW Power Supply

3.2 Safety

3.2.1 General requirements

WARNING

Obey the safety instructions given below and take note of appropriate precautions. If you do not, you can cause injury to people and damage to equipment.

- Read this instruction manual and the instruction manuals supplied with other AUTO 306 accessories before you install any accessories.
- Switch off the electrical supply and disconnect the AUTO 306 from the electrical supply before you start installation work.
- These accessories have been designed for installation and use on the BOC Edwards AUTO 306 vacuum coater with its comprehensive safety features to BS 5304. If they are installed and used on any other equipment, you must install devices to ensure that you adequately support, safely enclose, insulate, interlock, and provide short circuit protection for the accessories, as appropriate.
- Ensure that the EB3 Multihearth Electron Beam Source is not installed in an area where equipment subject to magnetic interference is used.
- Ensure that installation is done by a suitably trained and supervised technician. Obey your local and national safety requirements.
- Observe all safety precautions when you come into contact with dangerous substances which have been used in the AUTO 306.
- Allow hot surfaces in the AUTO 306 to cool before you start work. Do not touch any part of the liquid nitrogen reservoir or connecting pipes (if fitted) in the AUTO 306. Do not allow liquid nitrogen vapour to touch your skin. These surfaces and the vapour are at a very low temperature and can cause tissue damage.
- Instructions to open the AUTO 306 electrical control cabinet and to remove the covers are given in the AUTO 306 instruction manual. It is important that you follow these instructions carefully to prevent damage to components such as the chamber leak valve.
- Wear clean lint-free gloves when you install components in the chamber to prevent contamination of the EB3 Multihearth Electron Beam Source and its accessories.

3.2.2 Electrical earth (ground) requirements

WARNING

Ensure that EB3 Multihearth Electron Beam Source components are adequately earthed (grounded). If they are not, components may have extremely dangerous electrical potential and can cause injury or death by electric shock.

The EB3 Multihearth Electron Beam Source operates at extremely high voltages with respect to electrical earth (ground). Unearthed (ungrounded) components can have dangerous electrical potential; this potential will vary directly with the connection between the EB3 Multihearth Electron Beam Source, other components and impedance to earth (ground).

You must correctly earth (ground) the EB3 components, not only for safety purposes, but also to prevent problems which could be caused by RFI (radio frequency interference). Both the EB3 3 kW Power Supply and the AUTO 306 must be securely bonded to a suitable earth (ground) connection. Consult a qualified electrical engineer or contact your electricity supplier who will advise on how to make your installation suitable.

One method of ensuring good earth (ground) resistance is as follows:

1. Drive two 20 mm ($^3/_4$ inch) diameter copper-clad steel rods into the ground, approximately 1.8 to 2 m (6 feet) apart.
2. Measure the electrical resistance between the rods. An acceptable earth (ground) connection is obtained when the electrical resistance between the rods is 3 Ω or less.
3. If the electrical resistance between the rods is greater than 3 Ω, pour a copper sulphate or salt solution around the two rods, then measure the electrical resistance between the rods again. If the electrical resistance between the rods is now 3 Ω or less, continue at Step 4 below. If you cannot obtain an electrical resistance of 3 Ω or less, do not continue with the installation, but consult a qualified electrical engineer or contact your electrical supplier for advice.
4. To ensure a low impedance path to earth (ground), connect the rods to each other and to the AUTO 306 by a 75 mm (3 inch) copper strap. The copper strap should be 0.9 to 1.3 mm (0.035 to 0.05 inches) thick if the distance between the rods and the AUTO 306 is 18.25 m (60 feet) or less. If the distance between the rods and the AUTO 306 is greater than 18.25 m (60 feet), contact your supplier or BOC Edwards for advice.
5. Silver solder the strap to one of the rods and secure it to the other rod mechanically, so that it can be disconnected for retesting the resistance between the rods.
6. Connect the other end of the strap to the AUTO 306 earth (ground) connection.

If you install the AUTO 306 on an upper floor of a building, and if the steel structure has a good earth (ground), you can use straps (as described above) to earth (ground) the AUTO 306 by connection to the steel structure. If necessary, use Steps 1 to 5 of the above procedure to create a good earth (ground) connection, then use the same type of strap as described above to connect the structure of the building to the rods.

3.2.3 Access to electrically live components

WARNING

Ensure that you cannot accidentally touch electrically live components through the leadthrough holes in the baseplate rear cover.

Refer to Figure 14, detail A. The baseplate rear cover (1) has plastic blanking plugs (2) fitted to leadthrough holes in the cover. These blanking plugs prevent accidental contact (through the leadthrough holes) with electrically live components in the system.

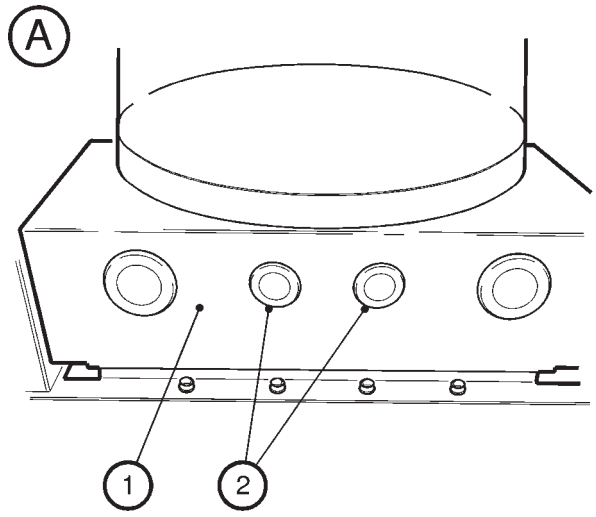
Do not remove any of the blanking plugs and leave the correspondng leadthrough hole uncovered. If you do, and the AUTO 306 is connected to the electrical supply, people may accidentally touch live components through the leadthrough hole, and there will be a danger of injury or death by electric shock.

If you need to route cables or wires for other AUTO 306 accessories (or other additional equipment) through one of the leadthrough holes:

- Refer to detail B. Make a suitable sized cut-out in the blanking plug (3), pass the cables or wires (4) through the cut-out, then refit the blanking plug to the baseplate rear cover.

  Alternatively, fit a suitable cable-gland or conduit fitting to the leadthrough hole, to allow the cables or wires to be routed into the system.

- When you route the cables or wires through the system, ensure that they are clear of any live terminals or other components.



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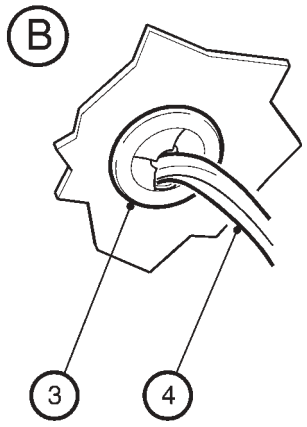


1. Baseplate rear cover
2. Plastic blanking plugs (fitted to the leadthrough holes)
3. Plastic blanking plug (with cut-out)
4. Cables/wires

Figure 14 - Leadthrough holes and covers on the baseplate rear cover

3.3 Installation options

3.3.1 Installation in the Bell Jar

Sections 3.4 to 3.17 describe the installation of the EB3 Multihearth Electron Beam Source and its accessories in the AUTO 306 Bell Jar. You can change the order in which you install the Source and its accessories. However, we recommend that you install the equipment in the order of the procedures given in Sections 3.4 to 3.17. If you do not, you may find it difficult to fit some of the accessories.

A summary of the recommended order of installation is as follows:

- Prepare the AUTO 306.
- Fit all leadthroughs to the AUTO 306 baseplate.
- Fit all other components in the AUTO 306 chamber and route all appropriate electrical wires and cables to the positions of the corresponding control units.
- Install the EB3 Power Supply Unit.
- Fit the (optional) control units (the EB3 Turret Control and EB3 Beam Sweep Unit) and the EB3 Source Control.
- Connect all of the electrical cables and wires to the control units.

3.3.2 Installation in the FL400 chamber

If you want to install the EB3 Multihearth Electron Beam Source and its accessories in the side evaporation configuration in the FL400 chamber, first install the FL400 chamber, then use the procedure in Section 3.18. Note that the order of installation is almost identical to the order of installation in the Bell Jar.

If you want to install the EB3 Multihearth Electron Beam Source and its accessories in the centre evaporation configuration in the FL400 chamber, first install the FL400 chamber, then use the Bell Jar installation procedures, as described in Sections 3.4 to 3.17.

3.3.3 Installation of other accessories

This manual does not specify when you should install other accessories, such as a shutter. When you fit an accessory depends on the type of accessory.

Read the instruction manuals supplied with the other accessories before you start any installation, to determine when you should install the accessories. If you do not, you may have to remove components you have already fitted in order to fit an accessory.

Note that the EB3/FL400 Mounting Kit contains an extension arm. Use this extension arm when you fit a shutter accessory into the FL400 chamber with the Source in the chamber in the side evaporation position.

We recommend that you fit the following accessories:

- A Secondary Electron Absorber, if the materials you will evaporate will cause secondary beam emission from the crucible. Fit the Secondary Electron Absorber as described in Section 3.15.
- A shutter accessory to shield the substrate until you are ready to start deposition. If you fit a shutter, it must be at least 25 mm above the top shield of the Source.
- A film thickness monitor so that you can measure the thickness of the deposition on the substrate.

The Item Numbers of suitable accessories are given in Section 6.

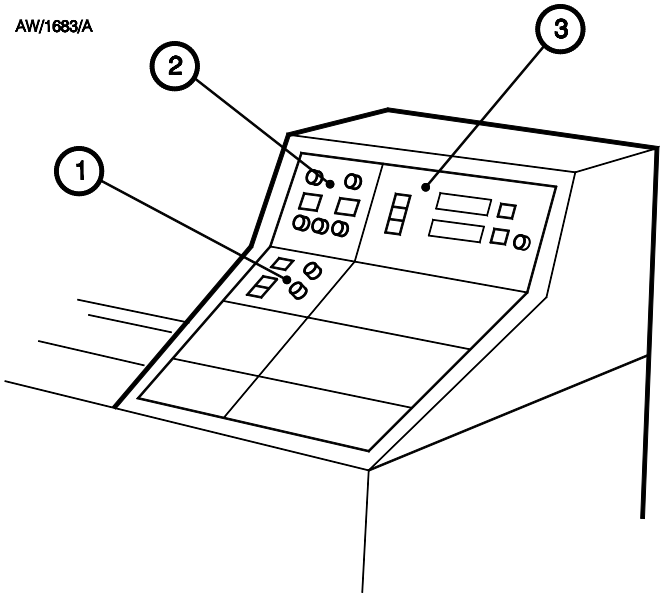
3.3.4 Local/remote control

Sections 3.4 to 3.18 describe installation of the EB3 Multihearth Electron Beam Source and its accessories for the local control mode. In this mode, control of the Source is by the use of the controls on the front panels of the EB3 Source Control, EB3 Sweep Control and EB3 Turret Control (if fitted).

If you want to use your own control equipment to control the operation of the Source, refer to Section 3.19.

3.4 Prepare the AUTO 306

1. Ensure that the AUTO 306 is switched off and is isolated from the electrical supply. Ensure that the AUTO 306 cooling-water supply is switched off.
2. Remove the Bell Jar from the AUTO 306 baseplate. Remove all accessories from the AUTO 306 baseplate except for the Tripod (if you have a Tripod fitted). If you do not have a Tripod fitted, fit one now before you start to install the Source.
3. Refer to Figure 15. Remove the appropriate blank panels from the AUTO 306 control unit and disconnect the earth (ground) wires from the rear of the panels; retain the securing screws:
   - Remove the blank panel (3) for the EB3 Source Control.
   - If you have an EB3 Motorised Turret Drive, remove the blank panel (1) for the EB3 Turret Control.
   - If you have an EB3 Beam Sweep Unit, remove the blank panel (2) for the EB3 Sweep Control.
4. Open all of the AUTO 306 electrical cabinet covers: refer to the AUTO 306 instruction manual.



1. EB3 Turret Control
2. EB3 Sweep Control
3. EB3 Source Control

Figure 15 - Panel fixing locations

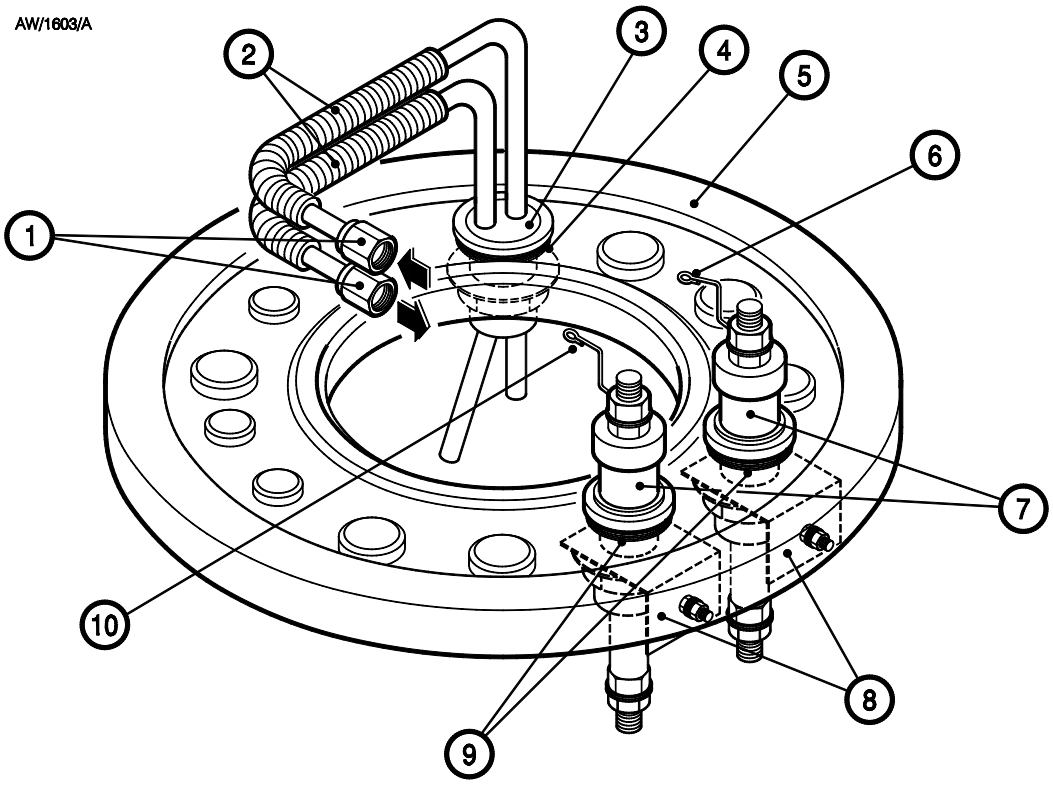
3.5 Fit the EB3 Leadthrough Kit

> CAUTION
>
> Ensure that the cooling-water pipes are routed away from sources of heat, such as the diffusion pump in the AUTO 306. If you do not, the pipes may melt.

Note: If required, fit suitable isolation-valves in the cooling-water pipes between the 'T' pieces and the reducing connectors. If you do, this will allow you to change the crucible on the Source and maintain the Source without the need to turn off the cooling-water supply to the rest of the AUTO 306 components.

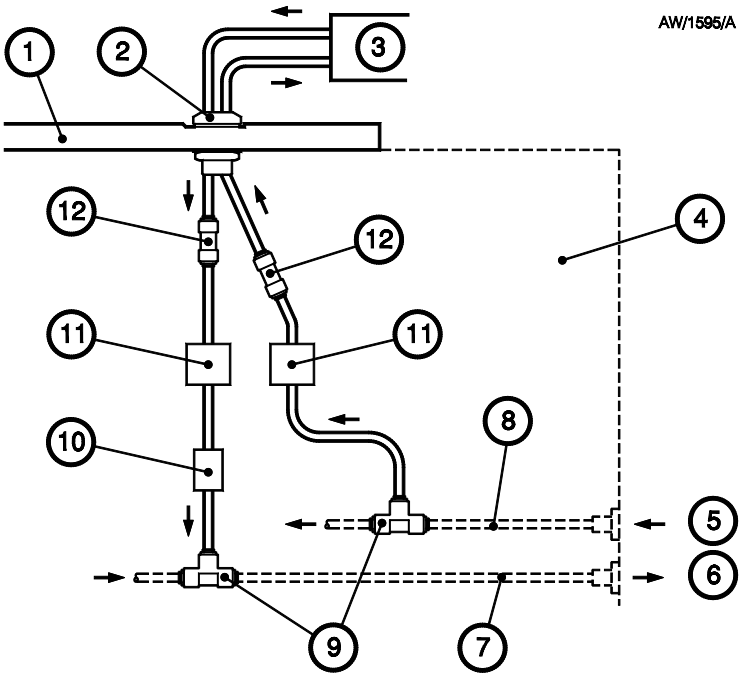
Refer to Figure 16 and use the following procedure to fit the EB3 Leadthrough Kit.

1. Remove the blanking plugs from leadthrough holes 1, 5, and 6 on the AUTO 306 baseplate (5).
2. Ensure that the baseplate 'O' rings (9) are clean, then fit the 'O' rings and the two 6EK25 leadthroughs (7) to leadthrough holes 5 and 6 in the AUTO 306 baseplate, with the two copper earth (ground) terminals (8) between the lower securing nut and the AUTO 306 baseplate (as shown in Figure 16).
3. Remove the nut and washer from the water leadthrough (3).
4. Ensure that the baseplate 'O' ring (4) is clean and is correctly located on the water leadthrough (3) and that the leadthrough is oriented as shown in Figure 6, then fit the water leadthrough to leadthrough hole 1 in the AUTO 306 baseplate (5).
5. Use the nut and washer removed in Step 3 to secure the water leadthrough to the baseplate.
6. Refer to Figure 17: Cut the AUTO 306 cooling-water inlet and outlet pipelines (7, 8) in the AUTO 306 cabinet, then fit the two 'T' pieces (9) to the cooling-water pipelines. Figure 18 shows how to connect the 'T' pieces to the cooling-water pipes.
7. Refer to Figure 17. Fit the two reducing connectors (12) to the cooling-water pipes on the bottom of the water leadthrough (2).
8. Cut two lengths of flexible pipe and fit between the 'T' pieces (9) and the reducing connectors (12). If required, fit isolation-valves (11) in the lengths of pipe. Ensure that you connect the inlet and outlet pipelines correctly: refer to the arrows which show the correct directions of cooling-water flow in Figures 16 and 17. Figure 18 shows how to connect the cooling-water pipes to the 'T' pieces and reducing adaptors.
9. Retain the two preshaped emitter wires (Figure 16, items 6 and 10, shown fitted to the 6EK25 leadthroughs); you will fit these to the leadthroughs and the EB3 Multihearth Electron Beam Source in Section 3.14.
10. If you will fit a Water Flow-Switch, continue at Section 3.6. Otherwise, use cable ties or other suitable means to secure all of the cooling-water pipes to the AUTO 306 cabinet.



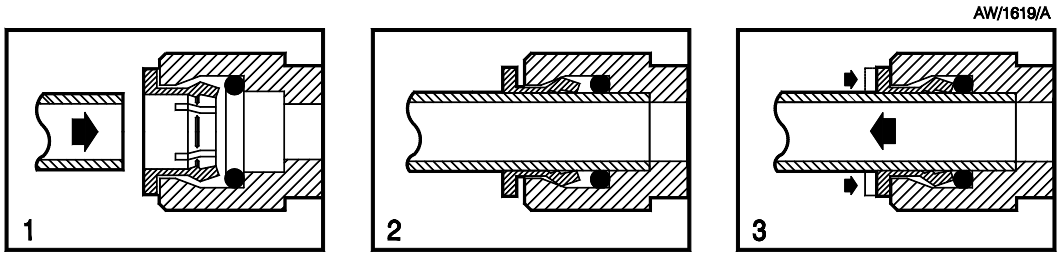
1. Cooling-water connections
2. Flexible cooling-water pipelines
3. Water leadthrough
4. Baseplate ‘O’ ring
5. AUTO 306 baseplate
6. Emitter wire
7. 6EK25 leadthroughs
8. Earth (ground) terminals
9. Baseplate ‘O’ rings
10. Emitter wire

Figure 16 - Fit the water and electrical leadthroughs



1. AUTO 306 baseplate
2. Water leadthrough
3. Source
4. AUTO 306 control cabinet
5. Cooling-water inlet
6. Cooling-water outlet
7. Cooling-water return pipeline
8. Cooling-water supply pipeline
9. 'T' pieces
10. Water flow-switch
11. Isolation-valves (optional)
12. Reducing adaptors

Figure 17 - Cooling-water pipelines



1. Connect the cooling-water pipe
2. Cooling-water pipe fitted
3. Remove the cooling-water pipe

Figure 18 - Connect the cooling-water pipes to the 'T' pieces and reducing adaptors

3.6 Fit the EB3 Water Flow-Switch

CAUTION

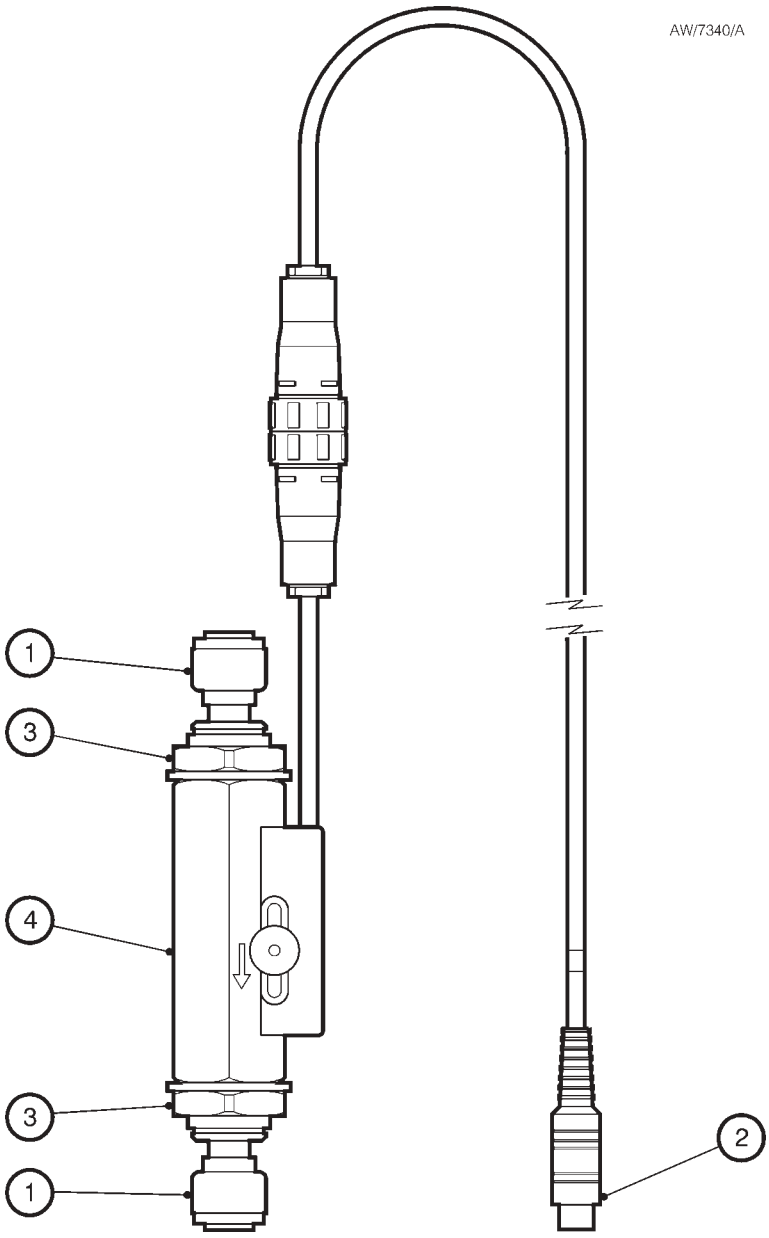
Fit a filter in the cooling-water supply. If you do not, particles may block the EB3 Water Flow-Switch and the Source may overheat and be damaged if the cooling-water supply fails.

CAUTION

Ensure that the cooling-water pipes are routed away from sources of heat, such as the diffusion pump in the AUTO 306. If you do not, the pipes may melt.

The components of the EB3 Water Flow-Switch are shown in Figure 19.

1. Refer to Figure 17. Cut the cooling-water outlet pipe between the reducing adaptor (12, or the isolation-valve (11), if fitted) and the 'T' piece (9) fitted in Section 3.5.
2. Fit the two ends of the cooling-water outlet pipe to the connectors on the Water Flow-Switch (Figure 19, items 1); ensure that the arrow on the Water Flow-Switch points in the correct direction of water flow, as shown by the arrows in Figure 17.
3. Use the cable ties or other suitable means to secure all of the cooling-water pipes to the AUTO 306 cabinet.
4. Route the cable from the Water Flow-Switch through the AUTO 306 cabinet as shown in Figure 33 and pass the end of the cable through the blank panel hole for the Source Control. You will fit the connector C2 (3) on the end of the cable to the Source Control in Section 3.12.7.



1. 10 to 8 mm reducer
2. Connector C2
3. $^1/_2$ inch BSP to 10 mm adaptor
4. Flow-switch

Figure 19 - EB3 Water Flow-Switch

3.7 Fit the EB3 Multihearth Electron Beam Source to the baffle plate

Refer to Figure 20 and use the following procedure to fit the Source to the baffle plate (which is supplied as part of the EB3 Motorised Turret Drive Kit or the EB3 Manual Turret Drive Kit).

1. Undo the two M3 screws (17) and remove the front cover (16) from the EB3 Multihearth Electron Beam Source.
2. Use the four M3 screws (22) supplied with the EB3 Manual or Motorised Turret Drive to secure the Source to the baffle plate (20). Note that:
   - The Source will only fit one way on the baffle plate; that is, with the turret drive shaft through a cut-out in the baffle plate.
   - The Source must be on the same side of the baffle plate as the baffle plate lugs: see Figure 6 (which shows the Source fitted to the baffle plate on the Tripod).
3. Retain the front cover (16) and the two M3 securing screws (17). You will refit the cover to the Source in Section 3.14.

A Detail of click-stop components

1. Screw: M3
2. Pole piece extension
3. Top shield
4. Screw: M3
5. Four hearth crucible
6. Crucible 'O' ring
7. Screw: M2
8. Water director
9. Circlip
10. Screw: M3
11. Clamp plate
12. Quad ring
13. Turret
14. Cooling-water outlet
15. Cooling-water 'O' ring
16. Front cover
17. Screw: M3
18. Cooling-water inlet
19. Turret drive gear
20. Baffle plate
21. Baffle plate lug
22. Screw: M3
23. Screw: M3
24. Emitter assembly
25. Emitter wire
26. Screw: M3
27. Beam sweep connector
28. Beam sweep coil assembly
29. Screw: M3
30. Screw: M3
31. Side of turret
32. Slot in turret
33. Spring-loaded ball
34. Locknut: M6
35. Adjuster screw: M6

Figure 20 - Components of the EB3 Multihearth Electron Beam Source: key

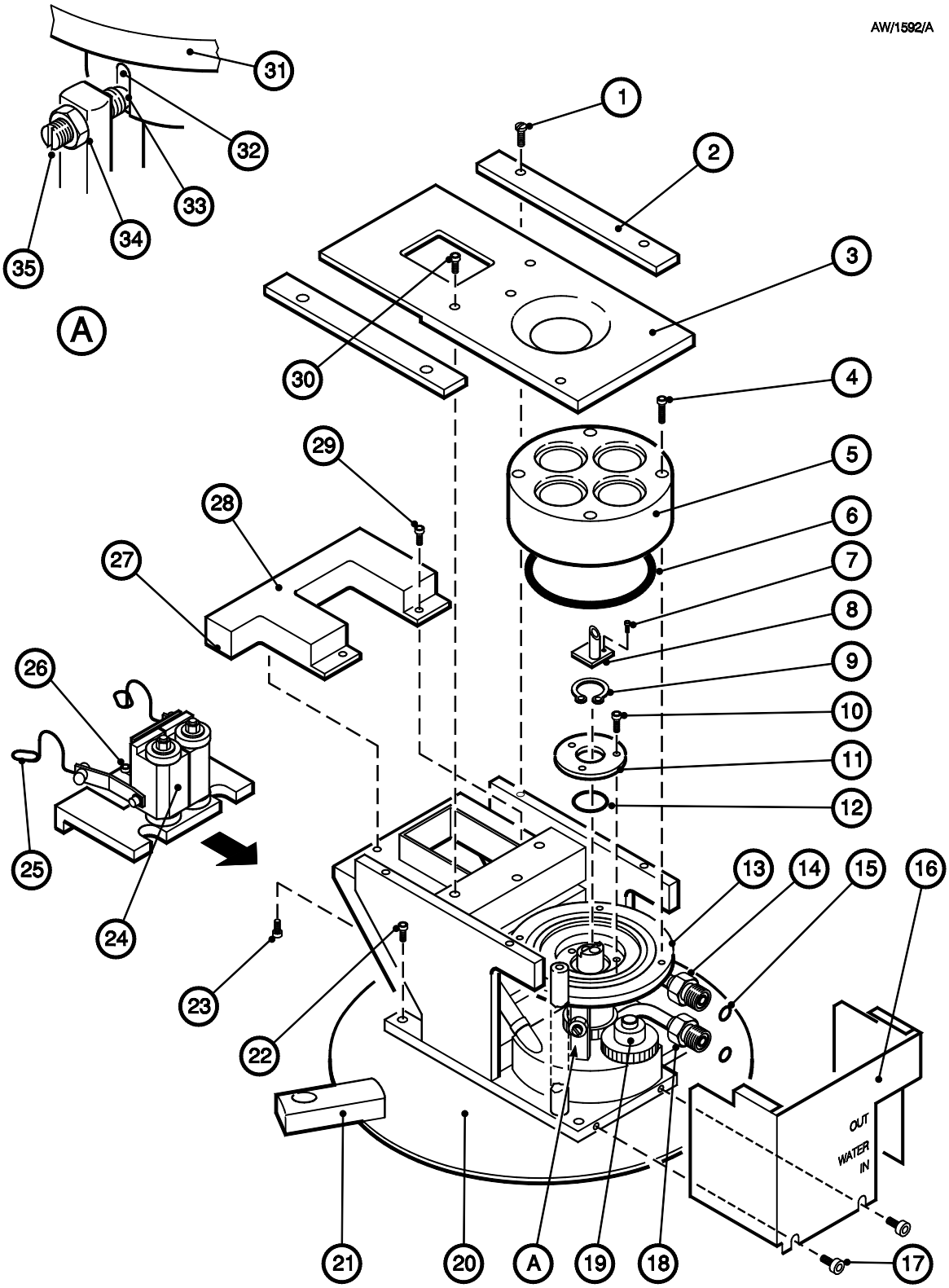


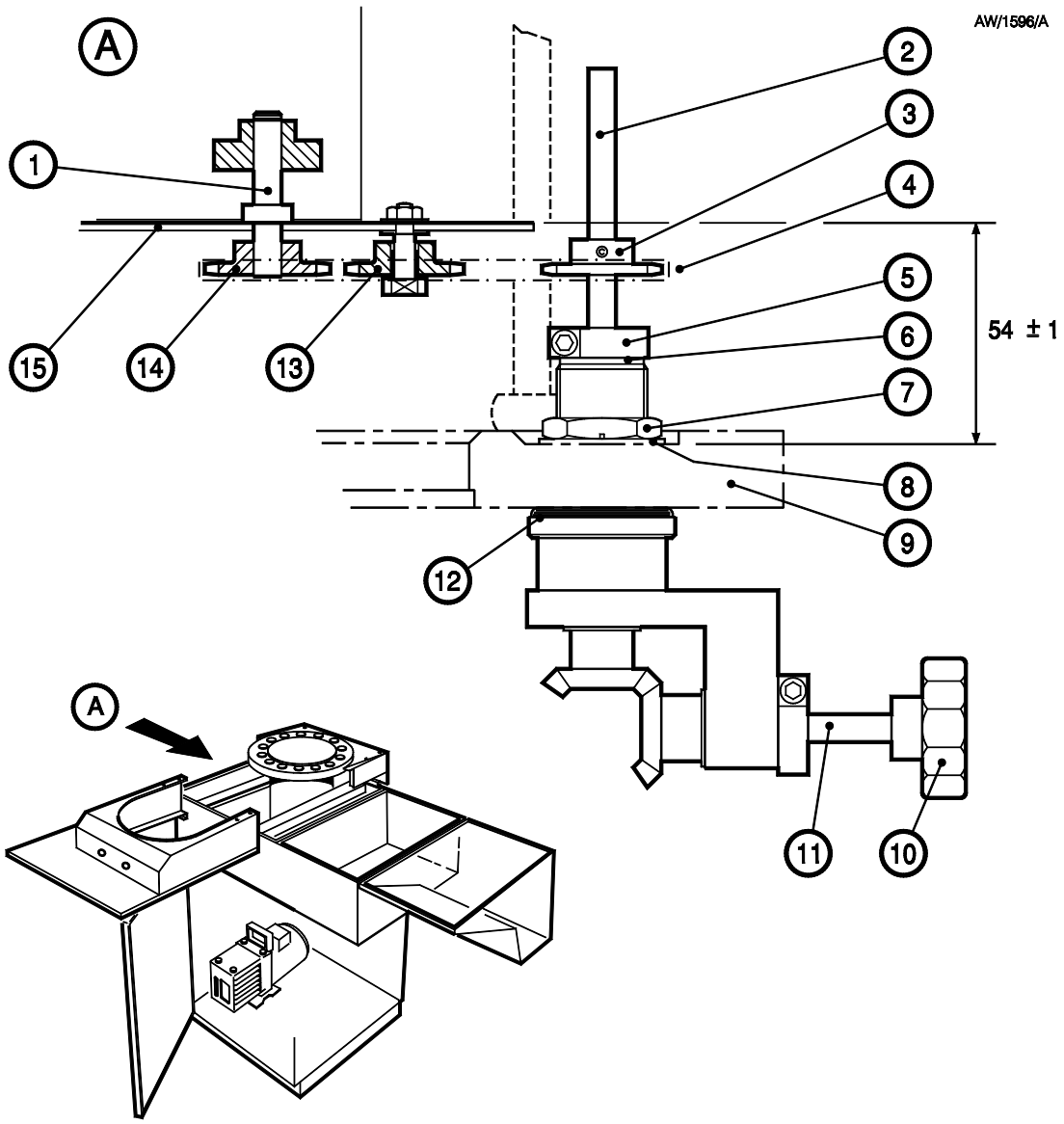
Figure 20 - Components of the EB3 Multihearth Electron Beam Source

3.8 Fit the EB3 Manual Turret Drive

> CAUTION
>
> Ensure that the EB3 Multihearth Electron Beam Source is level. If it is not, when you operate it, molten evaporant will spill out of the crucible.

Refer to Figure 21 and use the following procedure to fit the EB3 Manual Turret Drive. Note that each sprocket (3, 13 and 14) is secured in place by two grub screws.

1. Remove the blanking plug from leadthrough hole 13 in the AUTO 306 baseplate (9).
2. Undo the securing screw on the clamp (5) and remove the clamp (5) and thrust washer (6) from the leadthrough.
3. Undo the leadthrough nut (7) and remove the nut and leadthrough washer (8) from the drive assembly.
4. From underneath the AUTO 306 baseplate, fit the drive assembly (complete with the baseplate 'O' ring, 12) through leadthrough hole 13 in the AUTO 306 baseplate.
5. Ensure that the handwheel shaft (11) faces the front of the AUTO 306 cabinet and then secure the drive assembly in place with the nut and washer (7, 8); ensure that the grooves on the nut face downwards towards the AUTO 306 baseplate.
6. Refit the thrust washer (6) and clamp (5) to the leadthrough.
7. Loosely fit the tension sprocket (13) in the slot on the baffle plate (15).
8. Fit one of the plain sprockets (14) to the turret drive shaft (1) on the EB3 Multihearth Electron Beam Source. Ensure that the bottom face of the sprocket (14) aligns with the end face of the turret drive shaft (1).
9. Engage the drive chain (4) over the turret sprocket (14) and the tension sprocket (13). Engage the other plain sprocket (3) in the drive chain (4).
10. Carefully lower the complete assembly over the baseplate, so that the lugs on the baffle plate locate over the legs of the Tripod (See Figure 6) and the drive sprocket (3) fits onto the drive shaft (2). Ensure that the Source is level and at the correct height, then tighten the securing screw in each baffle plate lug to secure the lugs to the Tripod legs.
11. Ensure that the drive chain (4) is level; if necessary, adjust the position of the drive sprocket (3) on the drive shaft (2), then secure the sprocket to the drive shaft.
12. Reposition and secure the tension sprocket (13) so that the drive chain (4) is not slack, then turn the handwheel (10) to ensure that the drive unit correctly turns the turret; if necessary adjust the position of the tension sprocket (13).



1. Turret drive shaft
2. Drive shaft
3. Drive sprocket
4. Drive chain
5. Clamp
6. Thrust washer
7. Leadthrough nut
8. Leadthrough washer
9. AUTO 306 baseplate
10. Handwheel
11. Handwheel shaft
12. Baseplate ‘O’ ring
13. Tension sprocket
14. Turret sprocket
15. Baffle plate

Figure 21 - Fit the EB3 Manual Turret Drive

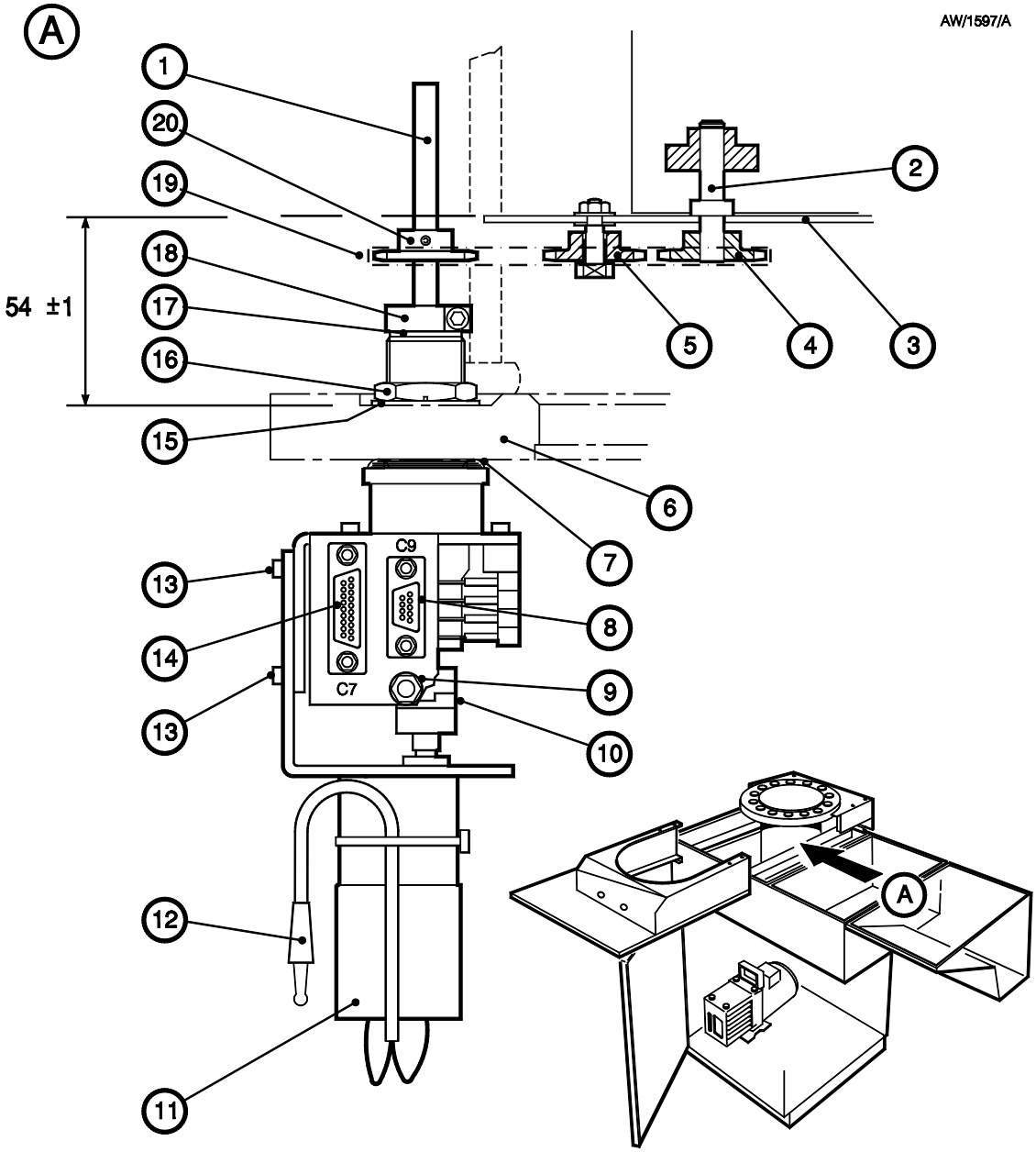
3.9 Fit the EB3 Motorised Turret Drive

> CAUTION
>
> Ensure that the EB3 Multihearth Electron Beam Source is level. If it is not, when you operate it, molten evaporant will spill out of the crucible.

Refer to Figure 22 and use the following procedure to fit the EB3 Motorised Turret Drive. Note that each sprocket (4, 5 and 20) is secured in place by two grub screws.

1. Remove the blanking plug from leadthrough hole 13 in the AUTO 306 baseplate (6).
2. Remove the plug (12) from the connector (9) on the plate on the side of the Motorised Drive assembly. Undo the two screws (13), then remove the motor (11) from the drive assembly.
3. Undo the securing screw on the clamp (18) and remove the clamp (18) and thrust washer (17) from the leadthrough.
4. Undo the leadthrough nut (16) and remove the nut and leadthrough washer (15) from the leadthrough.
5. From underneath the AUTO 306 baseplate, fit the leadthrough (complete with the baseplate 'O' ring, 7) through leadthrough hole 13 in the AUTO 306 baseplate.
6. Ensure that the leadthrough is oriented as shown in Figure 22, then secure the leadthrough in place with the nut and washer (16, 15); ensure that the grooves on the nut face downwards towards the AUTO 306 baseplate.
7. Refer to Figure 20. If necessary, turn the crucible (5) until one of the hearths in the crucible is centralised under the hole in the top shield (3) of the Source.
8. Refer to Figure 22. Gently pull the drive shaft (1) upwards to prevent the drive shaft dropping, then refit the thrust washer (17) and clamp (18) to the leadthrough.
9. Ensure that the two halves of the drive coupling (10) are correctly engaged, then refit the motor (11) to the leadthrough and secure with the two screws (13). Refit the plug (12) to connector C10 (9) on the plate of the side of the assembly.
10. Loosely fit the tension sprocket (5) in the slot on the baffle plate (3).
11. Fit one of the plain sprockets (4) to the turret drive shaft (2) on the Source. Ensure that the bottom face of the sprocket (4) aligns with the end face of the turret drive shaft (2).
12. Engage the drive chain (19) over the turret sprocket (4) and the tension sprocket (5). Engage the drive sprocket (20) in the drive chain (19).
13. Carefully lower the complete assembly over the baseplate, so that the baffle plate lugs locate over the legs of the Tripod (as shown in Figure 6) and the drive sprocket (20) fits onto the drive shaft (1). Ensure that the Source is level, then tighten the securing screw in each lug to secure the lugs to the Tripod legs.

(Continued on page 48)



1. Drive shaft
2. Turret drive shaft
3. Baffle plate
4. Turret sprocket
5. Tension sprocket
6. AUTO 306 baseplate
7. Baseplate 'O' ring
8. Turret position connector C9
9. Motor connector C10
10. Drive coupling
11. Motor
12. Motor connector plug
13. Screws (2 off)
14. Drive control connector C7
15. Leadthrough washer
16. Leadthrough nut
17. Thrust washer
18. Clamp
19. Drive chain
20. Drive sprocket

Figure 22 - Fit the EB3 Motorised Turret Drive

14. Ensure that the drive chain (19) is level; if necessary, adjust the position of the drive sprocket (20) on the drive shaft (1) and the position of the turret sprocket (4) on the turret drive shaft (2), then secure the drive sprocket to the drive shaft.

15. Reposition the tension sprocket (5) so that the drive chain (19) is not slack.

16. Refer to Figure 20. Loosen the click-stop locknut (34), turn the adjuster screw (35) anti-clockwise until the turret (13) turns freely, then tighten the locknut (34) to secure the click-stop in its disengaged position.

3.10 Fit the EB3 Beam Sweep leadthrough

If you have the EB3 Beam Sweep Unit accessory, use the following procedure to fit the leadthrough in the chamber. Note that you will connect the cable from the TL8K25 leadthrough in Section 3.12.3.

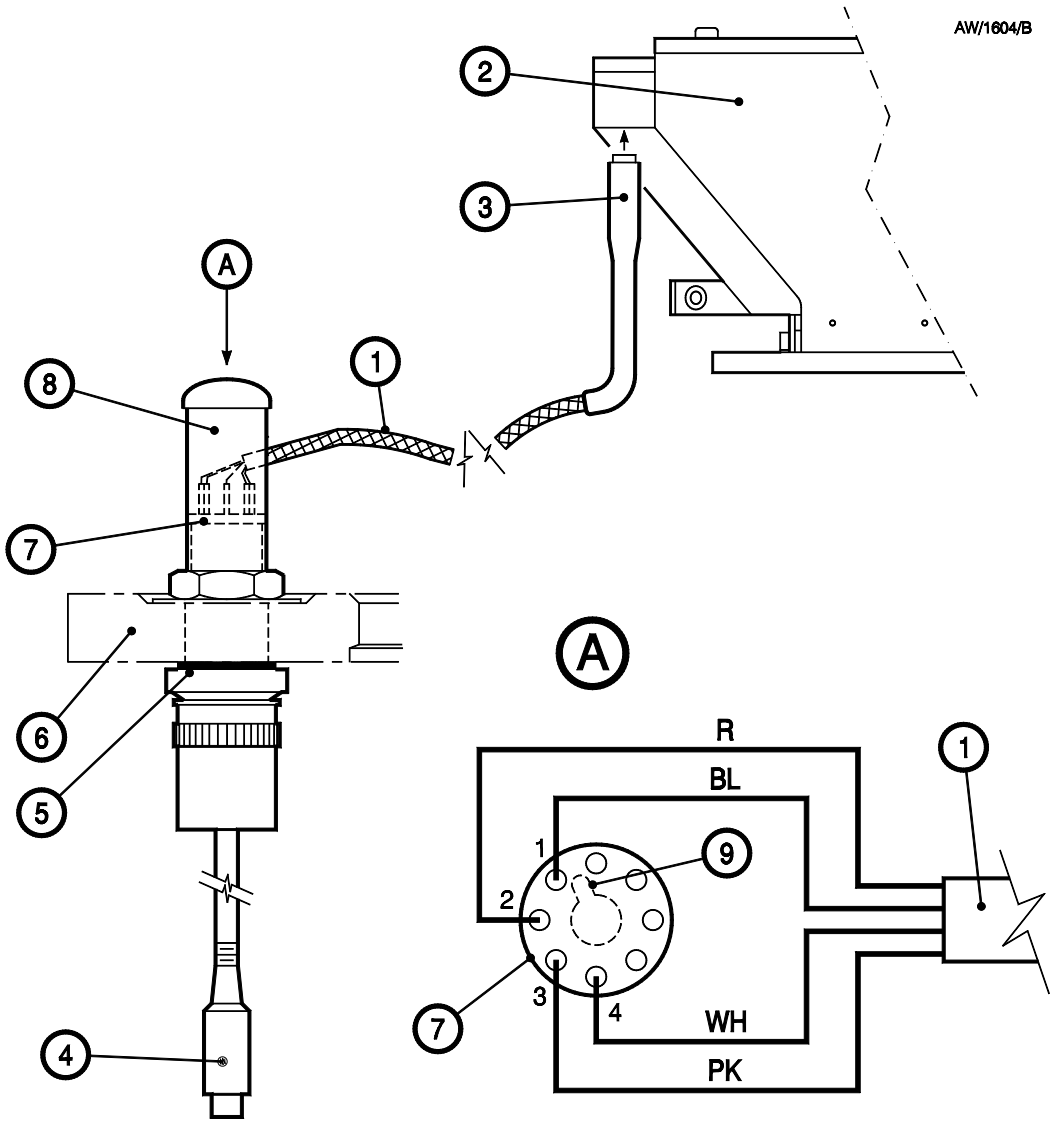
1. Refer to Figure 23. Remove the blanking plug from leadthrough hole 4 on the AUTO 306 baseplate (6).

2. Ensure that the baseplate 'O' ring (5) is in place and fit the TL8K25 leadthrough (7) to the leadthrough hole in the AUTO 306 baseplate (6).

3. Pass the end of the coil cable (1) through the hole in the electrode shield (8), then connect the cable to the top of the TL8K25 leadthrough (7). Ensure that you connect the wires of the coil cable to the correct pins of the TL8K25 leadthrough, as shown in detail A. The locating lug (9) on the leadthrough plug (underneath the AUTO 306 baseplate) will help you to identify the pins on the top of the leadthrough.

4. Place the electrode shield (8) over the TL8K25 leadthrough (7).

5. Fit the connector (3) on the end of the coil cable (1) to the connector on the EB3 Multihearth Electron Beam Source (2).



A Top view of leadthrough

1. Coil cable
2. EB3 Multihearth Electron Beam Source
3. Connector plug
4. Connector C11 (to EB3 Sweep Control)
5. Baseplate 'O' ring
6. AUTO 306 baseplate
7. TL8K25 leadthrough
8. Leadthrough shield
9. Locating lug on plug

R Red
BL Black
WH White
PK Pink

Figure 23 - Beam sweep pin connections

3.11 Install the EB3 Power Supply Unit

3.11.1 Install the EB3 Power Supply Unit in its operating position

WARNING

If you use a ramp to install the Power Supply Unit in a rack, get someone to help you to move the Power Supply Unit up the ramp. The mass of the Power Supply Unit is over 100 kg.

WARNING

If you install the Power Supply Unit in a rack, ensure that the rack is stable and cannot fall over.

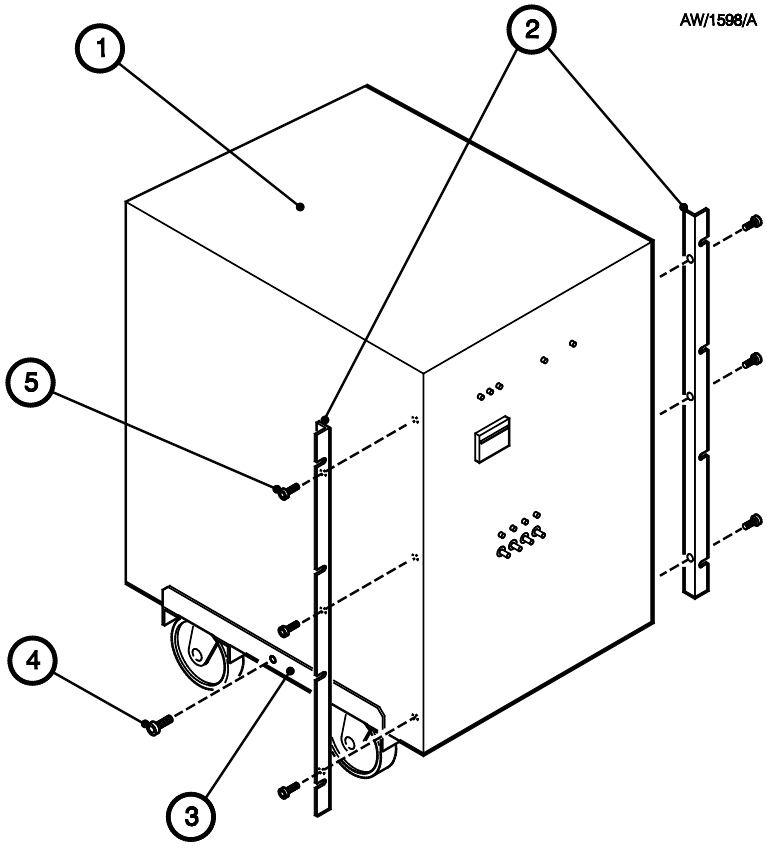
CAUTION

When you install the Power Supply Unit in its operating position, ensure that there is sufficient space for cooling-air to flow around the Power Supply Unit.

If you will leave the Power Supply Unit on its castors, push the Power Supply Unit into its final operating position.

If you will fit the Power Supply Unit in a rack, we recommend that you use the following procedure.

1. Refer to Figure 24. Push the Power Supply Unit on its castors close to the rack in which it will be installed.
2. Install a loading ramp next to the rack so that when you push the Power Supply Unit up the ramp it goes into the rack and will be at the required height for installation inside the rack.
3. Use the screws (5), to secure the rack mounting strips (2) to the sides of the Power Supply Unit.
4. Get someone to help you push the Power Supply Unit up the ramp and inside the rack, then use suitable nuts, bolts and washers (not supplied) to secure the rack mounting strips (2) to the rack.



1. Power Supply Unit
2. Rack mounting strips
3. Baseframe
4. Screws
5. Screws

Figure 24 - Installation of the Power Supply Unit

3.11.2 Prepare the EB3 Power Supply Unit

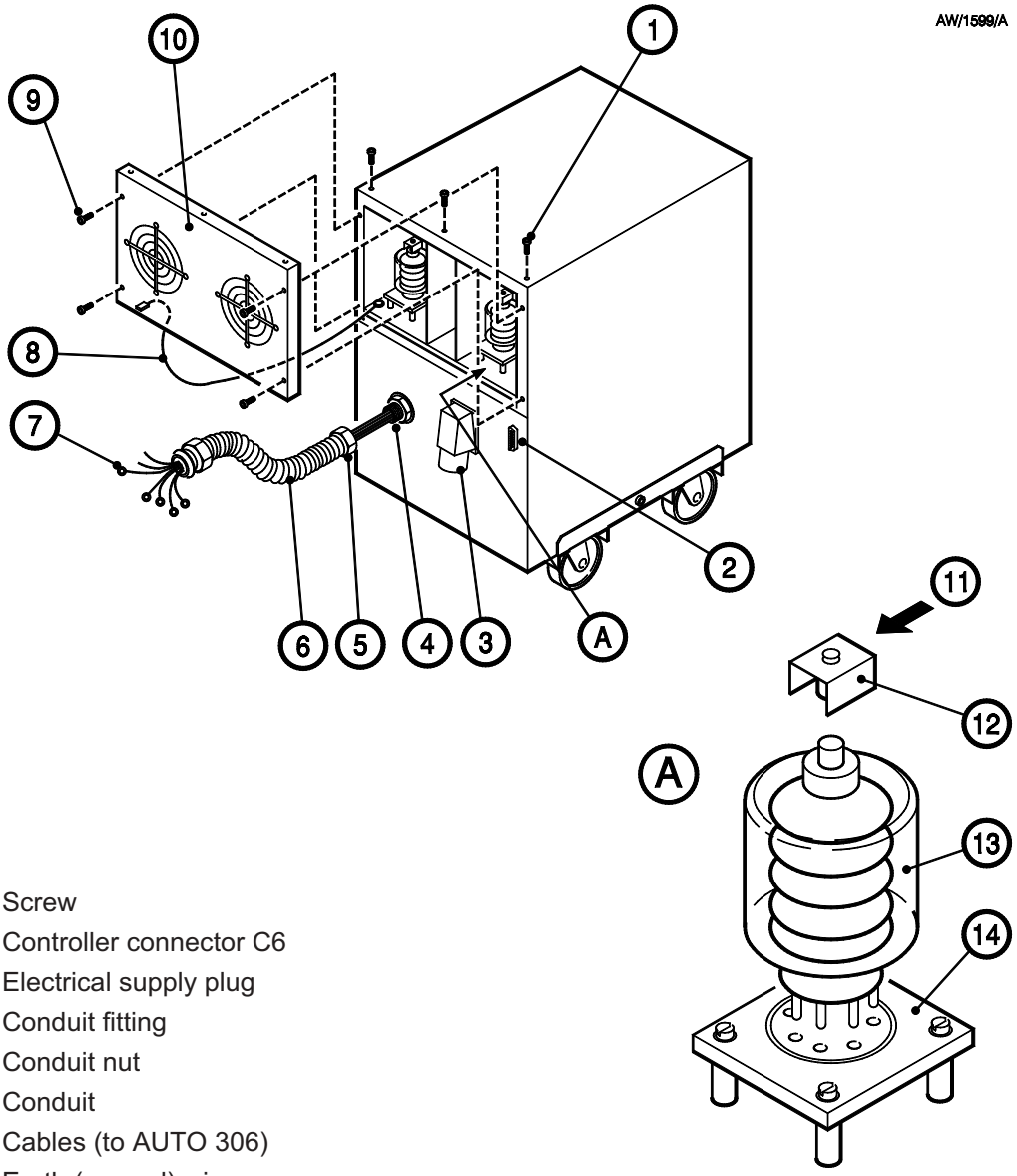
WARNING

Ensure that the rear cover of the Power Supply Unit is earthed (grounded) before you operate the Power Supply Unit. If you do not, there may be a risk of electric shock.

CAUTION

Ensure that the Power Supply Unit is suitable for use with your electrical supply. If it is not, you can damage the Power Supply Unit and other EB3 equipment if you operate it.

1. Ensure that the Power Supply Unit is suitable for use with your electrical supply: refer to the rating plate on the rear panel of the Power Supply Unit. Do not install the Power Supply Unit if it is not suitable for use with your electrical supply.
2. Refer to Figure 25. Remove the three screws (1) which secure the top panel of the Power Supply Unit to the rear cover (10). Remove the four screws (9) which secure the rear cover (10) to the frame and remove the rear cover. If necessary, to make further installation work easier, remove the push-on connector on the earth (ground) wire (8) from the inside of the rear cover so that you can completely remove the cover.
3. Remove the fixings which secure the anode wires and the cables in the Power Supply Unit during transit; these may be secured by cable ties or another suitable method.
4. Remove the two electronic valves (13) (supplied in the carton: refer to Section 3.1.2) and fit them to the base connectors (14) inside the Power Supply Unit. The valves will only fit into the base connectors in one orientation; look at the pins on the bottom of the valves and the holes for the pins on the base connectors to ensure that the valves are correctly oriented and then push the valves firmly into the base connectors.
5. Fit the anode connections (12) to the valves (13). Ensure that the anode connections are correctly oriented so that they are in the airflow from the cooling fans; that is, the inverted 'U' shape formed by each heatsink must directly face the rear of the Power Supply Unit. Refer to detail A which shows the direction of cooling-air flow (11) and the correct orientation of the anode connections (12).
6. If you removed the earth (ground) wire (8, in Step 2), refit the push-on connector on the earth (ground) wire to the inside of the rear cover (10).
7. Use the four screws (9) to secure the rear cover (10) to the Power Supply Unit, then use the three screws (1) to secure the top panel to the rear cover (10).
8. Remove the nut(5) and clip from the conduit fitting (4) on the Power Supply Unit. Push the end of the conduit (6) through the nut, then fit the clip to the conduit, approximately 25 mm (1 inch) from the end of the conduit (as in Figure 26 detail B).
9. Pass the cables (7) through the conduit (6), then fit the nut (5) on the end of the conduit to the conduit fitting (4) on the Power Supply Unit.



1. Screw
2. Controller connector C6
3. Electrical supply plug
4. Conduit fitting
5. Conduit nut
6. Conduit
7. Cables (to AUTO 306)
8. Earth (ground) wire
9. Screw
10. Rear cover
11. Direction of cooling-air flow
12. Anode connection
13. Electronic valve
14. Valve base connector

Figure 25 - Rear of the EB3 Power Supply Unit

3.12 Electrical connections

Note: The procedures in the following sections describe the electrical connections when you fit the EB3 components to an AUTO 306 with a serial number of 3321 and higher. If your AUTO 306 has a serial number lower than 3321, refer to Appendix 1 before you make the electrical connections.

Use the procedures in the following sections to make the electrical connections. Figure 28 shows a schematic diagram of the electrical connection between the EB3 components.

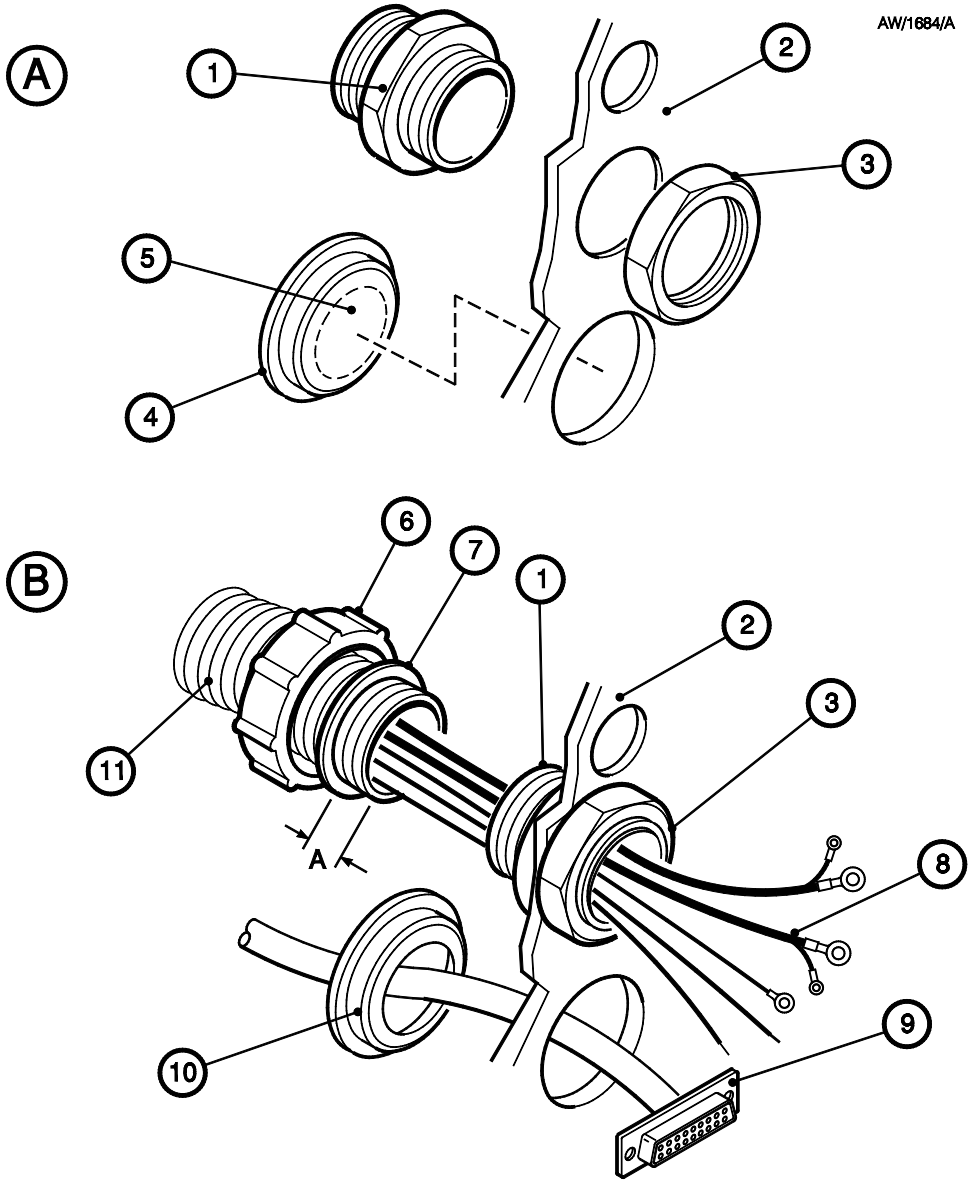
The procedures in the following sections assume that you will use local control. If you will use remote control equipment to control the Source, refer to Section 3.19.

3.12.1 Connect the Power Supply Unit cables to the AUTO 306

> WARNING
>
> You must connect the safety interlock wires as described in the following procedure. If you do not, the safety interlock will not operate correctly and there may be a danger of injury or death by electric shock.

1. Refer to Figure 26. Remove the blanking grommet from the middle leadthrough hole on the side of the AUTO 306 electrical control cabinet (2).
2. Remove the securing nut (3) from the conduit fitting (1).
3. Push the conduit fitting (1) through the leadthrough hole and secure with the nut (3).
4. Refer to detail B. Slide the knurled nut (6) over the conduit (11), then fit the clip (7) approximately 25 mm (1 inch: dimension A) from the end of the conduit.
5. Pass the cables (8) through the conduit fitting (3).
6. Push the end of the conduit (11) against the conduit fitting (1) and secure in place with the knurled nut (6).
7. Refer to detail A. Remove the blanking grommet (4) from the lower leadthrough hole on the side of the AUTO 306 electrical cabinet (2), then cut or drill out the centre (5) of the blanking grommet.
8. Refer to detail B. Pass the connector C6 (9) on the Power Supply to Source Control cable through the blank grommet (10), then pass the connector through the lower leadthrough hole on the side of the AUTO 306 electrical cabinet (2).
9. Fit the blanking grommet (10) to the lower leadthrough hole on the side of the AUTO 306 electrical cabinet (2).
10. Refer to Figure 27. Remove the four screws (3) which secure the baseplate rear cover (2) on the AUTO 306 cabinet, then carefully remove the rear cover and support it; ensure that you do not disconnect or break any of the cables (4) connected to the cover.

(Continued on page 56)



1. Conduit fitting
2. Side panel of the AUTO 306 electrical control cabinet
3. Conduit nut
4. Blanking grommet (removed from the electrical cabinet)
5. Cut-out area
6. Knurled nut
7. Clip
8. Cables (from Power Supply Unit)
9. Connector C6
10. Blanking grommet (with centre removed)
11. Conduit

Figure 26 - Fit the conduit to the AUTO 306 electrical cabinet

11. Route the cables from the conduit as shown in Figure 29. Connect the two high voltage wires in the high voltage cables (4) to the 6EK25 leadthroughs (1).

12. Connect the two green/yellow earth (ground) wires (3) in the high voltage cables (4) to the earth (ground) terminals (2) on the 6EK25 leadthroughs (1).

13. Connect the other green/yellow earth (ground) cable (9) to the earth (ground) stud (10) on the AUTO 306 baseplate.

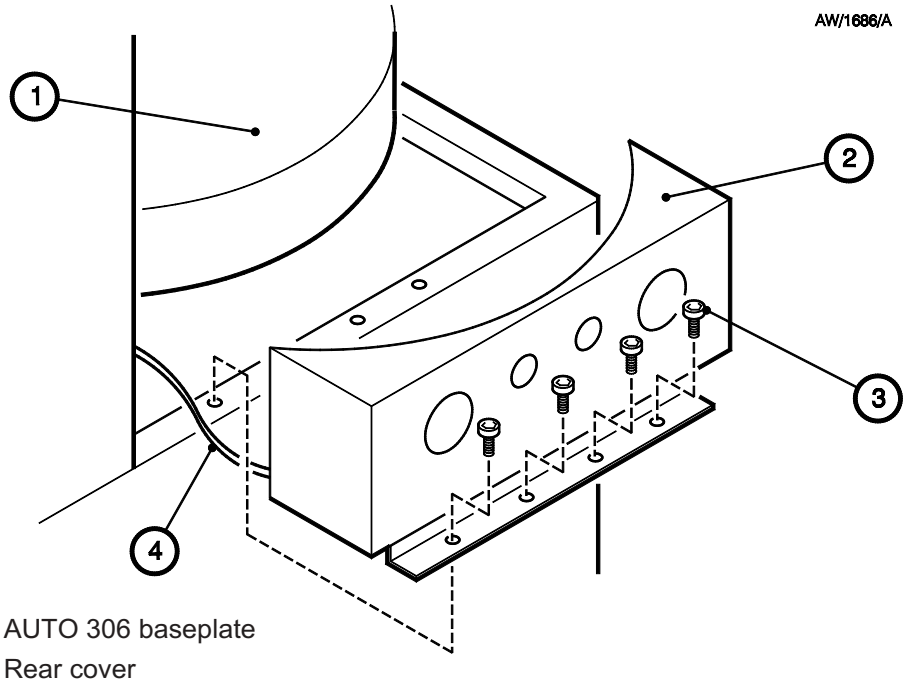
14. Refer to Figure 26. Fit the 25-way connector on the end of the Power Supply to Source Control cable C6 (9) to the controller connector C6 on the rear panel of the Power Supply Unit (Figure 25, item 2)

15. Route the Power Supply to Source Control cable C) as shown in Figure 29, then pass the connector C6 through the blank panel hole (6) for the Source Control.

16. Route the safety interlock wires (8) as shown in Figure 29, towards terminal block TB1 (7). The location of the terminal block in the AUTO 306 electrical cabinet is shown in Figure 30 and Figure 31 shows the configuration of the terminal blocks.

17. Connect the two wires to terminal block 2 as follows:

    - Connect wire #14 to a terminal 14 on the terminal block (see Figure 31).
    - Connect wire #22 to a terminal 22 on the terminal block.



1. AUTO 306 baseplate
2. Rear cover
3. Screw (4 off)
4. Cables

Figure 27 - Remove the baseplate rear cover from the AUTO 306 cabinet

1. Turret Control
2. Sweep Control
3. TL8K5 leadthrough
4. Beam sweep coils
5. Turret drive switches and motor
6. Turret position switches
7. Source Control
8. Power Supply Unit
9. Water Flow-Switch
10. Vacuum level interlock
(AUTO 306 process relay 4)

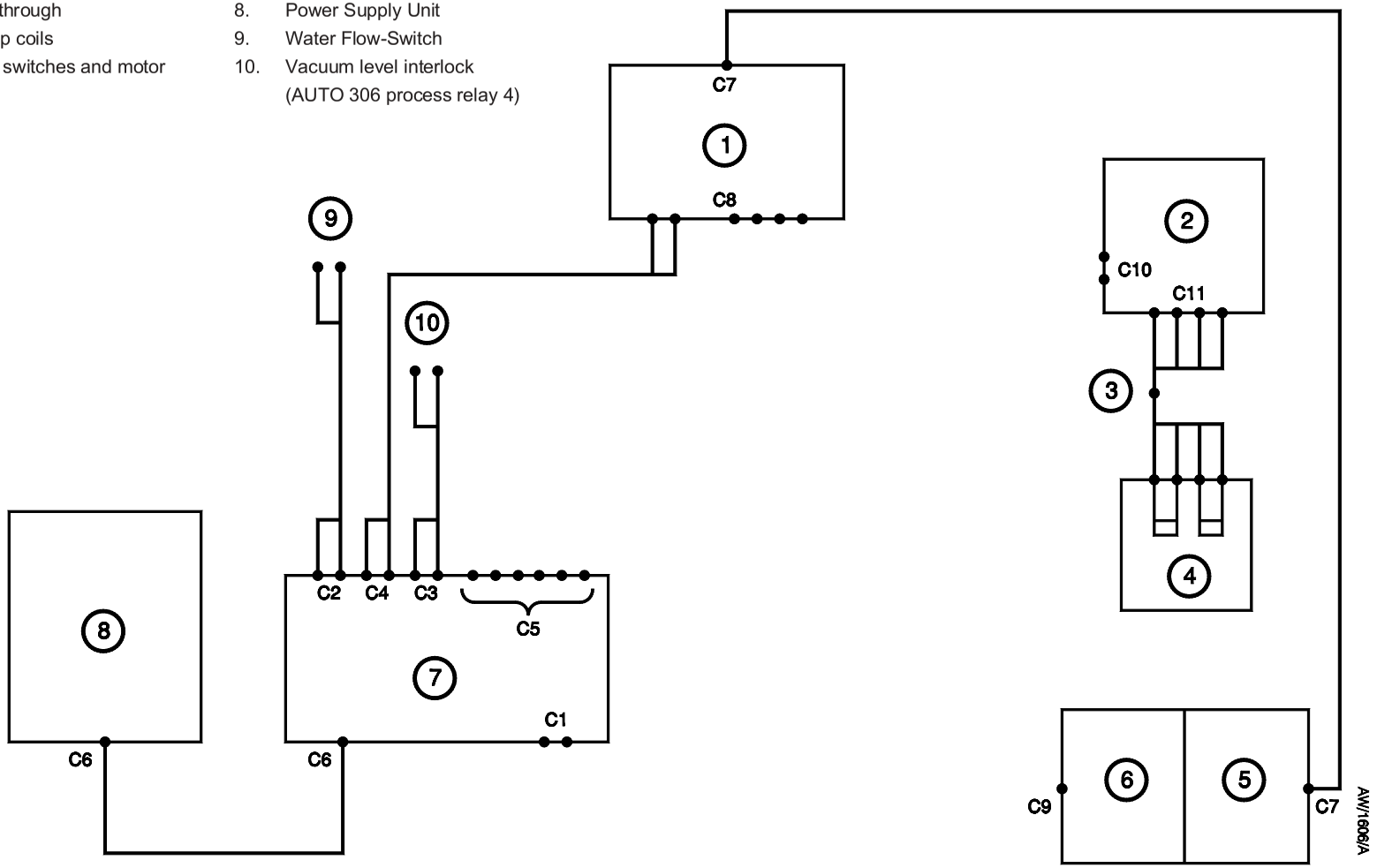


Figure 28 - Schematic diagram of the EB3 electrical connections (local control)

1. 6EK25 leadthroughs
2. Earth (ground) terminals
3. Earth (ground) wires
4. High voltage cables
5. Power Supply to Source Control cable C6
6. Blank panel hole for the Source Control
7. Terminal block TB2
8. Safety interlock wires
9. Earth (ground) cable
10. Earth (ground) stud on baseplate

Cable Name	Wire Number	From	To
Safety interlock wires	#14	Power Supply Unit*	Terminal Block TB2, terminal 14
	#22	Power Supply Unit*	Terminal Block TB2, terminal 22
High voltage cable	High voltage wire (10 ˘ ring terminal)	Power Supply Unit*	6EK25 leadthrough (leadthrough hole 5)
	Earth (ground) wire (5 ˘ ring terminal)	Power Supply Unit*	Earth (ground) terminal on 6EK25 leadthrough (leadthrough hole 5)
High voltage cable	High voltage wire (10 ˘ ring terminal)	Power Supply Unit*	6EK25 leadthrough (leadthrough hole 6)
	Earth (ground) wire (5 ˘ ring terminal)	Power Supply Unit*	Earth (ground) terminal on 6EK25 leadthrough (leadthrough hole 6)
Earth (ground) cable	- (green/yellow)	Power Supply Unit*	Earth (ground) stud on AUTO 306 baseplate
Power Supply to Source Control cable	C6	Power Supply Unit connector C6	Source Control connector CONN 6

* Through the conduit

Figure 29 - Cable routes for the Power Supply Unit electrical connections: key

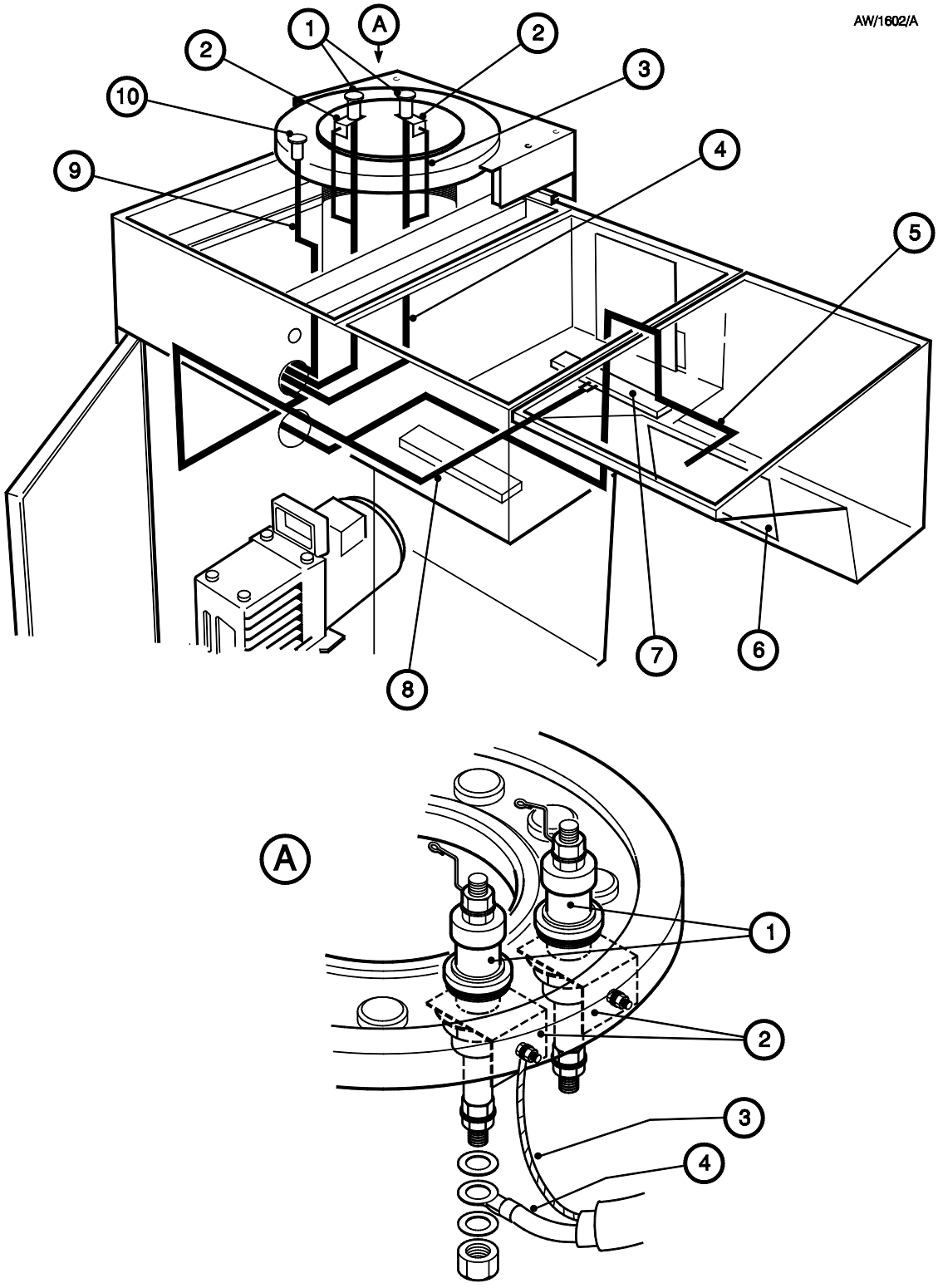
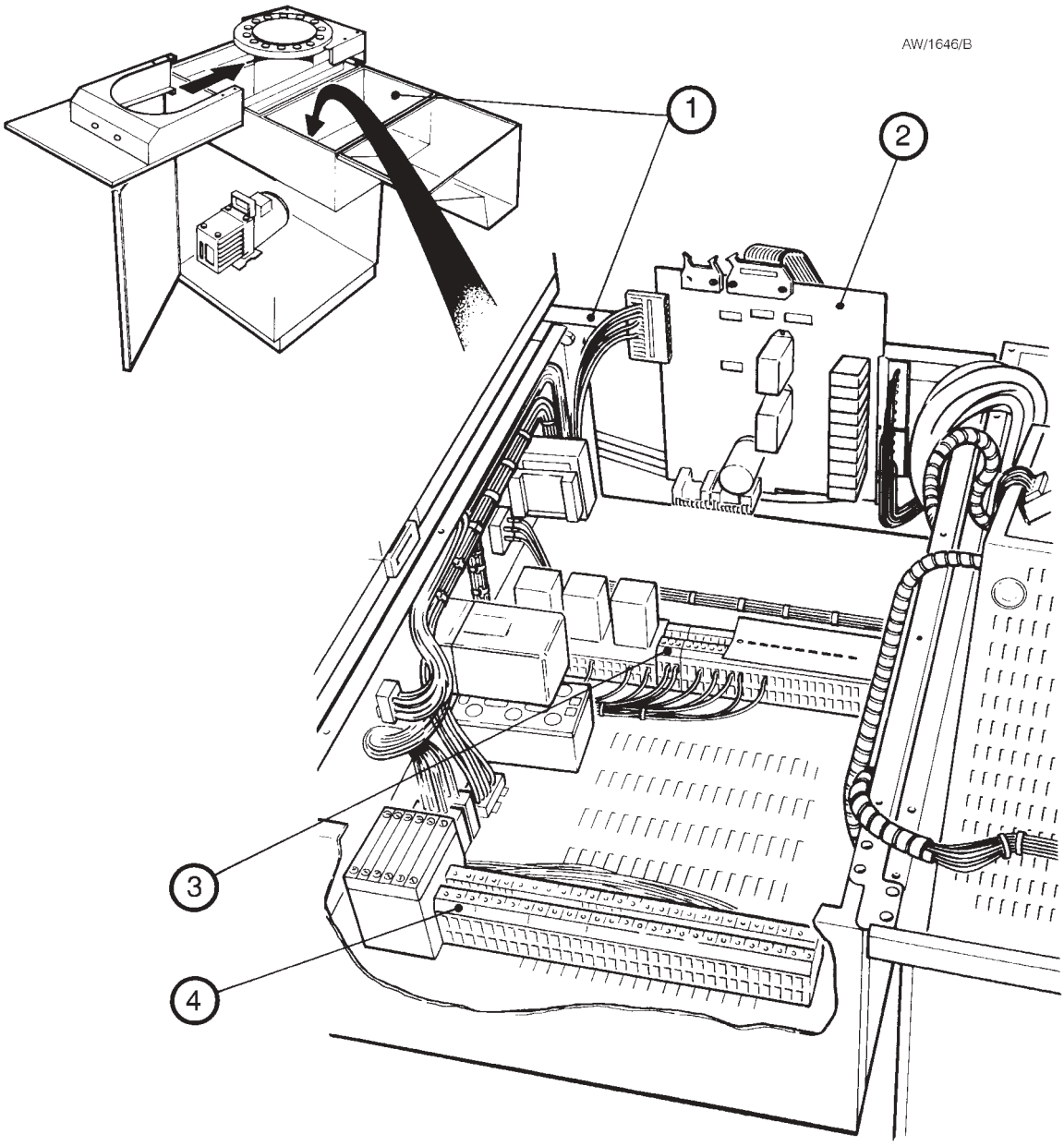


Figure 29 - Cable routes for the Power Supply Unit electrical connections



1. AUTO 306 electrical control cabinet
2. IO relay board
3. Terminal block TB2
4. Terminal block TB1

Figure 30 - Locations of the terminal blocks in the base
of the AUTO 306 electrical control cabinet

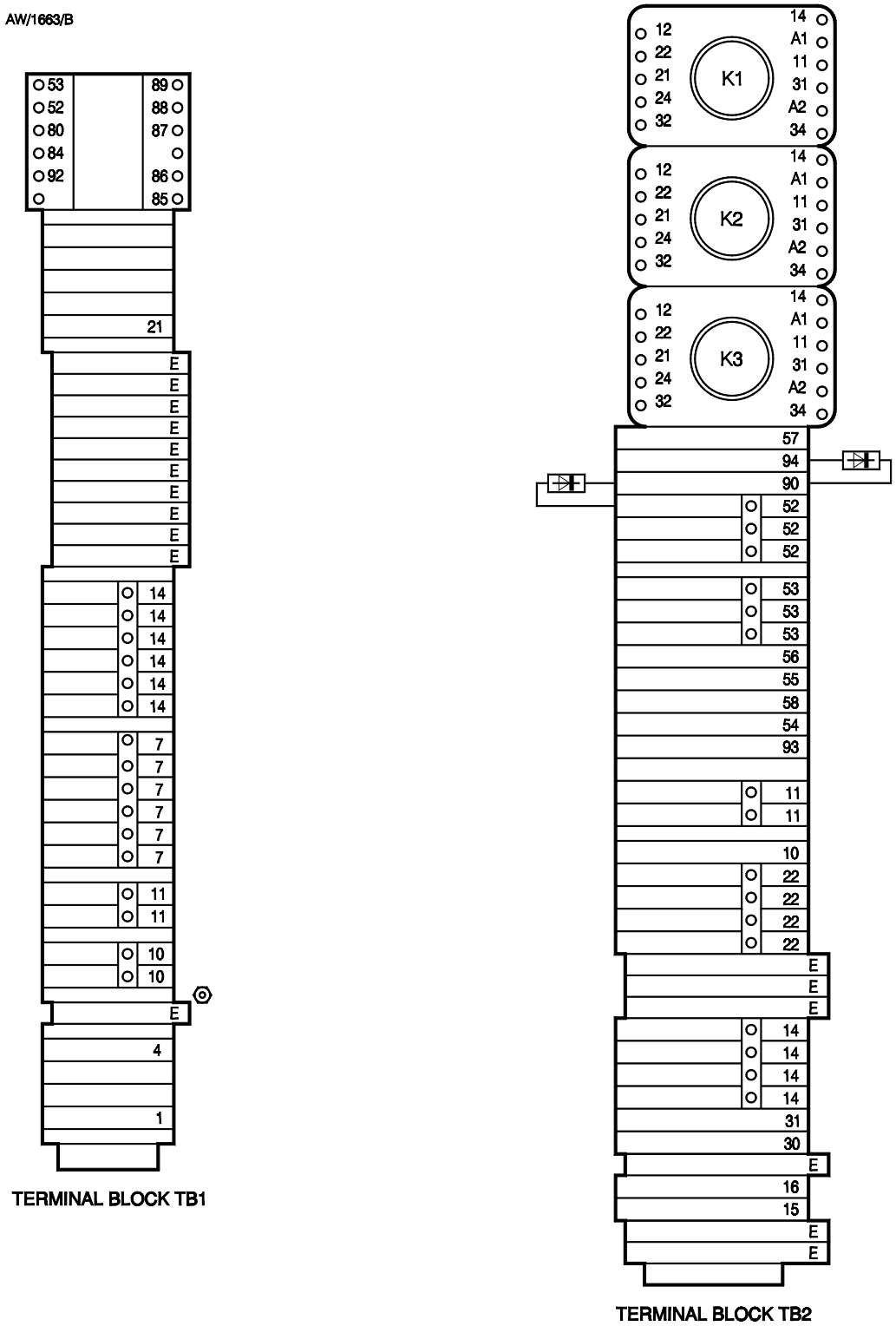


Figure 31 - Configuration of the terminal blocks

3.12.2 Fit the EB3 Turret Control cables

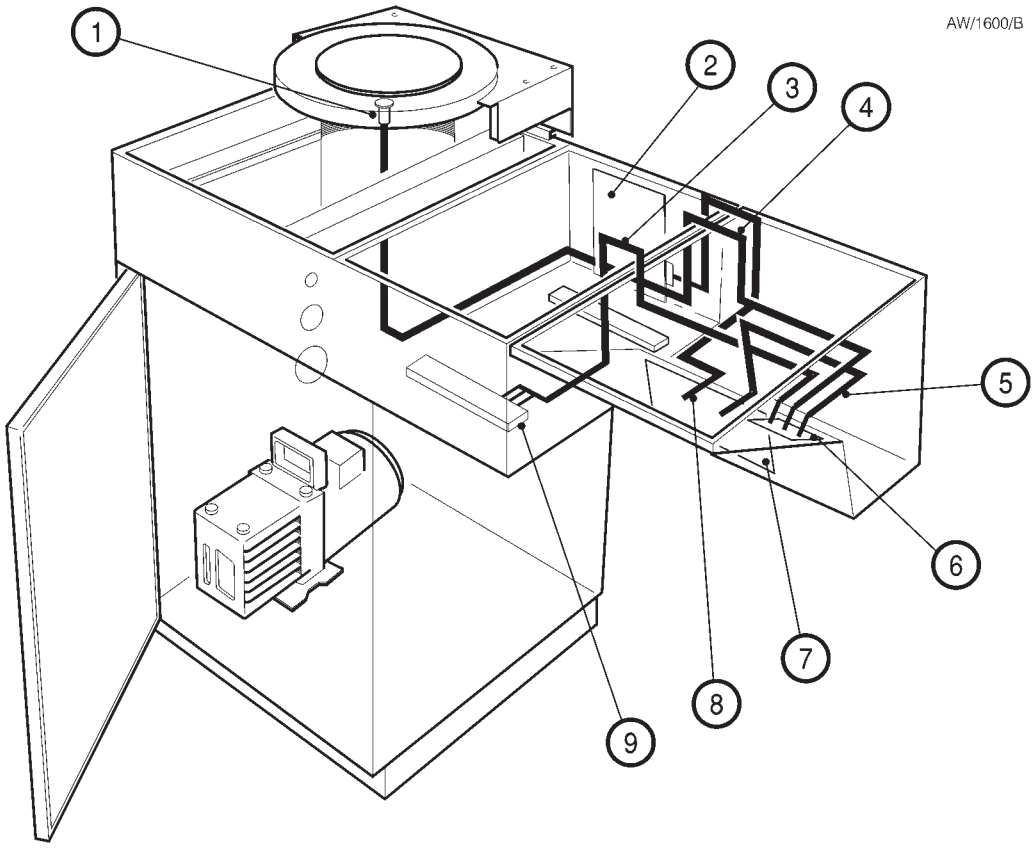
If you have fitted the EB3 Motorised Turret Drive, use the following procedure to fit the EB3 Turret Control cables.

1. Refer to Figure 32. Fit the connector on the drive control cable C7 (4) to connector C7 on the Motorised Drive Unit (Figure 22, item 14).
2. Route the cable as shown in Figure 32 and pass the end of the cable through the blank panel hole (6) for the EB3 Turret Control.
3. Route the EB3 Turret Control electrical supply cable (3) as shown in Figure 32, with the connector through the blank panel hole. Connect the wires at the other end of the cable to terminal block TB1 in the AUTO 306 electrical control cabinet (see Figure 31):
   - Connect the blue wire to a terminal 14.
   - Connect the brown wire to a terminal 7.
   - Connect the green/yellow earth (ground) wire to an earth (ground) terminal.
4. Refer to Figure 32. Route the drive interlock cable C4 (5) as shown in Figure 32, with:
   - The 4-way DIN connector (C4) through the blank panel hole (7) for the EB3 Source Control.
   - Connector CONN 8 end of the cable through the blank panel hole (6) for the EB3 Turret Drive.

3.12.3 Fit the EB3 Sweep Control cables

If you have an EB3 Beam Sweep Unit, use the following procedure to fit the EB3 Sweep Control cables.

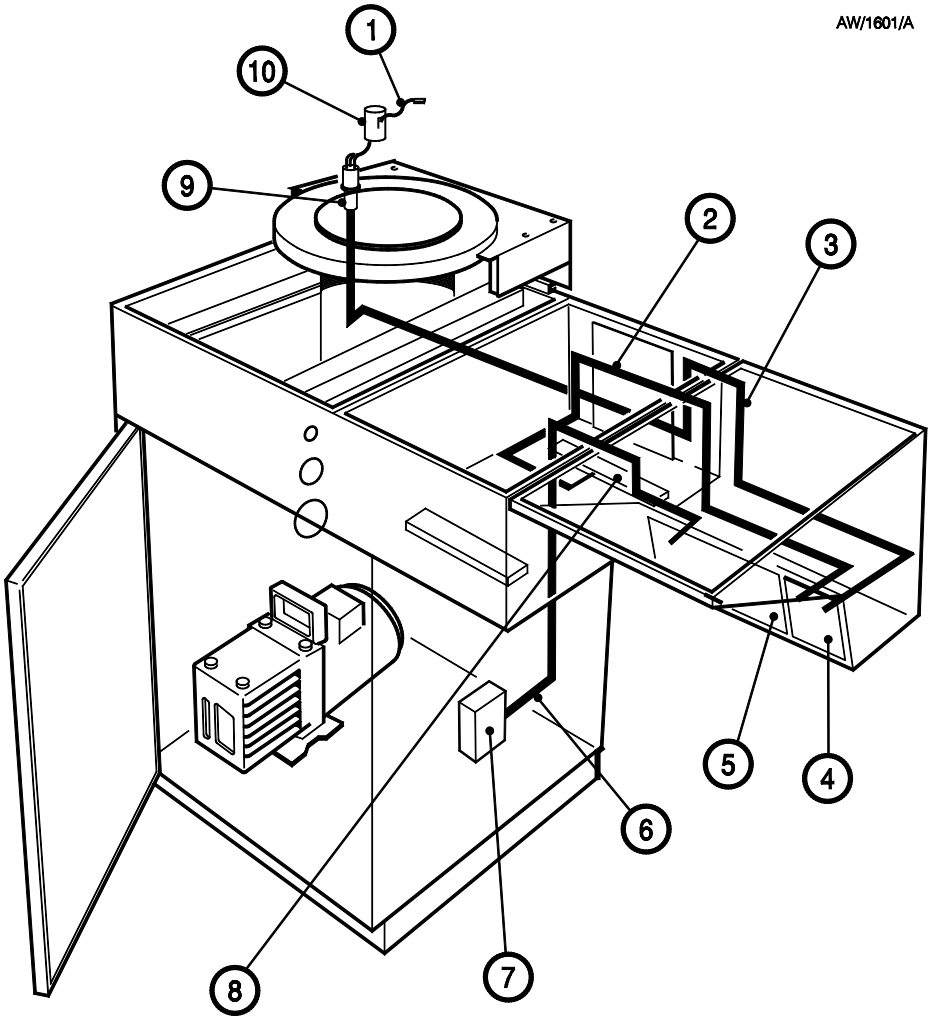
1. Refer to Figure 33. Route the beam sweep control cable C11 (3) from the TL8K25 leadthrough (9) as shown in Figure 33 and pass the end of the cable through the blank panel hole (4) for the EB3 Sweep Control.
2. Hold the Sweep Control under the blank panel hole (4) where you will fit it and pass the end of the sweep control electrical supply cable from the Sweep Control through the blank panel hole.
3. Route the sweep control electrical supply cable (2) as shown in Figure 33, then connect the wires in the cable to terminal block TB2 (see Figure 31) as follows:
   - Connect the blue wire (#14) to a terminal 14.
   - Connect the brown wire (#22) to a terminal 22.
   - Connect the green/yellow earth (ground) wire to an earth (ground) terminal.



1. Motorised drive unit
2. IO relay board
3. Turret Control electrical supply cable
4. Drive control cable C7
5. Drive interlock cable C4
6. Blank panel hole for the Turret Control
7. Blank panel hole for the Source Control
8. Vacuum level interlock wires
9. Terminal block TB1

Cable Name	Wire Number	From	To
Drive control cable C7	-	Motorised Drive connector C7	Turret Control connector C7
Electrical supply cable	Earth (ground) (green/yellow)	Turret Control	Terminal Block TB1, earth (ground) terminal
	#14 (blue)	Turret Control	Terminal Block TB1, terminal 14
	#7 (brown)	Turret Control	Terminal Block TB1, terminal 7
Drive interlock cable C4	-	Turret Control connector C8	Source Control connector CONN 4
Vacuum level interlock cable	black	Source Control connector CONN 3	IO relay board, terminal 14
	white	Source Control connector CONN 3	IO relay board, terminal 15

Figure 32 - Cable routes for the Turret Control and the Source Control vacuum level interlock electrical connections



1. Coil cable
2. Sweep Control electrical supply cable
3. Beam sweep control cable C11
4. Blank panel hole for the Source Control
5. Blank panel hole for the Sweep Control
6. Water Flow-Switch cable C2
7. Water Flow-Switch
8. Terminal block TB2
9. TL8K25 leadthrough
10. Leadthrough shield

Cable Name	Wire Number	From	To
Coil cable	1 - (Black)	TL8K25 leadthrough pin 1	Source beam sweep connector
	2 - (Red)	TL8K25 leadthrough pin 2	
	3 - (Pink)	TL8K25 leadthrough pin 3	
	4 - (White)	TL8K25 leadthrough pin 4	
Sweep Control electrical supply cable	Earth (ground) (green/yellow)	Sweep Control	Terminal Block TB2, earth (ground) terminal
	#14 (blue)	Sweep Control	Terminal Block TB2, terminal 14
	#22 (brown)	Sweep Control	Terminal Block TB2, terminal 22
Beam sweep control cable	C11	TL8K25 leadthrough	Sweep Control connector C11
Flow-switch cable	C2	Water Flow-Switch	Source Control connector CONN 2

Figure 33 - Cable route for the Sweep Control and Water Flow-Switch electrical connections

3.12.4 Fit the EB3 Source Control cables

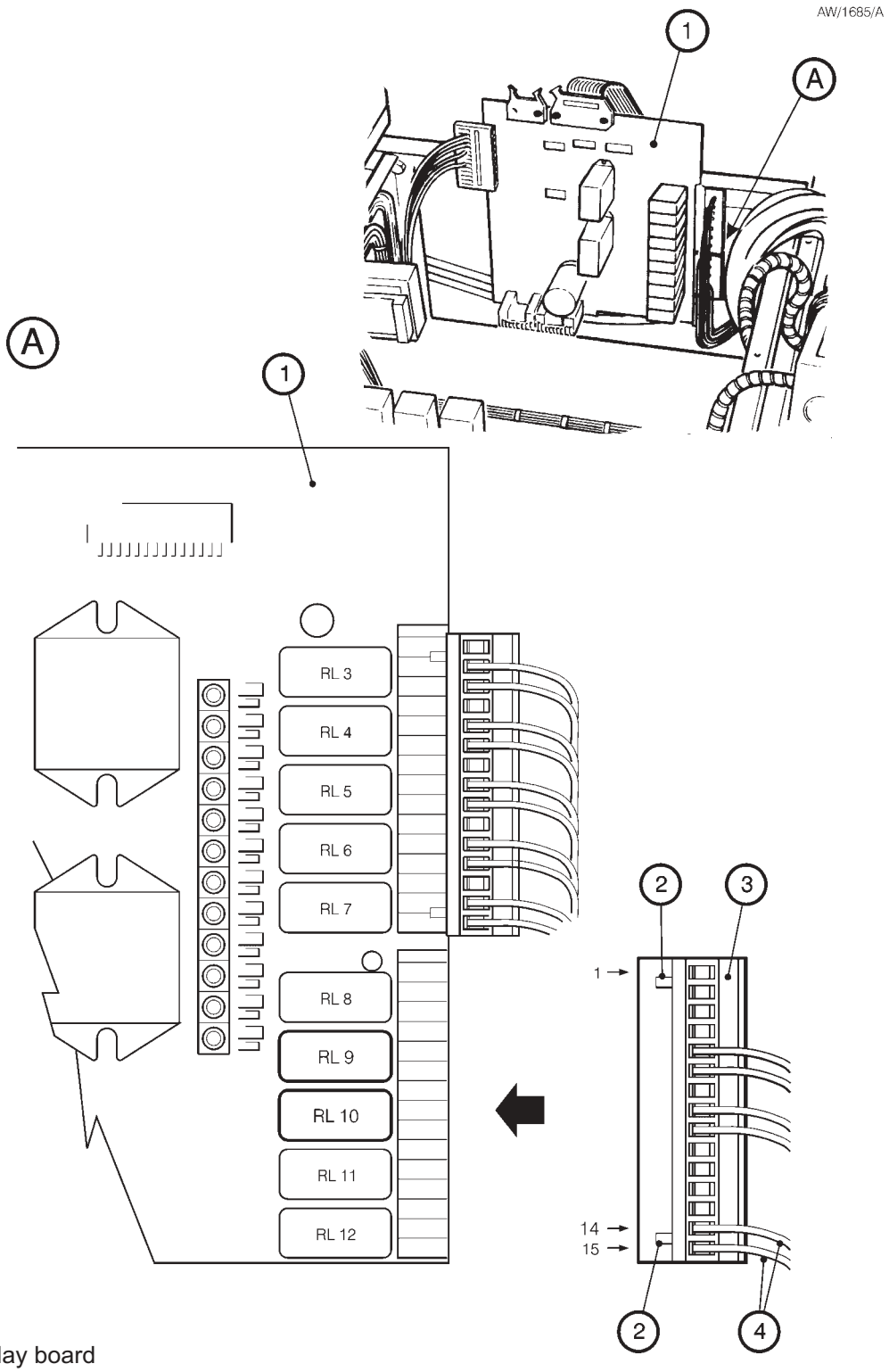
> WARNING
>
> You must connect the vacuum level interlock wires as described in the following procedure. If you do not, the interlock will not operate correctly and there may be a danger of injury or death by electric shock.

1. Refer to Figure 32. Route the vacuum level interlock wires (8) as shown in Figure 32, so that the VAC LEVEL connector (CONN 3) is passed through the blank panel hole (7) for the EB3 Source Control and so that the other end of the wires are close to the IO relay board (2).
2. Refer to Figure 34. Prise up the clips (2) on the lower edge connector (3) and remove the edge connector from the IO relay board (1).
3. Connect the two vacuum level interlock wires (4) to the lower two terminals (terminals 14, 15) of the edge connector (3).
4. Refit the edge connector (3) to the IO relay board (1): push the edge connector firmly to ensure that the clips (2) engage correctly.
5. Close the top cover of the AUTO 306 electrical control cabinet (that is; the part of the cabinet from which you removed the appropriate blank panels).

3.12.5 Fit and connect the EB3 Turret Control

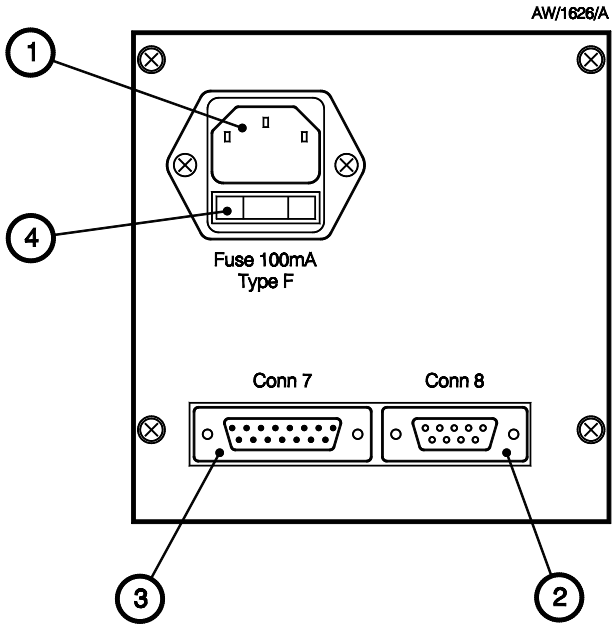
If you have fitted the EB3 Motorised Turret Drive, use the following procedure to fit and connect the EB3 Turret Control.

1. Support the Turret Control next to the blank panel hole where you will fit it (Figure 15, item 1).
2. Fit the connector on the end of the electrical supply cable (Figure 32, item 3) to the connector (Figure 35, item1) on the rear of the Turret Control.
3. Fit the connector (CONN 8) on the end of the drive interlock cable (Figure 32, item 5) to connector CONN 8 (Figure 35, item 2) on the rear of the Turret Control.
4. Fit the connector (CONN 7) on the end of the drive control cable (Figure 32, item 4) to connector CONN 7 (Figure 35, item 3) on the rear of the Turret Control.
5. Fit the Turret Control in the blank panel hole and secure with the screws removed in Section 3.4.



1. IO relay board
2. Clip
3. Edge connector
4. Vacuum level interlock wires

Figure 34 - IO relay board connections



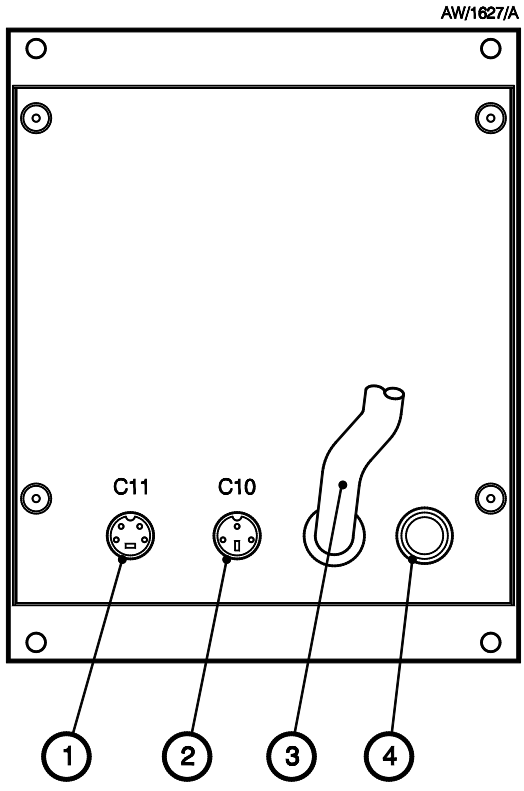
1. Electrical supply connector
2. Remote control connector CONN 8
3. Drive control connector CONN 7
4. Fuse holder

Figure 35 - Rear panel of the EB3 Turret Control

3.12.6 Fit and connect the EB3 Sweep Control

If you have the EB3 Beam Sweep Unit accessory, use the following procedure to fit and connect the EB3 Sweep Control.

1. Fit the connector on the end of the beam sweep control cable C11 (Figure 33, item 3) to connector C11 (Figure 36, item 1) on the rear of the Sweep Control.
2. Refer to Figure 36. Ensure that the linking connector is fitted to connector C10 (2) on the rear of the Sweep Control. If the connector is not fitted, you will not be able to operate beam sweep.
3. Fit the Sweep Control in the blank panel hole and secure with the screws removed in Section 3.4.



1. Beam sweep control connector C11
2. Remote control connector C10
3. Electrical supply cable
4. Fuse holder

Figure 36 - Rear panel of the EB3 Sweep Control

3.12.7 Fit and connect the EB3 Source Control

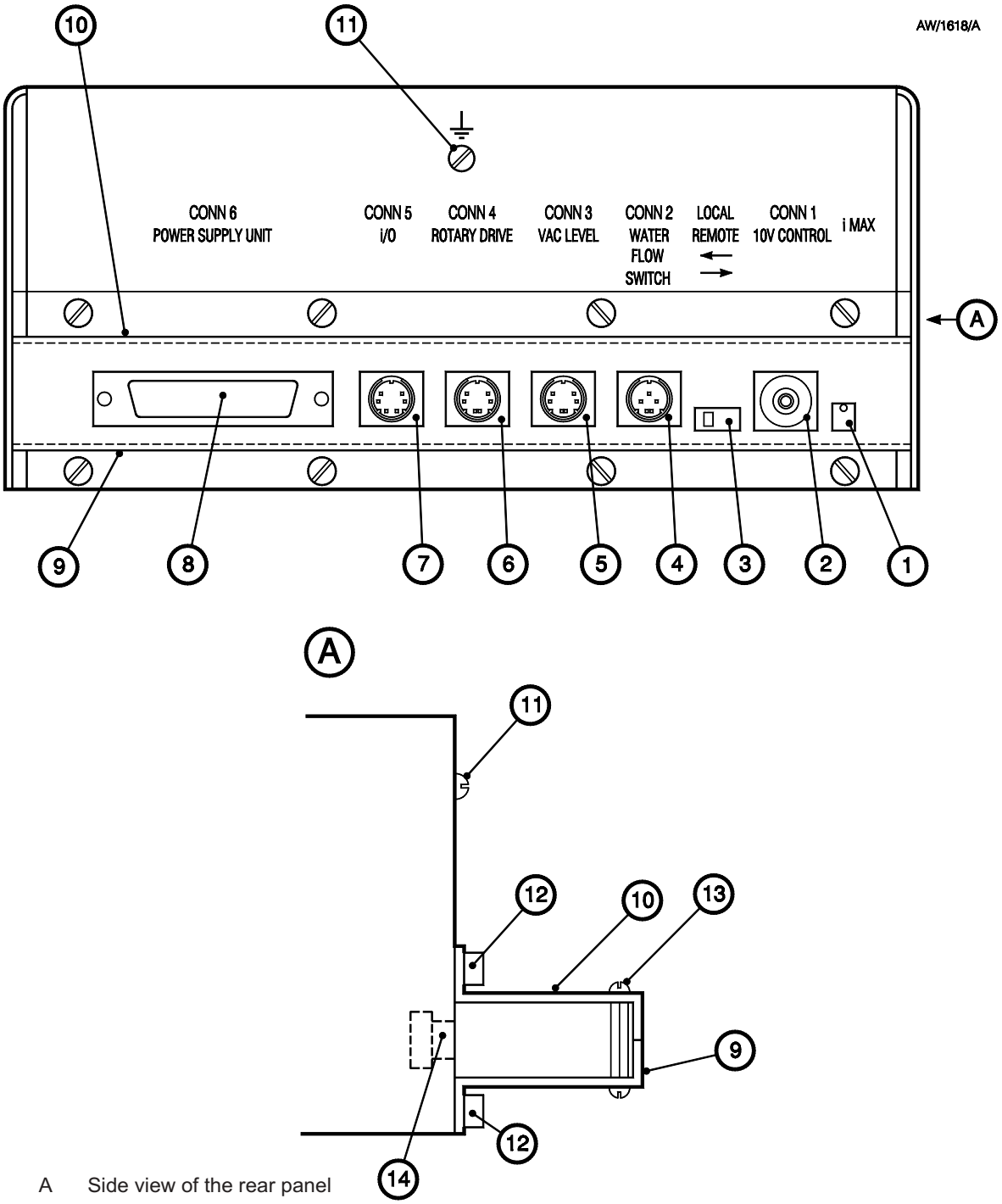
Note: The following procedure assumes that you have fitted the EB3 Water Flow-Switch. If you have fitted a different type of switch, remove the 3-way DIN connector from the rear of the EB3 Source Control, connect it to your flow-switch and then refit the connector to the EB3 Source Control.

1. Refer to Figure 37. Undo and remove the screws (13) which secure the upper connector cover (10) to the lower connector cover (9).
2. Undo and remove the screws (12) which secure the upper connector cover (10) to the Source Control and remove the upper connector cover.
3. Support the EB3 Source Control in position under the blank panel hole (Figure 15, item 3) where you will fit it.
4. Fit the connector (C6) on the Power Supply to Source Control cable (Figure 29, item 5) to the POWER SUPPLY UNIT connector CONN6 (8) on the rear of the Source Control.
5. If you have not fitted the EB3 Motorised Turret Drive, leave the linking connector (C4) fitted to the ROTARY DRIVE socket CONN4 (6) on the rear panel of the Source Control.

   If you have fitted the EB3 Motorised Turret Drive:

   - Remove the linking connector (C4) fitted to the ROTARY DRIVE socket CONN4 (6) on the rear panel of the Source Control.
   - Fit the 4-way DIN connector on the drive interlock cable C4 (Figure 32, item 5) to the ROTARY DRIVE socket CONN4 (6) on the rear panel of the Source Control.
6. Remove the water interlock 3-way DIN connector fitted to the WATER socket CONN2 (4) on the rear panel of the Source Control (4).
7. Fit the connector C2 on the end of the water flow-switch cable (Figure 33, item 6) to the WATER connector CONN 2 (4) on the rear panel of the Source Control.
8. Fit the connector (CONN 3) on the end of the vacuum level interlock cable (Figure 32, item 8) to the VAC LEVEL connector CONN 3 (5) on the rear of the Source Control.
9. Ensure that the Local/Remote switch (3) is in the local position, then refit the upper connector cover (10) and use the screws (12) removed in Step 2 to secure the cover to the rear panel of the Source Control.
10. Use the screws (13) removed in Step 1 to secure the upper connector cover (10) to the lower connector cover (9).
11. Connect the blank panel earth (ground) wire (removed in Section 3.4) to the earth (ground) screw (11) on the rear of the Source Control. If you cannot connect the earth (ground) wire (because the wire will not reach the back of the panel):

    - Cut the cable tie(s) which secure the wire in the AUTO 306 electrical cabinet.
    - Connect the earth (ground) wire, then use cable tie(s) to secure the wire.
12. Fit the Source Control in the blank panel hole and secure with the screws removed in Section 3.4.



A Side view of the rear panel

1. Maximum current adjuster
2. Control connector CONN 1
3. Local/Remote switch
4. Water interlock connector CONN 2
5. Vacuum level interlock connector CONN3
6. Rotary drive interlock connector CONN 4
7. Remote control connector CONN 5
8. Power supply connector CONN 6
9. Lower connector cover
10. Upper connector cover
11. Earth (ground) screw
12. Screw
13. Screw
14. Connectors on rear panel

Figure 37 - Rear panel of the EB3 Source Control

3.13 Change the crucible or fit hearth liner(s)

1. If required, change the crucible as described in Section 4.8.
2. If required, fit hearth liner(s): refer to Volume 2, Section 3.2.

3.14 Make the final connections to the EB3 Multihearth Electron Beam Source

> CAUTION
>
> Do not overtighten the cooling-water connectors. If you do, you may damage the connectors and they will leak.

1. Refer to Figure 20. Place a light wipe of high vacuum grease on the cooling-water 'O' rings (15), then place the 'O' rings in position on the cooling-water connections (14, 18) on the Source.
2. Fit the connectors on the end of the flexible cooling-water pipes (Figure 16, item 1) to the cooling-water connectors on the Source (14 and 18): fit the lower pipe first and fit the connectors by hand so that they are finger-tight. Do not over-tighten the connections.
3. Refer to Figure 16. Fit the two preshaped emitter wires (6, 10) to the 6EK25 leadthroughs (7).
4. Refer to Figure 20. Connect the ends of the two emitter wires (25) to the emitter assembly (24).
5. Use the two M3 screws (17, removed in Section 3.7) to secure the front cover (16) to the Source.

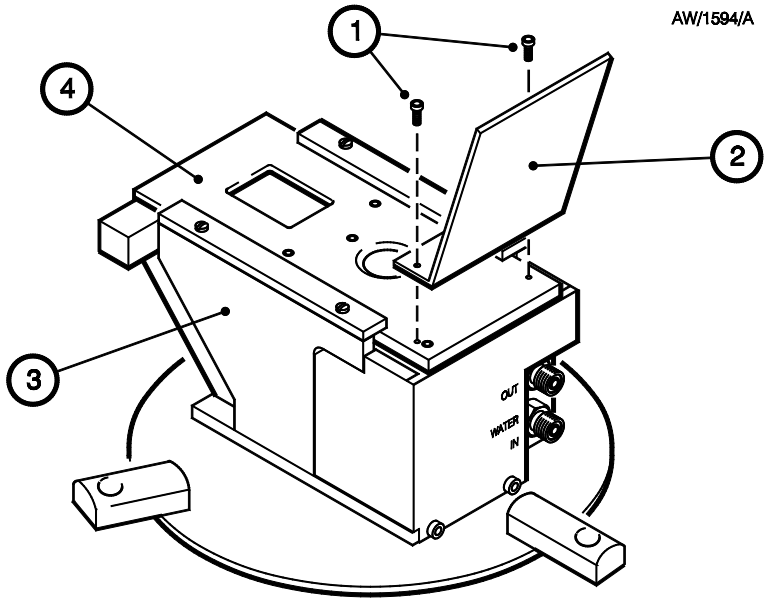
3.15 Fit a Secondary Electron Absorber

CAUTION

If the evaporation materials will cause secondary beam emission from the crucible, you must fit a Secondary Electron Absorber. If you do not, the Bell Jar and accessories in the chamber may be damaged by the secondary electron beam.

When you evaporate materials which have a high atomic weight (such as tungsten and gold), part of the electron beam can be reflected off of the material in the crucible and can strike the chamber wall and accessories in the chamber. This will cause overheating and can damage the chamber and accessories. When you evaporate such materials, you must therefore fit a Secondary Electron Absorber (available as an accessory: see Section 6.3.3); this will absorb the reflected electrons and prevent damage to the chamber wall and accessories.

Refer to Figure 38. Use the two screws supplied (1) to fit the Secondary Electron Absorber (2) to the top shield (4) of the Source.



1. Screw
2. Secondary Electron Absorber
3. Source
4. Top shield

Figure 38 - Fit the Secondary Electron Absorber

3.16 Connect the Power Supply Unit to your electrical supply

Refer to Figure 25.

1. Connect a suitably rated cable to the electrical supply socket (IEC 309/2, CEE17) supplied.
2. Fit the socket to the electrical supply plug (3) on the rear panel of the Power Supply Unit.
3. Connect the other end of the cable to your electrical supply through a suitably rated isolator. Do not switch on the electrical supply yet.

3.17 Complete the installation

3.17.1 Prepare the AUTO 306 for operation

> CAUTION
>
> The cooling-water supply must comply with the specification in Section 2.8. If it does not, the Source will overheat and can be severely damaged.

1. Secure all of the cables in the AUTO 306 electrical control cabinet with the cable ties supplied; ensure that none of the cables touch components which can be very hot or very cold (for example, the diffusion pump or liquid nitrogen trap).
2. Refer to Figure 27. Refit the baseplate rear cover (2) and secure with the four screws (3).
3. Refer to Figure 21. If you have fitted the Manual Turret Drive, loosen the fixing screw which secures the handwheel (5) and remove the handwheel from the shaft (4).
4. Refit the rest of the covers to the AUTO 306: if necessary, refer to the AUTO 306 instruction manual.
5. Refer to Figure 21. If you have fitted the Manual Turret Drive, fit the handwheel (5) to the shaft (4) and tighten the fixing screw which secures the handwheel.
6. Ensure that your cooling-water supply and return pipelines are connected to the AUTO 306 and turn on the water supply.
7. Inspect all of the cooling-water pipelines and check for leaks. If there are any leaks:
   - Turn off the cooling-water supply.
   - Refit any connections that leak.
   - Repeat Steps 6 and 7 to ensure that any leaks have been sealed.
8. Place the Bell Jar on the AUTO 306 baseplate.
9. Switch on the electrical supplies to the AUTO 306 and the Power Supply Unit.

3.17.2 Set the vacuum level interlock pressure

> CAUTION
>
> Do not set the vacuum level interlock to a pressure higher than 1×10^{-4} mbar (1×10^{-2} Pa). If you do, the life of the filament will be reduced.

We recommend that you set the vacuum level interlock so that the Source cannot be operated when the pressure in the AUTO 306 vacuum chamber is above 1×10^{-4} mbar (1×10^{-2} Pa). If the Source is operated when the pressure in the chamber is higher than this pressure, the life of the filament will be significantly reduced.

To set the vacuum level interlock pressure, use pressure stores 14 and 15 in the AUTO 306 Controller. You must also set time store 13 for correct operation of the interlock. Refer to the 'Advanced Controller Operation' section of the AUTO 306 instruction manual for the procedure to set the pressure stores and the time store.

- Pressure store 14 is the lowest pressure at which the interlock will be closed: we recommend that you set this pressure store to 9×10^{-5} mbar.
- Pressure store 15 is the highest pressure at which the interlock will be closed: we recommend that you set this pressure store to 3×10^{-4} mbar.
- Time store 13 is the time delay (after the pressure in pressure store 15 is reached) after which the interlock is made: we recommend that you set this time store to 0 seconds.

3.17.3 Adjust the EB3 Motorised Turret Drive

If you have fitted the EB3 Motorised Turret Drive, use the following procedure to check for correct operation of the drive and adjust it if necessary.

1. Turn on the cooling-water and electrical supplies for the AUTO 306.
2. Ensure that the Bell Jar and implosion guard (or other chamber accessory, such as the FL400 chamber door) are in place.
3. Start up the AUTO 306: refer to the 'Start up' section of the AUTO 306 instruction manual.
4. Press PROCESS on the AUTO 306 controller. The chamber will then be pumped down.
5. Turn on the electrical supply to the Power Supply Unit, then move the electrical supply isolator on the Power Supply Unit (Figure 3, item 4) to the 'on' position.
6. Refer to Figure 5. Press the on/off switch (8) on the Turret Control, use the index/continuous rotation switch (1) to select indexing and move the hearth selector switch (6) to select a different hearth. The crucible on the Source will then rotate.

7. When the crucible has stopped rotating:

   - Press the on/off switch (8) to switch off the Turret Control.
   - Press VENT on the AUTO 306 controller.
   - When the chamber is at atmospheric pressure, remove the Bell Jar (or open the FL400 chamber door).

8. Refer to Figure 20. Inspect the crucible (5) on the Source. If a hearth is directly under the hole in the top shield (3), continue at Section 3.17.4. If a hearth is not directly under the hole in the top shield (that is, is partly hidden by the top shield), continue at Step 9 to adjust the position of the crucible.

9. Refer to Figure 22. Firmly hold the drive shaft (1) so that it cannot turn, then loosen the two grub screws which secure the drive sprocket (20).

10. Continue to hold the drive shaft (1) so that it cannot turn and rotate the crucible on the Source so that a hearth is directly under the hole in the top shield of the Source, then tighten the two grub screws which secure the drive sprocket (20).

11. Repeat Steps 2 to 8 to operate the Turret Control and check for correct positioning of all the hearths. When you operate the Turret Control, take note of the hearth selected on the Turret Control and the corresponding hearth on the crucible.

3.17.4 Commission the installation

Operate the EB3 Multihearth Electron Beam Source as described in Volume 2 of this manual to ensure that the equipment has been installed and operates correctly. If the equipment does not operate correctly, refer to Section 4 to determine the cause of the fault and rectify the fault.

3.18 Installation of the EB3 Multihearth Electron Beam Source in the side evaporation position in the FL400 vacuum chamber

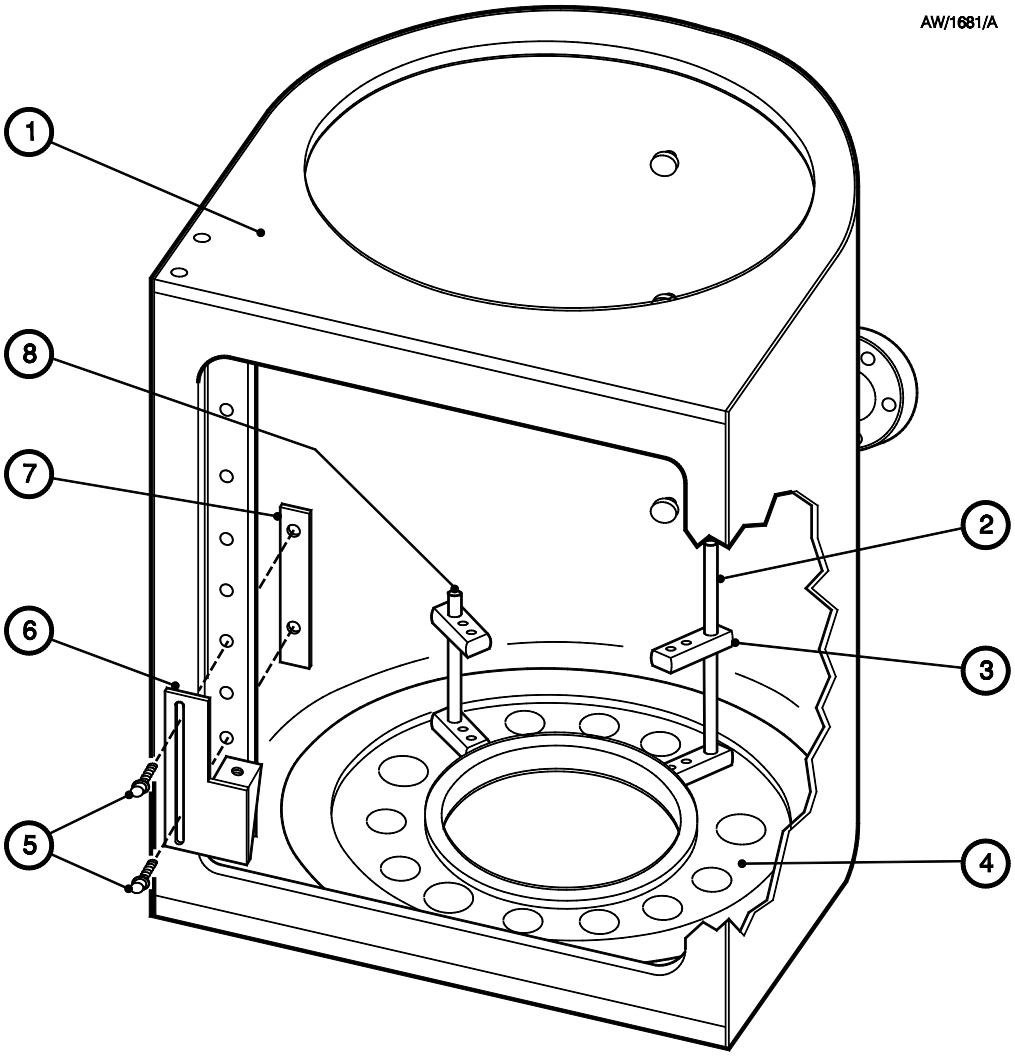
Note: You must have an EB3/FL400 Mounting Kit to fit the Source in the side evaporation position in the FL400 chamber.

3.18.1 Prepare the AUTO 306

1. Prepare the AUTO 306 as described in Section 3.4 and fit the FL400 chamber as described in the instruction manual supplied with the chamber.

2. Refer to Figure 39. Place the support bracket (6) in position and at the correct height (refer to Figure 41) on the mounting strip of the FL400 chamber. Place the support plate (7) inside the FL400 chamber and use the two M5 screws (5) to secure the support bracket and support plate in position.

3. Fit two legs of the Tripod (2, 8) and the baffle plate lugs (3) as shown in Figure 39: refer to the instruction manual supplied with the Tripod. Ensure that the lugs (3) are at the correct heights to fit the baffle plate: refer to Figure 41.



1. FL400 chamber
2. Long Tripod leg
3. Baffle plate lug
4. AUTO 306 baseplate
5. Screws: M5 (2 off)
6. Support bracket
7. Support plate
8. Short Tripod leg

Figure 39 - Fit the Tripod legs and support bracket to the FL400 chamber

3.18.2 Fit the leadthroughs and water flow-switch

1. Fit the EB3 Leadthrough Kit as described in Section 3.5, however, note that the cooling-water connections on the water leadthrough (as shown in Figures 16 and 17) are reversed; that is:
   - You must connect the short (vertical) pipe from the leadthrough under the AUTO 306 baseplate to the AUTO 306 cooling-water supply pipeline.
   - You must connect the long (angled) pipe from the leadthrough under the AUTO 306 baseplate to the AUTO 306 cooling-water return pipeline.
2. Fit the water flow-switch as described in Section 3.6.
3. If you have an EB3 Beam Sweep unit, fit theEB3 Beam Sweep leadthrough as descibed in Section 3.10. Note that the EB3/FL400 Mounting Kit contains a long coil cable; you must use this long cable instead of the standard coil cable supplied with the EB3 Beam Sweep Unit.

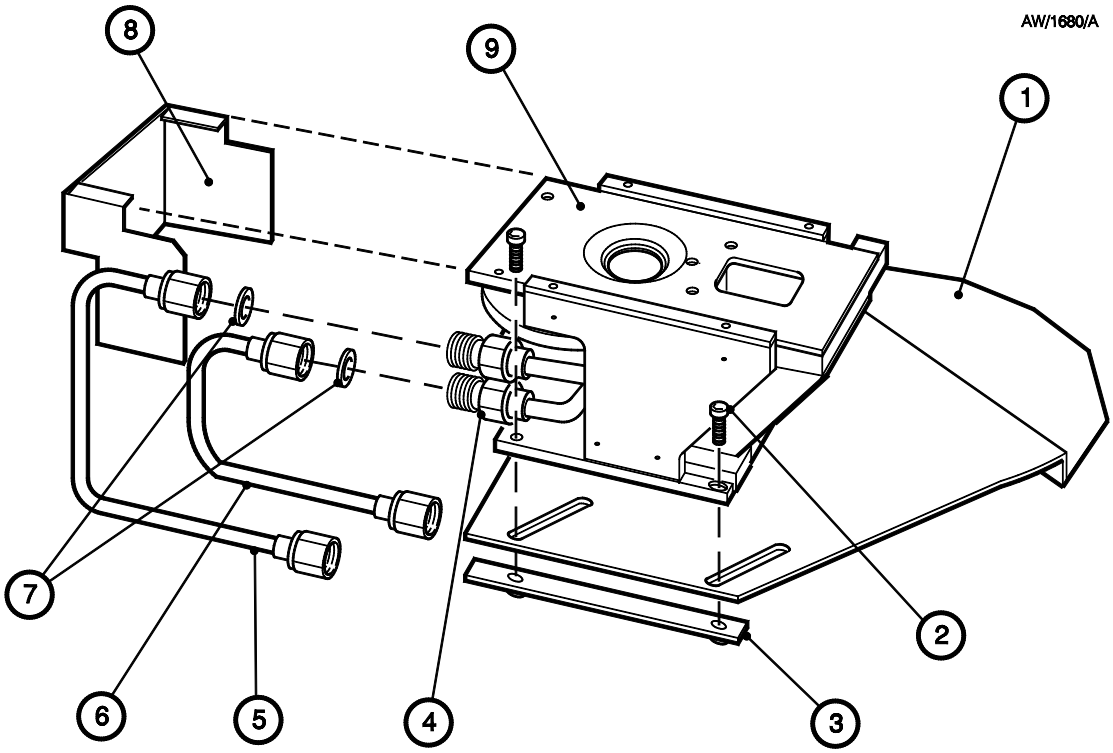
3.18.3 Fit the Source to the baffle plate

> CAUTION
>
> Do not overtighten the cooling-water connectors. If you do, you may damage the connectors and they will leak.

Note: The fixing holes on the baffle plate are shown in Figure 42.

1 Refer to Figure 20. Loosen the two M3 screws (17) and remove the front cover (16) from the EB3 Multihearth Electron Beam Source.

2. Refer to Figure 40. Place a light wipe of high vacuum grease on the cooling-water 'O' rings (7), then place the 'O' rings in position on the cooling-water connections (4) on the Source.
3. Fit the connectors on the ends of the cooling-water pipes (5, 6) to the cooling-water connectors (4) on the Source: fit the lower pipe first and fit the connectors by hand so that they are finger-tight. Do not over-tighten the connectors.
4. Place the Source (9) on the front of the baffle plate (1).
5. Place one of the clamp bars (3) under the front of the baffle plate (1) as shown in Figure 40, then use two M3 screws (2) to secure the Source to the baffle plate and clamp bar.
6. Repeat Step 5 to fit the second clamp bar and secure the rear of the Source to the baffle plate.
7. Refer to Figure 20. Refit the front cover (16) to the Source and secure with the two M3 screws (17).



1. Baffle plate
2. M3 screw
3. Clamp bar
4. Cooling-water connections
5. Cooling-water outlet pipeline
6. Cooling-water inlet pipeline
7. Cooling-water ‘O’ rings
8. Front cover
9. Source

Figure 40 - Fit the EB3 Multihearth Electron Beam Source to the baffle plate

3.18.4 Fit the EB3 Manual Turret Drive

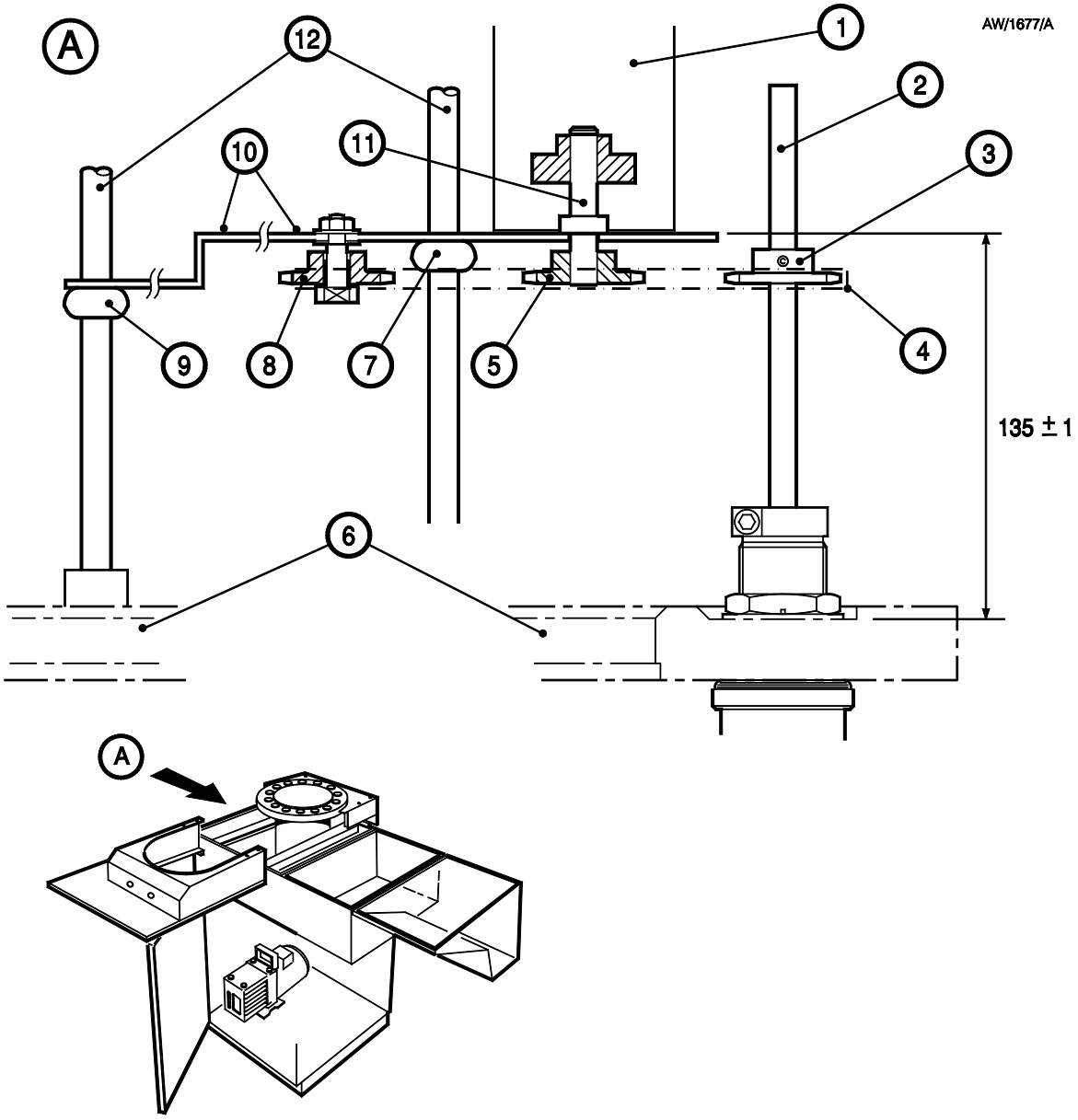
> CAUTION
>
> Ensure that the EB3 Multihearth Electron Beam Source is level. If it is not, when you operate it, molten evaporant will spill out of the crucible.

Use the following procedure to fit the EB3 Manual Turret Drive. Figure 42 shows the sprockets fitted to the baffle plate.

1. Fit the Manual Turret Drive as described in Section 3.8, Steps 1 to 6.
2. Refer to Figure 41. Loosely fit the tension sprocket (8) in the slot on the baffle plate (10).
3. Fit one of the plain sprockets (5) to the turret drive shaft (11) on the Source (1). Ensure that the bottom face of the sprocket (5) aligns with the end face of the turret drive shaft (11).
4. Engage the drive chain (4) over the turret sprocket (5) and the tension sprocket (8). Engage the other plain sprocket (3) in the drive chain (4).
5. Refer to Figure 39. Carefully lower the complete assembly over the baseplate, so that the baffle plate rests on the lugs (3) and the support bracket (6). Ensure that the Source is level and at the correct height, then use the three screws to secure the baffle plate to the lugs and the support bracket.
6. Refer to Figure 41. Ensure that the drive chain (4) is level; if necessary, adjust the position of the drive sprocket (3) on the drive shaft (2), then secure the sprocket to the drive shaft.
7. Reposition and secure the tension sprocket (8) so that the drive chain (4) is not slack; if necessary adjust the position of the tension sprocket (8).
8. Turn the handwheel (Figure 21, item 10) to ensure that the drive unit correctly turns the turret.

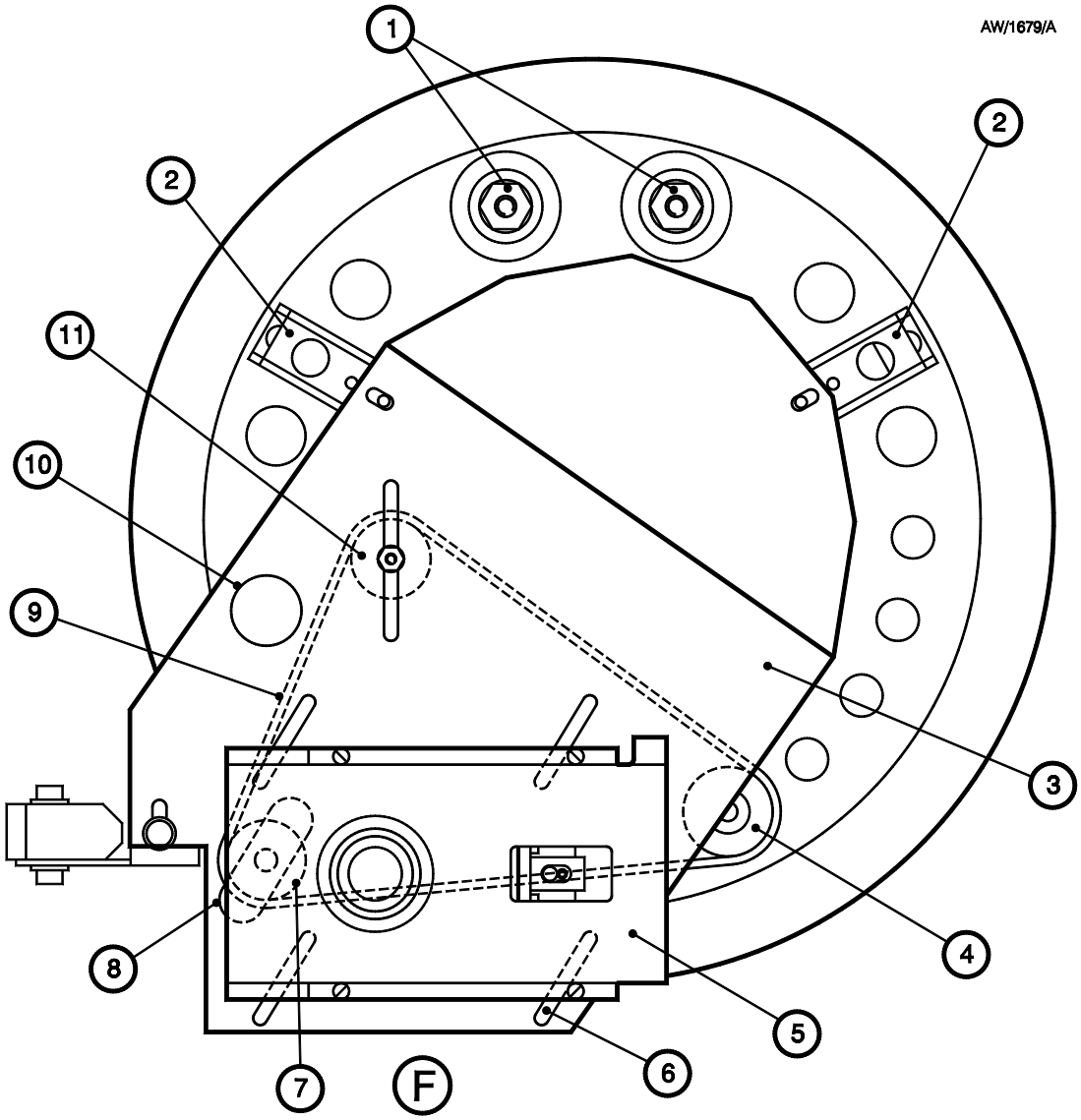
3.18.5 Fit the EB3 Motorised Turret Drive

1. Fit the EB3 Motorised Turret Drive as described in Section 3.9, Steps 1 to 9.
2. Fit the assembly into the chamber and adjust the drive chain as described in Section 3.18.4, Steps 2 to 7.



1. Source
2. Drive shaft
3. Drive sprocket
4. Drive chain
5. Turret drive sprocket
6. AUTO 306 baseplate
7. Baffle plate lug
8. Tension sprocket
9. Baffle plate lug
10. Baffle plate
11. Turret drive shaft
12. Tripod legs

Figure 41 - Fit the EB3 Manual Turret Drive in the FL400 chamber



F Front of the FL400 chamber

1. 6EK25 leadthroughs
2. Baffle plate lugs
3. Baffle plate
4. Drive sprocket
5. Source
6. Source fixing slots
7. Turret drive sprocket
8. Turret drive shaft leadthrough hole
9. Drive chain
10. Shutter leadthrough hole
11. Tension sprocket

Figure 42 - Source mounted on the FL400 baffle plate

3.18.6 Install the EB3 Beam Sweep leadthrough and the EB3 Power Supply Unit

1. If you have an EB3 Beam Sweep Unit, fit the EB3 Beam Sweep leadthrough as described in Section 3.10.
2. Install the EB3 Power Supply Unit as described in Section 3.11.
3. Make the electrical connections as described in Section 3.12.
4. If required, change the crucible or fit hearth liners: refer to Section 4.8 and Volume 2, Section 3.2.

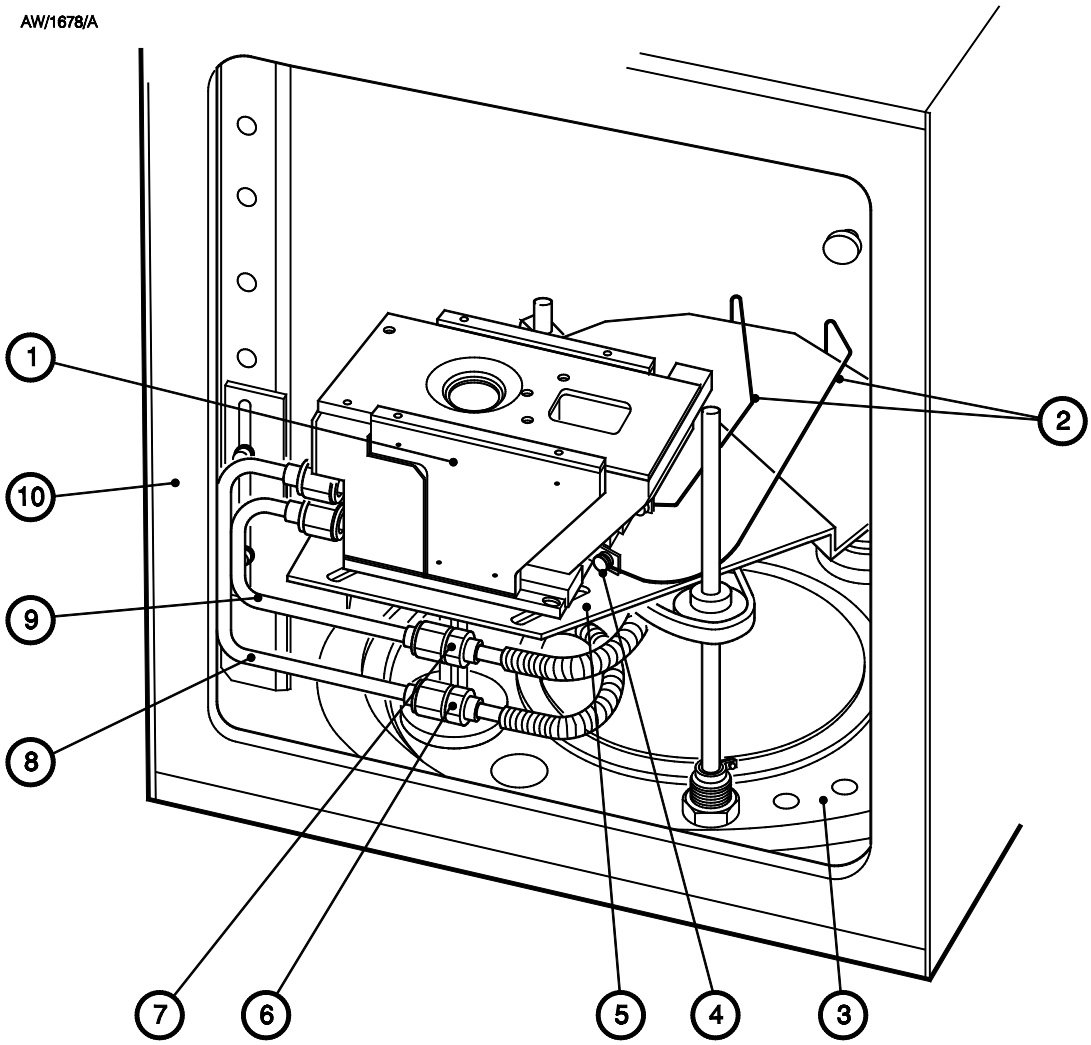
3.18.7 Make the final connections to the EB3 Multihearth Electron Beam Source

> CAUTION
>
> Do not overtighten the cooling-water connectors. If you do, you may damage the connectors and they will leak.

> CAUTION
>
> Ensure that the emitter wires are not too close and do not touch components in the chamber. If you do not, the Source may not operate and you may damage the Source or other equipment in the chamber.

Note: The shapes and lengths of the two emitter wires will depend on the exact positions of the Source and other components in the chamber.

1. Refer to Figure 20. Place a light wipe of high vacuum grease on the cooling-water 'O' rings (15), then place the 'O' rings in position on the cooling-water connections (14, 18) on the Source.
2. Refer to Figure 43. Fit the connectors on the end of the cooling-water pipes (8, 9) to the water leadthrough connectors (6, 7): fit the connectors by hand so that they are finger-tight. Do not over-tighten the connectors.
3. Cut two lengths of the copper wire supplied and shape them into emitter wires (2). Make a loop on the end of each wire and then fit the wires (2) to the 6EK25 leadthroughs (Figure 16, items 7).
4. Make a loop on the other end of each emitter wire and connect the ends of the two wires (2) to the emitter connections (4) on the emitter assembly. Ensure that there is a gap of least 10 mm between the wires and any other components in the chamber.



1. Source
2. Emitter wires
3. AUTO 306 baseplate
4. Emitter connection
5. Baffle plate
6. Cooling-water outlet connection (from leadthrough)
7. Cooling-water inlet connection (from leadthrough)
8. Cooling-water outlet pipeline
9. Cooling-water inlet pipeline
10. FL400 chamber

Figure 43 - EB3 Multihearth Electron Beam Source and baffle plate in the FL400 chamber

3.18.8 Complete the installation

1. If necessary, fit a Secondary Electron Absorber as described in Section 3.15.
2. Connect the Power Supply Unit to your electrical supply as described in Section 3.16.
3. Complete the installation as described in Section 3.17.
4. Fit the shutter extension arm supplied with the EB3/FL400 Mounting Kit. When you fit the extension arm, ensure that the shutter is free to travel and that the shutter is positioned 25 mm above the top shield of the Source.

3.19 Remote control of the EB3 Multihearth Electron Beam Source

3.19.1 Introduction

The Source can be controlled in a number of modes:

- Local control (that is, manually, by the use of all of the controls on the EB3 control panels).
- Full remote control by the use of signals input into the Source Control and other accessories from, for example, a thin film deposition controller. The use of a thin film deposition controller will provide full control of and repeatability of deposition process cycles.
- Semi-remote control, by the use of some of the EB3 control panels and signals input into the Source Control and other accessories.

Figure 28 shows a schematic diagram of the electrical connections for the local control mode and Figure 44 shows a schematic diagram of the electrical connections for the remote control mode; these modes are more fully described in the following sections.

Tables 3 to 6 show the electrical signals which are required to control the EB3 equipment in the semi-remote and remote control modes.

Before you use your own equipment to control the Source, we recommend that you fully understand the installation of, and manual control of, the EB3 equipment (refer to Sections 1 to 3 of this Volume and to Volume 2); you should take particular note of emission currents for the degassing of evaporants and the start of evaporation.

If you use your own control equipment to control the Source, ensure that you use fully screened cables and connectors to make the connections between the EB3 control units and your control equipment.

3.19.2 Local control

The previous sections of Section 3 describe the installation of the Source and its accessories for local control mode. In this mode:

- The local/remote switch on the rear panel of the Source Control (Figure 37, item 3) must be in the 'local' position, that is, in the left-most position.
- The local/remote switch on the front panel of the Source Control (Figure 4, item 9) must be in the 'local' position; that is, not depressed.
- The local/remote switch on the front panel of the Turret Control (Figure 5, item 10) must be in the 'local' position; that is, not depressed.
- The linking connector C10 must be fitted to the rear of the Sweep Control (see Figure 36, item 2).

In this mode, control of the Source is by the use of the controls on the front panels of the Source Control, Sweep Control and Turret Control (if fitted).

1. Turret Control
2. Remote turret selector
3. Sweep Control
4. TL8K25 leadthrough
5. Beam sweep coils
6. Turret drive switches and motor
7. Turret position switches
8. DIP
9. Deposition controller
10. DOP
11. Fans/timer
12. Cont. on
13. Gun on
14. Vacuum level interlock (AUTO 306 process relay 4)
15. Water Flow-Switch
16. Source Control
17. BNC
18. Analogue control signal
19. Power Supply Unit

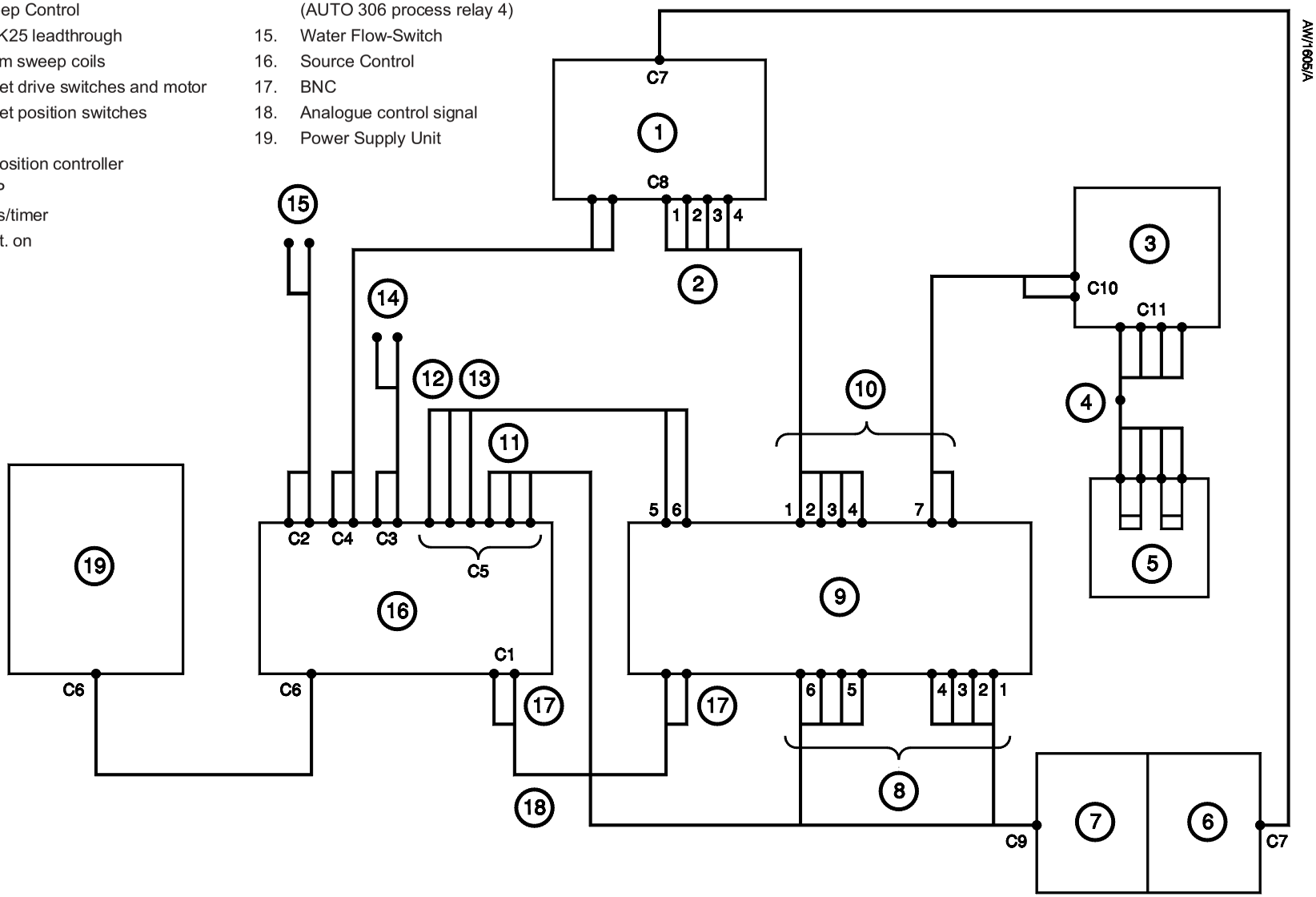


Figure 44 - Schematic diagram of the EB3 electrical connections (remote control)

3.19.3 Semi-remote control

This mode is useful if you have a thin film deposition controller, but also want to use the control panels to control the Source. In this mode:

- The local/remote switch on the rear panel of the Source Control (Figure 37, item 3) must be in the 'local' position, that is, in the left-most position.
- The local/remote switch on the front panel of the Source Control (Figure 4, item 9) must be in the 'remote' position; that is, depressed.
- The local/remote switch on the front panel of the Turret Control (Figure 5, item 10) must be in the 'local' position; that is, not depressed.
- You must connect your control equipment to the remote control connector (I/O, CONN 5) on the rear panel of the Source Control (Figure 37, item 7)

In this mode of operation, the gun switch and the current control on the front panel of the Source Control (Figure 4, items 10 and 5) do not affect the operation of the Source and the power output to the Source is controlled by a signal input to the voltage control connector (CONN 1, 10V CONTROL: Figure 37, item 2). This signal selects the output power as follows:

- 0 V selects 0% output power.
- – 10 V selects 100% output power (600 mA emission current).
- The relationship between the control signal and the output voltage is linear (that is, – 5 V selects 50% output power, and so on).

To switch on the Source, the connections between pins 1 and 2 of the remote control connector on the rear panel of the Source Control must be closed (see Table 3).

3.19.4 Remote control

Use this mode if you want to use your own control equipment to control the operation of the EB3 Multihearth Electron Beam Source. To select remote control mode, the local/remote switch on the rear panel of the EB3 Source Control (Figure 37, item 3) must be in the 'remote' position, that is, in the right-most position.

In this mode, none of the controls on the front panels affect the operation of the Source and you must connect your control equipment to the following:

- Remote control (I/O) connector CONN 5 on the rear panel of the Source Control (Figure 37, item 7).
- 10 V control signal (10 V CONTROL, CONN 1) on the rear panel of the Source Control (Figure 37, item 2).
- Remote sweep select connector (C10) on the rear panel of the Sweep Control (Figure 36, item 2).
- Remote turret select connector (CONN 8) on the rear panel of the Turret Control (Figure 35, item 2).
- Remote position connector (C9) on the Motorised Turret Drive (Figure 22, item 8).

A typical process sequence for remote control is given in Section 4 of Volume 2 of this manual.

Connector	Type	Pin	Use	Notes
C5 (6-pin mini DIN)	Control signal	1	Control signals common	See below (pins 2 and 5)
	Control signal	2	Select Source on	Close pins 1 and 2 to select Source on
	Status signal	3	Status signals common (0 V)	See below (pins 4 and 6)
	Status signal	4	Fans on (+12 V d.c. out)	Pins 3 and 4 are closed when fans are on
	Control signal	5	Control on	Close pins 1 and 5 to select Control on
	Status signal	6	Internal timer OK (+12 V d.c. out)	Pins 3 and 6 are closed when internal timer is ok
C1 (BNC)	Control signal	-	0 to – 10 V analogue control signal	Selects power output to Source

Table 3 - EB3 Source Control remote control and status signals

Connector	Type	Pin	Use	Notes
C10 (3-pin mini DIN)	Control signal	2	Sweep select	Close pins 2 and 3 to select beam sweep
	Control signal	3	Sweep select	

Table 4 - EB3 Sweep Control remote control signals

Connector	Type	Pin	Use	Notes
C8 (9-pin D type)	Control signal	1	Hearth 1 select	Close pin 6 and the corresponding one of these pins to select a hearth.
	Control signal	2	Hearth 2 select	
	Control signal	3	Hearth 3 select	
	Control signal	4	Hearth 4 select	
	Control signal	5	Turret indexing interlock	Close pins 5 and 9 to select turret indexing interlock
	Control signal	6	Hearth select common	See above (pins 1 to 4)
	Control signal	7	Continuous rotation common	Close to select continuous rotation
	Control signal	8	Continuous rotation select	
	Control signal	9	Turret indexing interlock	See above (pin 5)

Table 5 - EB3 Turret Control remote control signals

Connector	Type	Pin	Use	Notes
C9 (9-pin D type)	Status signal	1	Turret at hearth 1: common	Pins 1 & 6, 2 & 7, 3 & 8, 4 & 9 are closed to indicate the corresponding hearth is in the evaporation position
	Status signal	2	Turret at hearth 2: common	
	Status signal	3	Turret at hearth 3: common	
	Status signal	4	Turret at hearth 4: common	
	-	5	Not connected	
	Status signal	6	Turret at hearth 1: normally open	
	Status signal	7	Turret at hearth 2: normally open	
	Status signal	8	Turret at hearth 3: normally open	
	Status signal	9	Turret at hearth 4: normally open	

Table 6 - Motorised Turret Drive remote position status signals

4 MAINTENANCE

4.1 Safety information

WARNING
Obey the safety instructions given below and take note of appropriate precautions. If you do not, you can cause injury to people and damage to equipment.

- You must periodically check the interlocks to ensure that they operate correctly.
- Switch off and disconnect the electrical supply from the AUTO 306 before you start any maintenance work.
- Do not touch surfaces inside the AUTO 306 which are very hot or very cold.
- Observe all safety precautions when you come into contact with dangerous substances which have been used with the EB3 Multihearth Electron Beam Source.
- Never dismantle the magnet or the pole pieces from the EB3 Multihearth Electron Beam Source, as this can weaken the magnets and pole pieces. Also, if you operate the EB3 Multihearth Electron Beam Source with the magnet incorrectly installed, the electron beam can strike the chamber wall and cause severe damage.
- Always wear clean lint-free gloves when you handle components which have been or are to be installed in the chamber, to prevent contamination of the chamber components.
- Do not use wire wool to clean accessories, as the fine wires break away and can cause damage to 'O' rings and the seal on the high vacuum valve.
- Periodically inspect electrical connections to ensure that they are not loose and check that the wires and cables are not damaged and have not overheated.
- Periodically inspect the cooling-water pipelines to ensure that they are not corroded and that there are no leaks.
- You can use glass bead blasting (if available) to clean the shield, cover and emitter assembly (without the filament) of the Source, and to clean other chamber components. Only use a mild abrasive cleaner (such as 3M 'Scotchbright') to clean other parts of the Source.

4.2 Maintenance frequency

You should check for correct operation of the interlocks (see Section 4.6) at least once a week.

The frequency of other maintenance operations depends on how you use the Source and how often the Source is used for deposition. Determine the best frequency of maintenance operations according to your experience.

4.3 Maintain the leadthroughs

Refer to the leadthrough instruction manual supplied with the equipment for information about the maintenance of the leadthroughs.

4.4 Inspect the cables and wires in the chamber

Regularly check that electrical cables and wires in the chamber are not damaged and have not overheated. If a cable or wire is damage or has overheated, you must replace it.

Ensure that the cables do not touch other components in the chamber.

Ensure that the emitter wires (Figure 16, items 6 and 9 and Figure 43, items 2) are at least 10 mm from each other and from other components in the chamber.

4.5 Clean the shields

> CAUTION
>
> Ensure that all glass beads have been removed before you refit a shield. If you do not, electrical arcing will result when you operate the EB3 Multihearth Electron Beam Source and it may be damaged.

> CAUTION
>
> You must clean the top **and** the bottom of the top shield of the Source. If you do not, deposits on the bottom of the shield could prevent rotation of the crucible.

You must regularly clean any deposits from the EB3 cover and shields. Use the following procedure.

1. Loosen the two M3 screws (1) which secure one of the pole piece extensions (2). Undo and remove the two M3 screws (1) which secure the other pole piece extension (2) and remove the pole piece extension.
2. Undo and remove the four M3 screws (30) which secure the top shield (3), then remove the top shield from the Source.
3. If you have the EB3 Beam Sweep Unit accessory:
   - Refer to Figure 23. Remove the plug (3) on the beam sweep coil cable from the connector on the Source (2).
   - Remove the shield (7) from the TL8K25 leadthrough.
4. Glass-bead blast the components removed in Steps 1 to 3 to remove any deposits.

(Continued on page 92)

5. Place the components in an ultrasonic bath to remove any glass beads.
6. If you have the EB3 Beam Sweep Unit accessory:
   - Refer to Figure 23. Refit the shield (7) to the TL8K25 leadthrough.
   - Refit the plug (3) on the beam sweep coil cable to the connector on the Source (2).
7. Refer to Figure 20. Refit the top shield (3) on the Source and secure with the four M3 screws (30).
8. Refit the pole piece extension (2) removed in Step 12 and secure with the two M3 screws (1). Tighten the two M3 screws (1) which secure the other pole piece extension (2).

4.6 Check for correct operation of the interlocks

Use the procedures in the following sections to check for correct operation of the interlocks at least once a week. These procedures assume that you have correctly installed the interlocks and that you can operate the EB3 equipment in manual control mode. Where necessary, refer to Volume 2 for operating instructions.

4.6.1 Check the rotary drive interlock

Note: The following procedure only applies if you have fitted the EB3 Motorised Turret Drive. If you have fitted the EB3 Manual Turret Drive, the linking connector C4 should be fitted to the rear of the Source Control to ensure that the rotary drive interlock is permanently closed: refer to Section 3.

1. Operate the AUTO 306 and ensure that the vacuum chamber is at the required pressure for evaporation.
2. Switch on the Source Control.
3. Select indexing on the Turret Control and wait until the crucible has stopped rotating. Check that the rotary drive interlock LED on the front of the Source Control (see Figure 4) is on.
4. Watch the rotary drive interlock LED while you select a different hearth on the Turret Control. The interlock LED should go off until the crucible has rotated to the required hearth position (indicated when the selected hearth LED on the Turret Control goes on); the rotary drive interlock LED should then go on again.
   - If the rotary drive interlock LED goes off as described above, the interlock operates correctly.
   - If the rotary drive interlock LED does not go off, the interlock does not operate correctly. Shut down the system, isolate it from the electrical supply and then check the installation of the interlock (refer to Sections 3.9, 3.12.2, 3.12.5 and 3.12.7).

4.6.2 Check the water interlock

Note: The following procedure assumes that you have fitted isolation-valves in the cooling-water supply and return pipelines for the Source (refer to Section 3.5). If you have not fitted isolation-valves, you must turn off the cooling-water supply in Step 3 below. When you turn off the cooling-water supply, this will also affect other AUTO 306 components which require water cooling (for example, the Cryodrive, if fitted).

1. Operate the AUTO 306 and ensure that the vacuum chamber is at the required pressure for evaporation.
2. Switch on the Source Control, then check that the water interlock LED on the front of the Source Control (see Figure 4) is on.
3. Watch the water interlock LED while you close the isolation valves in the Source cooling-water supply and return pipelines. When the cooling-water flow rate falls to below 3 $l.min^{-1}$, the water interlock LED should go off.
   - If the water interlock LED goes off as described above, the interlock operates correctly. Open the isolation-valves again.
   - If the water interlock LED does not go off as described above, the interlock does not operate correctly. Shut down the system, isolate it from the electrical supply and then check the installation of the interlock and the Water Flow-Switch (refer to Sections 3.6 and 3.12.7).

4.6.3 Check the vacuum level interlock

1. Operate the AUTO 306 and ensure that the vacuum chamber is at the required pressure for evaporation.
2. Switch on the Source Control, then check that the vacuum level interlock LED on the front of the Source Control (see Figure 4) is on.
3. Watch the vacuum level interlock LED while you slowly open the leak-valve on the AUTO 306. When the pressure in the chamber rises to above the preset level (see Section 3.17.2), the vacuum level interlock LED should go off.
   - If the vacuum level interlock LED goes off as described above, the interlock operates correctly.
   - If the vacuum level interlock LED does not go off as described above, the interlock does not operate correctly. Shut down the system, isolate it from the electrical supply and then check the installation of the interlock (refer to Section 3.12.7).

4.6.4 Check the safety interlock

1. Operate the AUTO 306 and ensure that the vacuum chamber is at the required pressure for evaporation, then check that the interlock lamp on the front of the Power Supply Unit (Figure 3, item 3) is on.
2. Watch the interlock lamp while you open the front door of the AUTO 306 cabinet. As soon as you open the cabinet, the interlock lamp should go off.
   - If the interlock lamp goes off as described above, the interlock operates correctly; continue at Step 3.
   - If the interlock lamp does not go off as described above, the interlock does not operate correctly. Shut down the system, isolate it from the electrical supply and then check the installation of the interlock (refer to Section 3.12.1).
3. Close the front door of the AUTO 306 cabinet and check that the interlock lamp goes on again.
4. Repeat Steps 2 and 3 above but open the rear door of the AUTO 306 cabinet instead of the front door.
5. Repeat Steps 2 and 3 above but remove the baseplate rear cover (see Figure 27) instead of opening the front door. Refit the baseplate rear cover.
6. Watch the interlock lamp while you vent the AUTO 306. When the pressure in the chamber rises to above the preset level (approximately 600 mbar), the interlock lamp should go off:
   - If the interlock lamp goes off as described above, the interlock operates correctly.
   - If the interlock lamp does not go off as described above, the interlock does not operate correctly. Shut down the system, isolate it from the electrical supply and then check the installation of the interlock (refer to Section 3).

4.7 Inspect the insulators

4.7.1 Dismantle and clean the emitter assembly

You must regularly check that insulators are not cracked and are not covered in deposits. Refer to Figure 45 and use the following procedure.

1. Disconnect the emitter wires (Figure 16, items 6 and 10) from the emitter connectors (8).
2. Loosen the M3 screw (14) then pull the emitter assembly from the rear of the Source.
3. Remove the M4 nuts and washers (3, 4) from the studs (10).
4. Remove the large top insulators (5), the right-hand and left-hand cathodes (7, 19) and the large bottom insulators (11) from the studs (10).
5. Inspect the cathodes (7, 19) and the anode plate (16). If they are covered in deposits, you must clean them: continue at Step 6. If they do not have to be cleaned, continue at Step 10.
6. Loosen the two M3 screws (15) and remove the anode plate (16) from the base (12) of the emitter assembly. Undo and remove the two M3 screws and washers (17) and remove the filament (18) from the cathodes.
7. Undo and remove the M3 screws and washers (9) to remove the emitter connectors (8) from the cathodes.
8. Undo and remove the M3 screw and washer (1) from the left-hand cathode (19), then remove the small insulator (2) from the cathode.
9. Separate the right-hand and left-hand cathodes (7, 19) and remove the small insulators (6).
10. Inspect the large top and bottom insulators (5, 11) and the small insulators (2, 6). If they are damaged, you must replace them (refer to Section 6).
11. If necessary clean the insulators, the cathodes and the anode plate:
    - Glass-bead blast the components to remove any deposits.
    - Place the components in an ultrasonic bath to remove any glass beads.

4.7.2 Reassemble the emitter assembly

> CAUTION
>
> Ensure that all glass beads have been removed before you refit the emitter assembly. If you do not, electrical arcing will result when you operate the Source and it may be damaged.

Note: When you reassemble the emitter assembly, cover all screw threads with a graphite or molybdenum disulphide suspension (Rocol DFSM or equivalent).

Refer to Figure 45.

1. If you have dismantled the cathodes and removed the anode plate, continue at Step 2, otherwise continue at Step 7.
2. Use the two M3 screws (15) to secure the anode plate (16) to the emitter assembly base (12).
3. Place the two small insulators (6) in position on the left-hand cathode (19), then hold the right-hand cathode (7) in place next to the left-hand cathode.
4. Fit the small insulator (2) in the left-hand cathode (19), then use the M3 screw and washer (1) to secure the cathodes.
5. Use the two M3 screws and washers (17) to fit the filament (18) to the cathodes, so that the bent part of the filament points towards the anode plate.
6. Use the M3 screws and washers (9) to secure the emitter connectors (8) to the cathodes.
7 Fit two of the large insulators (11) to the studs (10).
8 Refit the cathodes to the studs (10).

(Continued on page 98)

1. Screw and washer: M3
2. Small insulator
3. Nut: M4
4. Washer
5. Top insulator
6. Small insulators
7. Right-hand cathode
8. Emitter connector
9. Screw and washer: M3
10. Studs: M4
11. Bottom insulators
12. Emitter assembly base
13. Source base
14. Screw: M3
15. Screw: M3
16. Anode plate
17. Screw and washer: M3
18. Filament
19. Left-hand cathode

Figure 45 - Emitter assembly: key

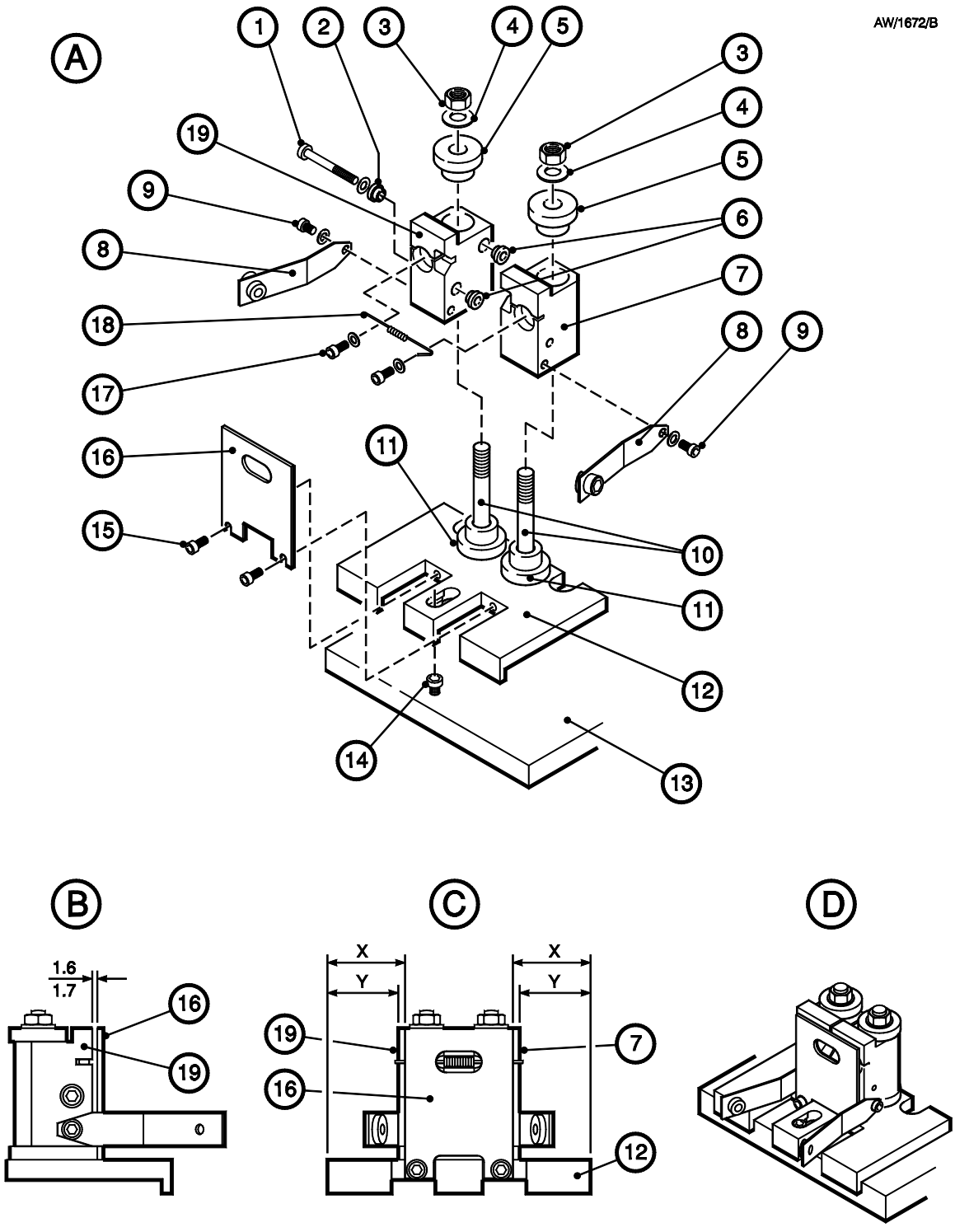


Figure 45 - Emitter assembly

9. it the other two large insulators (5) to the tops of the cathodes and secure with the M4 nuts and washers (3, 4).

10. Ensure that the components of the emitter are correctly assembled. If necessary, loosen the M3 screws (15) which secure the anode plate (16), the M3 screw (1) which secures the cathodes and the M4 nuts (3) which secure the cathodes to the studs:

    - Refer to detail B. The top of the anode plate (16) must be level with the tops of the cathodes (7, 10).
    - Refer to detail B. The gap between the anode plate (16) and the cathodes (7, 10) must be set correctly.
    - Refer to detail C. The cathodes (7, 10) must be centrally located on the emitter assembly base (12); that is, the cathodes must be the same distance (Y) from the sides of the base.
    - Refer to detail C. The anode plate (16) must be centrally located on the emitter assembly base (12); that is, the sides of the anode plate must be the same distance (X) from the sides of the base, so that the aperture in the anode plate is centrally located over the filament (18).

11. Tighten the M3 screws (15) which secure the anode plate (16), the M3 screw (1) which secures the cathodes and the M4 nuts (3) which secure the cathodes to the studs.

12. Refit the reassembled emitter assembly (as shown in detail C) to the Source, then tighten the M3 screw (14) to secure the emitter assembly in place.

13. Reconnect the emitter wires (Figure 16, items 6 and 10) to the emitter connectors (8).

4.8 Change the filament

Note: When you reassemble the emitter assembly, cover all screw threads with a graphite or molybdenum disulphide suspension (Rocol DFSM or equivalent).

Refer to Figure 45 and use the following procedure to replace a damaged filament.

1. Remove the emitter assembly from the Source as described in Steps 1 and 2 of Section 4.7.1.

2. Remove the M3 screws (15) which secure the anode plate (16) and remove the anode plate from the emitter assembly base (12).

3 Remove the M3 screws (17) which secure the filament (18) and remove the old filament.

4. Fit the new filament (18) so that the bent part of the filament points towards the anode plate (16) and secure with the two M3 screws (17).

5. Refit the anode plate (16) to the emitter assembly base (12) and loosely secure with the two M3 screws (15).

6. Ensure that the components of the emitter are correctly assembled, then refit the reassembled emitter assembly to the Source as described in Steps 10 to12 of Section 4.7.2.

4.9 Change the crucible

Note: The following procedure assumes that you have fitted isolation valves in the cooling-water supply and return pipelines for the Source (refer to Section 3.5). If you have not fitted isolation valves, you must turn off the cooling-water supply in Step 2 below. When you turn off the cooling-water supply, this will also affect other AUTO 306 components which require water cooling (for example, the Cryodrive, if fitted).

Refer to Figure 46 which shows the different crucible types:

- The four hearth crucible (4) is supplied with a tall cooling-water director (7) and a top shield (2) with a small aperture (which when fitted only exposes one of the four hearths to the electron beam).
- The single hearth crucible (11) and the disk crucible (13) are supplied with a short cooling-water director (12) and a top shield (10) with a large aperture (which when fitted exposes the whole hearth to the electron beam).

Use the following procedure to replace a damaged crucible or to fit a different type of crucible.

1. Ensure that the Source is off, then vent theAUTO 306 vacuum chamber to atmospheric pressure.
2. Close the isolation valves in the cooling-water pipelines to the Source.
3. Remove the bell jar from the AUTO 306 baseplate or open the FL400 door.
4. Loosen the two M3 screws (14) which secure one of the pole piece extensions (15) to the Source. Remove the two M3 screws (14) which secure the other pole piece extension (15) and remove the pole piece extension.
5. Undo and remove the four M3 screws (1) which secure the top shield (2 or 10), then remove the top shield from the Source.
6. Undo and remove the four M3 screws (3) which secure the crucible (4, 11 or 13).
7. Remove the crucible and the crucible 'O' ring (5) from the turret (16).
8. Remove the M2 screw (6) which secures the cooling-water director (7 or 12) and remove the cooling-water director from the turret (16). Retain the cooling-water director for future use.
9. Fit the new cooling-water director (7 or 12) supplied and secure with the M2 screw (6).
10. Place a light wipe of high vacuum grease on the crucible 'O' ring (5) supplied with the crucible kit and place it on the turret (16).
11. Place the new crucible (4, 11 or 13) on the turret (16).
12. Use the four M3 screws (3) to secure the crucible to the turret (16).
13. Slide the new top shield (2 or 10) supplied with the crucible kit onto the top of the Source and secure with the four M3 screws (1).
14. Refit the pole piece extension (15) removed in Step 4 and secure with the two M3 screws (14). Tighten the M3 screws (14) which secure the other pole piece extension.

4.10 Replace the beam sweep coils

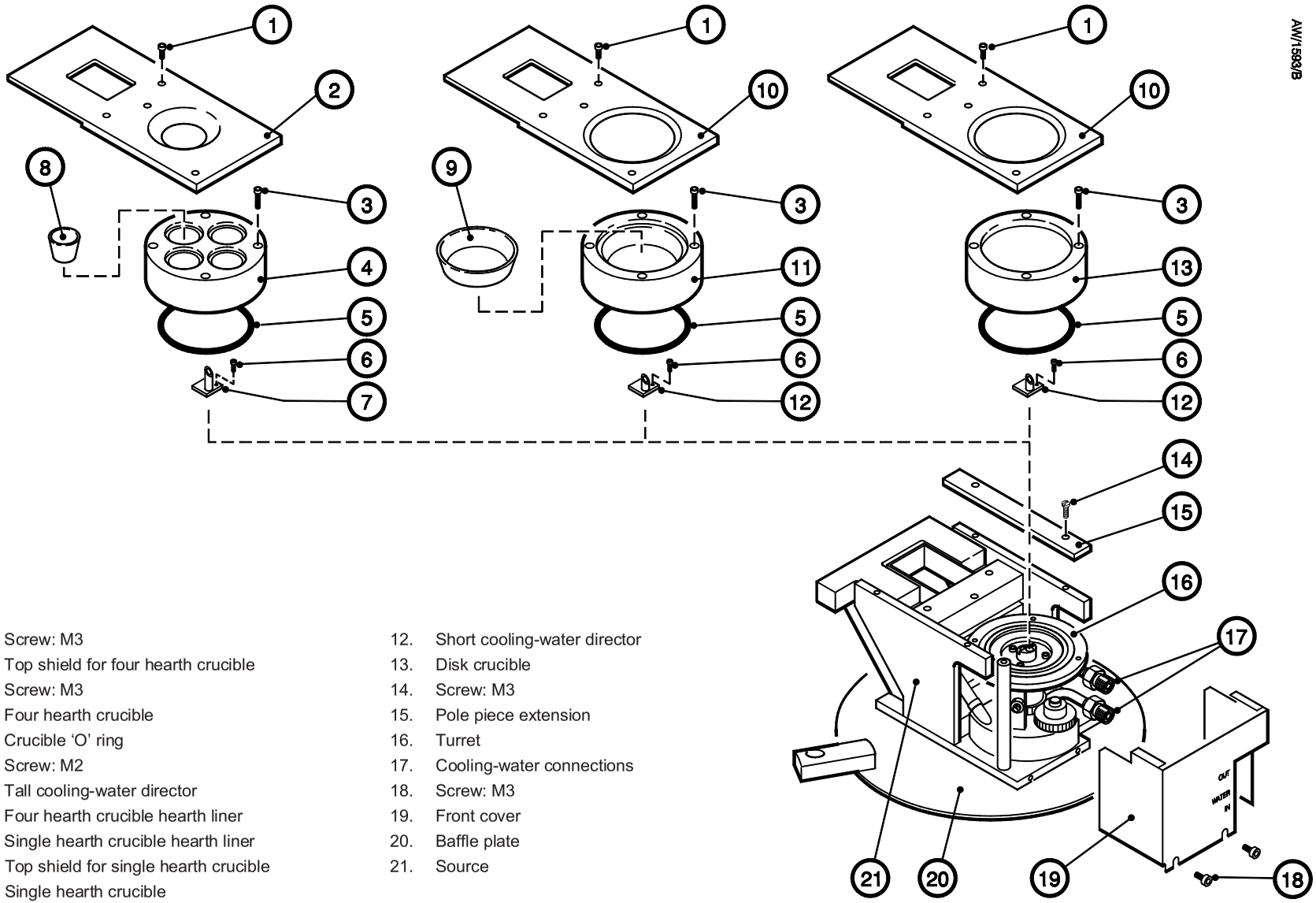
If the beam sweep coils are damaged, use the following procedure to replace them. Refer to Figure 20.

1. Loosen the two M3 screws (1) which secure one of the two pole piece extensions (2).
2. Remove the two M3 screws (1) which secure the other pole piece extension (2), then remove the pole piece extension.
3. Undo and remove the four M3 screws (30) which secure the top shield (3) to the Source, then remove the top shield (3).
4. Refer to Figure 23. Remove the connector plug (3) on the beam sweep coil cable from the connector on the Source (2).
5. Refer to Figure 20. Remove the two M3 screws (29) which secure the top of the beam sweep coil assembly (28).
6. Remove the two M3 screws (23) which secure the bottom of the beam sweep coil assembly (28) and remove the beam sweep coil assembly.
7. Place the new beam sweep coil assembly (28) in position, then secure with the two lower M3 screws (23) and the two upper M3 screws (29).
8. Place the top shield (3) in position on top of the Source and secure with the four screws (30).
9. Refit the pole piece extension (2) removed in Step 2 and secure with the two M3 screws (1). Tighten the two M3 screws (1) which secure the other pole piece extension (2).
10. Refer to Figure 23. Refit the connector plug (3) on the beam sweep coil cable to the connector on the Source (2).

4.11 Replace the cooling-water seals

If the cooling-water seals are damaged, use the following procedure to replace them.

1. Refer to Figure 46. Remove the top shield (2, 10), crucible (4, 11, 13), crucible 'O' ring (5) and cooling-water director (7, 12) as described in Steps 4 to 8 of Section 4.9.
2. Refer to Figure 20. Remove the circlip (9).
3. Remove the three M3 screws (10) and remove the clamp plate (11).
4. Lift up the turret (13) to remove the quad ring (12), then push down the turret to its original position.
5. Place a light wipe of high vacuum grease on the new quad ring (12), then place the quad ring on the turret (13), fit the clamp plate (11) and secure with the three M3 screws (10).
6. Refit the circlip (9).
7. Refer to Figure 46. Fit the new crucible 'O' ring (5), then fit the cooling-water director (7, 12), the crucible (4, 11, 13) and the top shield (2, 10) as described in Steps 10 to 14 of Section 4.9.



1. Screw: M3
2. Top shield for four hearth crucible
3. Screw: M3
4. Four hearth crucible
5. Crucible ‘O’ ring
6. Screw: M2
7. Tall cooling-water director
8. Four hearth crucible hearth liner
9. Single hearth crucible hearth liner
10. Top shield for single hearth crucible
11. Single hearth crucible
12. Short cooling-water director
13. Disk crucible
14. Screw: M3
15. Pole piece extension
16. Turret
17. Cooling-water connections
18. Screw: M3
19. Front cover
20. Baffle plate
21. Source

Figure 46 - Change the crucible

4.12 Replace a fuse

You must replace a failed fuse with a fuse of the same size and rating (refer to Section 2).

If the fuse fails again after replacement, you must determine the cause of the fault and rectify the fault before you replace the fuse and use the Source and its accessories again.

4.13 Fault finding

Use Table 7 to determine the cause of faults and rectify the faults. If you cannot determine the cause of a fault, or if you have made the necessary actions, but the fault is still present, contact your supplier or BOC Edwards for advice.

To assist you in electrical fault finding, refer to Figures 28 and 44 which show the electrical connections between the EB3 components.

Symptom	Check	Action
All the LEDs on theSource Control are off	Is the Power Supply Unit off ?	Ensure that your electrical supply is on and switch on the Power Supply Unit.
	Is the interlock lamp on the front of the Power Supply Unit off ?	If the interlock lamp is off, one of the AUTO 306 covers or doors is open or the pressure in the AUTO 306 chamber is too high. If none of the above, check that the interlock is correctly installed as described in Section 3.
No electron beam is generated when the Source is selected on; that is, the gun switch is pressed.	Are the interlocks set correctly ?	If the interlock lamps on the Source Control are not on, check that the cooling-water supply is switched on, that the pressure in the chamber is correct and that the crucible is not rotating.
	Are the interlocks correctly installed ?	If all the operating conditions are correct, switch off the AUTO 306 and check that the interlocks are correctly installed as described in Section 3.
	Is the filament incorrectly installed ?	Check that the filament is correctly installed as described in Section 4.8.
	Has the filament failed or is it damaged ?	Replace the filament as described in Section 4.8.

Table 7 - Fault finding

Symptom	Check	Action
No electron beam is generated when the Source is selected on; that is, the gun switch is pressed (continued).	Has one of the circuit breakers in the Power Supply Unit tripped ?	Reset the circuit breaker. if the circuit breaker continues to trip, contact your supplier or BOC Edwards.
	Are the connectors correctly fitted ?	Check that the emitter cables are correctly fitted to the leadthroughs and emitter assembly. Check that the high voltage cables are correctly fitted to the leadthroughs.
	Has the Power Supply Unit failed ?	Check the operation of the Power Supply Unit; if necessary contact your supplier or BOC Edwards for advice.
Evaporation is poor; emission power is low.	Is the filament incorrectly installed ?	Check that the filament is correctly installed as described in Section 4.8.
	Is the filament damaged ?	Check the filament in the emitter assembly. If necessary, replace the filament as described in Section 4.8.
The emission current fluctuates.	Are there deposits on the insulators or are the insulators cracked or broken ?	Inspect the insulators; clean and replace as necessary: refer to Section 4.7.
The beam cannot be focused on the hearth.	Are the pole piece extensions loose ?	Secure the pole piece extensions.
	Is the filament incorrectly installed ?	Check that the filament is correctly installed as described in Section 4.8.
	Is the magnetic field too weak ?	Fit wider pole piece extensions.
	Is the magnet weakened due to high temperature ?	Check that the temperature and flow rate of the cooling-water supply are correct: refer to Section 2.

Table 7 - Fault finding (continued)

Symptom	Check	Action
The beam cannot be focused on the hearth (continued).	Is the magnetic field being distorted ?	Check that there are no components in the chamber which could distort the magnetic field. If there are none, the magnet/pole pieces may be damaged: contact your supplier or BOC Edwards for advice.
	Are the pole pieces, pole piece extensions or the magnet damaged ?	Contact your supplier or BOC Edwards for advice.
There is a water leak in the chamber.	Are the cooling-water pipelines connections loose ?	Check the connections and tighten if necessary.
	Have the 'O' rings in the cooling-water pipe connections failed ?	Inspect the 'O' rings and replace if necessary.
	Has the crucible 'O' ring or quad ring failed ?	Remove the crucible and inspect the crucible 'O' ring and the quad ring; replace if necessary.
Pressure in the chamber rises when the crucible rotates.	Has the crucible 'O' ring or quad ring failed ?	Remove the crucible and inspect the crucible 'O' ring and the quad ring; replace if necessary.
The beam sweep controls have no effect.	Is remote control mode selected ?	Check the mode and select local control mode if necessary.
	Have the beam sweep coils failed ?	Check the beam sweep coils and replace if necessary.
You cannot rotate the crucible with the manual turret drive.	Is the drive chain loose or broken ?	Check the chain; tighten or replace if necessary.
	Are there deposits under the top shield ?	Remove and inspect the top shield; clean if necessary.
You cannot rotate the crucible with the motorised turret drive (no overload indicated).	Is the drive chain loose or broken ?	Check the chain; tighten or replace if necessary.
	Are the cables correctly fitted ?	Check that the cables are correctly fitted to the Turret Control and the motorised drive unit.

Table 7 - Fault finding (continued)

Symptom	Check	Action
You cannot rotate the crucible with the motorised turret drive (overload indicated).	Are there deposits under the top shield ?	Remove and inspect the top shield; clean if necessary.
	Is the click-stop engaged ?	Disengage the click-stop.
You cannot evacuate the chamber.	Are the leadthroughs correctly fitted ?	Check that the leadthroughs are correctly fitted to the AUTO 306 baseplate.
	Have one of the 'O' rings in the water or drive unit leadthrough failed ?	Check the 'O' rings and replace if necessary: refer to the leadthrough instruction manual.
	Have one of the lip seals in the drive unit leadthrough failed ?	Check the lip seals and repair as necessary.
There is arcing between components of the Source.	Is the temperature of the Source too high ?	Check that the temperature and flow rate of the cooling-water supply are correct: refer to Section 2.
	Are there deposits on the insulators or are the insulators cracked or broken ?	Inspect the insulators; clean and replace as necessary.
The anode has overheated/melted.	Is the emitter misaligned ?	Adjust the emitter assembly as described in Section 4.7. If necessary replace the emitter assembly.
The Source Control overload LED goes on.	Is the emitter misaligned ?	Adjust the emitter assembly as described in Section 4.7.
	Is there an electrical fault ?	Inspect the equipment for electrical short circuits.
A circuit breaker on the Power Supply Unit continually trips.	Is there an electrical fault ?	Contact your supplier or BOC Edwards for advice.

Table 7 - Fault finding (continued)

5 STORAGE AND DISPOSAL

5.1 Storage

1. Return the accessory to its protective packaging.
2. Store in a cool dry place.

5.2 Disposal

Dispose of the accessory and any components safely in accordance with your local and national safety and environmental requirements.

6 SERVICE, SPARES AND ACCESSORIES

6.1 Introduction

BOC Edwards products, spares and accessories are available from BOC Edwards companies in Belgium, Brazil, China, France, Germany, Israel, Italy, Japan, Korea, Singapore, United Kingdom, U.S.A. and a world-wide network of distributors. The majority of these centres employ Service Engineers who have undergone comprehensive BOC Edwards training courses.

Order spare parts and accessories from your nearest BOC Edwards company or distributor. When you order, please state for each part required:

- Model and Item Number of your equipment
- Serial number (if any)
- Item Number and description of part.

6.2 Service

BOC Edwards products are supported by a world-wide network of BOC Edwards Service Centres. Each Service Centre offers a wide range of options including: equipment decontamination; service exchange; repair; rebuild and testing to factory specifications. Equipment which has been serviced, repaired or rebuilt is returned with a full warranty.

Your local Service Centre can also provide BOC Edwards engineers to support on-site maintenance, service or repair of your equipment.

For more information about service options, contact your nearest Service Centre or other BOC Edwards company.

6.3 Spares

Description	Figure	Item	Item Number
Filament	45	18	E036-15-005
Anode plate	45	16	E090-72-015
Emitter assembly	45	D	E090-72-026
Emitter assembly large insulators	45	5, 11	E001-00-234
Emitter assembly small insulators	45	2, 6	E090-37-019
Crucible 'O' ring	46	5	H021-20-053
Tall cooling-water director	46	7	E090-72-006
Short cooling-water director	46	12	E090-87-015
Beam sweep coil assembly	20	28	E090-72-035
Water leadthrough baseplate 'O' ring	16	4	H021-24-025
6EK25 leadthrough baseplate 'O' ring	16	4	H021-24-025
TL8K25 leadthrough baseplate 'O' ring	23	5	H021-24-025
Manual Turret Drive unit baseplate 'O' ring	21	12	H021-24-025
Motorised Turret Drive unit baseplate 'O' ring	22	7	H021-24-025
Rotary drive lip seals	-	-	H021-09-111
Quad ring (pack of 2)	20	12	H021-24-167
Cooling-water connection 'O' rings	20	15	H021-06-000

6.4 Accessories

6.4.1 Crucibles

A range of crucibles is available for the EB3 Multihearth Electron Beam Source; all of the crucibles are directly water-cooled and are easily changeable (as described in Section 4). The crucibles available are described below.

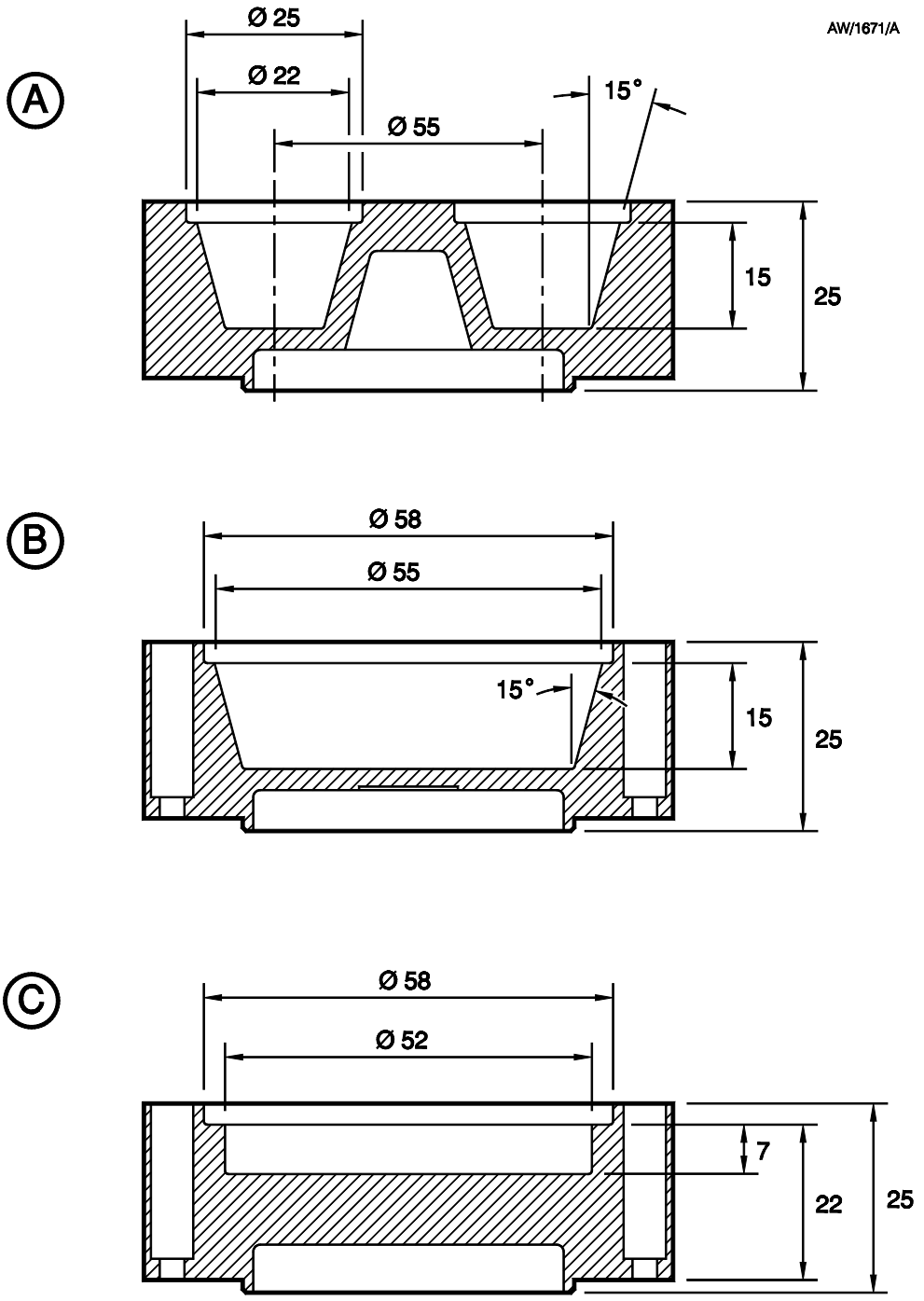
Each crucible is supplied with a new crucible 'O' ring and a top shield for the Source. Figure 47 shows the dimensions of the crucibles and Table 8 gives the volumes of the hearths and the Item Numbers of the crucibles.

- Four hearth crucible — This crucible has four identical hearths and is supplied fitted to the Source. If you fill the hearths with the different evaporants required, you can use a four hearth crucible to do multilayer depositions without the need to raise the chamber to atmospheric pressure (which you would otherwise need to do with a single hearth crucible, to clean the crucible and load a different evaporant).
- Single hearth crucible — This crucible has a single large hearth and is useful when you wish to evaporate and deposit a large quantity of material.
- Disk crucible — This crucible has a single shallow hearth, and is designed to hold a single disk (50 ˘ x 6 thickness) of a material such as silicon dioxide (quartz). If the crucible is slowly rotated during evaporation and beam sweep is used to scan the electron beam across the surface of the disk, you will get very repeatable results, without the 'spitting' problems which are normally encountered when you evaporate granular materials.

Crucible type	Approximate hearth volume (ml)	Item Number
Four hearth crucible	4*	E090-87-020
Single hearth crucible	30	E090-87-023
Disk crucible	11.8	E090-87-022

* Total hearth volume = 16 ml

Table 8 - Crucible hearth volumes



A Four hearth crucible
B Single hearth crucible
C Disk crucible

Figure 47 - Dimensions of the crucibles (mm)

6.2.5 Hearth liners

Hearth liners can increase the evaporation rate of the material evaporated. The use of hearth liners also makes it easier to change evaporants and can reduce spattering of the evaporant.

Hearth liners are available in three different types of material. Choose the most suitable type of hearth liner for your process as described below. The dimensions of the hearth liners are shown in Figure 48 and the volumes and Item Numbers of the hearth liners are shown in Table 9.

- Intermetallic hearth liners

  Use an intermetallic hearth liner to evaporate aluminium. Intermetallic hearth liners have good thermal shock resistance up to 1800 ^{o}C. In general, you should not use intermetallic hearth liners for the following:

  - Evaporants (such as nickel, iron, silicon, silicon monoxide, silicon dioxide, cobalt and titanium) that react with boron.
  - Metal evaporants which have a high melting temperature, such as tantalum and tungsten.

- Graphite hearth liners

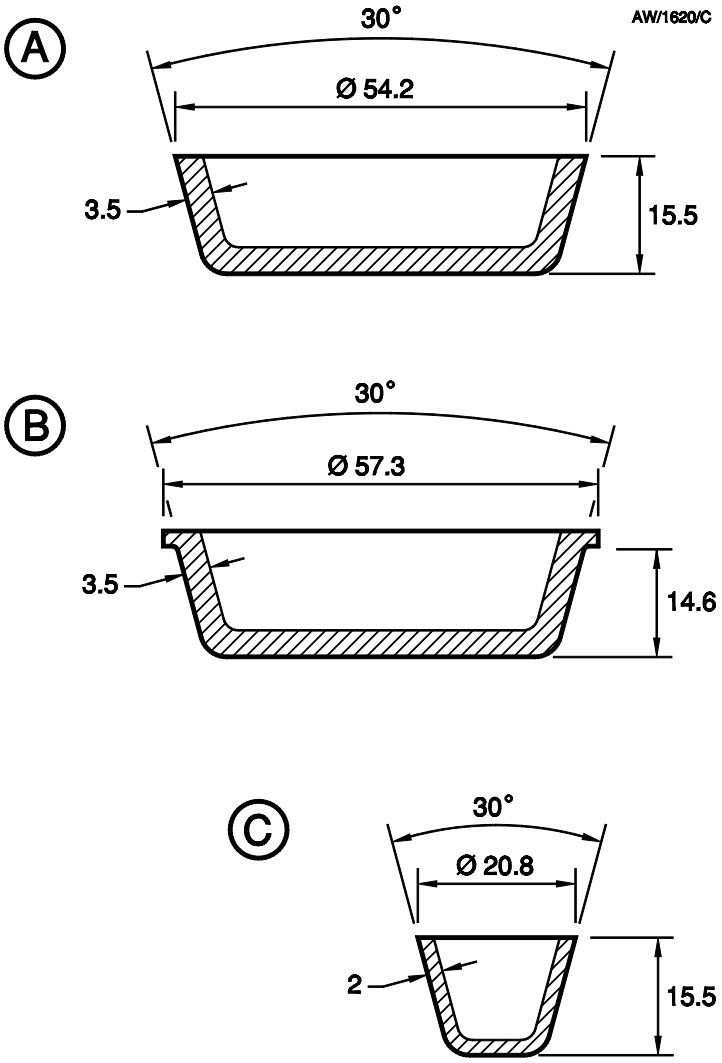
  Use graphite hearth liners when you evaporate pure gold, silver or copper. These metals do not alloy with graphite and are easy to remove from the graphite hearth liners.

- Molybdenum hearth liners

  Molybdenum hearth liners have high strength and do not scratch easily. Use molybdenum hearth liners to evaporate gold and reduce spitting. Do not use these hearth liners with other metals which will alloy with molybdenum.

Crucible type	Hearth liner type	Hearth liner volume (ml)	Item Number
Four hearth crucible	Intermetallic	2	E090-88-032
	Graphite	2	E090-88-030
	Molybdenum	2	E090-88-031
Single hearth crucible	Intermetallic	18	E090-88-022
	Graphite	18	E090-88-020
	Molybdenum	18	E090-88-021

Table 9 - Hearth liner volumes



A Graphite/molybdenum hearth liner for single hearth crucible

B Intermetallic hearth liner for single hearth crucible

C Graphite/molybdenum hearth liner for four hearth crucible

D Intermetallic hearth liner for four hearth crucible

Figure 48 - Dimensions of the hearth liners (mm)

6.3.3 Secondary electron absorber

Fit a secondary electron absorber when you evaporate materials with a high atomic weight (such as tungsten and gold) to absorb secondary beam emission off of the evaporant in the crucible and prevent damage to the chamber wall and accessories in the chamber. Fit the secondary electron absorber as described in Section 3.15. The dimensions of the secondary electron absorber are shown in Figure 8.

Description	Item Number
Secondary electron absorber	E090-89-000

6.3.4 Rack adaptor

Use the rack adaptor to fit the EB3 Source Control, the EB3 Turret Control and the EB3 Sweep Control into a standard 19 inch rack.

Description	Item Number
Rack adaptor	D354-22-000

6.3.5 Shutter

Fit a shutter to shield the substrate until conditions are suitable for coating.

Description	Item Number
Manual source shutter	E090-32-000
Electrical shutter actuator	E090-44-000
Electrical shutter controller	E090-45-000

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Appendix 1

Electrical connections for an AUTO 306 with a serial number lower than 3321

Section 3 of this volume describes the electrical installation of the EB3 Source and its accessories on an AUTO 306 which has a serial number of 3321 or higher.

If your AUTO 306 has a serial number lower than 3321, the terminal block configuration is different from the configuration shown in Figure 30 (refer to your AUTO 306 instruction manual for the correct configuration) and you must make the following changes to the electrical installation procedures:

- In Step 17 of Section 3.12.1 (Connect the Power Supply Unit cables to the AUTO 306), connect wire #14 to a terminal 14 on terminal block TB1, and connect wire #22 to a terminal 22 on terminal block TB1.
- In Step 3 of Section 3.12.2 (Fit the EB3 Turret Control cables), connect the blue wire to a terminal 14 on terminal block TB1, connect the brown wire to a terminal 22 on terminal block TB1, and connect the green/yellow earth (ground) wire to an earth (ground) terminal on terminal block TB1.
- In Step 3 of Section 3.12.3 (Fit the EB3 Sweep Control cables), connect the blue wire to a terminal 14 on terminal block TB1, connect the brown wire to a terminal 22 on terminal block TB1, and connect the green/yellow earth (ground) wire to an earth (ground) terminal on terminal block TB1.

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BOC EDWARDS

Form HS1

Return of BOC Edwards Equipment - Procedure

INTRODUCTION

Before returning your equipment, you must warn BOC Edwards if substances you used (and produced) in the equipment can be hazardous. This information is fundamental to the safety of our Service Centre employees and will determine the procedures employed to service your equipment.

Complete the Declaration (HS2) and send it to BOC Edwards before you dispatch the equipment. It is important to note that this declaration is for BOC Edwards internal use only, and has no relationship to local, national or international transportation safety or environmental requirements. As the person offering the equipment for shipment, it is your responsibility to ensure compliance with applicable laws.

GUIDELINES

- Equipment is '**uncontaminated**' if it has not been used, or if it has only been used with substances that are not hazardous. Your equipment is '**contaminated**' if it has been used with any substances classified as hazardous under EU Directive 67/548/EEC (as amended) or OSHA Occupational Safety (29 CFR 1910).
- If your equipment has been used with radioactive substances, biological or infectious agents, mercury, polychlorinated biphenyls (PCB's), dioxins or sodium azide, you must decontaminate it before you return it to BOC Edwards. You must send independent proof of decontamination (for example a certificate of analysis) to BOC Edwards with the Declaration (HS2). Phone BOC Edwards for advice.
- If your equipment is contaminated, you must either:
  - Remove all traces of contamination (to the satisfaction of laws governing the transportation of dangerous/hazardous substances).
  - Or, properly classify the hazard, mark, manifest and ship the equipment in accordance with applicable laws governing the shipment of hazardous materials.

Note: Some contaminated equipment may not be suitable for airfreight.

PROCEDURE

1. Contact BOC Edwards and obtain a Return Authorisation Number for your equipment.
2. Complete the Return of BOC Edwards Equipment - Declaration (HS2).
3. If the equipment is contaminated, you must contact your transporter to ensure that you properly classify the hazard, mark, manifest and ship the equipment, in accordance with applicable laws governing the shipment of contaminated/hazardous materials. As the person offering the equipment for shipment, it is your responsibility to ensure compliance with applicable law. **Note: Equipment contaminated with some hazardous materials, such as semiconductor by-products, may not be suitable for airfreight - contact your transporter for advice.**
4. Remove all traces of hazardous gases: pass an inert gas through the equipment and any accessories that will be returned to BOC Edwards. Where possible, drain all fluids and lubricants from the equipment and its accessories.
5. Seal up all of the equipment's inlets and outlets (including those where accessories were attached) with blanking flanges or, for uncontaminated product, with heavy gauge tape.
6. Seal equipment in a thick polythene/polyethylene bag or sheet.
7. If the equipment is large, strap the equipment and its accessories to a wooden pallet. If the equipment is too small to be strapped to a pallet, pack it in a suitable strong box.
8. Fax or post a copy of the Declaration (HS2) to BOC Edwards. The Declaration must arrive before the equipment.
9. Give a copy of the Declaration (HS2) to the transporter. You must tell your transporter if the equipment is contaminated.
10. Seal the original Declaration in a suitable envelope: attach the envelope securely to the outside of the equipment package, in a clear weatherproof bag.
    WRITE YOUR RETURN AUTHORISATION NUMBER CLEARLY ON THE OUTSIDE OF THE ENVELOPE OR ON THE OUTSIDE OF THE EQUIPMENT PACKAGE.

BOC EDWARDS

Form HS2

Return of BOC Edwards Equipment - Declaration

Return Authorisation Number:

You must:

- Know about all of the substances which have been used and produced in the equipment before you complete this Declaration
- Read the Return of BOC Edwards Equipment - Procedure (HS1) before you complete this Declaration
- Contact BOC Edwards to obtain a Return Authorisation Number and to obtain advice if you have any questions
- Send this form to BOC Edwards before you return your equipment

SECTION 1: EQUIPMENT

Equipment/System Name_____

Part Number _____

Serial Number_____

Has the equipment been used, tested or operated ?

YES ❑ Go to Section 2 NO ❑ Go to Section 4

IF APPLICABLE:

Tool Reference Number_____

Process _____

Failure Date_____

Serial Number of Replacement Equipment_____

SECTION 2: SUBSTANCES IN CONTACT WITH THE EQUIPMENT

Are any substances used or produced in the equipment:

- Radioactive, biological or infectious agents, mercury, poly chlorinated biphenyls (PCBs), dioxins or sodium azide? (if YES, see Note 1) YES ❑ NO ❑
- Hazardous to human health and safety? YES ❑ NO ❑

Note 1 : BOC Edwards will not accept delivery of any equipment that is contaminated with radioactive substances, biological/infectious agents, mercury, PCB's, dioxins or sodium azide, unless you:

- Decontaminate the equipment
- Provide proof of decontamination

YOU MUST CONTACT BOC EDWARDS FOR ADVICE BEFORE YOU RETURN SUCH EQUIPMENT

SECTION 3: LIST OF SUBSTANCES IN CONTACT WITH THE EQUIPMENT

Substance name	Chemical Symbol	Precautions required (for example, use protective gloves, etc.)	Action required after a spill, leak or exposure

SECTION 4: RETURN INFORMATION

Reason for return and symptoms of malfunction _____

_____

If you have a warranty claim:

- who did you buy the equipment from ? _____
- give the supplier's invoice number_____

SECTION 5: DECLARATION

Print your name:_____Print your job title:_____

Print your organisation:_____

Print your address:_____

_____

Telephone number: _____Date of equipment delivery: _____

I have made reasonable enquiry and I have supplied accurate information in this Declaration. I have not withheld any information, and I have followed the Return of BOC Edwards Equipment - Procedure (HS1).

Note: Please print out this form, sign it and return the signed form as hard copy.

Signed: _____Date_____

E090-72-880
Issue F

Instruction Manual

AUTO 306 accessories:
EB3 Multihearth Electron Beam Source and accessories

Volume 2 - Operating Instructions

Description	*Item Number*
EB3 Multihearth Electron Beam Source	*E090-72-000*
EB3 Leadthrough Kit	*E090-80-000*
EB3 Water Flow-Switch Kit	*E090-81-000*
EB3 Beam Sweep Unit	*E090-82-000*
EB3 Motorised Turret Drive Kit	*E090-83-000*
EB3 Manual Turret Drive Kit	*E090-84-000*
EB3 3 kW Power Supply, 380/415/440 V, 3 phase 50 Hz	*E090-60-000*
EB3 3 kW Power Supply, 220 V, 3 phase 60 Hz	*E090-61-000*
EB3/FL400 Mounting Kit	*E090-88-000*

BOC EDWARDS

Manor Royal, Crawley, West Sussex, RH10 9LW, UK
Telephone: +44 (0) 1293 528844 Fax: +44 (0) 1293 533453
http://www.bocedwards.com

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CONTENTS (Volume 2)

Ipsitech 8074-04

Illustrations

Tables

1 INTRODUCTION

1.1 Scope and definitions

This manual is supplied in two volumes; Volume 1 provides installation and maintenance instructions for the EB3 Multihearth Electron Beam Source and its accessories for the AUTO 306, Volume 2 provides operating instructions. You must use the EB3 Multihearth Electron Beam Source and its accessories as specified in this manual.

Read this volume of the manual before you operate the EB3 Multihearth Electron Beam Source and its accessories. Important safety information is highlighted as WARNING and CAUTION instructions; you must obey these instructions. The use of WARNINGS and CAUTIONS is defined below.

WARNING
Warnings are given where failure to observe the instruction could result in injury or death to people.

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

The units used throughout this manual conform to the SI international system of units of measurement.

1.2 Controls and indicators

1.2.1 Overview

This section describes in detail the controls and indicators of all of the EB3 equipment.

Note that your installation can be configured in a number of different ways; for example:

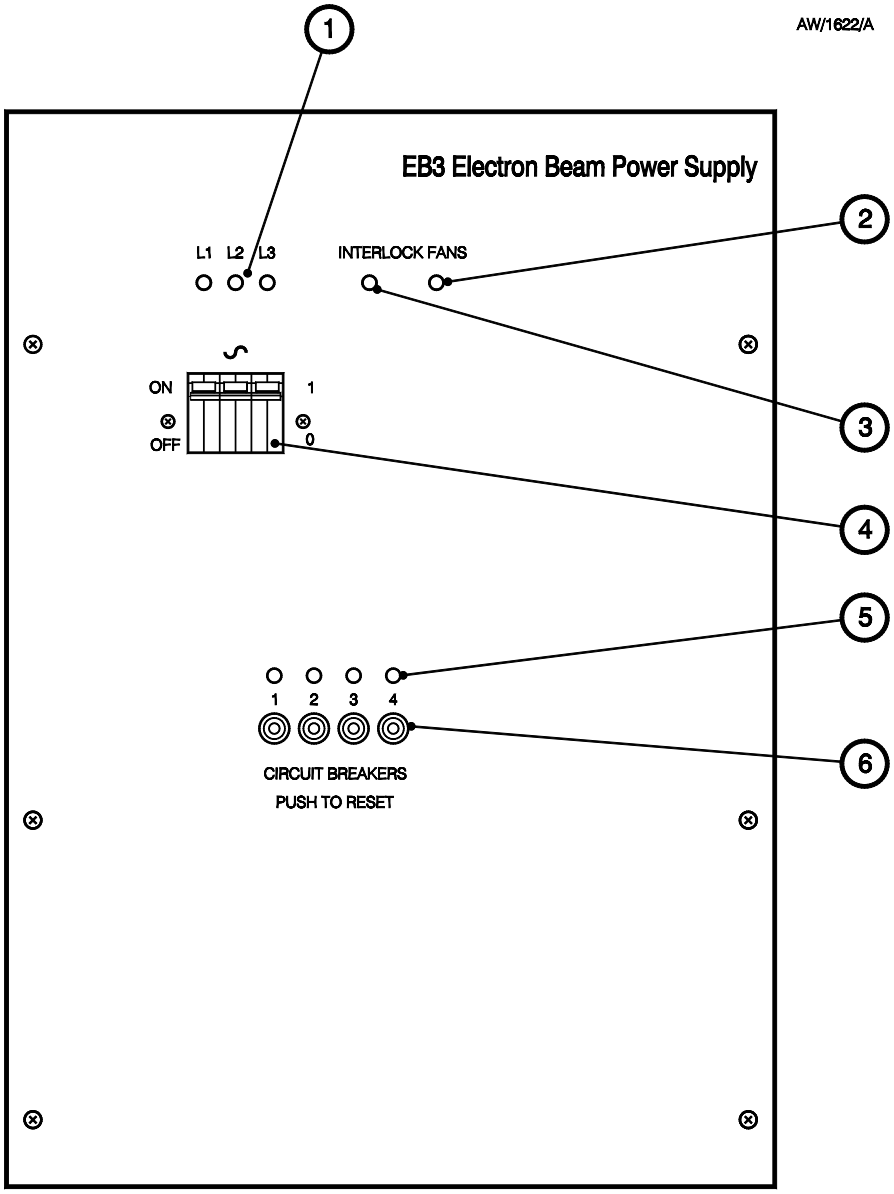
- You may have an EB3 Motorised Turret Drive or an EB3 Manual Turret Drive.
- You may not have the EB3 Sweep Control installed.
- Your installation may be configured for the use of remote control; that is operation of the Source through other remote control equipment (for example, a thin film deposition controller).
- Your Source may be installed in the Bell Jar or in the FL400 chamber.

1.2.2 EB3 Power Supply Unit

The EB3 Power Supply Unit provides the high and low voltage electrical supplies to the EB3 Multihearth Electron Beam Source and the EB3 Source Control.

The front panel of the Power Supply Unit is shown in Figure 1. The controls and indicators on the front panel are as follows:

Electrical supply isolator (4)	Use this isolator to switch the Power Supply Unit on and off.
Phase supply lamps (1)	Each of the lamps is on when the corresponding phase of the electrical supply to the Power Supply Unit is on.
Interlock lamp (3)	This lamp is on when the safety interlock is closed; that is, all of the AUTO 306 panels and doors are closed and the vacuum chamber is under vacuum.
Fans lamp (2)	This lamp is on when the cooling-fans in the Power Supply Unit are on.
Circuit breakers indicator lamps (5)	An indicator lamp is on when the corresponding circuit breaker has tripped.
Circuit breaker reset buttons (6)	When a circuit breaker has tripped (that is, a circuit breaker indicator lamp is on: see above), use the corresponding reset button to reset the circuit breaker.



1. Phase supply lamps
2. Fan lamp
3. Interlock lamp
4. Electrical supply isolator
5. Circuit breaker indicator lamps
6. Circuit breaker reset buttons

Figure 1 - Front panel of the EB3 Power Supply Unit

1.2.3 EB3 Source Control

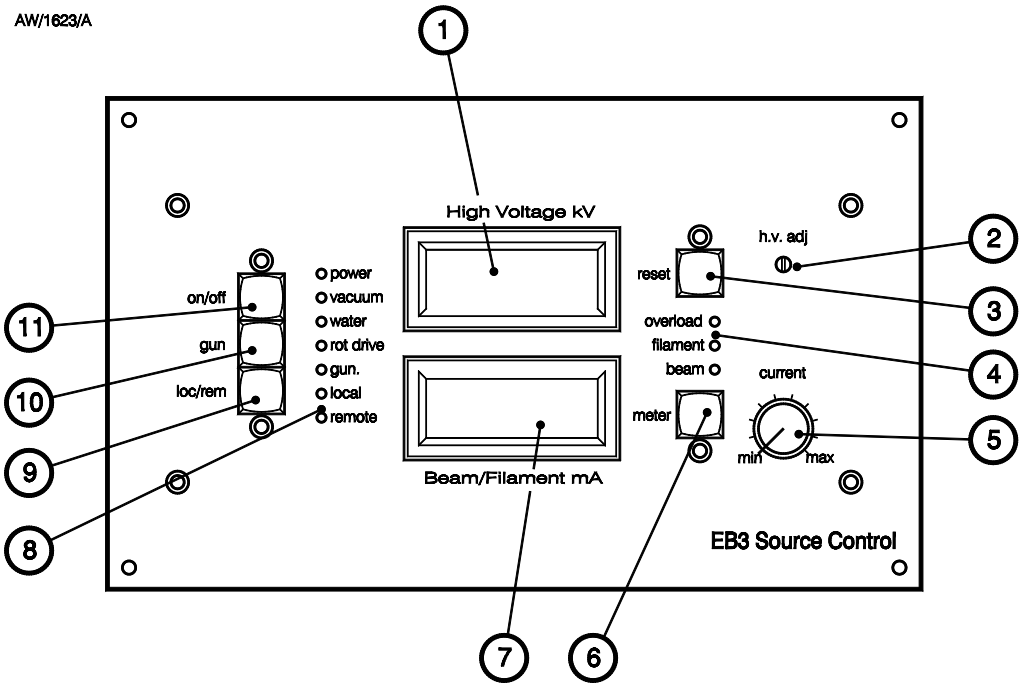
Note: There is a local/remote switch on the rear panel of the EB3 Source Control. This switch must be in the 'local' position if you will use the controls on the Source Control; if the switch is in the 'remote' position, none of the controls on the Source Control will have any effect. Refer to Section 3.19 of Volume 1 for more information.

The EB3 Source Control is used to control the operation of the Source and to switch between local and remote operation modes.

The front panel of the Source Control is shown in Figure 2. The controls and indicators on the front panel are as follows:

On/off switch (11)	Press this to switch on the Power Supply Unit. If the safety interlock is closed, the Power Supply Unit will then switch on the electrical supplies to the Source Control. Note that the Power LED will only go on if the interlock LEDs are on (see below).
Gun switch (10)	Press this to switch on the electron beam.
Local/remote switch (9)	Press this to change between local and remote control modes. In the local mode, the emission current is controlled by the current control (as described later). In the remote mode, the emission current is controlled by a signal from your control equipment (for example, a thin film deposition controller). The operation mode is indicated by the local and remote LEDs.
Power LED	This LED is on when the high voltage electrical supplies to the Source are on.
Vacuum level interlock LED	This LED is on when the pressure in the vacuum chamber is low enough for evaporation. This pressure is adjustable: refer to Section 3.17 of Volume 1.
Water interlock LED	This LED is on when the cooling-water flow to the Source is acceptable. Note that this signal is generated by the EB3 Water Flow-Switch; if the Water Flow-Switch is not fitted and a linking connector is fitted, the LED will be on permanently; refer to Section 3.12.7 of Volume 1 for further information.
Rotary drive interlock LED	This LED is on when the crucible is stationary. Note that this signal is generated by the EB3 Motorised Turret Drive. If a linking connector is fitted, the LED will be on permanently; refer to Section 3.12.7 of Volume 1 for further information.
Gun LED	This LED is on when the electron beam is on.

(Continued on page 6)



1. Voltmeter
2. Voltage adjuster
3. Overload reset switch
4. LEDs
5. Current control
6. Meter switch
7. Ammeter
8. LEDs
9. Local/Remote switch
10. Gun switch
11. On/off switch

Figure 2 - Front panel of the EB3 Source Control

Local and remote LEDs	These LEDs show the current mode of control of the Source Control: • If the Local LED is on, the Source Control is in local control mode; that is, the emission current is controlled by the current control (5) and you can use the controls on the Source Control to operate the Source. • If the Remote LED is on, the emission current is controlled by a signal from your control equipment (see Section 3.19 of Volume 1).
Voltmeter (1)	This meter shows the high voltage supplied to the Source.
Ammeter (7)	This meter shows the beam (emission) current or the filament primary current. Use the meter switch (6) to select the current to be displayed. The current displayed is indicated by the filament and beam LEDs (4).
Meter switch (6)	Press this biassed switch to change the current shown on the Ammeter (7). When the switch is not pressed, beam (emission) current is displayed. When the switch is pressed, filament primary current is displayed. The current displayed is indicated by the filament and beam LEDs.
Current control (5)	Use this control to vary the current supplied to the Source.
Overload LED	This LED is on when the Source Control has overloaded (that is, the beam (emission) current has exceeded 650 mA for more than 50 ms). Use the reset button (3) to reset the overload.
Reset button (3)	Use this button to reset the Source Control after an overload.
Filament LED	This LED is on when the filament primary current is displayed on the Ammeter (7).
Beam LED	This LED is on when the beam (emission) current is displayed on the Ammeter (7).
Voltage adjuster (2)	Use this adjuster to set the high voltage supplied to the Source.

1.2.4 EB3 Sweep Control

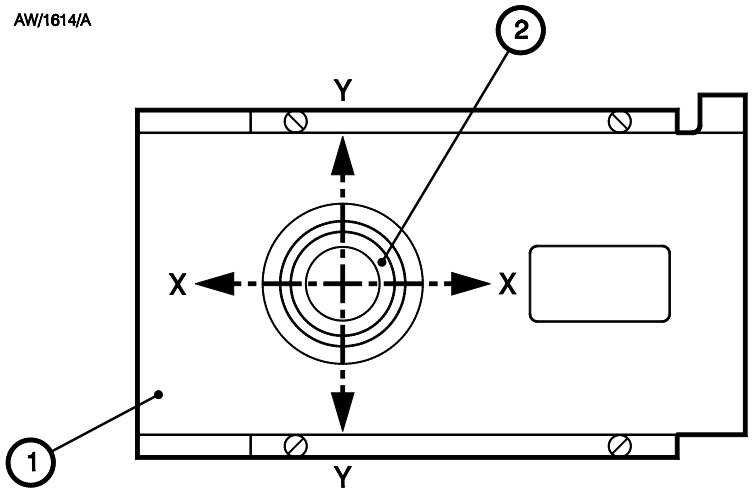
Without beam sweep, the electron beam would hit the same point on the hearth all the time (if you do not rotate the crucible). However, you can operate the controls on the EB3 Sweep Control so that the beam sweep coils in the Source are energised to scan the electron beam across the hearth in a specific way according to your application.

The Sweep Control has two identical sets of controls for deflection of the electron beam in two directions, as shown in Figure 3:

- 'X' direction; that is, forwards and backwards along the length of the Source.
- 'Y' direction; that is, sideways across the width of the Source.

The uses of beam sweep are described in Section 3.4.

(Continued on page 8)

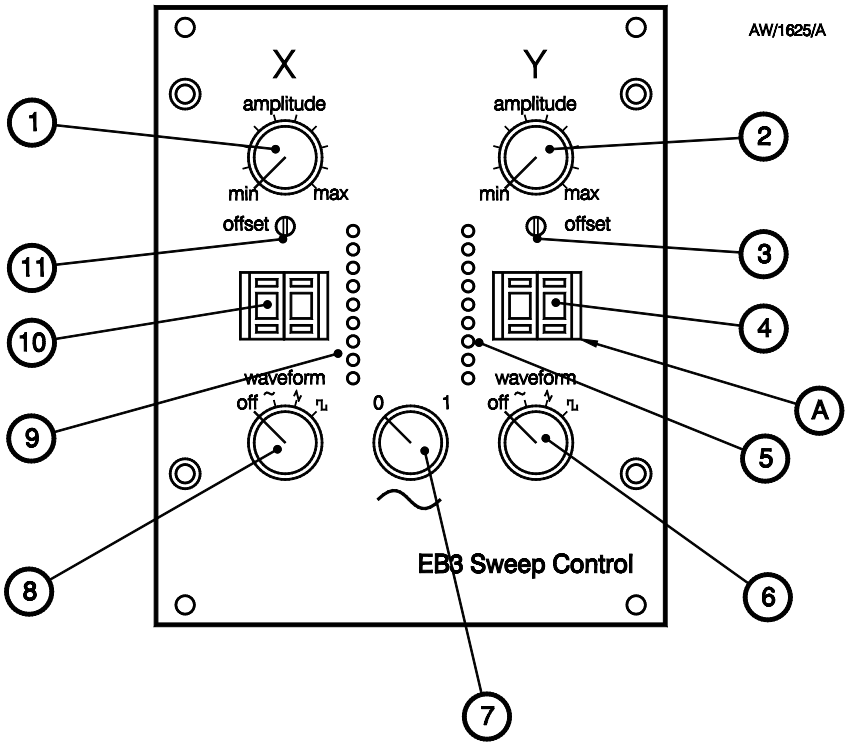


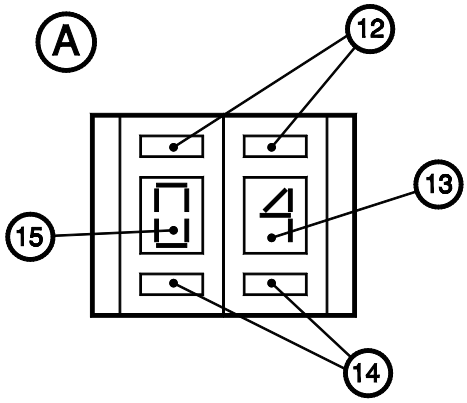
1. Top shield
2. Hearth

Figure 3 - Beam sweep operation

The front panel of the Sweep Control is shown in Figure 4. The controls and indicators on the front panel are as follows:

On/Off switch (7)	Use this to switch the Sweep Control on and off. When the Sweep Control is on (and the waveform selectors are not off), the beam sweep coils are energised to deflect the electron beam as specified by the current settings of the beam sweep controls.
Offset adjusters (3, 11)	Use these controls to adjust the electron beam initial position: refer to Section 3.3.
Amplitude controls (1, 2)	Use these controls to adjust the amplitude of the electron beam deflection in the X and Y directions.
Frequency controls (4, 10) and indicators (13, 15)	Use these controls to select the frequency of the deflection. The indicators show the currently selected frequency (in Hz). Select the required frequency as follows: • Press buttons (12) to increase the frequency • Press buttons (14) to decrease the frequency.
Scanning LEDs (5, 9)	These LEDs show the current deflection of the beam (in the corresponding direction). When the electron beam is in its initial (base) position (that is, it is not deflected), a single LED is on at the centre of the row of LEDs. As the electron beam is deflected, the LEDs go on in sequence (from the centre LED), upwards or downwards, to indicate the amplitude and frequency of the deflection: • The number of LEDs which go on depend on the amplitude: when minimum amplitude is selected, only the centre LED (and perhaps one more LED) will go on; at maximum amplitude, all of the LEDs above (or below) the centre LED will be lit when the electron beam is fully deflected • The speed at which the LEDs go on depends on the selected frequency: the higher the selected frequency, the faster the LEDs will go on and off.
Waveform selectors (6, 8)	Use these controls to switch off beam sweep in a direction or to select the waveform of the deflection in that direction: sine, triangular or square.





A Detail of frequency control

1. Amplitude control (X)
2. Amplitude control (Y)
3. Offset adjuster (Y)
4. Frequency control (Y)
5. Scanning LEDs (Y)
6. Waveform selector (Y)
7. On/off switch
8. Waveform selector (X)
9. Scanning LEDs (X)
10. Frequency control (X)
11. Offset adjuster (X)
12. Pushbutton (increase)
13. Frequency indicator (units)
14. Pushbutton (decrease)
15. Frequency indicator (tens)

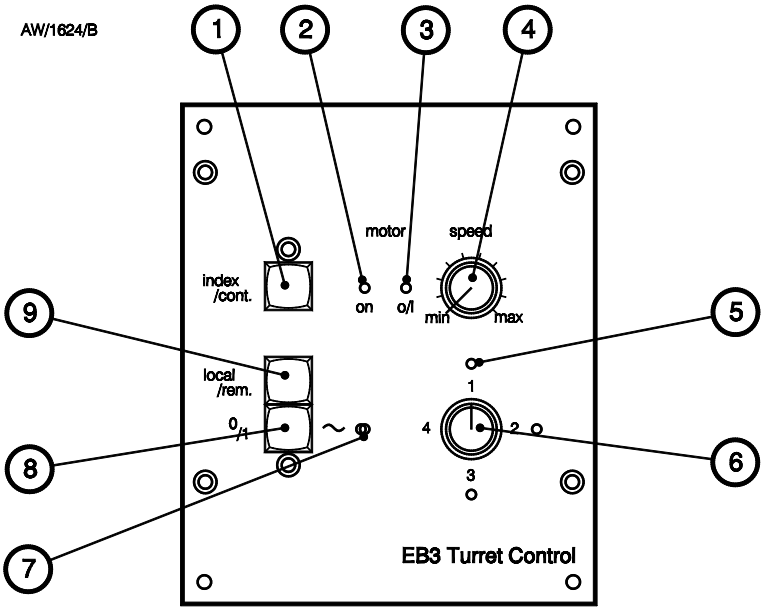
Figure 4 - Front panel of the EB3 Sweep Control

1.2.5 EB3 Turret Control

Use the EB3 Turret Control to control the rotation of the crucible when you have a Motorised Turret Drive fitted.

The front panel of the EB3 Turret Control is shown in Figure 5. The controls and indicators on the front panel are as follows:

On/off switch (8)	Press this to switch the Turret Control on and off.
On/off LED (7)	This LED is on when the electrical supply to the Turret Control is on.
Index/continuous rotation select switch (1)	Press this switch to change between continuous rotation (where the speed is selected by the rotation speed control) and indexing (where the hearth position is selected by the hearth selector switch).
Continuous rotation speed control (4)	Use this control to adjust the crucible rotation speed when continuous rotation is selected. The rotation speed is adjustable between approximately 0.1 and 3 $rev.min^{-1}$. Turn the control clockwise to increase the crucible rotation speed and anticlockwise to decrease the crucible rotation speed.
Hearth selector switch (6)	Turn this switch to select the hearth (1, 2, 3 or 4) that you want to evaporate from. If indexing is selected (on the index/constant rotation switch), the crucible is automatically rotated until the hearth selected on the switch is in the evaporation position.
Hearth indicator LEDs (5)	The corresponding LED is on when the hearth is in the evaporation position.
Motor on LED (2)	This LED is on whenever the motor is operation (that is, the crucible is rotating).
Overload LED (3)	This LED is on when the motor has overloaded (and so the crucible has stopped rotating).
Local/remote switch (9)	Press this to switch between local and remote control modes. In local control mode, use the controls on the Turret Drive to control the rotation of the crucible. In remote operation mode, rotation of the crucible is controlled by signals from your control equipment (refer to Section 3.19 of Volume 1 for further information).



1. Index/constant rotation switch
2. Motor on LED
3. Motor overload LED
4. Continuous rotation speed control
5. Hearth indicator LEDs
6. Hearth selector switch
7. On/off LED
8. On/off switch
9. Local/remote switch

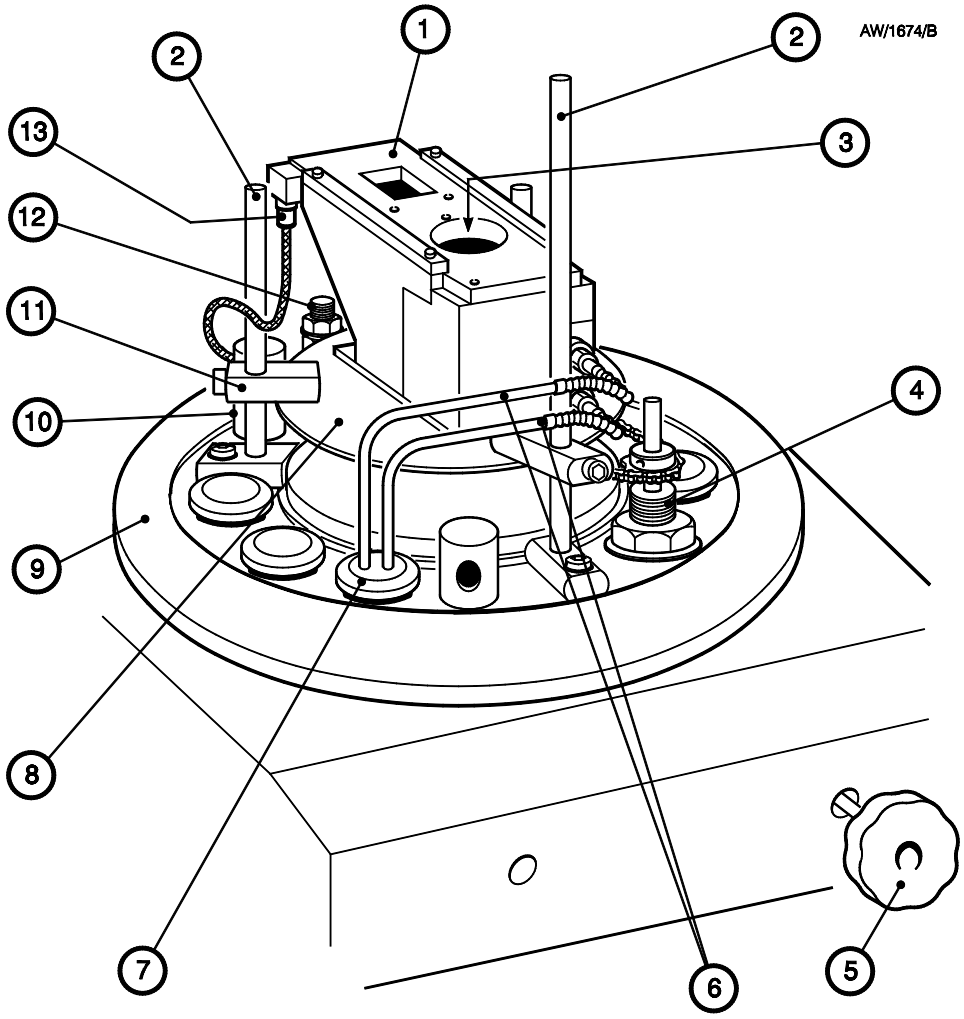
Figure 5 - Front panel of the EB3 Turret Control

1.2.6 EB3 Manual Turret Drive

Refer to Figure 6.

If you have a manual turret drive, turn the handwheel (5) to rotate the crucible.

If you use a four hearth crucible, a click-stop on the turret allows you to feel when a hearth is in the correct evaporation position; that is, is directly under the hole in the top shield (1).



1. Top shield of the Source
2. Tripod leg
3. Hearth and hearth liner
4. Turret drive
5. Handwheel
6. Cooling-water pipes
7. Water leadthrough
8. Baffle plate
9. AUTO 306 baseplate
10. Shield (over TL8K25 leadthrough)
11. Tripod lug
12. 6EK25 leadthrough
13. Beam sweep connector

Figure 6 - EB3 Multihearth Electron Beam Source fitted on the AUTO 306 baseplate (with Manual Turret Drive)

2 MANUAL OPERATION

2.1 Operator safety

WARNING

Obey the safety instructions given below and take note of appropriate precautions. If you do not, you can cause injury to people and damage to equipment.

- Read all of the relevant instructions before you operate any accessories.
- Surfaces within the AUTO 306 may be very hot or very cold. Do not touch hot or cold surfaces such as the pump body, source holders, vacuum chamber and components of the Source.
- Intense light will be emitted from the Source. Always use dark safety glasses when you look in the chamber.
- Observe all safety precautions when you come into contact with dangerous substances which have been used with the Source.
- Wear clean lint-free gloves when you handle components in the chamber to prevent contamination of the Source and its accessories.
- Do not operate the Source in an area where there is equipment subject to magnetic interference.

2.2 General operating notes

The way in which you operate the Source and its accessories will depend on your application. The procedure in Section 2.3 describes a typical sequence of manual operation. You can use this procedure and switch the Source on and off, change the beam sweep settings and select a different hearth (or change the crucible rotation) at any time.

Note that if you have a Motorised Turret Drive, the rotary drive interlock will prevent operation of the Source when the crucible rotates.

If you have installed the interlocks correctly, you can switch on the Source Control and the Sweep Control and select the Source on before you select PROCESS on the AUTO 306 Controller. The Source will not actually go on until the pressure in the chamber is the required pressure for evaporation. Refer to Section 1.12 of Volume 1 for detailed information of the operation of the interlocks.

Take a note of operating parameters (such as beam sweep settings, emission current and so on) during your evaporation processes, so that you can do repeatable evaporation processes at a later date.

For details of remote operation, refer to Section 5.

2.3 Operating procedure

The following procedure assumes that the AUTO 306 and other equipment are all switched off.

2.3.1 Start up the AUTO 306

1. Turn on the cooling-water supply for the AUTO 306.
2. Switch on the electrical supply to the AUTO 306.
3. Start up the AUTO 306: refer to the 'Start up' section of the AUTO 306 instruction manual.

2.3.2 Configure the EB3 Multihearth Electron Beam Source

> CAUTION
>
> Do not overfill the hearth with evaporant. If you do, molten evaporant can spill out of the crucible and contaminate the Source and evaporant in other hearths.

1. Ensure that the correct crucible is fitted to the Source. If necessary, change the crucible: refer to Section 4.8 of Volume 1.
2. If necessary, change the hearth liner(s) and add or change the evaporant loaded in the crucible hearth(s): refer to Sections 3.1 and 3.2.
3. Load the substrate in the substrate holder: if necessary, refer to the instruction manual supplied with your substrate holder.
4. Ensure that the Bell Jar and implosion guard (or other chamber accessory, such as the FL400 chamber door) are in place.

2.3.3 Evaporation with a four hearth crucible

Notes: When you use a four hearth crucible with the Manual Turret Drive, ensure that the click-stop on the Source is engaged (refer to Section 3.8 of Volume 1). You will then be able to feel when a hearth is in the correct evaporation position.

The following procedure assumes that you will not use hearth liners. If you will use hearth liners, you must degas the hearth liners before you use them: refer to Section 2.3.6.

1. Press PROCESS on the AUTO 306 Controller. The chamber will then be pumped down to the required pressure for evaporation (see Section 3.17.2 of Volume 1).
2. Turn on the electrical supply to the Power Supply Unit, then move the electrical supply isolator on the Power Supply Unit (Figure 1, item 4) to the 'on' position to switch on the Power Supply Unit. Ensure that the interlock lamp on the front panel of the Power Supply Unit (Figure 1, item 3) goes on. If the interlock lamp does not go on, you will not be able to operate the Source until the interlock is closed: refer to Section 4.

(Continued on page 16)

3. Check that the vacuum, water and rotary drive interlock LEDs on the front of the Source Control (Figure 2, items 8) are all on. If any interlock LED is off, you will not be able to operate the Source until the appropriate interlock is closed: refer to Section 2.4.

4. If you have an EB3 Motorised Turret Drive, continue at Step 5, otherwise:

   - Use the handwheel on the Manual Turret Drive (Figure 6, item 5) to rotate the crucible until the correct hearth is in the evaporation position.
   - Continue at Step 7.

5. Refer to Figure 5. Press the on/off switch (8) on the Turret Control to switch on the Turret Control, then use the Index/continuous rotation switch (1) to select indexing.

6. Use the hearth selector switch (6) to select the hearth from which you will evaporate. Wait until the crucible has stopped rotating and the selected hearth is in the evaporation position.

7. Refer to Figure 2. Ensure that the current control on the Source Control (5) is in the 'min' position, then press the on/off switch (11) to switch on the Source Control. Check that the fans lamp on the Power Supply Unit (Figure 1, item 2) goes on. After a short delay (for the electronic valves in the Power Supply Unit to heat up), the power LED on the Source Control (see Figure 2) should go on.

8. Press the gun switch (10) to switch on the electron beam.

9. Set/change the controls on the Sweep Control (if fitted) to the required beam sweep configuration: refer to Section 3.4.

10. Refer to Figure 2. Slowly turn the current control (5) on the Source Control clockwise to heat and degas the evaporant in the crucible hearth. The setting of the current control that you will need to degas the evaporant will depend on the evaporant material used.

    Monitor the pressure in the chamber while you degas the evaporant. If there is a sudden rise in pressure, turn the current control anticlockwise to reduce current for a few seconds. If you do not, the pressure rise could cause the vacuum level interlock to open or could overload the Source.

    Use your experience and look at the condition of the evaporant to judge when the evaporant has been degassed.

11. Slowly turn the current control (5) clockwise to increase the power of the electron beam to the required evaporation rate, then open the shutter (if fitted).

12. Use the current control (5) to control the evaporation rate until the film deposited on the substrate is the required thickness (as measured by the film thickness monitor, if fitted).

13. Close the shutter (if fitted) and turn the current control (5) anticlockwise to the 'min' position to stop the evaporation.

14. If you want to do a multilayer deposition:

    - If you have an EB3 Motorised Turret Drive, turn the hearth selector switch on the Turret Control (Figure 5, item 6) to select the next hearth from which you will evaporate. Note that the electron beam will go off while the crucible is indexing (that is, rotating to the next hearth). Continue the procedure from Step 9, until you have deposited all of the required evaporants.
    - If you have an EB3 Manual Turret Drive, turn the handwheel on the Manual Turret Drive (Figure 6, item 5) to rotate the crucible until the next hearth you wish to evaporate from is in the evaporation position. Continue the procedure from Step 9, until you have deposited all of the required evaporants.

15. When you have finished deposition, press VENT on the AUTO 306 Controller. When the chamber is at atmospheric pressure, remove the bell jar (or open the door of the FL400 chamber) and unload the substrate.

2.3.4 Evaporation with a single hearth crucible

You can use the single hearth crucible when you want to evaporate large quantities of dielectrics and other materials which sublime.

You will probably need to slowly rotate the crucible during evaporation; this depends on your particular evaporation process. We therefore recommend that you fit and use the EB3 Motorised Turret Drive.

Use the procedure in Section 2.3.3, but with the following changes:

- In Steps 5 and 6, use the Index/continuous rotation switch to select continuous rotation and use the continuous rotation speed control to select the required crucible rotation speed.
- In Step 9, adjust the Sweep Control so that the electron beam scans slowly only in the X direction, that is, linearly across the radius of the crucible (see Figure 3).

The type of evaporant, crucible rotation speed, beam sweep settings and emission current will all affect the rate of evaporation and deposition. Select the crucible rotation speed, beam sweep settings and emission current according to your experience.

2.3.5 Evaporation with a disk crucible

You can use the disk crucible to evaporate a disk made from a dielectric material. You will need to slowly rotate the crucible during evaporation. A typical crucible rotation speed is $^1/_4$ r min^{-1}, though this depends on your particular evaporation process. We therefore recommend that you fit and use the EB3 Motorised Turret Drive.

Use the procedure in Section 2.3.3, but with the following changes:

- In Steps 5 and 6, use the Index/continuous rotation switch to select continuous rotation and use the continuous rotation speed control to select the required crucible rotation speed.
- In Step 9, adjust the Sweep Control so that the electron beam scans slowly only in the X direction, that is, linearly across the radius of the crucible (see Figure 3).

The type of evaporant, crucible rotation speed, beam sweep settings and emission current will all affect the rate of evaporation and deposition. Select the crucible rotation speed, beam sweep settings and emission current according to your experience.

2.3.6 Evaporation with hearth liners

You must fully degas hearth liners before you use them for evaporation. To degas the hearth liners:

- Fit the hearth liners in the crucible (but do not load the evaporant): refer to Section 3.2.
- Degas the hearth liners as described in Section 2.3.3. We recommend that you slowly heat the hearth liners (until they are red hot) over a period of approximately five minutes.

After you have degassed the hearth liners, ensure that you do not overfill them with evaporant, particularly if you use aluminium as the evaporant. As it heats, aluminium can flow up the side and over the top of the hearth liner; this will cause thermal losses.

After use, leave hearth liners under vacuum, to prevent the re-adsorbtion of moisture.

2.3.7 Shut down

If you have finished evaporation and want to shut down the AUTO 306, use the following procedure.

1. Refer to Figure 2. Press the gun switch (10) to switch off the electron beam, then press the on/off switch (11) to switch off the Source Control.
2. Press the on/off switch (Figure 5, item 8) to switch off the Turret Control.
3. Press the on/off switch (Figure 4, item 7) to switch off the Sweep Control.
4. Move the electrical supply isolator (Figure 1, item 4) to the 'off' position to switch off the Power Supply Unit.
5. Press VENT on the AUTO 306 Controller. When the chamber is at atmospheric pressure, continue at Step 6.
6. Shut down the system: refer to the 'Shut down' section of the AUTO 306 instruction manual.
7. Switch off the electrical supplies to the AUTO 306 and the Power Supply Unit.
8. Turn off the cooling-water supply.

3 CHANGE THE OPERATING CONFIGURATION

3.1 Add evaporant

Note: If you have a hearth liner in the hearth, we recommend that you remove the hearth liner from the Source before you add evaporant. This will prevent contamination of the Source and the chamber by spilled evaporant.

1. Ensure that the Source is off, then vent the AUTO 306 chamber to atmospheric pressure.
2. Open the vacuum chamber.
3. Refer to Figure 6. If you have a hearth liner in the hearth:
   - Remove the hearth (through the hole in the top shield, 1) from the Source.
   - Add evaporant to the hearth liner
   - Replace the hearth liner (through the hole in the top shield, 1) in the Source.
4. Alternatively, or if you do not have a hearth liner in the hearth, carefully add evaporant to the hearth (or hearth liner) through the hole in the top shield of the Source (as shown in Figure 6, item 3).

3.2 Change the hearth liner(s)

Refer to Figure 6.

1. Remove the hearth liner(s) (3) through the hole in the top shield (1) of the Source.
2. Fit the new hearth liner(s) (3) through the hole in the top shield (1) of the Source.

3.3 Adjust the electron beam position

If you have an EB3 Sweep Control fitted, you can adjust the position of the electron beam on the crucible hearth. Use the following procedure. This procedure assumes that the AUTO 306 has been pumped down to the evaporation pressure and that the Source and accessories are switched off.

1. Refer to Figure 1. Switch on the electrical supply to the Power Supply Unit, then move the electrical supply isolator (4) to the 'on' position to switch on the Power Supply Unit. Ensure that the interlock LED (3) is on.
2. Refer to Figure 2. Ensure that the current control (5) on the Source Control is in the 'min' position, press the on/off switch (11) to switch on the Source Control, then press the gun switch (10) to switch on the electron beam.
3. Adjust the current control (5) until you can see the position of the electron beam on the material in the crucible; use the lowest possible setting.
4. Refer to Figure 4. Ensure that the waveform selectors (6, 8) on the Sweep Control are off, then move the on/off switch (7) to the 'on' position to switch on the Sweep Control.
5. Look at the position of the electron beam on the hearth. To adjust the beam position:
   - Use a small screwdriver to turn the X offset potentiometer (11) to move the beam forwards or backwards in the X direction (see Figure 3).
   - Use a small screwdriver to turn the Y offset potentiometer (3) to move the beam left or right in the Y direction (see Figure 3).

3.4 Change the beam sweep operation

3.4.1 Principle of operation

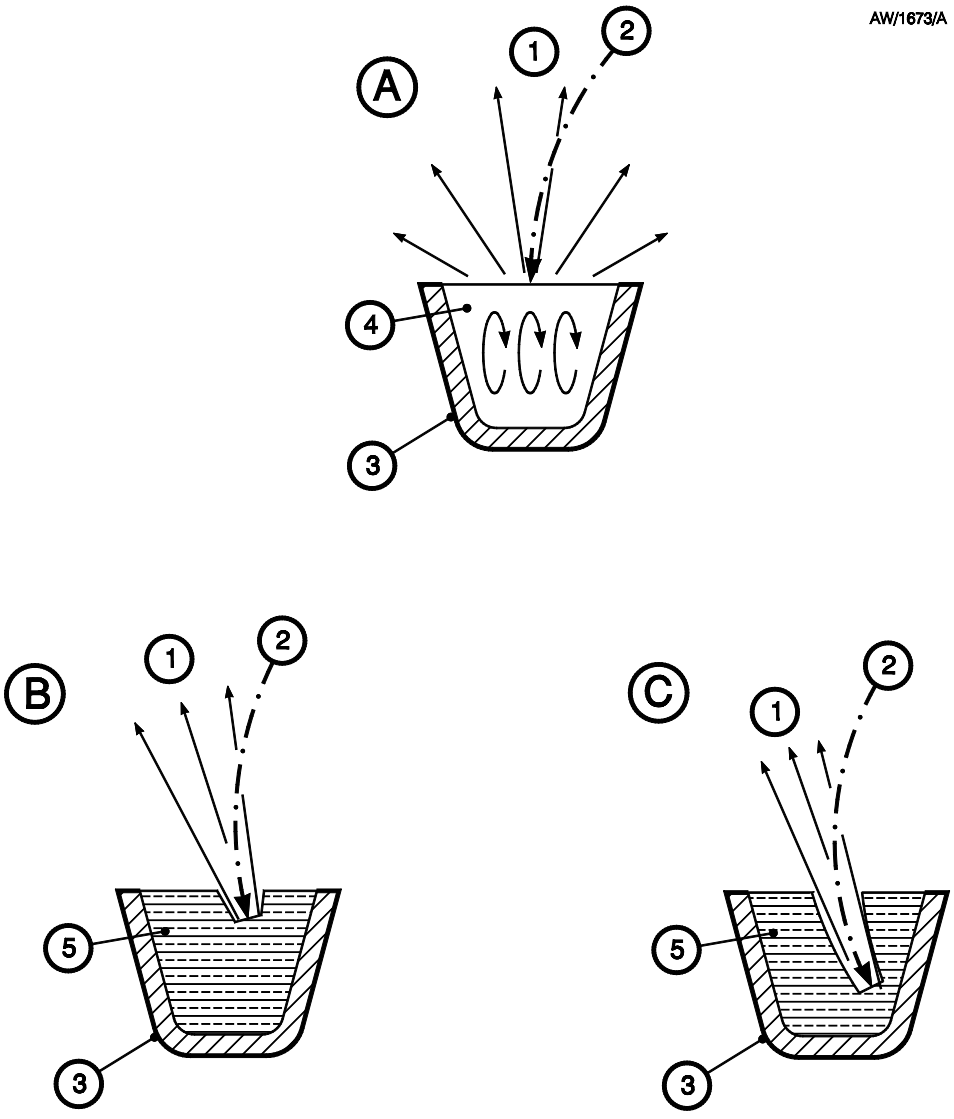
Refer to Figure 7. If you do not use beam sweep, the electron beam hits the same point on the evaporant all of the time.

If the evaporant is a material which melts (see detail A), this generally does not cause a problem. The hearth liner soon contains a pool of liquid material and the material evaporates evenly from the top of the hearth.

However, if the evaporant is a material which sublimes and does not pass through a liquid phase (most dielectrics, such as silicon dioxide, magnesium fluoride and some metals such as chromium and chromium-nickel alloys), the electron beam forms a crater (in the shape of the beam) in the solid evaporant material (see detail B). Continued evaporation deepens the crater and the material evaporates from within the crater, directly upwards from the bottom of the crater in the evaporant in the hearth (see detail C). Deposition on the substrate will be uneven in these circumstances.

(Continued on page 22)

To produce more even deposition when you evaporate materials which sublime, you should use beam sweep. If you use beam sweep (see Section 1.2.4), the electron beam moves over the evaporant and so does not form a single crater; the evaporant streams more evenly from the top surface of the evaporant in the hearth.



1. Evaporant
2. Electron beam
3. Hearth
4. Liquid evaporant material
5. Solid evaporant material

Figure 7 - Evaporation of materials which melt or sublime

3.4.2 Set/change the beam sweep settings

Notes: If required, you can change beam sweep settings at any time; that is, you do not need to switch off the EB3 Sweep Control to change the sweep control settings.

If you do not want to use beam sweep, switch off the Sweep Control. Do not leave the EB3 Sweep Control on, with the two frequency controls set to 0; if you do, you will get an undefined and unrepeatable beam sweep.

The sine waveform is the waveform most commonly used (with low X and Y frequencies) to scan the beam over the surface of the evaporant. A combination of triangular and square waveforms at different frequencies can be used to scan a rectangular 'raster' pattern across the surface of the evaporant.

If you take a note of the beam sweep settings you use for different evaporant materials, you will be able to do repeatable evaporation processes.

To set/change beam sweep settings, refer to Figure 4 and use the following procedure:

1. Ensure that the EB3 Sweep Control is off (that is, the on/off switch (7) is in the 'off' position.
2. Set the X and Y waveform selectors (8, 6) to the required waveform: sine, triangular or square.
3. Set the X and Y amplitude controls (1, 2) to the required amplitude.
4. Set the X and Y frequency controls (10, 4) to the required frequency.
5. When you want to start beam sweep, move the on/off switch (7) to the 'on' position to switch on the EB3 Sweep Control.

3.5 Adjust the filament maximum current

> WARNING
>
> The current control must be adjusted when the Source Control is switched on. Only a suitably trained and supervised technician must adjust the current control.

The rear panel of the EB3 Source Control has a maximum current control which allows the maximum emission current to be preset. The maximum emission current is the emission current to the EB3 Multihearth Electron Beam Source when the current control on the front of the EB3 Source Control (Figure 2, item 5) or the remote control signal (see Section 3.19 of Volume 1) are at the maximum setting.

The maximum current control is preset when supplied. However, if you know what current levels are necessary for correct evaporation (of, for example, dielectric materials) in a repetitive evaporation process, you can adjust the maximum current control to prevent the application of excessive energy to the evaporant.

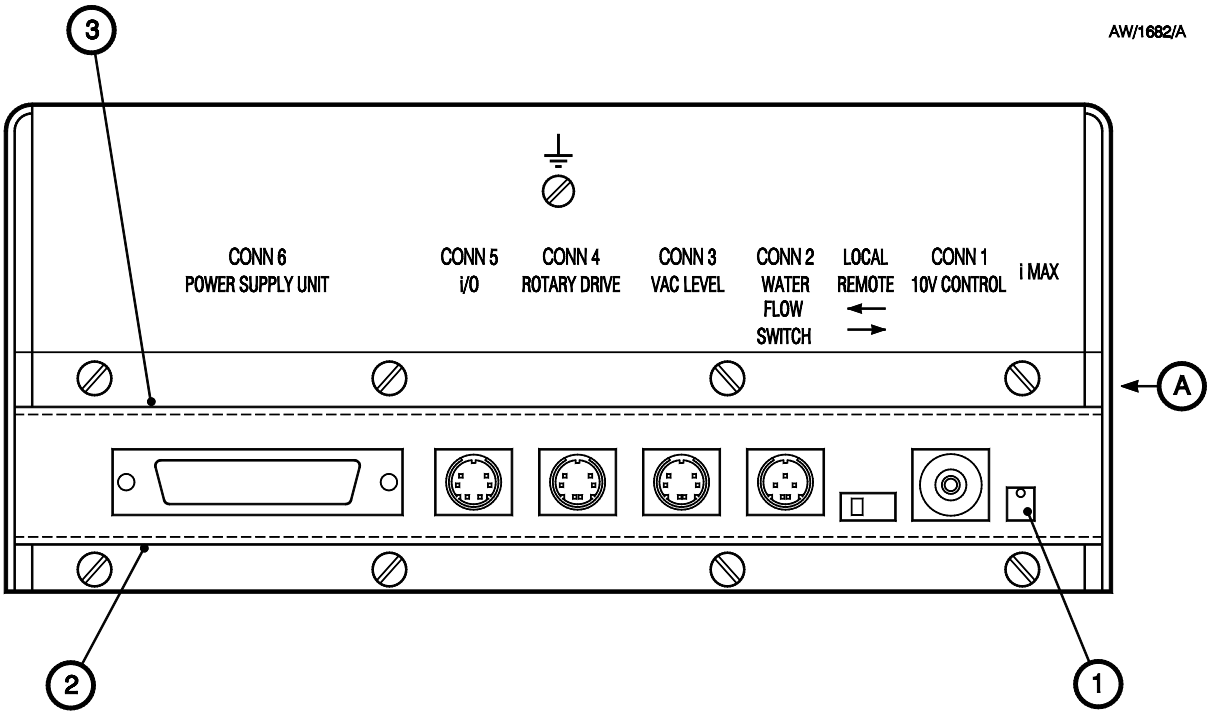
(Continued on page 24)

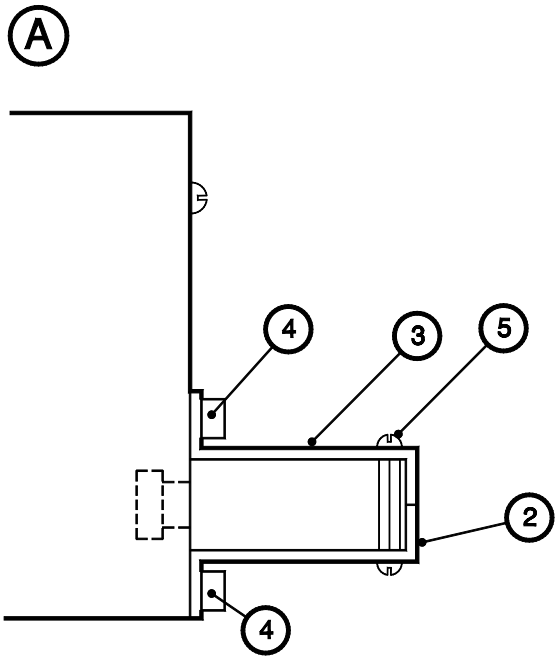
Use the following procedure to adjust the filament maximum current:

1. Shut down the AUTO 306 and switch off and isolate the AUTO 306 and the Power Supply Unit from the electrical supply.
2. Remove the screws which secure the EB3 Source Control in the AUTO 306 electrical cabinet.
3. Carefully pull out the EB3 Source Control from the cabinet; ensure that you do not disconnect or break any of the cables.
4. Refer to Figure 8. Remove the four screws (5) which secure the upper connector cover (3) to the lower connector cover (2).
5. Remove the four screws (4) which secure the upper connector cover (3) to the rear panel and remove the upper connector cover.
6. Reconnect the AUTO 306 and the Power Supply Unit to the electrical supply, then switch on the AUTO 306 and the Power Supply Unit.
7. Switch on the Source Control, then use the adjuster (1) to adjust the filament maximum current to the required current level. Use the meter switch (Figure 2, item 6) to display the current on the ammeter (Figure 2, item 7) on the Source Control. When the current is set to the required level, continue at Step 8.
8. Switch off the Source Control, the Power Supply Unit and the AUTO 306 and isolate the AUTO 306 and the Power Supply Unit from the electrical supply.
9. Refit the upper connector cover (3) and use the four screws (3) to secure the cover to the rear panel.
10. Use the four screws (5) to secure the upper connector cover (3) to the lower connector cover (2).
11. Refit the Source Control in the AUTO 306 electrical cabinet.

3.6 Adjust the high voltage

Refer to Figure 2. Use the voltage adjuster (2) on the EB3 Source Control to adjust the high voltage. The high voltage is adjustable between 4.5 and 5.5 kV and is displayed on the voltmeter (1).





1. Current adjuster
2. Lower connector cover
3. Upper connector cover
4. Screw
5. Screw

Figure 8 - Rear panel of the EB3 Source Control

4 REMOTE OPERATION

4.1 Introduction

To use remote control equipment to operate the EB3 Multihearth Electron Beam Source, you must have installed the EB3 Multihearth Electron Beam Source and its equipment correctly: refer to Sections 1.12 and 3 of Volume 1.

We recommend that you fully understand manual operation of the EB3 equipment (as described in the previous sections of this Volume) before you attempt to use your own control equipment (for example, a thin film deposition controller) to operate the Source.

Refer to Section 3.19 of Volume 1 for the specification of the electrical signals required for remote operation of the Source.

4.2 Typical remote operation sequence

An example remote operation sequence for a two layer metal-dielectric film deposition process is described in Table 1. This is only a typical sequence and the complexity of an actual sequence will depend on the type of remote controller you use (for example, the number of input/output signals the controller can process). If you require further information on your controller, consult the instruction manual for your controller. If you require further information on the interface between the EB3 equipment and your controller, refer to Section 3.19 of Volume 1 or contact your Supplier or BOC Edwards.

The sequence assumes that the necessary components of the EB3 equipment have already been prepared for remote operation; for example, that the beam sweep controls have been set up for the required beam sweep. For details of switch-on of the equipment and the set-up of the beam sweep controls, refer to the appropriate procedures in the previous sections of this Volume of the manual.

Stage of operation	Outputs from deposition controller to Source (*or other accessory)	Inputs from Source to deposition controller	Notes
1	Switch on EB3 Source Control	-	Close pins 1 and 5 of C5
2	-	Fans running OK	Pins 3 and 4 of C5 closed
3	-	Timer OK	Pins 3 and 6 of C5 closed
4	Select hearth 1 on the EB3 Turret Control	-	Close pins 1 and 6 on C8. (for example, silver in hearth 1)
5	-	Hearth 1 in position	Pins 1 and 6 of C9 closed
6	Switch on EB3 Source	-	Close pins 1 and 2 of C5
7	Ramp up power to level 1	-	0 to 10 V control signal to C1
8	Soak at power level 1	-	
9	Ramp up power to level 2	-	
10	Soak at power level 2	-	
11	Open shutter*	-	-
12	Control power for the required deposition rate	-	0 to 10 V control signal to C1
13	Close shutter* at terminal thickness	-	-
14	Ramp down power to zero level	-	0 to 10 V control signal to C1
15	Switch off EB3 Source	-	Open pins 1 and 2 of C5
16	Deselect hearth 1	-	Open pins 1 and 6 of C8
17	Select hearth 2	-	Close pins 2 and 6 of C8 (for example, silicon dioxide in hearth 2)
18	-	Hearth 2 in position	Pins 2 and 7 of C9 are closed
19	Select beam sweep on	-	Close pins 2 and 3 of C10
20	Switch on EB3 Source	-	Close pins 1 and 2 of C5
21	Ramp up power to new level 1	-	0 to 10 V control signal to C1
22	Soak at new power level 1	-	
23	Ramp up power to new level 2	-	
24	Soak at new level 2	-	
25	Open shutter*	-	-
26	Control power at required deposition rate	-	0 to 10 V control signal to C1
27	Close shutter* at terminal thickness	-	-
28	Ramp down power to zero level	-	0 to 10 V control signal to C1
29	Switch off beam sweep	-	Open pins 2 and 3 of C10
30	Switch off EB3 Source	-	Open pins 1 and 2 of C5
31	Deselect hearth 2	-	Open pins 2 and 6 of C8
32	Switch off EB3 Source Control	-	Open pins 1 and 5 of C5

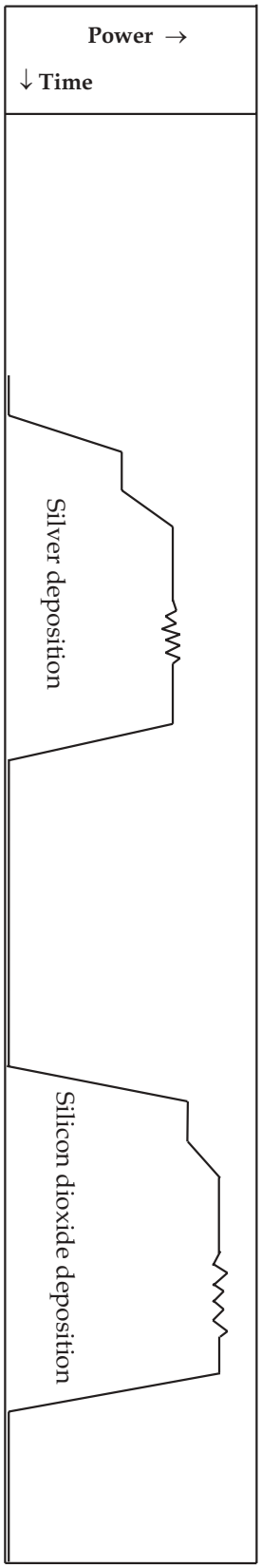


Table 1 - Typical remote operation sequence

5 FAULT FINDING

5.1 Rectification of interlock problems

If any of the interlock LEDs on the EB3 Source Control are off, you will not be able to operate the EB3 Multihearth Electron Beam Source. Use the following procedures to determine what action to take when an interlock LED is off.

5.1.1 Safety interlock

If the safety interlock lamp on the Power Supply Unit (Figure 1, item 3) is off, this means that one of the AUTO 306 doors or covers are open or the pressure in the chamber is too high. Check that all doors and covers are closed and that the leak valve in the AUTO 306 is fully closed.

If you are sure that all the doors and covers are closed and you have already pumped down the AUTO 306, but the interlock lamp is still off, the installation of the interlock is probably incorrect. You must therefore shut down the system and check the installation of the safety interlock: refer to Section 3.12 of Volume 1.

5.1.2 Vacuum level interlock

The vacuum level interlock is designed to prevent operation of the Source if the pressure in the vacuum chamber is too high. When the interlock LED on the Source Control (see Figure 2) is off, this shows that the interlock is not closed. The interlock LED may be off for a number of reasons, as follows:

- There has been a pressure burst due to degassing of the evaporant. Wait for the pressure in the chamber to reduce; the interlock LED should then go on again.
- There has been a pressure burst due to a water leak in the chamber. Such pressure bursts are most likely to occur when the crucible rotates. If you use a four hearth crucible, you may be able to continue evaporation after the crucible has stopped and the pressure in the chamber has been reduced again. If the pressure does not reduce again, check for water leaks in the chamber.
- The chamber leak valve is open. Close the leak valve; the pressure should then reduce and the interlock LED should go on.
- The EB3 3 kW Power Supply is not switched on. Ensure that the electrical supply is on, then switch on the EB3 3 kW Power Supply.
- The vacuum level interlock pressure has been set incorrectly. Check the vacuum level interlock pressure and reset as necessary: refer to Section 3.17.2 of Volume 1.
- You have pressed CYCLE instead of PROCESS on the AUTO 306 Controller.
- The interlock has not been installed correctly; shut down the system and check the installation of the interlock: refer to Section 3.12.7 of Volume 1.

5.1.3 Water interlock

The water interlock is designed to prevent operation of the Source when there is no cooling-water flow. If the water interlock LED is off:

- Your cooling-water supply may be off. If the cooling-water supply is off, turn it on; the interlock LED should then go on.
- The flow rate of the cooling-water supply may not be as specified in Section 2 of Volume 1. Shut down the system and rectify the problem.
- If the cooling-water supply is acceptable, there may be a blockage in the Water Flow-Switch or the Source, or the Water Flow-Switch may have failed. Shut down the system and inspect and clean the Water Flow-Switch and the cooling-water pipelines to the Source.
- The Power Supply Unit is not switched on. Ensure that the electrical supply is on, then switch on the Power Supply Unit.
- The interlock may be installed incorrectly. Shut down the system and check the installation of the interlock: refer to Sections 3.6 and 3.12.7 of Volume 1.

5.1.4 Rotary drive interlock

The rotary drive interlock prevents operation of the Source when the turret is indexing between hearths on a four hearth crucible. If the rotary drive interlock LED is off when the crucible is not rotating, or is on when the crucible is rotating:

- The Power Supply Unit is not switched on. Ensure that the electrical supply is on, then switch on the Power Supply Unit.
- The interlock may be installed incorrectly. Shut down the system and check the installation of the interlock: refer to Sections 3.9 and 3.12.7 of Volume 1.

5.2 Reset after error condition

5.2.1 Source Control overload

Refer to Figure 2. If the Source Control overloads, the overload LED (4) will go on. To reset the overload, turn the current control (5) anticlockwise to the minimum setting, then press the Reset switch (3). If the Source Control continues to overload, there is probably a fault in the equipment; refer to Section 4.13 of Volume 1 for fault finding.

5.2.2 Power Supply Unit circuit breaker trip

Refer to Figure 1. If one of the Power Supply Unit circuit breakers have tripped (that is, one of the circuit breaker lamps (3) are on), press the corresponding circuit breaker reset button (6). If the circuit breaker(s) continually trip, there is probably a fault in the equipment; refer to Section 4.13 of Volume 1 for fault finding.

5.2.3 Motorised Turret Drive motor overload

Refer to Figure 5. If the motor in the EB3 Motorised Turret Drive overloads, the overload LED (3) will go on. Once the Turret Drive has overloaded, it will automatically reset itself.

If the motor continues to overload (indicated by the overload LED flashing), there is probably a fault in the equipment; refer to Section 4.13 of Volume 1 for fault finding.

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UNITED KINGDOM

CORPORATE HEADQUARTERS
BOC EDWARDS
Manor Royal
Crawley
West Sussex
RH10 9LW
Tel +(44) 1293 528844
Fax +(44) 1293 533453

BOC EDWARDS
Wingates Industrial Estate
Great Bank Road
Westhoughton, Bolton
Lancashire
BL5 3SL
Tel +(44) 1942 652652
Fax +(44) 1942 652651

AMERICA (USA)

USA HEADQUARTERS
BOC EDWARDS
One Edwards Park
301 Ballardvale Street
Wilmington, MA 01887
Tel +(1) 978 658 5410
Toll free (USA only) 1 800 848 9800
Fax +(1) 978 658 7969

3901 Burton Drive
Santa Clara, CA 95054
Tel +(1) 408 496 1177
Fax +(1) 408 496 1188

1810 West Drake Drive
Suite 101
Tempe, AZ 85283
Tel +(1) 602 777 7007
Fax +(1) 602 777 2244

11701 Stonehollow Drive
Suite 100
Austin, TX 78758
Tel +(1) 512 491 6622
Fax +(1) 512 491 0629

3501 Island Avenue
Philadelphia, PA 19153
Tel +(1) 215 365 8653
Fax +(1) 978 753 6846

BELGIUM

BOC EDWARDS
Bergensesteenweg 709
B1600 Sint-Pieters-Leeuw
Brussels
Tel +(32) 2 363 0030
Fax +(32) 2 363 0064

BRAZIL

BOC DO BRASIL LTDA
DIVISÃO EDWARDS ALTO VACO
Rua Bernado Wrona 222
02710 São Paulo-SP
Tel +(55) 11 3952 5000
Fax +(55) 11 3965 2766

CANADA

BOC EDWARDS
5975 Falbourne Street
Mississauga, Ontario L5R3W6
Canada
Tel +(1) 905 501 2558
Fax +(1) 905 501 1632

12055 Cote de Liesse
Dorval, Quebec H9P1B4
Canada
Tel +(1) 514 631 3501
Fax +(1) 514 631 3502

CHINA

BOC TRADING
(SHANGHAI) CO. LTD.
23 Fu Te Road (N)
Wai Gao Qiao Free Trade Zone
Pudong
Shanghai, 200131
PRC China
Tel +(86 21) 5866 9618
Fax +(86 21) 5866 9993

FRANCE

BOC EDWARDS
125 Avenue Louis Roche
92238 Gennevilliers, Cedex
Paris
Tel +(33) 1 47 98 24 01
Fax +(33) 1 47 98 44 54

GERMANY

BOC EDWARDS
Ammerthalstraße 36
85551 Kirchheim
Munich
Tel +(49) 89 99 19 18 0
Fax +(49) 89 99 19 18 99

HONG KONG S.A.R.

BOC EDWARDS (ASIA)
12 Chun Yat Street
Tseung Kwan O Industrial Estate
Tseung Kwan O, Kowloon
Hong Kong S.A.R.
Tel +(852) 2372 2640
Fax +(852) 2796 9095

INDIA

BOC EDWARDS
DIVIN. OF BOC INDIA LIMITED
203 Surya Kiran Building
19 Kasturba Gandhi Marg
New Delhi - 110 001
India
Tel +(91) 11 851 0065
Fax +(91) 11 851 0245

ISRAEL

EDWARDS ISRAEL VACUUM LTD.
5 Habarzel Blvd
Gat 2000 Industrial Zone
Qiryat Gat 82000
Tel +(972) 8 681 0633
Fax +(972) 8 681 0640

ITALY

BOC EDWARDS
Via Carpaccio 35
20090 Trezzano sul Naviglio
Milan
Tel +(39) 02 48 4471
Fax +(39) 02 48 401638

JAPAN

HEADQUARTERS
BOC EDWARDS
Shuwa Shiba Park Building A-3F
2-4-1 Shibakoen Minato-ku
Tokyo, 105-0011
Tel +(81) (0) 3 5470 6530
Fax +(81) (0) 3 5470 6521

KOREA

HEADQUARTERS
SONGWON EDWARDS LTD.
5th FL. Daewoo Engineering Bldg.
Soonae-dong
Bundang-gu, Sungnam City
Kyungki-do, Korea
Tel +(82) 31 716 7070
Fax +(82) 31 738 1001-3

FACTORY & GV
SONGWON EDWARDS LTD.
625-7 Upsong-dong
Chunan City
Chungchong Nam-do
Korea
Tel +(82) 41 621 7070
Fax +(82) 41 621 7700

SINGAPORE

BOC EDWARDS (ASIA)
42 Loyang Drive
Loyang Industrial Estate
Singapore 508962
Tel +(65) 6546 8408
Fax +(65) 6546 8407

TAIWAN, R.O.C.

EDWARDS TECHNOLOGIES
LIMITED
No. 434 Chung hua Road
Toufen Town, Miaoli County
Taiwan ROC
Tel +(886) 37 611422
Fax +(886) 37 611401

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