Operating and Maintenance Handbook
The XL Sample Transfer and Sample Handling System
Document Number UI42395A

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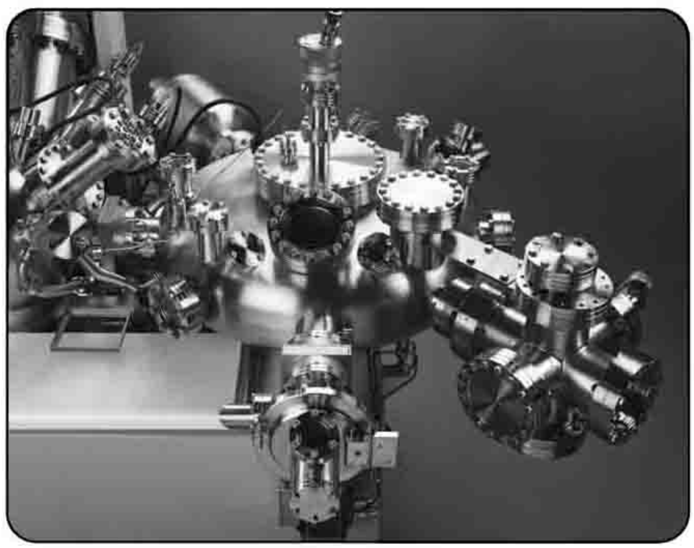

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1. Subject to fair wear and tear and the due, observance of any installation user, storage, operating or maintenance instructions the Seller undertakes to replace or, at its option repair free of charge to the purchaser, any goods which the purchaser can establish are defective by reason of defective workmanship or materials which are returned to the Seller, carriage paid, within 12 months of the date of despatch by the Seller. In the event, however, that the Seller supplies spare parts either direct, or that are fitted or installed or replaced by the Sellers' service center such spare parts will be subject to a warranty period of six months only.
2. The Purchaser cannot return any product for warranty repair without the prior approval of Thermo Vacuum Generators and the issue of a Goods Return Number (GRN). This shall be obtained by contacting the service center at Thermo Vacuum Generators. All returned products must be accompanied by a completed Declaration of Contamination form. Customers must, in the first instance, contact the local selling agent.
3. We reserve the right to decline to service equipment, we consider is in any way hazardous until a clearance or safety certificate, in a form satisfactory to Thermo Vacuum Generators, has been completed and returned by the customer.

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The following additional terms and conditions apply in the event that the customer, elects to use the services of Thermo Vacuum Generators workshop on a chargeable basis.

1. At its own cost the customer shall despatch the equipment to the workshop, carriage paid, suitably packaged, protected and insured, bearing, a Goods Return Number (GRN) and a completed Declaration of Contamination certificate obtained from Thermo Vacuum Generators in advance of shipment.
2. During the period that the equipment is on Thermo Vacuum Generators premises, Thermo Vacuum Generators will insure the equipment against all risks.
3. Thermo Vacuum Generator will provide an acknowledgement of the receipt together with an estimate of the repair charges. Such estimates are carried out on a visual basis and are therefore intended as a guide only. Formal fixed price repair quotations are available and involve the disassembly of the equipment to determine the full extent of the work necessary to restore the equipment to an acceptable standard. In the event that the customer chooses not to proceed with the repair Thermo Vacuum Generators will make a charge to cover this examination effort.

Note:
The above are extracts from Thermo Vacuum Generators Conditions of sale. Complete copies can be obtained from:
Thermo Vacuum Generators,
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1.0 Introduction

The XL system comprises three main components: a sample carrier, a receiver and a transfer device. Together, these create a powerful sample handling tool providing impressive sample transfer, manipulation and conditioning. These operating instructions give guidance on the use and maintenance of the individual assemblies.

Important:
It is important that certain features of the operation of the XL system are operated correctly in order to maintain the proper functioning of the system, or to avoid hazards. These are highlighted throughout the text by a Note or Warning such as this one. Ensure that all the users of the system are made aware of these features before operating the system.

Thermo Vacuum Generators would appreciate any comments that you may have on the commissioning or operation of the XL sample transfer system, whether it be a difficulty encountered, an omission from these instructions, or an application note arising from the use of the system.

2.0 Carriers

The carriers, or blocks, form the heart of the XL sample handling system. They carry the sample together with the heater and thermocouple connections where applicable. Four standard blocks are available. Some special blocks, not described here, may also be available on request.

The Heat and Cool Block (XL25HC) provides the optimum range of sample heating and cooling possibilities and should be suitable for the majority of experimental conditions. The XL25BA is similar to the XL25HC but has reduced width to allow transfer through a 34mm bore tube, rather than the standard 38mm bore.

The Very Hot Block (XL25VH) is designed for applications where high temperature working is critical with cooling as a secondary option. Both types of block can handle samples up to 25.4mm diameter; a summary of the block specifications is given below.

A plain block is available for setting up the transfer system or for custom applications.

	Heat and Cool Block	Very Hot Block
Sample Size	25.4mm Diameter	25.4mm Diameter
Maximum Temperature*	1000^{o}C (1273K)	1200^{o}C (1473K)
Time to Maximum Temperature*	5 minutes	5 minutes
Minimum Temperature*	-140^{o}C (133K)	-80^{o}C (193K)
Time to Minimum Temperature*	60 minutes	60 minutes

* Data are approximate and depend on experimental conditions. All temperatures are measured on the bare sample plate; the nature of the sample will affect the actual temperature achieved.

2.1 The Plain Block (XL25P)

This carrier is shown in figure 1. It has no heater or thermocouple attached, but is fitted with an isolated socket for power connection, attachments for a thermocouple, and mounting points suitable for the addition of a sample plate.

The XL25P is a component part of the other carriers (XL25HC and XL25VH blocks) and is offered for use as a 'do-it-yourself sample carrier,' or for setting up the transfer system. Remember that if the plain block is being used for sample heating, the current limitations of the other carriers still apply (see section 2.2.1 below)

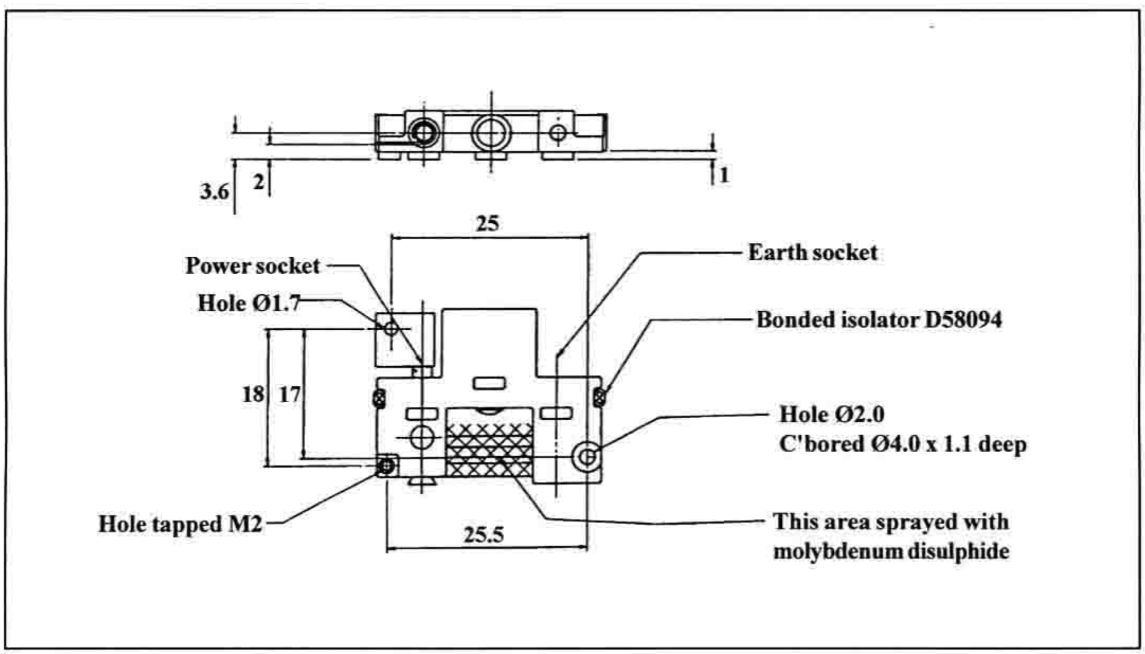

Figure 1. The XL25P Plain Block.

2.2 Heat and Cool Block (XL25HC)

This carrier uses the plain block as a base onto which are attached the heater element, heat shields, sample plate and thermocouple (see figure 2). The heat shield, sample plate and sample clips are made from molybdenum. The various screws and nuts are either made from molybdenum or tantalum; the ceramics are alumina. An N-type thermocouple is used.

2.2.1 Heating

The heater element is pyrolytic graphite (PG) encapsulated in pyrolytic boron nitride (PBN); this is generally referred to as a PBN heating element.

The current-carrying capacity of the power connections dictate the following limitations:

Maximum Continuous Current:	**1.2 Amps (see section 4.2)**
Maximum Short Term Current:	**5 Amps for up to 1 0 minutes from a cold start. If the element is pre-heated, this must be reduced accordingly.**

Important:
Do not exceed the current limitations given above. Permanent damage may result.

Further information on sample heating is given in section 4.

2.2.2 Cooling

Cooling of the sample is achieved by bringing the plate into contact with two cooled sapphire discs on the receiver. Since the thermal efficiency is very dependant on this junction, the condition of the cooling fingers, and their fit to the sapphire discs is very important (too loose a fit will impair the cooling of the sample, too tight a fit will make sample transfer difficult).

The cooling fingers are factory coated with a bonded dry film lubricant. This can be removed by abrasion so handle with care. The film may eventually wear with use and the sample plate and heat shields should be replaced. When this becomes necessary it is likely that other components that also have the bonded lubricant will need to be replaced. Refer to section 5.1

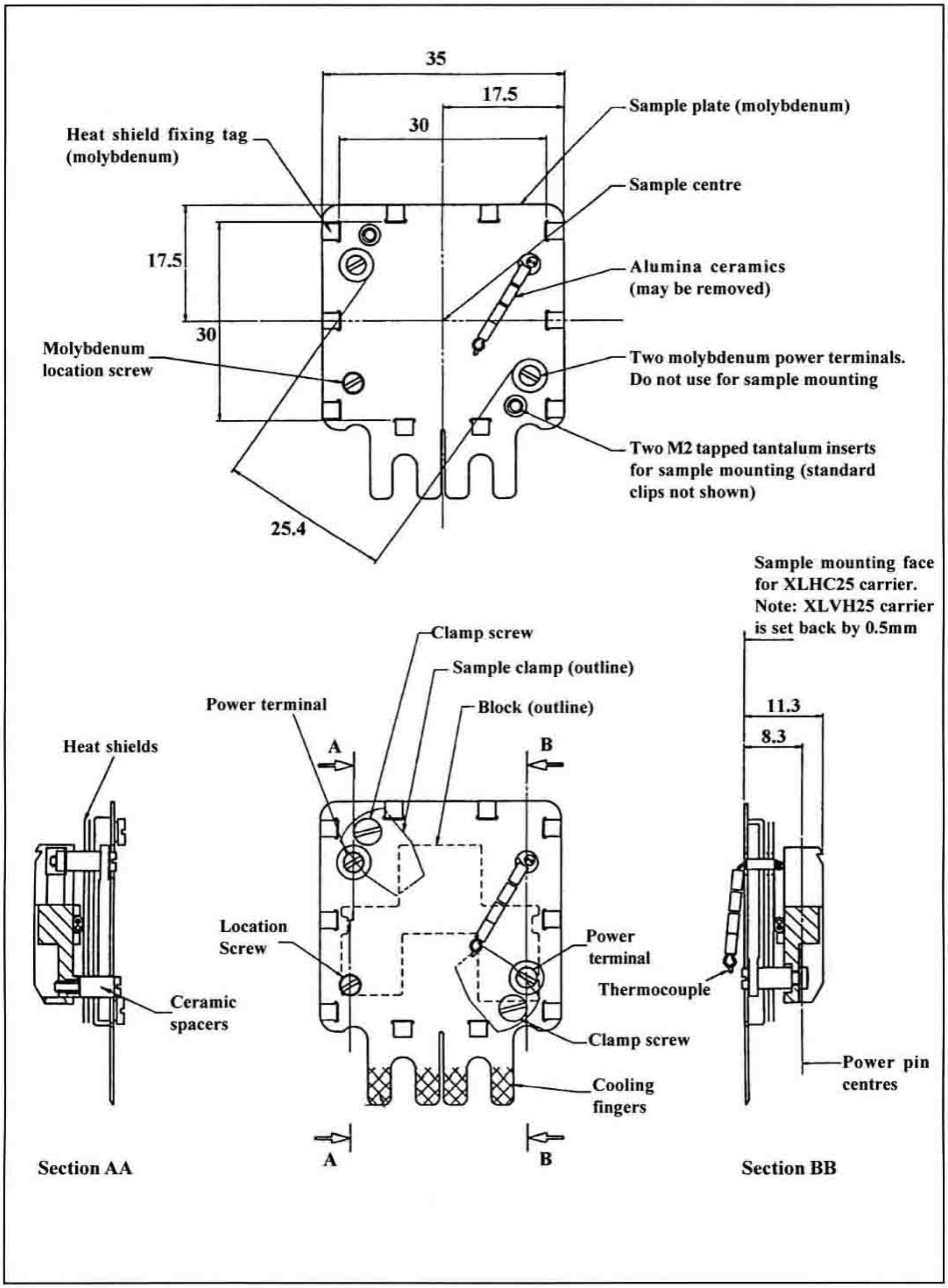

Figure 2. The XL25HC Heat and Cool Block.

2.2.3 Replacing the Thermocouple

Before replacing the thermocouple it is necessary to dismantle the carrier (see figure 2):-

Important.
When attempting to loosen screws which have been heated under vacuum, use a drop of alcohol (ethanol or similar solvent) to lubricate the threads of the screw. Initially, gently rotate the screw by a fraction of a turn to allow the alcohol to penetrate. This will make the screw very much easier to remove and will considerably extend its life.

1) Remove the sample clips to aid access.

2) Remove the two element screws, but do not remove the location screw.

3) Straighten the thermocouple to allow the element assembly and heat shields to be removed. Carefully note the position and orientation of the heat shields.

4) Unless absolutely essential, do not dismantle the element assembly by straightening the tags visible on the sample plate. These tags will probably break and a new heater tray will be required.

The old thermocouple can now be cut away (the insulators should be retained). To fit the new thermocouple, refer to figure 3 and the following instructions.

5) Use 0.3mm diameter N-type thermocouple wire Thermo Vacuum Generators code: XTHWO9.
It is essential that the N+ and N- wires are fitted to the correct side of the carrier as shown in figure 3.

6) Starting with the N+ (orange insulation) wire, strip a 1 00mm length of all the insulation and then loop the wire around the correct bonded insulator on the body.

Important:
The wire must be worked into a tight loop which lies on the outside of the insulator, and as close to it as possible. DO NOT pull on the wire whilst holding the body as the insulator may break away. Instead, pull both ends of the wire in opposite directions simultaneously. Ensure that the wire cannot short to the body.

7) Repeat step 2) for the N- blue insulation wire.

8) Fit the remaining insulators as shown and then weld the hot junction.

9) Reassembly is the reverse of the above procedure, steps 1 through 4.

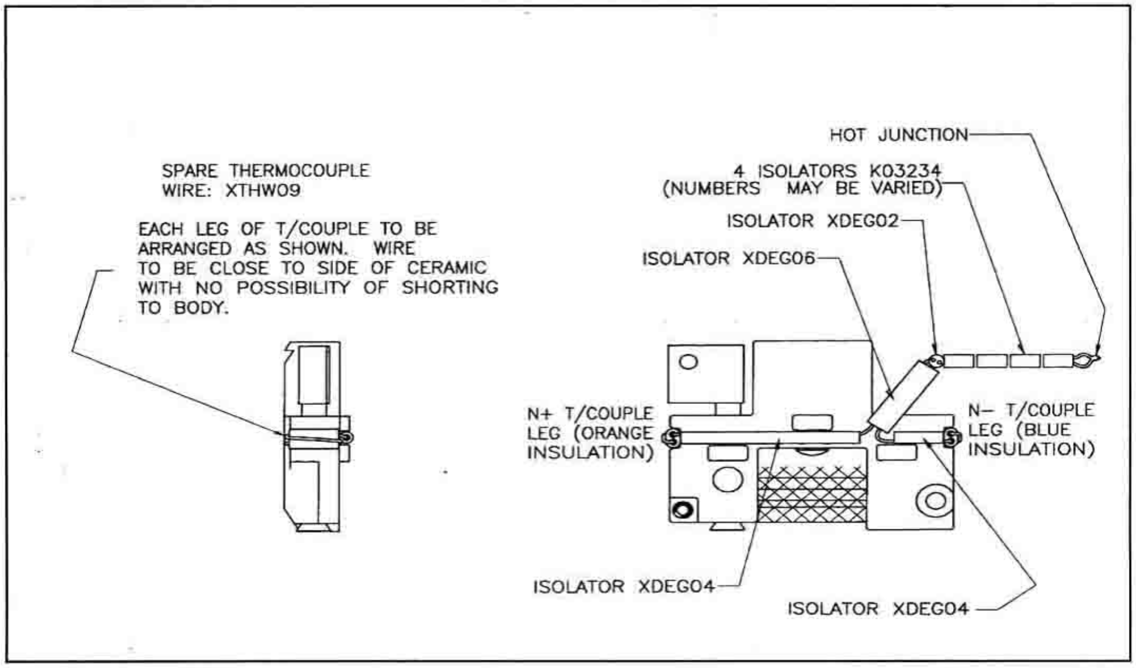

Figure 3. The XL25HC thermocouple arrangement.

2.3 The Very Hot Block (XL25VH)

This carrier is very similar to the Heat and Cool block (XL25HC, see section 2.2). The only difference is that the sample plate has a large cut-out which allows the sample to rest directly on the heater element surface (see figure 4). This reduces the temperature differential between the element and the sample since there is no intermediate plate. However, the cooling performance is severely restricted since heat must now be conducted through the element (which is a poor thermal conductor), or through the sample clamps.

The temperature performance is therefore very dependant on the sample itself and on the sample mounting arrangement. For example, a sample which transmits thermal radiation will not achieve such a high temperature as a 'black body' sample. If large sample clamps are used the cooling performance will improve, but the high temperature performance will be degraded since heat will be conducted away via the clamps.

Due to the similarities between the XL25VH and XL2SHC blocks, the user should refer to section 2.2 for specific information on heating, cooling and thermocouple replacement.

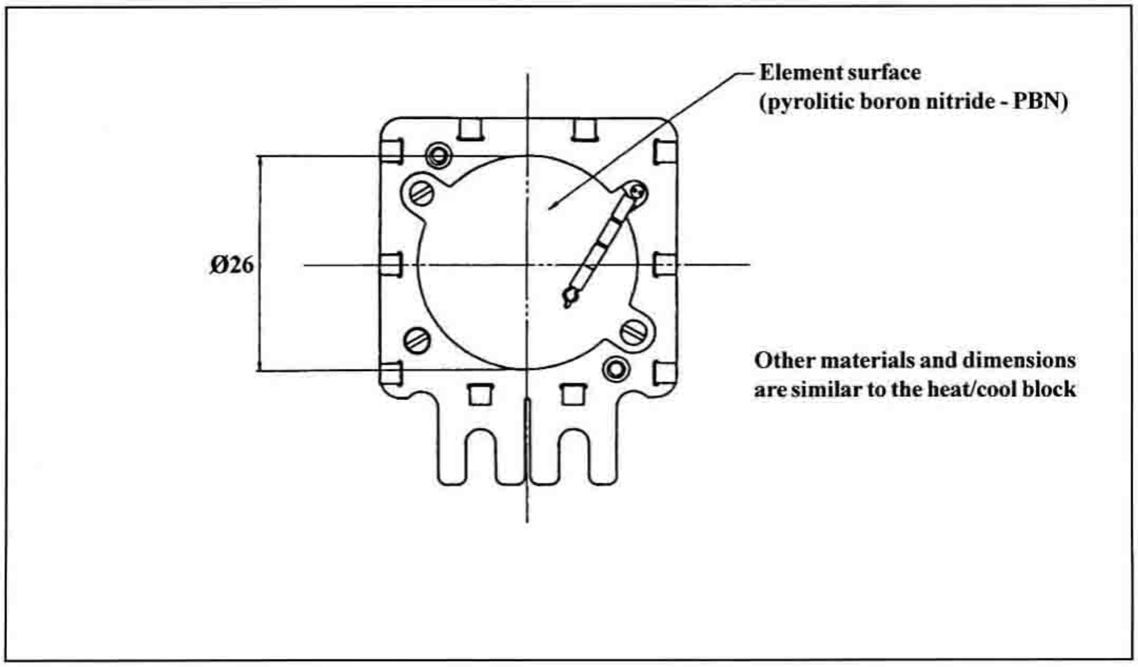

Figure 4. The XL25VH Very Hot Block.

3.0 Receiver

All sample holders and preparation stages are fitted with a receiver to allow them to accept (receive) a sample carrier. The construction of all receivers is similar, but the services attached to them may vary (see section 4.0).

A stainless steel housing is used as a base into which two power pins are fitted. As well as supplying current to the carrier, these pins also serve to locate the carrier. A detent spring is used to hold the carrier in place and to maintain good electrical contact between the carrier and the power pins.

The construction of the receiver is straightforward to understand once the cooling services have been removed (see figure 5). Use a drop of ethanol to lubricate screw threads when loosening any screws which have been subjected to high temperatures. To remove the detent spring, straighten the two tags, unscrew the single M1.6 screw, and remove. To remove either power pin, first remove the electrical connection by unscrewing the outer M2 nut, and then the inner M2 nut, to free the pin. When refitting the pin, use the carrier to check the pin alignment – this may require some patience to achieve the good fit necessary to ensure easy sample transfer.

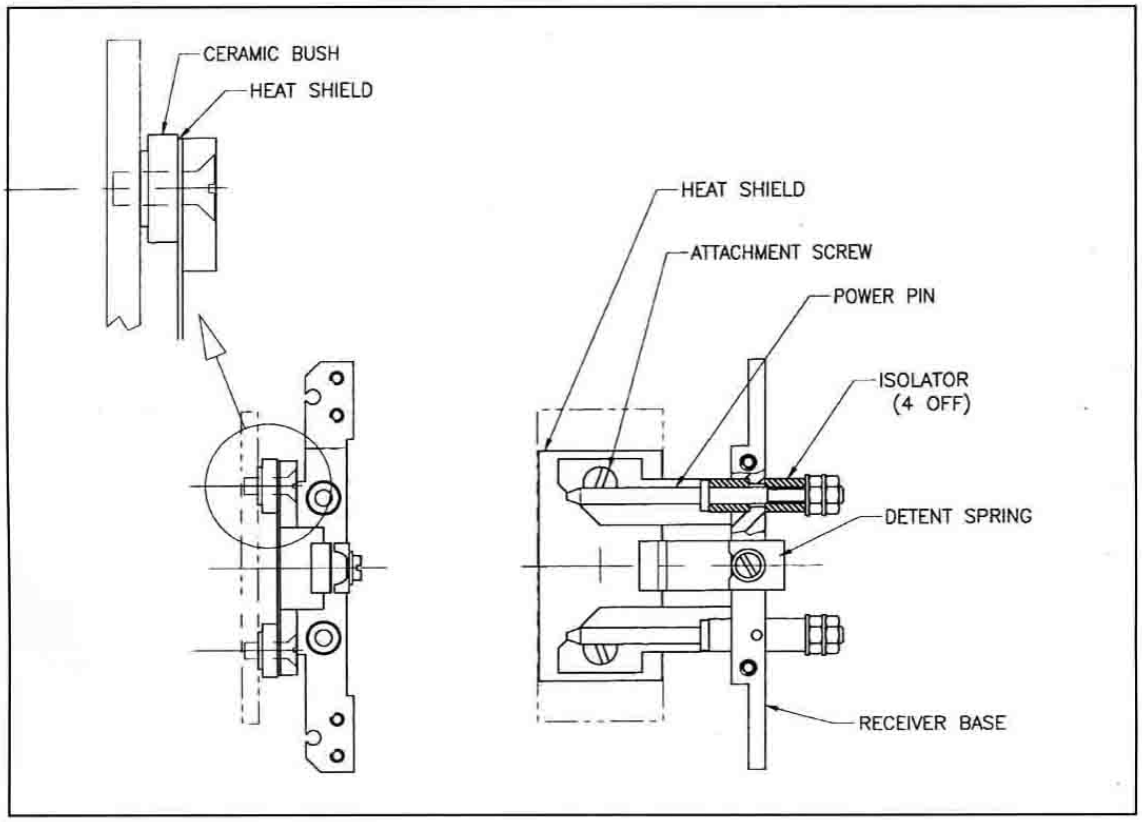

Figure 5. The XL25 receiver.

4.0 Services

The XL25 system allows the sample to be heated and cooled with the temperature being monitored by a thermocouple. It is also possible to apply a bias voltage to the sample, or to measure sample landing current, by means of a separate electrical connection. A schematic diagram of the sample services is shown in figure 6.

All these services may be fitted simultaneously to the sample holder receiver. Other receivers (such as parking stages) may vary in the services that they provide to the carrier. The necessary electrical connections to provide these services are detailed in figures 7 to 11.

Important:
Where high voltages are to be used on the receiver/carrier, the electrical connections should be checked beforehand to ensure that all contacts are secure, and that no electrical breakdown will take place at the operating voltage.

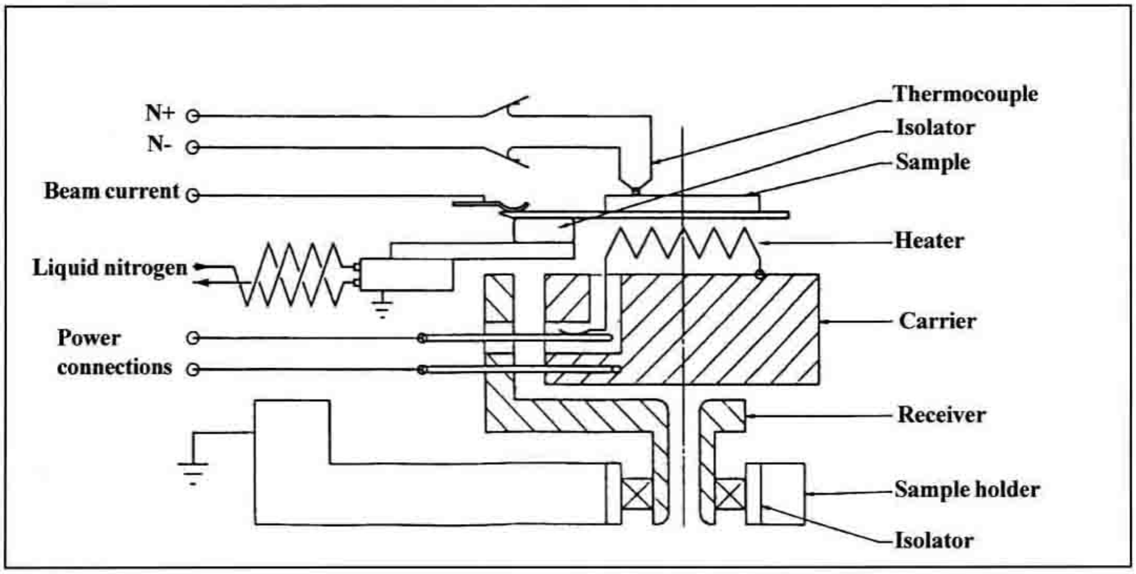

Figure 6. XL25 services overview.

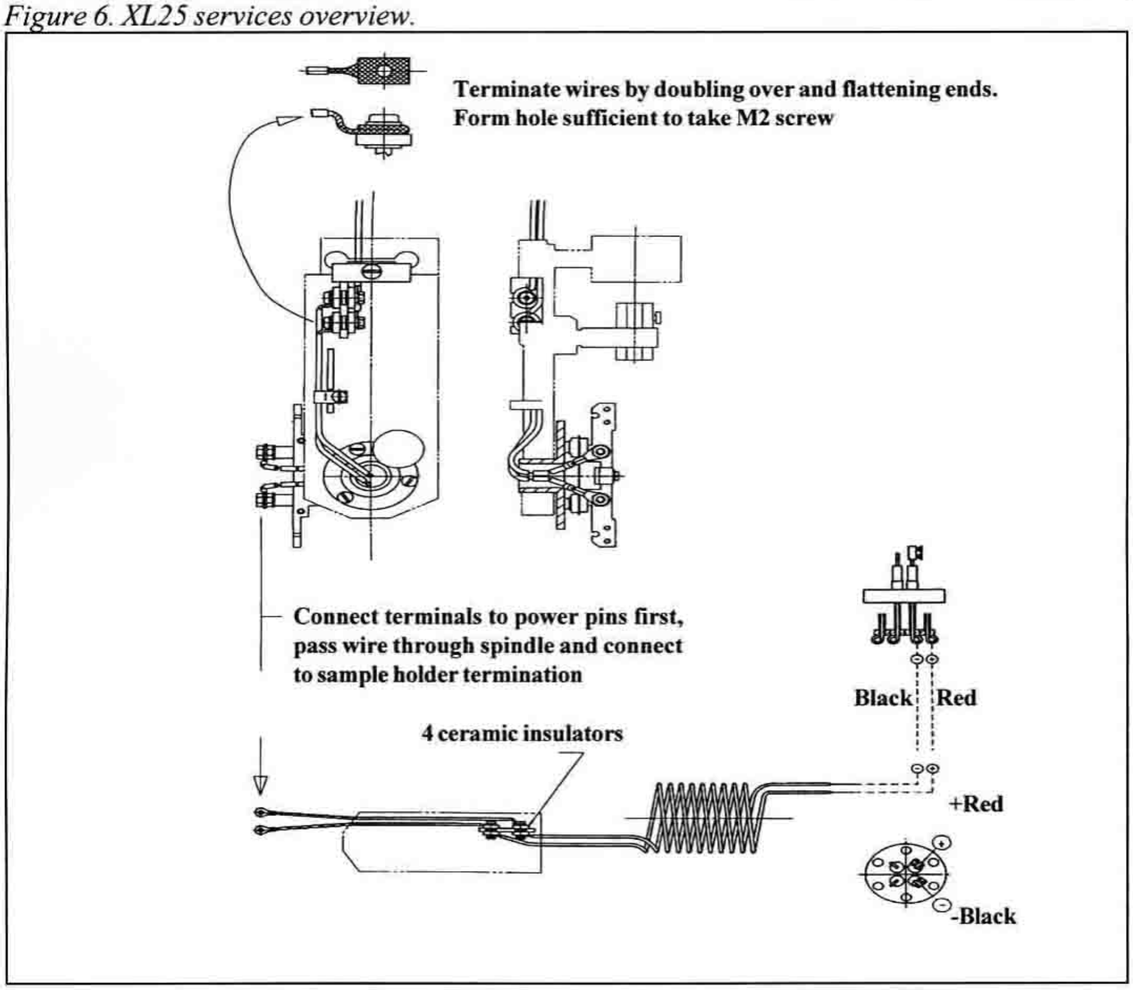

Figure 7. XL25 Receiver power connections.

4.1 Heating (XLHEAT)

The heated carriers, XL25HC and XL25VH, are fitted with resistive heating elements. Power connections are made to the receiver location pins by a pair of wires (see figure 7); these wires are insulated partly by ceramic beads, and partly by PTFE sleeving. If the rated current of 3 Amps in exceeded for long periods, these wires will overheat; this may cause the PTFE to degrade, resulting in contamination of the vacuum system.

Note:
If the rating of the wiring is increased to allow greater than 3 Amps capacity, the carrier body will overheat due to the self-heating effect of the power connections on the carrier as the current is increased.

However it is normal practice to briefly use up to 5 Amps in order to achieve the desired temperature, and then to reduce the heater current to maintain that desired temperature.

4.2 Long Term Heating

Long term heating in the UHV environment will cause a significant rise in the surface friction of most materials. This can make transfer difficult. The following guidlines should be applied to ensure smooth transfer and good component life:

* Aim to achieve the target temperature rapidly and to dwell for the briefest time possible.
* Limitations: These limits assume the carrier is cold at the start and the temperature is measured on the bare sample plate.

Current	Approximate Power	Approximate sample plate temperature	Maximum dwell time
3.5 A	100 W	1000° C	Flash only
3.0 A	60 W	900° C	3 mins
2.5 A	35 W	800° C	6 mins
2.0 A	23 W	700° C	12 mins
1.5 A	13 W	600° C	30 mins
1.2 A	8 W	500° C	continuous

* Observe the current limitations: Do not rely on the sample temperature as variations in size, material and experimental conditions will affect the power required to achieve the target temperature.
* If the required duration of applied current is beyond the above limits, then subsequent transfer should not be attempted. Damage to associated components may result.
* Components which slide during transfer are coated to reduce friction. This coating will wear in time and will need to be replaced. Parts affected are:

a) Receiving power pins
b) Cooling spring (if used with cooling or bias kits)
c) Detent spring
d) Sample plate
e) The carrier body

The complete carrier can be returned to Thermo Vacuum Generators in Hastings, UK for refurbishment of items (d) and (e). Note that if the material surface has been damaged, replacement will be required. Parts (a), (b) and (c) are normally replaced without refurbishment.

4.3 Thermocouples and Temperature Measurement

Important:
The accuracy of the N-type thermocouple will suffer if the temperature of the thermocouple feedthrough (which uses nickel conductors) varies from ambient. Position the thermocouple feedthrough away from the coolant feedthrough. For the same reason the user should also take care when degassing the heater following bakeout if the vacuum system (and hence the thermocouple feedthrough) is still hot.

Important:
Where accurate sample temperatures are required, any error between the actual temperature and the measured temperature must be minimised. The XL25 system, which uses a powerful heater with very uniform temperature distribution over its surface, is designed to provide accurate temperature measurement with the on-board thermocouple. Poor setup of the sample/thermocouple can introduce errors which may adversely affect the sample temperature monitoring.

Since the measured temperature will be that of the thermocouple hot junction, it is important that the sample attachment and thermocouple placement are carefully considered. Also note that as the temperature rises the discrepancy between the measured and the actual temperature will increase, and can vary by as much as 200^{o}C at 1200^{o}C. This is because thermal radiation overtakes conduction and the thermocouple junction becomes shadowed by the sample itself. It may also be significantly cooled by the sample clamp if positioned between the sample and the clamp.

In order to minimise these errors the following steps may help:

1) Ensure that the thermocouple is securely fixed to the sample; weld the two together if possible. If the sample clips are used to mount the thermocouple, remember that at high temperatures sample clamps may soften; this will reduce the clamping force between the thermocouple and the sample, and may reduce the thermal contact.

2) Try to minimise the thermocouple hot junction mass.

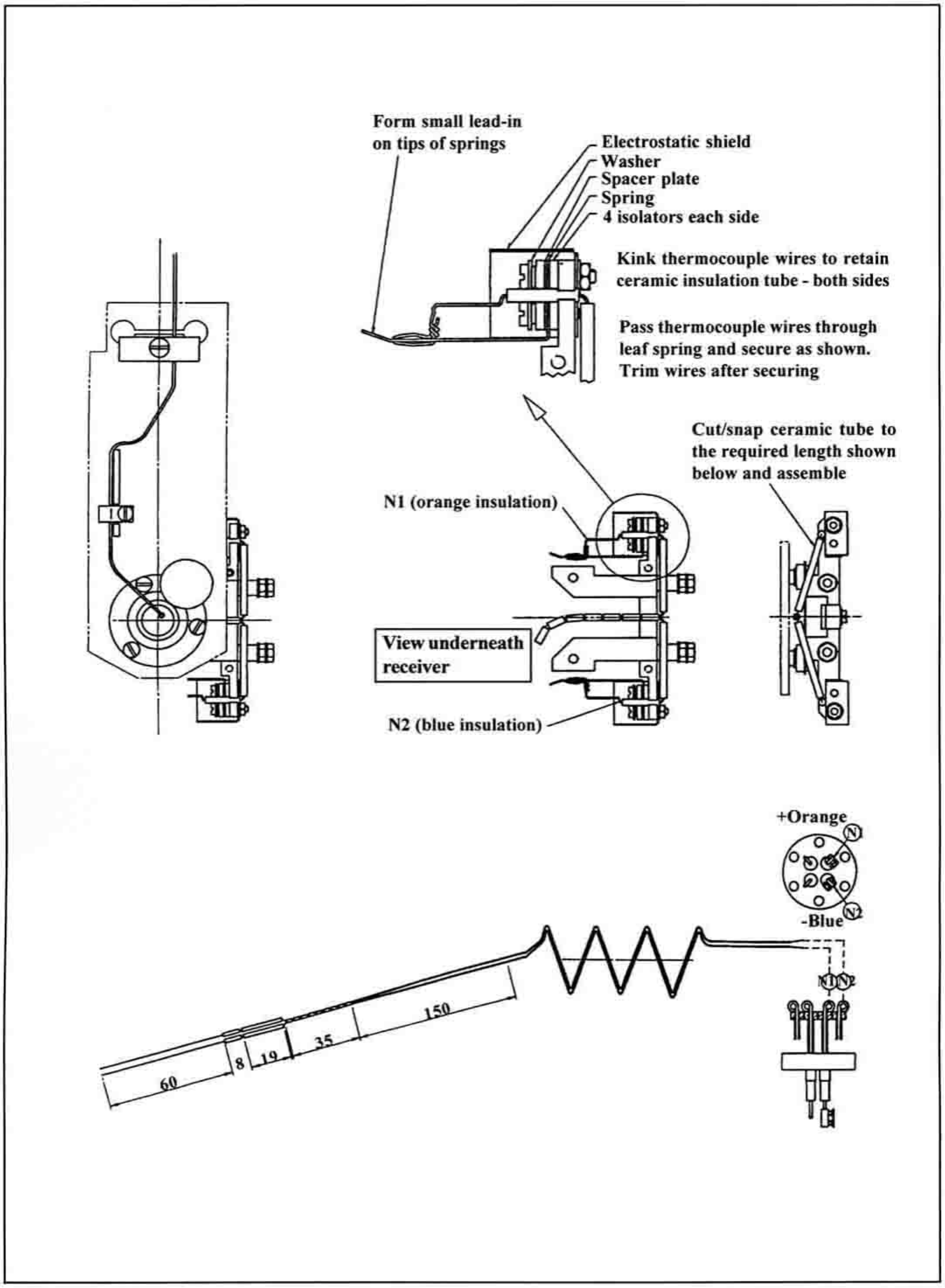

Figure 8. XL25 Receiver thermocouple connections.

3) The thermocouple will measure the average temperature between the sample and any clip that is used to secure it. Careful experiments can determine a correction factor for this discrepancy.

4) At high temperatures, the error between the sample temperature and any clamped/ welded thermocouple will increase. The use of an optical pyrometer is recommended if accurate sample temperature measurements are required at high temperature (the pyrometer can be used to provide a correction factor for the indicated temperature on the temperature controller.)

5) It is recommended that the thermocouple is calibrated against a known thermocouple when new and, if used above 1100^{o}C or below 0^{o}C, it must be recalibrated every six months. If the accuracy of the thermocouple reading is suspect (for example, standard heater settings give unusual indicated temperatures), it is recommended that the thermocouple wire is replaced (refer to section 2.2.3).

To fit the thermocouple pick-ups to the receiver, attach as shown in figure 8. Note the position of the spacer plate.

The thermocouple wire must be made up with the lengths of ceramic tube fitted as shown in figure 8 before looping the wire through the small holes in the pickups, and twisting to secure. It is essential that the thermocouple pair is fitted the correct way round to match the carrier thermocouple. Make sure that the length of wire used is long enough to make a continuous run back to the thermocouple feedthrough.

4.4 Cooling

If the cooling cradle is to be fitted to the sample holder receiver for the first time, fit the sapphire discs and the cooling spring as shown in figure 9 (section A-A) before fitting the assembly to the receiver. Check the fit of the carrier sample plate cooling fingers between the sapphires and the spring. This must be a close, but not tight, fit. Ensure that the fingers have a coating of graphite beforehand, and make adjustments by bending the tabs on the receiver spring up or down to achieve the correct fit. Do not deform the cooling fingers of the sample carrier. Unscrew the two screws which hold the receiver to the sample holder, taking care not to lose the spacers between the two parts. The cooling cradle can be maneuvered into position past the thermocouple and power connections (if fitted), and screwed to the receiver as shown (figure 9, section B-B). Then re-attach the receiver.

The recommended method of liquid nitrogen cooling uses the arrangement shown in figure 10. This is an easy, safe, method which uses the Thermo Vacuum Generators LNHX cooling accessory kit.
In addition, a dry nitrogen gas cylinder and a source of liquid nitrogen are required. To cool the system down proceed as follows:

Note:
Appropriate hand and face/eye protection should be worn when handling liquid nitrogen or items cooled by liquid nitrogen. Ensure that the area is well ventilated as the build up of nitrogen gas can be rapid in confined spaces.

1) Purge the system of air by passing nitrogen gas at a pressure of 1 bar through the system for approximately 2 minutes. Make sure that the coolant lines are not blocked by checking that gas is emerging from the outlet pipe.

2) Fill the dewar with liquid nitrogen and immerse the condenser coils in the liquid.

3) Observe the exhaust nitrogen which will cool steadily. After approximately 15 minutes, droplets of liquid nitrogen will emerge. Reduce the gas pressure so that occasional liquid droplets emerge. Too much emerging liquid is wasteful and will impair the efficiency of the cooling system.

On completion of the cooling run, remove the coil from the liquid nitrogen and allow the system to return to ambient temperature whilst continuing to purge gently with dry nitrogen. This will prevent the risk of condensation within the internal cooling coils. It is possible to speed up this process by gently heating the carrier element.

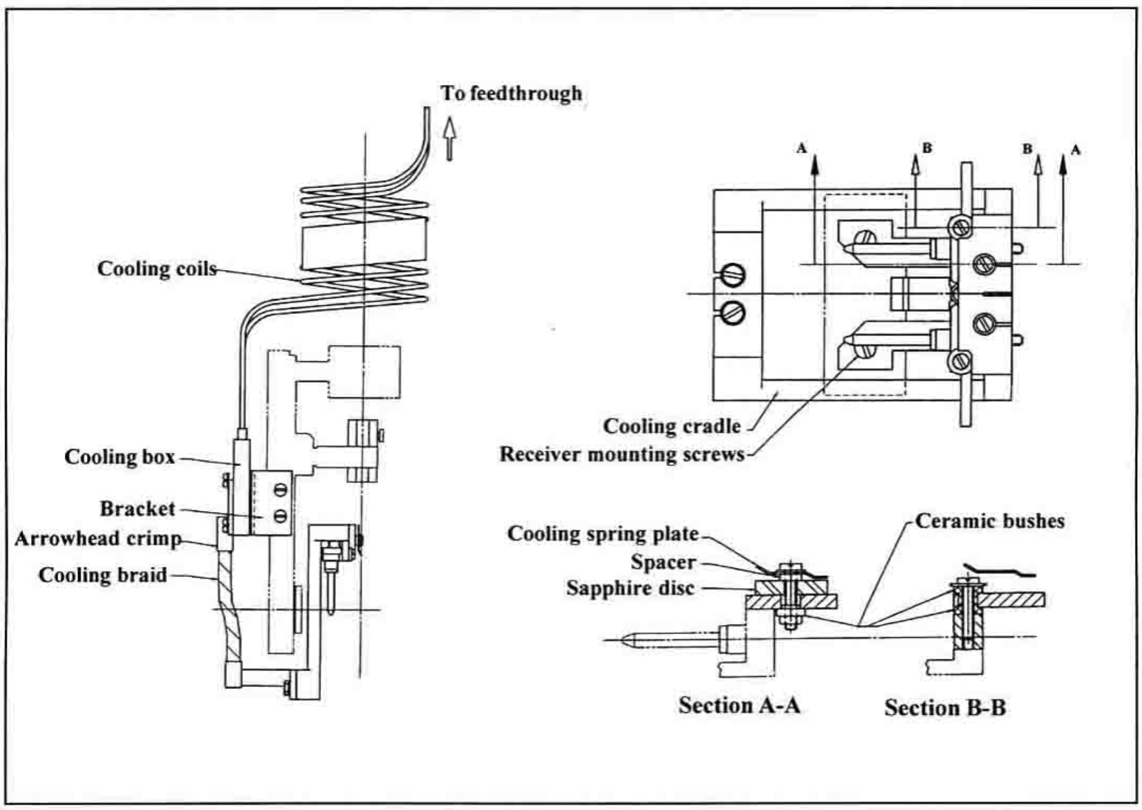

Figure 9. XL25 Receiver cooling arrangement.

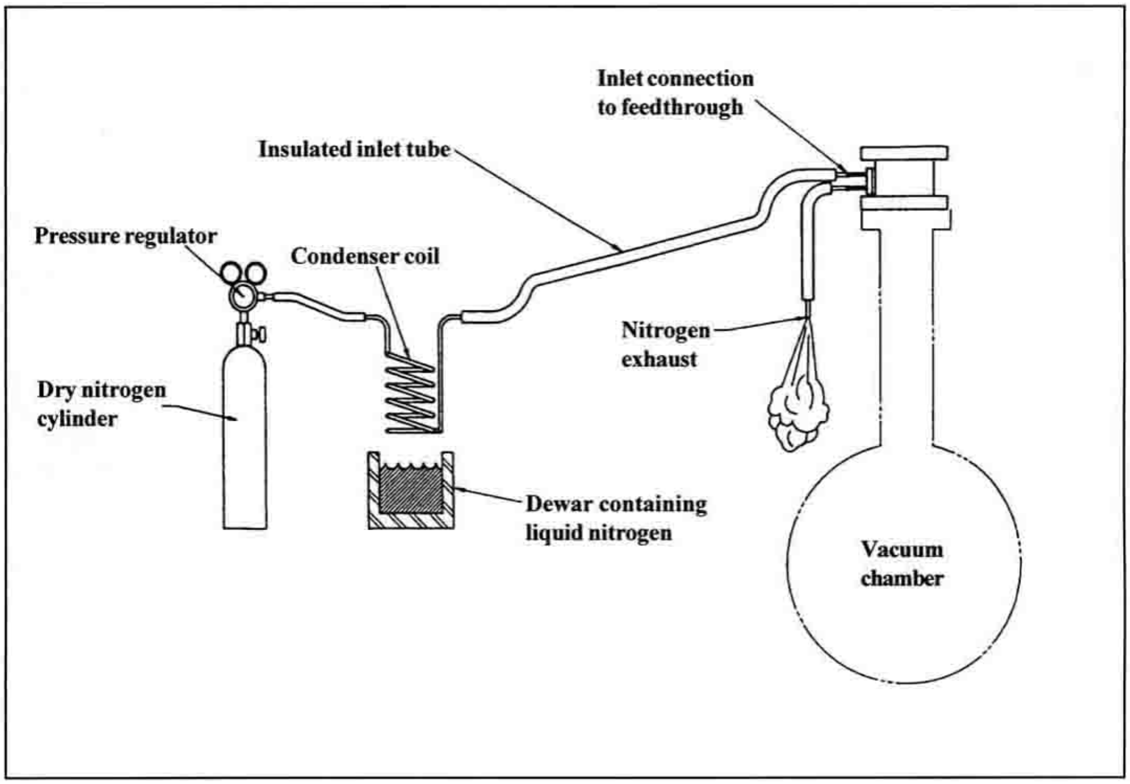

Figure 10. Schematic of the nitrogen cooling method.

4.5 Sample Bias

The sample bias attachment provides an electrical connection to the sample plate (and thereby the sample) which is otherwise electrically isolated. The wire is screened for most of its length and is taken to a coaxial feedthrough with a screened earth connection. This arrangement is shown in figure 11.

The connection to the receiver is normally made to the cooling spring attachment. If cooling is not fitted a bracket is provided as a substitute for the main cooling cradle. Also ensure that the screen does not touch the power connection as it passes through the back of the sample holder, but is clamped under the retaining clips to prevent movement.
The power rating of the sample bias attachment is 500V, 0.5A.

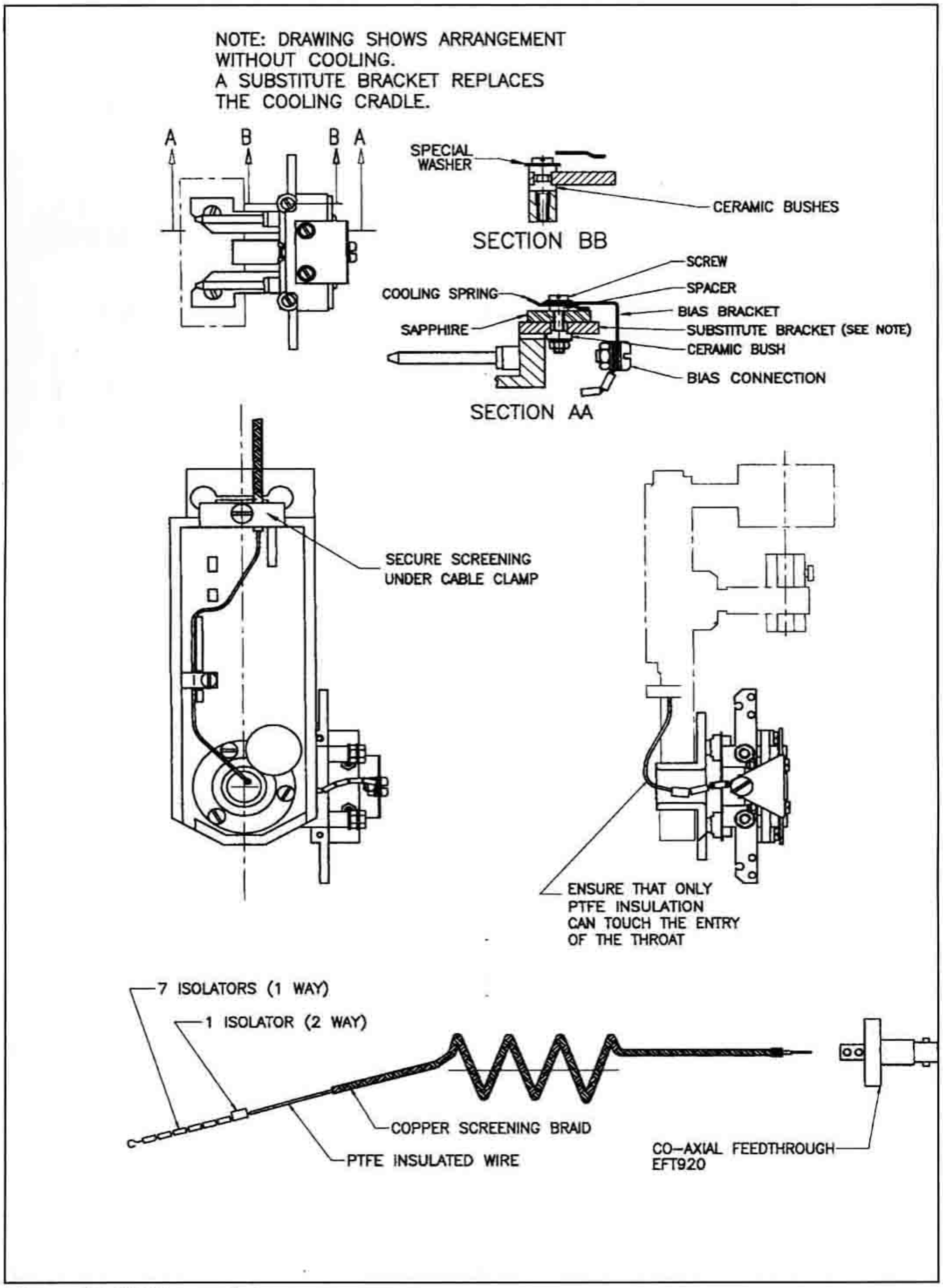

Figure 11. XL25 Sample Bias Arrangement.

5.0 Transfer Devices

The carriers are always transferred by the same method, although the transfer device may vary. The transfer arm has a single pin which locates in the carrier (see figure 12). A spring clip locks into an undercut on the underside of the carrier. This clip can be unlocked by the transfer device, but until then the block is securely held. This arrangement, although secure, is intentionally designed to be loose fitting which allows for a small amount of misalignment of the carrier and receiver during transfer. This misalignment will occur when the transfer force pushes against the mounting to which the receiver is attached.

Important:
To achieve good transfer it is important that all relevant rotations of the sample transfer system are accurately set up.

5.1 Setting Up the Transfer System

The procedure for setup will depend on the individual system and on the position of suitable viewports for viewing the transfer. Use a plain block to start with and attach it to the receiver. Observe the concentricity of the transfer arm pin to the hole in the carrier, and adjust all the relevant motions of the receiver manipulator to achieve good location. It should then be possible to advance the transfer arm until the clip latches into position. Apply only minimum force to achieve this. Withdraw the transfer arm which should bring the carrier away from the receiver.

When the block is attached to the transfer arm, return it to the receiver; realign the receiver to achieve good location of the power pins. Remember to operate the transfer arm release mechanism and then withdraw the transfer arm leaving the carrier on the receiver. Repeat this alignment process until the block can be easily transferred between transfer device and receiver. Mark or record these transfer positions for future reference. Be aware of backlash in the manipulation system; always approach the transfer position from the same direction in order to minimise any backlash-induced errors.

Important:
The transfer system must be aligned with the vessel under vacuum; the relative positions for transfer will be different with the chamber under vacuum and at air. Never leave the carrier attached to both the transfer arm and the receiver during pumpdown or venting of the vacuum system as the relative motion of the components of the transfer system is likely to cause permanent damage.

Components which slide during transfer have been coated to reduce friction. This coating will wear in time and will need to be replaced. Parts affected are:

a) Receiving power pins
b) Cooling spring (if used with cooling or bias kits)
c) Detent spring

d) Sample plate
e) The carrier body

The complete carrier can be returned to Thermo Vacuum Generators in Hastings, UK for refurbishment of items (d) and (c). Note that if the material surface has been damaged, replacement will be required. Parts (a), (b) and (c) are normally replaced without refurbishment.

Following high temperature runs, some slight bonding of the carrier to the receiver may occur. This bond can normally be broken by oscillating the primary (R1) motion back and forth and at the same time gently pulling the carrier out with the transfer arm. Resist the temptation to pull hard; this can cause a misalignment of the R2 axis. If bonding has occurred, the carrier should be checked for any sign of roughening of these fingers or the cutout used to latch the detent spring; any roughness will greatly increase transfer friction and the part should be replaced. As a temporary solution, the roughened component can be smoothed using very fine paper once it has been removed from its surrounding parts. This will remove the factory bonded coating, and a film of colloidal graphite (carbon dag) may be applied to the cleaned surface to act as an interim lubricant. Note that this is an inferior coating to the standard treatment and its continued use may result in damage to mating components, for which Thermo Vacuum Generators cannot be held responsible.

5.2 Linear Transfer Devices (XLTL, XLTLB.)

The Linear Transfer Device (figure 13) is based on the standard Thermo Vacuum Generators RLRP rotary/linear drive. This uses a rack and pinion assembly to give a positive transfer motion in and out of the vacuum system. A rotary drive, acting down the centre of the device, provides the cam action which is used to unlatch the XL sample carrier from the transfer arm (see figure 12). An external rotation sleeve (XLTLBS) is available as an option on the XLTLB to bring the actuation point closer to the chamber and to provide user friendly operation. The XLTL has a spring return action and is provided with rotational stops. A combination of transporters can be used to create an integrated multi-chamber transfer system. A more detailed description of the linear transfer device is given in Appendix A.

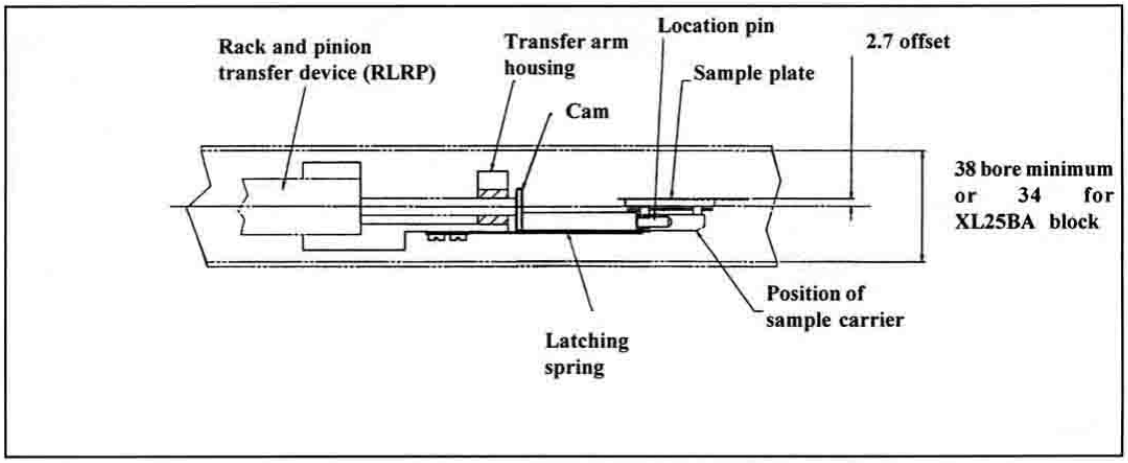

Figure 12. The XL25 transfer arm.

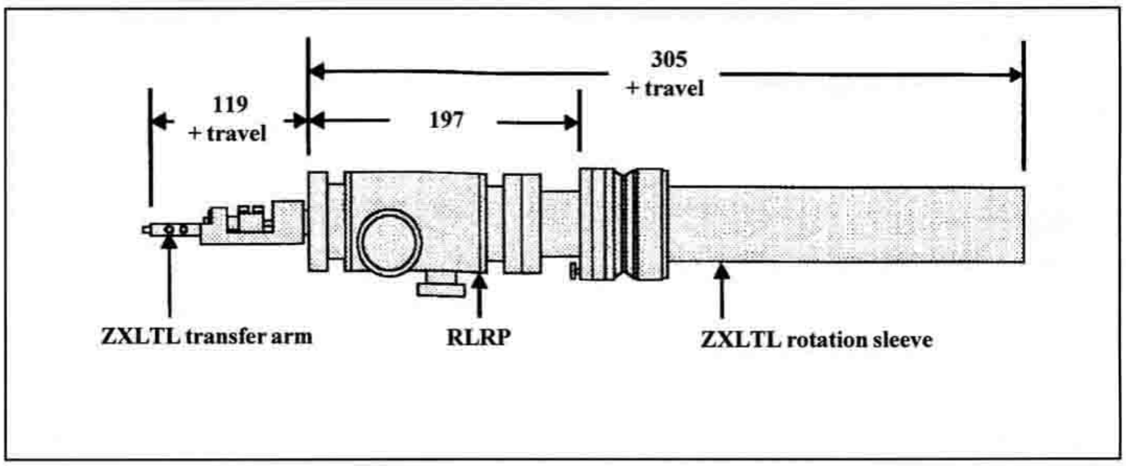

Figure 13. The XLTL linear transfer device.

5.3 The XLTR Rotary Transfer Device

The XLTR Series Radial Transfer Mechanism is based on the standard Thermo Vacuum Generators R2P2 rotary transfer device. The XLTR (figure 14) uses a single rotary drive (RD2) to provide both rotation of the transfer arm within the vessel (to a preset index position), and extension of the transfer arm into the selected transfer station. The transfer arm is locked at a particular transfer position by an index plunger. A linear drive (part of the main rotary drive) provides the latch actuator motion to disengage the XL carrier from the sample arm.

The XLTR is designed to be placed at the centre of an XL radial distribution system and thus can be used to load/unload samples from anywhere in the system. A range of standard chambers are available to take the XLTR mechanism. These are normally configured with 4, 6 or 8 transfer ports.

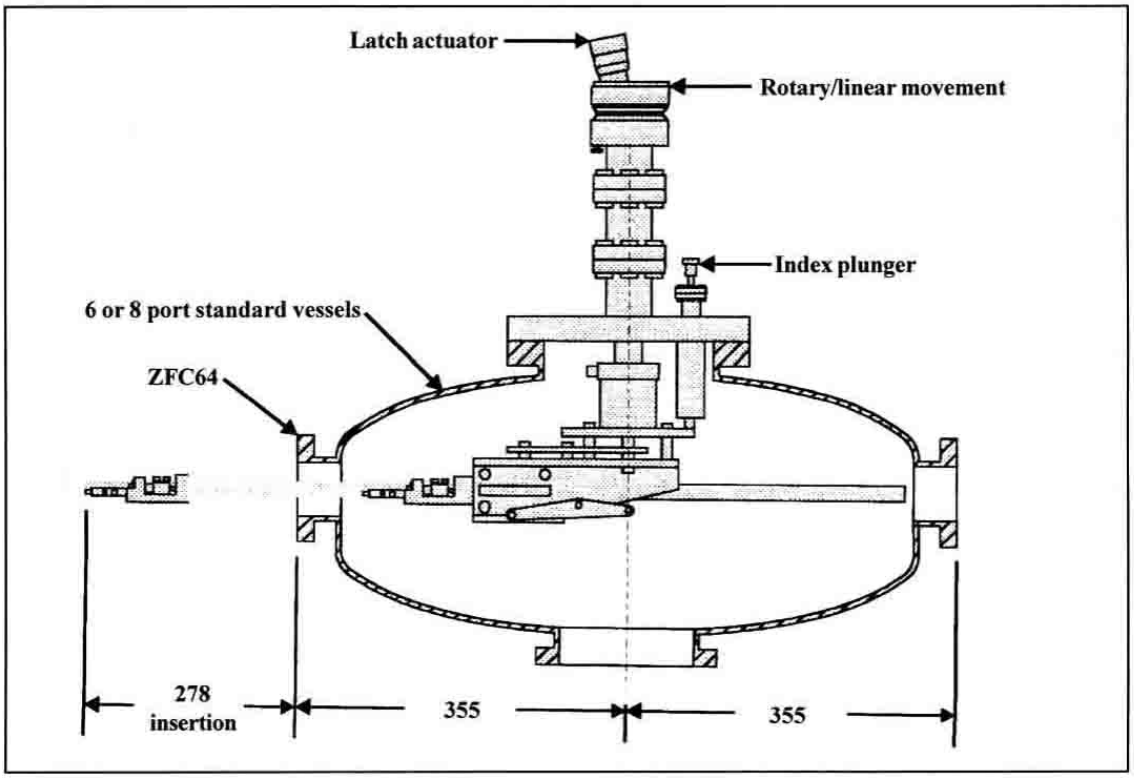

Figure 14. The XLTR Rotary Transfer Device.

6.0 Sample Holders

The XL system is designed to be compatible with the standard range of Thermo Vacuum Generators sample holders. The XL Receiver (see section 3.0) can be mounted directly to the SH series of sample holders to provide a range of sample manipulation options. Details of the SH series sample holders are given in appendix B.

7.0 Spare parts

DC-35-03--4	Receiver power pin
DC-35-16-3	Cooling spring
DC-35-12-3	Detent spring
DC-36-12-3	Sample plate kit (XL25HC). Includes the heat shield set.
DC-36-23-3	Sample plate kit (XL25VH). Includes the heat shield set.
DC-36-11-3	Heat shield set
DB-07-28-4	Sample clamp screw
DB-07-29-4	Sample clamp
XTHWO9	Thermocouple wire, PTFE insulated (state length required)

Additional spares and hardware can be requested by indicating, on a copy of the relevant assembly drawing, which part is required.

The attached appendices include spares information on associated Transfer Devices and Sample Holders.

Please state serial number in any correspondence.

Appendix A

A1.0 Linear Transfer Devices

These are rack and pinion devices offering rapid linear motion of samples in a manner that is both repeatable and reliable. The XLTL and XLTLB series are designed specifically for use with the XL sample introduction and transfer systems. By combining linear motion with the cam release mechanism (rotary motion) in a single device.
The XLTL units have a spring return extension sleeve for cam release with limit stops included. The XLTLB cam release is the bare rotary drive, although an extension sleeve (XLTLBS) is available.

A2.0 Specification

Travel	XLTL3 andXLTLB3:	305mm
	XLTL4 and XLTLB4:	460mm
	XLTL6 and XLTLB6:	610mm
	XLTL9 and XLTLB9:	914mm

Mounting Flange:	70mm OD
Bakeout Temperature:	230^{o}C Maximum
Operating Temperature:	-20^{o}C to +200^{o}C
Pressure Range:	Atmosphere to 10^{-11} mbar
Linear Lock:	Fitted as Standard

A3.0 Construction

The vacuum envelope is constructed from stainless steel and all joints are welded. The internal bearing housing is made from a high grade aerospace aluminium alloy. Mounted into this housing are 6 stainless steel radial bearings for the linear movement.

The shaft is a one piece stainless steel item that incorporates both the rack for the drive and the bearing surfaces for the linear movement. The rotary motion for cam release is provided by a secondary shaft running through the main shaft and supported by stainless steel bearings. This shaft is driven by a rotary drive mounted on the end of the device.

The bearing system is arranged so as to give equal support to the rack no matter what orientation the device is mounted in. Simple eccentric adjustment is provided to maintain internal clearances throughout the life of the device.

A4.0 Installation Guidelines

The transporters may be mounted in any orientation, but if the axis of movement is not positioned horizontally then it is strongly advised that the friction clutch option is fitted to the linear rotary drive (see section A8.0). This is because it is possible for the device to free wheel to its end stops causing possible damage to both the transporter and the workload. Care must be taken not to damage the transporter rack when installing the device, as this will cause the device to feel rough in use and will also reduce its life span.

If the device is mounted in a position other than vertical then the transporter may require some external support (for example a prop from the system bench or from the floor) to prevent damage to itself or to the vessel. This is especially true of the long travel transporters which can exert considerable forces on the vacuum vessel flange if not adequately supported.

A5.0 Operation

The linear transporters are simple and robust devices which will give excellent service throughout their life. Care must be taken, to remain within the design specification when the device is in use, especially when it is fully extended, as it may be possible to cause a permanent "set" in the shaft, or "dimpling" of the shaft at the contact point with the bearings. Such overloading could be caused by indelicate use of other equipment such as a second transporter.

Rapid motion of the linear shaft is possible but care should be taken when docking with the manipulators or parking stages and coming to end stops. These operations must be done gently with consideration to alignment. Indelicate use will considerably shorten the life of all XL equipment.

A6.0 Bakeout

The transporter may be baked to 230°C without any dismantling. It is however recommended that the transporter is baked with the shaft fully retracted within the housing.

A7.0 Maintenance

Little routine maintenance is required due to the simple design of the transporter. However, routine inspections should be carried out to ensure that the movement of the device has not become rough or tight, as this would indicate that the rotary drive for the linear motion or the support bearings require servicing. If this is the case it is recommended that the complete transporter is returned to the Thermo Vacuum Generators service department for repair. The shaft must be fully retracted during transit.

A8.0 Spares and Accessories

Order Code	Description
ZRD91	Replacement Drive for the XLTL Linear Motion
ZRD93	Replacement Drive for the XLTL Rotary Motion
MRD91FD	Slipping Clutch for the XLTL Linear Motion
XLTLBS	Optional Rotational Sleeve for XLTLB (State travel length)

Appendix B

B1.0 The XL25SH1 Sample Holder

The SH1 sample holder provides a means of mounting the XL25 receiver and various services which may include sample heating, cooling and condition monitoring options (see figure B1). It is designed for attachment to rotary drives such as the RD1 to give primary rotation. The mounting plate itself can be preset to orientate the azimuthal angle of the sample, although this cannot be changed during use. The material used for construction is principally non-magnetic stainless steel. The sample holder is readily adjusted.

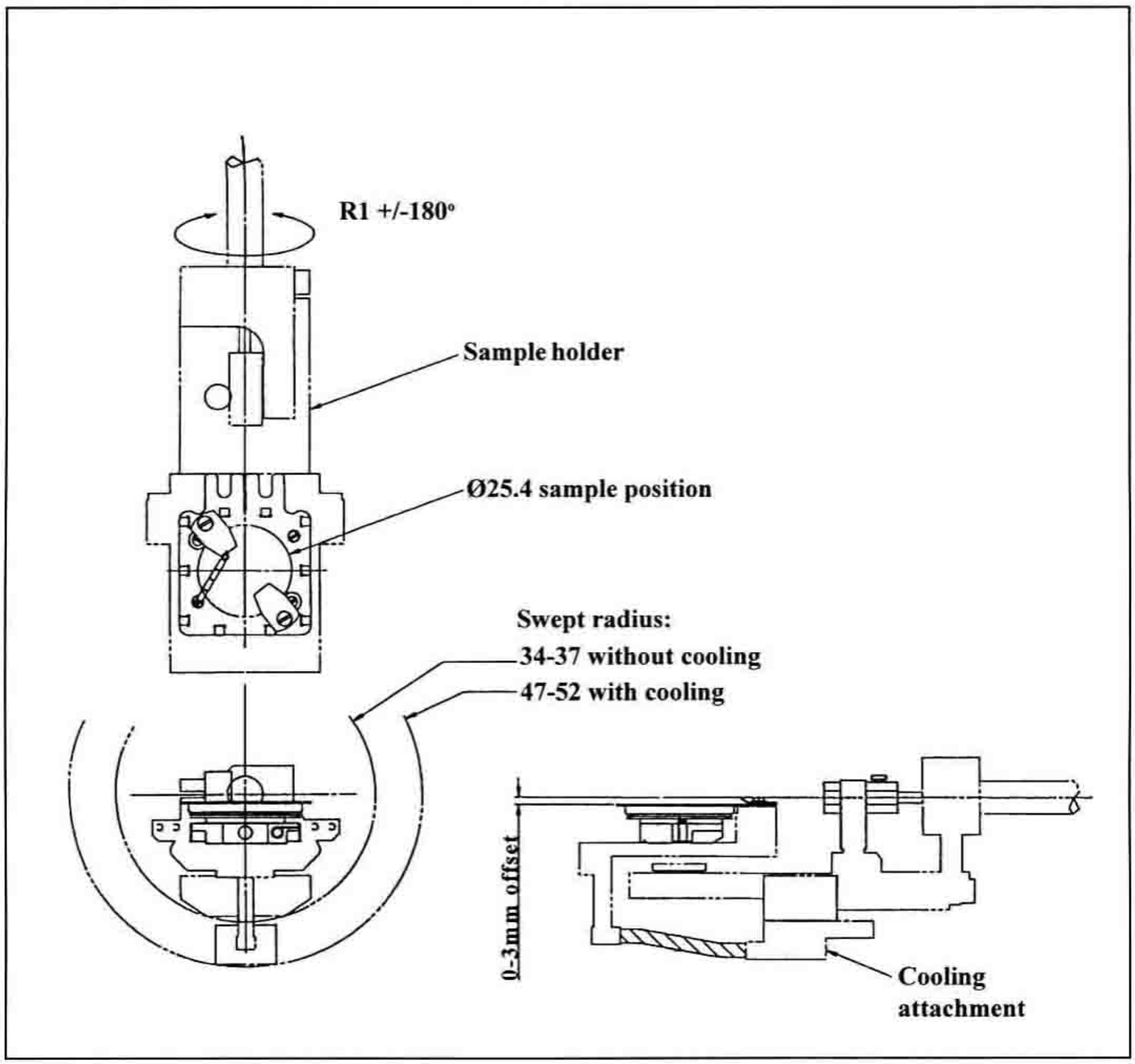

Figure B1. The XL25SH1 Sample Holder.

B1.1 Specification of the SH1 Sample Holder

Mating Rotary Drive Module	RD1
Secondary Rotation (Azimuthal)	+/- 108^{o} - preset only
Pressure Range	Atmosphere to less than 10^{-11} Torr
Bakeout Temperature	230^{o}C

B1.2 Operation of the SH1

To alter the position of the surface of the specimen mounting plate relative to the primary axis of rotation, proceed as follows:

1) Release the M4 cap head bolt (located on the edge of the main body of the SH1 beneath the clamp block) retaining the clamping block pins to the SH1 body.

2) Adjustment may then be made to achieve the desired sample position, and the M4 bolt retightened.

To adjust the secondary rotation (azimuthal) slacken the three screws which clamp the azimuthal bearing in position (on the back of the sample holder). Adjust the sample plate to the required position and then retighten the three screws.

B1.3 Bakeout

The SH1 sample holder is fully bakeable to 230^{o}C.

B1.4 Spares for the SH1

Replacements for any part of the SH1 sample holder are available on request. Accessories for the SH1 are listed in section B4.

B2.0 The XL25SH2 Sample Holder

The SH2 sample holder is constructed from high quality materials and has been designed to give accurate and reproducible movements. It is designed for use with the model RD2 rotary drive. The SH2 is very similar to the SH1 (described in section B1.0), but is fitted with a precision mechanism which allows adjustment of the azimuthal angle during use (see figure B2).

Note:
The user is requested to exercise reasonable care in the use of this sample holder in order to avoid possible damage to the precision drive mechanism.

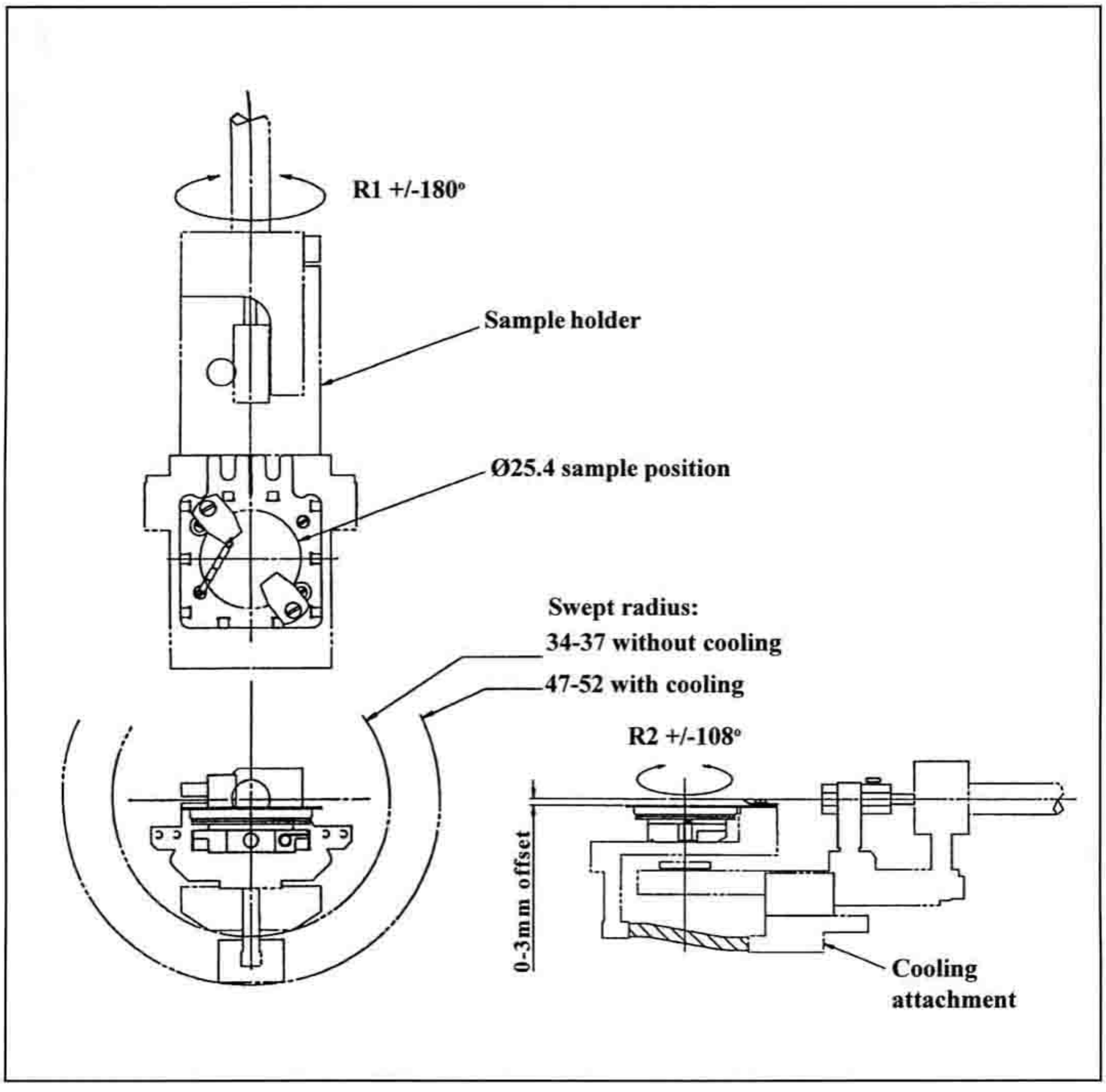

Figure B2. The XL25SH2 Sample Holder.

B2.1 Specification of the SH2 Sample Holder

Mating Rotary Drive Module	RD2
Construction	Stainless steel
Guidance Constraints	Sapphire Ball Bearings
Drive Mechanism	Wire Belt Drive via Precision Rack and Pinion
Angular Motion (Azimuthal)	+/- 108^o
Angular Resolution (Azimuthal)	+/- 0.3^o
Pressure Range	Atmosphere to less than 10^{-11} mbar
Baking Temperature	230^{o}C

B2.2 Construction of the SH2

The materials used are principally low magnetic stainless steel and all permanent joints are welded. The conversion of linear motion (from the RD2 rotary drive) to rotary azimuthal motion is achieved by means of a precision rack and pinion drive. The final drive to the sample plate is by means of a wire belt arrangement. Both the rack and pinion are located by miniature beryllium copper bearings. Provision is made for adjustment of the rack and pinion mesh (see section B2.4.3). The specimen mounting plate is insulated electrically from the body of the sample holder.

B2.3 Limits of Rotation of the SH2

Rotation about the primary axis (of the RD2 rotary drive) can be continuous unless limited by attachments to the specimen. For example, if heating and/or cooling accessories have been fitted, rotation is limited to +/- 180^o. Rotation about the secondary axis is limited to +/- 108^o; however, the angular position of the specimen mounting plate is adjustable (by adjustment of the wire drive) relative to the drive mechanism, thus rotation can be about any desired datum except when fitted with the cooling kit, in which case the nominal position must be as shown in figure B2.

B2.4 SH2 Mechanical Adjustments

B2.4.1 Adjusting the Mounting Plate Offset to the Primary Rotation Axis

Release the M4 cap head bolt (located on the edge of the main body of the SH2 beneath the clamp block - see figure B2) retaining the clamping block pins to the SH2 body. Adjustment may then be made to achieve the desired sample position, and the M4 bolt retightened.

B2.4.2 Setting the SH2 Rotation Datum

To adjust the angular position of the SH2 specimen plate, slacken the tensioning roller locknut (see figure B3). Rotate the sample plate to the desired datum position. Tension the wire so that the secondary drive functions correctly. Retighten the tensioning roller locknut.

Note:
Do not over-tension the wire as this may result in premature failure of the drive wire.

B2.4.3 Adjusting the Rack and Pinion Mechanism

The meshing of the rack and pinion should be adjusted to allow the drive to run smoothly over the full extent of the travel with a minimum amount of backlash. If backlash is completely eliminated, the drive will be rough and damage to the gearing will result (see below). Should it be necessary to make this adjustment. proceed as follows, (referring to figure B2):-

1) Slacken the rack adjustment roller locknut.

2) Adjust the roller to give the required amount of rack engagement, and hence the required backlash. Do not attempt to remove all the backlash; this could cause damage to the rack and pinion gears, and will result in the drive feeling "rough".

3) When the adjustment is complete, retighten the roller locknut and then check once more that the required backlash has been achieved.

B2.5 Bakeout

The SH2 specimen attachment is fully bakeable to 230^{o}C.

B2.6 Maintenance

With the exercise of reasonable care in the use, the SH2 sample holder should give accurate and reproducible operation over an extended period. Only two adjustments (detailed in B2.4.2 and 2.4.3 above) are provided; either of these can affect the accuracy and life of the secondary rotation.

B2.6.1 Replacing the Drive Wire

Should it become necessary, the drive wire can be replaced as follows (refer to figure B3, and to section B2.4.2 above):

1) Release the tension on the drive wire (see section B2.4.2).

2) Remove the old drive wire belt from the drive pulleys.

3) Fit the new drive wire belt (Part Code ZSHWDB) to the drive pulleys as shown in figure B3. Ensure that the wire is routed around the pulleys as shown in this figure.

4) Re-tension the wire as described in section B2.4.2.

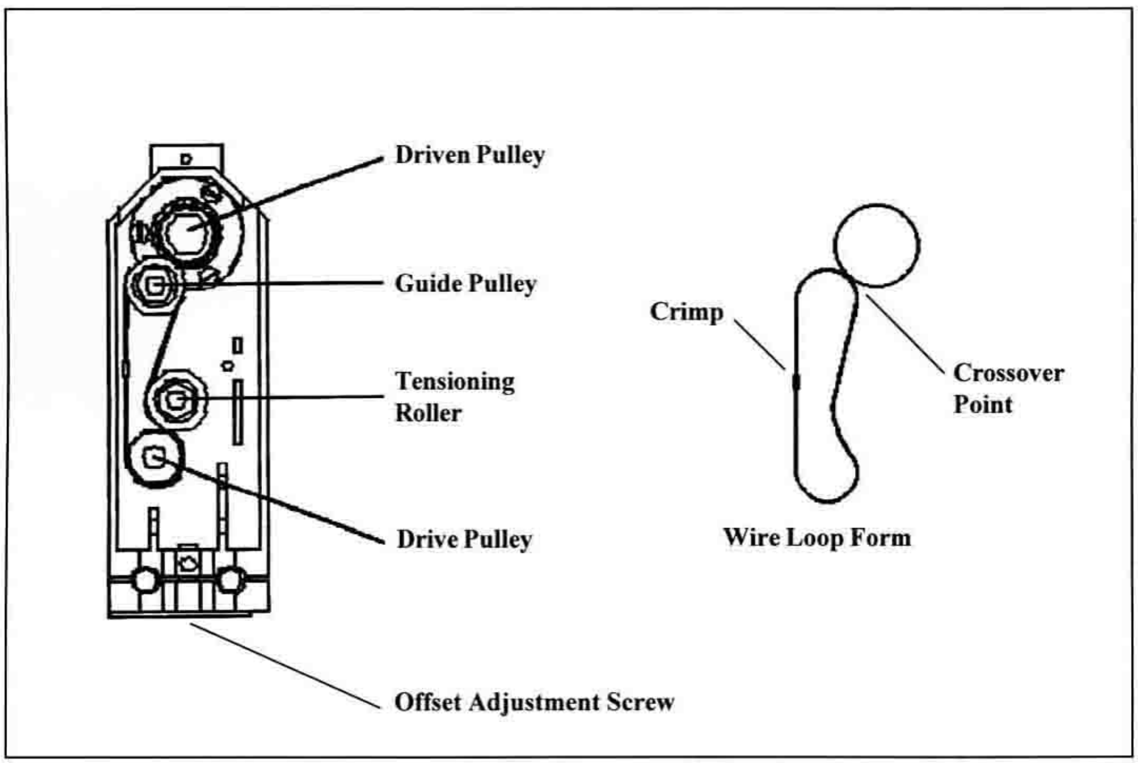

Figure B3. Replacement of the Drive Wire.

B3.0 Spares for the SH2

Spare sapphire and beryllium-copper bearing sets (with screws etc.) are available on application. A wire drive kit and wire drive belts are also available.

Part Code	Description
ZSHWDK	SH2 Wire Drive Kit including Torque Screwdriver and Drive Belts
ZSHWDB	SH2 Wire Drive Belts

B4.0 Accessories for the SH1 and SH2 sample Holders

Part Code	Description
ZRD1	Rotary Drive (primary rotation)
ZRD2	Rotary Drive (secondary rotation)

Declaration of Contamination of Vacuum Equipment and Components

Return Goods to: Thermo Vacuum Generators, Maunsell Road, Castleham Industrial Estate, Hastings, East Sussex, TN389NN, England.

The repair and/or servicing of vacuum equipment and components will only be carried out if a correctly completed declaration has been submitted. Non-completion will result in delays. The manufacturer will refuse to accept any equipment without a signed declaration securely fastened to the outside of the packaging.

This declaration can only be completed and signed by authorised and qualified staff.

1. Description of Vacuum Equipment and Components

Equipment Type..
Model Number..
Serial Number...
Invoice Number...
Delivery Date..

2. Reason for Return

3. Condition of Vacuum Equipment and Components

Has the equipment been used? Yes [ ] No [ ]

Is the equipment free from potentially harmful substances? Yes [ ] No [ ]

4. Process-related contamination of Vacuum Equipment and Components

Toxic?	Yes [ ]	No [ ]
Corrosive?	Yes [ ]	No [ ]
Explosive?	Yes [ ]	No [ ]
Biological Hazard?	Yes [ ]	No [ ]
Radioactive?	Yes [ ]	No [ ]
Other Harmful Substance?	Yes [ ]	No [ ]

5.0 Legally Binding Declaration

Please list all substances, gases and by-products which may have come into contact with the equipment, giving: trade name, product name, manufacturer chemical name or symbol, dangerous material class, measures to take in case of spillage and first aid in case of human contact.

I hereby declare that the information supplied on this form is complete and accurate. The despatch of the contaminated vacuum equipment and components will be in accordance with the appropriate regulations covering Packaging, Transportation and Labeling of Dangerous Substances.

Name of Organisation or Company ....

Name... Job Title...

Address.. Date...

.... Legally Binding Signature

Postcode...

Telephone...

Fax.. Company Stamp

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