Operating and Maintenance Handbook
Transax Translator
Document Number UI4223A

Change Control

Issue	Date	ECN#
A	09/97	-------

WARRANTY

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 Vacuum Generators and the issue of a Goods Return Number (GRN). This shall be obtained by contacting the service center at 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 Vacuum Generators, has been completed and returned by the customer.

REPAIR

The following additional terms and conditions apply in the event that the customer, elects to use the services of 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 Vacuum Generators in advance of shipment.
2. During the period that the equipment is on Vacuum Generators premises, Vacuum Generators will insure the equipment against all risks.
3. 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 Vacuum Generators will make a charge to cover this examination effort.

Note:
The above are extracts from Vacuum Generators Conditions of sale. Complete copies can be obtained from:
Vacuum Generators,
Maunsell Road, Castleham Industrial Estate.
St. Leonards on Sea, East Sussex,
TN38 9NN, United Kingdom.

Contents

Contents

1. INTRODUCTION

1.1 HEALTH AND SAFETY INFORMATION

This equipment is a component for use with vacuum systems. Whilst every effort has been made to eliminate hazards, its safe use is also dependant on the system to which it will be connected.
The owner of the equipment must ensure that all users are aware of the Health and Safety information contained in this handbook. If the equipment is sold or passed to another owner, this handbook must be included with the equipment.
If in doubt contact Vacuum Generators.

Warning: This equipment must be installed by qualified personnel.

Warning: It is the responsibility of the user to consider the safety requirements of hazardous materials used with this equipment and the consequence of any leakage, however caused. Consider possible reactions with materials of construction. Any equipment returned to Vacuum Generators must have the correct Declaration of Contamination securely fastened to the outside of the packaging.

Warning: Harmful gases may be evolved if this equipment is heated to temperatures above the maximum specified bakeout temperature.

Warning: Lubricants used in this assembly may cause irritation to sensitive skin. Wear protective clothing.

Warning: Where cryogenic liquids are used with the equipment, it is the responsibility of the user to ensure that the correct safety precautions are taken when handling and storing these materials.

Warning: Safe disposal of the equipment is the responsibility of the user.

Warning: It is the responsibility of the user to fit emergency stops to automated equipment.

Warning: Keep clear of moving pans.

Warning: Do not use this equipment with positive internal pressure above the specified maximum.

Warning: Some equipment may develop extreme hot or cold surfaces. Wear protective clothing.

Warning: Equipment must be fully earthed to prevent dangerous electrostatic charge build-up.

1.2 GENERAL

The TRANSAX is a precision ultra-high vacuum (UHV) specimen translators of modular construction, suitable for a range of X,Y and Z motions. The modular construction means that the specification can be upgraded or modified by the addition or replacement of well defined modules.
The TRANSAX series has been designed for ease of use and most functions should be straightforward. This handbook outlines the general considerations for installation, use and maintenance.
Most manipulator configurations utilising the TRANSAX translator may also use drives and instrumentation that are not included in this handbook. This handbook should therefore be read in conjunction with documentation supplied for the other equipment.

1.3 SPECIFICATIONS

Support tube:
Normally supplied with a 29 mm bore (32mm OD) support tube. Positional control.
X, Y: Micrometer or stepper motor
Z: Handwheel or stepper motor
Pressure range:
1 bar to 10^{-11}mbar
Operating temperature:
-20^{o}C to +55^{o}C
Baking temperature:
230^{o}C (motors, instrument cables and other non-bakeable ancillary hardware removed.)
Standard base flange:
NW100CF (151.5mm (6") OD)
Travelling flange:
NW35CF (70mm (23/4 ") OD)
Environment:
This equipment is intended for use in clean, dry environments. For use in other conditions, please contact Vacuum Generators Technical Sales.
Materials of Construction.
All units are manufactured mainly from austenitic stainless steel or aluminium alloy. Stainless steel is used for parts that form the vacuum envelope. Demountable vacuum seals use copper gaskets. Bearings surfaces may include martensitic stainless steel, bronze alloys and PTFE
polymer compounds. Atmosphere side bearing surfaces may use high temperature 'Carbaflo' grease or fluid. The micrometers are conditioned for bakeout to 230^{o}C. Motors contain non-bakeable plastic and must be removed for bakeout. Atmosphere side fixing screw threads are treated with ZTL thread lubricant.

1.4 BASIC DIMENSIONS

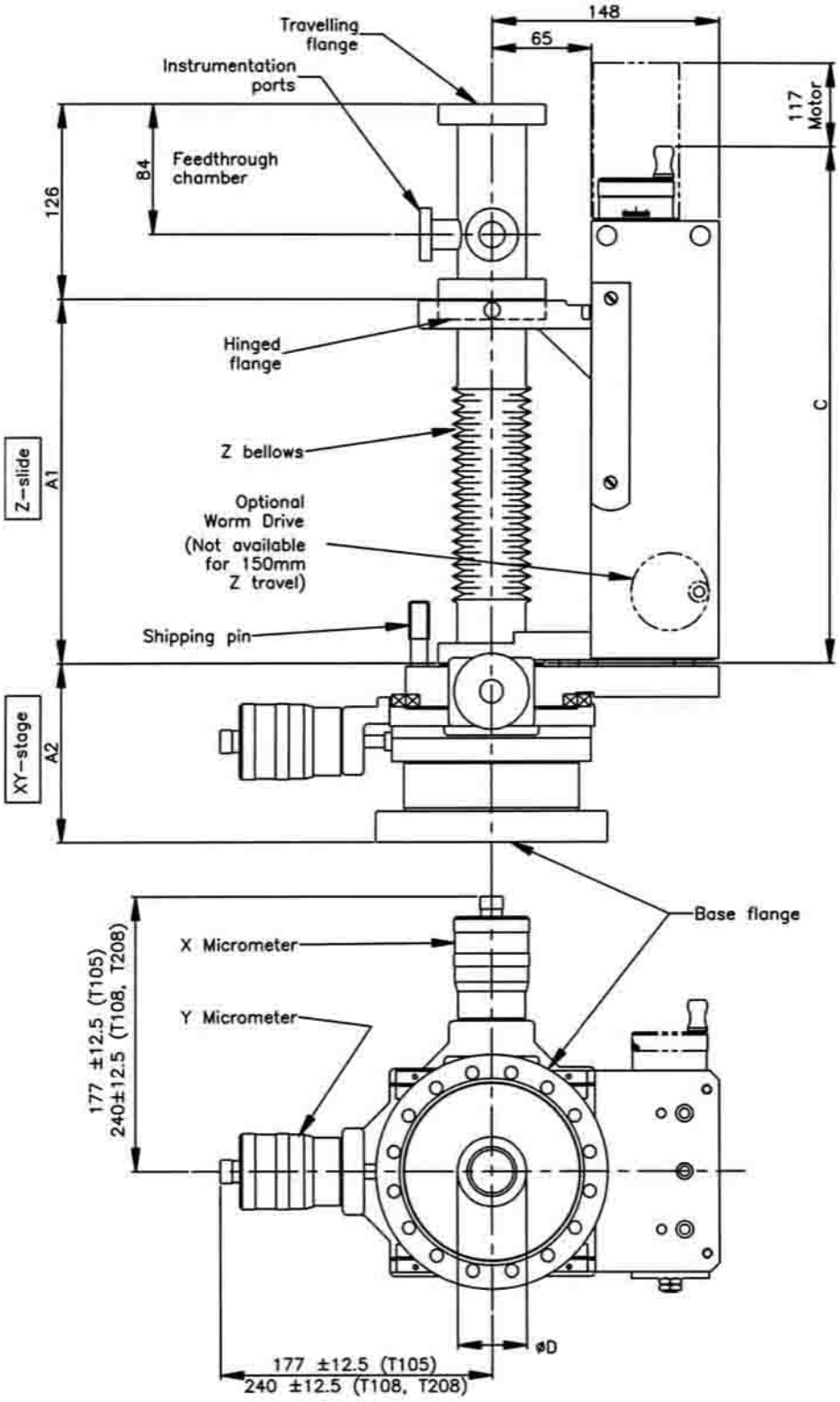


Figure 1: Basic dimensions and layout of Transax
(Variable dimensions given in following tables).

1.5 Z MOTION

Z Travel	A1	C	Weight [1] (kg)
150	129 to 279	360	22
300	166 to 466	545	24
450	202 to 652	734	25

Notes

[1] The weight of the Transax manipulator will vary depending on configuration details.

[2] Motor specifications assume the use of a Vacuum Generators motor drive-controller.

Z-SLIDE SPECIFICATIONS:	
Resolution	10 microns manual 5 microns motorised [2]
Repeatability [3]	10 microns manual [3] 5 micron motorised [2][3]
Maximum Speed	10 mm/s motorised [2]

[3] Repeatability assumes the drive is always from the same direction, and at constant temperature conditions.

1.6 XY MOTION

XY Travel	Basic code of XY stage	A2	Bellows bore ØD
±0	None	0	N/A
±0	T000	80	95
±6.0 [4][5]	T105 [4]	114	44
±12.5 [4][5]	T108	135	85
±25.0 [5]	T208	167	85

[4] The T105 stage has a normal range of ±12.5 mm but will allow only ±6.0 mm when the support tube is fitted.

[5] The XY travel is limited by the vectorial sum of the X and Y movement, i.e.: $\sqrt{(X^2+Y^2)}$. Some examples are shown in the table below.

XY STAGE SPECIFICATIONS:		
Resolution	Manual (all stages)	5 microns
	Motorised (T105 stage)	2.5 microns [2]
	Motorised (T108 & T208 stages)	0.5 microns [2]
Repeatability [3]	Manual (all stages)	5 microns manual [3]
	Motorised (T105 stage)	5 micron motorised [2][3]
	Motorised (T108 & T208 stages)	1 micron motorised [2][3]

Caution: These limits are not protected by limit stops or by switches

Examples of vectorial limits (in millimetres):

For ±12.5mm; $\sqrt{(X^2+Y^2)}=12.5$	Xmax =	12.5	10	8.8	5	3
	Ymax =	0	7.5	8.8	11.4	12.1
For ±25mm; $\sqrt{(X^2+Y^2)}=25.0$	Xmax =	25	20	17.6	12	3
	Ymax =	0	15	17.6	21.9	24.8

2. INSTALLATION

2.1 IMPORTANT - READ BEFORE UNPACKING

Warning: Take care when lifting the unit that the weight and position do not exceed comfortable limits, When installing the device make sure that it is adequately supported at all times.

a. With two or more persons, lift out the translator. DO NOT use bellows, drives or instrumentation as lifting points. Take care not to hit or damage any protruding parts of the translator. Lie the translator on its back.

b. Carefully inspect the translator for visual signs of damage. The packaging is designed to with stand shock and vibration but some of the fixing screws may become loose, more especially with air freight shipment. All parts should be secure and there should be no 'play' in any of the movements. All screws should be securely fastened but not excessively tight.

c. Any damage in transit should be, reported to the carrier and to Vacuum Generators at Hastings, or your local agent, within three days. Retain the packaging.

d. Remove all transit items before operating any of the controls.

2.2 INSTALLATION GUIDELINES

Warning: This equipment must be installed by qualified personnel.
Warning: It is the responsibility of the user to consider the safety requirements of hazardous materials used with this equipment and the consequence of any leakage, however caused. Consider possible reactions with materials of construction. Any equipment returned to Vacuum Generators must have the correct Declaration of Contamination securely Fastened to the outside of the packaging.
Warning: Lubricants used in this assembly may cause irritation to sensitive skin. Wear protective clothing.
Warning: It is the responsibility of the user to fit emergency stops to automated equipment.
Warning: Equipment must be fully earthed to prevent dangerous electrostatic charge buildup.

a. The TRNSAX will operate when mounted in any orientation. Consideration must be given to ensuring that that the level of stress exerted onto the chamber and within the translator itself is as low as possible. Where practical the translator should be vertically mounted. For horizontally mounted units special mounting arrangements are required. See section 2.3.
b. Bolt the translator to the system flange using the correct size bolts and gaskets as indicated in the table below. For tapped flanges use a thread lubricant, such as Vacuum Generators ZTL on the bolt threads. Use washers under bolt heads or nuts.

Flange Size:	**NW35CF (2.75" OD)**	**NW63CF (4.5" OD)**	**NW100CF (6" OD)**	**NW150CF (8" OD)**
Gasket size (VG ref):	ZCU38	ZCU64	ZCU100	ZCU150
Tapped holes:	M6	M8	M8	M8
Clearance holes(mm)	Ø 6.8	Ø 8.4	Ø 8.4	Ø 8.4

c. Install equipment to the top flange, using the same guidelines as the base flange.
d. Fit and adjust the micrometer as described in the sections below.
e. The hinged flange may be 'locked' in position by tightening the grub screw at the front of the knee: Some configurations will be more stable in locked position, particularly long vertically mounted manipulators
f. before operation remove the shipping pin.

2.3 HORIZONTAL MOUNTING

2.3.1 Z-only applications (TRS stand)

a. Offer up the manipulator to its installed position (assistance is required).
b. Measure the vertical distance from the 10mm diameter hole in the rear of the structural member to the floor, dimension 'A',
c. Set the nuts to 12mm apart as shown.
d. Cut the support stand assembly to the measured length "A" (cut plain end only).
e. Fix stand location ring in the appropriate position on the floor.
f. Locate the cut end of the stand within the floor mounted ring. Locate the adjustment end stud with the central hole of the manipulator structure.

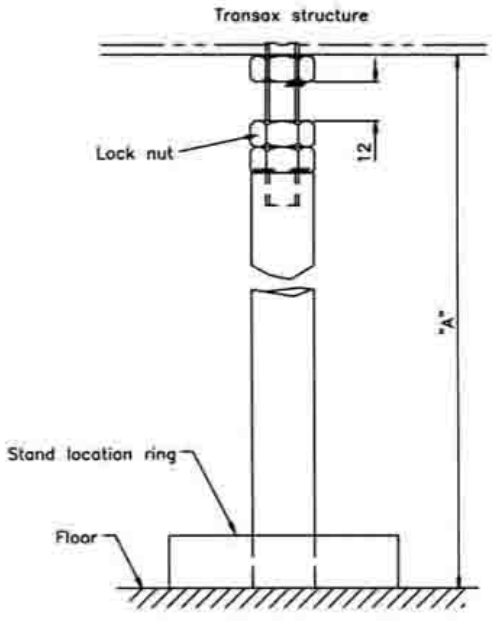


Figure 2: TRS support stand

g. Adjust the position of the stud so that the vacuum flange joint faces are parallel. Tighten stud locking nut down on to the tube to secure setting (see caution note).
h. Locate gasket with flange, tighten vacuum joint as normal procedure.

Caution: The adjustment range is +/-12mm from the 12 mm set position stated in instruction (c). above. Do not attempt to exceed this as it is possible for the stud to unscrew completely.

It is advisable to install a barrier around the support stand and manipulator to guard it and personnel from accidental damage or injury.

2.3.2 Sprung horizontal stand (HSA stand)

The HSA horizontal stand comprises a floor mounted sprung lever mechanism, a tube clamp attached to the translator and a connecting push-rod. Constant tension springs on one side of the lever provide an upward force on the opposite side. Since there are two positions of both the spring drums and push rod mount, four multiplying ratios are possible. Also, the number of spring leaves can be varied and so the upward force can be closely matched to the weight of a particular device. The position at which the compensator acts against the translator should be set at the centre of gravity when the Z-slide is in mid-position.

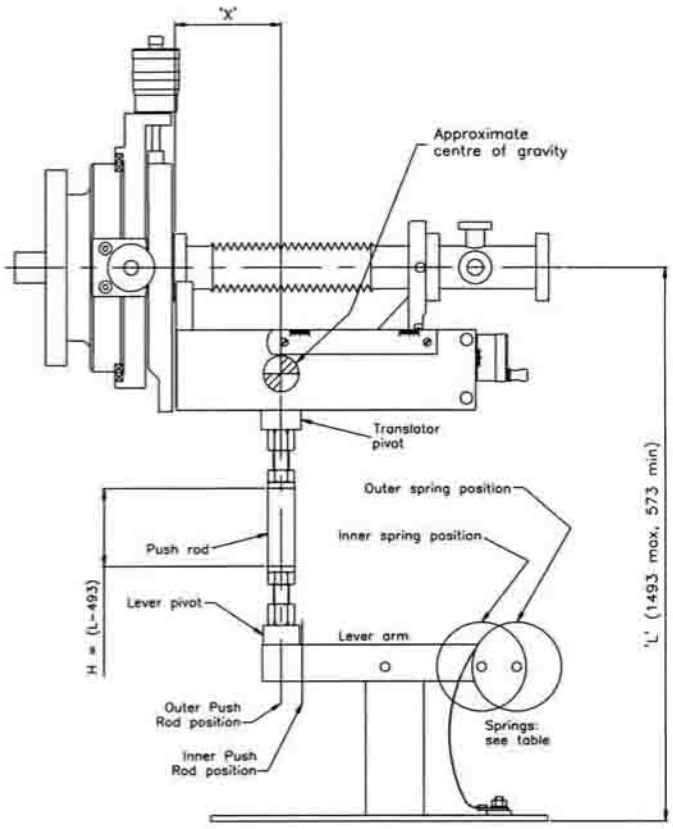


Figure 3: HAS Horizontal stand

HSA Spring Parameters

Warning: These springs are very powerful and have sharp edges. GREAT CARE should be taken to avoid physical injury if any attempt is made to disconnect the springs. First remove the translator from the system. ALWAYS wear tough gloves and remove the spring from the axle rather than the outer end.

These values relate to TRANSAX translators that include an XY stage, rotary drive, feedthrough chamber with feedthroughs, normal sample holders and manual drives. For other configurations, some changes to these parameters may be necessary to achieve the correct horizontal balance.

Z Travel (mm)	Approximate centre of gravity, X (mm)	Spring Position	Pushrod mount position	Total number of spring leaves
150	110	Inner	Outer	4
300	170	Inner	Inner	4
450	235	Outer	Outer	4

HSA Installation

Important: The system flange will need to carry approximately 25% of the weight of the TRANSAX. Ensure that the system construction is stable, its designed to support at least 50% of the full TRANSAX weight. The HSA stand will relieve the majority of the cantilevered weight of the unit.

Normally the TRANSAX will be matched with its compensating stand, and so there will be no need to alter any of the parameters outlined in the table above.
It will be necessary first to ensure that the push rod is of the correct length:

a. Establish the correct length, H, of the push rod tube from the measured value, L. (H = L -493). The push rod end fittings should be adjusted to their mid position when making this calculation.
b. Pull one of the end fittings from the push rod tube and cut the tube back by the required amount.
c. Replace the end fitting.

When ready to install, offer the TRANSAX to the chamber and, WHILST SUPPORTING THE END CAREFULLY ON JACKS, bolt to the chamber.
Continue to support the device whilst the compensator stand is maneuvered into position and the push rod is fitted between the two countersunk pivot points. The jacks may now be carefully removed checking the following points before applying vacuum:

* With the X, Y and Z motions at mid travel check that the Y micrometer is as free to move as the X micrometer. If any undue stiffness is noticed or if there is more resistance in one direction than the other, then advice should be sought from Vacuum Generators.

* With the XY stage centralized check that the lever arm is horizontal and the push rod vertical. Adjustment may be made via the end fitting. Also check that full Y travel can be achieved without contact being made with the lever arm stops.
* The base of the stand must be firmly bolted in position.
* IMPORTANT: Protect the TRANSAX and the compensation unit from accidental knocks that could dislodge the spring loaded push rod and over-stress the system flange.

2.4 XY MICROMETER INSTALLATION

Caution: Note the vectorial limits of travel as given in the 'XY Motion' section of the introduction. Exceeding these limits can permanently damage the bellows. There are NO stops fitted to restrict vectorial movement.

a. Some micrometers are supplied with the barrels intentionally loose in the housing. With the shipping pin in position, adjust the micrometers to read the central position of the stage. The graduated thimble can be rotated to 'zero' the scale. Tighten the clamp and remove the shipping pin before use.

2.5 XY MOTOR INSTALLATION (T105 STAGES)

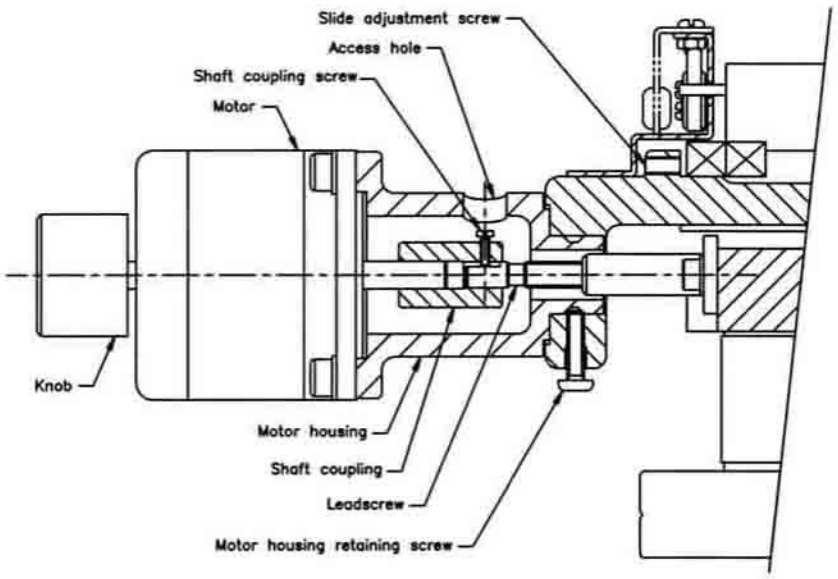


Figure 4: T105 XY stage motor

Warning: It is the responsibility of the user to fit emergency stops to automated equipment. (Note: Vacuum Generators stepper motor controllers have a facility for adding emergency stops.)

a. Motor wiring details are given in Appendix A.
b. Rotate each motor so that the single screw on the shaft coupling is in line with the access hole in the motor housing.

c. The flat on the lead screw that protrudes from the stage will also need to be aligned with the single screw on the motor shaft coupling. Rotate the lead screw to achieve this condition.
d. The motor housing must fully enter the bore so that the shoulder makes contact. If it is prevented from entering to this depth, the lead screw should be screwed in, one full revolution at a time, until this can be achieved. If the lead screw is tightened too far, the coupling may not have enough length of engagement.
e. Once the motor housing and shaft coupling are in correct alignment, both axially and radially, tighten the motor housing retaining screw and then tighten the coupling screw against the flat of the lead screw.
f. Mark the motors to identify the correct location for future use
Caution: Do not operate the stage unless the shipping pin is removed.
Caution: Note the vectorial limits given in the 'Specifications' section of the introduction. Exceeding these limits can permanently damage the device. There are NO stops fitted to restrict vectorial movement

2.6 XY MOTOR INSTALLATION (T105 AND T208 STAGES)

Warning: It is the responsibility of the user to fit emergency stops to automated equipment. (Note: Vacuum Generators stepper motor controllers have a facility for adding emergency stops.)

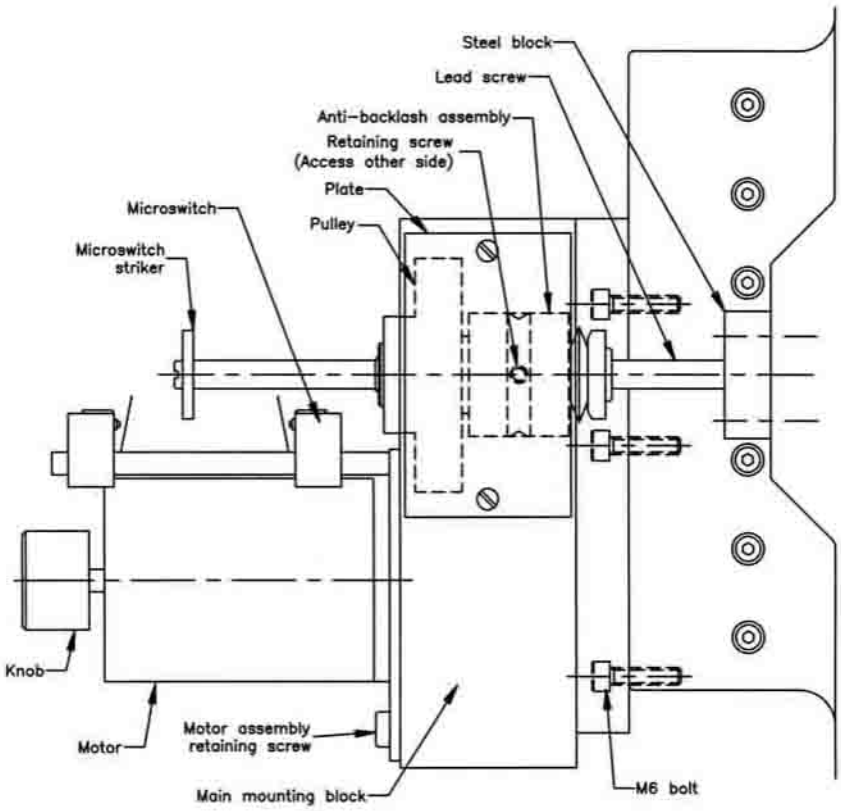


Figure 5. Motor on T108 and T208 stages

a. Motor wiring details are given in Appendix A.
b. Bolt the stainless steel block and lead screw assembly to the slide.
c. Screw the anti-backlash assembly onto the lead screw.
d. Carefully fit the main mounting block over this assembly. Secure the anti-backlash assembly by tightening the single lead screw, located under the plate, against the central spacer. It may be necessary to unscrew the anti-backlash assembly to achieve this.
c. Rotate the anti-backlash assembly so that the mounting block is within 1mm of the side of the XY Table. (Tip: The pulley can be turned around and used as a convenient handwheel.)
f. Remove the shipping pin and loosen the stainless steel block holding the lead screw.
g. Bolt the mounting block to the side of the Table using 3 x M6 bolts.

2.7 XY MOTOR LIMIT SWITCHES

(All motorised XY stages)
a. Remove the shipping pin and switch off any power to the motors.
b. Use the manual knob to move either motor from the central position to either limit of travel.
c. Loosen the limit protection microswitch and adjust its position until the switch can be heard to operate (click) at the limit position. Repeat for the other limit of travel.
d. Return the first motor to the central position before attempting to set the second pair of microswitches.

Caution: Microswitches do not protect against vectorial limits unless they are set to the 45^{o} vector, i.e. X=Y=8.8mm for ±12.5mm stages, or X=Y=17.6mm for $\pm$25.0 stages. It is important that both microswitches are correctly adjusted so that there is no risk of driving into the end stops as this may damage the support tube, XY bellows or drive mechanism.

Caution: Microswitches are intended for emergency use only. Do not use microswitches as position indicators or datum markers. Stepper motors may overrun by several steps when a microswitch is activated, particularly if travelling at speed. Always check the datum position and reset as necessary.

2.8 Z MOTOR INSTALLATION

a. Remove the "Z" motion handwheel from the drive screw shaft.
b. Attach the motor coupling (6) to the motor; ensure that the depth of shaft engagement within the coupling is 6-7mm.
c. Screw the motor mounting block (3) to the aluminium end plate.
d. Locate the motor coupling (6) with the drive screw shaft, and attach the motor (7) to the mounting block. Tighten coupling screws.
e. It is recommended that the motor is connected with the windings "series connected" as detailed in the motor wiring diagrams (Appendix A).

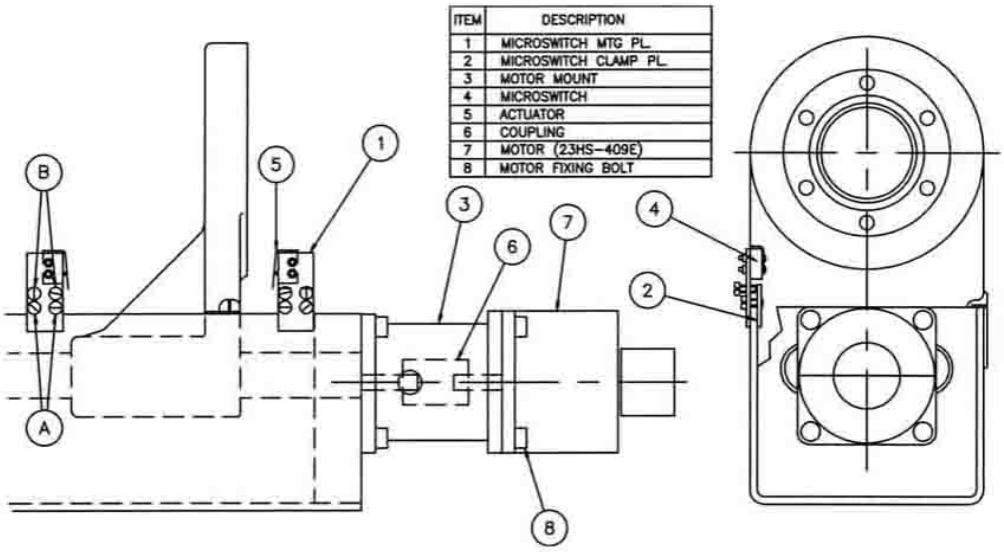


Figure 6: Z Motor arrangement

2.9 Z MOTOR LIMIT SWITCHES

Refer to figure 6.

Caution: It is important that both microswitches are correctly adjusted so that there is no risk of driving the knee into the end stops as this may damage the drive mechanism or lead screw.

Caution: Microswitches are intended for emergency use only. Do not use microswitches as position indicators or datum markers. Stepper motors may overrun by several steps when a microswitch is activated, particularly if traveling at speed. Always check the datum position and reset as necessary.

a. Mount the microswitch units to the edge NOT occupied by the rule.
b. The screws that hold the microswitch (4) to the mounting plate (1) must be arranged so that the nuts are to the outside as drawn.
c. Orientate the microswitch units as shown.
d. Tighten screws ‘A’ before screws ‘B’, ensuring that the two plates item 1 and 2 are parallel.

e. All cables must be clear of moving parts.
f. Check the microswitch settings by slowly driving the Z-slide to either end of the travel until the switch operates, preventing further movement in that direction.

3. OPERATION

3.1 NORMAL USE

3.1.1 Important information

Warning: Do not use this equipment with positive internal pressure above the specified maximum.

Warning: Keep clear of moving parts.

Caution: Note the vectorial limits of XY travel as given in the 'XY Motion' section of the introduction. Exceeding these limits can permanently damage the bellows. There are no stops fitted to restrict vectorial movement.

Caution: The TRANSAX uses precision guidance mechanisms: avoid undue strain due to clashes with fixed objects, overloading, leaning on the equipment, etc.

Caution: Where the motor is fitted, the motor connector must not be disconnected unless the power to the drive has first been switched off. Allow a few seconds for the circuits to discharge.

Caution: Microswitches are intended for emergency use only. Do not use microswitches as position indicators or datum markers. Stepper motors may overrun by several steps when a microswitch is activated, particularly if traveling at speed. Always check the datum position and reset as necessary.

3.1.2 Operation

• The unit must be correctly installed, and the information above followed carefully.
• Manual operation is straightforward and needs no special consideration.
• Operation with the stepper motor is dependant on the motor controller used, and the user should refer to the controller instructions.
• If any movement becomes tight or if backlash (play) becomes visible, the unit will require maintenance. Refer to section 4.
• Routine maintenance is required. See section 4.1

3.2 BAKEOUT

3.2.1 Bakeout guidelines

Warning: Harmful gases may be evolved if this product is heated above the maximum specified bakeout temperature.

- Remove all microswitches, motors and non-bakeable equipment from the bakeout zone.
- Heater tape should he avoided as this can cause local hot spots.
- The temperature sensing element controlling the heaters must be suspended in air near the translator and at a level approximately 50 -100 mm below the highest part of the translator.
- In no event should the temperature sensing element be in contact with or attached to any part of the translator or the vacuum system, i.e. it must always sense the air temperature.
- Centralise the XY stage and on horizontally mounted translators, position the Z slide at mid travel.

3.2.2 Removing XY motors for bakeout

a. Centralise the X and Y axes and fit the shipping pin.
b. For T105 stage motors, loosen the single shaft coupling screw visible through the motor housing, loosen the screw which retains the motor housing and remove the unit (see figure 4).
c. For T108 and T208 motors, remove the three screws securing the motor mounting plate and remove the motor and drive belt (see figure 5).
d. Remove the microswitches and all cabling from the bakeout zone.

3.2.3 Removing Z motor for bakeout

a. For horizontally mounted units, it is recommended that the Z slide is moved to mid-position.
b. Loosen the motor coupling screws (see figure 6) from the main drive shaft. Remove the four motor mounting screws. Remove the motor and coupling.
c. Remove the microswitches if bakeout is greater than 180^{o}C.

4. MAINTENANCE

4.1 ROUTINE MAINTENANCE.

4.1.1 Inspection schedule

The following inspections and procedures should be performed after 150 to 200 hours of accumulated bakeout or when the Z-slide has traveled 150m.

4.1.2 Screw fixings

Check that all screws are secure: not slack nor excessively tight. It will be noted during any dismantling that Belville washers (disc springs) have been fitted under certain screw heads. It is important that these washers are refitted in the correct locations.

4.1.3 Gravity compensation springs

(Horizontally mounted units only):
Warning: The spring compensators are pre loaded and have sharp edges. Do not attempt to dismantle.
a. Visually inspect the springs to check that no spring leaves have broken. Any broken springs must be replaced as soon as possible. Contact Vacuum Generators Service Department for information.
b. Check that the springs correctly support the payload by operating the vertical (Y) micrometer (or manually operate the Y motor). It will be possible to find a position where the resistance to raising the stage is the same as the resistance to lowering it. This is the neutral position.
c. Check that the neutral position is within 5mm of the central position. If the neutral position is beyond this limit, the compensator is not balanced, and action is required to correct it. Contact Vacuum Generators Service Department for information.

4.1.4 XY Micrometer or motor stiffness

a. Compare the action of the X and Y drives by hand operation at the neutral position (see above to establish the neutral position). Both movements should feel smooth and have the same degree of stiffness. If a movement is believed to be stiffer than normal, proceed as follows:
b. At the neutral position, loosen (but do not remove) the screw(s) that secure the micrometer or motor housing to the XY table. Repeat the check for stiffness.
c. If the drive is now significantly smoother or less stiff than previously, the slides may have loosened or the drive may be misaligned with the XY table.
d. Check for loosened slides.
e. Check for misaligmnent by observing the gap between the micrometer (or motor) and the housing when the bolts are just loosened. An uneven gap indicates misaligmnent. This can be rectified by fitting shims: e.g.. a thin sheet of foil between the housings at the correct position to eliminate misalignment.

f. If the drive remains stiff this may be due to incorrect lubrication, wear of the drive or damage.

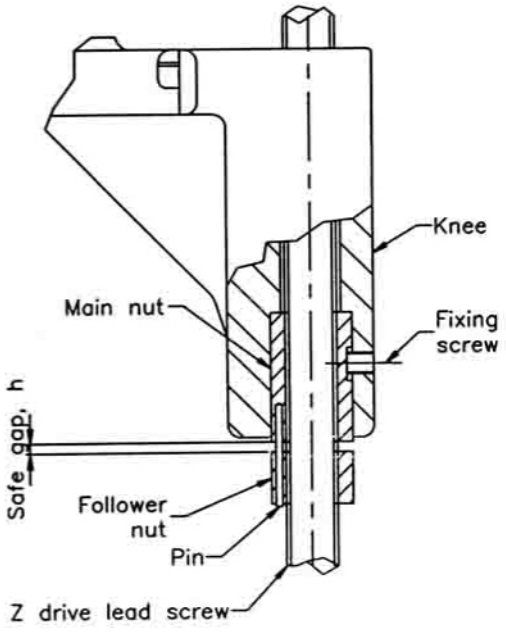
4.1.5 Monitoring the Two-Part Nut on the Z slide

The two-part nut helps prevent collapse of the Z-slide into the chamber in cases of extreme thread wear. The diagram below shows the arrangement.

Warning: is essential for safety reasons that regular checks are made.

• The rate of wear depends on many factors such as lubrication, usage, applied load and orientation.
• When failure of the main nut occurs, the gap between the two nuts (shown as 'h' in the figure) will become zero as the full load is taken on the follower nut.

Warning: The slide must not be used in this condition. If useage continues, a dangerous collapse is possible.



• The condition of the nut must be monitored to ensure that wear of the main nut is never such that the follower nut is needed to support the load.
• The state of wear of the main nut can be checked by monitoring the following three conditions:
a. The gap distance, h: If the gap reduces by 0.5 mm from that measured when first installed, the nut should be replaced.
b. The torque required to turn the worm gear shaft. If the torque required reaches a level of 40 Ncm.
c. The free play of the follower nut on the pin connecting it to the main nut: If the follower nut has no free play on the pin, the nut should be replaced.

4.1.6 Lubrication

Warning: Lubricants used in this product may cause irritation to sensitive skin. Wear protective clothing.

Note that Carbaflo grease discolours with time, particularly where regular bakeouts are applied to the equipment. This is normal and does not affect the behavior of the lubricant.

Warning: Keep clear of moving parts.

a. **Z slide lead screw and worm and wheel gear (if fitted):** Clean dirty and excess grease off the components. Lubricate with Carbaflo grease, ensuring that all contact surfaces are covered by a film of grease.
b. **Z slide linear guide shafts**: DO NOT LUBRICATE. The slide bearings are lined bushes which run dry.
c. **Ball bearings (e.g. lead screw and worm drive shaft):** Use a small quantity of Carbaflo fluid to lubricate each bearing. Apply using a dropper or by dipping a clean wire into the container and allowing it to drip onto each bearing.
d. **XY Micrometers**: Move one micrometer at a time to the limit position so that the spindle is fully retracted. Unscrew and remove the small knurled knob that retains the micrometer thimble. Pull the thimble away carefully. Apply Carbaflo grease to the lead screw. Replace the thimble and knob.
e. **XY stage motor lead screw**: Drive the motor to either limit of travel, periodically stopping to lubricate the lead screw as it becomes visible on either side of the anti-backlash assembly.
f. **XY Slides**: Use a small quantity of Carbaflo fluid to lubricate the slide. Apply using a dropper or by dipping a wire into the container and allowing it to drip onto the exposed slide. Note that it is not possible to lubricate the full length of the slide, but by cycling the movement a few times, the lubricant will be adequately dispersed.
g. **Fixing screws**: All fixing screws should be treated with high temperature thread lubricant.

4.1.7 Adjustment of the XY slides

a. If play develops in the XY slides, three adjustment screws are provided on each axis. The X slide adjustment screws are located below the Y axis micrometer (or motor). The Y adjustment screws are on the side of the top plate, on the same side as the shipping pin.
b. Before making any adjustment, it is first necessary to loosen the screws that hold the bearing slide closest to the adjustment screws.
c. Check that the roller cage between the slides is centrally positioned along the length of the slide.
d. Tighten the middle adjustment screw first, to finger tight only. Then tighten the outer adjustment screws, to finger tight.
e. Finally, tighten the bearing retaining screws.

4.2 CORRECTIVE MAINTENANCE

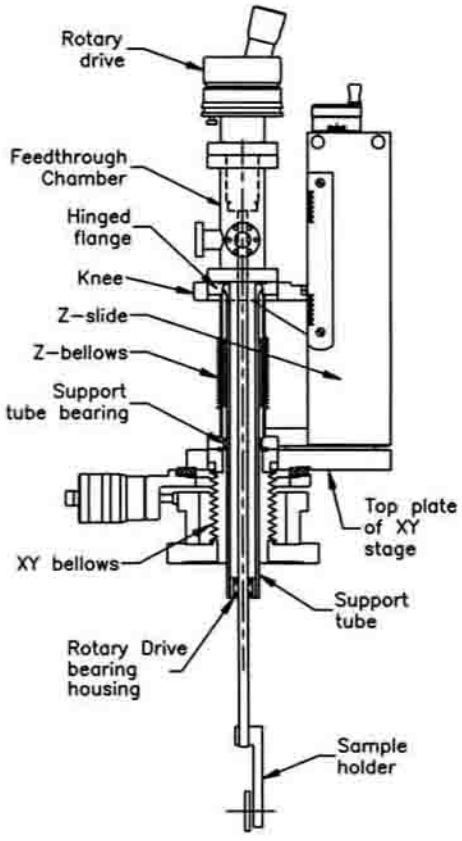
4.2.1 Guidelines for dismantling and re-assembly

a. Centralise the XY stage and retract the Z slide.
b. Disconnect all power and instrumentation connections and remove the TRANSAX from the vacuum chamber.
c. Bolt the Transax to a suitable stand that allows it to be worked on securely in the vertical position (such as the transit stand supplied with the translator).
d. Note the orientation of parts as they are dismantled: e.g., disk (or Bellville) spring washers under screw heads, the orientation of bearings and tubes.
e. When reassembling always fit new copper gaskets.
f. Apply thread lubricant to all fixings which are not in-vacuum but do not allow contamination of the vacuum with thread lubricant.
g. Replace parts in their original orientation.

4.2.2 Removal of the central assembly

(i.e.: support tube + sample holder + Z bellows + rotary drive or other equipment fitted above the knee).

a. All sample handling equipment must be removed from the probe of the manipulator.
b. Unscrew and remove the six bolts which hold the lower flange of the Z bellows to the XY module.
c. Loosen the grub screw at the front Support of the knee which locks the hinged tube bearing-flange. Unscrew and remove the two hinge pins which retain the upper bellows flange to the knee. Carefully lift the assembly away.



4.2.3 Z-slide removal

a. First remove the central assembly as described above.
b. Unscrew and remove the six M6 bolts that secure the base of the Z slide to the top plate of the XY stage, and lift this assembly away. Note the six spacers positioned between the Z slide and XY stage.

4.2.4 Z bellows removal

a. First remove the central assembly as described above.
b. Details for dismantling will vary depending on the configuration. The following text assumes a rotary drive is used.
c. Check the condition of the rotary drive shaft that protrudes from the bearing housing. Carefully clean off any burrs or high spots that might prevent the shaft from being drawn through the bearing housing. Wet the surface of the protruding rotary drive shaft with alcohol and
withdraw the rotary drive. Be careful to avoid straining the rotary drive shaft which is now unsupported.
d. Remove the six M6 bolts holding the feedthrough chamber (or other equipment) to the hinged flange.
a. Remove the two radial screws which retain the rotary drive bearing housing to allow the support tube to be removed past the support tube bearing.
b. Note carefully the orientation of the rotary drive bearing housing screw holes in the support tube for reference when reassembling.
c. Looking inside the hinged flange, loosen the three radial grub screws that secure the top of the support tube to the inside of the hinged flange.
d. Remove the support tube through the hinged flange.
e. All bellows are fragile and expensive to replace. Please handle with care.

4.2.5 XY Bellows and flange assembly (T105 stages)

a. Remove the Central Assembly and Z-slide
b. Remove the top (NW4OCF) (2.75") flange by removing the six screws around its periphery. This holds a retaining wire ring which can be withdrawn to release the flange.
c. For NW100CF (6") base flanges, the stage will need to be partially dismantled.
d. Loosen the three slide adjustment set screws for the X axis (refer to section 4.1.7)
e. Remove the screws which secure the bearing that is in contact with the adjustment screws. The table can then be separated at the X slide.
f. Unscrew the ten large cap head screws now exposed to allow the bellows unit to be removed.
g. When refitting the slides, ensure that the rollers between the bearing slides are central. Adjust the slides as outlined in section 4.1.7

4.2.6 XY Bellows and flange assembly (T105, T208, T211 stages)

a. Remove the Central Assembly and Z-slide.
b. Remove the top flange by removing the screws around its periphery.
c. Remove the twelve screws that retain the spinning to the lower slide housing. The bellows assembly can then be removed.

4.2.7 Spares and Accessories

Lubrication kit. LUBEK, including; TVG Thread Lubricant, Carbaflo grease, solvent for Carbaflo and gloves.
Tool kit. TOOLK, including; Metric spanners, hexagon keys, circlip pliers and gloves
Electrical and thermocouple instrumentation. EFT series feedthroughs:
Contact Vacuum Generators for available feedthroughs and for information on instrumentation options.
Rotary Drives. RD series (RD1, RD2 and RD224) precision rotary drives.
These are compatible with the Transax.
Sample Holders and Sample Mounts. SH series: An extensive range of compact sample handling options is available, many in low magnetic materials as standard. These include secondary rotation sample mounts (or sample holders),
Sample heating and cooling. Resistive or electron beam heating, HST and EBH series. Sample cooling accessories, LN and LNHX, integrated sample transfer system, the XL25 series, and others.
Sample Accessories. Vacuum Generators can provide individual items of sample hardware, such as UHV compatible wiring, molybdenum screws, ceramic isolators and so on. Please state your requirements clearly.
Motors. Manual Transax actuators can be upgraded to stepper motor options. Most rotary actuators can also be upgraded. Incremental encoders versions are also available. Please state your requirements clearly.
Motor controllers. The SDU, SMC and SMC-E series of powerful, bipolar motor controllers can be used to operate any Vacuum Generators motor, or any other 4 phase hybrid stepper motor.
Associated Equipment. Details of rotary drives, specimen manipulators, heating, cooling and other accessories are covered by separate instructions. If in any doubt regarding compatibility or fitting procedure, contact Vacuum Generators for assistance

4.2.8 Factory Servicing

A factory servicing scheme exists for all translators. The translator should be returned to the Vacuum Generators factory with a covering order. Please note also the terms and conditions for returning goods, outlined in the 'Repair' section in the front of this manual that apply to good returned for servicing. The servicing scheme includes a complete strip down, cleaning, re-lubrication and re-assembly.
When shipping the unit use the original packing and pack with care to avoid expensive transit damage. Consider that the crate is liable to be dropped on any face or corner.

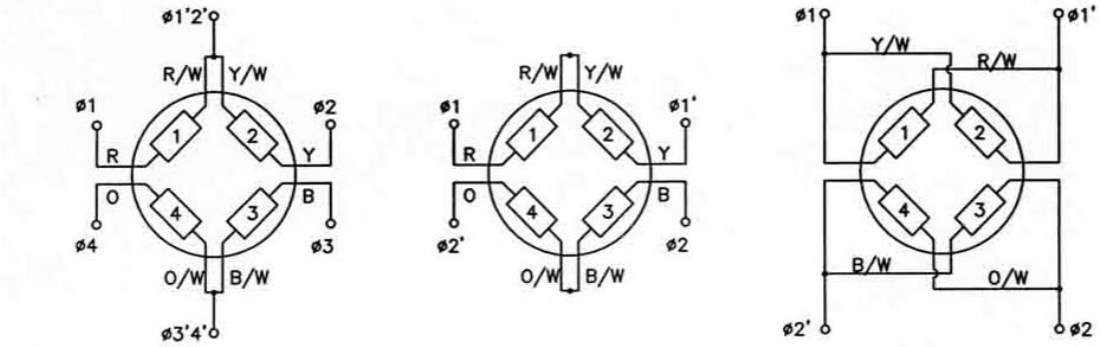
APPENDIX A. STEPPER MOTOR CONNECTIONS

Al. OVERVIEW

Motors and encoders used in Vacuum Generators equipment achieve their intended performance with Vacuum Generators controllers (SDU, SMC or SMC-E) and no responsibility can be accepted should performance be inadequate when other controllers are used.
For attachment to Vacuum Generators controllers, the motors (and encoders if applicable) can be supplied wired with suitable connectors. Otherwise, motors are supplied without connectors to allow connection to alternative drive and controller systems.

All motor variants are 4 phase, 8-lead hybrid stepper motors that can be wired up in most normal configurations as shown below. Some motor kits may include microswitches.

For motors fitted with incremental encoders, the Vacuum Generators SMC-E range of controllers is required to provide passive feedback. If the motor has no encoder fitted, the controller cannot be used in the "Loop Active" mode. Note that encoders cannot be retrofitted to motors.



UNI–POLAR:
Use only where low torque at low speed is sufficient.

BI–POLAR IN SERIES
Provides high torque at low speed.

BI–POLAR IN PARALLEL
Provides moderate torque at low and high speeds.

Key to Colour Coding:

Wire colours as follows.
R - Red, W - White, Y - Yellow. B - Black, O - Orange, G - Green

Alternative motors may be used, with alternative colours. Refer to the following sections.

A2. MOTOR SPECIFICATION

Motor Type	Step angle	Step angle tolerance	Rotor inertia	Resistance per phase	Current per phase	Inductance per phase
23HS-108E	$1.8^{o(1)}$	5%	0.12 kg cm^2	0.33	$3.9A^{(2)}$	0.38mH
23HS-309E	$1.8^{o(1)}$	5%	0.23 kg cm^2	0.40	$4.7A^{(2)}$	0.84mH
23HS-409E	$1.8^{o(1)}$	5%	0.33 kg cm^2	0.48	$4.6A^{(2)}$	1.00mH
34HS-109E	$1.8^{o(1)}$	5%	0.67 kg.cm^2	0.45	$4.7A^{(2)}$	1.30mH
34HS-209E	$1.8^{o(1)}$	5%	11.30 kg cm^2	0.55	$4.6A^{(2)}$	2.50mH

Notes:
(1) Step angle quoted for full step drive. Vacuum Generators controllers use half step drives with step angle being 0.9^o.
(2) Limit the maximum current to the following values, determined by the drive used. (Note that running at maximum current can cause motor to run hot and can give rise to resonance.)
* Maximum current/phase for unipolar drive = rated current.
* Maximum current/phase for bi-polar in series = 0.70 x rated current.
* Maximum current/phase for bi-polar in parallel = 1.4 x rated current.

A3. COLOUR CODING OF MOTOR WIRES

Key to Colour Coding:
R - Red, W - White, Y - Yellow, B - Black, 0 - Orange, G - Green

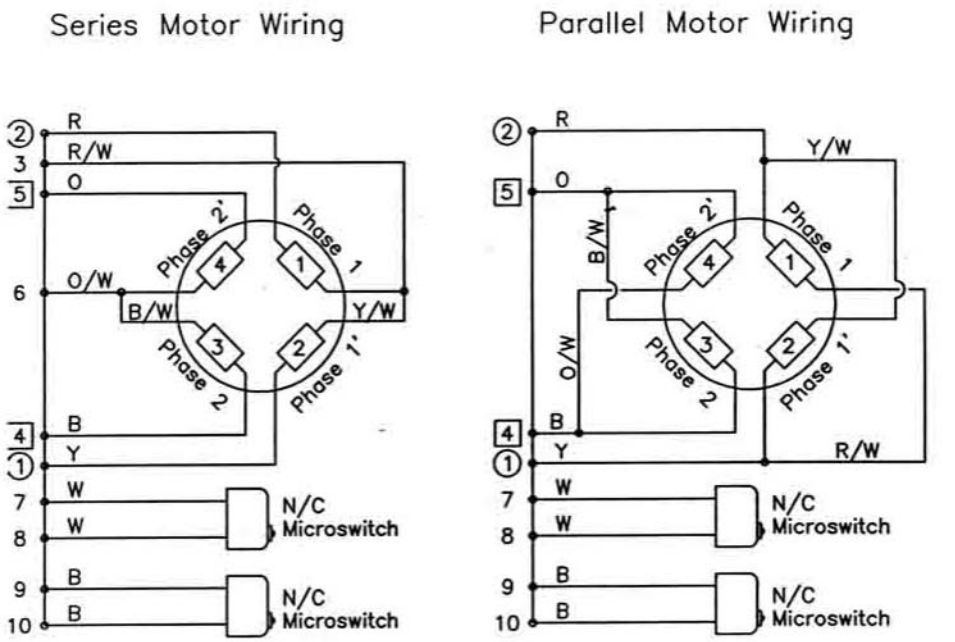
Alternative motors may be used. Wire colours as follows.

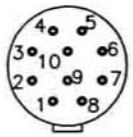
	As drawn	Alternative 1	Alternative 2
Phase 1	R	R	R
	R/W	B	Purple
Phase 1'	Y	R/W	Y
	Y/W	W	Blue
Phase 2	B	G/W	Pink
	B/W	B/W	Grey
Phase 2'	O	G	B
	O/W	O	W

A4. MOTOR WIRING DIAGRAMS

Caution: When wiring motors, care must be taken to make all connections secure. Failure to do so may result in disconnection during use and this can permanently damage the motor drive. For the same reason, never disconnect a motor from its drive unless the power has first been switched off.

Refer to previous section for colour coding of wires.





These diagrams show connections for compatibility with Vacuum Generators motor controllers.

Socket used is ref. XSOC24 (Series and parallel connection).

Series connection is prefered for high torque at low speed. Parallel connection is used for higher speed applications.

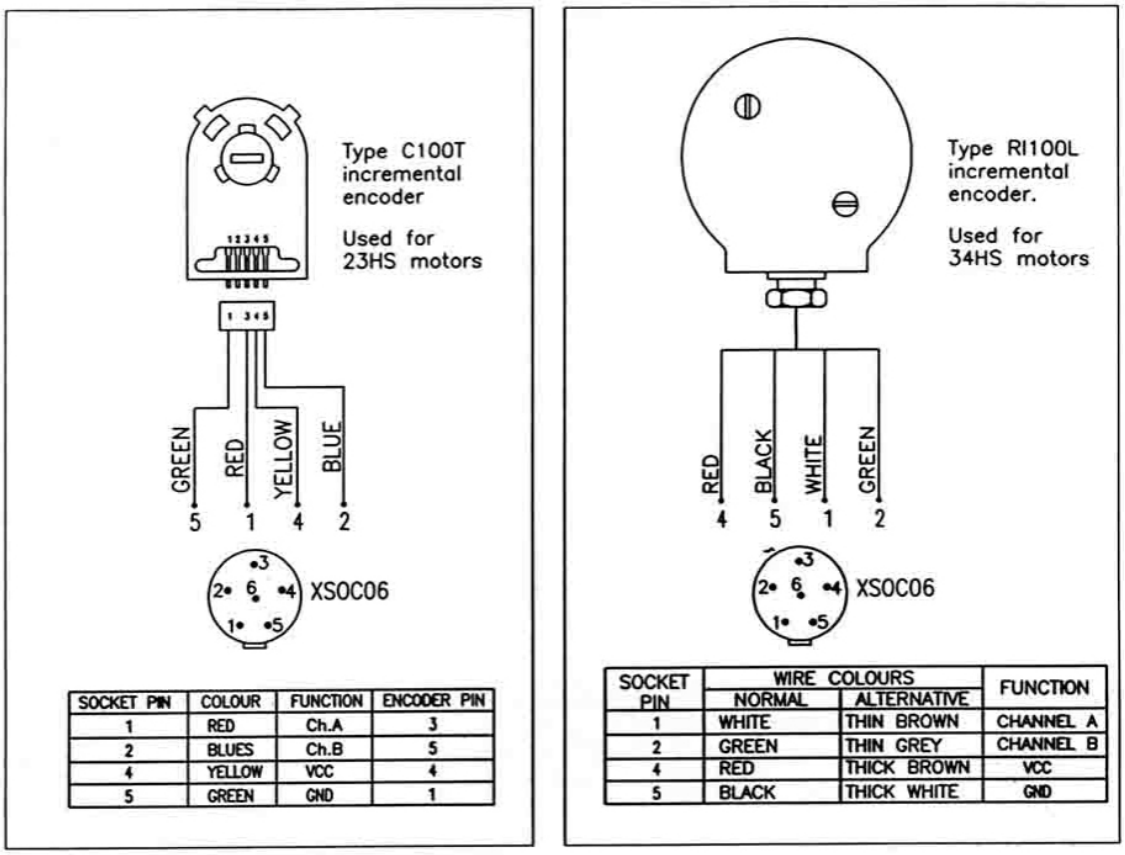
Where microswitches are not used, links must be made between pins 7 and 8, and between pins 9 and 10.

If the rotation direction is opposite to that required, reverse the connections on pins 1 and 2.

Twist together phase pairs to reduce electro–magnetic emission, ie.: ① and ② , and 4 and 5 .

Wiring diagrams for motors suitable for Vacuum Generators Controllers

A5. ENCODER WIRING DIAGRAMS



SOCKET PIN	COLOUR	FUNCTION	ENCODER PIN
1	RED	Ch.A	3
2	BLUES	Ch.B	5
4	YELLOW	VCC	4
5	GREEN	GND	1

SOCKET PIN	WIRE COLOURS		FUNCTION
	NORMAL	ALTERNATIVE	
1	WHITE	THIN BROWN	CHANNEL A
2	GREEN	THIN GREY	CHANNEL B
4	RED	THICK BROWN	VCC
5	BLACK	THICK WHITE	GND

Wiring diagrams for incremental motor encoders.

A6. MOTOR SPARES

Order Code	Description
ZSMPC3LH	Cable: Motor to SMC, SME-E or SDU controller.
DB08073	Cable: Encoder to SMC-E controller.
XSOC24	Connector socket. Fitted to motor lad or connection to Vacuum Generators controllers.
XPLU11	Connector plug. Fitted to controllers for connection to XSOC24 motor socket.

APPENDIX B. HEATER AND THERMOCOUPLES

B1. DESCRIPTION

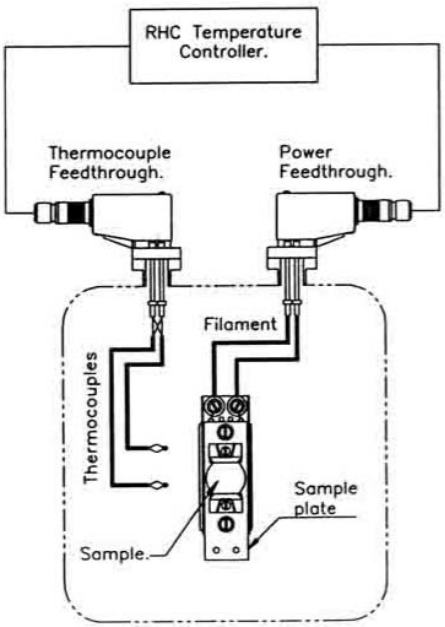
Sample heating is normally by either:
* Resistance heating (HST option), or
* Electron bombardment heating (FBH option).

These heaters are intended for mounting onto the standard range of Vacuum Generators sample holders (e.g. SH1, SH1E50, SH2, SH2E50, SH2R64, SH2F, SH2RT, SM2T and SM2VT.)

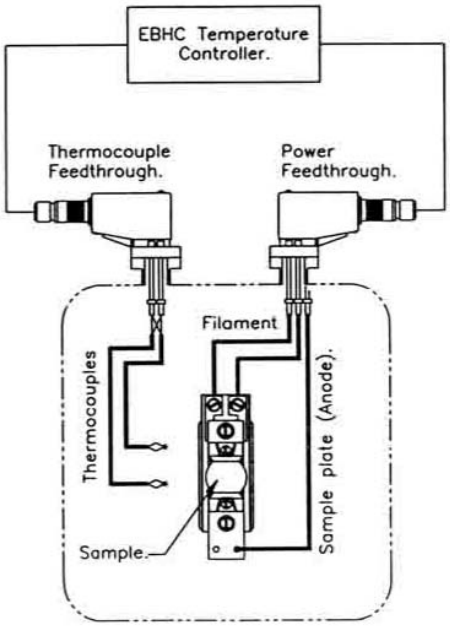
Two thermocouples are provided with either heater module. These are available as either Type K (Chromel-Alumel) or Type N (Nicrosil-Nisil). Type N is recommended where low magnetic permeability is important. Temperature control is recommended, using:
* the RHC controller for the HST and
* the EBHC controller for the EBH

B2. WIRING DIAGRAMS

HST heater schematic.

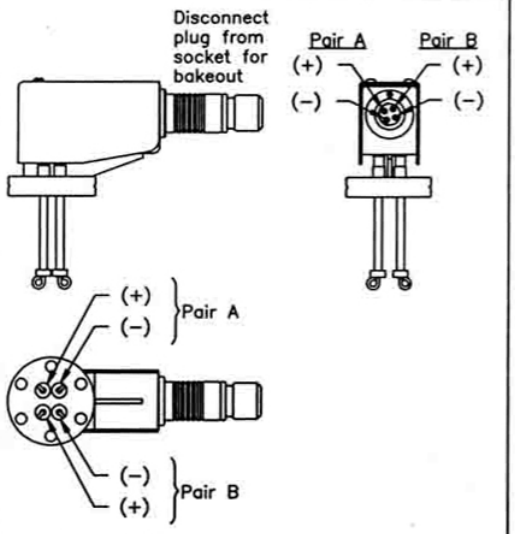


EBH heater schematic.

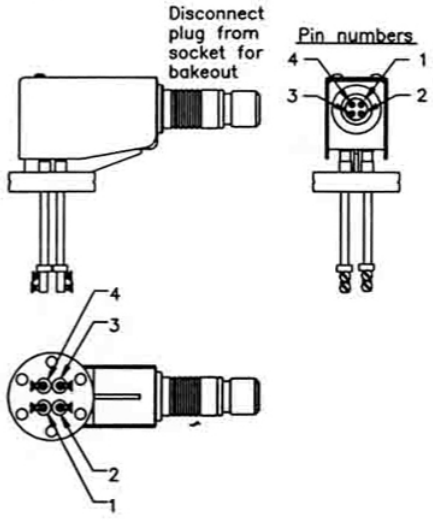


WARNING: It is very dangerous to leave feedthrough contacts isolated, especially during bakeout and when high voltages are present near to the sample. It is the responsibility of the user to be aware of electrostatic charge buildup and to provide suitable earthing.

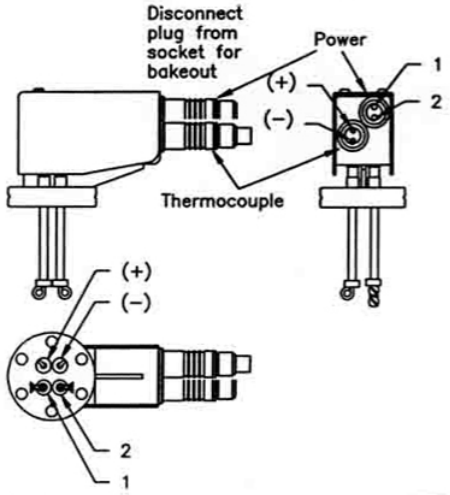
THERMOCOUPLE CONNECTIONS



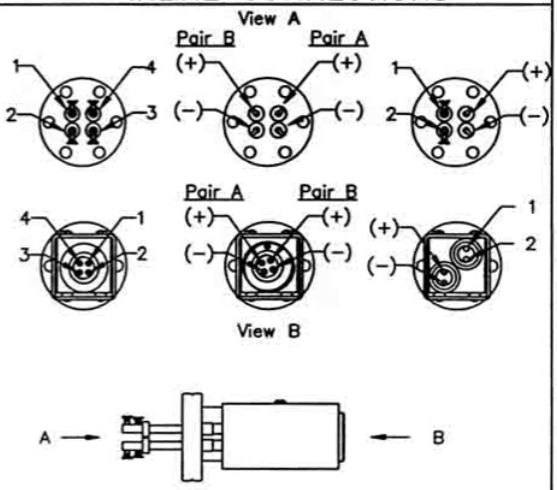
POWER CONNECTIONS



THERMO/POWER CONNECTIONS

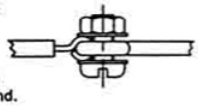


INLINE CONNECTIONS



Making thermocouple connections

1. Loop wire around hooked end as shown.
2. Use one washer each side and secure with M2 nut and screw.
3. tightening the screw should have the action of closing the hooked end.



Wire colours:

K Type:		N Type:	
T1 (+):	green	N1 (+):	pink
T2 (−):	white	N2 (−):	white

Making heater connections

HST heater:
1: Filiament (red)
2: Filament (black)
3: Not used
4: Not used

EBH heater:
1: Filiament (red)
2: Filament (black)
3: Specimen plate anode (green)
4: Not used

APPENDIX C. LIQUID NITROGEN COOLING

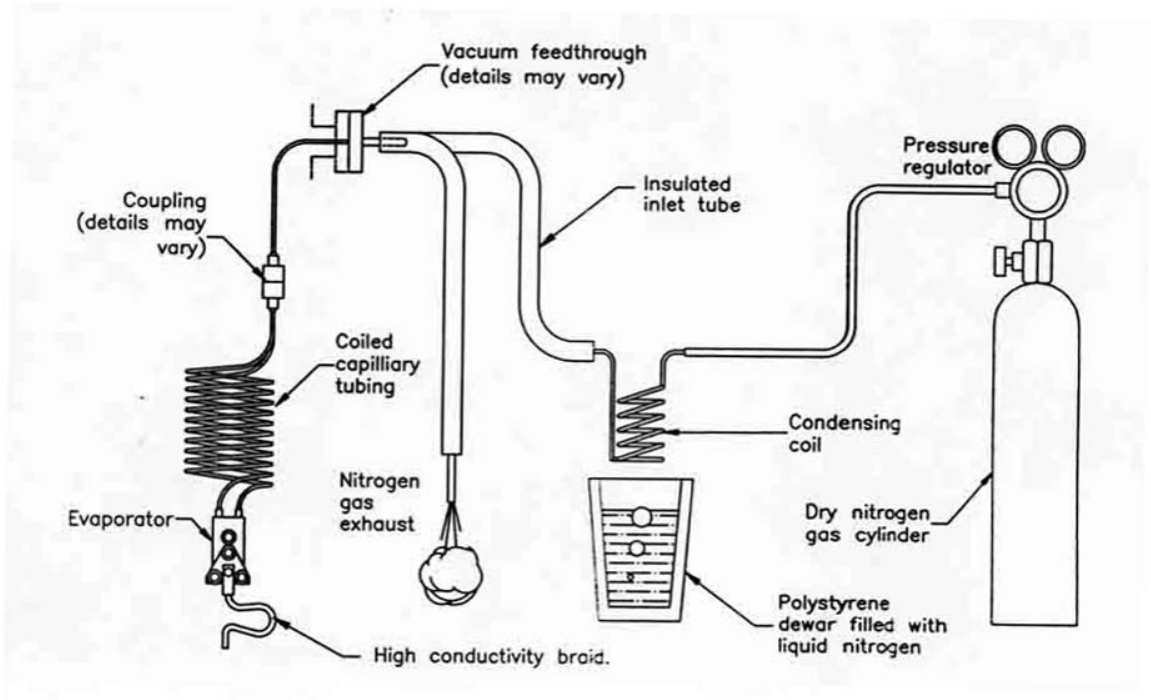
WARNING: Vacuum Generators cannot advise on the safe use and handling of liquid gases which is entirely the responsibility of the user. The use of liquid nitrogen in confined spaces can be extremely dangerous as nitrogen gas levels can build up rapidly. Ensure that the area is well ventilated. Always wear insulated gloves and safety goggles when handling liquid gases and surfaces that may be cold.

C1. REQUIREMENTS

A supply of high purity nitrogen gas from a regulated supply.
A supply of liquid nitrogen.
A condenser coil, insulated open polystyrene dewar and connecting polythene tubes with insulation (These items are available from Vacuum Generators as an accessory, order code ZLNHX).

C2. DESCRIPTION

Liquid nitrogen condensed from dry gas, enters and leaves the translator through liquid feedthrough connections. In-vacuum capillary tubing extends to the evaporator which should be mounted close to the sample position. The capillary tube is normally coiled to allow movement.
Conductive braid, electrically isolated from the evaporator, is supplied for mounting as near as possible to the sample.



LIQUID NITROGEN COOLING SCHEMATIC

C3. SETTING UP

Position the copper condenser coil and polystyrene dewar as near as possible to the nitrogen entry feedthroughs. Using 6.35mm bore tubing, connect the regulator on the cylinder to the coiled end of the copper coil and secure with hose clips.
Connect the vertical end of the coil using 3mm bore tube to (either) feedthrough port. External insulating tube should cover the tube as completely as possible.
The outlet connection should be made to the other manipulator port. Ensure that the exhaust gas/liquid is well away from equipment that could be affected by moisture.
For horizontally mounted units a simple foil sheet should be fitted under the inlet 1 outlet connections to help to prevent condensation dripping onto the drive screw and bearing shafts.

C4. OPERATION

a. Open the regulator to 0.5 bar to start a flow of gas through the system. Check that flow is coming from the system outlet pipe. Allow the gas flow to continue through the system for at least 2 minutes. This will purge the system of air to avoid formation of ice during cooling.
b. Place the coil in the dewar and fill the dewar with liquid nitrogen. Always maintain at least 25 mm of liquid above the top coil.
c. Increase the pressure to a maximum of 2 bar to start the cool-down cycle.
d. Liquid nitrogen will start to emerge in droplets from the outlet pipe within 10 minutes.
c. Reduce the gas pressure so that occasional droplets of nitrogen emerge. Excessive liquid mixed with the exhaust gas will reduce the cooling efficiency.
f. Once the desired temperature has been reached the gas flow can be reduced further.
g. On the completion of the cooling run, remove the copper coil from the dewar and allow the system to return to ambient temperature with a very gentle flow of nitrogen gas to prevent condensation.

C5. PERFORMANCE

The cooling performance will vary depending on many factors, including the nature of the sample, the sample mounting arrangements, radiated heat from the chamber, vacuum pressure and experimental conditions. The temperature will drop sharply once liquid has reached the evaporator, (when liquid droplets begin to emerge from the exhaust.) The temperature
will continue to fall and stabilise after approximately 1 hour.

C6. BAKEOUT

Disconnect all plastic tubes from the liquid nitrogen feedthrough connections before commencing bakeout.

Vacuum Generators
Maunsell Rd
Castleham Industrial Estate
East Sussex
TN38 9NN
England
Tel: +44 (0) 3424 851291
Fax: +44 (0) 1424 851489

E.C. Declaration of Incorporation
ref DoI-147 (VGF 4.06d Iss2)

We hereby declare that the following product range:
Part Codes:
Z Slides: MTX1570, MTX3070, MTX4570
XY Stages: MT000A.., MT105A…, MT108A.., MT208A..,
Motor Kits: MTRWD, MT05 (X & Y), MT08 (X & Y)
Stands: TRS, HAS

are, suitable for incorporation or assembly into a vacuum system or other machinery. These products may only be put into service if it has been verified that the system or machinery into which it is incorporated conforms to the provisions of the appropriate EU directives and with the limitations of the equipment specifications.

Applicable regulations:
89/392/EEC Version.93/68/EEC
Appropriate harmonised or national standards.

EN292-1
EN292-2

(Signed).....

Dr R J K Nicholson
Director of Development

Vacuum Generators

The Vacuum Company
Maunsell Road
Castleham Industrial Estate
Hastings
East Sussex TN38 9NN
England
Tel: +44 (0)1424 851291
Fax: +44 (0)1424 851489

Declaration of Contamination of Equipment and Components

Serving and repairs will only be carried out if the conditions for Servicing and Repair are complied with in full, according to the Vacuum Generators Ltd. Conditions of Sale. A summary of these requirements are included on the inside front cover of the Operating Instructions. The manufacturer will refuse to accept any equipment without a signed declaration attached to the OUTSIDE of the packaging. This declaration can only be completed and signed by authorized and qualified staff.

1 Description of Equipment and Components

Equipment Type…….Model Number…….
Serial Number……...Your Reference Number…….

2 Reasons for return……

3 Condition of Equipment

YES ( ) NO ( ) Toxic?
YES ( ) NO ( ) Explosive?
YES ( ) NO ( ) Radioactive?
YES ( ) NO ( ) Corrosive?
YES ( ) NO ( ) Biological Hazard?
YES ( ) NO ( ) Other Harmful Substances?

Equipment and Components that have been contaminated, WILL NOT be accepted without written evidence of decontamination.

5 Contamination Materials

List all the substances, gases and by-products that may have come in contact with the equipment, giving trade name, manufacture, chemicals names or symbols.
Please note that any of these listed, must be completely removed, so it is safe to handle and weld, without giving off health threatening gases. Please enter details below and/or attach data sheets
……
……
……

6 Legally Binding Declaration

I hereby declare that the information supplied on this form is complete and accurate.
There by stating that the goods offer no risk to health or safety
Organization…….. Name…….
Country…….. Job Title…….
Post/ZIP code……..Telephone……..
FAX……..
Signature……..Date……..

Return goods to: Dave Darvill (Address at top)
Email: dave.darvill@thermo.com Phone: (0) 1424 856360 Fax (0) 1424 851489 (Form VGF33)