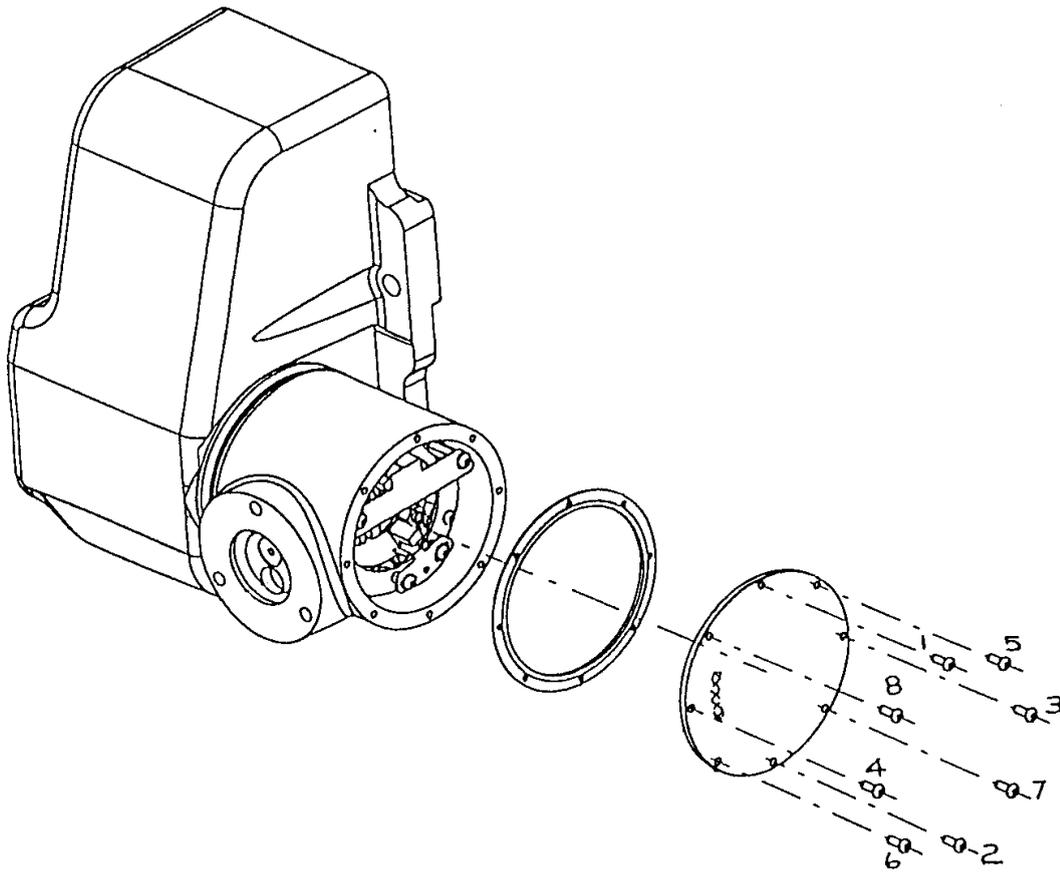


TSA

Motorised Tool Setting Arm



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Renishaw part no: H-2000-5090-01-A

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Changes to specification

Renishaw plc may modify or change its products or specifications without notice and without obligation.

Warranty

This document defines the procedure for fault finding and repairing TSA returned to the OEM after expiry of the warranty.

This document is to be used in conjunction with Renishaw parts supplied in the Repair Kit (A-2116-0131).

Renishaw plc cannot take responsibility for any Renishaw product repaired by the OEM.

The OEM may only repair Renishaw product if its warranty has expired.

Equipment requiring attention under warranty must be returned to your supplier. No claims will be considered where Renishaw equipment has been misused, or unauthorised persons have attempted repairs or adjustments.

PRECAUTIONS

Safety

Remove power before performing any maintenance operations.

Only competent persons observing relevant safety precautions may carry out repairs.

Anti static handling

The electronic circuit board assemblies within the TSA and those supplied in the Repair Kit are sensitive to static discharge.

Anti static precautions must be observed during handling or installation of the electronic circuit board assemblies. Failure to do so could result in permanent damage to the electronics.

Product integrity

The torque wrench settings defined in this manual ensure the integrity of sealing elements and fixings within the TSA.

Failure to use these settings when repairing TSA could result in coolant ingress or poor repeatability.

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When down in the 'Active' position, ensure: - 'Stow' status LED is OFF
'Active' status LED is ON

If the LEDs do not show the correct status, consult section 2 (a) of Fault Diagnosis.

Attempt to rotate the hub by applying slight hand pressure to the arm in the 'Stow' and 'Active' directions. Ensure there is no rotational movement of the hub with respect to the base in either direction. If the hub can be moved freely consult section 2 (e) of Fault Diagnosis.

Drive the hub to a position halfway between 'Stow' and 'Active' and switch off the power to the TSA.

Holding the hub casting firmly by hand, rotate it in both directions using moderate force. The maximum permissible rotation is 2°. If the hub can be moved further than this consult section 2 (e) of Fault Diagnosis.

Switch on the power to the TSA and allow the hub to continue to its 'Stow' position.

Disconnect the power to the TSA before removing it.

2.0 FAULT DIAGNOSIS.

Possible Faults, Causes and Solutions

Problem: -

(a) Arm moves into 'Active' position, but 'Active' confirm LED is not lit.

| Possible Causes | Rectification |
|---|---|
| a) Opto switch vanes incorrectly set or damaged | Consult section 4.2 |
| b) Soft limits PCB defective | Consult section 3.2 |
| c) Hard limits PCB defective | Consult section 3.3 |
| d) Operating voltage <21.6 v (min) | Measure voltage with suitable meter and correct supply if possible |
| e) Motor performance deterioration | Return TSA to Renishaw if renewal/replacement is required |
| f) Control PCB fault | Replace PCB, section 3.4 |
| g) Wiring fault | Check all wiring as per TSA Installation & User's Guide (H-2000-5088-05) section 5. |

(b) Arm moves into 'Stow' position, but 'Stow' confirm LED is not lit.

| Possible Causes | Rectification |
|--|-------------------------------------|
| a) Opto switch vanes incorrectly set or broken | Consult section 4.3 |
| b) Hard limits PCB defective | Consult section 3.3 |
| c) Control PCB fault | Replace PCB, section 3.4 |
| d) Loose mechanics | Check all recommended torque values |

(c) Arm moves too slow or with excessive judder

| Possible Causes | Rectification |
|----------------------------|---|
| a) Main bearing seizing up | Return TSA to Renishaw if renewal/replacement is required |
| b) Motor defective | Return TSA to Renishaw if renewal/replacement is required |
| c) Control PCB fault | Replace PCB section 3.4 |
| d) Loose mechanics | Check all recommended torque values |

(d) Arm does not move in either direction.

| Possible Causes | Rectification |
|-------------------------------|---|
| a) Control PCB failure | Replace PCB section 3.4 |
| b) Motor failure | Return TSA to Renishaw if renewal/replacement is required |
| c) Total main bearing seizure | Return TSA to Renishaw if renewal/replacement is required |
| d) Wiring fault | Check all wiring as per TSA Installation & User's Guide (H-2000-5088-05) section 5. |

(e) Excessive hub end float and rotation

| Possible Causes | Rectification |
|-------------------------------------|---|
| a) Loose main bearing | Return TSA to Renishaw if renewal/replacement is required |
| b) Anchor plate screws loose | Re-tighten screws, section 3.3 |
| c) Loose kinematic structure | Return TSA to Renishaw if renewal/replacement is required |
| d) Excessive wear in motor assembly | Return TSA to Renishaw if renewal/replacement is required |

For additional fault diagnosis, consult section 5.0 - Trouble Shooting

3.0 DISASSEMBLY/REASSEMBLY.



Disconnect power before commencing work. Observe anti-static handling precautions.
A proprietary thread locking compound must be applied to screws where stated, to prevent loosening during operation of the TSA.
Molybdenum disulphide grease must be applied, where stated, to maintain smooth running of sealing surfaces.

A spare O-ring (P-RS01-0041) is supplied in the Repair Kit for re-assembly of the Arm to the Hub. Heatshrink (P-CA57-0032) is also supplied to provide additional strain relief for the Arm/Probe Cable if required.

3.1 HUB COVER PLATE AND GASKET.

| | |
|-----------------------|---|
| <p>Strip</p> | <p>Remove cover plate and gasket.</p> <p>Inspect gasket for any damage, and any evidence of coolant ingress.</p> <p>Ensure both opto switch vanes are securely in place, and screws are tight.</p> |
| <p>Rebuild</p> | <p>Renew gasket (M-2116-0085).</p> <p>Replace cover plate with serial number nearest to arm attachment face.</p> <p>Tighten all 8 M3 screws (P-SC17-0308) to 0.7 Nm following the sequence shown in figure 3.1.</p> |

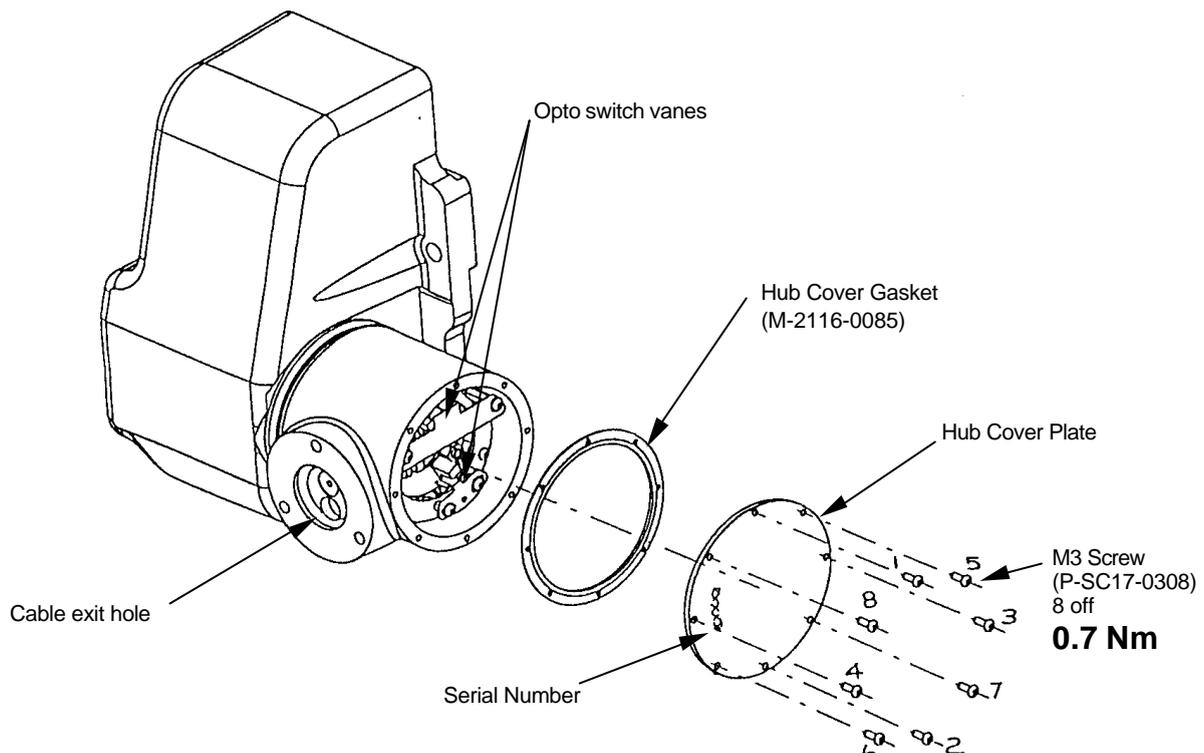


Figure 3.1

3.2 VANES AND SOFT LIMITS PCB.

| | |
|--|---|
| <p>Strip</p> | <p>Unscrew and carefully remove both opto switch vanes to give complete access to the Soft Limits PCB. Do not bend the vanes as this could affect operation.</p> <p>Remove 2 off Ty-raps, unsolder probe wires from pins and unplug Hard Limits PCB cable loom from Soft Limits PCB.</p> <p>Unscrew 3 off M3 screws to remove Soft Limits PCB.</p> |
| <p>Rebuild</p> | <p>Insert Soft Limits PCB (A-2116-0570) into hub and secure with 3 off M3 screws (P-SC17-0304).</p> <p>Solder probe wires to pins. Plug Hard Limits PCB cable loom into socket on Soft Limits PCB as per figure 3.2a.</p> <p>Fit new Ty-raps (P-CA66-0922) around probe wires and cable loom to Soft Limits PCB to give strain relief as shown.</p> <p>Refit opto switch vanes as per figure 3.2.</p> <p>Note: For set up of opto switch vanes, consult section 4.2 & 4.3 of Setting Up.</p> |
| <p>To continue rebuild go to section 3.1</p> | |

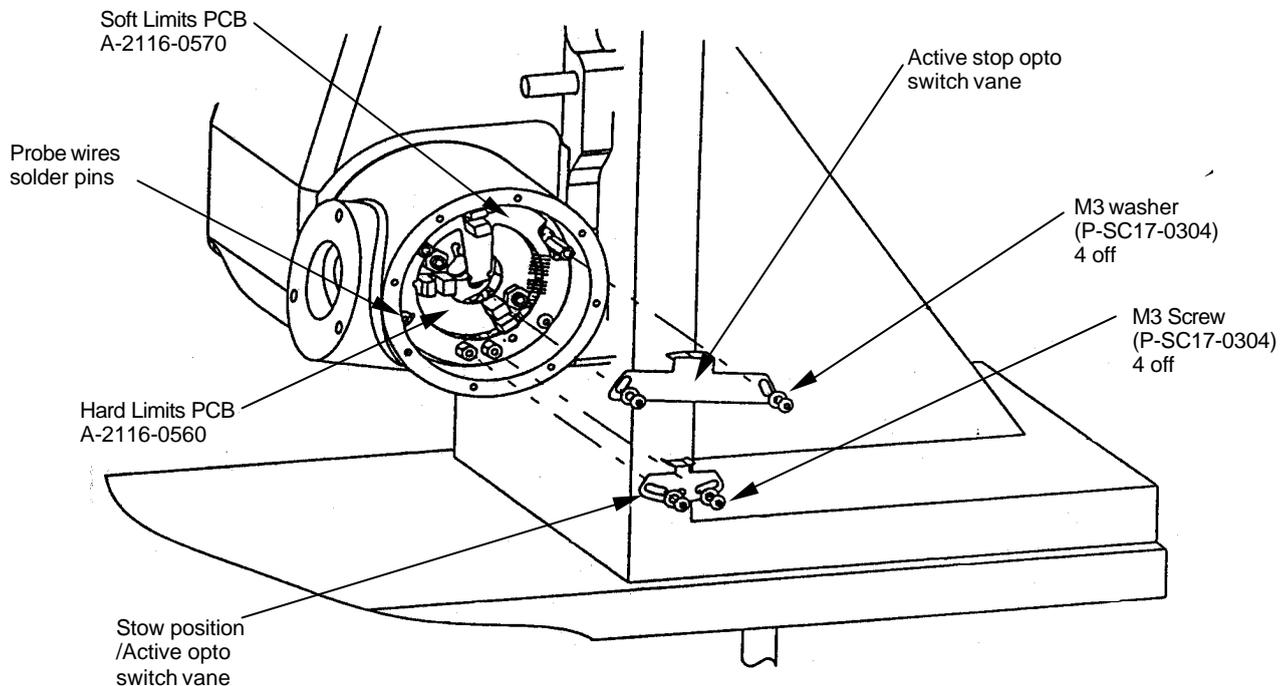


Figure 3.2

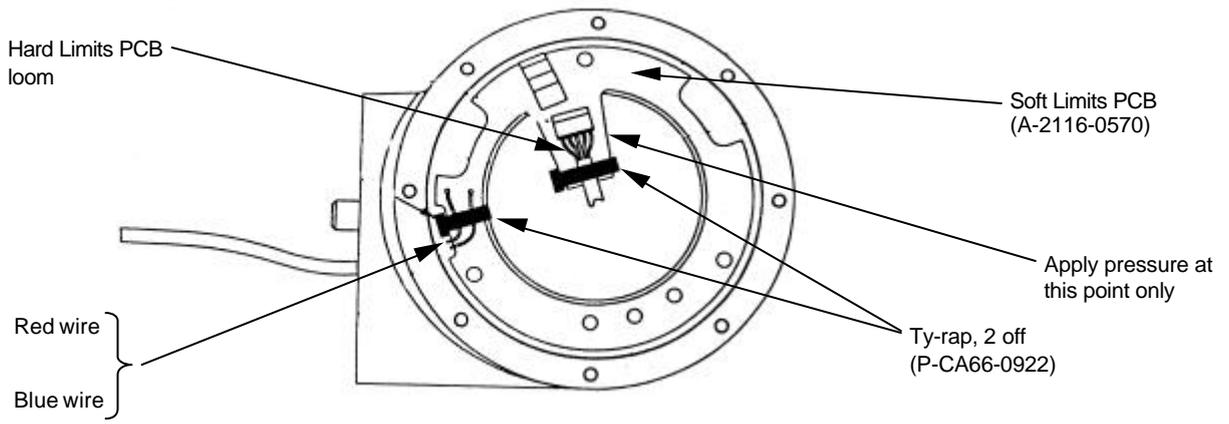


Figure 3.2a

3.3 HUB ASSEMBLY AND HARD LIMITS PCB.

| | |
|---------------------------------------|---|
| Strip | <p>Unplug 8-way connector from Hard Limits PCB. Undo 2 off M5 nuts. Hard Limits PCB is now free to remove.</p> <p>Undo 4 off M4 screws in centre of hub plate and remove hub.</p> |
| Rebuild | <p>Apply grease to front kinematic spools and lugs on structure.</p> <p>Renew face seal (P-RS05-0006) as per figure 3.3a. Ensure the lip stands up evenly all the way around.</p> <p>Locate hub assembly onto bearing end face and check for free rotation of hub in both directions. If this rotation is restricted to less than 90° of rotation and a repair or replacement is required, then the TSA must be returned to Renishaw.</p> <p>To secure hub to bearing as per Figure 3.3, apply thread locking compound to 4 off M4 screws and torque to 2 Nm.</p> <p>Place Hard Limits PCB (A-2116-0560) onto locating tubes and secure with 2 off M5 nuts. Plug in 8-way connector and push excess wire back down tube. Stretch 1 off O-ring (P-RS01-0093) over hub and locate into groove instead of the garter spring.</p> |
| To continue rebuild go to section 3.2 | |

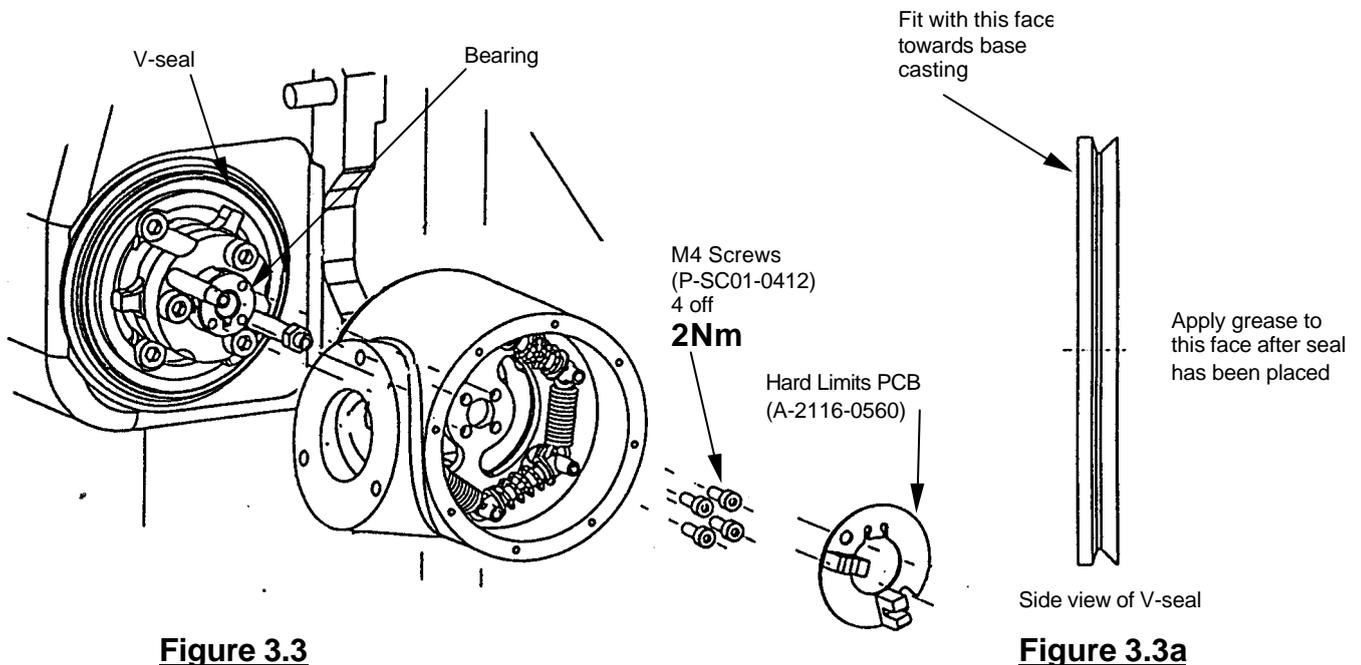


Figure 3.3

Figure 3.3a

3.4 COVER PLATE, GASKET AND CONTROL PCB.

| | |
|--------------|--|
| Strip | <p>Remove all screws from cover plate.</p> <p>Inspect gasket for any damage, and any evidence of coolant ingress.</p> <p>Before removal, ensure the Control PCB is securely fixed and that the main cable wires are correctly connected as per section 4.1 of Setting Up. Remove by loosening the single M3 socket screw in the keyhole slot in the middle of the PCB and withdrawing the PCB from the connector and over the screw.</p> |
|--------------|--|

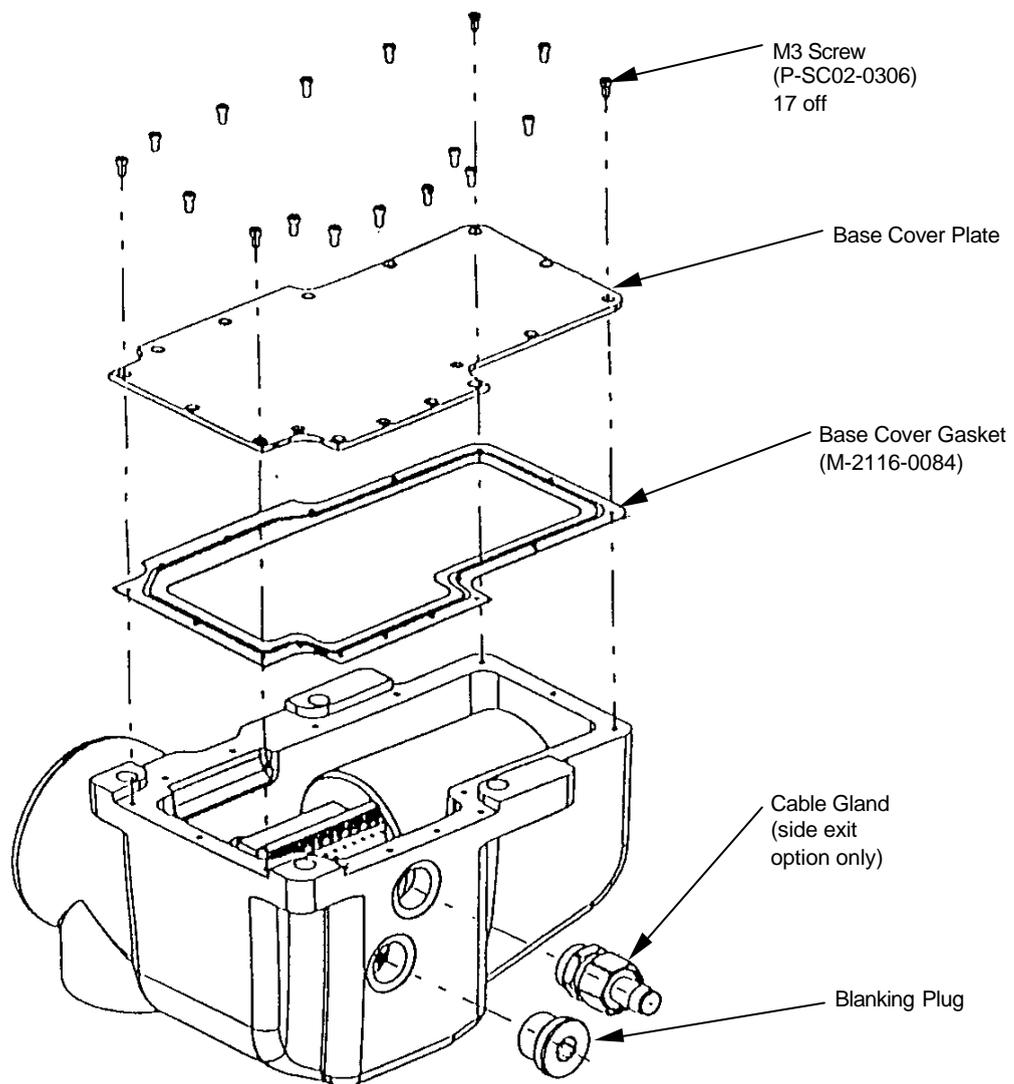


Figure 3.4

| | |
|--|--|
| <p>Rebuild</p> | <p>Insert the control PCB (A-2116-0520) into the assembly and push the board into the connector at the same time as pushing the keyhole slot in it over the M3 socket screw. Tighten the screw to secure PCB in place as per figure 3.4a.</p> <p>Re-connect the main cable wires as per section 4.1 of Setting Up.</p> <p>Renew cover gasket (M-2116-0084)</p> <p>Place base cover plate onto casting and secure with 17 off M3 screws (P-SC02-0308). Torque all screws to 0.7 Nm as per tightening sequence shown in figure 3.4b.</p> |
| <p>To continue rebuild go to section 3.1</p> | |

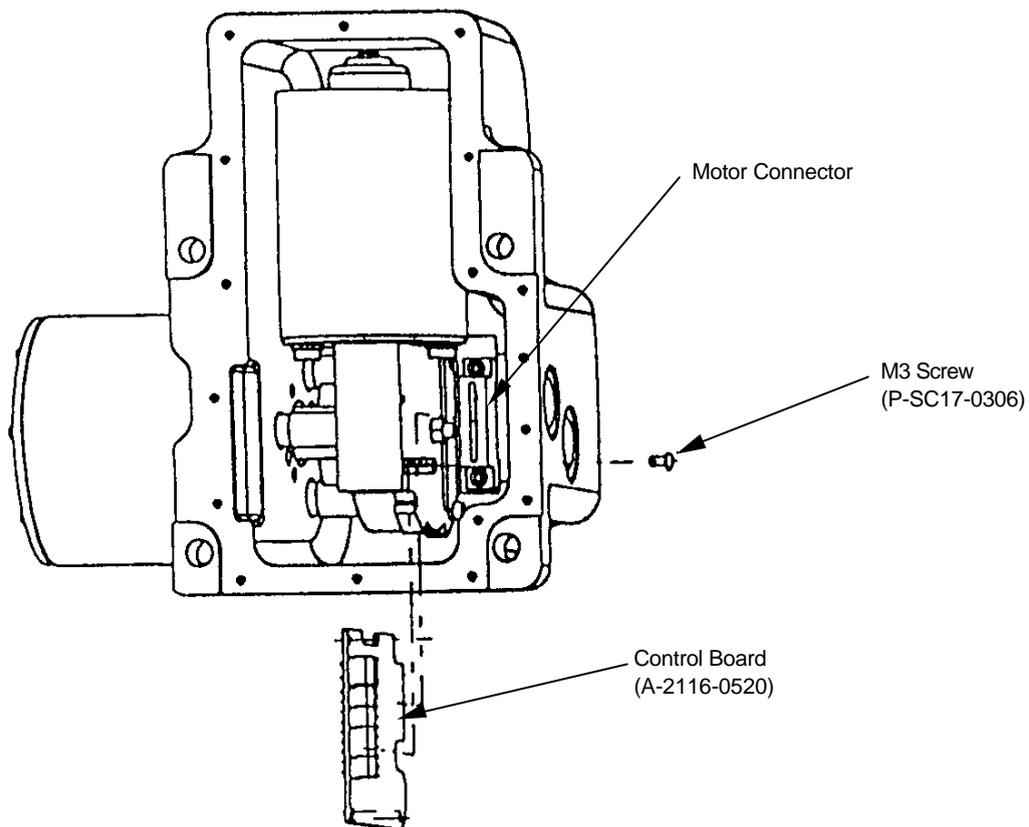


Figure 3.4a

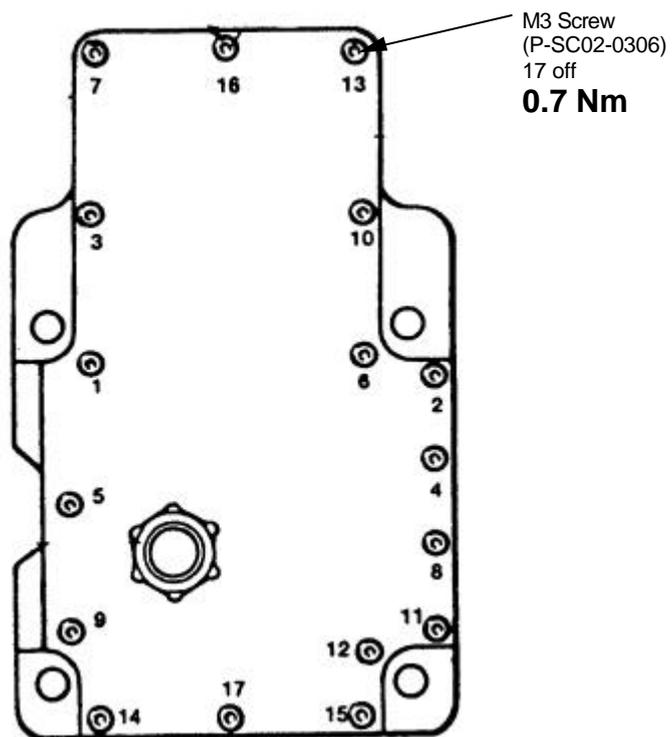
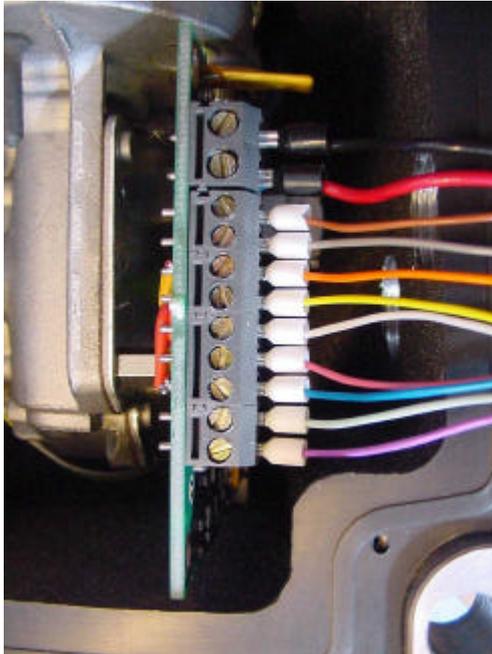


Figure 3.4b

4.0 SETTING UP.

4.1 CONTROL PCB WIRING.

Connect main cable to Control PCB as per figure 4.1.



| Control board connectors | |
|---------------------------------|-----------|
| 1 | Black |
| 2 | Red |
| 3 | Brown |
| 4 | Grey |
| 5 | Orange |
| 6 | Yellow |
| 7 | White |
| 8 | Pink |
| 9 | Blue |
| 10 | Turquoise |
| 11 | Violet |

Figure 4.1

4.2 ACTIVE STOP OPTO SWITCH VANE.

This set-up requires:

- That the Control PCB (A-2116-0520) is already fitted.
- All connectors are plugged in and wires are connected.
- Power is supplied to the TSA

Adjust the tightness of the 2 off M3 screws (P-SC17-0304) such that the vane can be rotated by hand under moderate pressure.

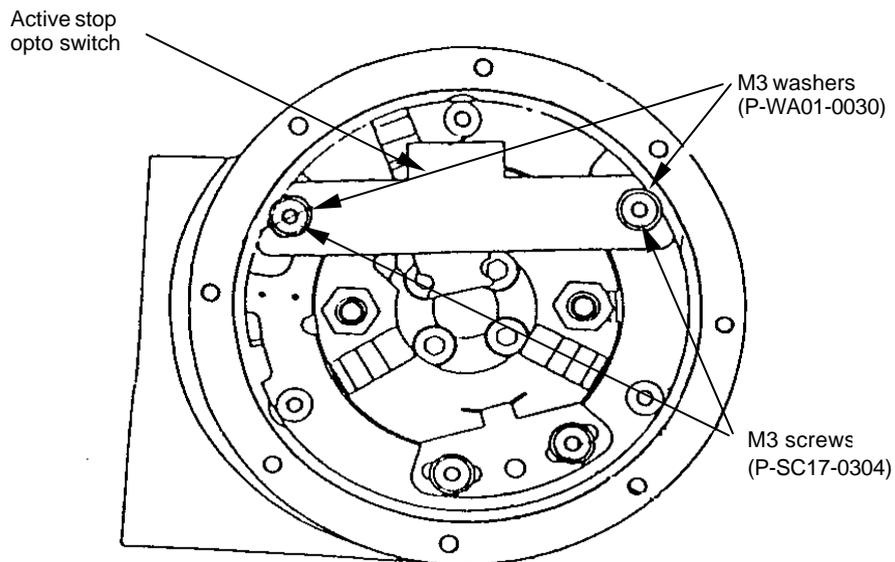


Figure 4.2

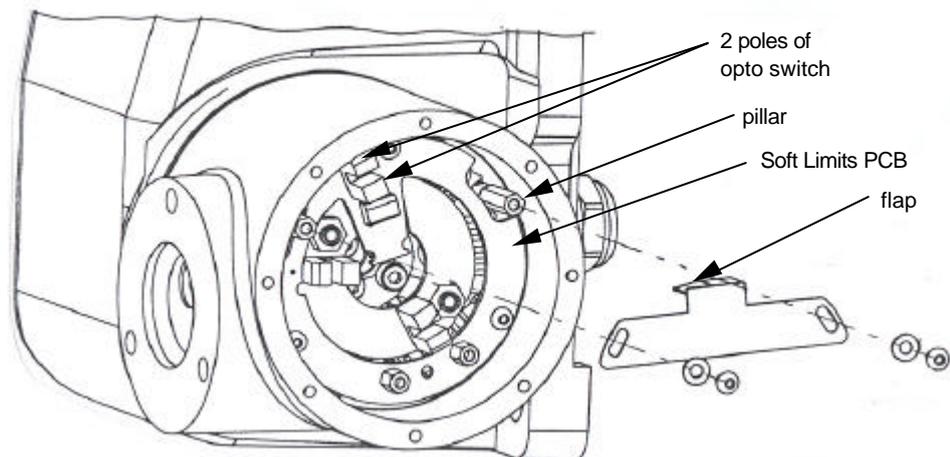


Figure 4.2a

Slide the vane fully anti-clockwise such that the flap lies midway between the poles of the opto switch.

Drive the hub from 'Stow' to 'Active' and watch for movement of the pillar relative to the Soft Limits PCB. Approximately 1mm movement is required.

A lack of movement means that the kinematics will not be preloaded by the springs and this will result in poor repeatability.

If there is no movement, slide the vane clockwise slightly then drive the hub from 'Stow' to 'Active' again. If necessary, repeat, making clockwise/anti-clockwise adjustments until approximately 1mm of relative movement between the pillar and PCB is observed.

Tighten both screws to 0.7Nm.

Visually check that the springs in the hub wind up approximately 1 mm.

4.3 STOW POSITION /ACTIVE OPTO SWITCH VANE

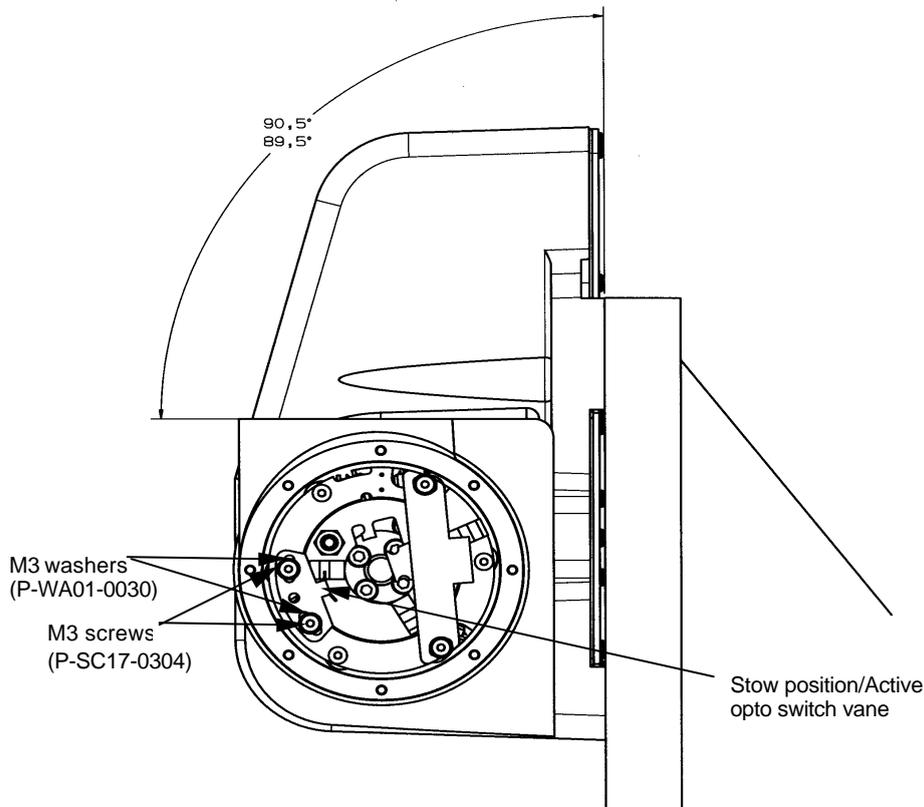


Figure 4.3

Move the vane to a central position as shown above. Adjust the tightness of the 2 off M3 screws (P-SC17-0304) such that the vane can be rotated by hand under moderate pressure.

1. Shield the exposed hub from any external light source.
2. From the active position drive the hub to the stow position.
3. Aim to have the hub stop such that the arm mounting face is $90^{\circ} \pm 0.5^{\circ}$ from the base mounting face.
4. Adjust the stow position of the hub by sliding the vane clockwise or anti-clockwise depending on the required position.
5. Repeat from 1. Until the correct position is achieved.
6. Tighten both screws to 0.7Nm.

Note: After adjusting the vane position always drive the hub from the active position to recheck new set-up. This is a very sensitive operation and may require several adjustments before the desired result is observed.

5.0 TROUBLE SHOOTING.

If the system exhibits poor repeatability or gives spurious readings, all aspects of the installation and operation should be investigated (eg operating method/conditions, software etc).

5.1 COLLISIONS.

In the event of collision, re-calibration of the probe is necessary.

5.2 DIAGNOSTIC LEDS.

Diagnostic LEDs have been incorporated in this product to assist installation and fault finding. These can be viewed by removing the M20 Viewing Plug located on the side of the TSA base as per figure 35 on page 61 of the TSA Installation and User's Guide. The LEDs are mounted on the PCB and assigned as follows:

| LED name | Colour | Lit when |
|-------------------|--------|--|
| Move Command | Green | 'Move' command received |
| Direction Command | Red | 'Move to Active' command received |
| Stow Confirm | Amber | Arm reaches Stow position |
| Active Confirm | Green | Arm reaches Active position |
| Probe Status | Red | Arm in Active and probe triggered or arm is in Stow |

| Inputs | | | Outputs | | | | LEDS | | | | |
|--------------------------|---------------------------------|---|-------------------|-----------------|---|---|-------------------------|---------------------------|-----------------------|-------------------------|---|
| Move L=Move H=Stop | Direction L=Active H=Stow | Trigger Input | Active Confirm | Stow Confirm | Probe Out | Probe Out | Move LED on Green | Direct LED on Green | Slow LED on Red | Slow LED on Amber | Trigger LED on Red |
| Move | Stow |  | H | L | L | H | ✓ | | ✓ | | ✓ |
| Move | Active |  | L | H |  |  | ✓ | ✓ | | ✓ |  |
| Stop | Active |  | L | H |  |  | | ✓ | | ✓ |  |

Note: A resettable fuse is incorporated in the circuit. This will automatically reset 30 seconds after the power is removed.

5.3 TROUBLE SHOOTING CHARTS.

| ARM SYSTEM NOT RESPONDING TO COMMANDS | |
|--|---|
| Possible Cause | Rectification |
| Power supply not connected | <p>Check electrical connections (ensure +24V and VI are connected)</p> <p>Check power supply (supplies for voltage and polarity)</p> |
| Command not received | <p>Check status of diagnostic LEDs</p> <p>Check machine control electrical outputs.</p> <p>Check electrical connections.</p> |
| NO PROBE OUTPUT | |
| Possible Cause | Rectification |
| Probe not connected | <p>Check wiring to machine.</p> <p>Remove probe and check probe to arm connection.</p> <p>Remove arm and check arm to hub connection.</p> |
| Probe open circuit | Remove probe and check continuity of probe (should be less than 1k Ω) |
| Active Confirm signal not present | Refer to Fault diagnosis section 2(a) |

| POOR SYSTEM REPEATABILITY | |
|---|--|
| Possible Cause | Rectification |
| Mounting screws not fully tightened | Tighten screws to specified torque. Re-datum probe. |
| Loose arm | Verify tightness of arm on hub Re-datum probe. |
| Loose probe | Verify tightness of probe in mounting Re-datum probe |
| Loose stylus | Tighten stylus Re-datum probe |
| Swarf on tool tip | Remove swarf |
| Calibration and updating of offsets is not occurring | Review software |
| Calibration and probing speeds are not the same | Review software |
| Probing is being performed within the machine acceleration/deceleration zones | Review software |
| Probing feedrate is too high for machine controller | Perform repeatability trials at various speeds (see section 11.4 of Installation and User's Guide) |
| Temperature variation is causing excessive movement in the machine and the TSA | Minimise machine and TSA temperature changes. |
| Machines has poor repeatability due to loose encoders, backlash, tight slideways and/or accident damage | Perform health check on machine tool e.g. use Renishaw's QC10 Ballbar system |
| Excess machine vibration | Eliminate vibration Utilise Vlf power input in place of VI |
| Vlf is being used with inconsistent probing speed | Change to VI and compare results |

5.4 TESTING.

Where possible a leak test should be carried out on TSA that have been opened. To do this, temporarily seal the probe cable connector and the free end of the main cable e.g. with insulation tape. Then apply a 500 mbar vacuum via a suitable adaptor fitted in the LED blanking plug hole. Once the vacuum has been achieved and the external vacuum source isolated, the rate of vacuum decay within the TSA should be less than 5cc/min.

To test for probe and machine tool repeatability a program should be written which continuously datums a reference tool (or a new tool) and records the updating of the appropriate tool offset.

The changes in the tool offsets will enable probe and machine tool repeatability to be defined.

NOTE: The machine's repeatability should be taken into account when analysing results. A minimum of 20 readings is necessary to obtain a satisfactory result.

System repeatability should be checked in all relevant machines axes.

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