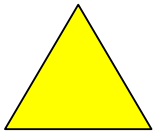
Keeler Applanation Tonometer

Service Manual

CE



ALWAYS READ THE INSTRUCTIONS

A HALMA GROUP COMPANY

Keeler Limited, Clewer Hill Road, Windsor, Berks, United Kingdom. SL4 4AA.
Tel No. +44 (0)1753 857177 Fax No. +44 (0)1753 830247

Issue A
18/10/2010

2415-P-7026

CONTENTS

Issue A
18/10/2010

Introduction

The Keeler Applanation Tonometer (KAT) is a complex assembly of numerous components interacting with each other. Each component involved must interact with the others with great accuracy. The customer has the ability to check the calibration of the assembly. There are two versions of the KAT – The T-Type and the R-Type. Both these assemblies have the same fundamental servicing areas as the only difference between the two is the mounting method. The two different assembly variants are shown in Figure 1 and Figure 2.

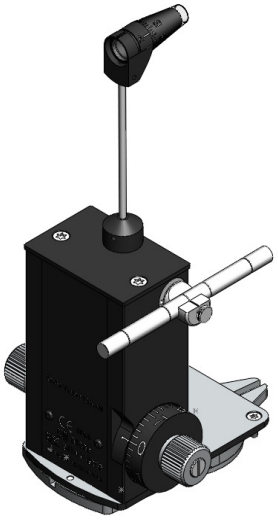


Figure 1 - KAT T-TYPE

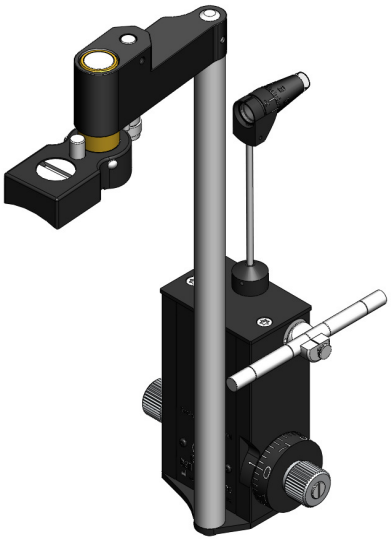


Figure 2 - KAT R-TYPE

This document will focus on the calibration of the main assembly of the tonometer (2414-P-5000) shown in Figure 3. Both the R-Type and the T-Type use the same main assembly.

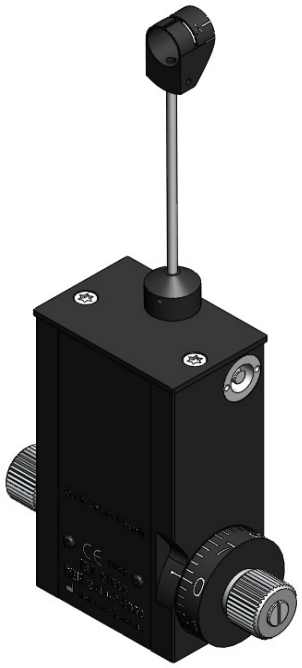


Figure 3 – 2414-P-5000

Service Principles

The main reason for servicing a KAT is to re-calibrate a system that has become out of calibration. Therefore, the first operation of the servicing will be to check the calibration.

Once the calibration error is diagnosed it is necessary to directly locate the problem and fix by whatever means are required to complete.

There are two key parts of the assembly that usually require attention depending on the diagnosis of issues. Details of the disassembly and servicing of these sub assemblies will follow.

There is a list of spare parts at the end of this document.

IT IS ESSENTIAL THAT THROUGHOUT THE SERVICE PROCEDURE THAT COMPONENTS ARE CHECKED FOR CONFORMITY WITH THE DESIGN DATA. COMPONENTS THAT ARE DAMAGED WILL LEAD TO AN INABILITY TO CALIBRATE AND EXTEND THE TIME TAKEN TO PERFORM THE SERVICE.

Tools Required

Key tools required are as follows:

- Circlip Pliers
- Slim 5.5mm spanner
- 4mm spanner
- T10 Torx head screwdriver
- T6 Torx head screwdriver
- Small Flat head screwdriver
- Small Phillips Screwdriver
- Large flat head screwdriver
- Tweezers
- Hex Heads: 1,3mm
  0,9mm
  1,5mm

Other materials required:

- Loctite Varnistop 7400 (RP18-00182)
- Loctite 222 (RP18-0086)
- Grease (RP18-00799)
- Loctite 638 (RP18-00027)
- Loctite 270 (RP18-00078)

Precautions

The calibration process is a very precise operation and requires very small and detailed alterations to the balancing of the entire system. Ensure all the details of the calibration are completed.

Care should be taken to carry out any repair work on a clean soft surface to minimise damage to the outside of the unit.

Calibration Checking

Notes Calibration Bar TD845 set at 20mmHg (2 on Dial)
Calibration Bar TD846 set at 60mmHg (6 on Dial)

Op. i.
Locate KAT Assembly into Nest TD817 and fit Prism (2401-P-8037) into Prism Holder of KAT Assembly, ensuring Prism is gripped and pushed in up to its shoulder.

Op. ii.
Rotate Dial until Prism Arm swings:

The swing arm should swing when the dial is moved from the positions shown in Figure 4.

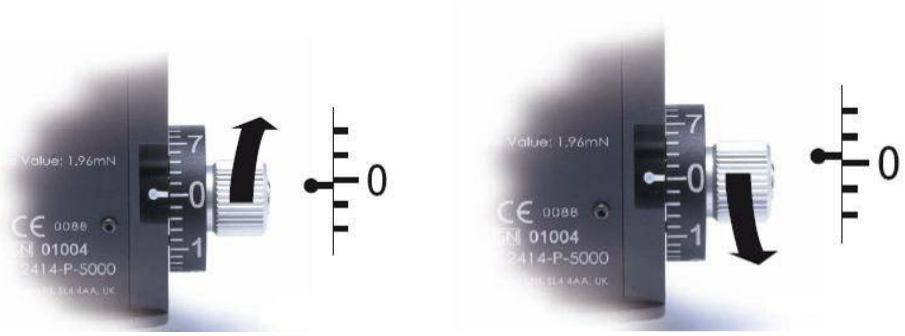


Figure 4

If the arm does not swing in this location it has failed calibration at 0

Op. iii.
Locate Calibration Bar TD846 (set at 6) onto KAT Assembly.

Rotate Dial until Prism Arm swings:

The swing arm should swing when the dial is moved from the positions shown in Figure 5.

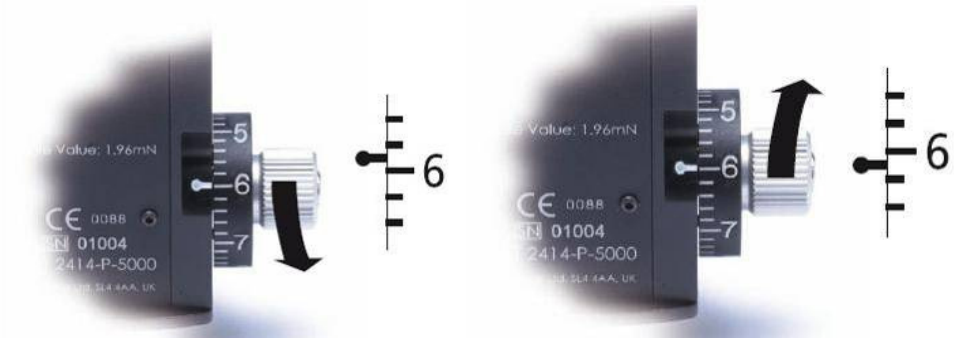


Figure 5

If the arm does not swing in this location it has failed calibration at 6.

Op. iv.

Locate Calibration Bar TD845 (set at 2) onto KAT Assembly.

Rotate Dial until Prism Arm swings:

The swing arm should swing when the dial is moved from the positions shown in Figure 6 .

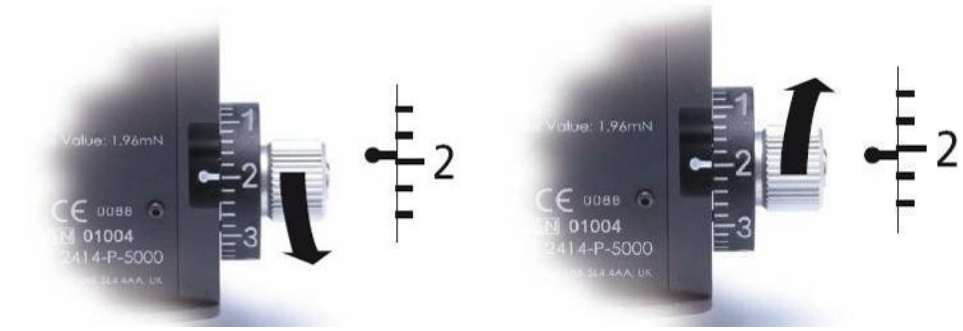


Figure 6

If the arm does not swing in this location it has failed calibration at 2.

Op. v.

Remove Calibration Bar and confirm Prism Arm still swings equally each side of Zero.

Once the calibration is checked make a note of the errors present in the calibration. Following the disassembly section there will be a section detailing the issues that could be causing the assembly to be out of calibration.

Assessment, Disassembly and Analysis

When removing components from the assembly it is essential to check whether components are dysfunctional. It is essential that all components are not bent or damaged in any way as this could lead to an inability to calibrate once assembled. It is essential to ensure that the mounting arm (for the R-Type) and the mounting plate (for the T-Type) are not damaged in any way. A damaged mounting feature will make a calibrated unit invalid once mounted.

Figure 7 shows an exploded view of the full assembly.

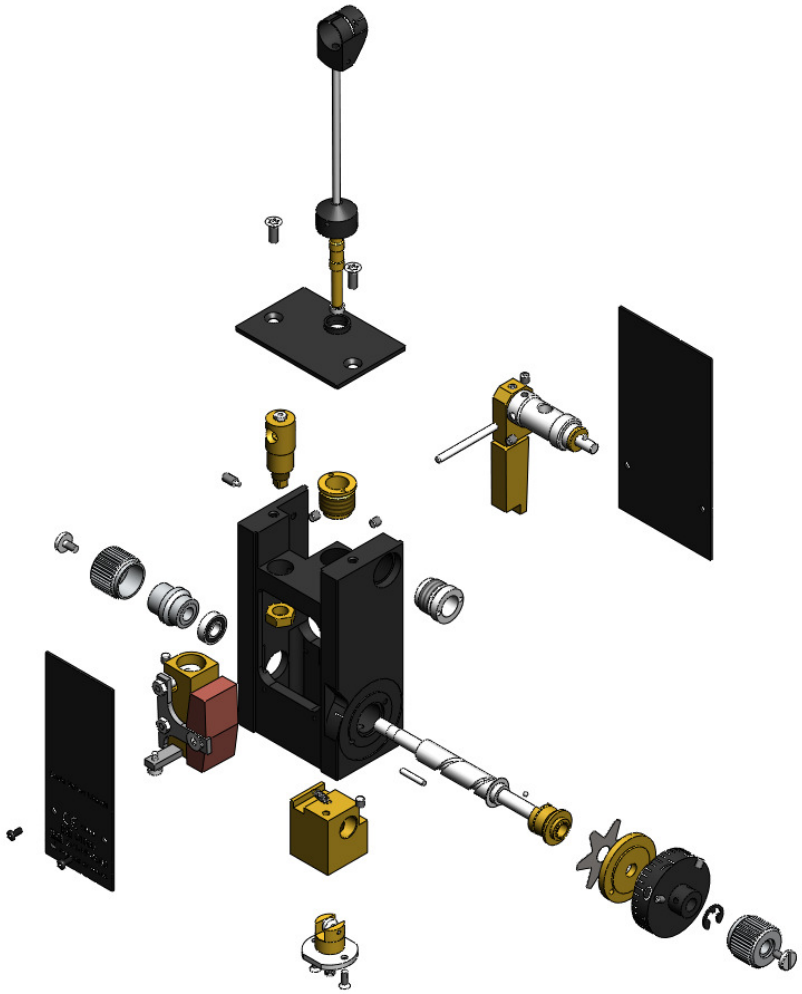


Figure 7 - Exploded View

Pivot Swing Arm

1. Loosen the grub screw at the front of the pivot assembly as shown in Figure 8.

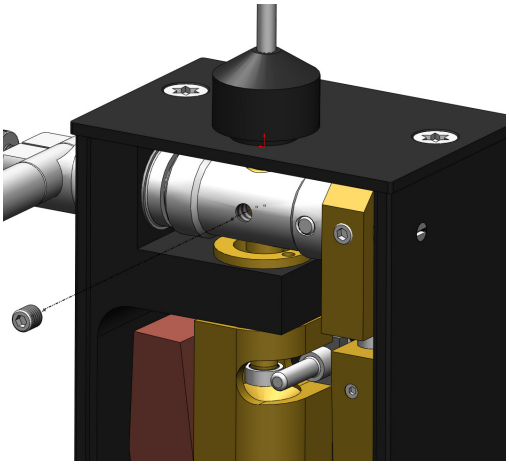


Figure 8 - Grub Screw Removal

Figure 9 - Arm Assembly Removal

2. Remove the arm assembly as shown in Figure 9 and confirm that it is not damaged in any way. Replace any damaged parts.

NOTE: CHECK THE BEARING HAS SUFFICIENT ROTATION AS A SLOW BEARING WILL CAUSE INEFFICIENCIES WITHIN THE SYSTEM

3. If required to the whole arm assembly can be replaced. This can occur in assemblies that have been dropped and badly damaged. Where possible please re-use components. Figure 10 shows the components of the prism arm assembly (the pivot collar contains a spring and a ball bearing but if collar is replaced please replace also)

Figure 10 - Prism Arm Assembly

Dial Assembly

Rotate the knurled knobs around in both directions to check the smoothness of the motion. This is shown in. Check the lead screw to see if it feels bent. Also, check for any movements that are not smooth.

If the motion is not smooth then the assembly requires dismantling and assessing. Figure 12 shows the exploded view of the assembly.

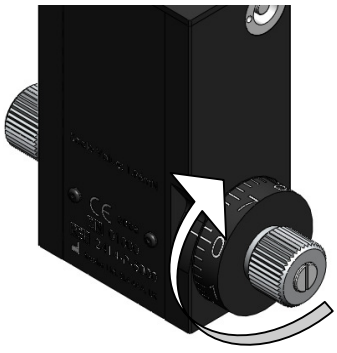


Figure 11

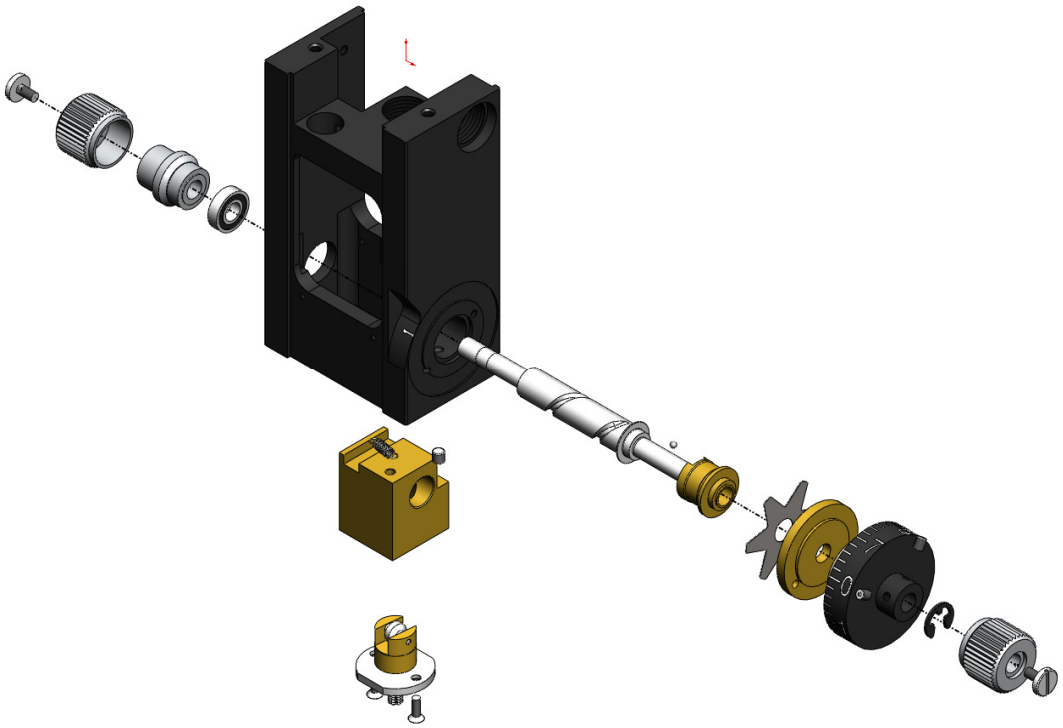


Figure 12 - Exploded View of Dial Assembly

If there is an issue with this assembly then follow the following instructions:

1. The base must be removed from the assemblies. For the R-Type and the T-Type the mounts are different but they are removed using the same three screws.
2. Remove all internal block components shown in Figure 13.

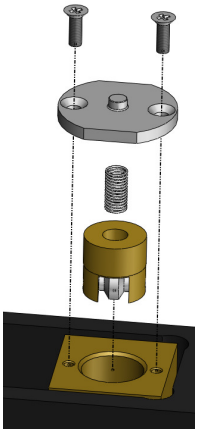
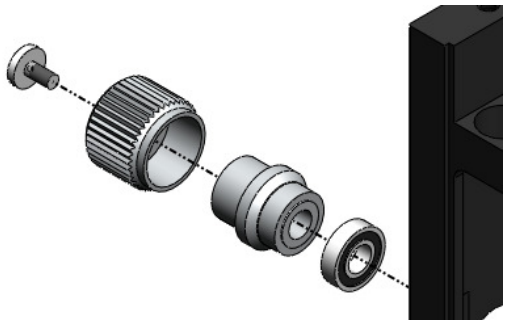


Figure 13

3. Remove all components shown in Figure 14. There is a grub screw to loosen the knurled knob spacer from the lead screw.

NOTE: CHECK THE BEARING THAT IS REMOVED TO ENSURE THAT IT HAS ADEQUATE FREEDOM OF ROTATION.



4

Figure 14 - Left Hand Dial Assembly components

4. Remove all components shown in Figure 15. There are two grub screws securing the dial to the lead screw. Ensure that all these components are not damaged in any way. Damage to either of the knurled knobs would indicate that the unit has been dropped. If this is the case ensure that the unit is checked thoroughly for any further damage as a result of this.

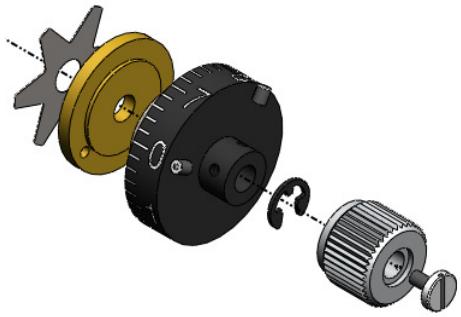


Figure 15 - Right Hand Dial Assembly components

5. Undo the grub screw within the KAT body, as shown in Figure 16. This will loosen the dial adjustment collar and enable the lead screw to be removed.

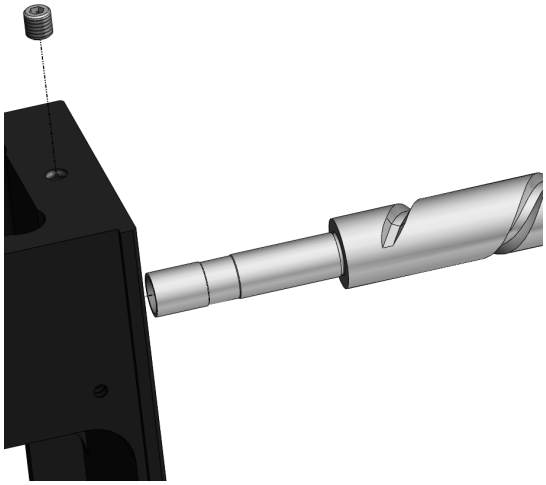


Figure 16 – Grub Screw removal

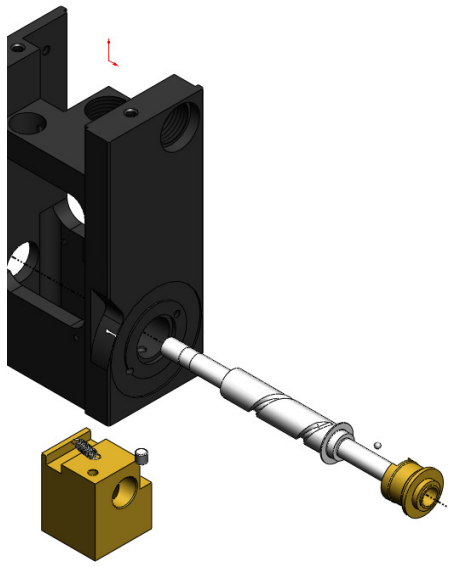


Figure 17

6. Remove the lead screw from the assembly. This should bring out all of the components shown in Figure 17. Care should be taken not to lose the small bearing within the assembly.

Removal of the lead screw will allow the block to fall out. Assess the assembly for any damaged components.

Check the components independently of each other at each interface to diagnose where the issue could be coming from. Replace any components that are causing problems with the smoothness of operation of the system. For a list of spare parts please see the spare parts list.

Pivot Assembly

Assess the motion of the pivot swing arm when moving from forwards to backwards. This is a very critical area of the assembly and requires setting up carefully in order to calibrate. The pivot arm should swing with a smooth motion. It should also swing between increments that would allow the calibration of the unit at each

Should the movement be inadequate to calibrate the unit the pendulum assembly should be looked at. Once the pivot arm has been removed the assembly shown in Figure 18.

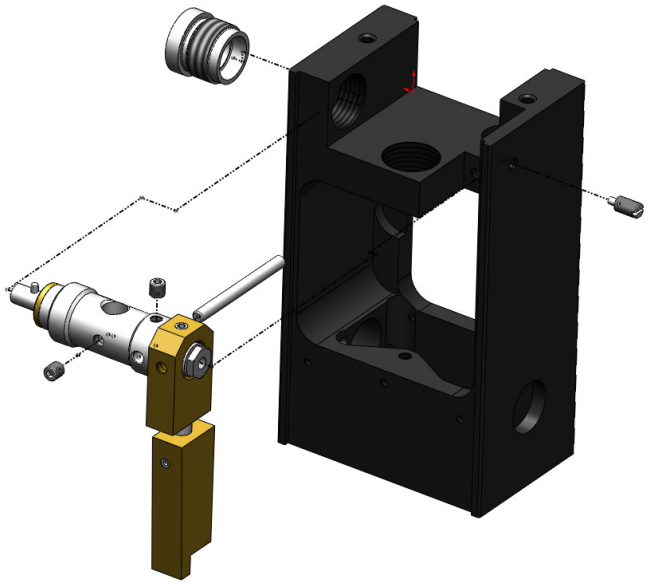


Figure 18 – Exploded Pendulum Assembly

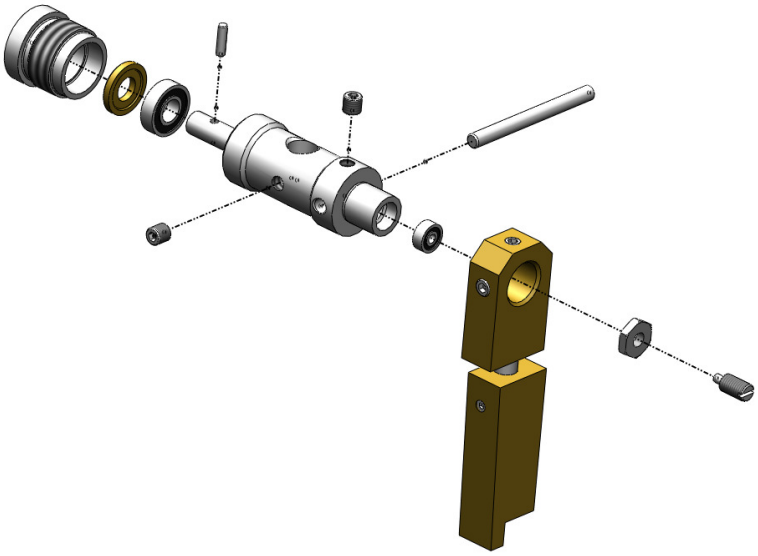


Figure 19 - Pivot Assembly

1. Loosen the M3 half nut and pendulum pivot screw as shown in *Figure 20*.

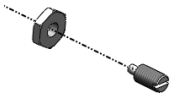


Figure 20 – M3 half nut and pendulum pivot screw

NOTE: THE WAY IN WHICH THIS IS SET UP CAN AFFECT THE FREEDOM OF MOVEMENT OF THE PIVOT. SOMETIMES THIS BEING ADJUSTED MAY REMOVE THE FRICTION FROM THE SYSTEM. IT IS WORTH ASSESSING THE PERFORMANCE OF THE UNIT ONCE THIS HAS BEEN ADJUSTED

2. Loosen and remove the Pendulum Pivot Collar and remove the pendulum assembly

Figure 21 – Pendulum Pivot Collar

3. There are 2 bearings present within this assembly that can cause friction in the assembly if inadequate rotation is achieved. Check these bearings for rotation and replace where it is required.

Figure 22 - Bearings

4. Check the rest of the components are secure and reassemble. Prior to assembly ensure threads are not damaged. Cross threaded components can cause a misalignment that will make the system not calibrate.

Summary of Errors that could be Present

Slow movement of the swing arm in one direction. (This can happen at all calibration points)

This error can be an indication that the damper sub-assembly is not set up correctly. Adjusting the alignment in the direction of the slow movement might correct the imbalance and help calibration. Continue with the rest of the calibration process once completed. If error is still present see below solution.

Slow movement of swing arm when calibrating at 6. (i.e. cannot achieve the 0.5 increment spacing when calibrating at 6)

There are a number of solutions that must be assessed when this issue occurs.

- Check the alignment of the prism arm pivot. Ensure that the pivot screw is correctly tightened. Also, check the pendulum pivot collar as this can affect the alignment of the assembly and add friction to the system.
- Check all the bearings within the assembly.
- Check all components are secured tightly within the assembly and assembled correctly.

Once the problem is solved repeat the calibration procedure.

Unable to move the pendulum down any further to calibrate at 2

Move the pendulum weight up to the top and start the calibration again. If after this the assembly is not calibrating please put it to one side and notify assembly supervisor / manager.

Not a smooth motion when rotating the dial

Remove the dial assembly and check all components within the lead screw assembly. Check the lead screw rotates smoothly within the block.

Cannot obtain required side to side motion for the block

Remove the lead screw and block assembly. Check that the ball bearing is rotated correctly within lead screw cap casing.

Calibration

Notes Calibration Bar TD845 set at 20mmHg (2 on Dial)
Calibration Bar TD846 set at 60mmHg (6 on Dial)

Op. i.
Using TD847 set Prism Arm swing movement. After setting movement tighten M2 Locknut (NP12-01002) onto M2×5 Grub Screw (SP12-00084) and M6x0.5 Locknut (NP16-01006) onto Damper Assembly.

Op. ii.
Locate KAT Assembly into Nest TD817 and fit Prism (2401-P-8037) into Prism Holder of KAT Assembly, ensuring Prism is gripped and pushed in up to its shoulder.

Op. iii.
Rotate Dial until Prism Arm swings:

Loosen grub screw

If Zero reading is towards '7' on Dial – Move Pendulum toward operator.
If Zero reading is towards '1' on Dial – Move Pendulum away from operator.

Pendulum is set correctly when Prism Arm swings each side of the Zero line as shown in figure 69. After adjustment of Pendulum, lightly tighten Grub Screws to hold in place.

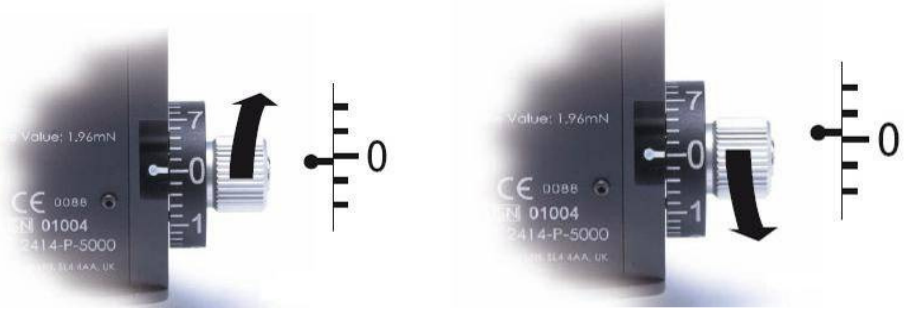


Figure 23

Op. iv.
Locate Calibration Bar TD846 (set at 6) onto KAT Assembly.

Rotate Dial until Prism Arm swings:

Loosen screw attaching the Tee Arm weight to the Tee Arm

If reading is greater than 6 on Dial – Move Tee Arm Weight out.
If reading is less than 6 on Dial – Move Tee Arm Weight in.

Adjust until Prism Arm swings each side of 6 on Dial as shown in figure 70.

Figure 24

Op. v.

Repeat Op. iii and Op. iv until both the 0 and the 6 are in calibration. If there are issues with the ability to calibrate the unit to your satisfaction please refer to the 'Troubleshooting Assemblies that will not Calibrate' section that follows this assembly operation.

Op. vi.

Locate Calibration Bar TD845 (set at 2) onto KAT Assembly.

Rotate Dial until Prism Arm swings:

If reading is greater than 2 on Dial – Move pendulum up
If reading is less than 2 on Dial – Move pendulum down

When adjusting the pendulum for this operation care must be taken that the rotating drive arm does not clash with the pendulum when the dial is at maximum.

Adjust until Prism Arm swings each side of 2 on Dial as in figure 71.

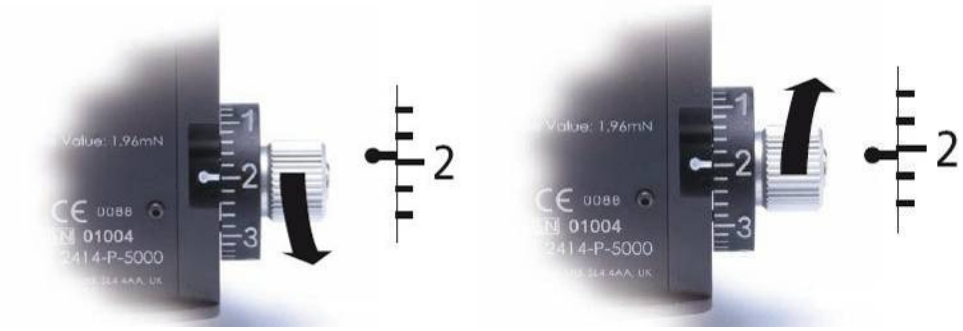


Figure 25

Op. vii.

Remove Calibration Bar and confirm Prism Arm still swings equally each side of Zero.

If reading has altered, repeat the calibration procedure from Op.ii

Op. viii.

Once calibrated ensure Pendulum Grub Screws and Tee Arm Weight Screw are secure.
Confirm Dial readings have not altered. Remove Prism and retain to be packed with assembly on which it was calibrated.

Spare Parts List

Part Number	Description
2401-P-8037	Keeler Applanation Tonometer Cone
2414-P-5008	K.A.T Polystrene Box
2414-P-7009	KAT User Instructions
EP29-40515	KAT Body
EP39-70501	Load Mechanism Pivot Collar
EP39-70502	Load Mechanism Pivot Screw
EP39-70503	Load Mechanism Body
EP39-70504	Load Mechanism Pivot Shaft
EP39-70505	Load Mechanism Tee Arm
EP39-70506	Load Mechanism Bearing Finger
EP39-70507	Load Mechanism Copper Weight
EP39-70508	Load Mechanism Drive Arm
EP39-70509	Load Mechanism Driving Pin
EP39-70511	Load Mechanism Bearing Spacer
EP39-70512	Pendulum Pivot Body
EP39-70513	Pendulum Upper Section
EP39-70514	Pendulum Lower Section
EP39-70516	Pendulum Bearing Washer
EP39-70517	Pendulum Pivot Collar
EP39-70518	Pendulum Pivot Screw
EP39-70519	Pendulum Damping Shaft
EP39-70521	Damper Body
EP39-70522	Damper Adjustable Body
EP39-70523	Damper Piston
EP39-70525	Drive Block
EP39-70526	Lead Screw Wheel
EP39-70527	Lead Screw Wheel Holder
EP39-70528	Lead Screw Wheel Pin
EP39-70529	Spring Cover Plate
EP39-70531	Lead Screw
EP39-70535	Dial Adjustment Collar
EP39-70536	Star Spring
EP39-70537	Dial Spacer
EP39-70539	I.O.P Dial
EP39-70541	Knurled Knob Spacer
EP39-70542	Knurled Knob

EP39-70543	M2.5x5mm Large Head Screw S/S 316
EP39-70545	Prism Arm Shaft
EP39-70547	Prism Arm Spacer
EP39-70548	Prism Arm Detent Spindle
EP39-70549	Prism Arm Cap
EP39-70550	Prism Holder
EP39-70551	Top Cover
EP39-70552	Front Cover
EP39-70553	Rear Cover
EP39-70555	Calibration Key
EP39-70556	Calibration Arm
EP39-70580	T-Type Base Plate
EP39-70581	T-Type Location Pin
EP39-70582	T-Type Foot
EP39-70585	T-Type Slit Lamp Guide Tongue
EP39-70563	R-Type Mounting Post
EP39-70565	R-Type Base Plate
EP39-70566	R-Type Bearing Shaft
EP39-70567	R-Type Bearing Sleeve
EP39-70568	R-Type CSK Bearing Washer
EP39-70570	R-Type Fixed Plate
EP39-70571	R-Type Stop Post
EP39-70572	R-Type Fixed Post
EP39-70573	R-Type Away Dowel
EP39-70574	R-Type Centre Dowel
EP79-70121	Compression Spring 3.55mmODx0.27T
EP79-70122	Compression Spring 2.8mmODx0.2T
EP79-70123	Compression Spring 1.45mmODx0.15T
WP17-09001	Shin Washer 7.5ID 10.8ODx0.3T