A HALMA GROUP COMPANY

Puls*air*

Non-contact Tonometer

Service Instructions

ALWAYS READ THE INSTRUCTIONS

CE

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CONTENTS

CONTENTS

1. SERVICE EQUIPMENT CHECKLIST AND TECHNICAL DATA

1.	2401-P-5100	TUBE & CONNECTOR ASSEMBLY
2.	2401-P-5119	RS232 COMMUNICATION CABLE
3.	2401-P-5127	PC SERIAL PORT CABLE ASSEMBLY
4.	2401-P-6736	CALIBRATION ELECTRONIC UNIT
5.	2401-P-6787	CALIBRATION JIG Pulsair 2000/3000
6	2401-P-6005	CALIBRATION JIG Pulsair (EasyEye)
7.	EP79-09146	14/15mm SPANNER
8.	EP79-09154	DAQ CABLE ASSEMBLY
9.	EP79-09162	DAQ CARD 1200
10.	EP59-10901	25 WAY DONGLE
11.	EP84-01130	SOFTWARE INSTALLATION DISC V2.7
12.	RP18-00094	LOCTITE 601 ADHESIVE
13.	RP18-00318	BOSTIC CLEAR ADHESIVE

CALIBRATION OF TEST JIG

This calibration function can only be carried out at KEELER LTD

The test unit must be returned to Keeler for recalibration periodically {once a year} as per the due date on the back of electronic unit.

The items to be returned are as follows

1. CALIBRATION ELECTRONIC UNIT AND CABLE ASSEMBLES
2. TRANSDUCER ASSEMBLY
3. CALIBRATION JIG & DUMMY EYE
4. DAQ CABLE ASSEMBLY AND CARD 1200

PLEASE RETURN TO
KEELER LIMITED
CLEWER HILL ROAD WINDSOR
BERKSHIRE SL4 4AA
ATTN DAVE GRAHAM

2. Puls*air* Spare parts list

Parts common to all models

2401-P-6744	AIR FILTER ASSEMBLY
EP39-05869	PUMP ADAPTOR
EP39-06896	BSP\NPT ADAPTOR
EP39-05500	BULB CONTACT
2110-P-7018	WIPES (PACK OF 24)
PP02-82056	PTFE TAPE
EP79-40899	CABLE-TIE
RP18-00094	LOCTITE 601 RETAINER
EP39-04639	NEEDLE VALUE

Puls*air* model 2000 only

2401-P-6664	UMBILICAL CORD ASSEMBLY (2000)
2401-P-6955	P.C.B (2000)
1024-P-5062	BULB (2000)
EP18-00203	CASE LEFT (2000)
EP18-00211	CASE RIGHT (2000)
2401-P-6437	MAINFRAME ASSEMBLY
EP79-03334	SPIRAL PIN
EP79-05161	M3 INSERT

Puls*air* model 3000 only

2401-P-6963	UMBILICAL CORD ASSEMBLY (3000)
2401-P-6998	P.C.B (3000)
1024-P-5118	BULB (3000)
EP19-01848	CASE LEFT (3000)
EP19-01856	CASE RIGHT (3000)
2401-P-6437	MAINFRAME ASSEMBLY
EP79-03334	SPIRAL PIN
EP79-05161	M3 INSERT

Puls*air* model EasyEye only

2414-P-5002	UMBILICAL CORD ASSEMBLY (EasyEye
2414-P-6002	MAINFRAME ASSEMBLY
EP29-50860	P.C.B (EasyEye)
EP39-50643	DISPLAY P.C.B
EP39-50651	SWITCH P.C.B
EP09-00501	CASE RIGHT (EasyEye)
EP09-00528	CASE LEFT (EasyEye)
1024-P-5118	BULB
EP39-50387	SCREW PLUG

3. SOFTWARE INSTALLATION FOR PULSAIR CALIBRATION

ITEMS REQUIRED

1. NATIONAL INSTRUMENTS PCMCIA ANALOGUE TO DIGITAL CONVERTER
2. NATIONAL INSTRUMENTS SOFTWARE DISC (6.1V)
3. PULSAIR CALIBRATION SOFTWARE DISC (2.7.0V)

LOADING PROCEDURE

It is **IMPORTANT** that the National Instruments Software for the **A.D.C** is installed first to minimise possible problems with the PCM CIA card

1. Place the **NATIONAL INSTRUMENTS CD ROM DISC** into CD-ROM drive bay.

2. **DOUBLE CLICK** My Computer on your Desktop.

3. **DOUBLE CLICK** the CD ROM icon /Drive Letter in My Computer.

4. **DOUBLE CLICK** onto the set-up icon.

5. Follow the on screen instructions. **DOUBLE CLICK** onto the install **NI-DAQ** option **FOR Windows 95 ONLY** select the language setting (this should be highlighted in blue). **DOUBLE CLICK** ok. Click next at each screen instruction until the install screen appears, then click ok.

6. When ok box has been clicked, the computer will automatically re-start.

7. After the computer has restarted, close the computer down completely and then switch off.

8. Connect the ribbon cable EP79-09154 to the ADC PCMCIA card carefully.

9. Place the national instruments PCMCIA **DAQ-1200** card carefully into the PCMCIA slot in the computer, ensuring that the card is in the correct position.(as the instruction written on top of the DAQ –1200 *card*) *insert card* ⇨

10. Turn the computer back on.

11. Windows 95/98 will automatically detect the new ADC card and install the appropriate software for it.

12. **CLICK ON TO START** in main menu, then **PROGRAMS** and then select **NATIONAL INSTRUMENTS DAQ MENU.** Run the NI-DAQ Configuration Utility programme from the National Instruments DAQ program group, accept new device in socket 1or 2.

3. SOFTWARE INSTALLATION FOR PULSAIR CALIBRATION

13. Single click Configure, which will find the ADC PCMCIA card. Follow the configuration wizard. **DO NOT** change the **AI Polarity/Range or Mode Settings** to there default settings. Change the **AO Polarity** to **UNIPOLAR.** Leave **Accessory** setting at none and **OPC** to disabled, click ok to continue.

14. Then click X on the top right hand corner of the window for exit from configuration utility. Click save if requested.

15. Remove NI-DAQ CD disc from CD bay

16. Place CD-ROM DISC for Pulsair Calibration (EP84-01130) into CD-ROM drive bay.

17. **Double Click** My Computer on main desktop.

18. **Double Click CD-ROM** icon.(CAL SW-V2-7) or (KEELER)

19. **Double Click Calibration Software V2.7.0** folder(**Calibration S**)

20. **Double Click SET-UP.** Follow all on screen instructions.

21. Allow Windows to install the calibration software. Click OK to Tonometer set up, and then click the *install icon* to install software. When completed click OK. Exit all open files by clicking on the **X** in the right hand corner

DONGLE SECURITY DEVICE SOFTWARE INSTALLATION INSTRUCTIONS

1. **Double Click** My Computer on main desktop

2. **Double Click CD-ROM** icon.(CAL SW-V2-7) or (KEELER)

3. Select and **Double Click** Hasp Command line Installer Latest version 120599 v3.83

4. **Double Click** Install Dongle

5. When Aladdin device Driver Installation Utility for Win32 screen instruction appears **Single Click OK**

6. Exit all open files by clicking on the **X** in the right hand corner.

3. SOFTWARE INSTALLATION FOR PULSAIR CALIBRATION

SHORT CUT INSTRUCTIONS

1. To obtain a **Short Cut** to the Calibration Software, first right click the mouse when in the main desktop.

2. Select new then Select short cut (single click)

3. At command line Select browse (single click). At browse, select folder programme files (double click).

4. At Programme files, select Tonometer, then (double click).

5. At tonometer, select eye symbol with Tonometer, then (double click).

6. At create shortcut, the command line will read “C:\ Programme Files. \Tonometer\Tonometer. exe” select next then (single click).

7. When select a name for shortcut appears, it will read Tonometer. Single click **Finish.**

8. A short cut symbol of an eye will now appear. When you double click the eye symbol it will take you into main Pulsair calibration software.

4. CALIBRATION JIG ELECTRONIC UNIT

Take cable assembly 2401-P-5127 (PC SERIAL) and connect into fifteen way A.D.C female socket on the front of calibration electronic unit (as per fig 1)

Take the other end of cable assembly and connect into the nine way male socket on the back of laptop computer.

Plug transducer assembly into nine way female socket on the front of calibration unit, which is engraved “Pressure Transducer” (as per fig 1)

Connect RS232 communication cable (2401-P-5127) into nine way male socket on front of calibration unit, which is engraved “Tonometer” (as per fig 1)

Take the other end of the cable and connect into the back of the Puls*air* tonometer mother unit.

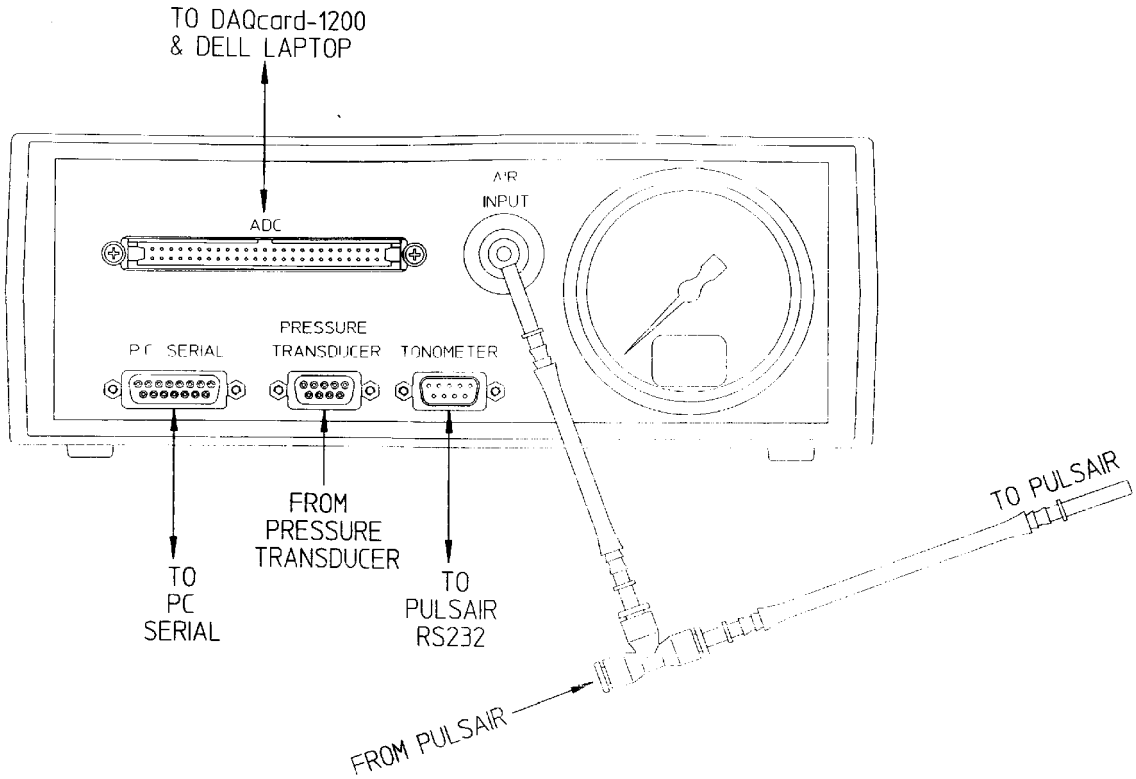


FIG 1

4. CALIBRATION JIG ELECTRONIC UNIT

The last cable assembly to be connected is the national instruments **ADC** ribbon cable (EP79-09154)

This is connected first to the multi way socket on the front of calibration unit engraved "**ADC"** (as per fig 1).

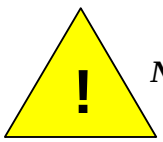
Ensuring that the arrow on blue multi way **ADC** sockets aligns with the arrow on multi way, plug on ribbon cable.

NOTE! WHEN CONNECTING DAQCARD INTO THE LAPTOP COMPUTER ENSURE LAPTOP IS SWITCHED OFF, AS THIS MAY CAUSE DAMAGE TO THE DAQCARD DEVICE

Once connected, lock into position with locking clips. The smaller end is connected to the **DAQCard-1200** (EP79-09162) aligning first the white dots together as plug is pushed into socket of **DAQCARD**.

Plug blue air tube assembly (2401-P-5100) into the front of the electronic unit marked AIR INPUT

Connect dongle software security device to back of laptop computer. Locate into printer port LP1.



NOTE! IF THE DONGLE IS NOT CONNECTED THE SOFTWARE WILL NOT BE ACCESSIBLE

5. DIS-ASSEMBLY AND RE-ASSEMBLE OF PULSAIR

***PULSAIR* 2000/3000**

1. Remove the four M4 screws and shakeproof washers holding the base moulding to the Puls*air* mother unit (as per fig 2)

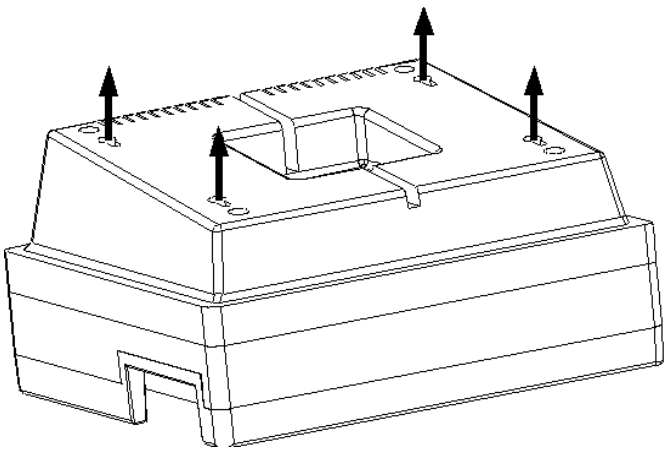


FIG 2

2. While in same position remove the two M4 transit screws and shakeproof washers holding the pump assembly in position at location **B** (as per fig 3)

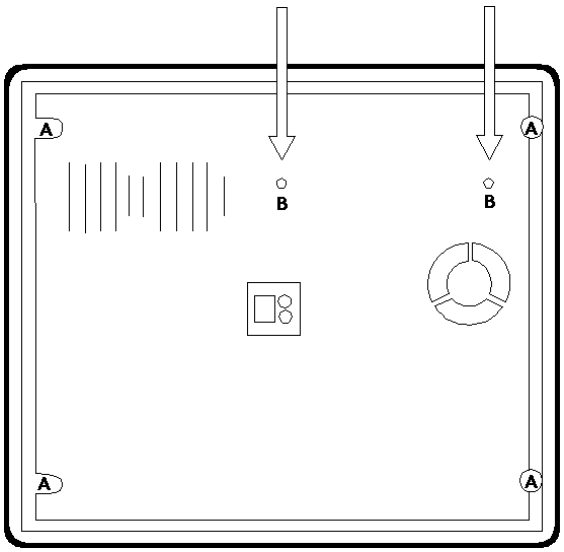


FIG 3

3. Remove the four M5 screws and shakeproof washers holding the top moulding to the mother unit as seen in fig 3 position **A**

   Ensure when removing top moulding that the white microswitch plunger is not mislaid

4. Re-assemble in reverse order fitting white plunger first

6. DIS-ASSEMBLY AND RE-ASSEMBLE OF PULSAIR

EasyEye

1. Remove the six M4 screws and shakeproof washers holding the base moulding to the Puls*air* top unit removing the wall/desk support **A** first to reveal the two hidden screws under the support (as per fig 2A)

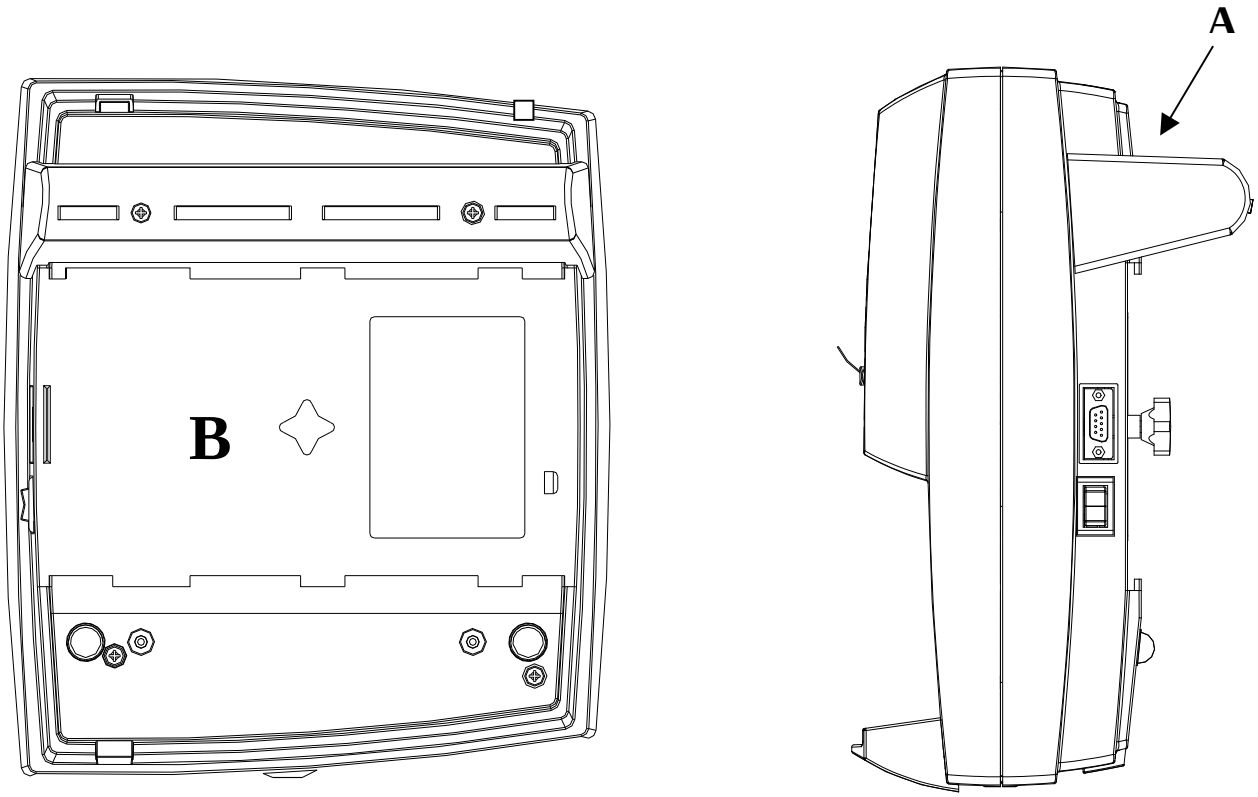


FIG 2A

2. While in same position remove the pump transit screw holding the pump assembly in position at location **B** (as per fig 2A)

Ensure when removing top moulding that the white microswitch plunger is not mislaid

3. Re-assemble in reverse order fitting white plunger first

7. CALIBRATION AND VERIFICATION PROCEDURE FOR PULSAIR 2000-3000- EasyEye

1. Remove the 8 screws holding the top and bottom mouldings from the Puls*air* 2000/3000 mother unit (as in fig 2).Remove the 6 screws for the Pulsair EasyEye refer to fig 2A

2. Remove the 2 transit screws if fitted from the pump assembly (as in fig 3) or fig 2A for Pulsair EasyEye

3. Disconnect the blue pipe from the umbilical cord assembly, which is connected to the filter, which is located in the inner part of the Puls*air* mother unit.

4. Connect the blue pipe from umbilical cord assembly and the connector assembly (2401-P-5100) from the calibration pressure gauge together and then into filter.

5. Place the Puls*air* mother unit back into bottom moulding ***(do not replace the screws at this stage)*** as this is only a method of holding the Pulsair while calibration and repair work is taking place.

6. Place the hand unit assembly onto the calibration jig, first removing puff tube shroud and trim ring from front of the hand unit assembly. Procedure 19 and 20 (fig 34 and 34A).

7. Locate the hand unit assembly from the Puls*air* **2000/3000** onto the 3 pillars **A - B** and **C** and slide into the central locking device **D** (as per fig 4) LOCK **INTO POSITION WITH LOCKING KNOB.** When calibrating Puls*air* **Easyeye** use the jig shown in fig 4a

8. Connect RS232 communication cable (2401-P-5119) from calibration electronic unit to the back of Puls*air* mother unit.

ELECTRIC SHOCK HAZARD
Electrical power is required for the next operations

9. Fit the mains lead to underside of the Puls*air* **2000/3000** mother unit (**DO NOT SWITCH ON**). Fit the lead from the power supply for the Puls*air* **EasyEye** to the front or back of the mother unit

IF MAINFRAME ASSEMBLY OR MAIN P.C.B ASSEMBLY HAS BEEN REPLACED REFER TO MAINFRAME MIRROR SETTING PROCEDURE (SECTION 15)

7. CALIBRATION AND VERIFICATION PROCEDURE FOR PULSAIR 2000-3000-EasyEye

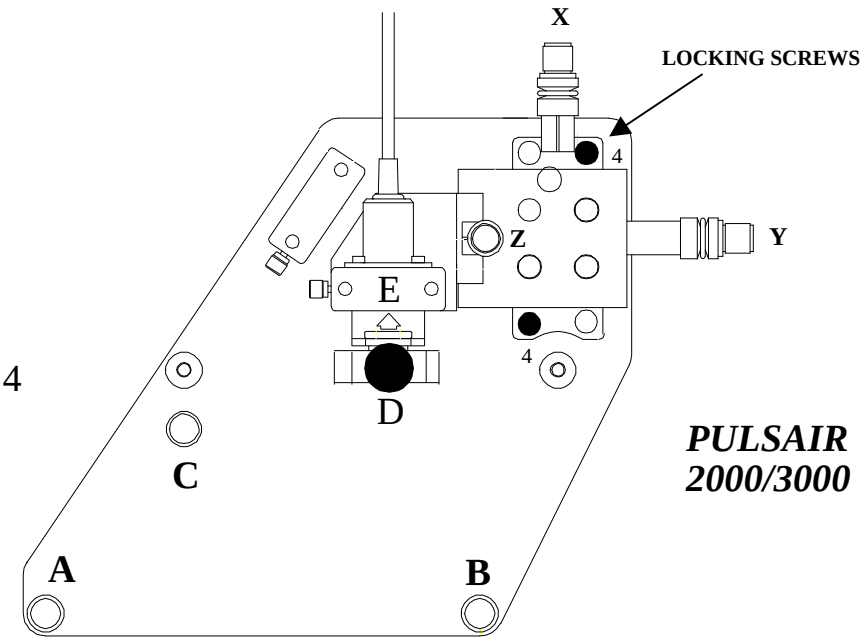


FIG 4

PULSAIR 2000/3000

The **X Y Z** indecking head is now interchangeable between the two calibration jigs undo the two locking screws and remove the head from the two dowels.

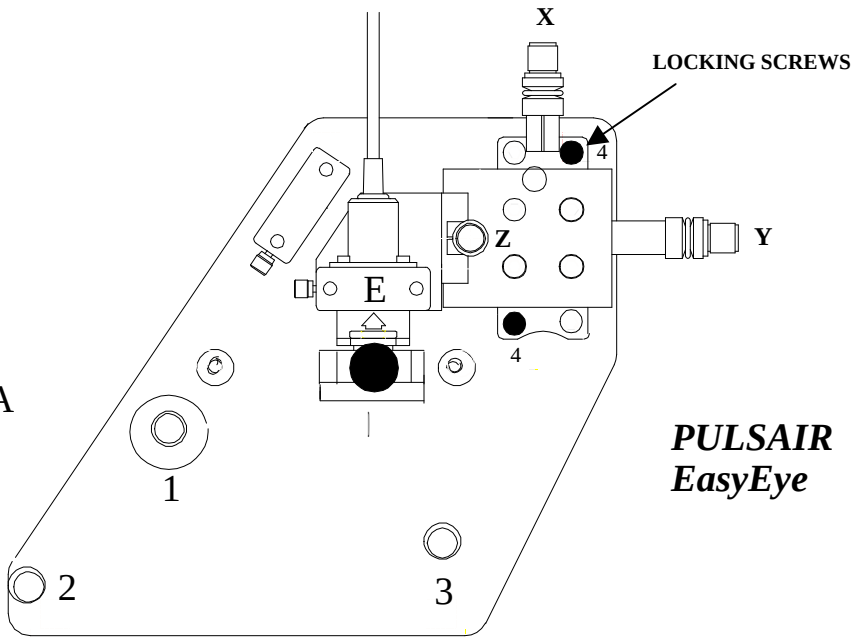


FIG 4A

PULSAIR EasyEye

10. Once the Pulsair is in position on calibration jig you must then follow the on screen instructions from the calibration software.

6. CALIBRATION AND VERIFICATION PROCEDURE FOR PULSAIR 2000-3000-EasyEye

Select the software icon, which is identified by an eye symbol on main screen menu. Double click and this will take you into the main Puls*air* menu (as per fig 5)

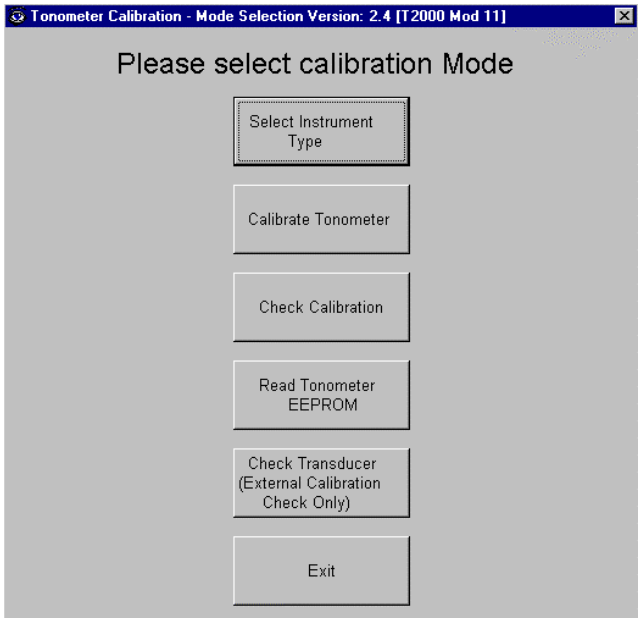


FIG 5

You are required to select a Puls*air* instrument type; to achieve this you must first click on **select instrument type** box. A tonometer menu will appear (as per fig 6)

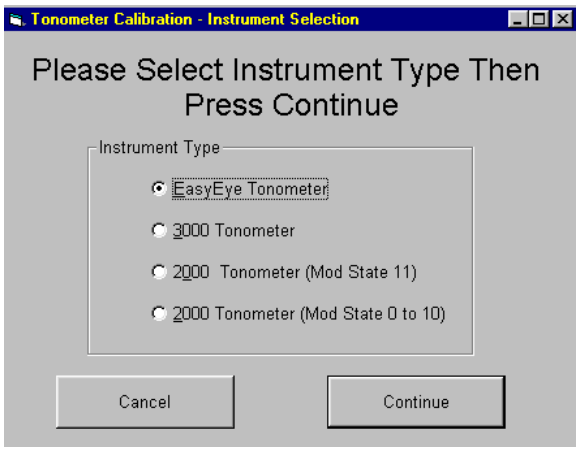


FIG 6

You must now select a Puls*air* type to be calibrated by clicking onto appropriate Puls*air* instrument type. This is verified by a black dot in the circular window

6. CALIBRATION AND VERIFICATION PROCEDURE FOR PULSAIR 2000-3000-EasyEye

WARNING IF INCORRECT PULSAIR TYPE IS SELECTED THE WRONG CALIBRATION DETAILS WILL BE INSTALLED INTO THE PULSAIR EPROM AFTER CALIBRATION

Once selected press continue box to continue, this will take you back to main Puls*air* menu (as per fig 5)

You then have a choice of six instruction boxes. If calibration is required, select "Calibrate Tonometer" and follow on screen instructions.

When screen instruction has been carried out, press continue to proceed to the next screen menu. This is for setting of pump pressure follow on screen instructions (as per fig 7)

THE PULSAIR TYPE IS DISPLAYED AT THE TOP OF ALL DATA AND INFORMATION MENUS ENSURE CORRECT TYPE HAS BEEN SELECTED

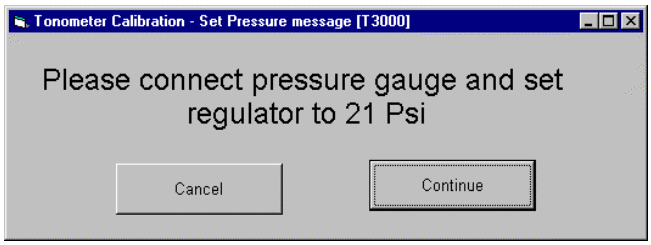


FIG 7

Press continue box and this will take you to ***DATA ENTRY***. This information data is required for ***KEELER*** records. Fill in data were required (as per fig 8)

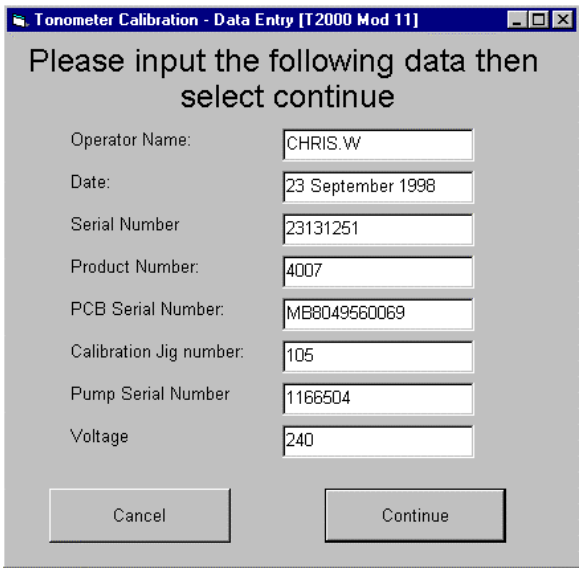


FIG 8

6. CALIBRATION AND VERIFICATION PROCEDURE FOR PULSAIR 2000-3000-EasyEye

When completed press the continue box. A switch on screen message will appear (as per fig 9)

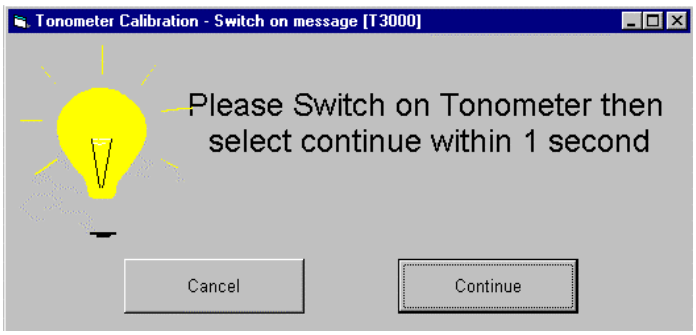


FIG 9

ENSURE THAT THIS INSTRUCTION IS FOLLOWED AS STATED.

If the instructions are not followed as stated an error message will appear (as per fig 10)

The error message will take 16 seconds to appear. You must then click on the OK button, which will take you back to main Puls*air* menu to start procedure again.

ENSURE WHEN COMMUNICATION IS MADE WITH THE *PULSAIR* THAT THE *PULSAIR* IS NOT SWITCHED OFF DURING THE CALIBRATION PROCEDURE.

AS THIS WILL CAUSE AN ERROR BETWEEN THE CALIBRATION SOFTWARE AND THE PULSAIR AND WILL RESULT IN YOU HAVING TO EXIT THE PROGRAMME AND RESTART.

7. CALIBRATION AND VERIFICATION PROCEDURE FOR PULSAIR 2000-3000-EasyEye

FIG 10

Fit dummy eye block to calibration jig in position E (as per fig 4 and 4A)

Follow on screen instructions for setting of **K FACTOR VALUE** (as per fig 11) the position is achieved by using the **X Y Z** adjusters on the calibration jig (as per fig 4 and 4A)

REFER TO SETTING OF MAINFRAME MIRROR ASSEMBLY PROCEDURE TO ENSURE
CORRECT METHOD FOR SETTING IS OBTAINED (SECTION 15)

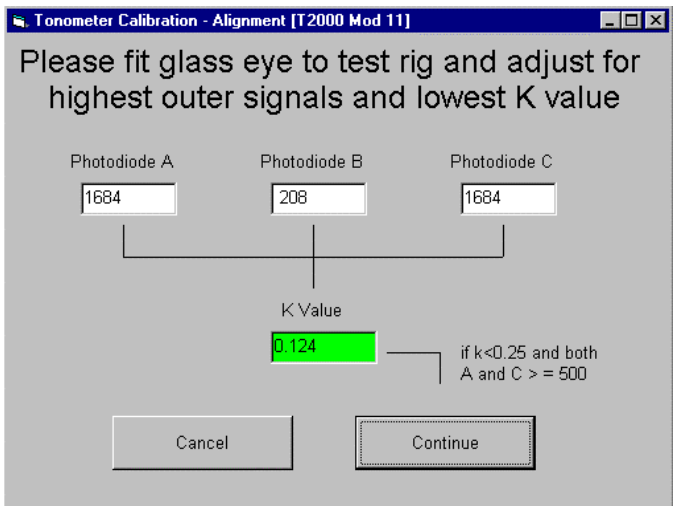


FIG 11

Once correct K VALUE has been obtained the **K VALUE** box will change from red to green to indicate that setting is correct.

Click onto continue box to proceed to next on screen instruction as seen in fig11A

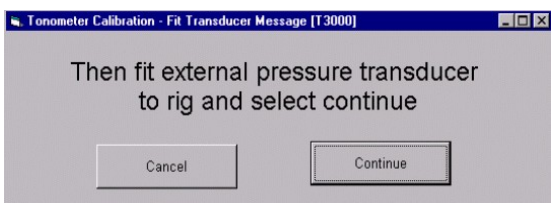


FIG 11A

7. CALIBRATION AND VERIFICATION PROCEDURE FOR PULSAIR 2000-3000-EasyEye

Remove dummy eye from calibration jig position **E** and re-fit with pressure transducer block into the same position

Click onto continue box to proceed to solenoid time graph as indicated in fig 11A. This will test valve response time for Puls*air* (as per fig 12)

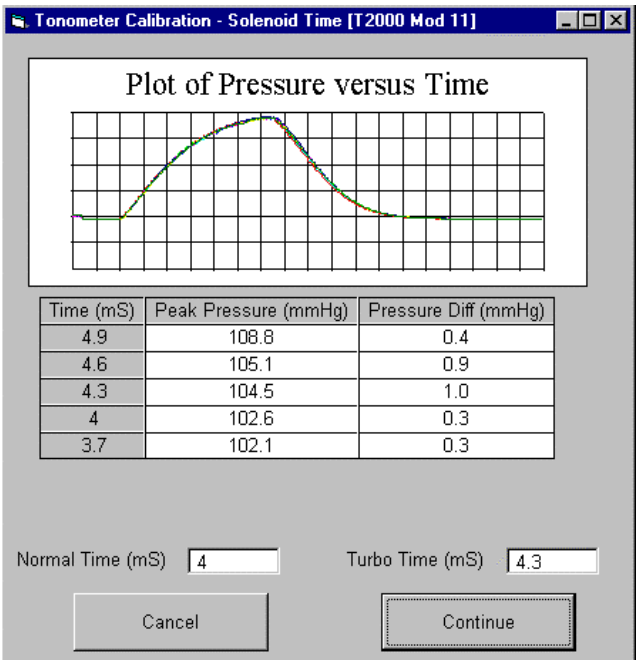


FIG 12

The time period in which the solenoid value will open is set automatically when the Pulsair type is selected at beginning of calibration procedure.

This time period will change from 3.1ms normal time and 3.4ms turbo time on the **Pulsair 3000** and the **Pulsair EasyEye** then to a higher time period of 4ms normal time and 4.3ms turbo time on **Pulsair 2000 mod state 1to10** and **Pulsair 2000 mod state 11**.

The time period is tested in steps of .3ms until correct time period is achieved and the Pressure difference is not > than the acceptable tolerance set in the software,

Each level is verified with 8 test puffs, (as seen in fig 12).

Once completed click continue box to proceed to next instructions.

6. CALIBRATION AND VERIFICATION PROCEDURE FOR PULSAIR 2000-3000- EasyEye

You must now click onto the **OK** box below **Calibration eeprom Values Written** this will now transfer calibration data into eeprom (as per fig 15).

Once completed the main data information box will appear again (as per fig14)

A **tick** will now be displayed in the **EEPROM Status box.** This will now verify that the eeprom data has been succesfully transferred as seen next to the EEPROM Data Written statement

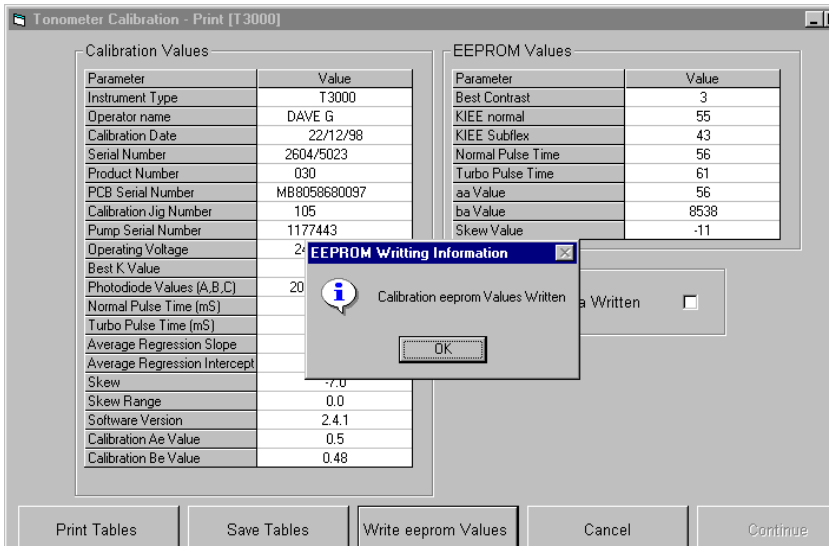


FIG 15

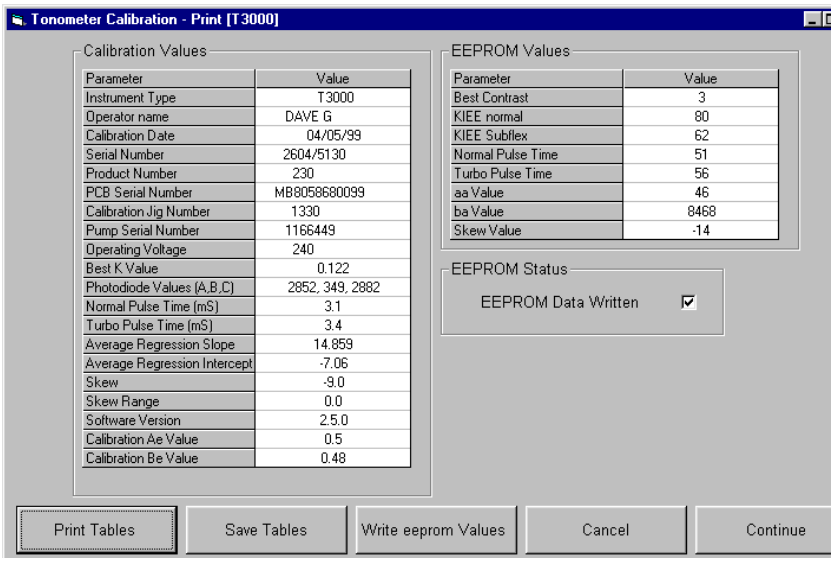


FIG 15A

7. CALIBRATION AND VERIFICATION PROCEDURE FOR PULSAIR 2000-3000- EasyEye

The next graph to appear is the Align Timing Regress graph (as per fig 13)

The Puls*air* will fire 32 times automatically to produce two graphs, the plot of external pressure versus the plot of internal pressure (as seen in fig 13)

Once completed the plot of internal versus external ADC VALUES will appear on right hand side of main graph.

All other calibration details will appear at bottom of graph.

ENSURE CORRECT PULSAIR TYPE IS SELECTED AT THE TOP OF GRAPH before the *continue* button is pressed

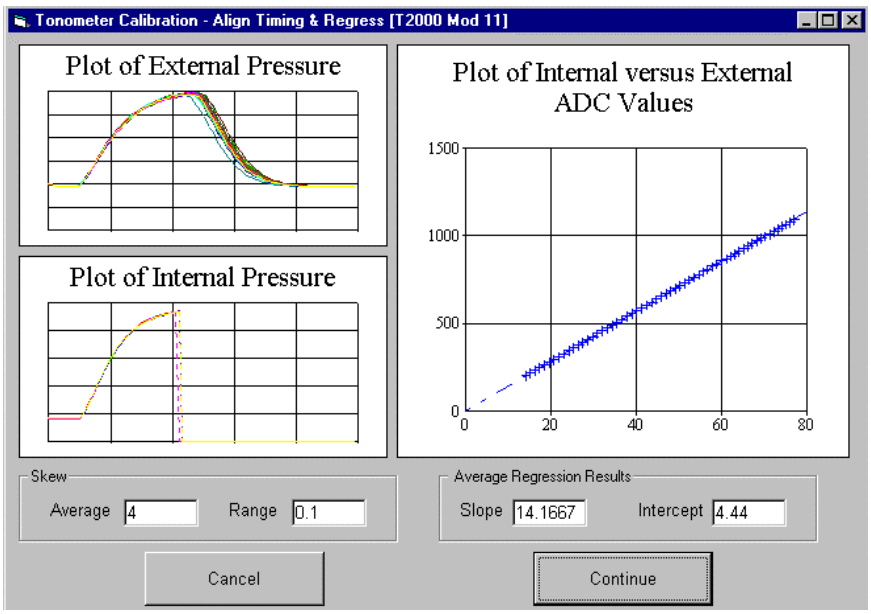


FIG 13

7. CALIBRATION AND VERIFICATION PROCEDURE FOR PULSAIR 2000-3000- EasyEye

The tonometer's Calibration data details will appear next (as per fig 14)

Ensure all details are correct before clicking onto **WRITE EEPROM VALUES,**

At this stage all calibration details are ready to be transferred to the Puls*air* eeprom,

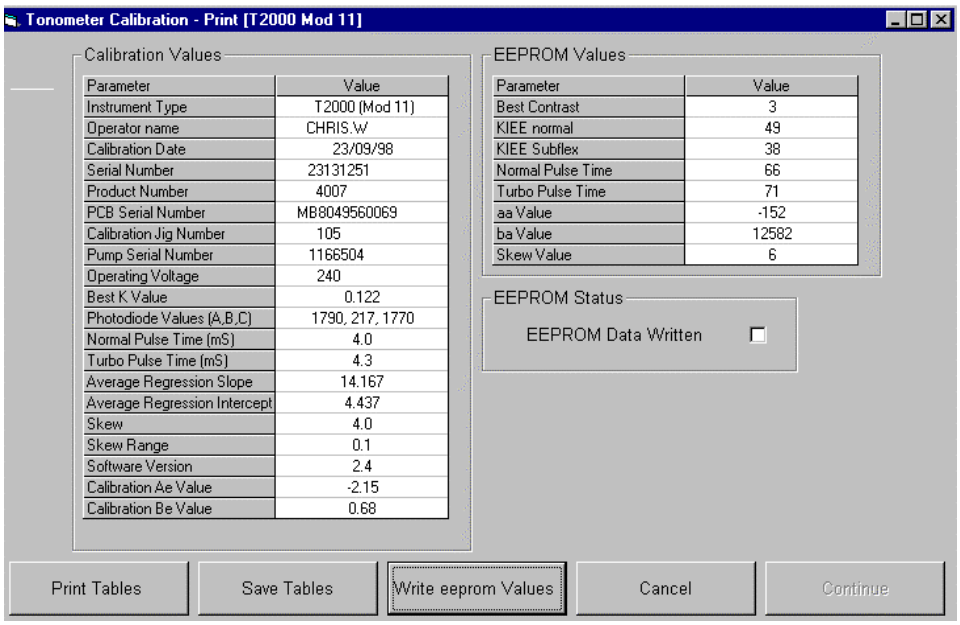


FIG 14

A verification box will now appear to ensure you that the details will now be transferred (as per fig 15)

ENSURE WHEN CALIBRATION IS COMPLETED THAT THE PUMP ADAPTOR LOCK NUT IS SEALED WITH LOCTITE 601 ADHESIVE

6. CALIBRATION AND VERIFICATION PROCEDURE FOR PULSAIR 2000-3000- EasyEye

You must now click onto the **OK** box below **Calibration eeprom Values Written** this will now transfer calibration data into eeprom (as per fig 15).

Once completed the main data information box will appear again (as per fig14)

A **tick** will now be displayed in the **EEPROM Status box.** This will now verify that the eeprom data has been succesfully transferred as seen next to the EEPROM Data Written statement

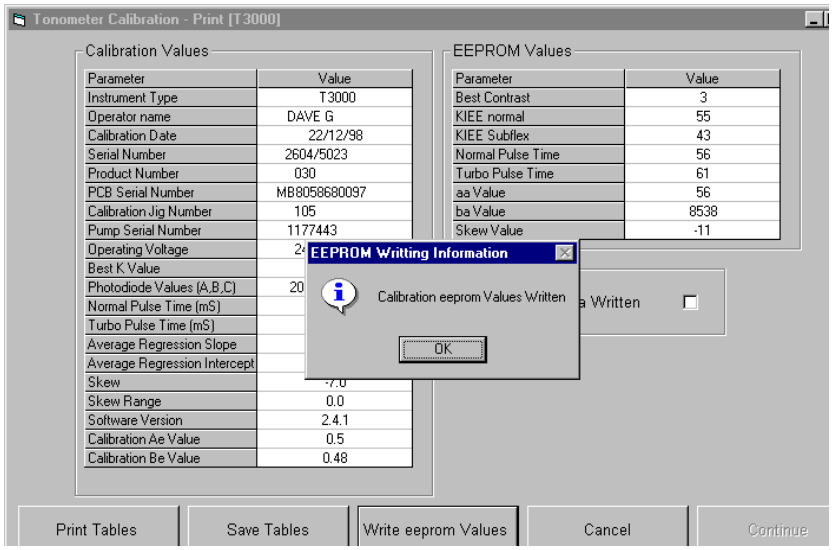


FIG 15

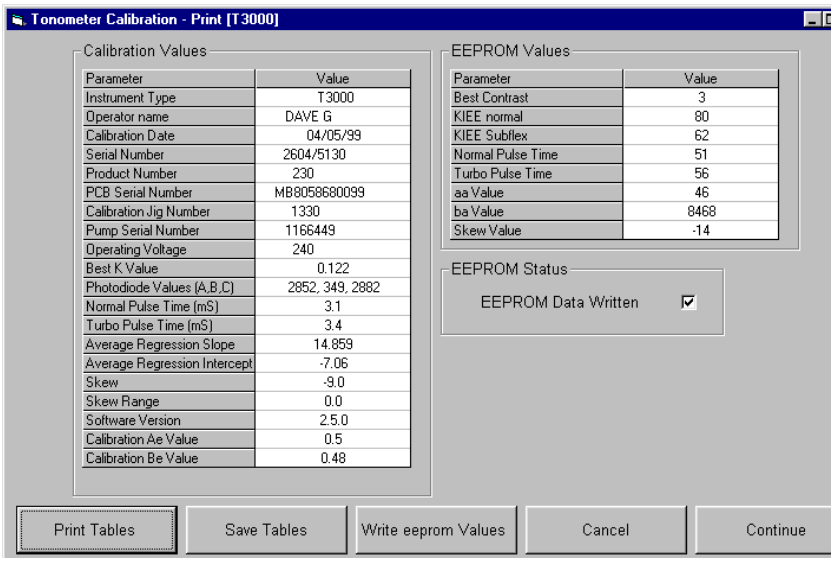


FIG 15A

7. CALIBRATION AND VERIFICATION PROCEDURE FOR PULSAIR 2000-3000- EasyEye

At this stage if the calibration data has not been transferred, the continue button will not be highlighted and will not allow you to proceed,

If you were to click onto Print tables or Save tables, a warning message will appear (as per fig 16) as a reminder that you must write to the eeprom before the completion of the calibration.

When calibration is completed, click continue box to return to main menu.

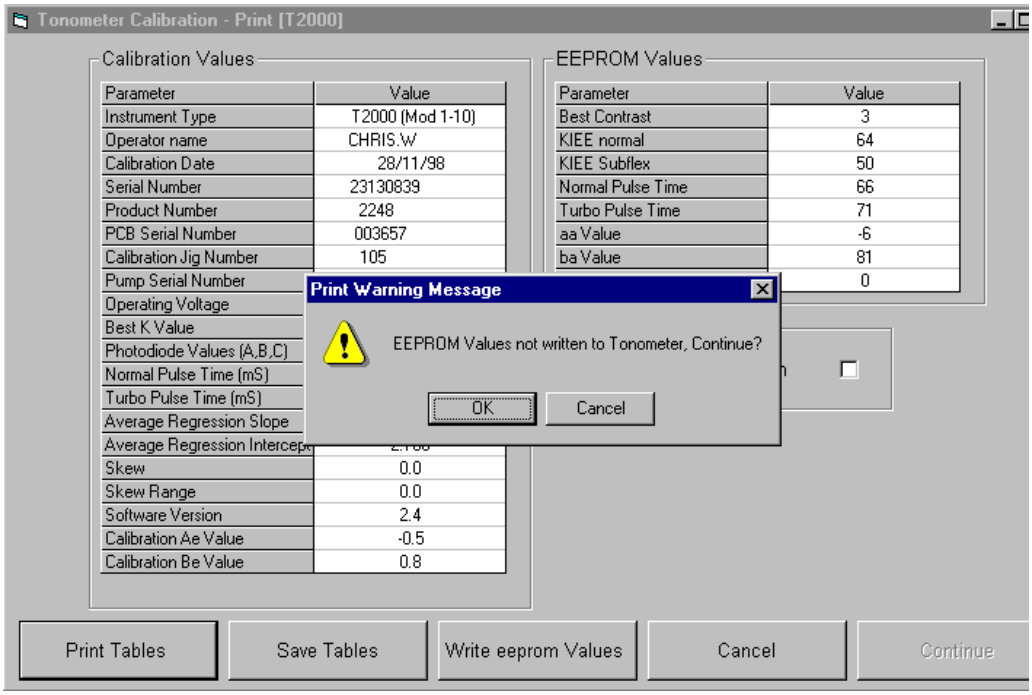


FIG16

7. CALIBRATION AND VERIFICATION PROCEDURE FOR PULSAIR 2000-3000- EasyEye

To verify calibration you must start at main Puls*air* menu as before

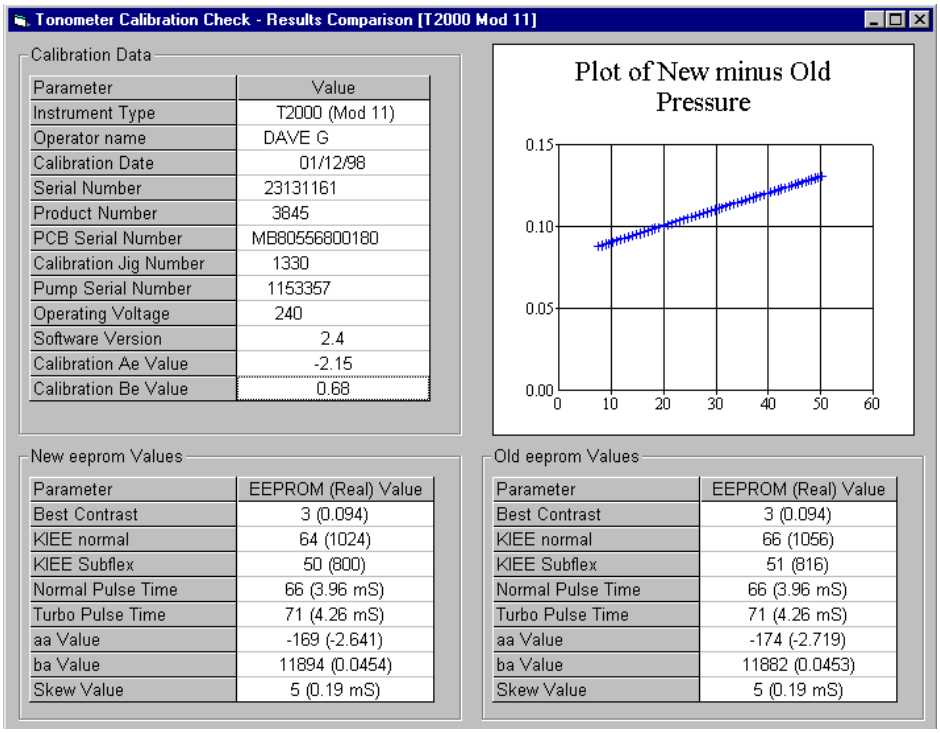
Then **Select Instrument Type** where you must then select correct Puls*air* to be checked i.e. Puls*air* 2000 mode state 0-10…Puls*air* 2000 mode state 11…Puls*air* 3000… Puls*air EasyEye*

Then select **CHECK CALIBRATION** by clicking onto the highlighted Check Calibration box.

All on screen instructions except for the setting of pump pressure (**see note**) are the same as the previous calibration instructions, but will change after the Align Timing Regress graph as (per fig 13).

At this stage a new graph will appear, which is the comparison graph (as per fig17). This will verify the calibration

NOTE! The pump pressure on screen instruction will not appear in this part of the procedure, as the pump pressure must not be adjusted in the verification of the Puls*air* calibration.



Parameter	Value
Instrument Type	T2000 (Mod 11)
Operator name	DAVE G
Calibration Date	01/12/98
Serial Number	23131161
Product Number	3845
PCB Serial Number	MB80556800180
Calibration Jig Number	1330
Pump Serial Number	1153357
Operating Voltage	240
Software Version	2.4
Calibration Ae Value	-2.15
Calibration Be Value	0.68

Parameter	EEPROM (Real) Value
Best Contrast	3 (0.094)
KIEE normal	64 (1024)
KIEE Subflex	50 (800)
Normal Pulse Time	66 (3.96 mS)
Turbo Pulse Time	71 (4.26 mS)
aa Value	-169 (-2.641)
ba Value	11894 (0.0454)
Skew Value	5 (0.19 mS)

Parameter	EEPROM (Real) Value
Best Contrast	3 (0.094)
KIEE normal	66 (1056)
KIEE Subflex	51 (816)
Normal Pulse Time	66 (3.96 mS)
Turbo Pulse Time	71 (4.26 mS)
aa Value	-174 (-2.719)
ba Value	11882 (0.0453)
Skew Value	5 (0.19 mS)

FIG 17

The software will compare old eeprom values against the new eeprom values, which will then be calculated to see if they correspond

7. CALIBRATION AND VERIFICATION PROCEDURE FOR PULSAIR 2000-3000-EasyEye

The pressure errors of the Puls*air* will now be displayed on the graph (as seen in fig17)

The errors at 10 and 20mmHg should not exceed more than **plus or minus** 1 mmHg. If this occurs the Puls*air* must be recalibrated.

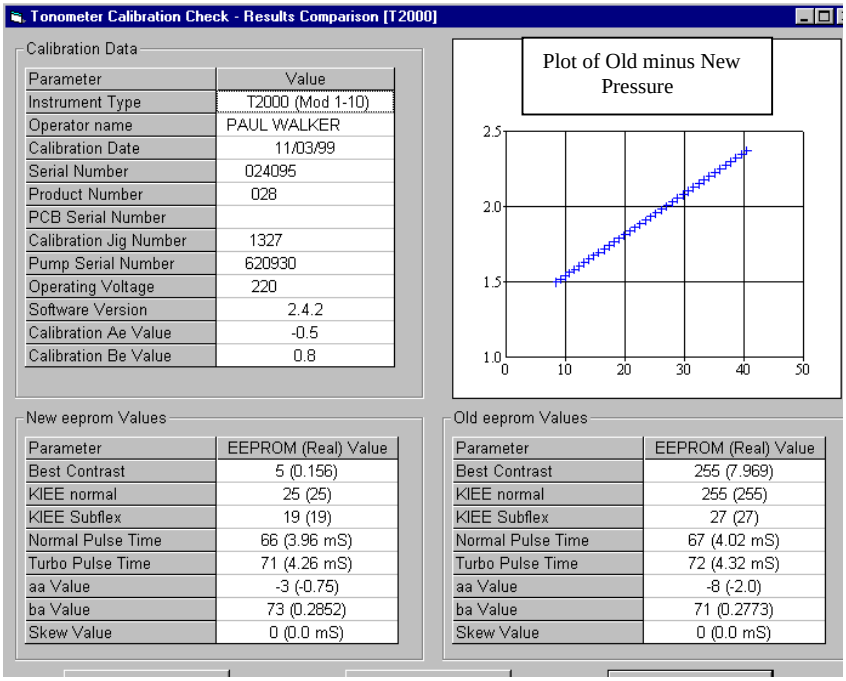


FIG 17A

If when checking the old eeprom values against the new values (as seen in fig 17A) the Best Contrast is set at a value of 255 and the KIEE normal is set at a value of 255 it would indicate that the calibration data is corrupt.

The Pulsair must now be recalibrated, as the unit will not auto fire when focussed on the eye.

Once completed, click continue box to return to main Puls*air* menu

When finished, **DISCONNECT MAINS LEAD** from mother unit. Remove RS232 communication cable from back of Pulsair.

Refit blue pipe from umbilical cord assembly to filter assembly and add tested label (EP39-05372) to top of pump assembly diaphragm block

Remove hand unit from calibration jig

Re-assemble puff tube shroud and trim ring to hand unit and locking screw. Refer to fig34 and fig34A

Re-fit transit screws to pump and 8 screws holding the top and bottom moulding **(Puls*air* 2000/3000)** Re-fit the 6 screws holding the top and bottom moulding to the **Puls*air* *Easyeye*** in reverse order. Refer to **procedure 5 and 6.**

8. CLEANING OF THE PULSAIR OPTICS

1. First remove puff tube shroud and eyepiece shrouds before cleaning procedure can take place.

Ensure when cleaning the lenses that they are not touched with the fingers as these are coated lenses and will easily smear

2. Using the cleaning wipes (2110-P-7018) in a circular motion remove any dirt deposits from front of puff Tube assembly and viewing lens assembly (as per fig18)

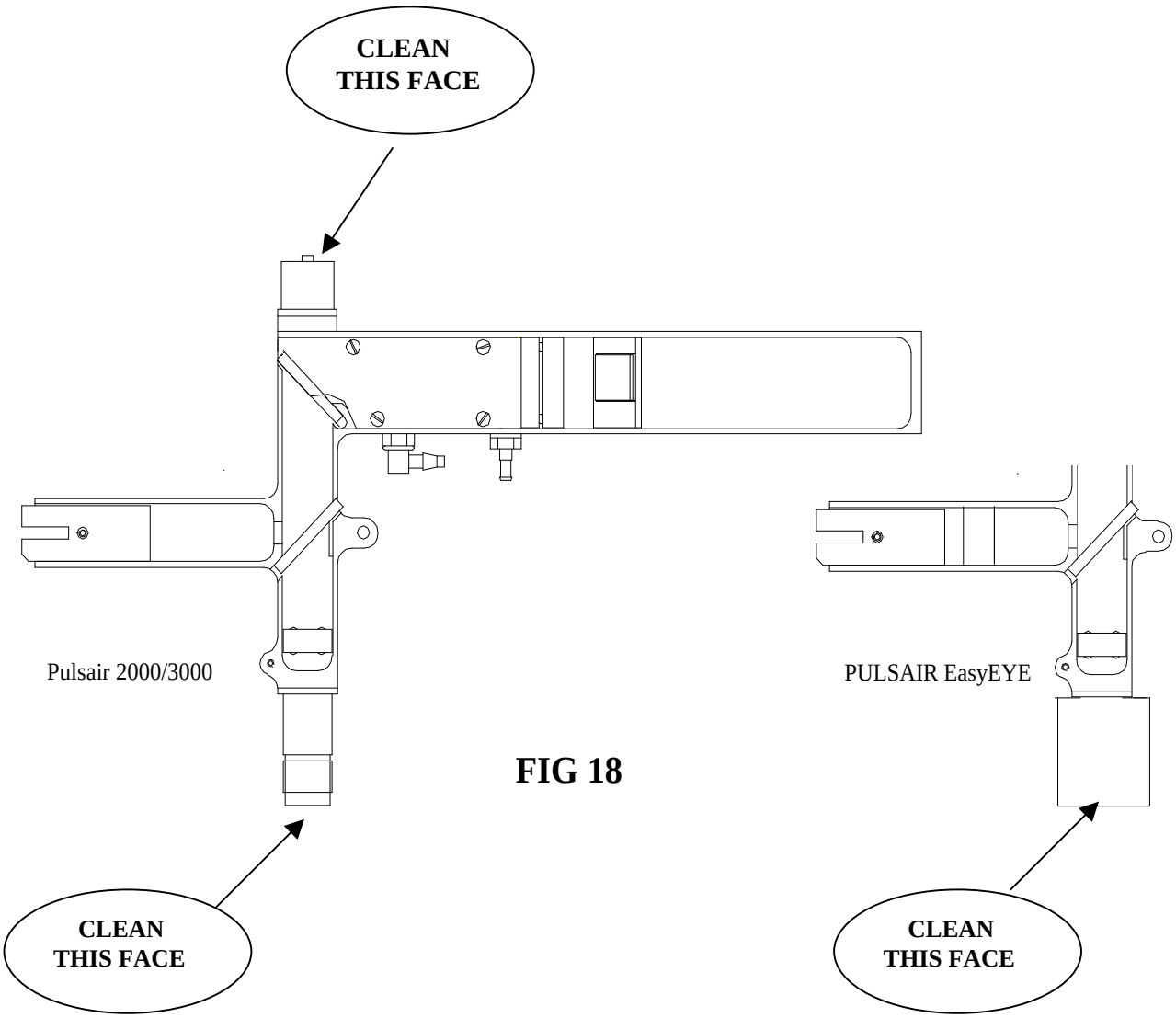


FIG 18

9. REPLACEMENT OF AIR FILTER

ELECTRIC SHOCK HAZARD

Electrical power is not required for this operation and the mains supply plug Should be removed before starting next operation.

1. Remove top and bottom mouldings as described in procedure 5 and 6

2. Disconnect blue tube from both sides of filter assembly (as in fig 19)

3. Remove filter from bracket and replace with new filter assembly (2401-P-6744) Reconnect blue tubes

4. Refer to calibration procedure 7 for recalibration instructions.

5. Refer to re-assemble of Pulsair procedure 5 and 6

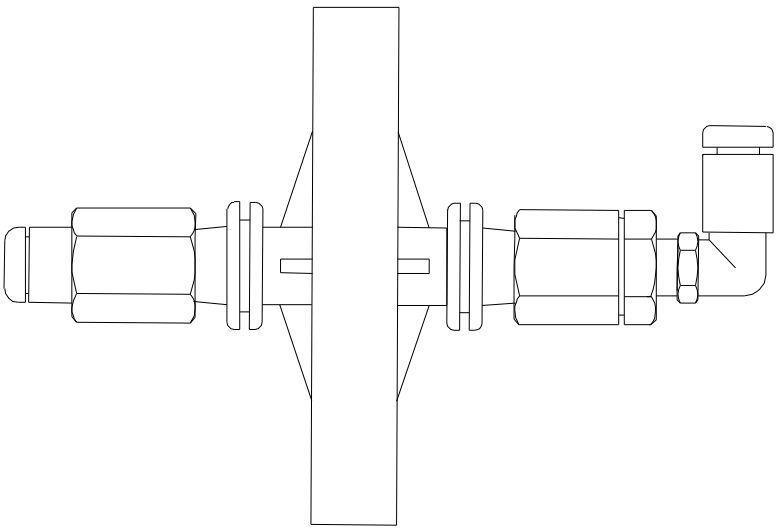


FIG 19

10. UMBILICAL CORD ASSEMBLY REPLACEMENT

***PULSAIR* 2000/3000**

ELECTRIC SHOCK HAZARD

Electrical power is not required for this operation and the mains supply plug Should be removed before starting next operation.

1. Remove the Puls*air* top and bottom mouldings as described in procedure **5 and 6**

2. Disconnect blue tube from filter in mother unit.

3. Remove either M4 nut from earth stud on microswitch bracket or M4 screw from side of transformer

4. Remove cable ties holding earth wiring to wire loom, unplug 8 way Molex connector from power supply P.C.B.

5. Remove M3 screw holding "P" clip and blue pipe from power supply P.C.B

6. Remove umbilical cord assy from mother unit.

7. At hand unit end, remove puff tube shroud, trim ring, eyepiece shroud and M3 locking screw at bottom of hand moulding (as per fig 34).

8. Remove top hand unit moulding

9. Disconnect Molex connector containing 8 wires from P.C.B.(as per fig 20)

10. Remove the M3 screw from centre of mainframe holding earth wires (as per fig 20).

11. Remove the screw holding yellow wire and bulb contact to top of mainframe. Cut the blue tube from hand unit value to mainframe and then remove the umbilical cord assembly.

    NOTE! The blue tube removed from hand unit value must be replaced before reassemble can take place.

12. Re-assemble new umbilical cord assy in reverse order. Refer to calibration procedure 7. For re-calibration.

10. UMBILICAL CORD ASSEMBLY REPLACEMENT

***PULSAIR* 2000/3000**

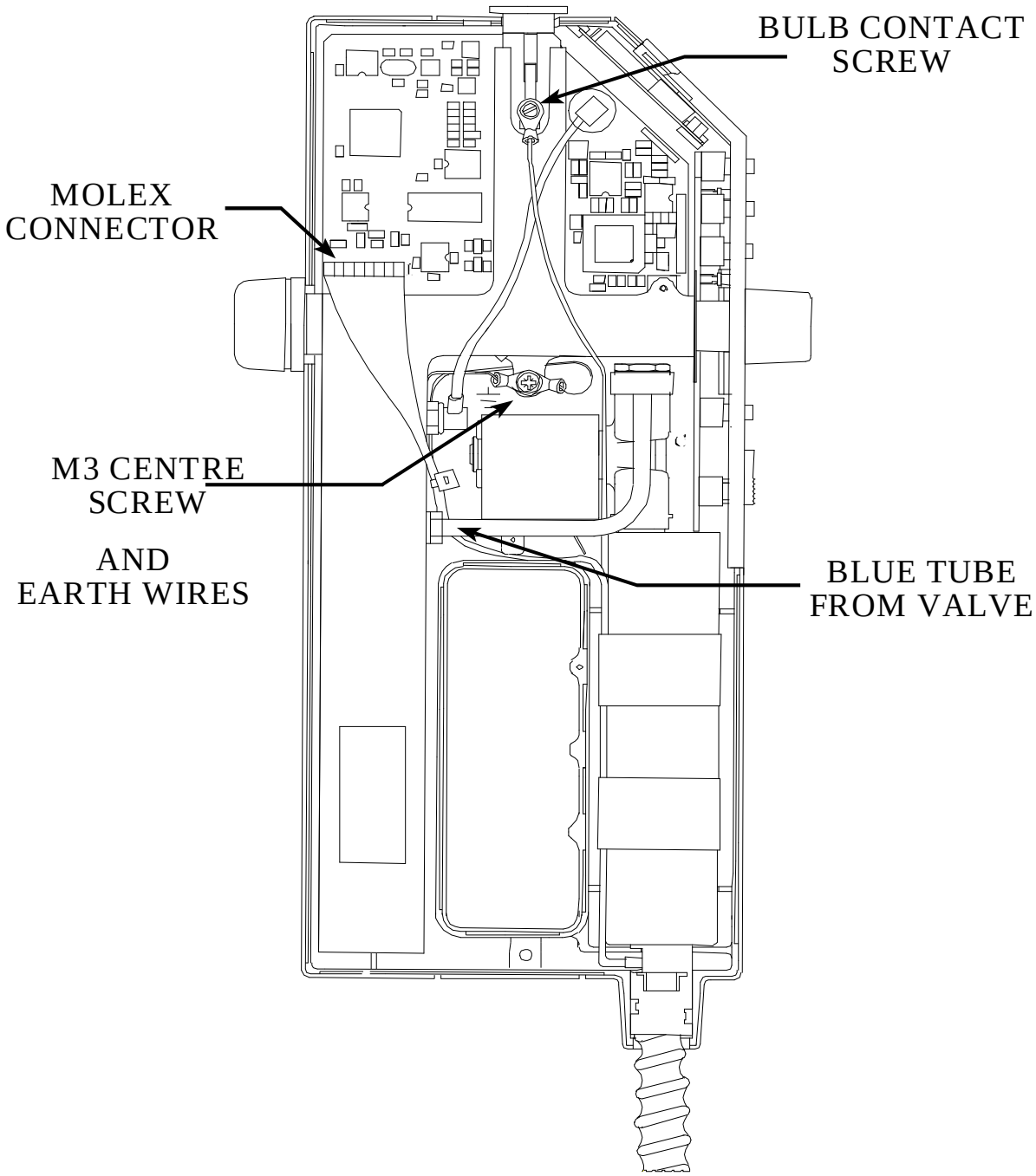


FIG 20

11. *UMBILICAL CORD ASSEMBLY REPLACEMENT*
EasyEye

ELECTRIC SHOCK HAZARD
Electrical power is not required for this operation and the mains supply plug Should be removed before starting next operation.

1. Remove the Puls*air* top and bottom mouldings as described in procedure **5 and 6**

2. Disconnect blue tube from filter in the mother unit.

3. Unplug the 8 way Molex connector from power supply P.C.B.

4. Remove the umbilical and cable gland assemble from the mother unit.

5. At the hand unit end, unscrew the puff tube shroud and the end cap from the hand unit mouldings refer to Fig 34A, remove the four locking screws holding the top hand unit moulding to the bottom moulding.

6. Remove the top hand unit moulding and the front panel assembly

7. Unplug the 8-way molex connector from the P.C.B and remove the clip from the coil on the handunit value (as per fig 20A).

8. Remove the M3 screw from centre of mainframe holding it to the bottom hand unit moulding (as per fig 20A).

9. Cut the blue tube from hand unit value to the mainframe, disconnect the blue tube from the reservoir you now remove the umbilical cord assembly.

   NOTE! The blue tube removed from hand unit value must be replaced before reassemble can take place.

12. Re-assemble new umbilical cord assy in reverse order. Refer to calibration procedure 7. For re-calibration.

11. *UMBILICAL CORD ASSEMBLY REPLACEMENT*
EasyEye

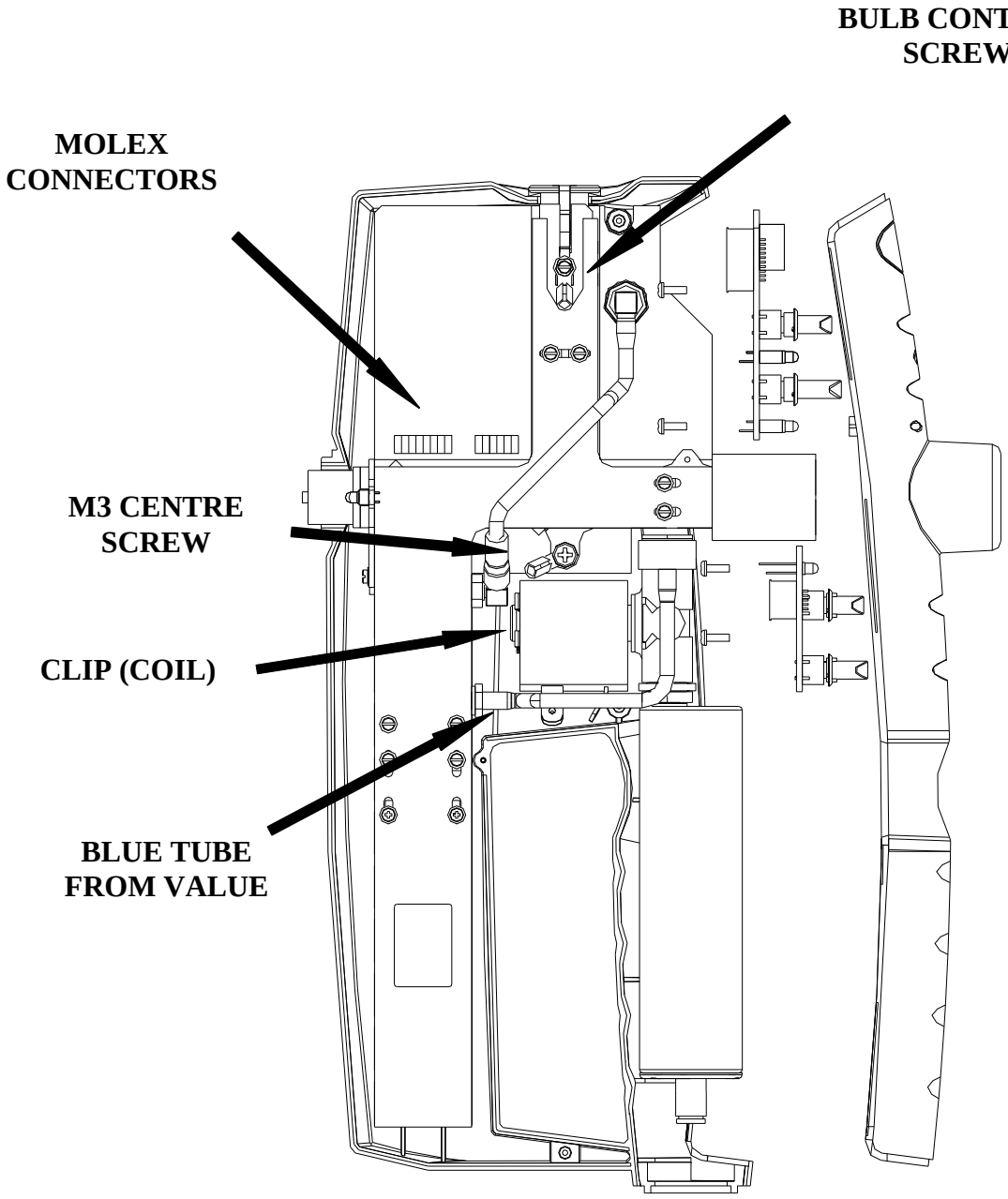


FIG 20A

12. REPLACEMENT OF MAINFRAME & P.C.B. ASSEMBLIES

ELECTRIC SHOCK HAZARD

Electrical power is not required for this operation and the mains supply plug Should be removed before starting next operation.

1. Disconnect the umbilical cord assembly from hand unit as described in the previous procedure 10 and 11. (from operation 7 onwards is required)

2. Remove the four screws holding P.C.B. to mainframe and earth wire; disconnect blue tube to transducer. Replace defective part (mainframe assembly or main hand unit P.C.B)

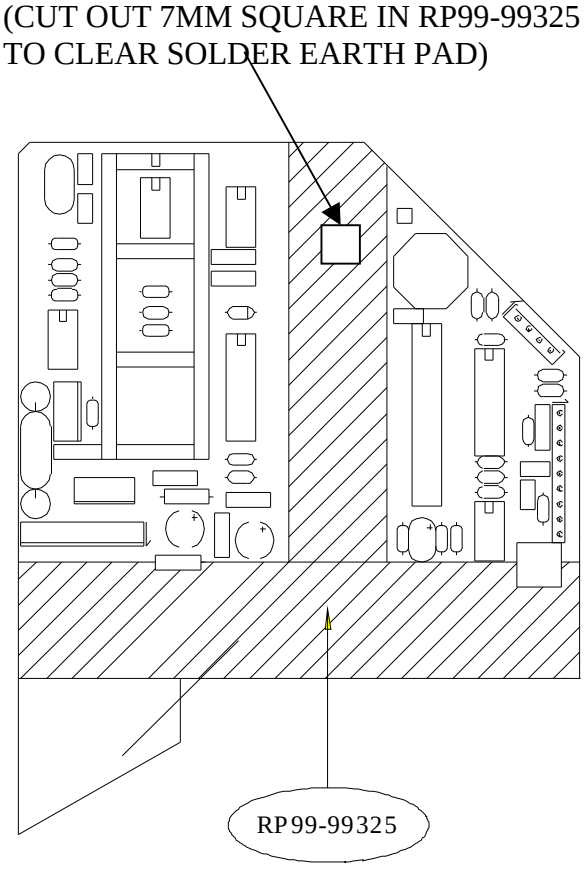
3. Ensure when re-assembling that the serial number label is removed from the P.C.B and re attached to the top of the mainframe. The insulation tape must be fitted to the P.C.B with 7mm cut out to clear solder earth pad (as per fig 21) and blue tube to transducer is reconnected from mainframe assembly with brass restrictior.

4. Fit M2 washer between bulb contact and P.C.B prior to the fitting of the mainframe; ensure the second bulb contact is fitted to the mainframe and the earth lead is attached.

5. Re-assemble umbilical cord assembly to bottom hand unit moulding.

6. Fit the dummy handunit case (EP29-04207) Pulsair 2000/3000(EP39-50272) Pulsair EasyEye prior to calibration so setting of mainframe mirror assembly can be carried out. (See fig 24 procedure 15.) and fig 24A for Pulsair Easy Eye ensure the calibration ring is attached

7. Refer to calibration procedure 7 for recalibration instructions.



ATTENTION
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For handling
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Devices

FIG 21

13. REPLACEMENT OF PUMP PARTS PULSAIR 2000/3000

ELECTRIC SHOCK HAZARD

Electrical power is not required for this operation and the mains supply plug should be removed before starting next operation.

1. Disconnect blue tube fitting from elbow connection on side of pump adaptor as in (fig22A)

2. Remove the three **mains** wires connected to the coil and valve assembly **(BLACK, WHITE, GREEN/YELLOW)** as in (fig 22B).

3. Remove coil and valve assembly from side of pump adaptor as in (fig 22C), using 14 and 15mm spanners.

4. Remove filter silencer from underside of pump adaptor fitted to pump block (as per fig 22D).

5. Remove pump adaptor (EP39-05869) and BSP/NPT adaptors (EP39-06896) from pump (as per fig 22E) using 14mm spanners
   ENSURE WHEN REFITTING BSP/NPT adaptors a small amount of PTFE tape (PP02-82056) is secured around threads

6. Replace faulty components and re-assemble in reverse order.

7. Refer to calibration procedure 7 for re-calibration instructions.

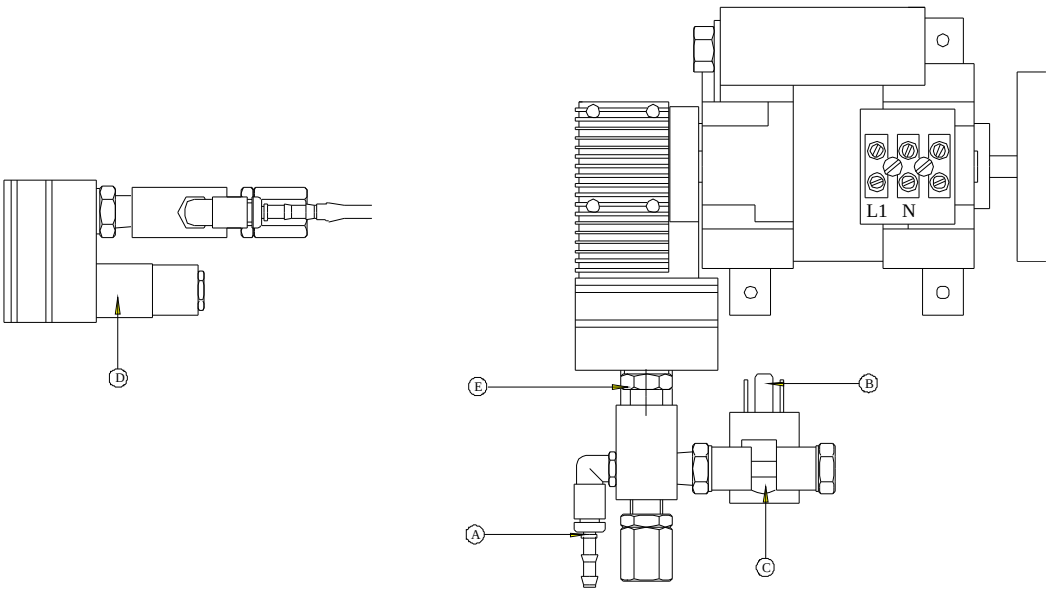


FIG 22

14. REPLACEMENT OF PUMP PARTS PULSAIR EasyEye

ELECTRIC SHOCK HAZARD

Electrical power is not required for this operation and the mains supply plug should be removed before starting next operation.

1. Disconnect blue tube fitting from elbow connection on side of pump adaptor as in (fig22A/A)

2. Remove the two wires connected to the coil and valve assembly **(BLACK, WHITE)** as in (fig 22A/B)

3. Remove coil and valve assembly from side of pump adaptor as in (fig 22A/C) using a 14 and 15mm spanners.

4. Remove filter silencer from underside of pump adaptor fitted to pump block (as per fig).

5. Remove pump adaptor (EP39-05869) and BSP/NPT adaptors (EP39-06896) from pump (fig 22A/D) using 14mm spanners

6. *ENSURE WHEN REFITTING BSP/NPT* adaptors a small amount of PTFE tape (PP02-82056) is secured around threads

7. Replace faulty components and re-assemble in reverse order.

8. Refer to calibration procedure 7 for re-calibration instructions.

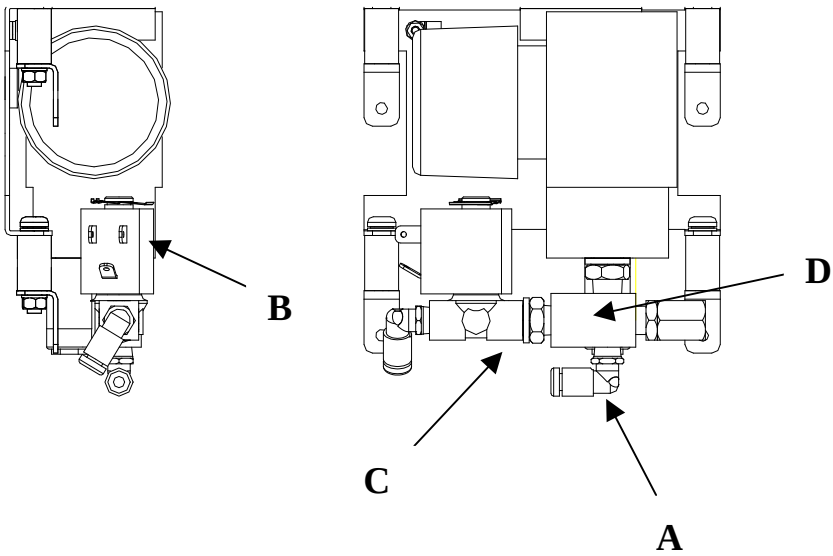


FIG 22A

15. SETTING OF MAINFRAME MIRROR ASSEMBLY AND TARGET FOR PULSAIR EasyEye

1. Place the hand unit assembly onto calibration jig as shown in (FIG 4 or 4a). **NOTE**! At this stage ensure that the dummy hand unit case is fitted.

2. Refer to calibration procedure 7 and follow on screen instructions for calibration until the setting of 'K' value is required (as per fig 23)

3. Loosen the two screws holding the mirror assembly in position on mainframe (as per fig 24) and adjust until the best reading is obtained on 'K' value. Refer to example shown below.

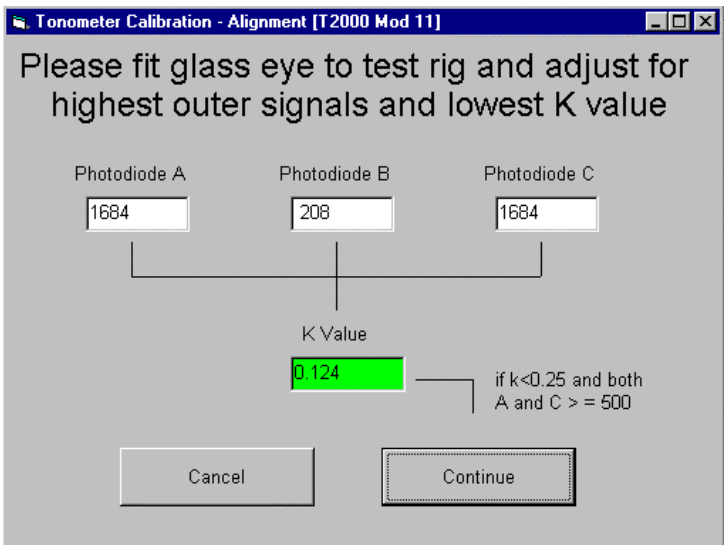


FIG 23

.

4. A and C photodiode value should be set equally first before obtaining the best 'K' value. Once achieved, lock mirror assembly into position as per fig 24.

5. Only on the Pulsair EasyEye will you see the bow tie target when you view through the Eye lens, the target must be adjusted to the central position as shown in fig 24A.

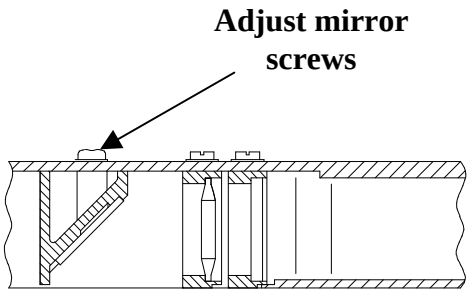


FIG 24

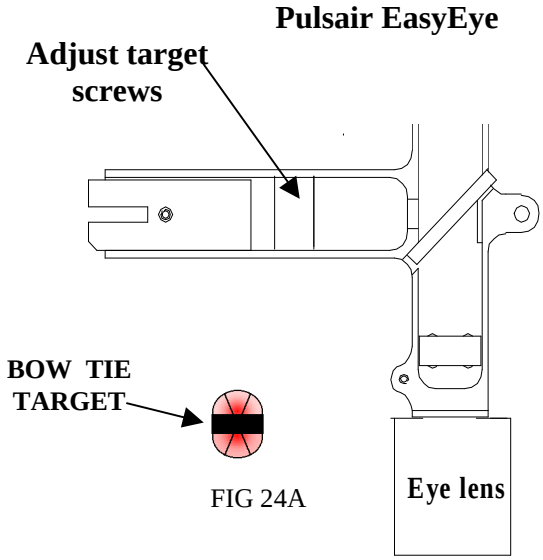


FIG 24A

16. UPGRADE OF POWER SUPPLY (P.C.B.)

THIS PROCEDURE APPLIES TO PULSAIR 2000 ONLY

1. Verify voltage at diode D6 (anode side of diode) and PL4/1 connectors on power supply P.C.B. as per figure 25. If voltage is 17 volts, the power supply P.C.B. must be modified.

ELECTRIC SHOCK HAZARD

Electrical power is not required for this operation and the mains supply plug Should be removed before starting next operation.

2. First remove P.C.B. from the mother unit by disconnecting wire looms PL1-PL4 and PL3 From the P.C.B plug connections.

3. Remove the five-m3 screws holding the power supply P.C.B. in position.

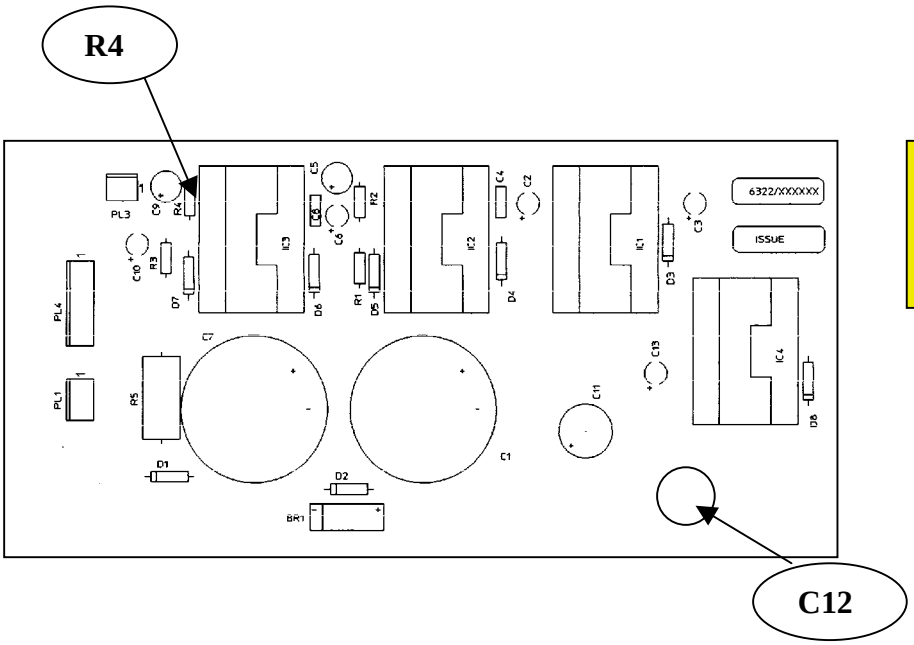
4. The P.C.B. can now be removed.

5. The next part of this procedure should only be carried out on **Pul*sair* 2000** as the Pulsair 3000 has a higher drive voltage of 23.8 volts on the solenoid value

6. REPLACE resistor R4 from 1k5 to 1k8 OHMS (**on Pul*sair* 2000 only**) this will increase voltage at D6 from 17 volts to 19.95 volts which enables the solenoid value to be more responsive.

7. Re-assemble power supply P.C.B. in reverse order.

8. Refer to calibration procedure 7. For re-calibration.



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17. GENERAL TROUBLE SHOOTING

PULSAIR WILL NOT AUTO FIRE

Envelope of bulb discoloured - R*equires replacement of bulb*

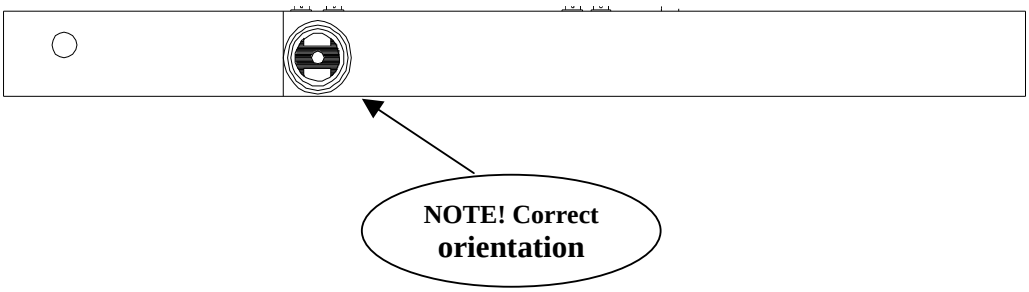
Front puff tube lens contaminated with splash back from tear film - R*equires cleaning off the puff tube lens*

Puff tube lens orientation incorrect or broken (as per fig 26) - R*equires realigning or new mainframe is required*

Calibration data erased in eeprom - R*equires recalibration*

No red light from hand unit - Check *6volt line to bulb and bulb contacts are not broken*

FIG 26



PULSAIR HAND UNIT FAILURE

ELECTRIC SHOCK HAZARD

Electrical power is required for the next test operations and the mains supply plug should be inserted into the *Pulsair* mother-unit before starting.

17. GENERAL TROUBLE SHOOTING

Hand unit display will not function
Pulsair 2000/3000

Verify the T2amp fuse inside the *Pulsair* mother unit
If faulty remove and replace.

Verify crimps on fuse holder
If faulty remove crimps and solder wires to fuse holder.

Verify the 10volt AC supply from transformer to power supply. The red and orange wires are required for this test (Edge connector PL1 pins 3&4)
If there is low or no voltage verified at this point, the transformer must be replaced.

Verify the 5volts DC supply from power supply P.C.B in mother unit, to hand unit. The black and red wires are required for this test (PL4 edge connector on power supply PCB pins 1&4)
If there is low or no voltage verified at this point, the power supply P.C.B must be replaced

Verify the 5volts DC supply from power supply P.C.B to the inside of the hand unit main P.C.B. The black and red wires are required for this test (Edge connector PL2 on main P.C.B 1&4)
If there is low or no voltage verified at this point, the umbilical cord assembly must be replaced

Hand unit will not puff on demo
Pulsair 2000/3000

Verify the 400ma fuse inside mother unit
If faulty remove and replace

Verify crimps on fuse holder
If faulty replace crimps and solder wires to fuse holder

Verify the 20volts AC supply from transformer to power supply P.C.B. The Grey and blue wires are required for this test (Edge connector PL1 on power supply P.C.B pins 1&2*)*
If there is low or no voltage verified at this point, the transformer must be replaced

17. GENERAL TROUBLE SHOOTING

Verify the 19.9volts DC supply on the Puls*air* 2000 and 23.8volts DC on the Puls*air* 3000 from the power supply P.C.B in the mother unit to the hand unit solenoid valve. The black and blue wires are required for this test
(Edge connector PL4 on power supply PCB pins 1&2)
If there is low or no voltage verified at this point, the power supply P.C.B must be replaced

Verify the 19.9volts DC supply on the Puls*air* 2000 and 23.8volts DC on the Puls*air* 3000 in side the hand unit on the main P.C.B. The black and blue wires are required for this test (Edge connector PL2 on main P.C.B pins 1&3)
If there is low or no voltage verified at this point, the umbilical cord assembly must be replaced

Verify inside *Pulsair* mother unit the inline fuse to the pump (T250ma)
If faulty remove and replace

Verify airflow from pump.
If no airflow from the pump the pump must be replaced

PULSAIR MOTHER UNIT NO POWER
Pulsair 2000/3000

Verify fuses on under side of *Pulsair* mother unit
If faulty remove and replace

Verify mainswitch on side of *Pulsair* mother unit
If faulty remove and replace

Verify *Pulsair* mains power cord lead
If faulty replace

INCONSISTENT AIR FLOW

Check pump adaptor for air flow
If faulty replace

Check pump assembly for airflow
If faulty replace

17. GENERAL TROUBLE SHOOTING

BATTERY not charging Pulsair easyeye

Check 5amp fuse inside Pulsair
If faulty replace

PRINTER will not function Pulsair easyeye

Check paper is present inside printer
Check lid is shut
Check printer is switched on

If Printer is faulty refer to section 21

NO POWER Pulsair easyeye

Check voltage from wall mounted P.S.U
12volts should be present.

If faulty replace

NO POWER Pulsair easyeye MOTHER UNIT

Verify the voltages from the mother unit power supply P.C.B
Check the voltages at the molex connector SK1

SK1 pin8 (orange) = common
SK1 pin7 (blue) = 24volts
SK1 pin6 (yellow) = 6volts
SK1 pin5 (red) = 5volts
SK1 pin4 (black) = common
SK1 pin3 (white) = -12volts

If faulty replace the P.S.U

17. GENERAL TROUBLE SHOOTING

NO POWER Pulsair easyeye HAND UNIT

Verify the voltages at the hand unit P.C.B
Check the voltages at the Molex connector SK2

SK2 pin8 (orange) = common
SK2 pin7 (yellow) = 6volts
SK2 pin6 (blue) = 24volts
SK2 pin5 (red) = 5volts
SK2 pin4 (black) = common
SK2 pin3 (white) = -12volts

If faulty replace the pulsair umbilical cord assembly (Procedure 11)

18. TROUBLE SHOOTING THE SOFTWARE

When calibrating or verifying the calibration of the Puls*air* the software has been designed to show warning messages or graphs to give a indication that there is a problem with the Puls*air* at this stage of the procedure (as seen in fig 27)

FIG 27

Communication Link Error (as shown in fig 27) is an indication that the RS232 communication cable has not been connected between the Puls*air* and calibration electronic unit, or when switching on the Puls*air* after being instructed by the software, has not taken place in the time period requested.

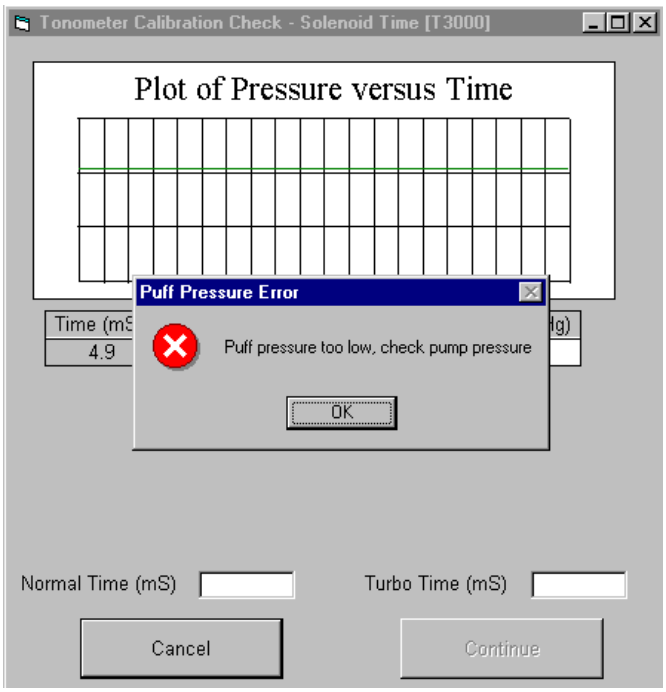


FIG 28

The graph above - **Puff Pressure Error** (fig 28) indicates that there is no pressure seen by the pressure transducer on calibration jig. This would suggest that there is a pressure problem from pump (no air pressure!) or that there may be a connection problem with air pipes from air filter! If the correct pump pressure is not set to 21psi this warning graph will then also appear.

18. TROUBLE SHOOTING THE SOFTWARE

The graph below (Pressure versus Time) shows how the Puls*air* calibration software has tried to set a Pulsair 3000 valve time out setting to a time period of 3.1ms (as shown in fig 29) this has not been achieved as illustrated.

Once this has occurred the software is designed to go back above the point of failure to try and reset the time period by reducing the time period's adjustment in step of.06ms.
This has also failed (as seen in fig 29).

At this stage the umbilical cord assembly must now be replaced, as the valve is faulty.
Refer to procedure 9 and 9A for replacement of umbilical cord assembly.

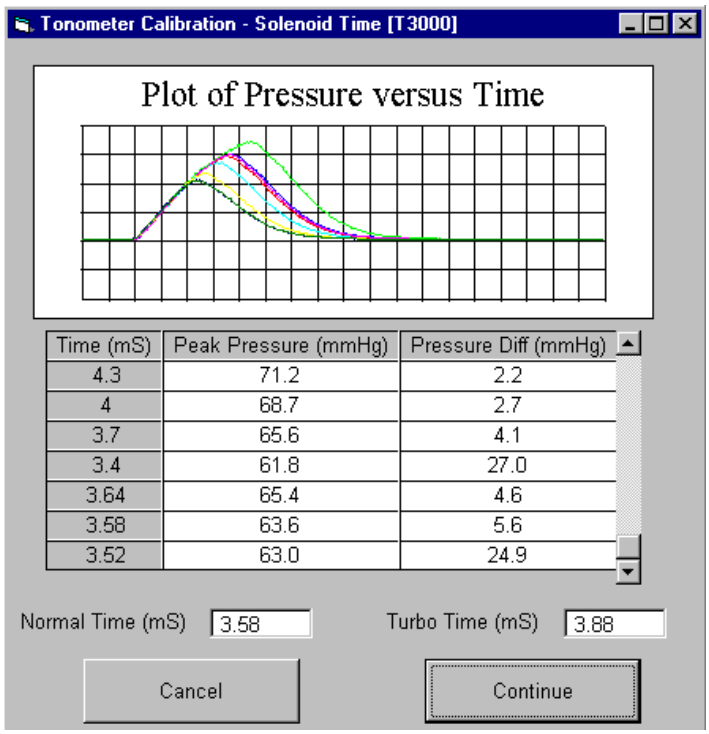


FIG 29

The graph reference (fig 30) **Puff PressureWarning** is an indication that the pump pressure has fallen out of the recommended calibration specification pressure setting of 21psi.

The reason for this could be as follows! Low output pressure from pump assembly, Pump adaptor faulty or requires internal cleaning. Air filter blocked requires replacing.
Leak in main air system (mother unit or hand unit)**!**

18. TROUBLE SHOOTING THE SOFTWARE

When fault of pressure problem has been identified and then rectified the Puls*air* must be recalibrated.

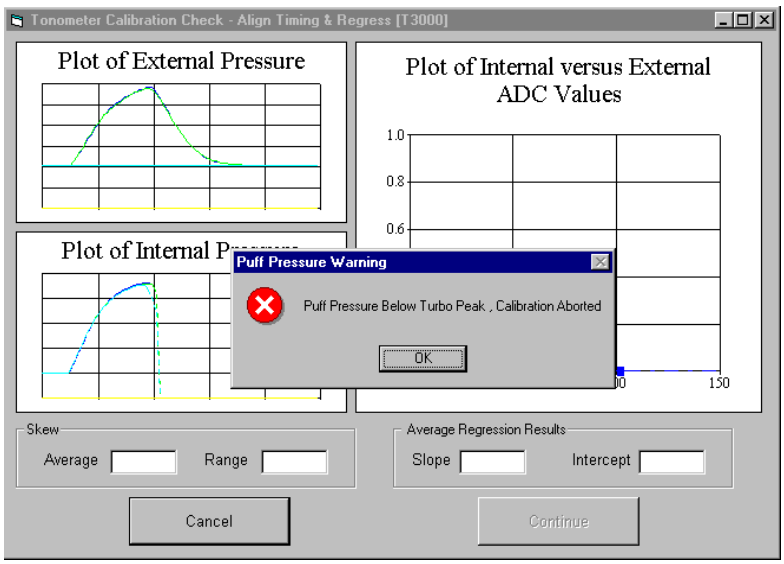


FIG 30

The graph reference (fig31 and 31A) **INTERNAL PUFF WARNING** and **Run time error 6 overflow** indicates that there is no internal pressure profile or a low signal from the hand unit's P.C.B pressure transducer (as seen in fig 31 and 31A).
Run time error 6 overflow will only appear on Puls*air* mod state 0-10 units

A faulty internal transducer, the air pipe not connected to transducer, blockage in air pipe restrictor could be the cause of this problem.

ELECTRIC SHOCK HAZARD

Electrical power is not required for this operation and the mains supply plug should be removed before starting next operation.

If found to be the transducer on the hand unit Printed circuit board, the printed circuit board must be replaced
Reference procedure 12. Replacement of Mainframe and P.C.B assemblies.
After replacement the Puls*air* must be recalibrated - refer to recalibration procedure 7.

18. TROUBLE SHOOTING THE SOFTWARE

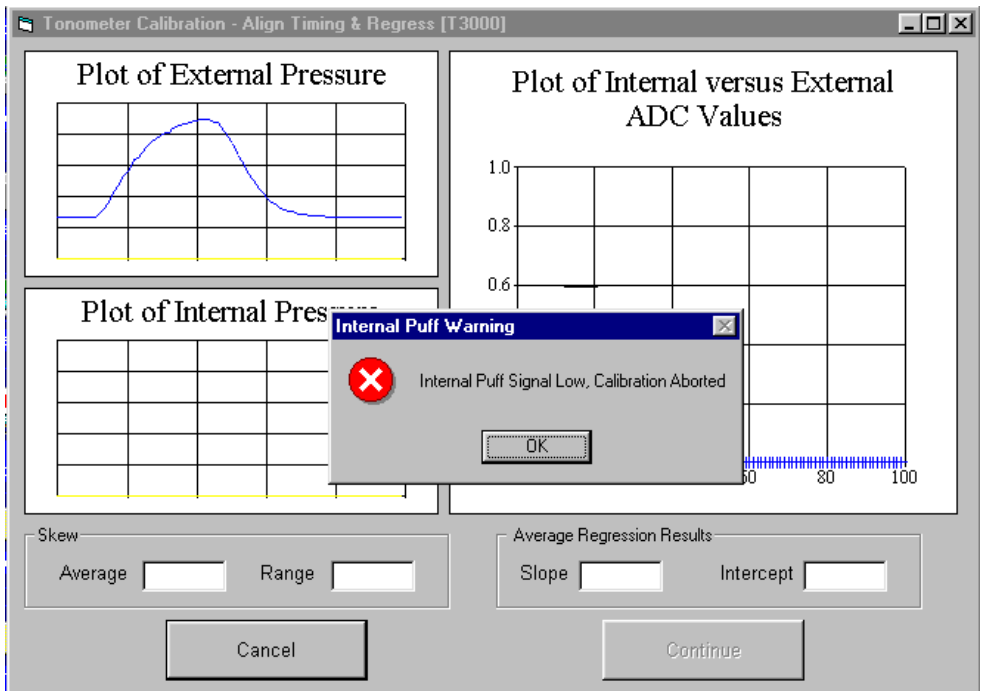


FIG 31

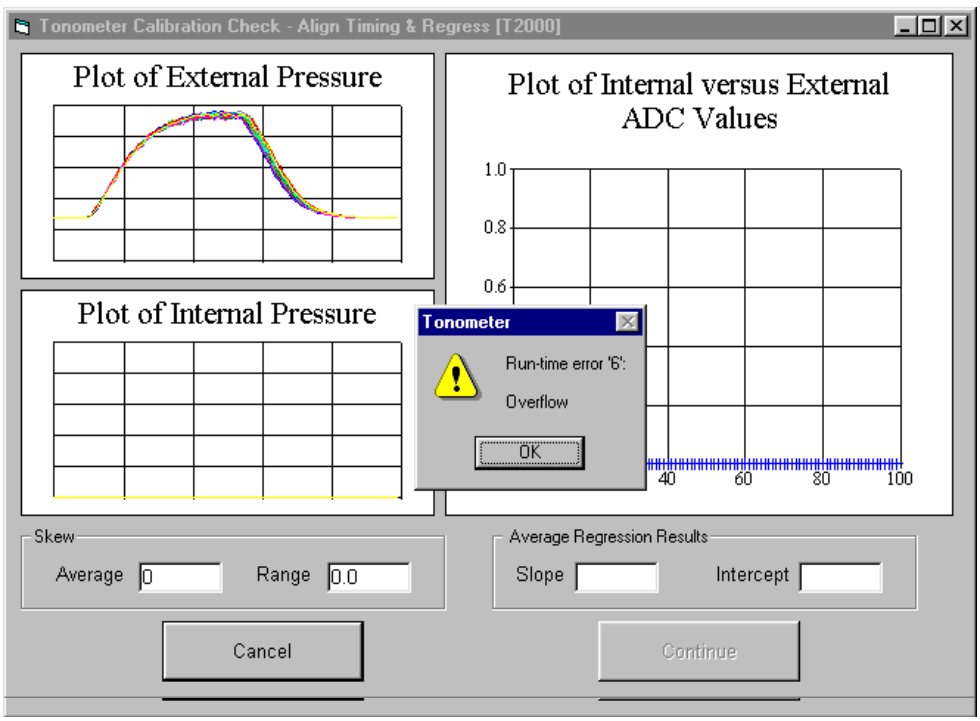


FIG 31A

18. TROUBLE SHOOTING THE SOFTWARE

In reference to (fig 32) **Alignment** of **K value** there is no reading shown in the K value box, only 0.000 in red.

This is a warning that the bulb is not functioning correctly, which may be caused by a loose or broken bulb contact, a blown bulb or a faulty bulb

Verify the voltage to bulb from power supply (check 6-volt power line),

Verify the main frame optical system; check fig 24 or 24a of procedure15. (**Setting of mainframe mirror assembly)**.

Ensure transducer has not been left on calibration jig when setting **K value,** this would give a similar fault

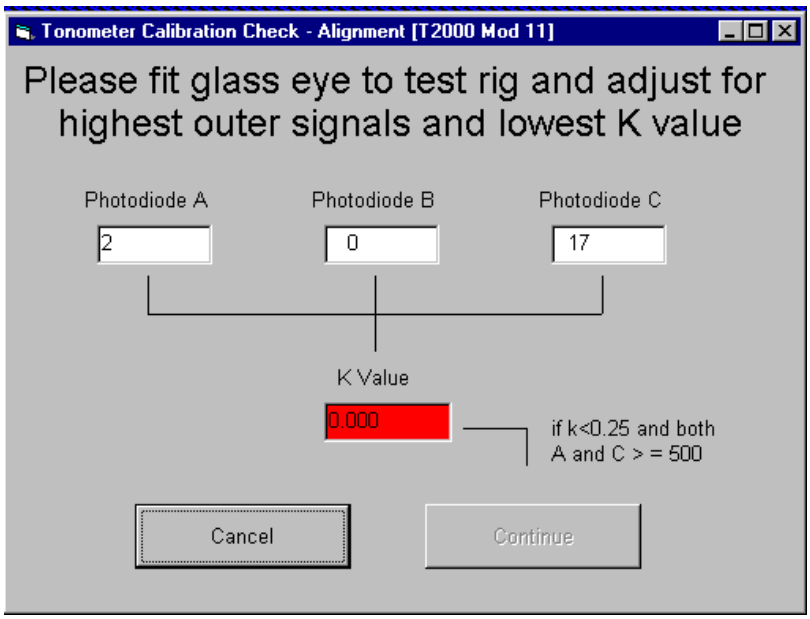


FIG 32

If the dongle security device is not connected into the back of laptop computer which is located into printer port LP1, a Error message will appear (as per fig 33)

Fig 33

18. TROUBLE SHOOTING THE SOFTWARE

When calibrating a Pulsair you are requested to select an instrument type a Puls*air* 3000 Puls*air EasyEye* or a Puls*air* 2000 mod state 11 or a Puls*air* 2000 mod state 0 to10 (refer to fig 6).

If the incorrect Puls*air* type has been selected when calibrating a Puls*air* 2000 mod state 0 to10 the Puls*air* calibration software will allow you to calibrate the Puls*air* until you are requested to write calibration values to the eeprom.

The software has been designed to detect at this stage that there has been a selection error and will reject your request to write calibration to the eeprom.

The same effect will be seen if trying to calibrate a Pulsair *EasyEye/* 3000/2000 mod state 11 and selecting a 2000 mod state 0-10 instrument type

A warning will now be displayed as seen as **Comms Error!** Error writing values to eeprom (fig 33A)

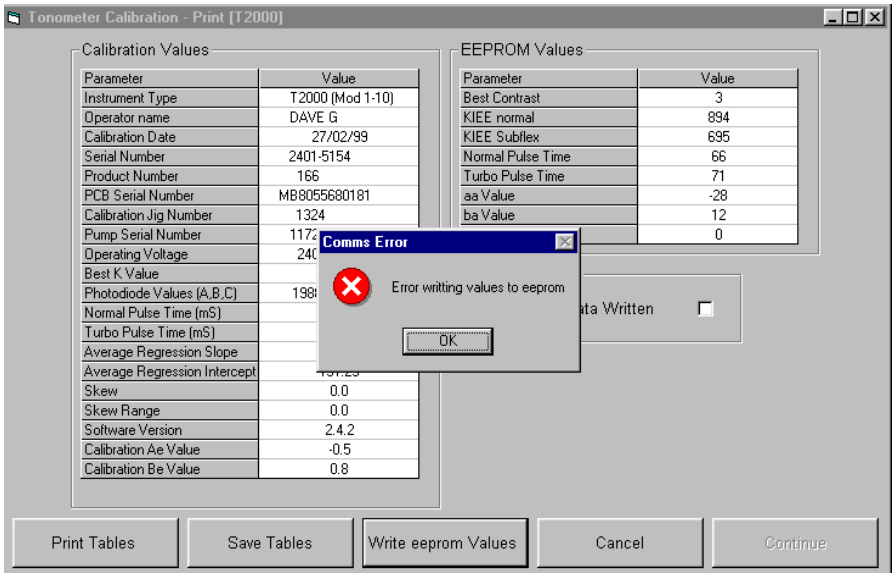


FIG 33A

To correct this error you must first click onto the **OK** on the **Comms error** box and then click onto the continue box to return to the start of the calibration procedure 7.

You must then re-select the correct Pulsair to be calibrated and re-start the calibration.

The software will not be able to distinguish between the Pulsair *EasyEye* Pulsair 3000 and the Pulsair 2000 mod state 11 after calibration if the incorrect Pulsair type has been selected

To verify that the correct type after calibration has been selected you must auto fire the Pulsair on to the glass eye.
The Pulsair 3000 display will show a flashing Er and the 2000 mod state 11 will show a zero and two flashing dots.

19. REPLACEMENT OF CASE HALVES PULSAIR 2000/3000

ELECTRIC SHOCK HAZARD

Electrical power is not required for this operation and the mains supply plug Should be removed before starting next operation.

1. Unscrew puff tube shroud and remove (as per fig 34)

2. Remove trim ring by sliding over case halves

3. Unscrew eye piece shroud and remove

4. Remove M3 locking screw from bottom of top case half

5. Remove top case half

6. Unscrew M3 centre locking screw holding mainframe and remove.

7. Remove bottom case half.

8. Replace bottom case halves with new adding spirol pin(EP79-03334) and M3 insert (EP79-01561) , add bostic clear adhesive to slot in case half to retain display p.c.b

9. Re-assemble in reverse order

19. REPLACEMENT OF CASE HALVES PULSAIR 2000/3000

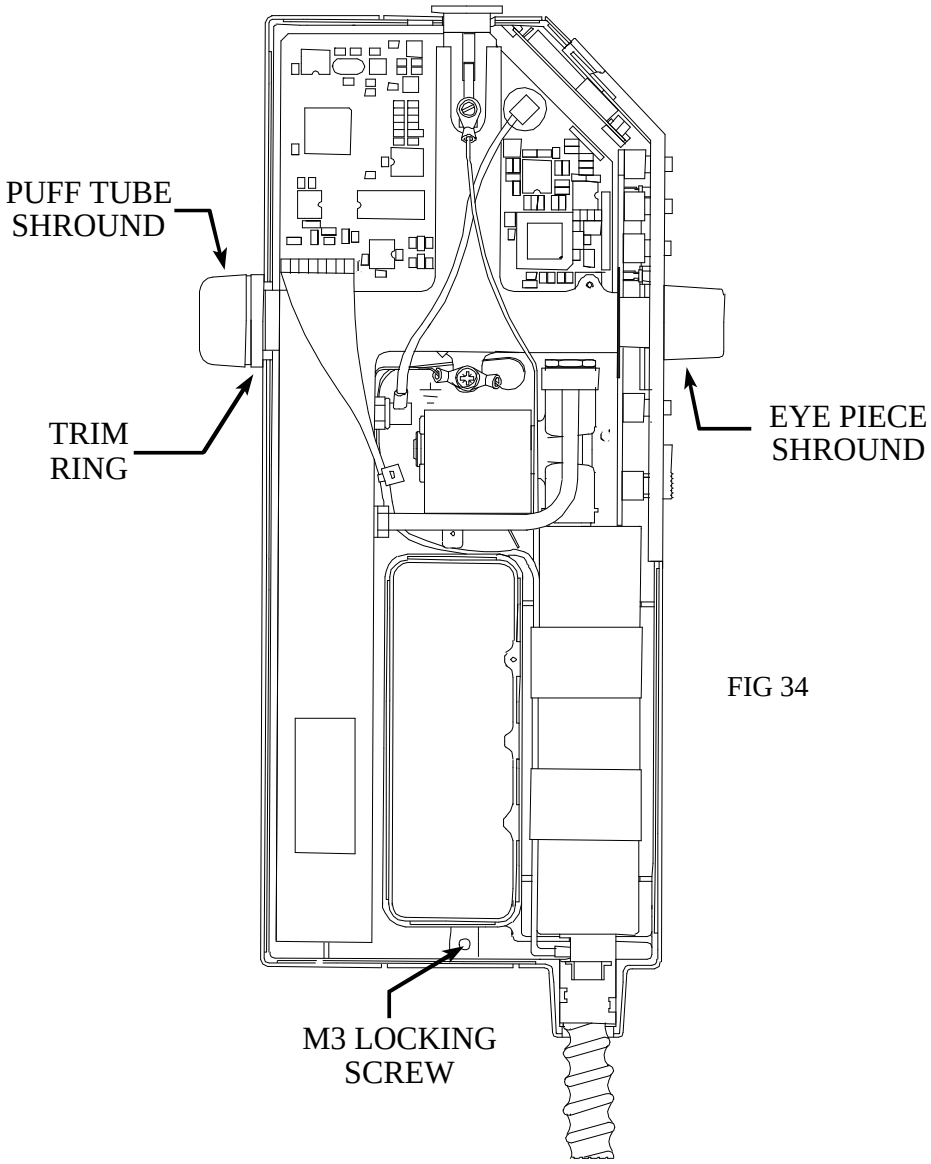


FIG 34

20. REPLACEMENT OF CASE HALVES PULSAIR EasyEye

ELECTRIC SHOCK HAZARD

Electrical power is not required for this operation and the mains supply plug Should be removed before starting next operation.

1. Unscrew the puff tube shroud from the case halves and remove (as per fig 34A)

2. Unscrew end cap on unbilical cord assembly and remove from case halves (As per fig 34A)

3. Push the Allen key supplied through the four screw plugs to access the cap headed screws Unscrew the four screws holding the two cases halves together.

4. Remove the top case half

5. Remove the front panel assembly.

6. Unscrew the M3 centre locking screw holding the mainframe and P.C.B.

7. Remove the bottom case half

8. Replace top and bottom case half adding new spiral pin (EP79-03334) to top case half and led covers (EP39-50387) if required

9. Re-assemble in reverse order.

20. REPLACEMENT OF CASE HALVES
PULSAIR EasyEye

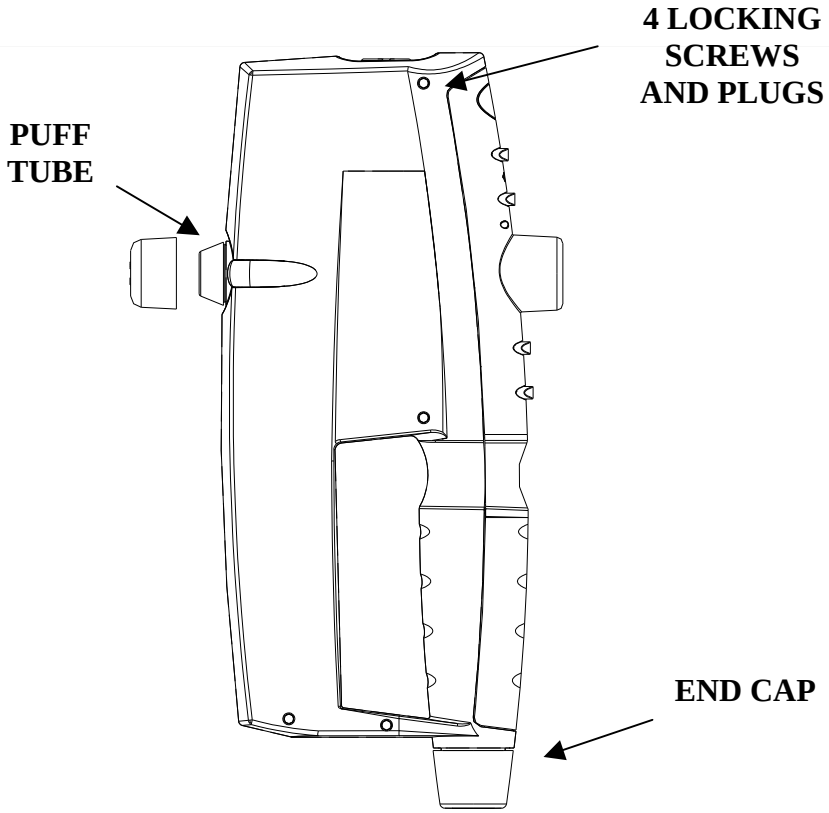
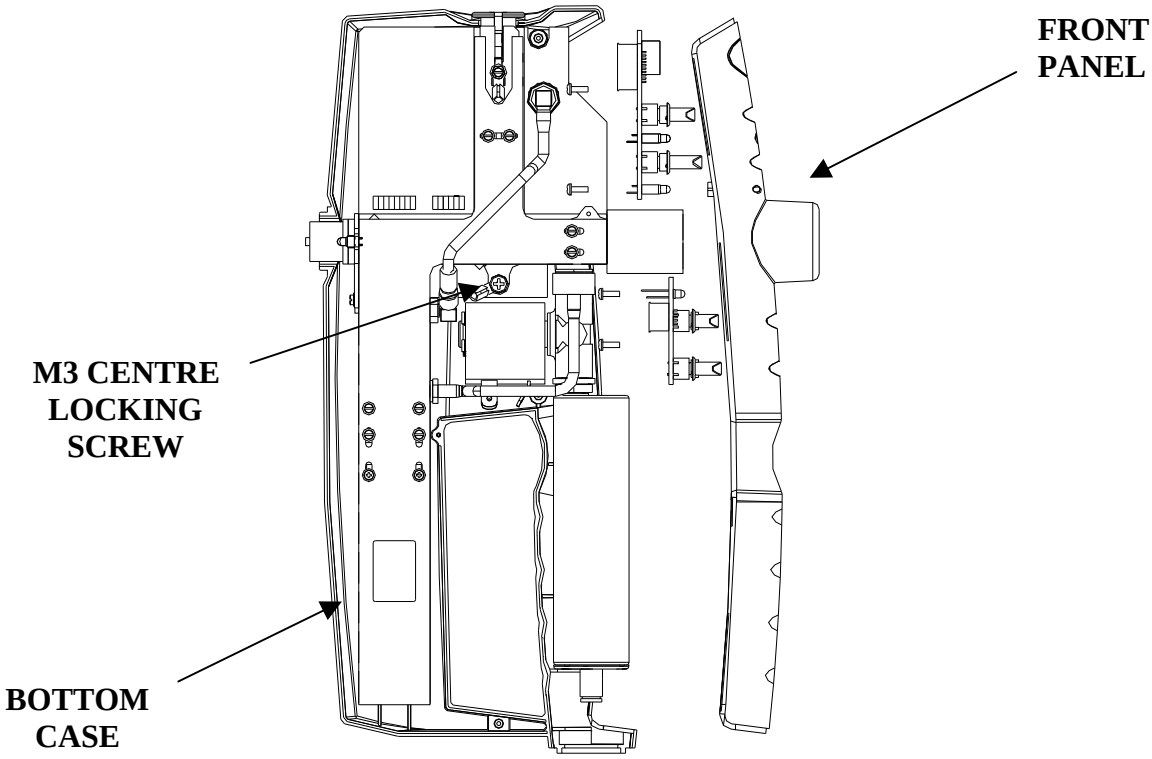
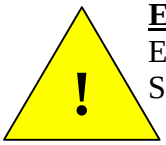


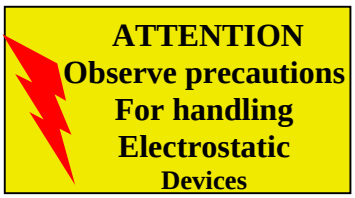
FIG 34A



21. REPLACEMENT OF THERMAL PRINTER (PULSAIR EasyEye)



ELECTRIC SHOCK HAZARD
Electrical power is not required for this operation and the mains supply plug Should be removed before starting next operation.



1. Unscrew the top assembly from the base as described in section **6**

2. Unplug the printer switch wiring loom from the powers supply P.C.B

3. Unplug the two ribbon cables from the lid which are connected to the power supply P.C.B

4. Remove the three screws from inside of the lid holding the printer in position

5. Remove the printer p.c.b located on the side of the top moulding.

6. Open the printers lid and then extract the printer.

7. Before fitting the new printer remove the lid attached, this is not required and can be discarded. Attach P.C.B from old printer prior to re-fitting.

8. Relocate the printer into the top assembly, before tightening the screws shut the printer's lid to allow the printer roller and gearing to be aligned correctly.

9. Re assemble in reverse order