Blease

Frontline Sirius

Anaesthetic Machines

Repair and Calibration Manual

MODIFICATIONS LABEL				
ECN 4678	ECN 2	ECN 3	ECN 4	ECN 5
ECN 6	ECN 7	ECN 8	ECN 9	ECN 10

CE 0120

Part Number: 136SM001

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Important

Read this manual before operating or servicing the machine.

Read the vaporizer manual before operating the machine.

For all users and Service Personnel, refer to the User Manual before operating the machine.

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Product Improvement

Blease Medical Equipment Limited has a policy of continued product improvement and therefore reserves the right to make changes which may affect the information contained in the manual without giving prior notice.

Responsibilities of the Manufacturer

The manufacturer accepts responsibility for the effects on safety, reliability and performance of the equipment only if:

- assembly operations, extensions, adjustments, modifications and repairs are carried out by persons with written authorisation from the manufacturer;
- the equipment is used in accordance with the instructions for use;
- the electrical installation of the relevant room complies with the 'Regulations for the Electrical Equipment of Buildings'.

NB
If during the warranty period the equipment is serviced by an unauthorised party, the warranty will be void.

Disclaimer

Opening of the control unit by unauthorised personnel automatically voids all warranties and specifications. The prevention of tampering is solely the user's responsibility; the manufacturer assumes no liability for any malfunction or failure of the ventilator if the control unit is opened.

The instructions in this manual assume that the engineer is familiar with and has had training in the servicing and care of anaesthetic equipment and is able to use pressure gauges, flowmeters and other laboratory equipment.

Blease accept no responsibility or liability for any patient injury or adverse circumstances which may arise from unauthorised maintenance of Blease Frontline Sirius Machines.

Note to Service Personnel

The Frontline Sirius® and integrated equipment must only be serviced by Qualified Service personnel.

The contents of this manual are not binding. If any significant difference is found between the product and this manual please contact Blease Medical Equipment Limited for further information.

To ensure correct functioning, the equipment must be serviced at regular intervals.

Blease Medical Equipment Limited recommends that the machine should be serviced at intervals not exceeding three months. Qualified Service Personnel and genuine spare parts should be used for all servicing and repairs. Blease Medical Equipment Limited will not otherwise assume responsibility for the materials used, the work performed or any possible consequences of the same.

In communication with Blease Medical Equipment Limited, quote the model and serial number of the equipment, with the approximate date of purchase. If the equipment is being returned for repair, indicate the nature of the fault or the work you require to be carried out.

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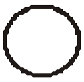
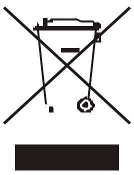
Symbols and Abbreviations

bpm BPM	**Breaths per minute**
cmH_2O	**Gauge pressure expressed in centimetres of water**
CPAP	**Continuous positive airway pressure**
PEEP	**Positive end expiratory pressure**
I:E Ratio	**A ratio of inspiratory to expiratory time**
	**IEC symbol to consult the instructions for use**
	**IEC symbol denoting type of equipment (B)**
	**WARNING: There is danger of personal injury to the user or patient**
	**Further relevant or helpful information**
	**Power off**
	Power on
	**Dangerous voltage**
l/m lpm	**Litres per minute**
ml	**Millilitres**
O_2	**Oxygen**
psi	**Pounds per square inch**
psig	**Pounds per square inch gauge**
l	**Litres**
	**IEC symbol for alternating current**
	**Confers approval under theEuropean Medical Device Directive**
E of C	**End of Case**
	**This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.**

Hazard Notices

This handbook contains important hazard information. You must read this hazard information before using the Frontline Sirius®.

Warning Notices

Warning notices denote a potential hazard to the health and safety of users and/or patients. These notices clearly state the nature of the respective hazard and the means by which it can be avoided.

Warning notices appear in full in the preliminary pages and are repeated at their points of application in the manual.

Caution Notices

Cautionary notices denote a potential hazard to the physical integrity of equipment/software but NOT a danger to personnel. These notices clearly state the nature of the hazard and the means by which it can be avoided.

Cautionary notices appear in full in the preliminary pages and are repeated at their points of application in the manual.

Relevant or helpful Information

Warnings

The following statements are made to comply with the requirements of IEC 60601-1.

1. This equipment must only be connected to gas pipeline supply lines that are fitted with pressure relief valves that limit the supply pressure to less than 7 bar.

2. The functioning of this machine may be adversely affected by the operation of equipment such as high frequency surgical (diathermy) equipment, defibrillators or shortwave therapy equipment in the vicinity. Increasing the distance from such equipment will minimise any possible interference.

3. Prior to connecting the machine to a patient carry out the pre-use check to verify correct alarm operation. To verify the O2 alarm, set the flowmeters to give a concentration of 50% oxygen. Using the controls on the oxygen monitor panel, set the low oxygen level to 60% and verify the oxygen low alarm operates. Set the high oxygen alarm level to 40% and verify that the oxygen high alarm operates.

4. The oxygen flow can only be reduced to zero by turning the ON/OFF switch to the OFF position. Excessive force on the oxygen control knob may damage the hypoxic guard.

5. To avoid explosion hazards, flammable anaesthetic agents such as ether and cyclopropane must not be used in these machines. Only anaesthetic agents which comply with the requirements on non-flammable anaesthetic agents in IEC 60601-2-13 'Specification for Anaesthetic Machines', are suitable for use in these machines.

6. As these machines are not suitable for use with flammable anaesthetic agents such as ether and cyclopropane the use of antistatic breathing tubes and face masks is not necessary.

   The use of antistatic or electrically conductive breathing tubes when utilising high frequency surgery equipment may cause burns and is therefore not recommended in any application that involves such apparatus.

7. The equipment must be periodically checked and maintained to ensure proper operation.

8. Performance of the equipment may be affected at temperatures below 10°C (50°F) and above 40°C (104°F).

9. The performance of the anaesthetic machines and vaporizers may be degraded if the two are mismatched. Refer to the vaporizer manufacturer's instruction manual before use.

10. If the integrated oxygen analyser is not fitted, an oxygen analyser complying with ISO 7767 shall be used when the anaesthetic machine is in use.

11. The units use semiconductor devices which are susceptible to damage by overloading, reversed polarity, electrostatic discharge and excessive heat or radiation. Avoid hazards such as reversal of batteries, prolonged soldering, strong RF fields or other forms of radiation, use of insulation testers or accidentally applied short circuits. Even the leakage current from an unearthed soldering iron may cause trouble.

Electrostatic Sensitive Devices (ESD)

Warnings and Cautions

All ESD must be stored in approved conductive packaging, tubes, shipping bags, foam or tote bins.

All persons handling ESD must be properly grounded via a 1MW resistive grounded wrist strap.

Cover all ESD bench tops with grounded conductive mats and connect all work surfaces and equipment to earth ground.

Transport all assemblies containing ESD in a conductive bag or container.

DO NOT use cellophane adhesive tape to wrap DIP (dual in-line package) tubes together.

DO NOT handle ESD by their pins or mix them with other routine electronic parts.

Never place ESD on ungrounded surfaces or leave them unattended in an open area.

Avoid cellophane wrappers, synthetic (non-conductive) carpeting, warm or cool air blasts, Styrofoam coffee cups, etc when working with ESD.

Use only properly designed heat lamps, heat chambers and/or ‘antistatic’ quick-chill sprays during troubleshooting or stress testing procedures.

NB
In particular electronic assemblies in the Frontline Sirius® range of machines are easily damaged by ESD and require special handling.

Cautions

Anaesthetic Machines

Do not leave gas cylinder valves open if the pipeline supply is in use and the system master switch is turned ON. Pressures from both supplies may become equal and, if simultaneously used, cylinder supplies could be depleted, leaving an insufficient reserve supply in case of pipeline failure.

The hypoxic guard control system only ensures that oxygen-nitrous mixtures will have a minimum oxygen concentration. HYPOXIC MIXTURES MAY BE DELIVERED IF GASES OTHER THAN OXYGEN, NITROUS OXIDE OR AIR ARE USED, OR WHEN OPERATING AT LOW OXYGEN FLOW RATES. When using carbon dioxide, as an additional gas, make sure the proportions of all gases are carefully adjusted in accordance with accepted clinical practice. Gas mixtures within the breathing system must be monitored when using these gases.

Leaking gases and vapours (downstream of the flow control valves and Oxygen Flush valve) may deprive the patient of metabolic gases and anaesthetic agent may pollute the atmosphere. Tests that detect leaks must be performed frequently. If detected, leakage must be reduced to an acceptable level.

Do not use the anaesthesia system if the hypoxic guard control system does not operate within permitted ranges. Using an incorrectly operating control system may result in incorrect gas mixtures and injury to the patient.

When occluding the breathing system for test purposes, do not use any object small enough to slip completely into the system. Objects in the breathing system can interrupt or disrupt the delivery of breathing system gases, possibly resulting in injury to the patient. Before using the breathing system on a patient, always check the breathing system components for foreign objects.

Do not place materials weighing more than 50kg on the bottom shelf, or more than 25kg on the upper monitor shelf. Overloading may cause damage to the shelves or cause instability.

Secure any equipment placed on the shelves.

To avoid stripping threads, do not use tools on the yoke gate T screws. Use only one cylinder gasket per yoke. Using more than one gasket could cause cylinder gas leakage.

Ventilator

The volume sensor must be correctly installed at either the distal location in the patient system's expiratory limb or the proximal end of the Y connector. If the sensor is installed incorrectly, volume data will be inaccurate and associated alarms, including the low minute volume alarm will not function properly.

Position the volume sensor's cable with care. If the cable is pinched or cut, the ventilator's volume monitoring may not function correctly.

Do not connect the ventilator or absorber exhaust directly to a vacuum source. The vacuum may remove required gases from the breathing system. (Only applies to Frontline Sirius 1000® and 2000®).

Ventilator inoperative messages indicate that a problem exists in the ventilator. Do not attempt to use the ventilator while a ventilator message is displayed.

Do not attempt to use the ventilator if the alarm mute button will not silence alarms.

WARNING: If an alarm condition cannot be resolved, do not continue to use the system.

Sterilise the bellows assembly periodically to minimise the risk of cross infecting patients. Use a sterilization schedule that complies with your institution's infection control and risk management policy. Only use Blease approved sterilization methods.

If any foreign materials or liquids are trapped in the driving gas circuit, or the pop off valve or the bellows base they could impair the valve's operation. Do not use the bellows assembly if you suspect that materials are trapped. Have the assembly repaired by trained service personnel.

Perform the Pre-Use Check procedures after cleaning and sterilizing the bellows.

Always perform the Pre-Use Check procedures for volume sensing functions after cleaning or replacing the volume sensor.

Vaporizer

Do not use any vaporizer that is visibly misaligned on the manifold or that, when it is locked, can be lifted off the manifold. Incorrect mounting may result in incorrect delivery of gases.

A vaporizer is calibrated and labelled for one agent only. Do not fill with anything other than the designated agent.

If a vaporizer is filled with the wrong agent, draining will not eliminate the agent, because the wick will have absorbed some of the agent. The wick must be thoroughly cleaned and dried by trained service personnel.

The vaporizers must be completely upright for the sight glass to properly indicate agent levels.

Never oil or grease any oxygen equipment unless the lubricant used is made and approved for this type of service. In general, oils and greases oxidise readily, and - in the presence of oxygen - will burn violently. Fomblin is the recommended oxygen service lubricant (stock number ST7014).

After performing any maintenance or repair procedure, always verify proper operation of the system before returning to use.

Use cleaning solution sparingly. Do not saturate system components. Excessive solution can damage internal devices.

Following ethylene oxide sterilization, quarantine the equipment in a well ventilated area to allow dissipation of absorbed ethylene oxide gas. In some cases, aeration periods of seven days or more may be required. Aeration time can be decreased when special aeration devices are used. Follow the sterilizer manufacturer's recommendations for aeration periods required.

Notes

1. Technical Description

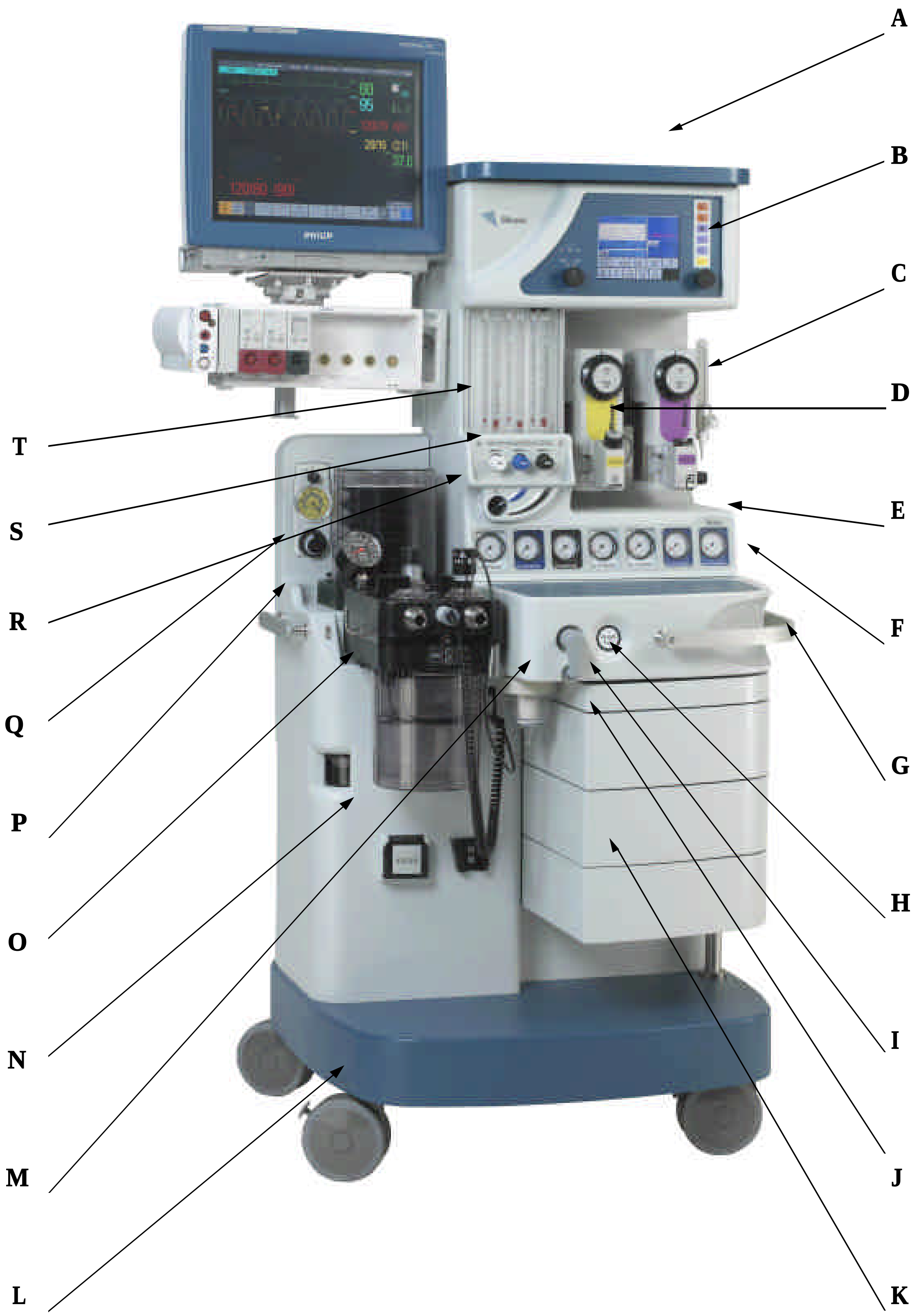


Figure 1 Frontline Sirius® 3000

Key to Figure 1

A Monitor shelf
B Ventilator
C Independent O_2 Flowmeter (only on the 3000 model)
D Vaporizer
E Cylinder/Pipeline Gauges
F Pneumatic Unit - (behind gauge panel)
G Handle
H Oxygen Flush
I Common Gas Outlet
J Writing Table
K Drawer
L Frame
M Suction Receiver Jar
N Anaesthetic Gas Scavenging System (AGSS)
O Absorber
P Bellows
Q Suction Controller
R Main On/Off or Off, N_2O/Air Interlock Switch
S Flow Control Valves with Hypoxic Guard
T Flowblock Assembly

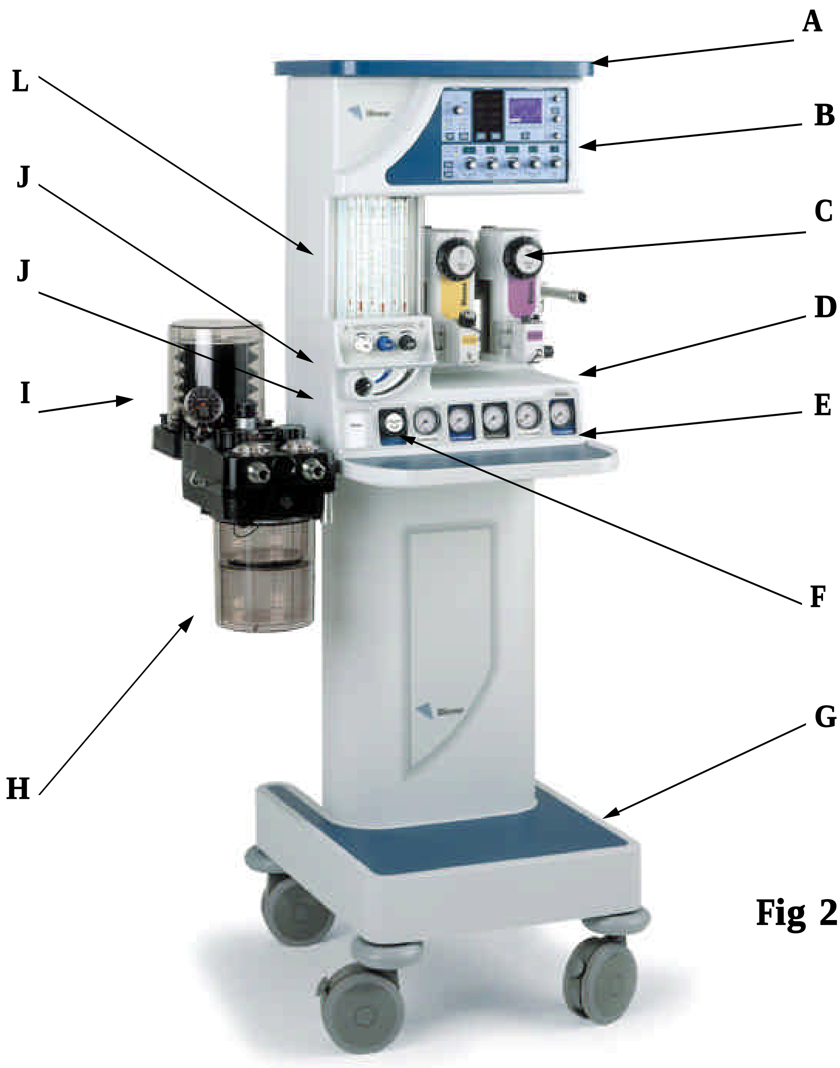


Fig 2 Sirius 2000 &

Sirius 1000

Key to Figure 2

Sirius 2000

A Monitor shelf

B Ventilator

C Vaporizer

D Cylinder/Pipeline Gauges

E Pneumatic Unit - (behind gauge panel)

F Oxygen Flush

G Frame

H Absorber

I Bellows

J Main On/Off or Off, N2O/Air Interlock Switch

K Flow Control Valves with Hypoxic Guard

L Flowblock Assembly

Sirius 1000

M Ventilator

N Vaporizer

O Cylinder/Pipeline Gauges

P Pneumatic Unit

Q Oxygen Flush

R Main On/Off or Off, N2O/Air Interlock Switch

S Flow Control Valves with Hypoxic Guard

T Flowblock Assembly

Notes

1.1 Mode Descriptions for the Sirius Ventilators

1.1.1 PEEP

1.1.2 Control Panel

The control panel has a permanent display of measured PEEP and a button to actuate the setting of the desired value.

The display box will have the heading "PEEP" and show the "SET" value.

The default is that PEEP will be at the minimum setting i.e the residual that is < 2cmH_2O caused by the bellows assembly. In this default condition or if the Set value is subsequently set below 3 cmH_2O the set value display will show as "OFF".

The method of control is that the user will rotate the Trak Wheel until the desired display is highlighted, press the Trak Wheel and then increase the set value by rotating the Trak Wheel until the desired value is reached, this is then accepted by a further press of the Trak Wheel.

The range of set values will be 3 to 20 cmH_2O. An alarm will be implemented to indicate to the user that the set value has not been maintained. The alarm will activate at ± 50% of the set value.

To activate a set value that has been chosen, be sure to press the Trak Wheel to confirm. If you fail to confirm the change will not be saved and the previous value will rest (reappear) after a time out period. This applies to all Trak Wheel controls.

The implication of PEEP on other alarms is that the Pressure cycle alarms will be PEEP referenced, the pressure Limit will be absolute. i.e. Referenced to atmosphere.

1.1.3 Control System

For the control system to effect PEEP the following will need to be activated :-

A pulse width modulator will control the power to the coil of a PEEP valve. This valve is a voice coil actuator working as a variable spring applying force to a disc that impinges on a seat. The implication being that the valve is closed until the gas pressure exceeds the actuator force.

The control processor will monitor the PEEP value and modify the PWM setting to maintain the desired value.

1.1.4 Volume Control Ventilation (CMV)

Volume Control Ventilation is a mechanical mode that delivers a tidal volume set by the user into the patient tubing. This delivered volume is to be independent of the compression losses in the absorber, bellows and associated tubing. It will also be independent of any small leaks that may be present. Fresh gas flowing into the breathing system will not cause a permanent change in the delivered volume. If a change in fresh gas flow rate occurs during ventilation the ventilator will re-adjust the delivered tidal volume to be correct within the next 4 breaths.

1.1.5 8700 Ventilator Fresh Gas and Compliance Compensation

1.1.6 Fresh gas

Fresh gas flow adds to the delivered Tidal Volume during the inspiratory period. To compensate for this, a reduction in the delivered volume needs to be made. This reduction is :-

$$\text{FG Flow rate } \frac{\text{ml / M} \times \text{Insp Time (sec)}}{60}$$

Take FG = 5 LPM TV 600 ml 10 BPM I:E 1:2.0

$$\frac{5000}{60} \times 2 \text{ seconds} = 166 \text{ ml}$$

New Effective TV is now 600 - 166 = 434 ml

1.1.7 Compliance

The effect of the gas being compressed in the dead space within the breathing system is to reduce the Volume (TV) that is delivered to the patient. In an ideal ventilator the Set TV would be the volume of gas that is delivered to the patients lungs. This can only be partly achieved because the anatomy of the patient is unknown, what can be done is the set TV can be made to be accurately delivered from the catheter mount. Thus reducing set TV errors to a minimum.

To calculate the effect of the Breathing System compliance on the delivered TV it is necessary top measure what the capacity or compliance of the system is (C_s). This can only be done by some form of pre-use check procedure. In essence it is necessary to have the ability to first of all select "Compliance Compensation" from a menu. It is then necessary to lead the user through the process of measuring the dead space within the particular breathing system for that period of use. It is obvious that should the system be re-configured the test will need to be repeated.

A possible process is to allow the ventilator to prompt the user to : -

1. Reduce the FG flow to minimum (but Allow for it as above).
2. Occlude the catheter mount. This can be a 15 mm male taper on the gas machine.
3. The ventilator then delivers a breath to pressurize the system to 10cmH_2O.
4. The ventilator records the volume required to achieve this pressure and verifies that a leak is not present.

The dead space is now calculated as follows : -

$$\text{Volume in } \frac{\text{ml}}{\text{Pressure}} = \text{Dead space compliance } C_s$$

This figure is stored until the ventilator is switched off or a re-test is asked for by the user.

The ventilator is then set to use on a patient and when the ventilation is stable measure the total compliance of system and patient C_t. An adjustment can then be made to the TV that will be increased to compensate for the lost volume due to compression within the breathing system. : -

$$\text{Increase in TV -= Set TV} \quad x \quad 1+ \frac{C_s}{C_t - C_s} = \text{new TV}$$

E.g

System test measurement using 200 ml gave 25 cmH_2O pressure rise.

$$\frac{80 \text{ ml}}{10\text{cm}H_2O} = C_s = 8$$

Running the ventilator on a patient with a set 500 ml TV gave 20 cmH_2O peak pressure.

$$\frac{500 \text{ ml}}{20 \text{ cm}H_2O} = C_t = 25$$

So to calculate the TV increase: -

$$500 \quad x \quad 1 + \frac{8}{25 - 8} = 735 \text{ ml}$$

So 735 ml is the actual ventilator output into the breathing circuit to give 500 ml at the catheter mount.

This figure would have to be recalculated in the light of any fresh gas flow change as above but would just be a variation on the 735 ml figure.

1.1.8 Pressure Control Ventilator (PCV)

Pressure control ventilation is time cycled mode where the ventilator strives to produce the user set inspiration pressure for the inspiratory period. To accomplish this goal, the inspiratory flow rate and pressure are set by the user. To do this, the control that is used for the Set TV function will be reassigned as "I Flow" and calibrated in LPM. The pressure Limit control becomes the "Set Pressure" control. This allows the user to define the delivered wave form. The default pressure will be 30 cm H_2O in both Adult and Paediatric modes.

1.1.9 Inspiratory Pause

A function that is "Inspiratory Pause" is to be implemented. This option will be available in volume and PCV mode such that a pause of 25% of the inspiratory time is used as a Plateau before starting the expiratory phase. This means the expiratory time is reduced by the plateau time. If at all possible the pause or plateau time should be made variable from 5 to 60 %. The x % should be displayed on the second row up of the display.

1.1.10 Sigh

Sigh is a function that can be selected in volume or Pressure ventilation the effect is that every 50 breaths the delivered breath is increased by 15%. The selection of this function will be displayed as an extension to the main mode display under the bar graph.

1.1.11 Spontaneous or ASB

Spontaneous is a mode that is equivalent to the machine being in standby will all monitoring enabled. This allows a patient to breath at their own rate and volume with the ventilator being able to display the monitored parameters and actuate alarms. At this level the Breathing rate would be a monitored parameter, it should follow the same pattern as other features in that it will display the monitored value in large characters and show Assisted Spontaneous Breathing 'ASB' as the mode.

1.1.12 Pressure Support

When a patient is taking a "Spontaneous Breath" from an anaesthetic system the work of breathing is higher than normal. To overcome this it is desirable for the ventilator to be able to assist the spontaneous breath. The assistance is provided by the ventilator sensing the negative pressure cause by the "Patient Attempt" to breath and initiating flow from the ventilator. This flow is continued to the point where the breathing circuit pressure has reached a set value.
i.e. Pressure Support. To implement this action the user needs to be able to set first the trigger threshold in the range –1 to –10 cmH_2O and secondly the Support Pressure 0 to 30 cmH_2O both referenced to the PEEP level.

It will also be necessary to define a inspiratory time in which the pressure support is delivered. In this case the breathing rate and tidal volume are not relevant. The inspiratory flow rate will be a fixed value of 40 LPM in Adult and 30 LPM in Paediatric.

The detection of a "Patient Attempt" will be carried out by the control system to aid the speed of support. A patient attempt will be indicated on screen by the negative excursion of the pressure wave form being green rather than blue for the positive phase.

1.1.13 SIMV

This mode is Synchronised Intermittent Mandatory Ventilation. This is an extension of the spontaneous mode in so far as the patient can take breaths on demand with pressure support but some mandatory breaths are included. To achieve this it is necessary to set a tidal volume, a breathing rate and all of the features described above for the pressure support. To simplify things a little the inspiratory flow rate an be assumed from the TV / inspiratory Time set values.

The patient attempt or trigger signal will be used to synchronise the mandatory breaths to the patients breathing pattern and initiate the pressure supported spontaneous breaths. Thus allowing the patient to establish the breathing rate.

In this way a patient could be breathing at say 12 BPM with the settings such that 4 breaths of say 500 ml are mandatory and 8 breaths are taken spontaneously with pressure support of up to 30 cmH_2O above the PEEP level.

The ventilator will monitor all of the breaths, display the parameters TV /BPM / I:E and indicate the patient attempt by showing negative excursions of the graph in RED. The set breathing rate and measured rate will be displayed, the Set Inspiratory time and I:E ratio will be displayed in the appropriate window.

A means if preventing hyperventilation will be implemented such that any change in breathing rate is only allowed to take place slowly.

The method of inflating the patient's lungs and the operation of the valves and the gas flows in the SIMV mode are the same as for the CMV mode.

The main difference between this mode and CMV is that a facility is provided for synchronising the mechanical breaths given by the ventilator to the patient's own respiratory efforts (spontaneous breaths).

If the patient fails to make any effort, then SIMV will default to ventilation functionally identical to CMV at the set SIMV rate.

The routine within the ventilator that detects the Patient Trigger is used to detect the instant a patient starts to inhale and is thus ready for a synchronised breath to be given by the ventilator. Whether a breath is spontaneous or mandatory depends on where it occurs in the SIMV cycle.

This can be explained as follows :-

1. The frequency control sets up an internal clock tick in the ventilator. The time between clock ticks is the Set breathing period and is equal to a time in seconds of 60/frequency in BPM. I.e. 4BPM = 1 tick every 15 seconds.

   With no patient triggers detected, the ventilator will deliver a mechanical breath at the start of each respiratory period on the clock tick.

2. Preceding each clock tick is a time window in which the ventilator will be looking for a patient trigger. If a trigger occurs within the window the patient will be given a synchronised mechanical breath. If it occurs outside the window it will be a spontaneous or Pressure Supported spontaneous breath depending on the ventilator setting.

   In practical use of the SIMV mode, the ventilator should first be set at an adequate RATE, TIDAL VOLUME, I:E RATIO, PEEP and PRESSURE LIMIT for controlled ventilation, say 600 ml, 12 BPM and 1.5 secs for an adult patient. When patient trigger signals are being displayed regularly the mandatory rate can be reduced and the total breathing rate will be controlled by the patient. If this rate is inadequate and the total breathing rate will be controlled by the patient. If this rate is inadequate the low MV or Rate alarm will be activated.

1.2 Matrix of Modes, Facilities and Alarms

Mode	Sigh	Pause	Press Supp	PEEP	MV Alm	Rate Alm	Press Alm
CMV	✍✍	✍✍		✍✍	✍✍		✍✍
Spont		✍✍	✍✍	✍✍	✍✍	✍✍	✍✍
SIMV		✍✍	✍✍	✍✍	✍✍	✍✍	✍✍
PCV	✍✍	✍✍	✍✍	✍✍			✍✍

1.2.1 CMV Defaults at start up

	Vol	Rate	Insp TIME	Press Limit	Vol Alm Lo / Hi	Press Alm Lo / Hi
Adult	500 ml	12	1.5	50	4 / 10	4 / 55
Paed	150 ml	20	1.5	40	1 / 6	4 / 45

SIMV Defaults at start up

	Vol	Rate	I:E	Press Limit	Vol Alm Lo / Hi	Press Alm Lo / Hi
Adult	500 ml	12	1:2.0	50	4 / 10	4 / 55
Paed	150 ml	20	1:2.0	40	1 / 6	4 / 45

Spontaneous Defaults at start up

	Support Pressure	Rate Alm Lo / Hi	Vol Alm Lo / Hi	Press Alm Lo / Hi
Adult	10	5 / 25	4 / 10	4 / 50
Paed	10	10 / 35	1 / 6	4 / 40

1.2.2 Spontaneous with Pressure Support Defaults at start up

	Insp Flow	Insp TIME	Support Pressure	Press Limit	Rate Alm Lo / Hi	Vol Alm Lo / Hi	Press Alm Lo / Hi
Adult	30L	1.5	10	50	5 / 25	4 / 10	4 / 55
Paed	20L	1.5	10	40	10 / 35	1 / 6	4 / 45

1.2.3 Pressure Control Ventilation Defaults at start up

	Insp Flow	Ventilation Pressure	Rate	Press Alm Lo / Hi
Adult	30L	30	12	4 / 50
Paed	20L	20	20	4 / 40

Default for all Modes is “PEEP off” in PCV the maximum PEEP available will be limited to 6 cmH_2O.

If PEEP is set, the default “PEEP Alarm” will be ± 50 % in the range 0 to 30 cmH_2O
The Rate or BPM alarm is to be the set value ± 50 % or in SIMV mode Lo 10 hi 20 BPM.

Figure 3 Inspired Gas Flow

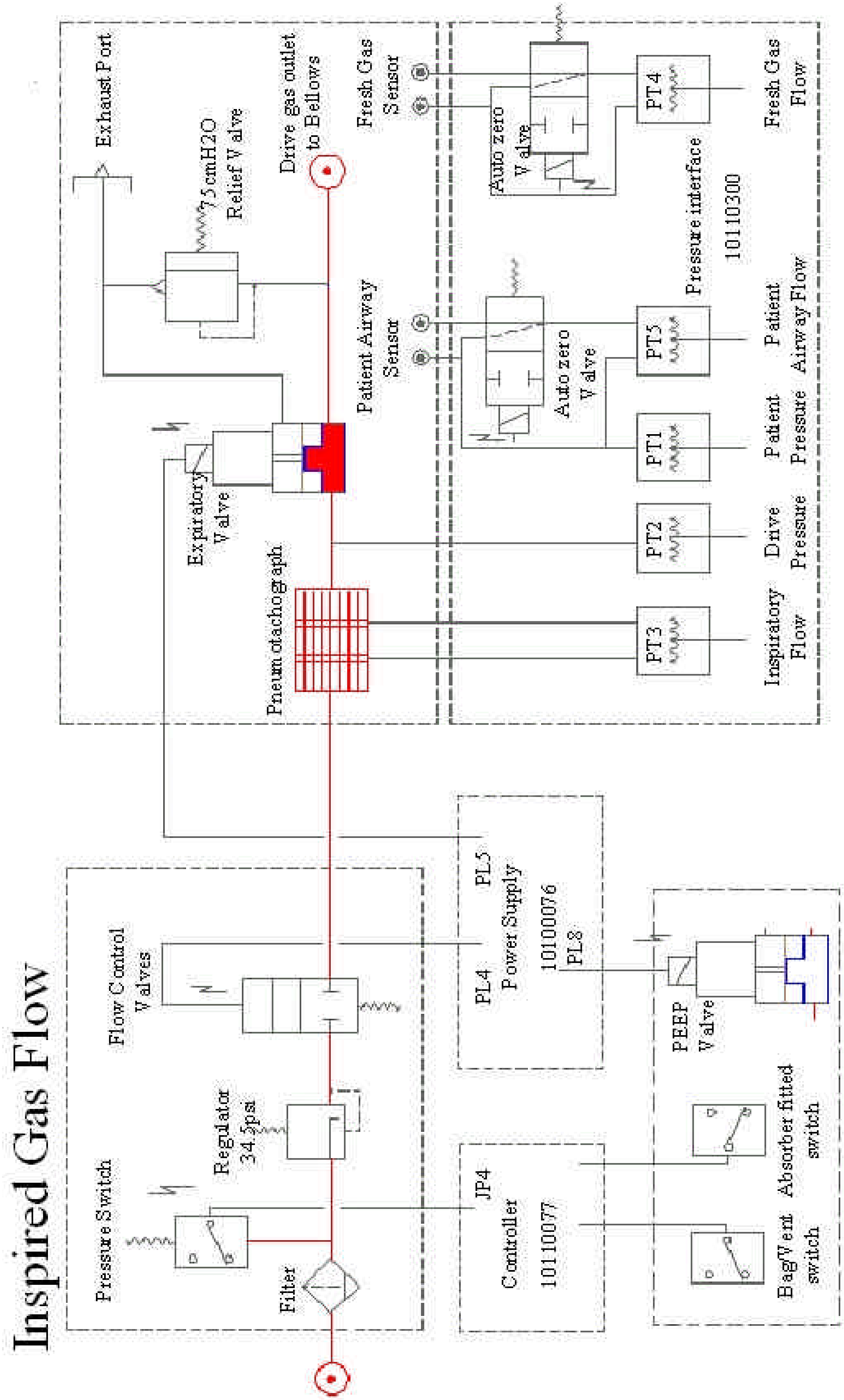
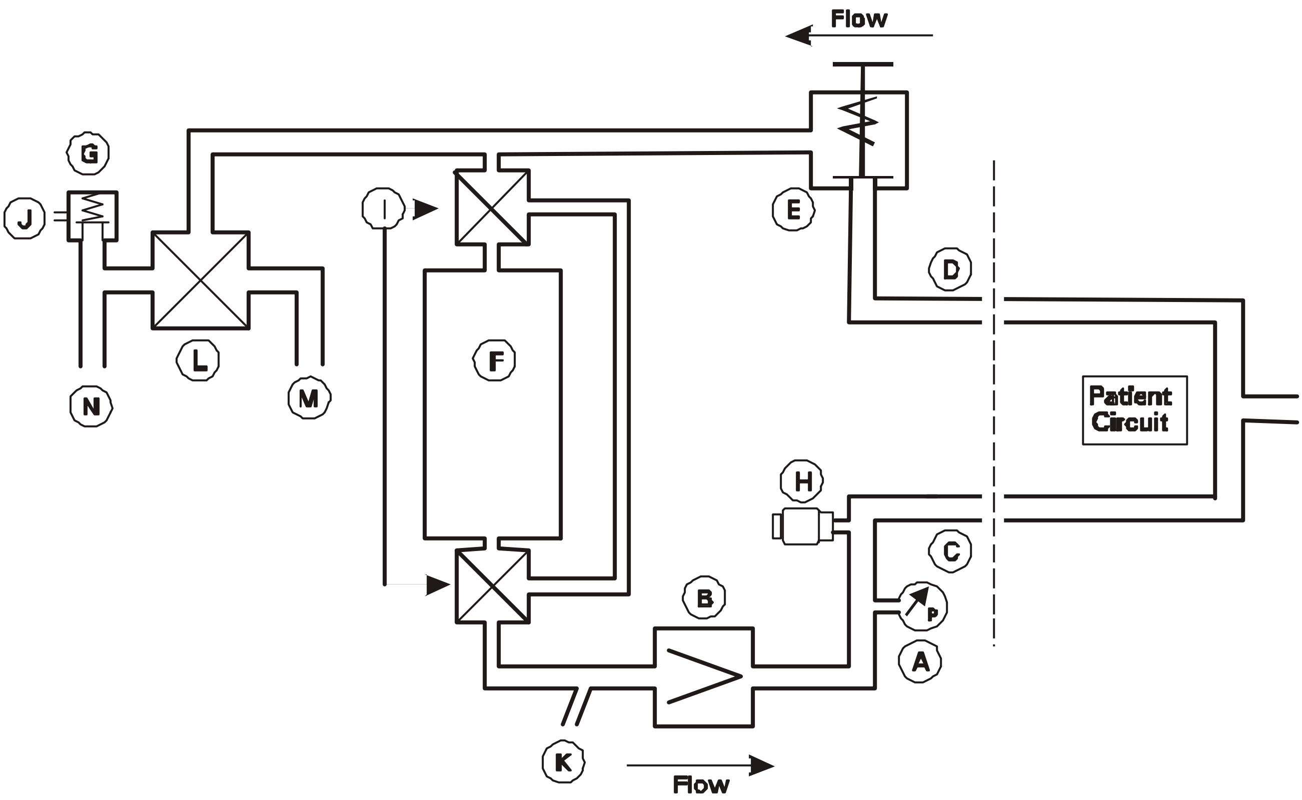
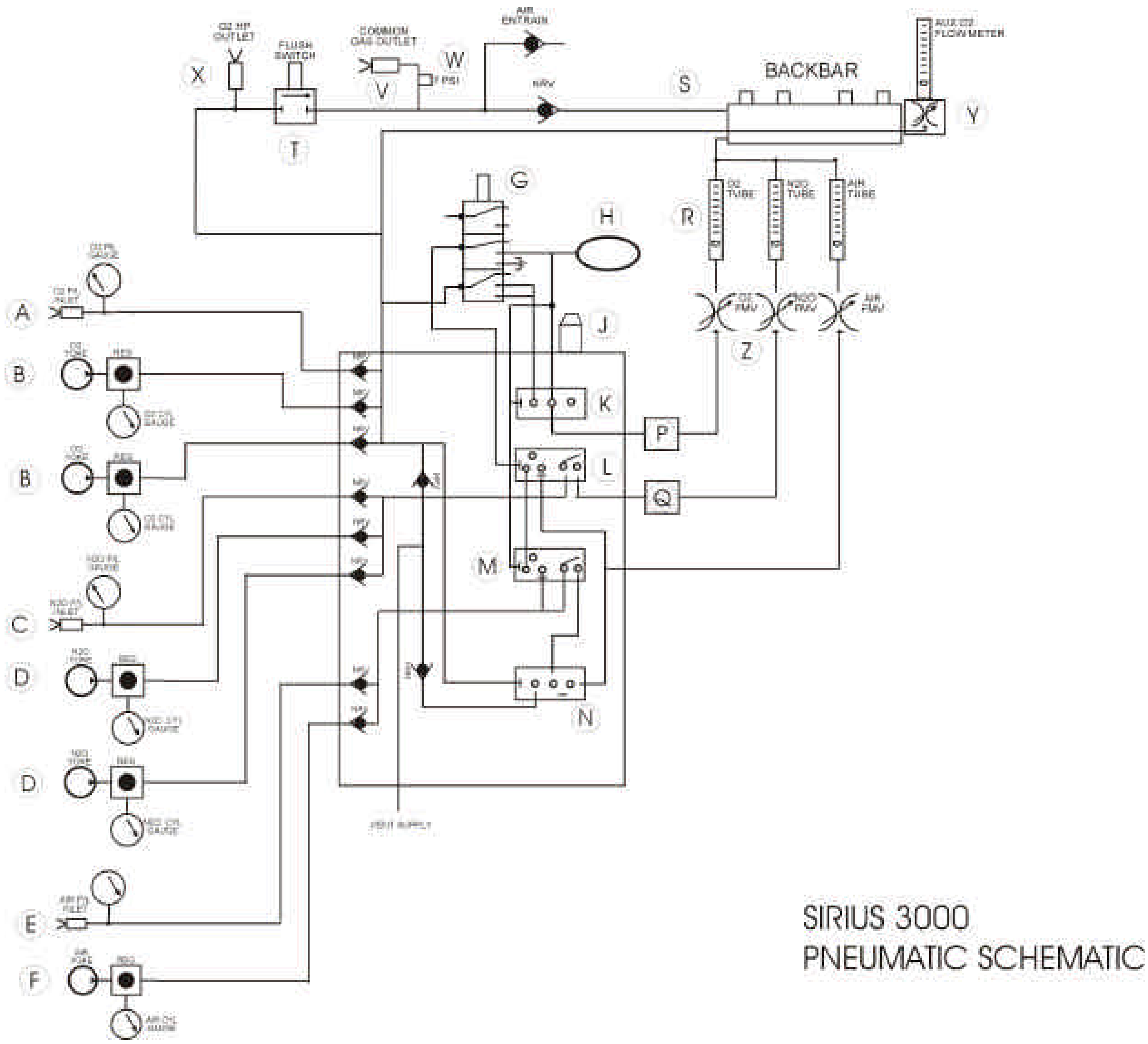


Figure 3a Absorber Pneumatic Schematic



A	Manometer
B	Inspiratory Non-return Valve
C	Patient Inspiratory Connector
D	Patient Expiratory Connector
E	Expiratory Non-return Valve & PEEP Valve
F	Canister(s)
G	APL Valve
H	Oxygen Sensor Port
I	Absorber Bypass Valve
J	APL Exhaust Valve
K	Fresh Gas Port
L	Bag/Vent Valve
M	Ventilatory Port
N	Bag Port

Figure 4 Sirius 3000 Pneumatic Schematic



A O2 Pipeline
B O2 Cylinder Yoke
C N2O Pipeline
D N2O Cylinder Yoke
E Air Pipeline
F Air Cylinder Yoke
G ON/OFF– N2O/AIR Switch
H Reservoir
J Oxygen Failure Alarm
K O2 Shut Off Valve
L N2O/AIR Interlock Valve
M Air Valve
N Air Take Over Valve
P O2 Secondary Regulator
Q N2O Secondary Regulator
R Flow Meters
S Backbar
T O2 Flush
V Common Gas Outlet
W Blow Off Valve
X O2 HP Outlet
Y Aux Flow Meter
Z Hypoxic Link System

1.2.4 6700 8700 Principles of Operation

For active inspiration, the flow control calve is opened to provide a specific gas flow into the bellows assembly. Simultaneously the expiratory solenoid closes and pressure is generated in the bellows assembly producing an inspiratory flow to the patient. The flow and pressure measured and monitored by the microprocessor feedback system.

Expiration occurs when the flow control valve is closed and the expiratory solenoid opens and releases the gas from the bellows assembly.

In PCV mode the set pressure is achieved during inspiration and maintained at that level by allowing a controlled bypass through the expiratory valve. This allows the required pressure level to be maintained whilst compensating for any fresh gas flow into the patient circuit.

For expiration the expiratory solenoid is opened which releases the gas from the bellows assembly.

During all modes of ventilation an autozero is periodically applied to the flow sensors just prior to a breath being delivered; at this point there is no flow through the sensors, this ensures that the measured values are maintained as accurately as possible regardless of environmental variations.

2. Removal / Replacement Instructions

Notes

When any repair or exchange is performed on internal components, a complete check must be made on all functions. A complete overall performance check must also be performed when any replacements or repairs have been completed.

2.1 Removal of Outer Cases

Figure 5 Removal of Top Surface

Remove the 4 screws shown here (black circles are to indicate where screws are located) and lift the top cover off.

Remove bottom screw as shown

Remove top left screw as shown

Remove top right screw as shown

Ensure work surface is clear then slide front cover forwards in the direction shown.

Figure 6 Removal of Front Moulding

Figure 7 Front of Machine

Figure 8 Close up of the Front of Machine

Figure 9 Rear of Machine

(Not necessary for Routine Service)

Removal of back - Remove all pipelines and cylinders before removing screws and GCX.

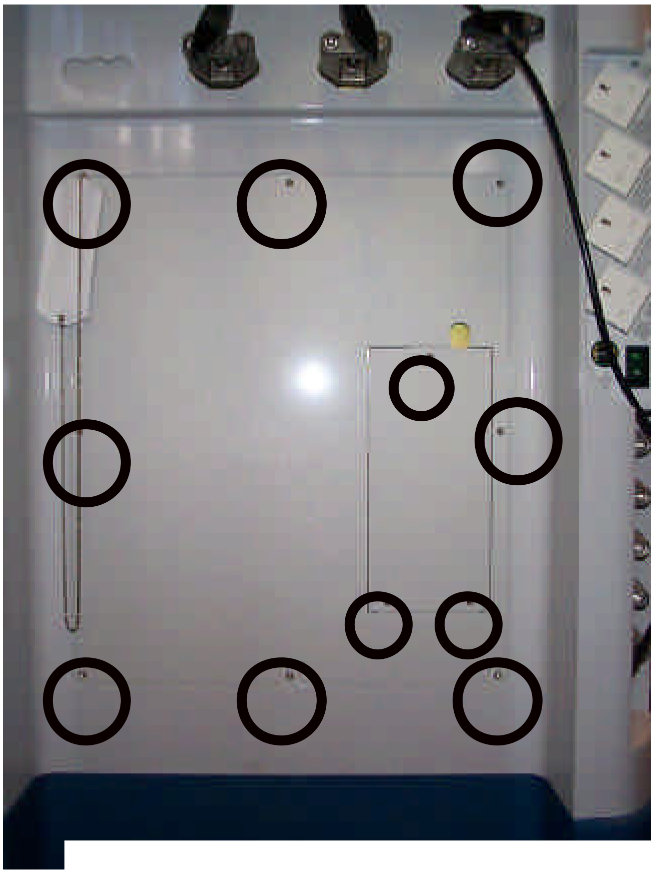


Figure 10 Location of Rear Screws

Remove small panel for partial access, remove larger panel for complete access.

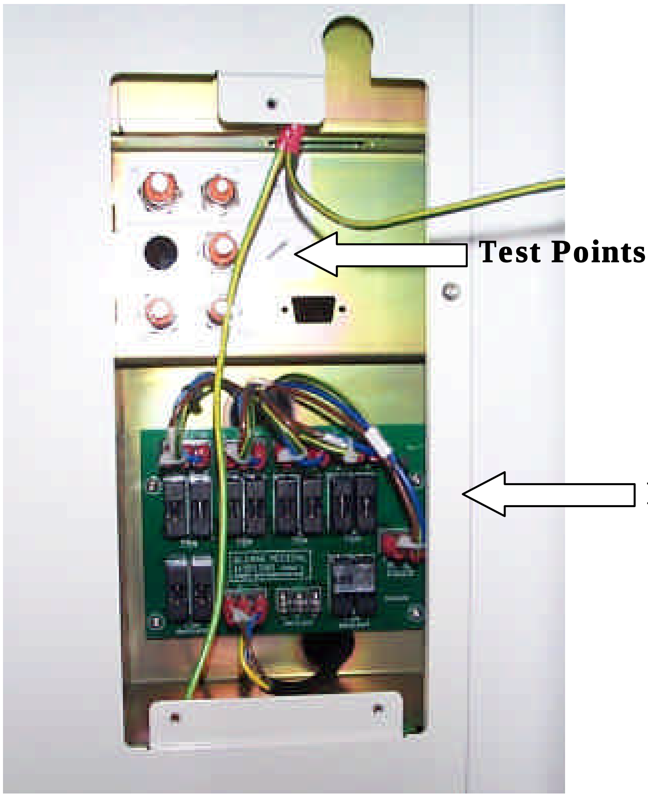


Figure 11 Part rear Panel Removed

Regulators

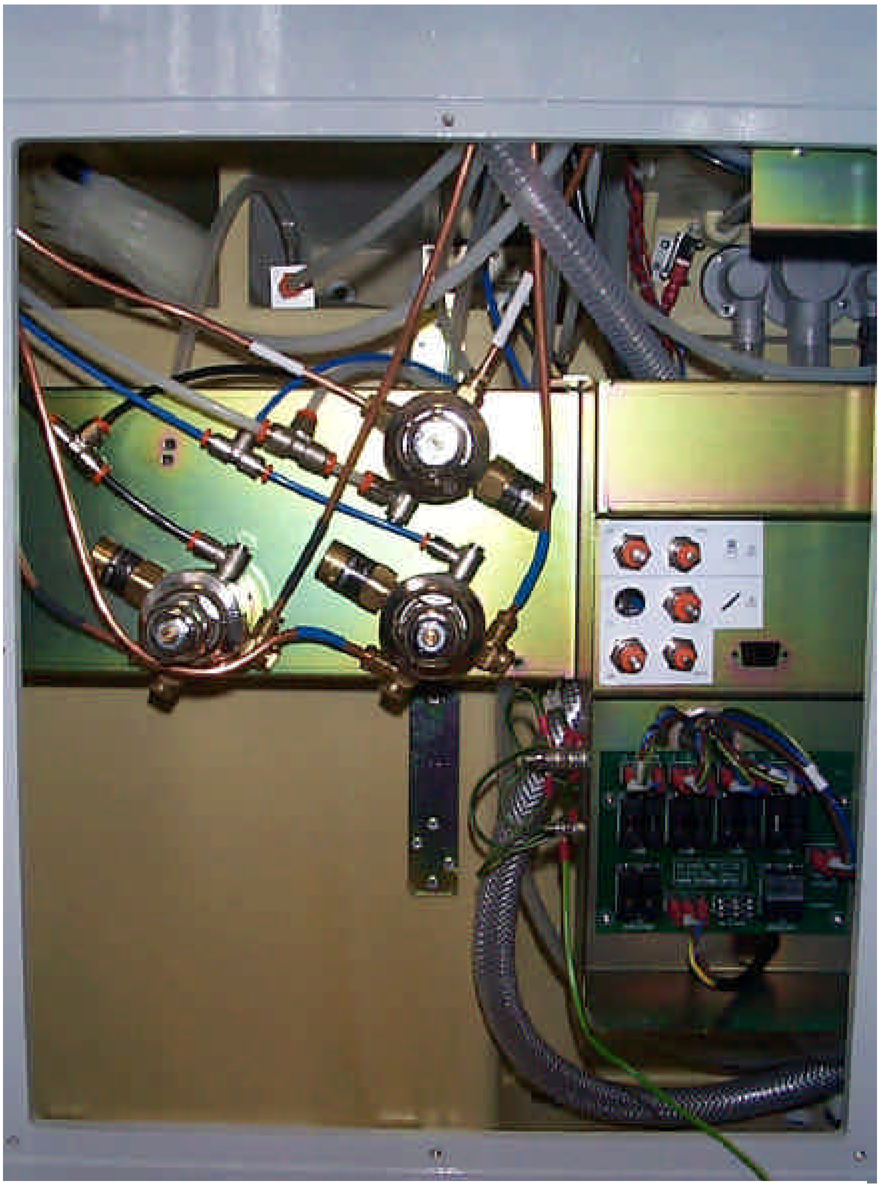


Figure 12 Complete Rear Panel Removed

2.2 Mechanical Hypoxic Guard Block

2.2.1 Introduction.

The hypoxic guard prevents the operator from administering a mixture of gases which contain less than 21% oxygen, to achieve this, the oxygen and nitrous oxide control valves are linked via a set of gears. Any attempt to reduce the flow of oxygen or to increase the nitrous oxide flow to a level which would result in a oxygen concentration below this, results in the nitrous oxide valve closing or the oxygen valve opening to maintain the 21% minimum oxygen concentration.

The flow meter has a minimum oxygen flow "Basal Flow" which is only turned off via the main system ON/OFF switch.

- The hypoxic guard is factory set and requires only routine calibration checks.

- If during routine checking any of the calibration results are found to be out of specification some adjustment can be made to correct this and this is described later in this section, this should be done with extreme caution.

- If due to damage or wear it is deemed necessary to replace the hypoxic guard valve block, a calibrated unit can be ordered which will be supplied with a test sheet which gives the regulator output pressures required for correct setting.

- The flow control valve cartridges should not be dismantled, they are gas specific and require no servicing and cannot be repaired.

2.2.2 Calibration of Hypoxic Guard system

In normal use the Hypoxic Guard unit requires only routine calibration checks, any variations outside the specified range should be investigated by checking that the nitrous oxide and air flow valves are shutting correctly (see section **2.4**) or Setting the Basal Flow (see section **2.3**) depending on the nature of the fault.

If the calibration is faulty the recommended course of action is to replace the block with a calibrated replacement unit from Blease.

It is possible to recalibrate the block provided that the valves have not become damaged (the precision valves should never be dismantled, internal damage to the seat or needle will not be visible to the eye but can make the valve unusable).

If it is necessary to recalibrate the block then the following method can be used, it should be noted that this operation can take some time for the inexperienced engineer to master and should only be used if a replacement block is not available, if it proves impossible to achieve a satisfactory result then the precision valves are most likely to have become damaged and a new block is the only solution.

2.2.3 Calibration procedure.

For the purpose of this procedure we will assume you have removed the front cover and removed the following parts from the Hypoxic block, the valve knobs, (remove end label and undo M3 retaining nut), the idler gear, (release by undoing the M4 nut and pulling the gear and bush from their shaft). The oxygen stop arm and the oxygen gear, this runs on a thread on the body of the oxygen valve, the stop screw can be left in place.

(see fig **14**)

1. The first step is to ensure that the Air and Nitrous oxide valves are shutting fully and not overly tight, follow the procedure “Setting Valve shut off stop” (see section **2.4**)

2. As we are doing a full calibration you should set the hypoxic regulators to a ‘start’ setting of 30 psi, (see Mechanical hypoxic Guard Regulator Adjustment, section **2.6**)

3. The next stage is to set the Oxygen Basal flow, fit the oxygen gear to the valve and screw it fully on but DO NOT tighten it, it must be free running.

4. Slide the oxygen stop arm onto the valve shaft and push it up to the oxygen gear just fitted, you will notice there is a groove around the gear into which the small drive ‘dog’ on the back of the stop should fit.

5. Turn the stop arm clockwise until it hits the stop screw, and turn the oxygen gear anti-clockwise until you feel the drive 'dog' hit the end of the groove, (this should give about one full turn of the gear from its fully back position).

6. There must be a small clearance between the gear face and the back face of the stop arm to ensure that the only point of contact is the 'drive dog' a 0.005in feeler gauge can be used or the thickness of a piece of standard writing paper is a useful alternative (see fig **16**).

7. Turn the machine on so that you have an oxygen supply to the flow meter.

8. You must now hold the stop arm against the stop screw in a clockwise direction and the gear turned fully anti-clockwise and hitting the 'drive dog'.

9. Turn the shaft of the valve so that oxygen starts to flow and adjust the flow to the prescribed Basal flow level (still holding the gear and stop arm in position, when this is achieved tighten the two grub screws on the stop arm.

10. The stop screw height must now be adjusted, turn the valve a full turn anti-clockwise and check that it just clears the top of the stop screw, if not adjust the stop by screwing it in till the arm JUST clears and tighten the lock nut and recheck that the arm hits the stop when turned clockwise and clears the top when turned anti-clockwise.

11. The 'Idler gear' must now be meshed to link the two valves, turn the stop arm clockwise to the stop and hold, and turn the oxygen gear fully anti-clockwise, (as in 8) this should give you the 'basal flow' showing on the oxygen flow meter. Turn the nitrous oxide flow up to approx 400ml and whilst holding the stop and gear in position carefully insert the idler gear and its bush onto it's shaft and meshing it's teeth with the oxygen and nitrous oxide gears, then fit the idler gear nut.

12. The unit can then be checked for performance against the calibration test sheet, the flow rates on this sheet are guide lines of what should be achieved but the definitive reading is always the oxygen analyser reading, it is recommended that two analysers are used to ensure accuracy.

13. If the calibration is not correct it will be necessary to 'fine tune' by adjusting the hypoxic regulators within the limits prescribed on the test sheet.

14. If the desired results are still not reached then the gears (step11) must be reset to give the required effect. If the oxygen level is high then the gears will need to be 'meshed' with the nitrous flow at 450 or 500ml if the level is low the opposite would be needed. This adjustment and adjustment of the regulator pressures should allow calibration of the unit.

Notes

2.3 Setting Oxygen Basal Flow

If the Basal flow has altered during normal use, (this can occur if the valve has been turned down with excess force, reducing the flow, or has increased sometimes due to settling in of the regulators) the following method can be used to restore the correct flow often without the need to recalibrate the entire hypoxic guard block.

1. Remove the front cover (see section **2.1**) and turn all flow controls to minimum, turn the machine on and allow basal flow on the oxygen to stabilize for a few minutes.
2. There are two grub screws holding the oxygen stop arm to the valve shaft, holding the stop arm tight against the stop screw slightly slacken the two screws and turn the valve shaft until the basal flow is within limits and retighten the grub screws.
3. Check that when the valve is opened that at its next complete revolution that the stop arm clears the top of the stop screw and that on closing it engages firmly with the stop screw (see fig 16), if not the screw may be adjusted by slackening its lock nut and screwing the stop in or out to achieve this.
4. Carry out a full check of the calibration of the Hypoxic Guard.

Small variations from the specified Basal flow can usually be rectified using the above method, if this does not give a satisfactory result it is possible that if the flow had been shut off completely that the valve seat may have been damaged, in these cases it may be necessary to replace the block with a new calibrated unit.

Figure 13 Assembled Hypoxic Guard Unit

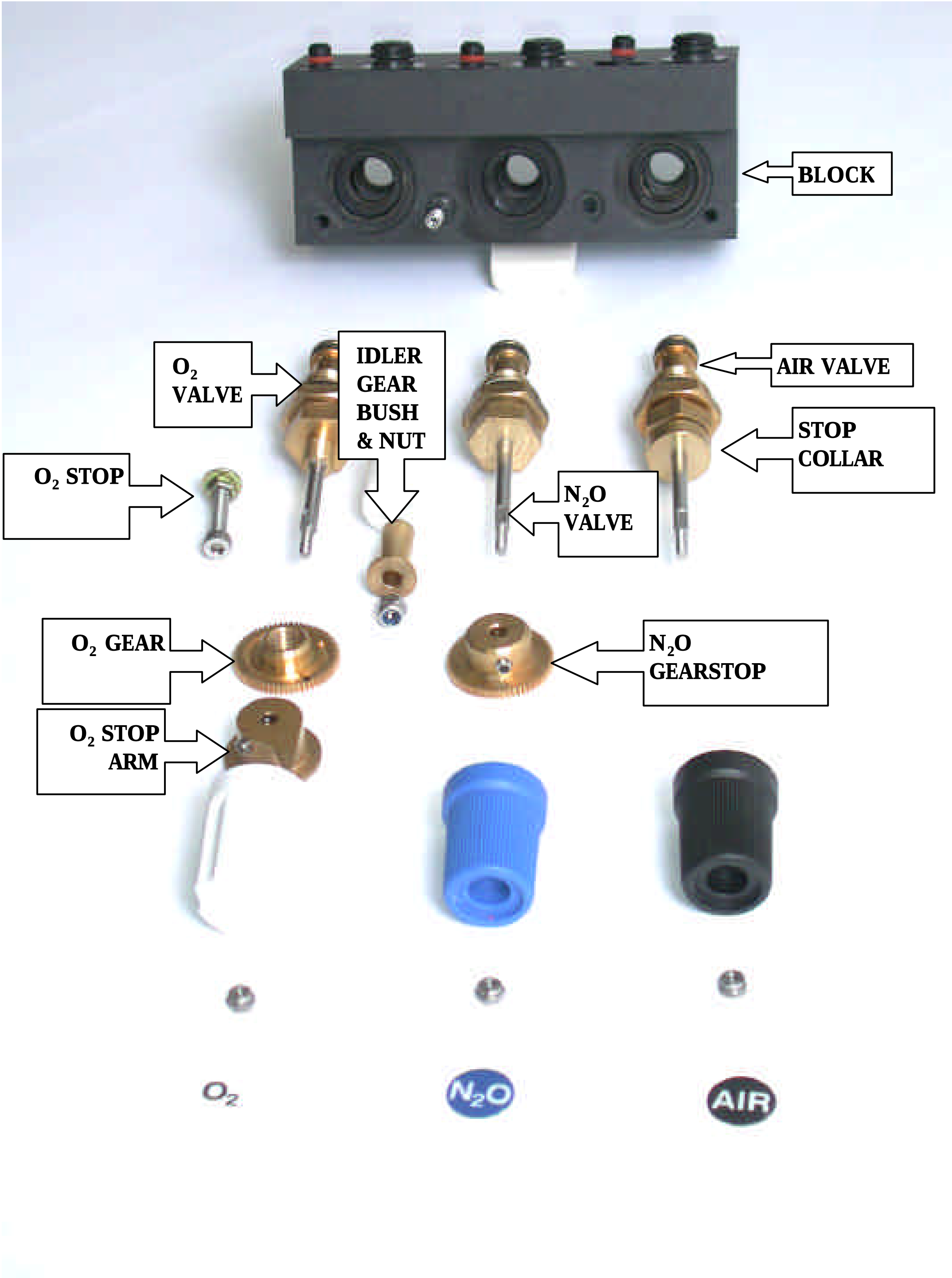


Figure 14 Exploded View of Hypoxic Guard Components

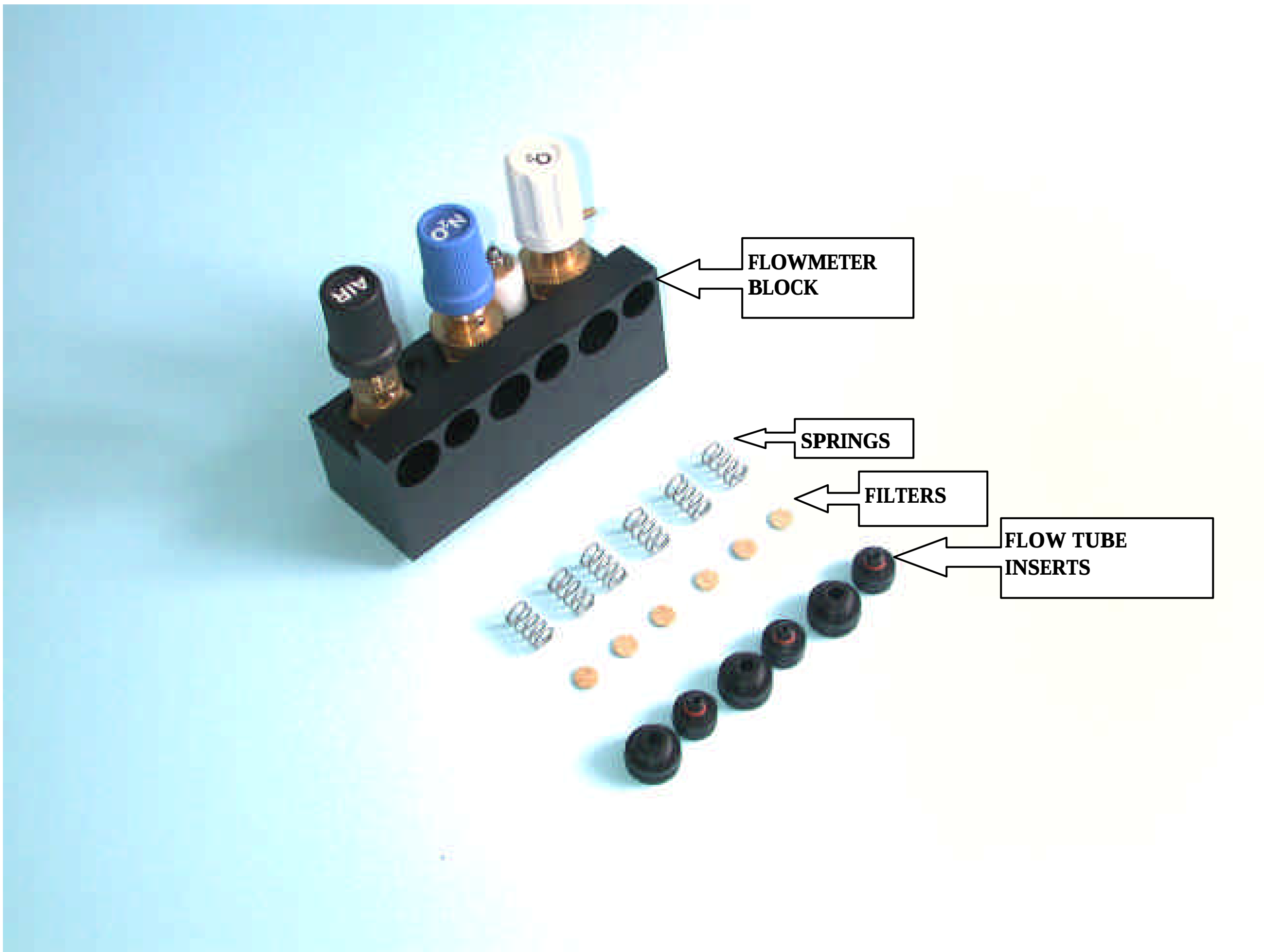


Figure 15 Flow Block Showing Flow Tube Filters and Tube Lower inserts

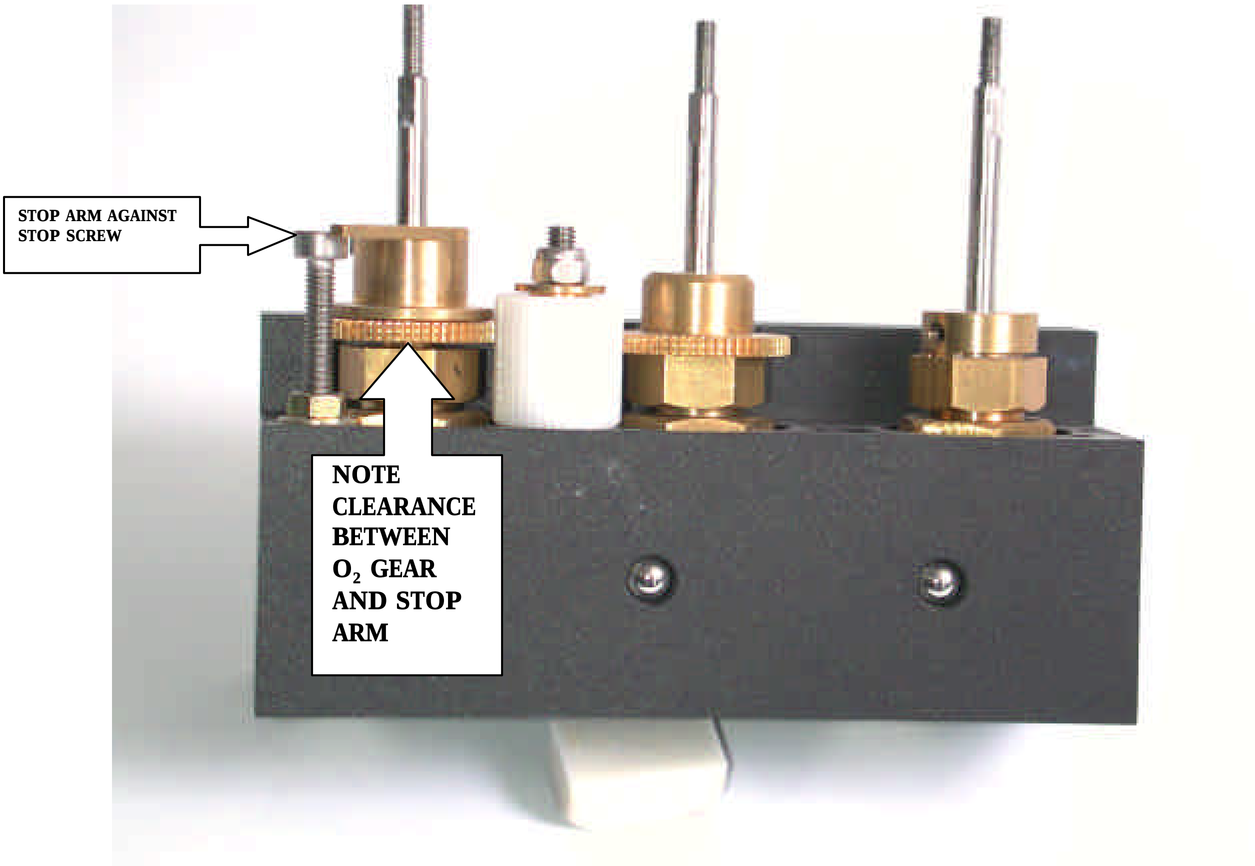


Figure 16 View of Assembled Hypoxic Guard From Below

2.4 Nitrous Oxide and Air Flow Valve Leak Test

Setting Valve shut off stop.

Due to the precision construction of these valves it is essential that the control needle and its seat are not over tightened. The nitrous oxide and air valves (oxygen valve is never fully closed "Basal Flow") are fitted with stop collars to prevent this (see fig **14**), and if during calibration checks it is found the unit is out of specification the first check should be to ensure there is no leakage through these valves.

To check these valves first remove the front cover (see section **2.1**)

1. Remove the smaller of the flow tubes for the gas to be insert and (see Removal of Flow Tubes section **2.5**)
2. Remove the spring and lower insert from the block (see fig **15**).
3. Ensure that all flow control valves are set minimum and turn on the machine.
4. Pour a small amount of leak detector fluid such as 'Snoop' into the insert bore of the block (in the absence of 'Snoop' plain water is effective) if the valve is not sealing there will be bubbles visible in the fluid, if there are no bubbles then the valve is sealing correctly.
5. If there are any bubbles then the valve stop must be adjusted, the stop collars of the two valves differ slightly in that the nitrous oxide valve collar is also the drive gear, both versions have two Allen grub screws holding them to the valve shaft.
6. To adjust the valve stop, slacken the grub screws slightly and gently turn the valve shaft till no bubbles are present and tighten the collar grub screws.
7. Slightly open and close the valve a couple of times and check that when the valve is shut there are no bubbles visible.
8. Carefully dry out the insert bore and open the valve to ensure that any fluid is blown out, the glass flow tube and is insert and spring can then be replaced.

2.5 Removal of flow Tubes

All flow tubes are removed in the same manner

Remove front cover (see section **2.1**)

Grip the flow tube to be removed and gently push it down.

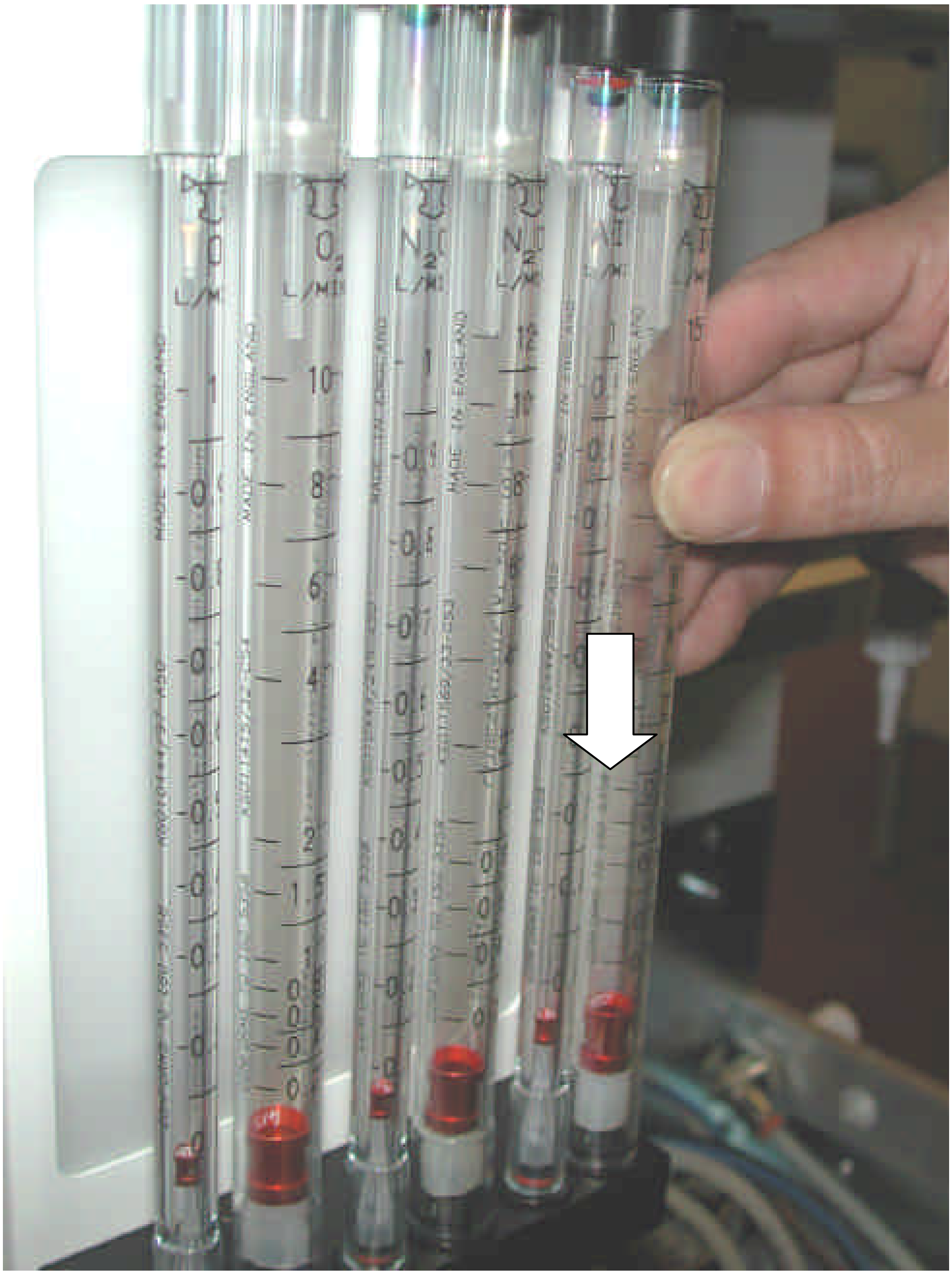
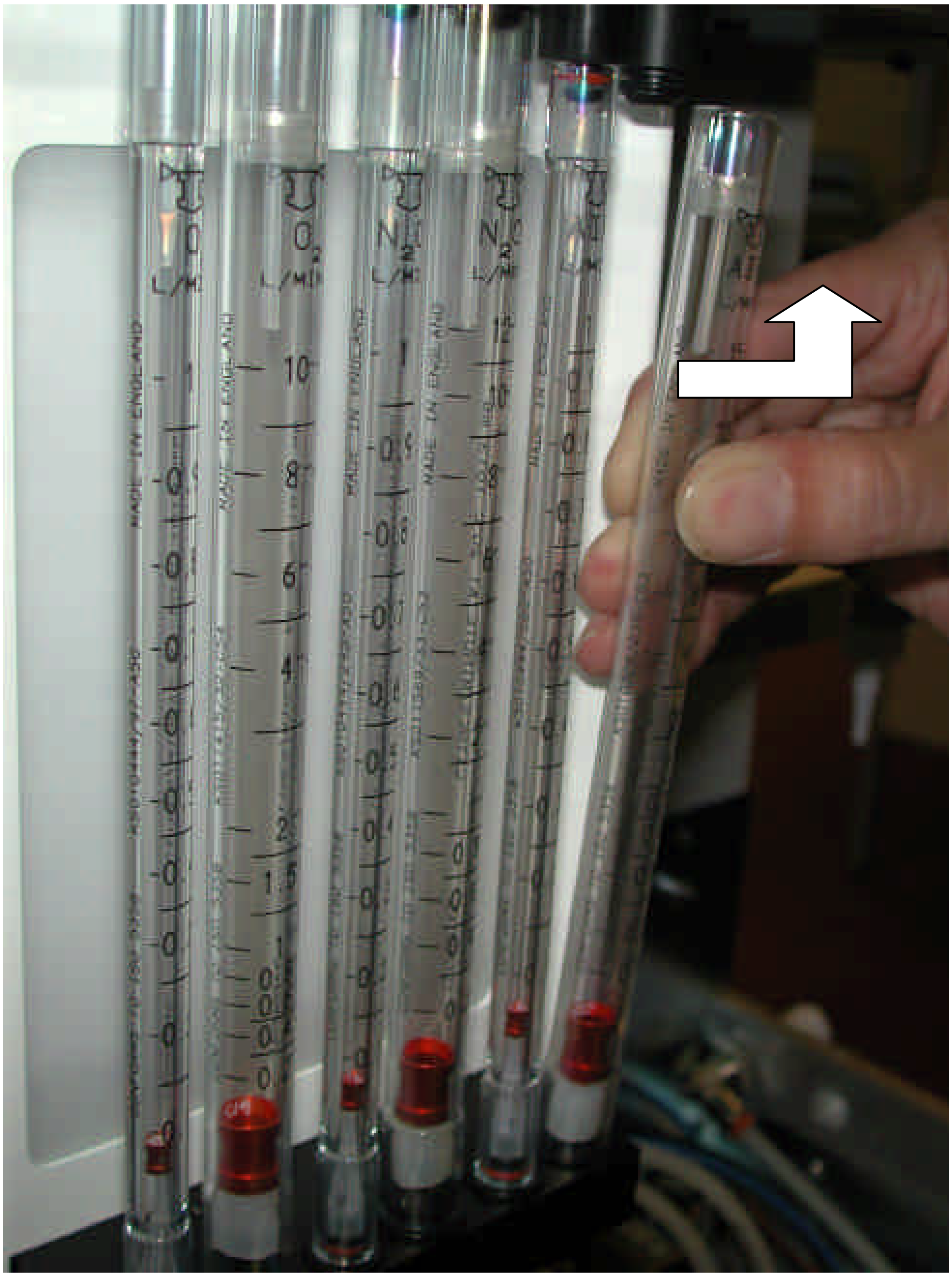


Figure 17 Flow Tube Removal

Then swing the top of the tube out from the top of the block and lift out.



Replacement is the reverse of this procedure.

2.6 Mechanical Hypoxic Guard Regulators, Adjustment and Output Check.

Do not adjust regulators if previous checks found the hypoxic guard to be within specification as changes in pressure settings will adversely affect the calibration.

These test points do not exist on the 1000 and 2000 models of the Sirius.

If due to damage or wear it is deemed necessary to replace the hypoxic guard valve block, a calibrated unit can be ordered which will be supplied with a test sheet which gives the pressures to which the secondary regulators should be set.

To check or adjust the regulators.

1. Remove the small rear inspection panel.
2. Connect a standard low pressure gauge capable of reading 0 to 100 psi ±5% into the test point by removing the blanking plug.

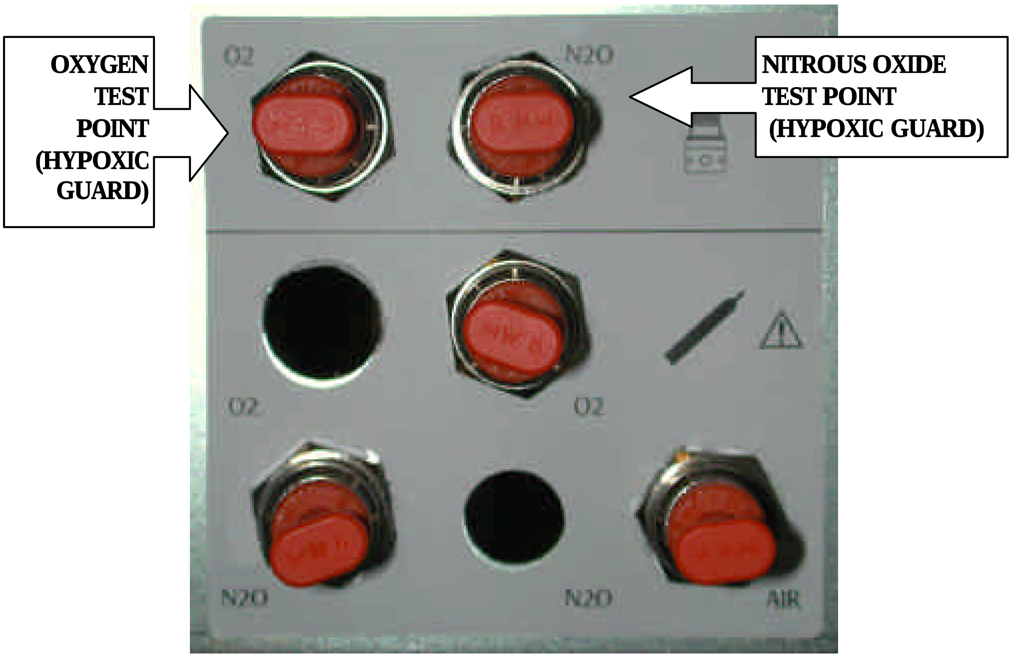


Figure 18 Test Points

3. Open the oxygen cylinder or connect the O_2 pipeline
4. Switch on the machine and set a flow of 0.5 lpm on O_2 flow meter
5. Check that the gauge registers the regulator output pressure.

7. Remove the front cover, see section **2.1**. The regulators are accessed from the left hand side of the flow meter.

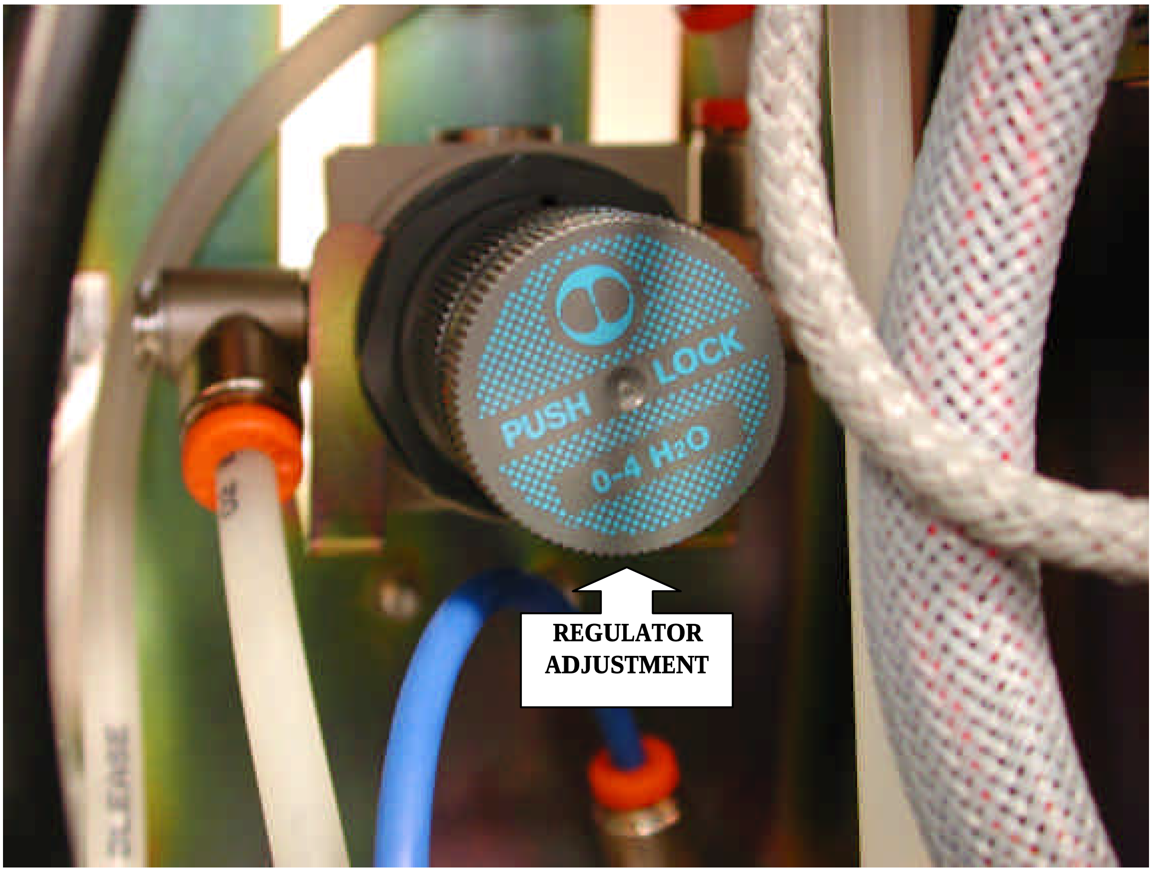


Figure 19 Regulator Adjustment

8. Adjust the pressure by pulling the adjusting knob to release it and turning it clockwise to increase the output pressure or counter-clockwise to reduce it.(the pressure should be set by adjusting the pressure UP to the desired level to give the most stable setting) Once the pressure is correct the knob should be pushed towards the regulator body to lock it in position.

9. Switch off the machine.

10. Disconnect the pressure gauge and refit the blanking plug.

11. Check the pressure of the secondary nitrous oxide regulator by repeating steps 3 to 10 for the nitrous oxide regulator.

2.6.1 Hypoxic Regulator Replacement

1. Remove the small rear inspection panel and note pressure setting of the regulators (see **Mechanical Hypoxic Guard Regulators, Adjustment and Output Check**).
2. Remove the front cover (see section **2.1**)
3. Remove tubes from their connectors on the hypoxic regulator to be replaced noting their positions.

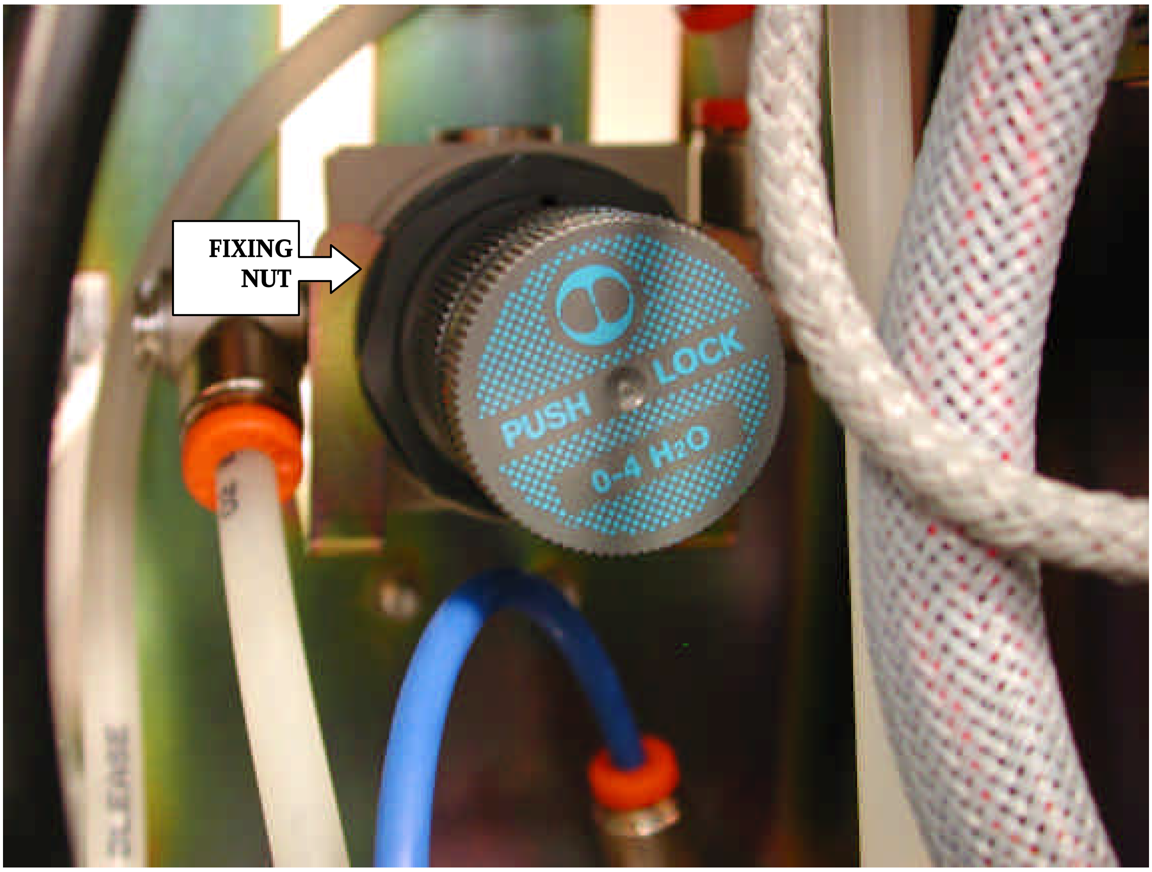


Figure 20 Regulator Nut

4. Release the regulator from its bracket by slackening the large securing nut and sliding the regulator up out of its mounting bracket.

5 Remove the fittings from the old regulator and refit them to the new regulator.

6. Refit the new regulator into its mounting bracket and reconnect the tubes to the fittings (check that the flow is the correct way through the regulator)

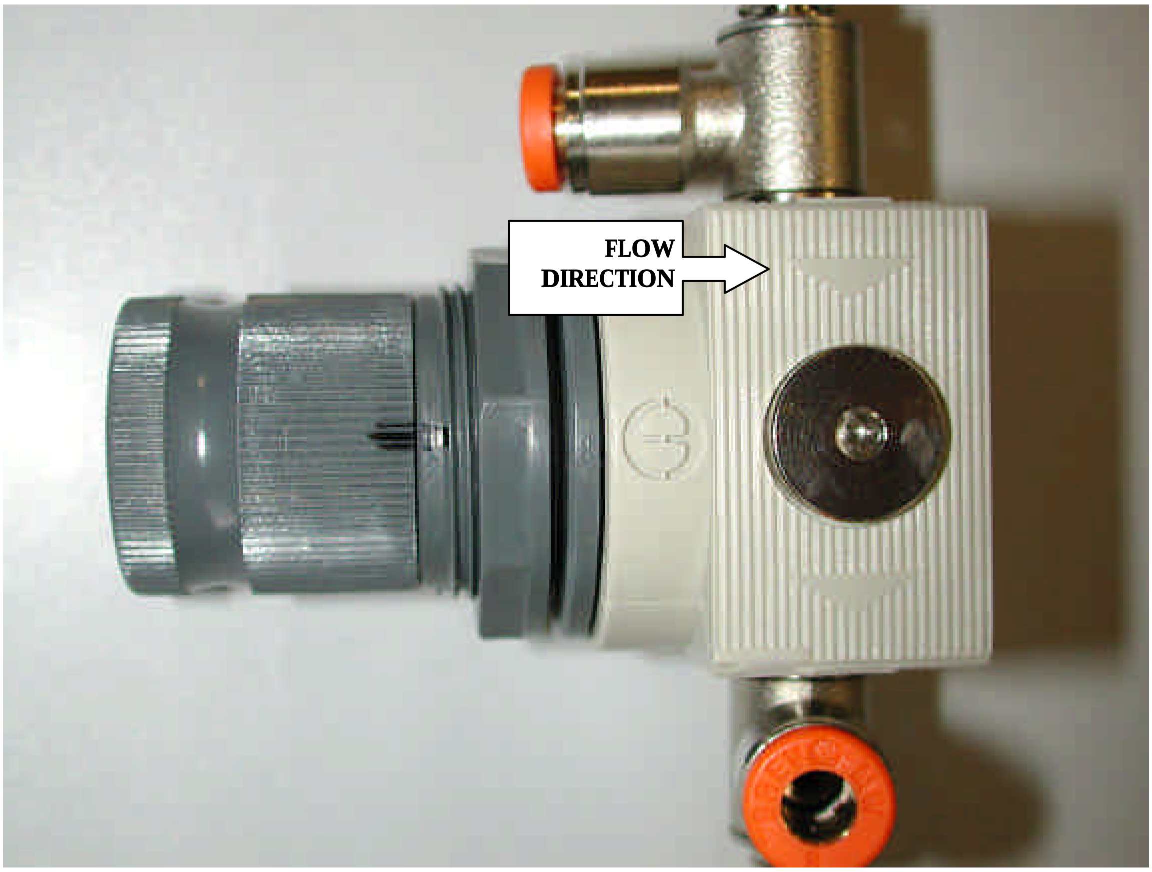


Figure 21 Regulator Flow Direction

5. Reset the regulator to the original output pressure. (see **Mechanical Hypoxic Guard Regulators, Adjustment and Output Check**).

When regulators have been replaced or adjusted it is essential that the calibration of the hypoxic guard is checked (see 2.6 Mechanical Hypoxic Guard Tests) before returning the machine back into service.

2.7 Backbar Test

1. Remove vaporizers where applicable.
2. Connect one source of oxygen to the machine.
3. Check that all flow control valves are turned fully clockwise.
4. Turn the machine on and set an oxygen flow of 300ml.
5. Turn the machine off.
6. Connect a 0-300mmHg pressure gauge to the common gas outlet.
7. Turn the machine on and check that the pressure rises above 150mmHg in 15 seconds and continues to rise.

To prevent damage to the gauge, ensure it is removed before the pressure reaches the full scale of the gauge.

8. If the above limit cannot be obtained, a leak exists in the low pressure system.
9. Normally leaks can be detected by using a leak detecting agent. The leak can be located by turning the gas supply on, and if not apparent by the sound it makes, brushing or spraying the leak detecting agent on the suspect component or connection and observing the bubbles made by the escaping gas.

WARNING: Only an authorised leak detecting agent such as Snoop should be used. Pay particular attention if using near electronic circuits.

2.7.1 Backbar Valve Test

Using Blease Backbar Test Kit Part (No. 930210) to check function of the inlet position valve (left-hand).

1. With the machine turned off and all flow control valves turned off, fit TJ 43 T1 on the first position on the back bar, attach CGO adapter and tube onto the common gas outlet, place the end of the tube into a water bottle just below the surface of the water.

If any bubbles are observed in the water bottle at this point it would indicate that the Oxygen Flush valve is leaking and this should be rectified before proceeding any further.

2. Using tubing provided, connect the pressure gauge and bulb to the test block.
3. Ensure bulb relief valve is fully open.
4. Turn the machine on (basal flow only).

5. Slowly close valve on the bulb until the pressure gauge maintains a reading of approximately 100 mmHg.
6. Check that no bubbles are observed in the water bottle.

Using Blease Backbar Test Kit Part No. 930210 to check function of the outlet position valve (right-hand).

1. Turn all gases off and ensure the machine is de-pressurized.
2. Close all flow control valves (for basal flow machines close O_2 valve to its stop).
3. Fit TJ 43 T2 to first position.
4. Fit a blanking plug to the CGO adapter and attach to common gas outlet.
5. Fit bulb and gauge to T2 inlet.
6. Use bulb to increase pressure shown by gauge to 100-120 mmHg.
7. Check that the pressure does not drop more than 10 mmHg in 10 seconds. If any valves fail the above test, replace the valve according to the instructions below.

2.7.2 BackBar Valve Replacement

Should a bypass leak be found on any of the Back Bar valves (see Back Bar Valve testing section **2.7.1**) the valve must be replaced.

To remove the defective valve,

Slacken the M4 screw on the under side of the back bar bellow the valve to be replaced.

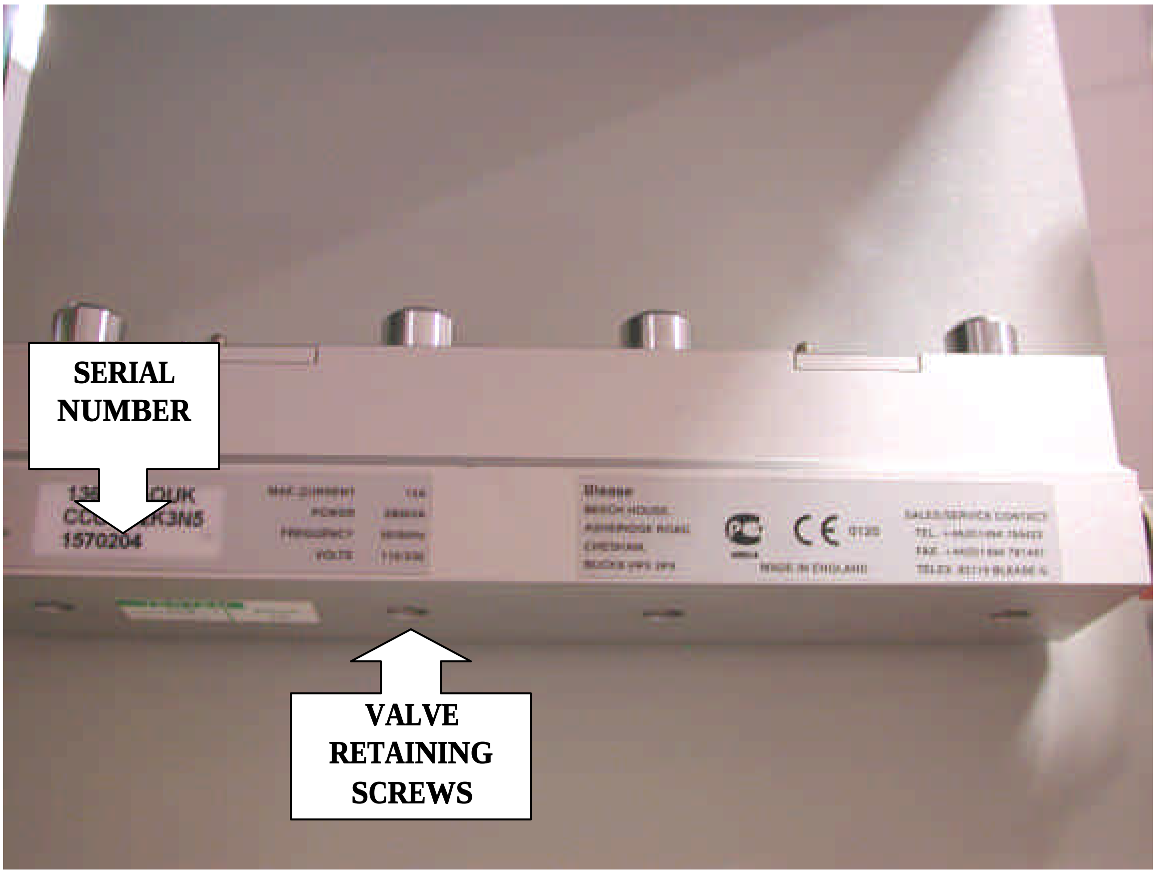


Figure 22 Backbar

Figure 23 Backbar Valve

Use the screw to push the valve upwards to free it from its seals, then remove the M4 screw completely and withdraw the valve.

Lightly lubricate the 'O'ring seals on the new valve with 'Fomblin' Oxygen safe grease and insert it into the back bar, replace the M4 retaining screw in the back bar and tighten.

Carry out the back bar leak tests as described in section **2.7.1** to ensure correct operation of valves.

2.8 Common Gas Outlet (CGO) Removal/Replacement

Remove the rubber gas feed connector from the CGO port on the front of the machine.

Remove rear panel (see section **2.1**)

The CGO block is located inside the main work surface of the machine and can be seen from the rear of the machine, there are two pipes connected to it and these are different diameters (6mm&8mm) and can therefore be disconnected without the need for marking.

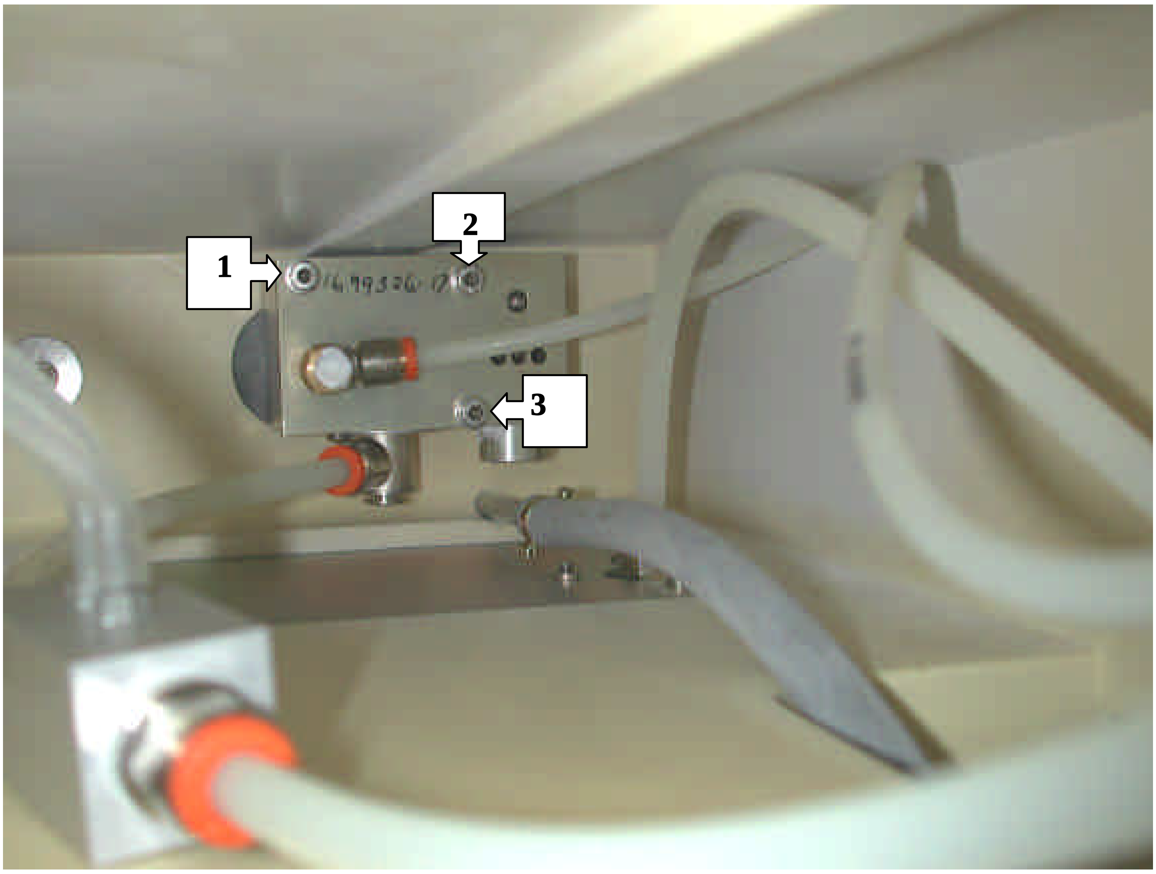


Figure 24 CGO Block

The block is held in place by three M5 screws, remove these screws and the block can be withdrawn from the machine.

Replacement is the reverse of this procedure.

2.9 Alarm Block Removal/Replacement.

Remove front cover (see section **2.1**).

Remove the two M4 fixing screws from the alarm block.

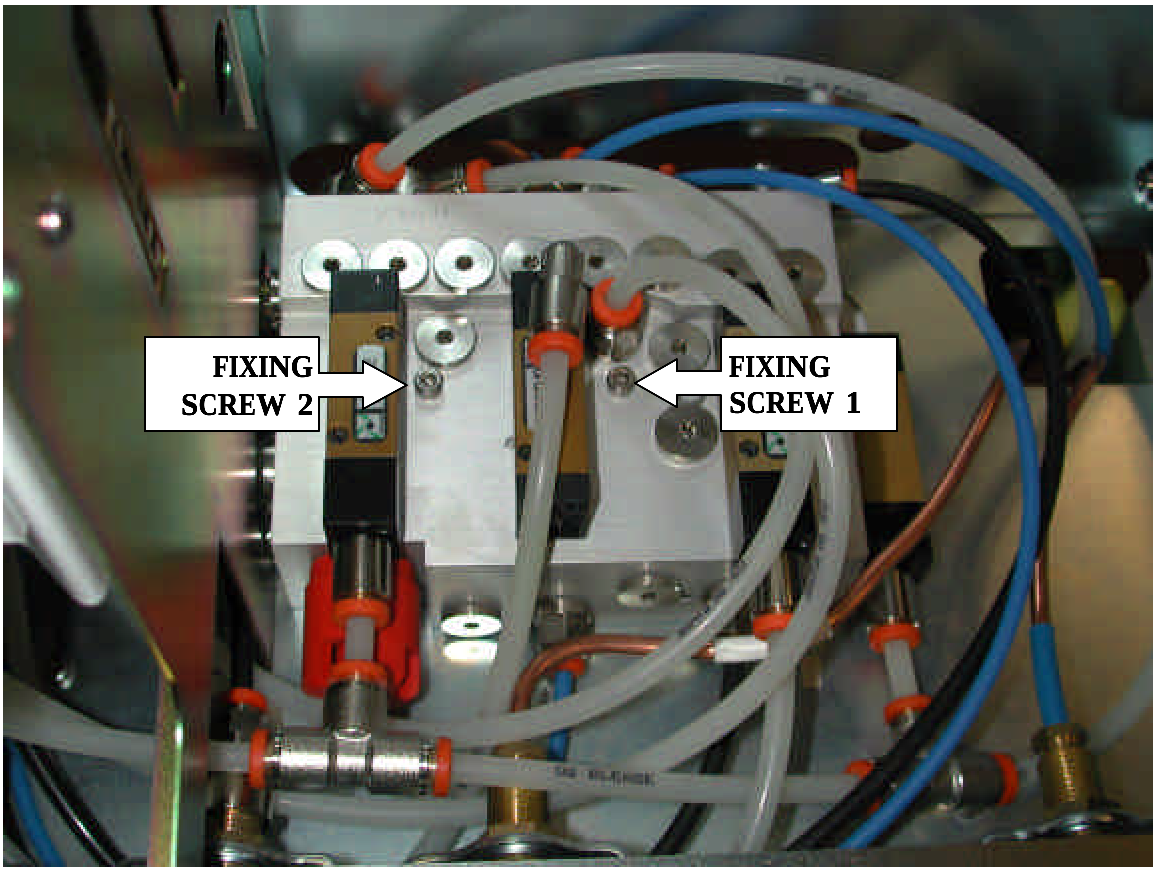


Figure 25 Alarm Block Removal

The positions of each pipe entering the block should now be marked clearly on each fitting and the relevant pipe (use masking tape or a marker pen), the removal of the fixing screws will allow the block to be moved slightly for access to some of the pipes. Once all pipes and connections are clearly marked (the different gases are also diameter indexed) the pipes may be disconnected and the block removed.

The replacement block will require the transfer of the fittings and blanking plugs from the old block to the same positions on the new block, this should be done one item at a time and their positions checked carefully. Once the fittings have been transferred the block can be reconnected and the fixing screws replaced.

Carry out function test on alarm (see section **2.17**)

2.10 Oxygen Flush & Common Gas Outlet Safety Valve Adjustment.

If Oxygen flush flow rate is outside of the specified range or the common gas outlet safety valve requires adjustment.

Remove rear panel (see section **2.1**)

The CGO block is located inside the main work surface of the machine and can be seen from the rear of the machine, there are two pipes connected to it and these are different diameters (6mm&8mm)

The 8mm pipe carries the mixed gases and vapours from the flow meter and back bar, the 6mm pipe is the high pressure (4bar) supply to the Oxygen flush control.

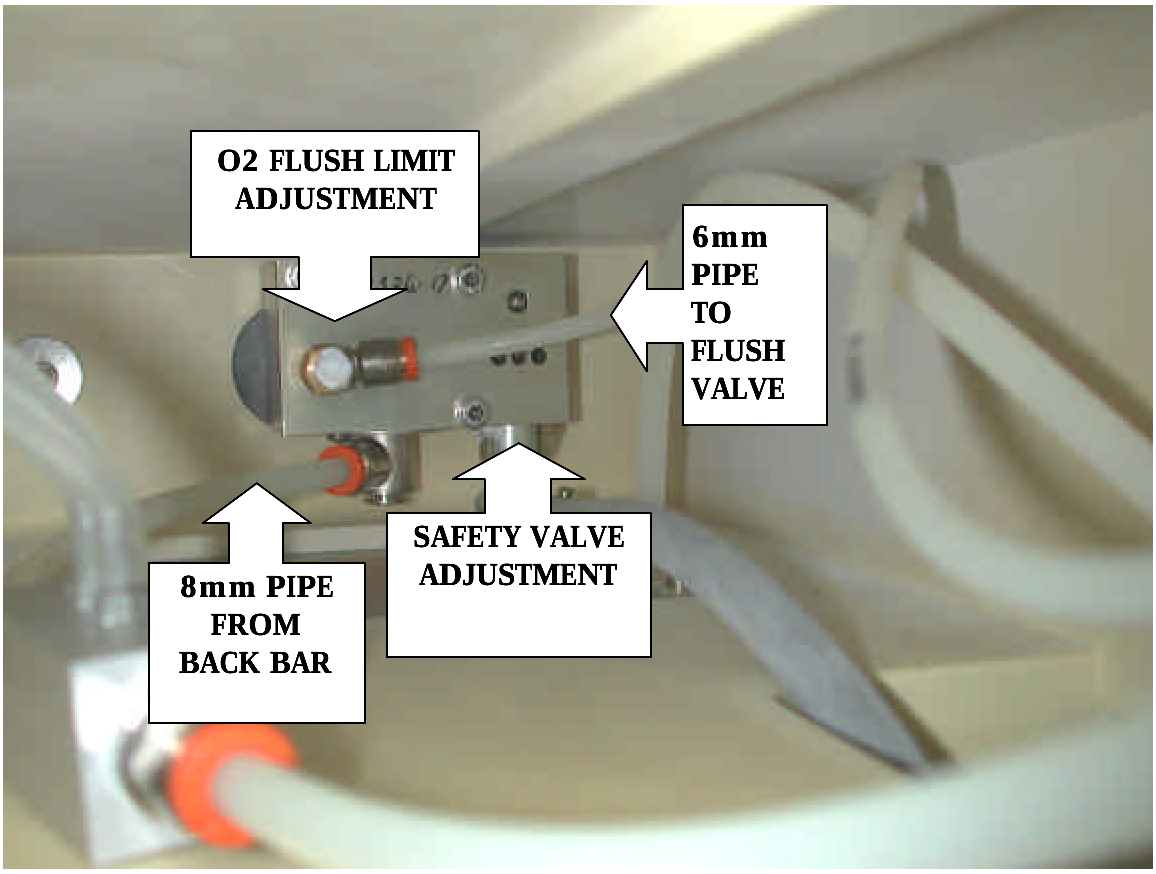


Figure 26 CGO Adjustment

2.10.1 Oxygen Flush Adjustment.

To adjust the Oxygen flush flow it is first necessary to remove the sealing compound from the adjusting screw on the CGO block (see fig 26).

The flow can then be set to the required level, turn adjuster clockwise to reduce the flow and anti-clockwise to increase the flow. When the flow has been set the adjuster should be sealed with 'Silcoset' or similar.

Common Gas Outlet Safety Valve Adjustment.

To adjust the safety valve, turn the adjuster clockwise to increase the pressure or anti-clockwise to reduce.

If the valve is found to be leaking the block should be removed, then the valve adjuster may be removed and the valve seat and disc bellow can be accessed and cleaned.

Figure 27 Valve Adjuster and disc removed

2.11 Flow Meter Removal

To remove the Flow meter Assembly.

Remove front cover (see section **2.1**)

Remove the 2 M4 screws each side of the flow meter whilst supporting the flow meter.

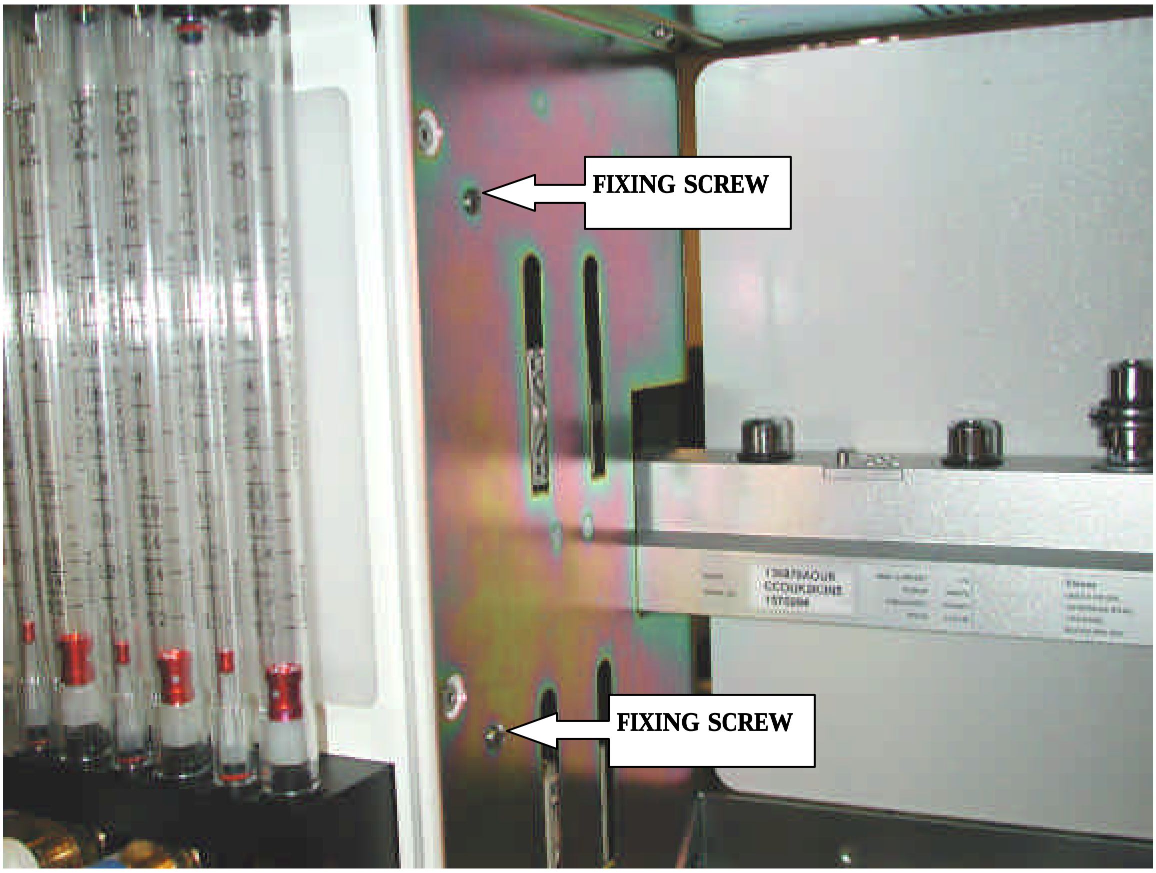
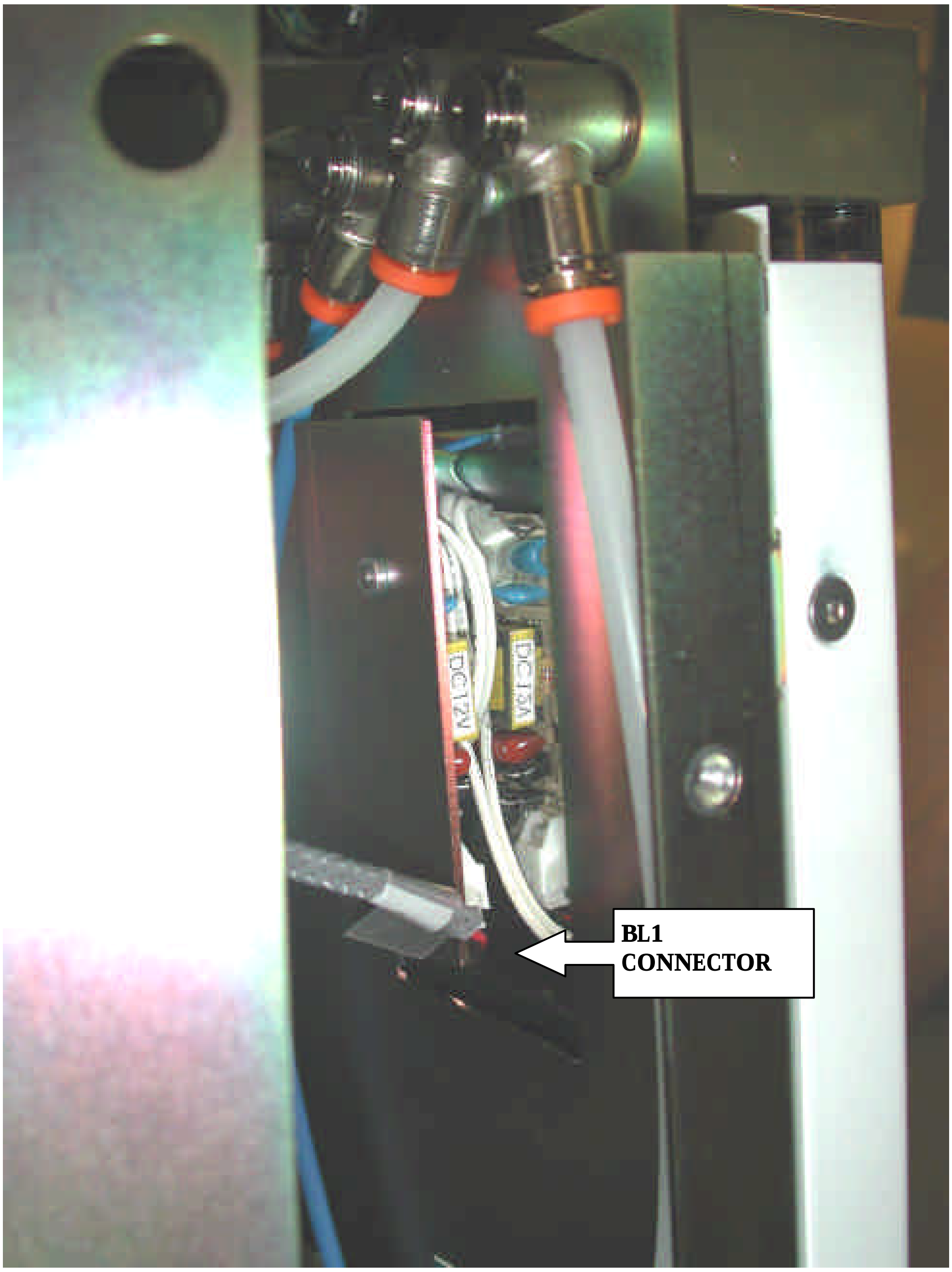


Figure 28 Flow Meter Removal

Carefully unplug the power supply cable from the back light invertor on the rear of the flow meter (marked BL1).



Mark the positions of the pipes entering the flow meter, and remove them from their fittings.

The flow meter can now be removed from the machine.

Replacement is the reverse of this procedure.

2.12 ON/OFF Switch Removal

Remove the front cover (see section **2.1**)

Remove the two M4 screws from the switch mounting plate.

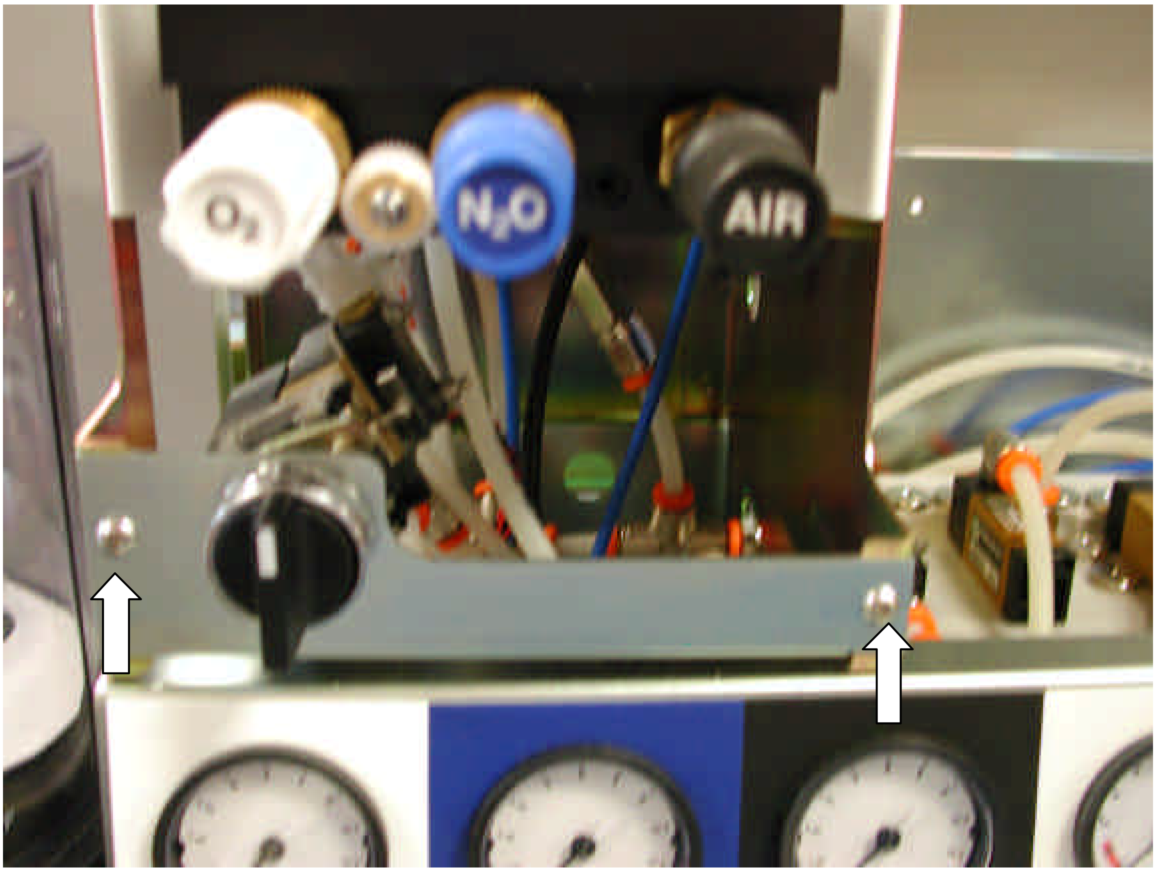
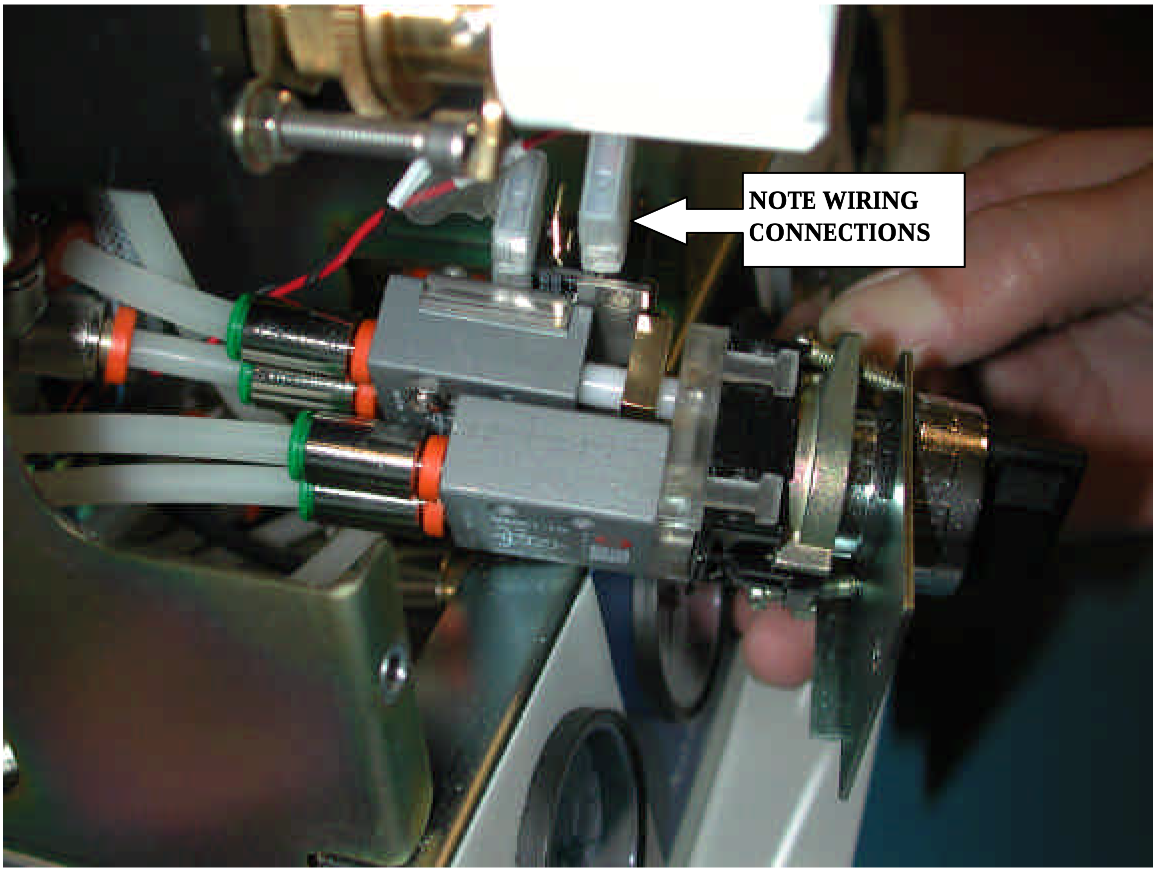


Figure 29 On/Off Switch Removal



Carefully pull the switch assembly forward and disconnect the two wires from the switch noting their positions, then mark the relative positions of the four pipes entering the switch and remove them from their fittings.

The switch assembly can then be removed.

Replacement is the reverse of this procedure.

2.13 Absorber Interface Manifold Assembly

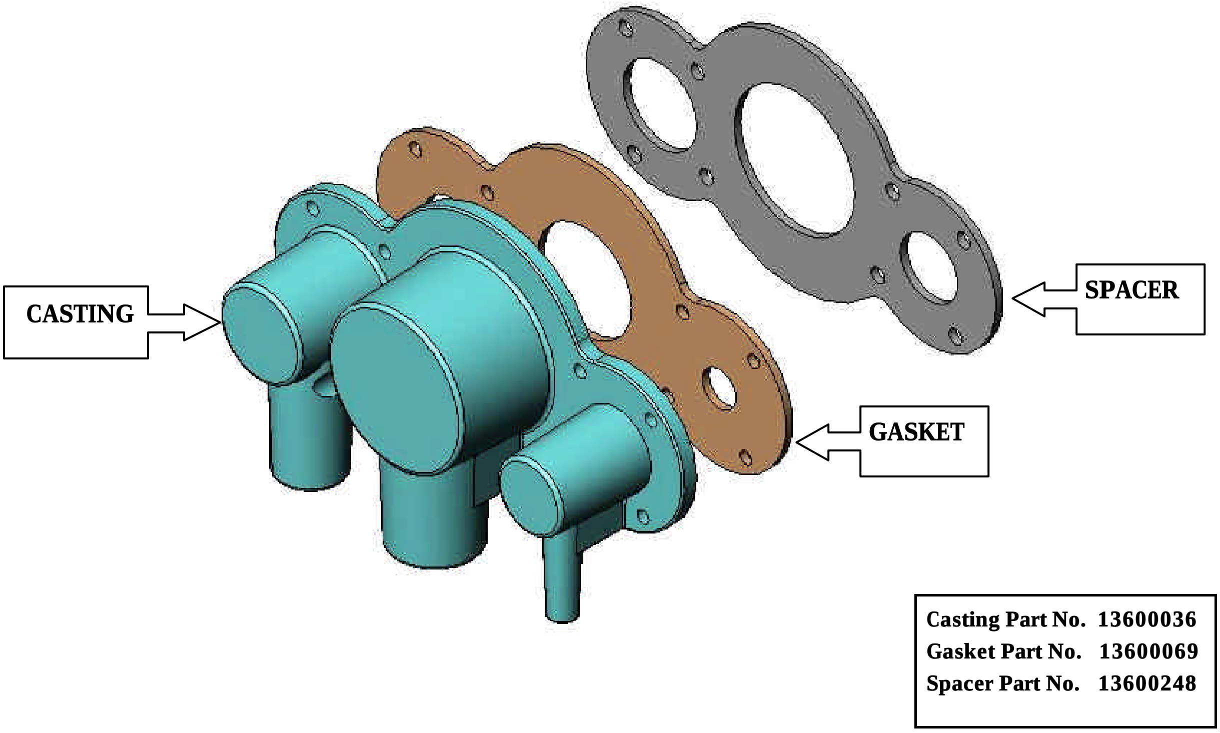


Figure 30 Absorber Interface Manifold Assembly

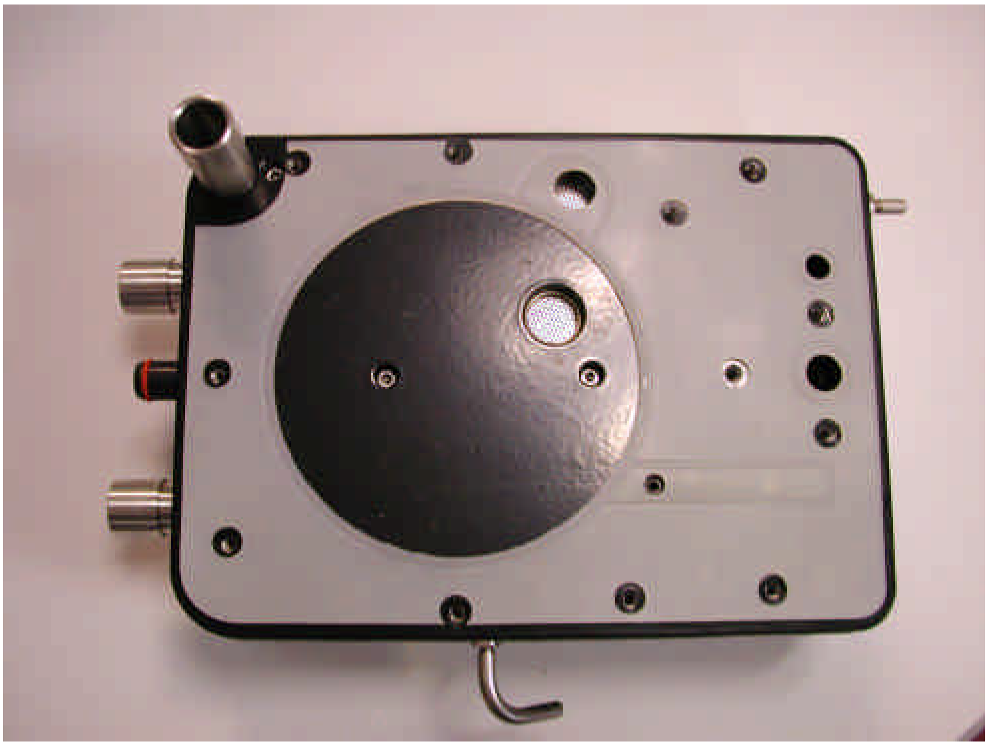
The three components are held in place in the main molding with 8 M3 screws, these should not be over tightened or the threaded inserts in the molding may be damaged.

If the pipes are removed from the casting (they are different diameters so cannot be inter changed) before refitting the mating surface of the casting should be lightly smeared with a silicone sealant to ensure a gas tight seal to the casting.

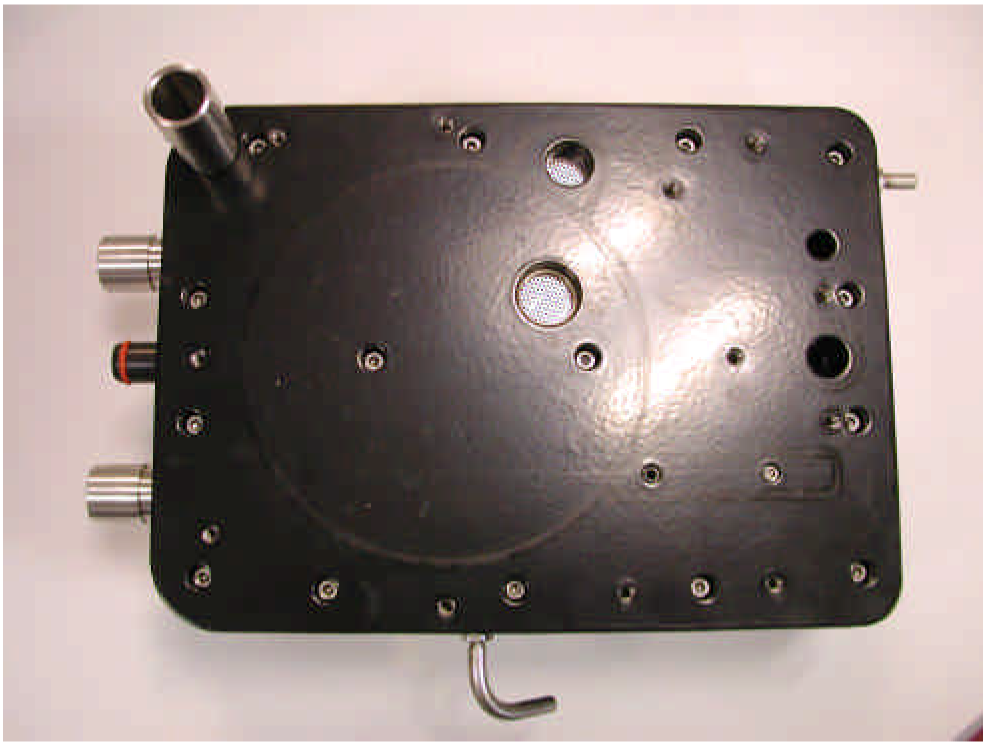
2.13.1 Absorber

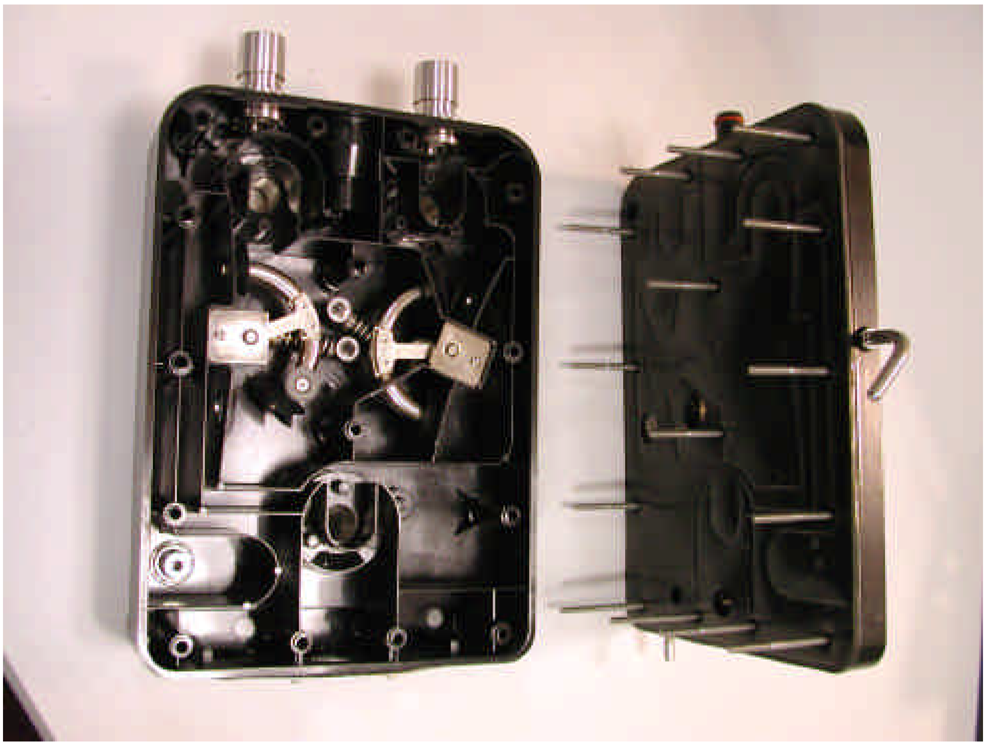
To release the lower moulding remove the 12 M5 screws.

Figure 31 Absorber

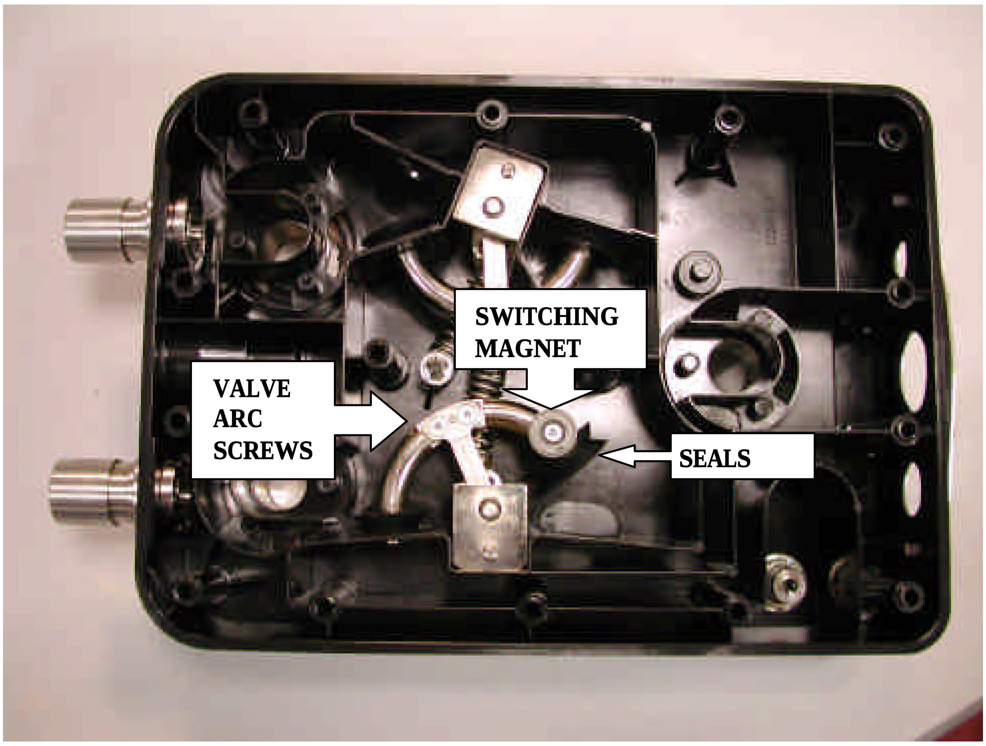


Remove gasket to expose the 15 M4 screws which hold the top moulding to the centre plate.





Note position of the four longer screws.



To replace seals remove the two M3 screws from the valve arc.

Remove seal from arc by removing the centre screw and washer,

Re-assembly is the reverse of this procedure.

2.13.2 Bellows Interface Gasket.

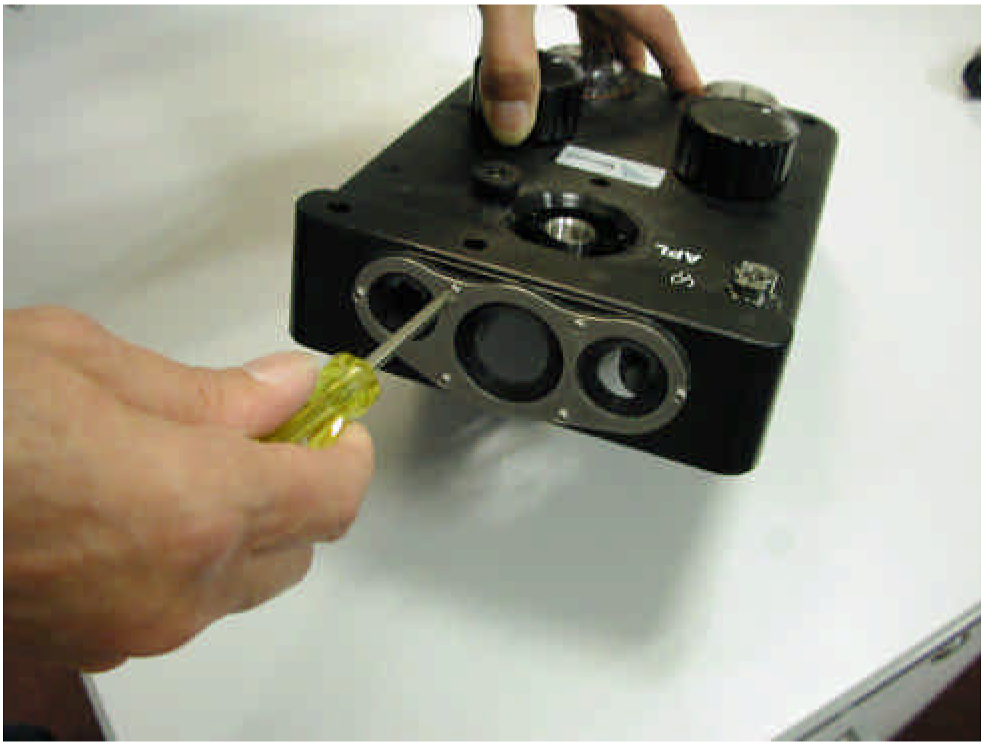


Figure 32 Bellows Interface Gasket

Remove the six cross head screws from the gasket plate.

Gasket can them be removed, do not over tighten screws upon re-assembly.

2.13.3 Absorber Alignment

It is essential that the absorber and its switching are aligned correctly for the ventilator to work. There are two separate switch functions;

1. Standby/run signal generated from the bag/vent switch.

2. Absorber docking signal.

2.13.4 Standby / Run

The Ventilator Standby / Run signal is generated by a magnet attached to the absorber Bag / Vent switch and operates a reed switch within the mounting rod. The adjustment range is approximately 5mm. There is no adjustment to the magnet but the reed switch is adjustable.

- To adjust the reed switch the rear cover of the Sirius must be removed.
- The cable attached to the reed switch can be seen coming out of the back of the absorber support rod nearest the outside. The cable will be secured by a 'P' clip on the main upright.
- Make sure the absorber is correctly positioned (it has been known for foreign objects to get between the absorber and the main Sirius moulding stopping the absorber from pushing back correctly).
- Loosen the 'P' clip and slide in or out until reliable switching is achieved. Then tighten the 'P' clip and check again.

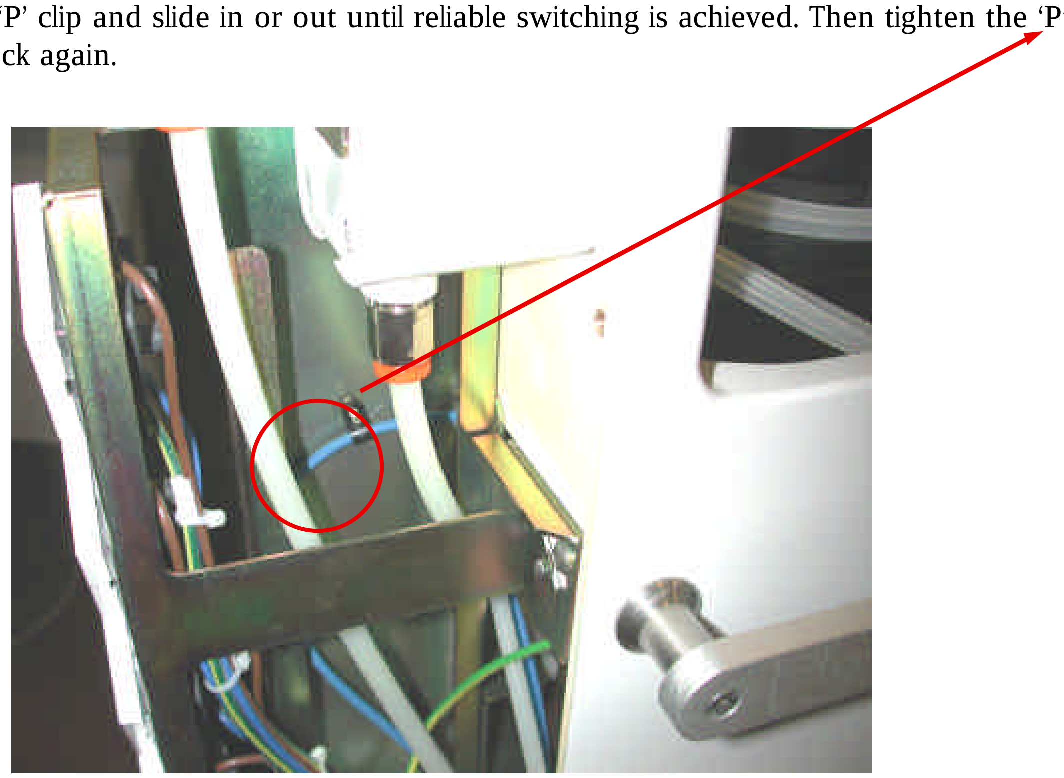


Figure 33 P-Clip

2.13.5 Absorber Docking

The Absorber docking signal is generated by a micro switch within the Sirius that is activated by a short pin on the back of the absorber. Again making sure that the absorber is correctly positioned check that this pin is working the micro switch. An error message ABSORBER NOT FITTED will be displayed on the ventilator screen if contact is not made. Adjust the pin as needed by screwing in or out.

Either of these errors will stop the ventilator from working. To help located the error the ventilator can be made to run with these temporarily disabled.

The ABSORBER NOT FITTED alarm can be over ridden by pressing the bottom purple button on the vent. (The error message will continue to display but the ventilator will work).

On new software in the features menu it is possible to select an on screen run/standby button to over come the bag/vent switch on the absorber.

Setting Ball Catch

- Fit an Absorber Rod into the Main Plate RF.
- Fit the Spring Plunger (54600073) and tighten until it “bottoms” solidly; slacken half a turn.
- Remove the Rod.
- Lock the Spring Plunger in place by fitting Grub Screw (SM0870) against it.

Note: Ensure correct setting - the Rod must “click” in and out of the Main Plate.

2.14 Writing Surface and Drawer Removal.

Remove the three crosshead screws (A) from the collar at the base of the draw pole.

Whilst supporting the draws slacken the two grub screws in the collar (C) under the lower drawer and the two grub screws (B) in the bottom collar.

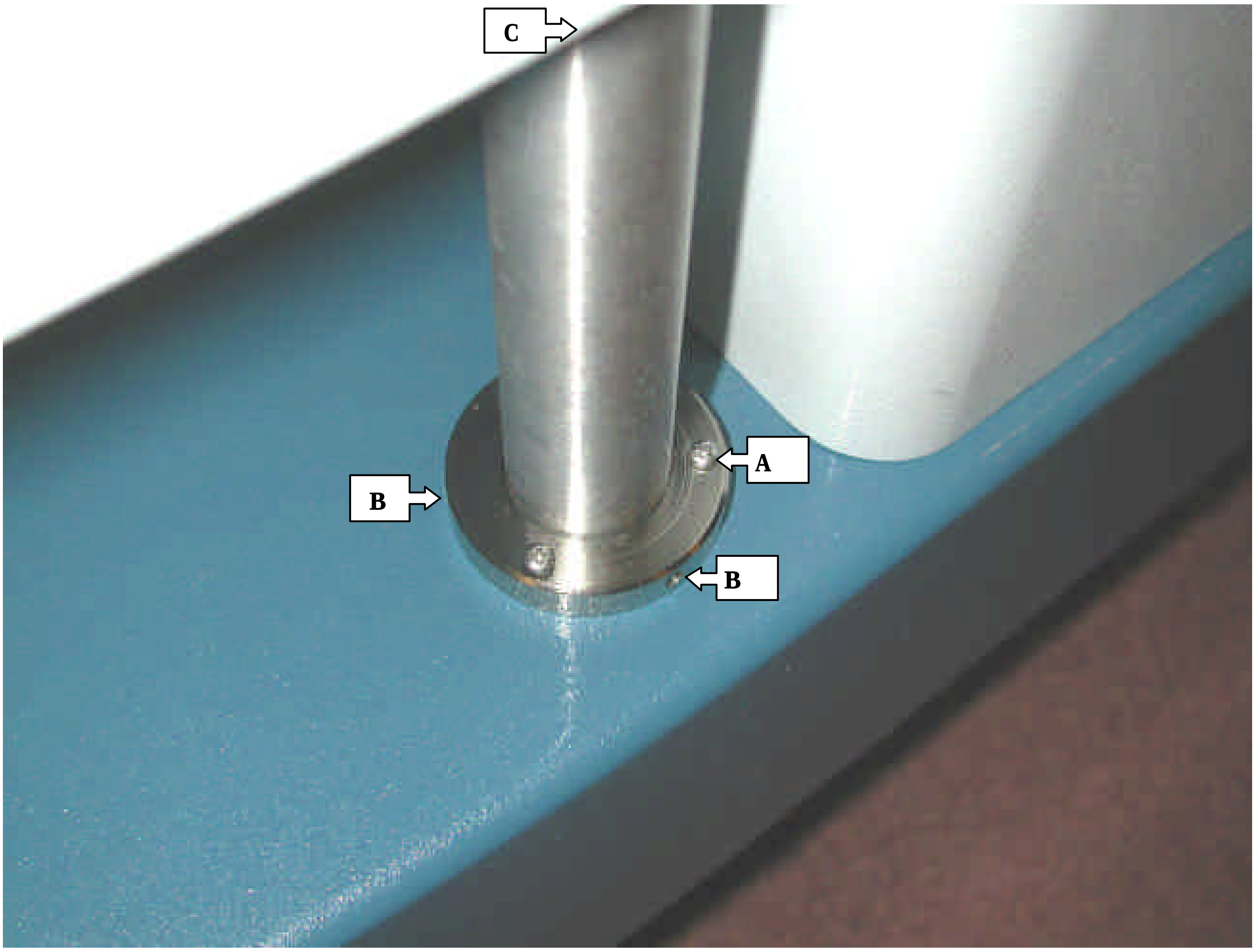
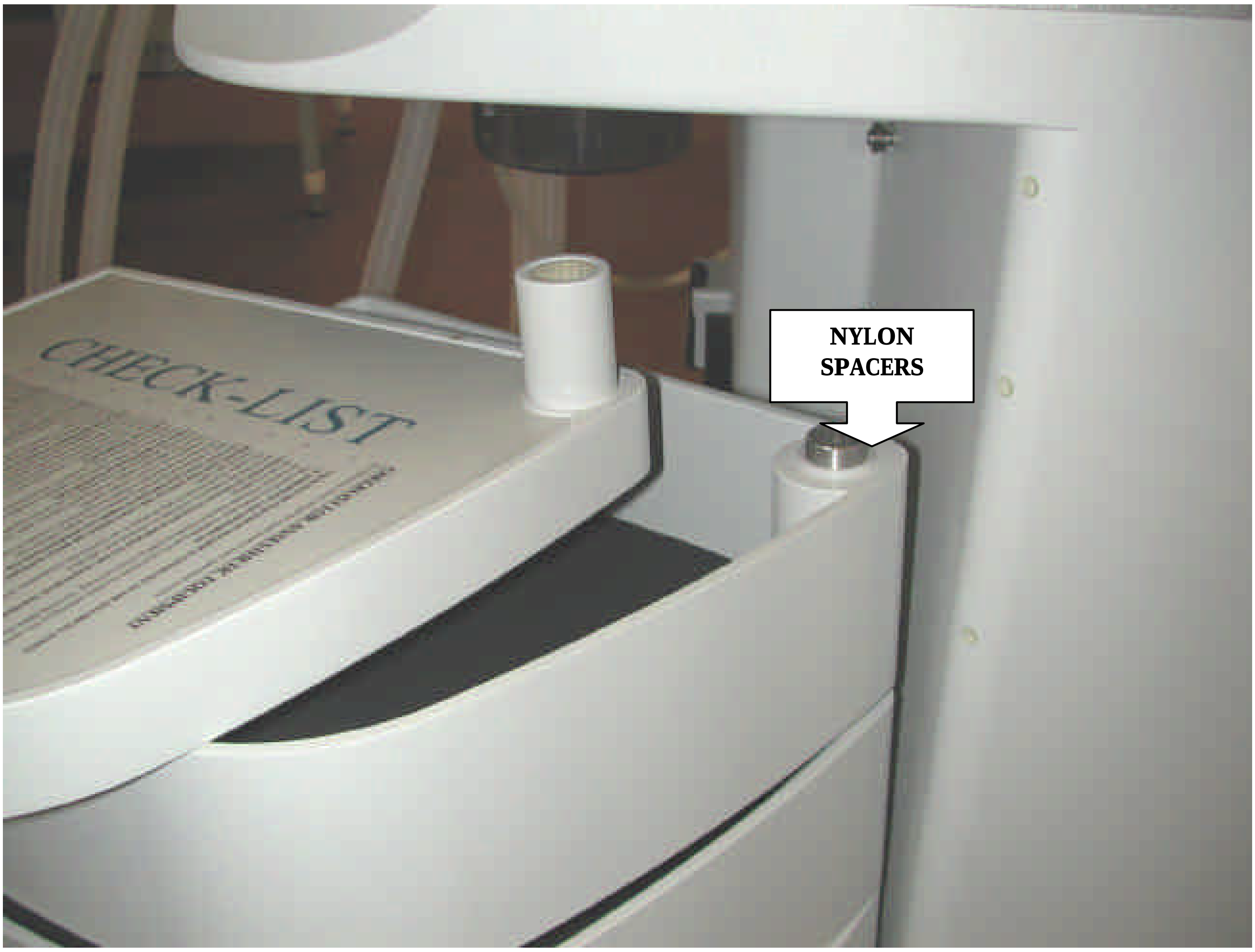


Figure 34 Writing Surface and Drawer Removal

The drawers and the pole can then be lowered onto the base of the machine and the pole pulled down as far as possible through the drawers from under the machine.

The writing surface and drawers can then be lifted off the pole in turn, taking care not to lose the nylon spacers between each.



The drawer pole and two collars can then be lifted out of the machine base.

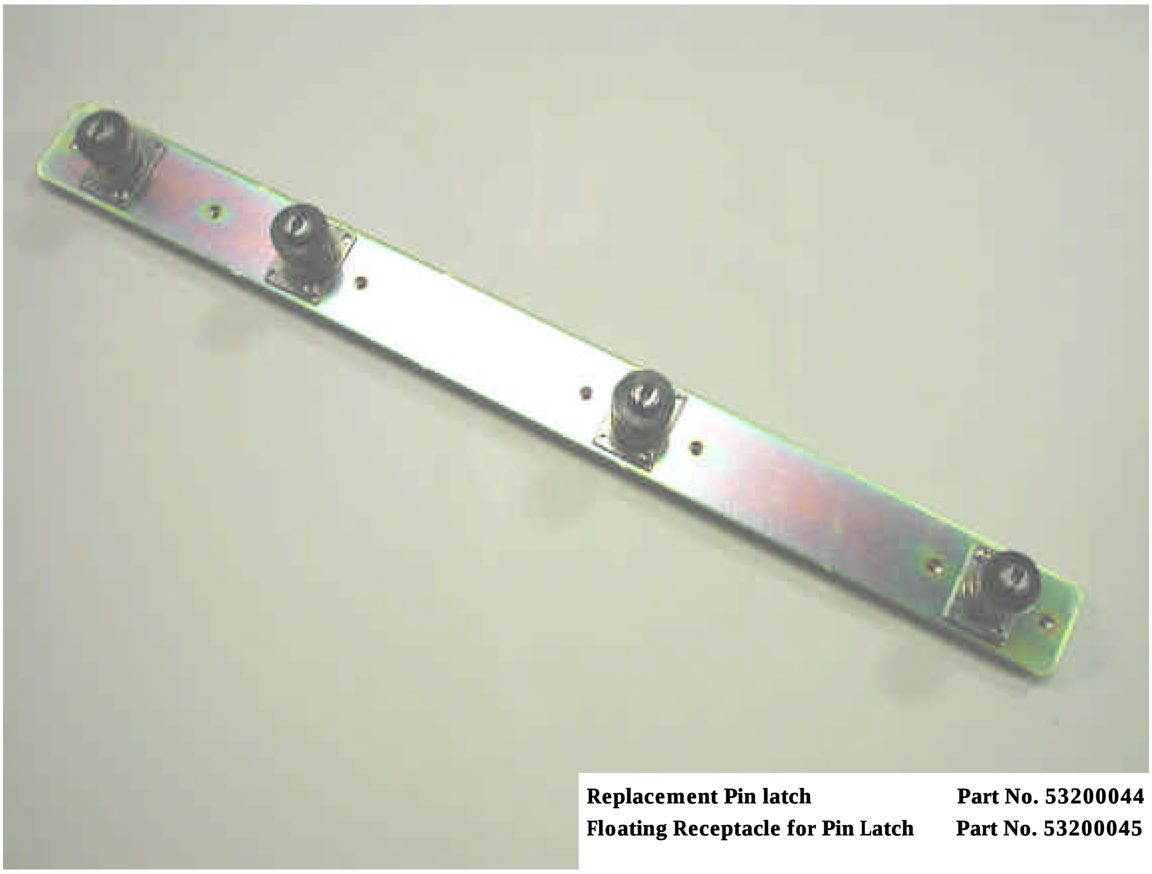
Replacement is the reverse of this procedure; drawers should be adjusted for height using the upper collar to ensure that they engage smoothly with their respective catch on the body of the machine.

2.15 Drawer catch removal and replacement.

Figure 35 Drawer Catch Removal and Replacement

Remove the seven cross head screws on the front panel to release the draw catch plate.

The catch plate can then be removed from the rear of the machine and any individual catch may be replaced.



Replacement Pin latch **Part No. 53200044**
Floating Receptacle for Pin Latch **Part No. 53200045**

After replacing the catch plate ensure all drawers and the writing surface lock smoothly, adjustment can be made by moving the height of the drawers using the collar under the lowest drawer.

2.16 Suction Controller Removal/Replacement

Remove rear panel (see section **2.1**).

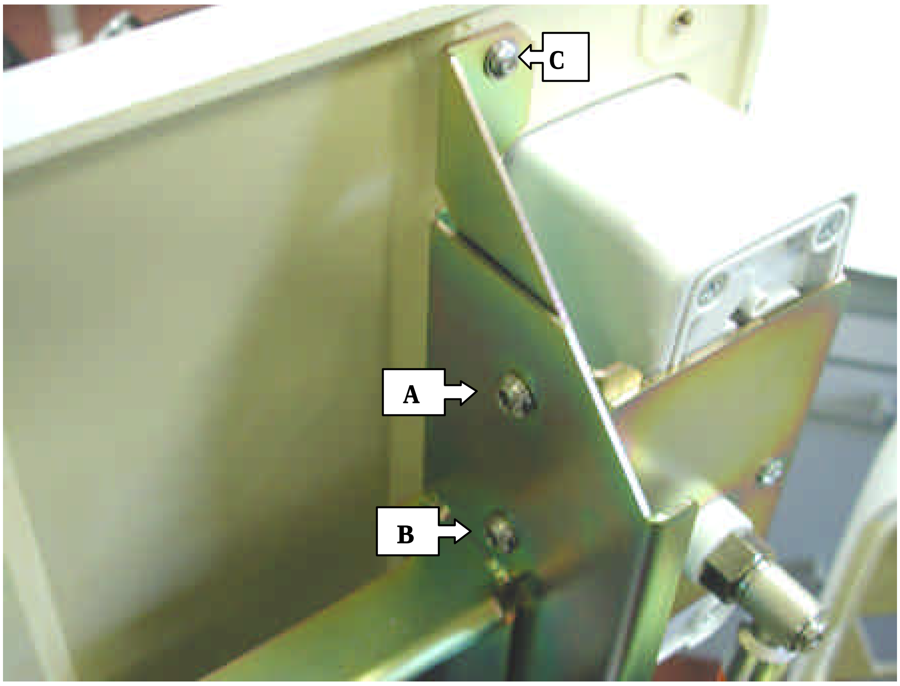
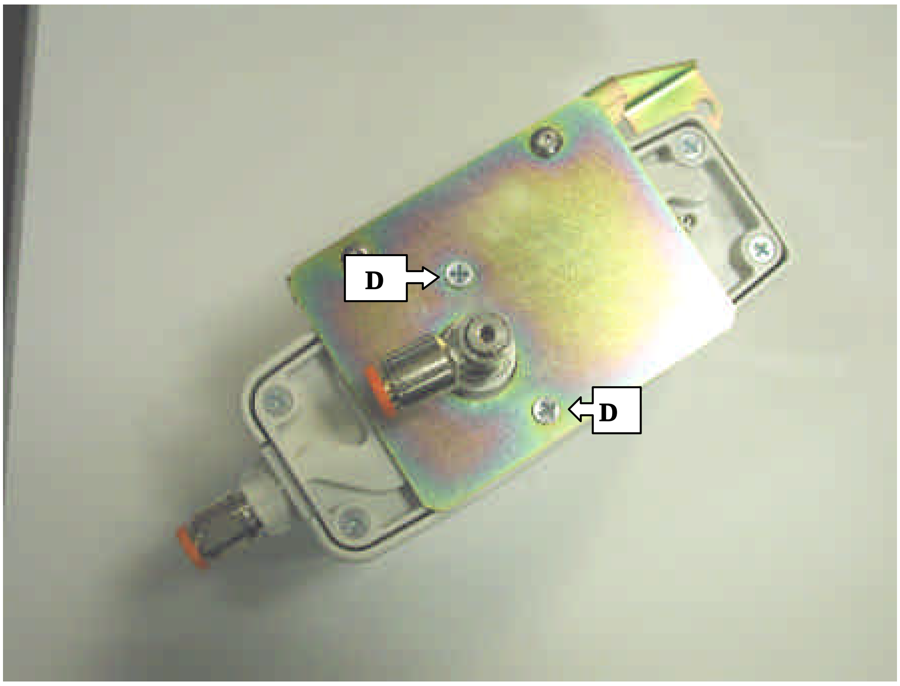


Figure 36 Suction Controller Removal/ Replacement

Remove the two M5 screws (A&B) and the M4 screw (C), the controller and its bracket can be pulled back clear of the front moulding and its pipe connections disconnected.



The suction controller can then be removed from its bracket by removing the two 'pozi-drive' screws (D).

Replacement is the reverse of this procedure.

Figure 37 Suction Controller in Position

2.17 Full System Test

2.17.1 Leak Test

1. Ensure that:

- only one cylinder of each gas is fitted securely and correctly to the machine.
- no pipelines are connected to the machine.
- the cylinder is closed (turned off).
- all the flowblock assembly controls are turned fully clockwise.
- no equipment is plugged into the pneumatic power outlets.
- the machine is switched off.
- the low oxygen alarm level is set to 18% and the high oxygen alarm level to 99%.
- the oxygen sensor is connected and in room air.

2. Open the cylinder and check that its gauge indicates the cylinder pressure.
   Note the correspondence between the cylinders and their gauges.

3. Close the cylinder and check that the pressure indication on its gauge does not decrease.
   If any cylinder gauge indication decreases by more than half a division in three minutes an unacceptable leak exists. If the leak persists after ensuring that the cylinder is correctly installed, the machine should be referred to the Service Department.

4. Remove the cylinder and repeat the above procedure for each cylinder yoke in turn.

5. Remove the cylinder from the machine.

6. Attach each pipeline in turn and check that each pipeline supply pressure gauge is indicating the correct pressure.

7. Open all flow valves by turning all the control knobs fully counter-clockwise.
   With the oxygen connected at all times turn on the machine and check that each cylinder and pipeline in turn (including oxygen) registers a flow on the appropriate flowblock assembly and discharges through the fresh gas outlet. Turn the machine off when complete.

2.17.2 On/Off Switch and Warning System Checks

1. Switch on the machine.
2. If the oxygen supply failure alarm operates for more than a few seconds, check that oxygen supply cylinders or pipeline are correctly installed and at the correct pressure.
3. The machine is fitted with a mechanical hypoxic guard, check that there is a standing flow of 130 to 170 ml/m through the oxygen flowblock assembly with the oxygen flow control turned fully clockwise.
4. Increase the oxygen flow to approximately 4 l/m.
5. Turn all the flow control valves counter-clockwise so that the flow indicated by each flow tube assembly is 1 l/m.
6. Simulate an oxygen supply failure by shutting off or disconnecting the oxygen supply cylinder(s) or pipeline(s).
7. Check that the oxygen failure warning device is activated after the pressure of the oxygen remaining in the machine has fallen, ensuring that:
   - Its whistle sounds for at least 8 seconds;
   - All the other gases on the machine are cut off with the exception of Air if fitted (I.e. the readings on their flowblock assemblies indicate zero).
8. Reconnect the oxygen supply and check that:
   - The oxygen failures alarm is cancelled;
   - The gas flows through the flowblock assemblies are restored.
9. Disconnect or shut off the nitrous oxide supply (cylinder and/or pipeline) and check that:
   - The flow indicated in the nitrous oxide flowblock assembly reduces to zero;
   - The flows indicated on the other flowblock assemblies remain unaltered.
10. Reconnect or turn on the nitrous oxide supply.
11. Repeat 9 and 10 for all the other gas supplies on the machine.

2.17.3 Mechanical Hypoxic Guard Test

The machine has a mechanical hypoxic guard fitted its function should be tested as follows.

1. Turn the oxygen and nitrous oxide flow control valves fully clockwise.
2. Check that the oxygen flow indicated on the oxygen flowblock assembly is 130 to 170ml/m and that no flow is indicated on the nitrous oxide flowblock assembly.
3. Increase the nitrous oxide flow (turn the knob counter-clockwise) to 10 l/m and check that the oxygen flowblock assembly indicates an oxygen flow of 3.15 to 4.7 l/m.
4. Turn the oxygen flow control counter-clockwise until an oxygen flow of 6 l/m is indicated.
5. Check that the indicated nitrous oxide flow remains between 9.5 and 10 l/m.
6. Gradually reduce the oxygen flow and check that the nitrous oxide flow has begun to decrease when the oxygen flow decreases below 2.8 l/m.
7. Turn the oxygen flow control clockwise until a flow of 1.5 l/m is reached. Check that the nitrous oxide flowblock assembly is reading 3.5 to 6.6 l/m.
8. Turn the nitrous oxide control fully clockwise.
9. Ensure all the flow control valves are turned fully clockwise and then switch the machine off.

2.17.4 Oxygen Flush Tap Test

With only oxygen connected to the machine, verify that the oxygen flush discharges gas through the common gas outlet.

2.17.5 Auxiliary Outlet Test

1. To test the oxygen, attach oxygen only to the machine and verify that gas flows from the oxygen auxiliary outlet when connected.
2. To test the air, attach oxygen only to the machine and verify that no gas flows from the Air auxiliary outlet when connected. Attach air to the machine and verify that there is flow from the Air auxiliary outlet when connected.

2.17.6 Vaporizer Test

See **2.17.1** Leak Test.

2.17.7 Ventilator Test

Is contained in the Pre-Use Testing that follows;

Notes.

2.18 Inspiratory Block Assembly

The inspiratory block (Part No. 13700001) is replaceable as an assembly.

If this is replaced a full transducer calibration MUST be performed.

Equipment required:

- Pressure measuring device 0 to 100cmH2O
- Volume measuring device. Must be capable of measuring more then 1LPM
- Blease programming cable
- Computer with BleaseTerm software
- Gas supply normally Oxygen. If an Air driven ventilator is used then Air is needed
- 20 Litre test lung.

Disconnect the gas supplies and ensure the electrical supply is turned off.

Remove the Top moulding, front cover and the main rear cover see section **2.1**

Remove the six screws around the edge of the ventilator case top.

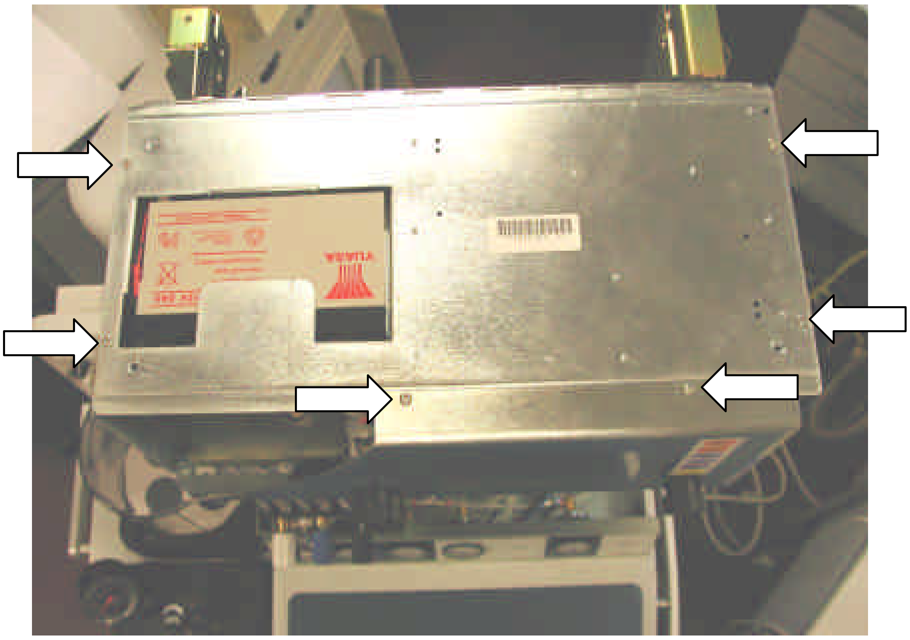


Figure 38 Ventilator Case Top

The front of the ventilator will now hinge forward a little to allow the top to open up completely.

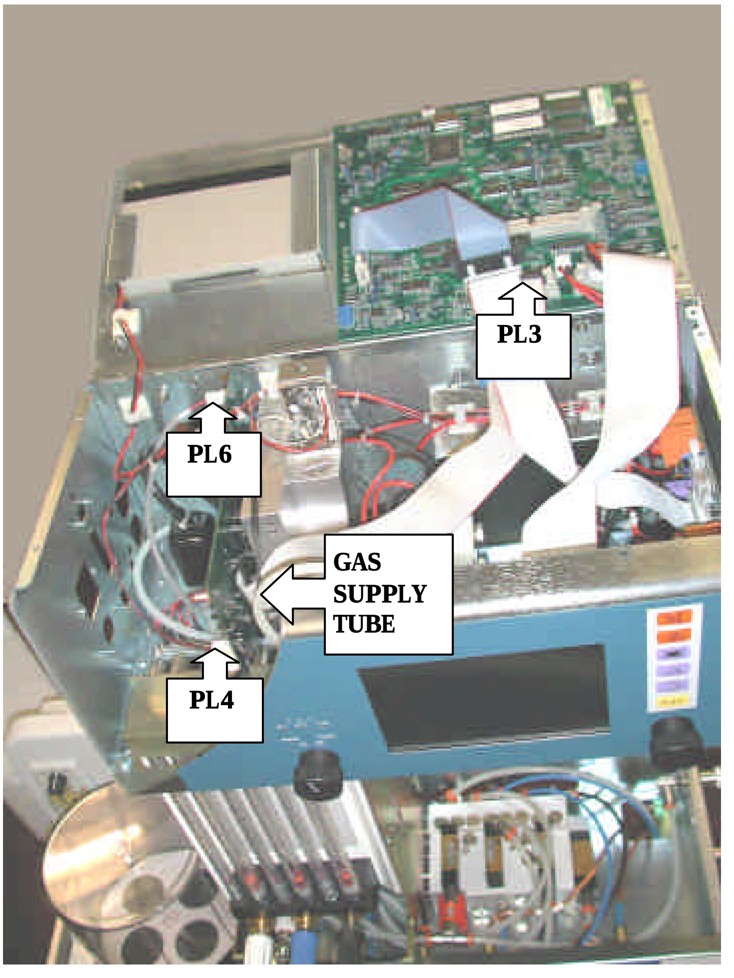
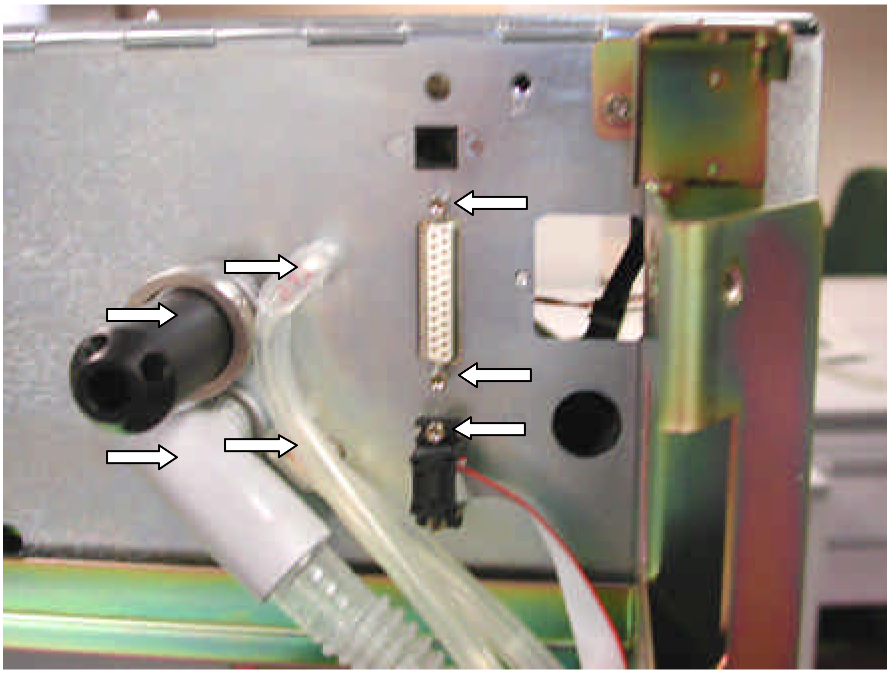


Figure 39 Inside Ventilator

Disconnect the connectors PL4, PL6 and the ribbon cable that goes to PL3 on the BAV controller. Remove the gas supply tube from the connector on the end of the manifold.

Remove the screw on the under side (between the flow block and Da-lites of the ventilator case)

From the rear of the unit remove the drive gas hose, the exhaust (do not unscrew or move the locating ring) and patient sensor tubing making a note of which tube comes from which connector then, remove the four screws for the “D” connectors and the top drive gas fitting.



The Inspiratory block is now free to be removed. Fit the replacement Inspiratory block and then see section **3.3** for sensor calibration.

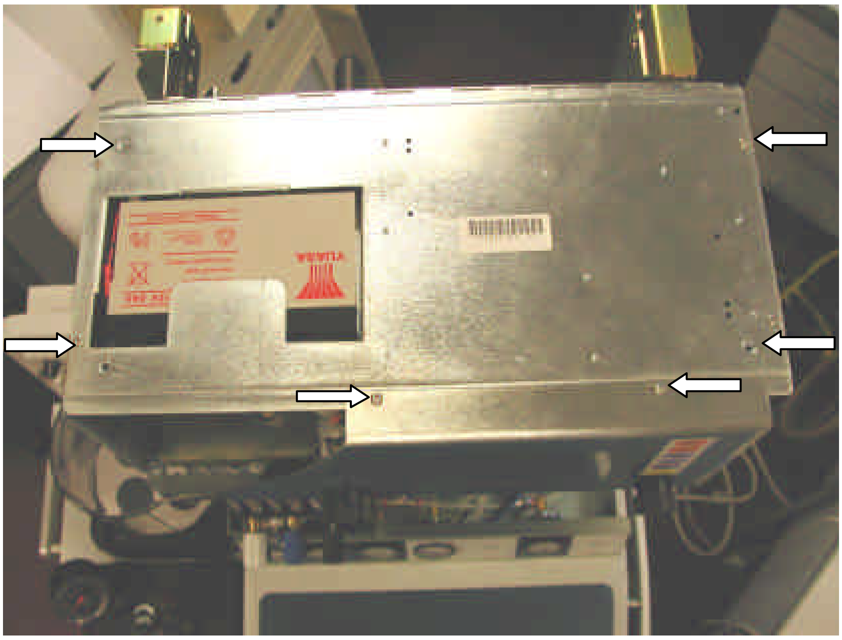
Flow control valves and regulator assembly Part no **13700003**

There are two flow valves and must be replaced as a matched pair. The assembly has both the valves and regulator matched.

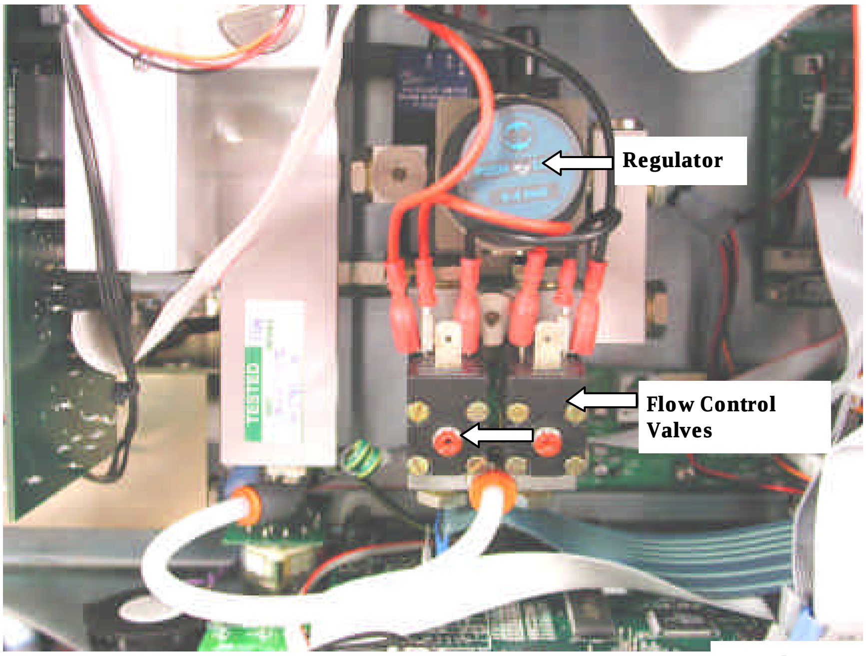
To replace the assembly first ensure that the gas supply is disconnected (both O2 and AIR) and the power is turned off.

Remove the Top moulding and front cover see section **2.1.**

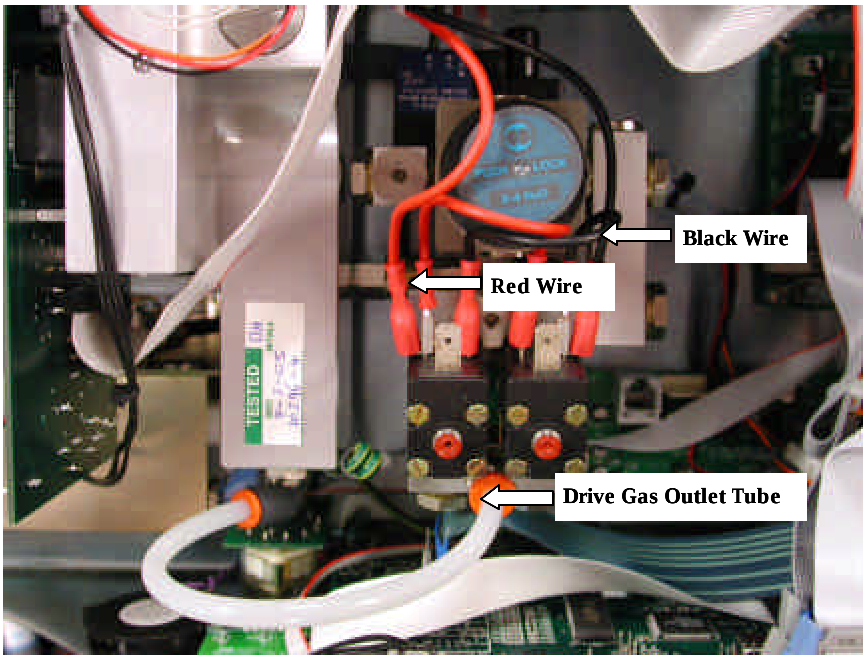
Remove the six screws around the edge of the ventilator case top.



The front of the ventilator will now hinge forward a little to allow the top to open up.

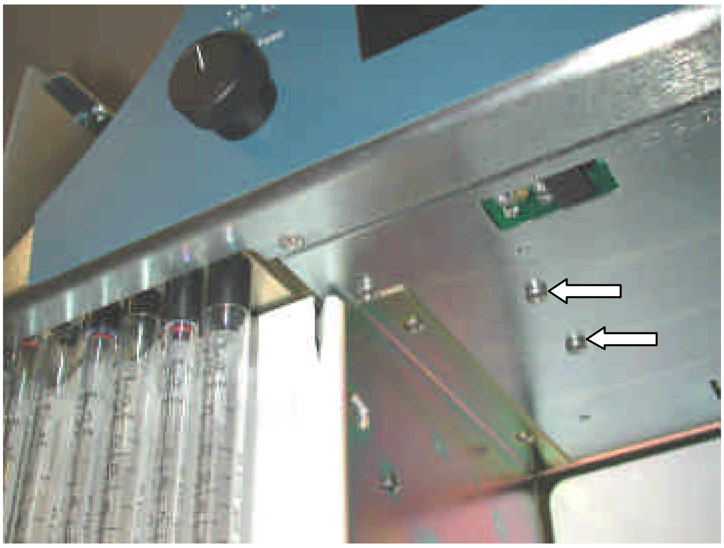


Gas Inlet Assembly Part No. 13700003



Disconnect the two wires (one red, one Black) from the flow control valves and the drive gas outlet tube.

Remove the two screws that hold the assembly to the bottom of the case.



Move the assembly up and to the right so that access can be gained to the drive gas inlet tube. Remove this tube from the connector. The pressure switch is mounted on the back of the assembly remove the two wires that are connected to this. The assembly can now be removed from the ventilator.

The replacement assembly has the pressure switch and pressure regulator set at Blease and should not need further adjustment. The flow valves will need to be calibrated for zero flow and max flow see section **3.2**

3. Ventilator Calibration Details

Notes

3.1 BleaseTerm

Calibration of the 8700/6700 is the same, exceptions are listed on pages 116, 120, 121, and 122 of this section.

3.1.1 Controls

BleaseTerm is a terminal communication programme written specifically to work with all Blease ventilators.

BleaseTerm will work on all Windows based computers. It will support USB connections, although a USB to serial converter will be needed to connect to the ventilator.

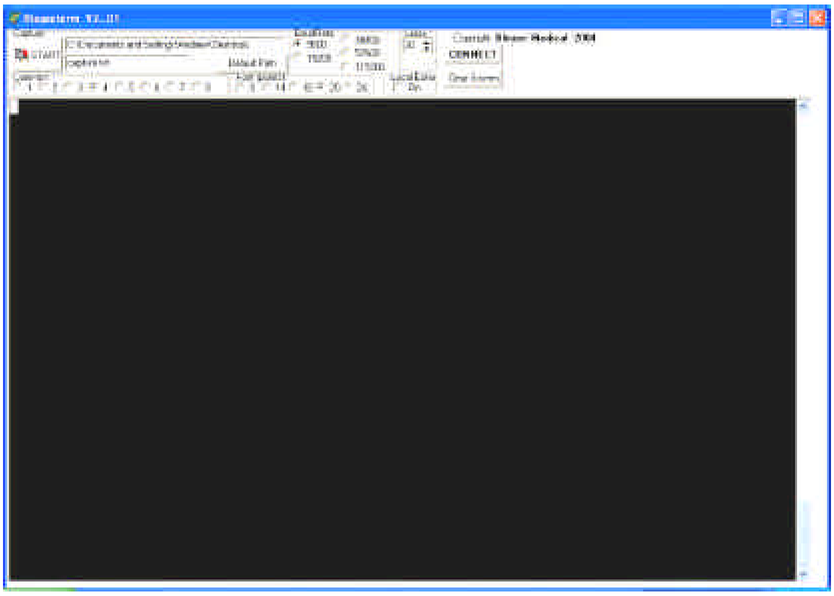


Figure 40 BleaseTerm Start Screen

BleaseTerm will find the com port that is being used.

Baud Rate is 9600 for all ventilators

Font size will depend on the computer screen resolution. Select the one that gives you all the information on one screen.

Lines set to 30

The capture Start button can be used to capture to a file or print any information on screen. This is very useful if BleaseTerm is set up to run then the start button is pressed before the ventilator is turned on. A full list if the ventilators current calibration data will then be captured. This can be saved or printed to compare with later calibrations or sent to Blease Technical Support to help in fault finding.

To connect to the ventilator for calibration press the CONNECT button. You are then requested to enter the password.

The password is currently NIGEL

There are Pages in the calibration

Page 1 Sensor calibration

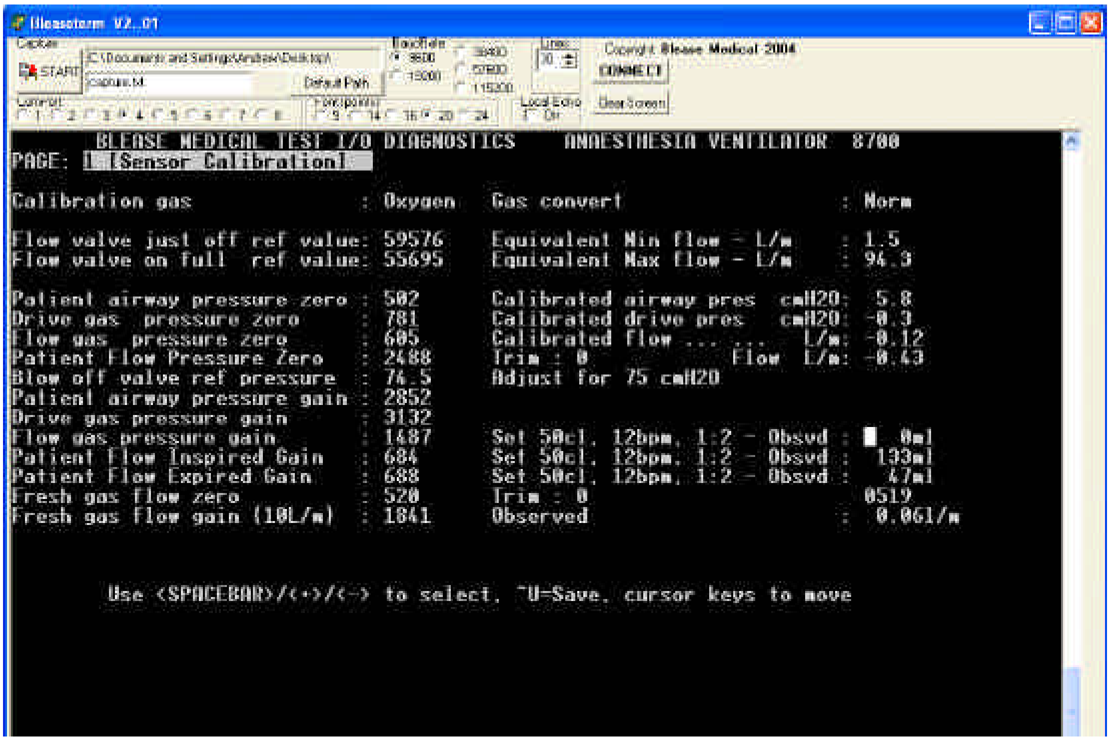


Figure 41 BleaseTerm Sensor Calibration

Page 2 Ventilator Options

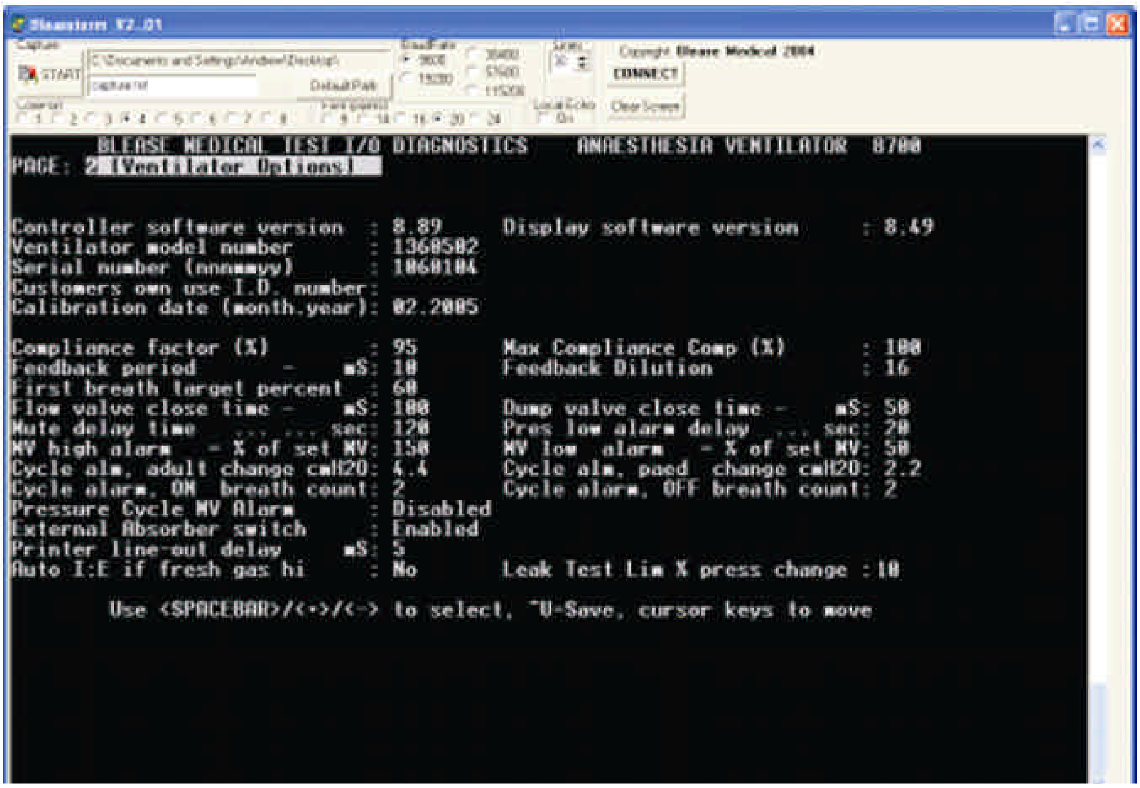


Figure 42 BleaseTerm Ventilator Options

Page 3 Default/Save Options

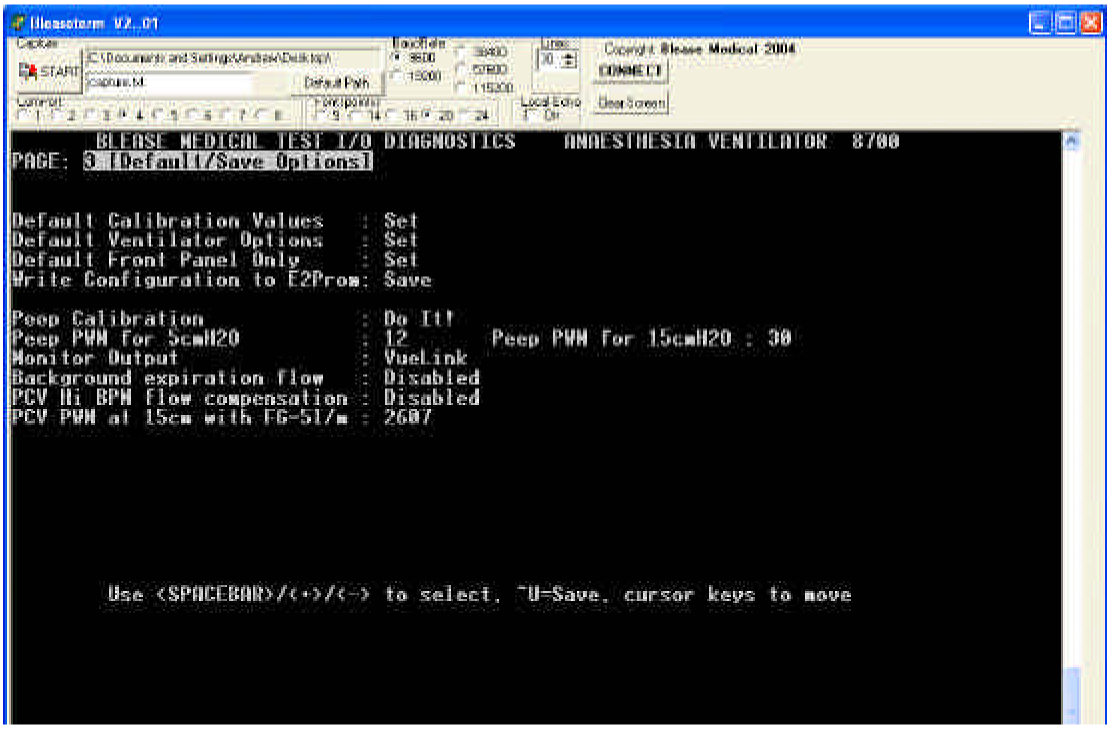


Figure 43 BleaseTerm Defaults/Save Options

With the cursor highlighting the page press the number on the computer keyboard to change to the page you want.

Page 1, is the main calibration page.

All the sensors and main flow control valves are adjusted here.

Page 2, are the ventilator options these should not be changed unless instructed by Blease.

Page 3, are the default values for start points in PCV and PEEP.

Keystrokes

Space bar	this is used to record/change the highlighted line
+ and -	are used to change items such as gas type
Arrows	are used to move the cursor from one position to another
Ctrl U	are pressed together to save all values
Ctrl E	are pressed together to exit calibration

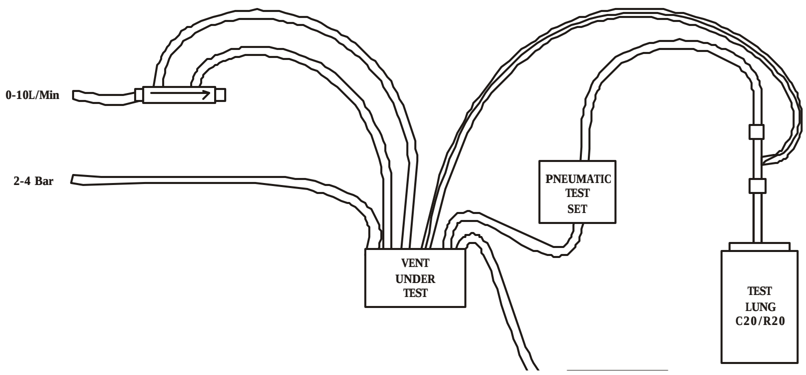
3.1.2 Flow control Calibration

Equipment required.

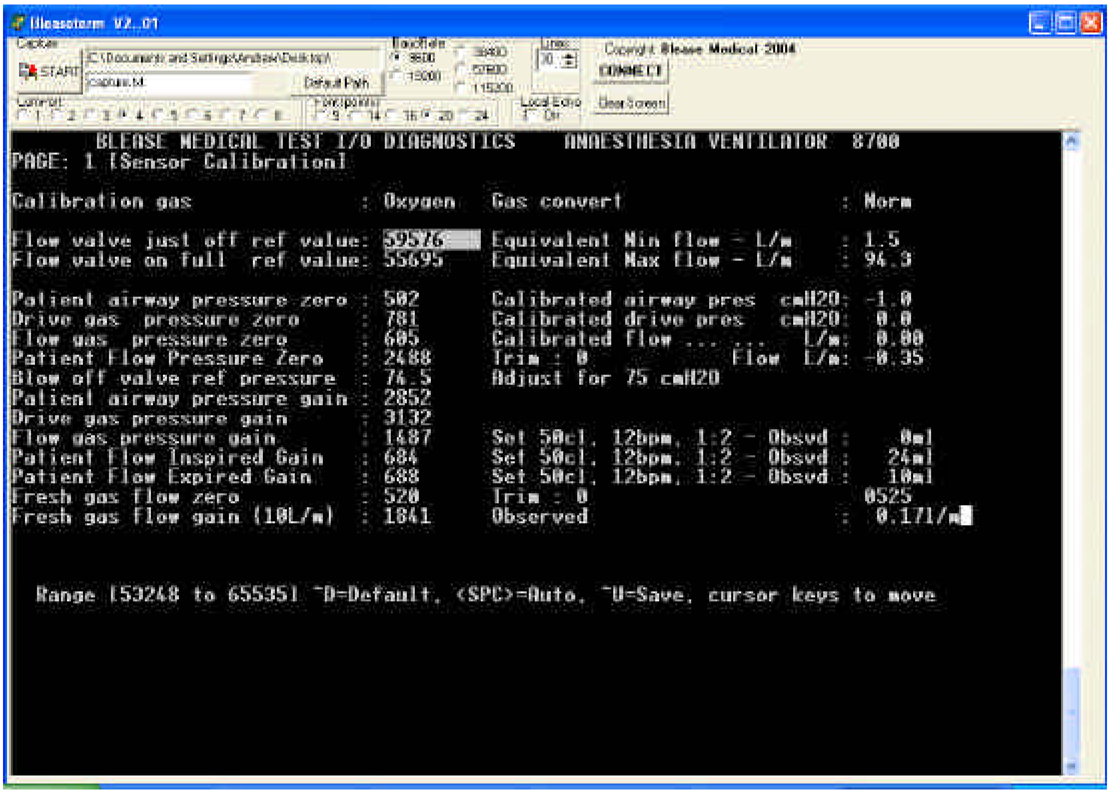
- A computer with BleaseTerm installed.
- Programming Cable.
- A flow measuring device capable of measuring more then 100LPM.
- Connect gas supply and mains power supply.
- Ensure that fresh gas is at minimum and the bellows and absorber are not in circuit.
- Flow sensor and tubing should be connected as shown below.
- The 22mm corrugated hose goes of to the flow measuring device.

Figure 44 Flow Control Calibration

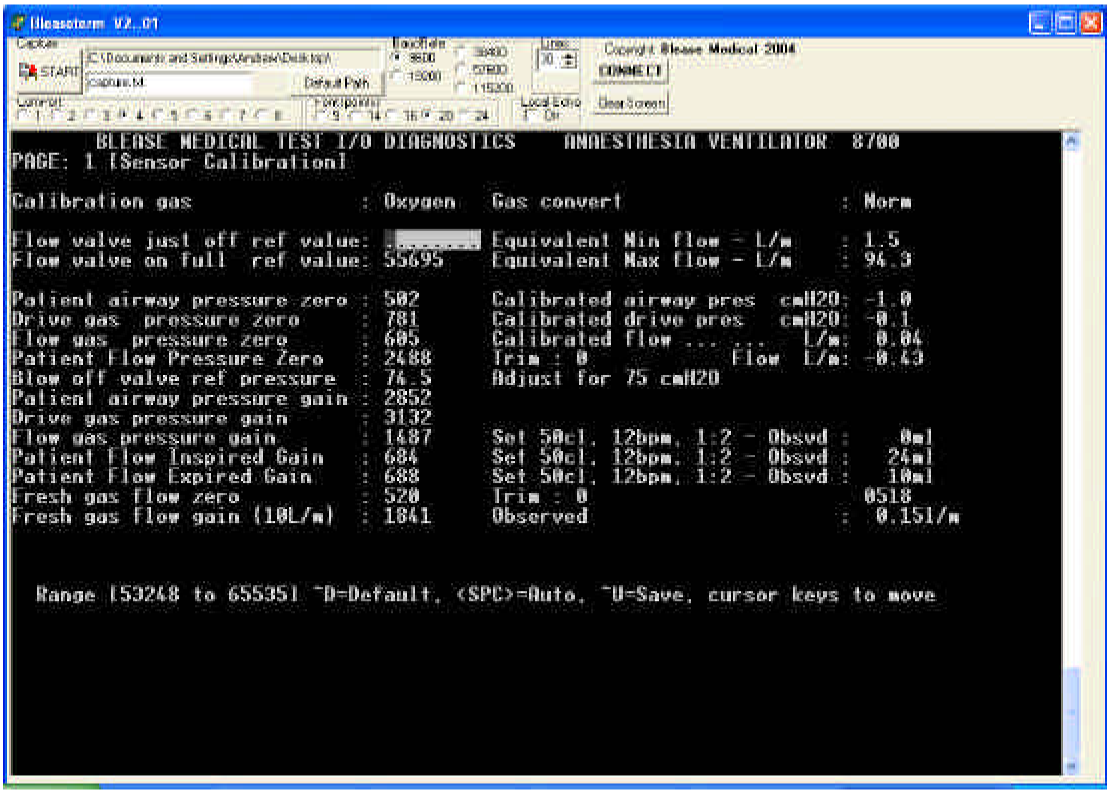
- Connect BleaseTerm (see section **3.1**)
- Select Flow valve just off ref. value



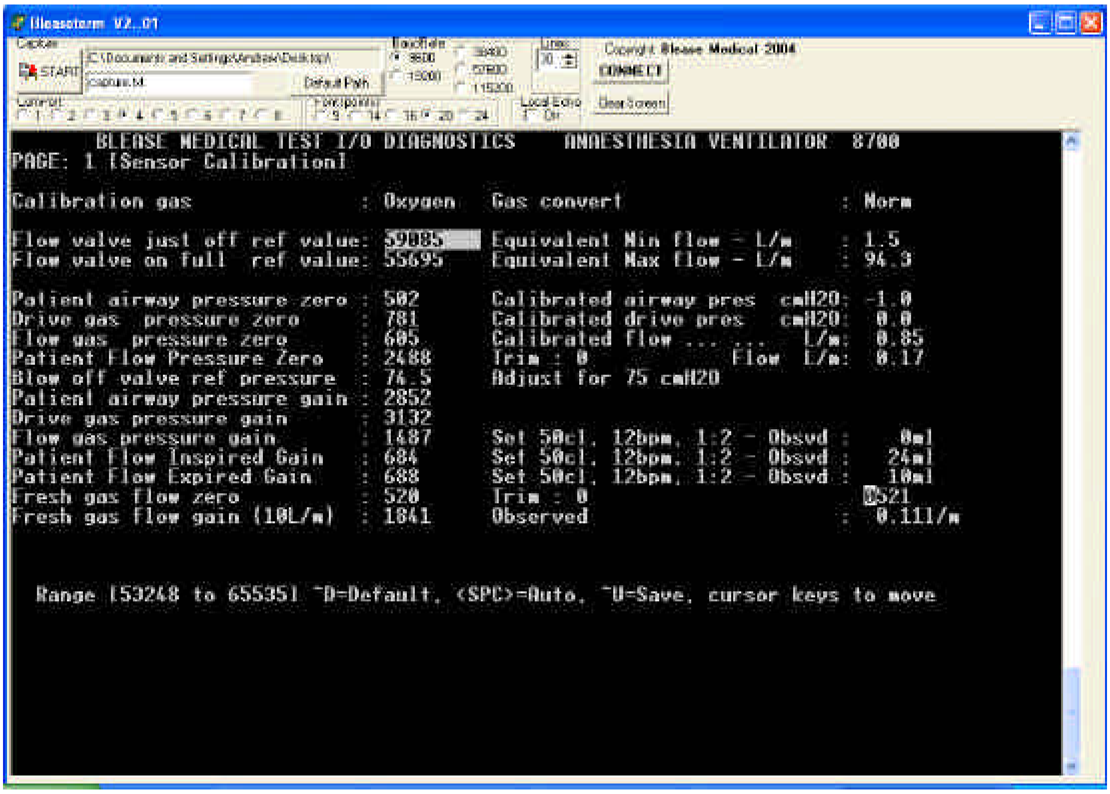
Recommended Setup



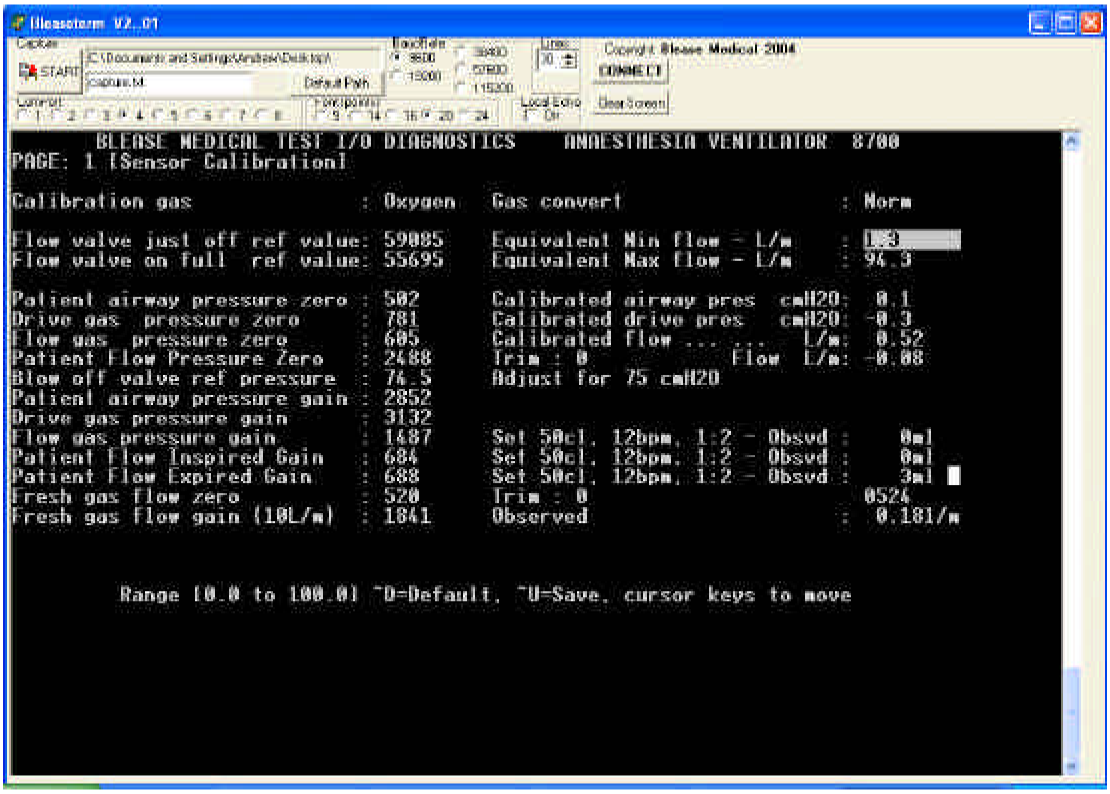
Press the space bar on the computer. The numbers in the cursor highlighted box will change to a series of dots



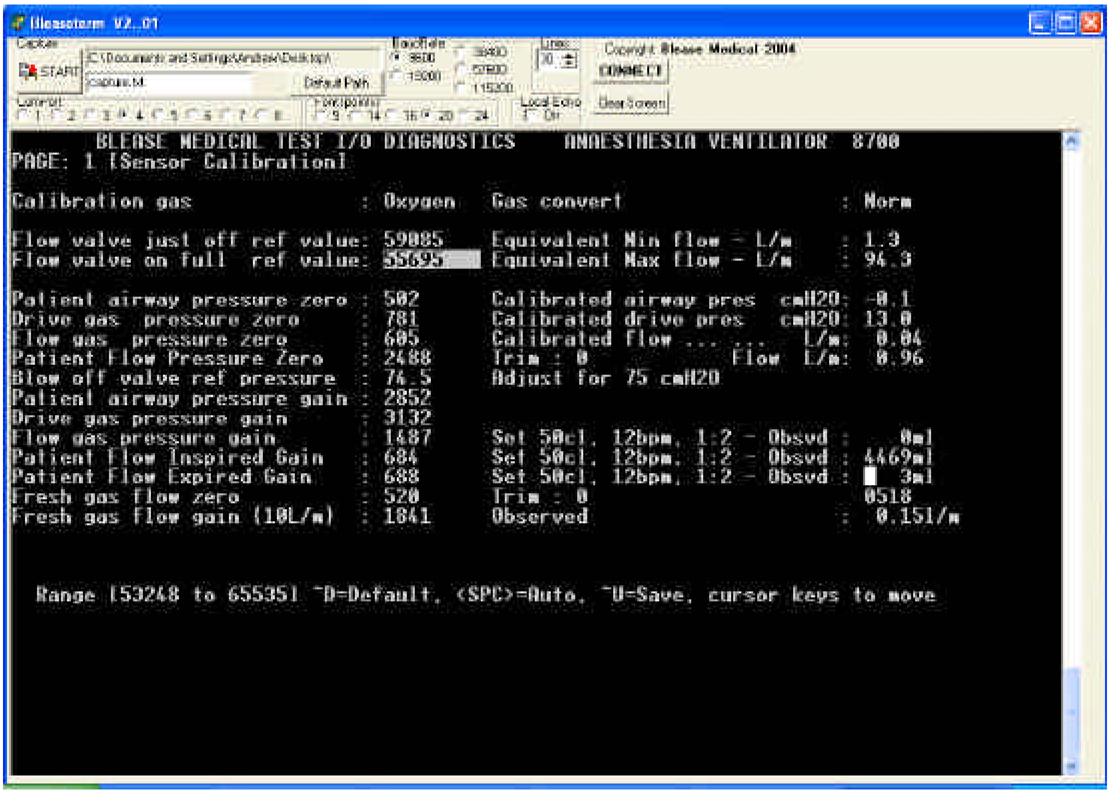
The valves will now be opening and closing. The system is attempting to find the lowest repeatable flow that it can deliver. Once this has been calculated the dots will be replaced with a new number.



It is possible to move the cursor sideways to the Equivalent Min flow L/m and type the value recorded by the flow measuring device. (this information is not needed for the calibration. It is only a recording of the real world value).

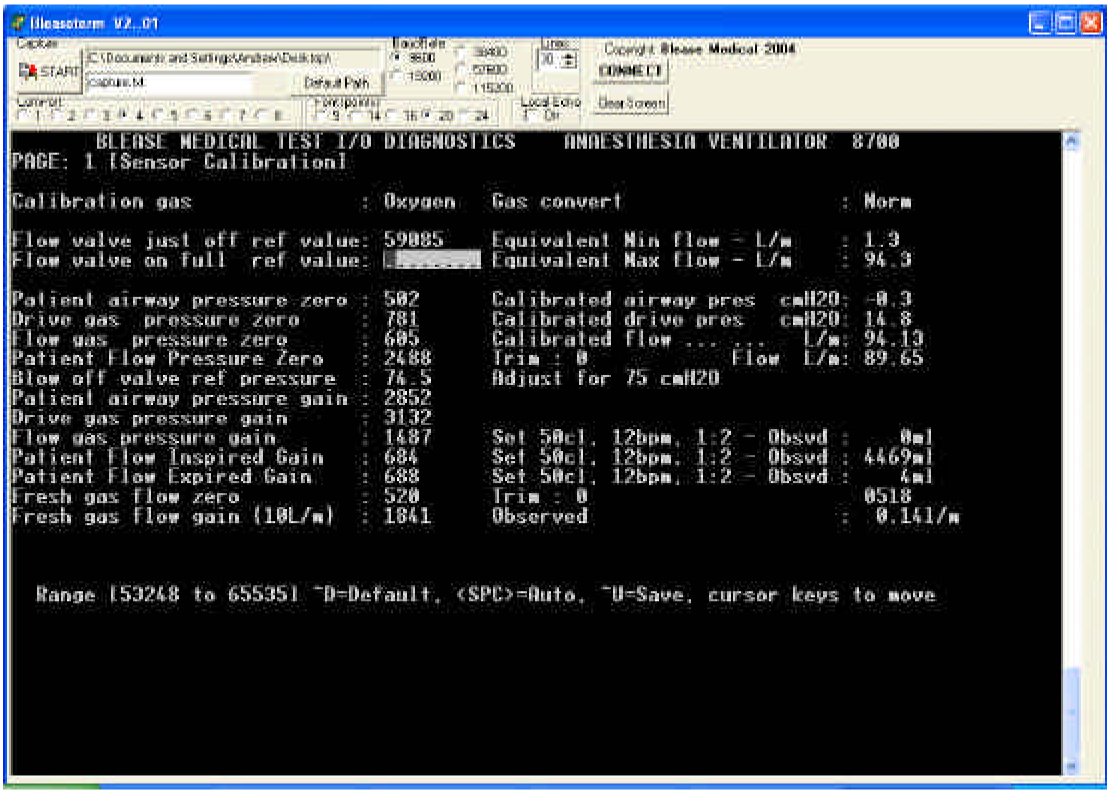


Move the cursor to Flow valve on full ref value.

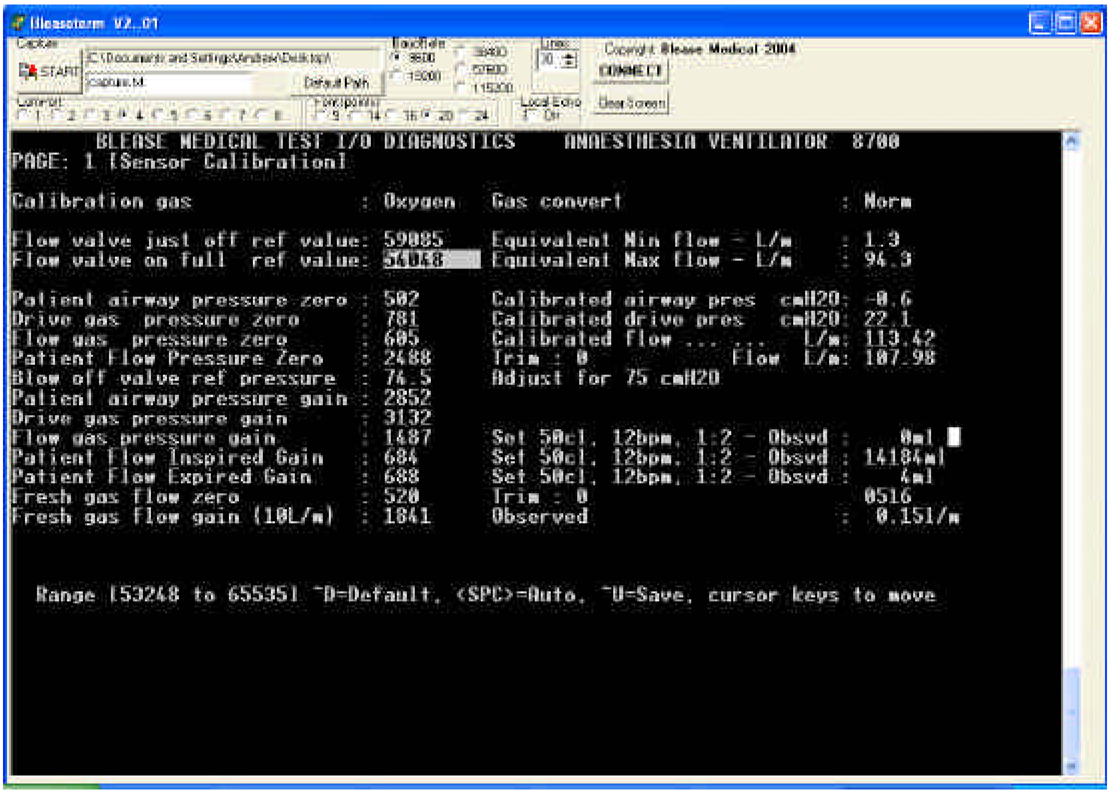


Press the space bar. Once again the number will be replaced with a series of dots.

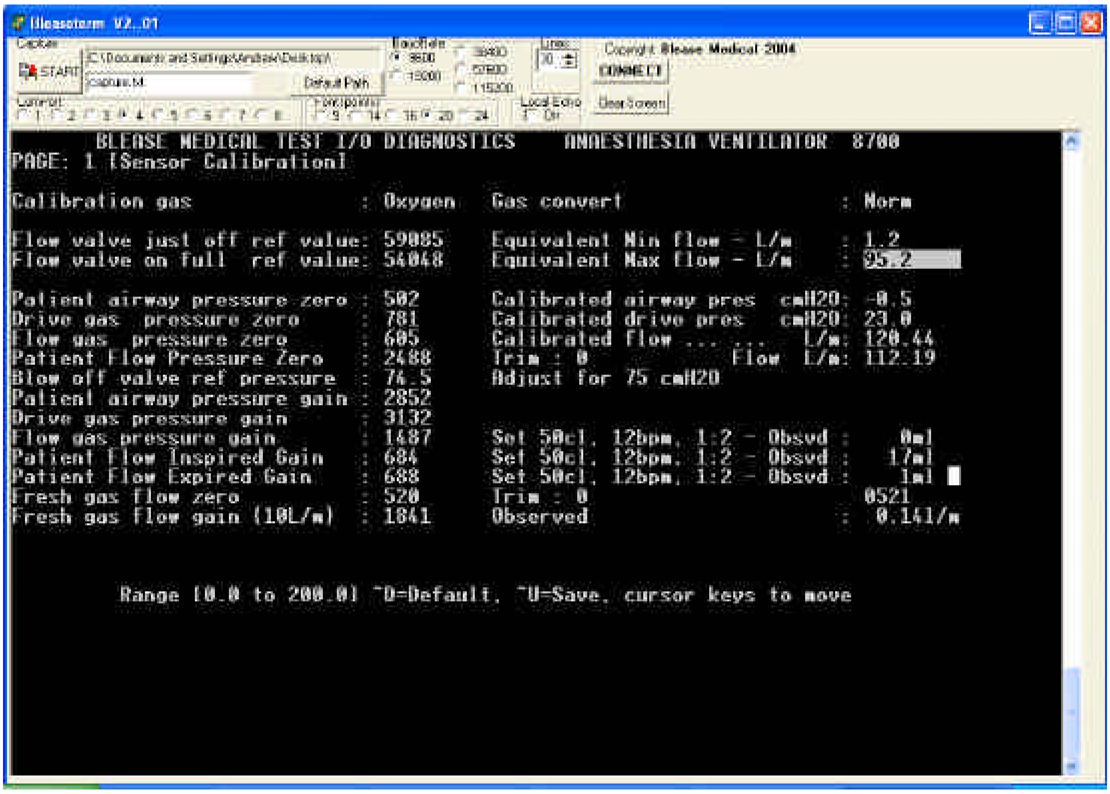
The system is now finding the maximum flow through the valves.



When the max flow is found the dots will be replaced with a new number.



Move cursor to Equivalent Max flow L/M and type in the value recorded on the flow measuring device.



Press Ctrl and U to save the values.

Press Ctrl and E to exit calibration.

3.1.3 Sensor Calibration

Read through section **3.1** for instructions on how to connect and run BleaseTerm

Never calibrate ventilator immediately after turning on, allow 15 mins for system to warm up.

Read through section **3.1** Calibration set up

3.1.4 Zero Offset Correction

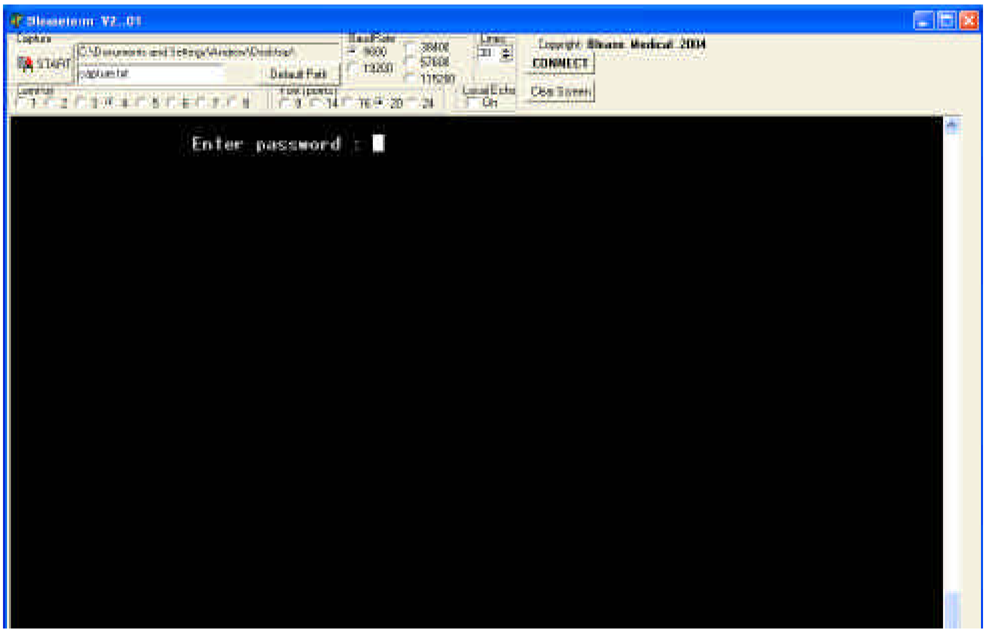
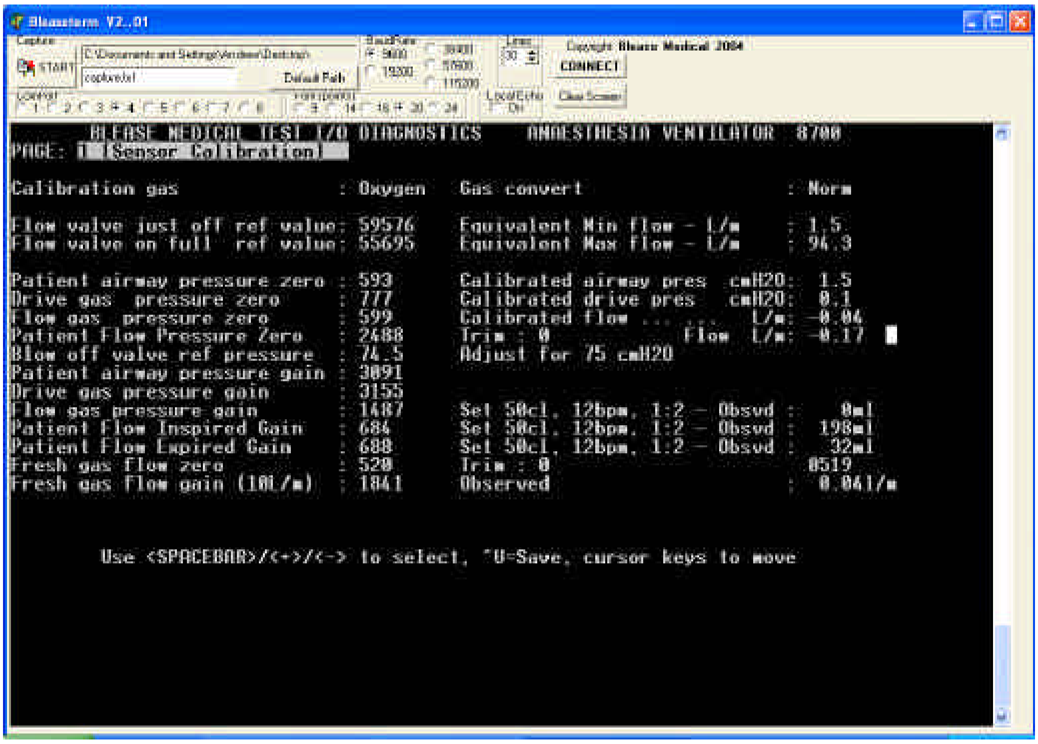
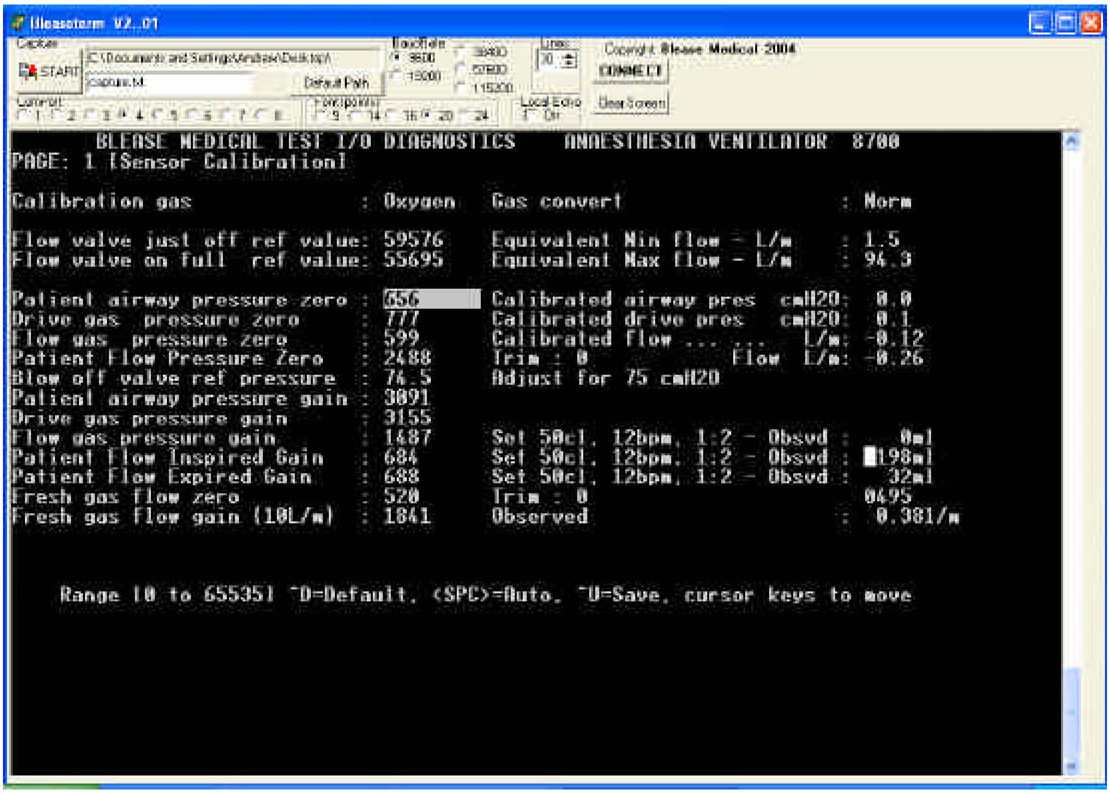


Figure 45 Sensor Calibration

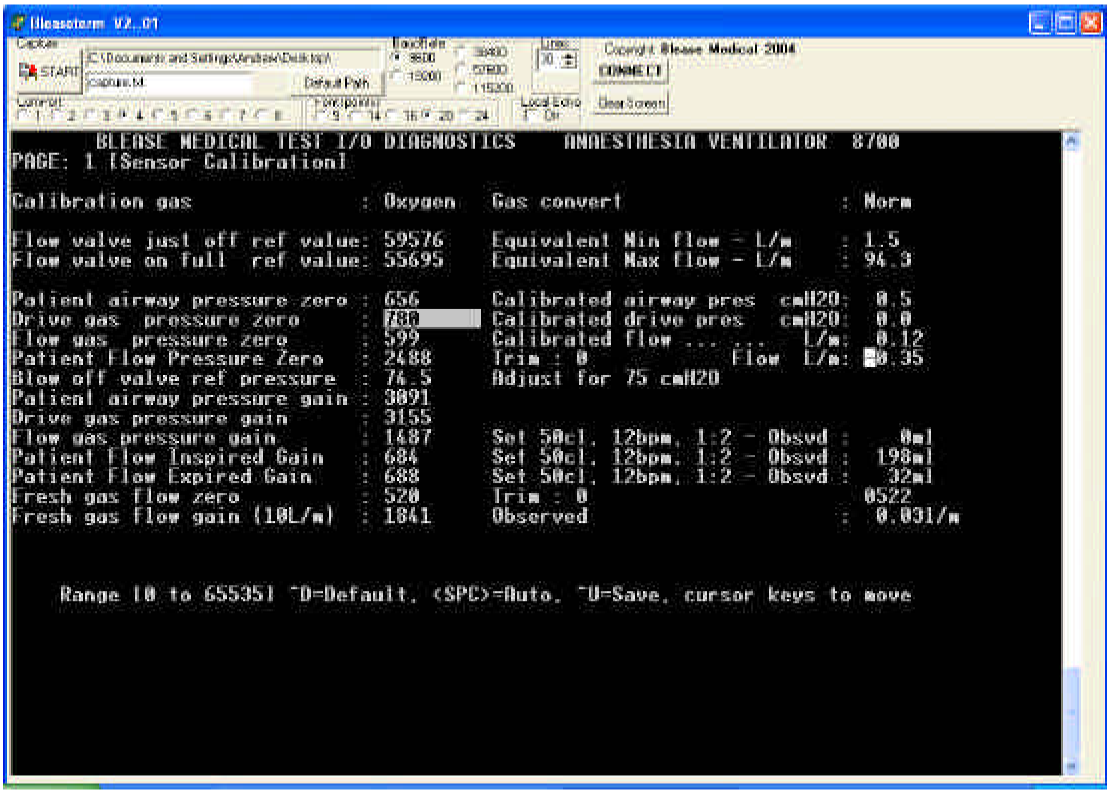
All sensor calibrations are performed on the default page 1 (shown below)



move the cursor down with the down arrow key on the keyboard to Patient airway pressure Zero

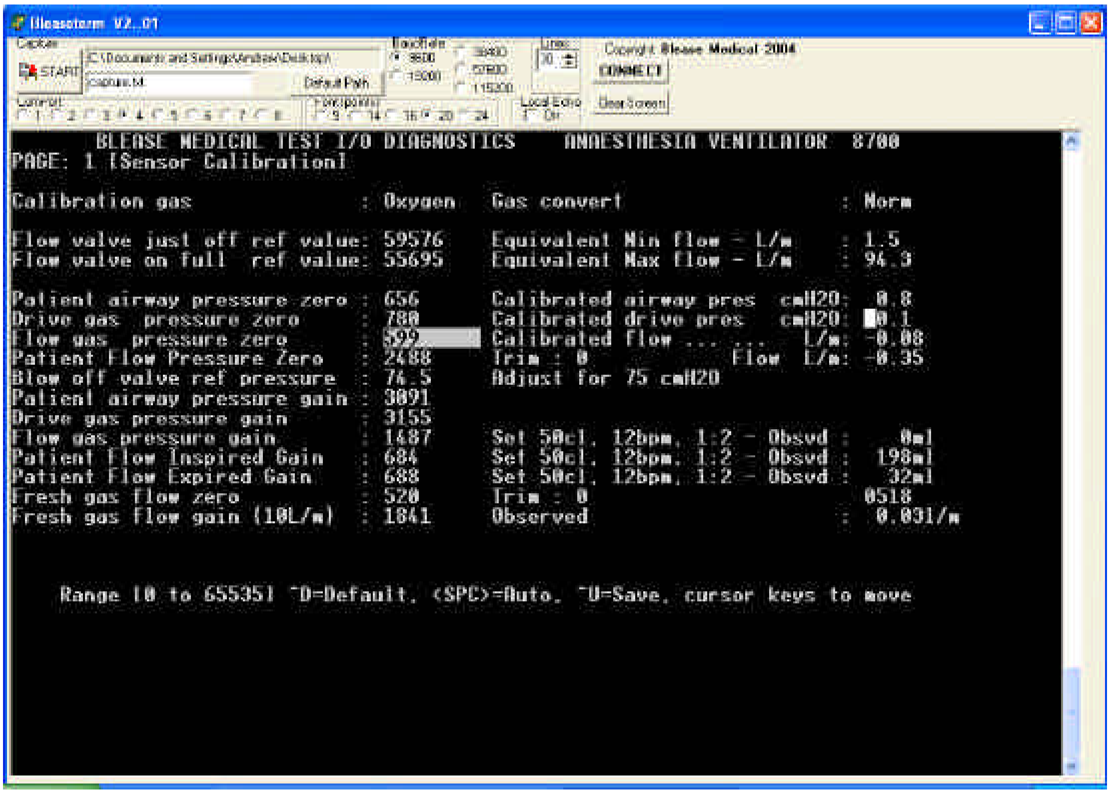


Press the space bar on the keyboard to record the value.
Move the cursor down to Drive gas pressure zero.

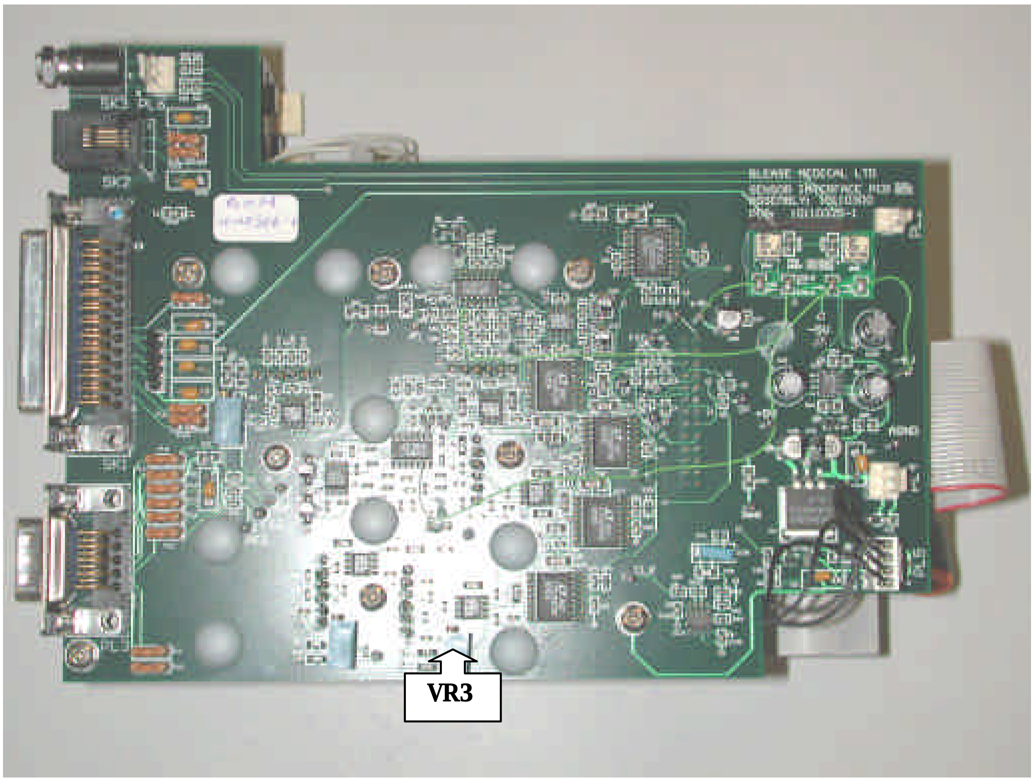


Press the space bar to record the value.

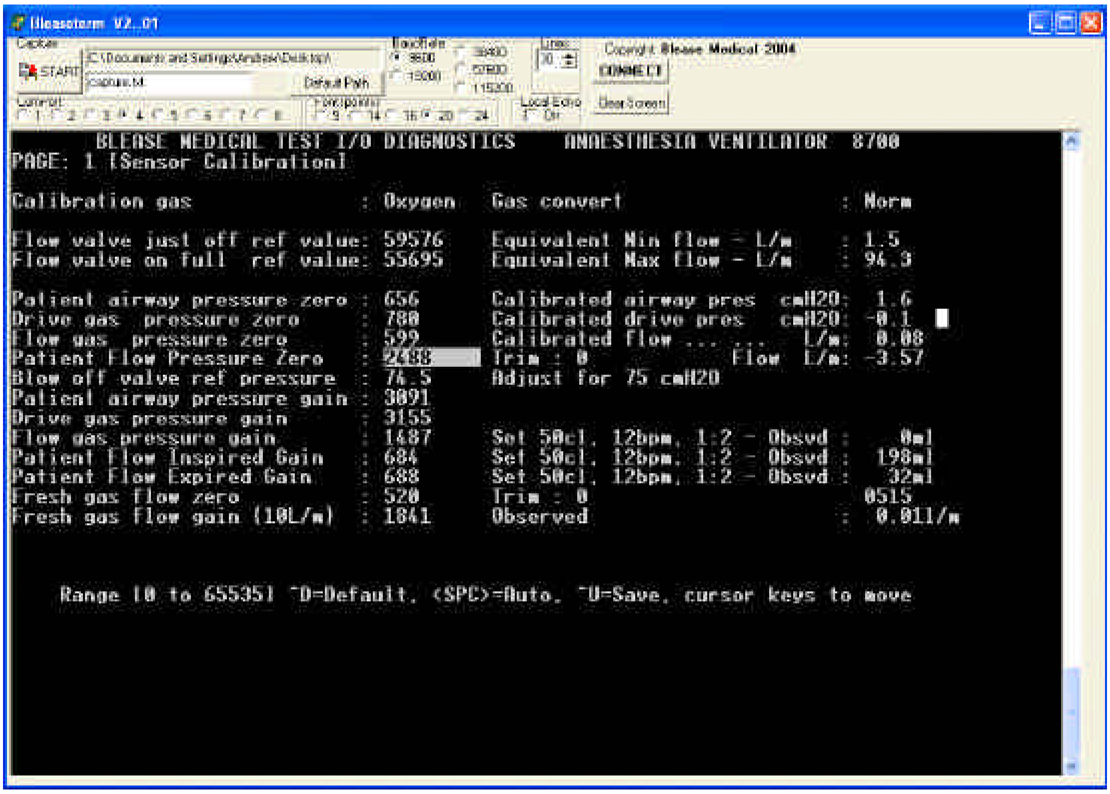
Move the cursor to Flow gas pressure zero



Adjust the pre-set potentiometer VR3 until 600 +/- 10 is shown. Note: the number in the cursor box will only update when the space bar is pressed. Therefore, it is necessary to make a small adjustment then press the space bar to update the number then if necessary make another small adjustment, press the space bar to update again repeating until the correct value is shown.



Move the cursor down to Patient Flow Pressure Zero

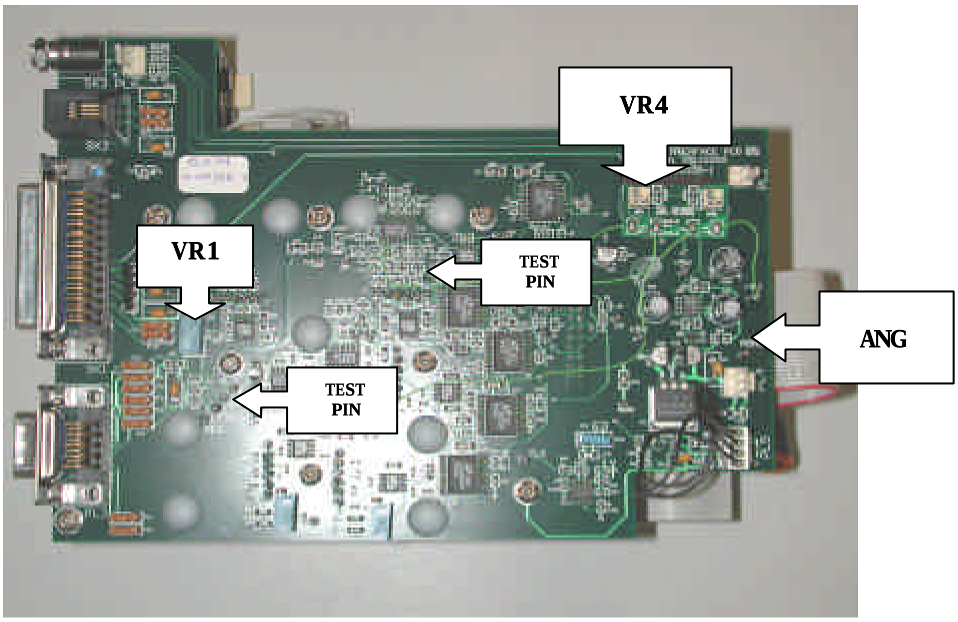


Connect a DVM set to read mV DC between the AGND test pin on the sensor interface board and the test pin marked PFI.

Adjust the pre-set potentiometer VR1 on the sensor interface board until the DVM reads 0.000V +/- 1mV. (This zeros the patient flow sensor).

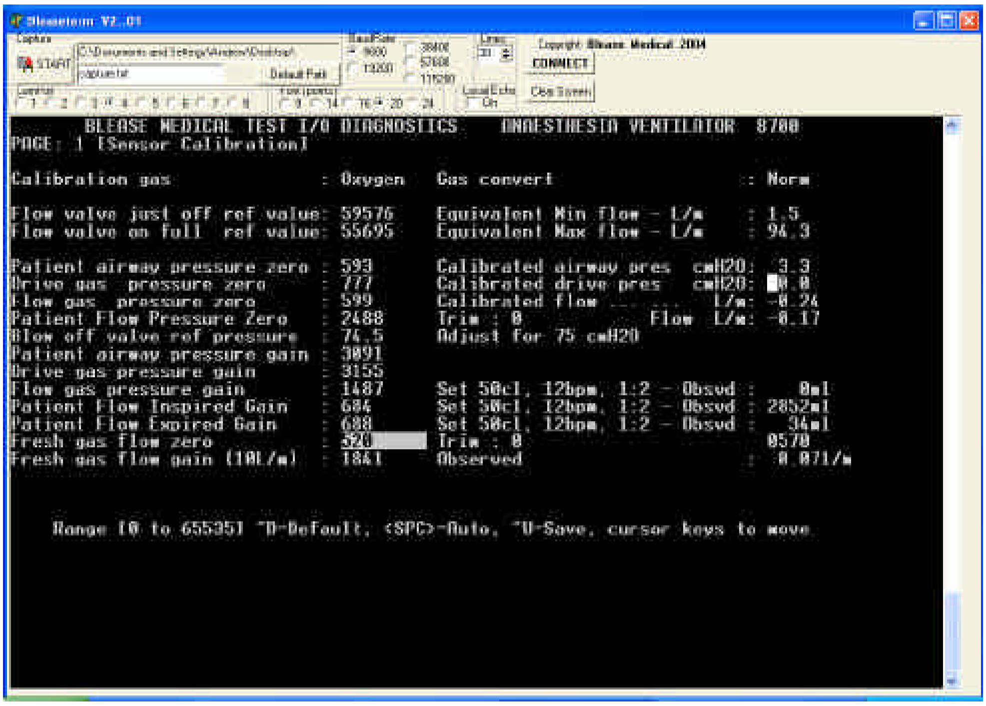
Move the DVM lead to the test pin PFZ. Adjust the pre-set potentiometer VR4 until the DVM reads 0.000v +/- 1mV (This zeros the square root circuit)

When these two values are correct, press the space bar to record the value.



Patient Flow Zero CAL (PFZ)

Move the cursor to Fresh gas flow zero. Ensure that there is no gas flow through the sensor

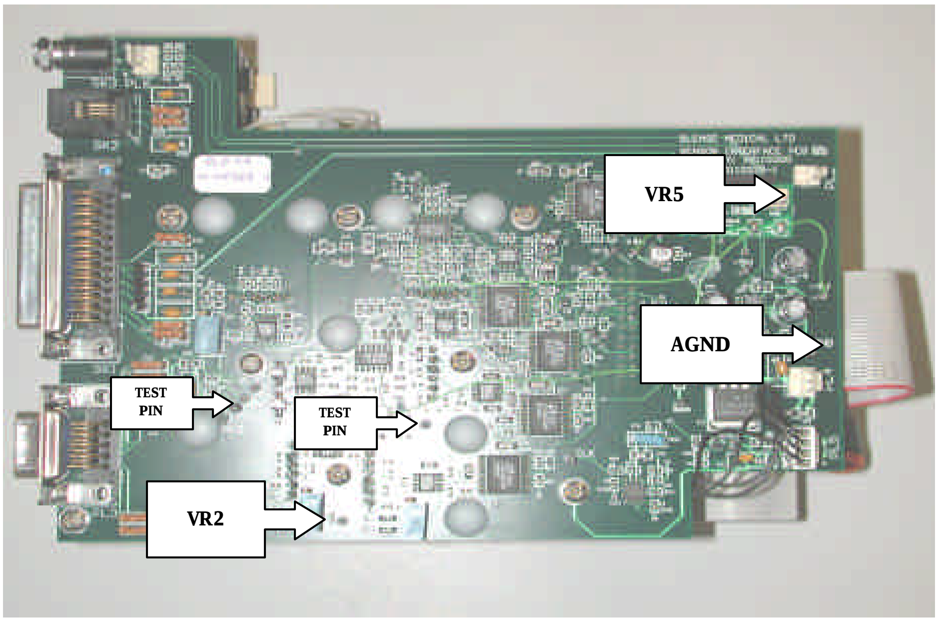


Connect a DVM set to read mV DC between the AGND test pin on the sensor interface board and the test pin marked FGI.

Adjust the pre-set potentiometer VR2 on the sensor interface board until the DVM reads 0.000V +/- 1mV. (This zeros the Fresh gas flow sensor).

Move the DVM lead to the test pin FGZ. Adjust the pre-set potentiometer VR5 until the DVM reads 0.000v +/- 1mV (This zeros the square root circuit). With the DVM still connected to FGZ re-adjust the pre-set potentiometer VR2 so that the DVM reads -50mV +/- 5mV

When these values are correct, press the space bar to record the value.



Fresh gas Flow Zero (FGZ)

Press both the Ctrl and U keys at the same time to save all the Zero's.

Disconnect the DVM.

3.1.5 Pressure Sensor Gain

Move the cursor up to Blow off valve ref. Pressure

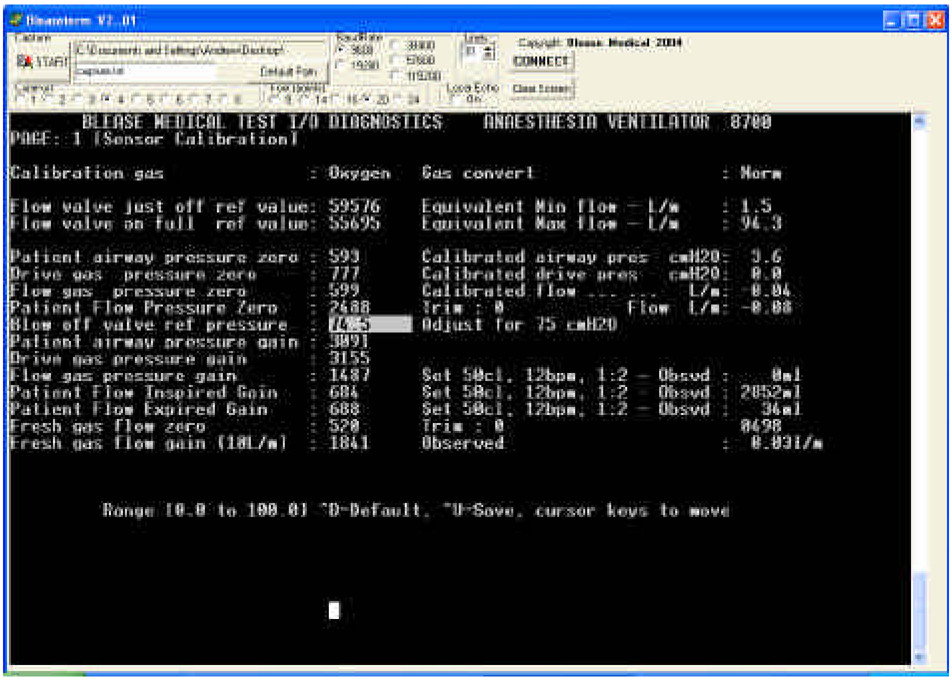
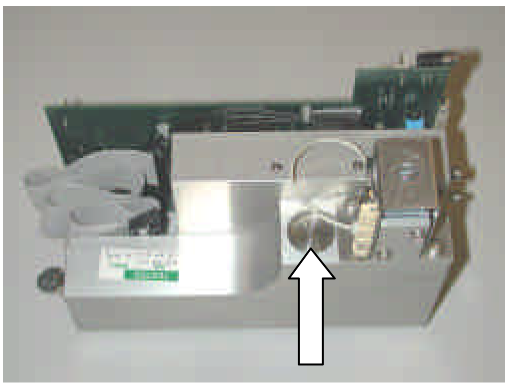


Figure 46 Pressure Sensor Gain

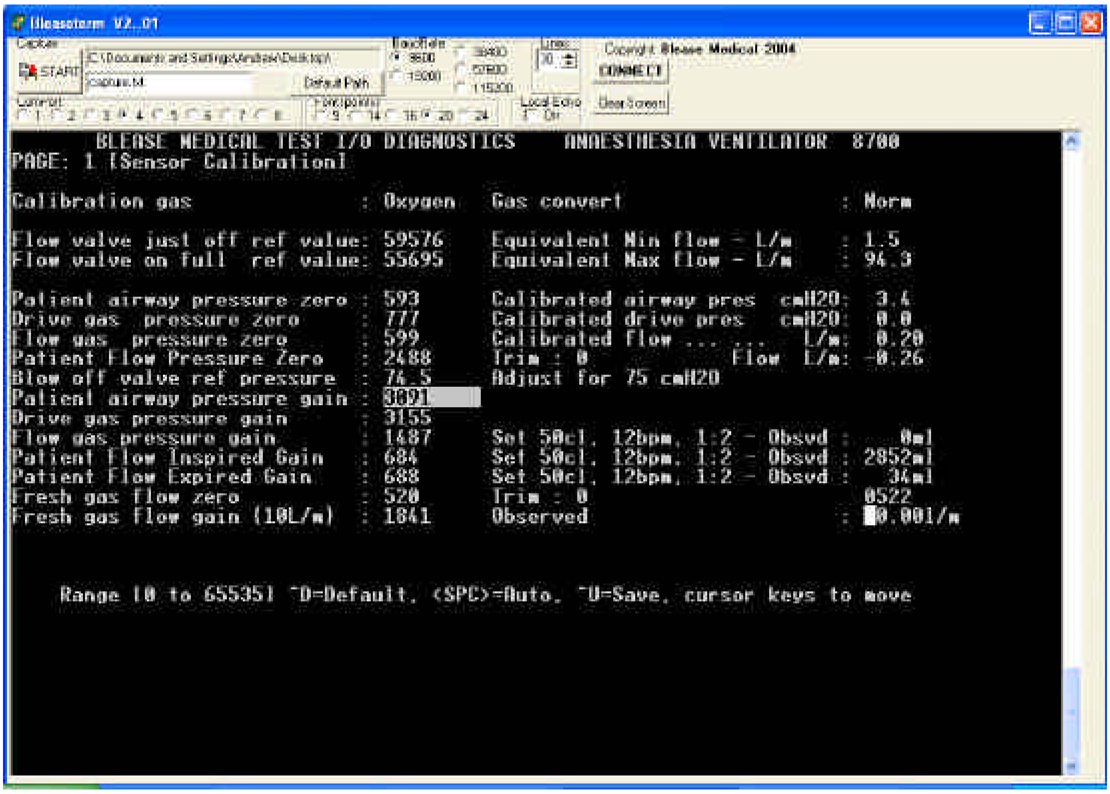
Tee in to the drive gas outlet the pressure measuring device and then block the flow sensor outlet. The internal pressure will now rise until the Blow off valve operates. The pressure will then stabilise, shown on the pressure measuring device, this should be 75 +/- 3 cmH2O.

It may be useful to reduce the tidal volume on the front panel to allow stable reading.

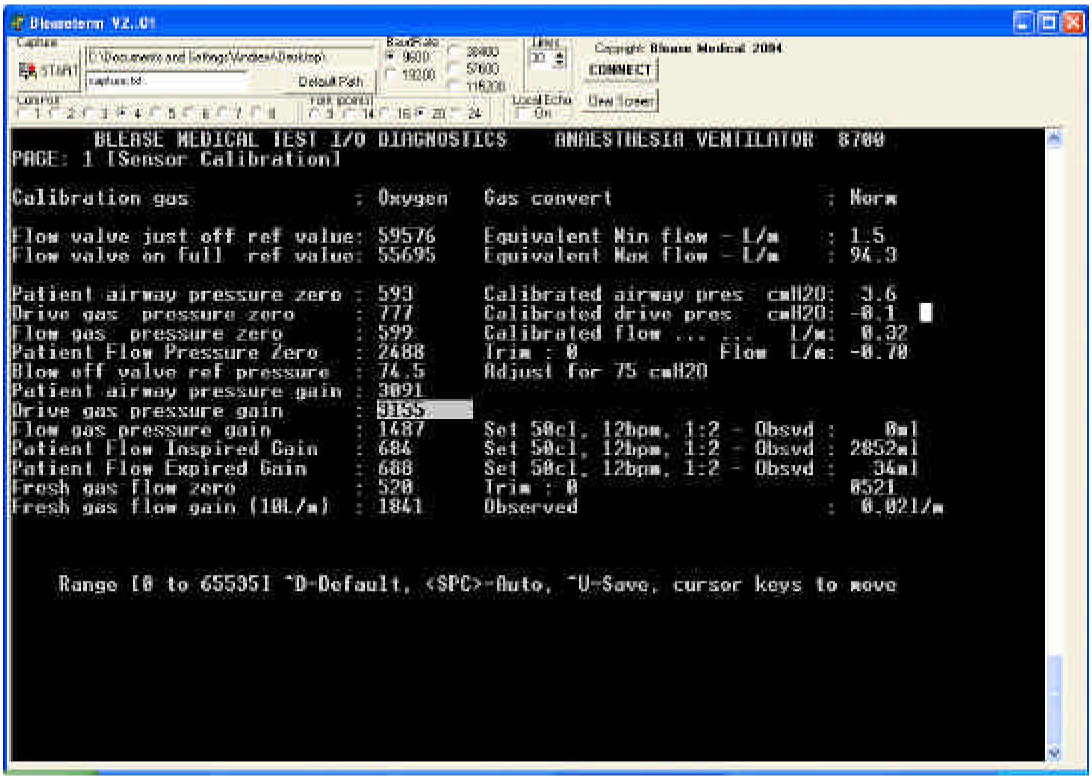
If the reading is outside 75 +/- 3cmH2O then adjust the valve.



Move the cursor to Patient airway pressure gain.



With the blow off pressure at 75 +/-3 cmH2O press the space bar to record the value.
Move the cursor to Drive gas pressure gain.



Check the pressure is still 75 +/- 3cmH2O and press the space bar to record the value.

Press both the Ctrl and U keys to save the values.

3.1.6 Delivered Volume Calibration

Connect the output through the flow sensor, volume measuring device and test lung. Do not connect through the bellows or absorber.

Check that the default settings are shown on the 8700 and/or set the values to:-

TV 500ml, BPM 12 and I:E 1:2 (6700)

Change the mode to run from Stand by

Move the cursor to Flow pressure gain

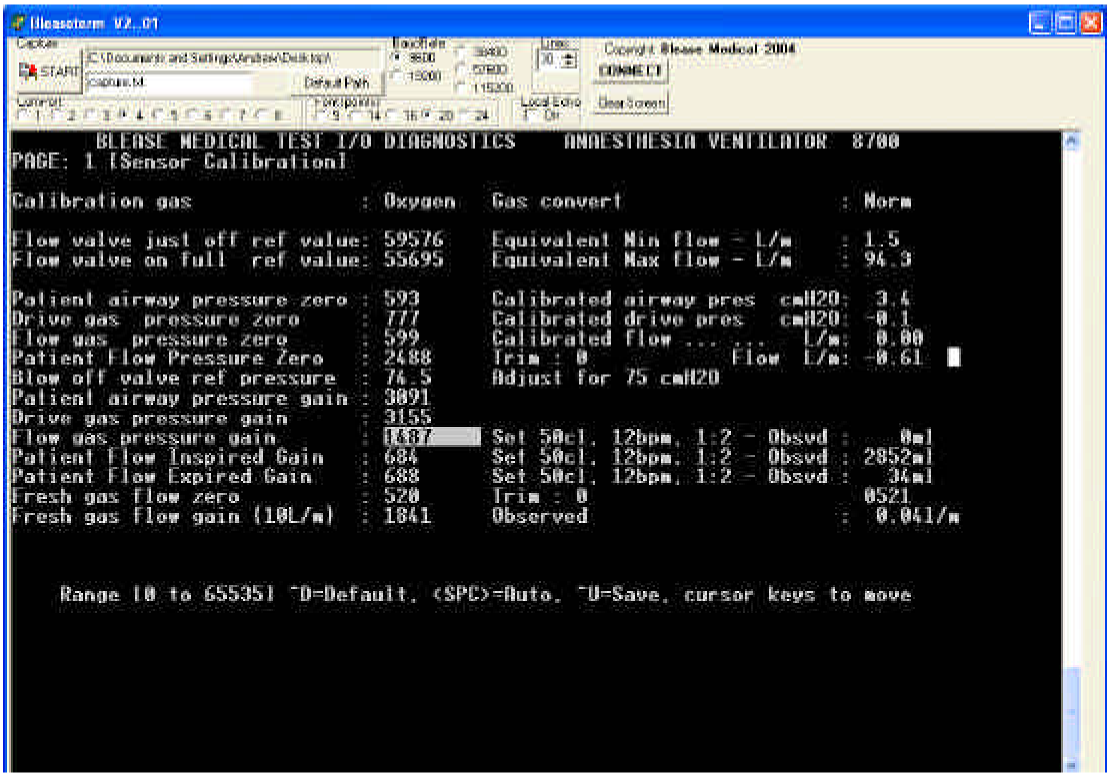
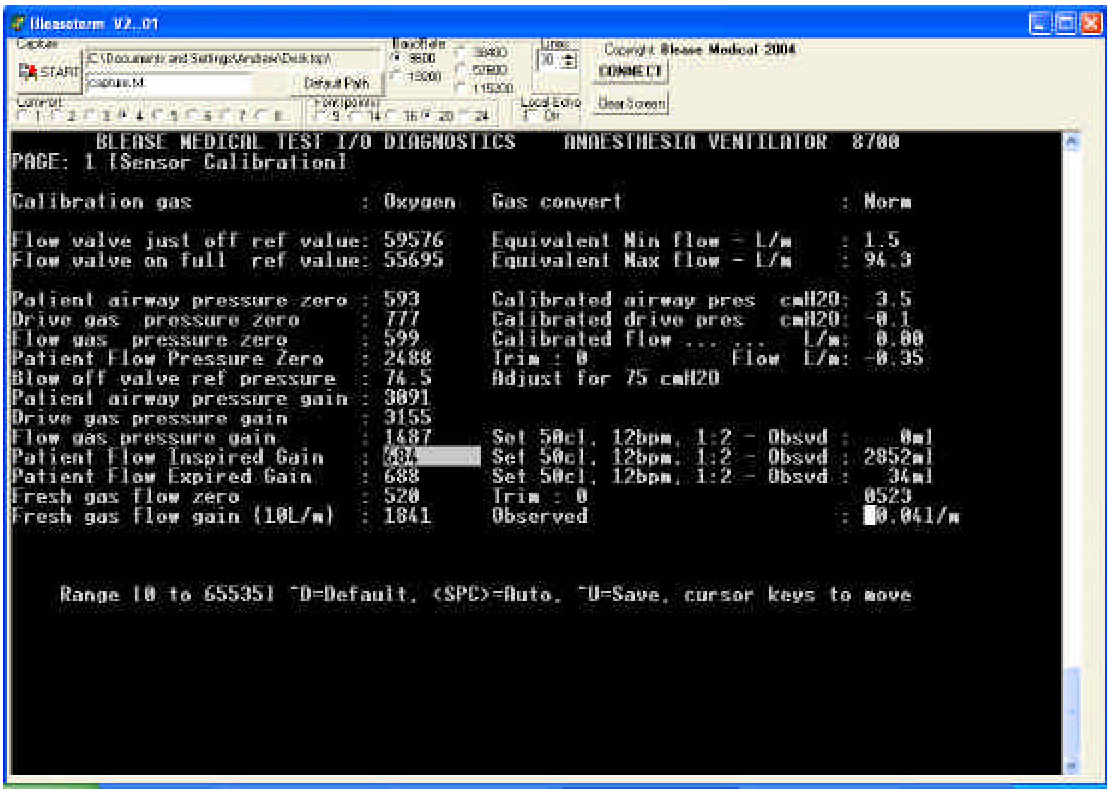


Figure 47 Delivered Volume Calibration

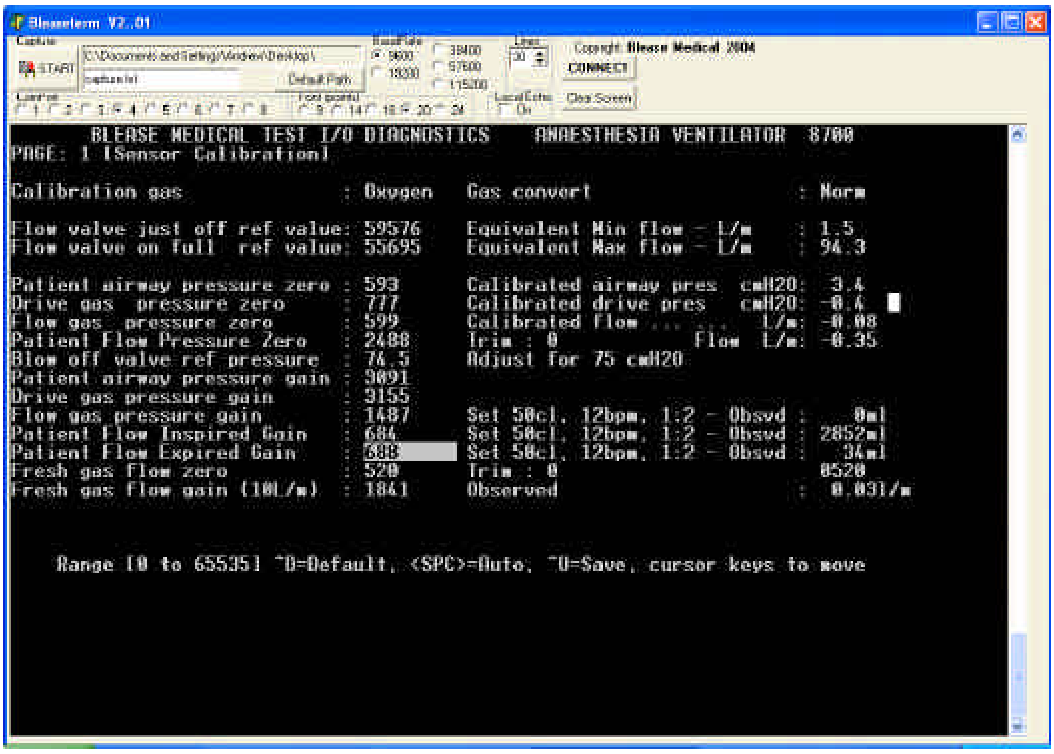
Adjust the tidal volume control until a monitored value of 500 +0/-30 ml is shown on the volume measuring device. NOTE the value in the display of the ventilator may be greatly different and is of no consequence during this procedure.

Press the space bar to record the value.

Move the cursor to Patient Flow Inspired Gain



Check that the delivered volume on the volume measuring device is still 500+0/-30ml and press the space bar to record the value. (DO NOT MOVE THE CURSOR (8700 only)) The EtidalV value will go RED (on the third breath) and then back to BLACK. The cursor can now be moved to Patient Flow Expired Gain. (6700; does not measure inspired volume, therefore no setup procedure).



Check that the delivered volume on the volume measuring device is still 500+0/-30ml and press the space bar to record the value. Press the Ctrl and U keys to save.

3.1.7 Fresh Gas Flow Sensor Gain

Move the cursor to Fresh gas flow gain.

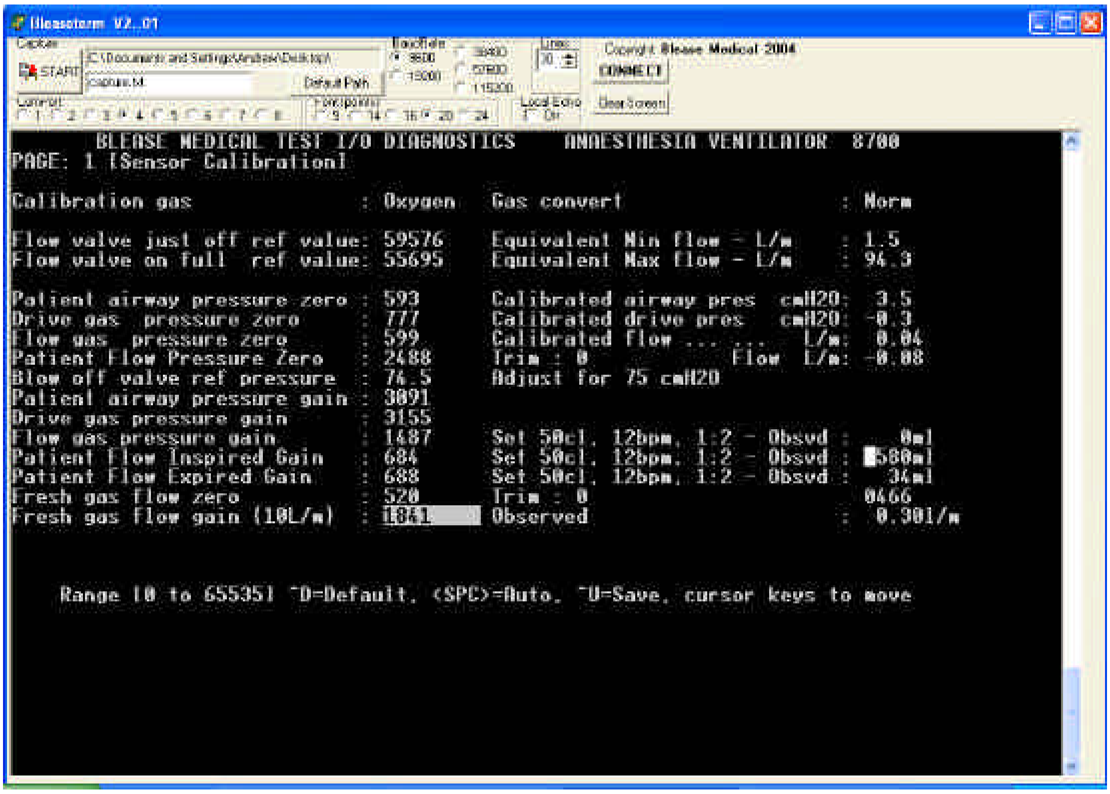
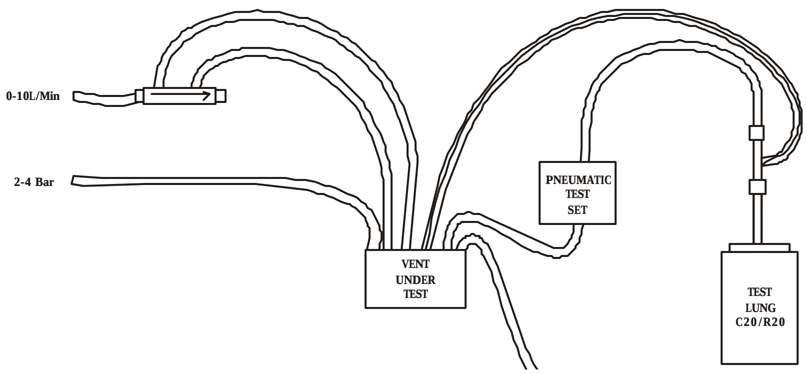


Figure 48 Fresh Gas Flow Sensor Gain

On the flow tubes set 10LPM of oxygen.

Press the space bar to record the value.

Press Ctrl and U at the same time to save all values.



Recommended Setup

3.1.8 Hardware Pressure Overload Backup

Put the ventilator into cal mode standby. All settings should be at default. Move the cursor to PAGE: [Sensor Calibration]

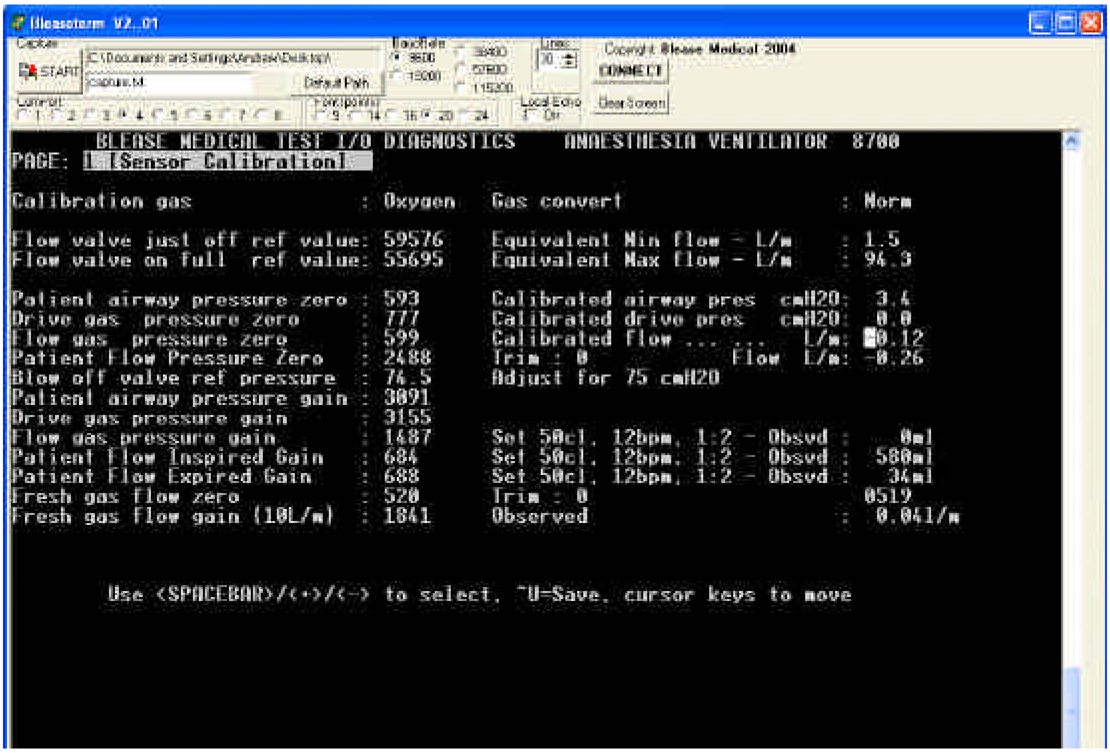


Figure 49 Hardware Pressure Overload Backup

With a C5 compliance connected to the patient flow sensor and drive gas outlet put the ventilator into run mode, then adjust flow for a peak pressure of 80cmH2O. Turn R99 on the BAV Controller board fully clockwise.

Adjust R98 on the BAV Controller board until pressure limiting is observer.

Once triggering has been achieved decrease the delivered volume, to reduce the peak pressure, to find the exact point of trigger. The trigger should be set to 80cmH20 and not have any effect on normal ventilator functions.

Press Ctrl and U to save all values

Press Ctrl and E to exit calibration

3.1.9 6700 Additional Steps

- Move the cursor down to the pressure low alarm set point.
- You will see the instruction 'control to 5cmH2O'.
- Then press spacebar.

- Move the cursor to pressure low alarm set point gain.
- You will see the instruction 'move the low alarm control to 60cmH2O'.
- Then press spacebar.

- Move the cursor to LCD pressure output zero
- At the lower edge of the display screen is the bar graph.
- By changing the number in the highlighted box, position the right hand edge of the bar as close to 0cmH2O marked on the label.

- Move the cursor to LCD output pressure gain, the bar graph on the display panel will have moved to the right hand side.
- By changing number in box in line in the right hand edge of the bar to the 70cmH2O water mark.
- Press ctrl and U to save.

3.1.10 On Screen Calibration

The following calibrations are to correct MONITORED values only. These procedures WILL NOT correct delivered value errors.

It is therefore very important that the delivered values must be check or adjusted before these procedures are performed.

3.1.11 Fresh Gas Calibration

The ventilator must be in STANDBY. The first reading is at ZERO therefore because of the basal flow set on the flow meters the only option is to disconnect all oxygen supplies (cylinders and pipeline) all other gases must be reduced to ZERO on the flow tubes. A warning message will be displayed stating LOW SUPPLY GAS. Ignore this message for this test. The flow tubes themselves are accurate enough for this calibration but an external flow monitor can be used to check if required.

Press the memory button (bottom purple button) then use the Trak Wheel® to select configuration. Next select setup. Use the Trak Wheel® to enter the password TECHY.

From this menu select Fresh Gas.

You are instructed to set Zero flow (on the flow tubes) then confirm.

Next you are instructed to set 1LPM (on the flow tubes) then confirm.

Then set 2LPM, 3LPM, 4LPM, 5LPM, 6LPM, 7LPM, 8LPM, 9LPM, 10LPM and finally 20LPM

If all is correct the ventilator will bleep and state DONE on the screen, after a few seconds you will be returned to the normal run screen.

If an error occurs the calibration will be aborted. The only reason for this error is that there was not a step change between one calibration point and the next.

3.1.12 Monitored Inspired and Expired volume (Vte and Vti)(8700 Only)

As this procedure is making adjustments to the calibration of the patient flow sensor it is important that the whole system is in good working order and complete before any adjustment is made.

A volume measuring device will be needed to confirm the correct delivery before adjustments are made.

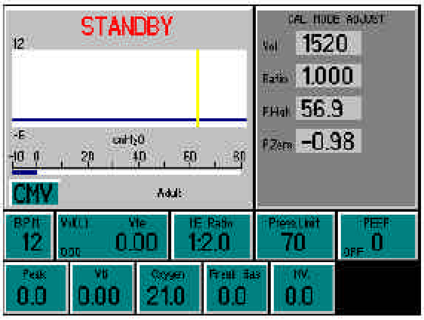
The ventilator must pass the pre-use test so that compliance compensation is working before adjustments are made.

With the ventilator running in CMV at the default values the volume measured by the volume measuring device should be 500ml +/- 30ml. The Vti and Vte values displayed on the ventilator screen should be 500ml +/- 50ml. If the monitored values are outside of this then this procedure can correct them. If the delivered is outside its tolerance check the compliance figure and the tubing first.

Press the memory button (bottom purple button) then use the Trak Wheel® to select configuration. Next select setup. Use the Trak Wheel® to enter the password PRAAA

From the menu select ADJUST CAL VALUES.

The following screen will be presented. The alarm panel is disabled and replaced with the CAL MODE ADJUST panel



Select the Vol box with the Trak Wheel®.

Increasing the number with the Trak Wheel® will increase both the Vti and Vte value.

Decreasing the number with the Trak Wheel® will decrease both the Vti and Vte value.

Pressing the Trak Wheel® stores the value. If the Trak Wheel® is not pressed the value will return to the previously stored value after a few seconds.

Adjust the value until the **Vte** value is in agreement with the value indicated on the monitoring device. The Vte value is the important number not the one in the Vol box.

Always after making an adjustment wait for two or three breaths for the Vte value to stabilize.

Select the Ratio box with the Trak Wheel®.

Adjust the value until the **Vti** value is in agreement with the Vte value. Vti =Vte (+5/-0%).

When the values of Vti and Vte are correct the system must be turned OFF to save them. Turn the system back ON, complete the Pre-use test and check that Vti, Vte and the measured values are within tolerance

3.1.13 6700 Only

From Version 6.12 it is possible to adjust the patient flow expired gain factor and hence the displayed Vte using the front panel using the following procedure.

1. With the ventilator fully warmed up and in run mode with compliance compensation ON and fresh gas at minimum, press the ‘secret button’ (to the right of the ‘*’ button) for 3 seconds. The unit will enter engineering mode and the top two lines of the display will show fresh gas calculations e.g.-

   FG 0.0 R000 A008
   E000 C000

   Turn overleaf for further instructions...

2. Hold the secret button for a further 3 seconds, the top two lines of the display will now show the Vte adjustment screen e.g;-

   VTE 1056 DSP/RNG - 1056 (in this example) is the calibrated gain factor
   */SAVE RST/QUIT

   Monitored TV will automatically be selected as the display parameter.

   Filtering of displayed volume will automatically be disabled in this mode.

3. Press the Display Select Key to decrease the calibrated gain factor, which will increase the displayed TV.
4. Press the Range Select Key to increase the calibrated gain factor, which will decrease the displayed TV.
5. When the adjustments have been made, press '*' to save the new gain factor or Alarm Reset to cancel the changes and revert to the original gain factor. Either of these keys will restore the display to normal.

3.1.14 Calibration Value Limits

SPC Configuration for 6700 Oxygen								
Bav Controller								
PWM								**Sensitives**
	Low	**High**		**Low**	**High**		**Low**	**High**
Min Flow l/m	1	2	**Max Flow l/m**	80	110			
Min Flow PWM	59200	60000	**Max Flow PWM**	55000	56500	**1 l/min**	40	80
PEEP 3cmH2O	6	25	**PEEP 15 cmH2O**	30	75	**20 l/min**	40	80
Pressure								**Sensitives**
	Low	**High**		**Low**	**High**		**Low**	**High**
Blow Off Pressure	73	77						
Pat Air Prs Zero	450	1000	**Pat Air Prs Gain**	2500	3500	**100cmH2O**	2500	4000
Drv Gas Prs Zero	450	1000	**Drv Gas Prs Gain**	2900	3500	**100cmH2O**	2500	4000
Flow								
	Low	**High**		**Low**	**High**			
Flw Gas Prs Zero	590	610	**Flw Gas Prs Gain**	1300	1700	**Data Set Revision ID:**		
Pat Flw Prs Zero	2450	2550	**Pat Flw Insp Gain**	600	800	129AC005_V2_120804		
			Pat Flw Exp Gain	600	800			
Fresh Gas Zero	450	550	**Fresh Gas Gain**	1600	2000			

3.1.15 SPC Configuration for 8700 Oxygen

Bav Controller

PWM	Low	High
Min Flow l/m	1	2
Min Flow PWM	59200	60000
PEEP 3cmH2O	6	25

	Low	High
Max Flow l/m	80	110
Max Flow PWM	55000	56500
PEEP 15cmH2O	30	75

Pressure	Low	High
Blow Off Pressure	73	77
Par Air Prs Zero	450	1000
Drv Gas Prs Zero	450	1000

	Low	High
Pat Air Prs Gain	2500	3500
Drv Gas Prs Gain	2900	3500

Flow	Low	High
Flw Gas Prs Zero	590	610
Pat Flw Prs Zero	2450	2550
Fresh Gas Zero	450	550

	Low	High
Flw Gas Prs Gain	1300	1700
Pat Flw Insp Gain	600	800
Pat Flw Exp Gain	600	800
Fresh Gas Gain	1600	2000

3.1.16 SPC Configuration for 8700 Oxygen

Pressure Actual Valves					
	Low	High		Low	High
Patient Prs High	53	110	Patient Prs Zero	-19	17
Drv Prs High	49	71	Drive Prs Zero	-3	12
Volume (actual values)					
	Low	High		Low	High
Expired Vol High	1368	1502	Expired Vol Zero	-13.92	-5.35
Inspired Correction	0.86	1.18			
Fresh Gas (actual values)					
	Low	High		Low	High
Fresh Gas Zero	65	215	Fresh Gas 10 l/m	394	613
Oxygen (actual values)					
	Low	High			
Oxygen % High	83	119			

Notes

4. Drawings and Diagrams