# GENESIS

## Anaesthesia Workstation

*SERVICE MANUAL*

*Training document*

HERSILL
Medical Devices

Document No. 9180021

Rev. 3.x.y.2 (2023-03)

Valid for software versions 2.x.y – 3.x.y

The Field Service Certification designates exclusively the ***Recipient*** person to conduct the procedures addressed in this documentation.



Edited and printed in Spain.

# Contents

# 1. Symbols

**WARNING**

A WARNING statement provides important information about a potentially hazardous situation which, if not avoided, could result in death or serious injury.

**CAUTION**

A CAUTION statement provides important information about a potentially hazardous situation which, if not avoided, may result in minor or moderate injury to the user or patient or in damage to the equipment or other property.

**NOTE**

A NOTE provides additional information intended to avoid inconvenience during operation.

---

Consult the attached documents

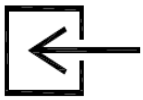
Do not use lubricants neither greases in the equipment

Equipotential bonding

Defibrillation-proof type BF applied part

Operating instructions

Refer to instruction manual



Gas sample (input to the side-stream multigas analyzer)

## 2. Abbreviations

| Abbreviation | Meaning |
|---|---|
| **AGSS** | Anesthetic Gas Scavenging System |
| **APL valve** | Adjustable Pressure Limiting valve |
| **AP-VG** | Adaptive Pressure -Volume Guaranteed |
| **BPM** | Breaths Per Minute |
| **C** | Compliance |
| **C.A.B.S.** | Compact Anaesthesia Breathing System |
| **EFG** | External Fresh Gas |
| **EXP** | Expiration |
| **F** | Respiratory Frequency |
| **F/V** | Flow/ Volume |
| **$FiO_2$** | Fraction of Inspired Oxygen |
| ***Flow-P* sensor** | Flow-Pressure Sensor |
| **HLD** | High Level Disinfection |
| **HF Surgical** | High Frequency electro-Surgical equipment |
| **I and E valves** | Inspiration and Expiration valves |
| **I : E** | Relation Inspiratory:Expiratory time |
| **INSP** | Inspiration |
| **M** | Manual |
| **MAC** | Minimum Alveolar Concentration |
| **MSMA** | Main Stream Multi-Gas Analyzer |
| **$P_{INSP}$** | Inspiratory Pressure |
| **$P_{MAX}$** | Maximum allowable pressure |
| **$P_{PEAK}$** | Peak Pressure |
| **$P_{PLAT}$** | Plateau Pressure |
| **$P_{AW}$** | Pressure Air Way |
| **PCV** | Pressure Controlled Ventilation |
| **PEEP** | Positive End Expiratory Pressure |
| **PS** | Pressure Support |
| **R** | Resistance |
| **S** | Stand-by |
| **Sp** | Spontaneous Breath |
| **SIMV** | Synchronized Intermittent Mandatory Ventilation |
| **SSMA** | Side Stream Multi- Gas Analyzer |
| **TFT** | Screen type Thin -Film Transistor |
| **Trigger** | Patient threshold to start inspiration |
| **UPS** | Uninterruptible Power Supply |
| **VCV** | Volume Controlled Ventilation |
| **$V_M$** | Volume Minute |
| **$V_T$** | Tidal Volume |
| **$V_T$e** | Tidal Volume Expired |
| **$V_T$i** | Tidal Volume Inspired |

## 3. User and Patient Safety

**WARNING**

**Read carefully and pursue the User and Patient safety information contents in the Instruction for Use (IFU) documentation.**

**The safety information below is complementary to the IFU.**

**WARNING**

Not for use in areas of explosion hazard:

GENESIS is neither approved for use in areas where combustible or explosive gas mixtures are likely to occur.

- Explosive anesthetics, such as ether or cyclopropane, must not be used due to the risk of fire.
- Do not introduce medicaments or substances based on flammable solvents (ex. alcohol) in the patient system. Danger of fire.
- If flammable substances are used for disinfection purposes, it is necessary to guarantee the correct evaporation.
- Do not use oil or grease.
- Do not smoke.

**WARNING**

Safe connection with other electrical equipment:
Electrical connections to equipment which is not listed in these Instructions for use should only be made following consultations with the respective manufacturers or an expert (i.e. should confirm the system as being in compliance with Clause 16 of IEC 60601-1:2005).

**CAUTION**

Strictly follow the Instructions for Use and the Service Manual:

Any use of the apparatus requires full understanding and a strict observation of these instructions.

The apparatus is only to be used for purposes specified here.

**CAUTION**

Maintenance:

The unit must be inspected and serviced regularly by trained service personnel according to the Maintenance Intervals

Repair and general overhaul of the apparatus may only be carried out by trained service personnel.

Only original Hersill spare parts may be used for maintenance.

**CAUTION**

The two side handles are intended to move the GENESIS on the floor thanks to its wheels; GENESIS is a 105 kg weight that cannot be raised from its handles. Trying to raise the equipment from these handles can damage the system.

# 4. Installation

**WARNING**

**Read carefully and pursue the Installation information contents in the Instruction for Use (IFU) documentation.**

## 4.1. Configuration of non-standard passive AGSS set-up

**CAUTION**

According to the standard ISO 8835-3, the AGSS system of the surgical room, required in to operate an anesthesia workstation in a safe way, must provide a suction flow between 35 and 70 L/min.
GENESIS integrates in the touch-screen an AGSS performance monitor that shows the level of the suction flow according to this standard.

**CAUTION**

The standard ISO 8835-3, defines AGGS system that the operation room must have. Nevertheless, there are surgical rooms that do not have an AGSS installation, and GENESIS can be configured to be operated in such non-regular installations.
The standard (correct) AGSS systems are called “Active AGSS”, and the non-regular (with risk of contamination) lack of an AGSS system are called “Passive AGSS”.
GENESIS is configured in factory set-up for regular “Active AGSS”, and can be modified (hardware and software) to operate in a “Passive AGSS” environment. The required procedure must be performed only by trained technical staff.

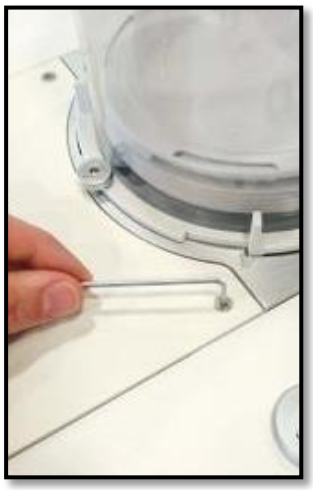
In order to use active AGSS with GENESIS, the scavenging is established by linking the GENESIS AGSS to the AGSS in the operating room by means of a specific tube. The efficiency of the *active AGSS* is limited by the anesthetic gas scavenging device.

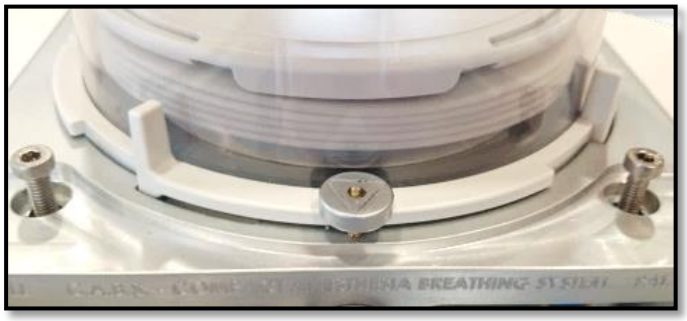
A passive AGSS is usually established by a wide diameter tube which links directly from GENESIS AGSS to outside from the operation room (the free air ambient). The wider and shorter the tube is, the best; but the efficiency of the passive AGSS cannot be monitored by the GENESIS sensors and a passive AGSS is usually a source of contamination for the surgical room, due to this reason it isn’t accepted by the standard ISO 8835-3.

In the factory standard configuration, when GENESIS is operating in a passive AGSS environment, the AGSS performance monitor is continuously alarming in the touch screen. It is able to modify the software configuration set-up to disable the AGSS monitoring and alarm, from the service screen access level, and at lower level, it is possible to simply disable the alarm from the user alarm configuration.

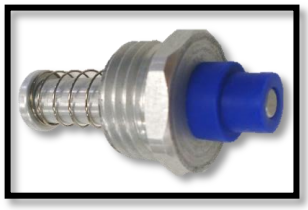
**To configure GENESIS for a passive AGSS set-up, it must be followed the next steps:**

– Take out the C.A.B.S. (Compact Anaesthesia Breathing System) from the GENESIS frame:

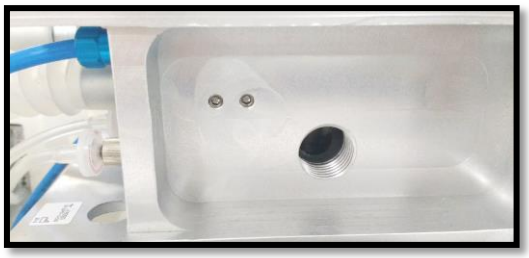




– Cover the relief hole with the valve included in the Passive AGSS kit - P/N 4180512:



Valve



Hole to cover

Screw the valve with the hand

Screw to the end without force

– Place the C.A.B.S. (Compact Anaesthesia Breathing System) on the GENESIS frame.

– Fix the sticker from the Passive AGSS kit - P/N 4180512 near by the text “AGSS”:



Now, GENESIS is ready to work in a Passive AGSS installation.

## 5. Cleaning, disinfection and sterilization

| | |
|---|---|
| ⚠ NOTE | **Read carefully and pursue the Cleaning, disinfection and sterilization procedures contents in the Instruction for Use (IFU) documentation.** |
| ⚠ NOTE | Cleaning, disinfection and sterilization procedures don't need technical expertise to be performed, and can be performed by the technical staff from the hospital surgical area. |

## 6. Maintenance

It is important to consider the difference between 'Maintenance' (as a planned program for preventive maintenance) and 'Service' (as a fault resolution procedure, not planned).

- Maintenance (in terms of planned maintenance or preventive maintenance): Genesis is designed to make able all the planned maintenance to be performed by the technical staff from the hospital, pursuant the procedures and plan dealt in the Instructions for Use, without the need of any 'in factory' technical training.
- Service (in term of fault resolution procedures): It is dealt in this Service Manual.

A ventilation verification test of the GENESIS Anesthesia Workstation needs to be carried out after every modification due to maintenance or service tasks.

| | |
|---|---|
| ⚠ NOTE | Additionally to the replacement of the Nomoline® gas sampling line when needed, ISA Sidestream multi-gas analyzer measurements must be checked every year.<br>Please, address to Masimo® Service Manual in order to carry out performance verification test of ISA Sidestream multi-gas analyzer. |
| ⚠ NOTE | For each service intervention, it must be fulfilled a new report from chapter 16.<br>A copy of all the service reports must be sent to the manufacturer if a defect or a failure has to be covered by the product warranty. |

# 7. Calibration

The software interface of GENESIS allows to calibrate all the sensors in the workstation.

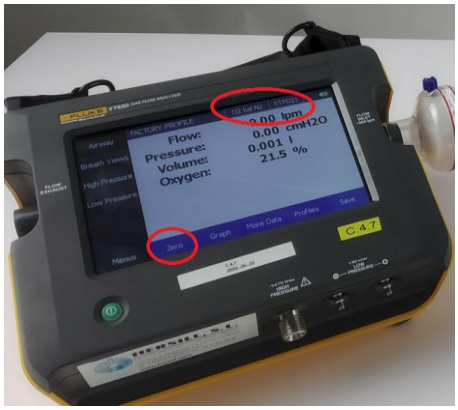
**NOTE**

**Every GENESIS is in factory calibrated, this way, during the unit installation it shouldn't be required to re-calibrate the sensors. Therefore, the calibration procedure will be only recommended when a non-calibration condition is suspected or confirmed.**

Tools required for GENESIS calibration:

- Ventilator analyzer, able to measure in STPD conditions:
  - With an accuracy in flow measurements of, at least, 0.05 L/min.
  - With a range in pressure measurements of, at least, 300cmH2O.

Best option: Fluke VT650




Alternative option: TSI certifier FA Plus

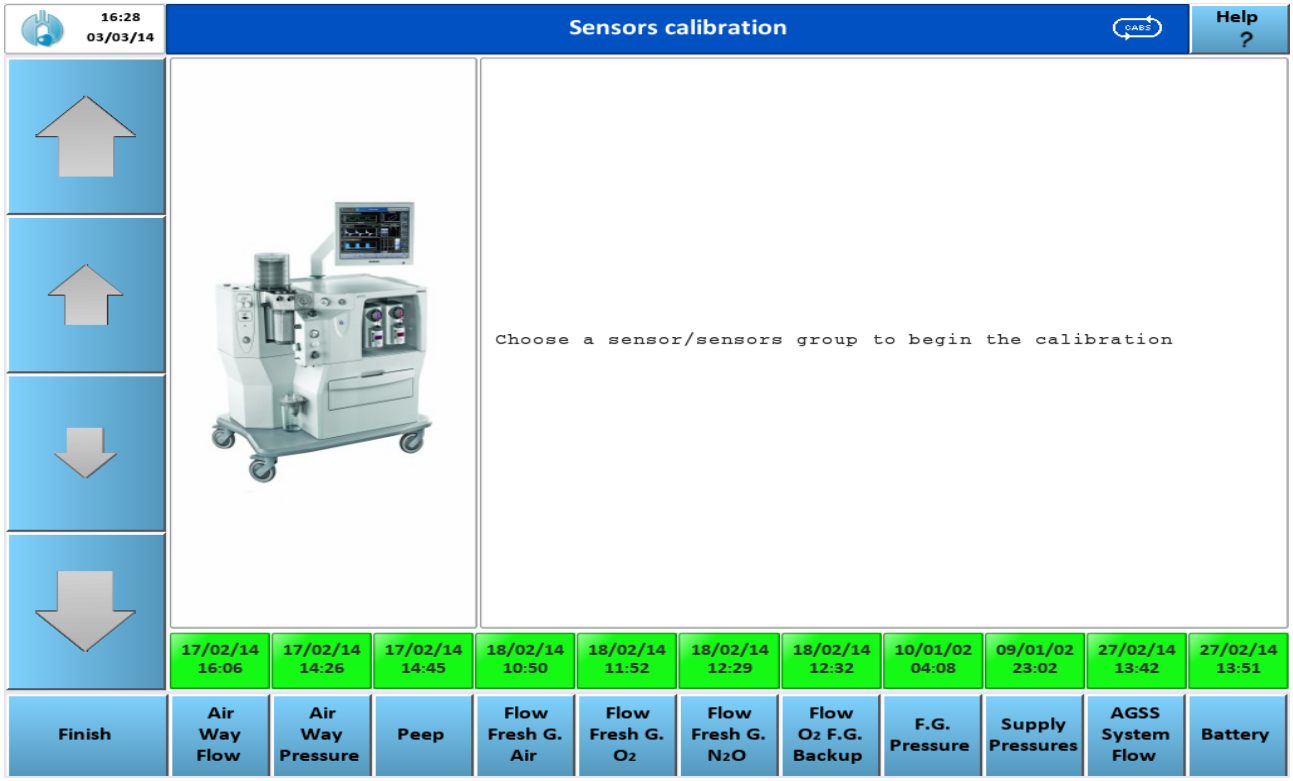

- Adapter 22F-22F
- Adapter 22M-22M
- A luer connector (3180182) + silicone tube 2x5 (3180183)

To access the GENESIS calibration screen, it is required to enter at Technical or Factory access level (see chapter 8).

From the Standby screen, press the right arrow

And press the **Calibration** option


Now you are in the sensors calibration menu screen




Proceed to calibrate the sensors that are needed to solve the trouble, pursuant the next chapters.

## 7.1. Introduction to calibration conditions

⚠ NOTE

According to the ISO 80601-2-13 (Medical electrical equipment -- Part 2-13: Particular requirements for basic safety and essential performance of an anaesthetic workstation), 201.5.101.2 (Specifications of the flow and the gas leakage): The specifications of the flow, volume and gas leakage are expressed in STPD conditions (Standard Temperature and Pressure Dry), with the exception of the associated to the Anaesthetic breathing system, that are expressed in BTPS conditions (Body Temperature and Pressure Saturated). (1)

Note 1 - STPD is 101,3 kPa at operation temperature of 20ºC.

Note 2 - BTPS is the local atmospheric pressure and a relative humidity of 100% at an operation temperature of 37 ºC.

All the test are corrected to express in STPD or BTPS.

**(1) Transcription from the ISO 80601-2-13 (Medical electrical equipment -- Particular requirements for basic safety and essential performance of an anaesthetic workstation), 201.5.101.2 (Specifications of the flow and the gas leakage):**

The quantities of gas are often expressed as the volume occupied by the gas under standard conditions. an atmosphere (101.3 kPa) is generally used as normal pressure. However, several normal temperatures are used. While 0ºC normal temperature is used as in physics, engineering often used either 20 °C or 21.2 °C (70 °F). In the ventilation, the gas in the lungs has an identical temperature to body temperature (approximately 37 °C) regardless gas temperature administered for anaesthesia ventilator. The volume of a given amount of gas increased by approximately 13.5%, from 0 °C to 37 °C or 5.8%, from 20 °C to 37 °C.

The gas delivery systems that supply pressurized gas to medical equipment including anaesthesia ventilators, follow technical conventions and specify the amounts of gas and flow rates in STPD conditions. This practice is followed in this international standard for all requirements related to the gas inlet.

However, anaesthesia ventilators that meet this international standard is probable that inflate the patient's lungs to values of a local atmospheric pressure range of 70 kPa to 110 kPa. Besides the gas in the lungs is always moisture saturated whatever the humidity of the administered gas from anaesthesia ventilator. With a normal temperature of 0 °C, 1L of gas referred to STPD conditions can expand the lungs 1.8L at a pressure of 70 kPa. So that values are comparable between different anaesthesia ventilators, it is essential that information for all anaesthesia ventilators are referred to the same normal conditions. Since the volume of gas and not the number of molecules which expands the lungs, BTPS conditions constitute the appropriate set of reference conditions to use.

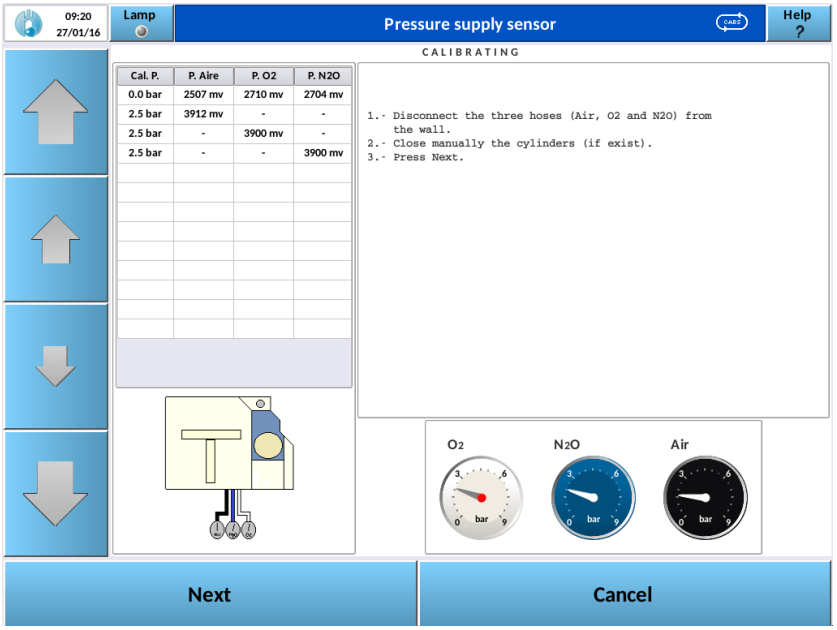
In anaesthesia ventilators are used a variety of flow transducers. While a hot wire anemometer measures the mass flow rate of gas regardless of pressure, a pneumotachograph measures the flow of gas at the present pressure. Therefore, the necessary corrections depend on the flow transducer. When a pressure correction is required, it can be estimated appropriately. Necessary corrections are also dependent on the flow transducer placement in the anaesthetic respiratory system. The gas humidity may be zero when the flow transducer measures the inspired flow within the anaesthesia ventilator. However, when the flow transducer is placed in the Y piece, the relative humidity can be any value up to 100%. When a moisture and heat exchanger is used for humidification, the transducer output depends on its placement (distal or proximal). For a turbine type anaesthesia ventilator that is using ambient air, the air moisture drawn inside may be unknown to the anaesthesia ventilator. All these effects together inevitably introduce some errors in the conversion of the flow signal measured at BTPS conditions. However, these errors are only a few percent.

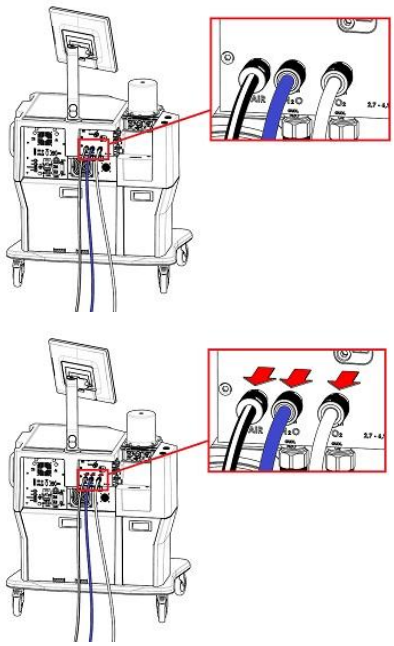
## 7.2. Supply Pressures

Calibrate the supply pressures sensors in STPD conditions (see chapter 7.1).

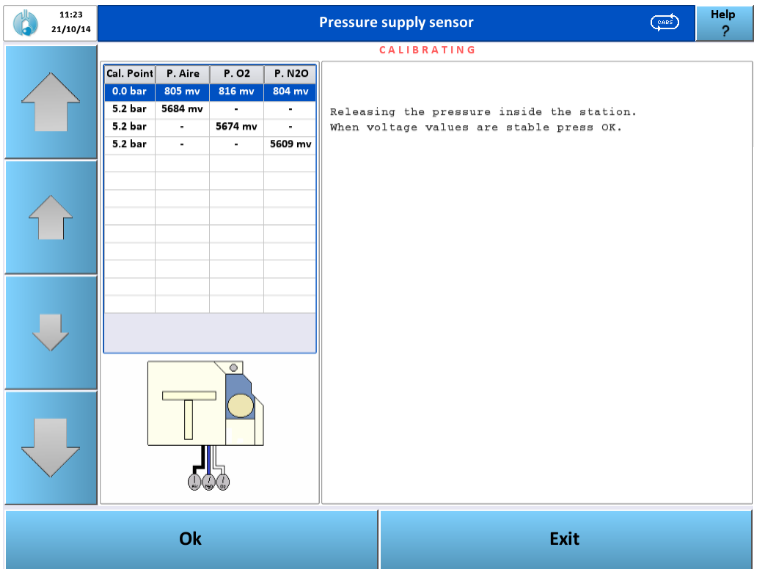
Proceed according to the steps and instructions described in the screen:

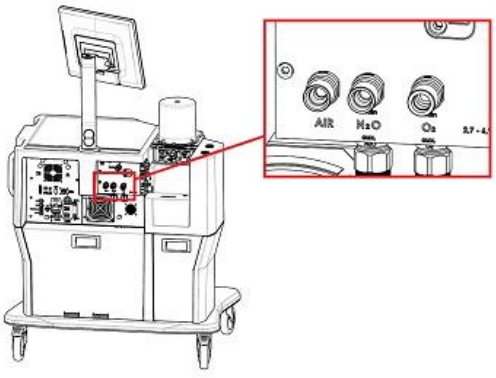
1- Disconnect the three main hoses (Air, Oxygen and $N_2O$)



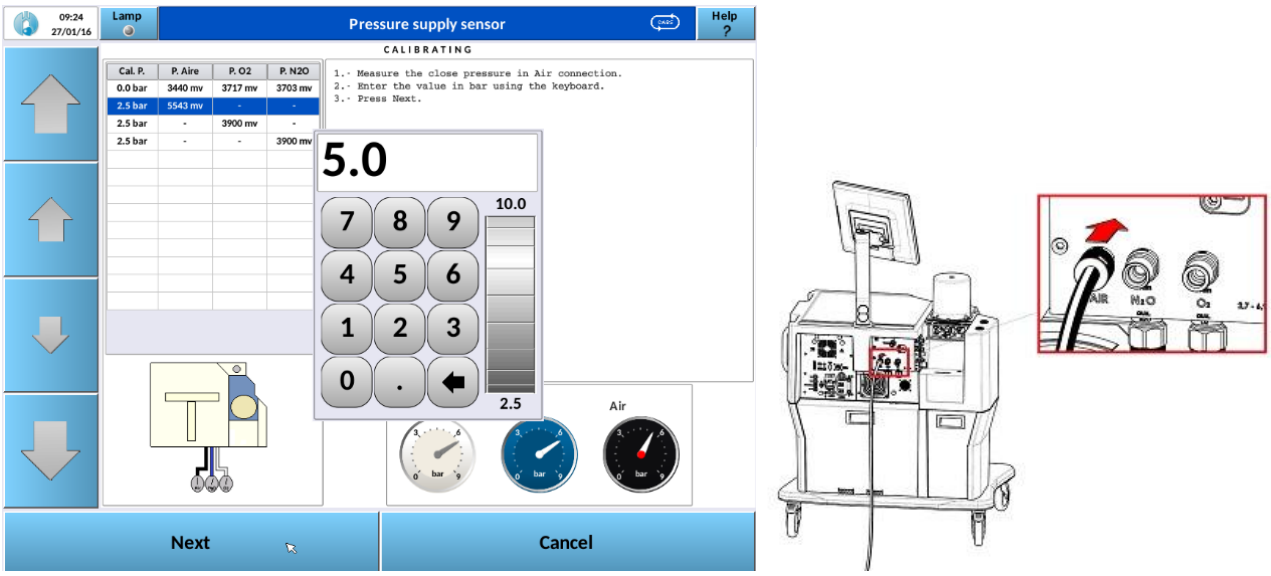




2- Disconnect the three main hoses (Air, Oxygen and $N_2O$)

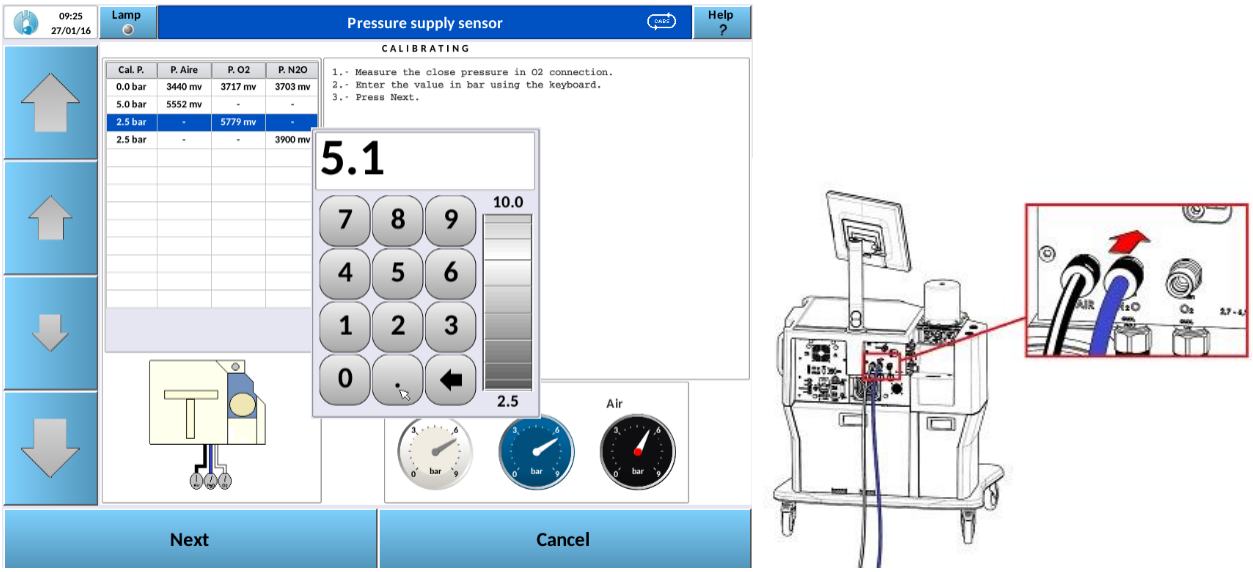


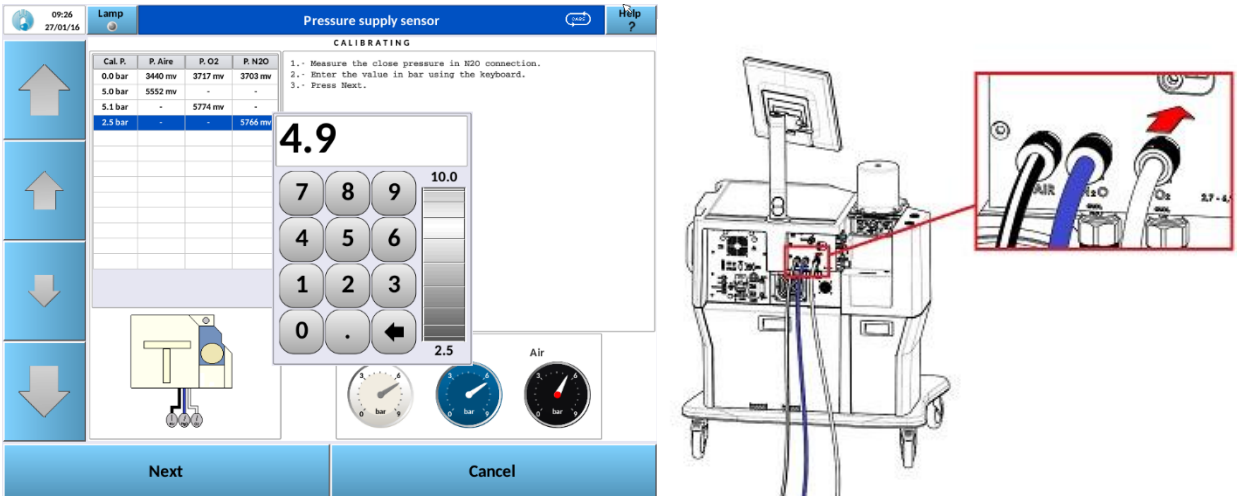
3- Connect the air hose and introduce the pressure




4- Connect the $N_2O$ hose and introduce the pressure

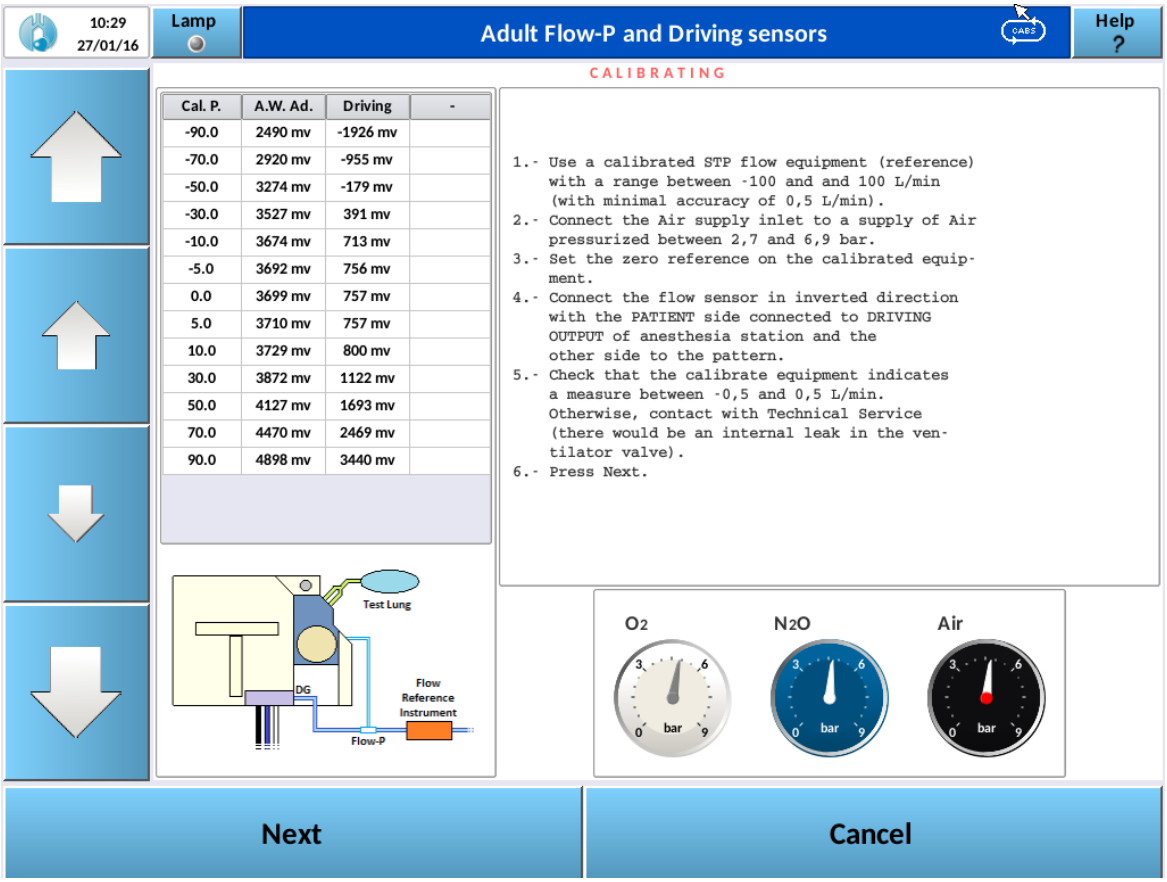


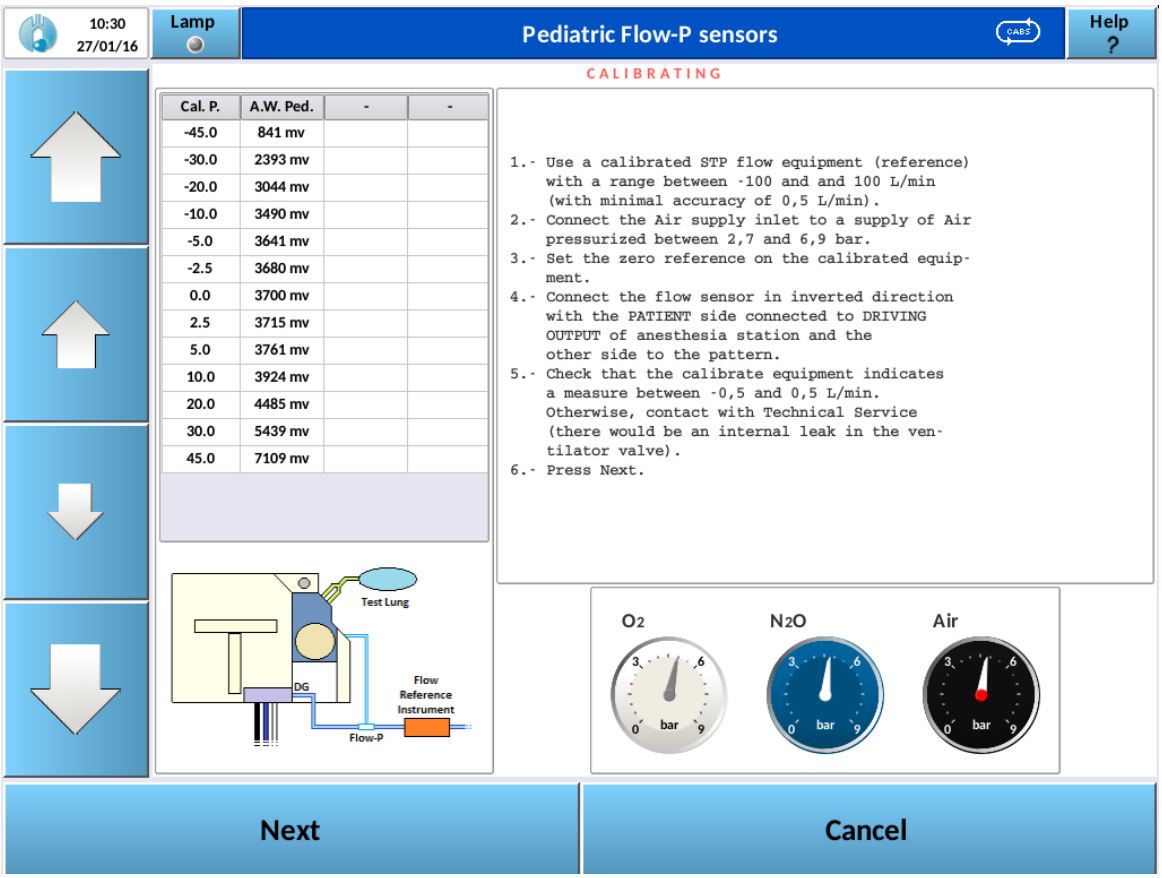

5- Connect the oxygen hose and introduce the pressure



## 7.3. Airway Flow

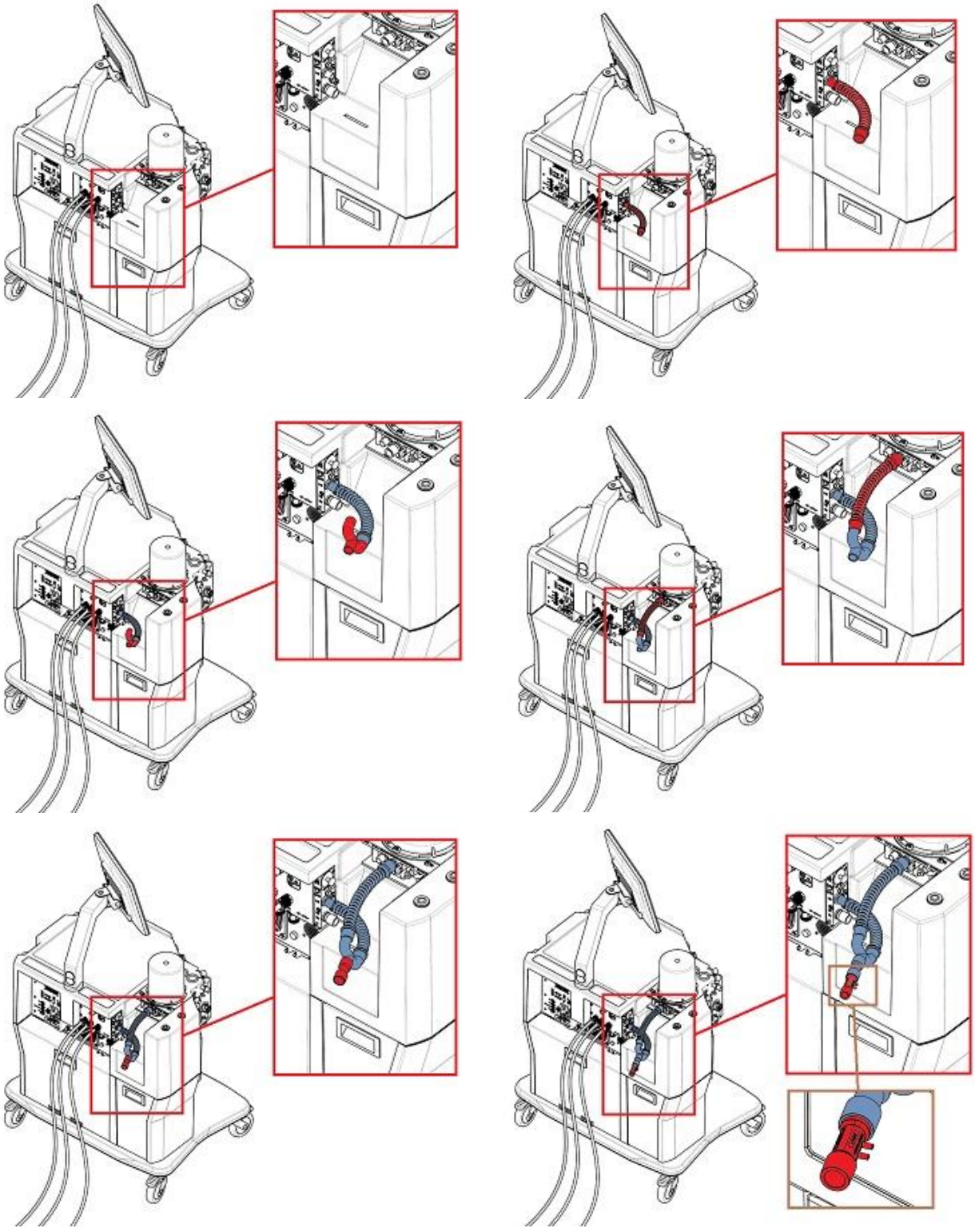
Calibrate airway flow in STPD conditions (see chapter 7.1).

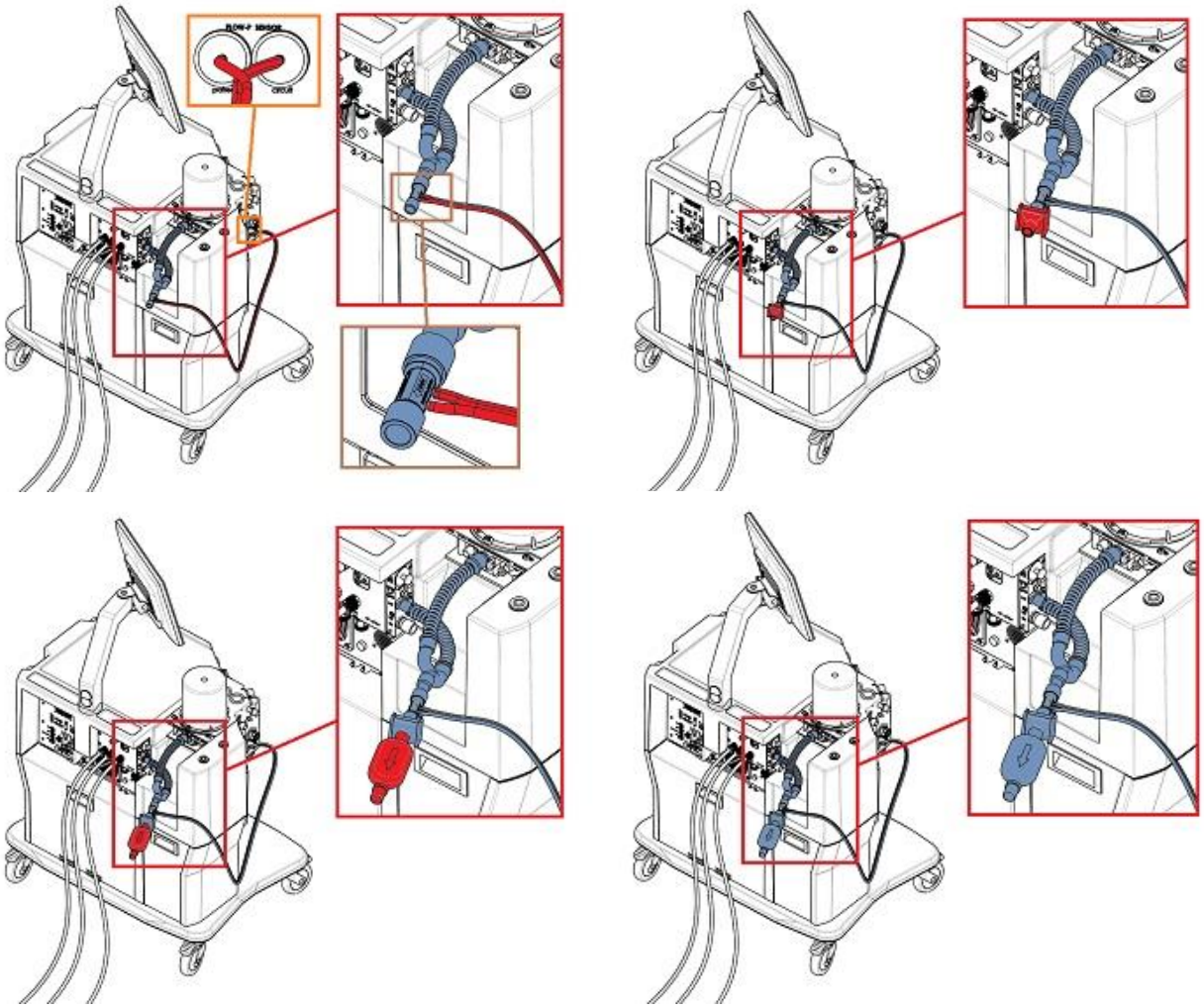


Proceed according to the steps described in the screen:

1- Connect the calibration kit as it's shown on these pictures. Make sure the arrow of the flow sensor points the anaesthesia machine instead of the flow analyzer until you reach the 0 L/min step. Once the 0L/min step is reached, change the direction of the flow-P sensor.

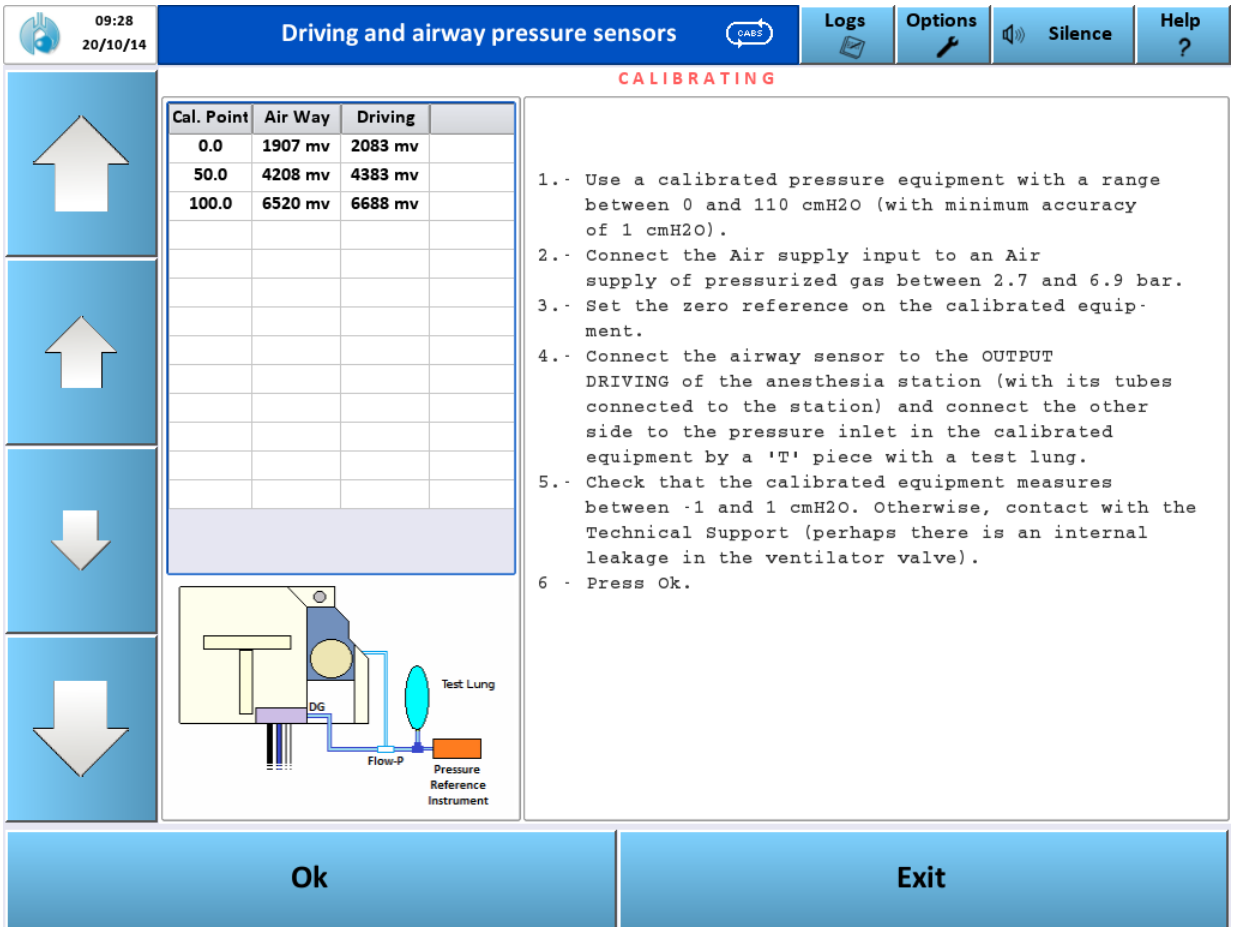




2- Repeat the procedure for the pediatric Flow-P sensor (Pediatric-flow-P calibration)

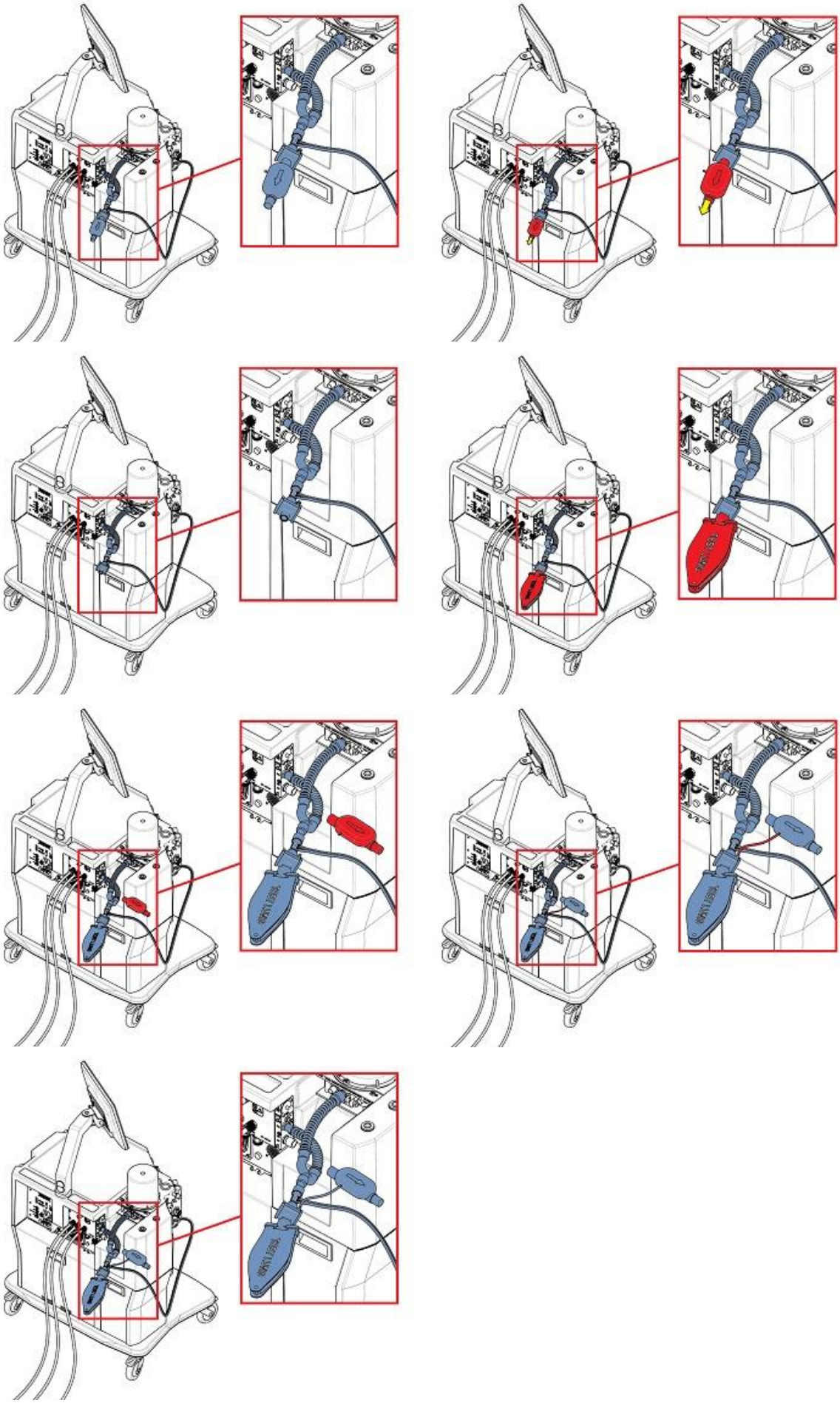
## 7.4. Airway Pressure

Calibrate airway pressure in STPD conditions (see chapter 7.1).



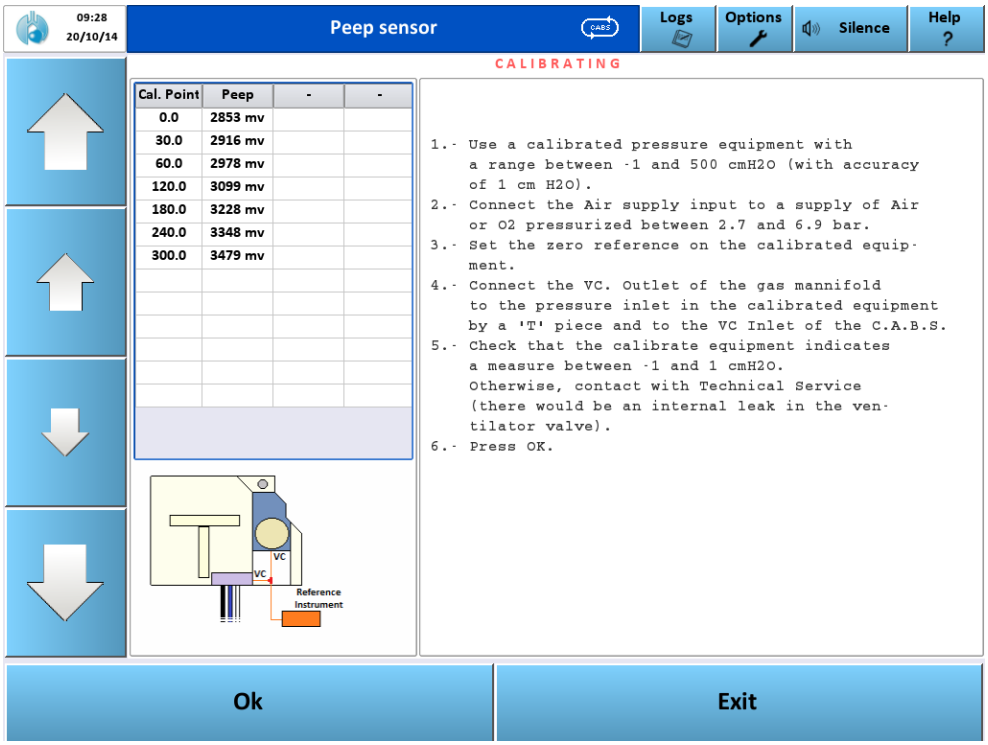

Proceed according to the steps described in the screen:

1- Connect the calibration kit as it's shown on these pictures. Make sure you use the adult flow-p sensor. Use the test lung to pressurize the line.
Use a calibrated pressure equipment with a 0 to 110cm$H_2O$ range.



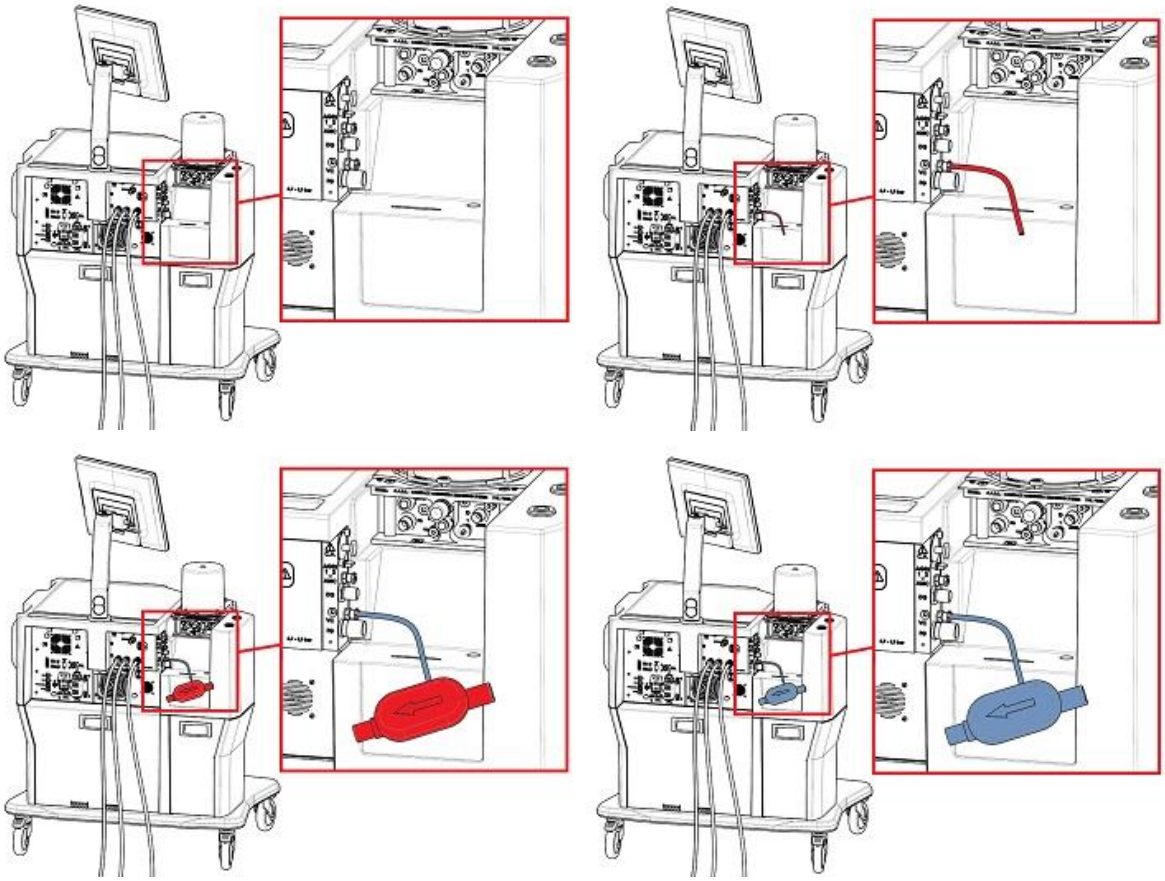
## 7.5. PEEP Sensor

Calibrate PEEP pressure in STPD conditions (see chapter 7.1).



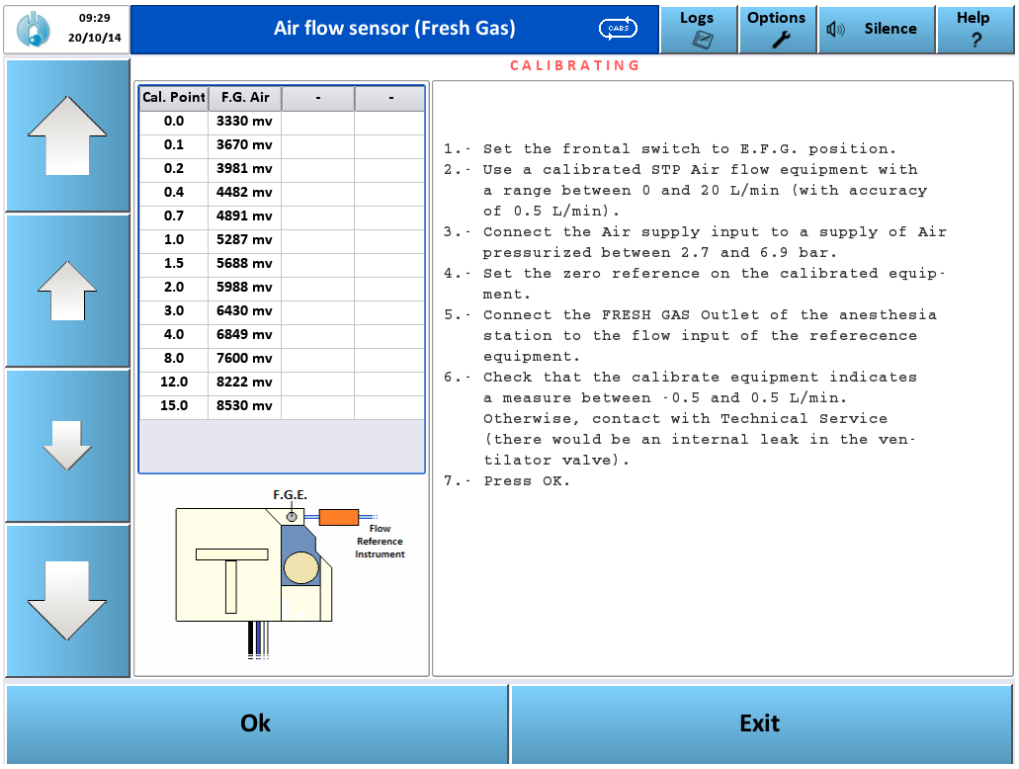

Proceed according to the steps described in the screen:

*Be sure to use a calibrated equipment that can measure over 300cm$H_2O$.*

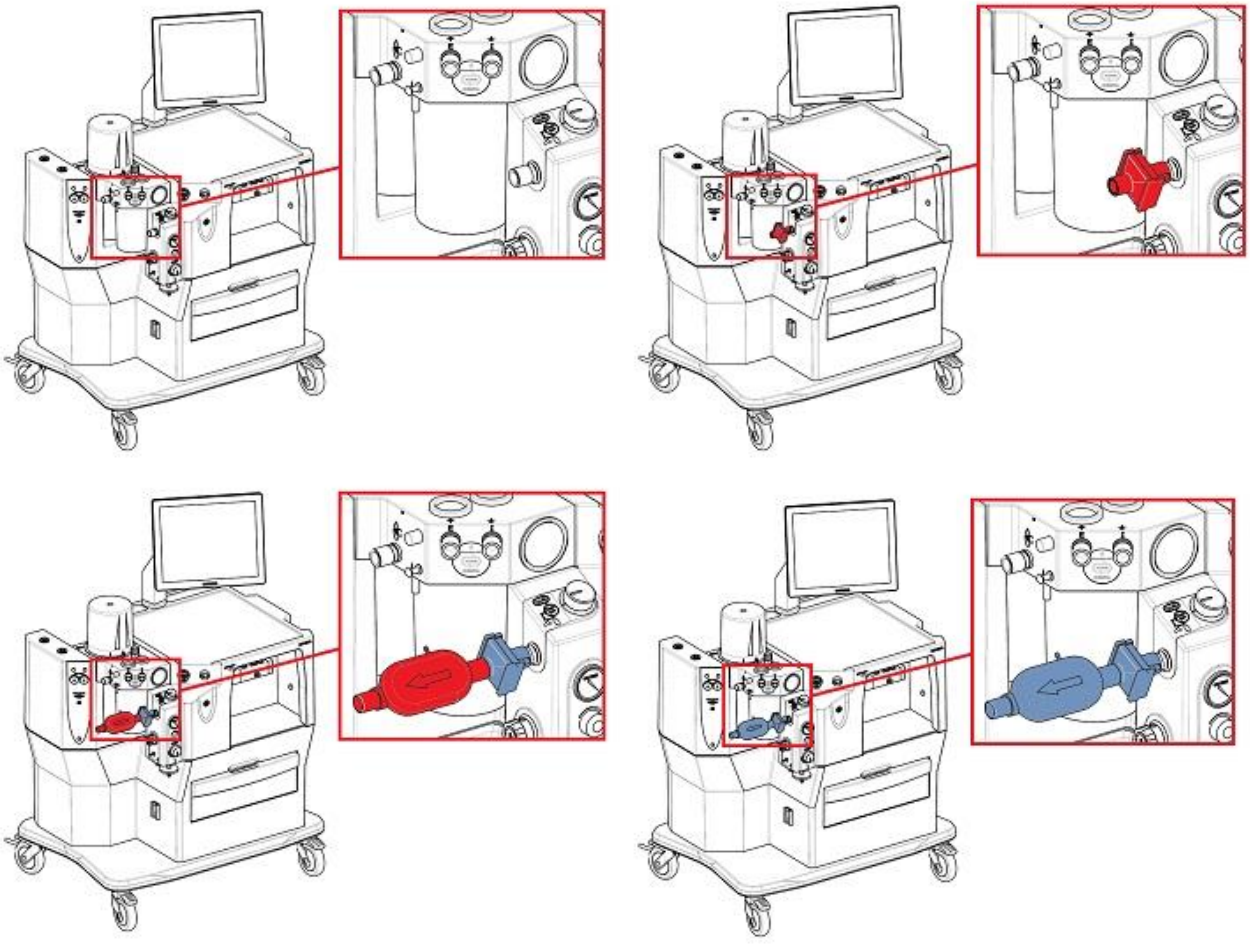


## 7.6. Air Flow Fresh Gas

Calibrate Air flow in STPD conditions (see chapter 7.1).

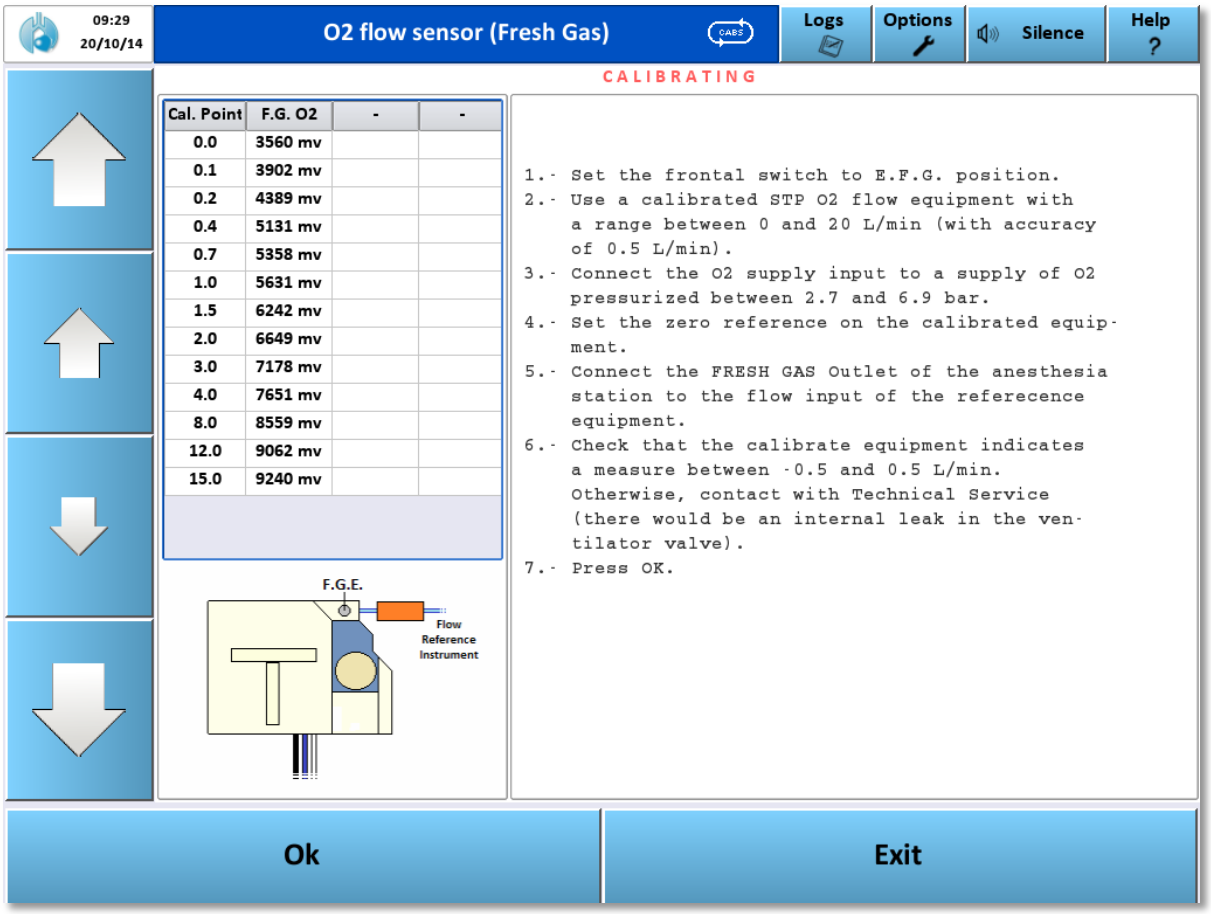



Proceed according to the steps described in the screen:



## 7.7. O2 Flow Fresh Gas

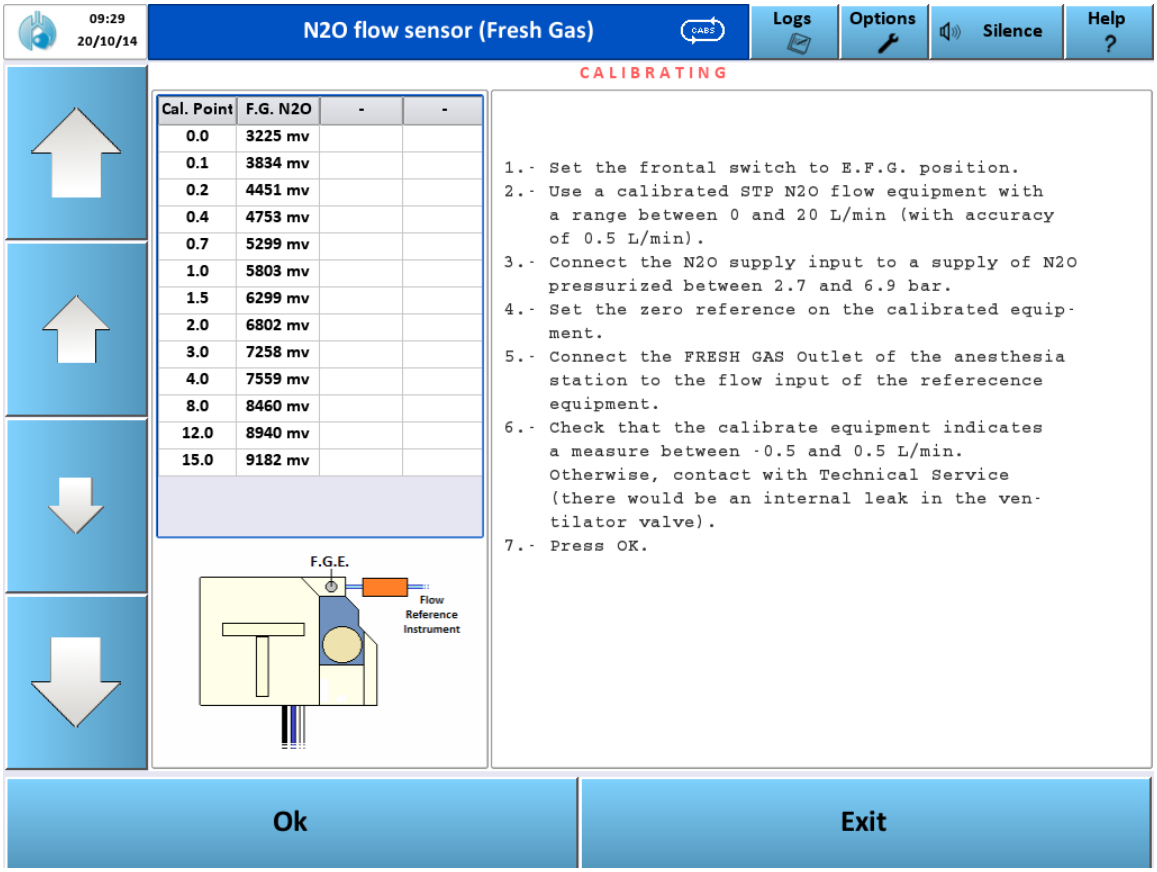
Calibrate O2 flow in STPD conditions (see chapter 7.1).




Keep the installation prepared previously for Air, and repeat the process with O2 instead of Air.

## 7.8. N2O Flow Fresh Gas

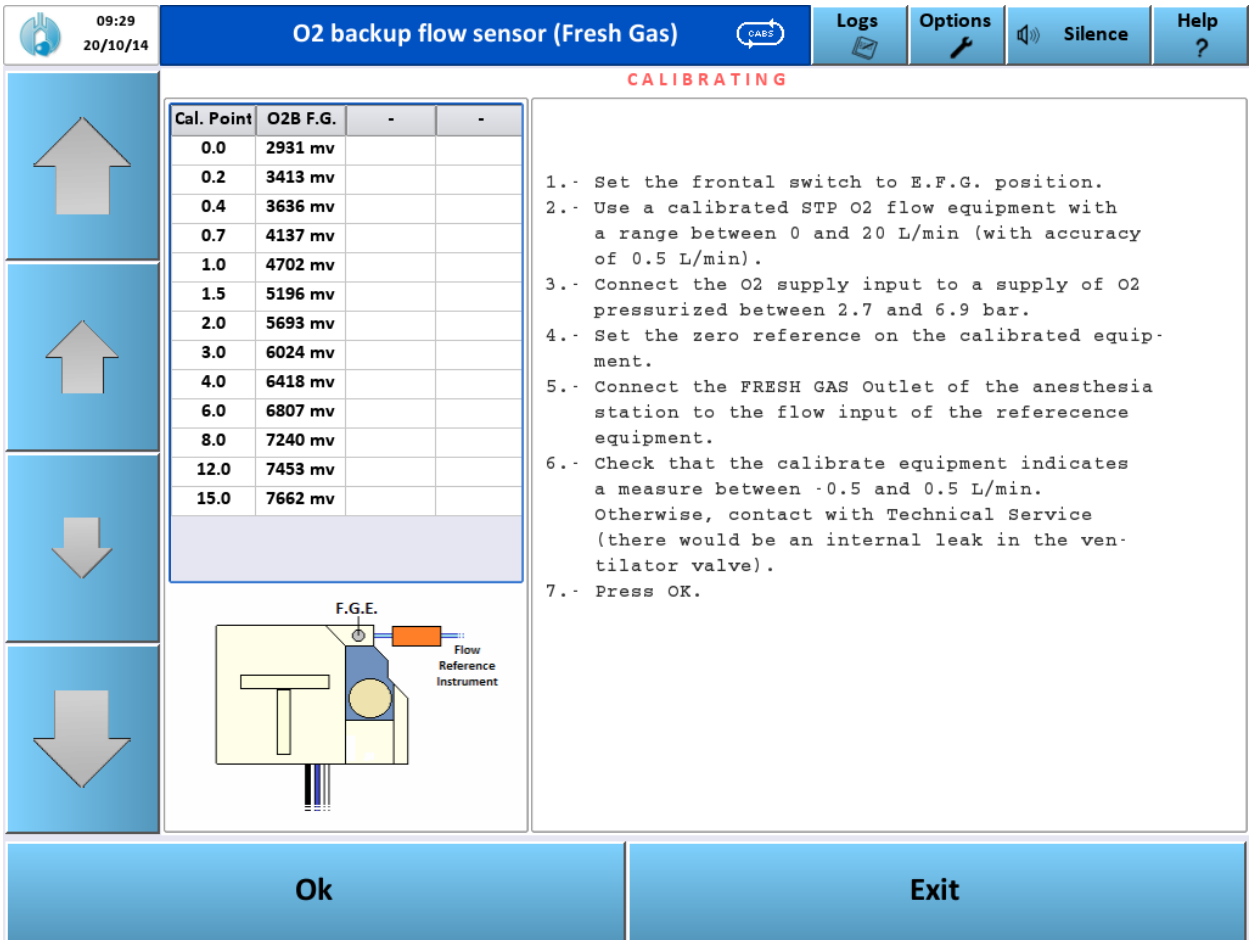
Calibrate N2O flow in STPD conditions (see chapter 7.1).




Keep the installation prepared previously for Air, and repeat the process with N2O instead of Air.

## 7.9. O2 Safety Backup Flow Fresh Gas

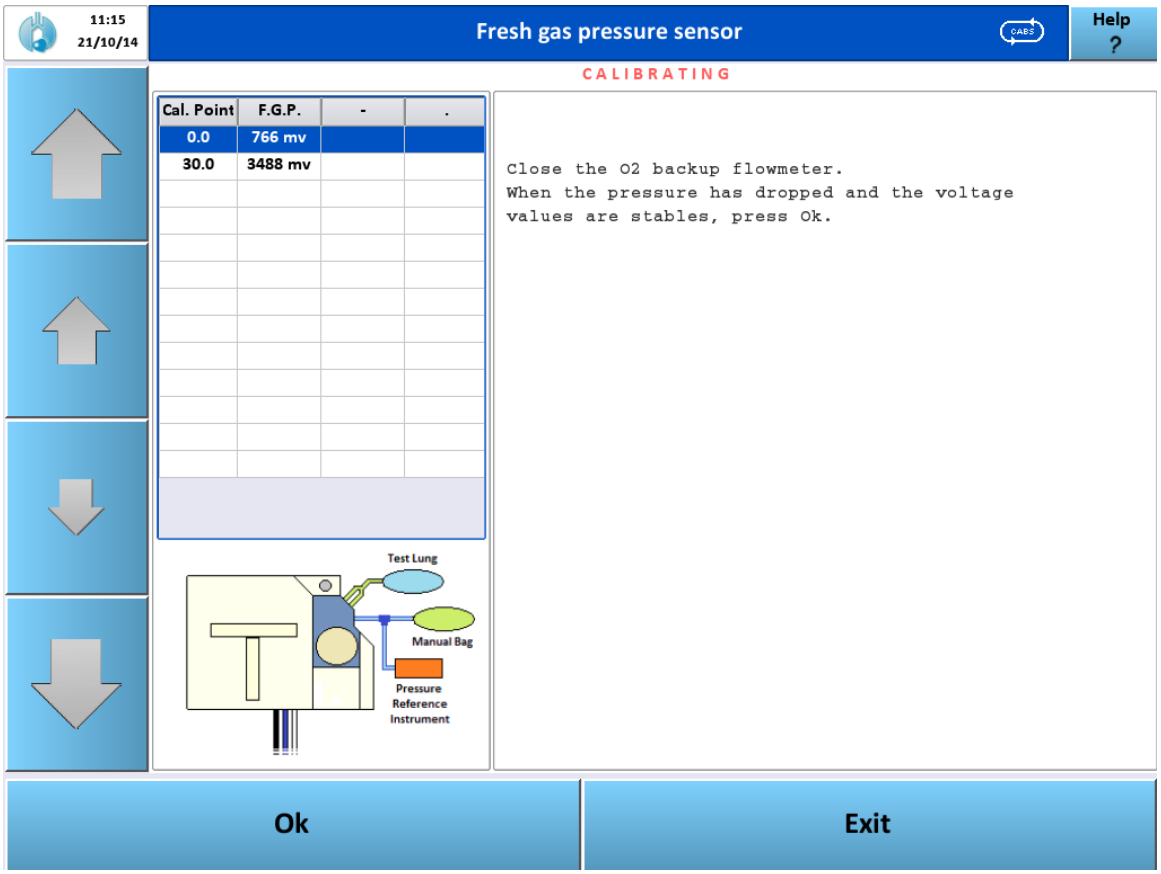
Calibrate O2 backup flow in STPD conditions (see chapter 7.1).




The procedure is the same as per of $O_2$ Flow Fresh Gas (chapter 7.7), but to control de flow it is required to turn the manual safety $O_2$ knob.

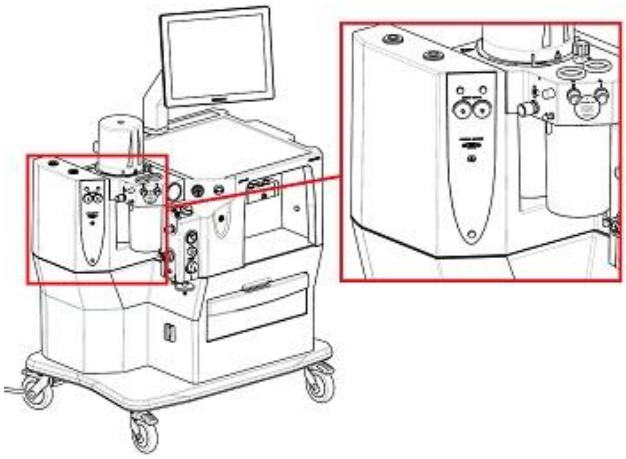
## 7.10. Fresh Gas Pressure

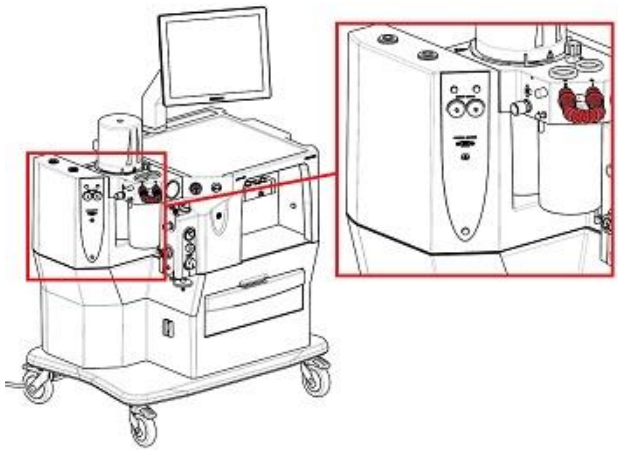
Calibrate fresh gas pressure in STPD conditions (see chapter 7.1).

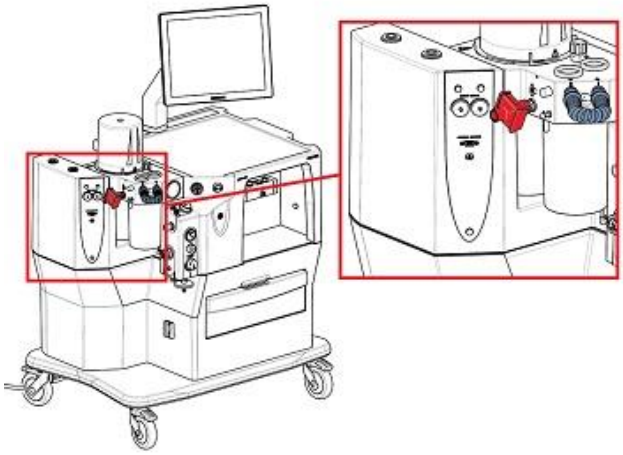


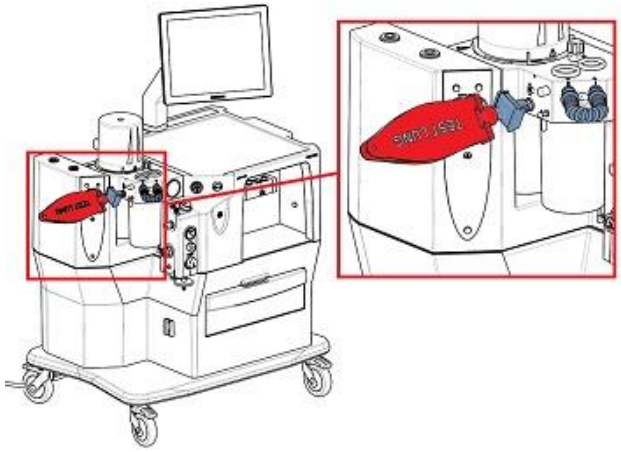


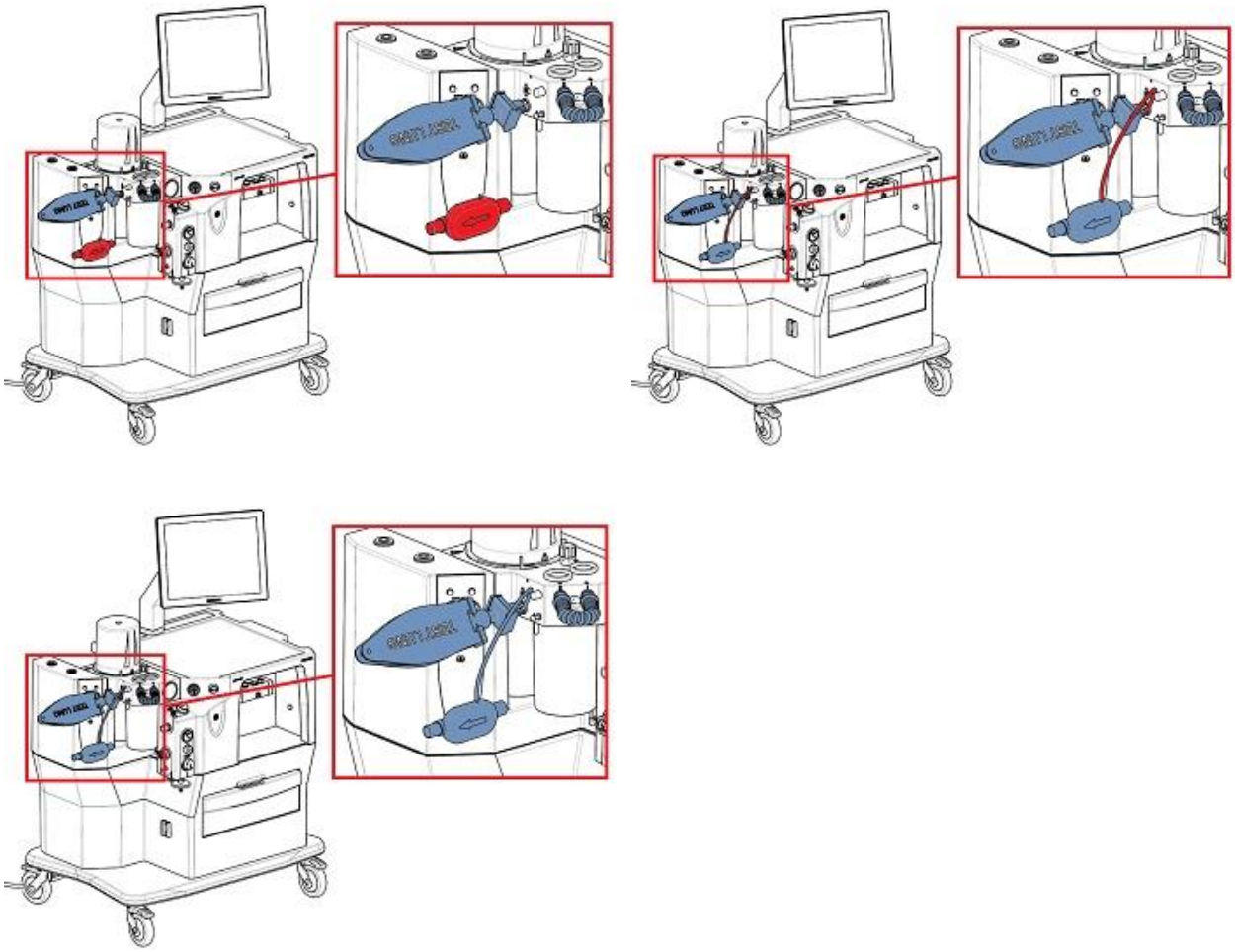
Proceed according to the steps described below.





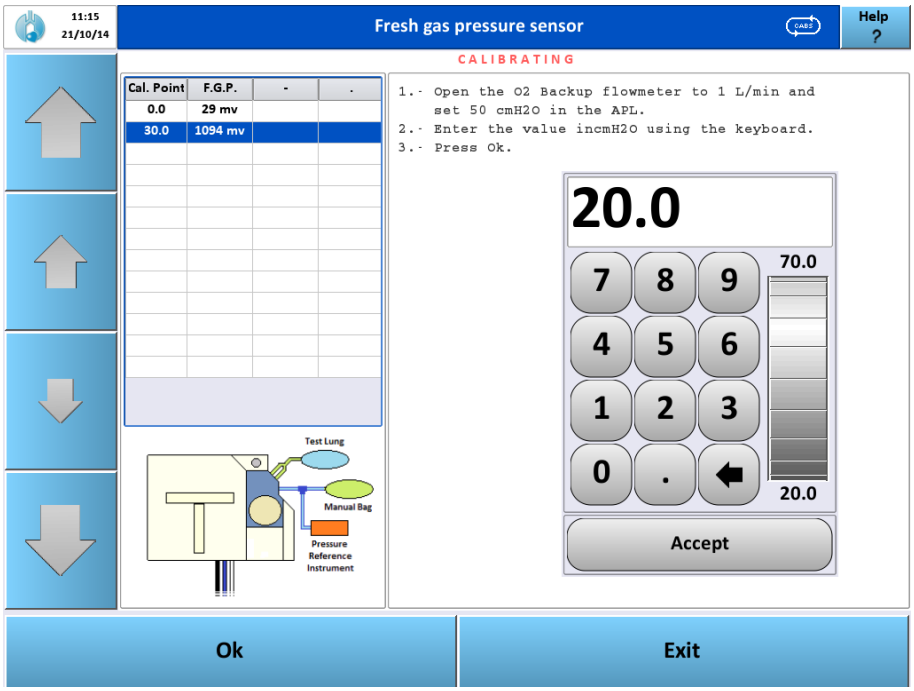






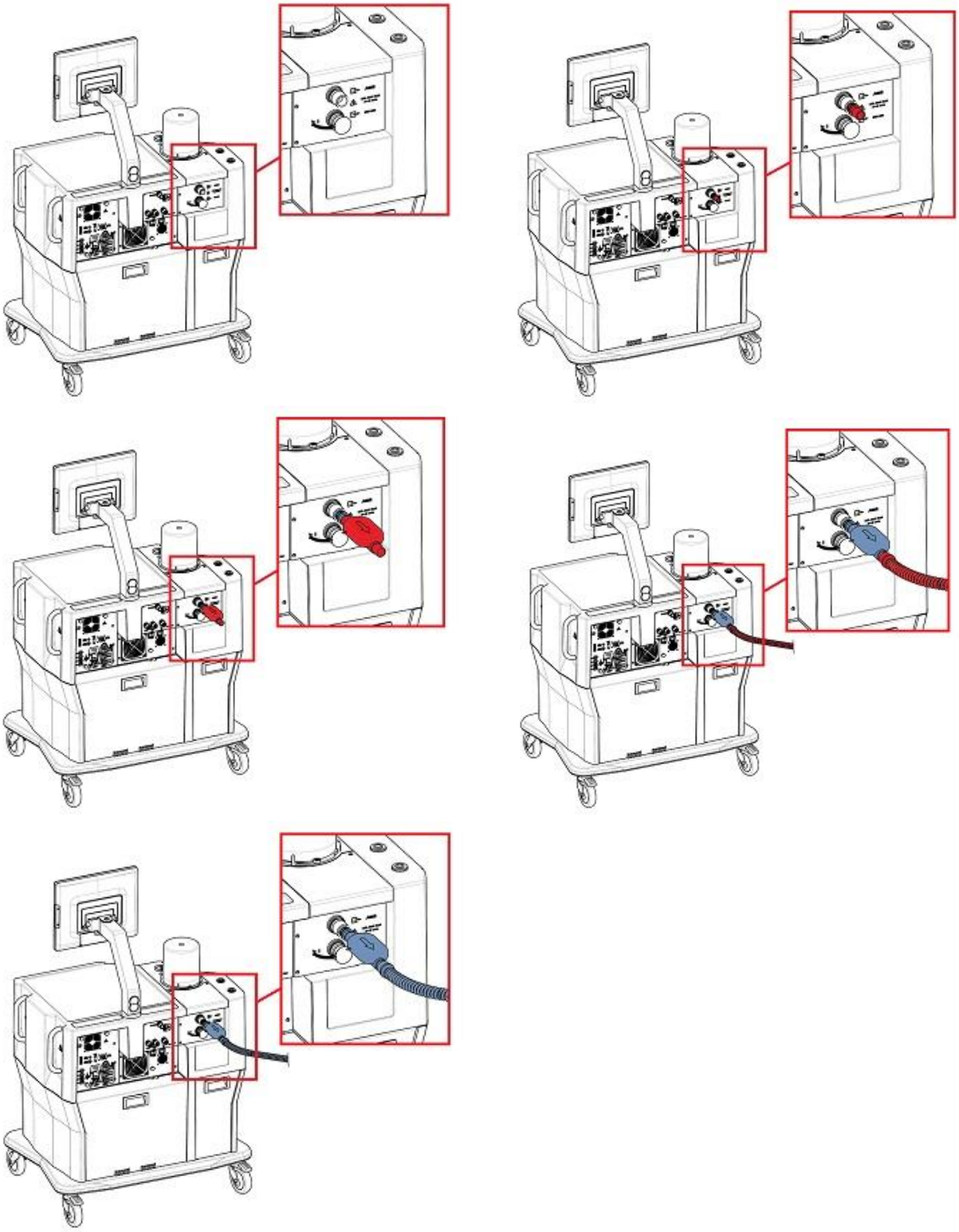
First step: Safety $O_2$= 0L/min; APL valve= 0 cm $H_2O$.
Second step: Safety $O_2$= 1L/min; APL valve= 50 cm $H_2O$.

Introduce the value of the pressure in the keyboard.



## 7.11. AGSS flow

Proceed according to the steps described in the screen (see below).



## 7.12. Battery charge

See Service Panel chapter first.

1.- Turn off the machine, disconnect the external power and battery.

2.- Connect the battery cables to an external power source.

3.- Set the source voltage at 12 V and the current at 6 A.


4.- Turn on the machine again, open the service panel, press "Start Hw" and "Inputs" tab.

5.- In "Outputs" activate outputs 1,3 and 12.

6.- In "Ventilation" set a filtering with a coefficient of 0.99.


6.- Select the input "BAT (112)". The default calibration will appear in the right column.

7.- The first calibration point is 0 % and 4500 mV. That is the input voltage, of the battery sensor, at which the machine is turned off for safety. It must be modified provisionally so that it does not happen. Change the 4500 mV to 2500 mV.

8.- In the box on the right "Calibrations", click in this order:

- “Make factory calibration file”
  Wait for the message that you're done to appear.
- “Recalculate calibrations in Service panel”
  Wait for the message that you're done to appear.
- “Update databases and recalculate calibration in ventilation”
  Wait for the message that you're done to appear.

9.- Write the value which is read with 12 V (measured with the polymeter at the battery terminals on the machine) in "BAT 12" (100% charge).

10.- Lower the voltage of the source to 11.3 V and also point the value (0% load).


11.- Raise the source back to 12 V.

12.- Change the calibration manually in the right column. It will be necessary to enter the values pointed for 0 % and 100 % of load.

13.- In the box on the right "Calibrations", click in this order:

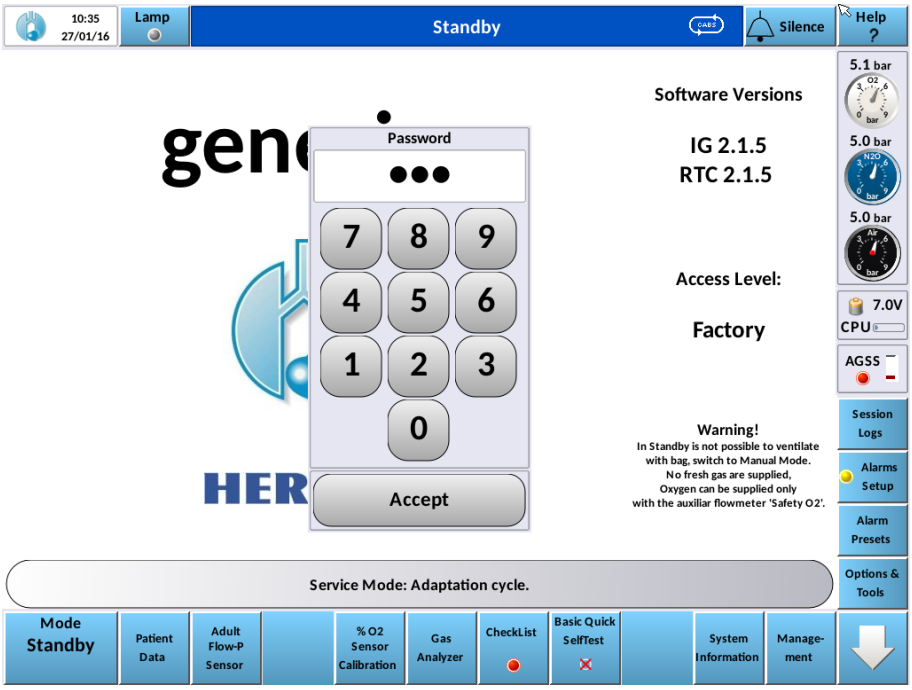
- “Make factory calibration file”
  Wait for the message that you're done to appear.
- “Recalculate calibrations in Service panel”
  Wait for the message that you're done to appear.
- “Update databases and recalculate calibration in ventilation”
  Wait for the message that you're done to appear.

14.- Exit the service panel and check the calibration by seeing the percentage of battery in the power frame. With 12 V you should dial 100% and go down to 5% which should be ~11.35 V (Do not go down to 11.3 V because it will turn off).

Keep in mind that the displayed load value is very filtered, so it will drop very slowly when changing the voltage of the source.

# 8. Access levels

To change the access level, touch the control **[Management]** from the Standby screen.




**NOTE**

After Starting Up GENESIS, it is always in access level User, this way when the access level is changed, simply Shooting Down GENESIS the unit will change to User access level.

There are 4 access levels: User, Installer, Technical and Factory; they require a password. Each one allows deeper access to control the software features (see the table below):

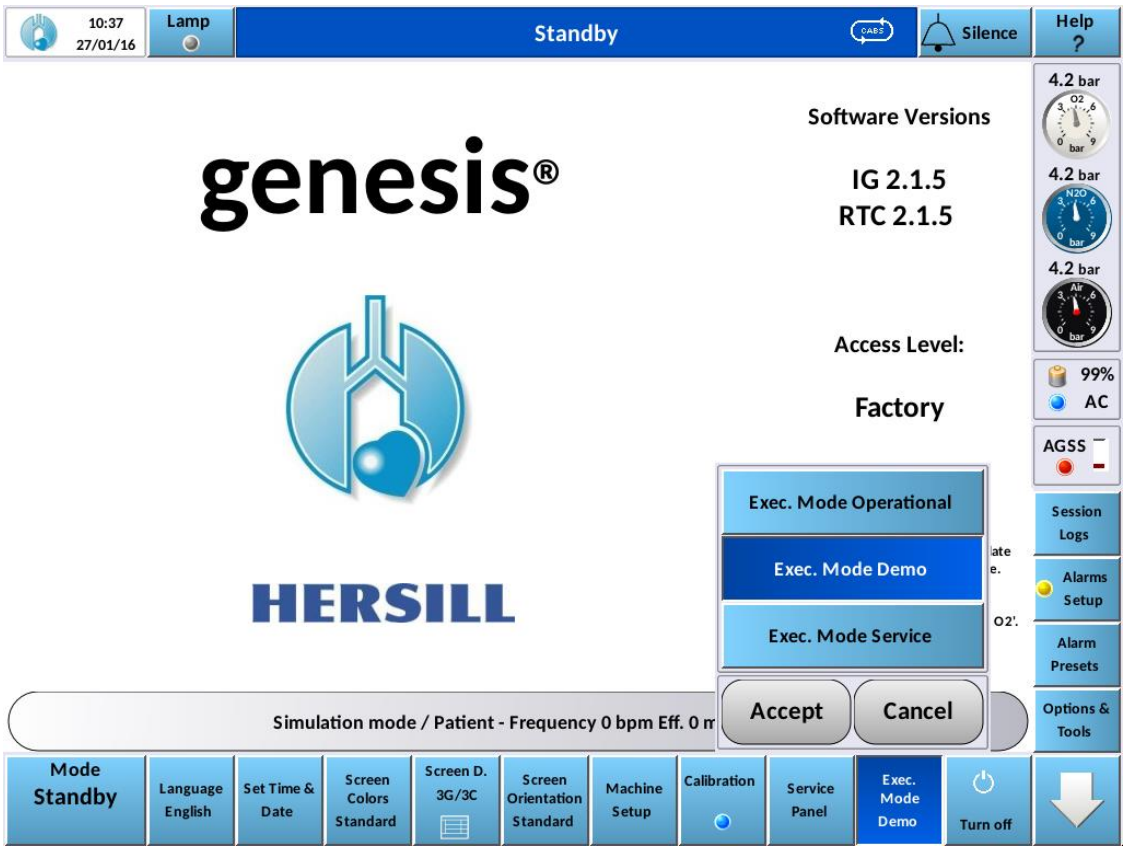
| Access level | User | Installer | Technical | Factory |
|---|---|---|---|---|
| password | 1111 | 4532 | 2676 | |
| Execution mode Standard | o | o | o | o |
| Execution mode Demo | | o | o | o |
| Machine setup | | o | o | o |
| Full machine setup | | | o | o |
| Execution mode Service + Service Control | | | o | o |
| See values in Self-Test | | | o | o |
| See values in Alarms | | | o | o |
| Modify the alarm preset values by default | | | o | o |
| Reset alarm preset values by default to factory values | | | o | o |
| Calibration | | | o | o |
| Technical Service Panel | | | o | o |
| Factory Service Panel | | | | o |

# 9. Execution modes

There are three execution modes: Standard, Demo and Service.

- Standard mode is the regular.
- Demo mode is intended basically for installing and training purposes, GENESIS substitute the patient circuit by a software simulator, and all the settings and graphics configuration are available.
- Service mode adds to the standard mode some debugging curves, in the graphics and in the controls, useful to analyze the behavior of the workstation.

| | | Execution mode | | |
|---|---|---|---|---|
| | | Standard | Demo | Service |
| Access level | User | o | | |
| | Installer | o | o | |
| | Technical | o | o | o |
| | Factory | o | o | o |



# 10. Machine setup

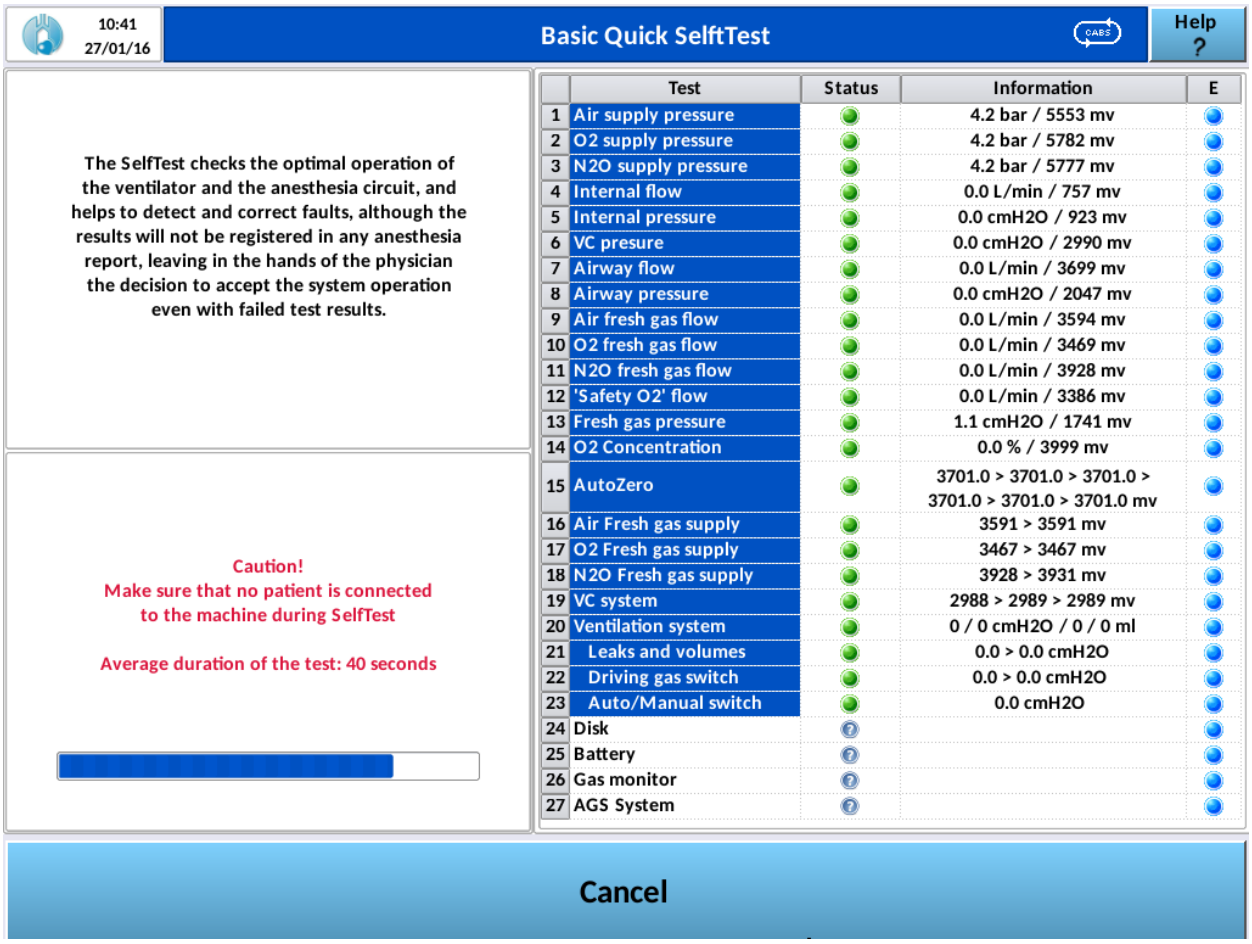
The machine setup is accessible from the Technical and Factory access levels.

**NOTE**

To maintain correctly the machine setup is necessary for the correct operation of the workstation. The setup is entered in factory at the end of the assembly procedure, and this setup must be updated if any module is changed after a repair procedure.

In the setup screen, it is indicated the version of each hardware module, the options enabled in the unit (advanced ventilation modes and advanced monitoring) and other special options defined by the manufacturer.

# 11. SelfTest




| | Test | Status | Information | E |
|---|---|---|---|---|
| 1 | Air supply pressure | | 4.2 bar / 5553 mv | |
| 2 | O2 supply pressure | | 4.2 bar / 5782 mv | |
| 3 | N2O supply pressure | | 4.2 bar / 5777 mv | |
| 4 | Internal flow | | 0.0 L/min / 757 mv | |
| 5 | Internal pressure | | 0.0 cmH2O / 923 mv | |
| 6 | VC presure | | 0.0 cmH2O / 2990 mv | |
| 7 | Airway flow | | 0.0 L/min / 3699 mv | |
| 8 | Airway pressure | | 0.0 cmH2O / 2047 mv | |
| 9 | Air fresh gas flow | | 0.0 L/min / 3594 mv | |
| 10 | O2 fresh gas flow | | 0.0 L/min / 3469 mv | |
| 11 | N2O fresh gas flow | | 0.0 L/min / 3928 mv | |
| 12 | 'Safety O2' flow | | 0.0 L/min / 3386 mv | |
| 13 | Fresh gas pressure | | 1.1 cmH2O / 1741 mv | |
| 14 | O2 Concentration | | 0.0 % / 3999 mv | |
| 15 | AutoZero | | 3701.0 > 3701.0 > 3701.0 > 3701.0 > 3701.0 > 3701.0 mv | |
| 16 | Air Fresh gas supply | | 3591 > 3591 mv | |
| 17 | O2 Fresh gas supply | | 3467 > 3467 mv | |
| 18 | N2O Fresh gas supply | | 3928 > 3931 mv | |
| 19 | VC system | | 2988 > 2989 > 2989 mv | |
| 20 | Ventilation system | | 0 / 0 cmH2O / 0 / 0 ml | |
| 21 | Leaks and volumes | | 0.0 > 0.0 cmH2O | |
| 22 | Driving gas switch | | 0.0 > 0.0 cmH2O | |
| 23 | Auto/Manual switch | | 0.0 cmH2O | |
| 24 | Disk | | | |
| 25 | Battery | | | |
| 26 | Gas monitor | | | |
| 27 | AGS System | | | |

**NOTE**

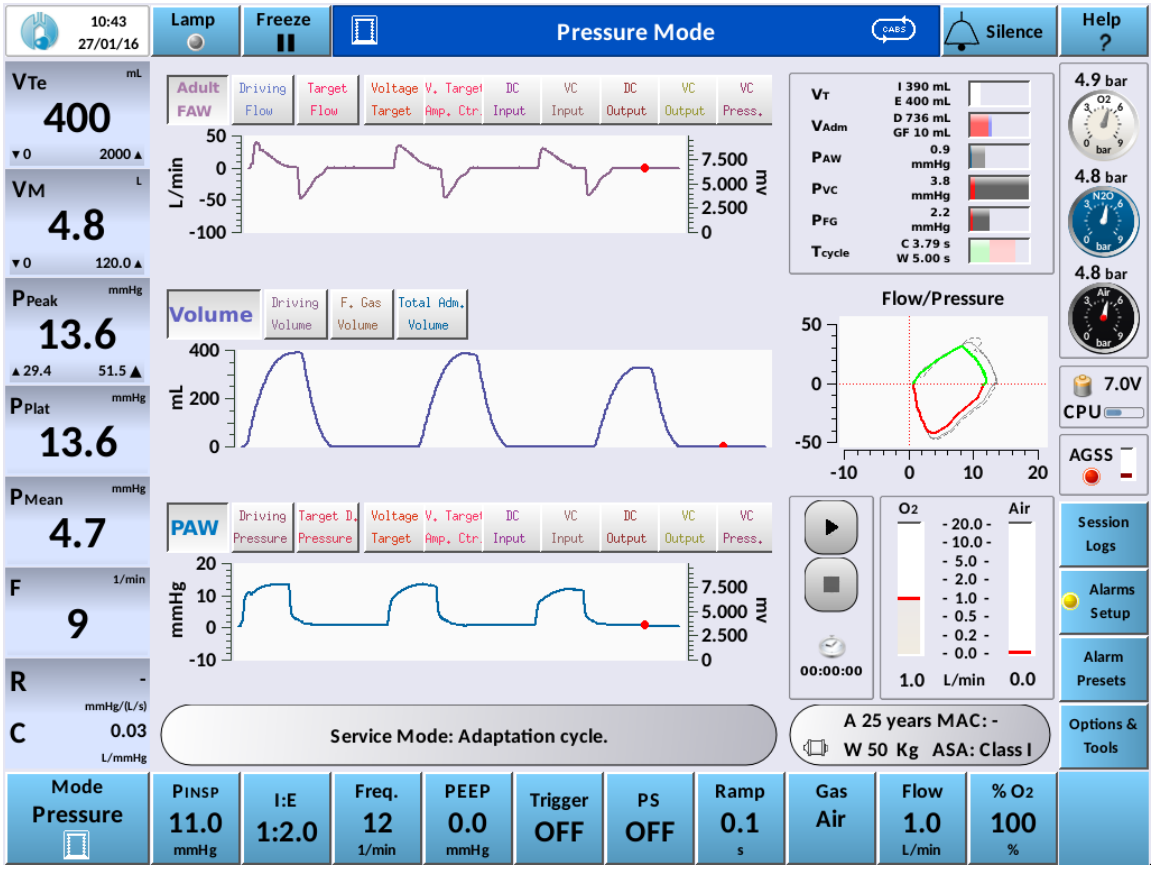
**To solve any failure in the SelfTest, apply the corresponding procedure detailed in troubleshooting chapter 15.**

# 12. Service control

The Service control is only available from the execution mode *Service* (accessible for technical and factory access levels).

This control is useful in order to find out and solve any problem on the machine, at engineering level technical service.

Once the engineer/technician has selected the *execution mode service* the ventilation screen will change. It will go on showing the same number of tables defined on the screen graphics design (maximum 3G/3C), but in each of these graphs it can be displayed display many different parameters.

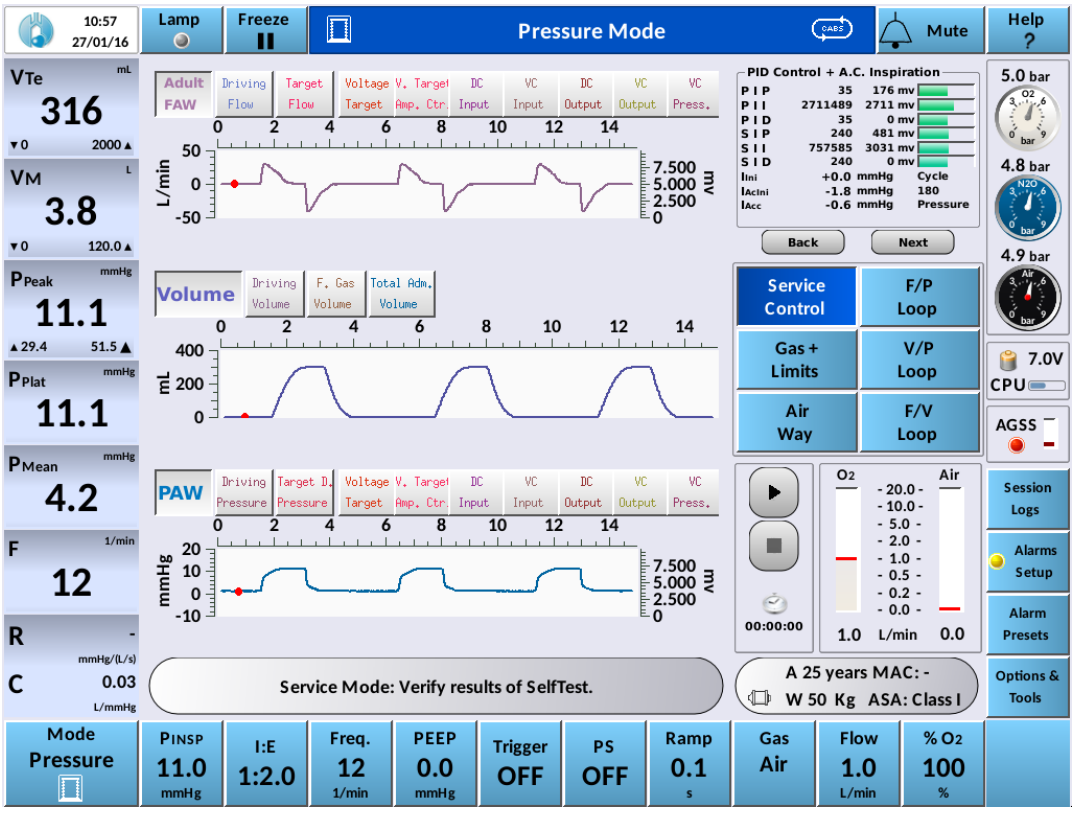


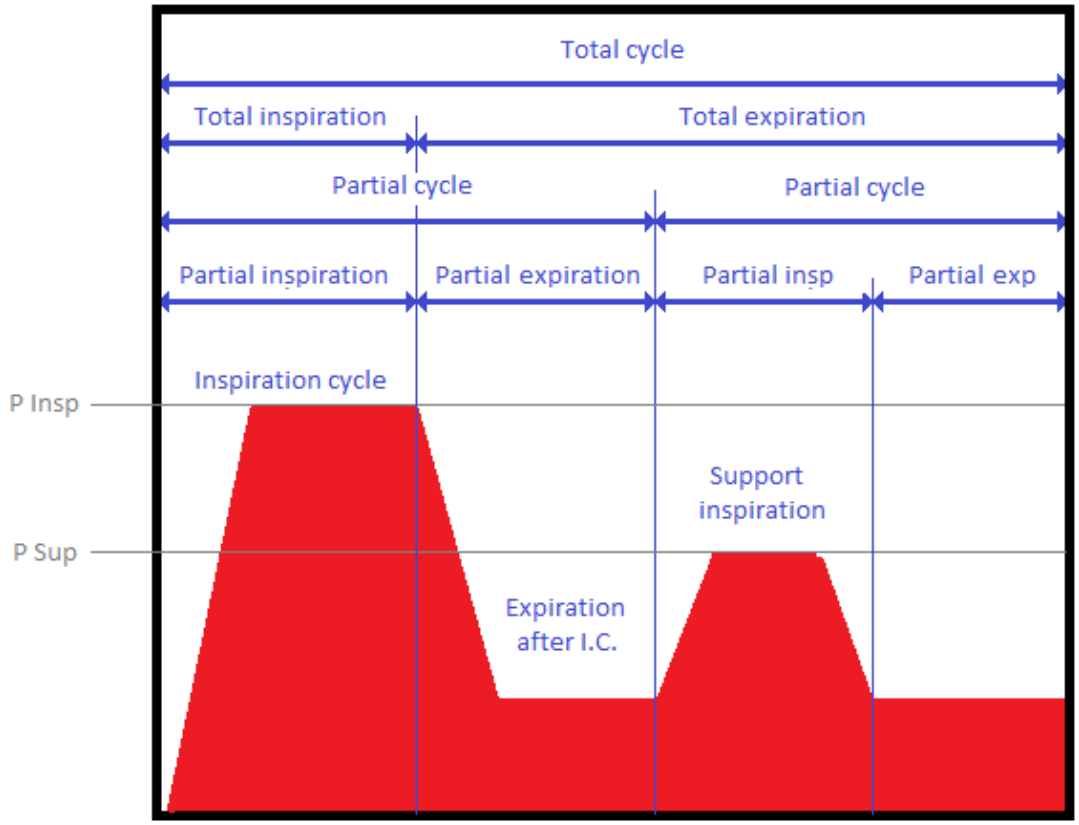

- **Flow graph**
  - Adult FAW — Curve of airway flow for adult Flow-P in units of flow.
  - Driving Flow — Curve of driving (internal flow) in units of flow.
  - Target Flow — Curve of objective flow in units of flow.
  - Voltage Target — Curve of objective flow in millivolts.
  - V. Target Amp. Ctr. — Curve of objective flow with amplitude control in millivolts.
  - DC Input — Curve of driving control (FAW or FD) input in millivolts.
  - VC Input — Curve of ventilation control (PAW) input in millivolts.
  - DC Output — Curve of driving control (solenoid) output in millivolts.
  - VC Output — Curve of ventilation control (solenoid) output in millivolts.

- **Volume graph**
  - Volume — Curve of volume in units of volume.
  - Driving volume — Curve of volume supply by driving flow in units of volume.
  - F. Gas volume — Curve of volume supply by fresh gas flow in units of vol.
  - Total Adm. Vol. — Curve of volume supply by driving and fresh gas in units of vol.

- **Pressure graph**
  - PAW — Curve of airway pressure in units of pressure.
  - Driving Pressure — Curve of driving (internal pressure) in units of pressure.
  - Target D. Pressure — Curve of objective pressure in units of pressure.
  - Voltage Target — Curve of objective pressure in millivolts.
  - V. Target Amp. Ctr. — Curve of objective pres. with amplitude control in mV.
  - DC Input — Curve of driving control (PAW) input in millivolts.
  - VC Input — Curve of ventilation control (PAW) input in millivolts.
  - DC Output — Curve of driving control (solenoid) output in millivolts.
  - VC Output — Curve of ventilation control (solenoid) output in millivolts.
  - VC Press. — Curve of VC pressure (under the membrane) in millivolts.

Beside these options, there is a new possibility on the chart zone that is called “service control”.
When the service control is selected the technician can displayed ten different charts on the same area.






- **PID Control + A.C. Inspiration**
  - P I P Primary (Driving) – Inspiration – Proportional gain and output.
  - P I I Primary (Driving) – Inspiration – Integral gain and output.
  - P I D Primary (Driving) – Inspiration – Derivative gain and output.
  - S I P Secondary (Driving) – Inspiration – Proportional gain and output.
  - S I I Secondary (Driving) – Inspiration – Integral gain and output.
  - S I D Secondary (Driving) – Inspiration – Derivative gain and output.
  - IIni Initial value of amplitude control.
  - IAccIni Accumulated initial (init. of cycle) value of amplitude control.
  - IAcc Accumulated value of amplitude control.
  - Cycle Number of cycles and type of control.

- **PID Control + A.C. PEEP**
  - P E P Primary (Driving) – Expiration – Proportional gain and output.
  - P E I Primary (Driving) – Expiration – Integral gain and output.
  - P E D Primary (Driving) – Expiration – Derivative gain and output.
  - S E P Secondary (Driving) – Expiration – Proportional gain and output.
  - S E I Secondary (Driving) – Expiration – Integral gain and output.
  - S E D Secondary (Driving) – Expiration – Derivative gain and output.
  - IIni Initial value of amplitude control.
  - IAccIni Accumulated initial (init. of cycle) value of amplitude control.
  - IAcc Accumulated value of amplitude control.

- **PID Control + A.C. Support**
  - P E P Primary (Driving) – Expiration – Proportional gain and output.
  - P E I Primary (Driving) – Expiration – Integral gain and output.
  - P E D Primary (Driving) – Expiration – Derivative gain and output.
  - S E P Secondary (Driving) – Expiration – Proportional gain and output.
  - S E I Secondary (Driving) – Expiration – Integral gain and output.
  - S E D Secondary (Driving) – Expiration – Derivative gain and output.
  - IIni Initial value of amplitude control.
  - IAccIni Accumulated initial (init. of cycle) value of amplitude control.
  - IAcc Accumulated value of amplitude control.

- **PID Control + F. G. N2O**
  - P Proportional gain and output.
  - I Integral gain and output.
  - D Derivative gain and output.
  - Input F.G. N2O flow (sensor) in millivolts.
  - Target F.G. N2O objective in millivolts.
  - Output F.G. N2O output (solenoid) in millivolts.

- **PID Control + F. G. Air**
  - P Proportional gain and output.
  - I Integral gain and output.
  - D Derivative gain and output.
  - Input F.G. Air flow (sensor) in millivolts.
  - Target F.G. Air objective in millivolts.
  - Output F.G. Air output (solenoid) in millivolts.

- **PID Control + F. G. O2**
  - P Proportional gain and output.
  - I Integral gain and output.
  - D Derivative gain and output.
  - Input F.G. O2 flow (sensor) in millivolts.
  - Target F.G. O2 objective in millivolts.
  - Output F.G. O2 output (solenoid) in millivolts.

- **Auxiliary sensors**
  - F N2O Fresh gas N2O flow in millivolts and in units of flow.
  - F Air Fresh gas Air flow in millivolts and in units of flow.
  - F O2 Fresh gas O2 flow in millivolts and in units of flow.
  - F Safety O2 Fresh gas safety O2 flow in millivolts and in units of flow.
  - F AGSS AGSS extraction flow in millivolts and in units of flow.
  - P FG Fresh gas pressure in millivolts and in unit of pressure.
  - Output F.G. N2O output (solenoid) in millivolts.

- **Pressures**
  - Total Max. Maximum pressure reached in total cycle.
  - Partial Max. Maximum pressure reached in partial cycle.
  - Insp. C. Max. Maximum pressure reached in mandatory inspiration.
  - VC Max. Maximum pressure reached in Ventilation control.
  - Total Mean Mean pressure reached in total cycle.
  - Partial Mean Mean pressure reached in partial cycle.
  - Insp. C. Mean Mean pressure reached in mandatory inspiration.
  - Total Min Minimum pressure reached in total cycle.
  - Partial Min Minimum pressure reached in partial cycle.
  - Insp. C. Min Minimum pressure reached in mandatory inspiration.

- **Patient volumes**
  - VTi total Inspiratory tidal volume in total cycle.
  - VTi partial Inspiratory tidal volume in partial cycle.
  - VTi insp cycle Inspiratory tidal volume in inspiratory cycle.
  - VTe total Expiratory tidal volume in total cycle.
  - VTe partial Expiratory tidal volume in partial cycle.
  - VTe insp cycle Expiratory tidal volume in inspiratory cycle.
  - VMe total Expiratory volume minute in total cycle.
  - VMe partial Expiratory volume minute in partial cycle.
  - 
- **Managed volumes**
  - VTd total Driving volume supplied in total cycle.
  - VTd partial Driving volume supplied in partial cycle.
  - VTd insp cycle Driving volume supplied in inspiratory cycle.
  - VTfg total Fresh gas volume supplied in total cycle.
  - VTfg partial Fresh gas volume supplied in partial cycle.
  - VTfg insp cycle Fresh gas volume supplied in inspiratory cycle.
  - VTa total Driving+Fresh gas volume supplied in total cycle.
  - VTa partial Driving+Fresh gas volume supplied in partial cycle.
  - VTa insp cycle Driving+Fresh gas volume supplied during insp. Cycle.

- **Times of last cycle**
  - D. Cycle Pr. Duration of cycle programmed.
  - D. Insp. Pr. Duration of inspiration programmed.
  - D. Exp. Pr. Duration of expiration programmed.
  - D. Compens. Duration of compensation (Advanced cycle in SIMV).
  - D. Exp. Ad. by Supp. Duration of additional exp. Time due to support.
  - D. Pause Pr. Duration of inspiration pause programmed.
  - D. Ramp Pr. Duration of ramp time programmed.
  - T. In. C. Par. Time of partial inspiration cycle.
  - D. Insp. P. Effect. Duration of partial inspiration effective.
  - D. Exp. P. Effect. Duration of partial expiration effective.
  - 

- **Times of penultimate cycle**
  - D. Cycle Pr. Duration of cycle programmed.
  - D. Cycle Effect. Duration of cycle effective.
  - D. Insp. Pr. Duration of inspiration programmed.
  - D. Insp. P. Effect. Duration of partial inspiration effective.
  - D. Exp. Pr. Duration of expiration programmed.
  - D. Exp. P. Effect. Duration of partial expiration effective.
  - D. Pause Pr. Duration of inspiration pause programmed.
  - D. Ramp Pr. Duration of ramp time programmed.

- **Ventilation parameters**
  - P Insp. Inspiration pressure programmed.
  - Previous P. Insp. Inspiration pressure programmed in previous cycle.
  - P. Support Support pressure programmed.
  - Previous P. Support. Support pressure programmed in previous cycle.
  - PEEP PEEP programmed.
  - Previous PEEP PEEP programmed in previous cycle.
  - Tidal volume Tidal volume programmed.
  - Previous VT Tidal volume programmed in previous cycle.
  - Trigger Trigger programmed.
  - Previous Trigger Trigger programmed in previous cycle.

- **Gas Analyzer 1**
  - Status Plugged / unplugged.
  - Sensor mode SelfTest / Demo / Measure.
  - O2 Compens. O2 compesation.
  - N2O Compens. N2O compensation.
  - Apnea time Apnea time.
  - Disab. Zero Disabled zero.
  - Zero in prog. Zero calibration in progress.
  - Span Error Span error.
  - Span cal. in prog. Span calibration in progress.

- **Gas Analyzer 2**
  - Register Cfg. 0 Register of configuration 0.
  - Register Cfg. 1 Register of configuration 1.
  - Hw. Rev. Hardware revision.
  - Sw. Rev. Software revision.
  - Comm. Rev. Communication revision.
  - Disab. Zero Disabled zero.
  - Serial N. Serial number.

- **System**
  - Disk free space — Disk free space.
  - Disk total space — Disk total space.
  - Task virtual memory — Task virtual memory.
  - Task Res. Mem. — Task Res. Memory.
  - % CPU User — Use of user processor.
  - % CPU System — Use of system processor.

- **Others**
  - P. Tgt. VC Insp. — Target VC pressure for inspiratory.
  - P. Tgt. VC Exp. — Target VC pressure for expiratory.
  - P. Tgt. AP-VG — Target AP-VG pressure for inspiratory.
  - P. Tgt. AP-VG + PEEP — Target AP-VG pressure for expiratory.
  - Flow Max T. — Total maximum flow.
  - Flow Max P. — Partial maximum flow.
  - Flow Mean I.C. — Insp. Cycle mean flow.

# 13. Service panel

To access the Service panel, it is required to enter at Technical or Factory access level (see chapter 8).

From the Standby screen, press the right arrow

And press the **Service Panel** option

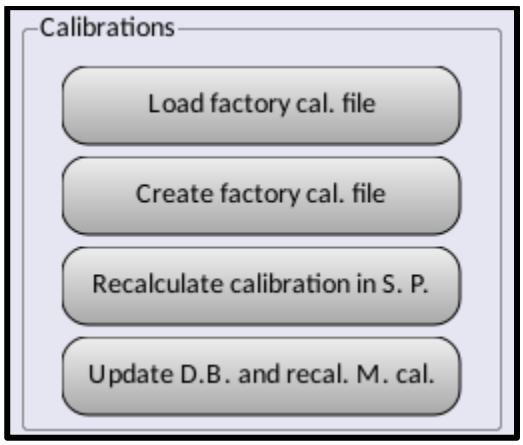

## 13.1. Screen selection bar

The bottom bar let change between the different screens of the service panel; each screen is explained forward.


## 13.2. Calibrations panel

Placed in the upper position from the right side panels.

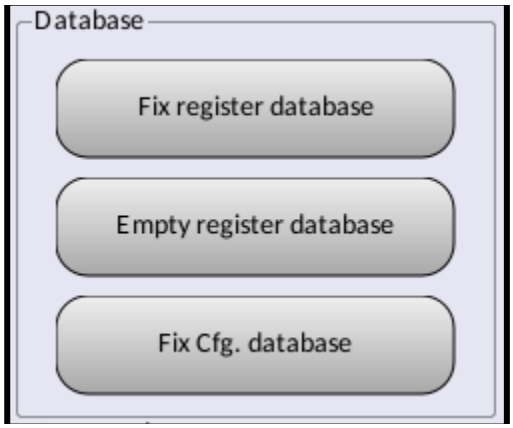
To access the Calibration panel it is required to enter at Factory access level.




- Load the factory calibration file: Load in the memory the data of the factory calibration.
- Create factory calibration file: Keep safe in the calibration data the current calibration.
- Recalculate the calibration in S.P.: Recalculate the calibration using the current safe data.
- Update the Database and recalculate machine calibration: Update the data base and recalculate the calibration using the current safe data.

## 13.3. Databases panel

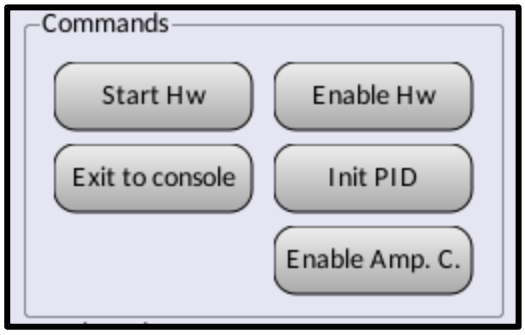
Placed in the second position from the right side panels.




- Fix register database: Repair the mistakes and the inconsistences on the database of the register.
- Empty the register of the database: Delete all data of the database.
- Fix configuration of the database: Repair the mistakes and the inconsistences on the database of the configuration.

## 13.4. Commands panel

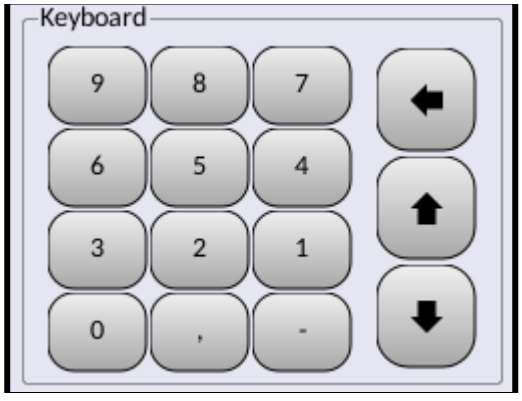
Placed in the third position from the right side panels.




- Start HW: Activate the acquisition and reading of the PCB's data.
- Exit to console: Let close graphic interface and go to the command console.
- Enable hardware: Sends manually pulses to deactivate the timeout of the watchdog.
- Initialize PID: Initialize all the parameters to the defaults of the driver PID.
- Enable Amp.C: Activate the amplitude control in the drivers of the PID.

## 13.5. Keyboard

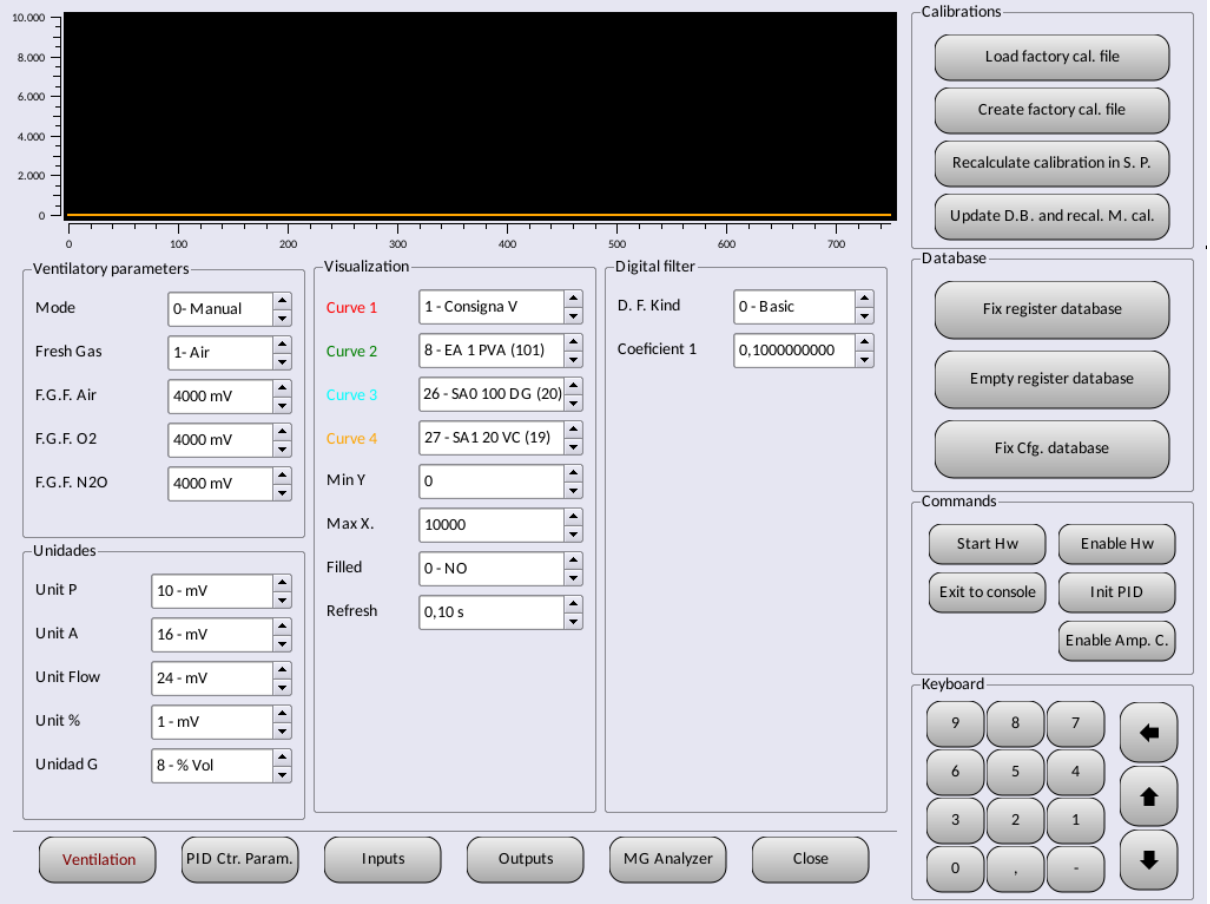
Placed in the last position from the right side panels.




- The keyboard let introduce numerical values. The up arrow let increase the selected value and the down arrow decrease it. The left arrow let delete the value.

## 13.6. Ventilation screen

There are four different groups of ventilation parameters on the ventilation screen: Ventilatory parameters, visualization, digital filter and units.




- Ventilatory parameters

  - Mode

    It's used to make ventilation in pressure or volume mode. The manual mode let fix all the exit signals manually.

  - Fresh Gas

    Air/ O2 /N2O

  - Fresh gas flow Air

    The tension of the fresh gas flow of air can be selected

  - Fresh gas flow O2

    The tension of the fresh gas flow of O2 can be selected

  - Fresh gas flow N2O

    The tension of the fresh gas flow of N2O can be selected

- Visualization:
    - Curve 1

      Can be an analogic input or and analogic output with the unit defined.
    - Curve 2

      Can be an analogic input or and analogic output with the unit defined.
    - Curve 3

      Can be an analogic input or and analogic output with the unit defined.
    - Curve 4

      Can be an analogic input or and analogic output with the unit defined.
    - Min Y

      Minimum value of the vertical axis
    - Max Y

      Maximum value of the vertical axis
    - Filled

      The curves can be filled in the graph
    - Refresh

      The period of time to update the graph
- Digital filter:

  There are three kinds of filter: Basic, FIR and IIR.
  It is a digital filter to the analogic inputs. For the filter of analogic input, the value is a constant. (100 high filtered – 0 low filtered).
- Units
    - Unit P

      Units for pressure measures (mv, Pa, mmHg, HPa, mbar, cm H2O,
    - Unit A

      Units for pressure supply measures (mv, Pa, KPa, bar)
    - Unit Flow

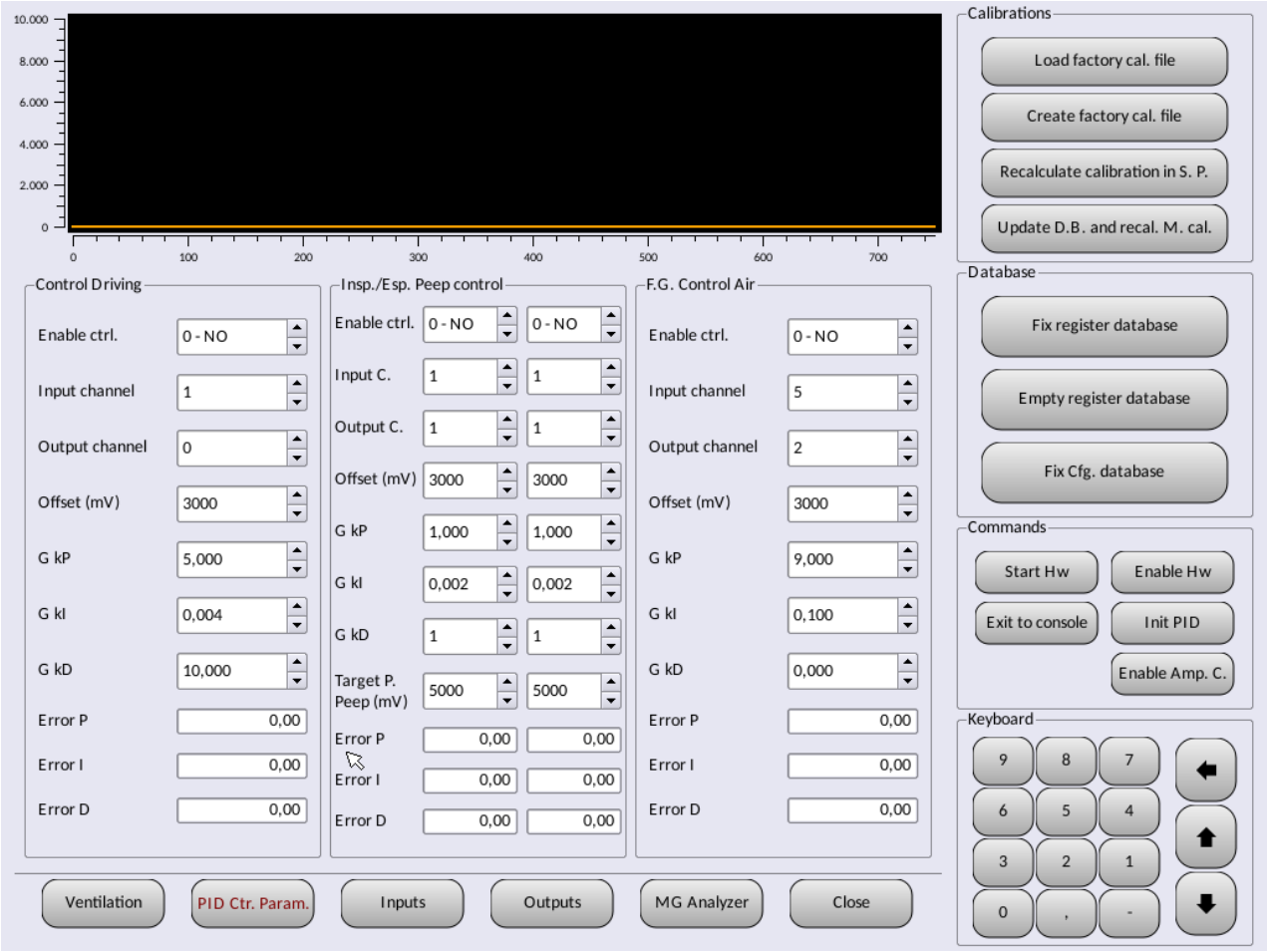
      Units for flow measures (mv, L/min, L/s)
    - unit %

      Units for % measures (mv / %)
    - Unit G

      Units for gas concentration measures (mmHg,%vol, kPa,)

## 13.7. PIDs screen

On the PID Crt. Param screen there are three different groups of configuration and/or motorized signals: Control driving, Insp/ Esp. Peep control and F.G Control Air.




- Control Driving
  - Enable Ctrl

    Enable and disable the PID control of the driving
  - Input channel

    Digital input to control PID of the driving
  - Output channel

    Digital output to control PID of the driving
  - Offset (mv)

    Output offset to control PID of the driving
  - G kP

    Proportional gain for the PID of the driving
  - G kI

    Integral gain for the PID of the driving

- G kP

  Derivative gain for the PID of the driving

- Error P

  Proportional error for the PID control of the driving (It's not an input parameter, it's a motorized signal)

- Error I

  Integral error for the PID control of the driving (It's not an input parameter, it's a motorized signal)

- Error D

  Derivative error for the PID control of the driving (It's not an input parameter, it's a motorized signal)

- <u>Insp/Exp Peep control</u>

  - Enable ctrl.

    Enable or disable the PID control of the inspiratory and expiratory PEEP

  - Input Channel

    Digital input for the PID control of the inspiratory and expiratory PEEP

  - Output channel

    Digital output for the PID control of the inspiratory and expiratory PEEP

  - Offset (mv)

    Offset for the PID control of the inspiratory and expiratory PEEP

  - G kP

    Proportional gain for the PID control of the inspiratory and expiratory PEEP

  - G kI

    Integral gain for the PID control of the inspiratory and expiratory PEEP

  - G kP

    Derivative gain for the PID control of the inspiratory and expiratory PEEP

  - Target P. Peep (mV)

    Target pressure in the VC chamber inspiratory and expiratory

  - Error P

    Proportional error for the PID control of inspiratory and expiratory PEEP (It's not an input parameter, it's a motorized signal).

  - Error I

    Integral error for the PID control of inspiratory and expiratory PEEP (It's not an input parameter, it's a motorized signal).

- Error D

  Derivative error for the PID control of inspiratory and expiratory PEEP (It's not an input parameter, it's a motorized signal).

- F.G. Control (Air-$O_2$-$N_2O$)

  This group of parameters changes according to the gas selected on the ventilation screen.

  - Enable ctrl.

    Enable or disable the PID control of the fresh gas (Air-O2-N2O)

  - Input channel

    Digital input to control the PID of the fresh gas (Air-O2-N2O)

  - Output channel

    Digital output to control the PID of the fresh gas (Air-O2-N2O)

  - Offset (mv)

    Offset for the PID control of the fresh gas (Air-O2-N2O)

  - G kP

    Proportional gain for the PID control of the fresh gas (Air-O2-N2O)

  - G kI

    Integral gain for the PID control of the fresh gas (Air-O2-N2O)

  - G kP

    Derivative gain for the PID control of the fresh gas (Air-O2-N2O)

  - Error P

    Proportional error for the PID control of the fresh gas (Air-O2-N2O) (It's not an input parameter, it's a motorized signal).

  - Error I

    Integral error for the PID control of the fresh gas (Air-O2-N2) (It's not an input parameter, it's a motorized signal).

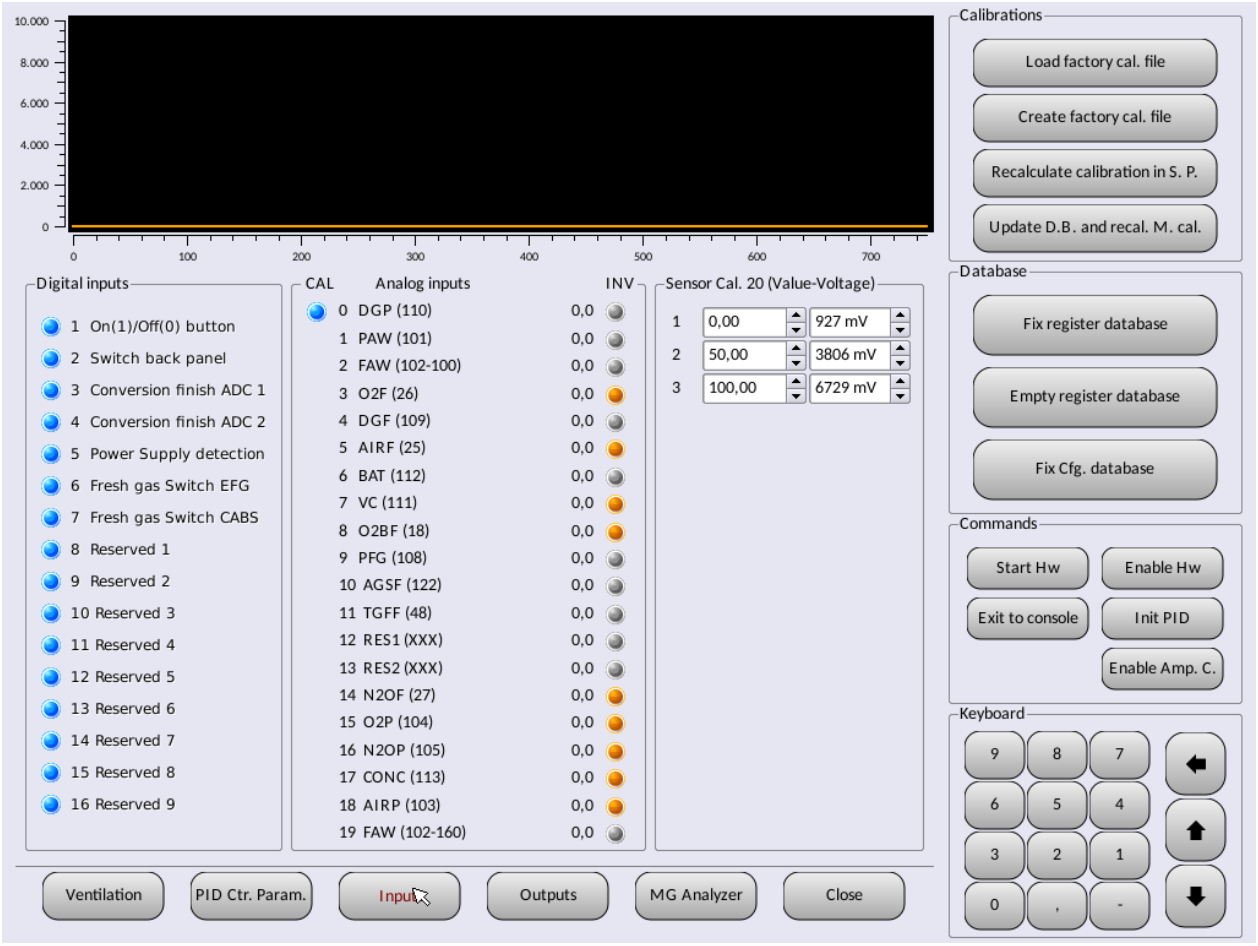
  - Error D

    Derivative error for the PID control of the fresh gas (Air-O2-N2) (It's not an input parameter, it's a motorized signal).

## 13.8. Inputs screen

There are three different configurations in the inputs screen: Digital inputs, Analog inputs and sensor Cal.20 (Value-Voltage)

A refresh is done sequentially; it can bring about a delayed effect.




- Digital inputs:
  - On(1) / Off (0) button

    Signal of the front switch button.
  - Switch back panel

    Reserved for future
  - Conversation finish ADC1

    Signal of conversation finish of the first converter analogic-digital.
  - Conversation finish ADC2

    Signal of conversation finish of the second converter analogic-digital.
  - Power supply detection

    Generated signal by the power supply source to show if it is receiving supply tension.

- Fresh gas switch gas EFG.

  Signal that comes from the frontal fresh gas switch and indicates the position

- Switch fresh gas CABS.

  A Signal that comes from the frontal fresh gas switch and indicates if the switch is heading CABS

The rest of the digital inputs are kept for the future.

- <u>Analogic inputs</u>

  The analogic inputs will be show on the screen according to the configured units on the ventilation screen. There is a single column on the left side (CAL), these bottoms allow you to see the calibration values and they will be shown on the right column (Sensor CAL.) There is another column on the right side that let invert the value of each analogic input (If the tension of a sensor decreases when the value grows, it's inverted)

  - DGP (110)

    Pressure driving gas signal (Absolute pressure)

  - PAW (101)

    Pressure airway signal (Absolute pressure)

  - FAW (102-100)

    Flow airway signal (Differential pressure)

  - O2F (26)

    Oxygen fresh gas flow (Mass-flow)

  - DGF (109)

    Driving gas flow signal (Differential pressure)

  - AIRF (25)

    Air fresh gas flow signal (Mass-flow)

  - BAT (112)

    It indicates the tension of the battery

  - VC (111)

    VC – Peep pressure signal (Absolute pressure)

  - O2BF (18)

    Oxygen backup fresh gas flow signal (Mass-flow)

- PFG (108)
  Fresh gas pressure signal (Absolute pressure)
- AGSF (122)
  AGS flow signal (Differential pressure)
- RES 1 (XXX)
  Reserved 1 (Differential pressure)
- RES 2 (XXX)
  Reserved 2 (Differential pressure)
- RES 3 (XXX)
  Reserved 3 (Differential pressure)
- N2OF (27)
  Nitrous oxide flow signal (Mass-flow)
- O2P (104)
  Oxygen supply pressure signal (Absolute pressure)
- N2OP (105)
  Nitrous oxide supply pressure signal (Absolute pressure)
- CONC (113)
  Oxygen concentration signal (Galvanic sensor)
- AIRP (103)
  Air supply pressure signal (Absolute pressure)
- FAW (102-160)
  Airway flow signal (Differential pressure)

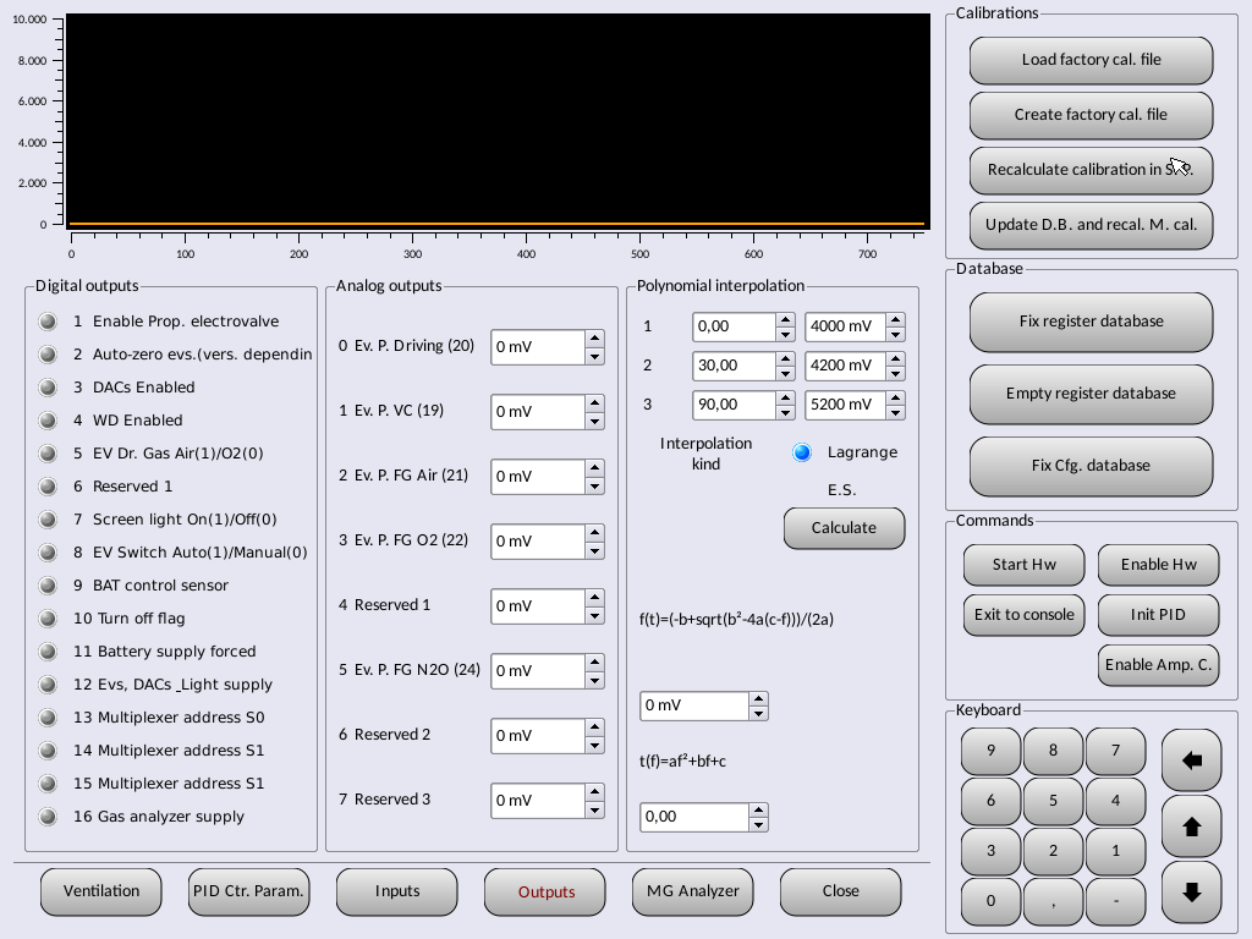
- Sensor Cal

It shows the calibration chart of the sensor chosen on the CAL column.

## 13.9. Outputs screen

There are three different groups of parameters on the output screen. Digital outputs, analog outputs and Polynomial interpolation

A refresh is done sequentially; it can bring about a delayed effect.




- Digital outputs

  - Enable Prop. Electro valve

    Activation proportional inputs signal

  - Auto-zero evs (Version depending).

    The auto-zero electro valves are piloted by this signal (Depending on the version).

  - DACs Enable

    Enable of the digital-analogic converters signal

  - EV Dr.Gas Air (1) / O2 (0)

    The electro valve which selects the driving gas is piloted by this signal

  - BAT control sensor

    This signal commutes the tension of the analog input BAT to the tension of charge.

- Turn off flag

  It activates the electronic of turned off (If it's on, the machine restarts)

- Battery supply forced

  It uses the battery when it is activated

- Evs, DACs and lights supply

  It let feed the circuits of the electro valves, digital-analog converters and LED light of the monitor

- Multiplexer address S0

  First bit of the multiplexer address of the analog inputs

- Multiplexer address S1

  Second bit of the multiplexer address of the analog inputs

- Multiplexer address S2

  Third bit of the multiplexer address of the analog inputs

- Gas analyzer supply

  It electrically feeds the gas analyzer

- <u>Analog outputs</u>

  - Ev. P. Driving (20)

    Piloted tension of the proportional electro valve of driving gas

  - Ev. P. VC (19)

    Piloted tension of the proportional electro valve of VC

  - Ev. P. GF Aire (21)

    Piloted tension of the proportional electro valve of air fresh gas

  - Ev. P. GF O2 (22)

    Piloted tension of the proportional electro valve of oxygen fresh gas

  - Reserved 1

    Piloted tension of the proportional electro valve of reserved 1

  - Ev. P. GF N2O (24)

    Piloted tension of the proportional electro valve of nitrous oxide fresh gas

  - Reserved 2

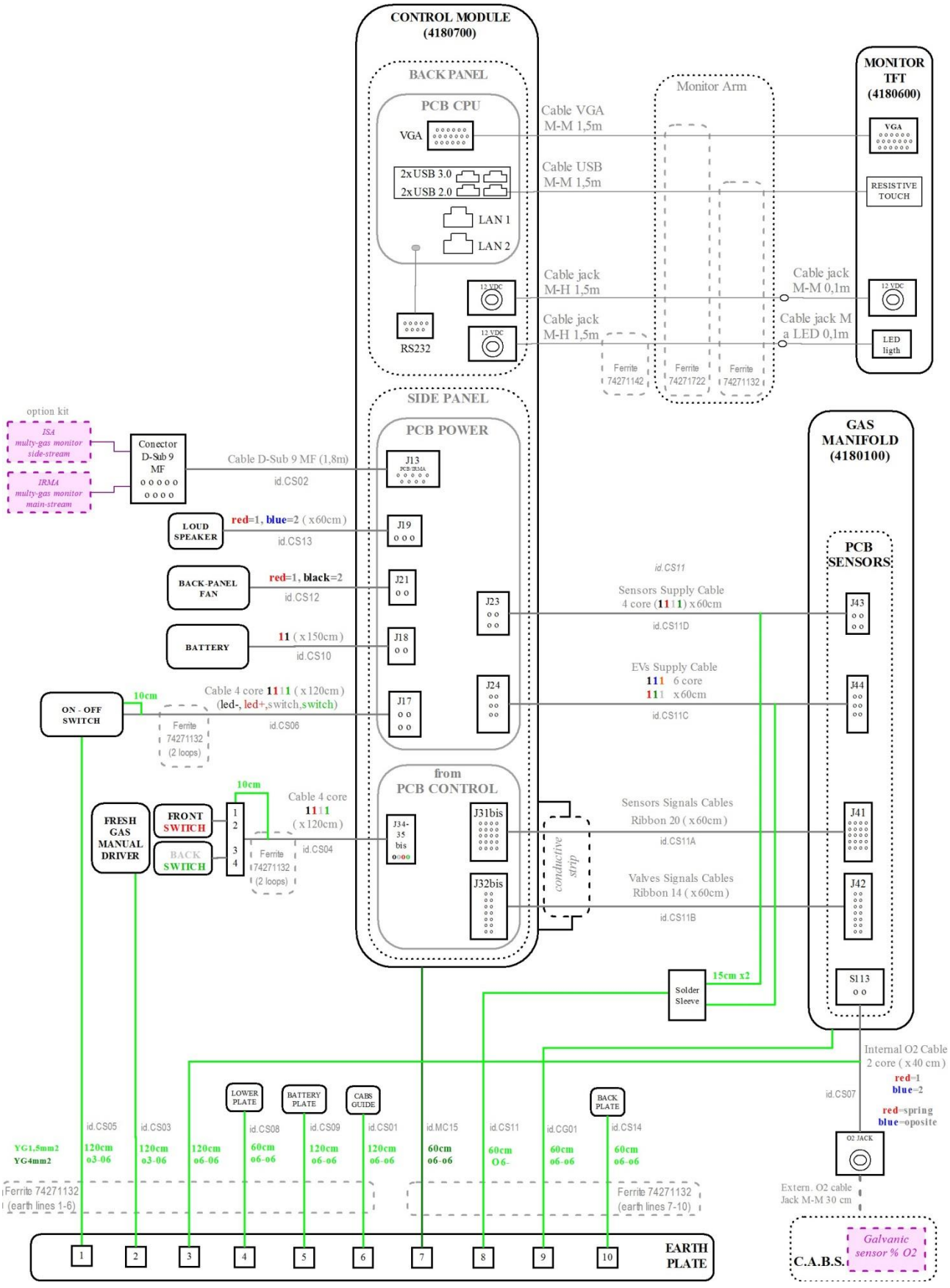
    Piloted tension of the proportional electro valve of reserved 2

  - Reserved 3

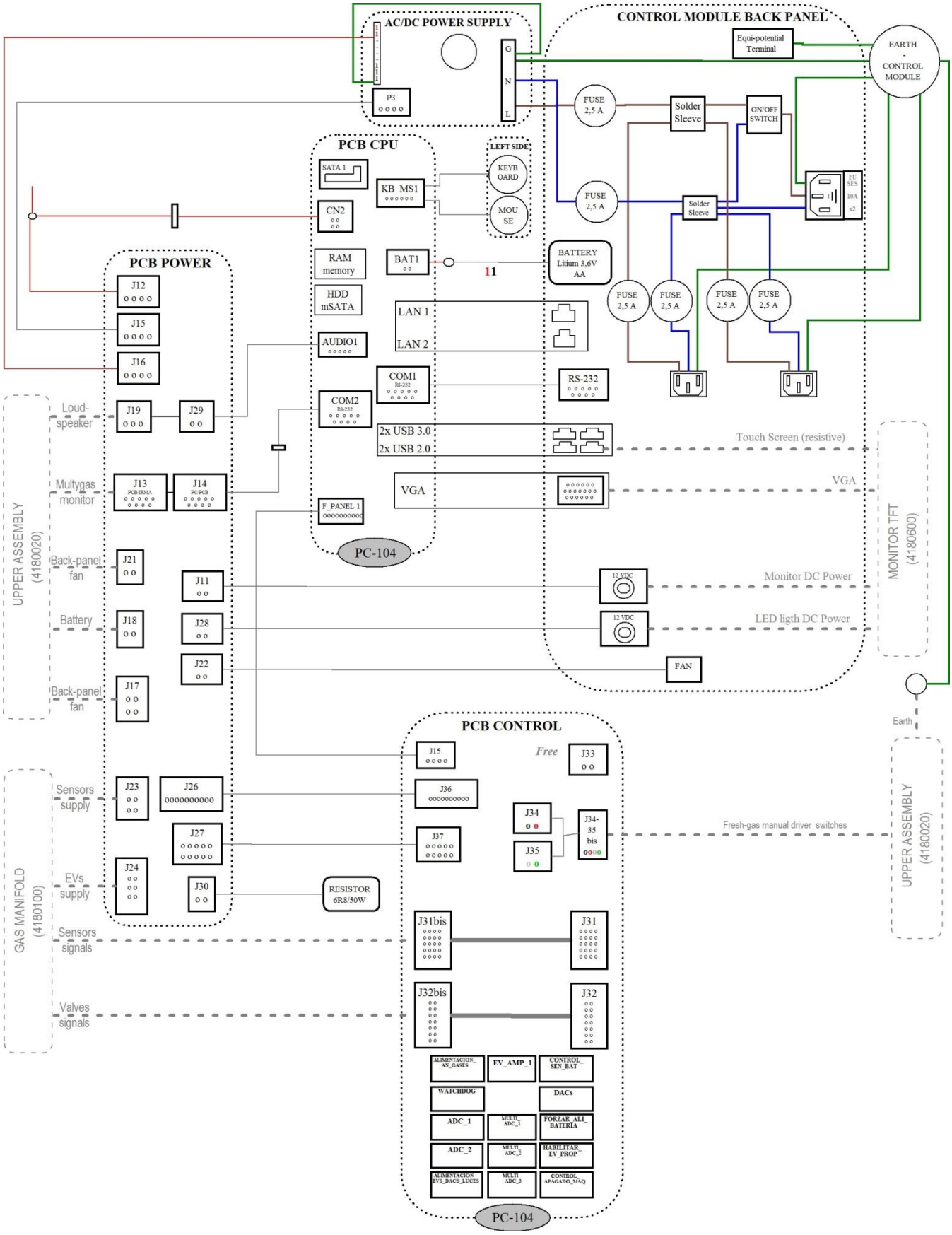
    Piloted tension of the proportional electro valve of reserved 3

# 14. Diagrams

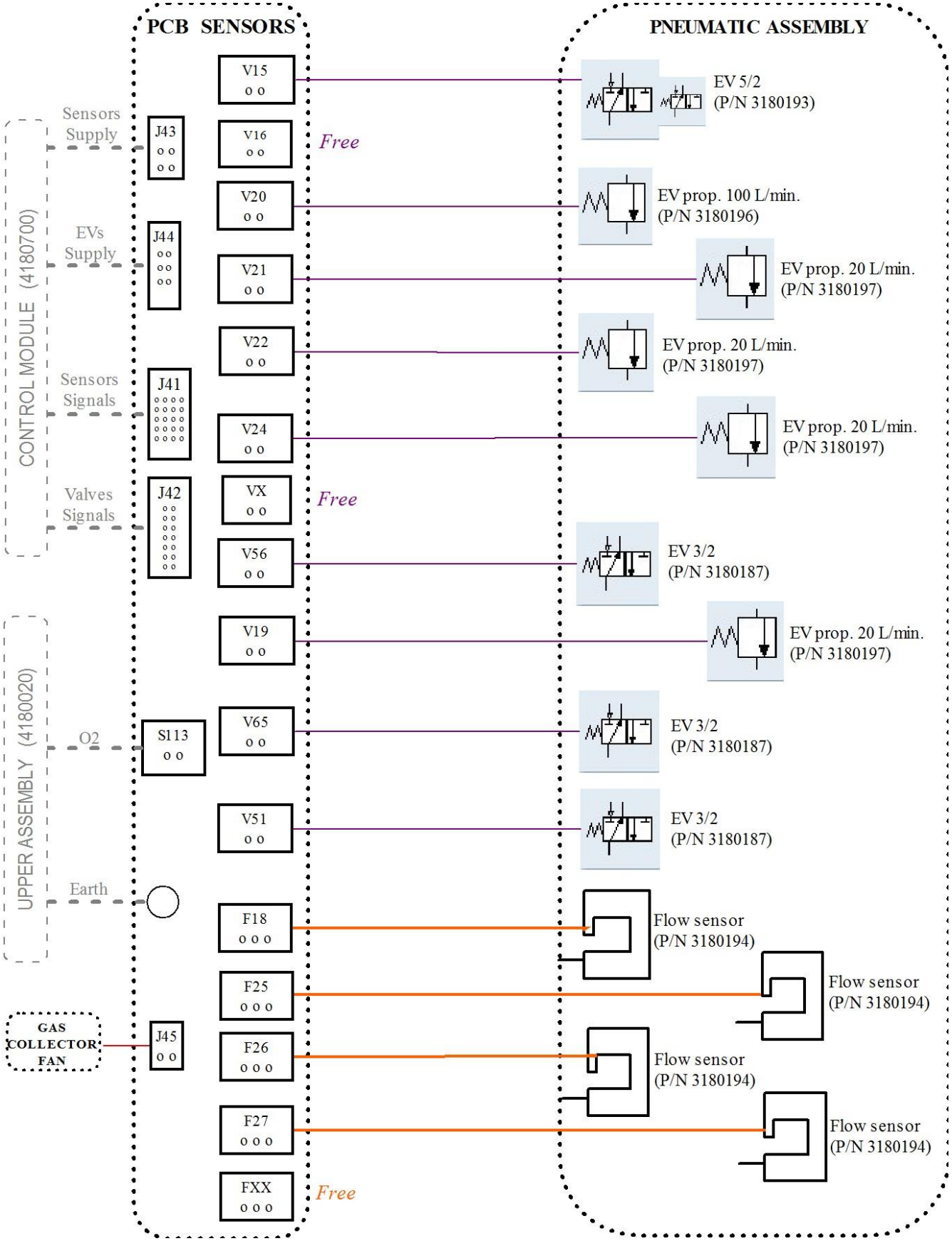
## 14.1. General electrical diagram



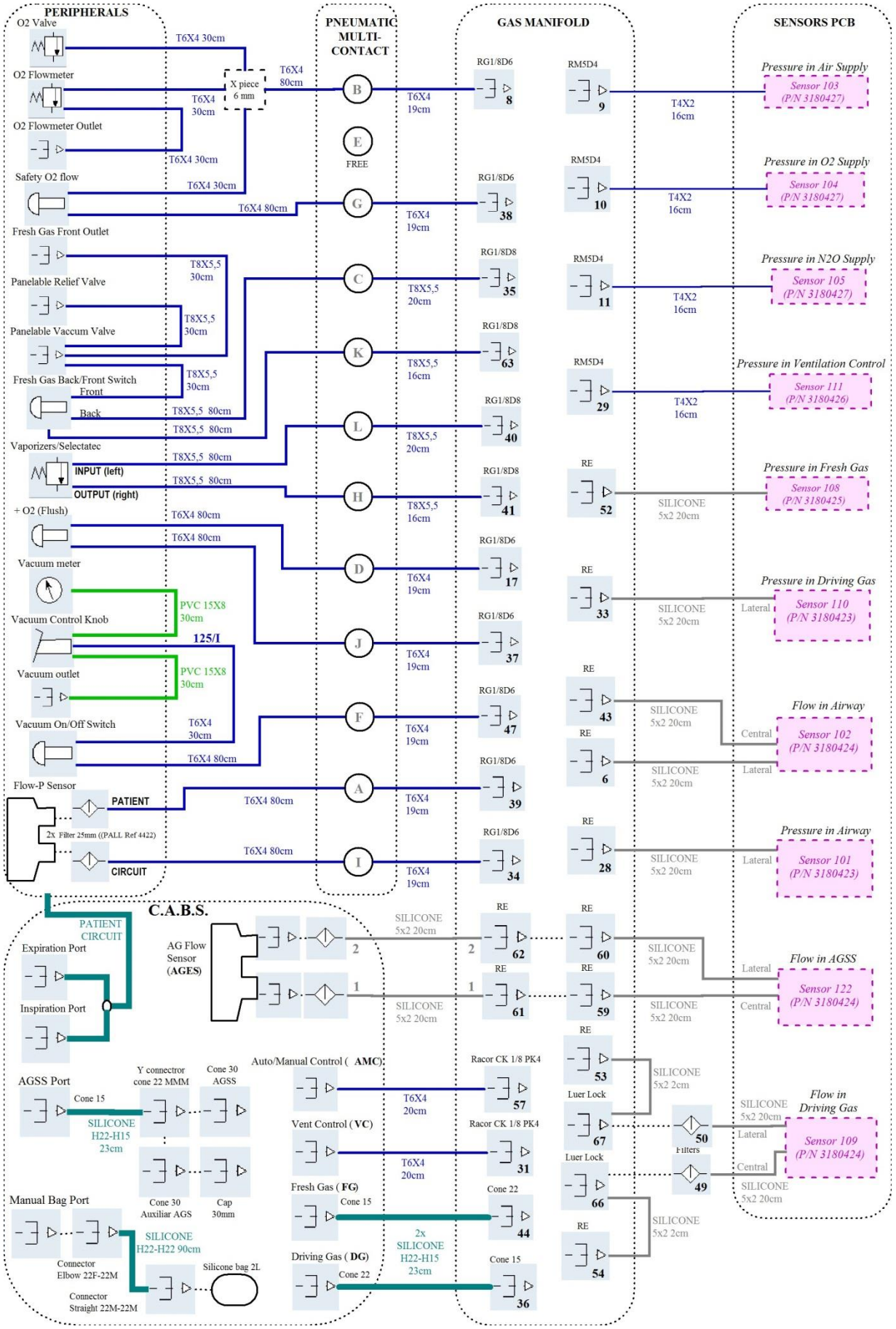
## 14.2. Control module - electrical diagram



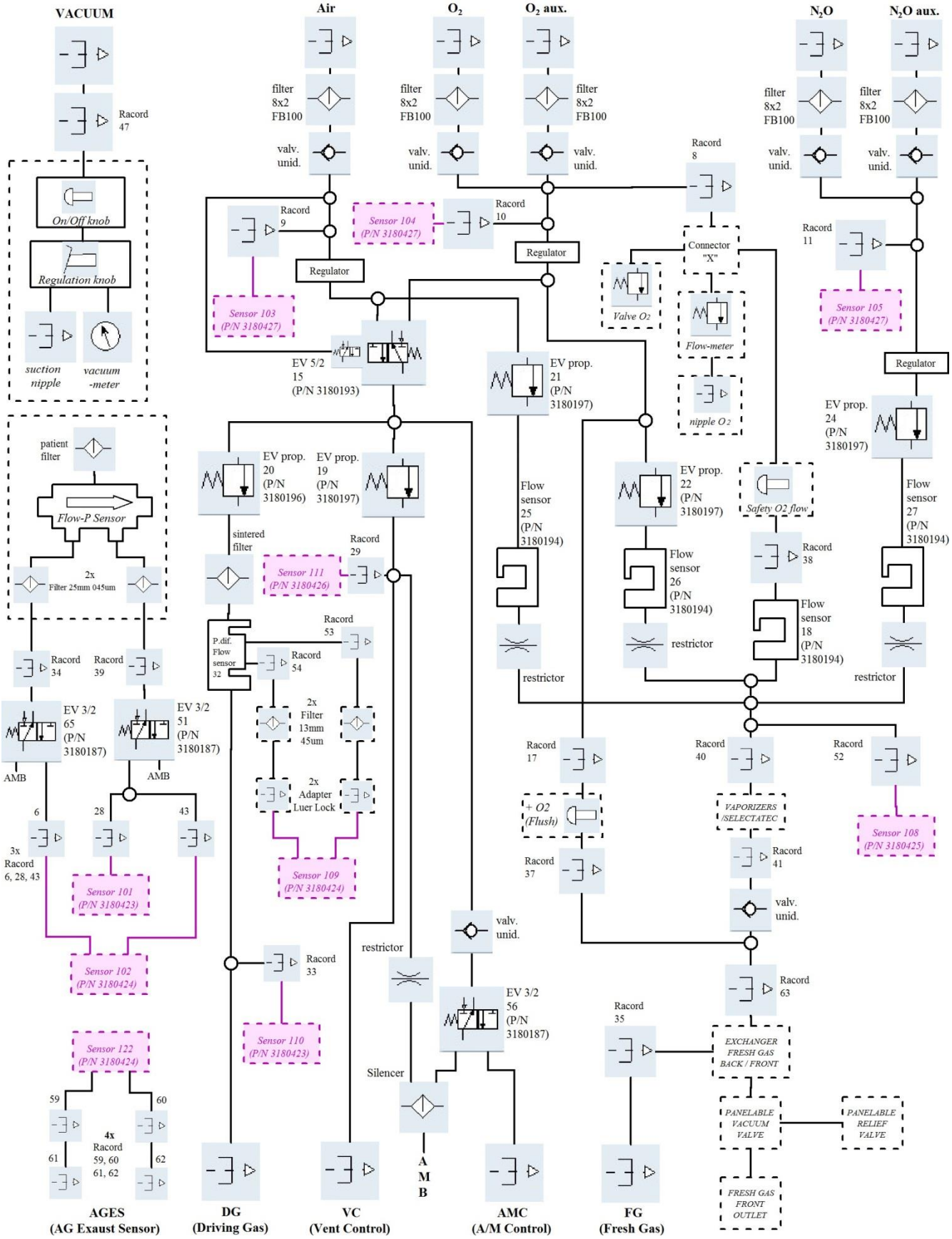
## 14.3. Gas manifold – electrical diagram



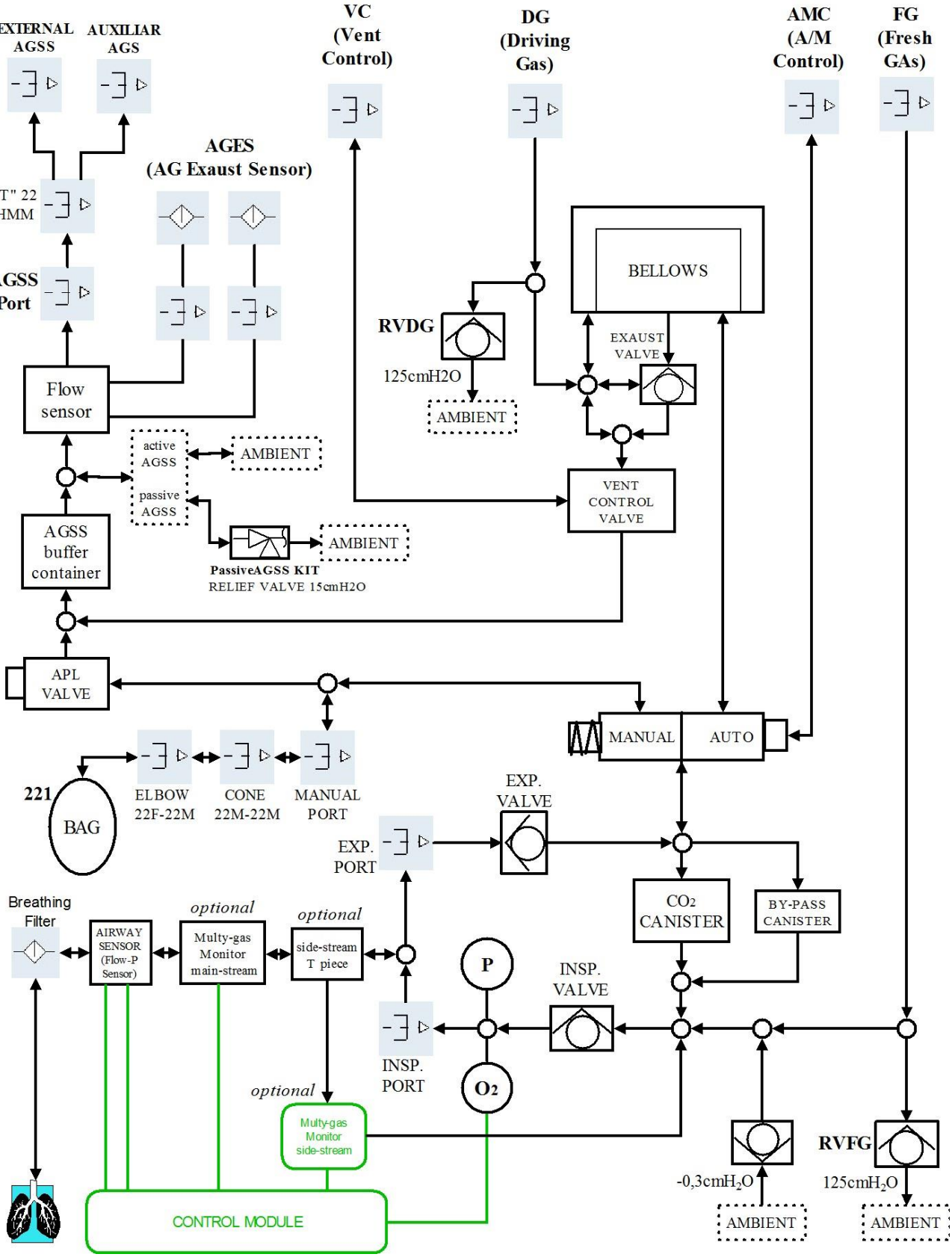
## 14.4. General pneumatic diagram



## 14.5. Gas manifold - pneumatic diagram



## 14.6. Breathing system - pneumatic diagram



# 15. Troubleshooting trees

**WARNING**

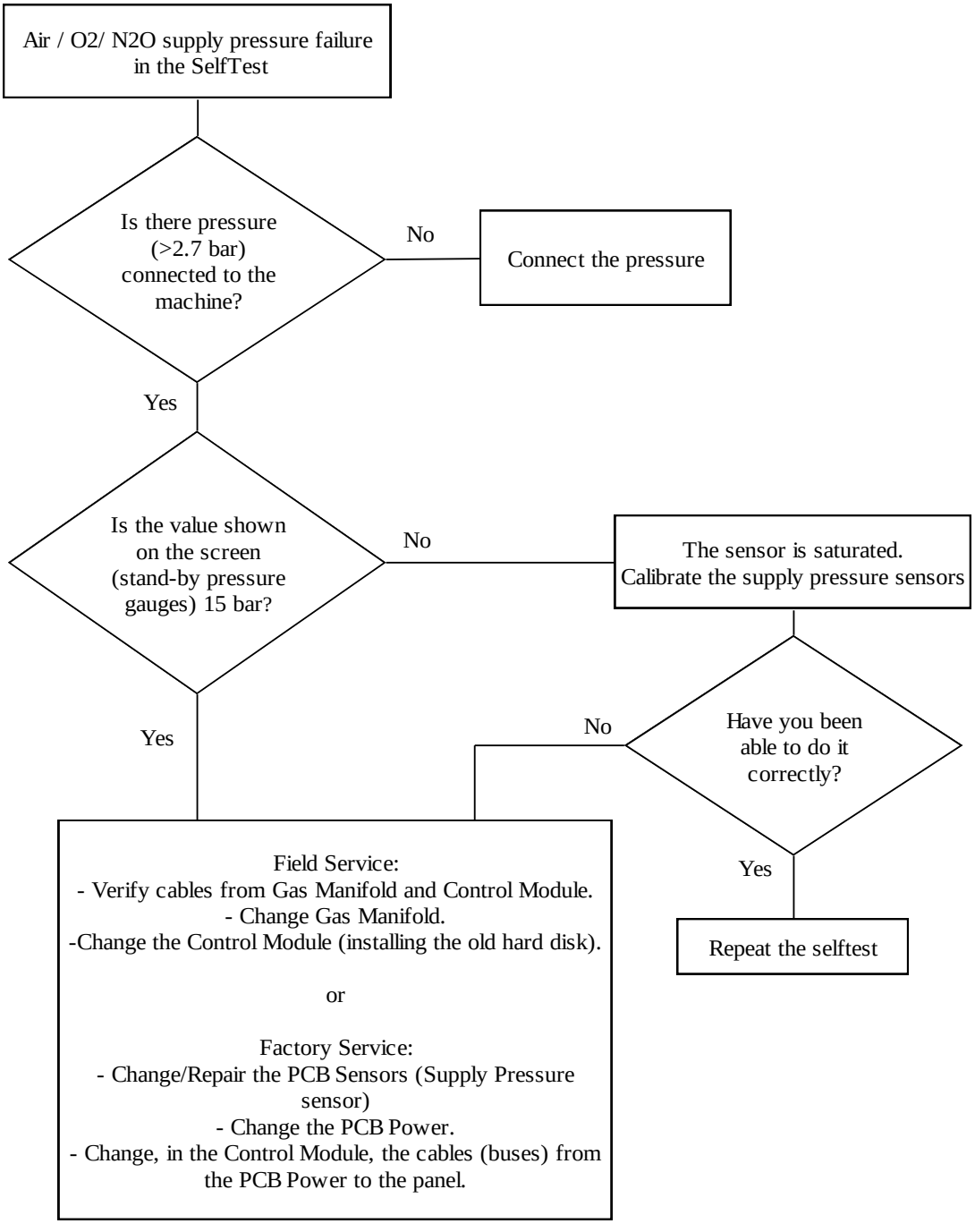
**After of finishing any troubleshooting procedure, involving hardware and parts changes or repairs, it is compulsory to proceed with the corresponding Electrical Safety Test (PICM 59.1 or according to national or local regulations).**

**NOTE**

**After of finishing any troubleshooting procedure, involving hardware and parts changes or repairs, it is needed to proceed with the corresponding calibration (see chapter 7).**

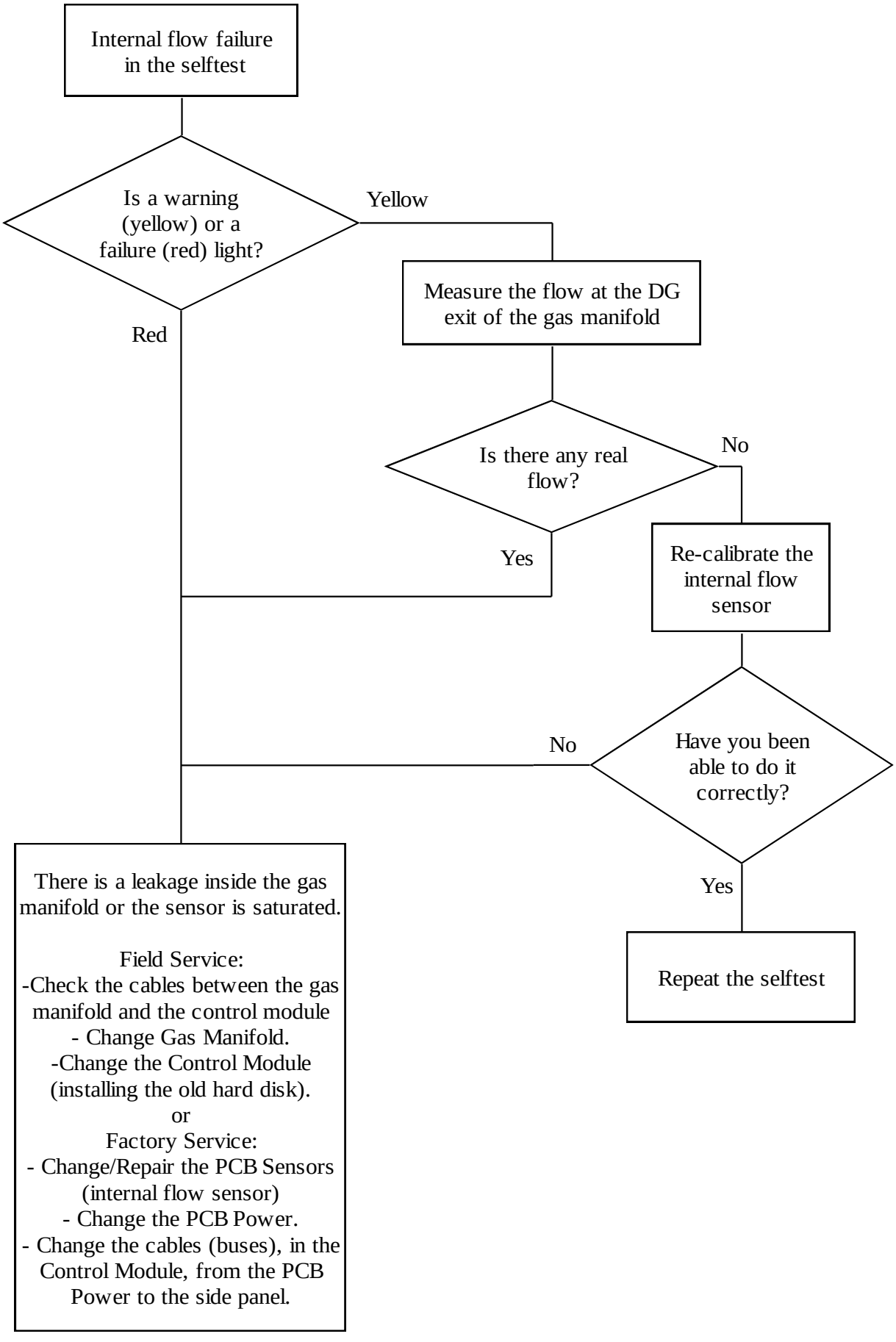
## 15.1. Air / O2 / N2O supply pressure failure

Autotest 1, 2 and 3



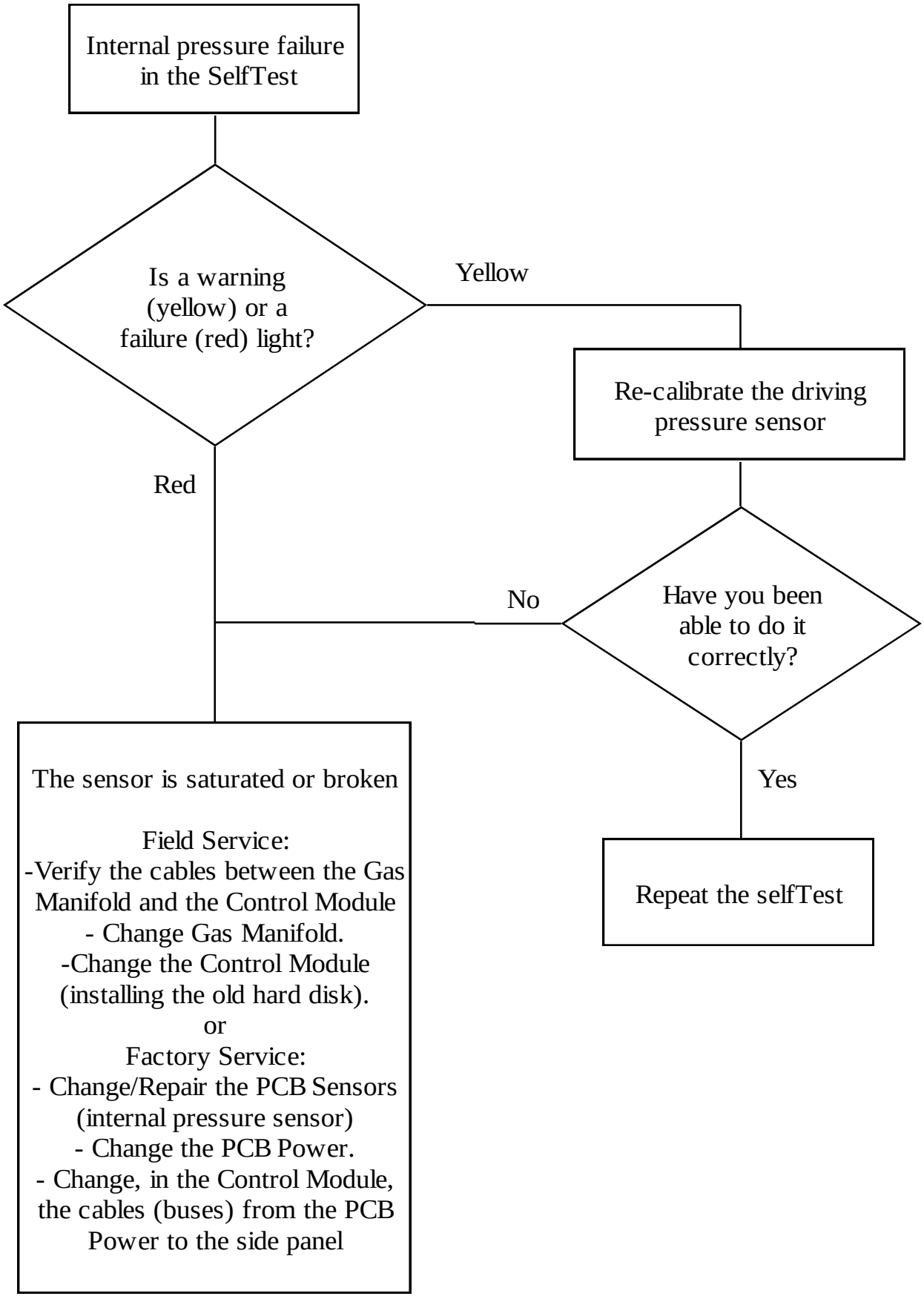
## 15.2. Internal flow failure

Autotest 4



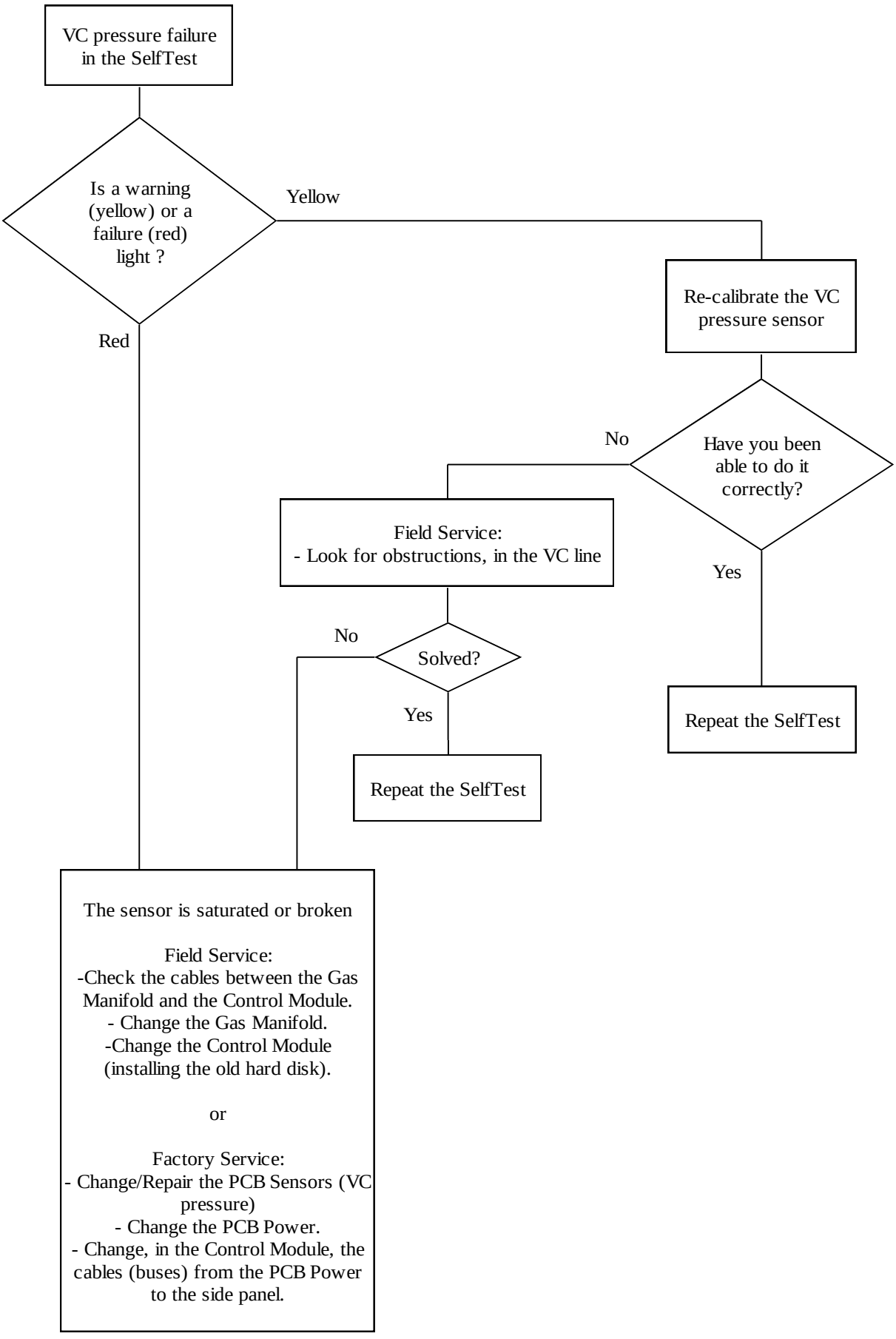
## 15.3. Internal pressure failure

Autotest 5



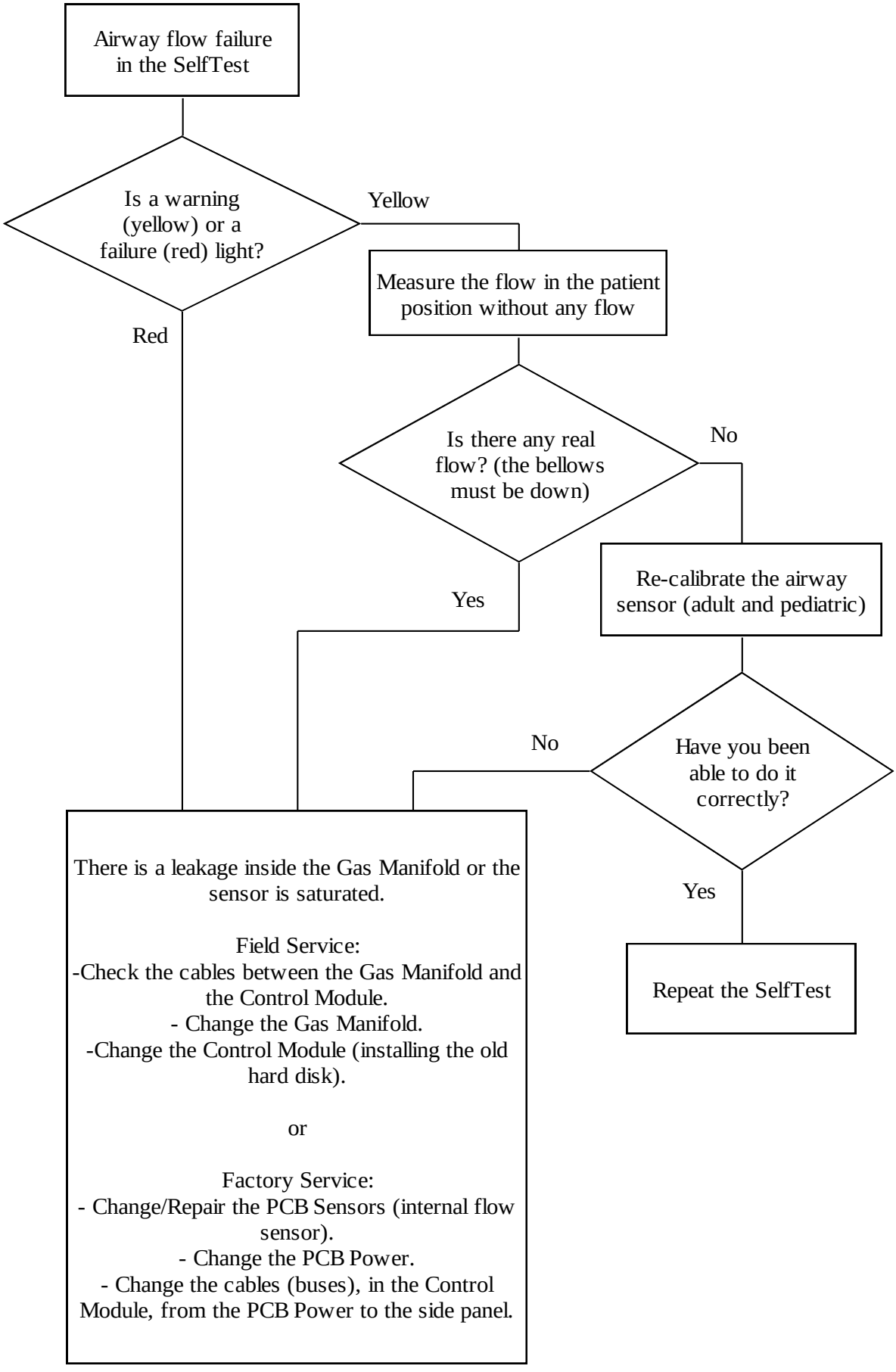
## 15.4. VC pressure failure

Autotest 6

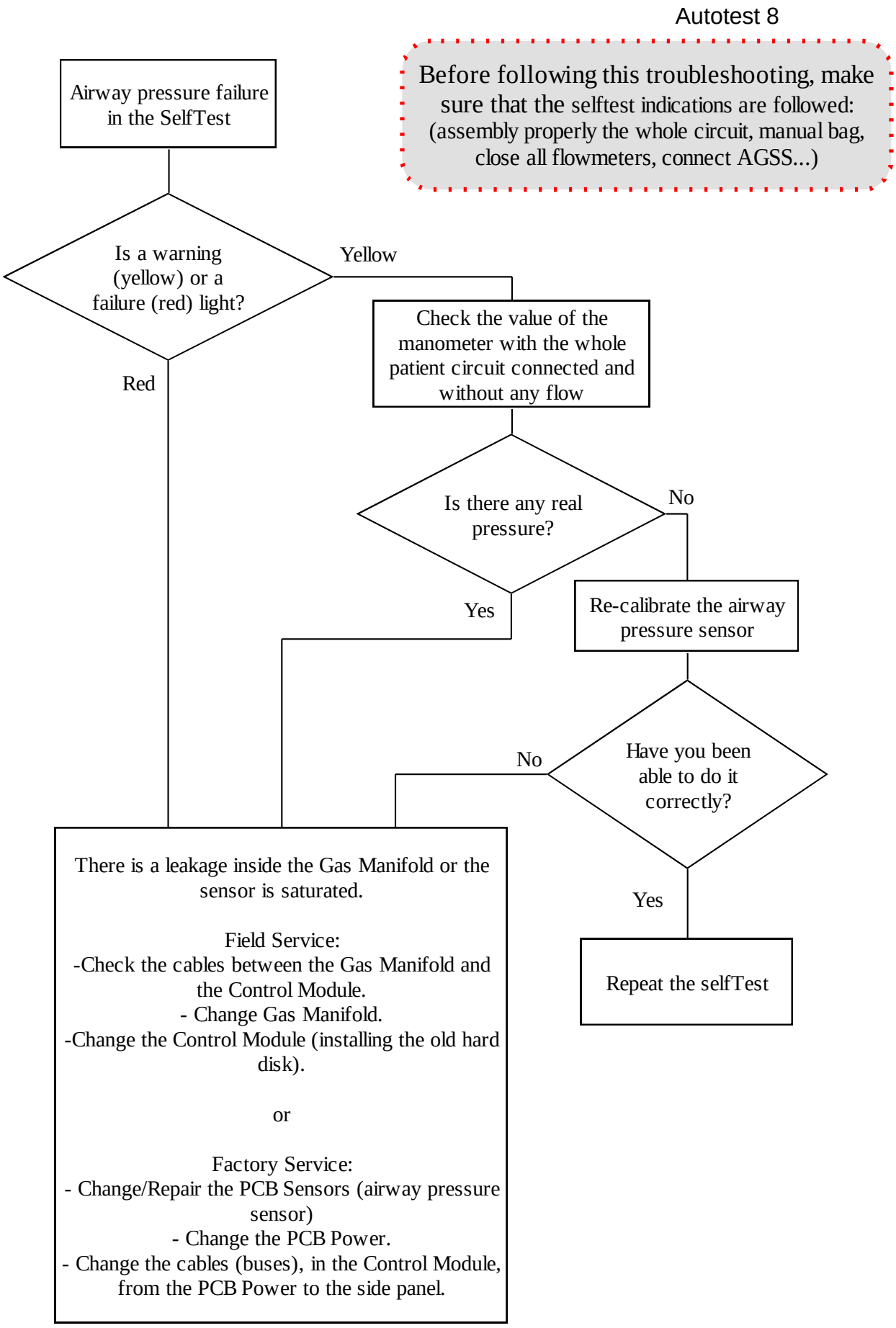


## 15.5. Airway flow failure

Autotest 7

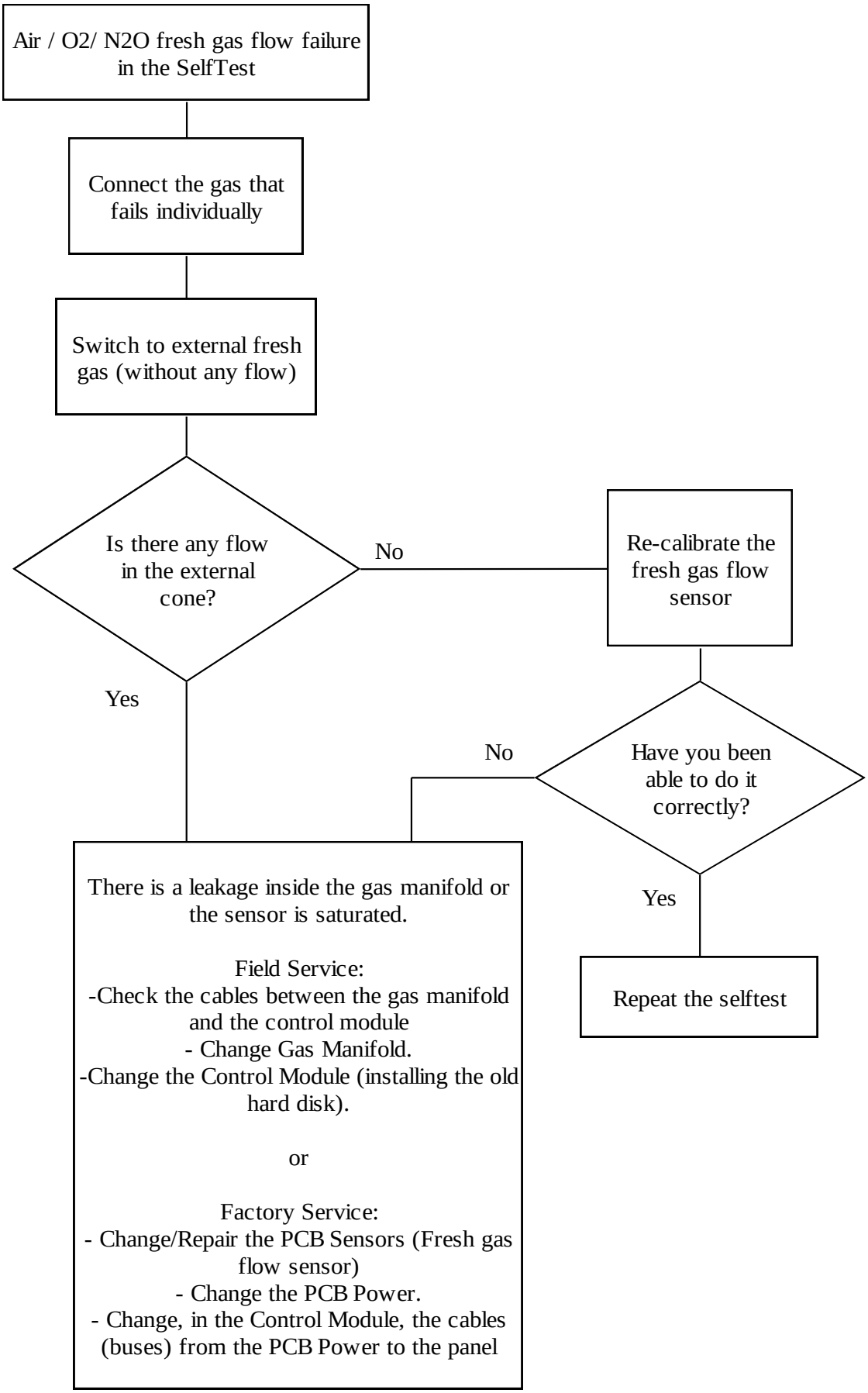


## 15.6. Airway pressure failure



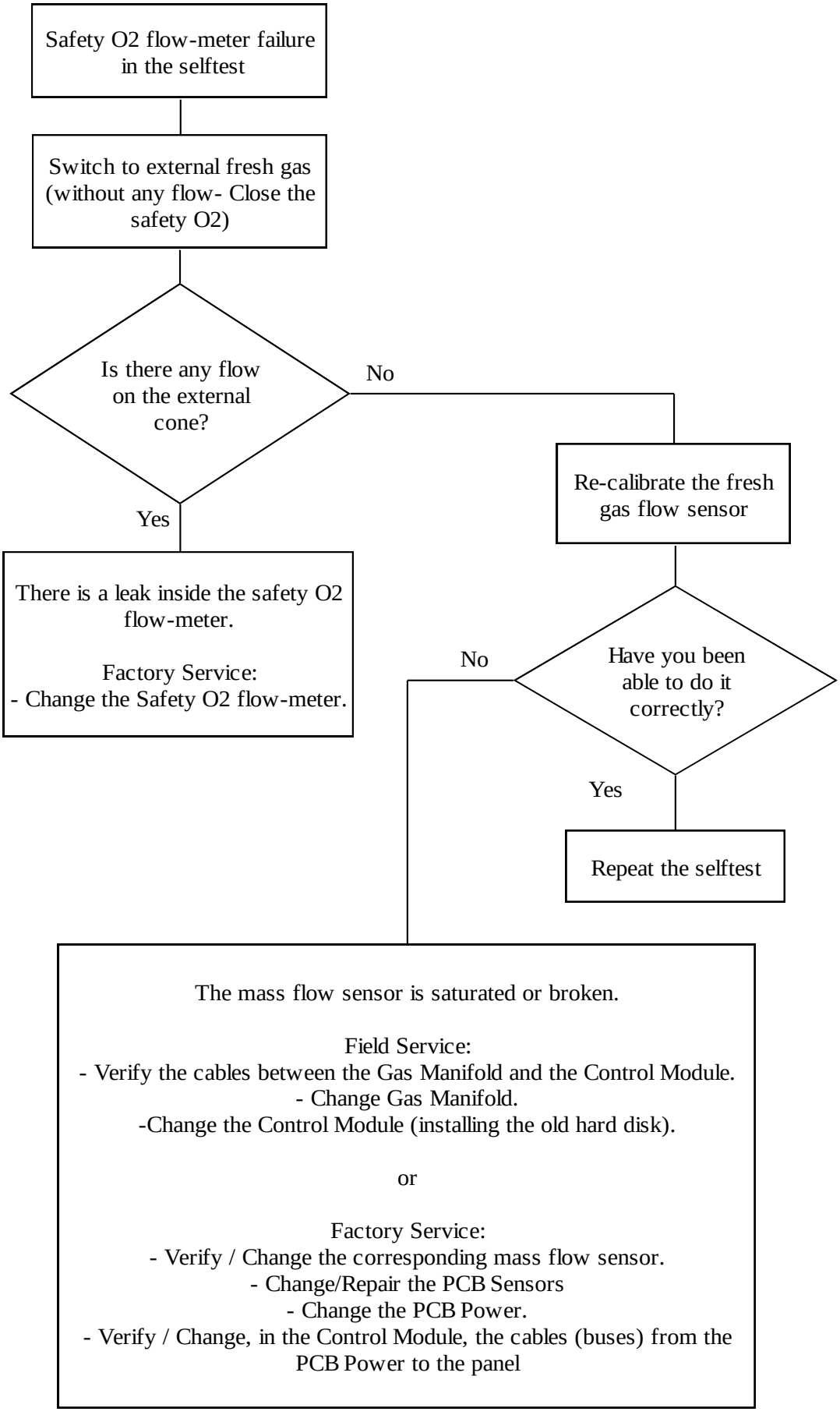
## 15.7. Air / O2 / N2O fresh gas flow failure

Autotest 9, 10 and 11



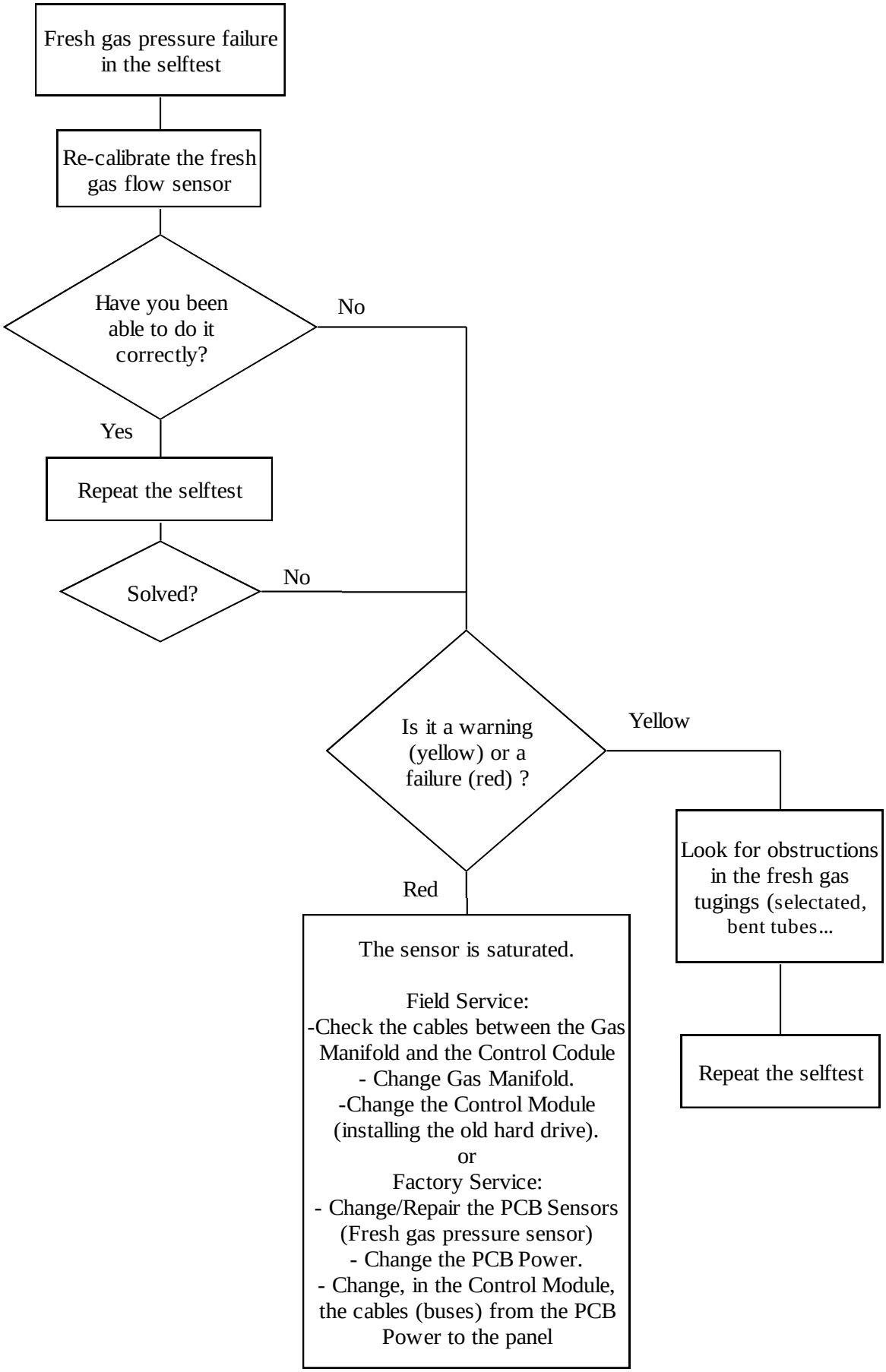
## 15.8. Safety O2 flow-meter failure

Autotest 12



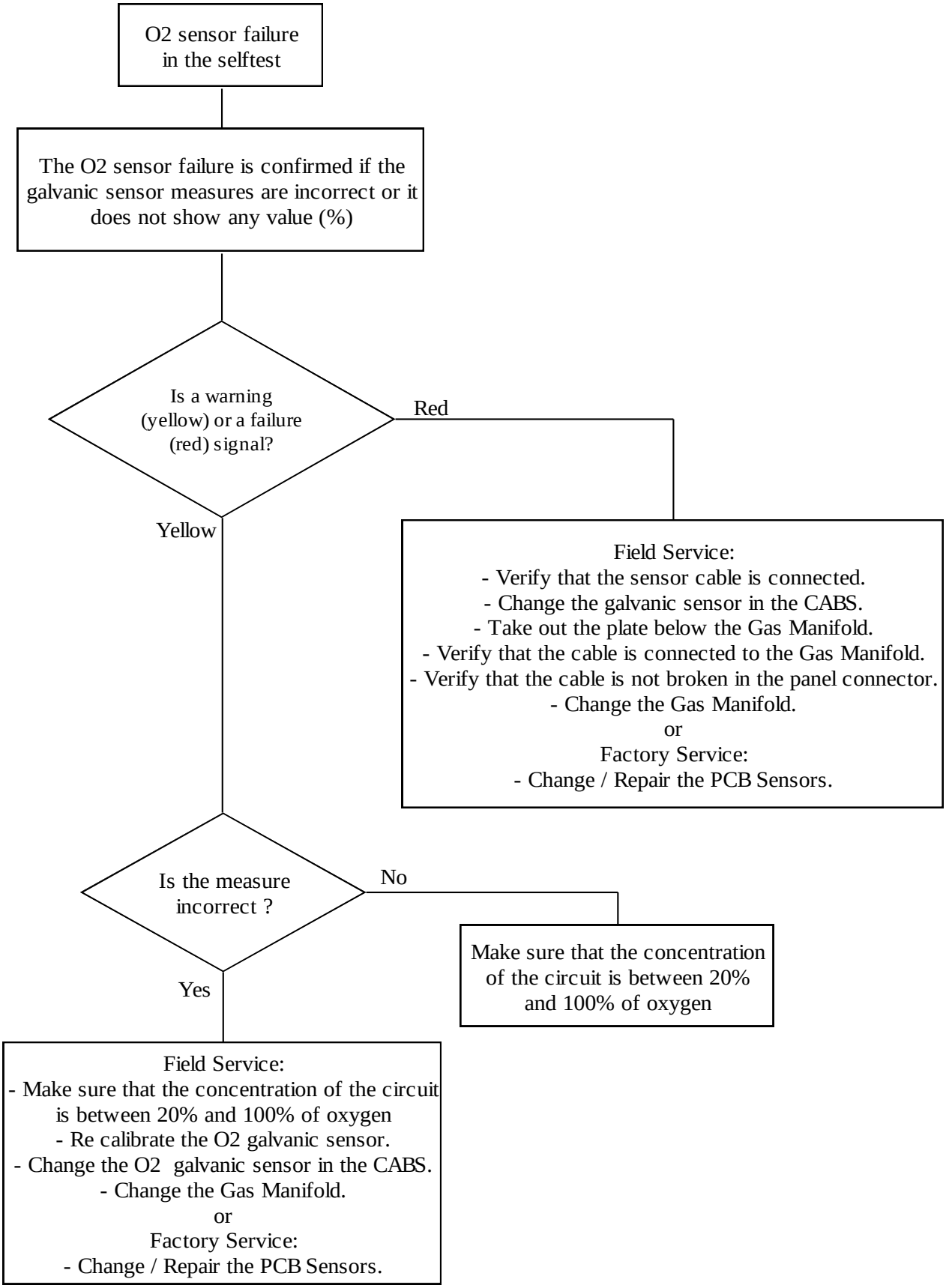
## 15.9. Fresh gas pressure failure

Autotest 13



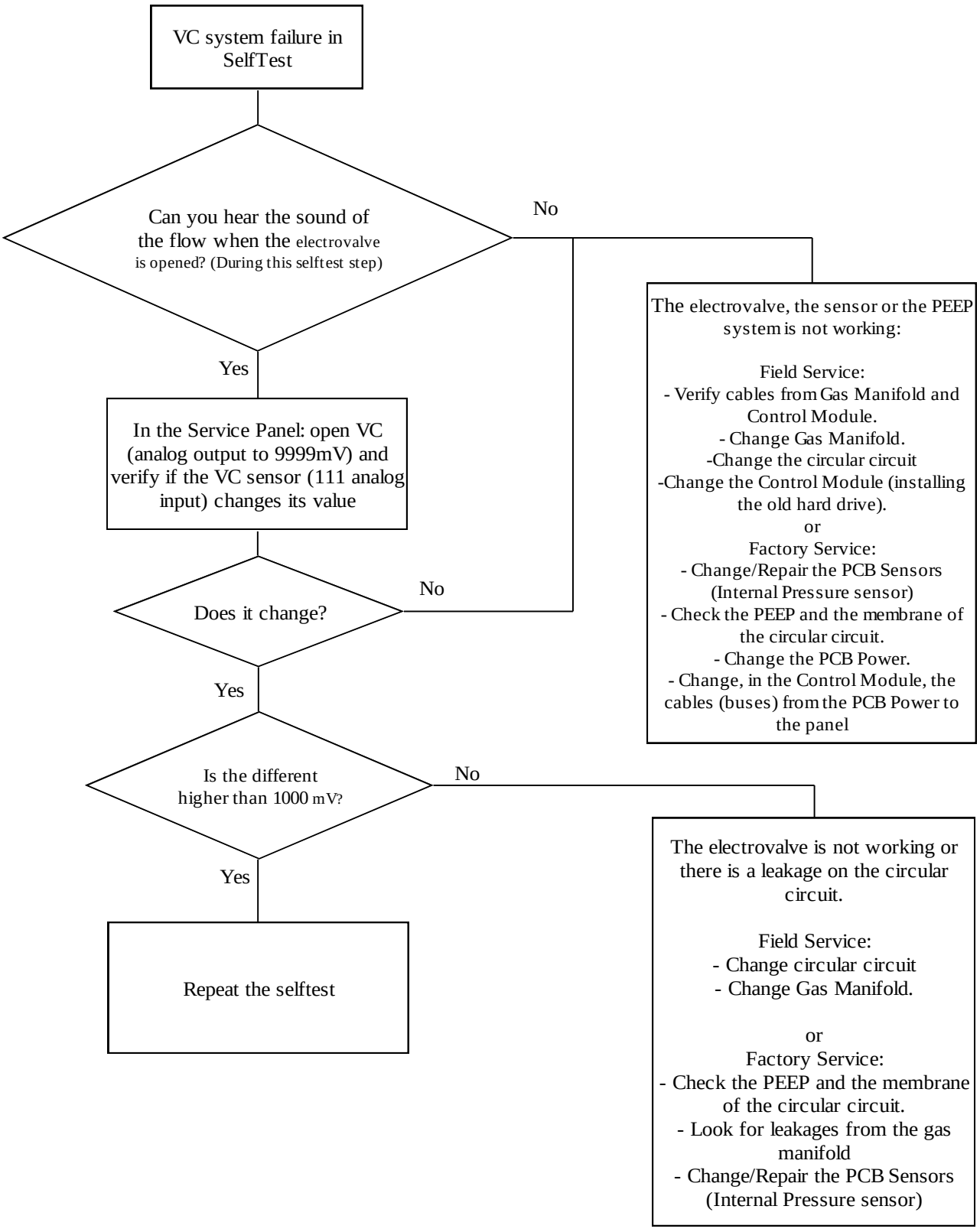
## 15.10. O2 sensor failure

Autotest 14



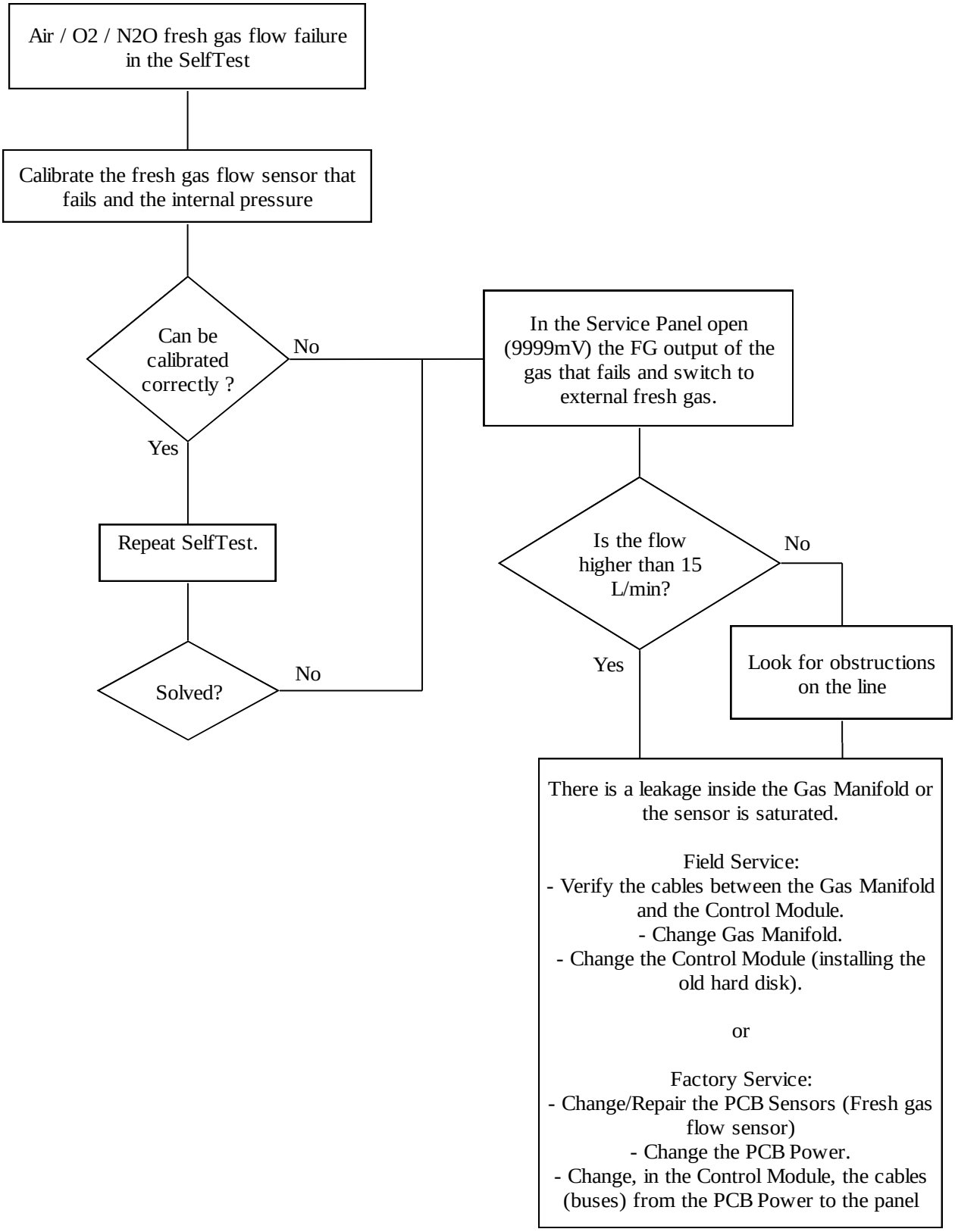
## 15.11. VC system failure

Autotest 15

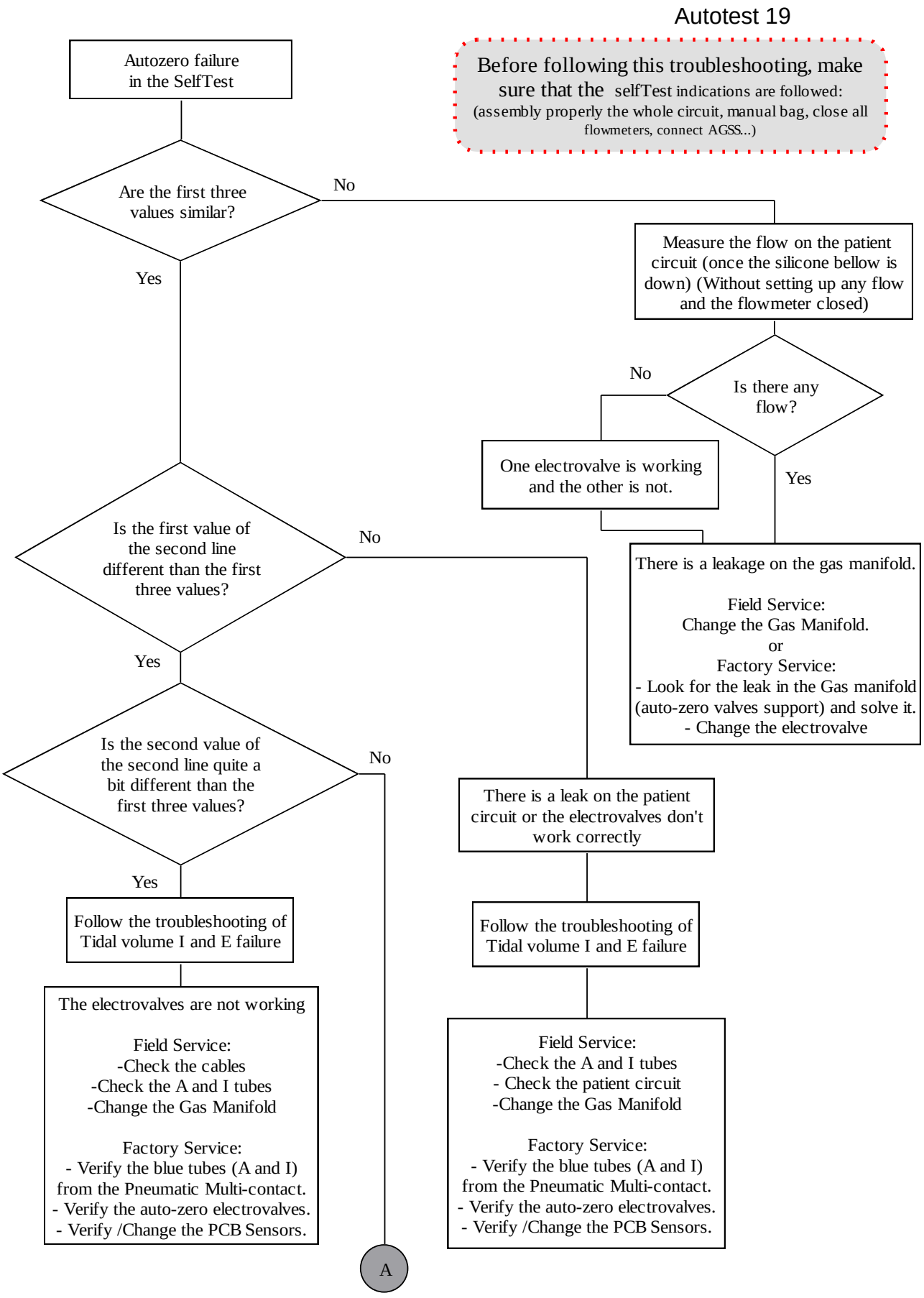


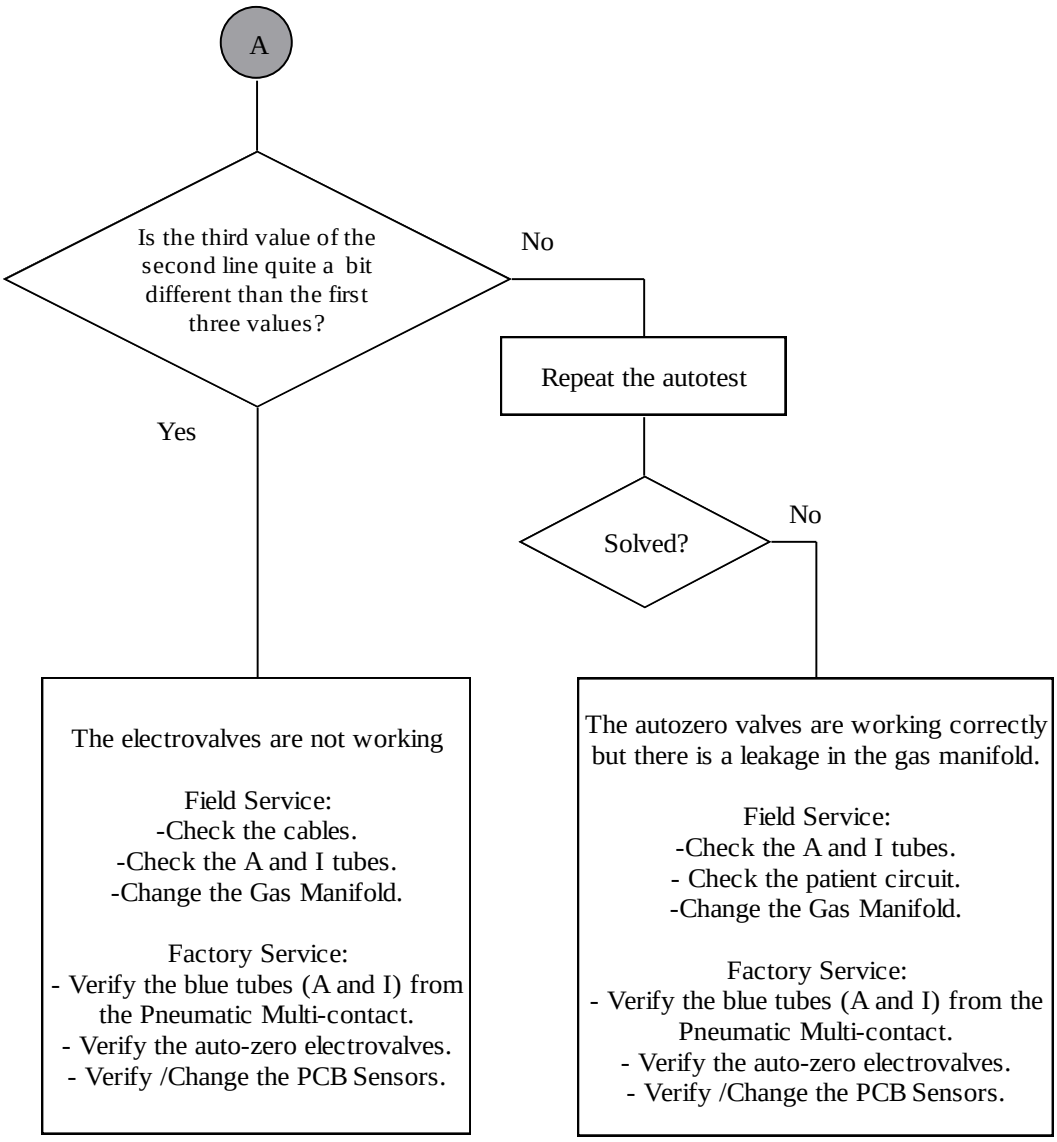
## 15.12. Air / O2 / N2O fresh gas flow failure

Autotest 16, 17 and 18



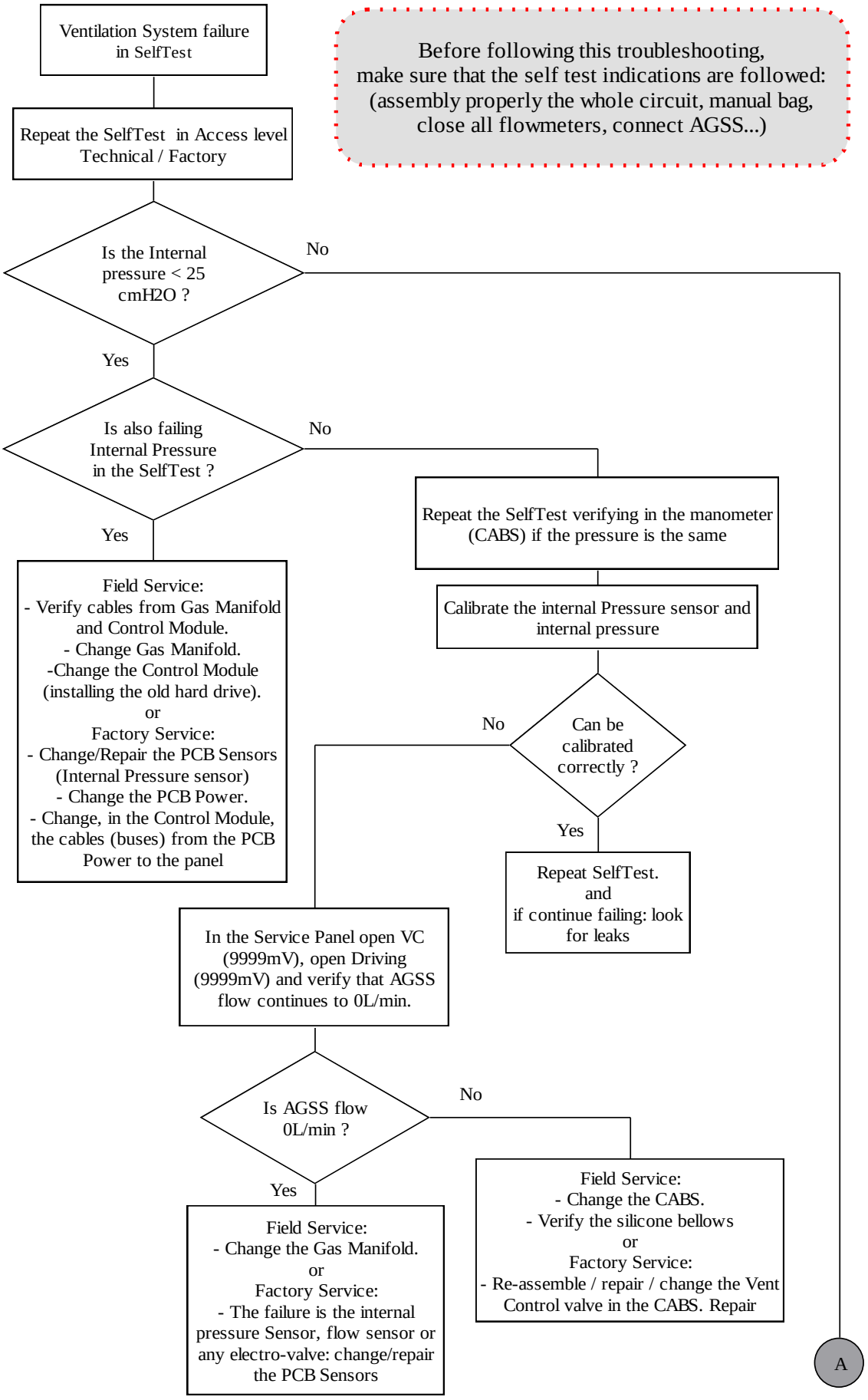
## 15.13. Autozero failure

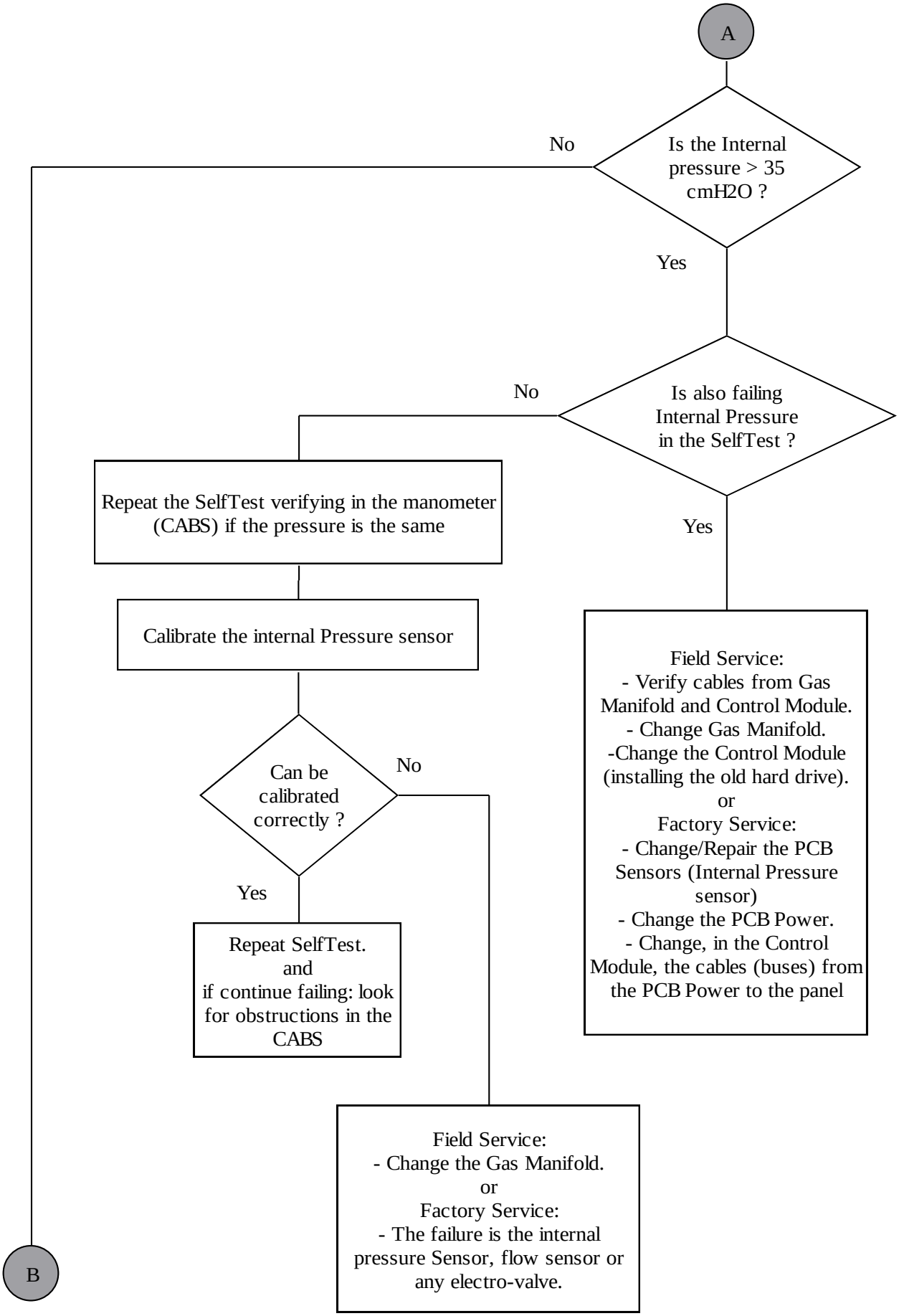


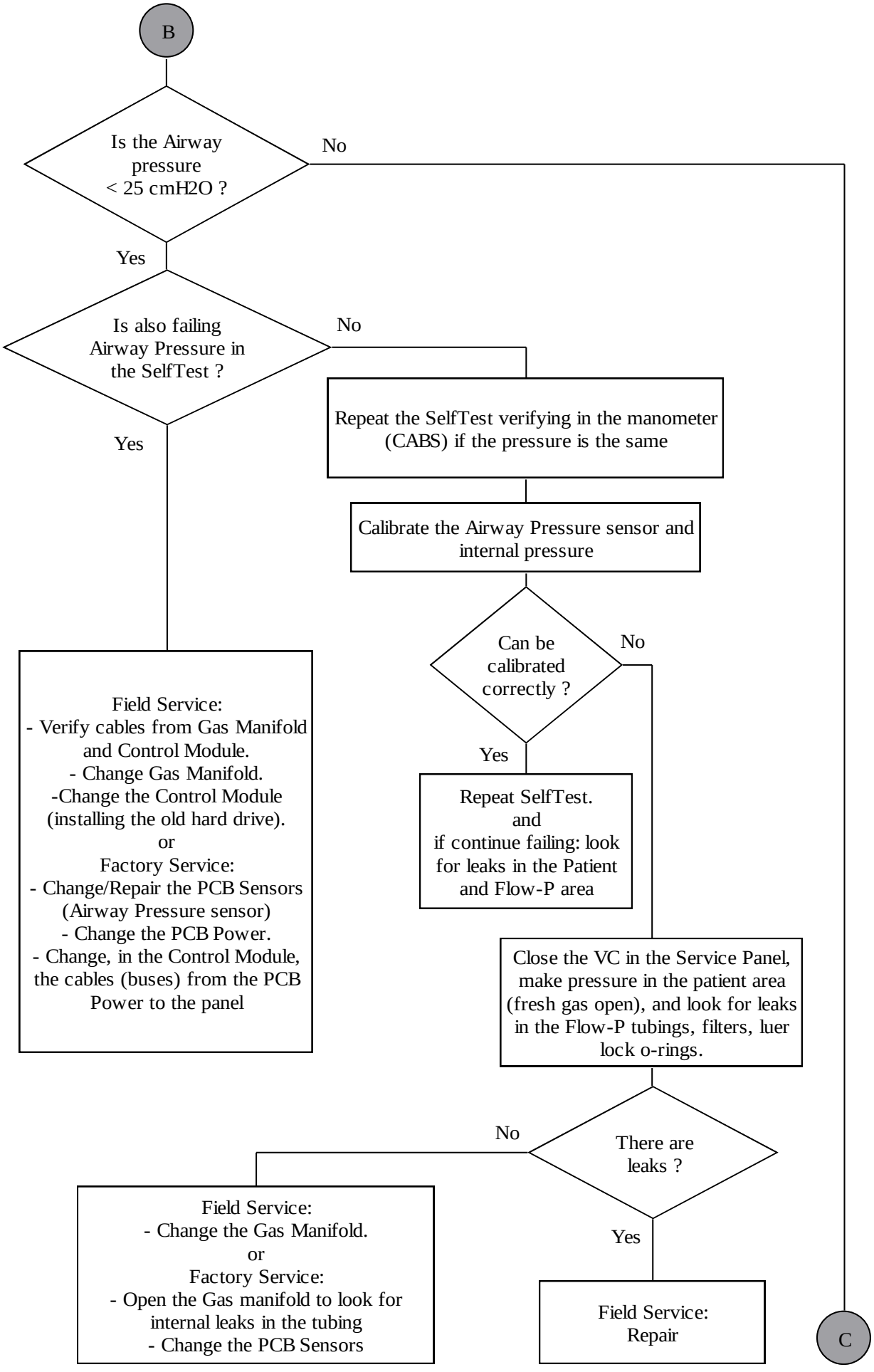

A
Is the third value of the second line quite a bit different than the first three values?
No
Repeat the autotest
Yes
Solved?
No
The electrovalves are not working
Field Service:
-Check the cables.
-Check the A and I tubes.
-Change the Gas Manifold.
Factory Service:
- Verify the blue tubes (A and I) from the Pneumatic Multi-contact.
- Verify the auto-zero electrovalves.
- Verify /Change the PCB Sensors.
The autozero valves are working correctly but there is a leakage in the gas manifold.
Field Service:
-Check the A and I tubes.
- Check the patient circuit.
-Change the Gas Manifold.
Factory Service:
- Verify the blue tubes (A and I) from the Pneumatic Multi-contact.
- Verify the auto-zero electrovalves.
- Verify /Change the PCB Sensors.

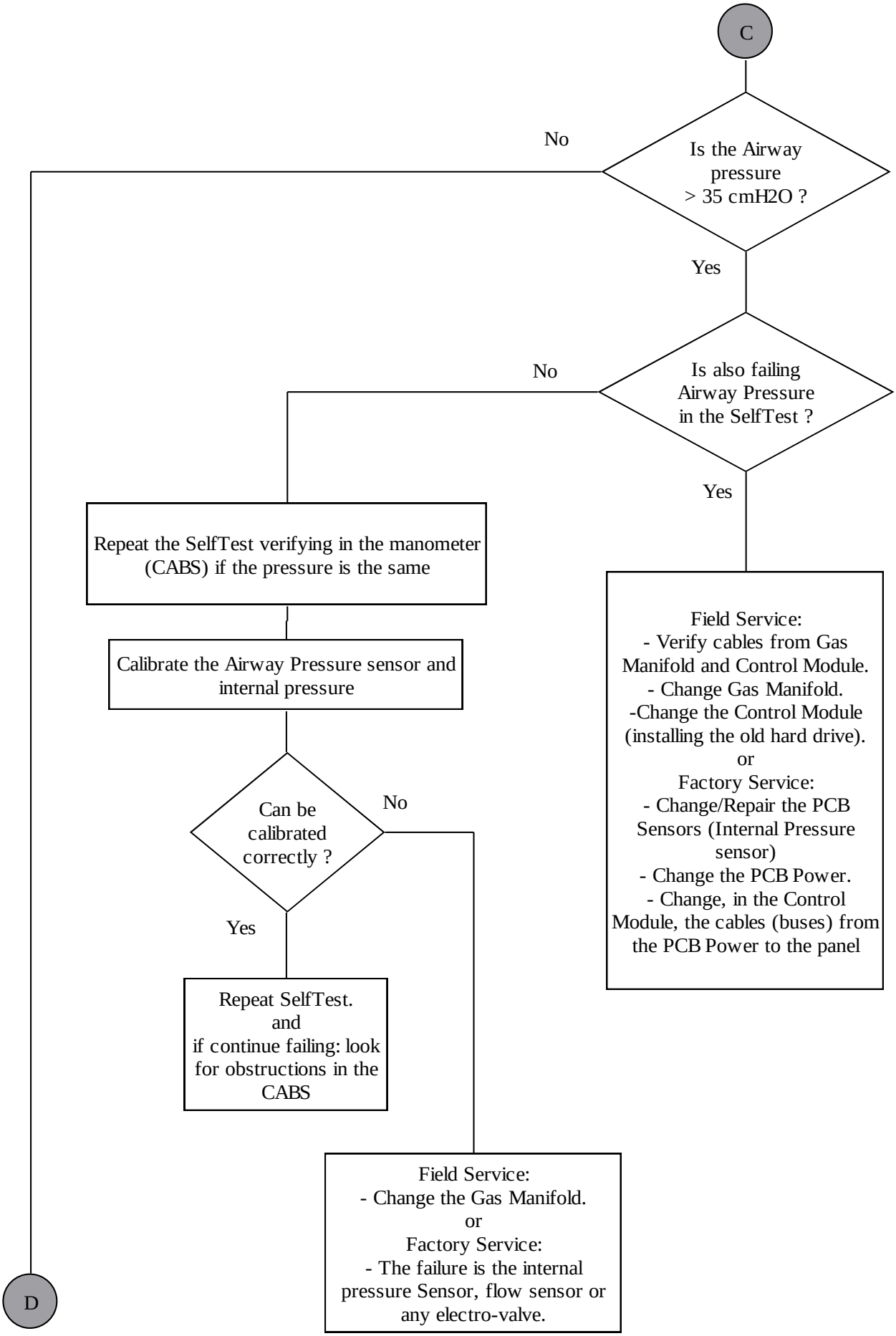
## 15.14. Ventilation System failure

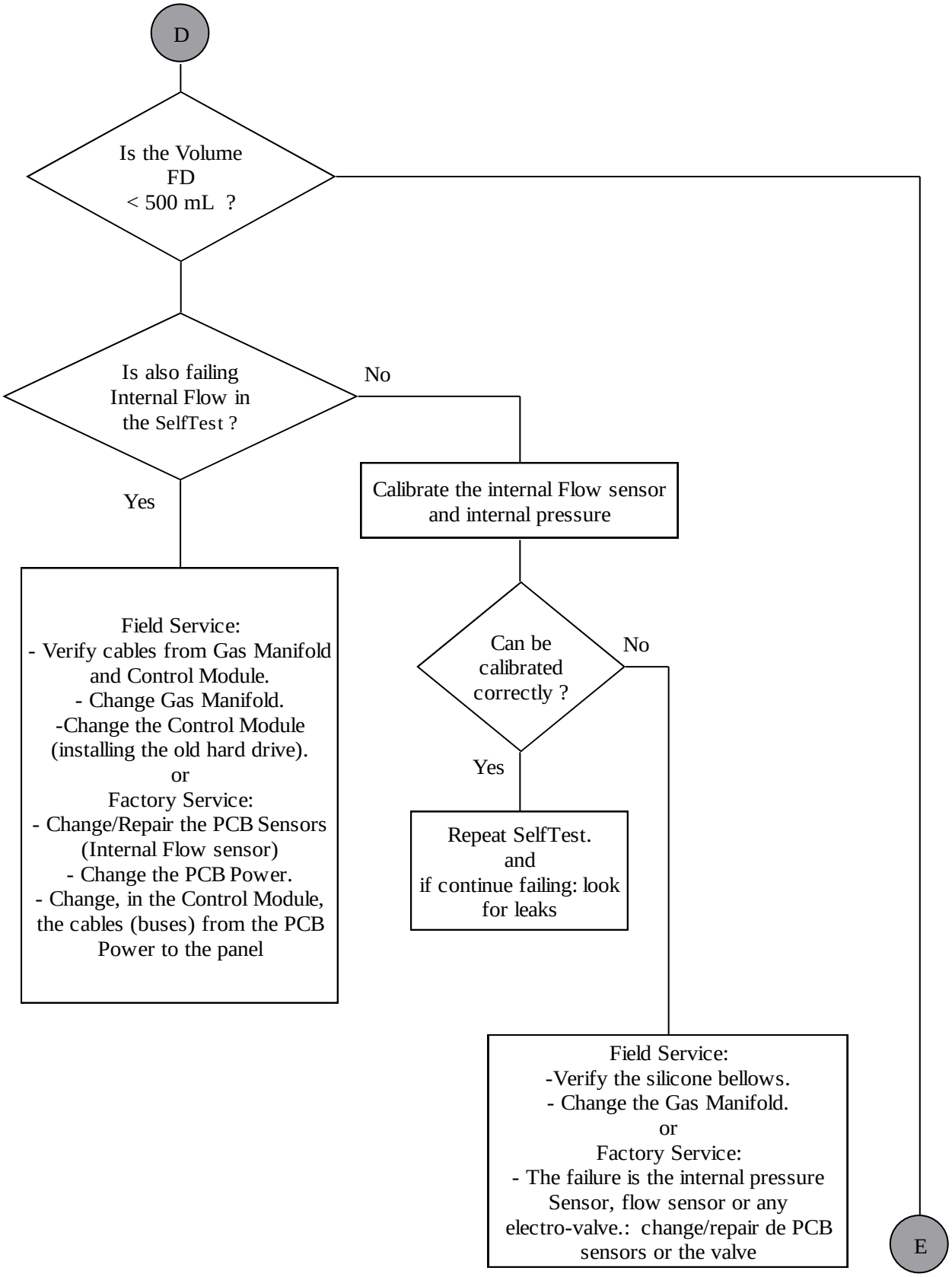
Autotest 20

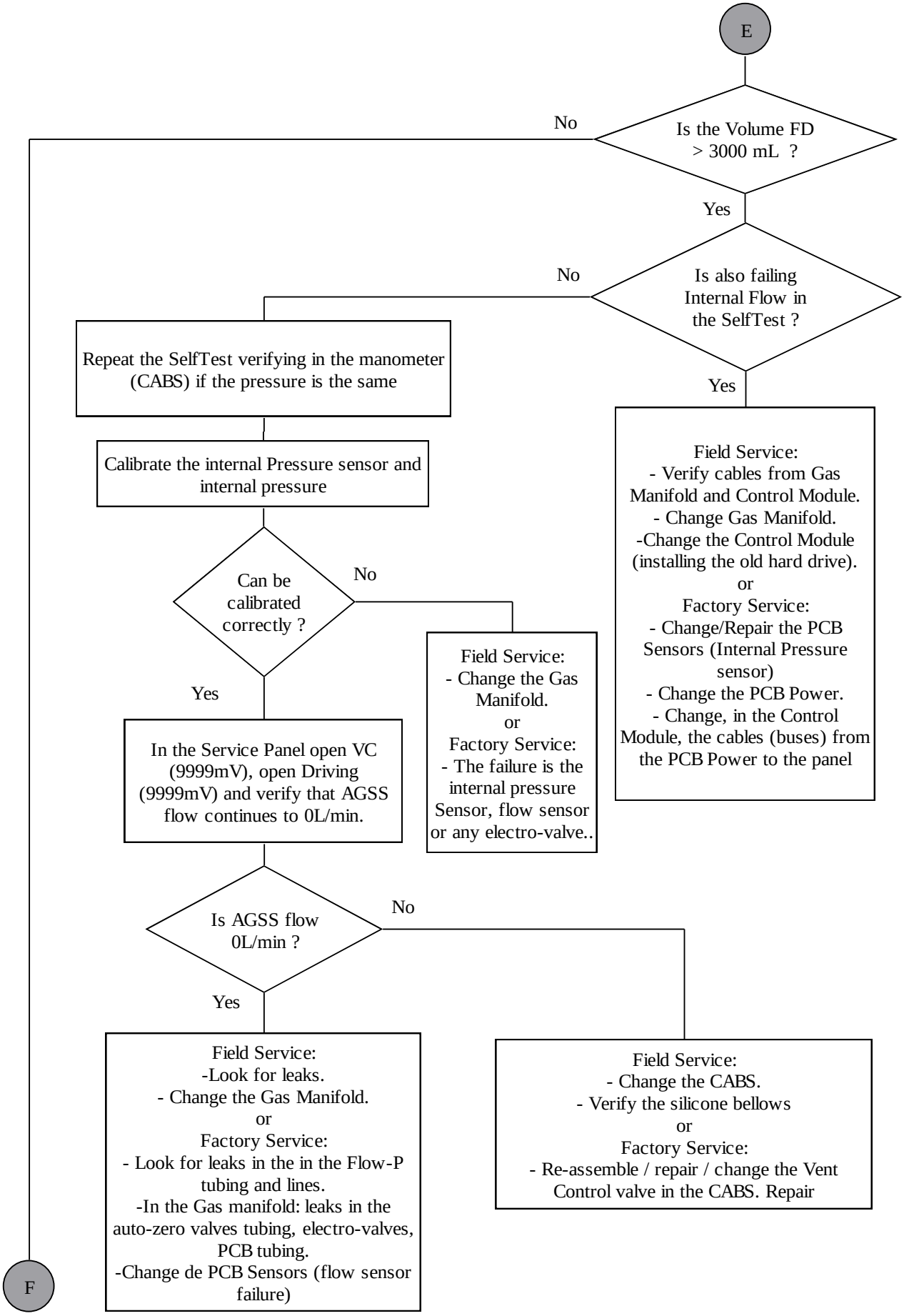


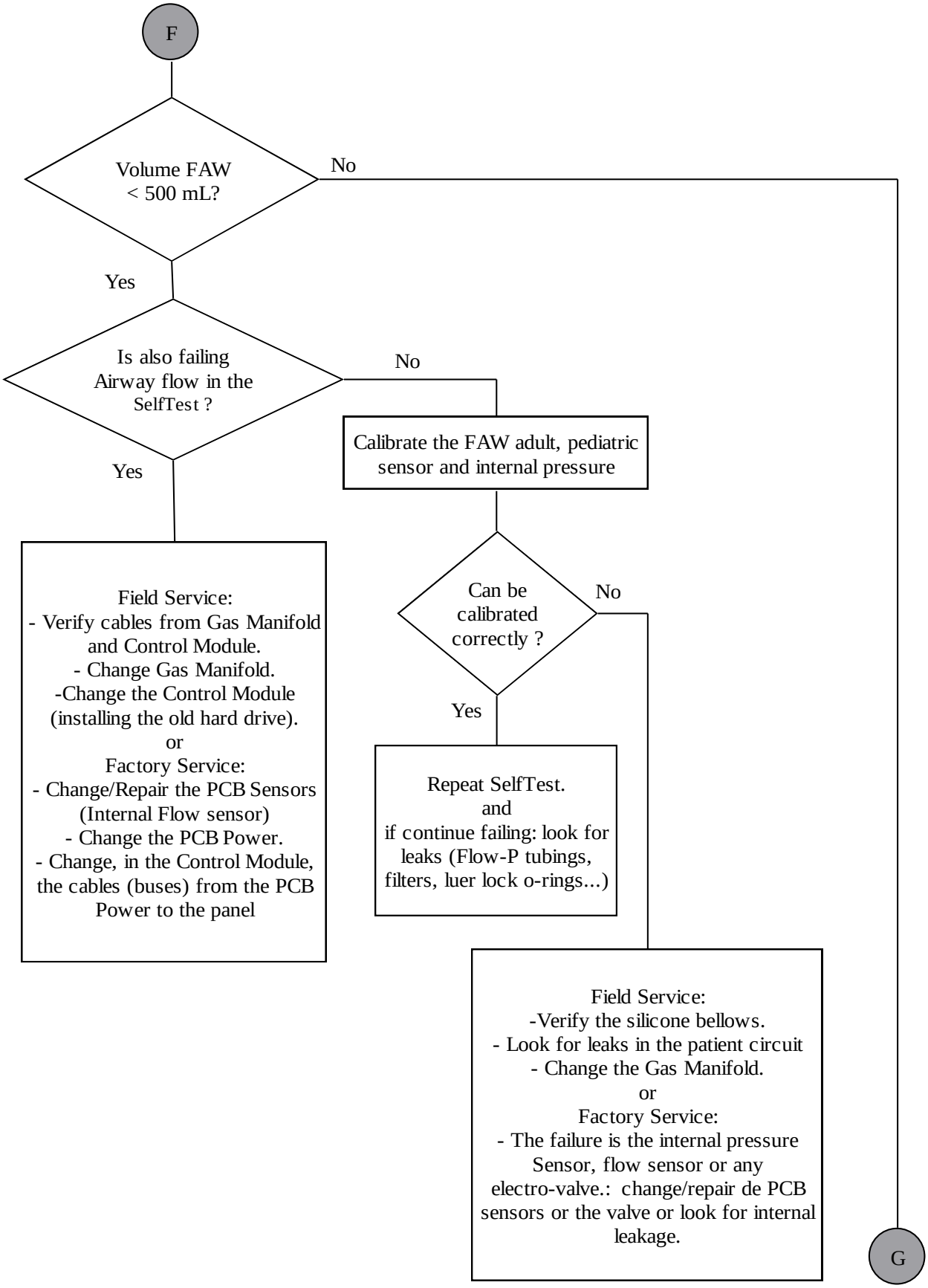

A
Is the Internal pressure > 35 cmH2O ?
No
Yes
Is also failing Internal Pressure in the SelfTest ?
No
Yes
Repeat the SelfTest verifying in the manometer (CABS) if the pressure is the same
Calibrate the internal Pressure sensor
Can be calibrated correctly ?
No
Yes
Repeat SelfTest. and if continue failing: look for obstructions in the CABS
Field Service: - Verify cables from Gas Manifold and Control Module. - Change Gas Manifold. -Change the Control Module (installing the old hard drive). or Factory Service: - Change/Repair the PCB Sensors (Internal Pressure sensor) - Change the PCB Power. - Change, in the Control Module, the cables (buses) from the PCB Power to the panel
Field Service: - Change the Gas Manifold. or Factory Service: - The failure is the internal pressure Sensor, flow sensor or any electro-valve.
B

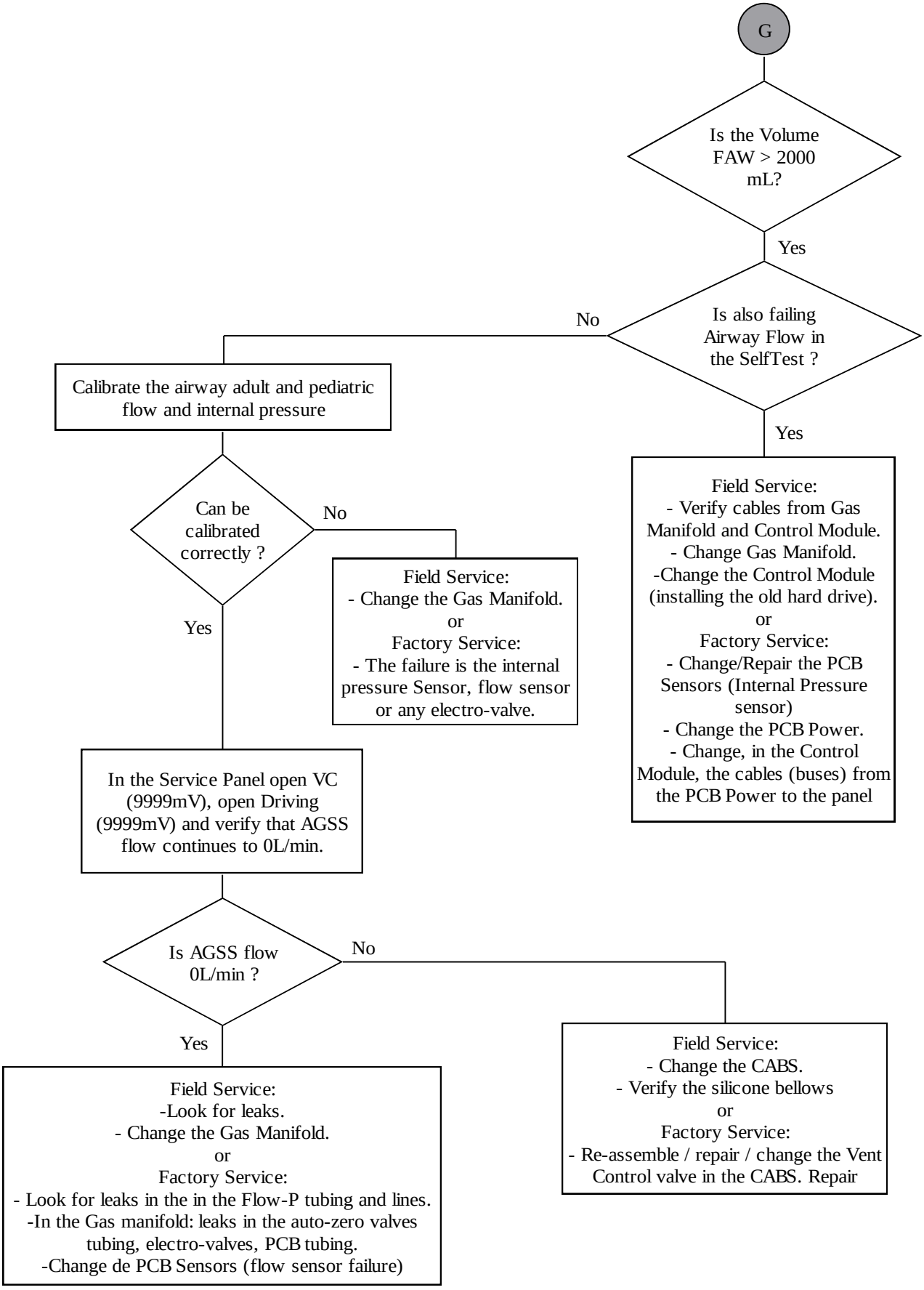

B
Is the Airway pressure < 25 cmH2O ?
No
Yes
Is also failing Airway Pressure in the SelfTest ?
No
Yes
Repeat the SelfTest verifying in the manometer (CABS) if the pressure is the same
Calibrate the Airway Pressure sensor and internal pressure
Can be calibrated correctly ?
No
Yes
Repeat SelfTest. and if continue failing: look for leaks in the Patient and Flow-P area
Field Service:
- Verify cables from Gas Manifold and Control Module.
- Change Gas Manifold.
-Change the Control Module (installing the old hard drive).
or
Factory Service:
- Change/Repair the PCB Sensors (Airway Pressure sensor)
- Change the PCB Power.
- Change, in the Control Module, the cables (buses) from the PCB Power to the panel
Close the VC in the Service Panel, make pressure in the patient area (fresh gas open), and look for leaks in the Flow-P tubings, filters, luer lock o-rings.
No
There are leaks ?
Yes
Field Service:
- Change the Gas Manifold.
or
Factory Service:
- Open the Gas manifold to look for internal leaks in the tubing
- Change the PCB Sensors
Field Service:
Repair
C


C
Is the Airway pressure > 35 cmH2O ?
No
Yes
Is also failing Airway Pressure in the SelfTest ?
No
Yes
Repeat the SelfTest verifying in the manometer (CABS) if the pressure is the same
Calibrate the Airway Pressure sensor and internal pressure
Can be calibrated correctly ?
No
Yes
Repeat SelfTest. and if continue failing: look for obstructions in the CABS
Field Service: - Verify cables from Gas Manifold and Control Module. - Change Gas Manifold. -Change the Control Module (installing the old hard drive). or Factory Service: - Change/Repair the PCB Sensors (Internal Pressure sensor) - Change the PCB Power. - Change, in the Control Module, the cables (buses) from the PCB Power to the panel
Field Service: - Change the Gas Manifold. or Factory Service: - The failure is the internal pressure Sensor, flow sensor or any electro-valve.
D

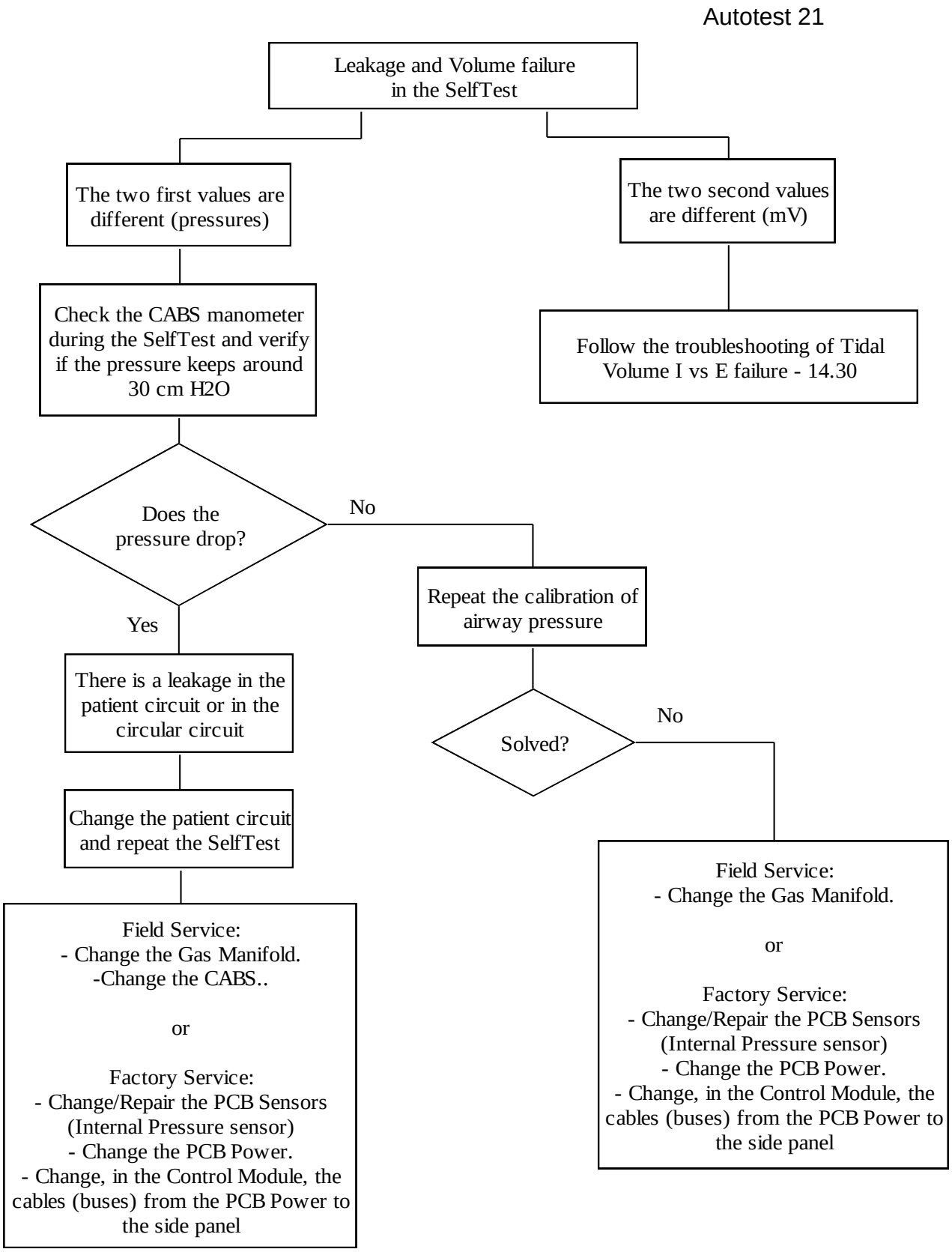

D
Is the Volume FD < 500 mL ?
Is also failing Internal Flow in the SelfTest ?
No
Yes
Calibrate the internal Flow sensor and internal pressure
Field Service:
- Verify cables from Gas Manifold and Control Module.
- Change Gas Manifold.
-Change the Control Module (installing the old hard drive).
or
Factory Service:
- Change/Repair the PCB Sensors (Internal Flow sensor)
- Change the PCB Power.
- Change, in the Control Module, the cables (buses) from the PCB Power to the panel
Can be calibrated correctly ?
No
Yes
Repeat SelfTest.
and
if continue failing: look for leaks
Field Service:
-Verify the silicone bellows.
- Change the Gas Manifold.
or
Factory Service:
- The failure is the internal pressure Sensor, flow sensor or any electro-valve.: change/repair de PCB sensors or the valve
E


E
Is the Volume FD > 3000 mL ?
No
Yes
Is also failing Internal Flow in the SelfTest ?
No
Yes
Repeat the SelfTest verifying in the manometer (CABS) if the pressure is the same
Field Service:
- Verify cables from Gas Manifold and Control Module.
- Change Gas Manifold.
-Change the Control Module (installing the old hard drive).
or
Factory Service:
- Change/Repair the PCB Sensors (Internal Pressure sensor)
- Change the PCB Power.
- Change, in the Control Module, the cables (buses) from the PCB Power to the panel
Calibrate the internal Pressure sensor and internal pressure
Can be calibrated correctly ?
No
Yes
Field Service:
- Change the Gas Manifold.
or
Factory Service:
- The failure is the internal pressure Sensor, flow sensor or any electro-valve..
In the Service Panel open VC (9999mV), open Driving (9999mV) and verify that AGSS flow continues to 0L/min.
Is AGSS flow 0L/min ?
No
Yes
Field Service:
-Look for leaks.
- Change the Gas Manifold.
or
Factory Service:
- Look for leaks in the in the Flow-P tubing and lines.
-In the Gas manifold: leaks in the auto-zero valves tubing, electro-valves, PCB tubing.
-Change de PCB Sensors (flow sensor failure)
Field Service:
- Change the CABS.
- Verify the silicone bellows
or
Factory Service:
- Re-assemble / repair / change the Vent Control valve in the CABS. Repair
F


F
Volume FAW
< 500 mL?
No
Yes
Is also failing
Airway flow in the
SelfTest ?
No
Yes
Calibrate the FAW adult, pediatric sensor and internal pressure
Field Service:
- Verify cables from Gas Manifold and Control Module.
- Change Gas Manifold.
-Change the Control Module (installing the old hard drive).
or
Factory Service:
- Change/Repair the PCB Sensors (Internal Flow sensor)
- Change the PCB Power.
- Change, in the Control Module, the cables (buses) from the PCB Power to the panel
Can be calibrated correctly ?
No
Yes
Repeat SelfTest.
and
if continue failing: look for leaks (Flow-P tubings, filters, luer lock o-rings...)
Field Service:
-Verify the silicone bellows.
- Look for leaks in the patient circuit
- Change the Gas Manifold.
or
Factory Service:
- The failure is the internal pressure Sensor, flow sensor or any electro-valve.: change/repair de PCB sensors or the valve or look for internal leakage.
G

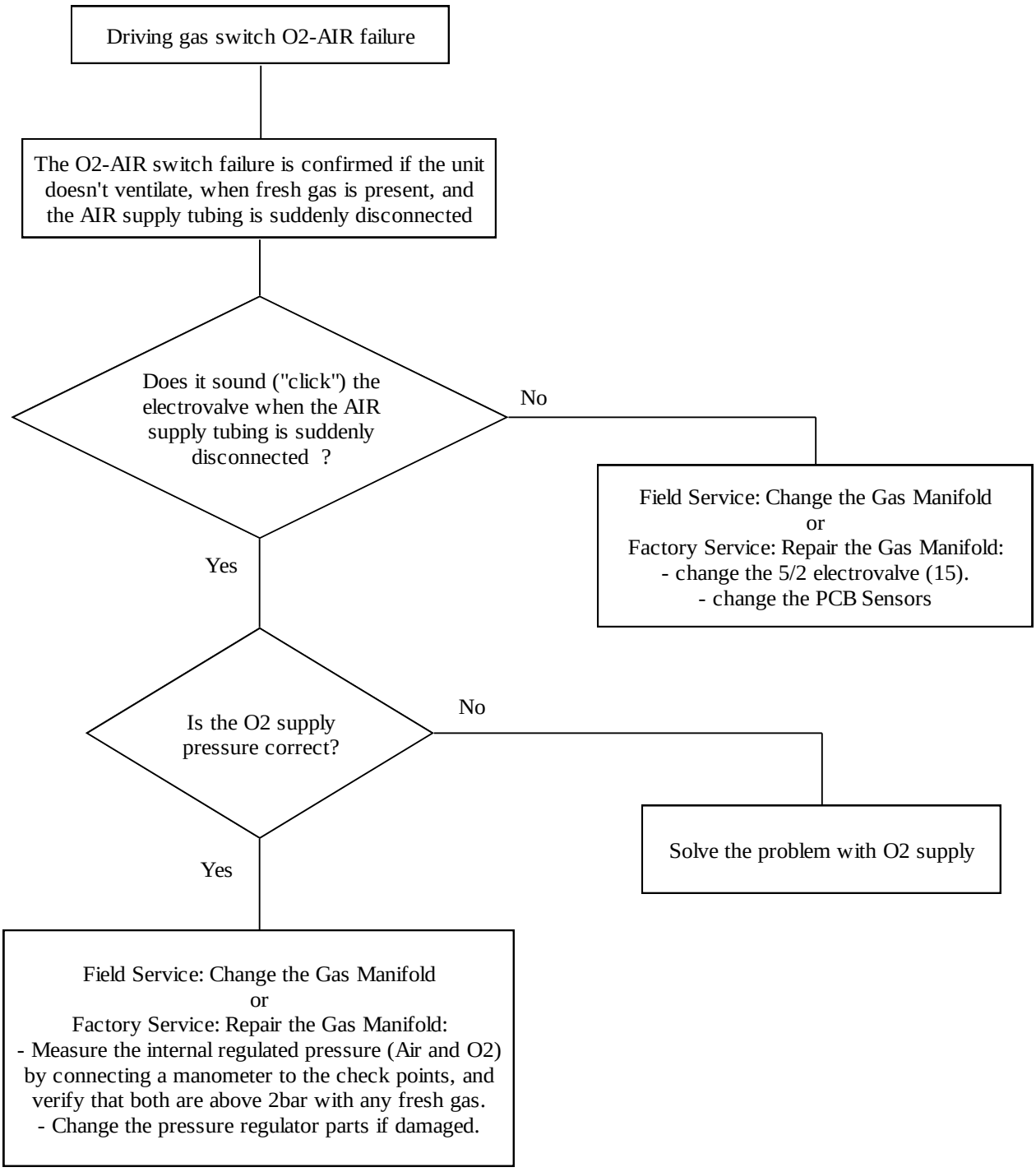

G
Is the Volume FAW > 2000 mL?
Yes
Is also failing Airway Flow in the SelfTest ?
No
Yes
Calibrate the airway adult and pediatric flow and internal pressure
Field Service:
- Verify cables from Gas Manifold and Control Module.
- Change Gas Manifold.
-Change the Control Module (installing the old hard drive).
or
Factory Service:
- Change/Repair the PCB Sensors (Internal Pressure sensor)
- Change the PCB Power.
- Change, in the Control Module, the cables (buses) from the PCB Power to the panel
Can be calibrated correctly ?
No
Yes
Field Service:
- Change the Gas Manifold.
or
Factory Service:
- The failure is the internal pressure Sensor, flow sensor or any electro-valve.
In the Service Panel open VC (9999mV), open Driving (9999mV) and verify that AGSS flow continues to 0L/min.
Is AGSS flow 0L/min ?
No
Yes
Field Service:
- Change the CABS.
- Verify the silicone bellows
or
Factory Service:
- Re-assemble / repair / change the Vent Control valve in the CABS. Repair
Field Service:
-Look for leaks.
- Change the Gas Manifold.
or
Factory Service:
- Look for leaks in the in the Flow-P tubing and lines.
-In the Gas manifold: leaks in the auto-zero valves tubing, electro-valves, PCB tubing.
-Change de PCB Sensors (flow sensor failure)

## 15.15. Leakage and Volume failure



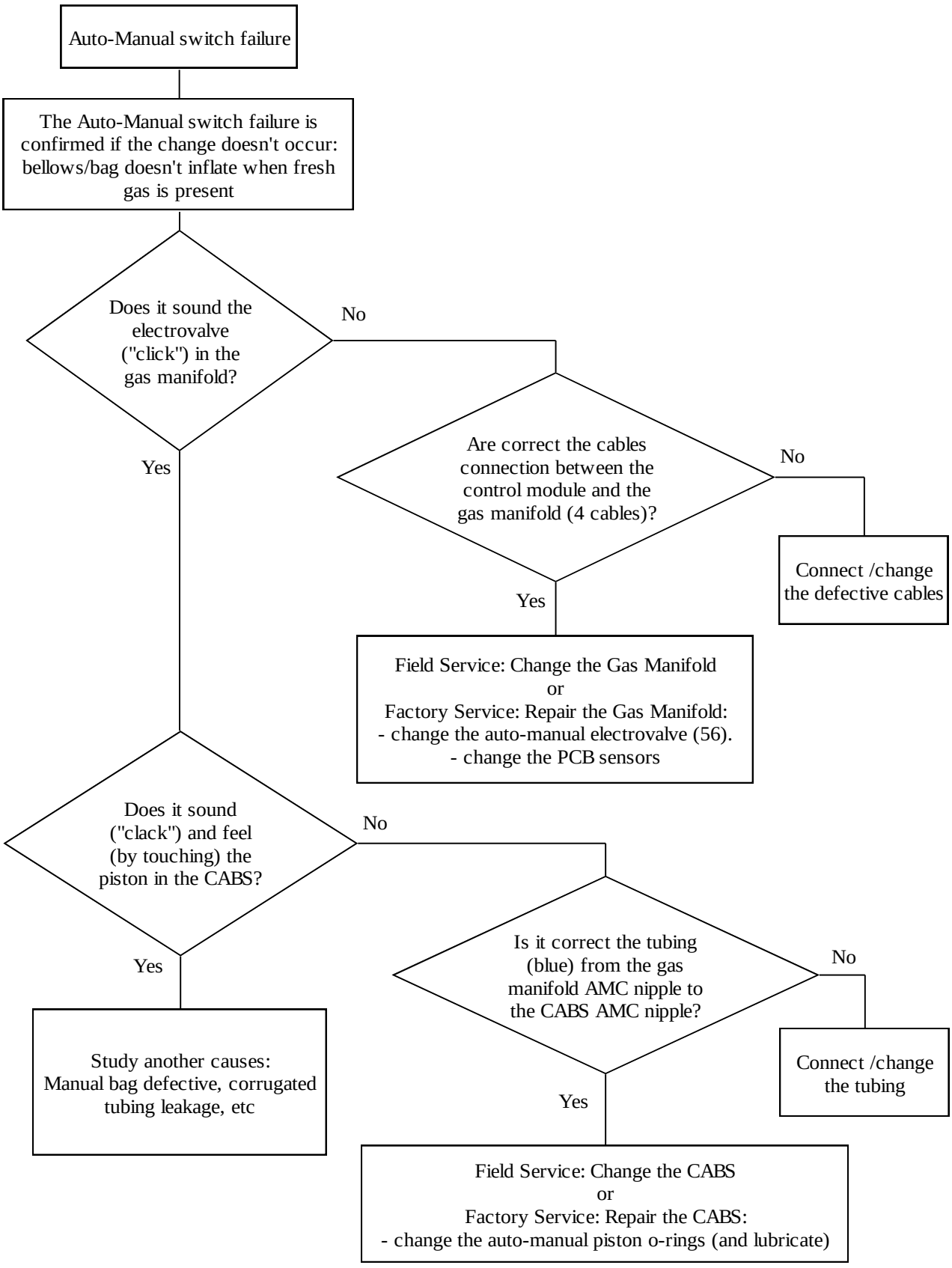
## 15.16. Driving gas switch O2-Air failure

Autotest 22



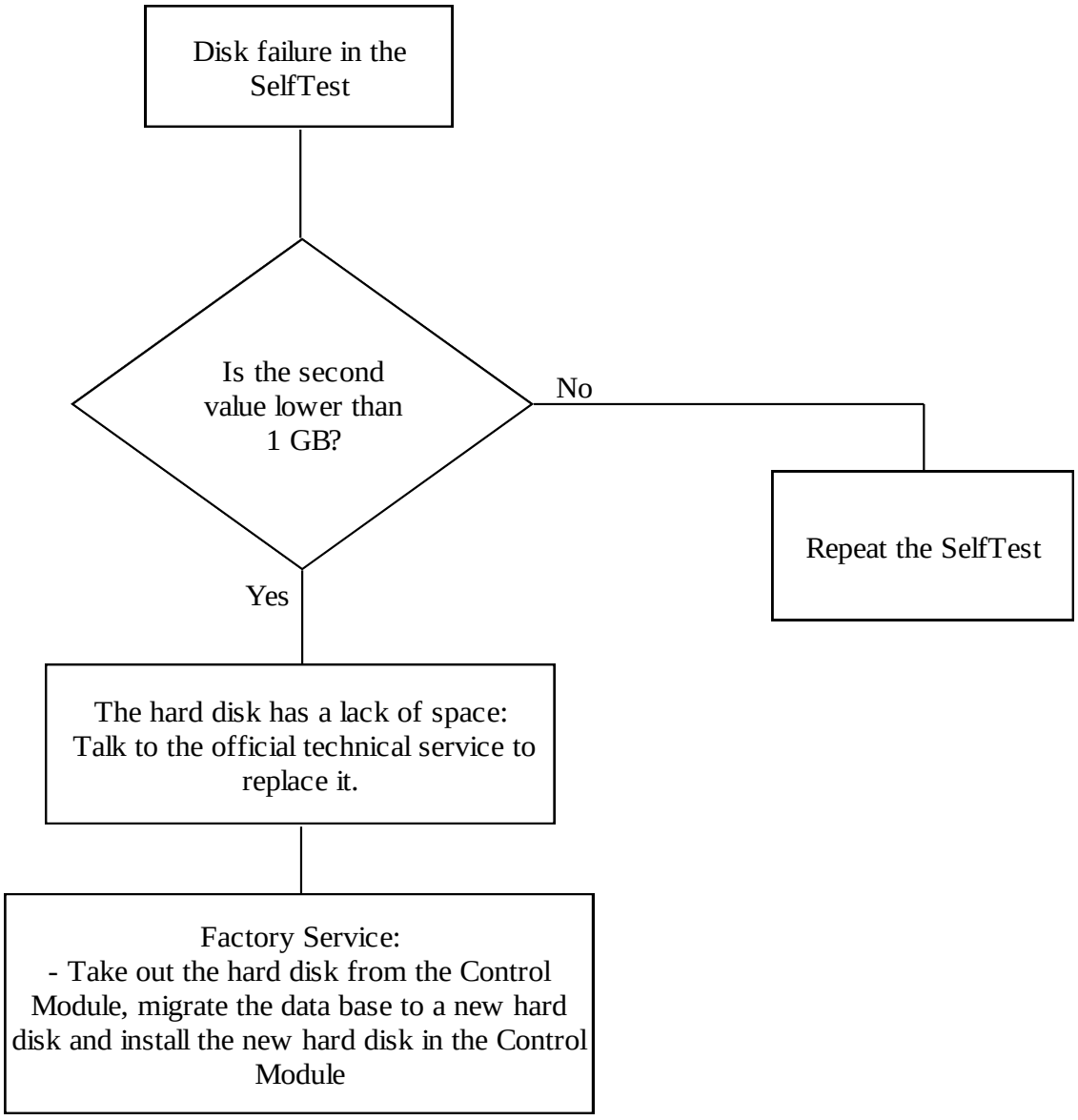
## 15.17. Auto-Manual switch failure

Autotest 23



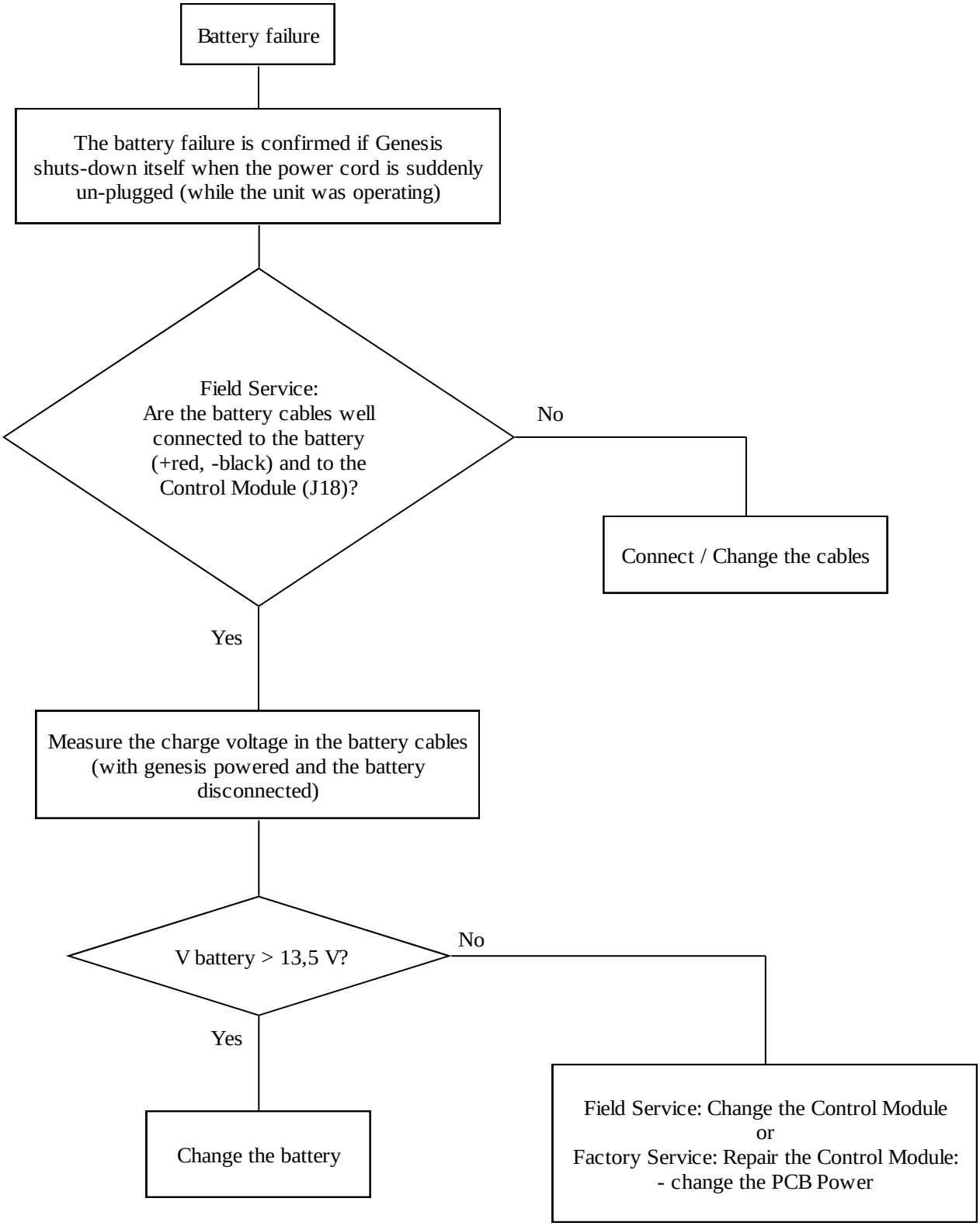
## 15.18. Disk failure

Autotest 24



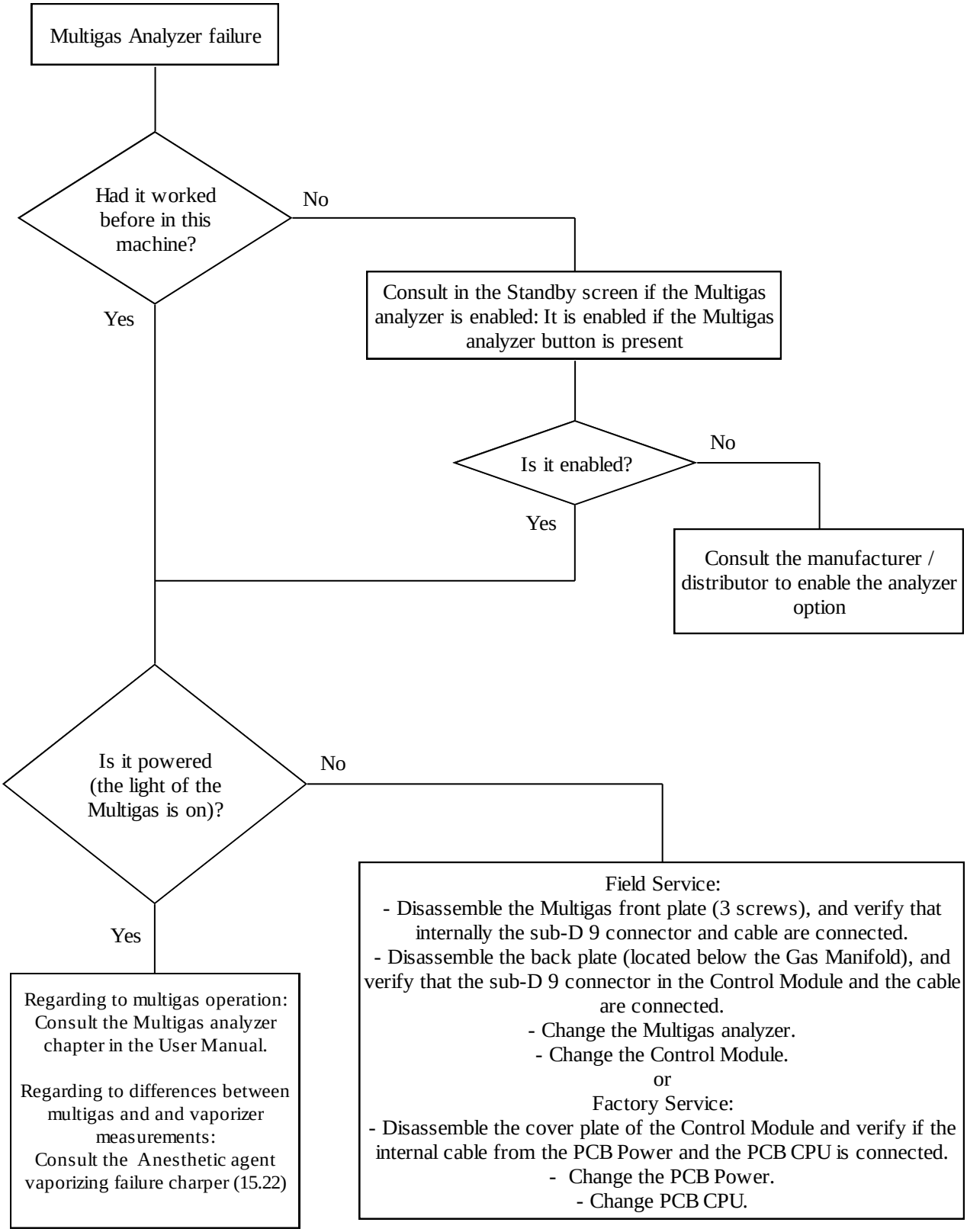
## 15.19. Battery failure

Autotest 25



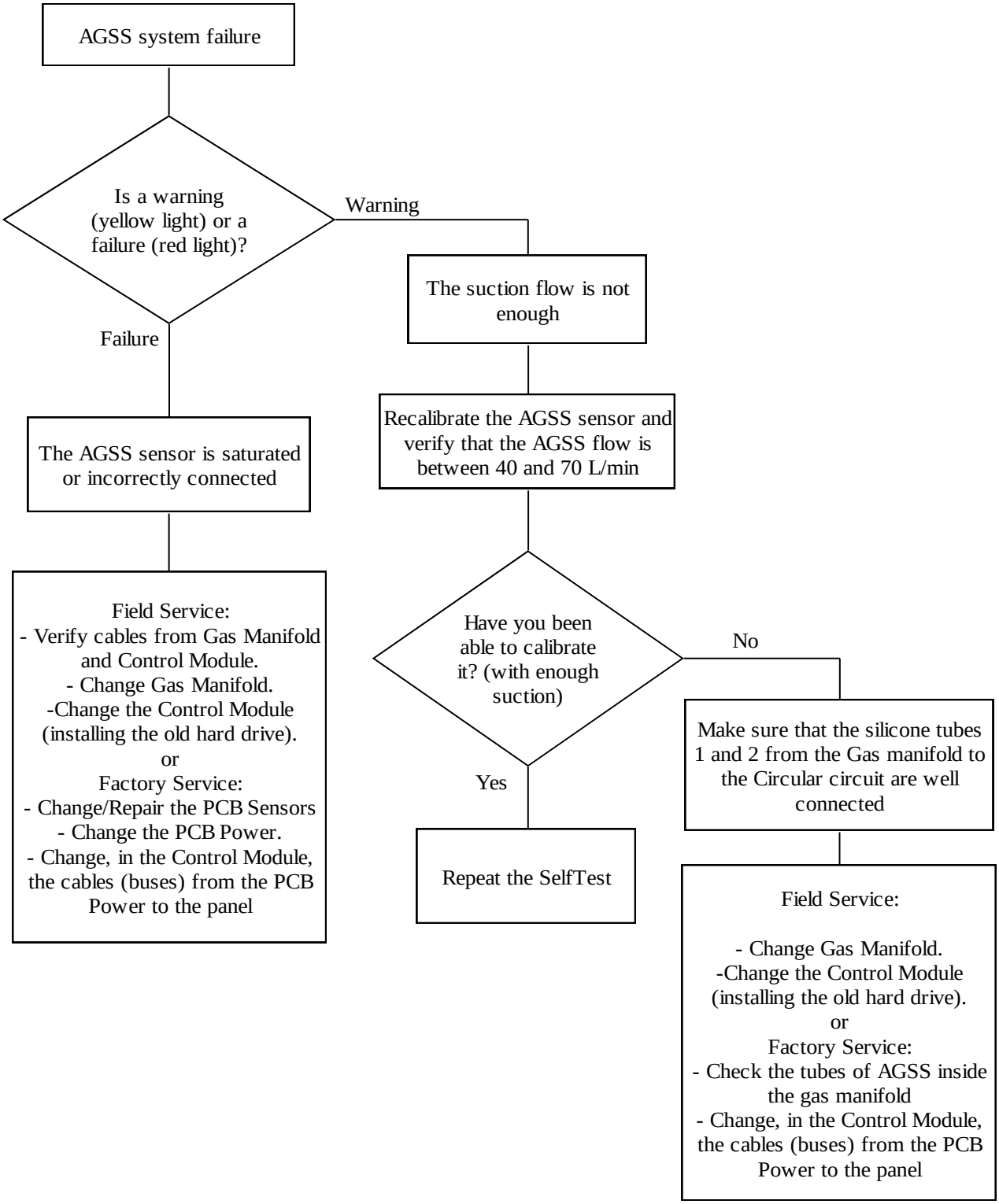
## 15.20. Multigas analyzer failure

Autotest 26

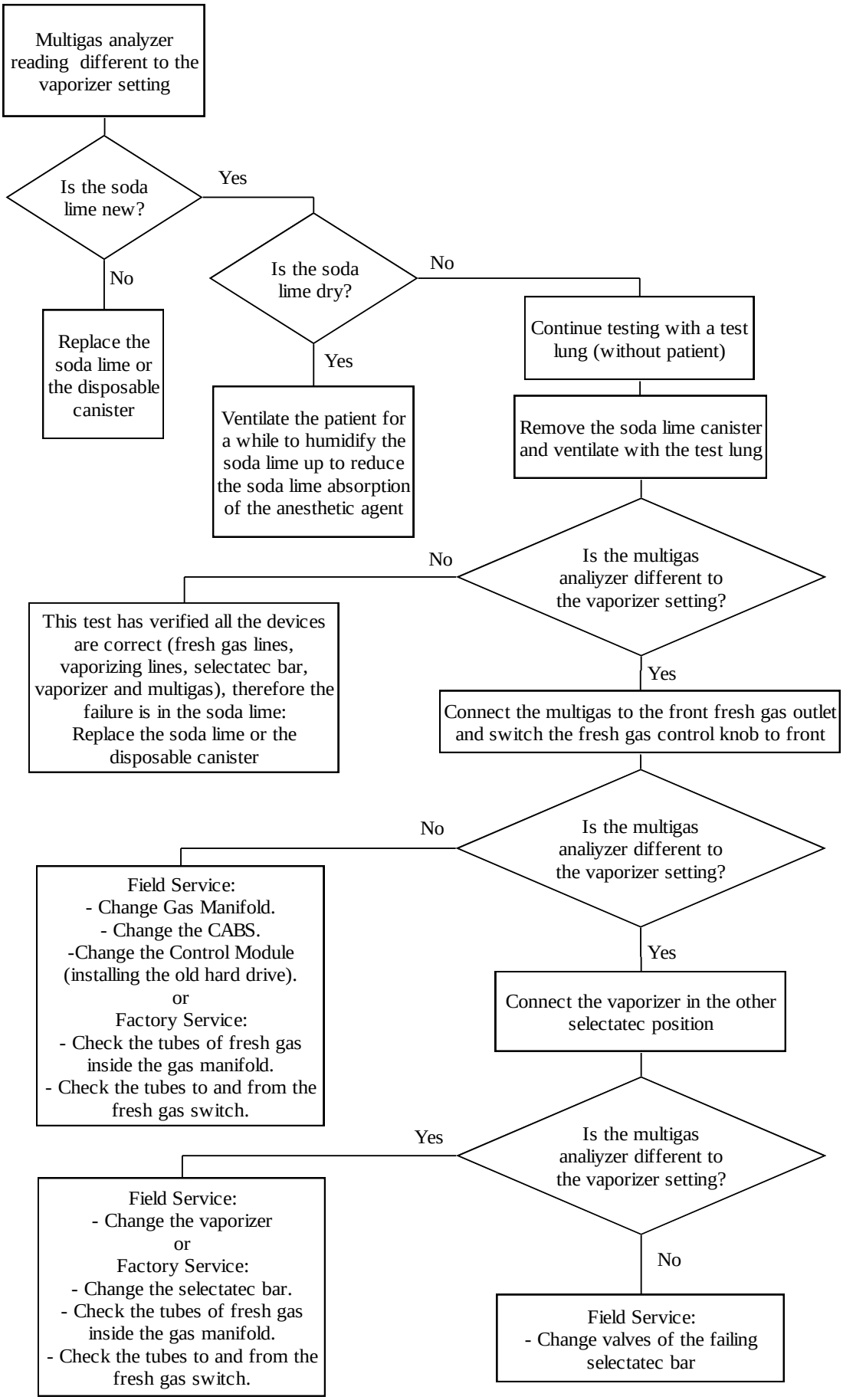


## 15.21. AGSS system failure

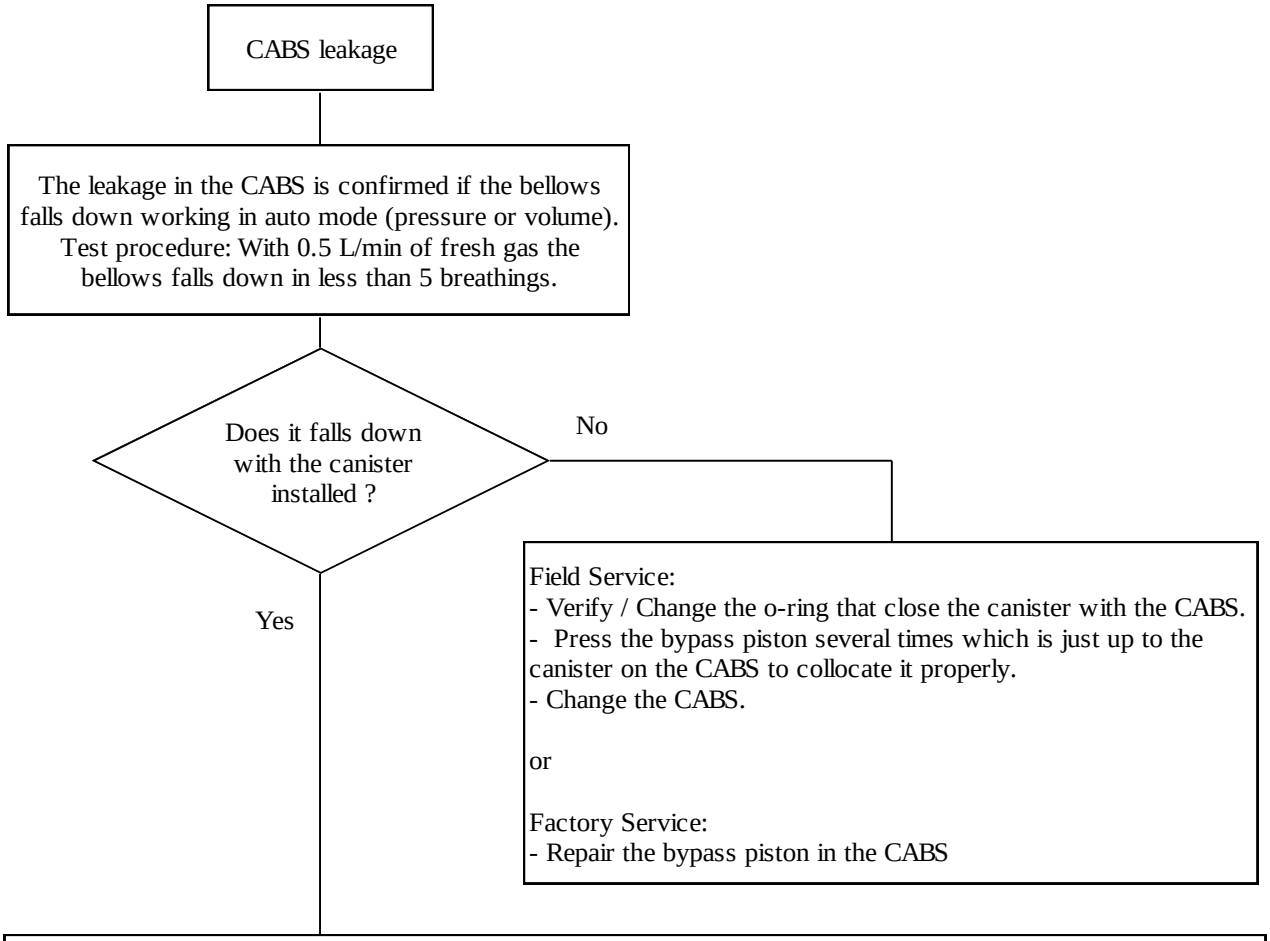
Autotest 27



## 15.22. Anesthetic agent vaporizing failure



## 15.23. CABS leakage




Field Service:
- Look for leaks in the patient circuit (tubes, Y piece, filters, sensor, test lung, ...).
- Verify that the I and E valves move up and down in the breathing cycle.
- Remove the I and E valve covers to verify that its o-rings are in good condition.
- Remove the bellows cover and verify the o-ring.
- Remove the silicone bellows and look for any damage.
- Remove the 6 allen screws under the bellows and verify that the part is well fixed and the silicone membrane is not damaged.
- Take off the CABS.
- Verify that the O2 sensor is well connected.
- Verify that the pressure relief valves are well placed ( both are in the rear part).
- Verify that the vacuum relief valve is well placed (under de circuit and is blue), if doubt push and pull them to put on its right position).
- Take off the screw that fix the manometer, remove the manometer and verify that the o-ring is in good condition.
- Remove the CO2 canister and verify the o-ring.
- Remove the AGS canister (take off before the fixation screw) and verify the o-ring.

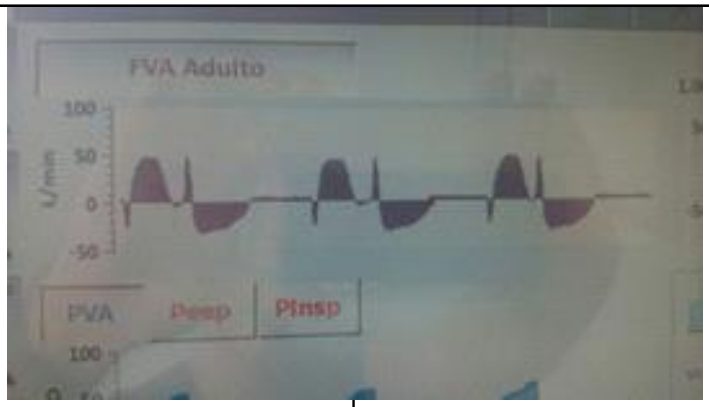
or

Factory Service:
- Remove the cover of the auto-manual piston (5 screws), placed just above the CO2 canister, take of the piston and verify all the o-rings.
- Remove the cover of the ventilation-control valve (5 screws), placed just above the AGS canister, take of the block to verify all the o-rings and the membrane to verify if it is damaged.

## 15.24. Flow graph failure

Flow graph failure

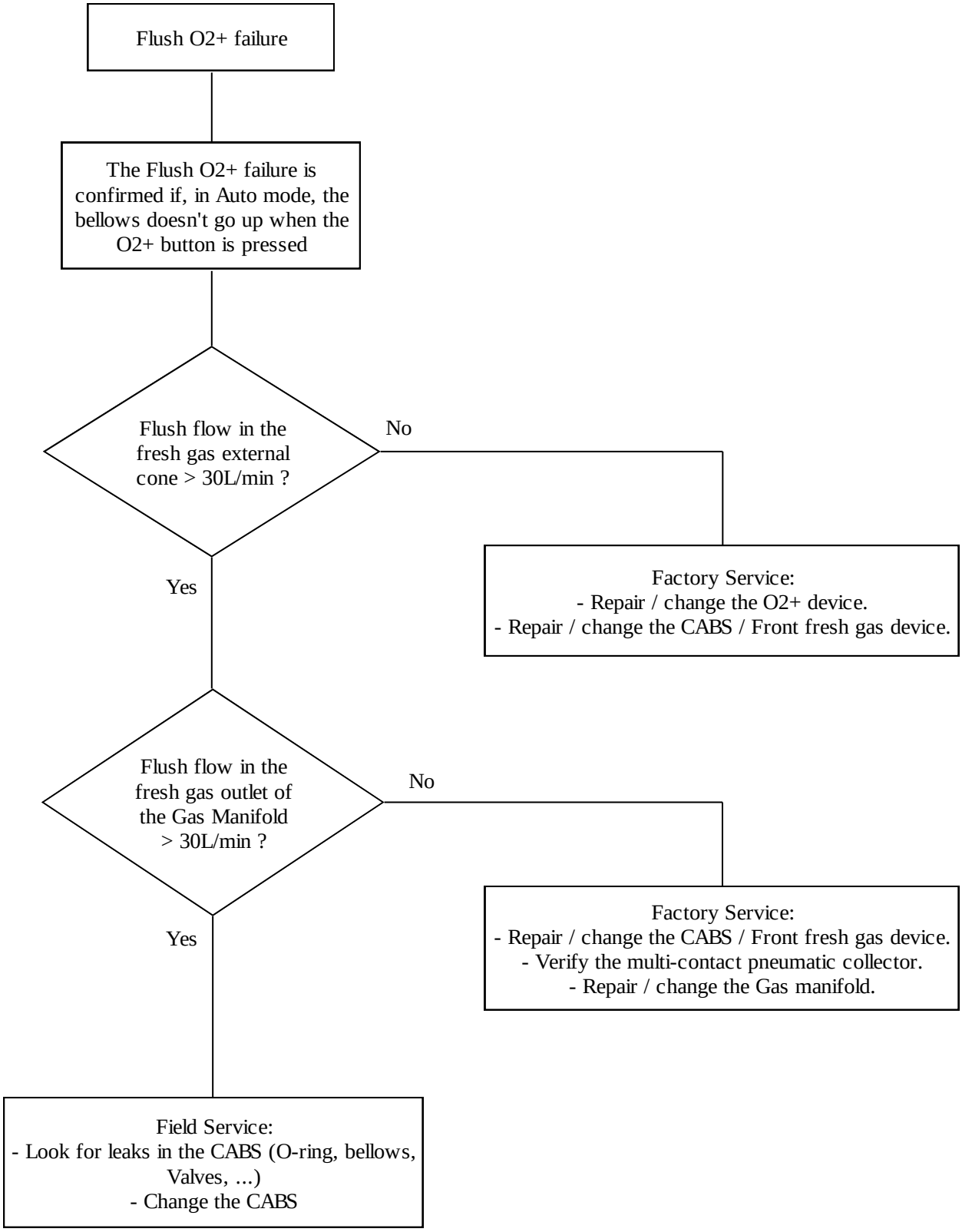
The flow graph failure is confirmed if the Flow vs Time curve presents unusual peaks, and the peaks become bigger if the pressure increases



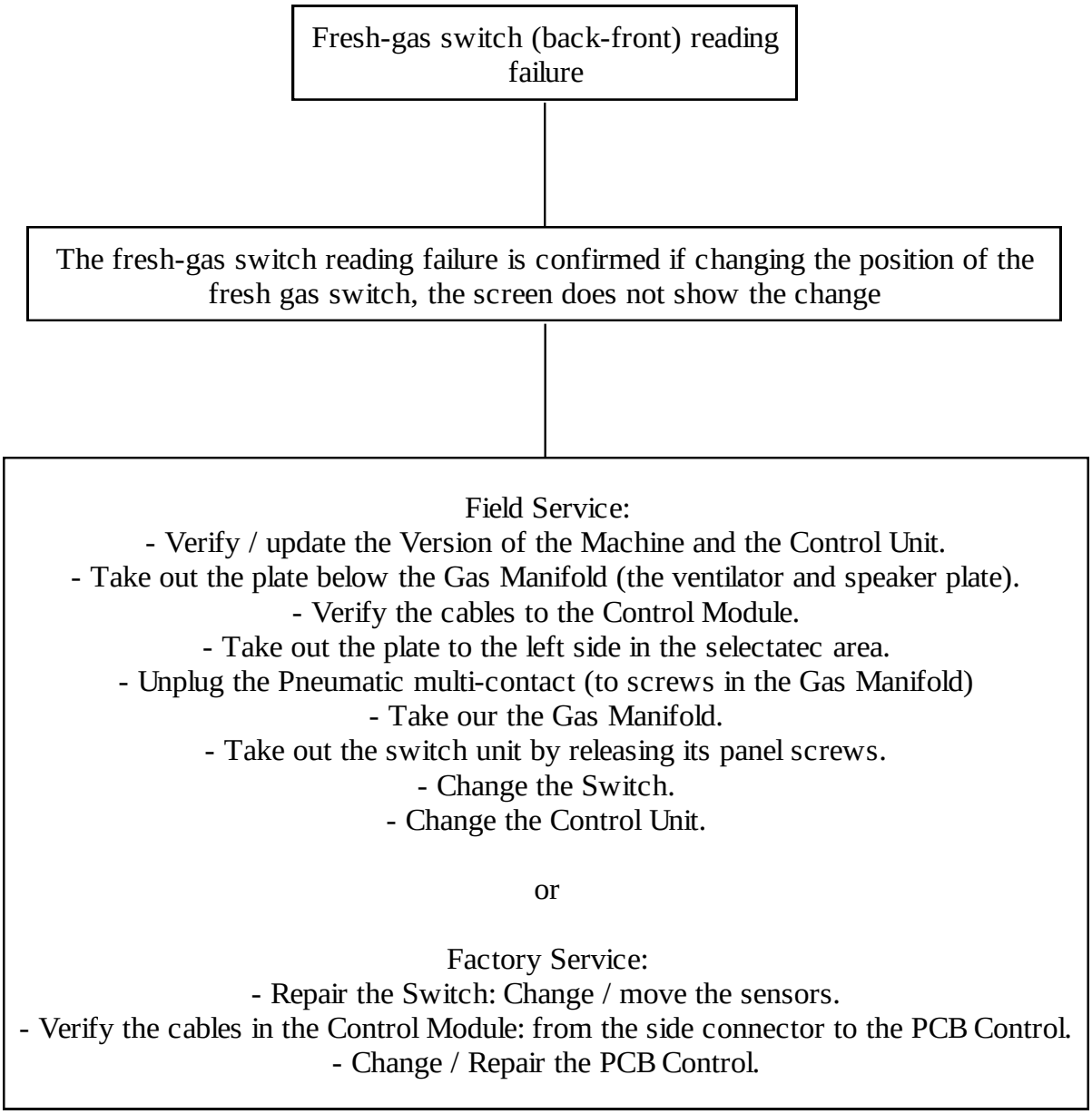

Conclusion:
There is a leakage in the Flow-P piping

Field Service:
- Change the two filters from the Flow-P.
- Verify / change the o-ring on the luer-lock piece for the filter connection.
- Verify / change the pair silicone tubes (cirular - hexagon.
Verify / change the Flow-P sensor.
- Change the Gas manifold.
or
Factory Service:
- Take out the front plate and verify the two blue tubing.
- Take out the Gas Manifold and verify A and I ports to the pneumatic multi-contact.
- Verify the tubing in the gas manifold.
- Look for leaks in the auto-zero valves.

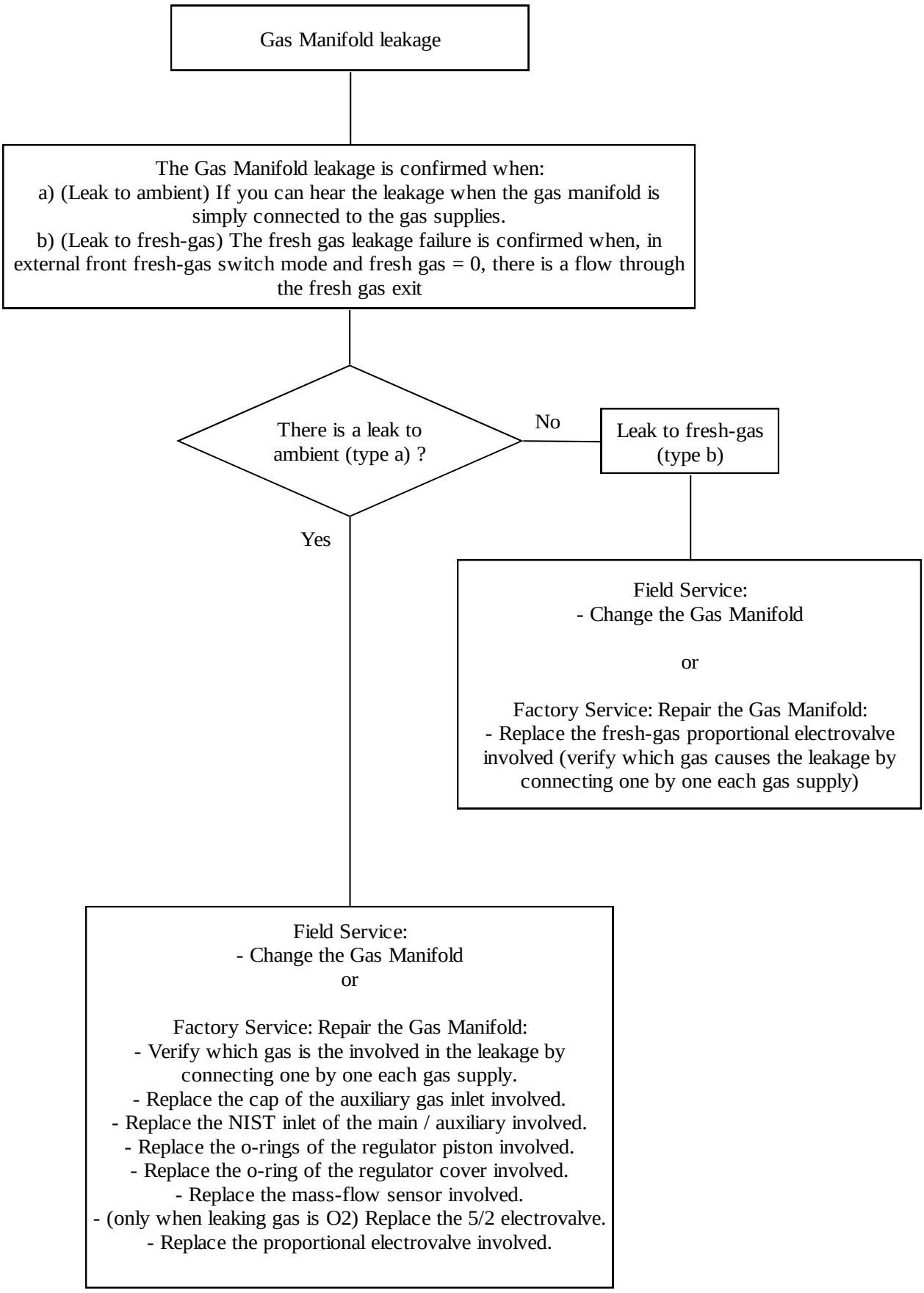
## 15.25. Flush O2+ failure



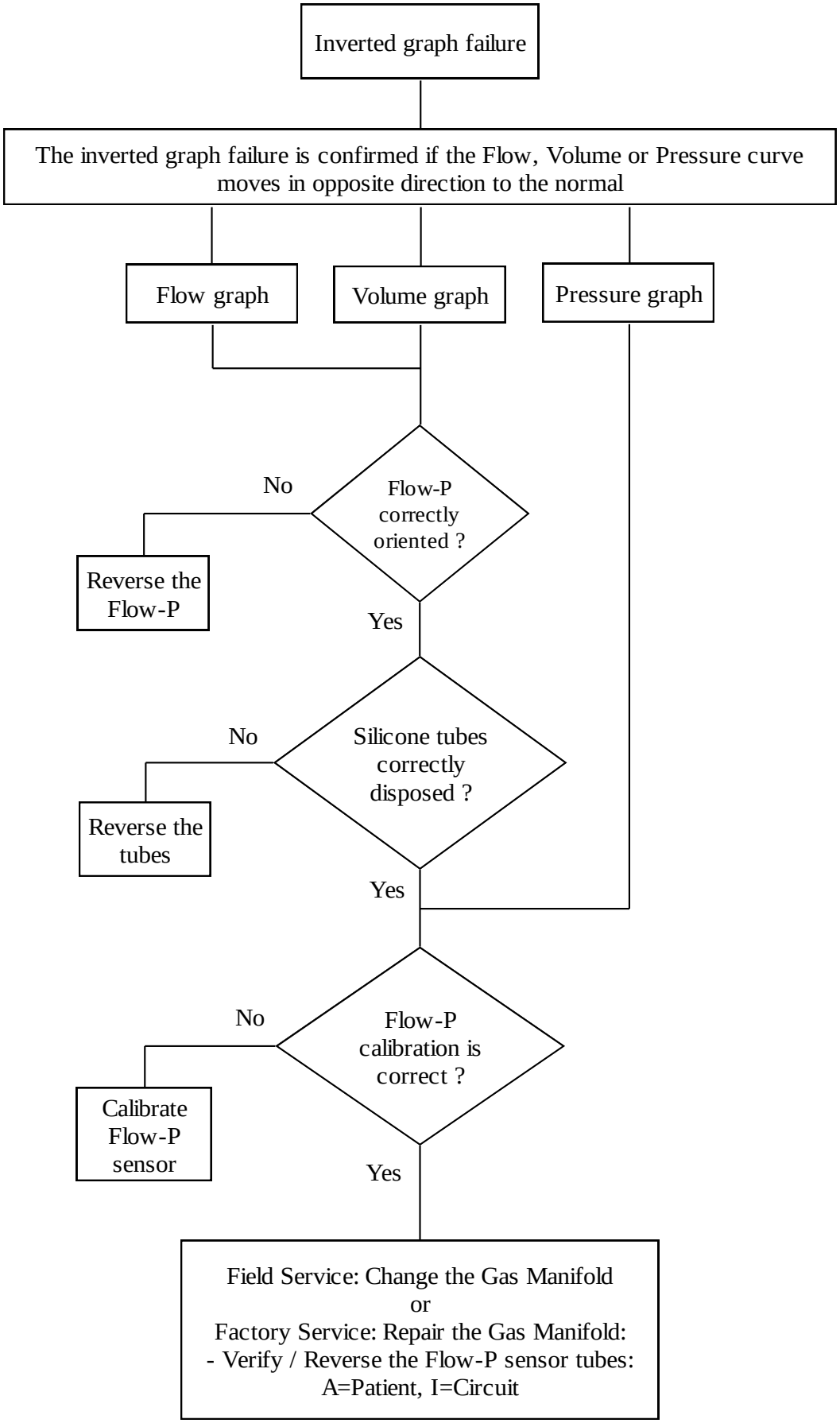
## 15.26. Fresh-gas switch (back-front) reading failure



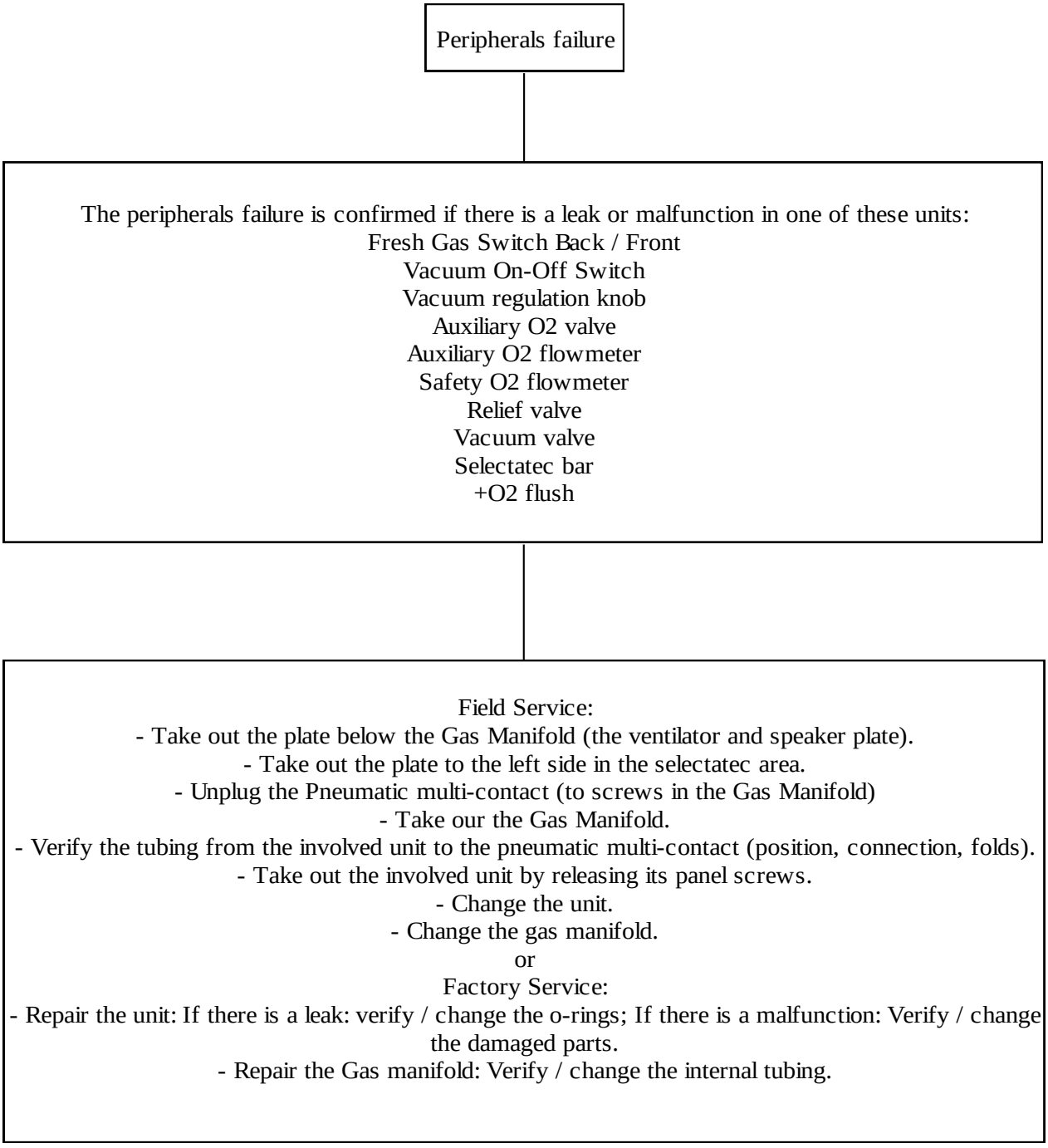
## 15.27. Gas Manifold leakage



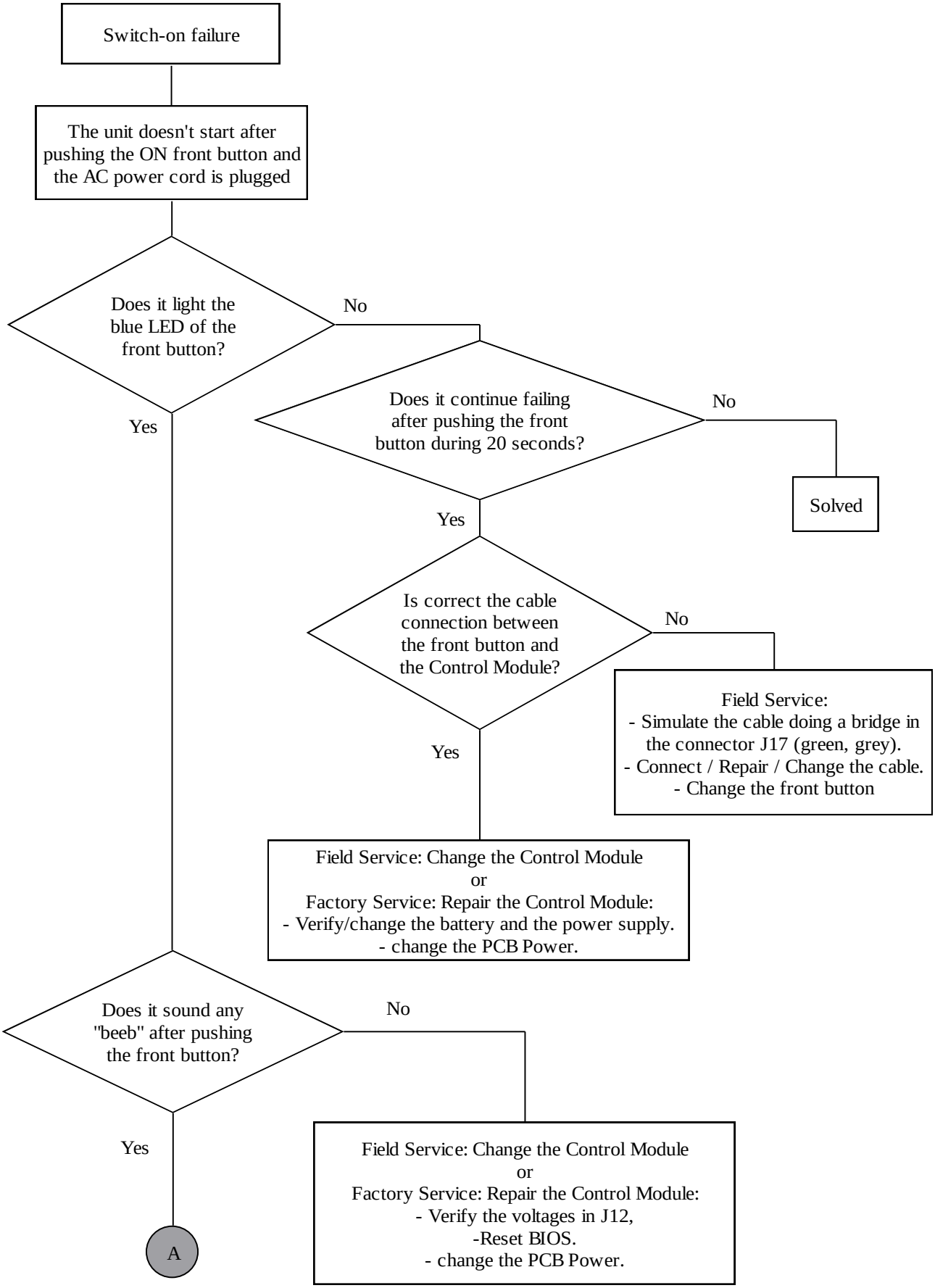
## 15.28. Inverted graph failure

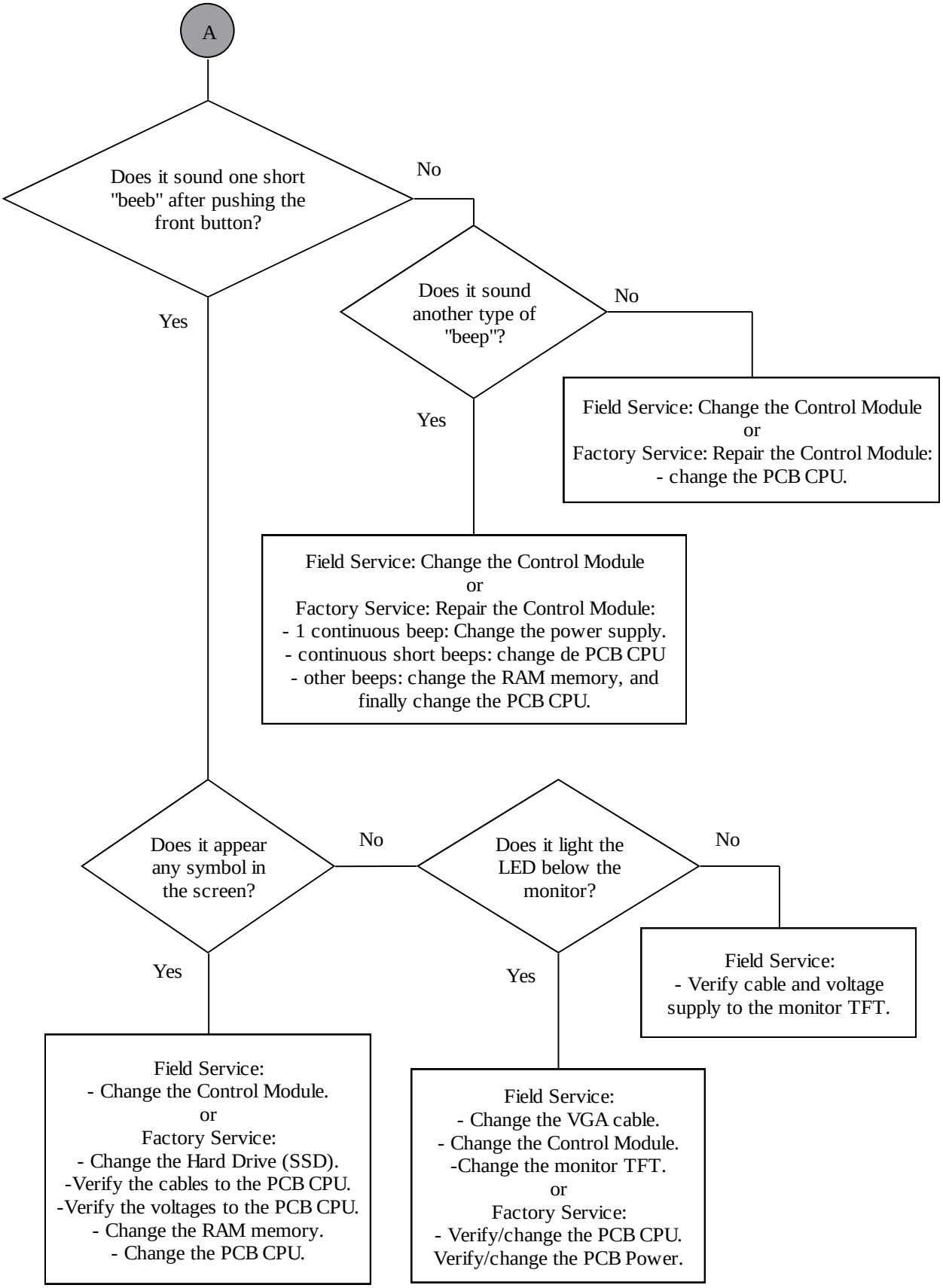


## 15.29. Peripherals failure

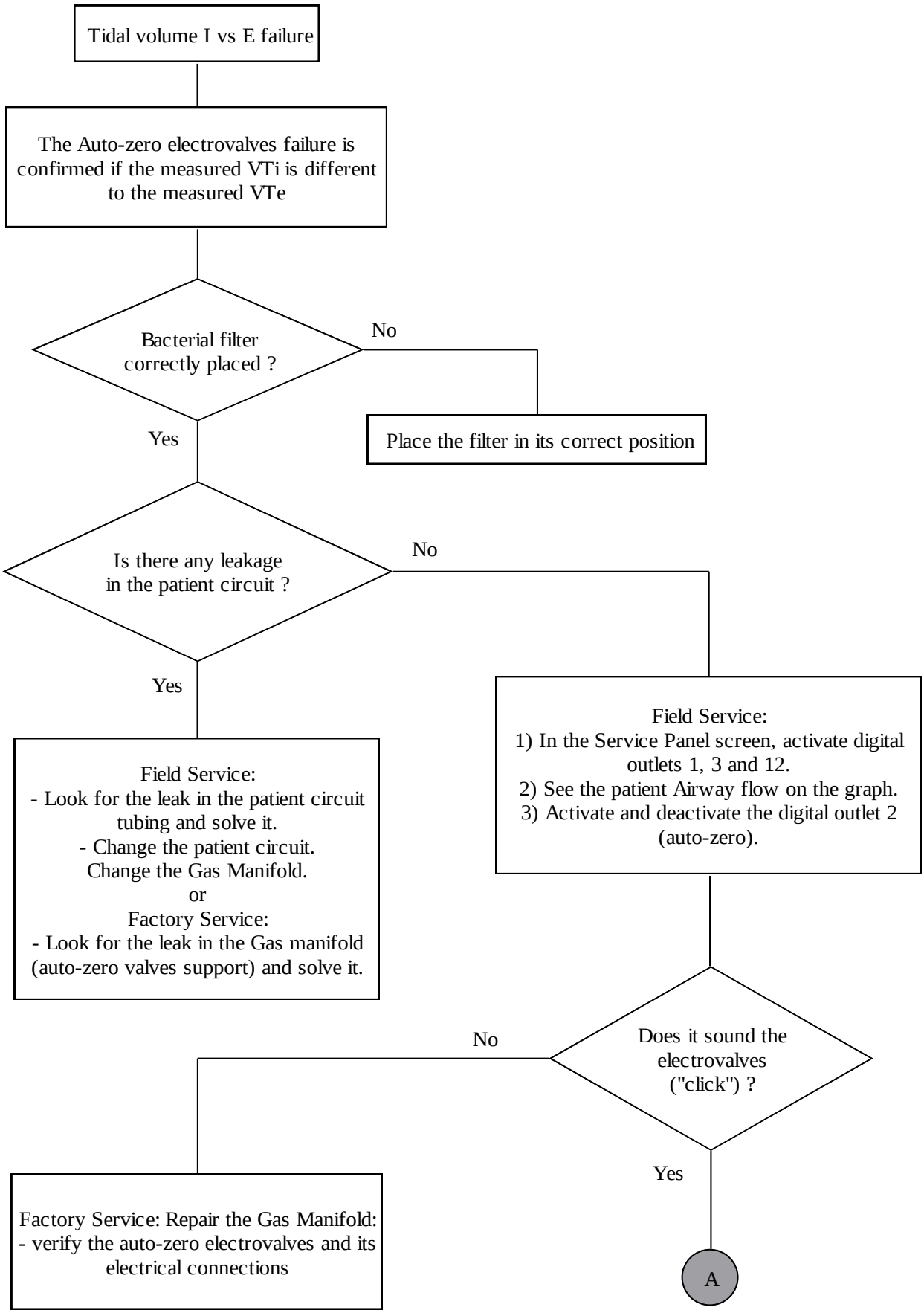


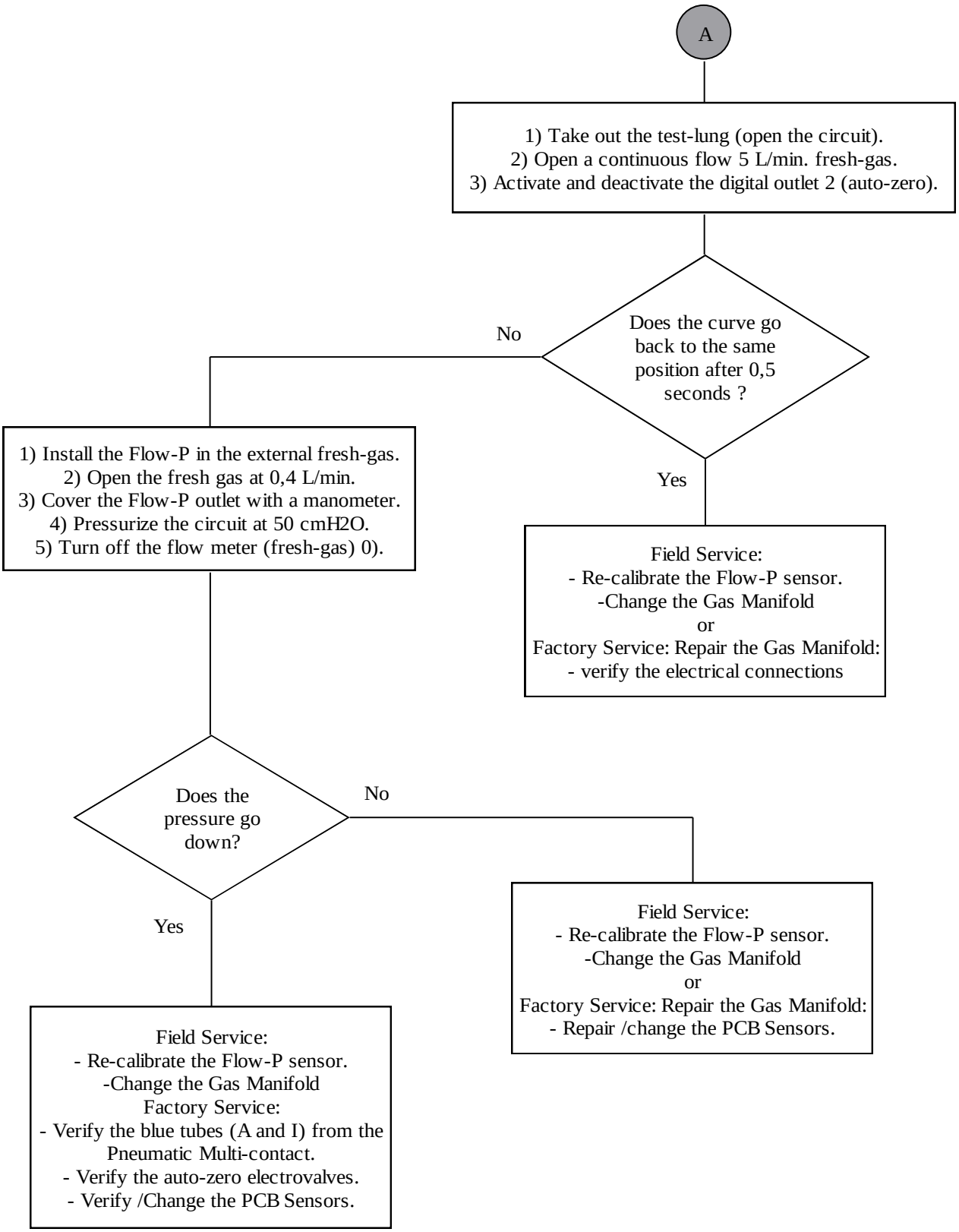
## 15.30. Switch-on failure



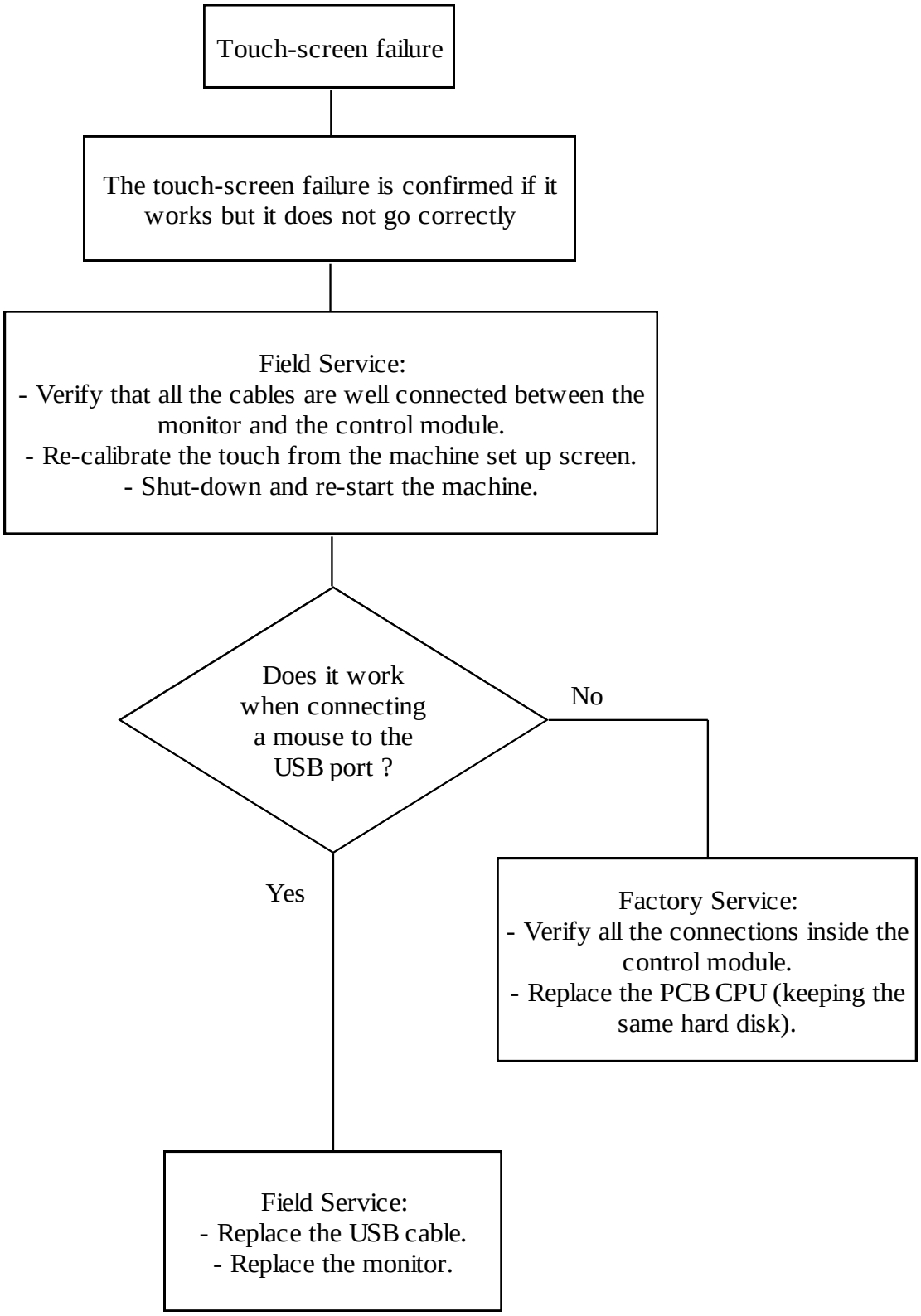

A
Does it sound one short "beeb" after pushing the front button?
No
Yes
Does it sound another type of "beep"?
No
Yes
Field Service: Change the Control Module
or
Factory Service: Repair the Control Module:
- change the PCB CPU.
Field Service: Change the Control Module
or
Factory Service: Repair the Control Module:
- 1 continuous beep: Change the power supply.
- continuous short beeps: change de PCB CPU
- other beeps: change the RAM memory, and finally change the PCB CPU.
Does it appear any symbol in the screen?
No
Does it light the LED below the monitor?
No
Yes
Yes
Field Service:
- Verify cable and voltage supply to the monitor TFT.
Field Service:
- Change the Control Module.
or
Factory Service:
- Change the Hard Drive (SSD).
-Verify the cables to the PCB CPU.
-Verify the voltages to the PCB CPU.
- Change the RAM memory.
- Change the PCB CPU.
Field Service:
- Change the VGA cable.
- Change the Control Module.
-Change the monitor TFT.
or
Factory Service:
- Verify/change the PCB CPU.
Verify/change the PCB Power.

## 15.31. Tidal volume I vs E failure




A
1) Take out the test-lung (open the circuit).
2) Open a continuous flow 5 L/min. fresh-gas.
3) Activate and deactivate the digital outlet 2 (auto-zero).
Does the curve go back to the same position after 0,5 seconds ?
No
Yes
1) Install the Flow-P in the external fresh-gas.
2) Open the fresh gas at 0,4 L/min.
3) Cover the Flow-P outlet with a manometer.
4) Pressurize the circuit at 50 cmH2O.
5) Turn off the flow meter (fresh-gas) 0).
Field Service:
- Re-calibrate the Flow-P sensor.
-Change the Gas Manifold
or
Factory Service: Repair the Gas Manifold:
- verify the electrical connections
Does the pressure go down?
No
Yes
Field Service:
- Re-calibrate the Flow-P sensor.
-Change the Gas Manifold
or
Factory Service: Repair the Gas Manifold:
- Repair /change the PCB Sensors.
Field Service:
- Re-calibrate the Flow-P sensor.
-Change the Gas Manifold
Factory Service:
- Verify the blue tubes (A and I) from the Pneumatic Multi-contact.
- Verify the auto-zero electrovalves.
- Verify /Change the PCB Sensors.

## 15.32. Touch screen failure



# 16. Service report

| System information: | |
|---|---|
| Model: GENESIS | Serial Number: |
| Customer information: | |
| Hospital Name: | City: |
| Country: | Address: |
| Service information:: | |
| Company: | Date: |
| Failure report: | Spare Parts changed (P/N):<br><br>Systems changed (P/N & S/N): |
| Calibration equipments (Model & S/N): | Electrical Safety Test equipments (Model & S/N): |
| Service | Hospital |
| Name: | Name: |
| Signature: | Signature: |

| System information: | |
|---|---|
| Model: GENESIS | Serial Number: |
| Customer information: | |
| Hospital Name: | City: |
| Country: | Address: |
| Service information:: | |
| Company: | Date: |
| Failure report: | Spare Parts changed (P/N):<br><br>Systems changed (P/N & S/N): |
| Calibration equipments (Model & S/N): | Electrical Safety Test equipments (Model & S/N): |
| Service | Hospital |
| Name: | Name: |
| Signature: | Signature: |

| | |
|---|---|
| System information: | |
| Model: GENESIS | Serial Number: |
| Customer information: | |
| Hospital Name: | City: |
| Country: | Address: |
| Service information:: | |
| Company: | Date: |
| Failure report: | Spare Parts changed (P/N):<br><br>Systems changed (P/N & S/N): |
| Calibration equipments (Model & S/N): | Electrical Safety Test equipments (Model & S/N): |
| Service | Hospital |
| Name: | Name: |
| Signature: | Signature: |

| | |
|---|---|
| System information: | |
| Model: GENESIS | Serial Number: |
| Customer information: | |
| Hospital Name: | City: |
| Country: | Address: |
| Service information:: | |
| Company: | Date: |
| Failure report: | Spare Parts changed (P/N):<br><br>Systems changed (P/N & S/N): |
| Calibration equipments (Model & S/N): | Electrical Safety Test equipments (Model & S/N): |
| Service | Hospital |
| Name: | Name: |
| Signature: | Signature: |

| System information: | |
|---|---|
| Model: GENESIS | Serial Number: |
| Customer information: | |
| Hospital Name: | City: |
| Country: | Address: |
| Service information:: | |
| Company: | Date: |
| Failure report: | Spare Parts changed (P/N):<br><br>Systems changed (P/N & S/N): |
| Calibration equipments (Model & S/N): | Electrical Safety Test equipments (Model & S/N): |
| Service | Hospital |
| Name: | Name: |
| Signature: | Signature: |

| System information: | |
|---|---|
| Model: GENESIS | Serial Number: |
| Customer information: | |
| Hospital Name: | City: |
| Country: | Address: |
| Service information:: | |
| Company: | Date: |
| Failure report: | Spare Parts changed (P/N):<br><br>Systems changed (P/N & S/N): |
| Calibration equipments (Model & S/N): | Electrical Safety Test equipments (Model & S/N): |
| Service | Hospital |
| Name: | Name: |
| Signature: | Signature: |

| | |
|---|---|
| System information: | |
| Model: GENESIS | Serial Number: |
| Customer information: | |
| Hospital Name: | City: |
| Country: | Address: |
| Service information:: | |
| Company: | Date: |
| Failure report: | Spare Parts changed (P/N):<br><br>Systems changed (P/N & S/N): |
| Calibration equipments (Model & S/N): | Electrical Safety Test equipments (Model & S/N): |
| Service | Hospital |
| Name: | Name: |
| Signature: | Signature: |

| | |
|---|---|
| System information: | |
| Model: GENESIS | Serial Number: |
| Customer information: | |
| Hospital Name: | City: |
| Country: | Address: |
| Service information:: | |
| Company: | Date: |
| Failure report: | Spare Parts changed (P/N):<br><br>Systems changed (P/N & S/N): |
| Calibration equipments (Model & S/N): | Electrical Safety Test equipments (Model & S/N): |
| Service | Hospital |
| Name: | Name: |
| Signature: | Signature: |

| System information: | |
|---|---|
| Model: GENESIS | Serial Number: |
| Customer information: | |
| Hospital Name: | City: |
| Country: | Address: |
| Service information:: | |
| Company: | Date: |
| Failure report: | Spare Parts changed (P/N):<br><br>Systems changed (P/N & S/N): |
| Calibration equipments (Model & S/N): | Electrical Safety Test equipments (Model & S/N): |
| Service | Hospital |
| Name: | Name: |
| Signature: | Signature: |

| System information: | |
|---|---|
| Model: GENESIS | Serial Number: |
| Customer information: | |
| Hospital Name: | City: |
| Country: | Address: |
| Service information:: | |
| Company: | Date: |
| Failure report: | Spare Parts changed (P/N):<br><br>Systems changed (P/N & S/N): |
| Calibration equipments (Model & S/N): | Electrical Safety Test equipments (Model & S/N): |
| Service | Hospital |
| Name: | Name: |
| Signature: | Signature: |

Manufacturer : HERSILL, S.L. – Puerto de Navacerrada 3; 28935, Móstoles, Madrid, Spain
Tel.: +34 916166000 / Fax: +34 916164892 / www.hersill.com