

InterMed

Penlon

*Sign-off Copy
Prima SP2 USA
August 2005*

**Prima SP2/3
Anaesthetic Machine Range
Service Manual**



Partnership for Life

IMPORTANT

Servicing and Repairs

In order to ensure the full operational life of this anaesthetic machine, servicing by a Penlon-trained engineer should be undertaken periodically.

The machine must be serviced to the schedule and methods detailed in sections 8 and 9.

For any enquiry regarding the servicing or repair of this machine, contact the nearest accredited Penlon agent:

or communicate directly with:

Technical Support
Penlon Limited
Abingdon Science Park
Abingdon
OX14 3PH
UK

Tel: +44 (0) 1235 547076
Fax: +44 (0) 1235 547062
E-mail: technicalsupport@penlon.co.uk

Always give as much of the following information as possible:

1. Type of equipment
2. Product name
3. Serial number
4. Approximate date of purchase
5. Apparent fault

FOREWORD

This manual has been produced to provide authorised personnel with information on the function, routine performance, maintenance and repair applicable to the Prima SP anaesthetic machine range.

Information contained in this manual is correct at the date of publication. The policy of Penlon Limited is one of continued improvement to its products. Because of this policy, Penlon Limited reserves the right to make any changes which may affect instructions in this manual, without giving prior notice.

Personnel must make themselves familiar with the contents of this manual and the machine's function before using the apparatus.

THE IMPORTANCE OF PATIENT MONITORING

WARNING

Anaesthetic systems have the capability to deliver mixtures of gases and vapours to the patient which could cause injury or death unless controlled by a qualified anaesthetist.

There can be considerable variation in the effect of anaesthetic drugs on individual patients so that the setting and observation of control levels on the anaesthesia systems does not in itself ensure total patient safety.

Anaesthesia system monitors and patient monitors are very desirable aids for the anaesthetist but are not true clinical monitors as the condition of the patient is also dependent on his respiration and the functioning of his cardio-vascular system.

IT IS ESSENTIAL THAT THESE ELEMENTS ARE MONITORED FREQUENTLY AND REGULARLY AND THAT ANY OBSERVATIONS ARE GIVEN PRECEDENCE OVER MACHINE CONTROL PARAMETERS IN JUDGING THE STATE OF A CLINICAL PROCEDURE.

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USER RESPONSIBILITY

This anaesthetic machine has been built to conform with the specification and operating procedures stated in this manual and/or accompanying labels and notices when checked, assembled, operated, maintained and serviced in accordance with these instructions.

To ensure the safety of this device it must be checked and serviced to at least the minimum standards laid out in this manual. A defective, or suspected defective, product must not under any circumstances be used.

The user must accept responsibility for any malfunction which results from non-compliance with the servicing requirements detailed in this manual.

Additionally, the user must accept responsibility for any malfunction which may result from misuse of any kind or non-compliance with other requirements detailed in this manual.

Worn, broken, distorted, contaminated or missing components must be replaced immediately. Should such a repair become necessary it is recommended that a request for service advice be made to the nearest Penlon accredited agent.

This device and any of its constituent parts must be repaired only in accordance with written instructions issued by Penlon Limited and must not be altered or modified in any way without the written approval of Penlon Limited. The user of this equipment shall have the sole responsibility for any malfunction which results from improper use, maintenance, repair, damage or alteration by anyone other than Penlon or its appointed agents.

USA and Canadian Federal Law restricts the sale and use of this device to, or on the order of, a licensed practitioner.

Statements in this manual preceded by the following words are of special significance:

WARNING *means there is a possibility of injury to yourself or others.*

CAUTION *means there is a possibility of damage to the apparatus or other property.*

NOTE *indicates points of particular interest for more efficient and convenient operation.*

Always take particular notice of the warnings, cautions and notes provided throughout this manual.

1. WARNINGS AND CAUTIONS

The following **WARNINGS and CAUTIONS** must be read and understood before using this anaesthetic apparatus.

WARNINGS

- This apparatus is designed for use only with non flammable anaesthetic agents. It must not be used with or in close proximity to flammable anaesthetic agents, due to a possible fire or explosion hazard.*
- Exterior panels must not be removed by unauthorised personnel and the apparatus must not be operated with such panels missing. On machines with an electrical power supply, there is a possible electric shock hazard.*
- No oil, grease or other flammable lubricant or sealant must be used on any part of the machine in close proximity to medical gas distribution components. There is a risk of fire or explosion.*
- When attaching cylinders of medical gases ensure that the machine yoke and cylinder faces are dust free and clean and that the sealing washer provided is in position between the cylinder valve and the yoke. Tighten the yoke securely before opening the cylinder valve. Dust and dirt presents a fire hazard in the presence of high pressure gas. Leakage of high pressure gas can cause serious injury.*
- Anaesthesia apparatus must be connected to an anaesthetic gas scavenging system (AGSS) to dispose of waste gas and prevent possible health hazards to operating room staff. This requirement must be observed during test procedures as well as during use with a patient.*
- Prima SP machines must only be used with Sigma Delta vaporizers (or other vaporizers approved by Penlon Limited) installed by means of the Selectatec system.*
- Free-standing vaporizers may be accidentally tipped, resulting in excessive and uncalibrated volumes of anaesthetic drug entering the breathing system*
- Do not install or connect any vaporizers of any description between the Common Gas Outlet (CGO) and the breathing system unless they are specifically designed for such use. (If this is done, the oxygen flush flow will pass through the vaporizer and may result in gross overdosage when the flush valve is operated.)*
- The breathing system which conveys gases from the anaesthetic machine to the patient and disposes of expired gases is a vital part of the anaesthetic delivery system. Because breathing systems require frequent cleaning and disinfection they are not a permanent part of the anaesthetic machine and therefore cannot be directly under the control of the anaesthetic machine manufacturer. However, we strongly recommend that only breathing systems which have been approved and authorised by Penlon for use with the Prima SP range should be employed. This is particularly important when mechanical ventilation is employed.*
- When mechanical ventilation is employed the patient breathing system must be connected directly to an over-pressure relief valve to prevent the possibility of barotrauma.*
- Always perform a pre-use check of the machine, including vaporizers, ventilator, circle absorber and monitors before clinical use. Follow the pre-use checklist (see section 5) as a minimum requirement. Many clinical incidents occur because of a failure to check for correct function.*
- The machine must not be used if any of the alarm, monitoring or protection system devices are not functioning correctly.*
- The machine must not be fitted with more than four operator accessible mains socket outlets. There is a risk of an excessive leakage current.*

WARNINGS AND CAUTIONS

12. ***The use of antistatic or electrically conductive breathing hoses is not recommended when using high frequency electrical surgery equipment (e.g. : Diathermy). Burns may be caused.***
 13. ***Before any electrically powered machine is used clinically for the first time, check that the hospital engineering department has carried out an earth continuity test.***
 14. ***Before using any additional electrical equipment powered by the auxiliary sockets on the machine, check that the additional equipment is correctly wired and is earthed through its plug. A missing or defective protective earth conductor may increase earth leakage currents to the patient to values exceeding the allowable limits, resulting in ventricular fibrillation, or interference with the pumping action of the heart.***
 15. ***Additional equipment placed on the top shelf must be securely attached. Take care when moving a fully loaded machine, particularly when negotiating ramps. Check that hoses or power leads are not trailing on the floor.***
6. *Compressed gas supplies must be clean and dry.*
 7. *When the auxiliary gas outlets are in use on a machine with cylinder supply only, or if the pipeline supply is not in use, check flow rate requirements, and ensure that adequate back-up cylinders are available.*

CAUTIONS

1. *Flowmeter needle valves are designed to seal with light torque and may be damaged if tightened excessively. Do not force the control knob past either the fully open or fully closed positions.*
2. *Open cylinder valves slowly to avoid damage to pressure reducing valves. Ensure that cylinder valves are at least one full turn open when in use.*
3. *Under no circumstances should anaesthetic agents be used for cleaning purposes.*
4. *After use, always disconnect the machine from the piped gas supply and/or close the gas cylinder valves.*
5. *Mechanical AHD system - The oxygen flow control is restricted to prevent the*

2. PURPOSE

The Prima SP2 anaesthesia workstation range is intended to provide controlled concentrations and flows of anaesthesia gases into a patient breathing system, from where the anaesthesia ventilator and breathing circuit will then deliver this fresh gas mixture to the patient

Use the Prima SP2 in conjunction with anaesthetic vaporizers, breathing hoses and patient connection fittings which comply with the relevant ISO standard or equivalent.

Depending upon the patient circuit selected, the machines can be used in open, semi-open, semi-closed or closed circuit configurations.

The range has been designed to give a wide choice of configurations and accessories, as follows:

Gas supplies

Up to three gases

Oxygen, nitrous oxide, and air, with pin-index cylinder yokes, and provision for up to three pipeline supply inlets.

Vaporizer mounting systems

Backbar manifold for Selectatec compatible vaporizers.

Anti-hypoxic Device (AHD)

The mechanical AHD system is designed to minimise the risk of a hypoxic mixture reaching the patient, see section 3.

3. DESCRIPTION

3.1 General Construction

Frame

The machine has a cast aluminium base, extruded aluminium uprights, with aluminium and plastic panels.

Mobility

Four castors are fitted, with a brake on each of the front castors. The castors are five inches diameter.

A footrest is built into the front of the machine and, to aid manoeuvrability, two handles are provided.

Mounting posts and brackets

A mounting system is built into each side upright, to allow the use of pole-mount brackets, V-brackets, and ventilator mounting brackets.

The pole mount upright can be used to mount an A200SP Absorber assembly.

Work surfaces

The work surface has raised edges to retain instruments, vials etc.

A pull-out writing tablet is mounted under the work surface.

3.2 Gas Circuit

Gas Circuit Schematic

A gas circuit schematic is shown on the following page.

All available gas supply options are shown.

Gas Supplies

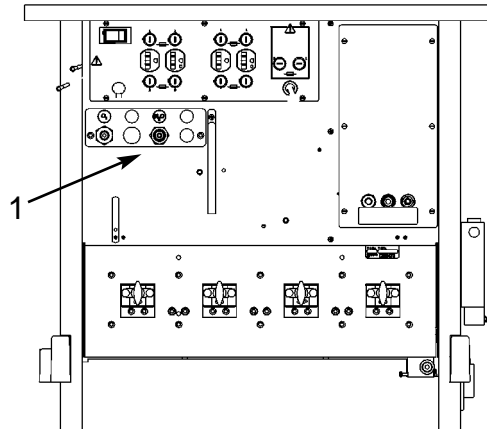
A variety of cylinder and pipeline combinations can be added to the basic specification of oxygen and nitrous oxide cylinder and pipeline supply.

For example, two extra gas cylinders (choose from one additional oxygen, one additional nitrous oxide, one air), and one extra pipeline supply - Air.

Cylinder Yokes

The yokes are rear mounted and conform with ISO standards for pin-index fitting.

To ensure that only cylinders of the appropriate gas may be installed the yokes are designed so that the retaining latch cannot be closed unless the index pins are fully engaged.



Pipeline Inlets (1)

Up to three, rear mounted pipeline gas inlets can be fitted.

Pipeline supply hoses are connected by non-interchangeable, screw threaded unions (DISS - diameter indexed safety system).

Filters

To prevent dirt entering the gas system, cylinder yokes and pipeline inlets are fitted with filters.

Gas Inlet Block

Each individual cylinder or pipeline supply, is routed through a separate gas block.

Each gas block has an integral high pressure gauge tapping for direct mounting of a pressure gauge, and a non-return valve to prevent back flow of gas.

In addition, cylinder gas blocks have a diaphragm pressure regulator to reduce the pressure of the compressed gas supply, and a factory set pressure relief valve. This prevents pressure build up under the diaphragm should any leakage develop across the reducing valve seat.

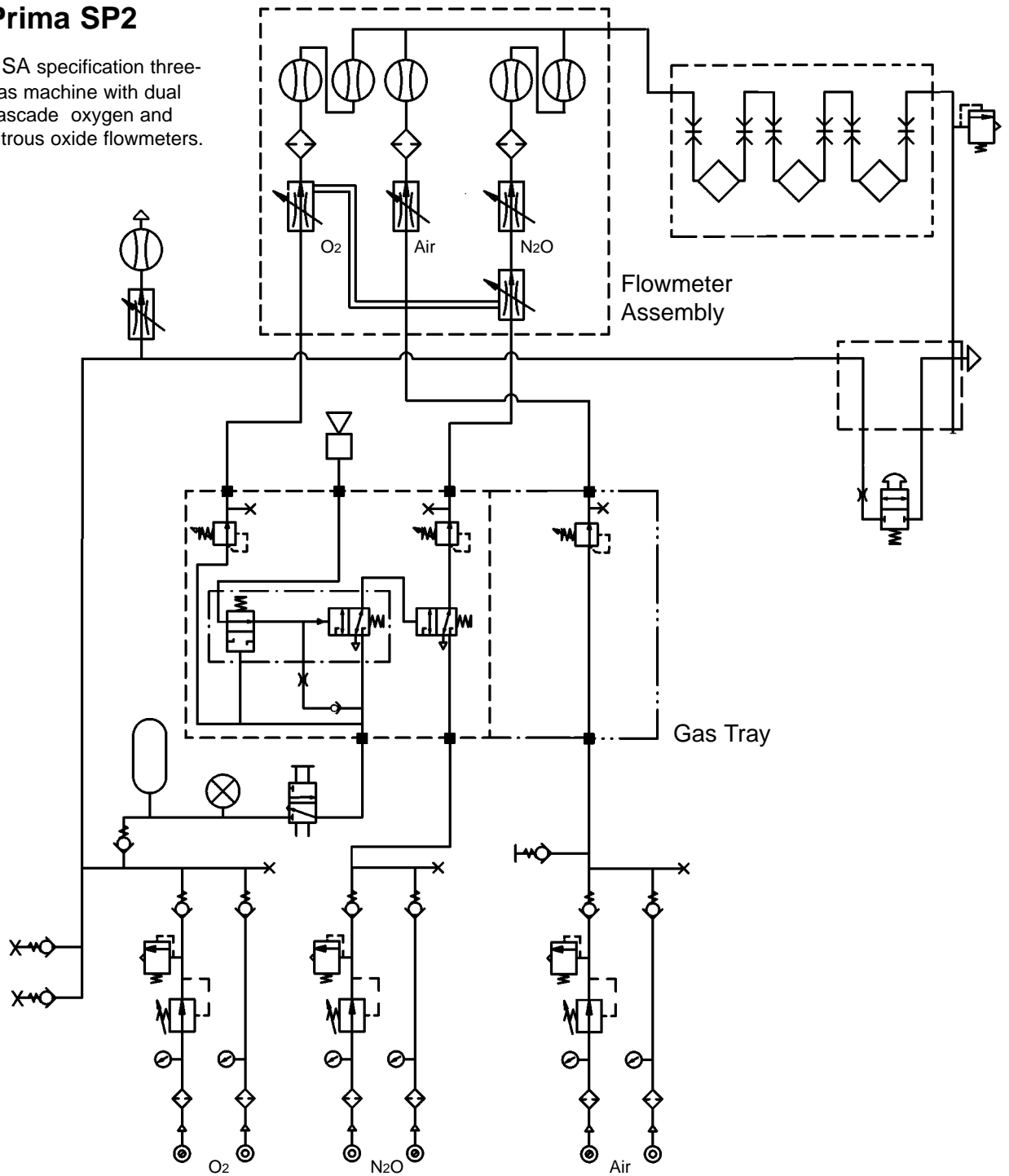
Secondary Pressure Regulator

A second stage regulator reduces the pressure supplied to each flowmeter control (see section 4).

The fitment of a secondary regulator for oxygen and nitrous oxide enhances the performance of the mechanical AHD system. Secondary regulation of the air supply aids the stabilisation of the output at the flowmeter.

Prima SP2

USA specification three-gas machine with dual cascade oxygen and nitrous oxide flowmeters.



	Pneumatic pressure source		Gas cut-off valve (normally open)		Flowmeter
	Filter		Pneumatic switch (optional Air/N ₂ O interlock)		Vaporizer
	Pressure gauge		Reservoir		Oxygen flush valve
	Pressure regulator		Pneumatic on/off switch		Non-return valve
	Pressure relief valve		Flow control valve (variable)		Power take-off point (or test point)
	Audible alarm				Visual indicator
	Restrictor				

DESCRIPTION

3.3 Gas Supply Safety Devices

3.3.1 Gas Supply Cut-off Device

A gas cut-off device, triggered by low oxygen supply pressure, cuts the supply of nitrous oxide, and carbon dioxide (if fitted).

The cut-off operates when the oxygen pressure falls to 186 ± 14 kPa (27 ± 2 psig).

Gas supplies are reinstated only when the oxygen supply pressure rises above 227 ± 14 kPa (33 ± 2 psig).

3.3.2 Oxygen Supply Failure Warning Whistle

A whistle gives an audible warning when there is a reduction of oxygen supply pressure.

Operated solely by the remaining oxygen in the machine system, the warning whistle is prolonged by an oxygen reservoir built into the gas circuit, allowing a minimum warning whistle of 7 seconds duration.

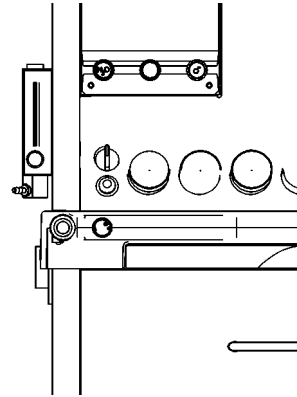
The whistle will start to sound when the pressure falls to 200 ± 21 kPa (29 ± 3 psig), and will continue to sound until the pressure falls to approximately 70 kPa (10 psig).

Oxygen consumption of the whistle is approximately 2 L/min when sounding and nil at other times.

3.3.3 Fresh Gas Pressure Relief Valve

The valve is designed to prevent fresh gas being delivered to the breathing system at pressures exceeding 41 kPa (6 psi).

This valve also protects machine components against excessive pressure in the event of a total blockage of the CGO.



3.3.4 Oxygen Supply Visual Indicator

The indicator (1) is mounted on the front of the machine and is operated from the oxygen supply and shows GREEN when the supply is at working pressure, and RED if the pressure falls.

3.3.5 Mechanical AHD

A mechanical link between the oxygen control valve and a needle valve in the nitrous oxide flow ensures that the machine delivers a fresh gas mixture with a minimum 30% ($\pm 3\%$) oxygen, irrespective of the flow of nitrous oxide set by the anaesthetist.

With the nitrous oxide control valve fully open, the oxygen and nitrous oxide flows are then both controlled by the oxygen control valve.

See section 3.4 for a full description

3.3.6 Low Pressure Gas Tubing

Diameter-indexed tubing is used for the low pressure gas system - see section 4.

DESCRIPTION

3.4 Mechanical AHD (Anti Hypoxic Device)

3.4.1 Introduction

The Mechanical AHD is housed within the flowmeter module and comprises a gear linkage between the oxygen control valve and a needle valve in the nitrous oxide flow.

The system controls the relative flow rates of oxygen and nitrous oxide.

A predetermined minimum oxygen concentration of 30% \pm 3% in the oxygen / nitrous oxide mixture is maintained over the flow range to prevent delivery of a hypoxic mixture.

3.4.2 Gas Delivery Switch

The Gas Delivery Switch (1) operates on the oxygen supply and must be in the 'On' position for normal operation of the anaesthetic machine.

The switch consequently controls the supply of all gases provided with a gas cut-off triggered by a predetermined pressure level within the oxygen supply (see section 3.3.1).

A whistle (oxygen failure warning whistle) will sound briefly whenever the gas delivery switch is turned on or off. Note that the whistle functions continuously if the oxygen supply fails (see section 3.3.2).

NOTE

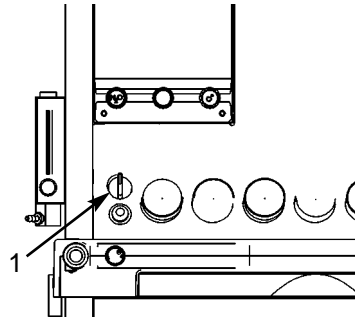
The switch also controls the electrical supply to the ventilator and optional flowmeter lighting unit.

3.4.3 Gear Linkage and Nitrous Oxide Control Valves

A gear linkage connects the oxygen control knob on the flowmeter module and a needle valve in the nitrous oxide flow. This linkage limits the flow of nitrous oxide relative to the flow of oxygen set by the user.

Note that this needle valve acts as the primary nitrous oxide valve, and is actuated only by movement of the oxygen control.

The nitrous oxide control knob on the flowmeter module operates a secondary needle valve in the nitrous oxide flow. It is positioned downstream of the primary valve and therefore is used only to restrict the flow already set by the primary valve, which itself has been determined by the position of the oxygen control knob.



Therefore, for any oxygen flow set by the user, the mixture delivered will still contain a minimum 30% \pm 3% oxygen even with the nitrous oxide control knob fully open.

As the nitrous oxide knob is progressively closed, the oxygen content of the mixture increases to 100%.

3.4.4 Oxygen Basal Flow

To allow the system to function correctly, an oxygen basal flow is continuously supplied.

Single Flow Tubes: 100 - 200 ml/min

Dual Cascade System Flow Tubes:
50 - 75 ml/min

This basal flow can only be turned on and off by using the Gas Delivery Switch.

CAUTION

The oxygen control is restricted to prevent the needle valve from fully closing. This ensures a minimum oxygen basal flow.

DO NOT attempt to close the flow to zero. Do not overtighten the knob.

3.5 Pressure Gauges

Pressure gauges (50 mm diameter) are located on the front panel below the flowmeter bank.

The gauge for Air is positioned between oxygen and nitrous oxide. Unused gauge positions are blanked out.

All pressure gauges are colour coded and labelled for the gases whose pressures they are indicating.

Cylinder gauges are marked: CYLINDER.

Pipeline gauges are marked: PIPELINE.

The gauges are calibrated in kPa x 100.

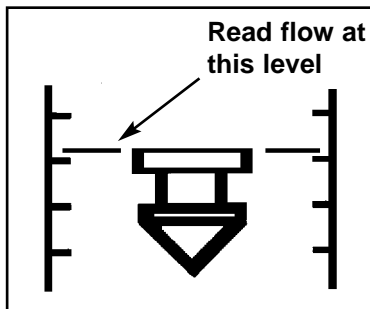
DESCRIPTION

3.6 Flowmeters and Controls

3.6.1 All models

The flowmeters, mounted behind the perspex cover on the left hand side of the machine, are length-indexed to prevent inadvertent, incorrect installation.

All floats indicate flow rate in line with the upper surface as shown below.



Each flow control valve is positioned directly underneath the flow tube assembly to which it corresponds, and the control knob is colour-coded for the gas which it controls.

The oxygen flow control knob is made physically distinguishable from the other flow controls for identification by touch in accordance with ISO standards.

When fitted, air and carbon dioxide flowmeters are always installed in the inner positions on the flowmeter assembly. These positions are blanked out if air or carbon dioxide are not specified for the machine.

The gas delivery switch, positioned on the front panel controls the supply of oxygen and must be in the ON position for normal operation of the machine.

Flow control of each gas is achieved by a needle valve comprising a polished stainless steel needle mounted concentrically in a common manifold block. To minimise wear and material pick-up the needle seat is manufactured from silver. The flow control knob is turned counter-clockwise to increase the gas flow.

CAUTION

Needle valves are designed to seal with light torque and may be damaged if tightened excessively.

DO NOT USE EXCESSIVE FORCE.

3.6.2 Dual Cascade Flow Tubes

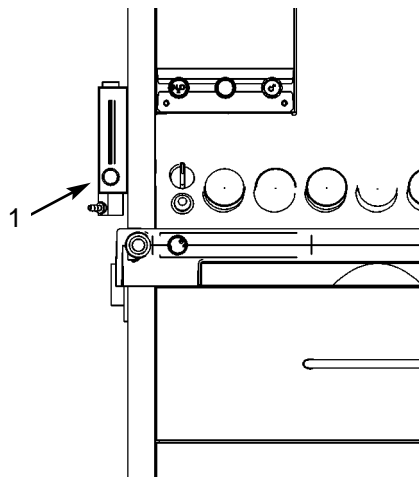
The flow of gas through dual cascade system flow tubes always flows through the low-flow tube first. The high-flow tube should not show any flow until more than 1 L/min is set.

At flows above 1 L/min, the high-flow tube reading indicates the rate of flow for that gas.

3.6.3 Auxiliary Oxygen Flowmeter

An auxiliary oxygen flowmeter (1) is mounted to the left of the machine flowmeter bank.

Flow range: 0 - 10 L/min



DESCRIPTION

3.7 Vaporizers

CAUTION

Read the instruction manual supplied with the vaporizer before clinical use.

3.7.1 Vaporizer Mounting Systems

Selectatec compatible vaporizers for the administration of volatile anaesthetic agents can be mounted on the compatible universal backbar.

WARNING

Vaporizers must always be securely mounted, and never used free-standing. Unmounted vaporizers may be accidentally tipped resulting in uncalibrated and excessive volumes of liquid anaesthetic drug entering the breathing system.

Vaporizers of any description must not be installed or connected between the Common Gas Outlet (CGO) and the Breathing System, unless they are specifically designed for such use. (If this is done, the oxygen flush flow will pass through the vaporizer, and severe overdose may result).

3.7.2 Selectatec Compatible Vaporizer

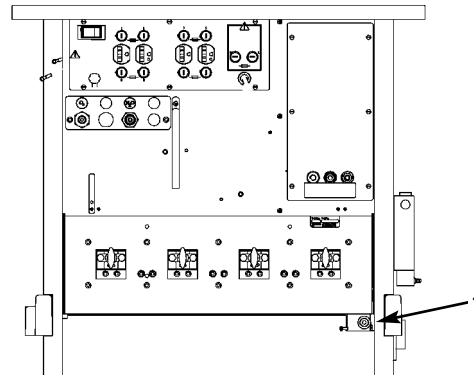
Selectatec compatible vaporizers, (e.g. the Sigma Delta with the Selectatec connector block), may be mounted on a universal compatible back bar manifold.

Two and three-station manifolds are available, with each station fitted with two valve capsule assemblies for vaporizer connector block attachment.

When a vaporizer is installed on a station the valves on that station open automatically to allow gas flow into and out of the vaporizer. Removal of the vaporizer from the station closes the valves on that station.

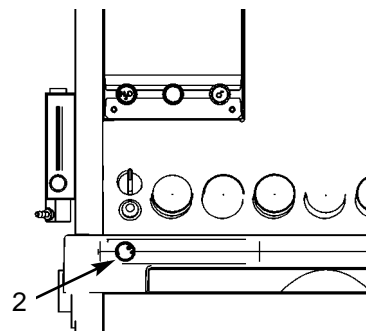
Selectatec compatible vaporizer interlock systems are described in the literature supplied with the vaporizer.

3.8 Common Gas Outlet (CGO)



The outlet (1) is at the rear of the machine, and has a 22 mm male taper and concentric 15 mm female taper. The male taper incorporates the Penlon Safelock system designed to prevent accidental disconnection of the breathing system.

Note - front mounted CGO available as an option.



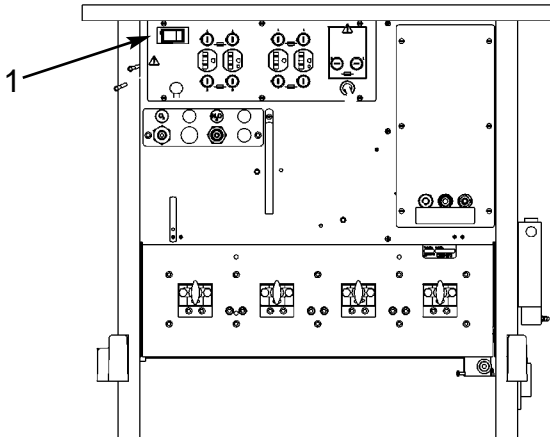
Oxygen Flush

An emergency oxygen flush valve button (2) is mounted at the front of the machine and is marked 'O₂ FLUSH'.

Depressing the button provides a delivery of between 35-75 litres/min of oxygen through the common gas outlet (1).

Releasing the button allows the spring-loaded valve to return to its normal position.

DESCRIPTION



3.9 Electrical Power Supply

3.9.1 Mains Power Supply

Power is fed to the machine via the mains lead, to power an auxiliary output panel, and optional flowmeter bank light.

Current Leakage

NOTE

a) *It is the user's responsibility to ensure that the total sum of leakage currents from additional equipment plugged into the auxiliary sockets plus the leakage current from the machine does not exceed the values specified in any relevant national standards that may apply in the country where the machine is in use.*

b) *Each socket is protected with two 5 A fuses.*

3.9.2 Auxiliary Power Supply Sockets

An optional mains electricity auxiliary panel with four sockets can be specified, and fitted to the rear of the machine.

The supply to the sockets is controlled by an ON/OFF switch (1), which also incorporates a circuit breaker.

3.9.3 Lighting System

The lighting system is controlled by the main ON/OFF switch (1).

3.9.4 Ventilator Power Supply

The mains lead for an AV-series ventilator can be plugged into one of the auxiliary power sockets on the rear of the machine.

AV-S with interface link to Prima SP2/3

(See section 3.15)

- Turn the machine Gas Delivery Switch ON. The ventilator will power-up.*
- While the Prima SP power is ON, the Ventilator can be turned OFF and ON, using the ventilator On/Off switch.*
- Turn the Gas Delivery Switch to OFF. The ventilator will power-down.*

AV-S Ventilator Back-up Battery

If the power supply to the ventilator fails, the ventilator back-up battery will power the ventilator for 30 minutes, if the battery has been maintained in a fully charged condition. Refer also to the user instruction manual supplied with the ventilator

Battery charging takes place automatically when the ventilator mains lead is connected to a 'live' mains supply.

The OFF indicator on the ventilator front control panel will show a yellow light during charging.

NOTE

The stated battery back-up period will only be available if the battery is kept fully charged.

If the battery has been allowed to discharge below the LOW BATTERY condition, the ventilator will not function correctly until the voltage raises above the LOW BATTERY level. A fourteen hours recharge will be necessary to bring the battery to full charge.

3.9.5 Monitor and other Accessories

The mains lead (or adaptor) for a monitor system or other accessories requiring an electrical supply can be plugged into one of the auxiliary sockets on the rear of the machine.

DESCRIPTION

3.10 Auxiliary Gas Outlets

CAUTION

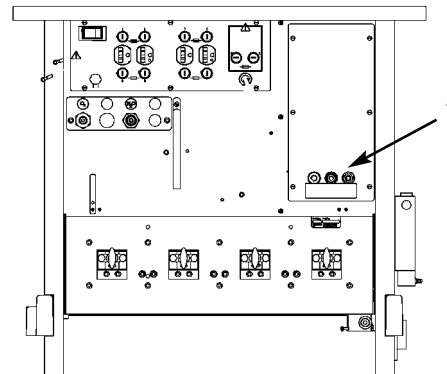
When the auxiliary gas outlets are in use on a machine with cylinder supply only, or if the pipeline supply is not in use, check flow rate requirements, and ensure that adequate back-up cylinders are available.

Oxygen and Air

Auxiliary outlets (1) are mounted on the rear of the machine.

Supply pressure

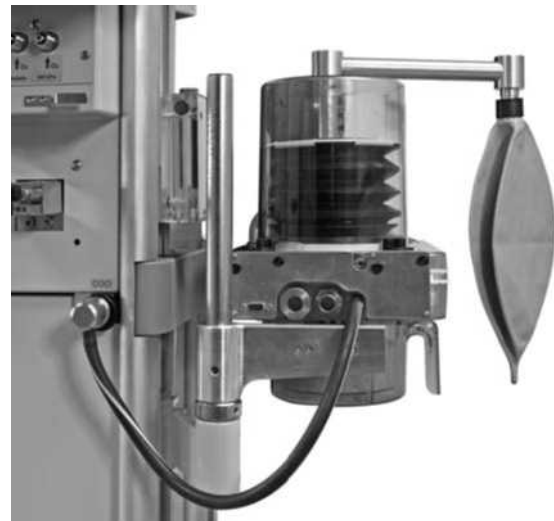
See section 4.5



3.11 A200SP Absorber

The A200SP Absorber and ventilator bellows assembly is mounted on a polemount bracket attached to the machine frame upright.

Refer to the user instruction manual for A200SP for detailed information on installation and operation.



3.12 AV-S Ventilator

Interface to Prima SP2/3

An interface cable links the rear of the ventilator control unit to the gas delivery switch on the anaesthetic machine.

Ventilator ON/OFF function

- a) Turn the machine Gas Delivery Switch (C) ON.
The ventilator will power-up.
- b) While the Prima SP2 power is ON, the Ventilator can be turned OFF and ON, using the ventilator On/Off switch (refer to ventilator user manual).
- c) Turn the Gas Delivery Switch to OFF.
The ventilator will power-down.

Refer to the user instruction manual for AV-S for detailed information on installation and operation.

DESCRIPTION

3.13 MRI Compatibility

CAUTION *Field strengths vary at individual MRI facilities - for additional information, contact Penlon Ltd.*

The following system components are MRI compatible:

1. PrimaSP2 basic* machine

**A 'basic' machine includes any variant of*
Back Bar Flowmeter Bank
Drawers Monitor Shelves

2. A200SP Absorber

CAUTION

Not MRI compatible if the A200SP Absorber is used as part of an Prima SP integrated system with the AV-S - this system is not MRI compatible.

3. Nuffield 200 Ventilator

4 . Delta Vaporizer

The following components are currently not MRI compatible:

1. Oxygen Monitor
2. Flowmeter lighting
3. Electrical power outlets
4. AV-series ventilator (AV-S / AV900 / AV800)
5. A200SP Absorber integrated with AV-S Ventilator

NOTE

- a) *MRI Compatible Plastic Laryngoscopes - available from Penlon Ltd (note that appropriate batteries must be used).*

4. SPECIFICATION

4.1 Physical Dimensions

Overall frame size:	Height x Width x Depth (cm) 139 x 71 x 70
Work surface	
Height:	86 cm
Size:	58 cm x 25 cm
Loading:	30 kg (66 lb) - evenly distributed.
Writing tablet:	30 x 22 cm
Top shelf:	71 cm x 35 cm
Loading:	30 kg (66 lb) - evenly distributed.
Drawers:	12 x 54.5 x 35 cm
Loading:	10 kg (22 lb) evenly distributed
Castors:	Diameter: 5 inches Front pair braked
Ventilator bellows post	Bushed to accept 25.4 mm (1 inch) or 22 mm (7/8 inch) poles.
Loading	30 kg (66 lb)
Gas scavenging fixing	Bracket on frame upright
Loading	30 kg (66 lb)
Common gas outlet:	22 mm male taper with coaxial 15 mm female taper connections, Safelock fitting
Weight (approximate, depending on specification):	75 kg (165 lb)

SPECIFICATION

4.2 Gas Supplies

Cylinders: A maximum of four cylinder fittings can be specified
All cylinder yokes are pin-indexed

Special order options: Helium, Xenon

Pipeline: Maximum of three (oxygen, nitrous oxide, air).
All to relevant national standards.

Medical gas colour codes:

Oxygen	green or White*
Nitrous oxide	Blue
Medical air	Yellow or Black/White*
Carbon dioxide	Grey
Helium	Brown
Xenon	Green (bright)

*To comply with relevant national standards.

Internal pipework is diameter indexed for each gas:

Oxygen:	8 mm	Carbon Dioxide:	4 mm
Nitrous oxide	6 mm	Helium	4 mm
Air	5 mm	Xenon	4 mm
Mixed gas	10 mm		

4.3 Flowmeters

Flow ranges:

Single flow tubes

Oxygen:	0 - 10 L/min
Nitrous Oxide:	0 - 10 L/min
Air	0 - 10 L/min
Helium	0 - 10 L/min

Cascade flow tubes

Oxygen /Air /Nitrous Oxide	(1)	0 - 1000 ml/min
	(2)	0 - 10 L/min

Flowmeter Accuracy

The accuracy of the flowmeter tubes is $\pm 2.5\%$ of full scale reading.

SPECIFICATION

Flowmeter construction and dimensions

Tubes and floats are matched, and must not be interchanged.
Flowmeter tubes have antistatic coatings.

Tubes are length indexed:

Oxygen	260 mm (10.24 inch)
Nitrous oxide	250 mm (9.84 inch)
Other gases	240 mm (9.45 inch) (see 3.12)

Scale length 152 mm (6 in) minimum
(all flow tubes except carbon dioxide)

4.4 Gas Pressures

	USA/ Canada/Japan	UK
Pipeline supplies:	340 kPa (50 psig)	400 kPa (58 psig)
Cylinder supplies:		
Reduced pressure from regulator (at 5 L/min flow)	310 kPa +15 kPa / -35 kPa (45 psig +2 psig / -5 psig)	380 kPa +15 kPa / -35 kPa (55 psig +2 psig / -5 psig)
Regulator diaphragm bursting pressure	2800 kPa (406 psig)	2800 kPa (406 psig)
Reduced pressure system safety valve	600 kPa (87 psig)	600 kPa (87 psig)
Safety valve (to protect flowmeter, vaporizer etc.)	41 kPa \pm 10% (6 psi \pm 10%)	41 kPa \pm 10% (6 psi \pm 10%)
Reduced pressure from secondary regulators (at 5 L/min flow)		
Oxygen and Nitrous Oxide	152 - 241 kPa (22 - 35 psi)	
Air	207 - 283 kPa (30 - 41 psi)	

4.5 Auxiliary Gas Outlets

Pipeline supply: Gas is supplied at pipeline supply pressure (see above)
Cylinder supply: Gas is supplied at reduced pressure from cylinder regulator (see above)

Oxygen

Two self sealing connections on rear of machine
Total flow rate: not less than 100 L/min to free air
80 L/min against 243 kPa (36 psig) resistance
70 L/min against 270 kPa (40 psig) resistance
50 L/min against 297 kPa (44 psig) resistance

Air (on machines with Air supply option)
One self sealing connection on rear of machine.

SPECIFICATION

4.6 Oxygen Failure Warning Devices

1. Gas system whistle
2. Visual indicator, direct pressure operated

4.7 Oxygen Flush

Button on front edge of worksurface
The system supplies 35 - 75 L/min when fully depressed.

4.8 Mechanical AHD System

Minimum oxygen concentration 30% \pm 3% (of total O₂ + N₂O flow)

Basal Flow

Cascade flow tubes

Oxygen basal flow 50-75 ml/min

Single Flow tubes

Oxygen basal flow 100-200 ml/min

Reduced pressure from secondary regulators:

See section 4.4.

4.9 Environmental

Operating Conditions

Temperature +10 to 38°C (50 to 100°F)
Atmospheric Pressure range 70 kPa to 106 kPa
Altitude 2438 m (8000 ft) maximum
Humidity 10 - 95% R.H. non-condensing.

Transport and storage temperature:

Basic machine -5 to 60°C (23 to 140°F)
Oxygen monitor option -5 to 50°C (23 to 122°F)

Cleaning

Wipe external surfaces with dry or damp cloth.
Use mild soap, or disinfectant solution if necessary.

SPECIFICATION

MRI Compatibility

See additional notes in section 3.16.

The following Prima SP2 system components are MRI compatible:

Prima SP2 basic machine (includes any variant of Back Bar, Flowmeter Bank, Drawers, Monitor Shelves, Additional Gases)

A100 (In-board and pole-mounted)

A200SP Absorber

CAUTION

Not MRI compatible if the A200SP Absorber is used as part of an Prima SP integrated system with the AV-S - this system is not MRI compatible.

Nuffield 200 Ventilator

Delta Vaporizer

The following components are currently not MRI compatible:

Oxygen Monitor,

Flowmeter lighting,

Electrical power outlets,

AV-series ventilator (AV-S / AV900 / AV800)

A200SP Absorber integrated with AV-S ventilator

4.10 Electrical Supply

Standard: 6 amp, 110-120 V, 60 Hz

Optional: 5.5 amp, 220-240 V, 50 Hz

Permanently attached 3 metre lead.

Stowage hooks for cable on rear.

Auxiliary electrical power outlets : 4 outlets, 5 A output

Maximum total current: 10 A

5. PRE-USE CHECKS

5.1 Pre-use Checklist

A pre-use checklist for the Prima SP2 range of machines is printed on the next page. This checklist is also supplied with the machine.

Where necessary, subsequent sections in this manual provide an explanation and procedure for setting up the machine and ancillary equipment and the various checks that must be carried out before clinical use.

WARNING

Pre-use checks must be performed before each period of clinical use.

These checks must be supplemented by periodic Function Testing, and full Service Testing by a Penlon-trained engineer to the Service Schedule given in this manual.

These checks will not in themselves ensure the safe use of the apparatus, which remains the responsibility of the qualified practitioner in charge of it.

PRE-USE CHECKS

PRE-USE CHECKLIST

The machine must be carefully inspected and checked as follows.

An incorrectly functioning machine must be repaired by a suitably qualified person before use.

1. Check for visible damage, machine stability, and condition of gas supply hoses.
2. Check for labelling which may indicate status of machine, including faults or recent servicing.
3. Check correct connection of electrical supply.
4. Check correct connections of gas supplies.
5. Check adequate pipeline supply and back-up cylinder supply.
6. Switch on gas delivery switch, and note special operating system:
Check functioning of flowmeters.
Check function of Mechanical AHD,
7. Check correct connection and functioning of the vaporizers.
8. Check functioning of oxygen flush.
9. Check leak rate of low pressure gas system.
10. Check the integrity of the patient circuit.
11. Test the alarm system.

Refer to Section 5 in the User Manual for further information.

Ancillary equipment

12. Check operation of the AGSS.
13. Check functioning of ventilator, including disconnect alarm.
14. Check that the oxygen analyser and other patient monitoring equipment functions correctly.

Refer to the relevant user manual for further information.

PRE-USE CHECKS

5.2 Pre-use Checks - Gas Supply

5.2.1 Gas Pipeline Supplies

Oxygen supply:

1. Connect the oxygen pipeline hose **only**.
Check that the correct pressure gauge reading is obtained.
2. Turn on the Gas Delivery switch (1).
Check that the warning whistle sounds briefly, and that the correct basal flow of oxygen is delivered (see section 3.8).
3. Open both oxygen and nitrous oxide flowmeter valves.
Check that flow is only shown in the oxygen flowmeter.
4. Close both valves.
Turn off the Gas Delivery switch.
Check that the warning whistle sounds briefly, and that the oxygen basal flow is stopped.

Nitrous Oxide supply:

5. Connect the Nitrous Oxide pipeline hose.
Check the gauge reading.
Turn on the Gas Delivery switch (1).
Check for a flow of nitrous oxide when the flowmeter needle valve is operated, and that the oxygen valve is open.

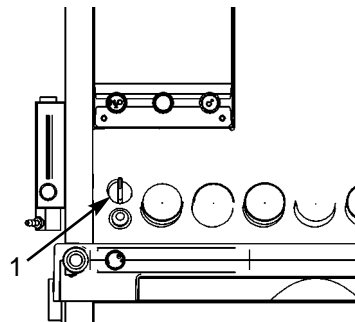
NOTE: cylinder supply can be used if necessary for this test.

Air supply:

6. Connect the Air pipeline hose.
Check the gauge reading.
Check for a flow of air when the flowmeter needle valve is operated.

CAUTION

The mechanical AHD system requires that the oxygen flowmeter control is restricted to prevent the needle valve from fully closing. This ensures a minimum oxygen basal flow. DO NOT attempt to close the flow to zero. Do not overtighten the knob.



5.2.2 Gas Cylinder Supplies

CAUTION

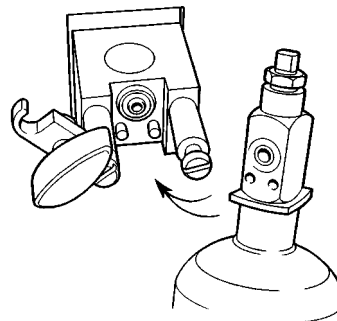
Open the cylinder valves slowly to avoid damage to the pressure reducing valve and pressure gauges. Ensure that valves are at least one full turn open when in use.

1. Fit the gas cylinders to their respective yokes, open the cylinder valves one at a time and check the pressure on each gauge.

NOTE

- A) When two cylinders are provided for a single gas, test each separately, clearing pressure after each test by opening the flowmeter valve.
- B) Turn off the reserve cylinders during normal use.
- C) N₂O - cylinder pressure does not indicate cylinder content.

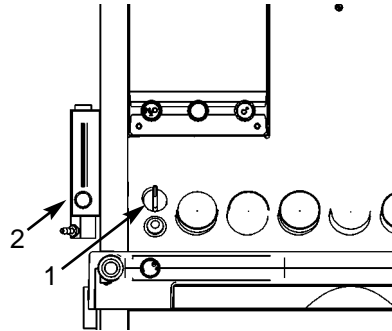
2. Ensure that all flowmeters are kept closed until gas supplies are required.



PRE-USE CHECKS

5.2.3 Flowmeters

1. Turn on the Gas Delivery switch (1) and check that the warning whistle sounds briefly briefly, and that the correct basal flow of oxygen is delivered (see section 4).
2. Open the nitrous oxide flowmeter needle valve and check that there is no nitrous oxide flow.
3. Operate the oxygen flowmeter needle valve.
Check that full scale of flow of oxygen and nitrous oxide can be achieved, and that the floats in both tubes move freely and rotate when at a steady flow.
4. Check that the nitrous oxide flow can be turned off by gentle rotation of the oxygen knob.
Check also that the nitrous oxide float reseats on the bottom stop, and that the oxygen basal flow continues to flow.
5. Operate the other flowmeter control knobs in turn to check:
the full scale of flow can be obtained;
the floats move freely and rotate at a steady flow;
the flow can be turned off by gentle rotation of the knob; and that the floats reseat on the bottom stop.
6. Dual cascade flow tubes:
Check that gas flow is through the low flow tube initially until full flow is achieved, then through the high flow tube.
7. Auxiliary flowmeter (2)
Rotate the flowmeter control and check that a gas flow can be obtained.



PRE-USE CHECKS

5.3 Vaporizers

5.3.1 Pre-use Checks

On ALL vaporizers, before use:

1. Check all joints for gas tightness.
2. Check vaporizer agent level.
3. Check for correct agent delivery concentrations - use an agent analyser.

Always follow the procedures and checklist given in the instruction manual supplied with the vaporizer, particularly when filling the vaporizer with anaesthetic agent.

5.3.2 General Information

WARNING

Vaporizers must always be mounted, never used free-standing.

Free standing vaporizers may be accidentally tipped resulting in excessive and uncalibrated volumes of anaesthetic drug entering the breathing system.

Do not install or connect any vaporizer of any description between the CGO and the breathing system, unless it is specifically designed for such use. (This allows the oxygen flush flow to pass through the vaporizer, and severe overdosage may result).

5.3.3 Selectatec Mounting System

Dependent on choice of backbar manifold system, up to three Selectatec compatible vaporizers may be fitted.

To install the vaporizer, carefully offer the vaporizer up to the manifold.

Check that the gas connection ports on the vaporizer are aligned with the valves on the manifold.

Carefully lower the vaporizer onto the manifold and lock the vaporizer into position by clockwise rotation of the locking lever through 90°.

NOTE Do not use excessive force to lock the vaporizer onto the manifold. Damage to the locking fastener will result.

CAUTION

To prevent damage to the locking shaft, ensure that the gas connection ports are aligned with the valves on the manifold, and are correctly engaged, before tightening the locking lever.

5.3.4 Selectatec Compatible Vaporizers with Interlock

WARNING

Only vaporizers with the Selectatec compatible interlock function will interlock if installed on a two station or three station manifold.

The installation of non-interlock vaporizers allows the possible operation of more than one vaporizer at the same time.

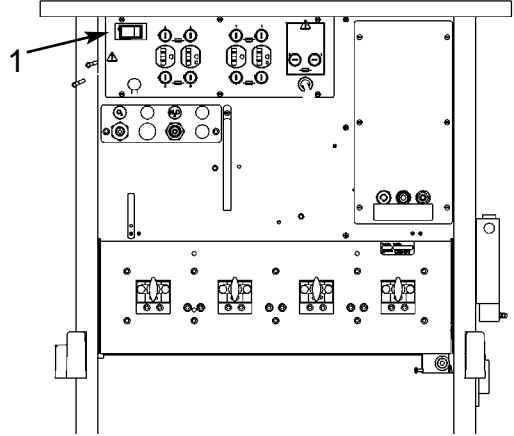
If two vaporizers only are mounted on a three station manifold, they must be installed on adjacent stations.

Check that the interlock mechanisms of all the vaporizers on the manifold are working correctly, i.e. check that only one vaporizer at a time can be turned on.

PRE-USE CHECKS

5.4 Electrical Supply

1. Connect the machine power lead to a suitable mains supply socket.
2. Set the switch (1) to ON.
Check for correct function of each auxiliary power outlet
3. Check all electrical equipment, including devices powered by the auxiliary power outlets on the rear of the machine.
4. Machines with optional flowmeter lighting:
Check for correct operation.



PRE-USE CHECKS - All models

5.5 Patient Breathing System

5.5.1 Hose Connections

Check that all hoses are secure.

5.5.2 Breathing System Hose, Reservoir Bag, Ventilator

Connectors for the Inspiratory hose and Expiratory hose, and the reservoir bag connector are 22 mm male.

All connectors comply with ISO 5356/1.

The ventilator connection point is also 22 mm male.

Hose and bag connections are fitted with Penlon Safelock high security fittings.

Check all connections for gas tightness.

5.5.3 Fresh Gas Supply

The fresh gas hose assembly supplied with the machine has a Penlon connector at the absorber inlet and a 22 mm Safelock taper at the other end.

This should be connected to the common gas outlet of the anaesthetic machine.

Check all connections for gas tightness.

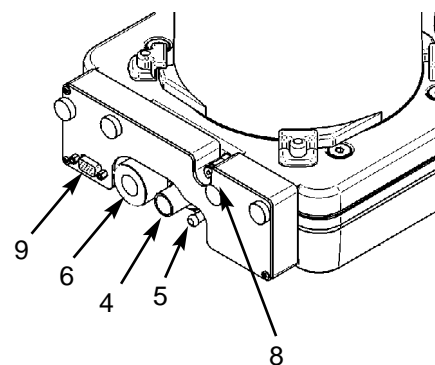
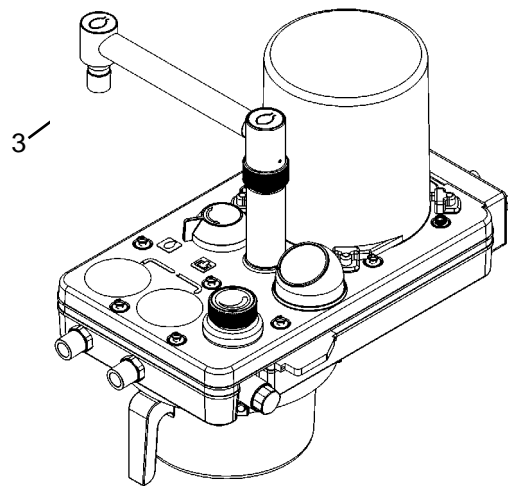
5.5.4 A200SP Absorber

Always follow the pre-use check procedures given in the instruction manual supplied with the absorber.

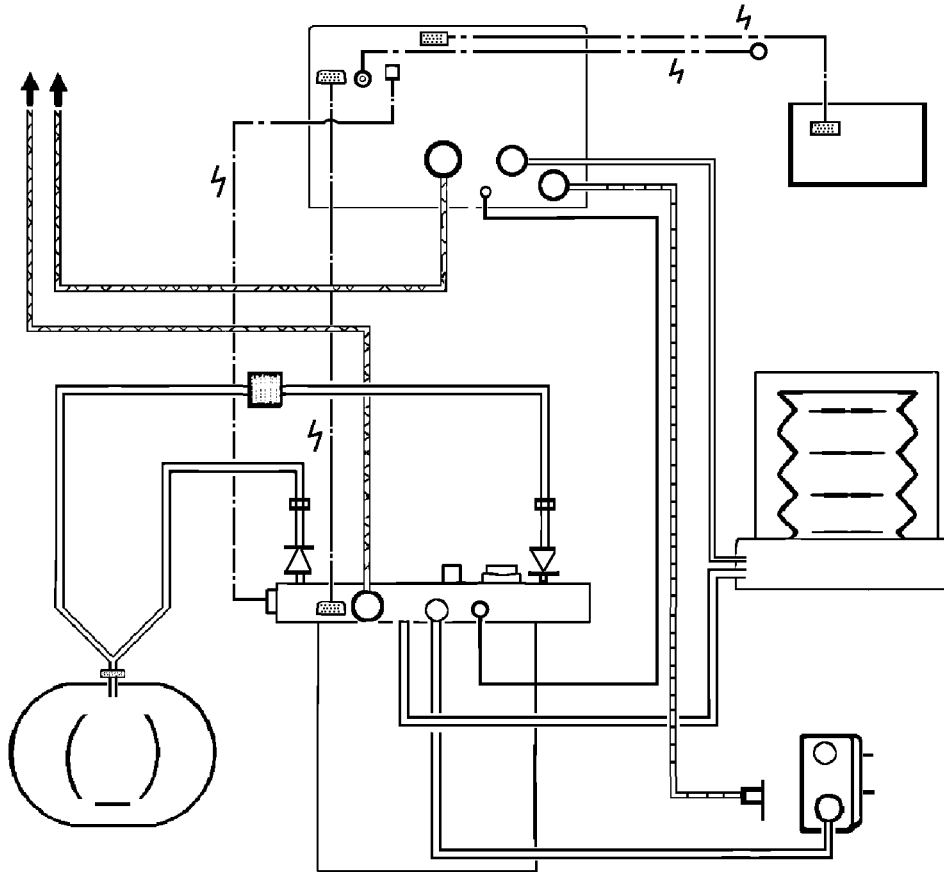
The use of an oxygen monitor (and a carbon dioxide analyser) is highly recommended when using any partial rebreathing anaesthetic system.

A200SP Connections

1. Inspiratory connector
2. Expiratory connector
3. Bag connector
4. Inlet - from DRIVE GAS outlet on ventilator control unit.
5. Inlet - fresh gas hose from Common Gas Outlet
6. Exhaust outlet from APL Valve - connect to Anaesthetic Gas Scavenge System
7. Oxygen monitor sensor
8. Outlet - sample line to Pressure Monitor Port on ventilator
9. Interface cable - Bag/Vent switch and spirometer (connects internally to Prima SP On/Off Switch interface, then to connector on ventilator control unit rear panel).



PRE-USE CHECKS



ite
 AV-S has spirometry and oxygen monitor. Interface cabling is shown for Prima SP2 On/Off switch and A200SP Bag/Vent switch.

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Bellows 2. Ventilator Control Unit 3. Outlets to Anaesthetic Gas Scavenging System (AGSS) 4. Bacterial Filter 5. Absorber valve block 6. Heat and moisture exchanger 7. Patient 8. CGO Block on anaesthetic machine (Fresh Gas Supply) 9. Auxiliary Outlet on anaesthetic machine (Drive Gas Supply) 10. Flow sensor - expiratory 11. Flow sensor - inspiratory 12. Connectors - sensor - pressure monitor 13. Expiratory Valve - Absorber 14. Inspiratory Valve - Absorber 15. Inlet - from Ventilator Bellows 16. Connector - Reservoir Bag 17. Inlet - Absorber - Fresh Gas Supply | <ol style="list-style-type: none"> 18. Drive Gas Inlet - Ventilator 19. Drive gas Outlet - ventilator control unit to bellows 20. Outlet - Exhaust Valve 21. Inlet - Bellows Drive Gas 22. Outlet - to breathing system 23. Input socket - Oxygen monitor sensor 24. Input socket - Prima SP interface (SP on/off switch) 25. Input socket: <ol style="list-style-type: none"> (i) A200SP Absorber Bag/Vent control position (ii) Spirometer sensor signal 26. Interface connections on Prima SP and A200SP 27. APL Valve 28. Outlet from APL Valve to AGSS 29. Oxygen sensor 30. AV-S remote screen 31. Cable - AV-S control unit to screen |
|--|---|

PRE-USE CHECKS

5.5.5 Breathing Circuit Schematic

Note

1. To protect the expiratory limb of the breathing circuit, and the spirometer, use a breathing circuit bacterial filter (4), and a heat and moisture exchanger (6) at the patient Y-piece.

CAUTION

Replacement/Disposal - always follow the instructions supplied with the filter or heat and moisture exchanger.

Always renew components at the recommended interval.

2. Follow the instructions in the relevant user manual for connection to analysers and monitors.
3. Ventilator connections shown are for AV-S with spirometry and oxygen monitor.
4. For A200SP, refer also to the user documentation supplied with the absorber.

5.5.6 Pre-use Test for Complete System

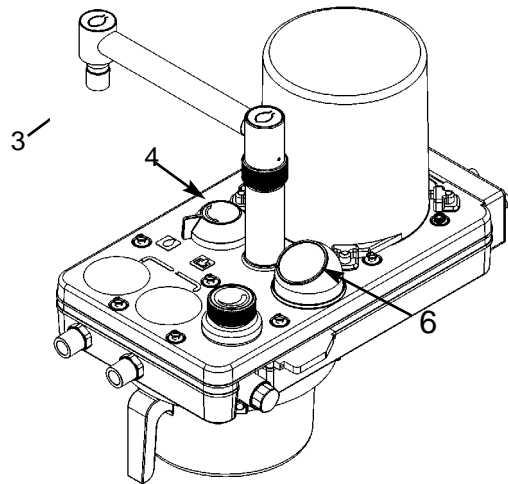
Connect the CGO outlet on the machine to the fresh gas inlet of the A200SP absorber.

NOTE

This machine must be fitted with a breathing system complying with approved design parameters, at the selection of the qualified practitioner.

The breathing system components do not constitute part of the machine but connections between the machine and breathing system should be verified as follows:

1. Fit a patient circuit to the inspiratory connector (1) and expiratory connector (2) on the absorber, and a breathing bag to the bag arm connector (3).
2. Set the bag/ventilator switch (4) on the absorber to 'Bag'
3. Close the adjustable pressure limiting (APL) valve (5), and occlude the patient connection port on the patient circuit. Press the oxygen flush valve button on the front of the machine briefly. Check that the reservoir bag inflates and the manometer (6) indicates approximately 40 cmH₂O.
4. Release the oxygen flush valve. Check that the pressure is maintained in the system with less than 200 ml/min fresh gas delivered into the breathing system, showing that no leaks are present.
5. If this test fails, check the low pressure system on the machine (section 5.6). If the machine low pressure test is successful, check the ventilator and absorber, referring to the relevant user instruction manual.



PRE-USE CHECKS

5.6 Machine Low Pressure Leak Test

NOTE

This test is necessary if the system fails the low pressure test 5.5.6.

1. Attach a side branch connector to the CGO outlet.
Connect the side branch tube to a sphygmomanometer.
2. Turn on a flow of 150 ml/min of oxygen.
Block the open port of the connector with a finger.
The pressure in the low pressure gas system will rise and be displayed on the sphygmomanometer.
3. Check that the pressure rises to at least 100 mmHg.
Release the finger seal immediately the pressure is reached.

CAUTION

Do not maintain closure of the open port longer than necessary to perform the test.

This test should be performed:

- (a) *With all vaporizers 'off' and isolated.*
- (b) *With each vaporizer in turn set to 1%.*

NOTE

This test is equivalent to (and in some cases exceeds) the requirements for system leakage rates quoted in national standards worldwide.

5.7 Oxygen Flush

Check for a high flow of oxygen through the CGO outlet when the flush valve button is pressed and that the flow ceases when the button is released.

This test is most conveniently done after the breathing system has been attached, using the reservoir bag as an indicator of gas flow.

5.8 Anaesthetic Gas Scavenge System (AGSS)

By inspection, check that all sources of expired anaesthetic gases, e.g. the absorber APL valve, and the ventilator bellows patient gas exhaust port, are connected to an approved collection system leading to an AGSS.

WARNING

Do not connect a vacuum system directly to the APL valve on the absorber. A receiving system with a positive and negative pressure control function must be interposed. Systems must comply with standard ISO 8835 part 2.

5.9 Ventilator

Always follow the pre-use check procedures given in the ventilator instruction manual.

Check all hose and tubing connections for gas tightness.

Check all wiring connections for correct fitment and security.

AV-S Ventilator

Check for correct fitment of the interface cable at each connector.

Check that the cable between the control unit and remote screen is securely in place.

Check the interface system function:

- a) *Turn the Gas Delivery Switch ON.
The ventilator will power-up.*
- b) *While the Prima SP2 power is ON, the ventilator can be turned off and on, using the ventilator On/Off switch.*
- c) *Turn the Gas Delivery Switch to OFF.
The ventilator will power-down.*

PRE-USE CHECKS

5.10 Alarm System Test

WARNING

The anaesthetic machine must not be used if any alarm is not functioning correctly.

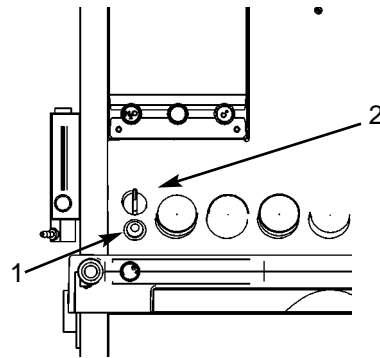
Primary Oxygen Failure Alarm

The machine is fitted with a warning whistle and a visual indicator (1).

These components act as oxygen supply failure devices and constitute the primary alarm system, powered only by the residual oxygen supply, as described in section 3.

The system can be checked whenever the low pressure oxygen system is first pressurised by turning on a cylinder or connecting a pipeline.

- a) The whistle will sound briefly as pressure increases, and,
- b) The visual indicator will turn from red to green.



Whistle, Visual Indicator, and Gas Cut-off Device Test

A formal test (including the action of the internal gas cut-off device) is performed as follows:

1. Connect oxygen, nitrous oxide and air supplies.
2. Set the Gas Delivery switch (2) to ON, and check that the warning whistle sounds briefly.
3. Set a flow of 2 L/min on both flowmeters.
4. Disconnect the oxygen supply at the wall socket or close the oxygen cylinder valve and check:
 - a) that as the oxygen flow slows down, the whistle starts to sound and continues for at least 7 seconds.
 - b) that the flow of nitrous oxide is cut off completely before the oxygen flowmeter shows zero flow.
 - c) that the visual indicator (1) turns red before the oxygen flow is entirely stopped.
 - d) air continues to flow.

NOTE

All gases must be included in the pre-use check.

5. Reinststate the oxygen supply.
Check that the flow of nitrous oxide is reinstated, and that the visual indicator turns green again.

6. FUNCTION TEST

6.1 Introduction

Commissioning a New Machine

Every PrimaSP anaesthetic machine is tested thoroughly before leaving the factory, but it is essential to undertake a complete performance check as described in this section before the machine is first used clinically.

This can be done by a Penlon trained engineer as part of the commissioning of a new machine.

Regular Function Test

Full function testing should be carried out, at six month intervals, by a Penlon trained engineer or other persons certificated by Penlon Limited.

Procedures for servicing and repair are described in subsequent sections in this Service Manual.

Read the procedure carefully before carrying out each test, noting references to machine specifications and equipment.

Perform these tests in sequence.

Equipment Required

No complex test equipment is required for the series of tests described below.

Leak tests

Apply a Leak Test Spray or a diluted solution of soap in water to the suspect connector, (not on high pressure cylinders) and check for a stream of bubbles at the joint.

Flow rates

Check with a respirometer or other suitable flow measurement device.

Electrical circuits

Check with a multi-meter.

Pressure

Check with a manometer.

Safety Precautions

WARNING

Before commencing any test work ensure that all vaporizers are in the "Off" position.

Note that the OFF position may be indicated on the vaporizer as a 0 (zero). Refer to the vaporizer instruction manual.

WARNING

During any test procedure the release of Nitrous Oxide or anaesthetic vapours into the working environment must be controlled.

Connect the machine to an approved anaesthetic gas scavenging system (AGSS).

WARNING

Do not contaminate pipeline connections, cylinder yokes, regulators or pressure gauges with oil or grease, or any other flammable lubricant or sealant.

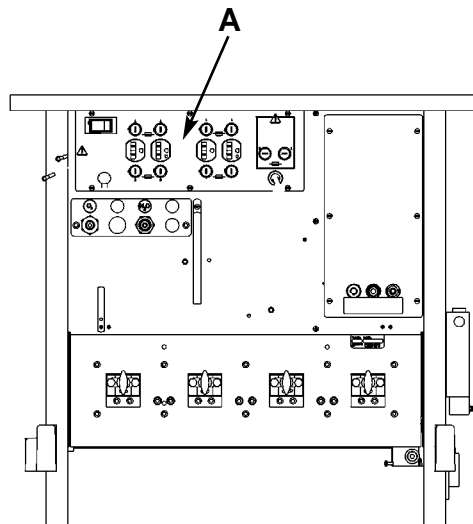
FUNCTION TEST

6.2 Machine Frame

1. Check the main structure of the machine is firmly assembled, free from obvious distortion and damage and that all attachments are secure.
2. Check that the castor wheels are securely attached to the machine frame and that the wheels run and swivel freely. Check that each front wheel locking mechanism is working.
3. Check the drawer unit open and close smoothly.
4. Check that the writing tablet (if fitted) opens and closes smoothly.

6.3 Electrical Safety Tests

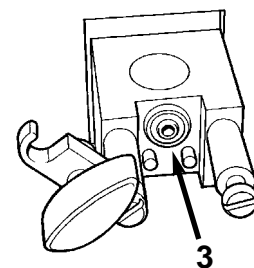
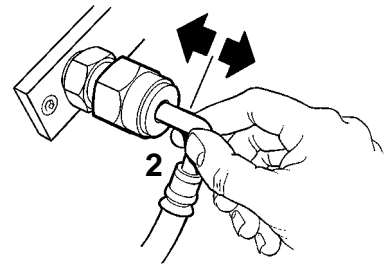
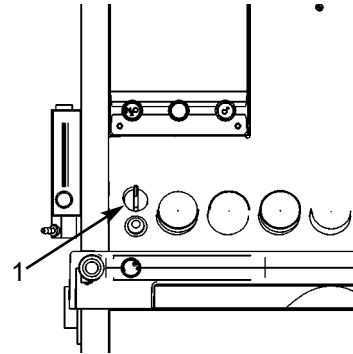
1. Disconnect the mains lead from the electrical supply.
2. Disconnect all equipment from the auxiliary power outlet panel (A).
3. Perform Electrical Safety Tests as specified by the National Standards applicable to your country.
4. Check electrical outlet sockets for correct output and earth continuity.



FUNCTION TEST

6.4 Pipeline Gas Supply and Non-Return Valve

1. Ensure that all reserve gas cylinders are turned off, and removed from the machine.
2. Leave the Gas Delivery ON/OFF switch (1) in the "OFF" Position.
3. Check ALL Pipeline Hose assemblies for correct probes, colour coding, and attachment to the machine.
4. Inspect ALL Pipeline hoses for cracks, and check that all clips and connections are secure.
5. Connect the Oxygen Supply to the anaesthetic machine using the pipeline hose.
6. Check that the oxygen pipeline pressure gauge indicates the correct pipeline pressure.
7. Check the security of the Oxygen Hose connections by tug-testing the hose (2).
Perform this test at both ends of the hose by tugging gently whilst grasping the hose between thumb and forefinger.
Firm leak free joints should be maintained, without any relative movement of the spigot, ferrule or hose.
Note: Renew all faulty hose assemblies.
8. Hoses:
Test for leaks from each hose by brushing leak detecting fluid generously about both end fittings.
9. Pipeline Non-return Valve (NRV)
Test for leaks, using a pipeline non-return valve or ball valve assembly.
The leak rate should be less than 10 kPa in one minute.
Alternatively, fit a tube securely to cover the hole in the centre of the Oxygen Cylinder Yoke Seal (3).
Brush leak detecting fluid over the other end of the tube.
Leaks will be indicated by bubbling of the fluid.
10. Dry with paper towel, fix any leaks (replace hose/NRV if necessary).
11. Connect the Nitrous Oxide Supply to the anaesthetic machine using the pipeline hose.
Repeat tests 5, to 10 for this gas.
12. Connect the Air Supply to the anaesthetic machine using the pipeline hose.
Repeat tests 5 to 10 for this gas.



FUNCTION TEST

6.5 Cylinder Gas Supply And Pressure Reducing Valves.

CAUTION

This machine is fitted with an hypoxia guard known as a Mechanical Anti Hypoxic Device (MAHD).

This device prevents the delivery of hypoxic mixtures to the patient and must only be adjusted by a Penlon-trained Engineer or other persons certificated to do so by Penlon Limited.

Incorrect adjustment of the MAHD could result in the failure of this device and the loss of hypoxia protection.

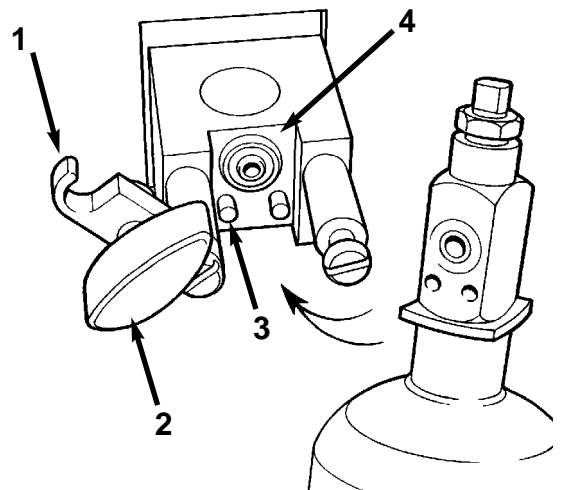
The oxygen control is restricted to prevent the needle valve from fully closing. This ensures a minimum flow of oxygen at all times while the machine is switched on.

This small flow of oxygen is known as the Basal Flow.

DO NOT attempt to fully close the oxygen flow to zero.

DO NOT overtighten Flow Control knobs for the other gases as this will reduce the life of the needle valves.

1. Ensure that all flowmeter control valves are shut. Disconnect all the pipeline gas supplies.
2. Remove all gas cylinders.
3. Check each cylinder yoke for security of attachment, and free movement of the clamp bar (1) and clamp screw (2). Check Pin Index system pins (3) are secure and undamaged.
4. Check that a seal (4) is in place and undamaged, in each cylinder yoke.
5. Attach each gas cylinder to its appropriate yoke, ensuring full engagement of the "Pin Index" system. Note: Use full bottles only.
6. Turn on the Oxygen Cylinder.
Check that the Cylinder pressure is indicated on the Oxygen Cylinder pressure gauge in a smooth sweeping movement.
Check that all other gauges indicate zero pressure.
Check that there is no flow of gas indicated on the Oxygen flow tube.
7. Turn on the Gas Delivery Switch (5).
Check that the warning whistle sounds briefly.
Check that a basal flow of oxygen is delivered, as indicated in the table.



Basal Flow

Cascade O₂ flowmeter 50-75 ml/min

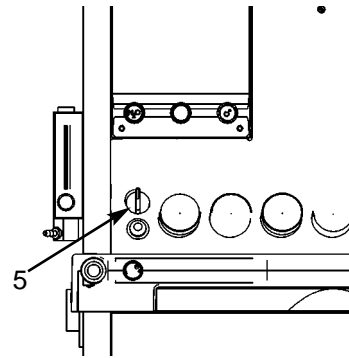
Single O₂ flowmeter 100-200 ml/min

FUNCTION TEST

Leak Tests

For each gas leak test, allow a minimum 2 minute period.

8. Turn OFF Gas Delivery Switch (5).
9. Turn the Oxygen Cylinder OFF.
10. Drain down the oxygen system and blank off the output of the O₂ secondary regulator. Turn on the O₂ cylinder then turn off again.
11. Observe the pressure gauge reading; a leak will be indicated by the needle pointer falling towards zero. Maximum acceptable leak is 500 kPa.
12. Drain down the oxygen system and remove the blank. Reconnect the output of the secondary regulator.
13. Turn the Oxygen Cylinder ON.
14. Turn the Gas Delivery Switch (5) ON (warning whistle will sound briefly).
15. Check that all flow control valves are in the OFF position and that the only flow indicated is the Oxygen Basal Flow.
16. Turn the Nitrous Oxide Cylinder ON. Check that the Nitrous Oxide pressure gauge responds in a smooth sweeping movement. Check that the only Gauges indicating pressure are those for Oxygen and Nitrous Oxide. Check again that the only indicated flow is the Oxygen Basal Flow.
17. Turn the Nitrous Oxide Cylinder OFF.
18. Observe the pressure gauge reading; a leak will be indicated by the needle pointer falling towards zero. Maximum acceptable leak is 200 kPa.
19. Turn the Air Cylinder ON. Check that the Air pressure gauge responds in a smooth sweeping movement. Check that the Oxygen, Nitrous



Oxide and Air gauges indicate pressure. Check again that the only indicated flow is the Oxygen Basal Flow.

20. Turn the Air Cylinder OFF.
21. Observe the pressure gauge reading. A leak will be indicated by the needle pointer falling towards zero. Maximum acceptable leak is 500 kPa.
22. Turn the Air Cylinder ON.
23. Set all gas flows, as required, to 5 litres/min.
24. Connect a manometer to each Primary regulator test point in turn and check regulator is set in accordance with specification for relevant country.
25. Connect a manometer to each Secondary regulator test point in turn and check regulator is set in accordance with specification for relevant gas.
26. Reduce gas flows to minimum settings.

FUNCTION TEST

6.6 Flowmeter Unit

1. Visually inspect the flowmeter tubes for damage.
Check that the transparent shield is in place.

2. Turn the Gas Delivery Switch (1) to ON.
Check that a basal flow of oxygen is delivered, as follows:

Cascade O₂ flowmeter 50-75 ml/min

Single O₂ flowmeter 100-200 ml/min

3. Open the Oxygen Flowmeter control slowly.
Check that a full flow can be obtained.

4. Set a flow rate of 6 L/min
Check that the float is stable in its setting and spins freely.
Repeat test at a flow rate of 500 ml/min.

5. Without rotating the control knob, check for wear by gently pulling on the knob, and check that any fluctuation in flow rate is within the range of ± 100 ml/min.

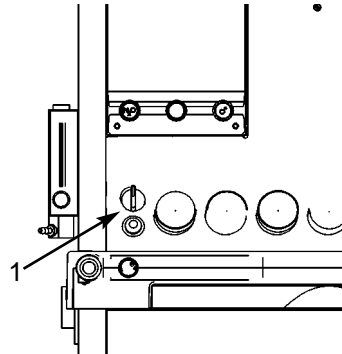
6. Close the Oxygen Flowmeter control valve gently until the mechanical stop engages.

7. Check Oxygen Basal Flow (see operation 2).

8. Nitrous Oxide / Oxygen Linkage

9. Fully open the Nitrous Oxide Flow control and check that **no** flow is indicated on the flow tube.

10. Slowly open the Oxygen Flowmeter control and check that the Nitrous Oxide flow tube float rises.
Pause briefly at an indicated Nitrous Oxide flow of 4 L/min.
Check that the Nitrous Oxide flow tube float is stable in its setting and spins freely.
Increase the Oxygen flow until maximum flow of Nitrous Oxide has been achieved.



11. Close the Oxygen Flowmeter control valve gently.
Pause briefly when Nitrous Oxide flow indicates 500 ml/min.
Check the stability of the Nitrous Oxide float and that it spins freely.
Decrease the Oxygen flow until the mechanical stop engages.
Check that as the Oxygen flow rate is reduced, so is the flow of Nitrous Oxide.
Check again that the only flow indicated is the Oxygen Basal Flow.
12. Close the Nitrous Oxide Flowmeter control.
13. Open the Air Flowmeter control slowly and see that a full flow can be obtained.
14. Set an Air flow of 5 L/min and check that the Air flow tube float is rotating and stable.
15. Close the Air Flowmeter control gently until no gas flows.

FUNCTION TEST

6.7 Gas Safety Devices

Mechanical AHD

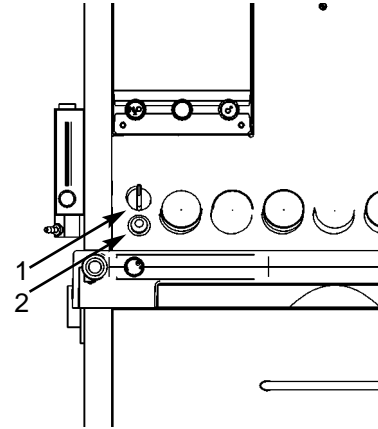
1. Gas Delivery Switch (1) ON.
Fully open the Nitrous Oxide Flowmeter and check that there is no flow of gas indicated on the N₂O flow tube.
2. Fit an Oxygen Analyser to the output of the Common Gas Outlet.
Refer to the table below, and check % Oxygen concentration at the oxygen flows specified.

Adjust the Oxygen Flowmeter control only - Do NOT adjust the N₂O flowmeter.

Note The flow rates for N₂O are given as a guide only.

O ₂ Flow (L/min)	%O ₂ (in O ₂ /N ₂ O mixture)	N ₂ O Flow
0.25	27 - 33 %	0.5 - 0.67
0.5	27 - 33 %	1.0 - 1.35
0.8	27 - 33 %	1.6 - 2.1
1.5	27 - 33 %	3.0 - 4.1
3.0	27 - 33 %	6.1 - 8.1

3. Turn OFF the Gas Delivery Switch.
Check that both gas flows are stopped.
4. Turn ON the Gas Delivery Switch
Check that both flows are reinstated.
5. Partially close the Nitrous Oxide flowmeter to check that it limits the Nitrous Oxide flow.
Check that the reducing flow gives an increased Oxygen concentration.
Fully open the Nitrous Oxide flowmeter.
6. Close the Oxygen flowmeter control valve gently until the mechanical stop engages.
Check that the same corresponding values of Oxygen and Nitrous Oxide flows are achieved as tabled above.
7. Ensure that when the Oxygen flow is at its basal level, all Nitrous Oxide flows have ceased.
Check that only the Oxygen Basal Flow is indicated on the flow tubes.
Close the Nitrous Oxide Flowmeter and switch off the Gas Delivery Switch.



Oxygen Fail Cut-off

8. Set the following flow rates:
Oxygen: 5 L/min
N₂O: 5 L/min
CO₂ (if fitted) : 500 ml/min.
9. Turn Off the Oxygen Cylinder and observe that the Oxygen Cylinder pressure gauge indicates falling Oxygen pressure.
10. Check that the warning whistle (Oxygen Fail Alarm) sounds before the supply of oxygen is exhausted from the anaesthetic machine and that its duration is a minimum of 7 seconds.
11. Check that before the supply of Oxygen is exhausted from the anaesthetic machine, that Nitrous Oxide flow is cut off automatically by the Oxygen Fail System.

Oxygen Fail Warning

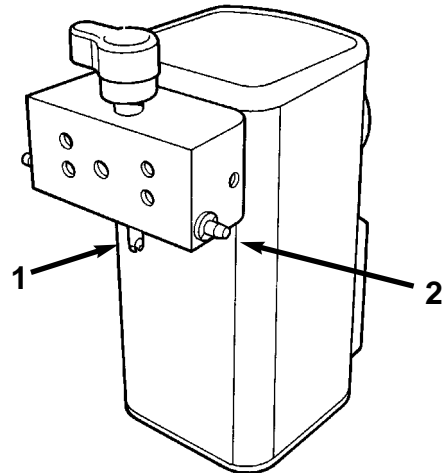
12. Check that before the supply of Oxygen is fully exhausted, that the visual indicator (2) has turned fully red.
13. Turn OFF all Flowmeters and turn ON the Oxygen cylinder so that only the Oxygen Basal Flow is indicated.
14. Check that the visual indicator (2) is showing fully green.

FUNCTION TEST

6.8 Vaporizers and Back Bar Manifold Assembly

6.8.1 Selectatec Compatible Vaporizer

1. Check that all the vaporizers are securely mounted on the manifold.
If a vaporizer is not secure, check the condition of the locking shaft (1).
2. On interlock vaporizers check that the interlock mechanism (interlock bolt, 2) of each vaporizer is working correctly, i.e only one vaporizer at a time can be turned on.
3. Selectatec Manifold - check all pillar valves open and seal correctly. Check pillar valve inserts sit proud or flush with the pillar valve.
A sunken pillar valve insert denotes failure of the internal spring.



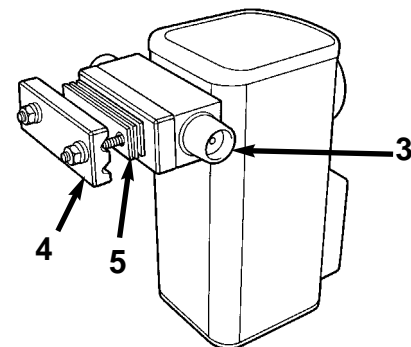
6.8.2 Cagemount Vaporizer (if fitted)

Vaporizers fitted with the Cagemount tapers have the male taper (Inlet Port - 3) on the left and the female taper on the right as viewed from the front of the vaporizer. Two M6 studs with nuts, washers and a clamp plate (4) are provided to fix the vaporizer to the anaesthetic machine.

NOTE

Some international standards demand that this type of vaporizer should only be used on machines with a single mounting station.

In addition, use a safety clip (Catalogue No 52275) to retain the Cagemount taper cones in position on the vaporizer.



Fitting the Vaporizer

1. The taper cone joints must be engaged axially and not sideways loaded.
Use the shims (5) provided so that the distance from the back bar to the taper joint can be adjusted by adding or removing shims from the vaporizer.
2. The cone joints should then be lightly smeared with an Oxygen compatible lubricant such as "Fomblin".
The taper joints must be engaged by applying axial pressure, and the fixing nuts tightened.
Check all joints for gas tightness.
3. Check flexible hoses for security of attachment and integrity.

FUNCTION TEST

6.9 Reduced Pressure Gas Circuit Leakage. (Back Bar Leak Test and Pressure Relief Test)

- 1 Connect a suitable test pressure gauge (Manometer) to the Common Gas Outlet (CGO) using suitable tubing and connector.
- 2 Ensure all vaporizers attached to the machine are turned OFF.
- 3 Using the Oxygen Flow Control Valve, raise the pressure in the circuit slowly until a flow of 10 L/min is set. Check that the Pressure Relief Valve (PRV) mounted under the gauge cover, on the right hand side, begins to leak in the range of 37 to 45 kPa.
- 4 Do not exceed this pressure.
- 5 Alter the pressure by reducing the Oxygen Flow Rate until the displayed reading on the test gauge is 20 kPa (150 mmHg).
- 6 The maximum permissible flow to maintain the above pressure is 200 ml/min.
- 7 If a higher flow rate is required to maintain a pressure of 20 kPa (150 mmHg) there is a leak in the system that must be fixed.
Use soap solution to detect leak, repair and repeat above tests (5, 6 & 7).
- 8 Repeat the above tests (5, 6 & 7) with all fitted vaporizers turned on (Test one at a time) to check gas tightness of each individual vaporizer.

A leaking vaporizer must be withdrawn from use.

Return the unit to your supplier.

6.10 Emergency Oxygen Flush Control Test

- 1 Ensure all flowmeter control valves are turned off.
- 2 Oxygen Cylinder is turned on and Oxygen Pipeline is unconnected from the wall outlet.
- 3 Depress the Emergency Oxygen Flush (O₂ Flush) button.
- 4 Check that the delivered flow rate is between 35 - 75 L/min.
- 5 Ensure the spring action cuts off the Oxygen flow when the button is released.
6. Check that the whistle does not sound when the Oxygen flush is operated. If this occurs check that the Oxygen Cylinder Valve is fully open. If the problem is not rectified, instruct the service engineer to check:
 - a) filters and Non-return valves for restriction.
 - b) the pressure of the primary Oxygen regulator.
7. Connect the oxygen pipeline and close the cylinder valve and repeat tests 3 - 6.

6.11 Auxiliary Outputs - Test

- 1 Check outputs for security and correct function.
- 2 With a suitable flowmeter measure the output from each outlet to ensure that greater than 100 litres/min can flow to free air.
- 3 Ensure that the oxygen failure alarm does not function during this test.
4. Repeat the test for both pipeline and cylinder supplies.

7. FAULT FINDING

7.1 Introduction

Provided the Anaesthetic Machine is regularly serviced and correctly used, it is unlikely that serious component faults will occur.

After several years' usage, some items may require replacement and regular performance checks - see section 8.

To trace possible faults, refer to the Fault Diagnosis Table, which will indicate the required action.

In many cases, apparent machine faults may be attributable to causes other than machine malfunctions; these causes are also listed.

FAULT FINDING

7.2 Fault Diagnosis Table

Component	Symptom	Possible Fault	Remedy
Cylinder pressure reducing valves, gauges and yokes.	Leaking high pressure connection from cylinder to yoke.	Bodok seal absent or worn.	Fit/replace seal.
		Cylinder clamp screw assembly damaged.	Replace as necessary.
		Inadequate engagement of pin-index system.	Ensure correct gas cylinder is attached. Check index pins not loose or damaged. Replace as necessary.
Pressure relief valve leaks or out of adjustment.	Diaphragm or valve disc worn, damaged.	Adjust/replace regulator as necessary.	
		Faulty relief valve.	Fit new relief valve.
	Outlet pressure too high, - may occur with leaking pressure relief valve	Diaphragm worn, damaged or out of adjustment.	Adjust/replace regulator as necessary.
		Regulator seat damaged.	Replace regulator.
	Outlet pressure too low.	Loose connections. Tighten leaking joints. (DO NOT use excessive force)	Test for leaks.
	Diaphragm / valve disc worn/damaged or regulator out of adjustment.	Adjust/replace regulator as necessary.	
	Pressure gauge reads zero when cylinder valve opened.	Cylinder empty.	Replace cylinder.
		Bodok seal absent or worn.	Fit/replace seal.
		Cylinder clamp screw assembly damaged. Pressure gauge seal damaged.	Replace as necessary. Replace as necessary.
Pressure gauge pointer sticks at above zero reading.	Inadequate engagement of pin-index system.	Ensure correct gas cylinder is attached. Check index pins not loose or damaged.	
Leaking high pressure non-return valve.	Defective gauge.	Replace gauge.	
		Replace gauge.	
	Gas trapped in system.	Open flowmeter and empty system.	
	Damaged 'O' seal.	Replace plunger 'O' seal assembly.	

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
Pipeline supply hoses and inlet blocks	Pressure gauge reads zero when connection to supply made.	Loose connections. Tighten leaking joints. (DO NOT use excessive force).	Test for leaks.
		Defective gauge.	Replace gauge.
		Faulty probe or hose.	Replace as necessary.
	Insufficient free flow.	Blocked filter.	Replace as necessary.
		Pipeline supply defective.	Contact hospital engineer.
		Pipeline supply defective.	Contact hospital engineer.
Flowmeter units	Float stays at bottom of tube when control valve opened.	No gas supply.	Check cylinder/pipeline connections.
		Pressure reduction valve defect.	See instructions under component group
		Pipeline supply defective.	See instructions under component group.
		Control knob loose on shaft.	Tighten.

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
Flowmeter units (Mechanical AHD system)	Float stays at bottom of tube when control valve opened(N ₂ O flowmeter)	Gas delivery switch left in off position.	Turn on gas delivery switch
		Gear linkage loose on O ₂ or N ₂ O primary valve shaft.	Reset gears and tighten
	Restricted flow through flowmeter (Control valve opening does not achieve expected flow)	Gear linkage loose on valve shaft.	Reset gears and tighten
	Incorrect O ₂ concentration.	N ₂ O flow limited by N ₂ O control valve.	Open N ₂ O control valve
		Secondary regulators out of alignment.	Check and reset secondary regulators. Replace if necessary
Gear linkage loose on valve shaft.		Reset gears and tighten	

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
Flowmeter unit	Float sticks at above zero reading when control valve closed.	Dirt in tube.	Remove tube and clean.
		Build up of electrostatic charge.	Check earthing contacts at bottom of flowmeter tubes. Increase flow rate sharply to break charge, then close valve.
		Flowmeter unit not vertical.	Ensure machine is on level surface.
		Upper float retaining peg not centralised or moulding flash not removed.	Remove flow tube and retaining peg. Clean off moulding flash and re-position retaining peg.
		Worn needle valve.	Replace complete valve and/or seat assembly.
	Float level unstable after start up.	Pressure reducing valve defect.	See instruction under component group.
		Flowmeter unit not vertical.	Ensure machine is on level surface.

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
Flowmeter unit	Restricted flow through flowmeter (Control valve opening does not achieve expected flow).	Faulty cylinder pressure reducing valve, yoke or connections.	See instruction under component group.
		Faulty pipeline supply hoses or connections.	See instructions under component group.
		Blocked flowmeter filter.	Clean or replace lower bobbin assembly.
		Control knob loose on shaft.	Tighten.
		Incorrect valve restriction shimming.	Reset valve shims.
		Damaged valve seat assembly.	Replace complete valve.
		Float level falls after initial setting.	Reducing valve defect.
	Pipeline supply defect.		See instructions under component group.
	Leak in 'upstream' connection.		Test for leaks. Tighten leaking joints. (DO NOT use excessive force.)
	Blockage in 'downstream' gas circuit.		Trace site of blockage and clear.
	(Not oxygen flowmeter) Gas cut-off units in operation or defective.		See instructions under component group.
	Worn needle valve and/or seat.		Replace complete valve assembly.

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
Vaporizer mounting facility.	Leakage at back bar manifold or vaporizer interlock joints.	Loose manifold or vaporizer retaining screws.	Tighten.
		Missing 'O' seals	Replace 'O' seals.
Selectatec compatible system.	Leakage from back bar.	Damaged or worn gas valves.	Replace valve.
	Leakage from vaporizer connections. Vaporizer difficult to remove.	Damaged or worn 'O' seals or seal faces. Damaged or worn locking system.	Replace as necessary. Replace components as necessary.
Gas cut-off unit.	No nitrous oxide.	Oxygen supply not turned on.	Turn on supply.
		No N ₂ O (or restricted flow)	Mechanical AHD gas delivery switch left in 'Off' position.
	Safety capsule valve fails to operate correctly.	Faulty safety capsule valve.	Replace valve.
		Valve shuttle or seals defective.	Fit replacement capsule valve.
		Loose valve retaining screws. Worn or damaged 'O' seals.	Tighten. Replace seals.
	Leaks at joint between manifold and valve seating.	Vent port blocked.	See instructions under component group.
		Loose valve.	Tighten retaining screws
Worn O seals.		Replace seals	
Valve cuts flow of nitrous oxide as required but does not restore it.	Valve shuttle or seals defective.	Fit replacement valve.	

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
Warning Whistle.	Leakage at whistle.	Loose connection.	Tighten. (DO NOT use excessive force).
		Faulty whistle.	Replace whistle.
	Whistle continually sounds when oxygen on.	Faulty whistle.	Replace whistle.
		Low pressure in circuit.	See instructions under component group.
	Whistle fails to sound.	Faulty whistle.	Replace whistle.
		Low pressure in circuit.	See instructions under component group.
Pressure relief valve (fresh gas circuit)	Leakage through valve.	High pressure in circuit.	Reduce pressure. Check for blockage in 'downstream' circuit.
	Relief pressure too high.	Faulty valve	Replace complete valve
	Relief pressure too low.	Faulty valve	Replace complete valve.

FAULT FINDING

Component	Symptom	Possible Fault	Remedy	
Emergency oxygen flush	Valve does not operate.	No oxygen supply.	See instructions under component groups.	
		Defective valve.	Replace valve.	
		Low Oxygen flow (less than 35 l/min).	Low oxygen supply pressure.	See instructions under components group.
		Worn valve seals.	Fit new seals or replace valves as necessary.	
		Incorrect adjustment of valve shaft.	Replace valve.	
	Leaks around control button.	Incorrect control jet.	Replace control jet.	
		Worn valve seals.	Fit new seals or replace valve as necessary.	
		O ₂ flow into breathing circuit or atmosphere (valve does not shut off flow).	Worn valve seals.	Replace valve.
			Incorrect adjustment of valve shaft.	Replace valve.
			Defective valve.	Replace valve.

FAULT FINDING

Component	Symptom	Possible Fault	Remedy
Electrical power supply	Machine 'dead'	Mains supply /socket	Check supply (plug ON).
		Faulty on/off switch	Replace switch (front panel).
		Mains supply faulty.	Reset circuit breaker (rear panel).

8. SERVICE SCHEDULE

1 Initial Checks

- 1.1 Check serial number to determine service required.
- 1.2 Check general condition and configuration of any attachments.
- 1.3 Inspect internal tubing.
Replace tubing that is discoloured or has lost flexibility

2 Check Castors

- 2.1 Operation and security.
- 2.2 Locking mechanism if fitted.

3 Examine Cylinder Yoke Assemblies

- 3.1 Check for damage, cleanliness, all fitting are tight and clamping screws for freedom of movement.
- 3.2 Replace Bodok seals.
- 3.3 Replace yoke inlet filters. (annual service)
- 3.4 Replace cylinder and pipeline NRV O-rings. (4 year service)

4 Check Pipeline Hoses

- 4.1 Examine pipeline connectors, probes and hoses for cleanliness and damage.
Replace seals if required, check for anti-confusion.
- 4.2 Replace hoses at 3-year intervals and date replacement hose.
Note age of hose on service report.
If hoses not dated work from age of machine.
- 4.3 Pressure Leak Test Hoses with cylinders removed and machine "OFF".
- 4.4 Replace pipeline inlet filters. (annual service)

5 Pressure Gauge Checks

- 5.1 Examine each Pressure Gauge for damage.
Check they read zero with no gases supplied, and operate smoothly with gases connected

6 Mechanical AHD Linkage Inspection. (annual service)

- 6.1 Connect O2 and switch on machine.
Note basal flow reading.
- 6.2 Remove Rotameter control knobs.
- 6.3 Remove manifold block cover.
- 6.4 Inspect the gears for alignment, wear and damage.
Reset or replace if required, lightly lubricate with Molykote BG87.
- 6.5 Ensure grub screws are tight.
- 6.6 Refit manifold block cover and Rotameter control knobs.
Ensure that basal flow is at the same rate as noted in 6.1.

7 Gas Delivery Switch Inspection.

- 7.1 Set a flow of 2 l/min O2 and 2 l/min N2O.
Operate the Gas Delivery switch to the OFF position and ensure both flows go to zero.
- 7.2 Set the Gas Delivery switch to ON and ensure the flows are correctly re-instated.
- 7.3 Set O2 and N2O flows back to minimum
- 7.4 Ensure that flowmeter backlight operates, if fitted, as switch is operated
Ensure that ventilator operates, if fitted, as switch is operated

SERVICE SCHEDULE

8 Check Regulators

- 8.1 Set relevant gas flow to 5 litres/min.
Check primary regulator outlet pressures (refer to section 4 - Specification)
- 8.2 Replace Primary regulators. (5 year service)
- 8.3 Check secondary O₂ and N₂O regulator outlet pressures (refer to section 4 - Specification)
- 8.4 Secondary regulator pressures can be adjusted as required to obtain MAHD readings.
Note Maximum flow rates MUST be available from the flow tubes.
- 8.5 Check secondary Air regulator (refer to section 4 - Specification)
- 8.6 Operate the gas delivery switch OFF then ON
Ensure regulator returns to set value.
Any regulator that cannot be correctly adjusted, or does not return to set value should be replaced

9 High Pressure Leak Checks

- 9.1 Turn OFF and drain all gases from machine.
Unplug all pipelines from wall outlets.
- 9.2 Fit all cylinders if not fitted - but do not turn on
- 9.3 Remove 8 mm O₂ pipe from output of cut-off block. (This is the O₂ Basal flow feed to the Rotameter)
- 9.4 Blank the 8 mm O₂ Connector (from which you have just removed the tubing) with the 8 mm blanking plug from your test case.
- 9.5 Turn on O₂ cylinder.
- 9.6 Turn "ON" on/off switch.
There should be no basal flow indicated on flow tube.
- 9.8 Turn on N₂O and Air cylinders.
- 9.9 Turn off O₂, Air and N₂O Cylinders.
- 9.10 Check High Pressure for leaks on all gases
(maximum allowable leak rate: O₂ and Air: 500 kPa in a 2 minute period
N₂O : 200 kPa in a 2 minute period).
- 9.14 Turn off O₂ cylinder and drain Oxygen from system.
- 9.15 Turn "OFF" on/off switch.
- 9.16 Remove blanking plug and connect 8 mm O₂ tube back into connector.
- 9.17 Turn on O₂ cylinder.
- 9.18 Turn "ON" on/off switch.
Check that the Oxygen basal flow has been re-instated with the O₂ Rotameter fully clockwise.
Check all other Rotameters are fully clockwise.

10 Check Common Gas Outlet

- 10.2 Check Safelock 'O' ring, replace if necessary.
- 10.3 Replace Safelock 'O' ring. (annual service)
- 10.4 Replace O₂ flush valve complete with 'O' rings x 2 and seal 'O' ring x 1. (4 year service)
- 10.7 Replace flexible hose from Manifold PRV block to CGO manifold (annual service)

11 Check Emergency Oxygen Flush

- 11.1 Flow rate is between 35-75 l/min., on cylinder and pipeline supply.
Ensure O₂ fail does not alarm.

SERVICE SCHEDULE

12 Check Oxygen Fail Alarm

- 12.1 Set O₂ at 2 l/min, set N₂O at 3 l/min, set Air at 3 l/min
- 12.2 Shut Off O₂ supply.
- 12.3 Check audible warning operates between 221 - 172 kPa dropping.
- 12.4 Check N₂O ceases flowing between 200 - 172 kPa dropping.
- 12.5 Visual indicator is Red between 138 - 200 kPa dropping.
- 12.6 Audible warning operates for 7 seconds minimum.
- 12.7 Check that after O₂ flow has ceased that Air continues to flow.
- 12.8 Turn On O₂ supply.
Ensure visual indicator is Green, and whistle sounds briefly.
Ensure all flows are re-instated.
Reset all flowmeters to minimum.

13 Check Flowmeter Operation

- 13.1 Check needle valves for smooth operation and positive off position.
- 13.3 Check flowmeter tube and freedom of bobbin.
- 13.4 Inspect flowmeter upper and lower seals, replace if necessary.
- 13.5 Replace flowmeter upper and lower seals and filters. (2 year service)

14 Additional Mechanical AHD Checks

- 14.1 Connect O₂ monitor to CGO
- 14.2 Turn On Gas Delivery switch.
Ensure whistle sounds briefly
Ensure a basal flow: 50 – 75 ml/min (Cascade machines),
150 + 50ml/min (single flow tube machines).
- 14.3 Fully open N₂O control and ensure **No** N₂O flow.
- 14.4 Slowly increase O₂ control throughout range.
Ensure reading correspond to table below: -

Set O ₂ Flow L/min	Observe N ₂ O Flow L/min	Observe N ₂ O Monitor % O ₂
0.25*	0.5 - 0.67	27 - 33%
0.5*	1.0 - 0.35	27 - 33%
0.8	1.6 - 2.2	27 - 33%
1.5	3.0 - 4.1	27 - 33%
3.0	6.1 - 8.1	27 - 33%

* Denotes Cascade machines only

15 Additional Mechanical AHD Checks

- 15.4 Partially close N₂O Rotameter
Ensure N₂O flow is reduced and O₂% increases.
Fully open N₂O Rotameter control.
Set O₂ flow at 8 l/min.
- 15.5 Gradually decrease O₂ control ensuring readings correspond to table above.
When fully closed basal flow should be:
50 – 75 ml/min (Cascade flowmeter)
150 + 50 ml/min (single tube flowmeter).
- 15.6 Fully close N₂O Rotameter.
- 15.7 Refit flow tube cover

SERVICE SCHEDULE

16 Check Back Bar Assembly (Selectatec fitting only)

- 16.1 Replace selectatec 'O' rings.
- 16.2 Replace vaporizer-locking springs. (annual service)
- 16.4 Ensure pillar valves protrude, check for positive spring function.
- 16.5 Gently twist valve body and ensure valve is secure

17 Fresh Gas Pressure Relief Valve.

- 17.1 Occlude CGO Outlet with a manometer
- 17.2 At 10 l/min PRV relieves at 41 kPa \pm 10%

18 Leak Test From Flowmeter to Common Gas Outlet.

- 18.1 Occlude CGO with manometer.
- 18.2 Set flow to maintain a pressure of 20 kPa (3 psi).
If flow is greater than 200 ml investigate and rectify internal leak.
- 18.3 Repeat this check on all stations with and without vaporizers fitted, and with vaporizers On and Off.
- 18.4 Remove manometer from CGO.

19 Auxiliary Outlets

- 19.1 Check auxiliary outlets for minimum of 100 l/min to free air.

20 Final Gas Concentration Test

- 20.1 Carry out final gas concentration tests using the table below:

Check No	Set O ₂ L/min	Set N ₂ O L/min	Set Air L/min	O ₂ Concentration
1	0.5	0.5	-	50% \pm 2%
2	0.5	0.5	0.5	33% \pm 2%
3	3.0	3.0	-	50% \pm 2%
4	3.0	-	3.0	60% \pm 2%

22 Electrical Safety Checks (i.a.w. MDA DB 9801 supp. 1)

- 22.1 Earth Continuity (Max 0.2 ohms) at 1 Amp or less
- 22.2 Insulation Resistance (not less than 20 Meg Ohms) at 340-500 Vdc
- 22.3 Earth Leakage (Max 500 micro amps)
- 22.4 Enclosure Leakage (Max 100 micro amps)
- 22.5 Check Flow tubes for continuity from glass tube to metal contact clip. Approx. 5 kohms.
- 22.6 Fit Electrical Safety Test Label if requested to do so by hospital.

23 Paperwork

- 23.1 Fill out appropriate service report.

9. SERVICING PROCEDURES

9.1 Servicing

The Prima SP range of anaesthetic machines must only be serviced by a Penlon-trained engineer to the following service schedule:

- Every 6 months
Inspection and Function Check
- Every 12 months
Annual service which includes routine replacement of seals, etc. as preventive maintenance
- At 3 years interval
Pipeline hoses - replace
- At 5 years interval
Primary regulators - replace
- Every 2 and 6 years
Additional tests / component replacement

Details of these service operations are given in this Prima SP Service Manual, available only to Penlon trained engineers.

Mechanical AHD System

Additional servicing for the mechanical AHD system only.

Function Test

(At 6 month intervals, see section 6.7)

Additional Servicing

(At 12 month intervals)

Secondary Regulators - check pressure setting

Gear linkage - inspect

Service Tools

015067

Regulator Spanner - Regulators manufactured by 'Gas Arc'

800612

Flow setting tool

9.2 Ancillary Equipment

9.2.1 Sigma Delta Vaporizer

Follow the instructions given in section 8 of the user instruction manual. These include:

- Every 6 months
Function test and calibration test
- Every 10 years
Major overhaul (if unit to be used beyond 10 years).

Note: Halothane vaporizers - major overhaul required at 5 years.

On vaporizers with interlock, test the function of the interlock system during the vaporizer calibration test.

9.2.2 Monitor

Follow the service recommendations detailed in the monitor user instruction manual.

9.2.3 AV-S Ventilator

If the anaesthetic machine was supplied with an AV- series ventilator, refer to section 7 of the ventilator user instruction manual, for servicing requirements.

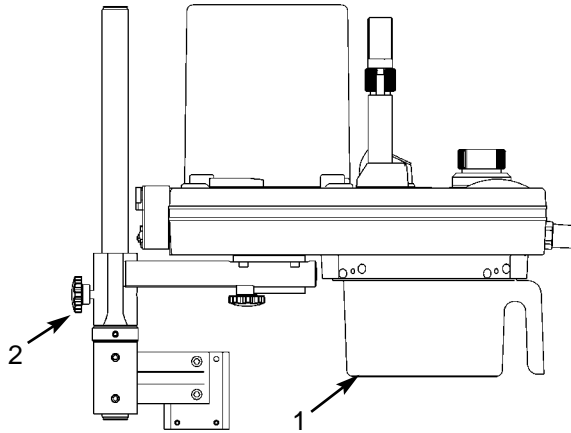
These include:

- | | |
|------------------|---|
| 6 months | Inspection and Function Check |
| 12 months | Replace bellows
Replace O seals and drive gas inlet filter, etc. |
| 24 and 48 months | Additional component replacement |

9.2.4 Anaesthetic Gas Scavenging System

Follow the service recommendations detailed in the AGSS user instruction manual.

SERVICING PROCEDURES



9.2.5 Circle System Absorber

A200 Absorber

6 months	Inspection and Function Check
12 months	Component replacement.
48 months	Additional component replacement

Removing the Absorber Assembly

CAUTION

The canister (1) may contain condensate. Before removing the absorber from the pole-mount assembly, refer to the A200SP user manual for instructions on draining the canister and disposing of absorbent.

1. Set the brakes on the anaesthetic machine front castors.
2. Slacken the knob (2), and lift the absorber assembly from the pole-mount.

9.2.6 User Maintenance

The Prima SP series user manual states that user maintenance is restricted to cleaning the external surfaces of the machine

All other maintenance and servicing must only be carried out by Penlon-trained engineers.

The Prima SP2 must be only be serviced according to the schedule and procedures given in the Service Manual.

9.3 Cleaning and Sterilisation

Frequently wipe over the external surfaces of the machine, the vaporizers, with a damp cloth. Always allow the machine to dry off thoroughly before using it.

(Mild antiseptic solutions may be used but should be rinsed off with clean water.)

Breathing system hoses and other components must be sterilised to the manufacturer's recommended methods.

Monitor

Refer to the monitor user instruction manual.

Ventilator

AV-series Ventilator Bellows Assembly

Cleaning

The user must follow the detailed instructions included in section 7.5 of the ventilator user instruction manual.

Never use any hard object or abrasive agent to clean any of the components, only a soft cloth.

If the valve seat is damaged, the diaphragm valve will leak and this may cause serious malfunction.

CAUTION

Do not use any cleaning solution containing alcohol or any harsh abrasive cleaning agent on the bellows housing.

Sterilisation

The user must follow the detailed instructions included in section 7 of the ventilator user instruction manual.

WARNING

Do not autoclave the bellows housing. The exhalation diaphragm valve assembly must be disassembled prior to sterilisation - do not sterilise the diaphragm.

SERVICING PROCEDURES

9.4 Internal Gas System

9.4.1 Pipework Identification

Internal pipework is colour coded and diameter indexed, as follows:

Colour codes

Oxygen	Green (or White, on non-US specification machines)
Nitrous Oxide	Blue
Medical Air	Yellow (or Black/white on non-US specification machines)

Tubing diameter

Oxygen	8 mm
Nitrous Oxide	6 mm
Medical Air	5 mm
Mixed Gas	10 mm

9.4.2 Tubing Connectors

Push-in type fittings are used throughout the low pressure circuit

To connect and disconnect the tubing from the connectors, follow the procedures detailed below.

Do not use excess force.

Disconnecting tubing from connector

Push in the tube and the connector end piece 'A'.

Hold the end piece 'A' in place.

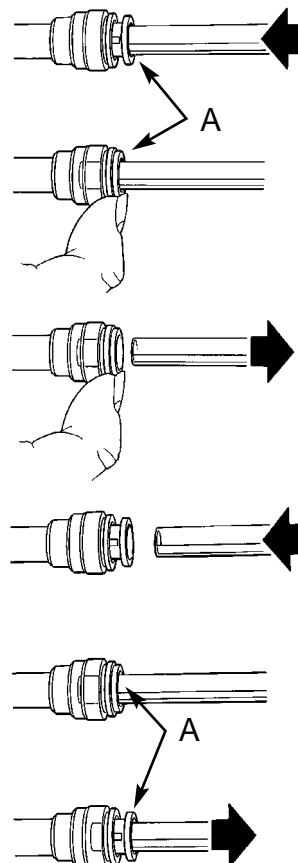
Pull the tube out to disconnect.

Fitting tubing to connector

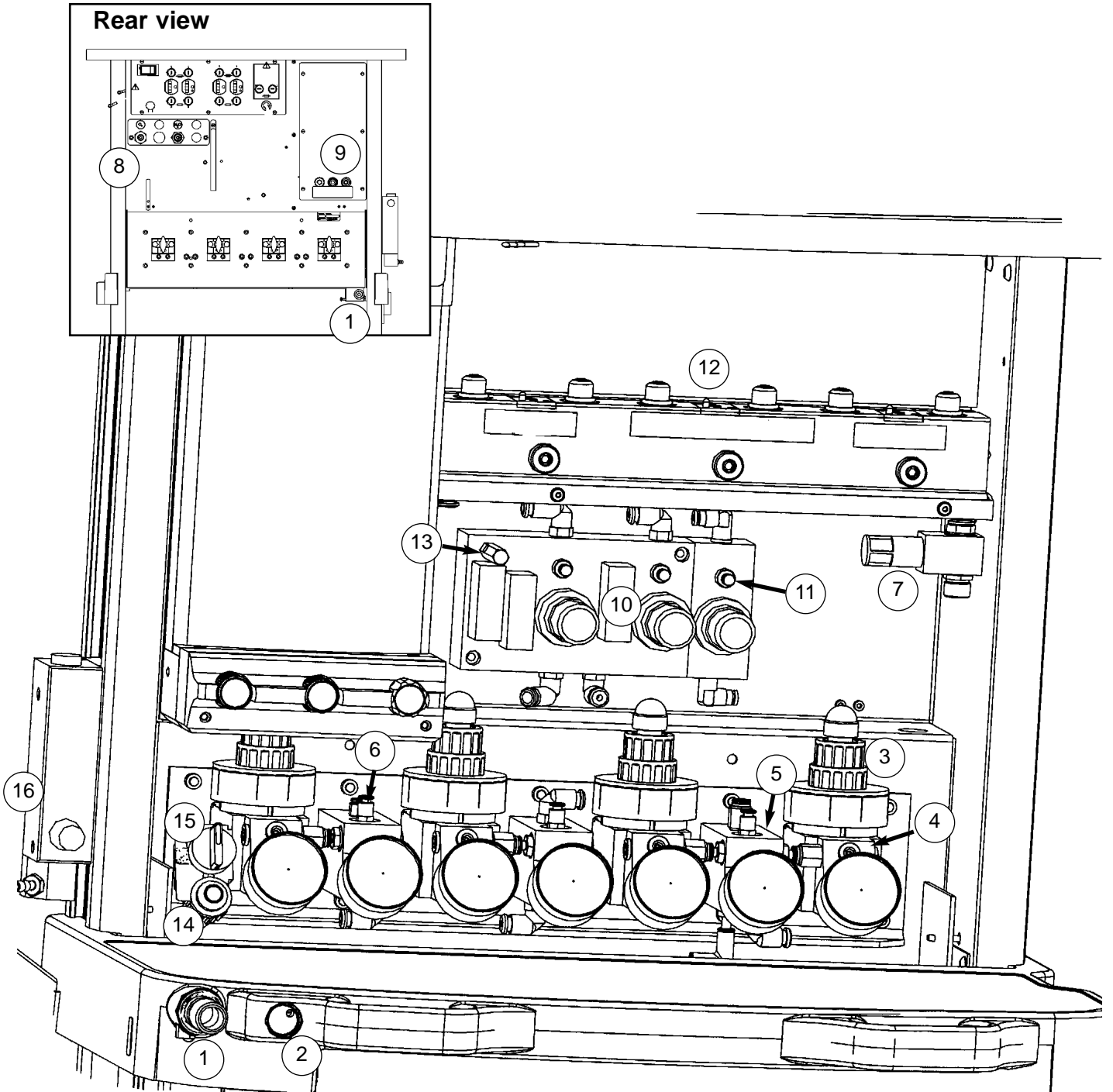
Push in the tube as far as possible
Do not use excessive force.

The connector end piece 'A' will also move inwards.

Pull the tube carefully outwards.
The end piece 'A' will be pulled outwards to the 'locked' position.



Rear view



SERVICING PROCEDURES

Gas System Components

1. CGO outlet
(optional front position also shown)
2. Oxygen flush button
3. High pressure regulator
4. High pressure block
5. Low pressure block
6. Test point - low pressure block
7. Fresh gas pressure relief valve
8. Pipeline supply inlet block
9. Auxiliary outlets
10. Secondary regulator
11. Test point - primary regulator
12. Vaporizer Manifold block
13. Warning whistle
14. Oxygen failure visual indicator
15. Gas delivery switch
16. Therapy Flowmeter

SERVICING PROCEDURES

9.5 Front Cover - Remove and Refit

CAUTION

Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.

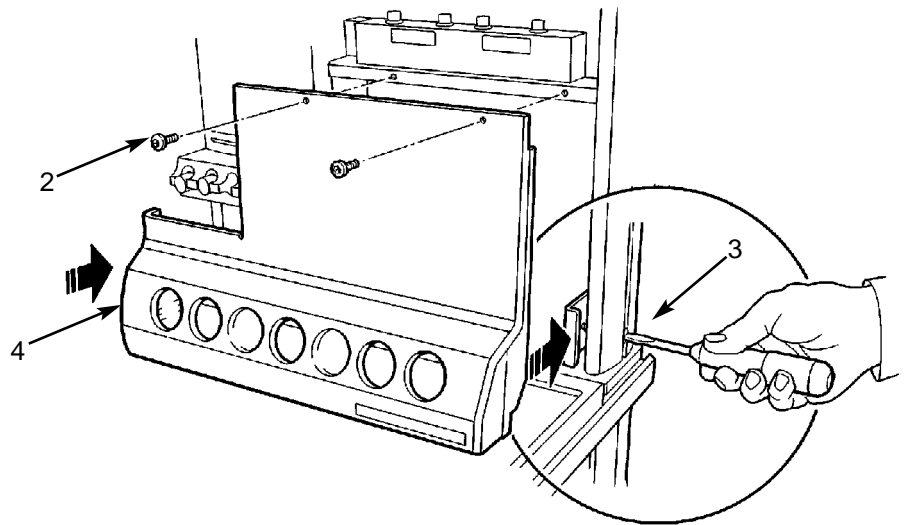
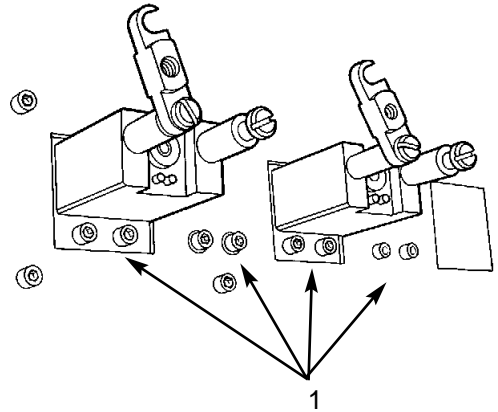
Removal

1. Remove all cylinders, and disconnect Pipeline supply hoses.
2. At the rear of the machine, slacken the screws (1) securing the gas blocks.
3. Remove the two top fixing screws (2) securing the panel to the front of the machine.
4. Slacken each screw (3) on the side of the machine, to loosen the side clamp plates.
5. Carefully pull the cover (4) away from the front of the machine.

Note that the gas delivery switch and oxygen fail

Refit

6. Line up the cover with the gauges and switches.
7. Check that the clamp plate on each side of the machine is positioned to allow the sides of the cover to fit between each plate and the frame.
8. Carefully push the cover into place.
9. Screw in the top fixings (2). Do NOT tighten.
10. Tighten the clamp plate screws (3).
11. Tighten the top fixings (2).
12. At the rear of the machine, tighten the screws (1)



SERVICING PROCEDURES

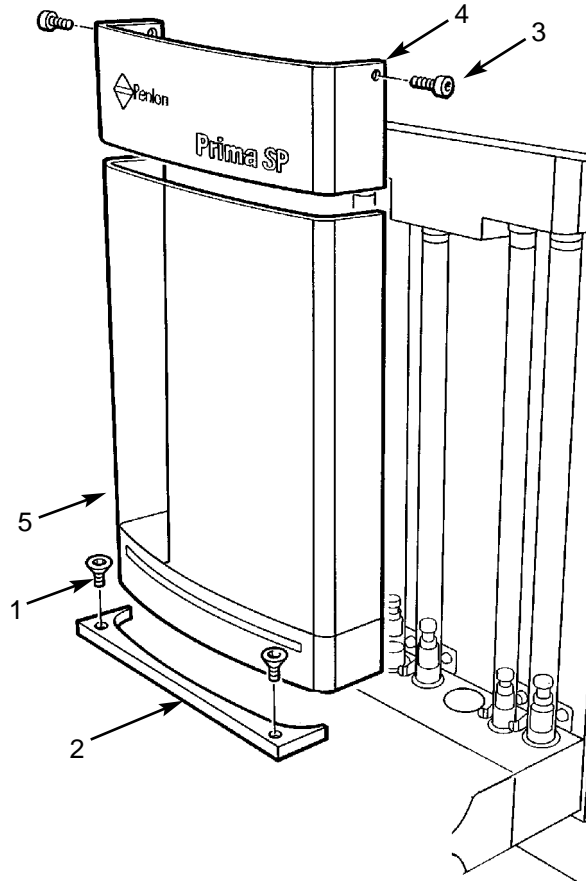
9.6 Flowmeter Cover

Removal

1. Slacken the screws (1) securing the spacer strip (2).
2. Remove the screws (3) and top guard (4).
3. Remove the cover (5).

Refitting

4. Reverse the removal procedure.



SERVICING PROCEDURES

9.7 Mechanical AHD System

9.7.1 Check and Adjust Basal Flow

Cascade flowmeter models
Oxygen basal flow 50-75 ml/min

Single flowmeter models Oxygen basal flow
100-200 ml/min

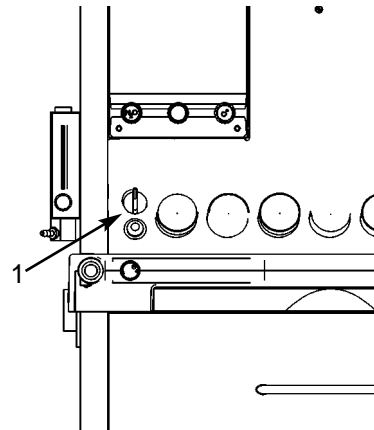
NOTE: *The machine must be on a flat surface.*

1. Check that all flowmeter controls are OFF.
2. Switch the gas delivery switch (1) to ON.
3. Check that a basal flow of oxygen is indicated, as shown above.

If the basal flow is outside the range given above:

- a) adjust the output of the secondary Oxygen regulator, (see section 9.7.2) to achieve the correct basal flow.
- b) check the oxygen concentration, see section 9.7.2.

4. Switch the Gas Delivery switch to OFF.
5. If the correct basal flow can not be achieved, reset the gear linkage - see section 9.7.3.



SERVICING PROCEDURES

9.7.2 Check Oxygen Concentration

NOTE: The machine must be on a flat surface.

1. If the machine is not fitted with an Oxygen monitor, connect a stand-alone analyser to the CGO outlet.
2. Set the Gas Delivery switch (1) to ON.
3. Turn the Nitrous Oxide flowmeter control to maximum.
4. Refer to the table below, and check % Oxygen concentration at the oxygen flows specified .

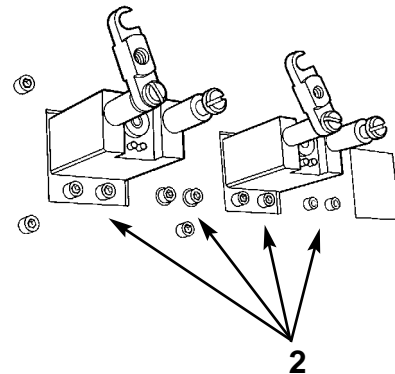
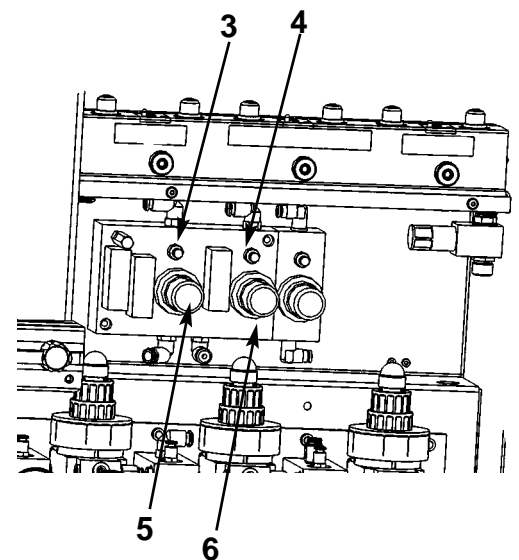
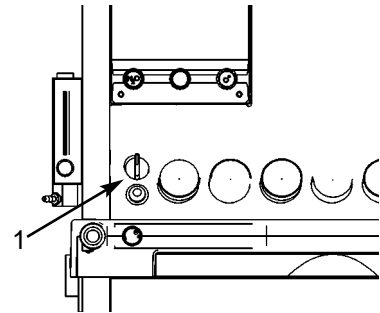
**Adjust the Oxygen Flowmeter control only
Do NOT adjust the N₂O flowmeter.**

Note that flow rates for N₂O are given as a guide only.

O ₂ Flow	%O ₂ (in O ₂ /N ₂ O mixture)	N ₂ O Flow
0.25 L/min	27 - 33 %	0.5 - 0.67
0.5 L/min	27 - 33 %	1.0 - 1.35
0.8 L/min	27 - 33 %	1.6 - 2.1
1.5 L/min	27 - 33 %	3.0 - 4.1
3.0 L/min	27 - 33 %	6.1 - 8.1

If the %O₂ concentration is outside the range given above, at any of the set flows, adjust the output of either or both of the secondary regulators, as follows:

5. Switch the Gas Delivery switch to OFF.
 6. Remove the front cover - follow the procedure given in section 9.5.
Retighten the screws (2) securing the gas blocks. Reconnect the cylinder and pipeline supplies.
 7. Attach a pressure gauge to the regulator test point (3 - oxygen, or 4 - nitrous oxide).
 8. Switch the Gas Delivery switch to ON.
 9. To increase output: turn the regulator cap, (5 or 6) slowly clockwise.
To decrease output: turn the regulator cap fully anti-clockwise, then clockwise to the correct setting. Maintain the output pressure within the range:
- Secondary regulator pressure 152 - 241 kPa
(22 - 35 psi)
10. If the correct basal flow can not be achieved, reset the gear linkage - see section 9.7.3.
 11. Recheck the Oxygen Concentration.



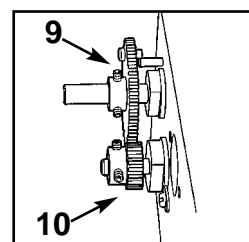
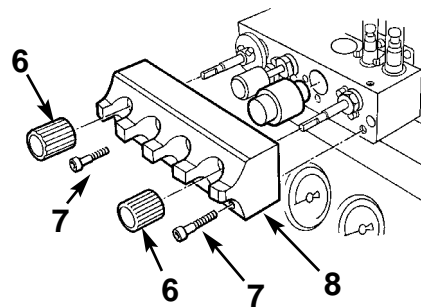
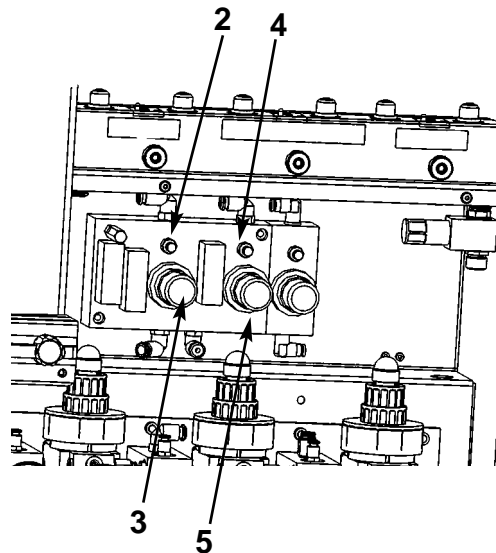
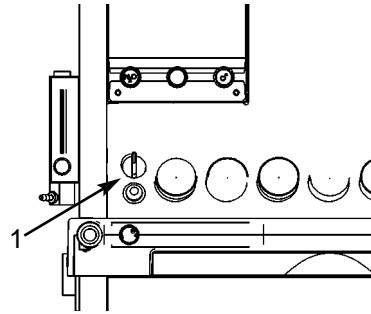
SERVICING PROCEDURES

9.7.3 Gear Linkage - Reset Cascade and Single Flowmeter Tube Systems

NOTE: The machine must be on a flat surface.

Set the secondary regulators

1. Set the Gas Delivery Switch (1) to OFF.
2. Disconnect all pipeline and cylinder supplies.
3. Remove the front cover - see section 9.6. Retighten the screws securing the gas blocks. Reconnect the cylinder and pipeline supplies.
4. Attach a pressure gauge to the oxygen regulator test point (2).
5. Set the Gas Delivery Switch to ON.
6. Set a flow of 5 L/min Oxygen. Reset the O₂ secondary regulator to 172 kPa (25.0 psi).
7. To increase output: turn the regulator cap, (3) slowly clockwise. To decrease output: turn the regulator cap fully anti-clockwise, then clockwise to the correct setting.
8. Return the flow to minimum.
9. Attach a pressure gauge to the N₂O regulator test point (4).
10. Set a flow of 5 L/min nitrous oxide. Reset the N₂O secondary regulator to 186 kPa (27.0 psi). To increase output: turn the regulator cap, (5) slowly clockwise. To decrease output: turn the regulator cap fully anti-clockwise, then clockwise to the correct setting. Return the flow to minimum.
11. Set the Gas Delivery Switch (1) to OFF.



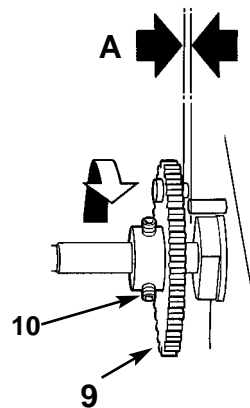
Gear Linkage

12. Remove the flowmeter control knobs (6), screws (7) and control knob cover (8).
13. Loosen the grub screws and remove the O₂ gear (9) and small N₂O gear (10).

SERVICING PROCEDURES

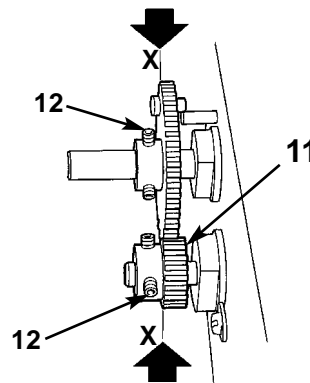
14. Check the condition of the gears and grubscrews.
Replace with new components if necessary.
Clean all traces of Loctite from the grubscrews and apply new Loctite 242.
15. Check that each gear slides easily on its shaft.
16. Set the Gas Delivery Switch to ON.
17. Open the N₂O valve to maximum, to check full flow.
18. Close the valve gently until the N₂O bobbin ceases to rotate.
Do not over tighten the valve when closing - this will cause irreparable damage to the valve seat.

19. Fit the O₂ gear (9) on the shaft.
20. Fit the O₂ control knob and open the O₂ control valve, to check full flow.
Cascade Flowmeter Tube Models:
Close the valve until a flow of 50-75 ml/min is obtained.
Single Flowmeter Tube Models:
Close the valve until a flow of 100-200 ml/min is obtained.



21. Distance the inner face of the O₂ gear (9) with a 0.1 mm feeler gauge at 'A'.
Tighten the grubscrews (10) to secure the O₂ gear.
Check the flow returns to the basal flow set in operation 20, above.

22. With the O₂ gear against the stop, replace the N₂O gear (11) and push on so that the front faces of the gears are flush, see X-X as illustrated.
Note that the rear face of the N₂O gear is closer to the manifold block than the O₂ gear.



23. Tighten the grubscrews (12) to secure the N₂O gear.
Apply a small amount of Molycote BG87 grease, evenly distributed, to the O₂ and N₂O gear teeth.
24. If the machine is not fitted with an Oxygen monitor, connect a stand-alone analyser to the CGO outlet.

SERVICING PROCEDURES

25. Check Oxygen concentration:

Turn the Nitrous Oxide flowmeter control to maximum.
Refer to the table below, and check % Oxygen concentration at the Oxygen flows specified .

Adjust the Oxygen Flowmeter control only - Do NOT adjust the N₂O flowmeter.

Note The flow rates for N₂O are given as a guide only.

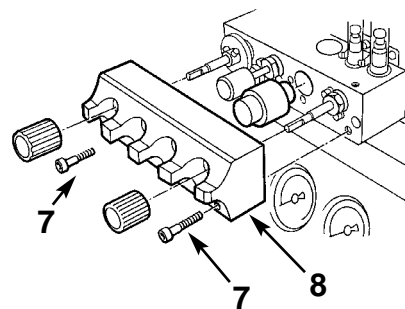
O ₂ Flow	%O ₂ (in O ₂ /N ₂ O mixture)	N ₂ O Flow
0.25 L/min	27 - 33 %	0.5 - 0.67
0.5 L/min	27 - 33 %	1.0 - 1.35
0.8 L/min	27 - 33 %	1.6 - 2.1
1.5 L/min	27 - 33 %	3.0 - 4.1
3.0 L/min	27 - 33 %	6.1 - 8.1

If the %O₂ concentration is outside the range given above, at any of the set flows, adjust the output of either or both of the secondary regulators - see 9.7.2.

NOTE

Maintain output pressures within the range: 152 - 241 kPa (22 - 35 psi)

26. Check the Oxygen basal flow - see 9.7.1.
27. Recheck the Oxygen Concentration.
28. Remove the O₂ control knob.
29. Carefully refit the control knob cover (8) and screws (7), ensuring that the basal flow does not change.
Fit the O₂ and N₂O control knobs.

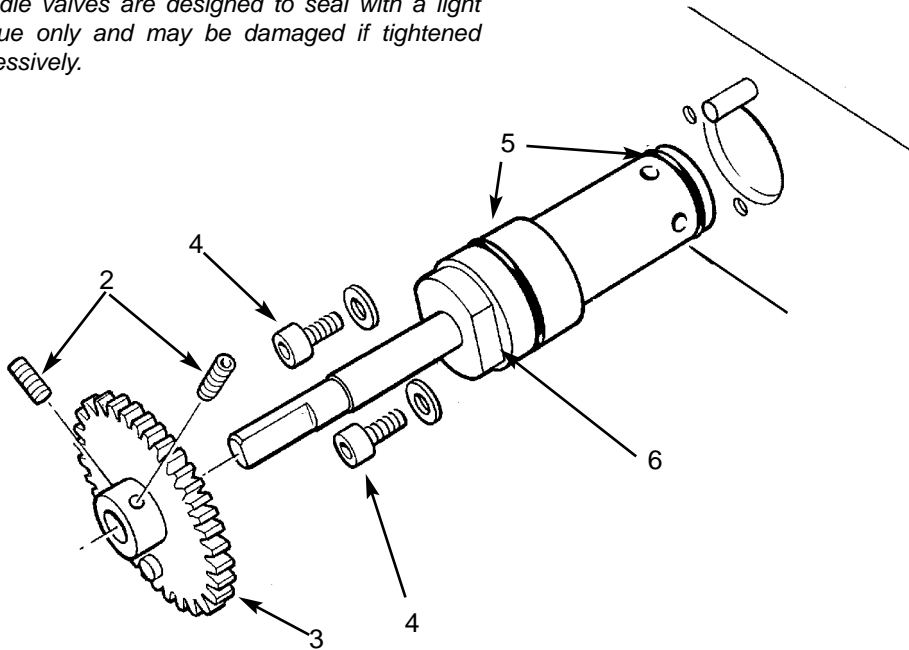


SERVICING PROCEDURES

9.8 Control Valve Capsule Removal/Replacement

CAUTION

Needle valves are designed to seal with a light torque only and may be damaged if tightened excessively.



Note:

There are no user serviceable components within each flow control valve capsule (1). This procedure relates only to the exchange of the complete, factory set, valves.

1. Remove all gas cylinders and disconnect all gas pipeline hoses.

CAUTION

Ensure that all gas supplies are exhausted before commencing these procedures. High pressure gas can 'fire' the valve out of the machine.

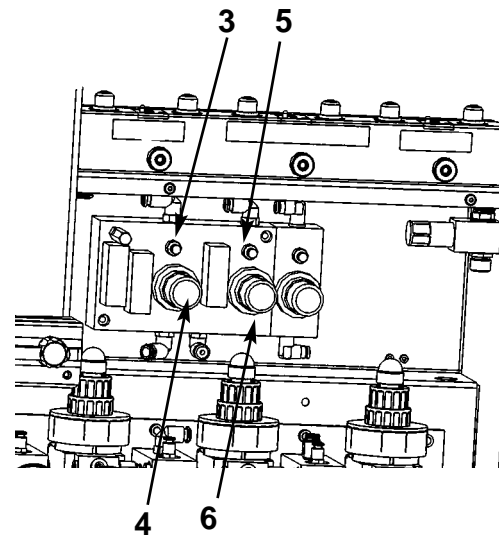
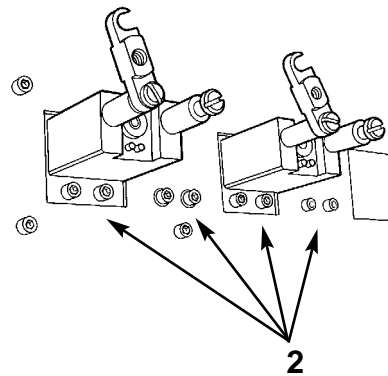
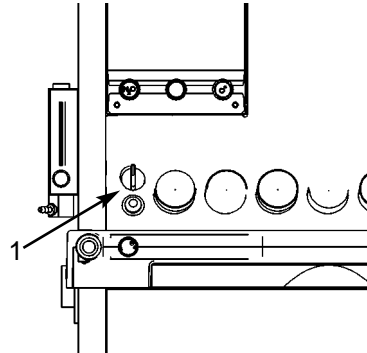
2. Remove the cover and flowmeter knobs, as detailed in section 9.7.3.
3. To remove a capsule, first loosen the grub screws (2) and remove the gear (3).
4. Undo the two securing screws and washers (4) and withdraw the capsule (1).

5. To replace the flow control valve, lightly smear the O-seals (5) with Fomblin and insert the capsule into the manifold block.
6. Align the two slots (6) with the securing screw holes, and refit the screws and washers (4).
7. If necessary reset the gears, as detailed in section 9.7.3, and check the gas flows.
8. Replace the flowmeter knobs and cover.
9. Perform a function test, section 6.

SERVICING PROCEDURES

9.9 Secondary Regulators Check and Reset Pressure Output

1. Turn the Gas Delivery Switch (1) to OFF.
2. Disconnect all pipeline and cylinder supplies
3. Remove the front cover - see section 9.5.
Retighten the screws (2) securing the gas blocks.
Reconnect the cylinder and pipeline supplies.
4. Attach a pressure gauge to the oxygen regulator test point (3).
5. Turn the Gas Delivery Switch to ON.
6. Set a flow of 5 L/min Oxygen.
Reset the Oxygen secondary regulator to the figure given in the table.
7. To increase output: turn the regulator cap, (4) slowly clockwise.
To decrease output: turn the regulator cap fully anti-clockwise, then clockwise to the correct setting.
8. Return the flow to minimum.
9. Attach a pressure gauge to the nitrous oxide regulator test point (5).
10. Set a flow of 5 L/min nitrous oxide.
Reset the N₂O secondary regulator to the figure given in the table.
To increase output: turn the regulator cap, (6) slowly clockwise.
To decrease output: turn the regulator cap fully anti-clockwise, then clockwise to the correct setting.
Return the flow to minimum.
11. Turn the Gas Delivery Switch to OFF.
12. Check the oxygen basal flow - see section 9.7.1.
13. Check % oxygen concentration. - see section 9.7.2.



Secondary regulators

Pressure output at 5 L/min flow:

Oxygen and Nitrous Oxide	152 - 241 kPa	(22 - 35 psi)
Air	207 - 283 kPa	(30 - 41 psi)

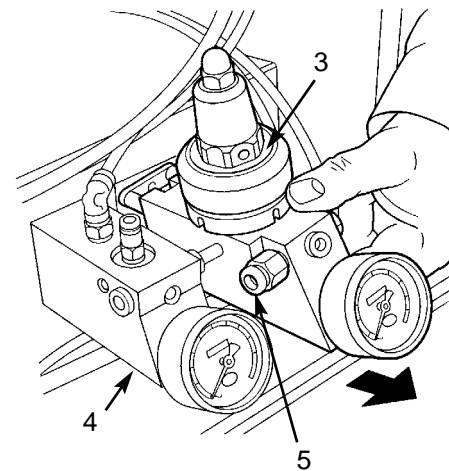
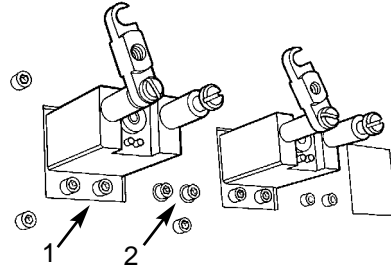
SERVICING PROCEDURES

9.10 High Pressure (Cylinder) Gas Block Remove and Refit

CAUTION

Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.

1. Remove all cylinders and disconnect all pipeline supplies.
2. At the rear of the machine, remove the two screws (1) at the rear of the block to be removed.
Refer to 9.6.2 if necessary.
3. Remove the screws (2) at the rear of the adjacent gas block.
4. At the front of the machine, carefully pull the blocks (3 and 4) from the machine.
Separate the blocks - detach the block (4) from the tubing connector (5).
5. To refit, reverse the above procedure and then carry out a full function test (see section 6).

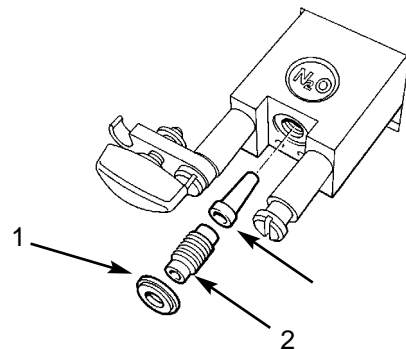


Yoke Filter - Remove and Refit

CAUTION

Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.

1. Remove all cylinders and disconnect all pipeline supplies.
2. Remove the Bodok seal (1).
3. Unscrew the yoke insert (2).
4. Use a suitable rod to carefully remove the filter (3).
5. To refit, reverse the above procedure.
Fit a new Bodok seal.
Function test the machine (see section 6).



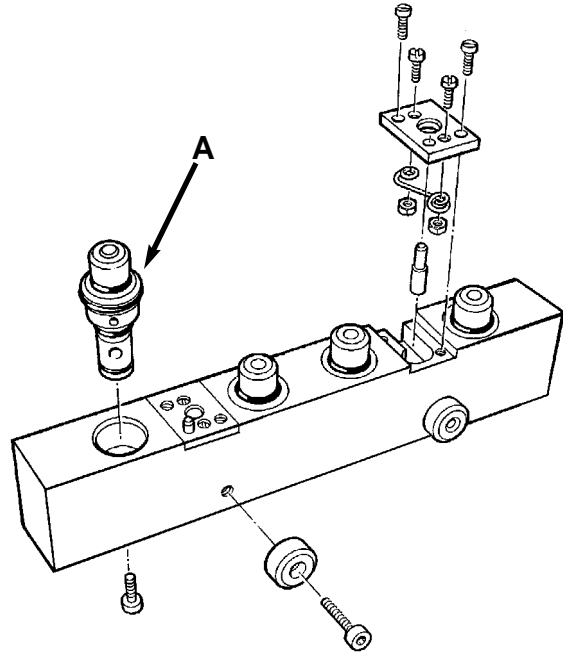
SERVICING PROCEDURES

9.11 Selectatec Compatible Manifold Block

1. The valve capsule top O-seal (arrowed 'A' on the illustration) must be regularly changed to prevent the possible occurrence of leaking. Check for splitting, perishing, and expansion, and also check if the seal is sticking to the vaporizer.

To ensure satisfactory performance:

- a. ALWAYS perform a leak test before using the manifold block or after changing the vaporizer.
- b. Replace these O-seals regularly (maximum 6 months interval). DO NOT apply grease or lubricant



Overhaul

CAUTION Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.

Removal

1. Remove all cylinders and disconnect all pipeline supplies.
2. Remove the front cover, (see section 9.6), to gain access to the manifold block.
3. Disconnect the inlet and outlet fresh gas hoses.
4. Remove the screws at the rear of the machine, to allow removal of the manifold block.

Overhaul and Refit

5. Dismantle the block as illustrated.
6. Renew all O-seals.
7. To refit, reverse the dismantling procedure. Function test the machine - see section 6.

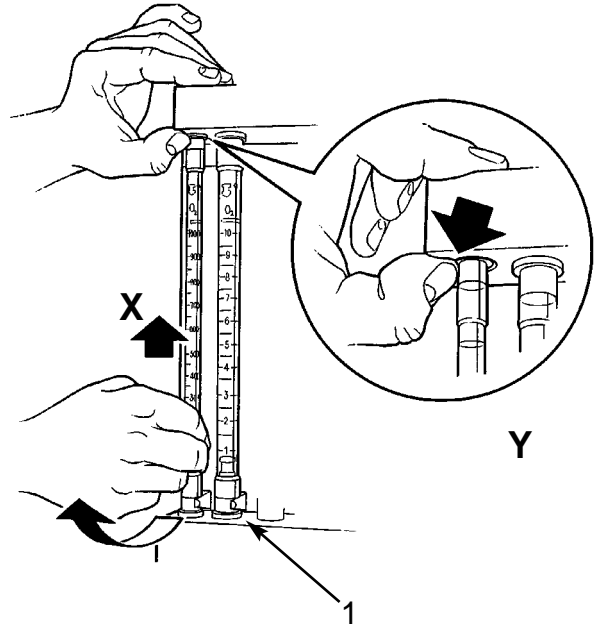
SERVICING PROCEDURES

9.12 Flowmeter Tubes - Removal

CAUTION Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.

Removal

1. Remove all cylinders and disconnect all pipeline supplies.
2. Remove the flowmeter cover, (see section 9.7).
3. Hold the tube, as illustrated, and press upwards (X) against the resistance of the spring.
4. Carefully detach the lower end of the tube from the bobbin.
5. Remove the tube, ensuring that the top bobbin remains in place (Y).

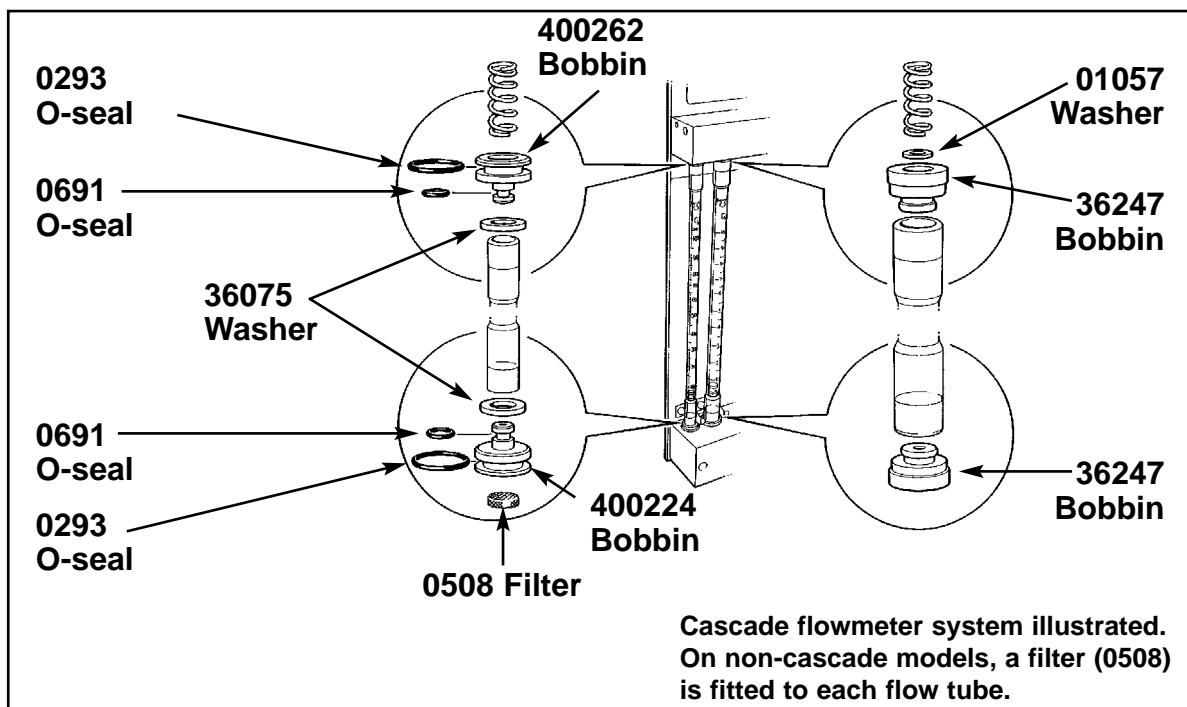


Overhaul - Bobbin Assemblies

6. Remove and refit the components, as illustrated below, taking care not to damage the O-seals when refitting the bobbins.

Refitting the Flowmeter

7. Reverse the removal procedure, noting:
 - a) the scale must be centralised.
 - b) the tube is touching the contact strip (1).
8. Carry out a machine Function Test - section 6.



SERVICING PROCEDURES

9.13 Flowmeter Assembly - Removal

CAUTION

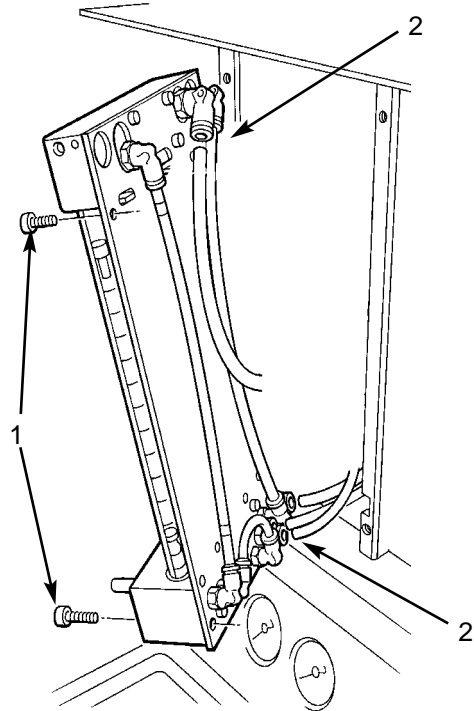
Ensure that any residual gas in the machine is exhausted before commencing the dismantling procedure.

Removal

1. Remove all cylinders and disconnect all pipeline supplies.
2. Disconnect the machine from the mains electrical supply.
3. Remove the flowmeter cover, (see section 9.6).
4. Remove the four screws (1) securing the flowmeter assembly to the machine frame.
5. Disconnect the tubing (2) where necessary to allow the removal of the flowmeter assembly.

Refitting

6. Reconnect the tubing at the back of the flowmeter assembly - see section 9.4.
7. Reverse the removal procedure.
8. Carry out a machine Function Test - section 6.



SERVICING PROCEDURES

9.14 Oxygen Monitor Sensor

Sensor - Cleaning and Disinfection

In case of contamination the sensor may be cleaned with distilled water and allowed to dry naturally.

CAUTION

The sensor is not suitable for sterilisation by steam or exposure to chemicals such as ethylene oxide or hydrogen peroxide.

Do not immerse the sensor in any cleaning solution.

Do not autoclave or expose the sensor to high temperatures.

Sensor Replacement

WARNING

The sensor contains:

a) A small quantity of electrolyte, classified as a harmful irritant which is potentially hazardous.

b) Lead

Do not attempt to open a cell.

ALWAYS check the integrity of the sensor assembly before use.

Once exhausted, the sensor must be disposed of according to hospital, local, state and federal regulations.

Sensor Expiry Date

The approximate expiry date is marked on the sensor label, using two boxes which represent the year and month.

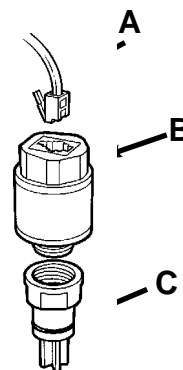
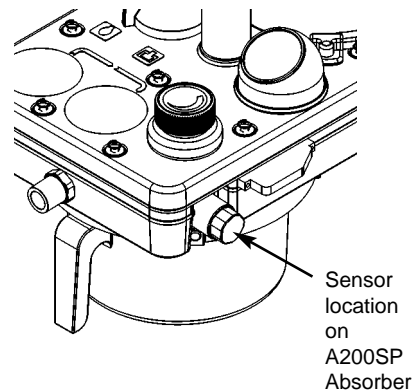
Thus, for a sensor marked as below, the approximate expiry date is end of December 2006.

YR 0 1 2 3 4 5 **X** 7 8 9

MTH J F M A M J J A S O N **X**

Sensor Unit - Remove and Refit

1. Pull out the cable connector (A) from the expired sensor (B).
2. Remove sensor from the absorber or Tee adaptor.
3. Discard the expired sensor and flow diverter (C).
4. Insert the cable connector into the new sensor (B).
5. If necessary, screw the new flow diverter (C) onto the new sensor, and fit new O rings.
6. Fit the assembly into the absorber.
7. Reconnect the cable
8. Calibrate the new sensor, see section 5.12.
9. Dispose of the used components according to hospital regulations and relevant national legislation.



Replacement part number	
102714	Sensor assembly

10. PARTS LIST

Preventive Maintenance Kits (PMKs)

Prima SP2/3 range is serviced on a 6 month; 1 year; 2 year; and 4 year cycle.

6 month Kit Part No. 57288

1 year Kit Part No. 57289

2 year Kit Part No. 57290

4 year Kit Part No. 57291

NOTE:

1. *Pipeline hoses must be replaced at **three years***
2. *Primary regulators must be replaced at **five years**.*

PARTS LIST

Prima SP Range

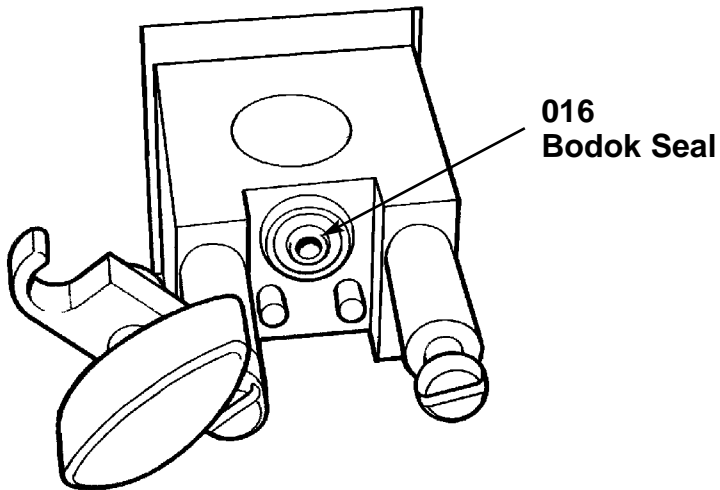
Preventive Maintenance Kit

6 Month Service

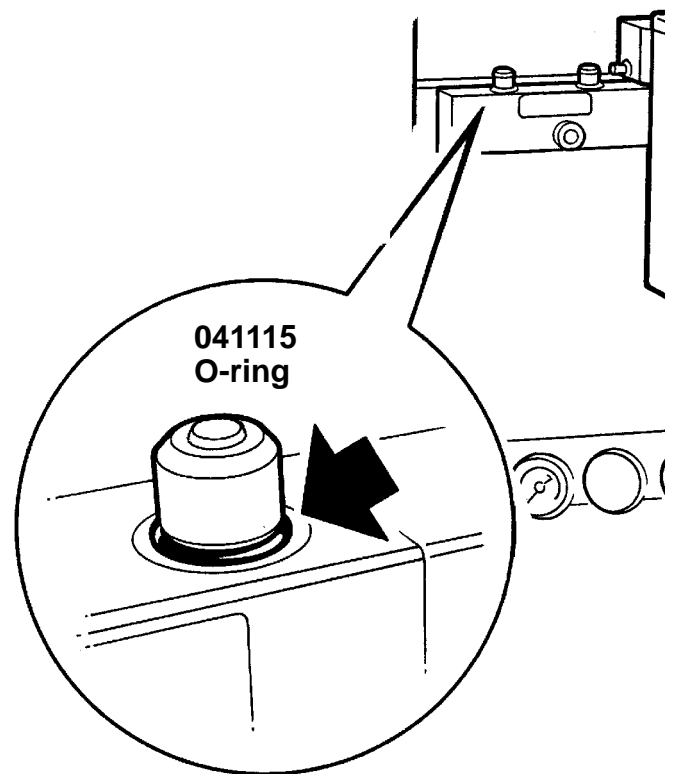
Part No. 57288

Kit Contents

<i>Part No</i>	<i>Qty.</i>	<i>Component Description</i>
016	5	Bodok Seal
041115	6	O-ring - Selectatec
043	1	O-ring - Safelock Connector on CGO outlet



043
O-ring

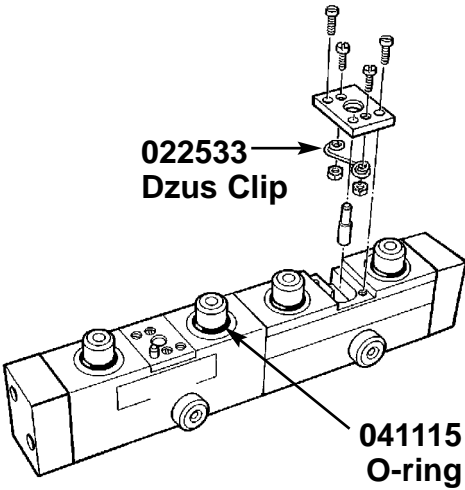
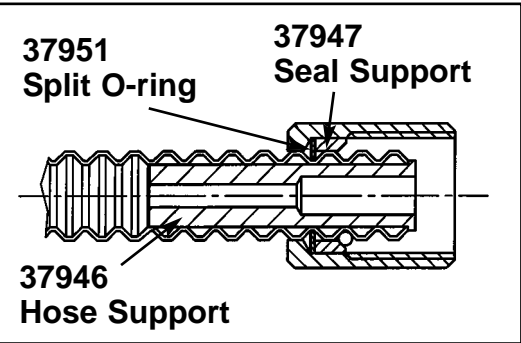
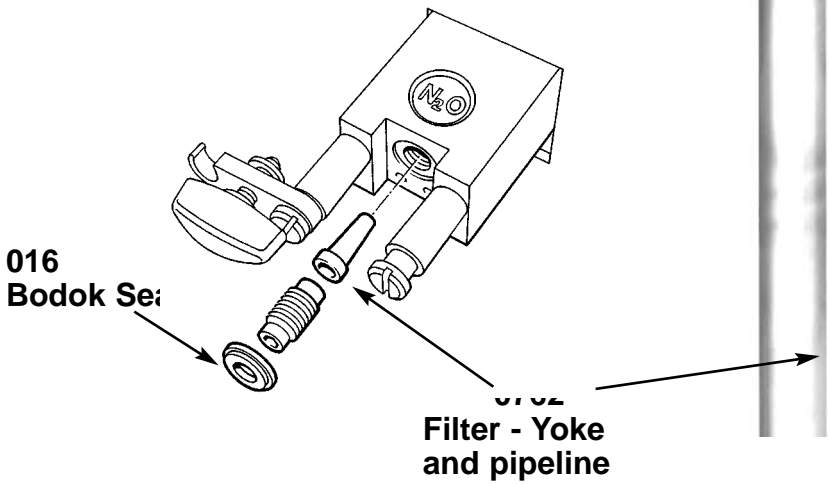
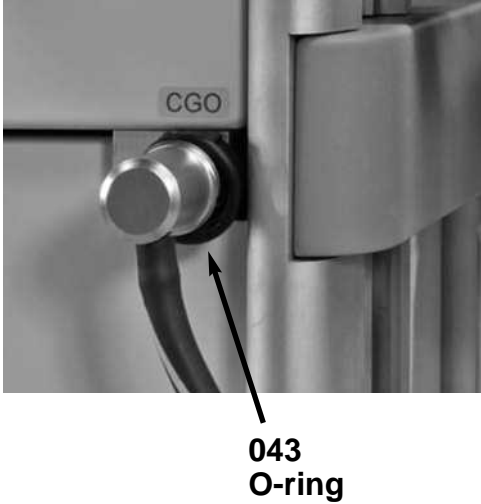


PARTS LIST

Prima SP2/3
Preventive Maintenance Kit
12 Month Service

Part No. 57289

Kit Contents		
Part No	Qty.	Component Description
462526	1.35 m	Hose - Backbar Outlet to CGO (not shown)
37946	4	Hose Support
37947	4	Seal Support
37951	4	Split O-ring
022533	3	Dzus Clip
041115	6	O-ring - Selectatec (2 station shown)
016	5	Bodok Seal
0762	8	Filter - Yoke and Pipeline
043	1	O-seal - Safelock
011017	100 mm	Tubing - Sample Block
0226	2	O-seal - Hose assembly Backbar Outlet to CGO (not shown)



PARTS LIST

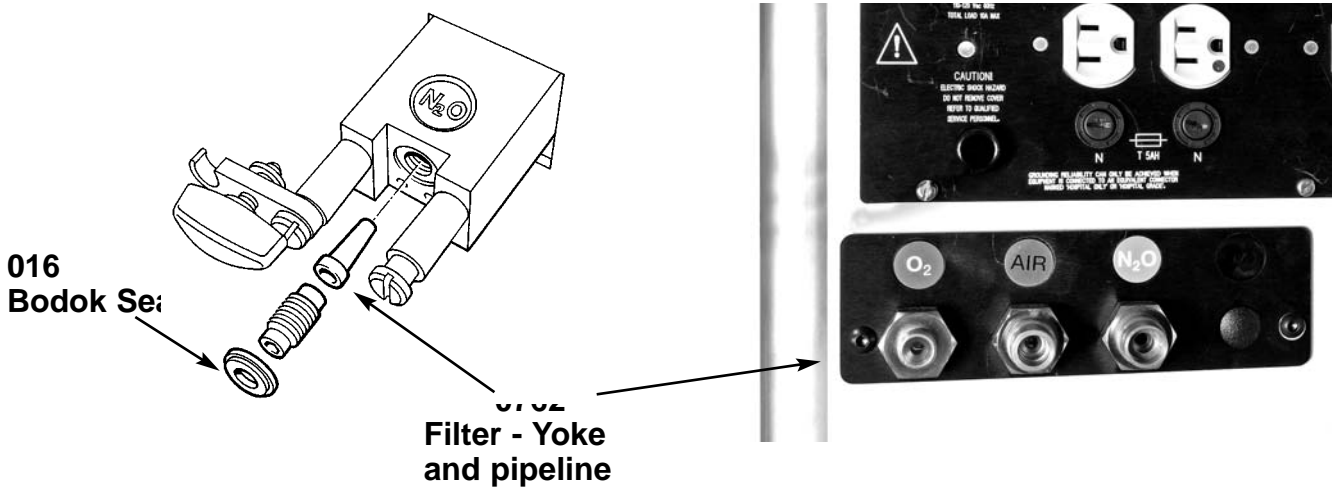
Prima SP2/3

Preventive Maintenance Kit

24 Month Service

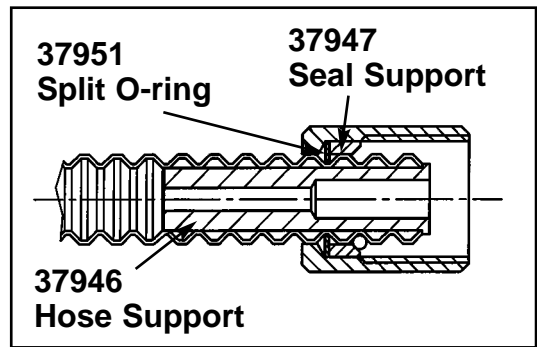
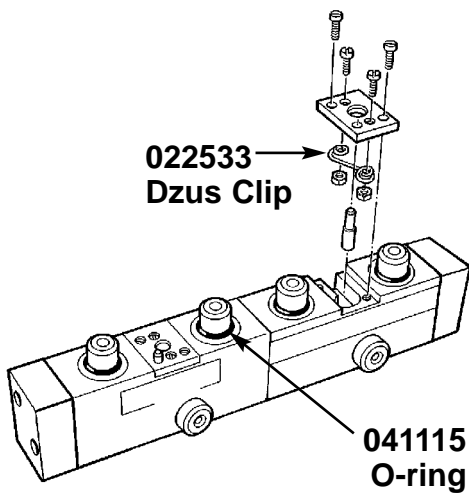
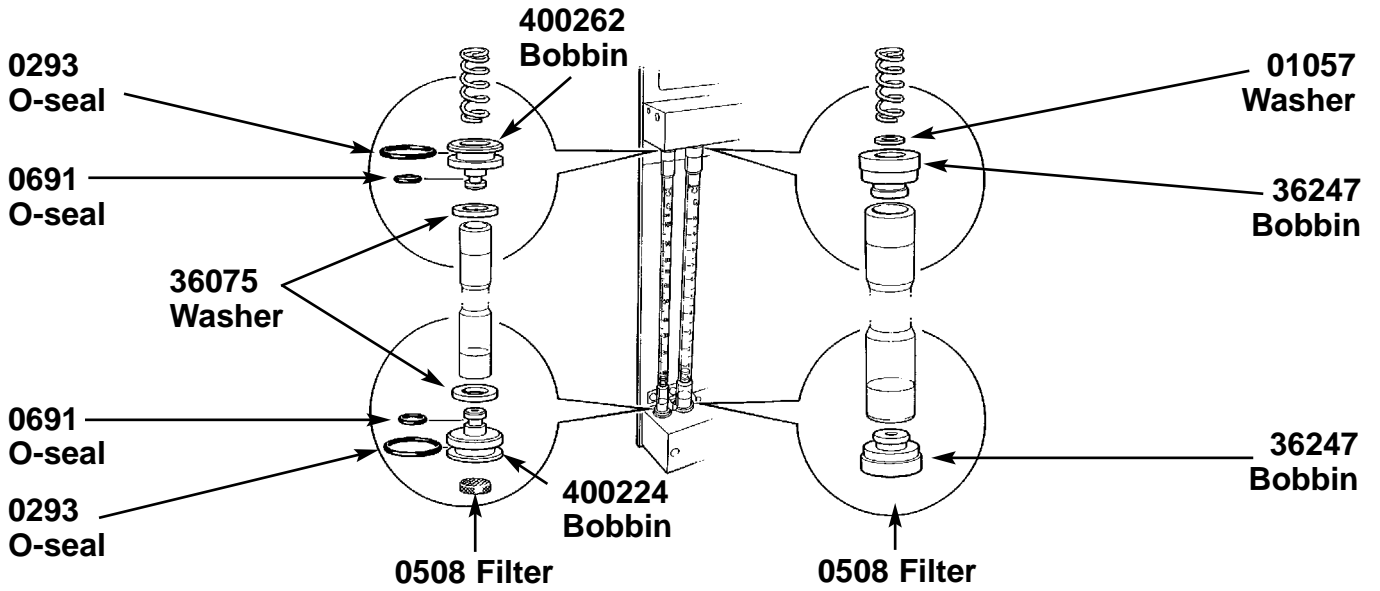
Part No. 57290

Kit Contents		
Part No	Qty.	Component Description
462526	1.35 m	Hose - Backbar Outlet to CGO (not shown)
37946	4	Hose Support
37947	4	Seal Support
37951	4	Split O-ring
041115	6	O-ring - Selectatec
016	5	Bodok Seal
400224	3	Flowmeter Bobbin - Metal with Filter
400262	3	Flowmeter Bobbin - Metal without Filter
0762	8	Filter - Yoke and Pipeline
0508	3	Filter - Flowmeter
36247	6	Flowmeter Bobbin - Tube Seals
01057	3	Washer
36075	6	Shock Washer
0691	6	O-seal - Flowmeter
043	2	O-seal - Safelock
011017	100 mm	Tubing - Sample Block
022533	3	Dzus Clip
0226	2	O-seal - Hose Assembly (backbar to CGO outlet) - not shown
0293	6	O-seal - Flowmeter Tube



PARTS LIST

Preventive Maintenance Kit - 24 Month Service



043 O-ring

PARTS LIST

Prima SP 2/3

Preventive Maintenance Kit

48 Month Service

Part No. 57291

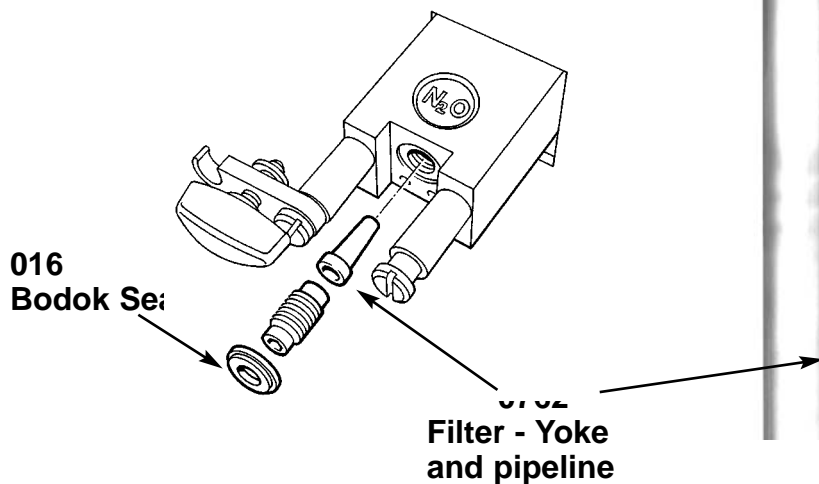
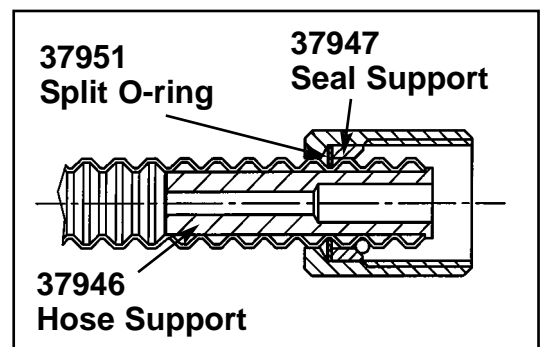
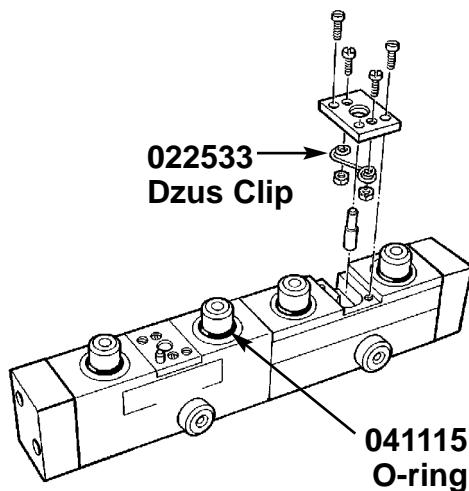
Kit Contents

Part No	Qty.	Component Description
041115	6	O-ring - Selectatec
016	5	Bodok Seal
400224	3	Flowmeter Bobbin - Metal with Filter
400262	3	Flowmeter Bobbin - Metal without Filter
0762	8	Filter - Yoke and Pipeline
0508	3	Filter - Flowmeter
36247	6	Flowmeter Bobbin - Tube Seals
01057	4	Washer
36075	6	Shock Washer
0691	6	O-seal - Flowmeter Tube
0293	6	O-seal - Flowmeter Tube

043	1	O-seal - Safelock
90183	1	Clippard Valve - Oxygen Flush
0314	2	O-ring - Oxygen Flush Clippard Valve
0691	6	O-ring - Cylinder/Pipeline NRV
37946	4	Hose Support
37947	4	Seal Support
37951	4	Split O-ring
022533	2	Dzus Clip

Following not shown:

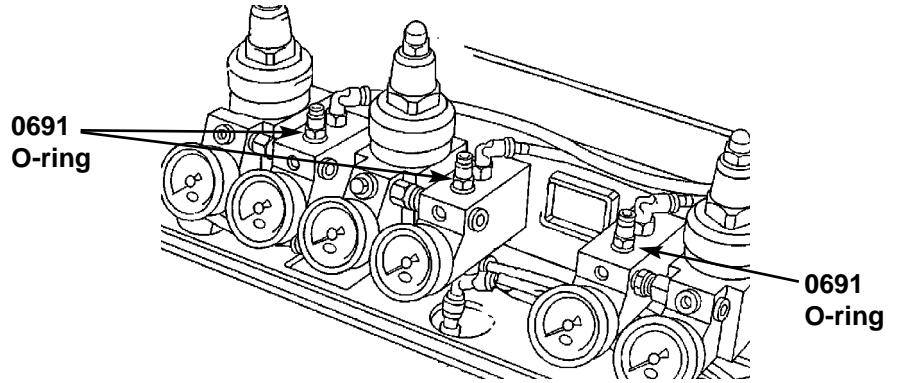
462544	3 m	8 mm Hose - Oxygen - Internal
462543	2 m	6 mm Hose - Nitrous Oxide - Internal
462542	2 m	5 mm Hose - Air - Internal
462541	1 m	4 mm Hose - Switch Feeds/CO ₂ - Internal
462526	1.35 m	Hose - Backbar Outlet to CGO
0226	4	O-seal - Hose assembly - Backbar Outlet to CGO



PARTS LIST

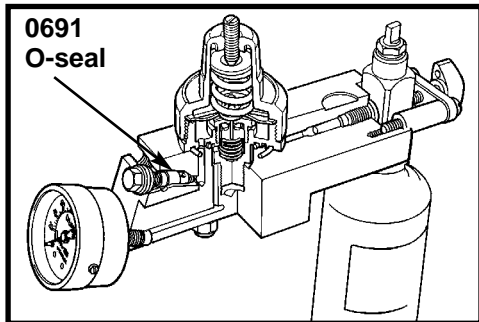


**043
O-ring**

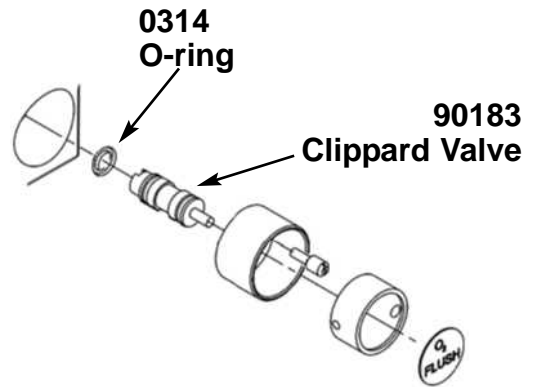


**0691
O-ring**

**0691
O-ring**

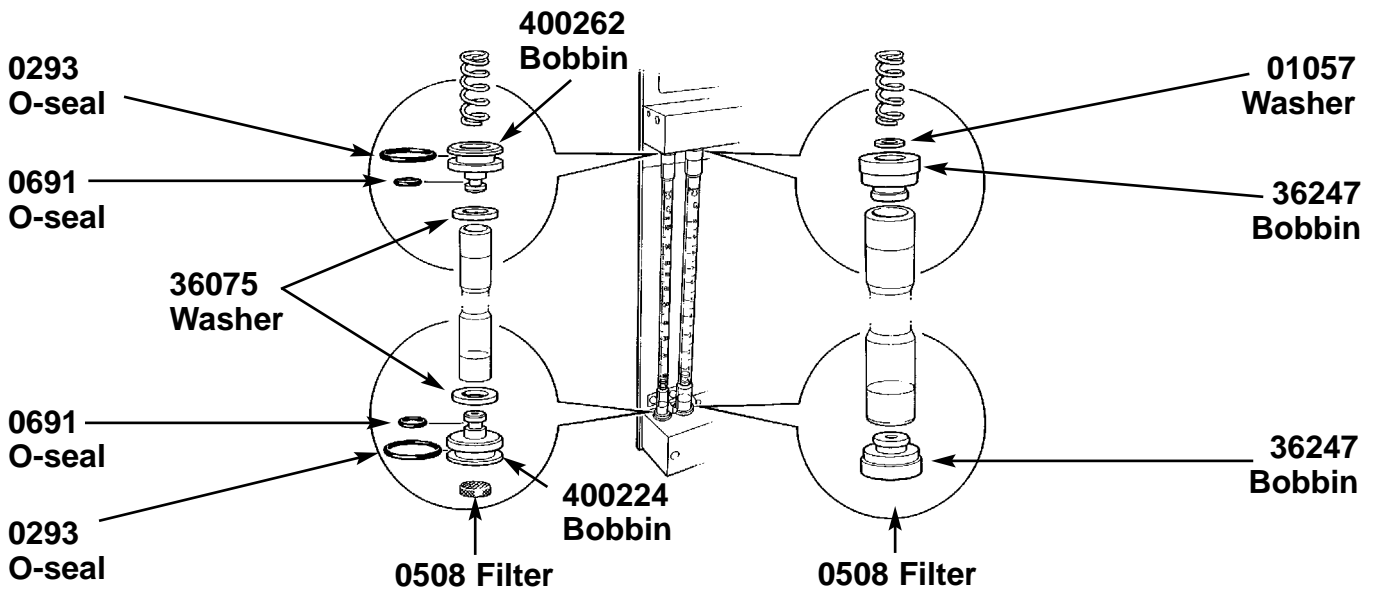


**0691
O-seal**



**0314
O-ring**

**90183
Clippard Valve**



**0293
O-seal**

**0691
O-seal**

**0691
O-seal**

**0293
O-seal**

**36075
Washer**

**400262
Bobbin**

**400224
Bobbin**

0508 Filter

**01057
Washer**

**01057
Washer**

**36247
Bobbin**

**36247
Bobbin**

0508 Filter

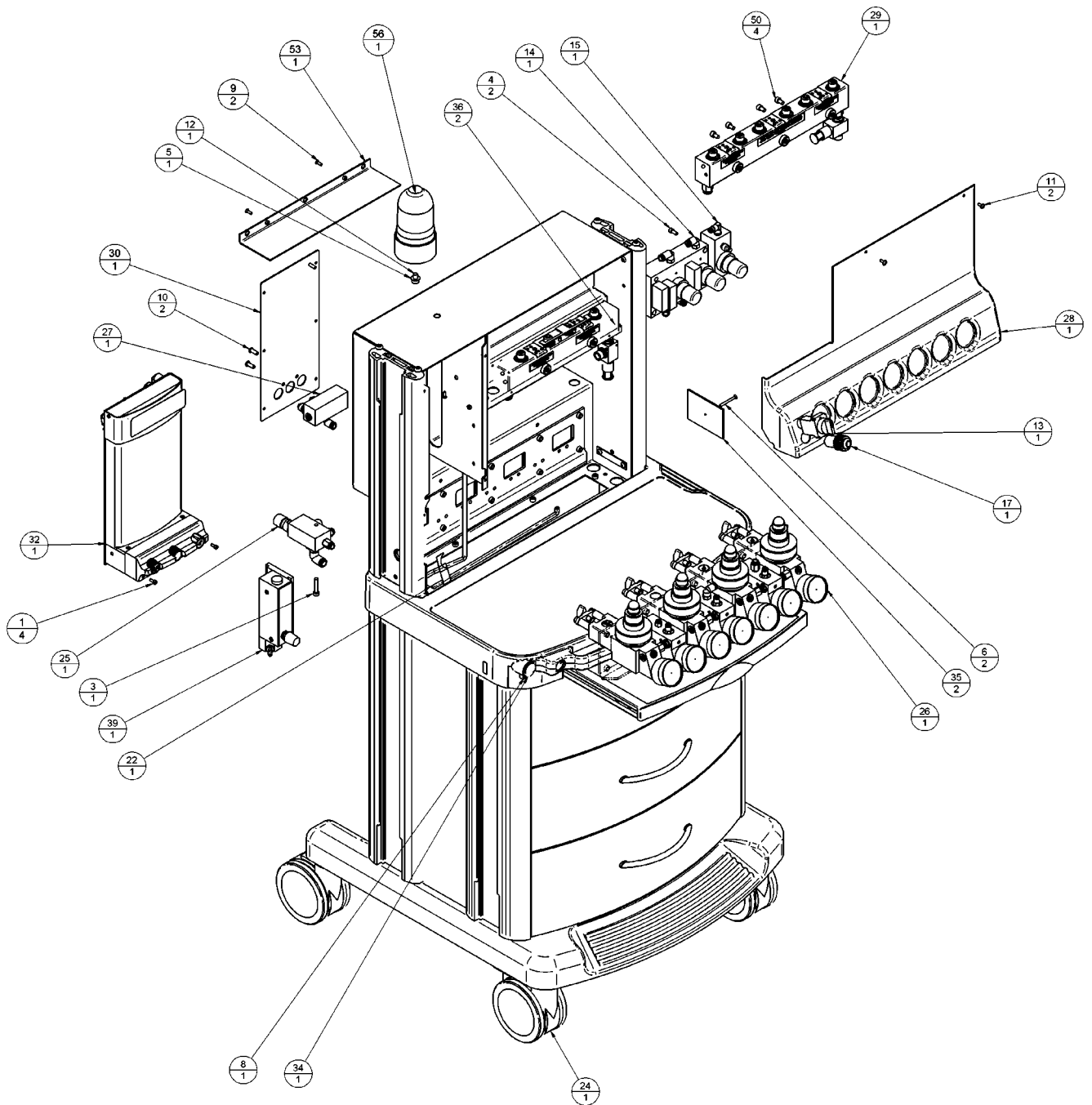
PARTS LIST

Main Assemblies and Miscellaneous Components

Note that parts lists for sub-assemblies are on following pages

Item	Part No.	Description	Quantity
1	01013	Screw - M4 X 10 SKT HD Cap	4
2	01017	Screw - M6 X 12	2
3	01028	Screw - M6 X 30	1
4	01056	Screw - M5 x 12	2
5	01148	Washer - M8	1
6	019033	Screw - M4 X 40 Slotted CSK SS	2
7	019048	Screw - M4 x 10 Pan Head SS	12
8	019127	Screw - M4 x 12 But CB	1
9	019142	Screw - M4 X 10 LG CSK HD, ST STL	2
10	019166	Screw - M6 X 16 SKT Button HD SS	2
11	019171	Screw - M4 x 10 But Flanged HD	2
12	019175	Screw - M8 X 10 LG	1
13	045055	Selector Switch	1
14	045076	O ₂ + N ₂ O Manifold Assembly (secondary regulators)	1
15	045077	Air Manifold Assembly (secondary regulator)	1
16	054540	Coupling	1
17	054945	Visual indicator (oxygen failure)	1
18	15023	Product Label	1
19	402948	Cable Retainer	1
20	462544	Pipe - Flush In (Ø8)	1
21	462544	Pipe - Flush Out (Ø8)	1
22	462544	Pipe - O ₂ In (Ø8)	1
23	462545	Pipe - CGO (Ø10)	1
24	5000220	Frame Assembly	1
25	5000265	Fresh Gas Manifold	1
26	5000272	Gas Bar Installation	1
27	5000276	Auxiliary Outlet Assembly	1
28	5000280	Gauge Cover	1
29	5000281	Backbar Assembly	1
30	5000285	Vertical Access Panel	1
31	5000286	Top Shelf Assembly	1

Parts List continues on following pages

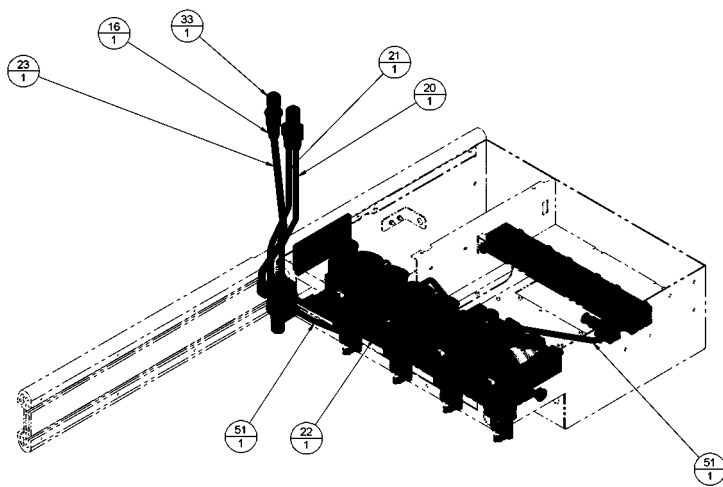
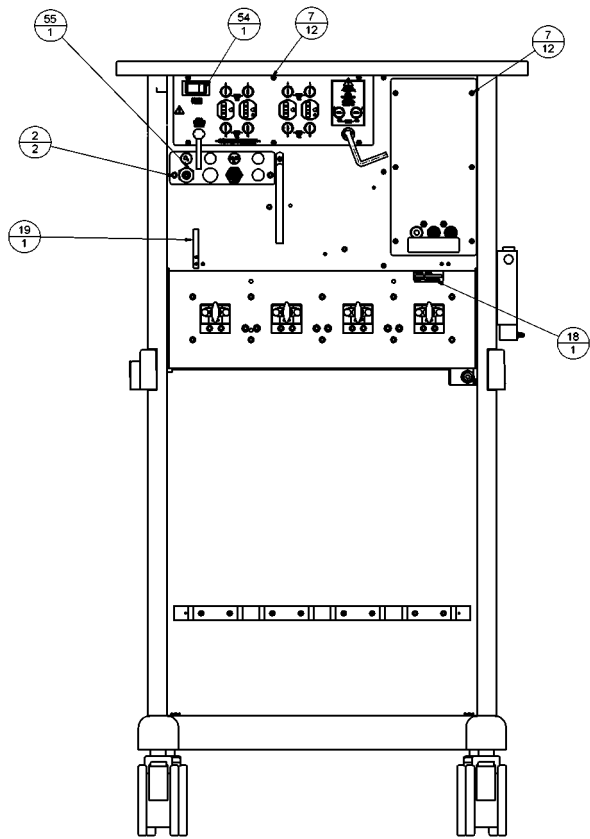


PARTS LIST

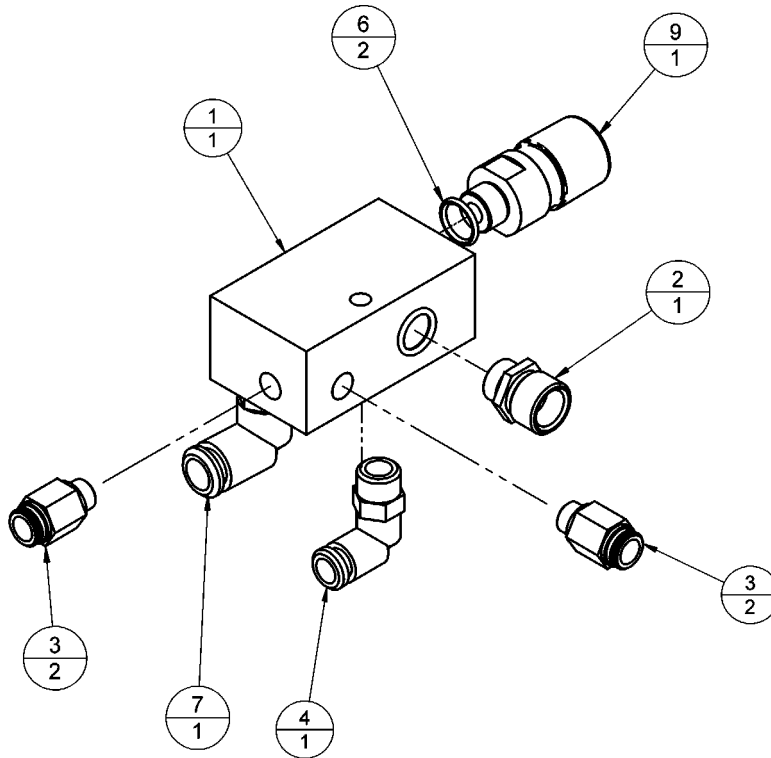
Main Assemblies and miscellaneous parts (continued)

Note that parts lists for sub-assemblies are on following pages

Item	Part No.	Description	Quantity
32	5000298	Flowmeter O2+N2O Cascade	1
33	5000332	CGO Outlet	1
34	5000333	Plug CGO Outlet	1
35	5000337	Gauge Cover Clamp Plate	2
36	5000362	Dome Plug Ø28.0 Black	2
37*	5000401	'V' Bracket GCX Assembly	1
38*	5000402	'V' Bracket Assembly RH Forward	1
39	5000422	Therapy Flowmeter Assembly	1
40*	5000426	Cable Management	1
41*	5000427	2 Hook Drip Pole Assembly	1
42*	5000454	On Off Label	1
43*	5000455	Label (Visual indicator - oxygen failure)	1
44*	5000456	Label - Auxiliary Outlet	1
45*	5000457	Label - CGO Outlet	1
46*	5000458	Label - Lighting	1
47*	5000469	Power Supply Unit Mains Lead	1
48*	5000470	Lighting PSU	1
49*	5000471	Lighting Loom PSU 2	1
50	5000539	M6 X 10 SKT Cap SCR. ST ST	4
51	700615	Pipe - Back Bar	1
52*	800217	Backbar (Selectatec 2 station)	1
53	800289	Safety Panel	1
54	800313	Electrical Panel - Int. Power CSA	1
55	800429	Pipeline Connector USA	1
56	800651	Reservoir (Norgren)	1



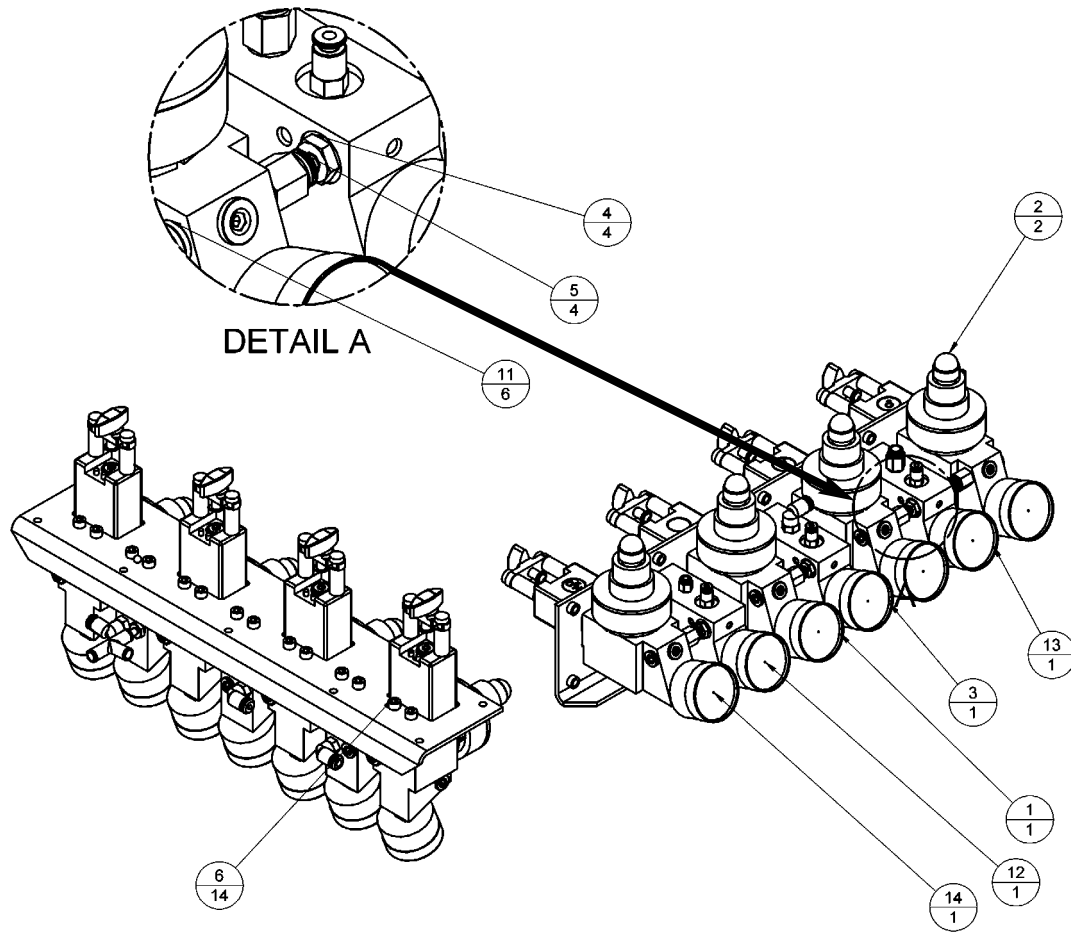
PARTS LIST



Fresh Gas Manifold

Item	Part No.	Description	Quantity
1	5000266	Gas Block	1
2	700650	Outlet Connector	1
3	054519	Coupling	2
4	054515	Elbow - 8mm Tube	1
6	0258	O-ring Ø0.45" X 0.070" CS	2
7	054524	Elbow - 10 mm Tube	1
9	5000443	22 mm Outlet Male Connector	1

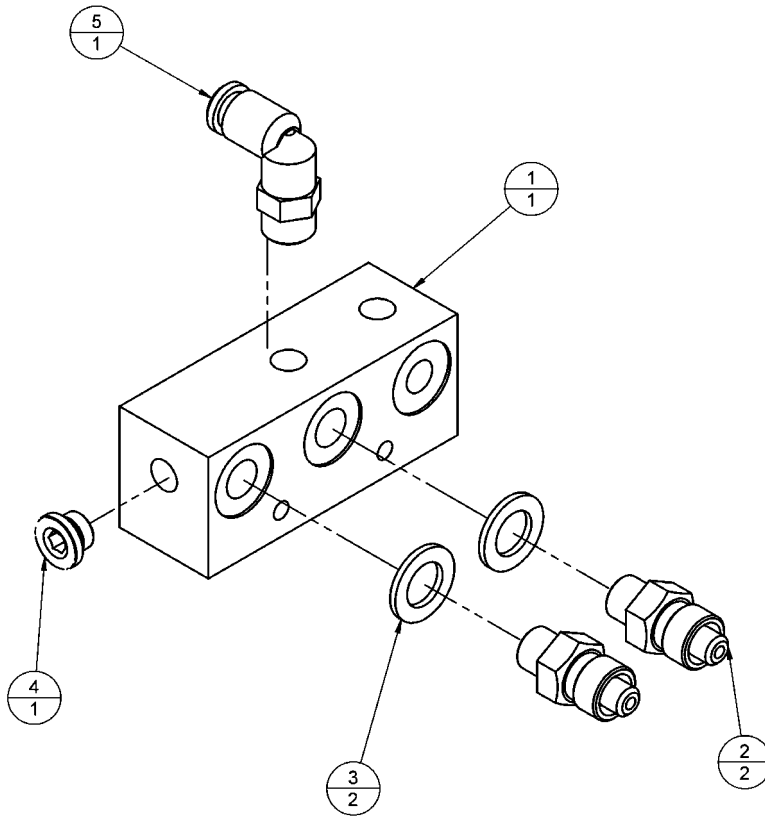
PARTS LIST



Gas Regulator Bar Assembly

Item	Part No.	Description	Quantity
1	800306	High Pressure Gas Block Air (USA)	1
2	800305	High Pressure Gas Block O2 (USA)	2
3	800206	Low Pressure Gas Block (Air)	1
4	054528	Stem Adaptor	4
5	054519	Coupling	4
6	01007b	Screw - M6 X 16	14
11	053207	O-ring - G 1/8 Plug C/W	6
12	800209	Low Pressure Gas Block N2O	1
13	800208	Low Pressure Gas Block O2 (USA)	1
14	800309	High pressure Gas Block N2O	1

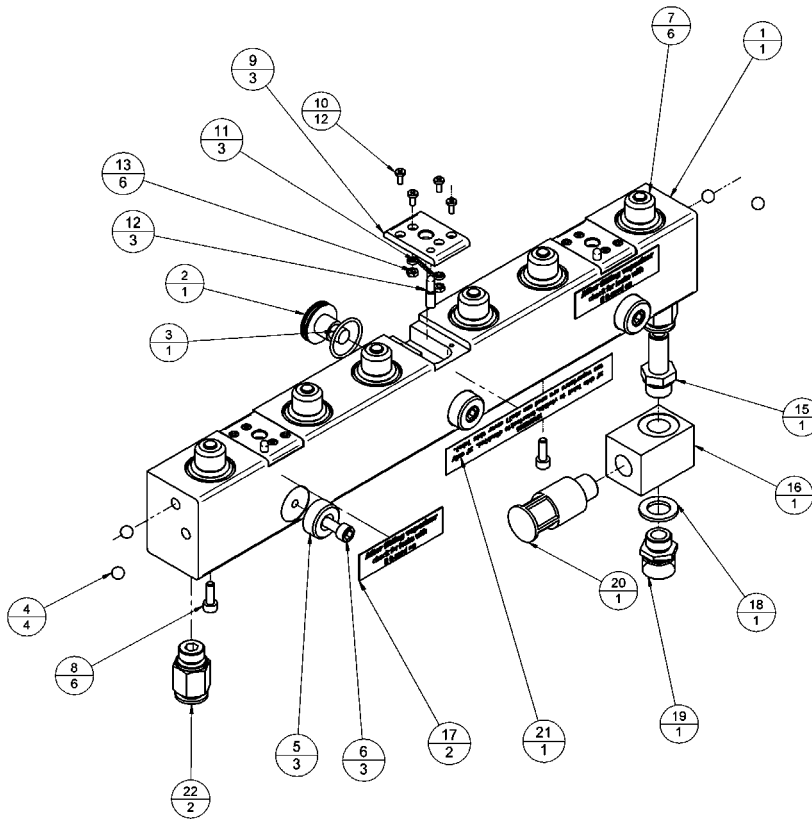
PARTS LIST



Auxiliary Outlet assembly

Item	Part No.	Description	Quantity
1	5000277	Auxiliary Outlet Block	1
2	34410	O2 Outlet (DISS 1240)	2
3	0408	Dowty Seal G 1/4	2
4	053207	Plug (G 1/8) complete with O-ring	1
5	054515	Elbow – 8 mm Tube	1

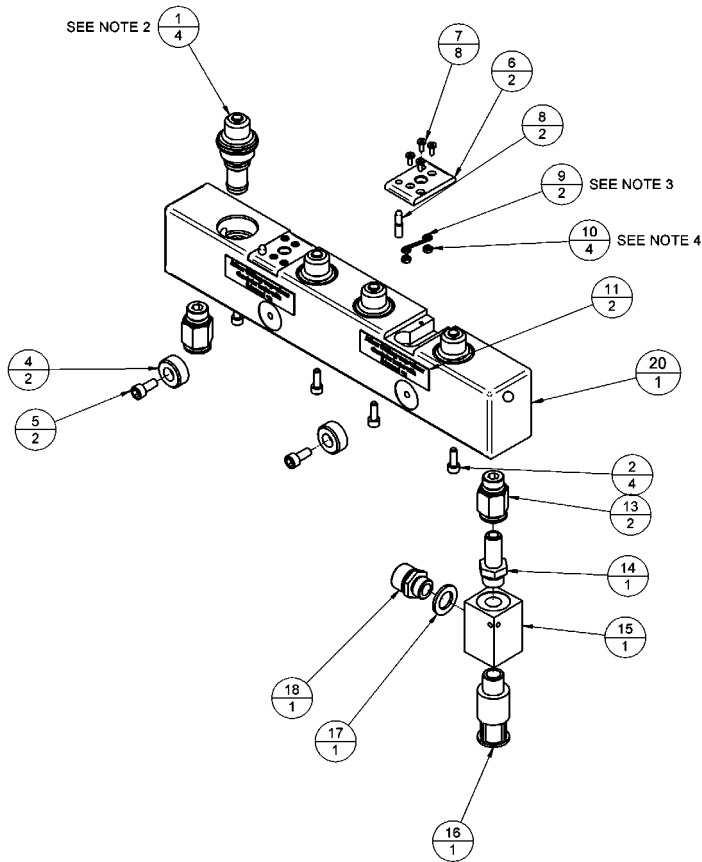
PARTS LIST



Backbar Manifold Assembly - 3 Station Selectatec

Item	Part No.	Description	Quantity
1	5000282	Three Station Backbar - Selectatec Compatible	1
2	5000283	Backbar Sealing Screw	1
3	041212	O-ring Ø19.1 X Ø1.6 Viton	1
4	0360	1/4" Ball	4
5	71577	Location Button	3
6	01056	Screw (M5 X 12 SKT HD)	3
7	045051	Valve Capsule	6
8	019067	Screw (M4 X 12 SKTHD)	6
9	700634	Clip Retaining Plate	3
10	01059	Screw (M2.5 X 6)	12
11	022533	Dzus Spring	3
12	71553	Interlock Peg	3
13	01250	Nut (M2.5)	6
15	5000431	Stem Adaptor	1
16	5000360	PRV Manifold Block	1
17	15464	Label - Leak Check	2
18	0408	Dowty Seal G1/4	1
19	700650	Outlet Connector	1
20	045435	PRV	1
21	15447	Warning Label	1
22	5000430	Coupling	2

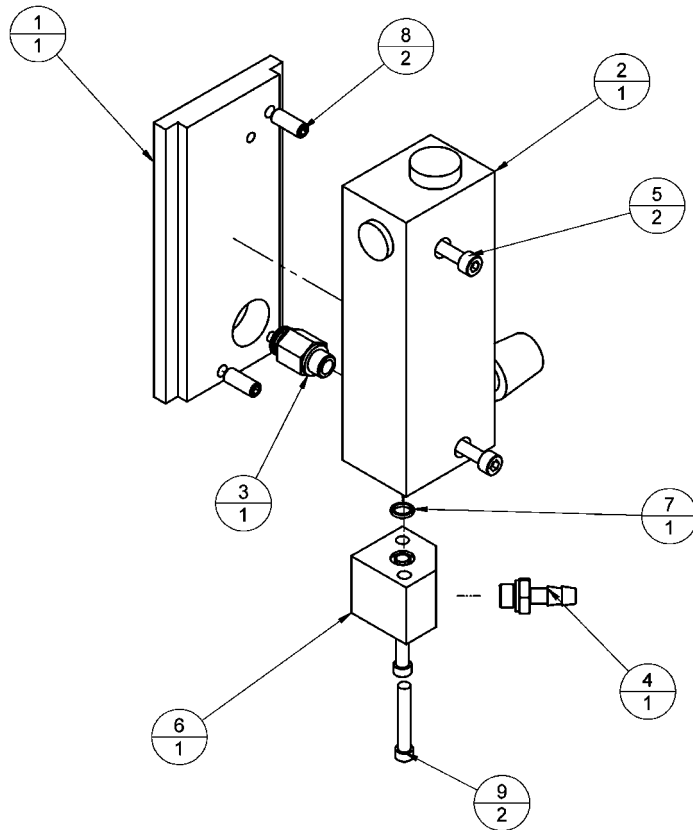
PARTS LIST



Backbar Manifold Assembly - 2 Station Selectatec

Item	Part No.	Description	Quantity
1	045051	Valve Capsule	4
2	019067	Screw (M4 X 12 SKT HD)	4
4	71577	Location Button	2
5	01056	Screw (M5 x 12 SKT HD)	2
6	700634	Clip Retaining Plate	2
7	01059	Screw (M2.5 X 6)	8
8	71553	Interlock Peg	2
9	022533	DZUS Spring	2
10	01250	Nut (M2.5)	4
11	15464	Label Leak Check	2
13	054540	Coupling	2
14	054525	Stem Adaptor	1
15	800238	PRV Manifold Block	1
16	045435	PRV	1
17	0408	Dowty Seal G1/4	1
18	700650	Outlet Connector	1
20	5000204b	2 Station Backbar	1

PARTS LIST



Therapy Flowmeter

Item	Part No.	Description	Quantity
1	5000423	Flowmeter GCX Bracket	1
2	5000424	Therapy Flowmeter	1
3	054519	Coupling	1
4	5000441	Hose Tail	1
5	019026	M5 X 40 SKT HD Cap	2
6	5000425	Flowmeter Adaptor Block	1
7	041202	'O' Ring Ø6.1 X Ø1.6	1
8	5000392	M6 X 16 SKT Set Screw ST STL Cup Point	2
9	019006	M5 X 30 SKT HD Cap	2

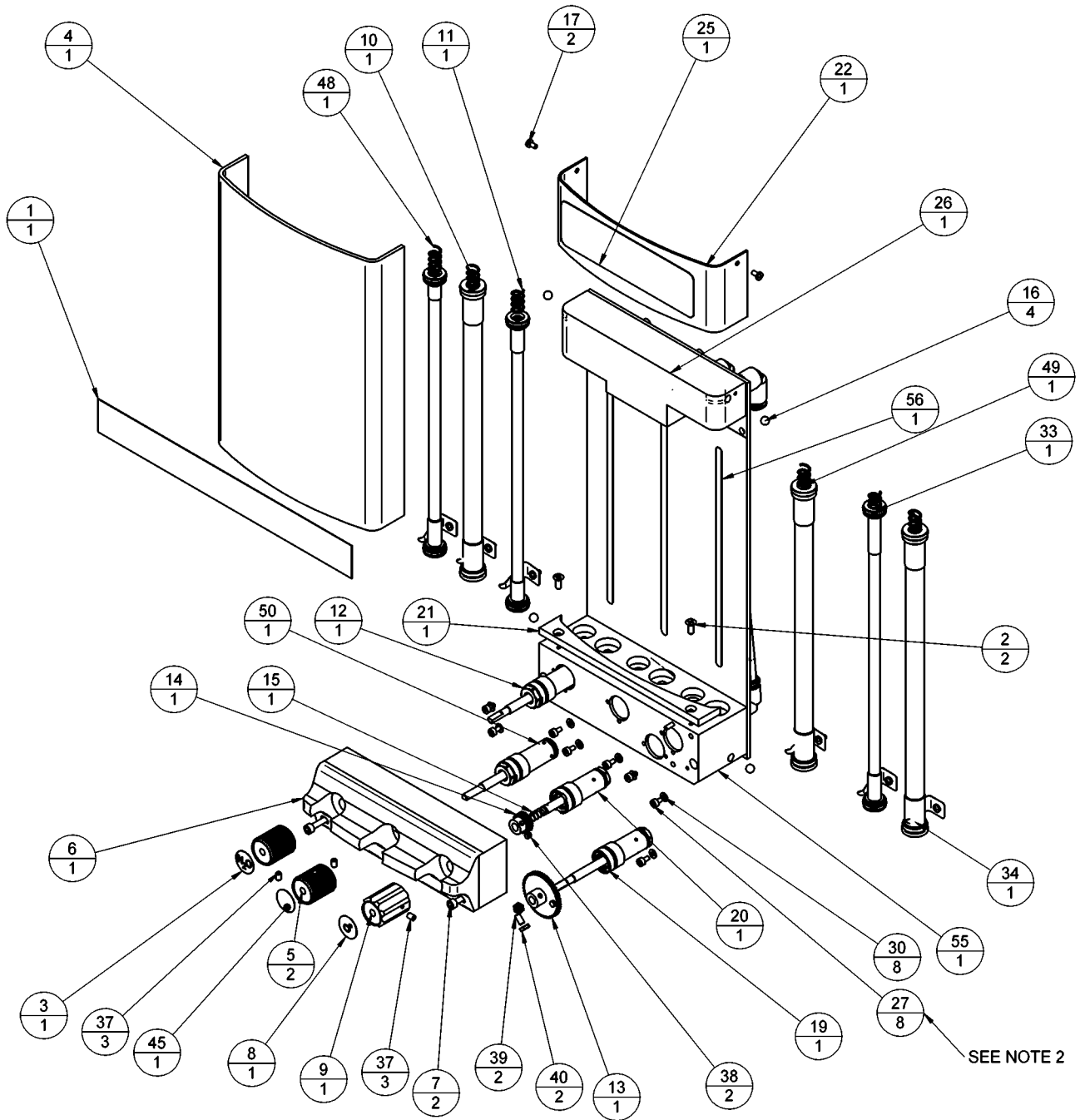
PARTS LIST

Flowmeter Assembly

Item	Part No.	Description	Quantity
1	800341	Flowmeter Overlay	1
2	019123	M4 x 10 CSK ST STL CHEM BLK	2
3	15277	Label N2O	1
4	800196	Flow Tube Cover	1
5	800230	Knob N2O, Air, CO2	2
6	800337	Anti-Tamper (3 Hole)	1
7	01031	M4 x 35 Cap Head SS	2
8	15051	Label O2 US	1
9	800231	Knob O2	1
10	800222	Flow Tube N2O Cascade	1
11	800226	Flow Tube N2O Low	1
12	38316	Needle Valve	1
13	015043	Spur Gear 50 Teeth	1
14	015044	Spur Gear 20 Teeth	1
15	031048	Spring Ø7.62 X 17.46 LG	1
16	0360	1/4" Ball	4
17	019133	M3 X 6 LG Button HD CHEM BLK	2
19	800622	Needle Valve Assembly O2	1
20	800708	L/H Needle Valve Assembly	1
21	800270	Spacer Plate	1
22	5000432	Top Cover	1
24	800234	Flowmeter Panel	1
25	5000446	Prima Us Label	1
26	5000433	Cascade Mixing Chamber	1
27	019011	M3 X 6 LG SKT HD	8
29	38349	Stop Pin	1
30	01067	M3 Plain Washer	8
31	054515	Elbow – 8 mm Tube	2
32	054524	Elbow – 10 mm Tube	1
33	800225	Flow Tube O2 Low	1
34	800223	Flow Tube O2 Cascade	1

Parts List continues on following pages

PARTS LIST

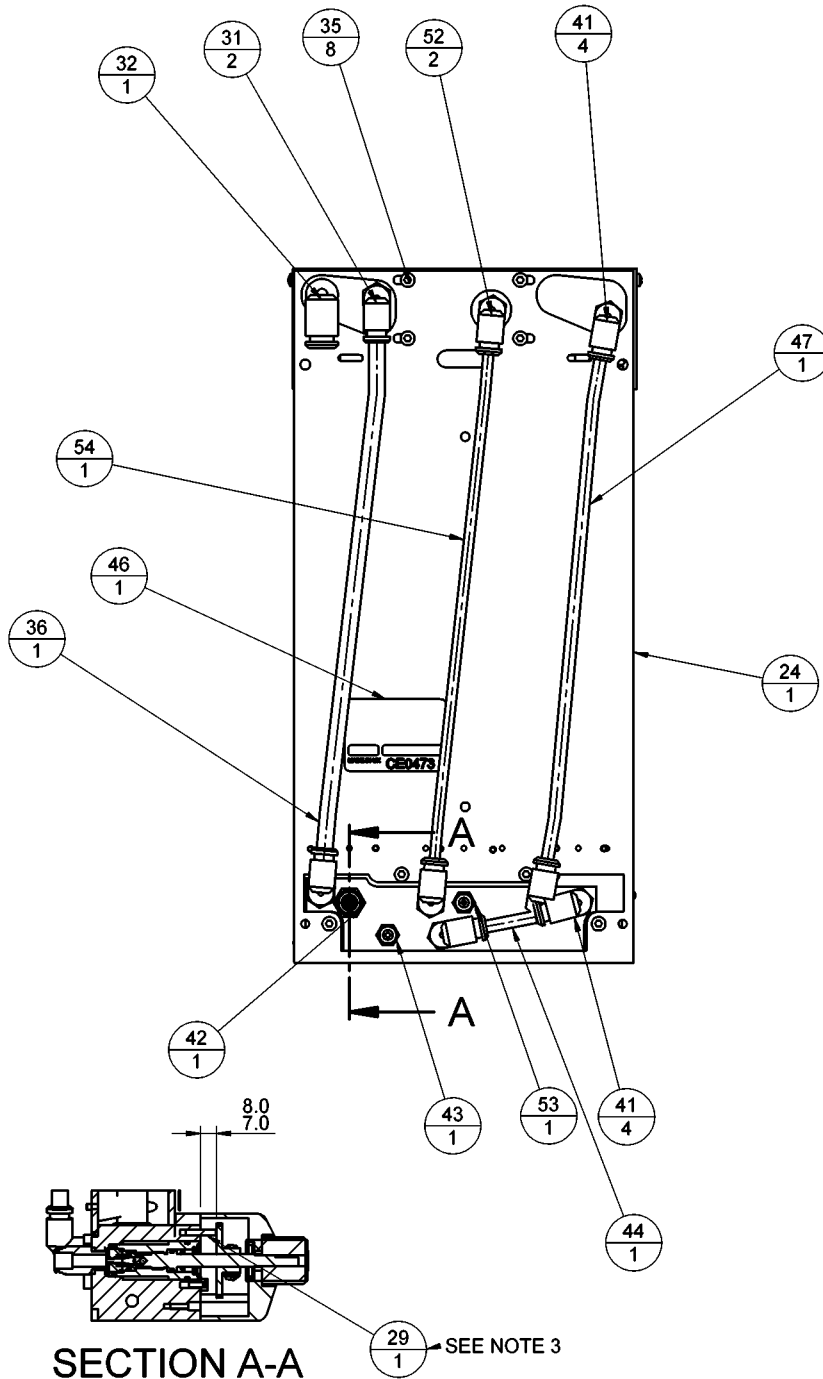


PARTS LIST

Flowmeter Assembly (continued)

Item	Part No.	Description	Quantity
35	019067	M4 X 12 SKT HD Cap	8
36	462544-A/R	Ø8 Mm Tube	1
37	01027	M4x6 Grubscrew Cup P't SS	3
38	019083	M4 X 4 LG Grub Screw	2
39	019025	M4 X 8 LG Grub Screw	2
40	01023	M4 Nut	2
41	054514	Elbow – 6 mm Tube	4
42	054519	Coupling	1
43	054518	Tube Conn'	1
44	462543 A/R	Ø6 Mm Tube	1
45	15278	Label Air	1
46	5000507	Product Label PNA	1
47	462543-A/R	Ø6 Mm Tube	1
48	800506	Flow Tube Low Air	1
49	800224	Flow Tube Air	1
50	38318	Needle Valve	1
52	054543	Elbow – 5 mm Tube	2
53	054517	Tube Conn'	1
54	462542-A/R	Ø5 mm Tube	1
55	800389	Manifold Block	1
56	5000447	Panel - Flowmeter US	1

PARTS LIST

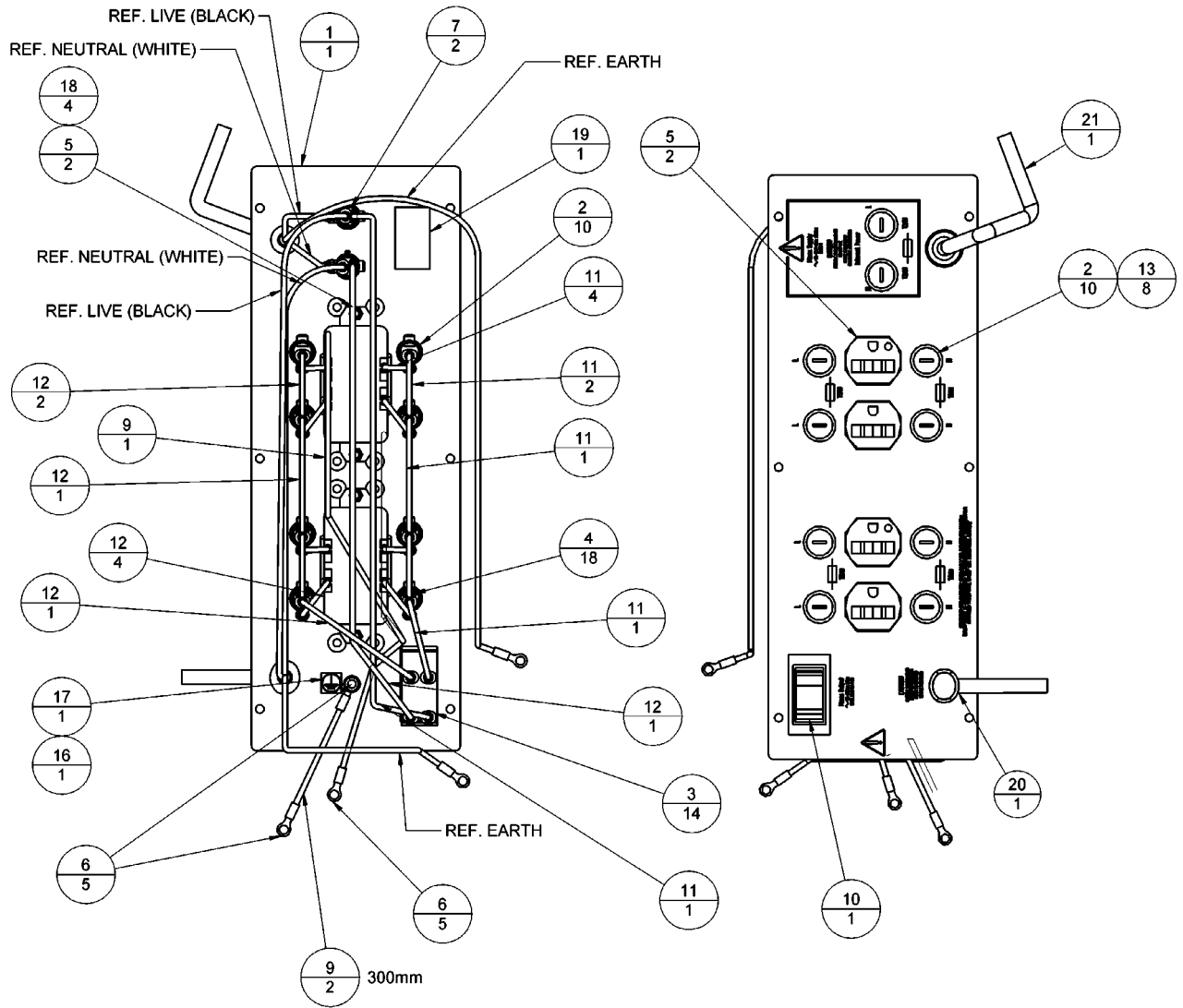


PARTS LIST

Electrical Panel Assembly

Item	Part No.	Description	Quantity
1	800280	Electrical Panel (CSA 102 INT PWR)	1
2	103994	Fuse Holder	10
3	103241	1/4" Spade Red Crimp, Shrouded	14
4	103237	Crimp Connector 3/16"	18
5	103299	Mains Socket CSA	2
6	103223	Eyelet Connector M5 Red	5
7	104033	Fuse (2 A Ceramic)	2
8	01023	Nut (M4)	4
9	103484	Wire (18 AWG PVC Equip' green/yellow - CSA)	1
10	102973	Circuit Breaker (110 v 10 amp)	1
11	103460	Wire (black 16/30 (18 AWG) PVC Equip)	1
12	103461	wire (white 16/30 (18 AWG) PVC Equip)	1
13	103995	Fuse (5 A Ceramic, HR)	8
14	01222	INT Star Washer M5	1
15	01057	M5 Plain Washer - ST ST	1
16	020001	Nut (M5)	1
17	104012	Earth Label	1
18	01035	M4 Int. S. Proof Washer	4
19	15477	Mains Wiring Colour Label	1
20	See 800218	Mains Lead Wiring Ref	1
21	800603	O2 Monitor Mains Lead	1

PARTS LIST

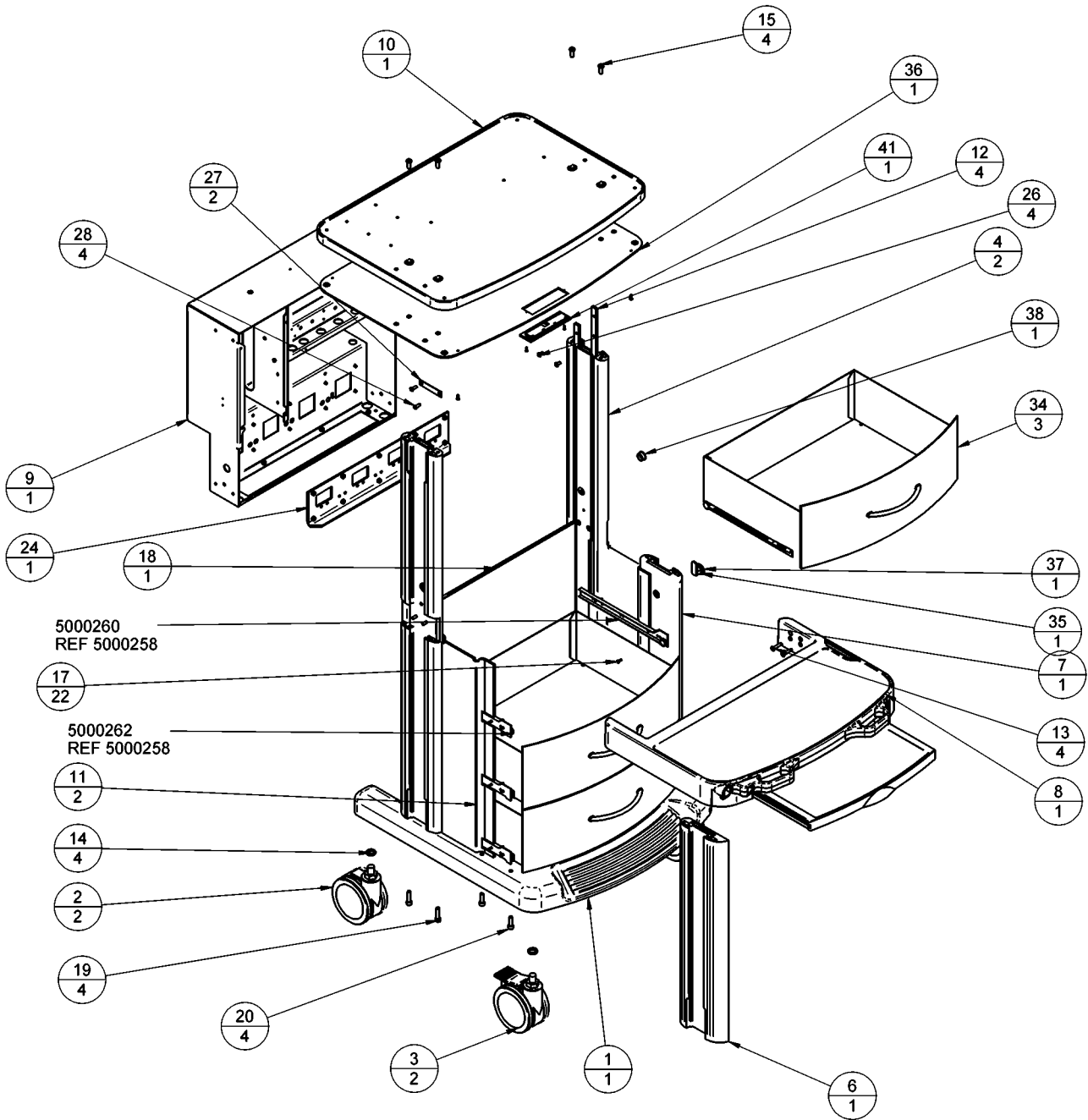


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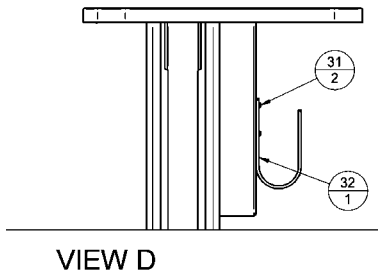
Frame Assembly

Item	Part No.	Description	Quantity
1	5000254	Base Casting	1
2	000084	Castor	2
3	000083	Castor (with brake)	2
4	5000230	Main Leg M/C	2
6	5000231	Front Leg LH	1
7	5000232	Front Leg RH	1
8	5000221	Work Surface Assembly	1
9	5000255	Main Box Assembly	1
10	5000226	Top Shelf	1
11	5000233	Side Panel	2
12	800185	Mounting Strip	4
13	019155	M6 X 30 SKT C/SK SS	4
14	025208	Ø16 Spring Washer	4
15	019167	M8 X 20 ST ST Button HD	4
16	800291	Cylinder Support	1
17	019142	M4 X 10 LG CSK HD, ST STL	22
18	5000288	Back Panel	1
19	019163	M8 X 30 LG Cap Screw	4
20	019001	M8 X 25 LG Cap Screw	4
21	85366	Bump Stop	4
22	01011	M4 Plain Washer	8
23	01043	M4 x 20 Cap Head SS	8
24	800233	Gas Carrier 102 SS	1
25	019135	M6 X 12 LG Cap Screw	10
26	019130	M6 X 12 Button HD SS	4
27	800451	Main Box Clamp Plate	2
28	019166	M6 X 16 SKT Button HD SS	4
29	019171	M4 x 10 But Flanged HD	2
31	019010	M4 x 12 Pan Head SS	2
32	5000284	Tube Hook	1
33	5000258	Drawer Runner (Set)	3
34	5000257	Draw Assembly Installation	3
35	5000340	Elesa Lock CSU.13/32	1
36	5000365	Boxing Plate	1
37	025002	Ø20 Washer SS	1
38	034069	Dome Plug Ø19.0	1
40	01008	M4 X 12 LG CSK HD	4
41	5000438	Lighting Sub Assembly	1
42	019049	M3 X 10 LG Pan HD	2

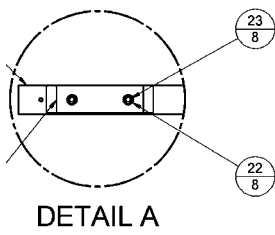
PARTS LIST



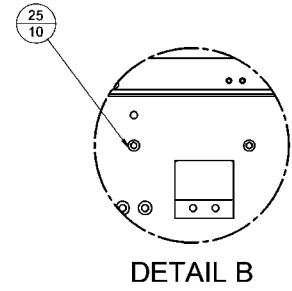
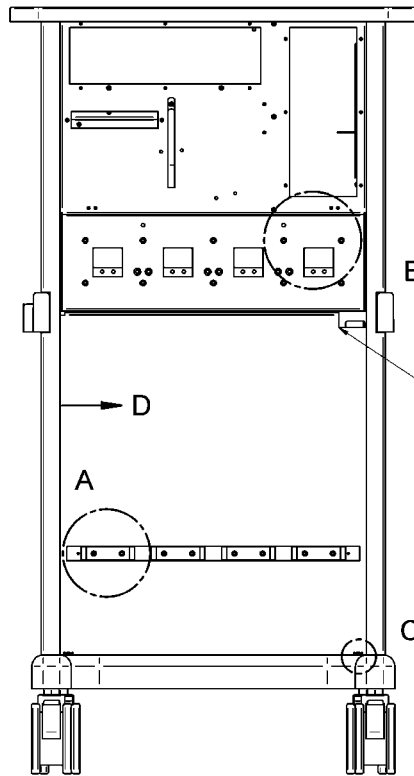
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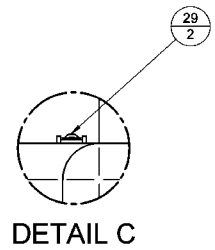
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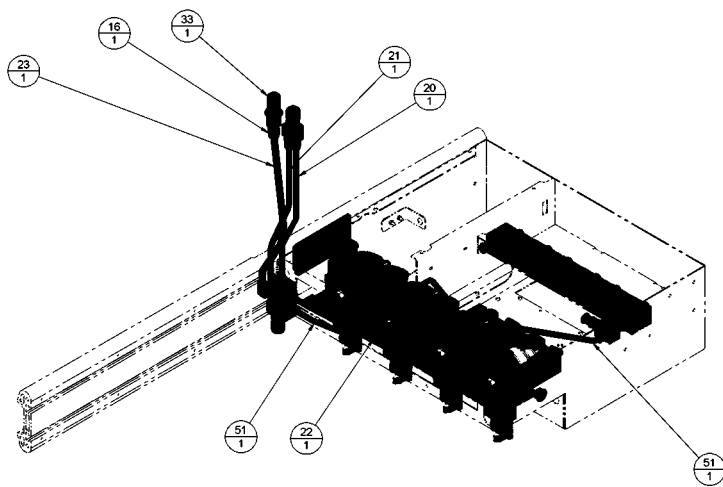
DETAIL A



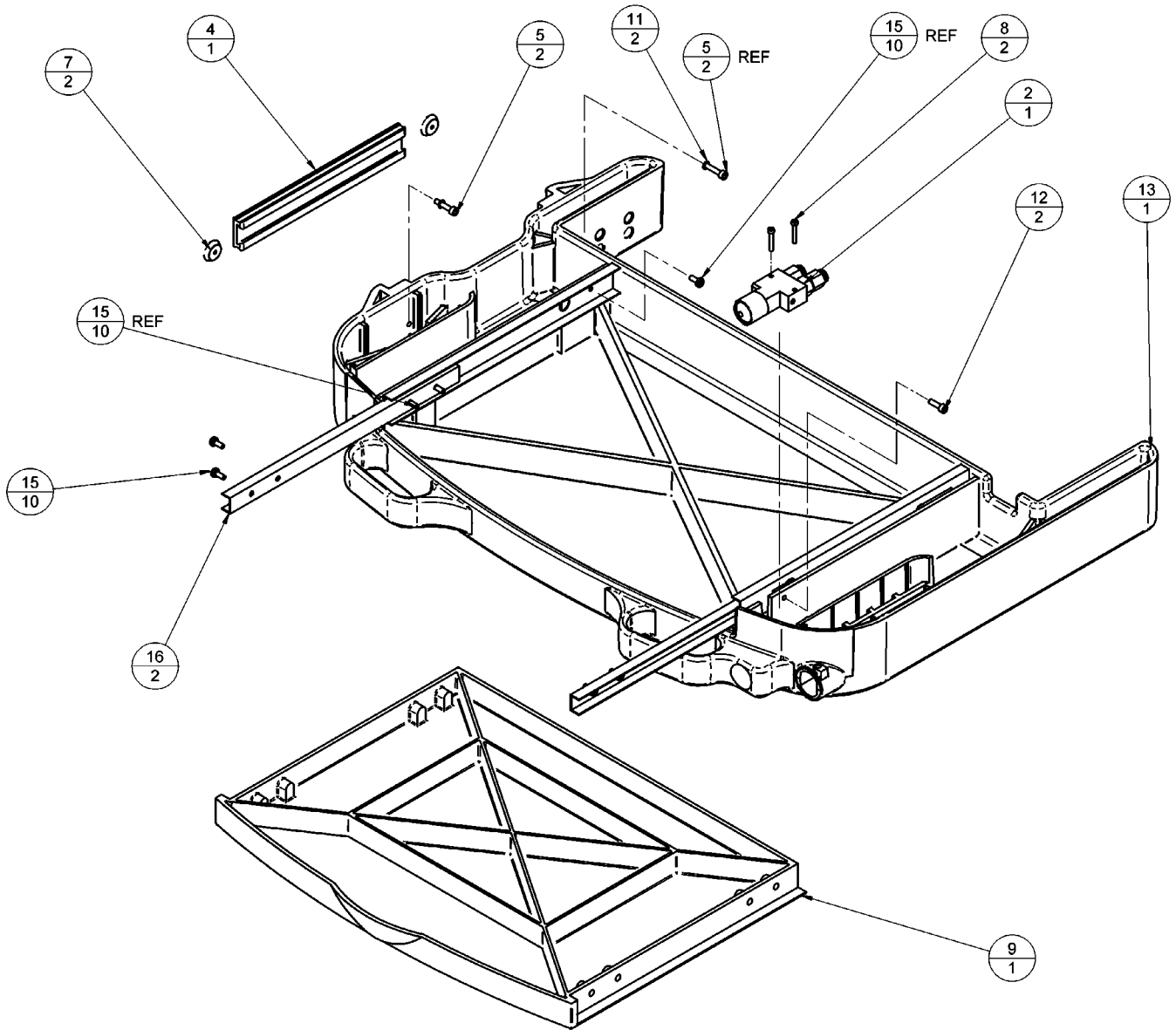
DETAIL B



DETAIL C



PARTS LIST



Work Surface Assembly

Item	Part No.	Description	Quantity
2	5000222	O2 Push Button Assembly	1
4	5000239	Work Surface Rail M/C	1
5	01043	M4 x 20 Cap Head Ss	2
7	5000235	Work Surface Rail Bracket	2
8	019003	M3 X 20 SS SK HD	2
9	5000224	Slide Out Work Surface	1
11	01011	M4 Plain Washer	2
12	019147	M4 X 14 SKT HD Cap	2
13	5000227	Worksurface	1
15	019048	M4 X 10 Button HD	10
16	5000270	Worksurface Runner	2

APPENDIX

APPENDIX

Product Classification and Labelling Terminology

The terms *Class 1* and *Type B* are defined in IEC 601-1 (the standard for electrical medical equipment).



This symbol denotes: Type B equipment

Type B equipment calls for a particular degree of protection against electric shock.

Class 1 equipment has additional protection such that metal parts of the unit that are accessible to the user (e.g. the metal casing of the oxygen monitor unit) cannot become live in the event of failure of the basic insulation of the electrical components within the unit.

This symbol denotes: Refer to the User Manual



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