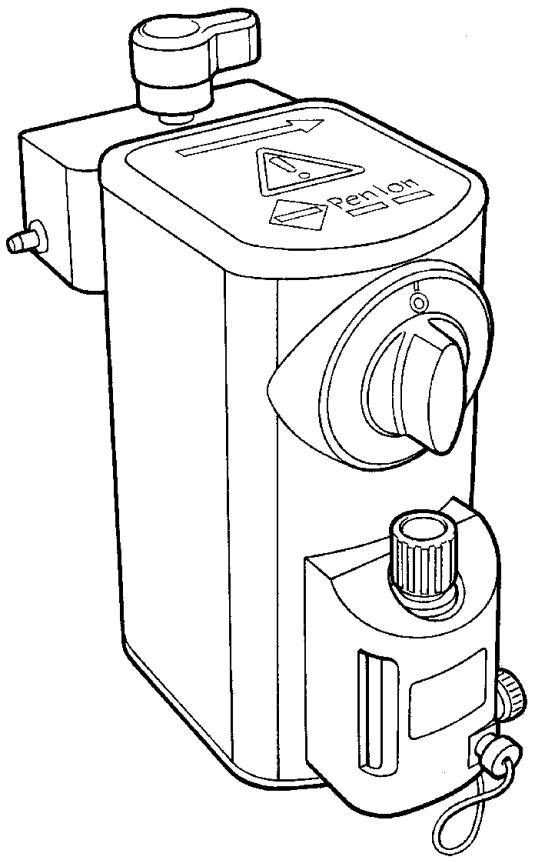
InterMed Penlon

Sigma Delta Vaporizer Service Manual



Quality and Assurance in Anaesthesia

IMPORTANT

Servicing and Repairs

In order to ensure the full operational life of the Sigma Delta vaporizer, we recommend that a periodic service check should be performed by a Penlon trained engineer. This check comprises a vaporizer LEAK TEST and CALIBRATION CHECK.
Note:
(a) The calibration check must be performed using a suitable agent analyser, e.g. a Riken refractometer or infrared analyser.
(b) The service check is part of the recommended pre-use check for your Anaesthesia System.

Should the calibration checks show the unit to be outside the specified performance requirement, then an overhaul service must be performed.

This may be done on site by:
(a) A trained user.
(b) An authorised Penlon agent.
(c) A Penlon service engineer.

A calibration and service record section is provided in the user instruction manual to maintain a record of the vaporizer's performance.

For any enquiry regarding the service or repair of this vaporizer, contact the nearest accredited Penlon agent* or contact the Service Department at Penlon Limited.

Service and Repair Department
Penlon Ltd
Abingdon
OX14 3PH
UK
Tel: +44 (0) 1235 547063
Fax: +44 (0) 1235 547062
E-mail: service@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 checks and repairs, applicable to the Penlon Sigma Delta vaporizer.
Information contained in the 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 before using the vaporizer.

Terminology
This manual complies with ISO 4135, Anaesthetic Apparatus Terminology.
The following additional definitions should be noted:
Vol.% - shortened form of volumetric percentage.
The commonly used method of expressing vapour concentrations so that they can be compared with concentrations of true gases. 100 Vol.% is equivalent to 100% partial pressure in a mixture.

CONTENTS

USER RESPONSIBILITY

This vaporizer 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 provided. To ensure the safety of this vaporizer 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 section 8.1.

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 is made to the nearest Penlon service centre,

This vaporizer 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 responsibility for any malfunction which results from improper use, maintenance, repair, damage or alteration by anyone other than Penlon Limited or its appointed agents.

This vaporizer must only be supplied to, and used by, suitably qualified medical practitioners.
Caution: USA and Canadian Federal Law restricts the sale and use of this device by or on the order of a physician.

Statements in this manual preceded by the following words are of special significance.
WARNING - means there is a possibility of personal injury to yourself or others.

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

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

The reader must take particular notice of the warnings, cautions,. and notes printed throughout the manual.

1. WARNINGS AND CAUTIONS

WARNINGS

1. ***The Sigma Delta vaporizer is to be sold to, and used on the order of, a medically qualified practitioner only.***

2. ***Anaesthetic agents are poisonous, and inhaling their vapours, even in low (sub-anaesthetic) concentrations may present a health hazard.***
   Care must be taken to avoid spillage of anaesthetic drugs when filling or draining the vaporizer.

3. ***The procedures described herein which involve dismantling the vaporizer must only be performed after the instrument has been drained and dried out.***

4. ***Calibration procedures must only be performed with the vaporizer outlet connected to an anaesthetic gas scavenging system designed in accordance with national standards or regulations.***

5. ***No oil or grease should be permitted in the vaporizer service area.***
   This applies equally to silicone based lubricants, flammable oil, and grease.

6. ***The Sigma Delta vaporizer is designed for use only with one anaesthetic agent - that which is named on the filler block.***
   Misdosage will occur if the vaporizer is filled with the wrong drug.
   Keyed filler devices are provided on certain models to meet national and international standards.

7. ***The Sigma Delta vaporizer must not be modified or disassembled by any unauthorised person. It should be regularly serviced by a Penlon authorised service agent, trained technician or engineer and by no other person (see section 6).***

8. ***The pharmacopoeia name of the drug is used on the label according to BP, USP or Ph EUR.***
   The user is responsible for confirming that any trade name of a drug is equivalent to the registered name.

9. ***Violent movement or tipping of a filled vaporizer may cause liquid agent to leak into the control mechanism and subsequently deliver uncontrolled doses of vapour.***
   The vaporizer must be empty, and the control must be in the zero position during transport.

   The vaporizer must be purged at maximum output with 5 L/min flow of oxygen for 2 minutes, and the output checked with an analyser prior to use.

10. ***The vaporizer control must be in the zero position during the filling or draining process. Delivered concentrations are inaccurate while the standard filler port is open or the key filler shoe loose. The vaporizer must be upright during filling, to prevent overfilling.***

11. ***Vaporizers may malfunction if exposed to excessively high temperatures, e.g. by storage above a radiator. This may permanently damage the vaporizer. Maximum storage temperature: $50^{O}C$ ($122^{O}F$)***
    Minimum storage temperature: $-20^{O}C$ ($-5^{O}F$).

12. ***Vaporizer outputs are sensitive to barometric pressure and a correction factor may be necessary when assessing the output using an analyser, for example at high altitude. Barometric pressure effect are not usually of clinical importance. (See user manual).***

WARNINGS AND CAUTIONS

13. Anaesthetic drugs must be treated as a pharmaceutical product. Liquid should never be drained from a vaporizer into an open container and then reused. Contamination is likely.
Always dispose of such drained liquid as a hazardous chemical.

CAUTIONS

1. The instructions given in this manual assume that the service engineer has received adequate training in the practice of servicing anaesthetic apparatus and is familiar with the use of flowmeters, pressure gauges and other laboratory equipment.
Details of such procedures are therefore not included.

2. Each Sigma Delta vaporizer is a tested and calibrated unit. It is most important that components are not transferred from one unit to another.
In particular, the service engineer must accept responsibility for ensuring that agent specific items such as labelling, keyed fillers, and control needles are treated as critical devices and that full records of vaporizer servicing are kept.

Following any service procedure, a label to indicate to clinical staff that the vaporizer has been serviced must be attached to each unit.

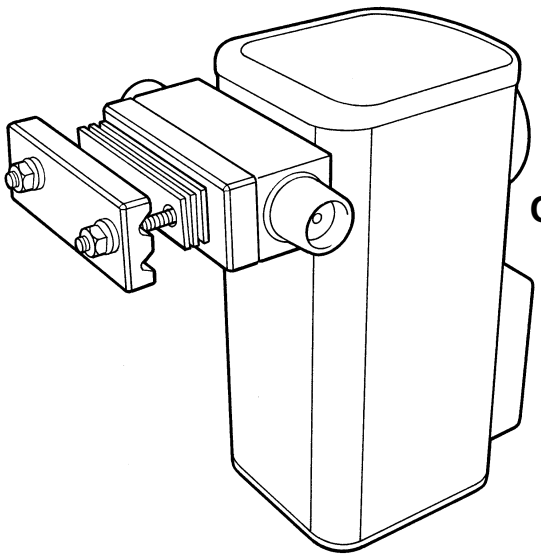
2. PURPOSE

The Sigma Delta vaporizer is designed for incorporation in the fresh gas supply system of continuous flow anaesthetic machines, directly connected between the flowmeter unit and the common gas outlet of the machine.

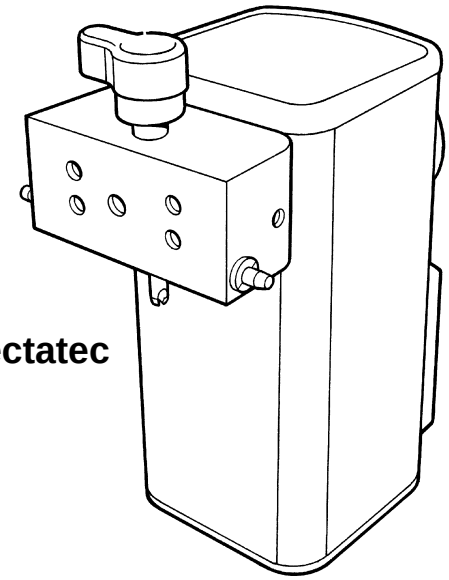
The vaporizer is unsuitable for use within a breathing system 'in circuit' because of the relatively high internal resistance.

Its purpose is the provision of accurate concentrations of anaesthetic drugs in the fresh gas supply, in accordance with the setting of the control dial, when the fresh gas supply flow is between 0.2 and 15 litres/min. Factors affecting output accuracy are listed in the user instruction manual (Section 7, Performance Characteristics), which shows the extent of modifications to the control calibration.

Delta Vaporizer
Connector Block Types

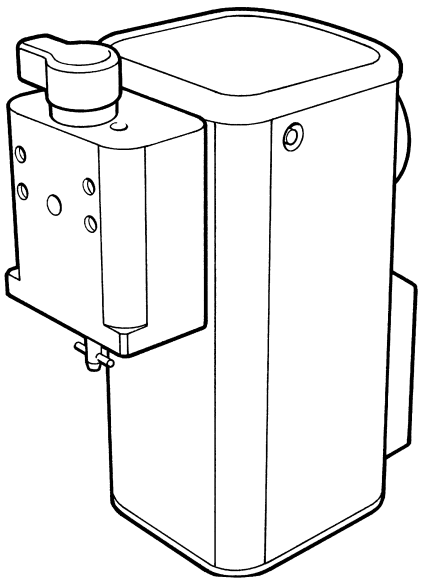


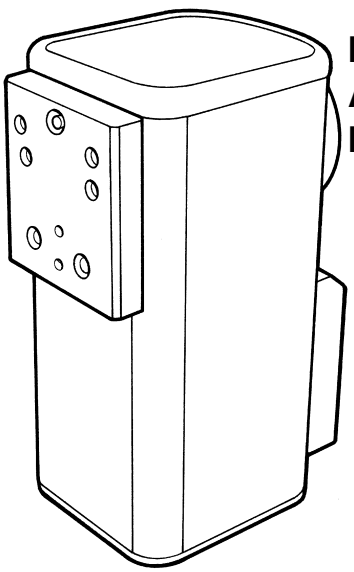
Cagemount



Selectatec

Drager





North American Drager

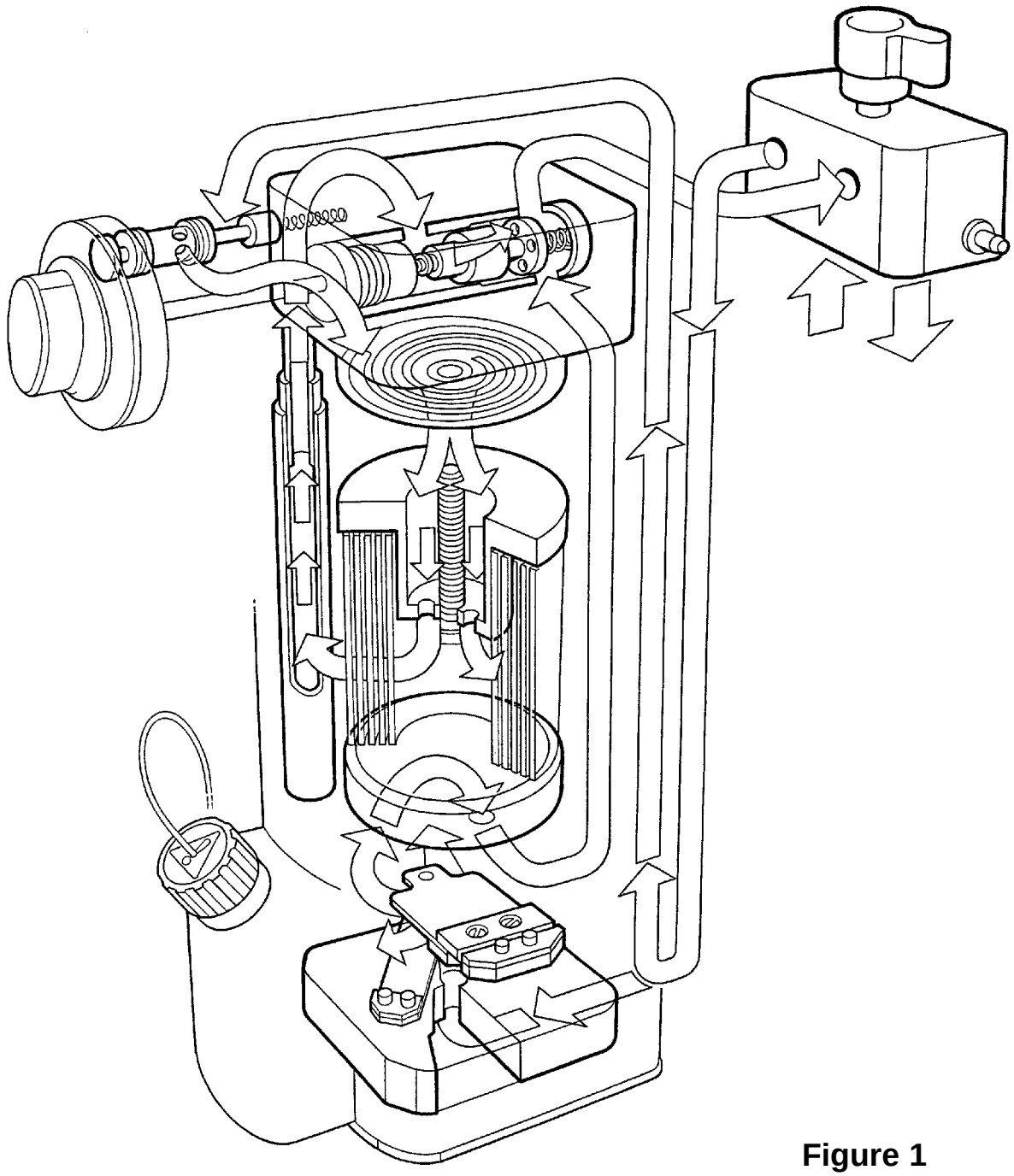


Figure 1
Gas Flow Path

3. DESCRIPTION

3.1 General Description

The Delta User Manual provides additional information on the operation of the vaporizer. The service engineer should have a copy for reference, in addition to this service manual.

Introduction

The Sigma Delta vaporizer enables the anaesthetist to add a predetermined amount of vapour of a volatile drug to the fresh gas stream supplied to the patient's breathing system.

All anaesthetic agents of a volatile nature have relatively high vapour pressures at normal room temperature so that this saturated vapour must be diluted considerably to produce the concentrations required clinically.

Gas Flow Path

Figures 1 and 2 show that the vaporizer contains two paths for gas flow. One is always open, through the bypass system. The second, which is open only when the control knob is moved from zero, is routed via the closing mechanism vapour chamber, and, vapour control orifice, and joins up with the bypass flow in a mixing chamber, and then on to the vaporizer outlet.

Vapour Chamber

The vapour chamber contains the liquid anaesthetic drug, and is filled through the filler unit to a level shown on the level indicator. The chamber contains a spiral wick assembly.

Gas which enters the chamber has to pass through the narrow passages between the wicks, becoming saturated with vapour before emerging through the vapour control orifice.

The proportion of the total flow which passes through the vapour chamber is determined by the relative resistances of the bypass orifice (which does not vary with control knob setting, but does vary with temperature) and the vapour control orifice (which varies only with control knob setting).

Compensation for total flow variation is achieved by the design of the orifice elements which are precision parts.

Temperature Compensation

Compensation for temperature variation (and therefore changes in vapour pressure, viscosity etc.) is achieved by the movement of a bypass control plate (in the form of a bimetallic strip) against the bypass orifice, thus changing the area of the orifice. This device is mounted within the vapour chamber so that it is exposed to both gas and liquid temperatures within the vaporizer.

Back-pressure Compensation

Compensation for fluctuating back-pressure on the vaporizer, as produced by the use of IPPV in the breathing system, is provided by:

A) the inclusion of a long gas flow path prior to the closing mechanism system, and

B) a spiral passage after the closing mechanism,

which prevents reverse flow of vapour from the chamber into the bypass gas flow.

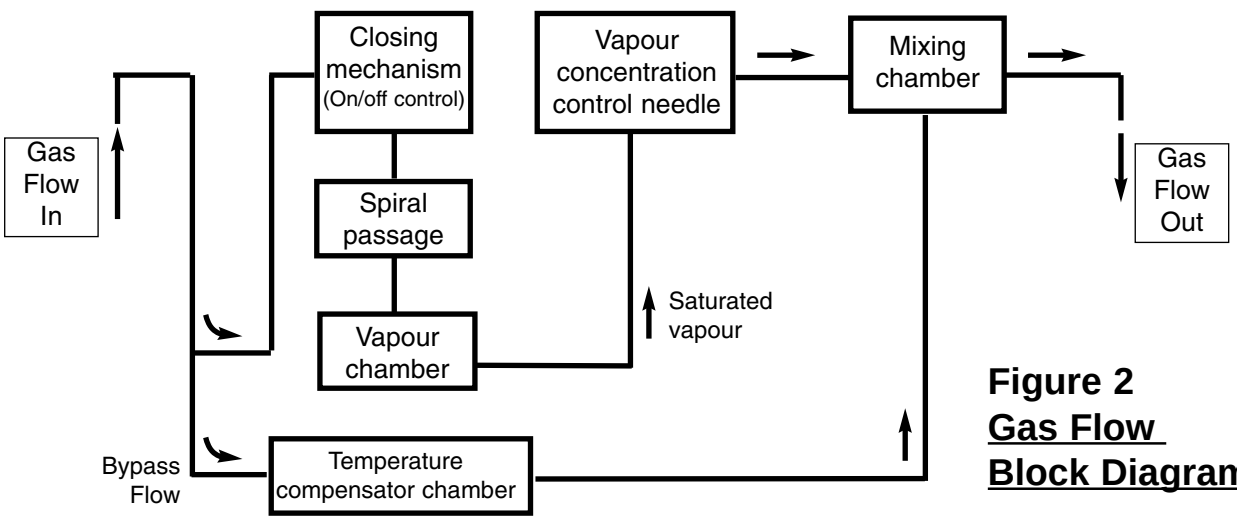
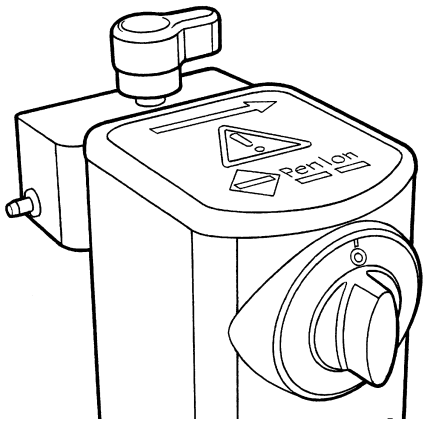


Figure 2
Gas Flow Block Diagram

DESCRIPTION

3.2 Concentration Control and Cut-off Mechanism



3.2.1 Control Knob Assembly

The laser engraved dial is etched to match the performance characteristics of the components of the individual vaporizer using its allotted agent.
A self-adhesive label, colour coded for the agent to be used with the vaporizer, is fixed to the knob.

3.2.2 Dial Stop Plate Assembly and Vapour Control Valve

When the control knob is pushed in, the dial drive plate disengages from the zero position dial stop (which prevents knob rotation in the zero (off) position), and opens the closing mechanism by pushing on the shaft assembly (see 3.2.4).

The stop plate is now disengaged from the dial stop and it is free to turn anti-clockwise. A drive screw produces movement of the vapour control needle valve within the needle housing, altering the size of the orifice available for the passage of vapour.

3.2.3 Dial Stops

The dial stop (zero position) prevents rotation of the knob assembly in the zero position.

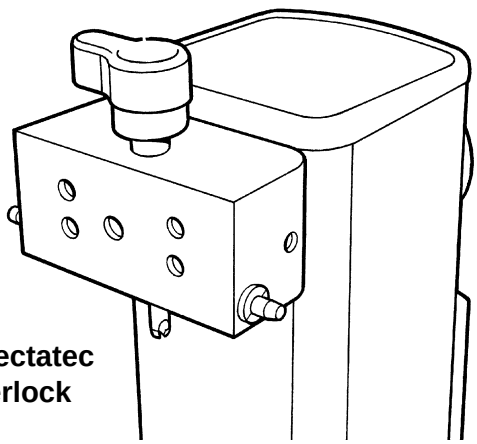
3.2.4 Cut-off Mechanism

When the control knob assembly is in the zero position, the spring-loaded cut-off valve is closed. This prevents gas flowing into the vapour chamber.

When the control knob assembly is pushed in, the closing mechanism shaft pushes a spring loaded seal off its seat on a spool assembly. Gas is then able to flow into the vapour chamber.

3.2.5 Interlock Mechanism

With two or three interlocked vaporizers on the anaesthetic machine back bar, initial operation of the concentration control dial, by pushing on, activates the interlock system. The interlock push rods move outwards, ensuring that only that vaporizer can be in use at any time.
The interlock deactivates as soon as the control dial is returned to the zero position.



Selectatec Interlock

DESCRIPTION

3.3 Temperature Compensator (TC)

This device alters the resistance to the flow of gas passing through a bypass valve.
The temperature sensitive element comprises a bimetallic assembly that expands/contracts with increase/decrease in temperature, causing the bypass plate to move away from, or towards the TC base.

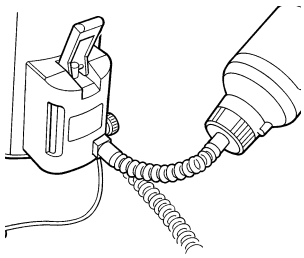
At low temperature the bypass resistance is increased, forcing more gas through the vapour chamber to compensate for the lower vapour pressure of the liquid. At high temperatures the reverse is effected.

3.4 Wick Assembly

The large wick assembly consists of a long strip of wick material attached to a metal backing strip, and rolled into a spiral. This forms a single unit cartridge assembly for ease of replacement.

DESCRIPTION

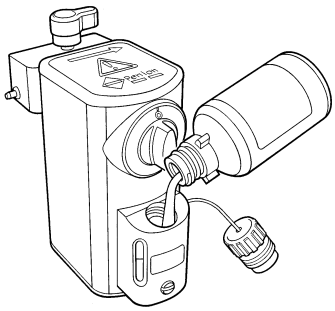
3.5 Filler Systems and Agent Level Indicator



3.5.1 Agent Specific (Keyed) Filler

This unit is designed to be used with a bottle adaptor only - refer to the vaporizer user manual.

Bottle adaptors for each agent type are available - see section 10, in the user instruction manual.



3.5.2 Screw Cap Pour Filler

This unit has a screw-plug, sealed filler opening.

3.5.3 Quik-Fil Filler

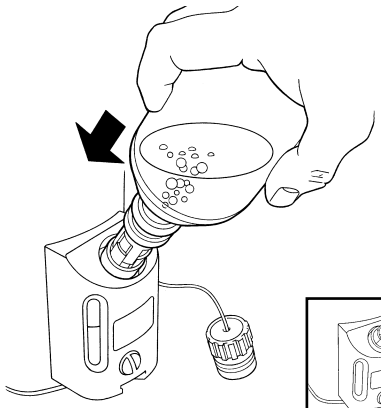
This unit is designed to be used with an agent-specific nozzle, permanently attached to the agent bottle.

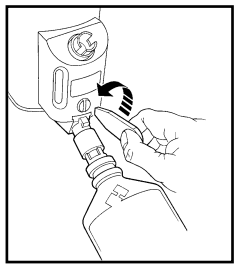
When the nozzle is inserted into the filler block, a valve opens inside the filler block.

When the nozzle is pressed further into the filler block, a valve in the nozzle opens and agent flows into the vaporizer.

The filler block utilises an air lock which automatically stops the filling process at the maximum fill position.

The vaporizer is drained through a separate valve in the base of the filler block.





3.5.4 Agent Level Indicator

The level indicator is a glass tube with maximum and minimum fill level marks printed on the glass.

Provided the vaporizer is upright, with the control knob set at zero, the chamber cannot be overfilled as the design of the air escape ports facilitates air trapping at the maximum safe level.

On agent specific (keyed) filler models, an overfill hole drains excess agent from the filler system.

On screw cap filler models, a drain hole is included in the side of the filler block to drain the filler funnel level should excess agent be tipped into the filler block during filling.

4. SPECIFICATION

4.1 Physical Dimensions

	Width	*Height*	*Depth*
Cagemount	133	219	158
Selectatec Compatible with Interlock	120	242	190
Drager 'plug in' Compatible	100	242	190

Dimensions given above are in millimetres

NOTE
The figures for Depth relate to Key Filler (Agent Specific) and Quik Fil models.
To calculate the depth dimension for Screw Cap Filler models, subtract 11 mm from the figures given above.

4.2 Weight

Approximate weight: 4.8 kg.

4.3 Capacity

Volume at MAX mark 250 ml (nominal)

Volume at MIN mark 35 ml (nominal)

NOTE After draining, approximately 60 ± 10 ml of liquid is retained by the wick.

4.4 Filling System

Key Filler (Agent Specific)- Use with corresponding agent specific filler adaptor, see section 10 (USER Manual), Ordering Information.

Pour Fill (Screw Cap)

Quik Fil - Sevoflurane only -
Use with corresponding agent specific bottle.

4.5 Control Dial Scale

The control dial is marked as follows:

From 0 to 2% vol, by intervals of 0.2% vol

From 2% to maximum, by intervals of 0.5% vol

The control dial is marked '0' at zero

4.6 Patents

The Sigma Delta is protected by UK and foreign patents.

4.7 Temperature Range

Operating Temperature Range 15 to 35^{O}C (58 to 95^{O}F)

Storage Temperature Range -20 to 50^{O}C (-5 to 122^{O}F)

Storage in Transit (up to 7 days) -40 to 60^{O}C (-40 to 149^{O}F)

4.8 Flow Range

Operating Flow Range: 0.2 to 15 litres/min.

See section 7.4.1 (User Manual) for output accuracies at extreme conditions.

4.9 Pressure Range

Operating Pressure Range 0 to 5 kPa (0 to 0.7 psi)

Maximum Manifold Pressure 38 kPa (5.5 psi)

Maximum Test Pressure 38 kPa (5.5 psi)

5. SERVICE PROCEDURES

5.1 Service Policy

The Sigma Delta must only be serviced at an authorised service centre or by Penlon-trained technicians in accordance with the following procedure.

(a) The calibration should be checked periodically under controlled conditions and a leak test performed.
Detailed information on the use of the Riken Analyser is given in the following pages.
Record the measured values in section 11 in the vaporizer user manual.

(b) Successive sets of figures should be compared to determine if performance is deteriorating.
Should deterioration be detected, a service should be carried out to restore normal operation.

(c) A major overhaul must be performed every ten years (Halothane models - 5 years) to maintain performance within the specification.

(d) The Selectatec compatible vaporizer locking system should be inspected during the vaporizer calibration test, and if damage to the locking shaft is suspected, the device must be referred to a Penlon certified engineer.

(e) Interlock system vaporizers -
function test the interlock system during the vaporizer calibration test.

(d) Quik-Fil system - at regular intervals (3 monthly minimum, 6 monthly maximum), filling and draining must be checked under controlled conditions

NOTE
The user must accept responsibility for any malfunction which results from non-compliance with the above requirements.

Returning the Vaporizer for Service / Repair

The vaporizer must be drained and allowed to dry out before packing.
Always use the original packaging, to prevent damage during transit.

SERVICE PROCEDURES

Checking Vaporizer Output

Calibration Procedure using the Riken Analyser

The Riken Model 1F-18 is normally calibrated by the manufacturer for measuring up to 8% vol. Halothane or up to 9% vol. Sevoflurane, either in air or in oxygen.
Service checks on the vaporizer must be performed with oxygen if the vaporizer is checked on an anaesthetic machine.
Use air or oxygen if the vaporizer is checked in a test laboratory.

CAUTION
A) It is essential that the gas used during service checks is recorded,
B) The reference cell of the Riken must be purged with the appropriate gas before measurements are made.

Agents

The Riken gas analyser measures the refractive index of the gases and vapours and, although normally calibrated for measuring halothane, the instrument can also measure other vapours if an appropriate correction factor is applied.
To obtain the true concentration of gases other than halothane multiply the reading shown on the Riken by the correction factors given below.

Carrier Gas

The refractive index of oxygen is higher than that of air so that,
(a) the unit must be re-zeroed if the carrier gas is changed, and
(b) the scale must be adjusted by a correction factor, applied by multiplying the Riken scale reading to obtain the true concentration.

Correction Factors

Halothane in Air Riken:

	Factor (using air)	*Factor (using O_2)*
Halothane	1	1.06
Enflurane	1.05	1.11
Isoflurane	1.06	1.12
Sevoflurane	1.05	1.10

Halothane in Oxygen Riken:

	Factor (using air)	*Factor (using O_2)*
Halothane	0.95	1
Enflurane	0.99	1.05
Isoflurane	1	1.06
Sevoflurane	0.99	1.05

Temperature and Barometric Pressure

Calibration checks must be performed at a temperature between 19 and 21^{O}C.
The correction factor is ± 1.5% of readings, which is negligible in view of the accuracy of the instrument.
Temperature correction is therefore not required, but the temperature should be measured and recorded to ensure that the test is carried out within the specified range.

Changes of barometric pressure due to weather are not normally of significance and can be ignored.

Altitude can, however, have significant effects and the following correction factors should be applied when appropriate.
The Riken reading multiplied by the stated correction factor gives the true concentration corrected to Standard Temperature and Pressure (STP).

Altitude	*Factor*	*Barometric pressure (for reference)*
600 m (2000 ft)	0.9	910 mb
1200 m (4000 ft)	0.85	850 mb
1800 m (6000 ft)	0.8	813 mb

Method of reading the Riken Analyser

1. Readings may be taken from a tee-piece connected to the common gas outlet of the anaesthetic machine.
   An AGS system must be connected.
2. The sampling tube must be nylon or PTFE (which do not absorb vapours).
   Rubber sleeves may be used to make end connections but there must be minimal length of rubber exposed to the gases being sampled.
3. Sample by 2 or 3 squeezes of the hand bulb. Wait for fringe movement to cease before taking the reading.
4. After each resetting of the vapour control, time must be allowed for the output to stabilise.
   Suggested timescale:
   2 L/min flow - wait 4 minutes
   4 L/min flow - wait 2 minutes
   8 L/min flow - wait 1 minute
5. a) The vaporizer must be half full, and rigidly supported in its correct operating position.
   b) Temperatures must be stabilised for approximately 4 hours before checking
   c) The temperature must be in the range 19 to 21^{O}C.

SERVICE PROCEDURES

Sample of Service Record Page

(see section 11 in the Delta User Manual)

Test Period	1	2	3	4
Vaporizer serial number:				
Date:				
Signature: Print name:				
Carrier Gas				
Leak Test (at 200 mmHg for minimum 60 secs) *Pressure must not drop below 180 mm Hg*				
Set ***Tolerance*** 0.0 0 - 0.1 0.2 0.14 - 0.26 0.6 0.45 - 0.75 1.0 0.8 - 1.2 3.0 2.4 - 3.6 *4.0 3.2 - 4.8 5.0 4.0 - 6.0 **7.0 5.6 - 8.4 **8.0 6.4 - 9.6 **7.0 5.6 - 8.4 5.0 4.0 - 6.0 3.0 2.4 - 3.6 1.0 0.8 - 1.2 0.6 0.45 - 0.75 0.2 0.14 - 0.26 0.0 0 - 0.1 * 4% Halothane vaporizer only ** 7% and 8% vaporizers only				
Bypass resistance at 4 L/min				

SERVICE PROCEDURES

5.2 Workplace and Equipment

NOTE
For complete safety when servicing this device, full reference must be made to the WARNINGS and CAUTIONS listed in section 1.

WARNING
Adequate ventilation of the work area must be provided. During calibration procedures, connect the outlet of the vaporizer to an anaesthetic gas scavenging system that conforms to your national standards or regulations.

Environment - servicing must be carried out in a stable temperature environment, preferably with thermostatic control or air conditioning, to maintain the temperature within 22°C ±1°C.
Gas Supply - flow check for bypass resistance measurement must be carried out using air. Calibration after servicing must be carried out using oxygen.
Small tools - as listed throughout the service procedures listed in this manual, and in the following pages.
Gauges, etc. - as listed in the following pages.
Test Rigs - layouts and components are listed in the following pages.

5.2.1 Standard Equipment

Pressure regulator 0 - 400 kPa (0 - 60 psig)
Pressure gauge 0 - 400 kPa (0 - 60 psig)
Pressure gauge 0 - 40 kPa (0 - 3000 mmHg)
Pressure gauge or
water column 0 - 10 kPa (0 - 100 cm H_2O)
Flow meter unit 0 - 10 L/min
Pressure isolating valve
Leak detection fluid
Torque driver 0 - 10 Nm

Gas analyser - The preferred form of analysis apparatus is an interferometer.
However, if used carefully, the following instruments are also suitable for a calibration check:

Infrared analyser
Mass spectrometer
Molecular absorption meter

The selected analyser should have a sensitivity better than ± 0.1%.

5.2.2 Test connectors and equipment (available from Penlon)

Pressure gauge tee connector	53196
Flexible hose with cagemount female connector end	37019
Blanking plug with pressure gauge connector (Cagemount male)	37018
Nylon Catheter	52605
Exhaust tubing (22 mm diameter breathing hose)	57004

5.2.3 Special Purpose Service Tools and Equipment (available from Penlon)

Test Connection Block	410579
Sample Tee Connector	53196
Blanking Plug with Pressure Gauge Connector	37018
Needle Housing Locknut Tool	410644
Small Wick Assembly Tool	410659
Needle Bal Seal Tool	410660
Interlock Checking Tool	410582
TC Assembly Tool (includes Bi-metallic Strip Assembly Tool)	410647
TC Hinge Assembly Tool	410694
Dial Stop Setting Tool	410695
Closing Mechanism Removal Tool	410650
Interlock Bush Tool	408889
Needle Setting Tool	410602
NAD Interlock Tool	410772

5.2.4 Test Apparatus

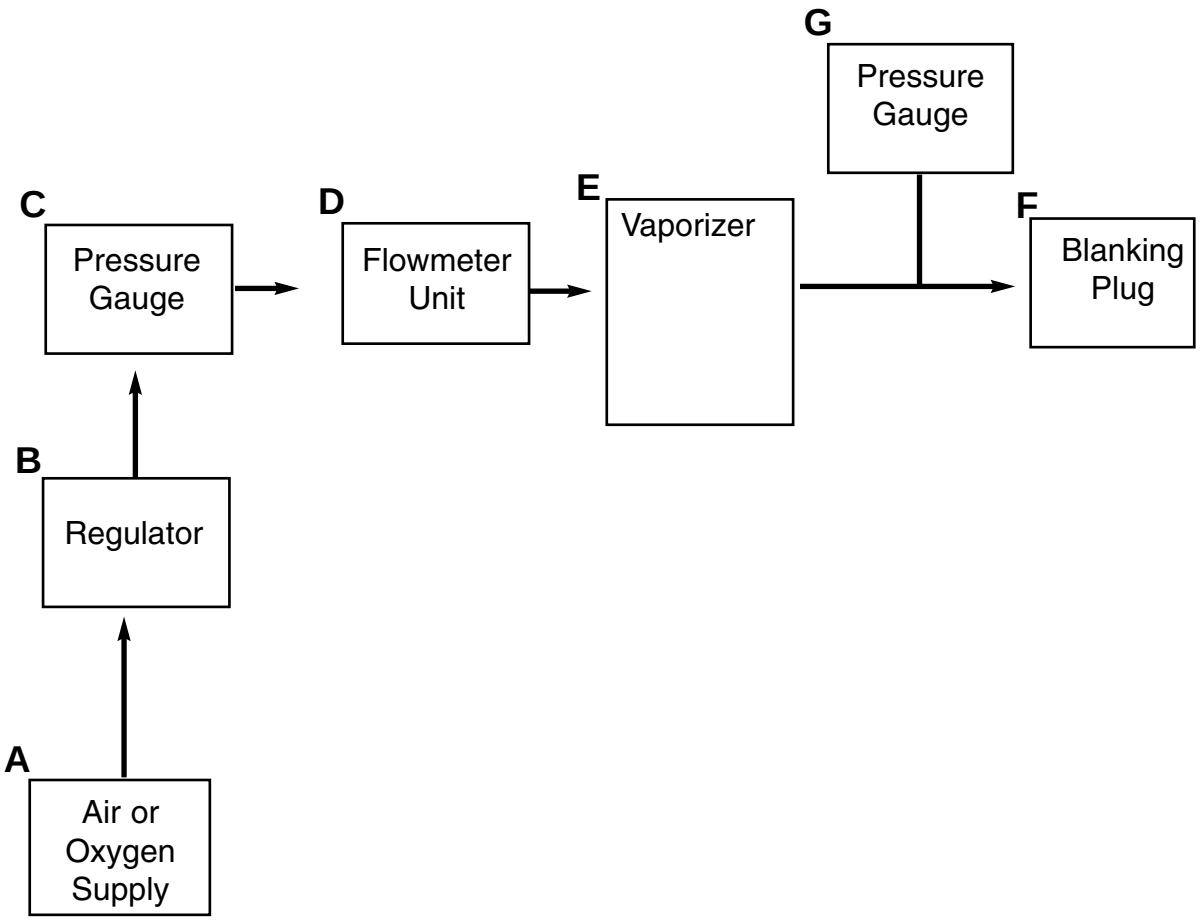
Leak Test
- 5.2.4.1 (Test Apparatus A)

Flow Check for Bypass Resistance Measurement
- 5.2.4.2 (Test Apparatus B)

Calibration Check
- 5.2.4.3 (Test Apparatus B adapted for calibration)

A schematic layout for each apparatus is given in the following pages.

SERVICE PROCEDURES

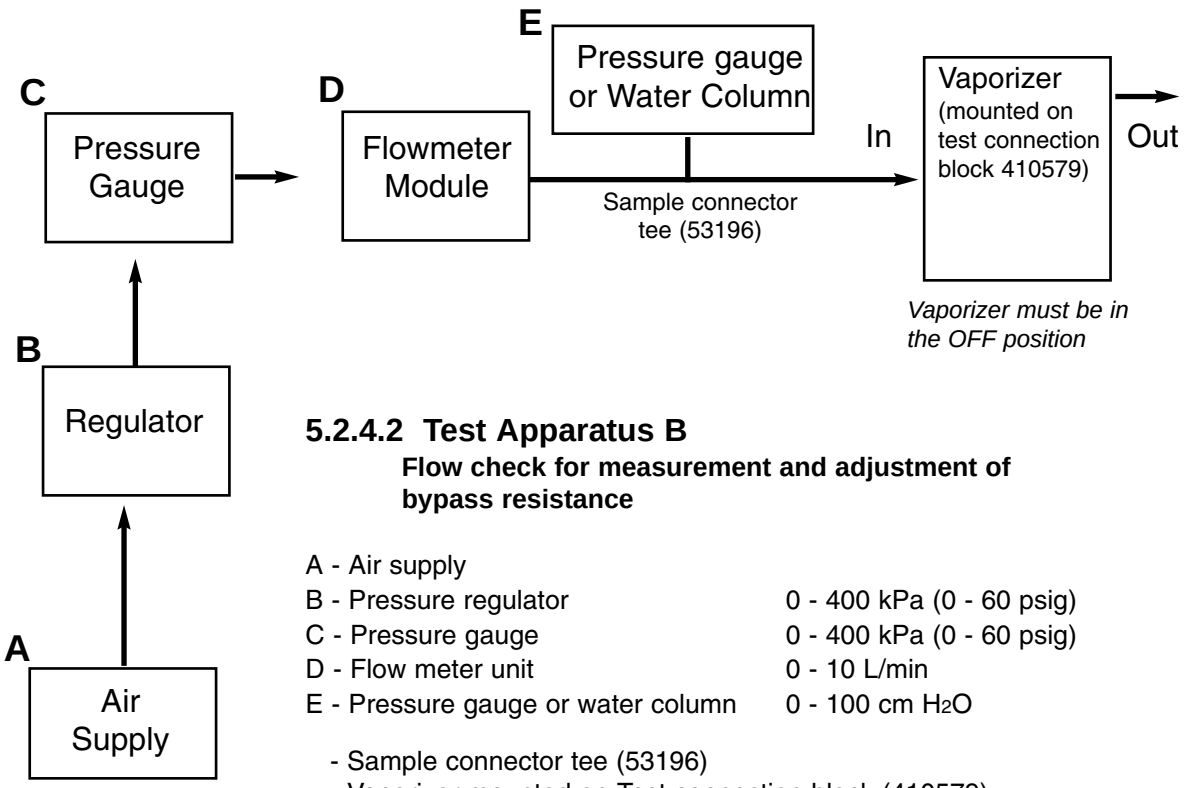


5.2.4.1 Test apparatus A

For leak testing

A	- Air or Oxygen supply	
B	- Pressure regulator	0 - 400 kPa (0 - 60 psig)
C	- Pressure gauge	0 - 400 kPa (0 - 60 psig)
D	- Flowmeter unit	0 - 10 L/min
E	- Vaporizer on Test connection block (410579)	
F	- Blanking plug with pressure gauge connector (cagemount male) (37018)	
G	- Pressure Gauge	0 - 40 kPa (0 - 300 mmHg)

SERVICE PROCEDURES



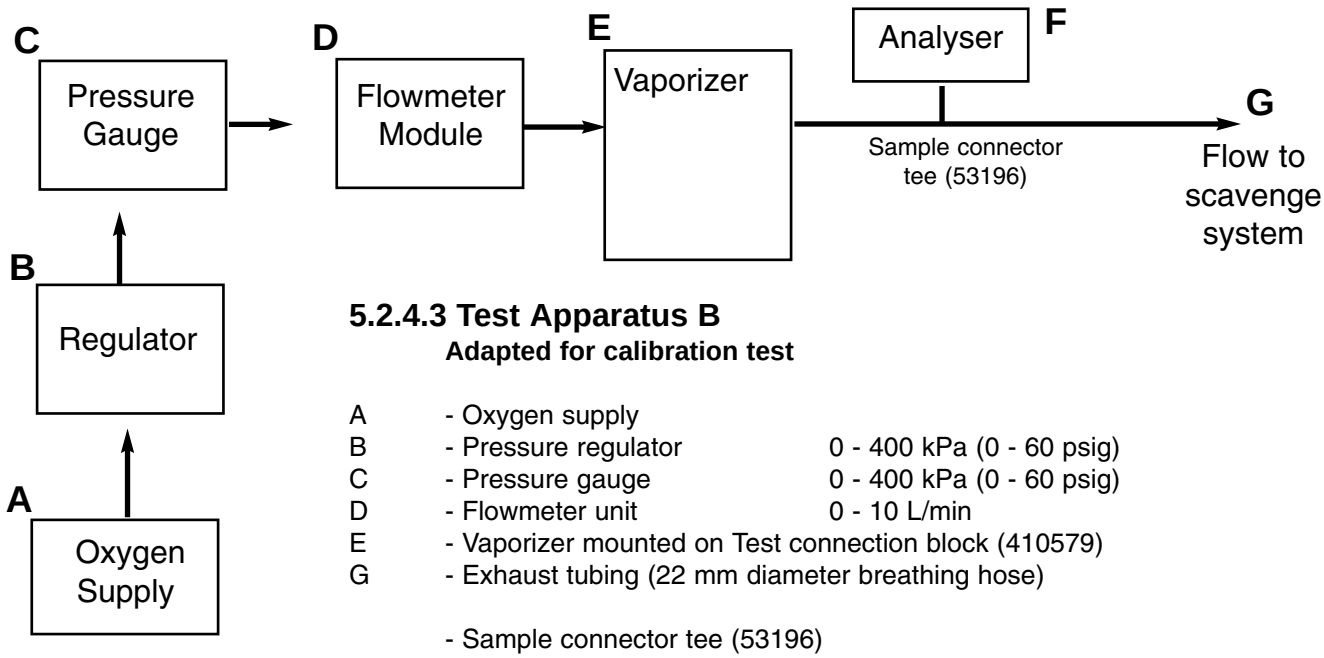
5.2.4.2 Test Apparatus B

Flow check for measurement and adjustment of bypass resistance

A - Air supply
B - Pressure regulator 0 - 400 kPa (0 - 60 psig)
C - Pressure gauge 0 - 400 kPa (0 - 60 psig)
D - Flow meter unit 0 - 10 L/min
E - Pressure gauge or water column 0 - 100 cm H_2O

- Sample connector tee (53196)
- Vaporizer mounted on Test connection block (410579)

NOTE While the bypass resistance is being measured, nothing must be attached to the outlet of the vaporizer.



5.2.4.3 Test Apparatus B

Adapted for calibration test

A - Oxygen supply
B - Pressure regulator 0 - 400 kPa (0 - 60 psig)
C - Pressure gauge 0 - 400 kPa (0 - 60 psig)
D - Flowmeter unit 0 - 10 L/min
E - Vaporizer mounted on Test connection block (410579)
G - Exhaust tubing (22 mm diameter breathing hose)

- Sample connector tee (53196)

SERVICE PROCEDURES

5.3 Pre-Service Checks

5.3.1 Leak Test and Bypass Resistance Measurement (Before servicing)

NOTE:
Anaesthetic gas scavenging equipment must be connected during these tests.

1. Drain the vaporizer and discard the contents - see section 5 in the vaporizer user Manual.
   Do NOT reuse the anaesthetic agent.
   Close the filler system.

2. Check for leaks from the vaporizer:
   Use Test Apparatus A (5.2.4.1),and set a pressure of 200 mmHg.
   Measure, and record the pressure drop after a minimum of 60 seconds.

3. Measure the Bypass Resistance:
   Allow 4 hours for temperature stabilisation.
   Use Test Apparatus B (5.2.4.2) to measure, and record the vaporizer Bypass Resistance, using a flow of Air at 4 L/min.

SERVICE PROCEDURES

5.3.2 Fault Finding (Before servicing)

Fault	Possible Cause	Treatment	Reference
1. Low or zero output at all settings	(a) Insufficient liquid in chamber	(a) Refill / check level indicator	User Manual
	(b) Leak to atmosphere from	(b) Service	5.4
	(c) Cut-off mechanism not operating	(c) Check operation of closing mechanism shaft	5.4
	(d) Incorrect needle setting	(d) Service	5.4
	(e) Bypass resistance out of adjustment	(e) Adjust	5.4
	(f) Wrong agent	(f) Drain and dry	User Manual
	WARNING ***If Halothane has been used in a non-Halothane vaporizer, DO NOT USE that vaporizer until all traces of Halothane have been removed.*** ***To prevent the possibility of malignant hypothermia, the vaporizer must be completely disassembled.***		
	(g) Leaking sight glass seals	(g) Fit new seal	5.4 (complete service not necessary)
	(h) Damaged sealing counterbores on Selectatec block	(h) Fit new block	5.4
	(j) Worn or damaged claws on Selectatec block locking shaft	(j) Fit new locking shaft	5.4 (complete service not necessary)
2. Low output at high setting only	(a) Contaminated wick	(a) Renew wick as part of Service	5.4
	(b) Leaking wick sealing washer	(b) Renew wick as part of Service	5.4
3. Excessive variation in output, when the set value required is selected (i) clockwise, and then (ii) anti-clockwise.	(a) Worn, or broken vapour control needle valve spring	(a) Return unit to Penlon or authorised distributor/agent	
	(b) Jamming needle	(b) Service	5.4
	(c) Loose needle drive	(c) Service	5.4

SERVICE PROCEDURES

Fault	Possible Cause	Treatment	Reference
4. Zero not obtained	(a) Cut-off mechanism O-seals leaking	(a) Service	5.4
	(b) Leak between seal assembly and spool	(b) Service	5.4
	(c) Leaks through TC assembly	(c) Service	5.4
	(d) Worn needle or seat	(d) Service	5.4
	(e) Jamming needle	(b) Service	5.4
	(f) Incorrectly adjusted needle and seat	(b) Service	5.4
5. High output	(a) Bypass out of adjustment	(b) Service	5.4
	(b) Bypass control plate contamination	(b) Return unit to Penlon, or authorised distributor/agent	
	(c) Bypass exit port partially blocked	(b) Service	5.4
6. Agent leaking from base	(a) Leak between TC cover and chamber	(b) Service	5.4
7. Air leaking from base during test	(a) Leak between TC base and body	(b) Service	5.4
8. Air or vapour leak around valve block	(a) Leak between valve block and body	(b) Service	5.4

SERVICE PROCEDURES

5.4 Service Overhaul

5.4.1 General Information

If the vaporizer fails the calibration test a Service Overhaul must be carried out.

NOTE

A service overhaul must be carried out at a maximum 10 year interval even if performance appears satisfactory. This is a mandatory preventive maintenance requirement.

Preparation

The vaporizer must be removed from the anaesthetic machine for this service.
The vaporizer must be drained of anaesthetic agent and then dried - pass an air flow of 10 L/min through it with the control at maximum setting until all trace of vapour at the output port is eliminated.
Check using an agent analyser.

Bypass Resistance Measurement

Measure and record the bypass resistance before and after servicing - see 5.3.1.

Service Area

These procedures should be carried out in a laboratory room at a temperature
of 22°C ± 1°C, not varying by ± 1°C over the test period.
Approximately 1 metre of bench space is required.
A scavenge system for anaesthetic vaporizers should be in operation.
A supply compressed air, dry and clean, at 0.6 bar (8.7 psi) should be available.

O seal Lubrication

Lightly lubricate O-seals / O-rings with PTFE based, oxygen compatible, lubricant.
APPLY SPARINGLY.

5.4.2 Health and Safety

Cleaning - always comply with the local health and safety regulations when using solvents to clean components.
Loctite Superlube - use sparingly.
Prolonged skin contact may cause irritation.
Always follow the manufacturer's instructions when using this product.

SERVICE PROCEDURES

5.4.3 Service Overhaul Procedure

CAUTION

Before servicing, always drain the vaporizer - follow the instructions given in the User Manual. Do not invert the vaporizer until the wicks are removed.

Leak Test and Bypass Resistance

(See section 5.3.1)

Before dismantling the vaporizer:
a) Leak test the vaporizer.
b) Measure the bypass resistance.

Dismantling the vaporizer

Connector Block

1. Remove the four M4 cap-head screws (1) and the connector block (2).

2. Remove the O-seals (3) (connector block to valve block).

3. Remove the top label (4) and lid (5) (M6 countersunk screw).

Dial Assembly

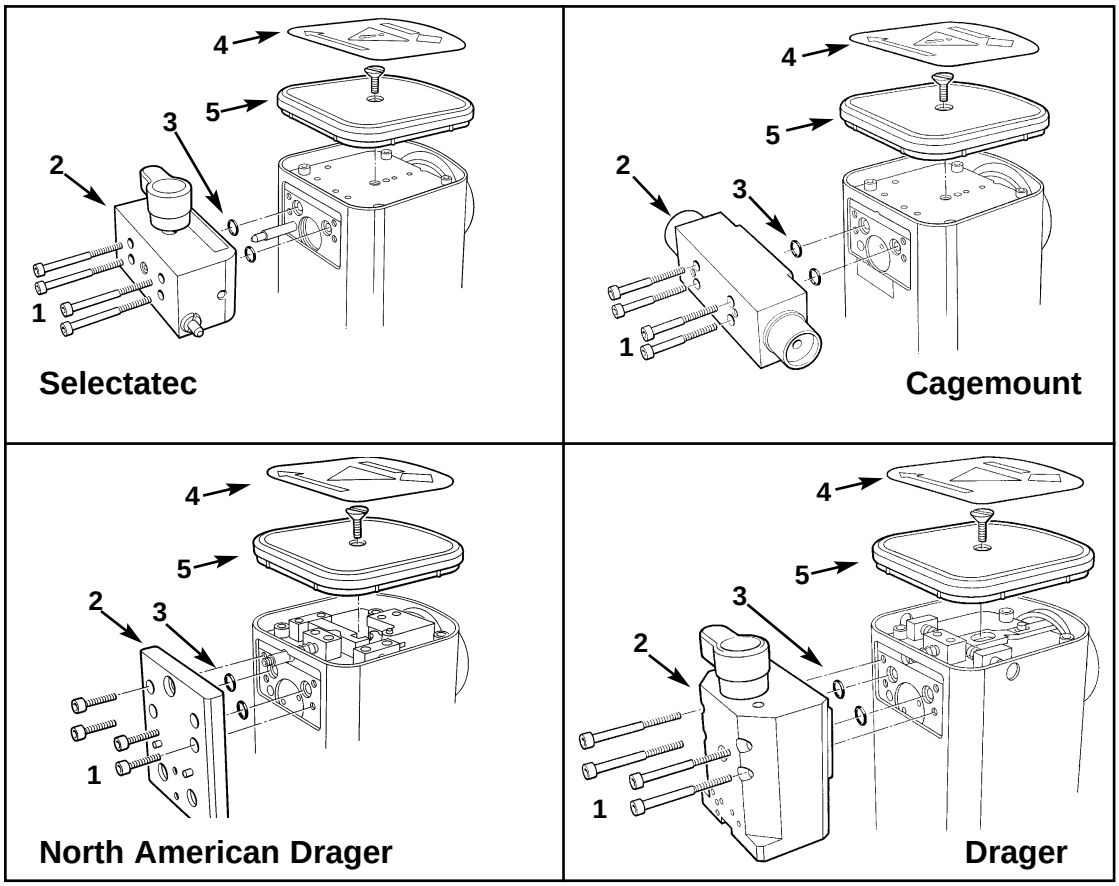
4. Remove the dial label (6), and discard.

5. Remove the two M3 cap head screws and dial assembly (7).

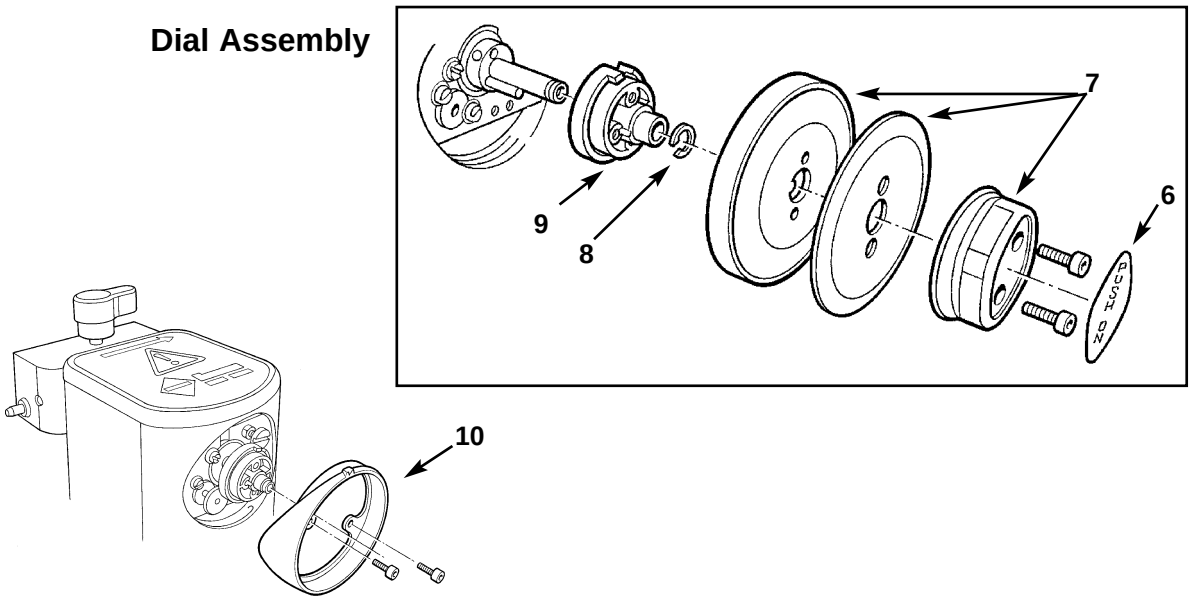
6. Remove the circlip (8) from the shaft, and remove the dial drive (9).

7. Remove the dial bezel (10) - two M3 cap-head screws.

Connector Blocks



Dial Assembly



SERVICE PROCEDURES

Interlock - Selectatec

8. Remove the interlock shaft (11) and spring (12).
   Note - on Cagemount, Drager and North American Drager models a dial return shaft (plus spring) is fitted.

Interlock - Drager and North American Drager

9. Remove the interlock system components (13).

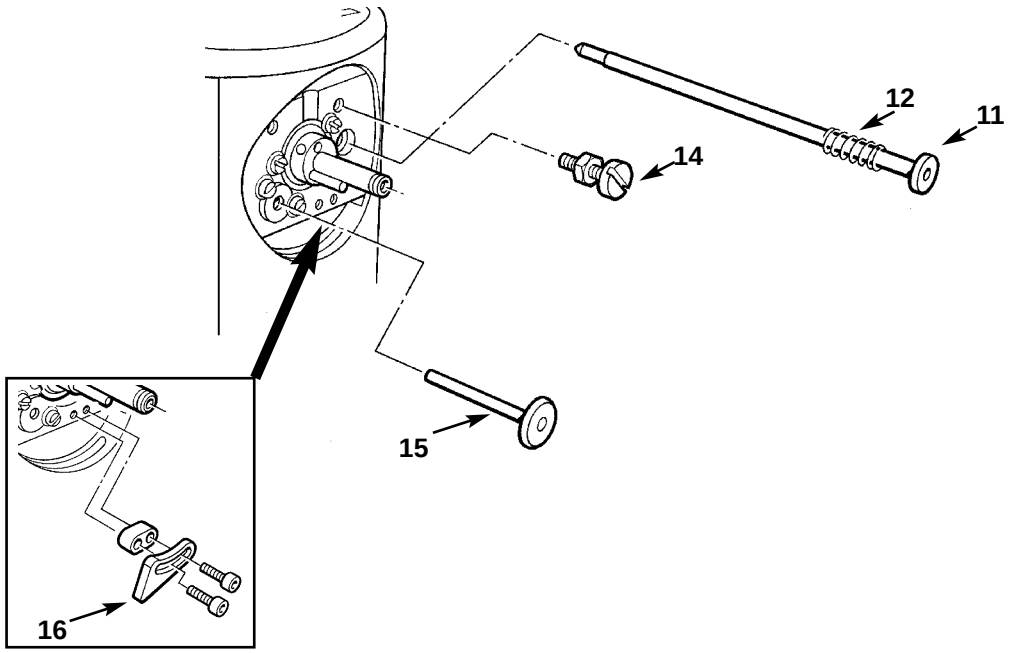
Dial Stops and Closing Mechanism Shaft - All models

10. Remove the dial ‘zero’ lock screw (14)

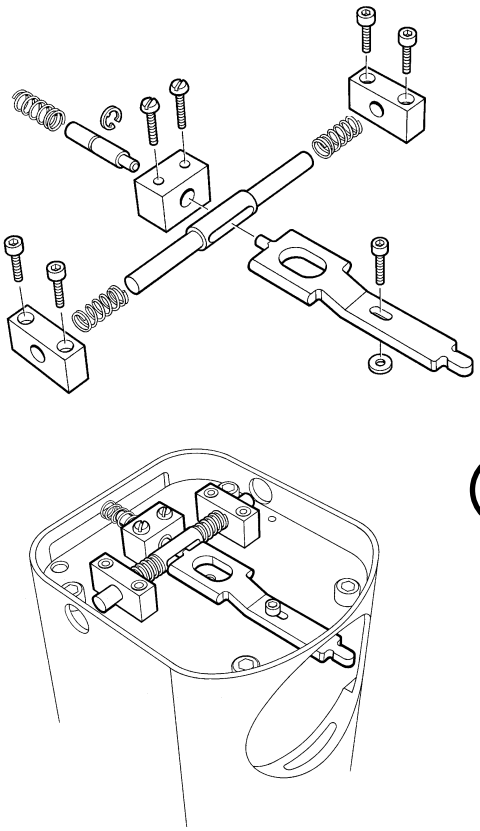
11. Remove the closing mechanism shaft (15).

12. Remove the dial ‘max’ stop (16).

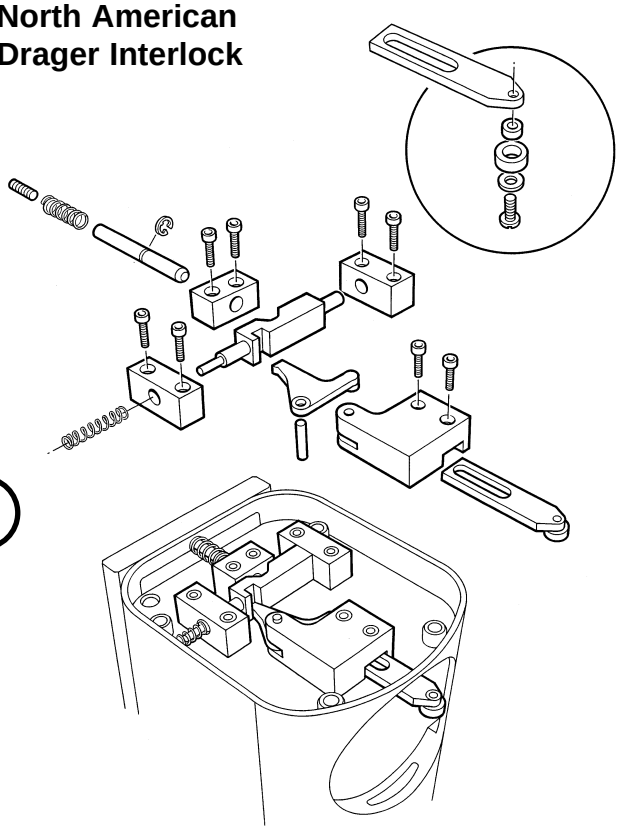
Selectatec Interlock Shaft, Dial Stops and Closing Mechanism Shaft



Drager Interlock



North American Drager Interlock



13

SERVICE PROCEDURES

13. **Needle drive assembly:**
Remove the two M3 pan-head screws and washers (1).
Unscrew the needle drive assembly (2)
Note: left-hand thread.

14. **Needle drive housing - Inspection**
Inspect the threads inside the housing (3).

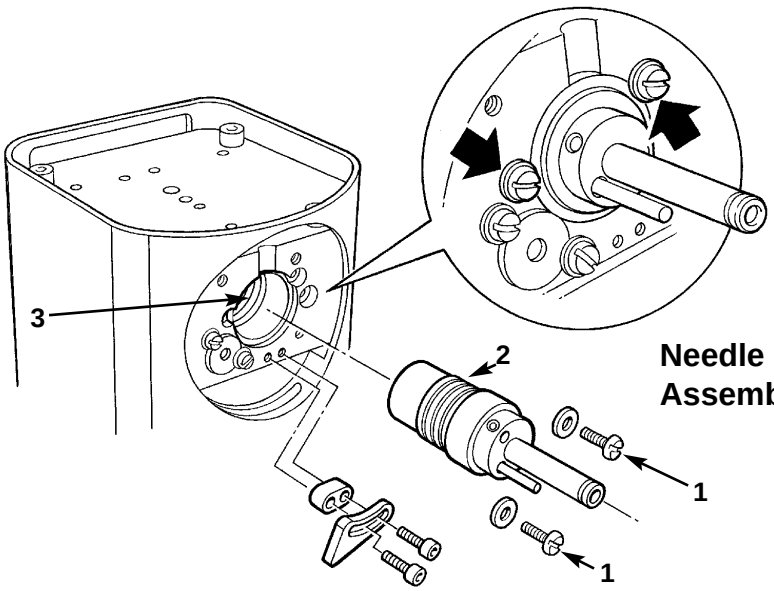
If the threads are worn or damaged, the housing <u>and</u> needle drive assembly must be replaced with new components.

Removing the housing:
a) Remove the M3 grub screw (4). The housing must be pushed out from the rear of the block. Note that the needle assembly must be removed to gain access to the housing (see operation 21, page 30).
b) Discard the housing.
c) Unscrew the setting screw from the needle drive assembly, and retain for fitment to the new drive.
d) Discard the needle drive.

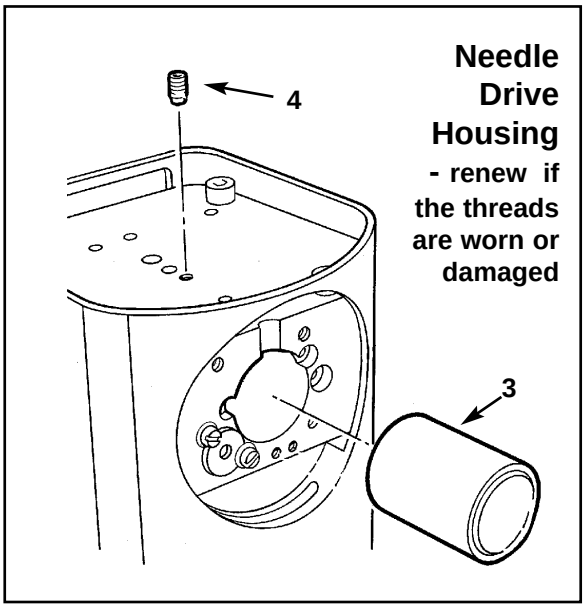
Refitting the housing - see page 54

If the housing threads are in good condition, continue with the standard overhaul procedure.

15. **Dismantling the needle drive assembly:**
Slacken the two M3 grub screws (5).
Insert a screwdriver blade into the assembly, and unscrew the setting screw (6).

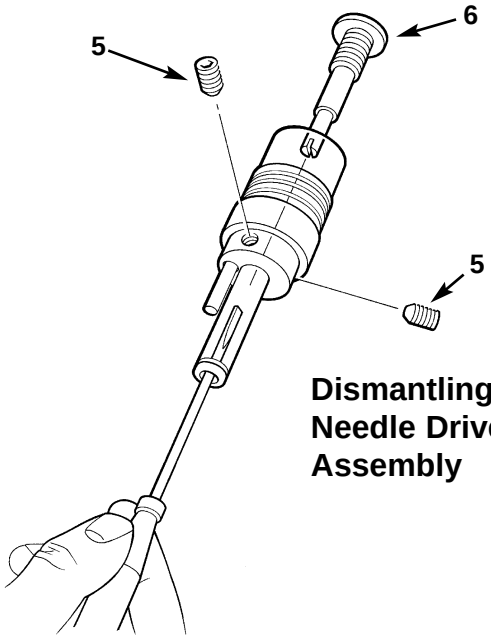


Needle Drive Assembly



Needle Drive Housing

- renew if the threads are worn or damaged



Dismantling the Needle Drive Assembly

Interlock - Selectatec

8. Remove the interlock shaft (11) and spring (12).
   Note - on Cagemount, Drager and North American Drager models a dial return shaft (plus spring) is fitted.

Interlock - Drager and North American Drager

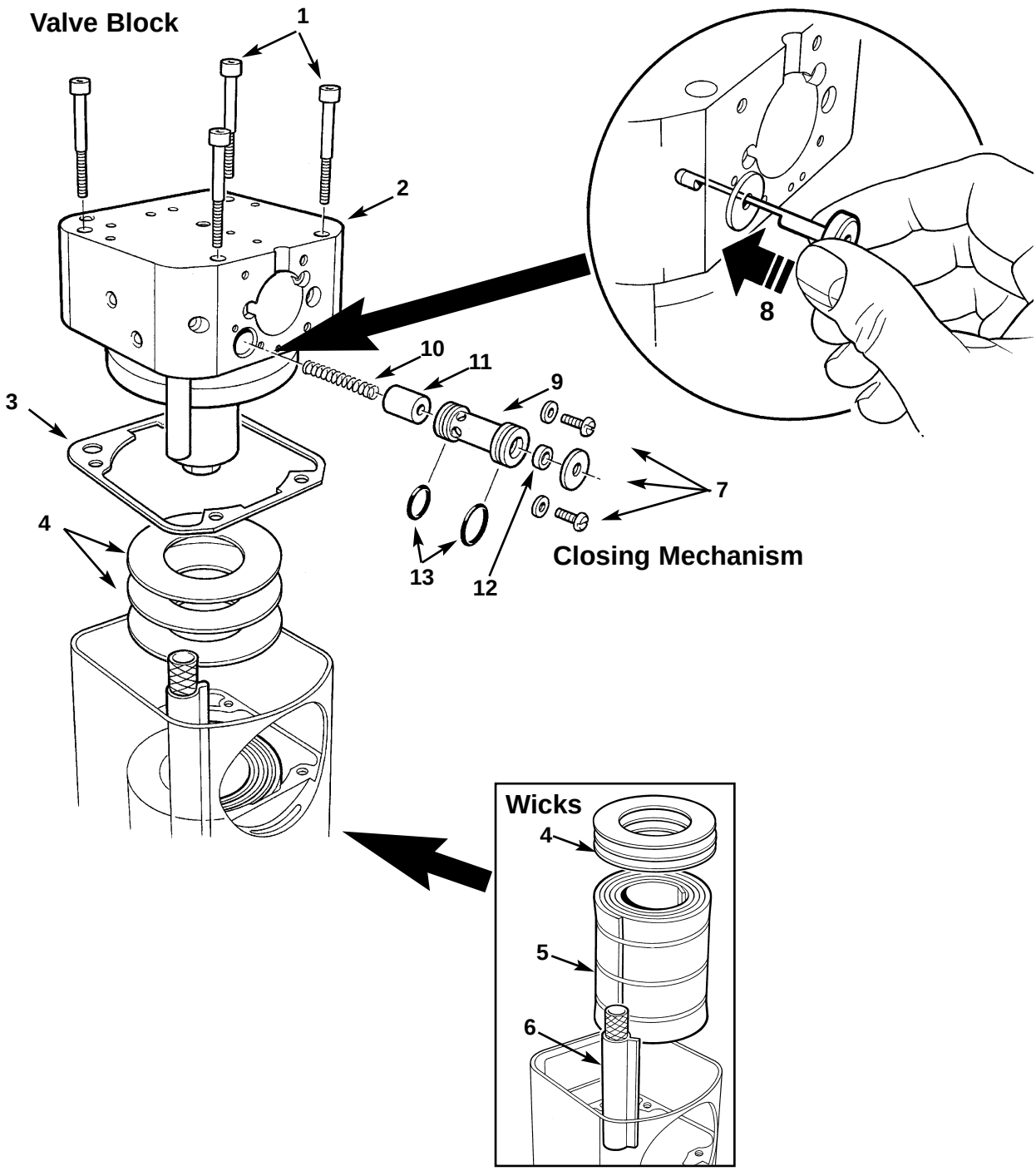
9. Remove the interlock system components (13).

Dial Stops and Closing Mechanism Shaft - All models

10. Remove the dial ‘zero’ lock screw (14)

11. Remove the closing mechanism shaft (15).

12. Remove the dial ‘max’ stop (16).


Valve Block
1
2
3
4
8
9
10
11
12
13
7
Closing Mechanism
Wicks
4
5
6

13. **Needle drive assembly:**
Remove the two M3 pan-head screws and washers (1).
Unscrew the needle drive assembly (2)
Note: left-hand thread.

14. **Needle drive housing - Inspection**
Inspect the threads inside the housing (3).

If the threads are worn or damaged, the housing <u>and</u> needle drive assembly must be replaced with new components.

Removing the housing:
a) Remove the M3 grub screw (4). The housing must be pushed out from the rear of the block.
Note that the needle assembly must be removed to gain access to the housing (see operation 21, page 30).
b) Discard the housing.
c) Unscrew the setting screw from the needle drive assembly, and retain for fitment to the new drive.
d) Discard the needle drive.

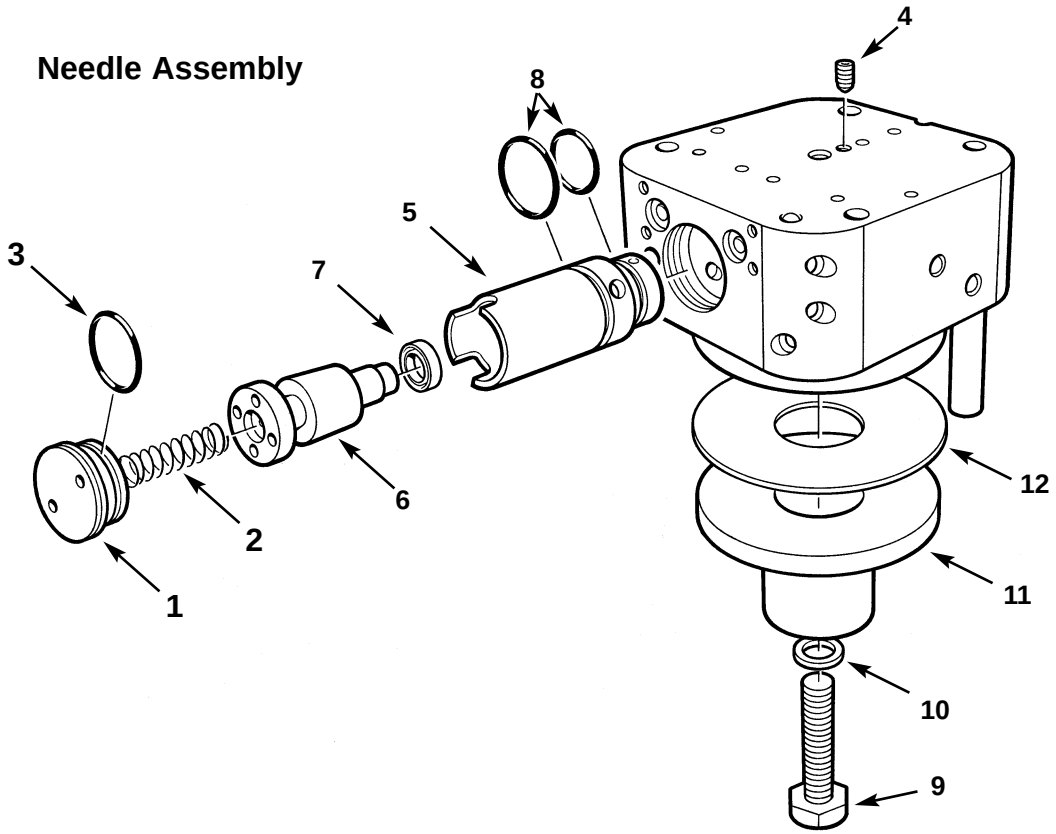
Refitting the housing - see page 54

If the housing threads are in good condition, continue with the standard overhaul procedure.

15. **Dismantling the needle drive assembly:**
Slacken the two M3 grub screws (5).
Insert a screwdriver blade into the assembly, and unscrew the setting screw (6).

16. **Valve Block and Wicks:**
Remove the four M6 cap-head screws (1) and lift the valve block (2) from the body.

Needle Assembly



SERVICE PROCEDURES

24. **Base Assembly and Cover**
Remove the anti-tamper label (1).
Remove the four M3 screws and bottom cover (2).

Remove the four countersunk screws, and remove the base assembly (3), and seal (4).

25. **Temperature Compensator (TC) Components:**
Remove the six screws (5), the cover (6), the seal (7), and the spring (8).
Discard the seal.

26. Remove the two screws (9), and plate (10).
Remove the two screws (11), and separate the remaining TC components:
TC plate (12),
Upper and lower small plates (13 / 14)
Hinge (15).

Note
The lower plate (14) and the TC plate (12) must be used together on the same vaporizer.

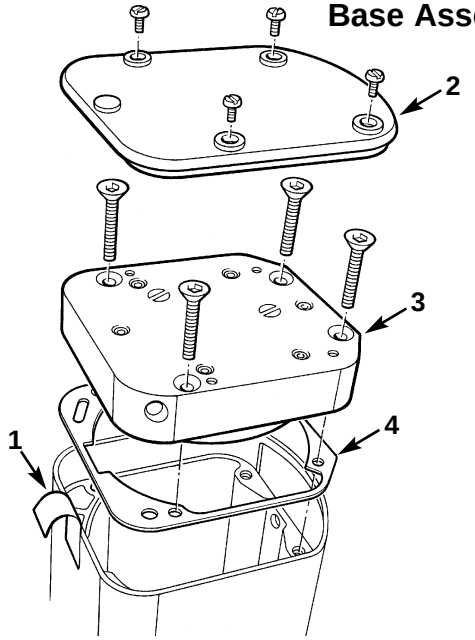
27. Remove the grub screw (16).

28. Remove the two screws (17), and the bi-metallic strip (18), and spacers (19).
Note orientation for correct refitment.

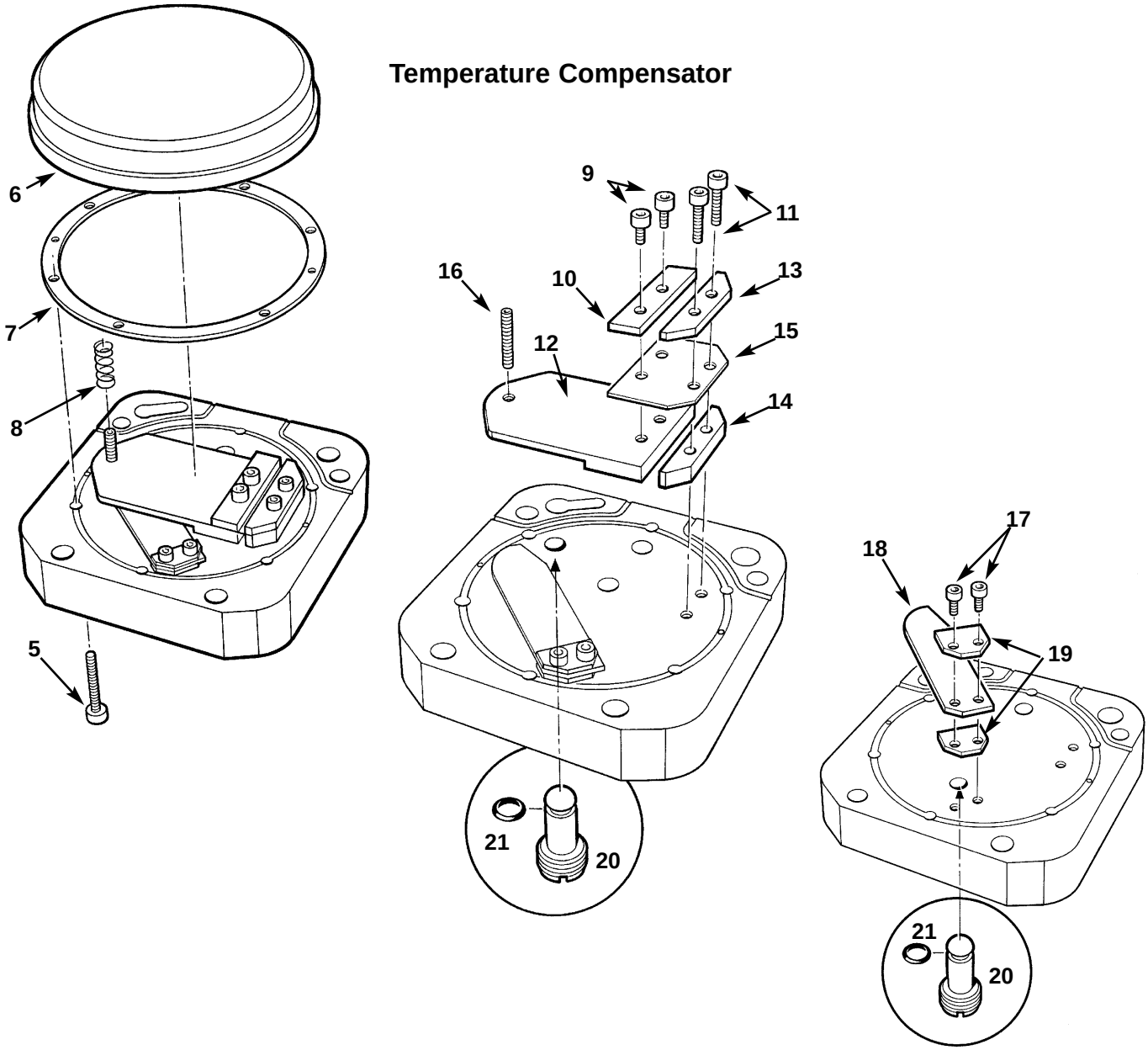
29. Invert the TC assembly and remove the bypass resistance adjusters (20).

30. Remove the O-seals (21) from the adjusters and discard.

Base Assembly



Temperature Compensator



SERVICE PROCEDURES

Filler Blocks

Quik-Fil Filler Block

Removal

CAUTION
Do not remove the filler block until the wicks are removed.

1. Remove the label (1).
2. Remove the two screws (2), and detach the filler block (3) from the vaporizer.
3. Remove the five O-seals (4), and discard.

Dismantling

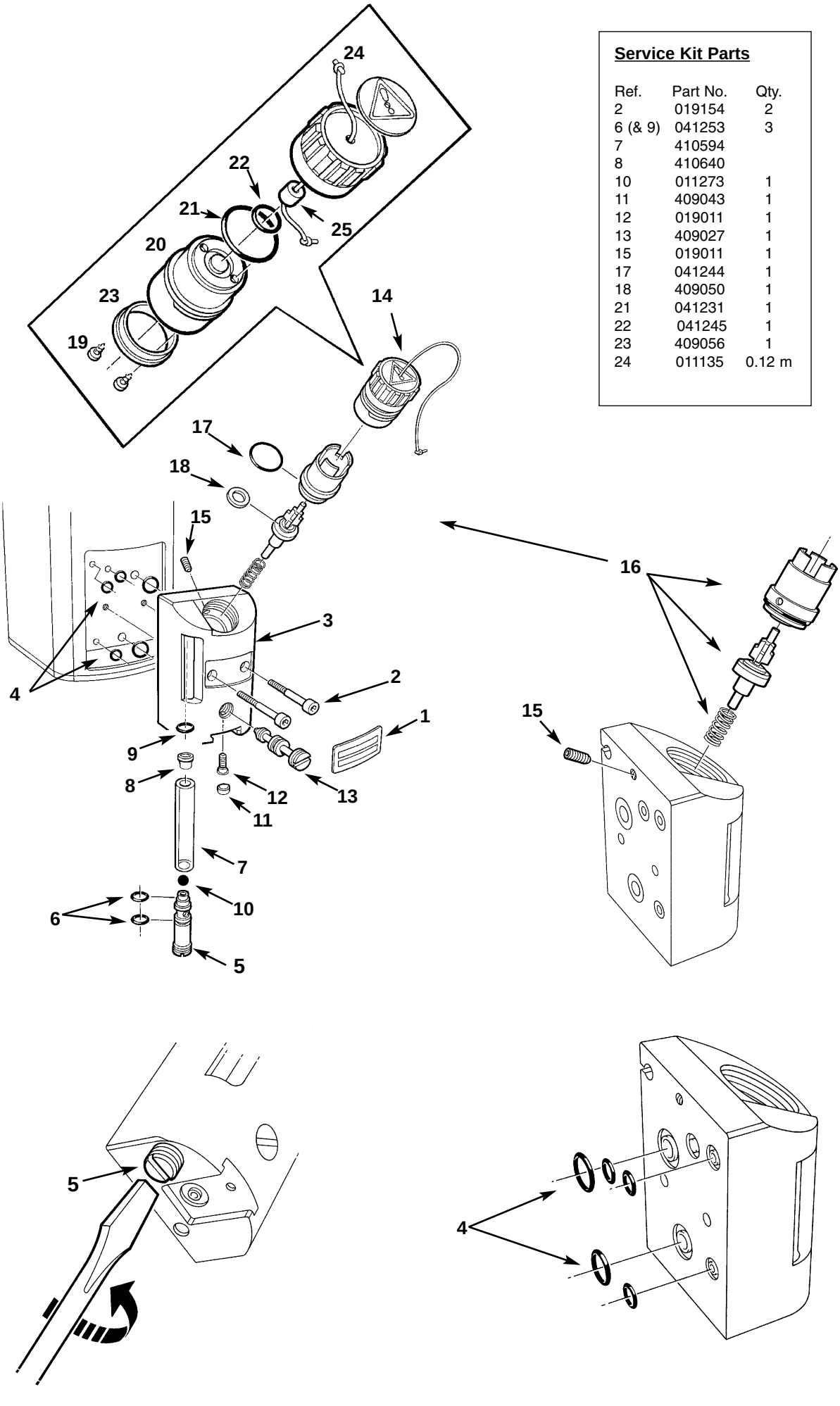
4. Carefully remove the the sight glass retaining screw assembly (5).
   CAUTION
   Use a correct size flat-head screwdriver (see illustration), to prevent damage to the slot in the screw.
   Discard the O-seals (6).
5. Withdraw the sight glass (7), insert (8), and top O-seal (9).
   Discard the O-seal.
   Discard the ball (10).
6. Remove the cap (11), screw (12), and withdraw the drain screw (13)
7. Remove the filler block cap (14).
8. Unscrew the grubscrew (15) and remove the sleeve assembly (16).
   Remove and discard the seals (17) and (18).

9. **Filler Cap - dismantling:**
   Remove the two screws (19), and separate the cap insert (20) from the cap.
   Remove the O-seals (21) and (22), and discard.
10. Remove the cap insert seal (23) and discard.

Reassembly

O seal Lubrication
Lightly lubricate O-seals / O-rings with PTFE based, oxygen compatible, lubricant. APPLY SPARINGLY.

11. Fit a new cap insert seal (23) - note orientation - square face into insert.
12. Fit a new cord (24).
13. Reverse the procedure (operations 4 to 9) given above.
    Note:
    Ensure free rotation of bush (25) after assembly
    Tighten the screws (19) to 0.42 Nm.
    Apply Loctite Activator 7471, then Loctite 222 to the threads of grubscrew (15), screw (12) and screws (2).



Service Kit Parts

Ref.	Part No.	Qty.
2	019154	2
6 (& 9)	041253	3
7	410594	
8	410640	
10	011273	1
11	409043	1
12	019011	1
13	409027	1
15	019011	1
17	041244	1
18	409050	1
21	041231	1
22	041245	1
23	409056	1
24	011135	0.12 m

SERVICE PROCEDURES

Key Filler Block

Removal

CAUTION
Do not remove the filler block until the wicks are removed.

1. Remove the label (1).
2. Remove the two screws (2), and detach the filler block (3) from the vaporizer.
3. Remove the five O-seals (4), and discard.

Dismantling

4. Carefully remove the the sight glass retaining screw assembly (5).
   CAUTION
   Use a correct size flat-head screwdriver (see illustration), to prevent damage to the slot in the screw.
   Discard the O-seals (6).
5. Withdraw the sight glass (7), insert (8), and top O-seal (9).
   Discard the O-seal.
   Discard the ball (10).
6. Slacken the key filler control screw (11), and detach the key (12).
7. Remove the four screws (13) and detach the side plate (14) and seal pad (15).
9. Open the flip top control (16) and remove the two screws (17).
10. Withdraw the filler control assembly (18).
11. Remove the pin (19) and detach the lever (20).
12. Remove the screw (21), and separate the components, as illustrated.
    Note the orientation of the Bal seal (22)
    Discard all seals.

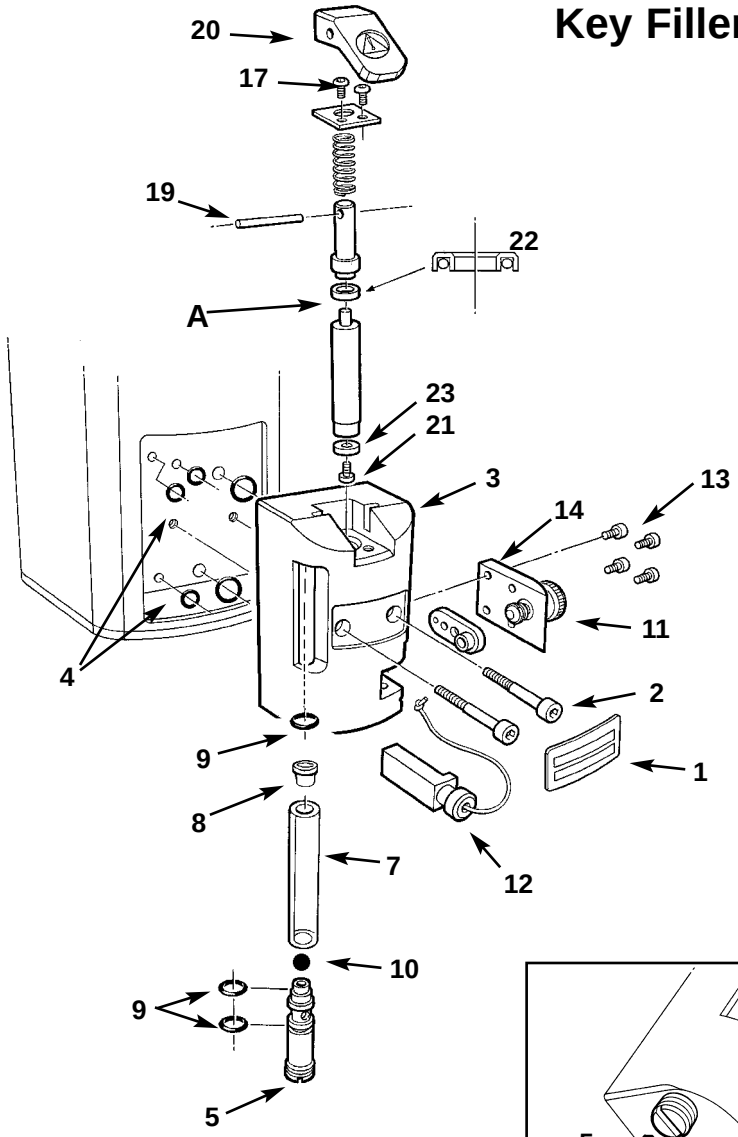
Reassembly

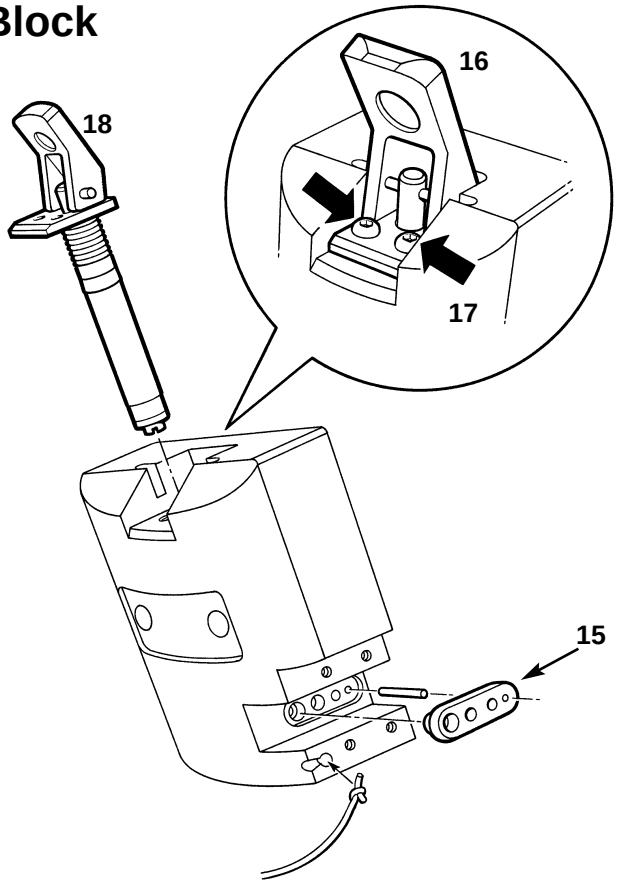
O seal Lubrication
Lightly lubricate O seals / O rings with PTFE based, oxygen compatible, lubricant.
APPLY SPARINGLY.

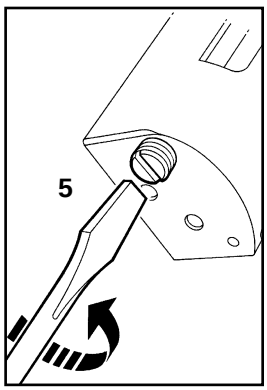
13. Reverse the procedure (operations 2 to 12) given above.

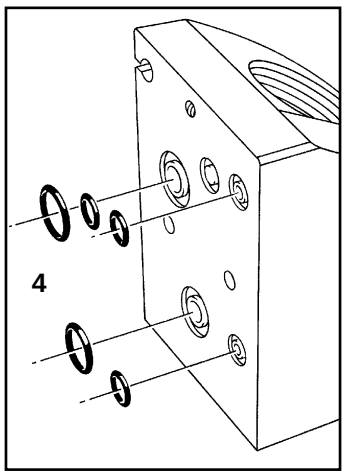
    Note:
    Apply Loctite Superlube to the threads of screw (11).
    Tighten screws (13) to 1.2 Nm
    *Apply Loctite Activator, then Loctite 242 to the threads of screw (21), and to the filler shaft at **A**.*
    Apply Loctite Activator 7471, then Loctite 222 to the threads of screws (17) and (2).

Key Filler Block









Service Kit Parts

Ref.	Part No.	Qty.
2	019154	2
7	410594	1
8	410640	1
9	041253	3
10	011273	1
12	410607 (Iso/Sevo)	1
	410608 (Hal/Enf)	1
13	019009	4
15	408294	1
17	019122	1
21	01059	1
22	042812	1
23	410685	1

SERVICE PROCEDURES

Pour-Fill Filler Block

Removal

CAUTION
Do not remove the filler block until the wicks are removed.

1. Remove the label (1).
2. Remove the two screws (2), and detach the filler block (3) from the vaporizer.
3. Remove the five O-seals (4), and discard.

Dismantling

4. Carefully remove the the sight glass retaining screw assembly (5).
   CAUTION
   Use a correct size flat-head screwdriver (see illustration), to prevent damage to the slot in the screw.
   Discard the O-seals (6).
5. Withdraw the sight glass (7), insert (8), and top O-seal (9).
   Discard the O-seal.
   Discard the ball (10).
6. Remove the cap (11), screw (12), and withdraw the drain screw (13)
7. Remove the filler block cap (14).
   Filler Cap - dismantling:
   Remove the two screws (15), and separate the cap insert (16) from the cap.
   Remove the O-seals (17) and (18), and discard.
8. Remove the cap insert seal (19) and discard.

Reassembly

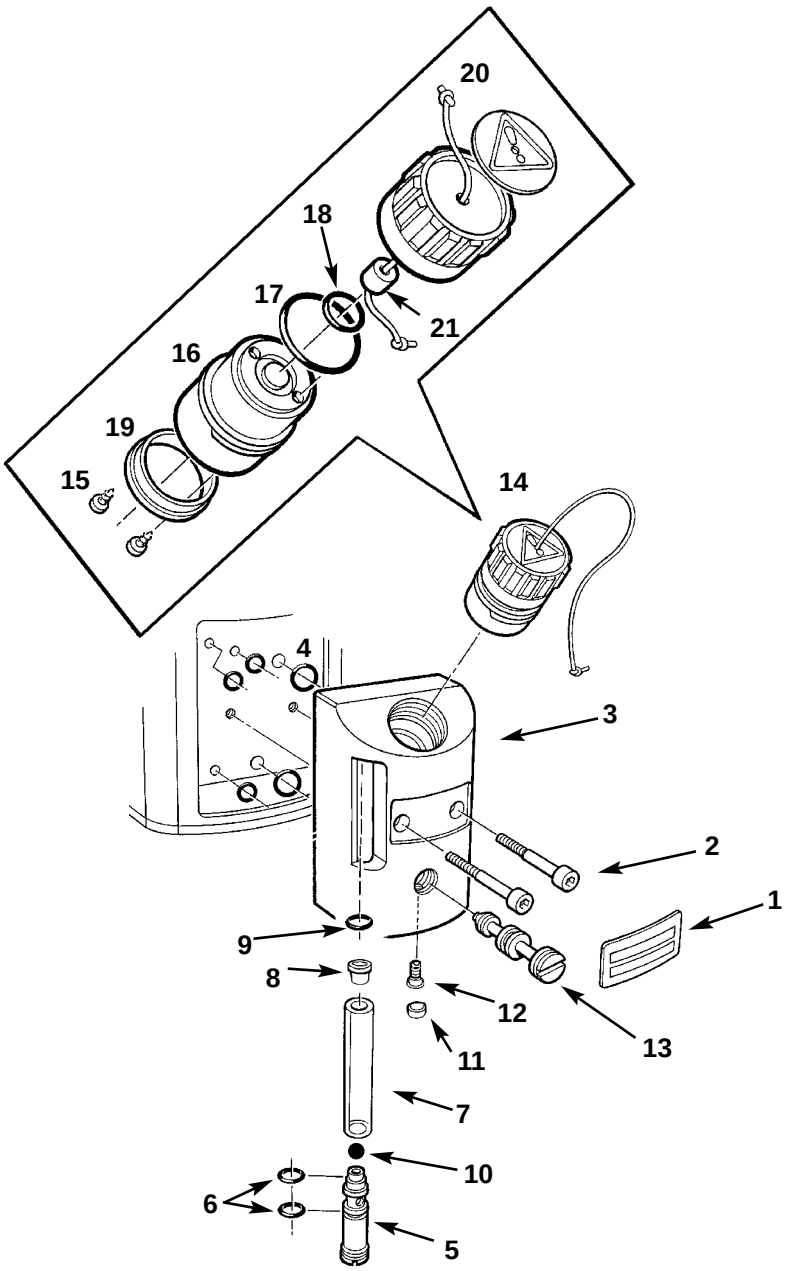
O seal Lubrication
Lightly lubricate O seals / O rings with PTFE based, oxygen compatible, lubricant.
APPLY SPARINGLY.

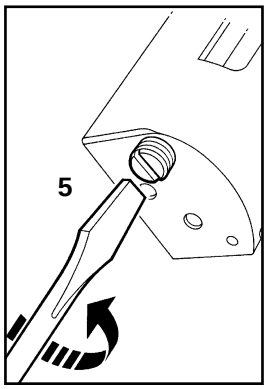
9. Fit a new cap insert seal - note orientation - square face into insert.
10. Fit a new cord (20).
11. Reverse the procedure (operations 4 to 8) given above.
    Note:
    Tighten the cap insert screws (14) to 0.42 Nm.
    Apply Loctite Activator 7471, then Loctite 222 to the threads of screw (12) and screws (2).
    Ensure free rotation of bush (21) after assembly

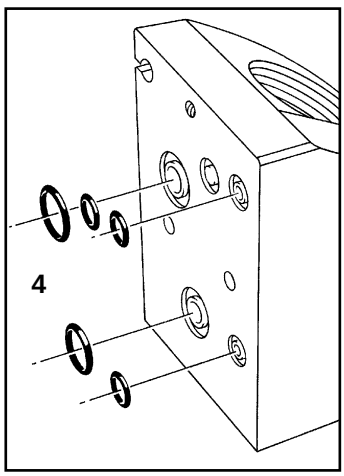
Pour-Fill Filler Block

Service Kit Parts

Ref.	Part No.	Qty.
2	019154	2
6 (& 9)	041253	3
7	410594	1
8	410640	1
10	011273	1
11	409043	1
12	019009	1
13	409027	1
17	041215	1
18	041245	1
19	409056	1
20	011135	0.12 m







SERVICE PROCEDURES

Filler Blocks

Quik-Fil Filler Block

Removal

CAUTION
Do not remove the filler block until the wicks are removed.

1. Remove the label (1).
2. Remove the two screws (2), and detach the filler block (3) from the vaporizer.
3. Remove the five O-seals (4), and discard.

Dismantling

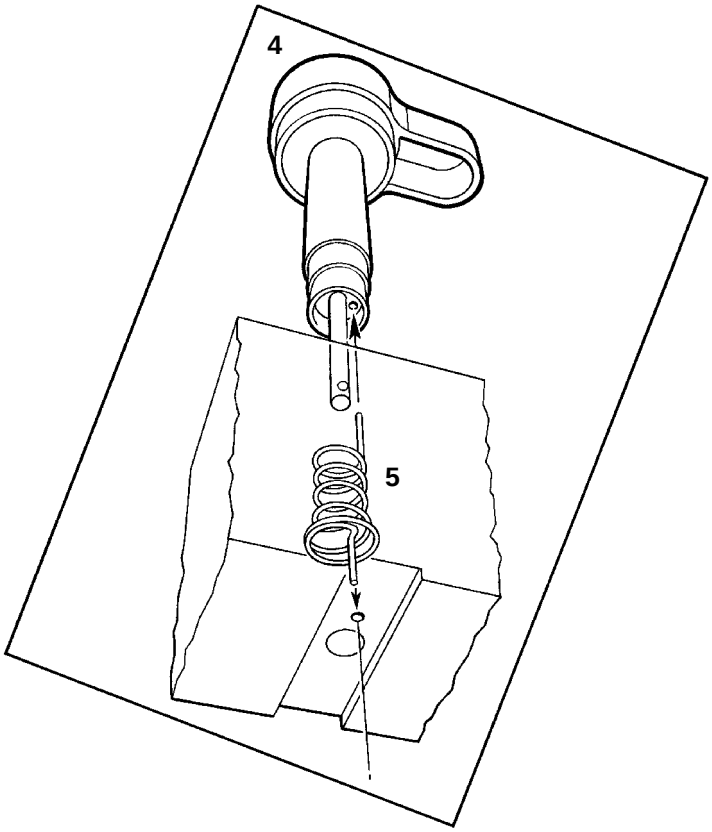
4. Carefully remove the the sight glass retaining screw assembly (5).
   CAUTION
   Use a correct size flat-head screwdriver (see illustration), to prevent damage to the slot in the screw.
   Discard the O-seals (6).
5. Withdraw the sight glass (7), insert (8), and top O-seal (9).
   Discard the O-seal.
   Discard the ball (10).
6. Remove the cap (11), screw (12), and withdraw the drain screw (13)
7. Remove the filler block cap (14).
8. Unscrew the grubscrew (15) and remove the sleeve assembly (16).
   Remove and discard the seals (17) and (18).

9. **Filler Cap - dismantling:**
   Remove the two screws (19), and separate the cap insert (20) from the cap.
   Remove the O-seals (21) and (22), and discard.
10. Remove the cap insert seal (23) and discard.

Reassembly

O seal Lubrication
Lightly lubricate O-seals / O-rings with PTFE based, oxygen compatible, lubricant. APPLY SPARINGLY.

11. Fit a new cap insert seal (23) - note orientation - square face into insert.
12. Fit a new cord (24).
13. Reverse the procedure (operations 4 to 9) given above.
    Note:
    Ensure free rotation of bush (25) after assembly
    Tighten the screws (19) to 0.42 Nm.
    Apply Loctite Activator 7471, then Loctite 222 to the threads of grubscrew (15), screw (12) and screws (2).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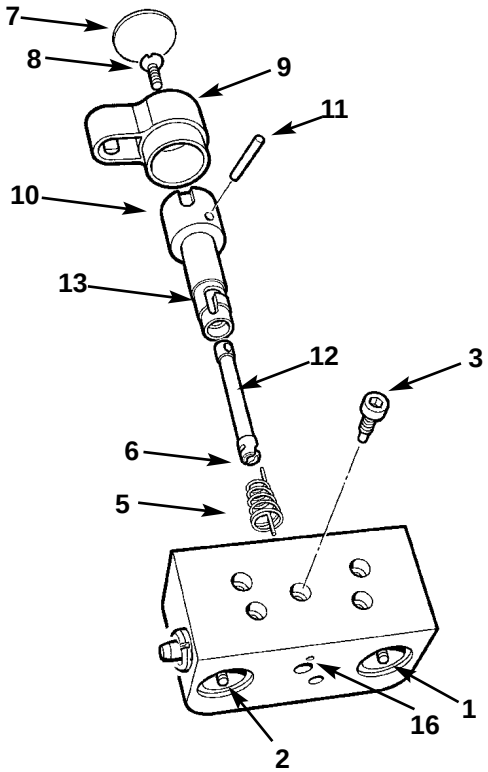
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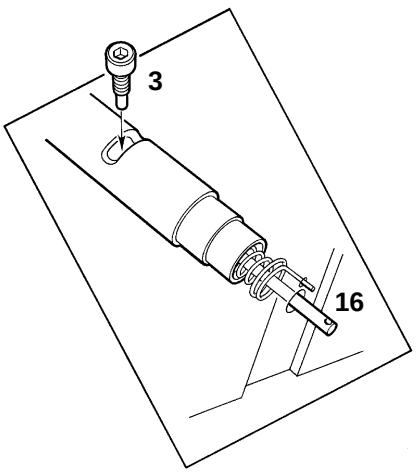
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16

SERVICE PROCEDURES

Key Filler Block

Removal

CAUTION
Do not remove the filler block until the wicks are removed.

1. Remove the label (1).
2. Remove the two screws (2), and detach the filler block (3) from the vaporizer.
3. Remove the five O-seals (4), and discard.

Dismantling

4. Carefully remove the the sight glass retaining screw assembly (5).
   CAUTION
   Use a correct size flat-head screwdriver (see illustration), to prevent damage to the slot in the screw.
   Discard the O-seals (6).
5. Withdraw the sight glass (7), insert (8), and top O-seal (9).
   Discard the O-seal.
   Discard the ball (10).
6. Slacken the key filler control screw (11), and detach the key (12).
7. Remove the four screws (13) and detach the side plate (14) and seal pad (15).
9. Open the flip top control (16) and remove the two screws (17).
10. Withdraw the filler control assembly (18).
11. Remove the pin (19) and detach the lever (20).
12. Remove the screw (21), and separate the components, as illustrated.
    Note the orientation of the Bal seal (22)
    Discard all seals.

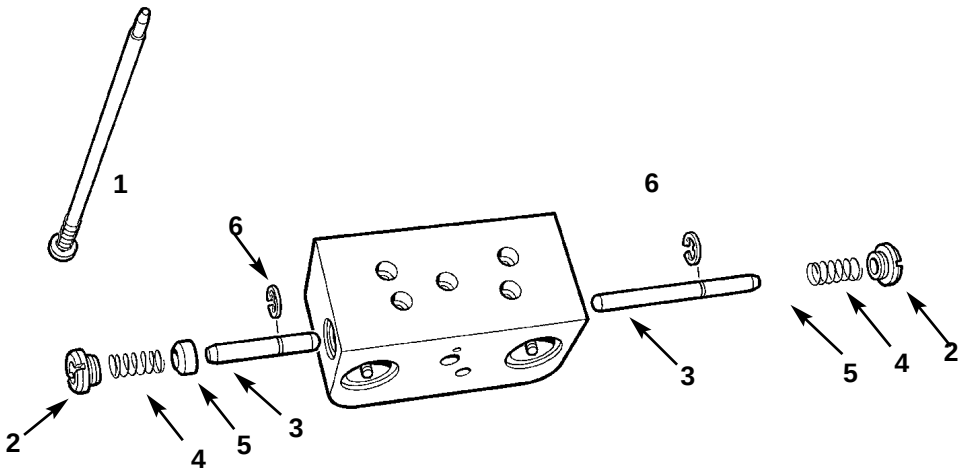
Reassembly

O seal Lubrication
Lightly lubricate O seals / O rings with PTFE based, oxygen compatible, lubricant.
APPLY SPARINGLY.

13. Reverse the procedure (operations 2 to 12) given above.

    Note:
    Apply Loctite Superlube to the threads of screw (11).
    Tighten screws (13) to 1.2 Nm

Selectatec



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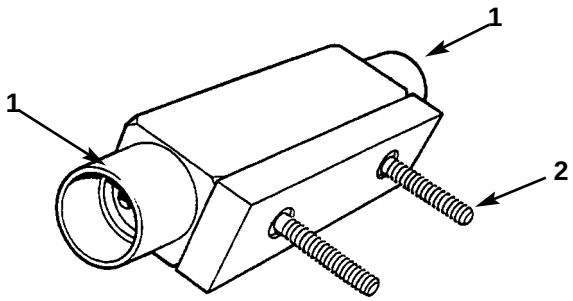


SERVICE PROCEDURES

Filler Blocks

Quik-Fil Filler Block

Removal

CAUTION
Do not remove the filler block until the wicks are removed.

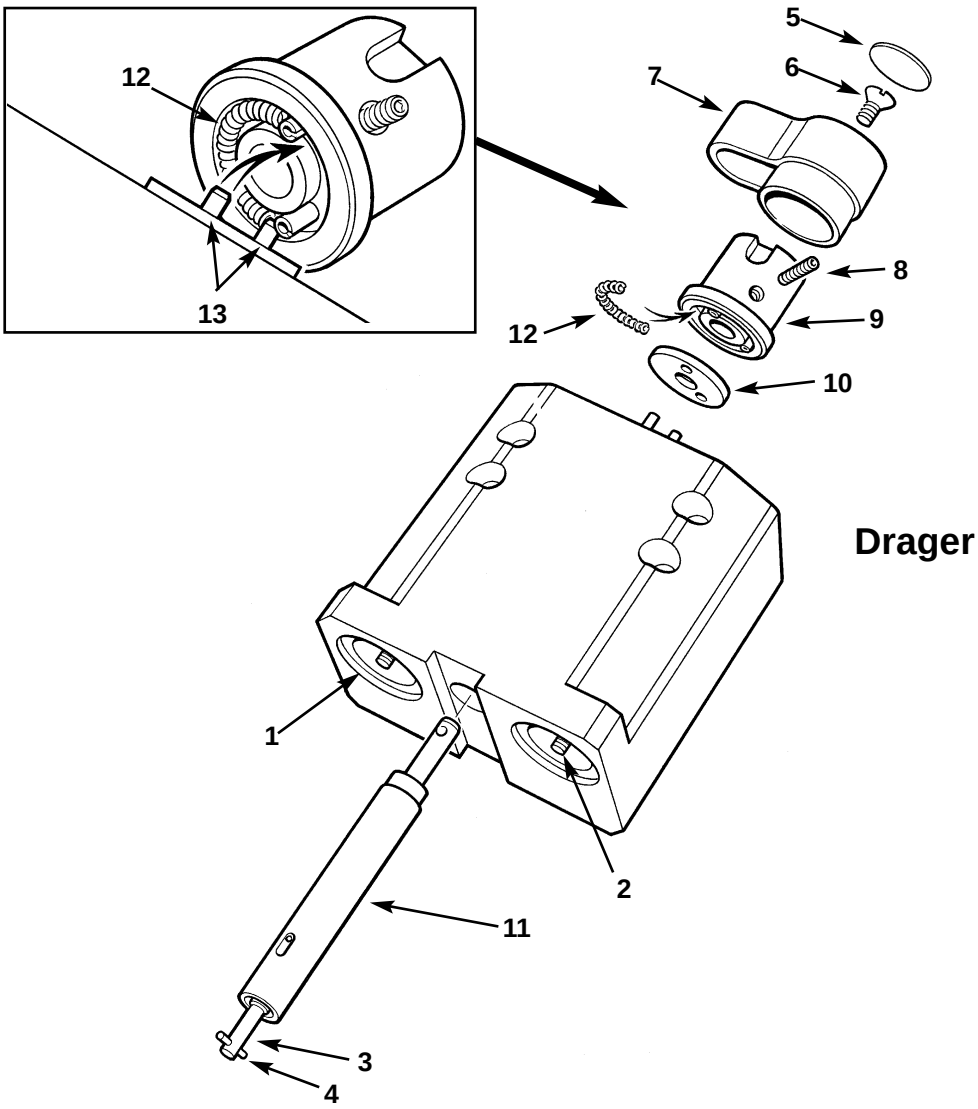
1. Remove the label (1).
2. Remove the two screws (2), and detach the filler block (3) from the vaporizer.
3. Remove the five O-seals (4), and discard.

Dismantling

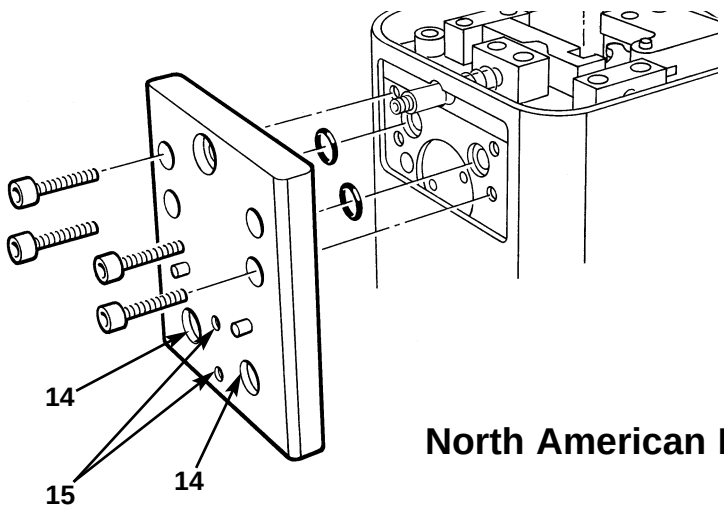
4. Carefully remove the the sight glass retaining screw assembly (5).
   CAUTION
   Use a correct size flat-head screwdriver (see illustration), to prevent damage to the slot in the screw.
   Discard the O-seals (6).
5. Withdraw the sight glass (7), insert (8), and top O-seal (9).
   Discard the O-seal.
   Discard the ball (10).
6. Remove the cap (11), screw (12), and withdraw the drain screw (13)
7. Remove the filler block cap (14).
8. Unscrew the grubscrew (15) and remove the sleeve assembly (16).
   Remove and discard the seals (17) and (18).

9. **Filler Cap - dismantling:**
   Remove the two screws (19), and separate the cap insert (20) from the cap.
   Remove the O-seals (21) and (22), and discard.
10. Remove the cap insert seal (23) and discard.

Reassembly



Drager



North American Drager

SERVICE PROCEDURES

Reassembling the vaporizer

NOTE

A) Clean all components before refitting.

B) Use new seals and O-rings

O seal Lubrication:

Lightly lubricate O-seals / O-rings with PTFE based, oxygen compatible, lubricant. APPLY SPARINGLY.

C) Use new screws where indicated

D) Use Loctite Activator 7471 on screw threads before applying Loctite 222 or 242, unless otherwise indicated in the text.

Valve block

1. **Needle assembly:**
Fit new O-rings (1A, 1B and 1C).
Fit the needle (2) into the housing (3).
Fit a new Bal seal (4) to the needle (2) - use Service Tool Set 410660.

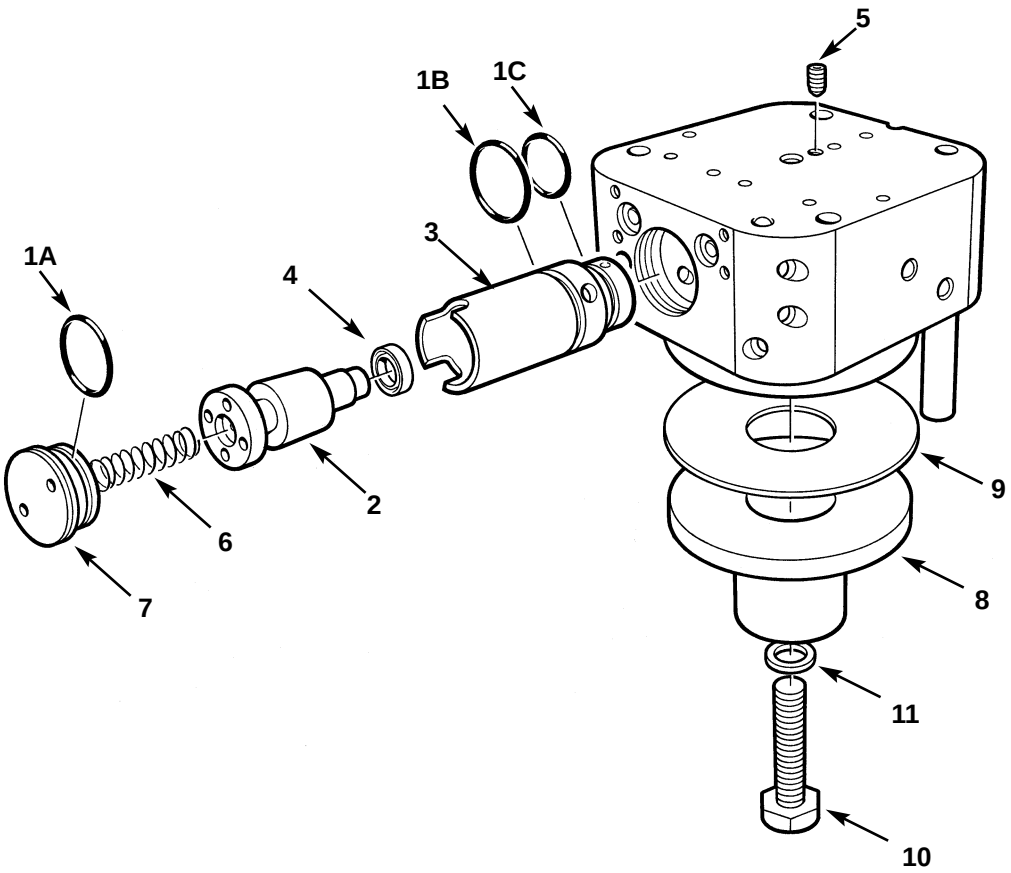
Refit the housing and needle assembly to the valve block.
Fit a new grubscrew (5).
Use Loctite Activator 7471, then Loctite 242 on the screw threads.
Fit the spring (6), and use Service Tool 410633 to fit the locknut (7).

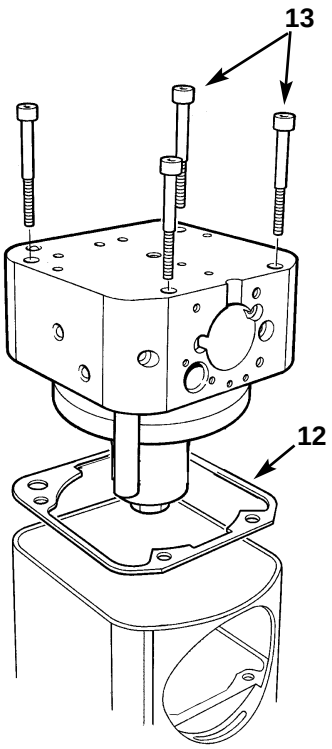
2. Fit the valve block lower cover (8) and a new seal (9).

Secure with the M12 bolt (10) and new washer (11).
NOTE:
Use Loctite Activator, then Loctite 242 on the bolt threads.
(Apply SPARINGLY, to prevent excess Loctite running into the cover or block.)
Tighten to 30 Nm.

3 Fit the valve block assembly, and a new seal (12), to the vaporizer body. **The seal must be fitted with the red line uppermost.**

Secure with four new M6 cap-head screws (13).
NOTE:
Apply Loctite Superlube to the four screws.
Tighten to 6 Nm.





Service Kit Parts

Ref.	Part No.	Qty.
1A	041214	1
1B	041239	1
1C	041243	1
4	042820	1
5	019028	1
9	410591	1
11	410638	1
12	410550	1
13	019069	4

SERVICE PROCEDURES

Wicks:

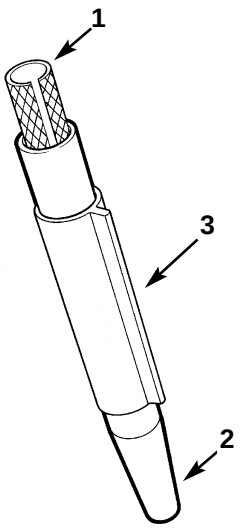
4. Assemble the small wick components, using service tool 410659:
   Fit the metal wick tube (1) inside the tool 2).
   Fit the cloth sheath (3) over the tool.
   Withdraw the tool.

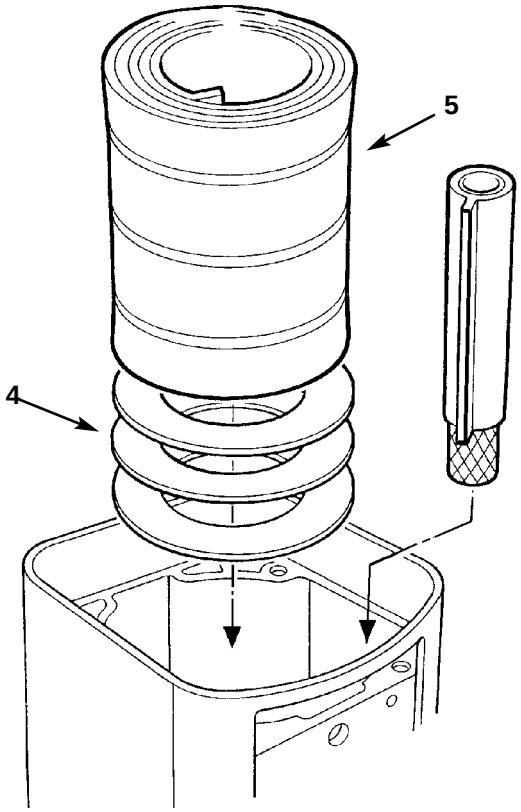
5. Fit new wick sealing discs (4).
   Note: refit the same number of discs as removed.

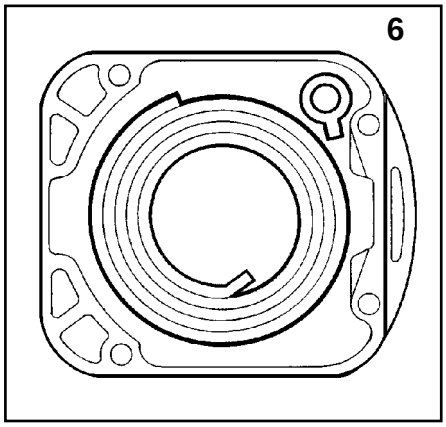
6. Fit the large wick (5), and small wick into the vaporizer chamber.
   Note the correct positions for each wick - shown in the plan view (6).

Service Kit Parts

Ref.	Part No.	Qty.
3	410643	1
4	410636	1 to 3
5	410615	1







SERVICE PROCEDURES

Temperature Compensator - Reassembly

1. Using Service Tool 410647 (1), fit the bi-metallic strip (2), and spacers (3), to the base (4).
   Secure with new screws (5).
   Note:
   Use Loctite Activator, then apply Loctite 242 to the screw threads only

2. Using Service Tool 410694 (6), fit the metal strip (7), and plate (8) to the TC plate (9).
   Secure with new screws (10).
   Note:
   Use Loctite Activator, then apply Loctite 242 to the screw threads only

3. Using service Tool 410647 (11), fit the TC plate and upper and lower small plates (12 and 13) to the base.
   Secure with new screws (14).
   Note
   *The lower plate (13) and the TC plate (9) **must** be used together on the same vaporizer.*
   Use Loctite Activator, then apply Loctite 242 to the screw threads only

SERVICE PROCEDURES

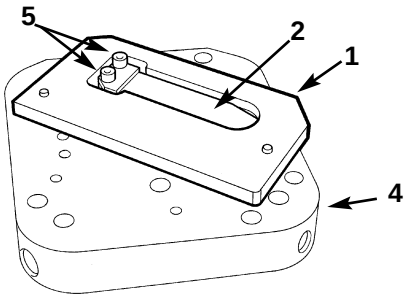
Temperature Compensator - Reassembly

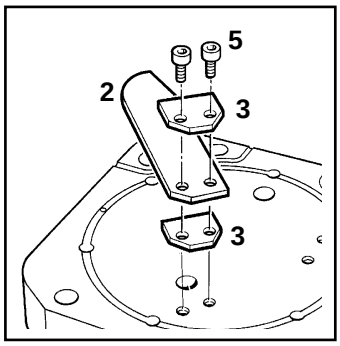
1. Using Service Tool 410647 (1), fit the bi-metallic strip (2), and spacers (3), to the base (4).
   Secure with new screws (5).
   Note:
   Use Loctite Activator, then apply Loctite 242 to the screw threads only

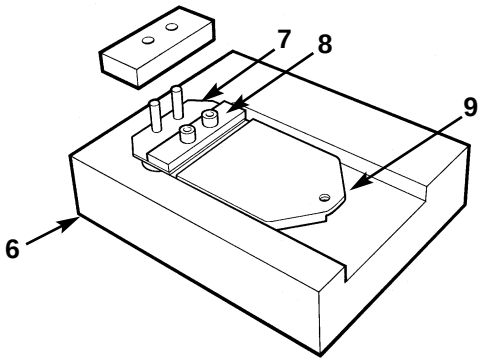
2. Using Service Tool 410694 (6), fit the metal strip (7), and plate (8) to the TC plate (9).
   Secure with new screws (10).
   Note:
   Use Loctite Activator, then apply Loctite 242 to the screw threads only

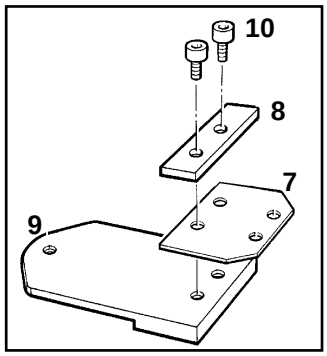
3. Using service Tool 410647 (11), fit the TC plate and upper and lower small plates (12 and 13) to the base.
   Secure with new screws (14).
   Note
   *The lower plate (13) and the TC plate (9) **must** be used together on the same vaporizer.*
   Use Loctite Activator, then apply Loctite 242 to the screw threads only

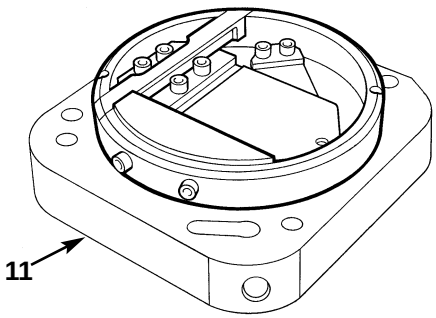
Temperature Compensator

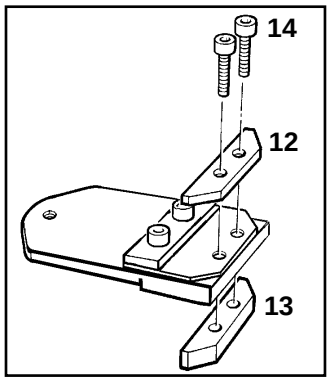












Service Kit Parts

Ref.	Part No.	Qty.
5	019009	2
10	019011	2
14	01083	2

Temperature Compensator

4. Refit the grub screw (15) to the TC plate (16). Screw in until contact is made with the bi-metallic strip.
   Note:
   Use Loctite Activator, then apply Loctite 242 to the grubscrew threads.

5. Fit the spring (17) over the grub screw (16).
   Using six new screws (18), and a new seal (19), fit the cover (20).
   Note the position of the seal - see inset.
   Drain holes (A) must align correctly.
   Note:
   Use Loctite Activator, then apply Loctite 242 to the screw threads only.
   Tighten screws to 2 Nm.

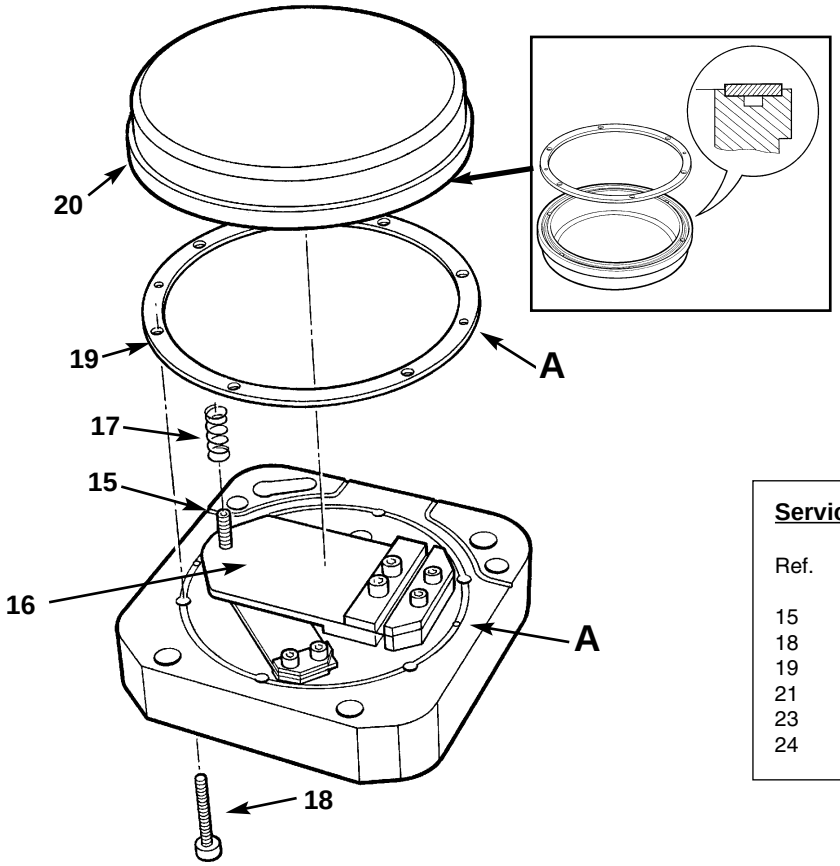
6. Fit new O-seals (21) to the bypass resistance adjusters (22).

7. Invert the TC assembly and screw the adjusters into the base.

8. Fit the base assembly to the vaporizer, use a new seal (23). **The seal must be fitted with the red line downwards (against the base assembly).**
   Secure with the four countersunk screws (24).
   Note:
   Apply Loctite Superlube to the four screws.
   Tighten to 6 Nm.

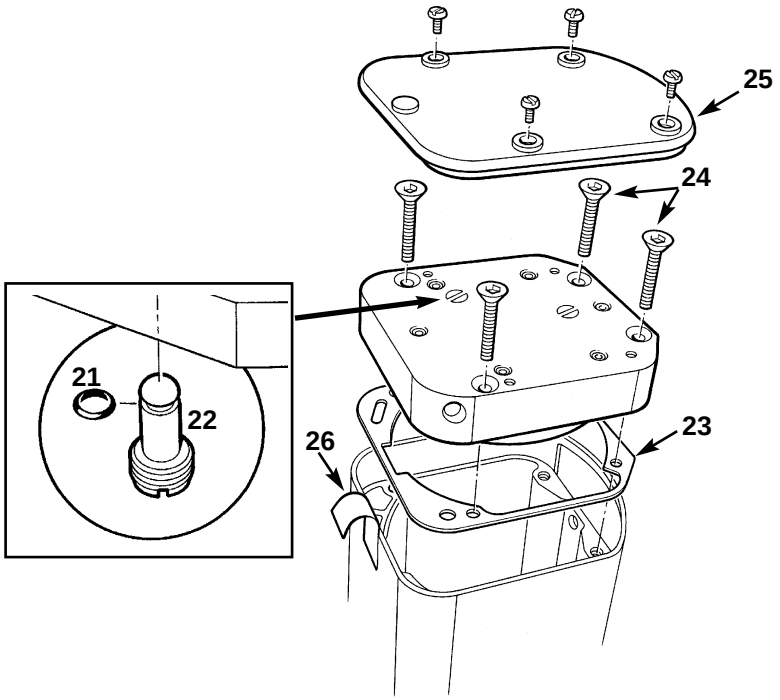
   Do not fit the bottom cover (25), and anti-tamper label (26) until calibration is completed.

Temperature Compensator



Service Kit Parts

Ref.	Part No.	Qty.
15	01195	1
18	019003	6
19	410684	1
21	041242	2
23	410551	1
24	019155	4



SERVICE PROCEDURES

Needle Drive - Reassembly

1. Fit the setting screw (1) into the needle drive assembly (2).

2. Apply a small amount of Loctite 222 to the new grubscrews (3), and fit to the drive assembly, but do not tighten.
   Do <u>not</u> use Loctite Activator on the screw threads.

If a <u>new</u> needle drive housing and needle drive are to be fitted (see page 26), follow instructions a) to g):

a) Apply Loctite 601 and fit a new pin (4) to the new needle drive (5).
b) Fit a new setting screw (1), and grubscrews (3).
c) Fit the assembly to the new housing (6) - screw the drive assembly in until the rear faces of the drive and the housing are flush, then unscrew one full turn.
b) Fit the housing and drive assembly to the valve block with the pin (4) at the 9 o'clock position.
c) Refit the grubscrew (7). Screw in carefully until contact is made with the housing.
DO NOT TIGHTEN.
d) Apply Loctite Activator, then Loctite 222 to the threads of the screws (8) and refit with the washers (9).
NOTE
If a new needle drive assembly and housing are fitted, the vaporizer must be calibrated when the rebuild is complete.

e) After calibration, remove the grubscrew (7).
f) Inject Loctite 641 into the threaded hole in the valve block to fill the hole.
g) Refit the grubscrew and tighten to 0.035 Nm.

If the original components are to be refitted:

3. Fit the drive assembly (10) into the valve block (11).
   Note: LEFT HAND THREAD.

4. Apply Loctite Activator, then Loctite 222 to the threads of the screws (12) and refit with the washers (13).

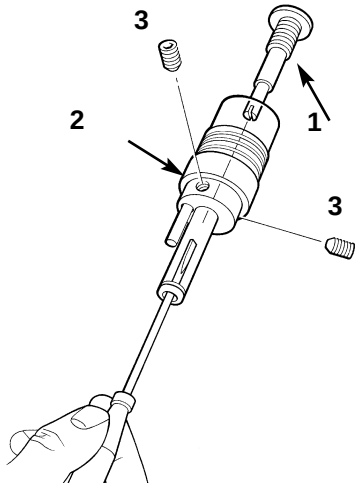
5. Unscrew the assembly one full turn (14).

6. Fit Service Tool No. 410602 (15) to set the needle assembly to its correct position.

7. Insert a screwdriver blade into the assembly, and turn the setting screw slowly until it makes contact with the needle (16).

8. Remove the service tool (15), and tighten the top grubscrew (3). Rotate the assembly and tighten the second grubscrew.

Needle Drive - Reassembly



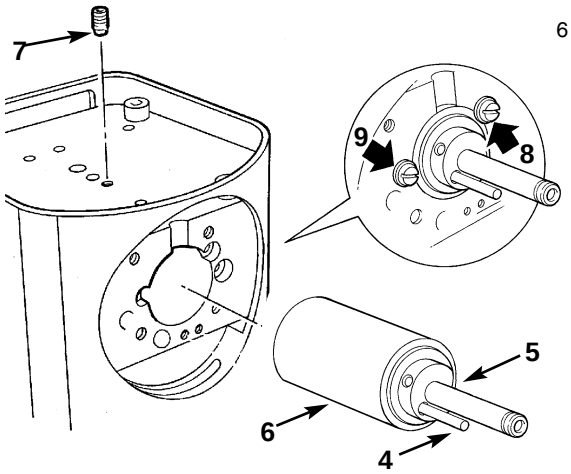
Service Kit Parts

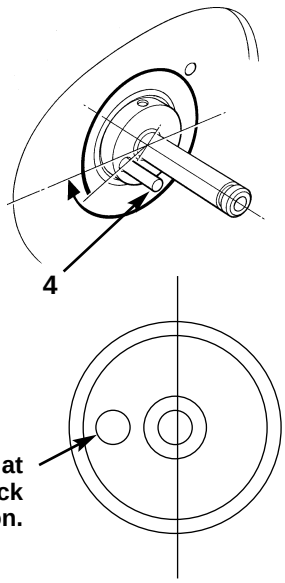
Reassembling the needle drive:

Ref.	Part No.	Qty.
3	019028	2

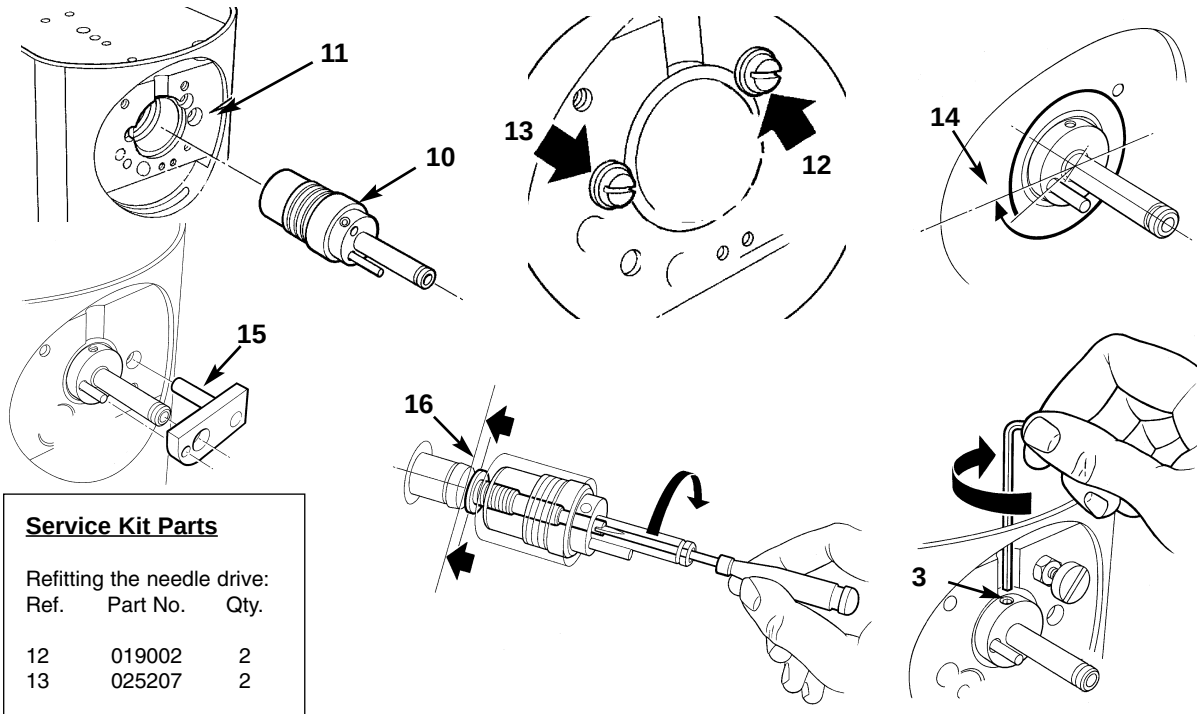
Fitting a new Needle Drive Assembly (5) and Needle Drive Housing (6)

Ref.	*Part No.*	*Agent*
5	410546	Enflurane
	410547	Sevoflurane
	410648	Isoflurane & Halothane
6	410586	Enflurane
	410587	Sevoflurane
	410649	Isoflurane & Halothane





Needle Drive Assembly - Refitting the original components



Service Kit Parts

Refitting the needle drive:

Ref.	Part No.	Qty.
12	019002	2
13	025207	2

Dial Stop, Closing Mechanism, and Dial Lock Screw

9. Refit the closing mechanism components (1-5):
   Note:
   Screws (5) - apply Loctite Activator and Loctite 222 to the screw threads.

10. Fit the dial 'max' stop (6 and 7).

11. Fit the closing mechanism shaft (8).

12. Fit the dial 'zero' lock screw (9)

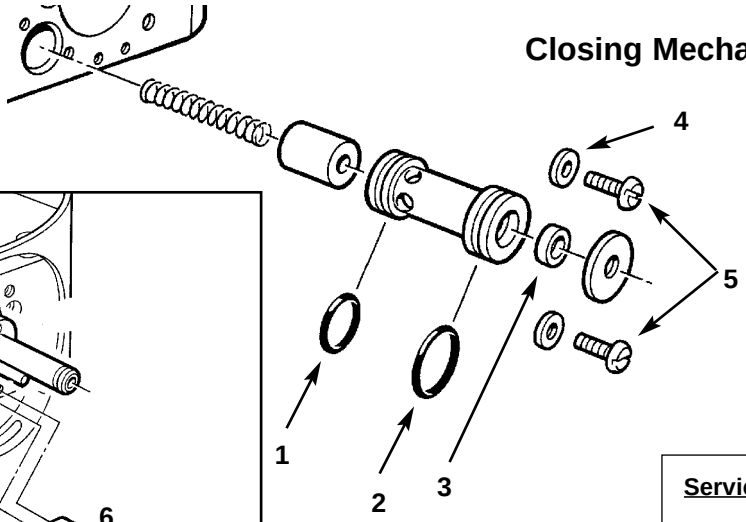
    Use Service Tool 410695 (10) to set the position of the screw.
    Tighten the nut (11).

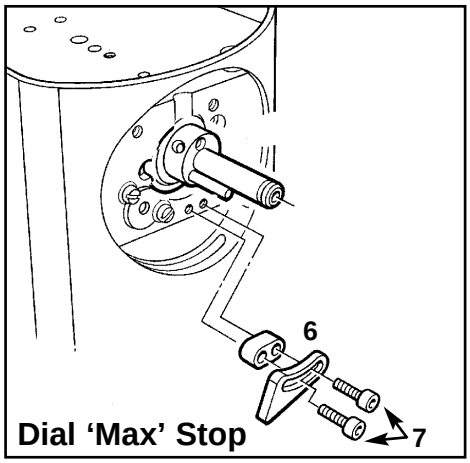
13. **Interlock System**
    Selectatec models:
    Fit the shaft (12) and Spring (13).

14. **Interlock System - Drager:**
    Assemble the components as illustrated (14).
    Note:
    Use Loctite Activator, then:
    Use Loctite 222 on screws A.
    Use Loctite 242 on screw B.

    Check for free movement of the slide C.

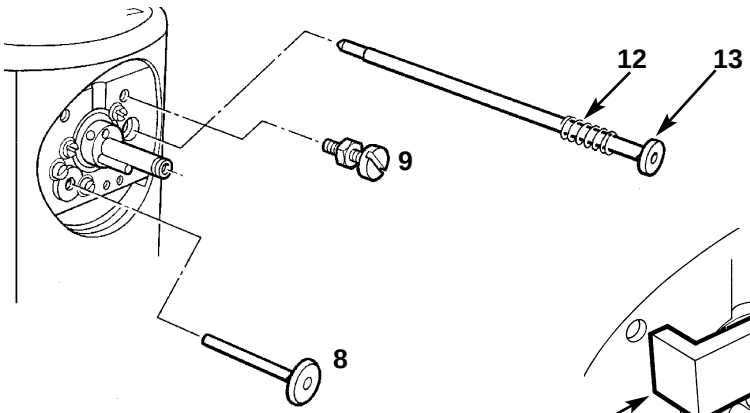
Closing Mechanism

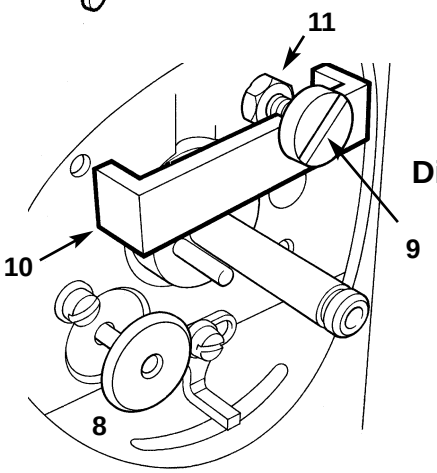




Service Kit Parts

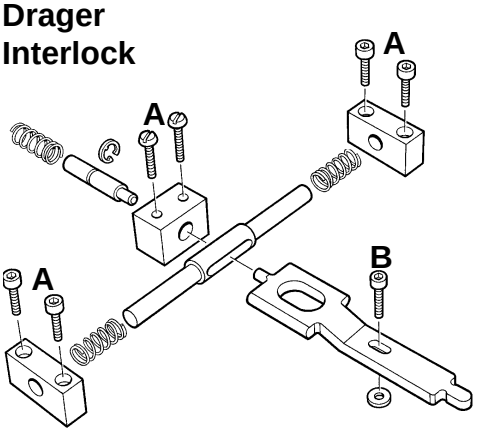
Ref.	Part No.	Qty.
1	041221	1
2	0226	1
3	042809	1
4	01067	2
5	019002	2
7	019159	2

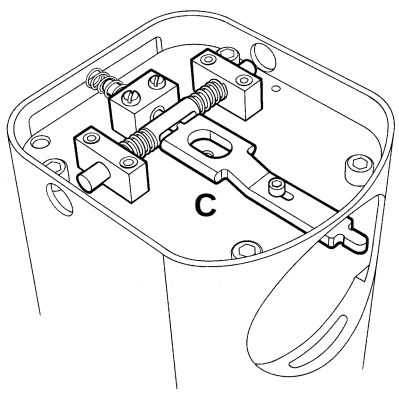




Dial Lock Screw

Drager Interlock (14)





Service Kit Parts

Ref.	Part No.	Qty.
A	019087	6
B	019049	1

SERVICE PROCEDURES

Interlock System - North American Drager:

1. Assemble the components as illustrated (1).
   Note:

2. *Use Loctite Activator, then apply Loctite 222 to all fixing screws (2).*
   Do not tighten screws on the front block (3).

2. Fit the Dial Bezel and Dial Assembly (see next page).
   Turn the vaporizer ON.

3. Fit the Service Tool (4).

4. Pivot the block (3) to ensure contact between the lever (5) and face X of the slot in the slide (6).

5. Tighten screws on the front block (3).

6. Remove the Service Tool.

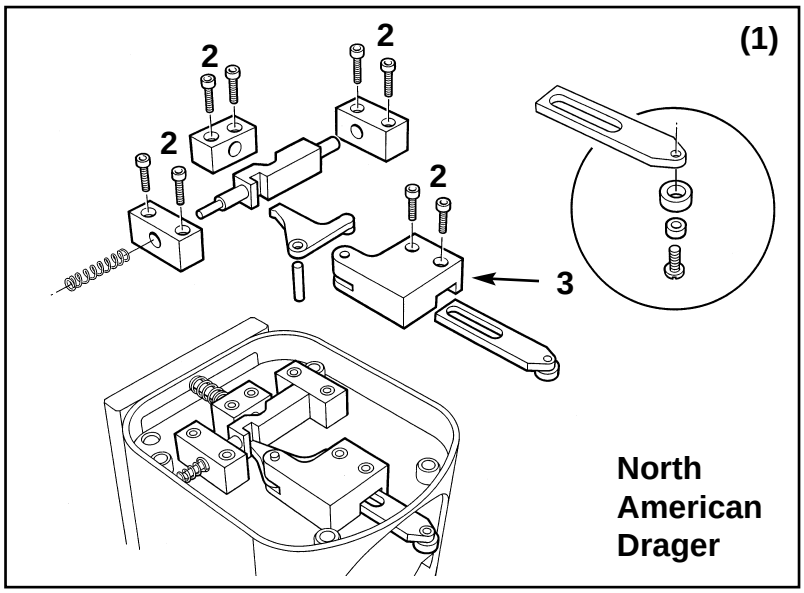
7. Fit the interlock pin, spring and circlip (7).

8. Set the position of the grubscrew (8) in the interlock pin:

   Remove the grubscrew and apply Loctite Activator, then Loctite 222 to the threads.

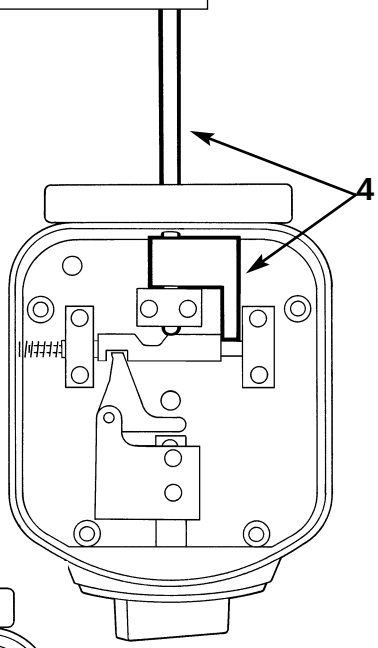
   Refit, to the position shown (0.7 mm / 0.8 mm from the face of the connector block).

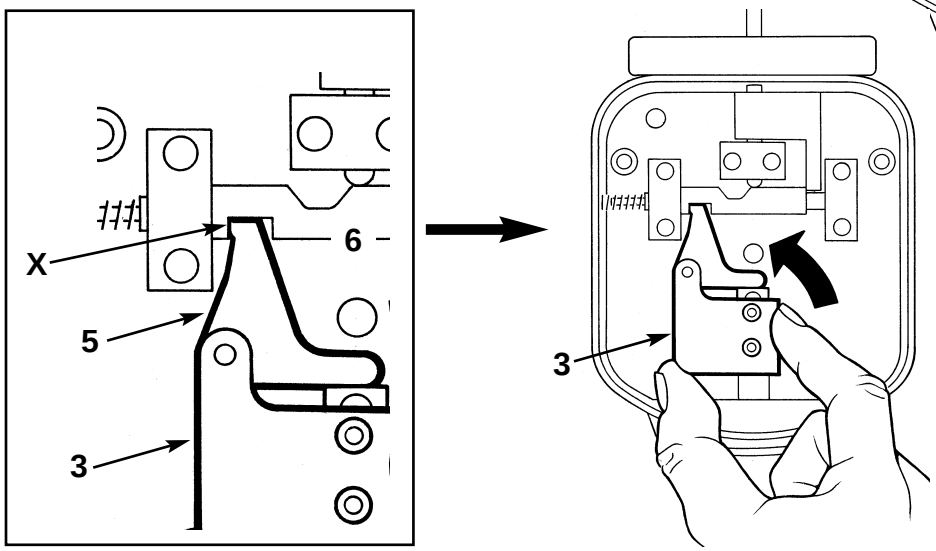
   NOTE
   The position of the grubscrew may have to be readjusted when the interlock system is tested with the vaporizer installed on the anaesthetic machine.

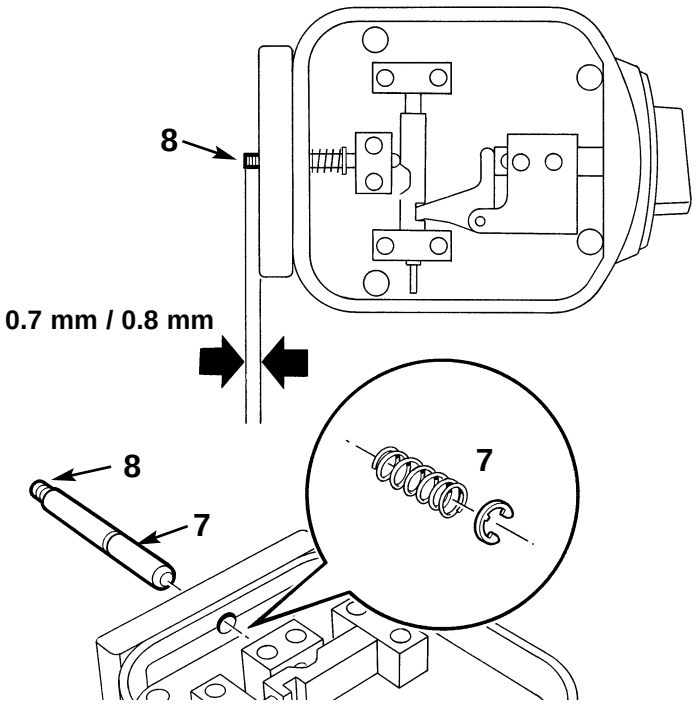


Service Kit Parts

Ref.	Part No.	Qty.
2	019110	8
8	019074	1







SERVICE PROCEDURES

1. **Dial Bezel**
   Fit the dial bezel (1) and screws (2).
   N*ote:*
   Use Loctite Activator, then apply Loctite 242 to the screw threads.

2. **Dial Assembly**:
   Fit the dial drive (3), and secure with the circlip (4).

   Fit the dial assembly components (5) and secure with the two screws (6).
   Note:
   Use Loctite Activator, then apply Loctite 222 to the screw threads.

3. **Filler Block**
   Fit the filler block (7), use new O-seals (8 and 9) and screws (10).
   Note:
   Use Loctite Activator 7471, then apply Loctite 222 to the screw threads.
   Lightly lubricate the O-seals with PTFE-based, oxygen compatible, lubricant.

Test and Calibration:

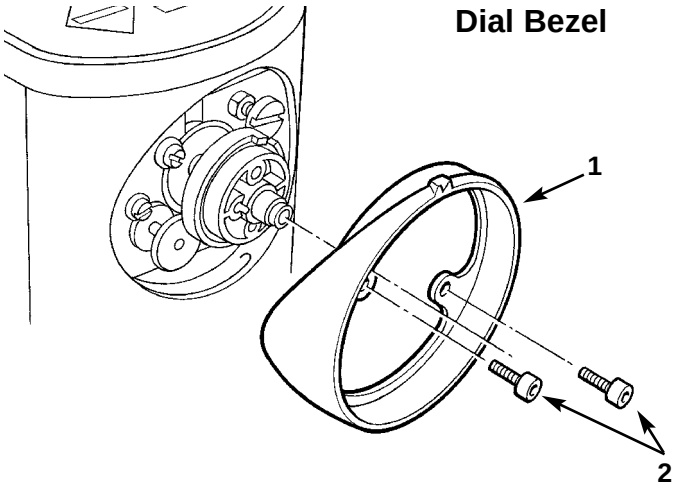
4. Fit the test connector block (Service Tool 410579) - Note - Use new O-seals.

The vaporizer is now ready for a leak test, bypass resistance check, and calibration test.

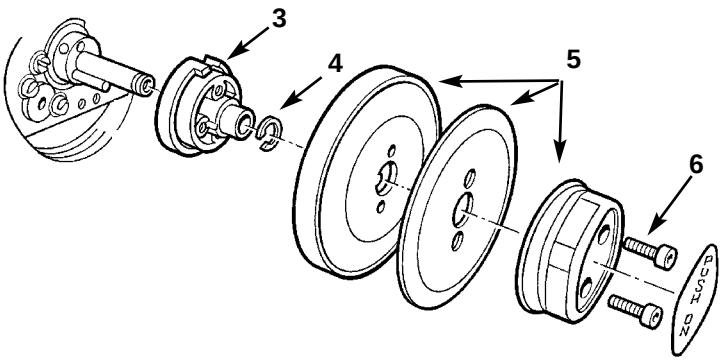
Service Kit Parts

Ref.	Part No.	Qty.
2	019011	2
4	020431	1
6	019087	2
8	041221	2
9	041215	3
10	019154	2

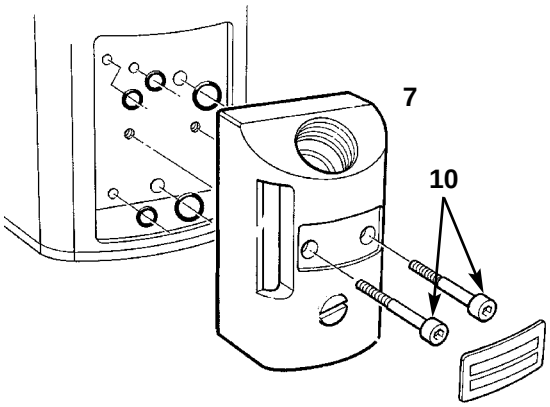
Dial Bezel

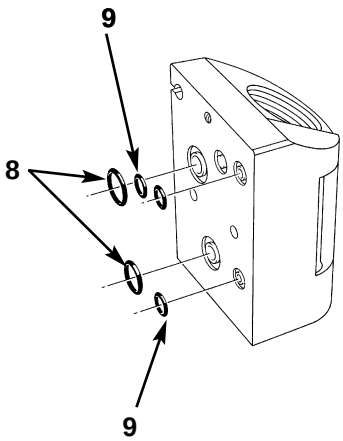


Dial Assembly



Filler Block





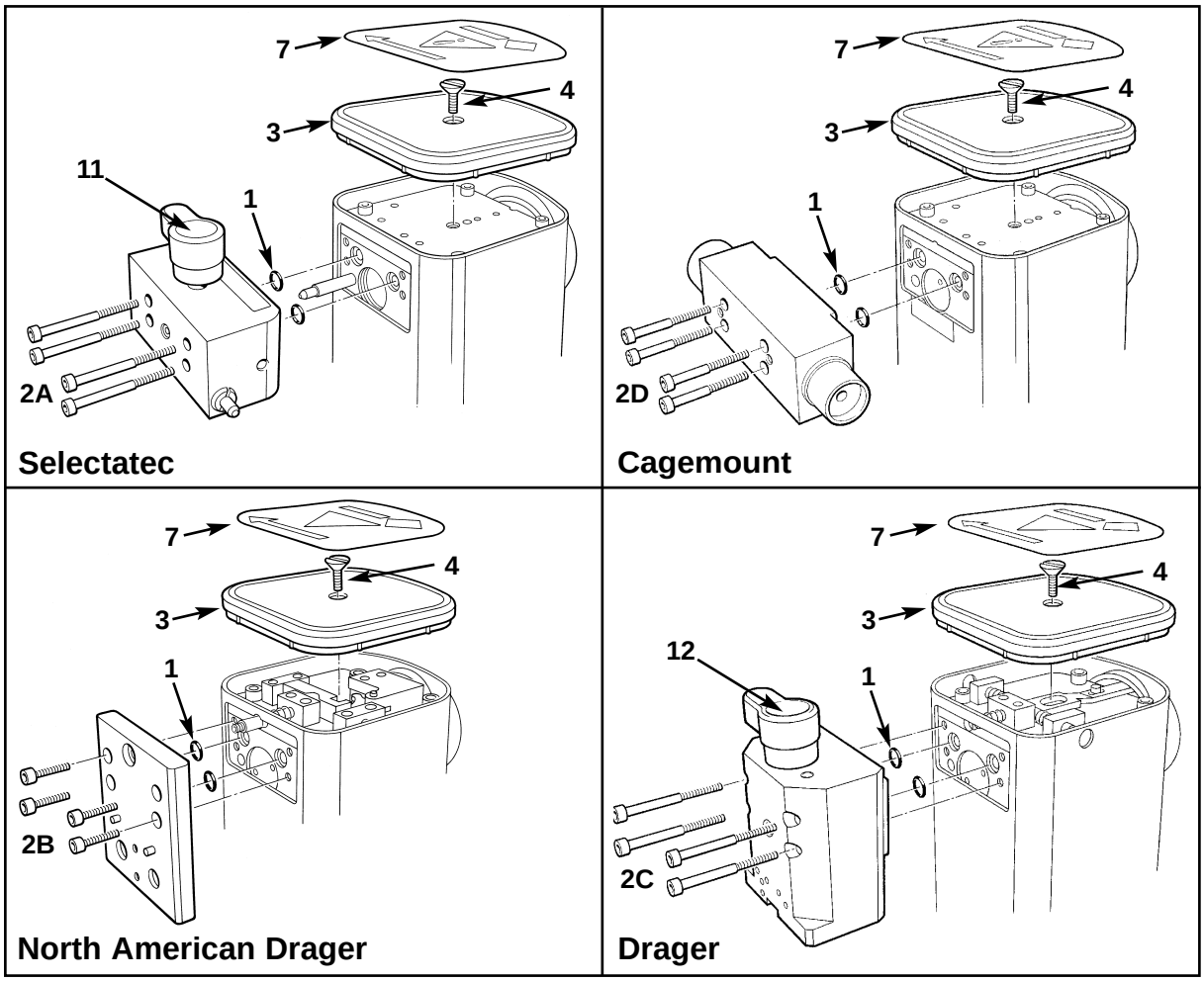
After Calibration:

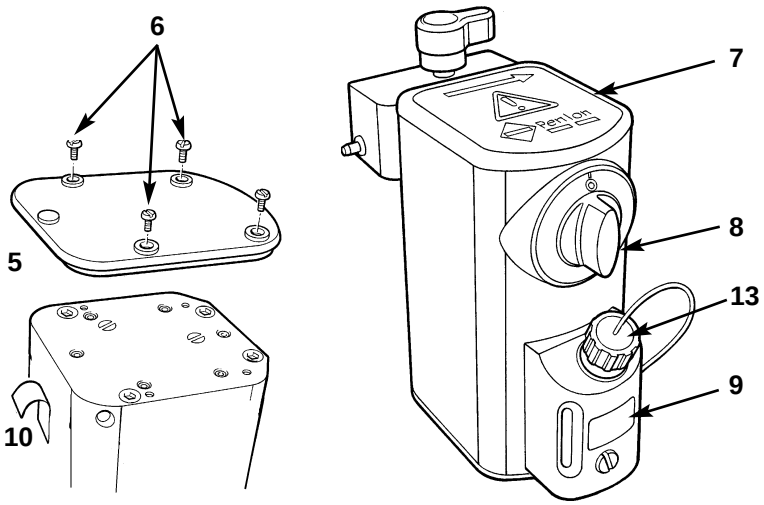
1. Remove the test connector block.
   Refit the original vaporizer connector block, use new O-rings (1) and screws (2A, 2B, 2C and 2D).
   Fit the lid (3) use a new screw (4).
   Fit the bottom cover (5) and use new screws (6).

2. **Labels:**
   Fit new labels to the lid (7), dial (8) and filler block (9) (check labels for correct agent type and language).
   Fit a new Warranty/Anti-tamper label (10).

3. **Service records:**
   Enter details of the service, including any repair work, in the Service Records section of the vaporizer User Instruction Manual.

Connector Blocks





Service Kit Parts

Ref.	Part No.	Qty.
1	041245	2
2A	019126	4
2B	01014	4
2C	019153	4
2D	01031	2
4	019063	1
6	019009	4
7	410554	1
8	410561	1
	Check Agent & Language	
9	410560	1
	Check Agent & Language	
10	15446	1
11	410555	1
12	410556	1
13	410557	1

5.4.4 Leak Test, Bypass resistance and Calibration Check (after servicing)

Allow 4 hours for the vaporizer to temperature stabilise.

5.4.4.1 Vaporizer Leak Test

Workshop Test (preferred method)

1. Use test apparatus A (5.2.4.1) and set a pressure of 200 mmHg.
   Acceptance value:
   pressure drop to 180 mmHg after minimum 60 seconds.

Anaesthetic Machine Test

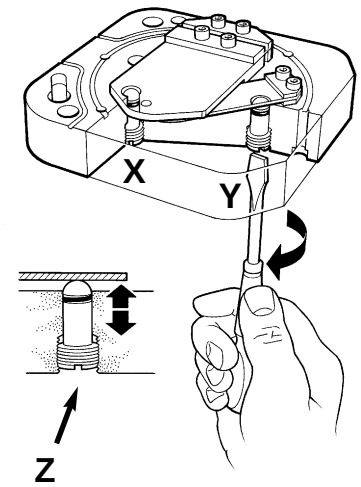
(Use this test only if test apparatus A is not available)

1. Verify the leak tightness of the anaesthetic machine.
   See applicable user/service manual for anaesthetic machine
2. Place vaporizer on the anaesthetic machine.
   The vaporizer must be rigidly supported in its operating position
3. Check for leaks from the vaporizer as follows:
   Attach a pressure gage to the common gas outlet.
   Set the vaporizer to half-scale, with the filler shut.
   Use the low-flow flowmeter of the machine to raise the whole fresh gas system to 150 mmHg.
   Observe the reading on the low-flow flowmeter required to maintain the system at 150 mmHg pressure.
   Acceptance value:
   100 ml/min flow rate or less, to maintain 150 mmHg.
   Confirm the leak is not from the anaesthetic machine by removing the vaporizer and retesting.

REJECT ANY VAPORIZER SHOWING EXCESSIVE LEAKS

5.4.4.2 Bypass Resistance

Use Service Tools 410579 and 53196
Use test apparatus B for flow check (see 5.2.4.2)
Use Loctite Activator 7471, then apply Loctite 222 to the screw threads X and Y.



1. Set the maximum bypass resistance - adjust screw ‘X’.
   Set to ***29 cmH_2O (2.9 kPa) at 4 L/min air***.

2. Adjust the bypass resistance - adjust screw ‘Y’
   Adjust to the value obtained prior to dismantling (unless that figure is outside the Acceptance Value given below)

   Acceptance Value:
   9.4 cmH_2O ± 3.4 cmH_2O
   (Sevoflurane: 10 cmH_2O ± 4 cmH_2O)

5.4.4.3 Checking Vaporizer Output

Calibration - using the Riken Analyser

The Riken Model 1F-18 is normally calibrated by the manufacturer for measuring up to 8% vol. Halothane, or up to 9% vol. Sevoflurane, either in air or in oxygen.
Service checks on the vaporizer must be performed with oxygen if the vaporizer is checked on an anaesthetic machine.
Use air or oxygen if the vaporizer is checked in a test laboratory.

CAUTION
A) It is essential that the gas used during service checks is recorded,
B) The reference cell of the Riken must be purged with the appropriate gas before measurements are made.

Agents

The Riken gas analyser measures the refracfive index of the gases and vapours and, although normally calibrated for measuring halothane, the instrument can also measure other vapours if an appropriate correction factor is applied.
To obtain the true concentration of gases other than halothane multiply the reading shown on the Riken by the correction factors given below.

Carrier Gas

The refractive index of oxygen is higher than that of air so that,
(a) the unit must be re-zeroed if the carrier gas is changed, and
(b) the scale must be adjusted by a correction factor, applied by multiplying the Riken scale reading to obtain the true concentration.

Correction Factors

Halothane in Air Riken:

	Factor (using air)	*Factor (using O_2)*
Halothane	1	1.06
Enflurane	1.05	1.11
Isoflurane	1.06	1.12
Sevoflurane	1.05	1.10

Halothane in Oxygen Riken:

	Factor (using air)	*Factor (using O_2)*
Halothane	0.95	1
Enflurane	0.99	1.05
Isoflurane	1	1.06
Sevoflurane	0.99	1.05

Temperature and Barometric Pressure

Calibration checks must be performed at a temperature between 19 and 21^{O}C.
The correction factor is ± 1.5% of readings, which is negligible in view of the accuracy of the instrument.
Temperature correction is therefore not required, but the temperature should be measured and recorded to ensure that the test is carried out within the specified range.

Changes of barometric pressure due to weather are not normally of significance and can be ignored.

Altitude can, however, have significant effects and the following correction factors should be applied when appropriate.
The Riken reading multiplied by the stated correction factor gives the true concentration corrected to Standard Temperature and Pressure (STP).

Altitude	*Factor*	*Barometric pressure (for reference)*
600 m (2000 ft)	0.9	910 mb
1200 m (4000 ft)	0.85	850 mb
1800 m (6000 ft)	0.8	813 mb

Method of reading the Riken Analyser

1. Readings may be taken from a tee-piece connected to the common gas outlet of the anaesthetic machine.
   An AGS system must be connected.

2. The sampling tube must be nylon or PTFE (which do not absorb vapours).
   Rubber sleeves may be used to make end connections but there must be minimal length of rubber exposed to the gases being sampled.

3. Sample by 2 or 3 squeezes of the hand bulb. Wait for fringe movement to cease before taking the reading.

4. After each resetting of the vapour control, time must be allowed for the output to stabilise.
   Suggested timescale:
   2 L/min flow - wait 4 minutes
   4 L/min flow - wait 2 minutes
   8 L/min flow - wait 1 minute

5. a) The vaporizer must be half full, and rigidly supported in its correct operating position.
   b) Temperatures must be stabilised for approximately 4 hours before checking
   c) The temperature must be in the range 19 to 21^{O}C.

SERVICE PROCEDURES

VAPORIZER OUTPUT CHECK

1. Half-fill the vaporizer with the correct anaesthetic agent.
   Do not refill with the old agent drained prior to disassembly

2. Allow 4 hours for temperature stabilisation.

3. Use Test Apparatus B with analyser and exhaust system (see 5.2.4.3).
   Measure the output of the vaporizer with an approved analyser at the flow and outputs shown. Note the room temperature which must be within $22^{o}C \pm 1^{o}C$.

   Use oxygen as the carrier gas.

   Test with a flow rate of 4 L/min at 0%, 0.2%, 0.6%, 1%,3%, 5%, 7%, and 8% output settings.
   NOTE
   a) Test at 7% and 8% on applicable vaporizers only.
   b) Test also at 4% on Halothane 4% vaporizers.

4. Record the actual value in the User Manual (see sample record sheet on next page).

   Test Values:
   Outputs should be within the Tolerances given in the record sheet.

   REJECT ANY VAPORIZER SHOWING A VARIANCE OUTSIDE THE TOLERANCE VALUES

   IF LOW OR ZERO OUTPUT IS OBTAINED AT ALL SETTINGS, REFILL/CHECK THE LEVEL INDICATOR.

   FOR REPEATED FAILURE OF THE CALIBRATION TEST, PERFORM A SERVICE ON THE VAPORIZER.

5. **When the calibration procedure is completed:**
   a) refit the connector block and top lid
   b) apply Loctite 7400 to the head of each adjusting screw (Z) and refit the bottom cover and labels.
   c) complete the service records for the vaporizer (follow the final three instructions in the Service Overhaul Procedure, section 5.4.3).

SERVICE PROCEDURES

Sample of Service Record Page
(see section 11 in the Delta User Manual)

Test Period		1	2	3	4
Vaporizer serial number:					
Date:					
Signature: Print name:					
Carrier Gas					
Leak Test (at 200 mmHg for minimum 60 secs) *Pressure must not drop below 180 mm Hg*					
Set	*Tolerance*	*Measured Output*			
0.0	0 - 0.1				
0.2	0.14 - 0.26				
0.6	0.45 - 0.75				
1.0	0.8 - 1.2				
3.0	2.4 - 3.6				
*4.0	3.2 - 4.8				
5.0	4.0 - 6.0				
**7.0	5.6 - 8.4				
**8.0	6.4 - 9.6				
**7.0	5.6 - 8.4				
5.0	4.0 - 6.0				
3.0	2.4 - 3.6				
1.0	0.8 - 1.2				
0.6	0.45 - 0.75				
0.2	0.14 - 0.26				
0.0	0 - 0.1				
* 4% Halothane vaporizer only ** 7% and 8% vaporizers only					
Bypass resistance at 4 L/min					

6. PARTS LIST

Overhaul Kits

55146	Delta Overhaul Kit	5 year Halothane - Pour Filler
55145	Delta Overhaul Kit	5 year Halothane - Agent Specific (Key) Filler
55144	Delta Overhaul Kit	10 year Enflurane - Pour Filler
55143	Delta Overhaul Kit	10 year Enflurane - Agent Specific (Key) Filler
55142	Delta Overhaul Kit	10 year Isoflurane - Pour Filler
55141	Delta Overhaul Kit	10 year Isoflurane - Agent Specific (Key) Filler
55140	Delta Overhaul Kit	10 year Sevoflurane - Pour Filler
55139	Delta Overhaul Kit	10 year Sevoflurane - Agent Specific (Key) Filler
55147	Delta Overhaul Kit	10 year Sevoflurane - Quik Fil Filler

PARTS LIST - Overhaul Kit Contents

Parts supplied in all kits:

	Part No.	Qty
Valve Block and Wicks		
Top Seal (EPE)	410550	1
Wick Seal (EPE)	410636	3
Screw - M6 x 60 cap head	019069	4
Bottom Seal (EPE)	410551	1
Small Volume Seal (EPE)	410591	1
Seal - Small Volume Bolt (Acetal)	410638	1
Sheath - metal wick	410643	1
Wick	410615	1
Needle Housing		
Needle Housing O-seal	041243	1
Needle Housing O-seal	041239	1
Needle Bal Seal	042820	1
Housing Locknut O-seal	041214	1
Grubscrew - M3 x 6 socket head	019028	1
Control Dial (fixings)		
Full Scale Stop		
M2.5 x 12 Cap Head Screw	019159	2
M3 x 8 Pan Head Screw	019002	2
Needle Drive Housing		
M4 Spring Washer	025207	2
M3 x 6 SKT. HD Grub Screw	019028	1
Dial		
M3 x 16 Cap Head Screw	019087	2
'E' Clip	020431	1
Closing Mechanism		
O-seal	0226	1
Retaining Washer	408042	1
M3 x 8 pan head Screw	019002	2
O-seal - Closing Mechanism	041221	1
Bal Seal	042809	1
M12 x 55 Hex Head Screw	019156	1
M3 Washer, Plain	01067	2
Covers (fixings)		
Lid and Base:		
Screw - M3 x 8 Cap Head	019009	4
Screw - M6 x 25 Csk Head	019063	1
Dial Bezel:		
Screw - M3 x 6	019011	2
Temperature Compensator		
Seal - TC Cover (EPE)	410684	1
M3 x 20 Cap Head Screw	019003	6
Bi-metallic Strip:		
M3 x 8 Cap Head Screw	019009	2
TC Plate:		
M3 x 6 Cap Head Screw	019011	2
Grubscrew - M3 x 8 SKT Head	01195	1
TC Hinge:		
M3 x 13 Cap Head Screw	01083	2
O-seal - TC Setting Screws	041242	2
M6 x 30 Screw	019155	4

	Part No.	Qty
Filler Block - all variants		
Sight Glass	410594	1
Ball	011273	1
O-seal	041215	3
O-seal	041221	2
Screw - M4 x 40 cap head	019154	2
Sight glass top insert	410640	1
O-seal	041253	3
Connector Block (all types)		
Screw - M6 x 25 CSK Head	019063	1
O-seal	041245	2
Selectatec Connector Block		
Screw M4 x 55 Cap Head	019126	4
Drager Connector Block		
Screw M4 x 50 Cap Head Screw	019153	4
Interlock:		
Screw M3 x 16	019087	6
North American Drager Connector Block		
Screw M4 x 50 Cap Head	01014	4
Interlock:		
Screw M3 x 14	019110	8
Grubscrew M5	019074	1
Cagemount Connector Block		
Screw M4 x 35 Cap Head	01031	4
Labels		
Top Lid	410554	1
Cap - Quik-Fil / Pour Fill	410557	1
Warranty / Anti-tamper	15446	1
Selectatec Knob	410555	1
Drager Knob	410556	1

Parts specific to Agent type or Filler Block:

Quik-Fil		
Cap seal	409056	1
Cap O-seal	041245	1
Plug	409043	1
Screw	019011	1
Drain Screw Assembly	409027	1
Grubscrew M3x6	019011	1
Cap O-seal	041231	1
Cord	011135	1
Plunger seal	409050	1
O-seal - Plunger housing	041244	1
Pour Fill		
Plug	409043	
Screw	019009	1
Drain Screw Assembly	409027	1
Cap O-seal	041245	1
Cap seal	409056	1
Cord	011135	1

PARTS LIST - Overhaul Kit Contents

Key Fill

Screw	019009	4
Seal	408294	1
Screw	019122	2
Screw	01059	1
Bal Seal	042812	1
Seal	410685	1
Key (Iso/Sevo)	410607	1
Key (Hal/Enf)	410608	1

Labels

(Kits contains English language labels only, please refer to the parts list on next page.)

Filler Block - English	410560	1
Dial - English	410561	1

PARTS LIST

Part No	*Description*

Labels

Label - Dial - 'PUSH ON'

Agent: Sevoflurane

410561-SEN	Label - English
410561-SFR	Label - French
410561-SGE	Label - German
410561-SSP	Label - Spanish

Agent: Isoflurane

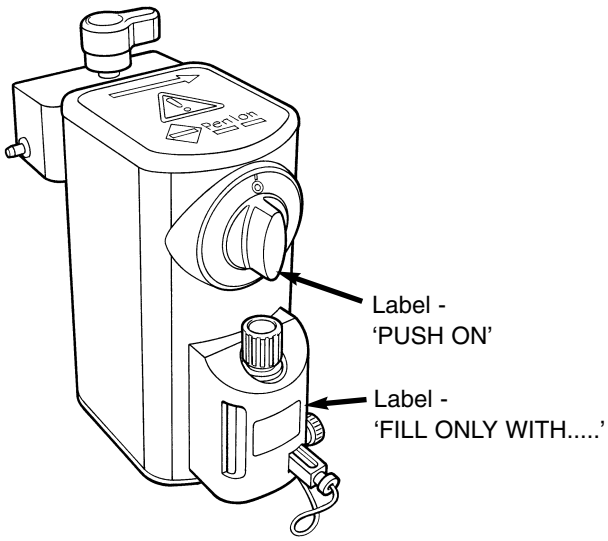
410561-IEN	Label - English
410561-IFR	Label - French
410561-IGE	Label - German
410561-ISP	Label - Spanish

Agent: Enflurane

410561-EEN	Label - English
410561-EFR	Label - French
410561-EGE	Label - German
410561-ESP	Label - Spanish

Agent: Halothane

410561-HEN	Label - English
410561-HFR	Label - French
410561-HGE	Label - German
410561-HSP	Label - Spanish



Label - Filler Block - 'FILL ONLY WITH.....'

Agent: Sevoflurane

410560-SEN	Label - English
410560-SFR	Label - French
410560-SGE	Label - German
410560-SSP	Label - Spanish

Agent: Isoflurane

410560-IEN	Label - English
410560-IFR	Label - French
410560-IGE	Label - German
410560-ISP	Label - Spanish

Agent: Enflurane

410560-EEN	Label - English
410560-EFR	Label - French
410560-EGE	Label - German
410560-ESP	Label - Spanish

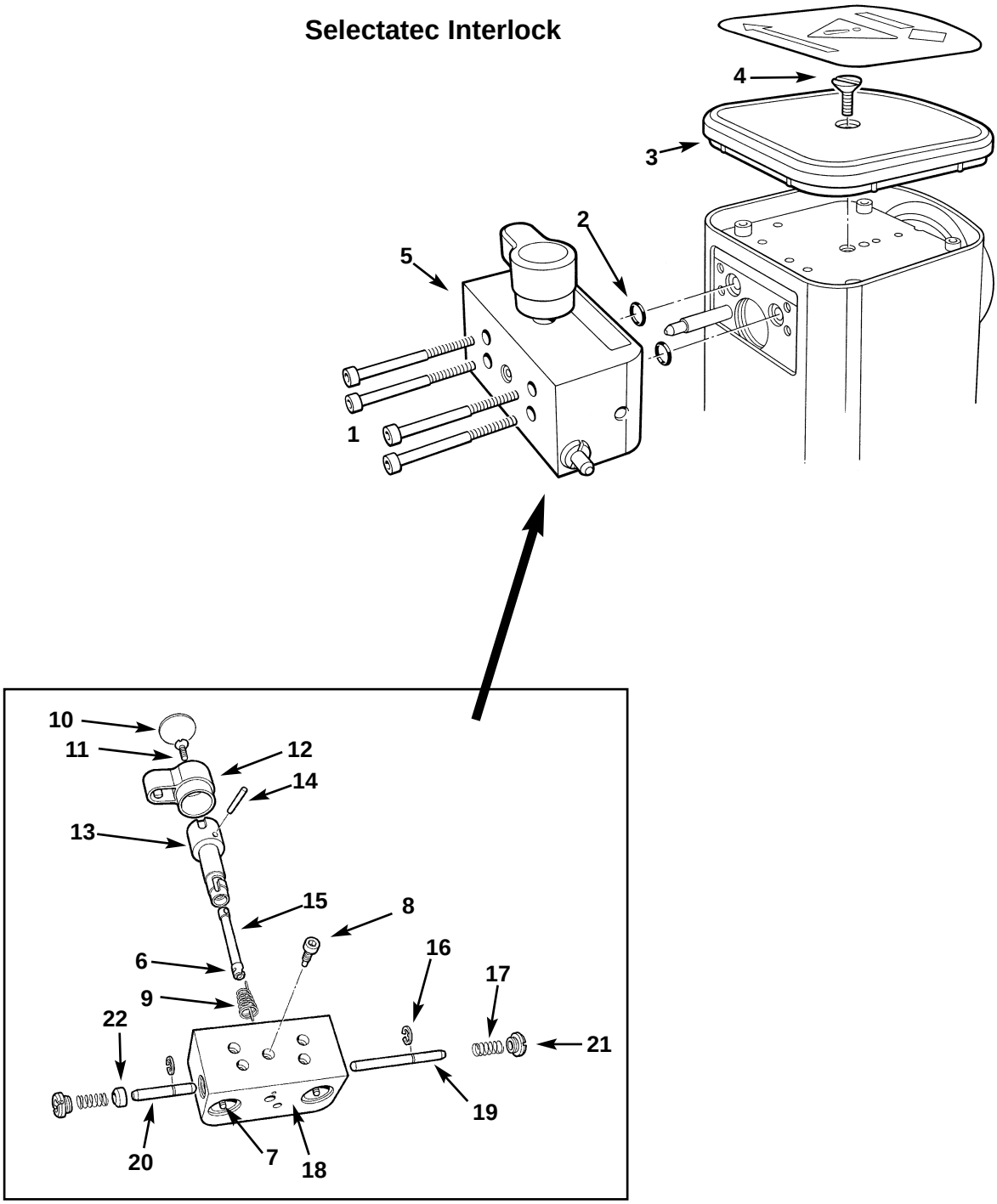
Agent: Halothane

410560-HEN	Label - English
410560-HFR	Label - French
410560-HGE	Label - German
410560-HSP	Label - Spanish

PARTS LIST

Ref	*Part No*	*Qty*	*Description*
Selectatec Interlock			
1	019126	4	Screw M4 x 35 Cap Head SKT. ST.STL
2	041245	2	O ring, 07 x 1.5, Viton
3	410537	1	Top Cover
4	019063	1	Screw, M6, countersunk
5	410529	1	Connector Block Assembly - Selectatec Interlock
			Comprising:
7	Not available		
8	408394	1	Locking Screw
9	031039	1	Spring
10	410555	4	Label, Push and Lock
11	01053	2	Screw M4 x 8 Csk Head
12	410534	1	Moulded Knob
13	410581	1	Knob Shaft
14	020510	2	Dowel Pin, 3.0 mm x 23
15	410576	2	Dzus Pin
16	020430	2	Circlip
17	031044	2	Spring
18	410580	2	Connector Block
19	410577	1	Shootbolt-large
20	410578	1	Shootbolt-small
21	410536	2	Moulded Bush
22	410681	2	Bush

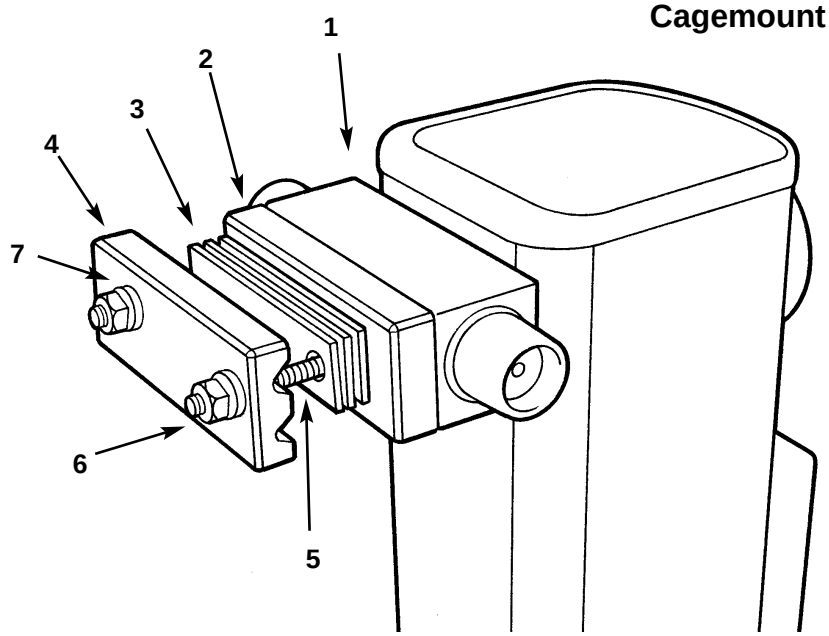
Selectatec Interlock



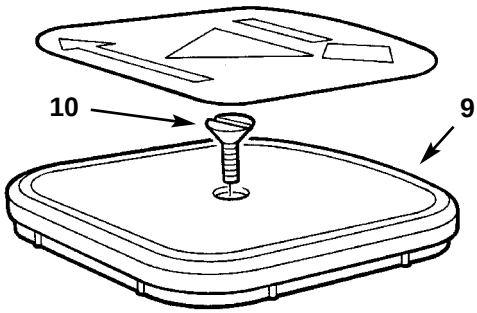
PARTS LIST

Ref	*Part No*	*Qty*	*Description*
2 Hole Cagemount			
1	410579	1	Cagemount Block
2	410631	1	Spacer
3	22693	6	Shim
4	36052	1	Backbar Clamp
5	23195	2	Stud
6	01012	2	Nut M6
7	01015	2	Washer M6
Three Hole Cagemount			
1	410730	1	3 Hole Cagemount Block
2	410731	1	3 Hole Cagemount Spacer
3	410733	6	3 Hole Shim
4	410734	1	3 Hole Backbar Clamp
5	01015	6	Washer M6
6	01012	6	Nut M6
7	01063	3	Screw M6 x 50 Cap Head
8	23195	3	Stud
Top Cover			
9	410537	1	Top Cover
10	019063	1	Screw, M6

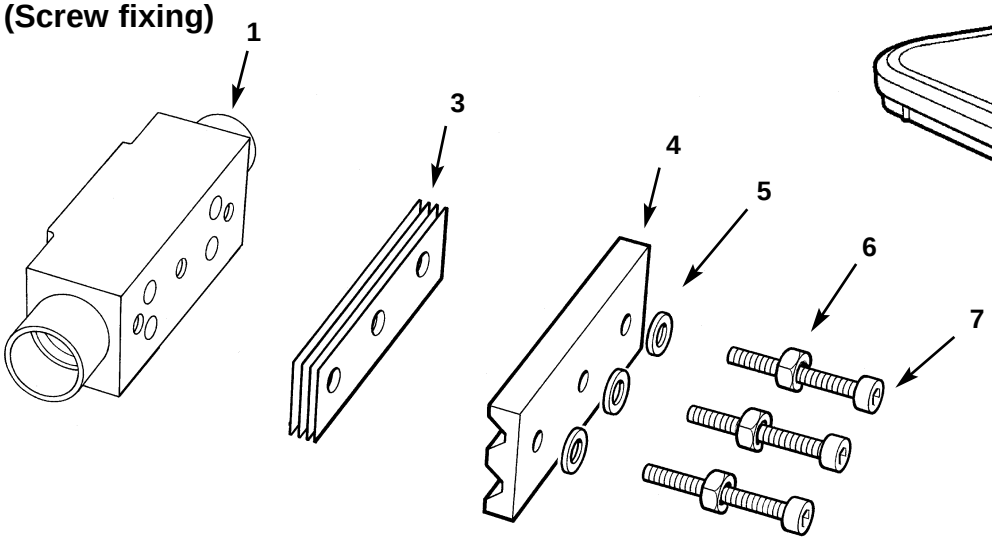
Cagemount - 2 hole

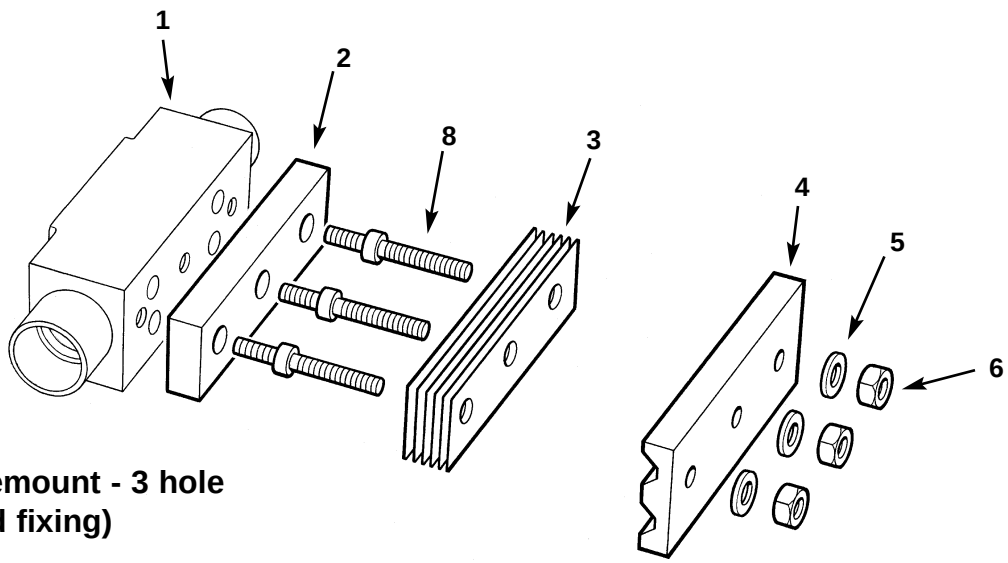


Top Cover



Cagemount - 3 hole (Screw fixing)

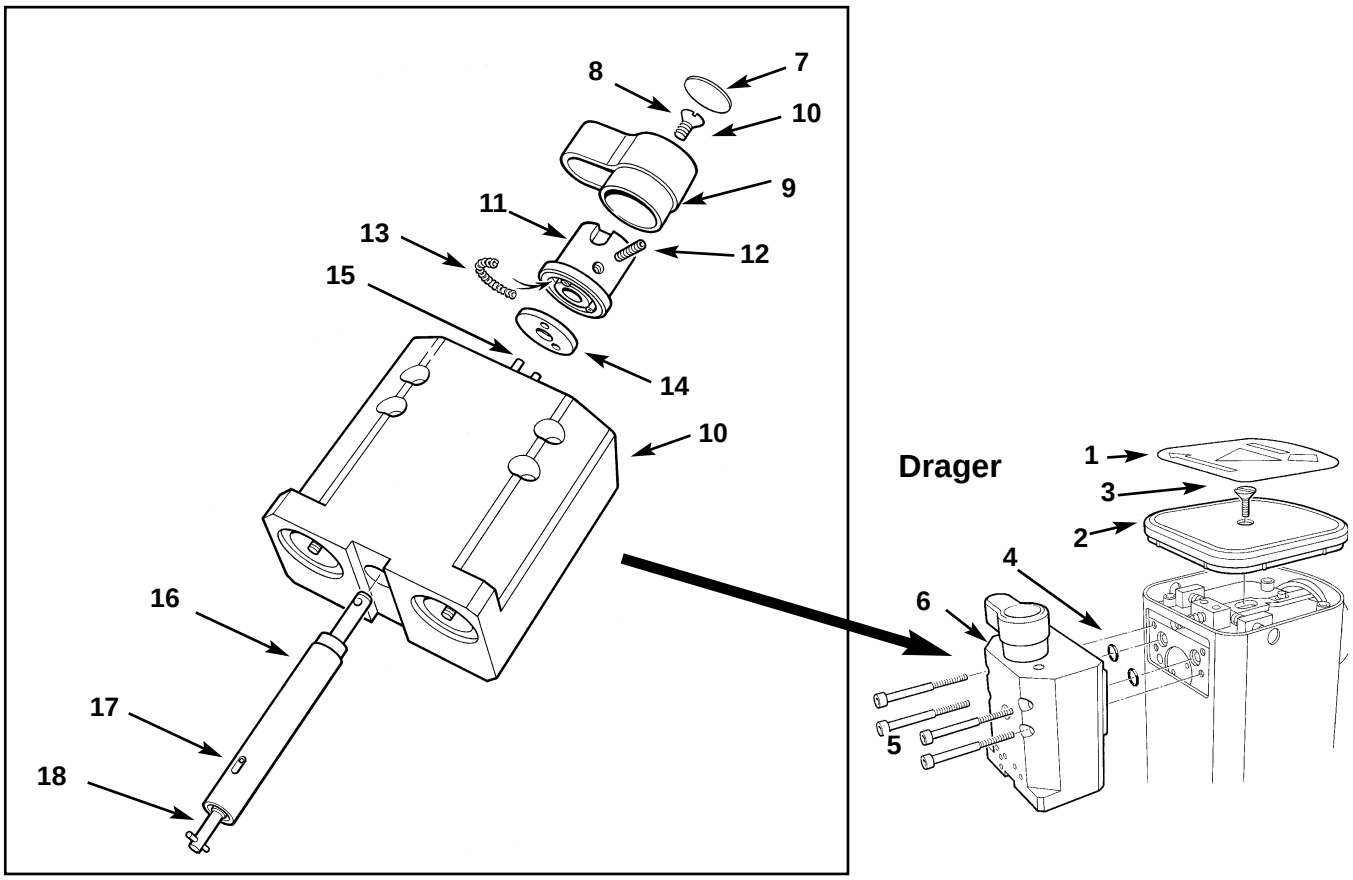




Cagemount - 3 hole (Stud fixing)

PARTS LISTS - Drager Connector Block and Top Cover

Ref.	*Part No.*	*Description*	*Qty*
Drager Connector Block and Top Cover			
1	410554	Label	1
2	410537	Top cover	1
3	019063	Screw, M6, countersunk	1
4	041245	O-ring, Viton	2
5	019153	Screw, M4 x 50, cap-head	4
6	410625	Drager Connector Block Assembly	1
Comprising:			
7	410556	Label	1
8	01053	M4 x 8 CSK 55	1
9	410534	Knob Cover (grey)	1
10	410660	Drager Connector Block	1
11	408326	Knob Assembly	1
12	019081	Grub Screw M3 x 12	1
13	031028	Spring	1
14	24647	Washer	2
15	0302	Roll Pin $^{3}/_{32}$" x $^{1}/_{2}$"	1
16	410624	Knob Shaft Assy	1
17	020512	Pin $^{3}/_{32}$" x $^{7}/_{16}$"	1
18	24627	Locking Shaft Pin Assy	1
Interlock System			
19	410669	Slide	1
20	410770	Push Rod Roller	1
21	410771	Push Rod Bush	1
22	019002	M3 x 8 Pan Head, ST. STL Screw	1
23	019049	Screw, M3 x 10	1
24	025608	Washer, M3, nylon	2
25	410667	Shaft	1
26	410672	Block	2
27	019043	Screw, M3 x 16 cap-head	6
28	410674	Pin Locator	1
29	410671	Pin	1
30	031044	Spring	3
31	020430	Circlip	1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Drager
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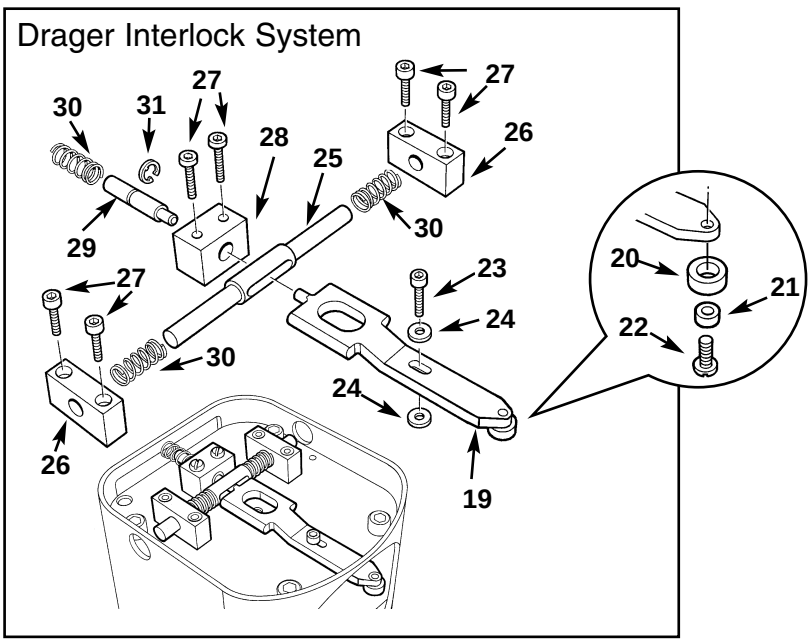
Drager Interlock System
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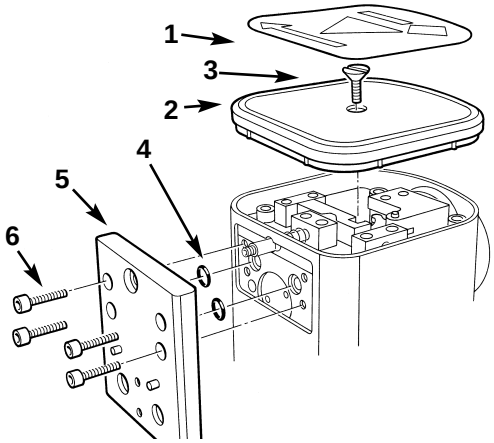
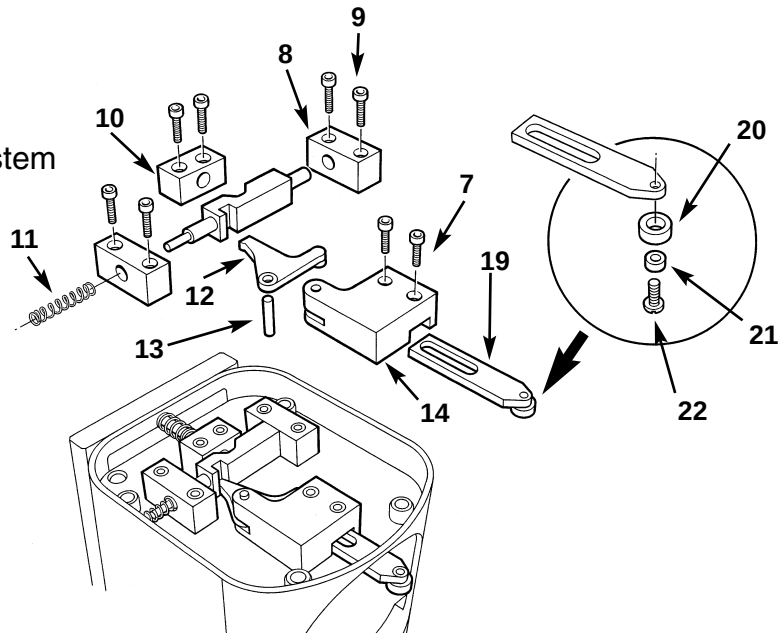
PARTS LISTS - NAD Connector Blocks and Top Covers

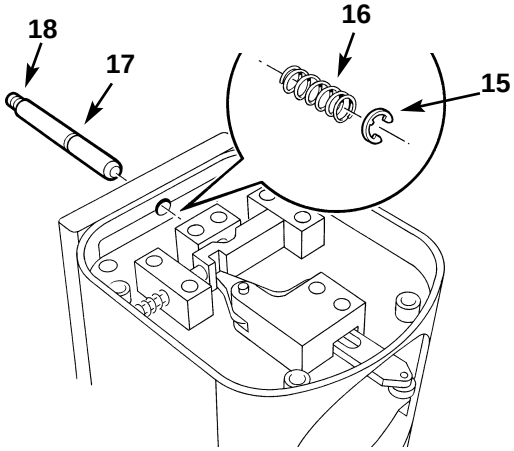
Ref.	*Part No.*	*Description*	*Qty*
NAD Connector Blocks and Top Covers			
1	410554	Label	1
2	410537	Top Cover	1
3	019063	Screw,M6 Csk	1
4	041245	O-ring , Viton	2
5	410665	Connector Block Assy - NAD	1
6	01014	Screw M4x16 Cap Hd	1
Interlock System			
7	410767	Guide block	1
8	410672	Shaft Block	2
9	019110	Screw M3 x 14 Cap Hd	8
10	410674	Pin Locator	1
11	031060	Spring	1
12	410675	Lever	1
13	020531	Dowel 3x 12	1
14	410767	Guide Block	1
15	020430	Circlip	1
16	031044	Spring	1
17	410678	Pin	1
18	019074	Grubscrew M5 x 16	1
19	410702	Push Rod Assembly, includes:	1
20	410770	Roller	1
21	410771	Bush	1
22	019002	Screw M3 x Pan Head, ST.STL.	1

North American Drager



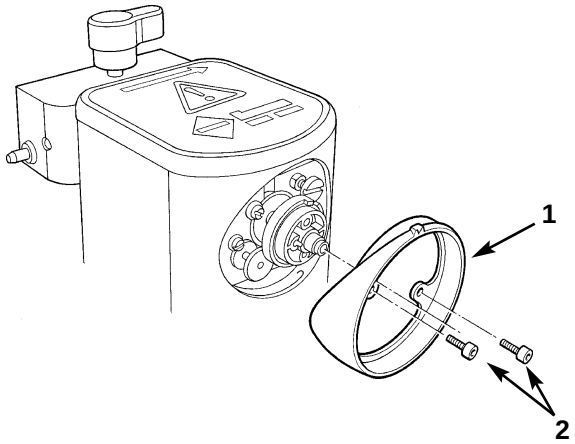
Interlock System



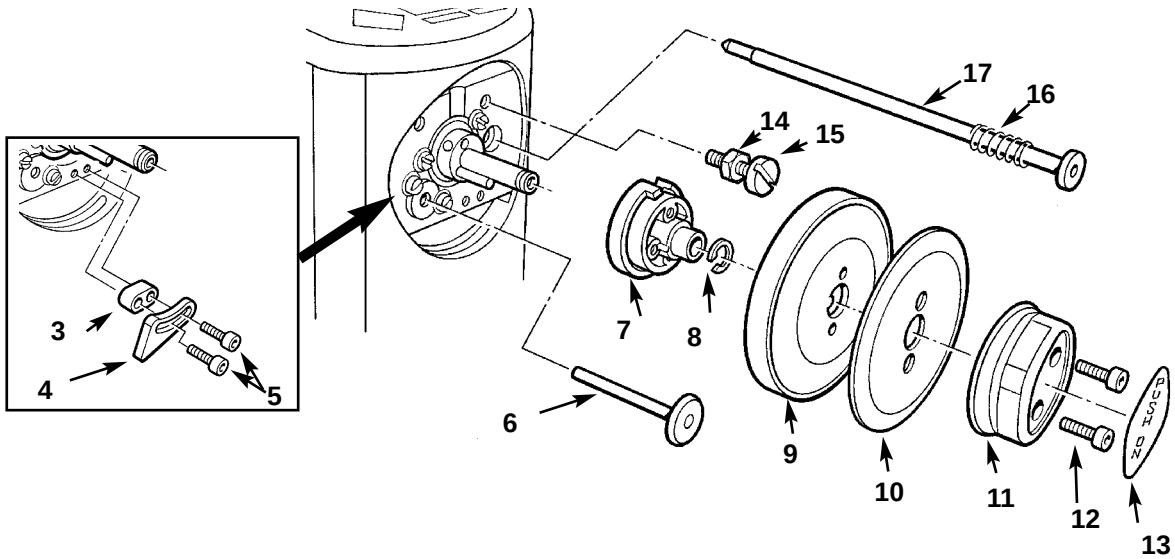


PARTS LISTS - Control Dial Mechanism

Ref.	*Part No.*	*Description*	*Qty.*
Control Dial Mechanism			
1	410535	Bezel	1
2	019011	Screw, M3 x 6, cap head	2
3	410635	Spacer	1
4	410634	(Dial Max.) Stop	1
5	019159	Screw M2.5 x 12 cap-head	2
6	410506	Shaft, Closing Mechanism	1
7	410664	Dial Drive	1
8	020431	Clip	1
9	410540	Dial Housing	1
10	410658	Dial Base	1
11	410544	Dial Knob	1
		Note: state language and agent required	
12	019087	Screw, M3 x 16, cap head	2
13	410561	Label (see page 69 for language and agent variants)	1
14	410595	Dial Zero Lock Screw	1
15	01023	Nut, M4	1
16	031060	Spring	1
17	410528	Interlock Pin (Selectatec)	1
	410527	Dial return shaft (Cagemount / Drager / North American Drager) - not shown	

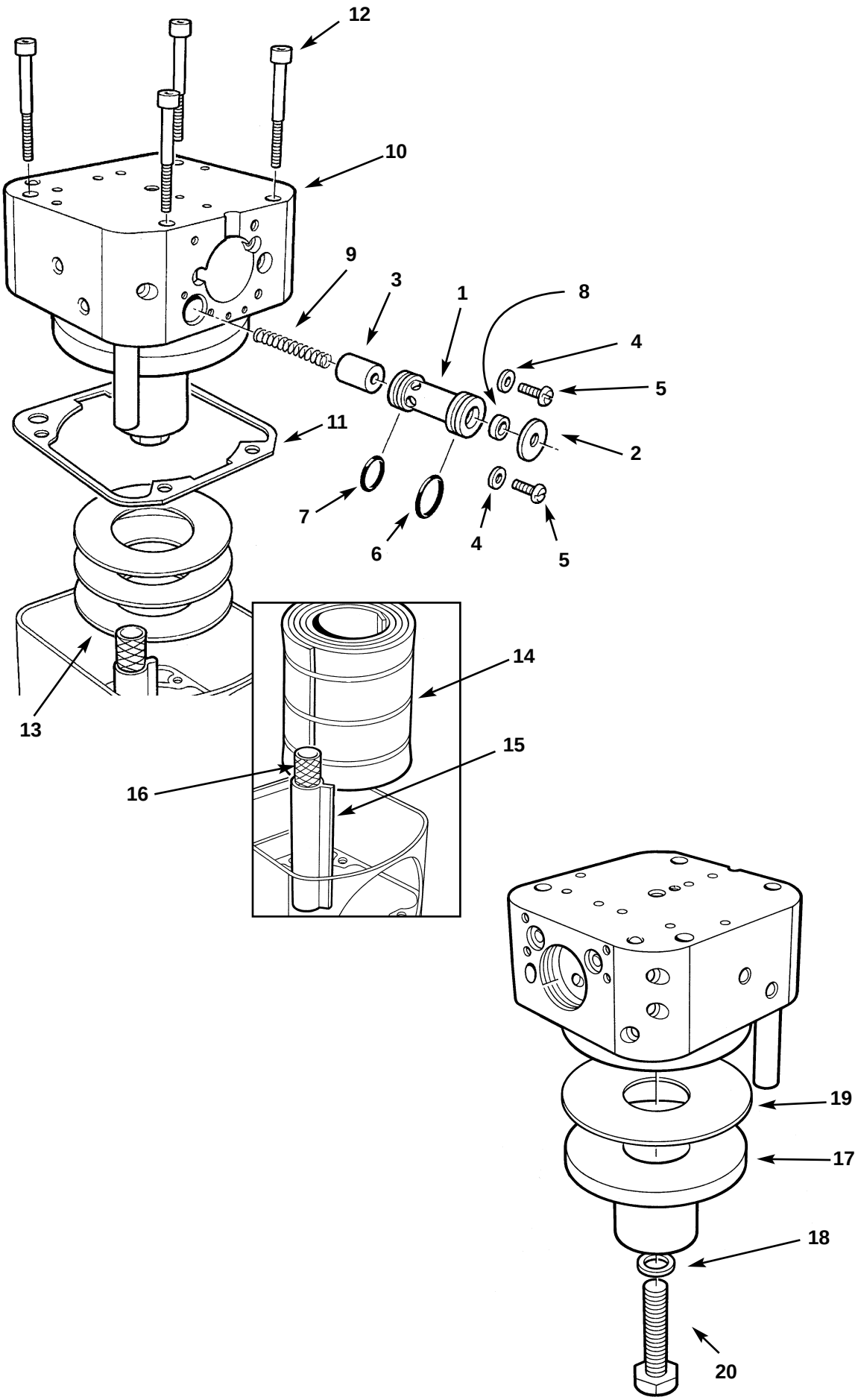


Control Dial Mechanism



PARTS LIST

Ref	*Part No*	*Qty*	*Description*
Closing Mechanism and Wicks			
1	408041	1	Spool
2	408042	1	Retaining Washer
3	410592	1	Seal
4	01067	2	Washer, M3
5	019002	2	Screw, M3 x 8 Pan Head
6	0226	1	O' Seal
7	041221	1	O' Seal
8	042809	1	Bal Seal
9	031054		Spring
10	410532	1	Valve Block
11	410550	1	Seal
12	019069	4	Screw M6 x 60 Cap Head
13	410636	3	Seal, Wick
14	410615	1	Wick
15	410643	1	Small Wick
16	410642	1	Small Wick Support
17	410667	1	Cover
18	410638	1	Seal,
19	410591	1	Seal,
20	019156	1	Bolt, M12 x 55 Hex. Head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PARTS LIST

Ref	*Part No*	*Qty*	*Description*

Needle Assembly and Needle Drive

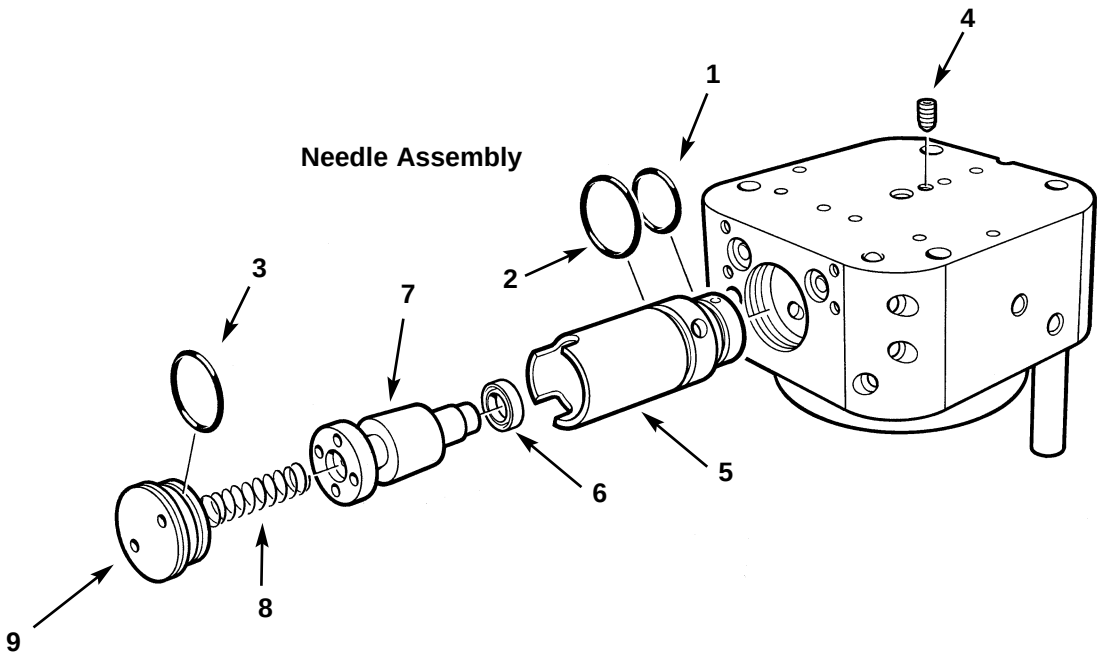
Needle Assembly

1	041243	1	O seal
2	041239	1	O seal
3	041214	1	O seal
4	019028	1	M3 x 6 Grubscrew
5	41059	1	Needle Housing
6	042820	1	Bal Seal
7	410542	1	Needle
8	031057	1	Spring
9	410545	1	Locknut - needle housing

Needle Drive

1	019028	2	Grubscrew
2	410548	1	Screw - needle setting
3	410546	1	Needle shaft - Enflurane
	510547	1	Needle shaft - Sevoflurane
	510648	1	Needle shaft - Isoflurane and halothane
4	410586	1	Housing - needle - Enflurane
	410587	1	Housing - needle - Sevoflurane
	410649	1	Housing - needle - Isoflurane and halothane

Note that the housing and needle drive assembly must be renewed together.


Needle Assembly
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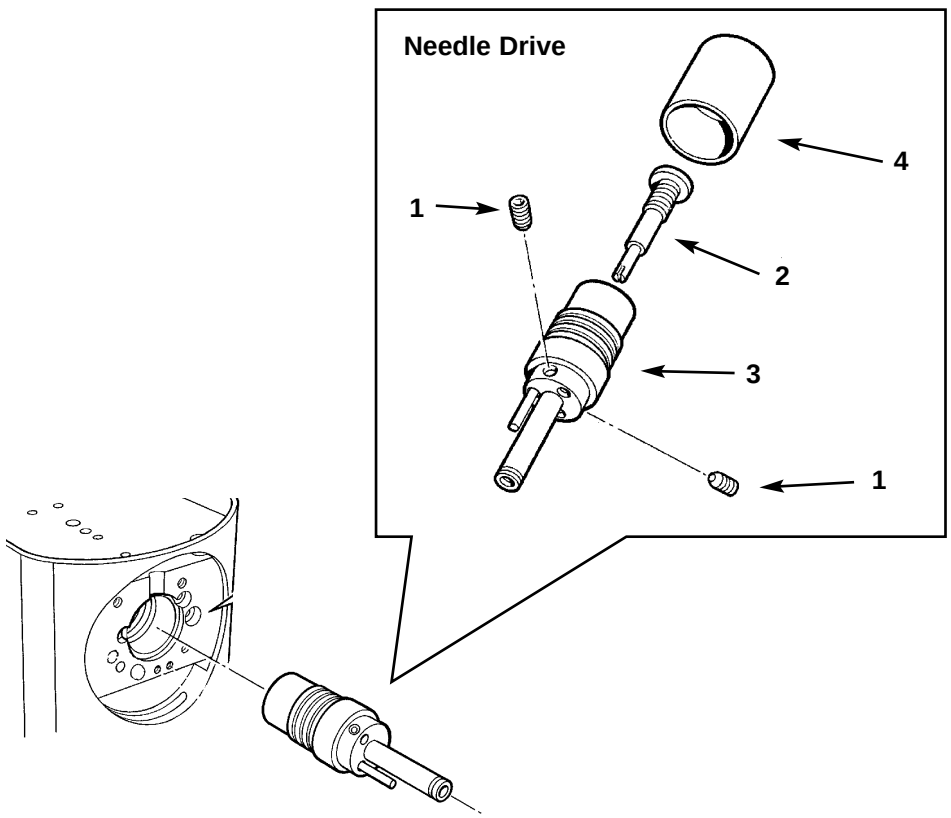
Needle Drive
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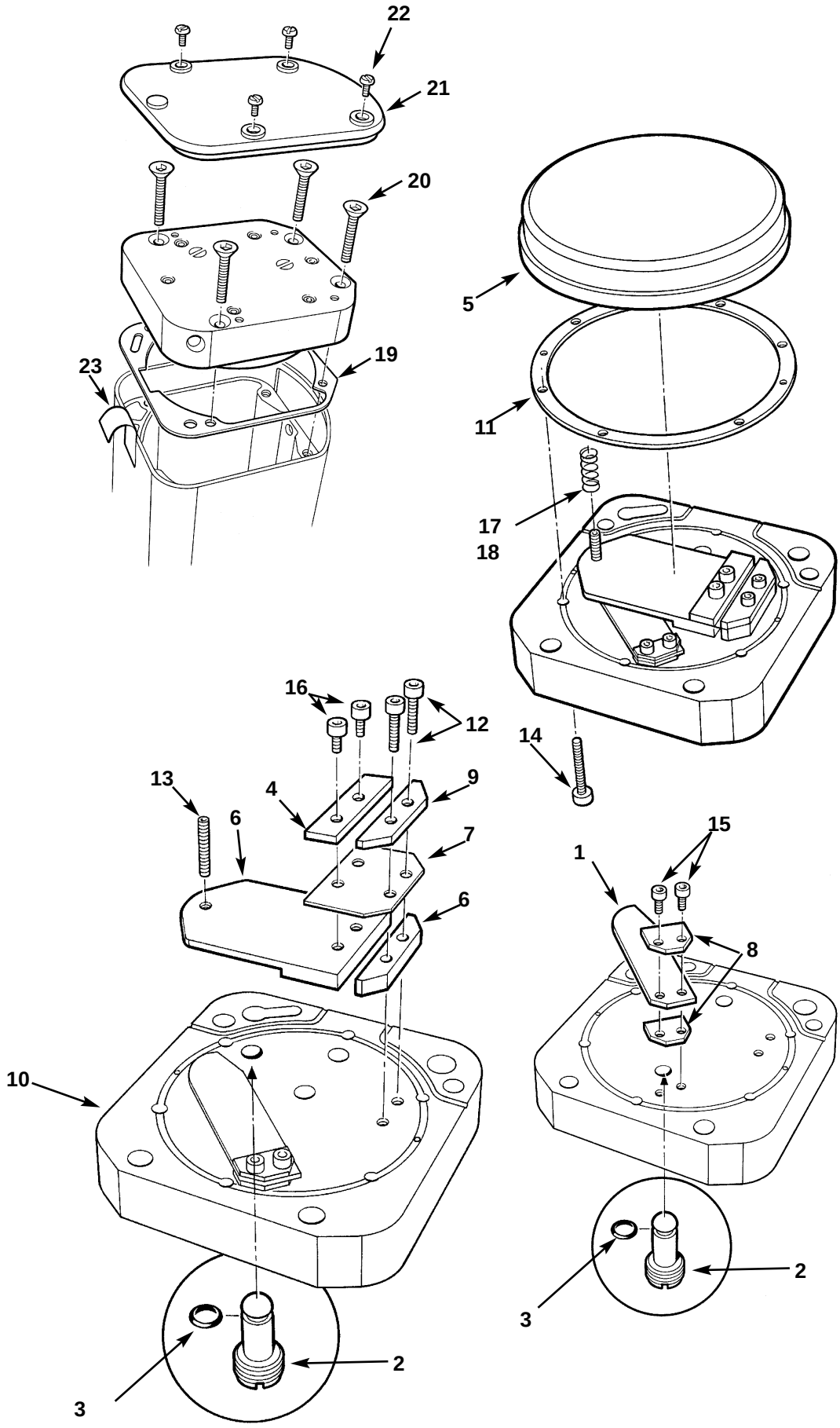
PARTS LIST

Ref	*Part No*	*Qty*	*Description*
Temperature Compensator			
1	410566	1	Bi-Metallic Strip
2	410567	2	Setting Screw
3	041242	2	O' Seal
4	410568	1	Bypass Fixing Plate
5	410569	1	TC Cap
6	410570	1	Bypass Plate (spring / Hinge spacer) (pair)
7	410571	1	TC Hinge
8	410572	2	Clamp
9	410574	1	Spring/ Hinge Clamp
10	410575	1	TC Base
11	410684	1	Cap Seal
12	01083	2	Screw, M3 x 13 Cap Head
13	01195	1	Grub Screw, M3 x 8
14	019003	6	Screw, M3 x 20 Cap Head
15	019009	2	Screw, M3 x 8 Cap Head
16	019011	2	Screw, M3 x 6 Cap Head
17	031055	1	Spring Sevo / Enf
18	031061	1	Spring Iso / Hal
19	410551	1	Seal
20	019055	4	Screw, M6 x 30 Csk Head
21	410538	1	Base
22	019009	4	Screw, M3 x 8 Cap Head
23	15446	1	Anti - tamper Label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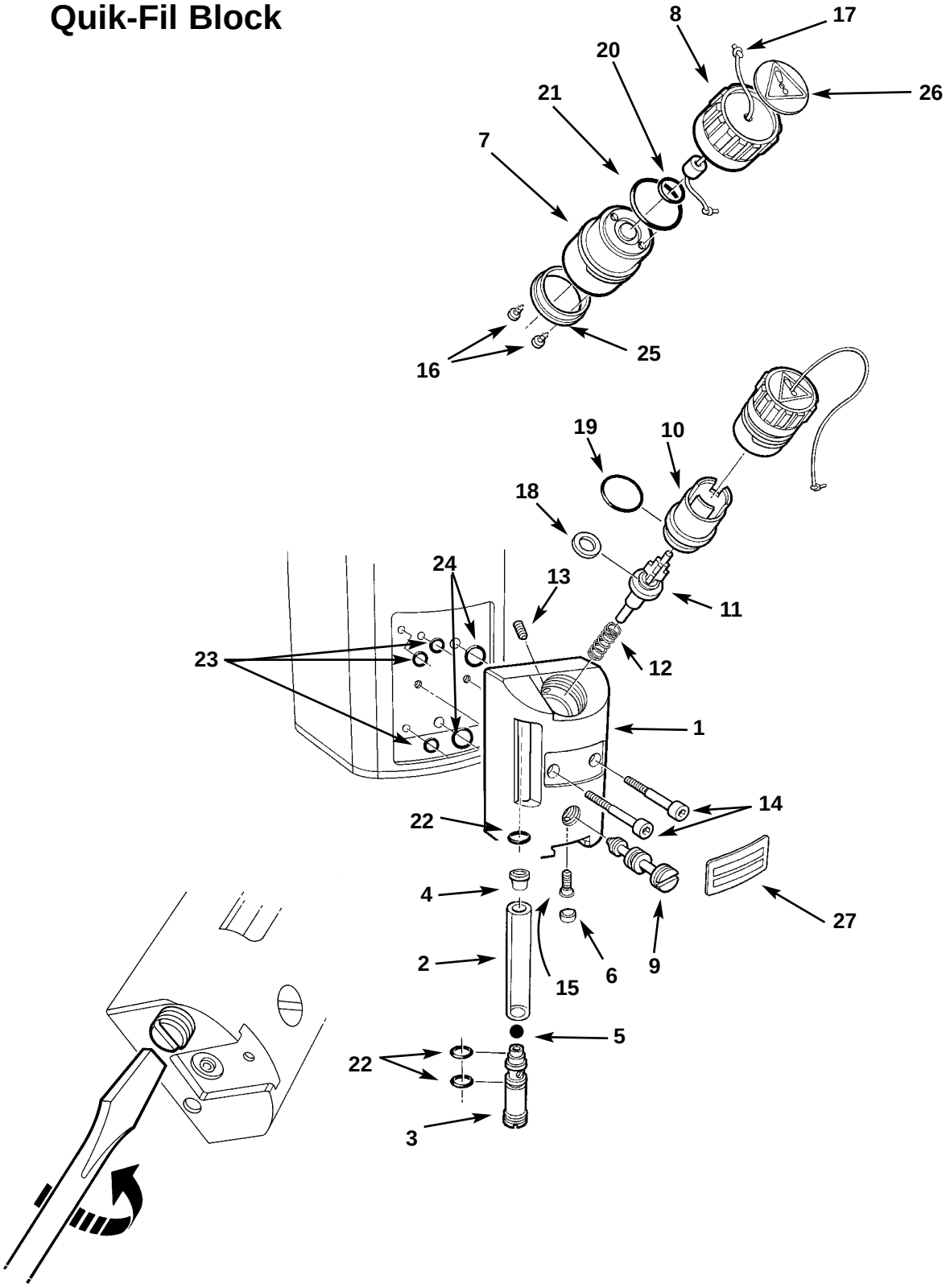
PARTS LIST

Ref	*Part No*	*Qty*	*Description*
Quik Fil Block			
1	410508	1	Filler Block, Quik Fil
2	410594	1	Sight Glass
3	410593	1	Sight Glass Screw
4	410640	1	Sight Glass Top
5	011273	1	Ball - 4 mm
6	409043	1	Plastic Plug
7	410630	1	Cap Insert
8	410539	1	Cap
9	409027	1	Drain Screw Assy
10	410522	1	Plunger Housing
11	409033	1	Plunger
12	031037	1	Spring
13	019081	1	Screw M3 x 12 Grub
14	019154	2	Screw, M4 x 40 Cap Head
15	019011	1	Screw, M3 x 6 Cap Head
16	020806	2	Screw
17	011135	1	Cord - 0.12 m
18	409050	1	Plunger Seal
19	041244	1	O-seal
20	041245	1	O-seal
21	041231	1	O-seal
22	041253	3	O-seal
23	041215	3	O-seal
24	041221	2	O-seal
25	409056	1	Cap Seal
26	410557	1	Label
27	410560	1	Label (see page 69 for language and agent variants)

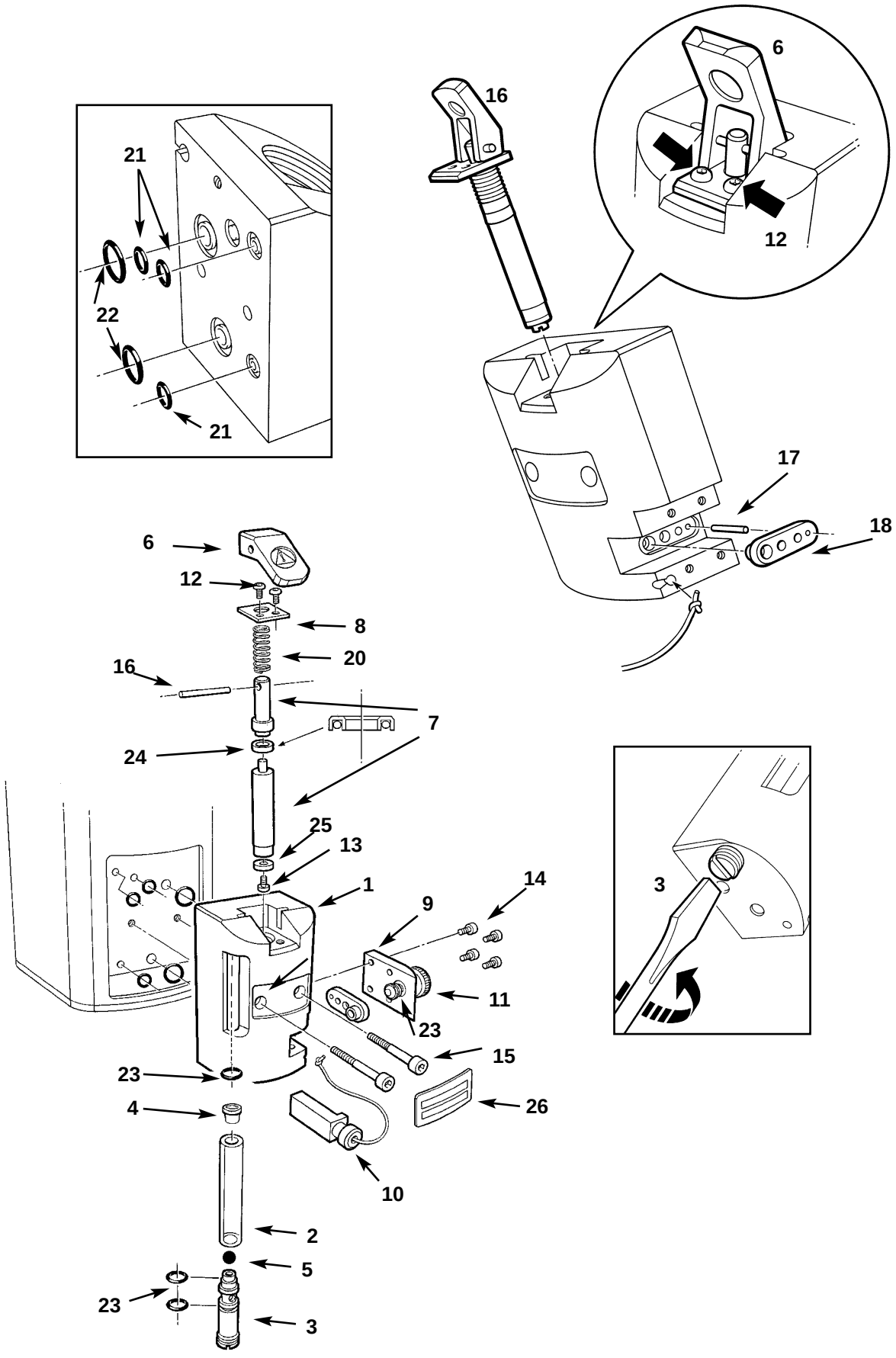
Quik-Fil Block



PARTS LIST

Ref	*Part No*	*Qty*	*Description*
Key Fill Block			
1	410509	1	Filler Block , Key Fill
2	410594	1	Sight Glass
3	410593	1	Sight Glass Screw
4	410640	1	Sight Glass Top
5	011273	1	Ball - 4mm
6	410692	1	Lever - filler control
7	410689	1	Shaft (two part component)
8	410668	1	Base Plate
9	410621	1	Side Plate (Iso)
	410622	1	Side Plate (Sevo)
	410653	1	Side Plate (Hal)
	410653	1	Side Plate (Enf)
10	410607	1	Key (Iso/Sevo)
	410608	1	Key (Hal / Enf)
11	410639	1	Clamp Screw
12	019122	2	Screw, M3 x 6 Skt Head
13	01059	1	Screw, M2.5 x 6 Slot Head
14	019009	4	Screw, M3 x 8 Cap Head
15	019154	2	Screw, M4 x 40 Cap Head
16	020528	1	Pin (Filler control lever)
17	01277	1	Pin
18	408294	1	Seal Moulding
19	020404	1	Circlip
20	031059	1	Spring
21	041215	3	O Seal
22	041221	2	O Seal
23	041253	3	O Seal
24	042812	1	Bal Seal
25	410685	1	Seal EPE
26	410560	1	Label (see page 69 for language and agent variants)

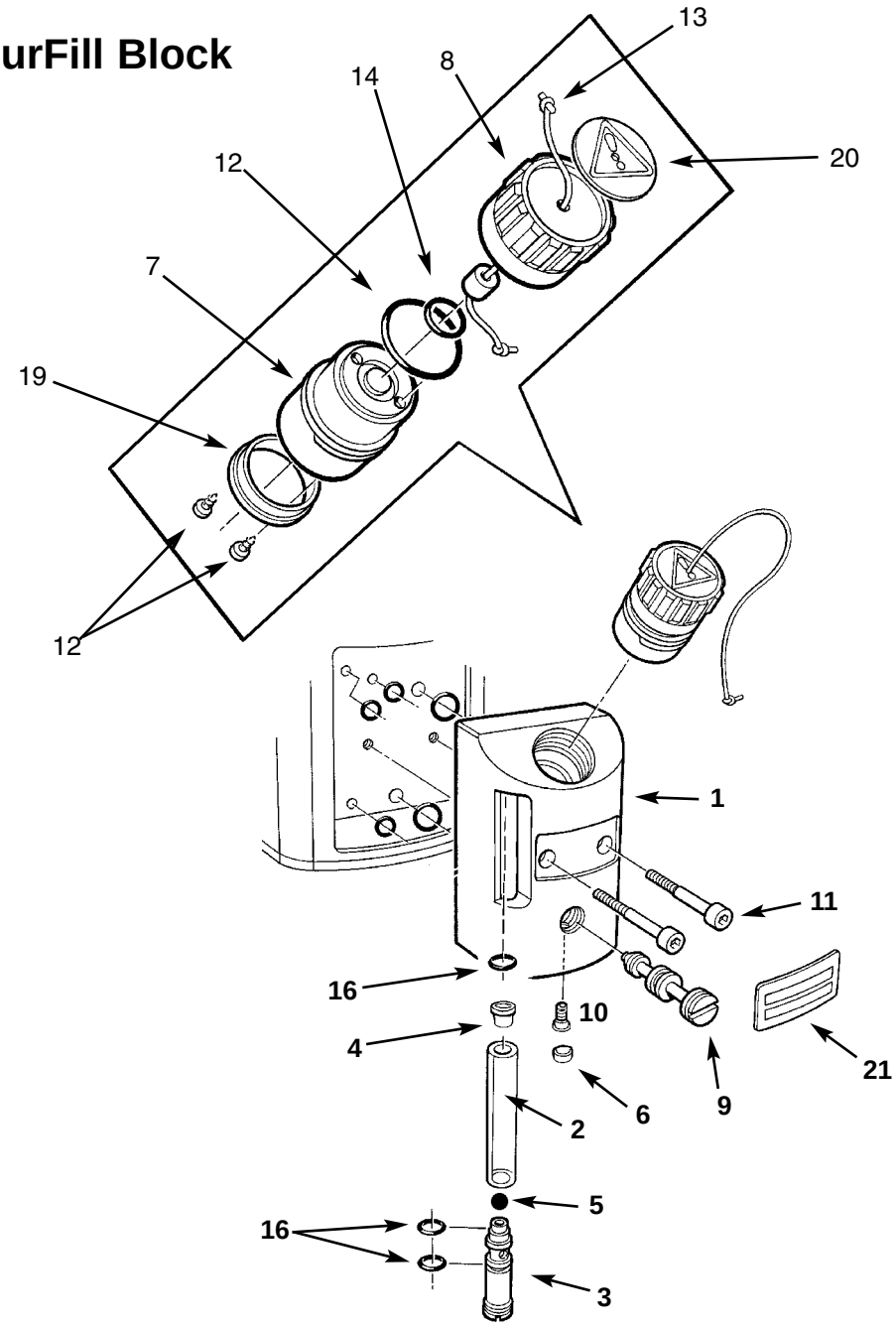
Key Filler Block

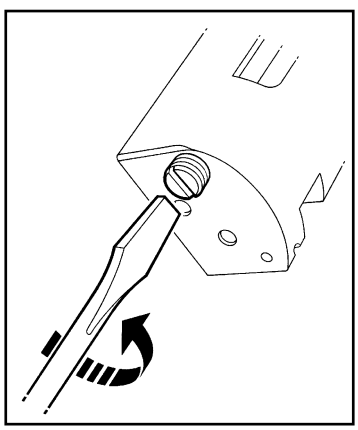


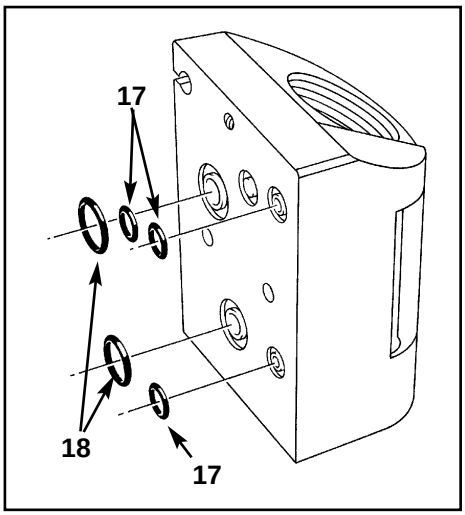
PARTS LIST

Ref	*Part No*	*Qty*	*Description*
Pour Fill Block			
1	410584	1	Filler Block, Pour Fill
2	410594	1	Sight Glass
3	410593	1	Sight Glass Screw
4	410640	1	Sight Glass Top
5	011273	1	Ball, 4 mm
6	409043	1	Plastic Plug
7	409047	1	Cap Insert
8	410539	1	Cap
9	409027	1	Drain Screw Assembly
10	019009	1	Screw, M3 x 8 Cap Head
11	019154	2	Screw, M4 x 40 Cap Head
12	020806	2	Screw
13	011135	1	Cord, 0.12 m
14	041245	1	O' Seal
15	041231	1	O' Seal
16	041253	3	O' Seal
17	041215	3	O' Seal
18	041221	2	O' Seal
19	409056	1	Cap Seal
20	410557	1	Label
21	410560	1	Label (see page 69 for language and agent variants)

PourFill Block







PARTS LIST

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CE

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January 2002

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