

Service Manual

Read these Instructions before use

Keep this 'Service Manual' in a safe convenient place for future reference. Read in conjunction with the Publication detailed in Part 1.

This Service Manual applies to the following Autoclaves:-

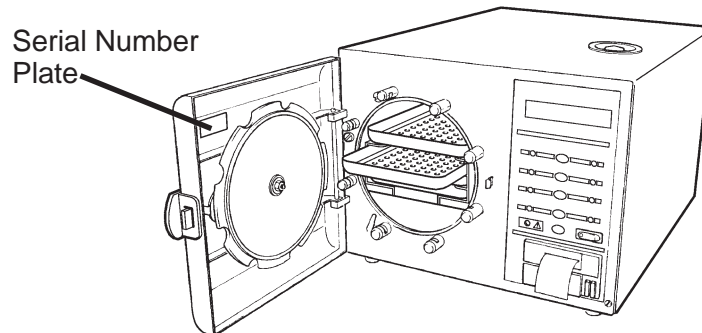
Note: The 'E' in the serial number below is the 'modification state' of the autoclave and is used within this manual to identify availability of spare parts where some items on early models are no longer available.

SES 2000 Vac (LS3) - Standard, from Serial Number SVE1A0000
without printer - REF 87-050-06
with printer - REF 87-050-14

SES 2000 Vac (LS3) - Long, from Serial Number SLVE1A0000
without printer - REF 87-050-22
with printer - REF 87-050-30

Eschmann After Sales Service Department

The Eschmann After Sales Service Department is staffed and equipped to provide advice and assistance during normal office hours. To avoid delays when making enquiries, please quote the Model and Serial Number of your Autoclave which is shown on the Serial Number plate, the location of which is shown below. Please ensure you include all alpha and numeric digits of the Serial Number.



For further information visit www.eschmann.co.uk

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Overseas Customers

Contact your local distributor. In case of doubt contact Eschmann Equipment.

Patents and Trade marks

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"SES200" is a trade mark of Eschmann Holdings Ltd.

Patents : **Patents Pending plus - Pat. US5090033 and Pat. GB2238407**

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The information in this publication was correct at the time of going to print. The Company, however, reserves the right to modify or improve the equipment referred to.

 The CE marking affixed to the product certifies that it complies with the European Medical Devices Directive 93/42/EEC and related legislation.

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TECHNICAL DATA (Standard Version)

Electrical Data

Supply	230Vac at 50/60Hz
Nominal Loading	@ 230V - 2kW (8.7A)
Fuses	Chassis F10A, 250V, (x2) Part No. 380003
	Relay board F5A, 250V (x1) T2A, 250V (x1, was x 2 see Parts List 3) T3.15A, 250V (x1)

Safety standards

EN61010-1:1993
EN61010-2-041:1996

Sterilizing Data (for software version 4.xx or later)

Sterilizing time	
At 134/137°C	3 mins 15 sec.
At 121/124°C	15 mins
Typical overall cycle time (D indicates drying included)	134°C Unwrapped: 20 minutes 134°C Unwrapped: 35 minutes (D) 134°C Wrapped: 53 minutes (D) 134°C Porous: 63 minutes (D) 121°C Unwrapped: 28 minutes 121°C Unwrapped: 42 minutes (D) 121°C Wrapped: 62 minutes (D) 121°C Porous: 70 minutes (D)

Note: Overall cycle times may vary depending on machine and loading conditions.








Nominal Operating pressures:
134°C cycle - 3.14 bar abs
121°C cycle - 2.11 bar abs

Water reservoir capacity 3.5 litres

Dimensions

Autoclave	Width	460mm
	Length	650mm*
	Height	360mm
	* Feet spaced to fit 600mm worktop	
Chamber	Diameter	200mm
	Length	348mm (max)
Porous Load basket	Width	156mm (max)
	Length	280mm
	Height	93mm
Trays	Width	183mm
	Length	282.6mm
	Height	17mm
Tray Loading	1.5 kg per tray	
Chamber capacity	10.6 litres	
Weight (approx.)		
Net	45.7kg	
Shipping	50.0kg	

Symbols

	For use with alternating current
	Caution Hot Surface
	Caution refer to accompanying documents
	"Porous load + Dry" cycle
	"Wrapped + Dry" cycle
	"Unwrapped+Dry" cycle
	"Unwrapped" cycle

TECHNICAL DATA (Long Version)

Electrical Data

Supply 230Vac at 50/60Hz
 Nominal Loading @ 230V - 2.75kW (12A)

Fuses Chassis
 15A, 250V, (x2)
 Part No. 301871
 Relay board
 F5A, 250V (x1)
 T2A, 250V (x1, was x 2 see Parts List 3)
 T3.15A, 250V (x1)

Safety standards

EN61010-1:1993
 EN61010-2-041:1996

Sterilizing Data

Sterilizing time
 At 134/137°C 3 mins 15 sec.
 At 121/124°C 15 mins
 Typical overall cycle 134°C Unwrapped:
 time (D indicates 15 minutes
 drying included) 134°C Unwrapped:
 31 minutes (D)
 134°C Wrapped:
 46 minutes (D)
 134°C Porous:
 56 minutes (D)
 121°C Unwrapped:
 26 minutes
 121°C Unwrapped:
 41 minutes (D)
 121°C Wrapped:
 57 minutes (D)
 121°C Porous:
 67 minutes (D)

Note: Overall cycle times may vary depending on machine and loading conditions.

Nominal Operating pressures:
 134°C cycle - 3.14 bar abs
 121°C cycle - 2.11 bar abs

Water reservoir capacity 3.5 litres

Dimensions








Autoclave	Width	460mm
	Length	650mm*
	Height	360mm
* Feet spaced to fit 600mm worktop		
Chamber	Diameter	200mm
	Length	500mm (max)
Porous Load basket	Width	156mm (max)
	Length	450mm
	Height	80mm
Trays	Width	180mm
	Length	450mm
	Height	23mm

Tray Loading 3.5 kg per tray

Chamber capacity 15.6 litres

Weight (approx.)
 Net 52kg
 Shipping 58kg

Symbols

-  For use with alternating current
-  Caution Hot Surface
-  Caution refer to accompanying documents
-  "Porous load + Dry" cycle
-  "Wrapped + Dry" cycle
-  "Unwrapped+Dry" cycle
-  "Unwrapped" cycle

PART 1 INTRODUCTION

GENERAL (Fig. 1)

1 This Manual contains descriptive, maintenance and spare parts information for the SES 2000 Vac (LS3) autoclave units only.

2 The autoclave is a portable, electrically operated steam unit designed for sterilizing wrapped, unwrapped or porous loads. A drying phase is included in the porous and wrapped cycles, which is optional for an unwrapped cycle.

3 Wrapped loads must be packed single-wrapped in L.M.G. SMITH BROTHERS "VIEW-PACK SELF SEAL" pouches, and sterilized using the special pouch rack accessory. The autoclave will also take cassettes using a cassette carrier. A wire basket is provided for sterilizing porous loads.

4 The autoclave operates automatically at the touch of a single programme selector touch button, and has eight sterilization programmes.

5 The autoclave is available with short or long chambers and with or without an integral printer for recording details of the sterilizing cycle. Details of the printer are given in Appendix A page 50.

ASSOCIATED PUBLICATIONS

6 Separate installation and user instructions are given in the SES 2000 Vac (LS3) autoclave 'Instructions for Use', ST-IM62.

SERVICING

WARNING

When replacing parts during maintenance procedures ONLY use parts supplied by Eschmann Equipment or the safety of the autoclave may be affected.

7 Ensure that routine servicing is carried out at regular intervals by either Eschmann trained personnel or suitably trained engineers only, otherwise the warranty could be infringed.

8 Keep the Instructions for Use and this Service Manual readily accessible for reference purposes prior to and during operation, cleaning and servicing of the autoclave.

CAUTION

In common with other systems containing static water reservoirs, water used in this unit can become contaminated over a period of time, or following an aborted cycle, and should be treated as a potential risk of infection.

Note: When sterilizing lubricated dental handpieces, the reservoir water should be changed every week to prevent contamination of the door seal, and other rubber components, used in the pressure system.

9 Eschmann recommend filling the reservoir with 'Sterile Water for Irrigation'. This is low in dissolved solids and has a low microbial count. In the U.K. the Department of Health recommend that 'Sterile Water for Irrigation' is used in bench-top Autoclaves (NHS Estates document HTM2031).

If 'Sterile Water for Irrigation' is not being used then Eschmann strongly recommend the use of either distilled water, deionized water, purified water or water treated by the reverse osmosis process. These types of water are low in dissolved solids and can help reduce the effects of tap water detailed below.

DO NOT USE TAP WATER, this is high in dissolved solids and can deposit lime scale, block filters and cause damage to the pressure vessel.

Eschmann also recommend that the reservoir is drained, allowed to dry and is refilled on a weekly basis, with the type of water detailed in 'a' (or 'b') above. At every service interval the reservoir **must be removed, be thoroughly cleaned and dried**, and then refilled. This will reduce the build-up of contaminants in the water that may cause blocked filters and/or damage to the pressure vessel. Your local Health Authority may suggest that you change the reservoir water more frequently. Eschmann advise you to follow your local Health Authority's recommendations (also see PART 3, MAINTENANCE para. 5 to 7).

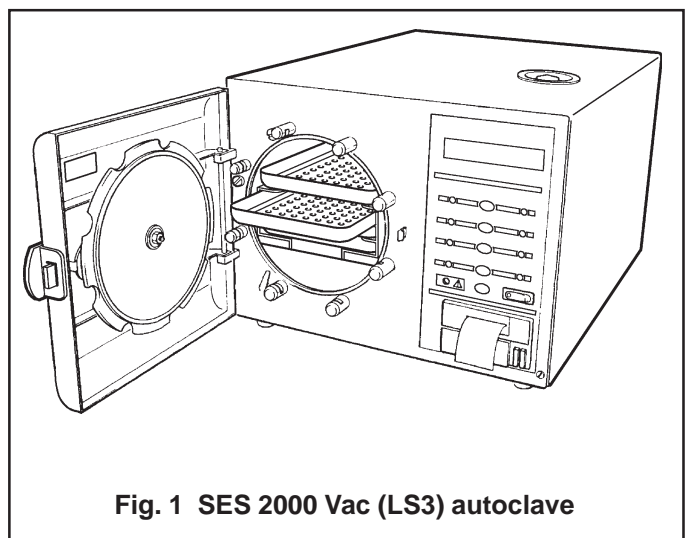


Fig. 1 SES 2000 Vac (LS3) autoclave

PART 2 DESCRIPTION

GENERAL (Fig. 1.1)

1 The autoclave is a portable steam unit heated by electric elements. For sterilization of porous loads, a vacuum is created in the chamber. The unit is supplied to suit the mains electrical supply shown in TECHNICAL DATA (pages 4 and 5).

2 The autoclave is electronically controlled and has eight sterilizing programmes:

- 134°C Porous load with drying
- 134°C Wrapped load with drying
- 134°C Unwrapped load with drying
- 134°C Unwrapped load
- 121°C Porous load with drying
- 121°C Wrapped load with drying
- 121°C Unwrapped load with drying
- 121°C Unwrapped load

For typical sterilization cycle times, refer to TECHNICAL DATA.

3 The required sterilizing programme is selected and started by pressing the appropriate programme button on the front panel of the unit, following which, the sterilizing/drying cycle proceeds automatically until complete. The printer (if fitted) will start automatically when the programme button is pressed.

4 Indication of cycle status or error codes during a cycle are provided by a digital display and printer (if fitted).

OPERATING FEATURES (Figs. 2.1, 2.2, 2.3 & 2.4)

5 The following equipment, designed for control or protection, is incorporated in the autoclave:

- Process Display Window (Fig. 2.2, item 1). The digital display indicates the temperature and pressure inside the chamber. It also provides simple messages for the user which indicate the stages through the cycle, and also error conditions, should any occur.
- Four Programme Selector Buttons (Fig. 2.1b, SW1 to SW4). These are used to select and start particular cycles. They can also be used to put the autoclave in the 'Engineering' mode as described later.
- Green Light Emitting Diodes (LED's) (Fig. 2.1b). There are eight LED's which flash primarily to indicate the cycles available for selection that can be started and, when this has been done, to indicate the particular cycle which is in progress.
- Power On/Off Switch (Fig. 2.1b). This switch controls the mains power supply to the autoclave.

- Overheat Warning Lamp (Fig. 2.1b). Illumination of this lamp indicates that one of the two protective overheat cut-outs has operated.
- Door Latching Handle (Fig. 2.2, item 3). This handle operates the door mechanism to secure the door in the locked position against the chamber face.
- Door Safety Latch (Fig. 2.2, item 5). Engages a safety catch to ensure that the door does not fly open should there be residual pressure in the chamber when the door latching handle is operated. It can also be used to keep the door slightly ajar when the autoclave is not in use.
- Door Interlock Microswitch (Fig. 2.4, item 4). This is used to signal the controller that the door is properly closed. It is operated by a simple, adjustable mechanism and should operate just as the door is fully closed.
- Pressure Door Lock (Fig. 2.3, item 14). This is a safety device designed to ensure that the door cannot be opened if the internal chamber pressure exceeds approximately 0.2 bar (3.0 lbf/in²). The device comprises a spring-loaded plunger driven by the chamber pressure via a rubber diaphragm.
- Chamber Pressure Safety Indicator (Fig. 2.1a). Fitted adjacent to the door latching handle (Fig. 2.2 item 3) and operated by the pressure door lock (Fig. 2.3 item 14), it indicates that the chamber is pressurised (red) and it is unsafe to open the door, or unpressurised (green) and it is safe to open the door.
- Solenoid Door Lock (Fig. 2.4, item 12). The solenoid door lock prevents the door being opened by the operator once the cycle has started. The lock holds the door closed until the sterilizing cycle is complete. It will also keep the door closed under all fault conditions. As absence of power is also a 'fault' the unit power switch must be set to 'on' in order to open the door.
Note: It is necessary to override the electrical door lock to clear an error code. This is done by setting the power switch to 'off', then, after a few seconds, setting it back to 'on' again while pressing and holding the 'P' selector (SW5) on the front panel (Fig 2.1b).
- Water Reservoir (Fig. 2.2, item 16). This is used to hold distilled or deionized water or water treated by reverse osmosis which is admitted into the chamber via the water fill valve. The water reservoir also receives hot water and steam vapour discharged from the chamber towards the end of the cycle, via the discharge valve. The vacuum pump (Fig. 2.3, item 7) also discharges into the water reservoir.

PART 2 DESCRIPTION

- ❑ Water Filter. The water filter is fitted on the end of the water fill pipe in the water reservoir, and filters the water entering the chamber.
- ❑ Reservoir Float Switch (Fig. 2.3, item 11). The water reservoir is fitted with a float switch which will stop the cycle being started if there is insufficient water in the reservoir to complete a chamber fill. 'Fill Reservoir' will be displayed should this occur.
- ❑ Heating Element (Fig. 2.4, item 1). The heating element consists of a single immersion element inside the chamber. The heating element is controlled by a solid state relay and protected from overheating by a manual reset thermostat. Refer to TECHNICAL DATA for heater element loading.
- ❑ Solid-State Relay Board (Fig. 2.4, item 14). **See Appendix B.** There are a number of key functions provided by the relay board:
 - ◆ Solid state relays (SSR) control the mains supply to the water heater element (10A), band heater (10A) and vacuum pump (2A).
 - ◆ SSR status LEDs, give an indication of drive status (On/Off).
 - ◆ Mechanical relay provides additional safety for heater and pump circuits.
 - ◆ Fuses for protecting the 20V a.c. supply (3.15A), condenser fan (2A) and vacuum pump (5A) see 'Parts List 3'.
 - ◆ Two voltage regulators.
 - ◆ Autoclave bleeper.
 - ◆ Connections for mains loom, signal loom, temperature and pressure sensors, solenoid valves, and transformer.
 - ◆ Interface for front panel, control board, and printer.
- ❑ Manual Reset Overheat Cutout (Fig. 2.4, item 21). The manual reset overheat cutout is fitted at the rear of the unit and is connected in series with the power supply switch, band heater overheat cutout, mechanical and SS relay and heater element. The manual reset overheat cutout is operated by a fluid-filled capsule clamped to the heating element, providing protection if the temperature of the heater surface exceeds 250°C. It will remake electrically if the reset button at the rear of the cabinet is pressed, after giving the heater element time to cool.
- ❑ Band Heater Overheat Cutout (Fig. 2.4, item 24). The band heater cutout is fitted on the band heater and is connected in series with the power supply switch, Manual Reset Overheat Cutout, mechanical and SS relay and Band Heater. It contains a bi-metallic disc thermostat which operates if the temperature of the heater surface exceeds 250°C. The cutout will remake electrically if the reset button is pressed when the heater has cooled.
- ❑ Fuses. The unit has five fuses:
 - ◆ Two fuses (Fig. 2.4, item 2) on the rear panel of the cabinet rated as shown in TECHNICAL DATA, which are connected in the 'mains supply' to the unit.
 - ◆ Three more fuses are fitted on the solid-state relay board (see TECHNICAL DATA).
- ❑ Transformer (Fig. 2.4, item 17). The transformer converts the incoming mains voltage to 24V a.c. It is rated at 50VA.
- ❑ Water Fill Solenoid Valve (Fig. 2.3, item 4). The water fill valve controls the water fill sequence. It is electrically operated from the 24V d.c. supply generated and signalled from the SSR board.
- ❑ Water Discharge Solenoid Valve (Fig. 2.3, item 3). The water discharge valve is used at the end of the sterilizing cycle to allow water and steam vapour from the chamber to pass back into the reservoir. The valve is electrically operated from a 24V d.c. supply generated and signalled from the SSR board.
- ❑ Discharge Line Filter (Fig. 2.3, item 12). Prevents debris from the chamber entering and fouling the water discharge valve.
- ❑ Steam Bleed Solenoid Valve (Fig. 2.3, item 2). The steam bleed solenoid valve operates in conjunction with the steam bleed valve.
- ❑ Steam Bleed Valve (Fig. 2.3, item 15). The steam bleed valve is connected in series with the steam bleed solenoid valve to bleed steam from the chamber during the 121°C cycles. It contains a ball and spring which allows air displaced by the steam generated in the chamber to pass into the reservoir. Once steam starts to pass, the ball then lifts and seals. A small 'bleed' remains, however, and it is quite normal for small quantities of steam to escape into the reservoir throughout the cycle.
- ❑ Safety Valve (Fig. 2.3, item 16). The safety valve is fitted on the chamber tee-piece at the rear of the chamber, and is factory set to release pressure from within the chamber. It is a primary safety device and must not be readjusted.
- ❑ Air In Solenoid Valve (Fig. 2.3, item 5). The air inlet valve controls the admission of bacteriologically filtered air to the chamber during the drying phase. A non-return valve prevents flow from the chamber to the bacterial filter to keep it dry.
- ❑ Vacuum Solenoid Valve (Fig. 2.3, item 1). When open, this valve allows the vacuum pump to suck air and steam from the chamber.

PART 2 DESCRIPTION

- ❑ Vacuum Pump (Fig. 2.3, item 7). The vacuum pump is a two stage diaphragm pump used to suck air and steam from the chamber. Some models were fitted with a piston pump (see Fig. 3.6) which is no longer available, in case of fault, replace it with the current diaphragm pump.
- ❑ Condenser (Fig. 2.3, item 6). The condenser pre-cools air and steam from the chamber before it enters the vacuum pump.
- ❑ Bacterial Filter (Fig. 2.3, item 10). The bacterial filter filters the air entering the chamber.
- ❑ Chamber Temperature Sensors (Fig. 2.4, item 16). These are used to sense the chamber temperature and are fitted at the rear of the chamber. One sensor controls the temperature within the chamber and the other controls the displayed and the printed temperatures.
- ❑ Band Heater Temperature Sensor (Fig. 2.4, item 15). The band heater temperature sensor is used to control the band temperature during the drying phase.
- ❑ Thermocouple Entry Port (Fig. 2.4, item 23). This is used to insert a thermocouple into the chamber to allow the operating temperature to be measured and, if necessary, adjusted.
- ❑ Pressure Test Port (Fig. 2.4, item 22). The pressure test port is used to insert a pressure measuring probe to monitor the chamber pressure.
- ❑ Control Board (Fig. 2.4, item 19). The control board interfaces with the relay board and front panel board to control every aspect of management of the autoclave. The main features are:
 - ◆ Twomicrocontrollers (U1 and U12) (idents. on PCB) which receive information from the front panel and all the sensors (temperature (3 off), pressure, door interlock, chamber water level, reservoir level). If any errors are detected they are shown on the display, and printed (if a printer is fitted) as error codes (see Part 2, para. 28 and 29).
 - ◆ Message memory (U13) in four variants covering all the main languages spoken by Eschmann customers.
 - ◆ Trimmer potentiometers for calibration of the band heater and temperature/pressure channels.
 - ◆ Engineering switch for set-up and calibration modes (see special operating modes page 30).
 - ◆ Outputs from the control board control the heaters, pump, and solenoid valves via the relay board interface.
- ❑ Front Panel Board (Fig. 2.4, item 13). This board incorporates the vacuum fluorescent display, programme select and cancel switches, and programme indicator LEDs. It interfaces with the control and relay boards via a 10-way ribbon connector.
- ❑ Pressure Transducer (Fig. 2.4, item 7). The pressure transducer monitors the pressure in the chamber and generates chamber pressure signals for cycle monitoring, control, and display.
- ❑ Printer (Fig. 2.2, item 21). The printer, if fitted, starts automatically when a cycle button is selected and will print out a hardcopy of the sterilization cycle. Details of the printer are given in Appendix A to this Manual.
- ❑ Fans (Fig. 2.4, items 10 and 11). Two fans are fitted in the autoclave. One fan provides cooling for the condenser and the PCB compartment (via a bleed conduit). The other fan draws air over the chamber for rapid cooling between cycles.
- ❑ Band Heater (Fig. 2.4, item 18). The band heater heats the chamber during the drying cycle.
- ❑ EMC Board (Fig. 2.4, item 5). The EMC board provides electro-magnetic compatibility protection for the autoclave.

OPERATION CYCLE

6 A detailed knowledge of the operation of the autoclave is not necessary to be able to repair it effectively; however, a basic understanding of the various processes of autoclave operation which occur during a cycle is given in the following paragraphs.

CAUTION

Ensure that the Autoclave is switched off before filling the reservoir. DO NOT USE TAP WATER.

Note: When filling the reservoir, consult the 'Instructions for Use' which provides information on the types of water that should be used.

7 Power is switched on by selecting the power switch (O-I) to I (Fig. 2.1b). If the chamber door is open there now follows a single audible tone accompanied by the display 'SES Vacuum LS3+cycle count+version of software', which then changes to 'CLOSE THE DOOR'.

8 If the door is closed, when power is switched on, the display will show 'SES Vacuum LS3+cycle count+version of software', which then changes to 'OPEN THE DOOR'.

9 After the work trays have been put in the chamber and the door closed, a programme can be selected and initiated by pressing one of the programme selector buttons (Fig. 2.1b). If the autoclave has a printer it will automatically start when the programme selector button is pressed.

PART 2 DESCRIPTION

10 When the door is closed, with the power switched on, this is sensed by the control board via the door interlock switch. If any attempt is made to open the door once the cycle has begun, the display 'ERROR 2' will appear and an audible signal will sound. Under these circumstances it is necessary to switch the autoclave off, wait 5 seconds, reset the error (see Part 3, para. 54) and restart the cycle.

11 The autoclave operates automatically at the touch of a single programme selector touch button (Fig. 2.1b), and has eight programmes:

- 134°C Porous load with drying (SW1)
- 134°C Wrapped load with drying (SW2)
- 134°C Unwrapped load with drying (SW3)
- 134°C Unwrapped load (SW4)
- 121°C Porous load with drying (SW1)
- 121°C Wrapped load with drying (SW2)
- 121°C Unwrapped load with drying (SW3)
- 121°C Unwrapped load (SW4)

12 Each programme selector button on the control panel (Fig. 2.1b) will select either the 134°C or 121°C cycles. The programme indicator lights, at each side of the programme selector buttons, will change to indicate a change of selection between 134°C and 121°C each time

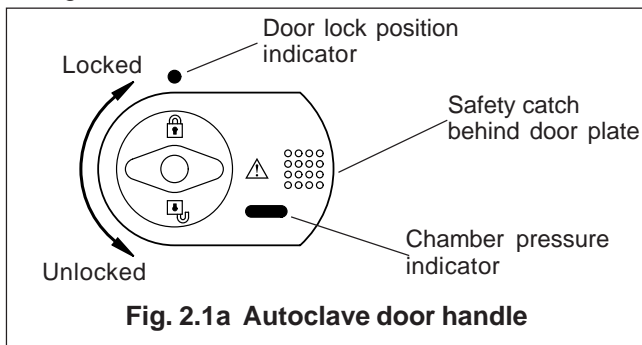


Fig. 2.1a Autoclave door handle

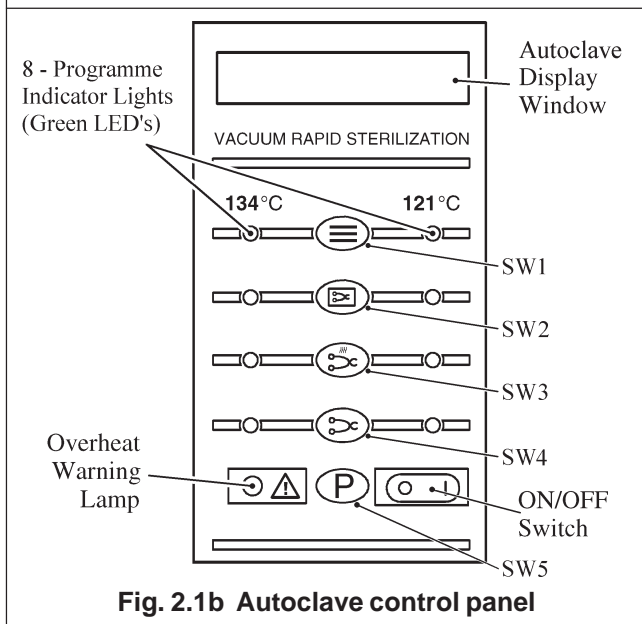


Fig. 2.1b Autoclave control panel

the appropriate selector button is pressed. In addition, the display will show the appropriate programme description to confirm the programme that has been selected. Once the programme and the temperature range has been selected, the sterilization cycle will start automatically, after a delay of approximately four seconds.

13 The printer, if fitted, will start printing and, as the cycle progresses, various display messages will appear in the display window to indicate the programme status.

Note: If a programme is started in error, it can be cancelled by pressing the 'P' selector button (SW5), provided that the cycle has not reached the water fill stage.

14 When a cycle is selected (SW1- SW4 pressed), 'CYCLE STARTED' will be displayed, quickly followed by 'VACUUM ON', indicating that the vacuum pump has started, and the vacuum solenoid valve has opened to evacuate the air from the chamber.

15 When the pressure in the chamber has decreased to the required value for the programme selected, the water fill valve will open and 'FILLING' will be displayed, indicating that water is being sucked from the reservoir and into the chamber.

16 When the cycle has started, the door cannot be opened due to the electric door lock and vacuum force on the door.

17 When the correct quantity of water has entered the chamber, the water fill valve closes together with the vacuum valve. The heater, controlled by the control board, will switch on, and the pressure in the chamber will increase. This phase is indicated by 'PULSING' being shown on the display.

18 The heater is controlled by a system which ensures that the operating temperature is reached with minimal overshoot. Initially, the heater will be 'on' continuously and the measured temperature will be displayed. Note, however, that the system does not register temperatures below 92°C.

19 Temperatures are displayed with a resolution of 0.1°C, using signal averaging to ensure a stable, accurate display.

20 Control of the cycle is fully automatic with temperature information being monitored by temperature sensors. Timing is controlled by the control board and cycle times cannot be adjusted. By comparing measured values with known time/temperature relationships, the control board is able to detect faults such as lack of water at the fill stage, or loss of water and steam during the process, and

PART 2 DESCRIPTION

it will indicate such problems by displaying errors codes such as 'ERROR 3' or 'ERROR 4' respectively, which will be accompanied by an audible warning signal (see Error Code Table page 12).

21 The autoclave operates at temperatures slightly above the usual recommended minimums. The operating temperature for the 121°C cycle is set to 122°C, and the 134°C cycle is set for 135°C.

22 As the cycle enters the sterilization phase, the display shows 'STERILIZING'. At the end of the sterilizing phase the heater is turned off and the discharge valve is opened to discharge water and steam from the chamber. This phase is indicated by 'CONDENSING' being shown on the display.

23 Once the controller detects that chamber temperature and pressure have fallen to a safe level, the display 'CYCLE COMPLETE' will be shown to indicate that the cycle is complete. When the chamber door is opened the display will show 'CLOSE THE DOOR'.

Note: If the autoclave has a printer, the printout will include the following details:

- Autoclave type and serial number.
- Date and time of sterilization cycle.
- Counter indication (five digits with leading zeros).
- Sterilization cycle type, e.g. 134°C without drying.
- Sterilization cycle time, temperature, and pressure.
- Sterilization cycle ended message.

Operating information relating to the printer is given in Appendix A to this Manual.

24 The overall time for the cycle is not fixed and depends on many factors such as the supply voltage, the load, and the ambient temperature. However, the control board will ensure a satisfactory sterilization cycle even when these factors vary over wide ranges.

25 If a cycle employing a drying phase is selected, operation to the end of the sterilizing phase is as described previously. After discharge of steam and water back into the reservoir, however, the display 'DRYING' will be indicated, together with the time remaining to the end of the cycle. During the drying phase, operation of the autoclave will alternate between vacuum pulses and filtered air inlet pulses to achieve optimum drying.

26 The length of the drying phase will vary according to the programme selected, and the chamber band heater will operate to promote drying. At the end of the drying phase, the display 'CYCLE COMPLETE' will appear indicating that the door can be opened.

DISPLAY MESSAGES

27 Throughout a selected cycle the following symbols may appear on the digital display:

Display	Meaning
OPEN THE DOOR	Door was closed when the autoclave was switched 'on'.
PLEASE WAIT*	The autoclave is measuring atmospheric pressure
CLOSE THE DOOR	The door is open and the cycle cannot start.
READY FOR USE	Waiting programme selection.
CYCLE STARTED	Programme selected and cycle started.
VACUUM ON	Chamber air/steam discharge in progress.
FILLING	Water entering chamber prior to sterilization
PULSING	Pre-sterilization steam treatment.
STERILIZING	Sterilization in progress.
CONDENSING	Discharging water and steam from chamber.
DRYING	Load being dried (time remaining to the end of cycle will also be shown).
CYCLE COMPLETE	Cycle completed successfully.

* Only applicable to software version 5.2 or above (as shown briefly on display when autoclave first switched on).

ERROR INDICATION

General

28 If an error occurs during the cycle, an error code will be displayed (see the Error Code Table on page 12).

29 If an error occurs during a cycle, the control board will cancel the cycle (see Fault Diagnosis, and Errors and Error Clearing in Part 3).

Note: These error codes will generally require investigation by an Eschmann trained engineer. If an error occurs during the cycle, the printer (if fitted) will print out the date and time, the message 'CYCLE FAILED' and the appropriate error code. Information relating to the printer, if fitted, is given in Appendix A to this Manual.

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ERROR CODE TABLE

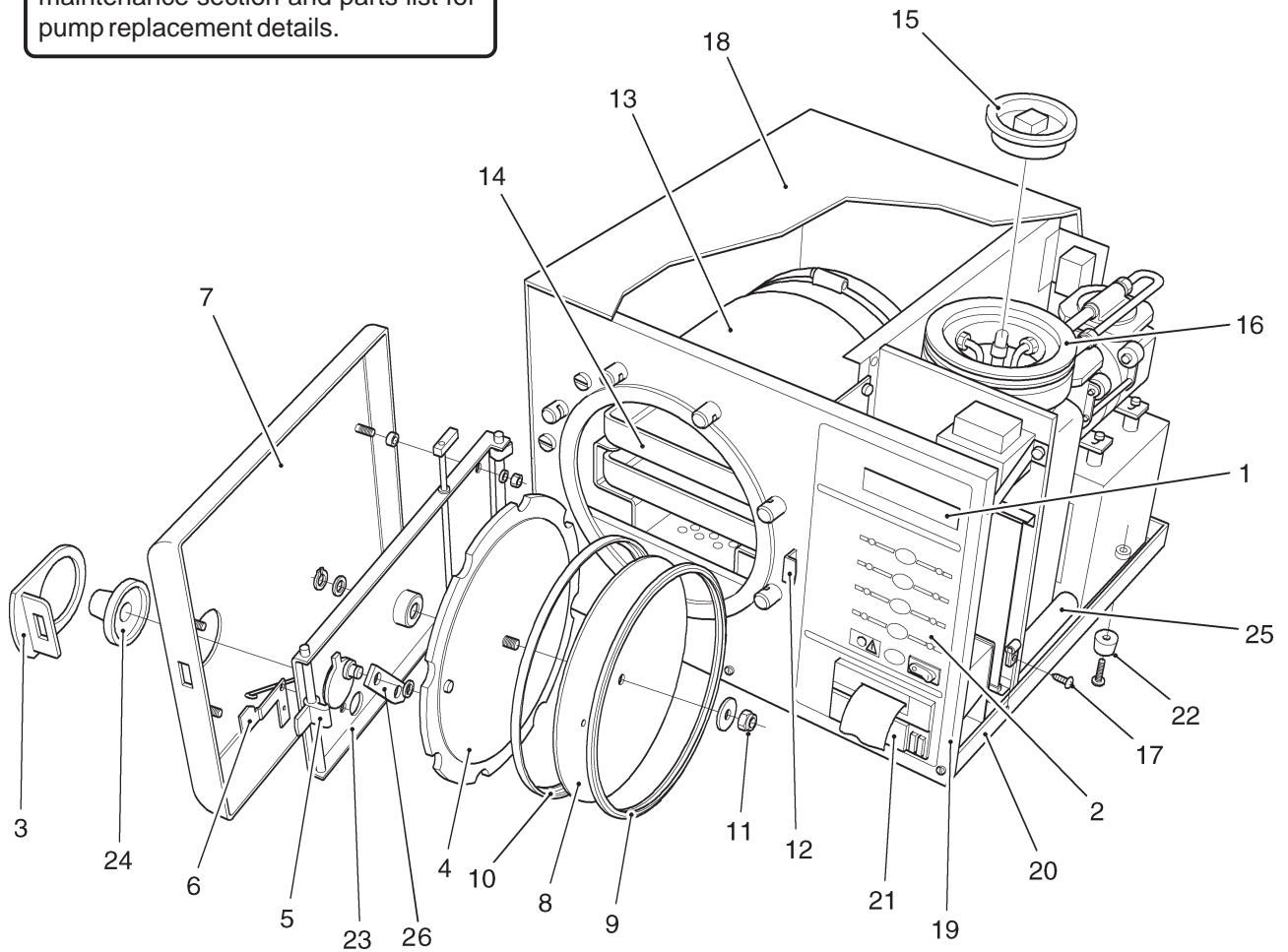
Display	Meaning / Cause
POWER FAILURE (Error 1 not shown)	Temporary failure in the mains supply to the unit.
Error 2	Faulty or incorrectly adjusted door switch, or door not fully closed at start of cycle.
Error 3	Water failed to enter chamber from reservoir.
Error 4	Water level in chamber has dropped during run-up to sterilizing cycle.
Error 5	Heater element not working during run-up to sterilizing phase.
Error 6	Control channel low temperature.
Error 7	Control channel high temperature.
Error 8	Display channel low temperature.
Error 9	Display channel high temperature.
Error 10	Insufficient first vacuum pulse.
Error 11	Insufficient second vacuum pulse.
Error 12	No steam pulse.
Error 13	(i) Before filling takes place = Air Detector test failure (ii) At beginning of sterilization = Steam quality error.
Error 14	Insufficient drying vacuum.
Error 15	Sensor system failure.
Error 16	Clock speed error during sterilizing phase.
Error 17	Band heater not achieving setpoint temperature during drying phase.
FILL RESERVOIR	Water level in reservoir has dropped below 'MIN' mark.

Overheating

30 In the unlikely event of overheating, the red overheat warning lamp (see Fig. 2.1b and Fig. 2.4 item 8) at the front of the autoclave will illuminate. If this happens, first allow 10 to 15 minutes to elapse for the autoclave to cool, then check the water level in the reservoir and top-up if required. When the water level is correct, press the 'PRESSTO RESET' button at the rear of the cabinet (Fig. 2.4 item 21) and restart the cycle as normal. If the fault persists, switch off the autoclave and call an Eschmann Trained Engineer.

PART 2 DESCRIPTION

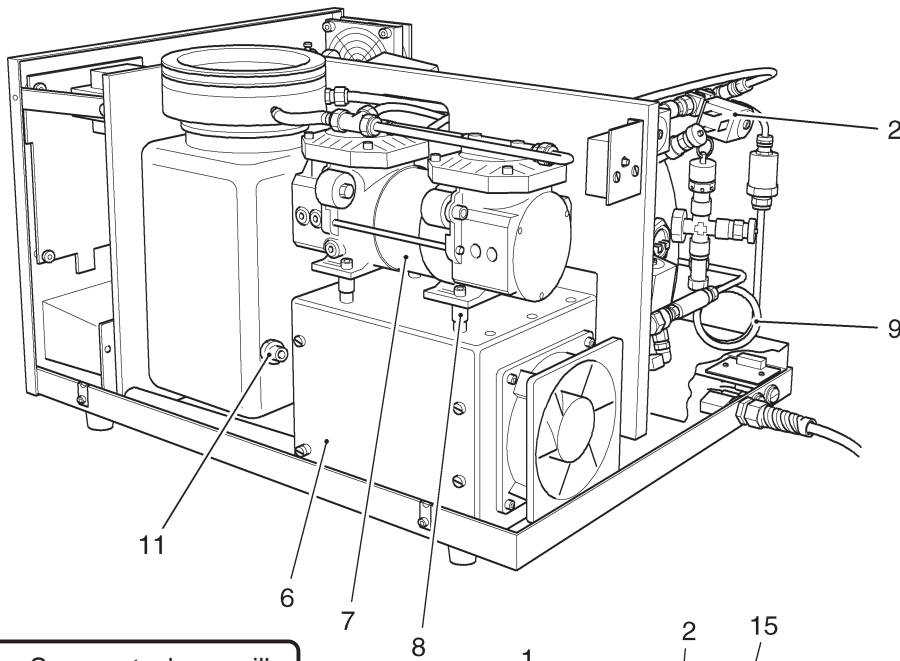
Note: Some autoclaves will have a different pump to that shown. See maintenance section and parts list for pump replacement details.



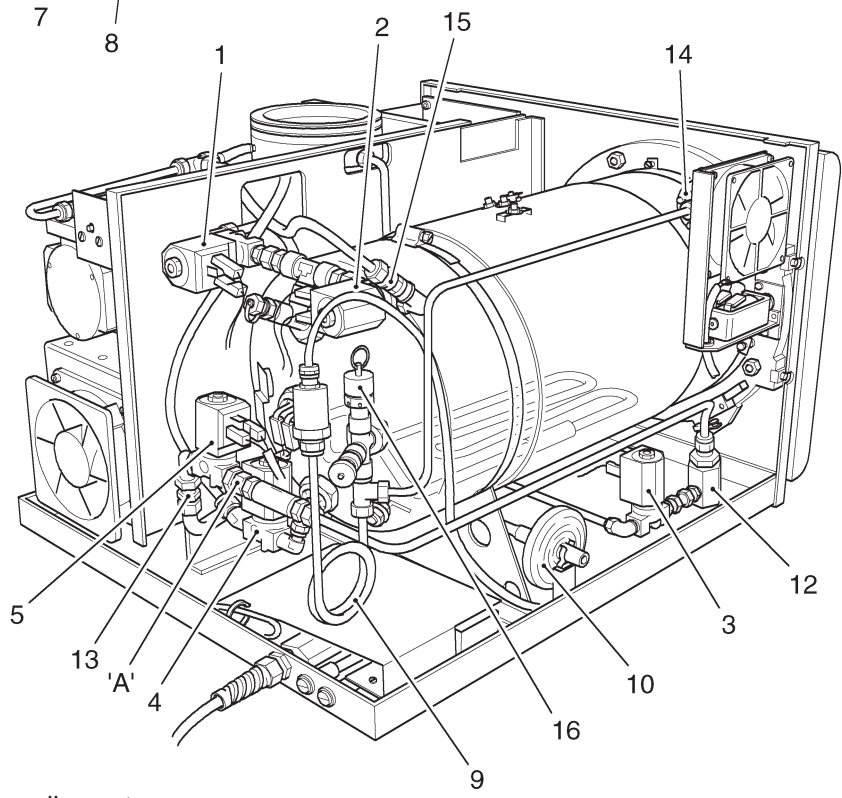
- | | | |
|-----------------------------|------------------------------|------------------------|
| 1 Process display window | 10 Seal retaining rim | 19 Front panel |
| 2 Control panel | 11 Aertight nut | 20 Chassis |
| 3 Door latching handle | 12 Door safety catch | 21 Printer |
| 4 Pressure door | 13 Pressure chamber assembly | 22 Foot |
| 5 Door latch | 14 Work tray | 23 Door beam |
| 6 Pressure safety indicator | 15 Reservoir lid | 24 Door knob |
| 7 Door cover | 16 Reservoir | 25 PCB cooling conduit |
| 8 Seal retaining disc | 17 Cover screw | 26 Link |
| 9 Door seal | 18 Unit cover | |

Fig. 2.2 Autoclave: General Arrangement

PART 2 DESCRIPTION



Note: Some autoclaves will have a different pump to that shown. See maintenance section and parts list for pump replacement details.

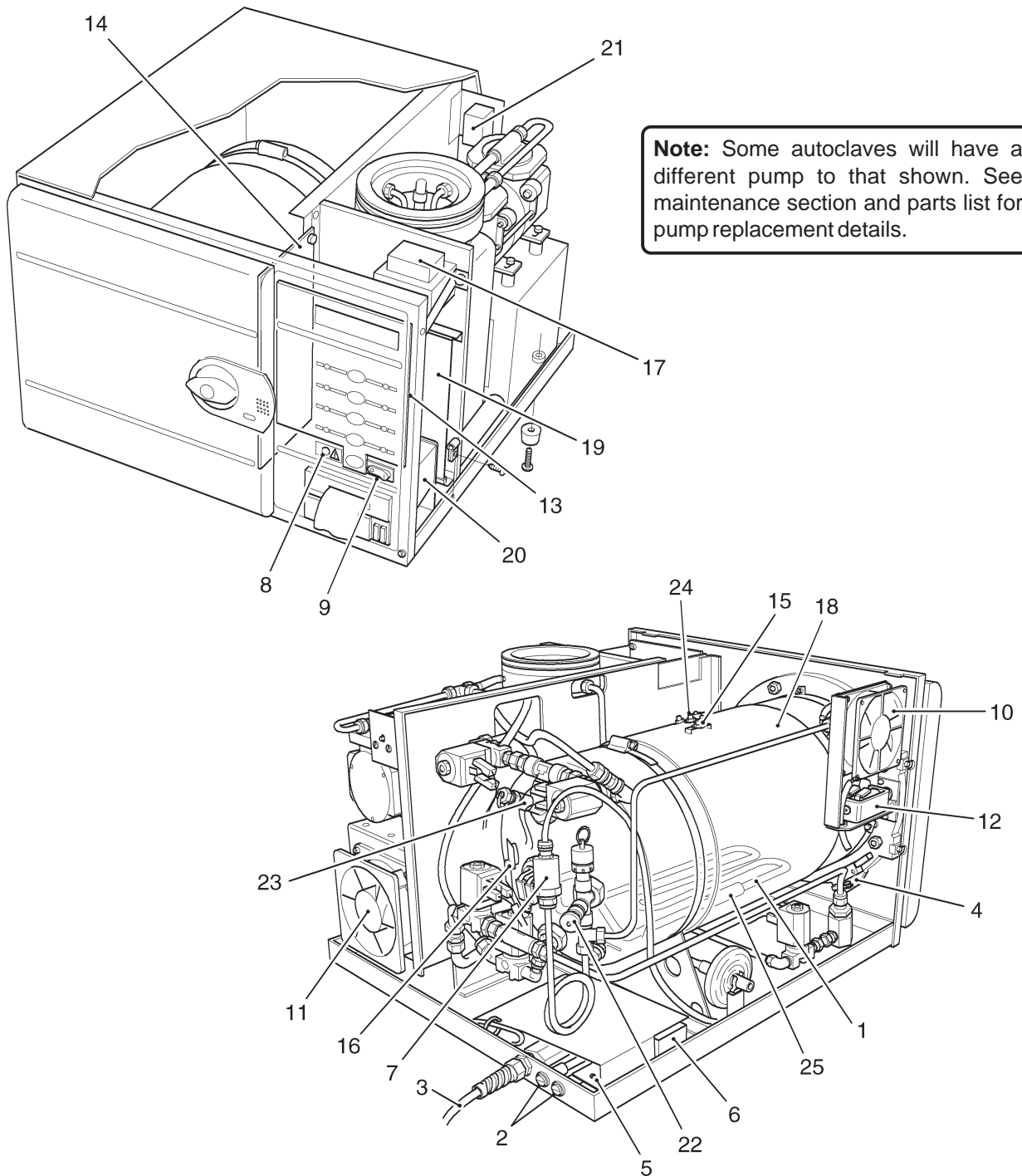


'A' - Stud coupling nut

- | | |
|------------------------------|---------------------------|
| 1 Vacuum valve | 9 Transducer coil |
| 2 Steam bleed solenoid valve | 10 Bacterial air filter |
| 3 Water discharge valve | 11 Reservoir float switch |
| 4 Water fill valve | 12 Discharge line filter |
| 5 Air in valve | 13 Non-return valve |
| 6 Condenser | 14 Pressure door lock |
| 7 Vacuum pump | 15 Steam bleed valve |
| 8 Pump foot | 16 Safety valve |

Fig. 2.3 Autoclave: Pipes and Valves

PART 2 DESCRIPTION



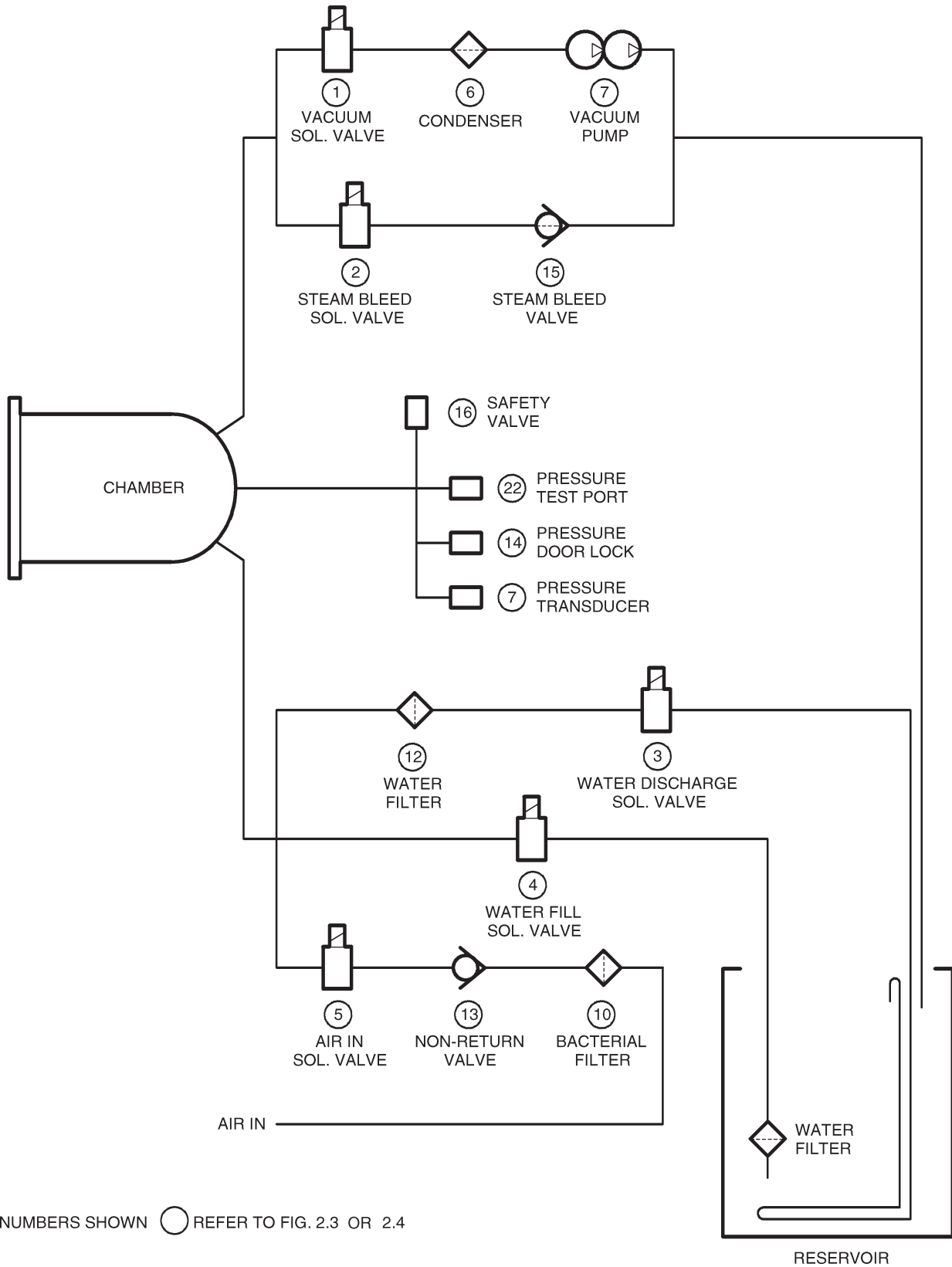
Note: Some autoclaves will have a different pump to that shown. See maintenance section and parts list for pump replacement details.

- | | | |
|-------------------------|-----------------------------------|----------------------------------|
| 1 Heating element | 9 ON/OFF (O/I) switch | 17 Transformer |
| 2 Mains fuses | 10 Enclosure fan | 18 Band heater |
| 3 Mains cable | 11 Condenser fan | 19 Control board |
| 4 Microswitch | 12 Solenoid door lock | 20 Printer |
| 5 EMC board | 13 Front panel board | 21 Manual reset overheat cut-out |
| 6 Choke | 14 Solid-state relay board* | 22 Pressure test port |
| 7 Pressure transducer | 15 Band heater temperature sensor | 23 Thermocouple entry port |
| 8 Overheat warning lamp | 16 Chamber temperature sensors | 24 Band heater overheat cut-out |
| | | 25 Bulb (for Manual Reset 21) |

* see Appendix B

Fig. 2.4 Autoclave: Heater and Process Controls

PART 2 DESCRIPTION



NUMBERS SHOWN REFER TO FIG. 2.3 OR 2.4

Fig. 2.5 Sterilizing System Schematic Diagram

PART 3 MAINTENANCE

FUSES (Fig. 2.4)

1 The autoclave is protected by five fuses. Two mains supply fuses are fitted on the rear cover of the autoclave (Fig. 2.4 item 2). Three more fuses are fitted to the solid state relay board (Fig. 2.4. item 14). All fuse ratings are given in the TECHNICAL DATA section.

FAULT DIAGNOSIS

2 A number of typical faults which could occur, their possible causes and how to remedy them are listed below. For maintenance procedures refer to Parts Replacement and Adjustment.

Note: Cross references in the 'Remedy' column (e.g. para.10) refer to paragraphs in the Parts Replacement and Adjustment section that follow later in Part 3.

WARNINGS

Switch-off and disconnect mains power supply before removing the autoclave cover, or doing maintenance procedures. During certain procedures mains voltage may have to be present with the cover removed and extreme care should be taken to avoid contact with mains voltage.

Check that chamber is at atmospheric pressure before opening the door.

Should the door be opened beware of possible very hot water or steam escaping from the chamber.

Fault Diagnosis Table

Fault	Possible Cause	Remedy
(1) Nothing happens when power switched on (No display).	(a) Mains supply failure.	(a) Check mains supply, also plug and supply cable for loose connections or breaks.
	(b) Main fuses blown (rear panel).	(b) Replace fuse(s)*.
	(c) Faulty power switch.	(c) Replace power switch (para 31).
	(d) Solid-state relay board fuse blown or loose.	(d) Replace fuse*.
	(e) Transformer failed.	(e) Check transformer secondary voltage (20V a.c. rms). Replace transformer if output is zero (para 8).
	(f) Short circuit on 24V circuit.	(f) Check sensor, fill valve, vent valve etc. for short circuit Replace where necessary.
	(g) Short circuit on solid-state relay board.	(g) Check SSR board is correctly fitted in bottom guide, with correct clearance from dividing panel. Also see Appendix B

***Note:** Blown fuses can indicate further problems. Always investigate the reason for any fuse blowing, but bear in mind that fuses can 'age' and blow for no other reason.

Continued

PART 3 MAINTENANCE

Fault	Possible Cause	Remedy
(2) Door cannot be opened.	(a) Pressure door lock jammed.	(a) Replace pressure door lock (para.10). To open chamber door, push pressure locking bolt back with a thin blade if spring faulty. If spring has seized, disconnect body from unit (para.10) and pull it backwards so that the locking bolt clears the door.
	(b) Pressure in chamber.	(b) Switch-on power to release pressure in chamber.
	(c) Vacuum in chamber.	(c) As (b) to open door then check discharge filter and bacteriological filter for blockage.
	(d) Solenoid door lock inoperative when autoclave power is switched on.	(d) Check wiring to solenoid door lock and check solenoid for shorting or open circuit. Replace solenoid door lock if necessary (para.13).
(3) Chamber will not fill (FILL RESERVOIR displayed).	(a) No water in reservoir.	(a) Fill reservoir.
	(b) Water in float switch.	(b) Fit new float switch (para.32).
(4) Display shows ERROR 3.	(a) No water in chamber due to water fill valve or associated pipes or filter blocked.	(a) Clean or fit new water filter (para.37). Strip pipework and clean. Empty and clean reservoir. Refill with distilled water (para.9 part 1).
	(b) Sensor not detecting water in chamber.	(b) Ensure chamber water level sensor is clear of obstructions. Also, ensure sensor is not dirty or corroded.
(5) Display still shows 'OPEN THE DOOR' after door is opened.	(a) Door interlock microswitch jammed in closed position.	(a) Check switch operating lever for freedom of movement.
	(b) Switch fault.	(b) Check operation of switch.
	(c) Door interlock microswitch out of adjustment.	(c) Adjust switch lever position, or fit new microswitch if adjustment is correct (para 12).
(6) Display shows 'ERROR 2' after cycle started.	(a) Door opened after cycle selected.	(a) Switch power off, wait 5 seconds, reset error (see para (53) and restart cycle.
	(b) Door switch out of adjustment.	(b) Adjust switch lever position, or fit new microswitch (para 12).

Continued

PART 3 MAINTENANCE

Fault	Possible Cause	Remedy
(7) Safety valve leaks (See also Fault (8)).	(a) Dirt on valve seat. (b) Check pressure and temperature to see if calibration is set too high.	(a) With low pressure in chamber carefully operate valve by hand (Warning: Beware of risk of scalds from escaping steam). If leakage persists, fit new safety valve (para.29). (b) Re-calibrate control board (para.57 onwards).
(8) Safety valve operates even though temp is below 136°C (See also Fault (7)).	(a) Safety valve fault. (b) Re-calibration needed. (c) Chamber temperature sensor fault. (d) Control board fault.	(a) Fit new safety valve (para.29). (b) See Calibration Procedure (para.57 onwards). (c) Fit new temperature sensor (para.14). (d) Fit new control board (para.9).
(9) Temperature above 137°C causing safety valve to operate.	(a) Failed solid state relay.	(a) Fit new solid state relay board (para.26). Also see Appendix B
(10) 'ERROR 4' displayed before sterilizing temp. reached.	(a) Water fill valve leaking. (b) Discharge valve leaking. (c) Chamber water level sensor fault. (d) Wiring loom fault. (e) Door seal leaking.	(a) Drain reservoir and fit new water fill valve (para.17). (b) Strip and clean water discharge valve or fit a new one (para.15). (c) Fit new chamber water level sensor (para.35) (d) Check terminations. (e) Clean mating surface of gasket around door with a soapy cloth. If leakage persists, replace door-seal (para.19).
(11) 'ERROR 5' displayed.	(a) Solid state relay failed (No voltage across heater). (b) Heater open-circuit. (c) Control board fault.	(a) Fit new relay board (para.26). Also see Appendix B (b) Fit new heater if resistance of element when cold is not approx. 30ohms (short autoclave) or 20ohms (long autoclave) (para.18). (c) Fit new control board (para.9).

Continued

PART 3 MAINTENANCE

Fault	Possible Cause	Remedy
(12) Temperature differs from measured value and display shows 'Err 6, 7, 8, or 9'.	(a) Recalibration required.	(a) Recalibrate (para.57 onwards).
	(b) Chamber temperature sensor fault.	(b) Check sensor fitted correctly, or fit new sensor (para. 14) and recalibrate (para.57 onwards).
(13) No discharge of steam/water at end of cycle.	(a) Discharge valve fault.	(a) Test valve, using 'Engineering Mode'(para.40). Replace if faulty (para. 15).
	(b) Wiring fault.	(b) Check connections to discharge valve.
	(c) Blockage in discharge line.	(c) Strip pipework and clean.
	(d) Control board fault.	(d) Replace control board (para.9).
	(e) Discharge line filter blocked.	(e) Clean or replace filter (para.24).
(14) Cycle time much longer than usual.	(a) Low mains voltage.	(a) Check supply to autoclave.
	(b) Autoclave overloaded.	(b) Avoid overloading (see Tray loading in Technical Data section)
	(c) Slow discharge at end of cycle.	(c) See Fault (13) (c) and (e).
	(d) Faulty vacuum pump.	(d) Repair or fit new vacuum pump (para.20).
	(e) Leak in pressure system.	(e) Check and repair.
(15) Unusual display when first switching on power.	(a) Control board failed to re-set properly.	(a) Switch-off power, wait for approx. 5 seconds and switch on again.
	(b) Control board fault.	(b) Fit new control board (para.9).
(16) Display shows 'POWER FAILURE'.	(a) Temporary mains failure during cycle.	(a) Check local supply conditions.
		(b) Check supply plug wiring and power cable for breaks.
		(c) Carry out error cancellation (para.53) then remove load from chamber. Ensure load is conditioned (dry) before restarting appropriate cycle.

Continued

PART 3 MAINTENANCE

Fault	Possible Cause	Remedy
(17) Overheat warning lamp illuminates.	(a) Band heater overheat thermostat operated.	(a) Faulty band heater temperature sensor. Fit new band heater temperature sensor (para.30). Or, Solid state relay faulty. Replace solid state relay board (para.26). Also see Appendix B
	(b) Heater element overheat thermostat operated.	(b) Faulty solid state relay. Fit new solid state relay board (para.26). Also see Appendix B. Or, ensure chamber water level sensor is clear of obstructions. Also, ensure sensor is not dirty or corroded.
(18) Pressure display reads too high or too low.	(a) Incorrect calibration.	(a) Check temperature/pressure calibration (para.57 onwards).
	(b) Faulty electrical connection.	(b) Check sensor connections and solid-state relay board and control board connection.
(19) Door stiff to rotate/open.	(a) Door mechanism requires lubrication.	(a) Lubricate hinge pivots with silicone grease (Part No.306055).
	(b) Door seal mating surfaces sticking.	(b) Clean mating surfaces of door seal and chamber flange with a clean cloth.
	(c) Chamber pressure slow to stabilise at atmospheric pressure.	(c) Check for blockages in discharge line and/or bacterial filter air inlet line.
(20) ERROR 10: Insufficient first vacuum pulse.	(a) Previous cycle has left chamber too hot and wet.	(a) Reset chamber condition by running a 134°C unwrapped with drying cycle and leave door open for 5 minutes on completion.
	(b) Pressure not less than 20kPa on display due to pump inefficiency.	(b) Carry out leak test (para.55) If it fails, check pump components for leaks, check all connections, door seal, and solenoid valves for leaks.
	(c) Pressure calibration error.	(c) Recalibrate pressure channel (para.57 onwards).
	(d) Pump cooling duct not fitted. (models up to mod state 'E' only)	(d) Fit cooling duct (para.33) and check cooling fan operation .

Continued

PART 3 MAINTENANCE

Fault	Possible Cause	Remedy
(21) ERROR 11: Insufficient second vacuum pulse.	(a) Previous cycle has left chamber too hot and wet. (b) Pressure not reducing to set point due to pump inefficiency. (c) Pressure calibration error. (d) Pump cooling duct not fitted.	(a) Reset chamber condition by running a 134°C unwrapped with drying cycle and leave door open for 5 minutes on completion. (b) Carry out leak test (para.55) If it fails, check all connections, door seal, and solenoid valves for leaks. (c) Recalibrate pressure channel (para.57 onwards). (d) Fit cooling duct (para.32) and check cooling fan operation.
(22) ERROR 12: No steam pulse.	(a) Display Pressure not reaching 120kPa (Porous and wrapped cycles) or 98kPa (unwrapped cycles).	(a) Check heater element (i.e. not open circuit), solid state relay (RL2) energised (red LED, D6 on SSRB Fig.2.4 item14) and mains voltage is reaching heater element. Also see Appendix B
(23) ERROR 13: Steam quality error, displayed at the beginning of the sterilizing phase.	(a) At beginning of sterilizing phase, pressure displayed is not within preset limits.	(a) Check chamber temperature sensors are fitted correctly, recalibrate pressure and temperature (para.57 onwards). Also see Appendix B
(24) ERROR 13: Air detector test failed, displayed prior to filling phase.	(a) Two minute duration leak test immediately prior to filling stage has failed. Displayed pressure has increased by 4kPa over a two minute period.	(a) Ensure load is correctly conditioned (dry) before starting cycle. Ensure autoclave passes a leak test (para.55). Ensure chamber has been ventilated with door open for at least one minute before starting cycle.
(25) ERROR 14: Insufficient drying vacuum (Display pressure not reaching 50kPa).	(a) Insufficient pump efficiency. (b) Pump failed to start at beginning of drying phase (stalled). (models up to mod state 'E' only)	(a) Check pump function, repair or replace (para.38 and 20) if required and check all connections for leaks. (b) Check pump valve seats have leakage path. (models up to mod state 'E' only)
(26) ERROR 15: Chamber temperature sensor failure.	(a) Temperature readings differ by more than 5°C during heat-up through 100°C.	(a) Check chamber temperature sensors are clamped tightly to chamber and re-calibrate (para.57 onwards).
(27) ERROR 16: Clock speed error during sterilizing phase.	(a) Real-time clock has stopped.	(a) Re-start clock by resetting time in SET-UP mode (para. 51). If this is not successful, replace control board (para.9).

Continued

PART 3 MAINTENANCE

Fault	Possible Cause	Remedy
(28) ERROR 17: Insufficient drying.	Band heater not reaching setpoint temperature due to: (a) Calibration error. (b) Band heater sensor faulty. (c) Control board faulty. (d) Faulty solid state relay or connections. (e) Faulty band heater.	(a) Check calibration (para.57 onwards). (b) Fit new sensor (para.30). (c) Fit new control board (para.9). (d) Fit new SSR board if connections satisfactory (para.26). Also see Appendix B (e) Fit new band heater (para.34).

PARTS REPLACEMENT AND ADJUSTMENT

WARNING

Switch-off and disconnect mains power supply before removing autoclave cover, or doing maintenance procedures.

Check that chamber is at atmospheric pressure before opening the door.

When the door is opened beware of possible very hot water or steam escaping from the chamber.

Autoclave Cover (Fig. 2.2, item 18)

Removal

3 To remove the cover:

CAUTION

An earth lead is connected between the terminal block and the earth stud inside the rear of the cover. Disconnect the lead before removing the cover completely.

- a Unscrew and remove the four cover screws (two on each side) from the casing lower edge.
- b Remove reservoir lid.
- c With unit facing towards you, remove the cover lifting it from the rear of the unit first.

Refitting

4 To refit the cover:

- a Re-connect the earth lead between the terminal block and the earth stud inside the rear panel of the cover.
- b Carefully locate the tabs at the front of the cover into the slots in the top of the front panel of the unit, then press the cover down in position.
- c Refit the four cover screws and the reservoir lid.

Reservoir Assembly (Fig. 2.2, Item 16)

Removal

5 Remove reservoir assembly as follows:

- a Remove reservoir cover.
- b Pull off silicone tubing from manifold connection.
- c Disconnect discharge and fill tubes from the manifold, ensuring that the manifold fittings do not rotate whilst releasing the compression nuts.
- d Disconnect reservoir float sensor electrical connections.
- e Withdraw reservoir and manifold from autoclave, whilst guiding the drain tube up through the chassis floor and dividing panel.

Cleaning

6 Clean reservoir and manifold as follows:

- a Separate the manifold and reservoir.
- b Wash the manifold and reservoir in a weak solution of detergent and tap water.
- c Rinse all cleaned components thoroughly with tap water to remove any residual detergent. Allow components to dry.
- d Clean or replace water filter.

Assembly

7 Assemble and refit reservoir assembly and fill with distilled water.

Note: If fitting the drain tube to the reservoir connection, dip the end of the tube in warm water first to soften it.

Transformer (Fig. 2.4, item 17)

8 Detach the transformer connections, noting the position of each one. Remove cable-tie and two nylon thumb nuts then withdraw transformer. The replacement transformer should be an identical unit, rated at 50VA. To fit replacement transformer, reverse the removal procedure.

PART 3 MAINTENANCE

Control Board (Fig. 2.4, item 19)

9 To remove control board, pull on handle provided and slide control board on tracks. Replacement is the reverse of the removal procedure, but ensure that board locates firmly in the solid state relay board.

Note 1: When a new control board is fitted, it will be necessary to recalibrate it to suit the temperature sensor fitted in the machine (see Calibration Procedure, para. 57 onwards).

Note 2: When ordering a new control board (part number 424424 for standard or 424425 for long) it is important to determine what version of software is driving the machine. The Version state of software for each particular Autoclave will be displayed momentarily upon switching ON the Autoclave and on later versions of the control board it is also printed on the EPROM on the board.

Pressure Door Lock (Fig. 2.3, item 14)

10 To remove pressure door lock for adjustment or replacement proceed as follows. From front of pressure door lock remove screw-slotted locking bolt. Detach plumbing connection from rear of lock body, then slacken the two hexagon headed screws in the lock housing to release lock body. Clean old locking compound fragments out of threaded hole in piston, if re-fitting original lock unit. To fit the original or a new pressure lock unit, proceed as follows:

- a Apply a drop of thread lock (Part No.306234) to female thread only in hexagon shaped piston, then fit lock body into lock housing on chamber neck ring and secure it with the two hexagon headed screws (use thread lock part number 306033 on threads).
- b Attach and secure plumbing connection.
- c Apply a smear of silicone grease (Part No.306055) to shaft only of locking bolt, avoiding the thread.
- d Insert locking bolt into front of lock body and screw it into piston thread until bolt head stands 1/2mm clear of cabinet front plate. Ensure that bolt is free to move in and out easily.
- e Ensure locking bolt is fully engaged with the door at its maximum extension.

Note: Do not try to repair a leaking or otherwise unserviceable door lock.

Steam Bleed Valve (Fig. 2.3, item 15)

11 The steam bleed valve is fitted to the steam bleed solenoid valve at the rear of the sterilizing chamber. To remove the valve:

- a Disconnect flexible PTFE pipe from steam valve.

- b Remove steam bleed valve from solenoid elbow fitting.
- c Replacement is the reverse of the removal procedure. When fitting replacement valve, use PTFE tape (Part No.301600) to make a leakproof joint.

Note: It is recommended that a valve suspected of unsatisfactory performance is renewed.

Door Interlock Microswitch (Fig. 2.4, item 4)

12 The door interlock microswitch is operated by an actuator lever. To remove and dismantle the microswitch actuator lever proceed as follows (the numbers in brackets refer to the relevant parts in Fig.3.1) :

- a Loosen clamp screw (7) and slide microswitch actuator lever (5), complete with leaf spring (4), from actuator lever (2), and then remove nylon washer (3).
- b Withdraw actuator lever (2) from the front of the panel, and remove nylon washer (1).
- c Remove clamp screw (7) and washer (8) to release leaf spring (4).
- d Remove nut (9) and striker screw (6).
- e Inspect, and renew all defective items.

Reassemble and adjust the mechanism as follows, refer to parts list if replacing parts to ensure compatible spare parts are used:

- f Apply a smear of silicone grease (Part No.306055) to both sides of nylon washer (1) and position it on spindle of actuator lever (2).
- g Apply a little silicone grease (Part No.306055) on spindle of actuator lever (2) and slide the lever through the front panel. Apply a smear of silicone grease to both sides of nylon washer (3) and locate the washer on the protruding end of the spindle, at the back of the neck ring.
- h Fit leaf spring (4) to microswitch actuator lever (5), with clamp screw (7) and washer (8).
- i Fit striker screw (6) [use thread lock (part number 306033) on threads] and nut (9) to microswitch actuator lever (5).
- j Fit microswitch actuator lever (5) to actuator lever (2) ensuring that the mechanism is located between limit stops (11).
- k Ensure leaf spring (4) is positioned and adjusted to keep microswitch actuator lever (5) clear of microswitch (10).
- l While tightening clamp screw (7), twist levers (2) and (5) apart to ensure that any slack between the flats on the spindle and lever is in its worse condition.

PART 3 MAINTENANCE

- m Set microswitch actuator lever (5) by closing the door and inserting a 0.125mm shim between switch body and head of striker screw (6). Turn door knob to lock door. Adjust striker screw (6) until screw head touches shim and tighten locking nut.
- n Open door to remove shim, then close door and check that microswitch (10) operates correctly.

Solenoid Door Lock (Fig. 2.4, item 12)

13 Maintenance procedures will depend upon whether the malfunction is mechanical (e.g. bolt or return spring sticking) or due to solenoid unit failure. Proceed as follows:

- a To remove locking bolt, compress the spring with a suitable spring compressor and open the autoclave door to provide access to the slotted bolt-head screw.
- b Grip the solenoid plunger, forward of the E-clip, and insert a screwdriver in the slot of the locking bolt head to remove the locking bolt.
- c Before refitting the locking bolt apply a little threadlock (Part No.306234) to the thread of the solenoid plunger.
- d Refit the nylon washer in the correct position.
- e To remove the solenoid unit, proceed as in (b) and (c) and detach the electrical connector from the solenoid coil, then remove the solenoid bracket fixing screws from the chamber head ring. Fit replacement solenoid unit by reversing the removal procedure.

Chamber Temperature Sensors (Fig. 2.4, item 16)

14 Remove cable-tie then loosen 14mm nut on chamber fitting and slide the clamp plate complete with spring, sensor pocket, and temperature sensors clear of the chamber fitting. Remove temperature sensors from the sensor pocket. When removing the temperature sensors, carefully note the position of the connectors on the control board and then disconnect them. When fitting a new unit, coat sensors and sensor pocket with a thin layer of heat sink compound (Part No.605092), and ensure that the assembly is free of dirt and grit.

Note: When a new temperature sensor is fitted, the autoclave must be re-calibrated (see Calibration Procedure para.57 onwards).

Solenoid Valves (Fig. 2.3, items 1, 2, 3, 4 and 5)

Valve Maintenance Note

- (a) If the valve assemblies are to be dismantled into their component parts, make sure that:
 - (i) Careful note is taken of the connections, and of the alignment and angles of components and pipes relative to the valve, to ensure correct re-assembly.
 - (ii) Connections are not overtightened.

CAUTION

Do not misplace the small internal springs in the sealing plunger.

- (b) All valves on the vacuum autoclave have 14 Watt coils and are not interchangeable with valves on other autoclaves.
- (c) The two electrical connections to the solenoid valves can be made either way round.

Vacuum, Steam Bleed, and Water Discharge Solenoid Valves (Fig. 2.3, items 1, 2 and 3)

- 15 To remove and replace valves, proceed as follows:
- a Disconnect electrical connections from valve and release plumbing connections at each side.
 - b Note carefully the orientation of the valve parts to ensure correct reconnection. Connection identified as '2' on valve body should always be connected to the chamber side.
 - c Remove pipework from valve, then remove the valve.

Note: On discharge valve remove the securing screws.

- d Examine the valve. If only the valve coil has failed (e.g. short-circuiting) it can be renewed. The valve can also be dismantled and cleaned, see Note preceding para 15.
- e Fit new or repaired valve in the same way as the original one, making connections as noted in (15b).

Air-Inlet Solenoid Valve Assembly (Fig. 2.3 item 5)

- 16 The air-inlet solenoid valve is removed and refitted as an assembly as follows:
- a Disconnect the two electrical connections to the valve.
 - b Support the valve, and undo 1/4 x 5/16 BSPT stud coupling nut 'A' (Fig.2.3).
 - c Withdraw valve assembly, and remove the silicon tube connecting the valve to the bacterial filter.
 - d Remove the valve assembly from the autoclave.

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- e Examine the valve assembly. If only the coil has failed it can be renewed. The valve can be also dismantled and cleaned, see Note preceding para 15 and note:-
- (i) The non-return valve is connected to the elbow connection using PTFE tape (Part No.301600) make sure that the tape does not cover the end of the non-return valve.
- (ii) The elbow connector is connected to port 1 of the valve using hydraulic sealant (Part No.306234) make sure that when it is fitted the non-return valve is pointing vertically down.
- (iii) The long, threaded end of the 1/4 x 5/16 male stud coupling is connected to port 2 of the valve using hydraulic sealant (Part No.306234) .
- f Refit a new, or a repaired valve assembly in reverse removal sequence using a small quantity of Hellerine oil (Part No.670170) to assist refitting silicon tube.
- g Operate the autoclave using a 134°C with drying cycle, to check that the solenoid valve assembly is working correctly.

Water-Fill Solenoid Valve Assembly (Fig. 2.3 item 4)

- 17 The water-fill solenoid valve is removed and refitted as an assembly as follows:
- a Disconnect the two electrical connections to the valve.
- b Support the valve, and undo the nut securing the 90° elbow to the lower manifold of the chamber (Fig. 2.3).
- c Withdraw the valve assembly, and undo the nut connecting the nylon tube to the solenoid.
- d Remove the valve assembly from the autoclave.
- e Examine the valve assembly. If only the coil has failed it can be renewed. The valve can be also dismantled and cleaned, see Note preceding para. 15 and note:-
- (i) The 90° elbow connector is connected to port 2 of the valve using hydraulic sealant (Part No. 306234).
- (ii) The 135° elbow connector is connected to port 1 of the valve using hydraulic sealant (Part No. 306234).
- f Refit a new, or a repaired valve assembly in reverse removal sequence.
- g Operate the autoclave using a 134°C without drying cycle, to check that the solenoid valve assembly is working correctly.

Heating Element (Fig. 2.4, item 1)

- 18 To replace heating element, proceed as follows:
- a Remove electrical connections from element terminals.
- b Remove sterilizing trays and tray carrier, and remove element clamp from inside chamber, together with heater thermostat sensor and clip.
- c Unscrew and remove large nut from heater mounting boss at rear of chamber.
- d Withdraw heating element through chamber door.

CAUTION

Avoid kinking the capillary tube.

- e Fit replacement heating element by reversing order of removal procedure.

CAUTION

Ensure that the Manual reset cut-out sensor is correctly positioned, see details para.36 .

Note: Ensure element is horizontal when fitted. Also ensure that a new sealing washer is used and that the nut is fully tightened, to avoid leaks.

Door Seal (Fig. 2.2, item 9)

- 19 Open chamber door and remove central airtight nut, stainless steel washer, seal retaining ring and seal retaining disk. Remove door seal from seal retaining disk. When fitting a new door seal ensure that it is correctly seated on seal retaining disk and that airtight nut is tight.

Vacuum Pump (Fig. 2.3, item 7)

- 20 The vacuum pump (diaphragm type) fitted to most autoclaves is illustrated in Fig. 2.3, item 7. The piston pump illustrated in Fig. 3.6 is no longer available. The diaphragm pump can be refurbished (see para.38). To remove and replace a diaphragm pump proceed as detailed in the section that follows.

Note: If the piston pump (see Fig. 3.6) is fitted to the autoclave this should be replaced (if problems are encountered) with a diaphragm pump. The kit (part number 111372) contains all the parts and fitting information required to achieve this replacement.

Diaphragm pump (Fig. 2.3 item 7)

To remove and replace the old diaphragm vacuum pump, proceed as follows:

- a Disconnect electrical connection from vacuum pump.

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- b Release the plumbing connections from the vacuum pump, noting the orientation of parts to ensure correct connection.
- c Remove pipework from vacuum pump.
- d Remove the nuts and washers securing the vacuum pump to the AVA mounts and remove the vacuum pump, noting orientation arrows on pump heads.
- e Fit new or refurbished vacuum pump (see para. 38) in exactly the same way as the original one. If the vacuum pump is new, remove the two plastic pipe fittings from each end of the pump and replace with 1/8 in. BSPT fittings.

Condenser (Fig. 2.3, item 6)

- 21 To remove the condenser, proceed as follows:
- a Disconnect electrical connections to fan and vacuum pump.
 - b Release plumbing connections to vacuum pump, noting the orientation of parts for reconnection.
 - c Remove two screws and washers securing condenser cover to dividing panel, and four screws and washers securing the cover to the condenser. Remove cover complete with fan and pump.
 - d Release plumbing connections from condenser, and remove pipework.
 - e Remove four screws and washers and remove condenser from chassis.
 - f Installation is the reverse of the removal procedure.

Note: When fitting the condenser in the chassis ensure the condenser is correctly positioned over the PCB cooling conduit and that the pipe connections face forward.

Cooling Fans (Fig. 2.4, items 11 and 10)

- 22 Remove Condenser Fan (Fig. 2.4, item 11) or Enclosure Fan (Fig. 2.4, item 10) as follows:
- a Disconnect electrical cables from fan.
 - b Remove screws and washers and remove fan.
 - c Installation is the reverse of the removal procedure. However, when installing Enclosure fan ensure that the flow arrow points away from the support and that the electrical wires are positioned at the bottom.

Bacterial Air Filter (Fig. 2.3, item 10)

- 23 Remove the bacterial air filter as follows:
- a Disconnect the outlet silicone tube.
 - b Release the air filter from the spring clips on the chamber support bracket.

- c Refit the filter in reverse removal order.

CAUTION

Avoid kinking the silicone tube.

The filter must be changed at the autoclave service interval, or at least every three months.

Discharge Line Filter (Fig. 2.3, item 12 and Fig. 3.2)

- 24 The filter in the discharge line should be removed and cleaned approximately every 12 months as follows:
- a Ensure all water has been discharged from chamber back into the reservoir and switch off the autoclave.
 - b Remove filter assembly from discharge line, disassemble components and rinse clean all parts, using distilled water only.
 - c Allow components to dry, then reassemble filter assembly. Ensure that copper washer is correctly positioned with bevel side against filter body. If washer is damaged, renew it.

Pressure Transducer (Fig. 2.4, item 7)

- 25 Remove the transducer as follows:
- a Release the plumbing connection at the bottom end of the pressure transducer.
 - b Remove the pressure transducer.
 - c Release the electrical cable from the securing ties and disconnect from the relay board.
 - d Refitting is the reverse of the removal procedure. On completion re-calibrate the autoclave (see para. 57 onwards).

Solid-State Relay Board (Fig. 2.4, item 14)

- 26 **See Appendix B before changing the Solid-State Relay Board.** Remove the relay board as follows:
- a Remove control board (see para.9).
 - b Remove transformer (see para.8).
 - c If a printer is fitted, remove fixing screw and move printer forward.
 - d Disconnect relay board electrical connections.
 - e Remove four nylon thumb nuts, tilt the relay panel away from the dividing panel and remove it from the PCB support.
- Refit the relay board in reverse removal sequence.

CAUTION

Ensure bottom edge of relay board is located in the PCB support slot.

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EMC Board (Fig. 2.4, item 5)

27 **See 'Appendix C' before proceeding.** Remove the EMC board as follows:

- a Remove cable-tie and lift cover, remove two screws and washers from the PCB and the choke and then remove the EMC board with the choke.
- b Refitting is the reverse of the removal procedure. However, ensure cover is installed under EMC board before the board is refitted.

Printer (Fig. 2.2 item 21)

28 Remove the printer as follows:

- a Disconnect all electrical connections noting their position and orientation for correct reconnection.
- b Remove two screws from the printer securing bracket.
- c Withdraw the printer through the front panel.
- d Refit the printer using the reverse removal procedure.

Safety Valve (Fig.2.3, item 16)

29 To remove and replace the Safety Valve proceed as follows:

- a Remove safety valve from cross assembly and clean female thread of cross piece.
- b Apply PTFE tape to thread of new valve and refit to cross assembly.

Band Heater Temperature Sensor (Fig.2.4, item 15)

30 To remove and replace the Band Heater Temperature Sensor proceed as follows:

- a Remove sensor cover from band heater loosen nut on sensor retaining clamp and remove sensor.
- b Release sensor wire from all cable clamps and the Ferrite clamp by releasing its tie and clips.
- c Unplug from the SSR board.
- d Refit by reversing the above and coat the sensor with a light smear of zinc-oxide based heat transfer compound. Ensure that the sensor is in tight contact with the band heater by adjusting the clamp if required.

Note: When a new temperature sensor is fitted, the band heater must be re-calibrated (see para.57 onwards).

Power Switch (Fig.2.4, item 9)

31 To remove and replace power switch proceed as follows:

- a Remove 4 spade connectors from the switch noting the terminals each was connected to.

- b Release switch from the front panel by pressing the retaining lugs in on each side and withdraw.
- c Replace new switch by reversing the above ensuring correct orientation ('0' left '1' right).

Float Switch (Fig.2.3, item 11)

32 To remove and replace the float switch proceed as follows:

- a Drain reservoir and disconnect the two in-line bullet connectors.
- b Remove float switch retaining nut and remove switch.
- c Refit by reversing the above ensuring that the sealing washer of the switch is correctly positioned (between the switch housing and the reservoir wall) and the thin section of the float is positioned uppermost.

Cooling Ducts

33 There is a cooling duct fitted the Standard autoclave (a sensor cover). This is fitted as follows:

- a The sensor cover is fitted by undoing the rear chamber clamp band and sliding the tag of the sensor cover under the clamp band from the rear of the autoclave. It is positioned on the dividing panel side of the chamber with its top edge 1cm short of the top test port. Retighten clamp band after positioning.

Band heater (Fig.2.4, item 18)

34 To remove and refit the band heater proceed as follows:

- a Remove band heater temperature sensor and retaining clamp para.30.
- b Remove heater connections and the spade connections to the overheat thermostat.
- c Release heater clamp bolts and carefully slide heater off the chamber vertically by allowing the heater to open up into a 'U' shape.
- d Refit new band heater by reversing the above, use threadlock 670650 on screws and refer to para.30 for details on how to refit the temperature sensor.

Note: When a new band heater is fitted it must be recalibrated see calibration para.57 onwards).

Chamber Water Level Sensor

35 To remove and refit the chamber water level sensor (see Figure on page 46 item 5) proceed as follows:

- a Remove nut and washer retaining the wire terminal and the nut holding the sensor in place at the rear of the chamber.

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- b Remove washer and plastic 'shouldered washer' from the outside of the chamber and the sensor, insulation bush and silicone bush (noting orientation of all components) from inside the chamber.
- c Clean internal chamber seating and refit new components (sensor, insulation bush, silicone bush and shouldered washer) by the reverse of above.

Manual reset cut-out (Fig.2.4, item 21 & 25)

36 To remove and replace the Manual reset overheat cut-out switch and attached bulb proceed as follows:

- a Ensure mains power is removed from the unit, remove cover and remove two spade connectors from the switch noting the terminals each was connected to.
- b Release switch from the mounting panel by removing two retaining screws.
- c Free the bulb inside chamber by releasing the clamp around bulb and heater element.
- d Remove capillary tube and bulb through chamber wall by undoing the tubes captive nut from the end of the thermal clamp.
- e Release capillary tubing from all constraints noting the path taken.
- f Replace new switch and bulb by reversing the above and noting the following :
 - (i) Apply PTFE tape around the captive nut on the tube before fitting and allow the tube to turn whilst tightening. **DO NOT OVER TIGHTEN.**
 - (ii) Reposition clamp and bulb approximately 50mm in from the back of the chamber around the right leg of the element. Lay the bulb into the clamp alongside the element and fold the clamp legs over to trap the bulb with a large pair of pliers.
 - (iii) Ensure the bulb is held tight in the clamp and that the tube is routed away from the water level sensor and not touching it.
- g Test new switch and bulb and perform a leak test (para.55 onwards).

Reservoir Water filter

37 To remove and replace the water filter proceed as follows:

- a Remove the reservoir lid and carefully pull the flexible tubing and filter up and out through the reservoir top without disconnecting the tube from the top elbow.

- b Whilst gripping the tube pull off the old filter and replace with new filter (Part No.424261) by pushing it onto the tube.
- c Reposition tube and filter back inside the reservoir ensuring the tube is not kinked and the filter is positioned inside the condensing coil.

Vacuum pump maintenance

38 Pump maintenance depends on the type of vacuum pump fitted. Autoclaves with the piston pump shown in Fig. 3.6 should have this changed (if problems with it are encountered) to the diaphragm type. The piston pump is no longer available and a kit (part number 111372) should be obtained. This kit includes all the parts and information required to replace and fit a diaphragm pump. Autoclaves with the diaphragm pump (as shown in Fig. 2.3) can be refurbished as detailed in the following section.

Diaphragm vacuum pump (as shown in Fig. 2.3)

Maintenance of the diaphragm vacuum pump entails the replacement of the Diaphragm, Valves and 'O' ring in both heads (Part No.759584) , proceed as follows:

- a Disconnect the two pipes (one on each head, items 9 and 16 of Figure in Parts List 2) at the olives, leaving the interconnecting pipe between heads attached.
- b Remove the head bolts and lift off the head assemblies together. (If head removal is difficult, side blows from a soft headed mallet may be required, to assist separation).
- c Remove diaphragm retainer plate screws and lift off retainer plates, remove diaphragms and discard.
- d Place new diaphragms on con-rod tops, replace retainer plate and screws using Loctite 242 (Part No.306039) on threads and torque to 2.5Nm.
- e Remove valve plate from the head assembly and discard valves and 'O' ring.
- f Fit new valves and 'O' rings, replace valve plate and screws using Loctite 242 and torque to 2Nm.
- g Position one of the diaphragms at the mid stroke position and ensure that the diaphragm is seated correctly.
- h Replace the head and head bolts and torque in a cross pattern to 3Nm re-torque the first bolt to each head.
- i Reassemble the autoclave and test. If an abnormal noise is heard, obtain assistance from the Eschmann After Sales Service Department (details inside front cover).

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Display Board (Fig. 2.4, item 13)

39 Remove the display board as follows:

- a Remove the solid state relay board (see para.26).
- b Disconnect display board electrical connections.
- c Remove nylon thumb nuts and remove the display board.

Refit the display board in reverse removal sequence

SPECIAL OPERATING MODES

40 The following switches, 'held-pressed' when power is switched ON, will initiate the following special operating modes (see Fig.3.3 for SW1-4 and Fig.3.4 for SW6):

- Switch 6 (SW6) - Machine set-up mode.
- Switches 1 and 2 (SW1+SW2) - Engineering mode.
- Switches 1 and 4 (SW1+SW4) - Clock-set mode
- 'P' button (SW5) - Function test (Door must be CLOSED).
- Switches 2,3 and 4 (SW2+SW3+SW4) - All cycles temporarily enabled for selection of calibration cycle.
- Switches 1 and 6 (SW1+SW6) - Test operation of the 'Air in' solenoid valve.
- Switches 2 and 6 (SW1+SW6) - Test operation of the 'Steam bleed' solenoid valve.

Note: When setting the clock use the SW1 and SW4 combination, not the set-up procedure. If the set-up procedure is used the complete set-up procedure will have to be done.

Engineering Mode

CAUTION

Inbuilt protection by the computer does not operate in Engineering Mode.

41 To enter the Engineering Mode proceed as follows:

- a Switch off power and wait 10 seconds.
- b Push and hold switches SW1 and SW2 (Fig. 3.3) and switch on power.
- c Release switches SW1 and SW2 when the bleeper sounds and the message 'ENGINEERING MODE' shows on the display. Both fans will also start.

42 In Engineering Mode the programme selector switches SW1 to SW4 toggle on/off sequentially. Switch SW5 operates in a press-and-hold mode, and programme indicator LED's operate as follows:

- a Switch SW1 - Press to check vacuum pump and AIR OUT solenoid valve. A red LED (D7) should also be illuminated on the relay board.

- b Switch SW2 - Press to check DISCHARGE valve solenoid valve and door bolt solenoid.
- c Switch SW3 - Press to check water heater heating element is energized, as indicated by red LED (D6) illuminated on the relay board.
- d Switch SW4 - Press to check WATER FILL solenoid valve.
- e Switch SW5 - Press to check that band heater has energized as indicated by LED (D5) on the relay board illuminating intermittently.
- f LED 1 (to the left of SW1) - illuminates to indicate that door interlock lever has operated.
- g LED 2 (to the left of SW2) - illuminates to indicate that water level sensor circuit is operative.
- h LED 3 (to the left of SW3) - illuminates when the reservoir is full, and is 'off' when the reservoir is empty.

43 To exit Engineering Mode, switch off power to the autoclave, wait 10 seconds and then switch it on again.

Machine Set-Up Mode

44 Once started, the Machine set-up procedure must be completed in full. Do not switch off the power before it has been completed. If a mistake is made, switch off the power and start again. On autoclaves fitted with a printer a printout showing the main items selected within the set-up procedure will be printed when the procedure has been completed.

45 Throughout the Machine set-up procedures the following switches are used (see Figs.3.3 and 3.4):

- Switch 1 (SW1) - Indicates 'Yes' or 'Up'.
- Switch 2 (SW2) - Indicates 'No' or 'Down'.
- Switch 3 (SW3) - Indicates 'Accept'.
- Switch 4 (SW4) - The fourth 'Down' control button.
- Switch 5 (SW5) - The fifth 'Down' control button.
- Switch 6 (SW6) - The button on the bottom outer corner of the control board (Fig. 3.4).

Set-Up Procedure

46 The machine must be set-up as follows:

WARNING

During the following procedure the autoclave cover is removed and mains voltage is exposed.

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- a Set mains power on/off switch to 'off' (0).
- b Press and hold switch SW6 on control PCB (Fig.3.4) and set mains power on/off switch 'on' (I). Continue holding switch SW6 until 'MACHINE SET-UP' is displayed, then release it.
- c Make sure that the two fans (one at the rear and one at the side of the autoclave) are working.
- d After a short time 'SES VACUUM 2000?' will be displayed. Press switch SW1('Yes').
- e Display will show 'STANDARD CHAMBER?'. If the autoclave has a 'Standard' chamber, press SW1 ('Yes'). If the autoclave has a 'long' chamber, press SW2 ('No') and display will change to 'LONG CHAMBER?'. Press SW1 ('Yes').
- f Display will change to 'PRINTER?'. If a printer is fitted, press SW1 ('Yes'), or if a printer is not fitted, press SW2 ('No').

NOTE: Do not press SW1 if a printer is not fitted as this may inhibit special functions, always press SW2 if a printer is not fitted.

Setting the Autoclave Serial Number (Fig. 3.3)

Note: This procedure is only applicable to units fitted with a printer.

47 The autoclave serial number (which is on the dataplate on the inside cover of the autoclave door and on the back of the autoclave cover) comprises 5 parts:



- *** Prefix letters determined by chamber size and model
- A** Modification state (A through Z)
- 5** Last digit from Year of manufacture (e.g. 7 = 1997, 0 = 2000)
- H** Month of manufacture (A = Jan, L = Dec).
- 0123** Serial No comprising two groups: 01 is the 'Hi' group (thousands and hundreds): 23 is the 'Lo' group (tens and units).

- The serial number will be automatically prefixed by the letters LV or LLV indicating Standard or Long chamber versions respectively. This is determined by the set-up procedure in para.48 (d & e).
- The modification state is represented by a letter (A to Z). It is entered into the autoclave as a two digit code (01 =A, to 26 = Z). Note that on the printout, the letter will be shown; not the number.
- The year of manufacture, which is represented by the last digit of the year, is entered into the autoclave

as a single number. Thus, if the year is 1996 a '6' will be indicated. (e.g. 7 = 1997, 0 = 2000).

- The month of manufacture is represented by a single letter (A = January, H = August).
- The serial number ('hi00' and 'lo00') which is represented by four digits, is entered into the autoclave as two, two-digit groups, 'hi' and 'lo' ('hi' = thousands and hundreds, 'lo' = tens and units). Thus, for serial number 0123, 'hi' = 01, 'lo' = 23).

48 Enter the autoclave serial number as follows:

- a Check that the display shows 'SET SER NO. ?'.
 - (i) Press switch SW1 to accept (YES) or switch SW2 to reject (NO). Pressing switch SW2 will move the cycle direct to 'Setting the Cycles in Use' mode.
 - (ii) If SW1 is pressed the display will change to 'SET MOD LEVEL'. Enter the modification state (01 = A, to 26 = Z) by pressing switch SW1 to increase the number, or switch SW2 to decrease the number.
 - (iii) When the number is correct, press switch SW3 to accept the entry.
- b Check that the display has changed to 'SET BUILD YEAR'.
 - (i) Enter the last digit of the year of manufacture (7 = 1997, 0 = 2000) by pressing switch SW1 to increase the number, or switch SW2 to decrease the number.
 - (ii) When the number is correct, press switch SW3 to accept the entry.
- c Check that display changes to 'SET BUILD MONTH A'.
 - (i) Enter month code (A=January, to L=December) by pressing switch SW1 to increase the number, or switch SW2 to decrease the number.
 - (ii) When the number is correct, press switch SW3 to accept the entry.
- d Check that display changes to 'SET SER NO. (HI)00'.
 - (i) Enter the first two digits of the serial number by pressing switch SW1 to increase the number, or switch SW2 to decrease the number.
 - (ii) When the number is correct, press switch SW3 to accept the entry.
- e Check that display changes to 'SET SER NO. (LO)00'.
 - (i) Enter the last two digits of the serial number by pressing switch SW1 to increase the number, or switch SW2 to decrease the number.
 - (ii) When the number is correct, press switch SW3 to accept the entry.

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The autoclave serial number is now set and you will be asked if the serial number is correct. Press switch SW1 if the answer is 'YES', or switch SW2 if the answer is 'NO'. If serial number is incorrect repeat the procedure to set the serial number.

Setting the Cycles in Use (Fig. 3.3)

49 Enter the cycles required as follows:

- a Check that display shows 'SET CYCLES?'.
 - (i) Press switch SW1 to accept (YES) or switch SW2 to reject (NO). Pressing switch SW2 will move the cycle direct to 'Setting the Display Language' mode.
 - (ii) If switch SW1 is pressed, the display will change to 'ANSWER YES/NO ALL?'. Press switch SW1 for 'YES', or switch SW2 for 'NO'.
- b Check that display changes to '134°C POROUS+DRY'.
 - (i) Press switch SW1 (YES) if this cycle is to be set, or switch SW2 (NO) to reject it.
- c Check that display changes to '121°C POROUS+DRY'.
 - (i) Press switch SW1 (YES) if this cycle is to be set, or switch SW2 (NO) to reject it.

50 Continue the procedure until all possible cycles have been accepted, or rejected.

Note: At least one cycle must be accepted.

Setting Date and Time (Fig. 3.3)

51 Set the date and time as follows:

- a Select 'DATE AND TIME' by pressing SW1 and SW4 simultaneously, then switch autoclave 'on'(I). Release switches after a bleep is heard.
- b Check that display shows 'SET DATE AND TIME?'. Then press switch SW1 for 'YES'.
- c Check that display shows 'MONTH?01'.
 - (i) Press and hold switch SW1. Observe that numbers change to 02, 03 etc. through 12. Also note that pushing and holding switch SW2 makes the number decrease.
 - (ii) Use switches SW1 and SW2 to set the number corresponding to the month (01 = January etc.). Push switch SW3 to accept.
- d Check that display shows 'DAY?01'.

Use switches SW1 and SW2 to display the day of the month. Note that the computer will prevent entry of dates such as 31 November and will allow for February with respect to leap/non-leap years. Push switch SW3 to accept the day.

- e Check that display shows 'YEAR ? 00'.

Use switches SW1 and SW2 to set any year from 00 to 99. Push switch SW3 to accept year.
- f Check that display shows 'HOURS ? 00'.

Use switches SW1 and SW2 to set the hour; the system uses a 24 hour clock. Push switch SW3 to accept the hour.
- g Check that display shows 'MINS ? 00'.

Use switches SW1 and SW2 to set the minutes. Push SW3 to accept minutes.

Note: Internally the seconds are set to zero when switch SW3 is pushed.

Setting Cycle Counter (Fig. 3.3)

52 Set cycle counter as follows:

- a Check that display shows 'RESET COUNTER?'.
 - (i) Push switch SW1 for 'YES' or SW2 for 'NO'.
 - (ii) If SW1 (YES) is pushed display will change to 'RESET' and cycle counter will reset to '0000'.

ERRORS AND ERROR CLEARING

53 If an error occurs during the operating cycle an error code will appear on the display, accompanied by continuous bleeps. If a printer is fitted, the error is reported together with the date and time of the occurrence and the message 'CYCLE FAILED' (in double size letters) is shown. The error codes, together with their meaning, are shown in Section 2 'Error Code Table'.

54 When an error occurs, autoclave operation is inhibited until the error is cleared as follows:

- a Switch off power to the unit.
- b Push and hold in 'P' selector switch (Switch SW5 Fig.3.3) and switch on power.
- c Release 'P' selector switch after two seconds.

LEAK TEST PROCEDURE

55 A leak test must be carried out before calibration takes place and may also be required during fault diagnosis. The acceptance criteria is 'leak rate not to exceed 0.13 kPa/min (1.3 mbar/min)'. Before doing a leak test make sure that the chamber is dry and at ambient temperature.

Leak test

56 The leak test procedure detailed below takes 15 minutes (excluding pump-down time).

Note: A stopwatch, a pressure probe, and a chart recorder are needed for this procedure. All test equipment used for calibration procedures should themselves be regularly calibrated with traceable records.

PART 3 MAINTENANCE

WARNING

This procedure is done with the autoclave cover removed, mains power switched 'on' and the system pressurized. Take care when making adjustments.

- a Remove the autoclave cover as described in para. 3.
 - b Insert a pressure probe into the pressure test port (Fig. 2.4 item 22) making sure that the probe is fully inserted into the port.
 - c Close the autoclave door, and select ENGINEERING MODE (para.41).
 - d Simultaneously, start the stopwatch and press switch SW1. Check that the vacuum pump starts, and the pressure shown on the process display (Fig. 2.2 item 1) decreases steadily.
 - e After 5 minutes, stop and reset the stopwatch, and note that the indication shown on the chart recorder is less than 12kPa, and is decreasing very slowly.
 - f Using a small screwdriver, adjust V5 (Fig. 3.4) on the control board (Fig. 2.4 item 19) to set the autoclave process display indication to the value shown on the chart recorder, (clockwise to decrease, and anticlockwise to increase the pressure indication).
- Note:** The autoclave process display can only be set in steps of 2kPa, and it must be adjusted to the nearest 1kPa of the chart recorder indication, rounded 'up' or 'down' as necessary.
- g Simultaneously, start the stopwatch and press switch SW1 to stop the vacuum pump, and then record (as P1, in kPa) the pressure shown on the chart recorder.
 - h After five minutes (\pm 10 seconds) has elapsed record (as P2, in kPa) the pressure shown on the chart recorder.
 - i Subtract P2 from P1. If the result (leak-rate) is less than 0.65kPa continue the leak-test, if greater, stop the leak-test and check the autoclave for leaks. After correcting all leaks, the leak-test procedure must be repeated.
 - j After 15 minutes (\pm 10 seconds) record (as P3, in kPa) the pressure shown on the chart recorder (stop and reset the stopwatch).
 - k Subtract P3 from P2 and check that the result is less than 1.3kPa.
 - l Press switch SW2 (Fig.3.3) to open the discharge valve to vent the chamber pressure to the reservoir.
 - m Remove the pressure probe from the pressure test port, and refit the test port blanking cap.

- n Disconnect and remove the chart recorder.
- o Refit the autoclave cover as described in para. 4.

AUTOCLAVE CALIBRATION

General

57 The autoclave will retain its calibration over long periods of time but, occasionally, and when a new sensor or control board has been fitted, re-calibration is necessary.

58 It is recommended that the calibration is checked at regular intervals, or if the autoclaves calibration is suspect.

59 For the purpose of this description it will be assumed that the autoclave is working correctly and that a routine temperature calibration is required.

60 It is particularly important that the following points are noted before calibration is started:

- (i) There must be no steam leaks (Check by running a leak test see para.55).
- (ii) The chamber steam bleed valve must be working correctly.
- (iii) The machine should have been run sufficiently to become thoroughly warm.
- (iv) Running calibration cycles will not advance the cycle counter.
- (v) Some of the error detection systems are automatically 'switched off' during the calibration phase.
- (vi) A machine with suspect calibration should only be run using the calibration procedure described below. This should avoid the possibility of the safety valve lifting due to excess chamber pressure, which might happen if the 134°C programme were to be selected.

Calibration Procedure

Note: During calibration replace the cover (do not fix) to ensure accuracy. On later models V1-V5 can be adjusted through the sliding port in the cover.

61 The autoclave control programme contains a special calibration sequence to ensure accurate calibration in the shortest possible time. Do not set-up the autoclave by doing normal sterilizing cycles; it is important to proceed methodically.

- 62 Prepare the autoclave for calibration as follows:
- a Switch off the autoclave and isolate from mains supply. Ensure the water reservoir is full and, for safety reasons, ensure that the reservoir is properly covered. Ideally a test load should be placed in the chamber, but this is not essential

PART 3 MAINTENANCE

- b With the autoclave cover removed, attach the bare wire tip of a twisted thermocouple tightly against the top outer surface of the band heater, next to the protective cover and as close as possible to the temperature sensor.

CAUTION

Take care not to damage the internal seals in the test port fitting. Avoid using a sharp pointed thermocouple probe, if possible.

- c Insert temperature probe into the thermocouple entry port (Fig. 2.4 item 23) on the top chamber fitting. The end of the probe must be inserted so that it protrudes approximately 20mm from the face of the chamber fitting.
- d Insert pressure probe into the pressure test port (Fig. 2.4 item 22) on the safety valve chamber fitting. Ensure that probe is fully inserted into the port.
- e Connect autoclave to mains supply and switch on.
- 63 Calibrate the autoclave as follows:
- a Close the door and push switch SW2 (Fig.3.3) to start a 121°C WRAPPED + DRY cycle. If the 121°C cycles are not available for selection use 'All Cycles' mode (para.39 fifth bullet point), then select 121°C WRAPPED + DRY Cycle.
- b While 'VACUUM ON' is displayed, and before 30 kPa is reached, press-and-hold switch SW6 (Fig.3.4) on the control board until two bleeps are heard indicating that 'Calibration Mode' has been selected, then release switch SW6.
- Notes:**
- (i) The display will continue to work as for a normal cycle. The unit will heat up to 121°C to allow initial calibration, with a sterilizing time of 15 minutes.
- (ii) To increase to 134°C, press and release switch SW1 (Fig.3.3). SW1 must be pressed within 15 minutes or the cycle will condense as for a normal cycle. A single bleep will be heard and the temperature will rise until the 134°C sterilize conditions are reached.
- (iii) Repeated pressing of switch SW1 will toggle between 134°C and 121°C, resetting the sterilizing time to one hour at each selection.
- c The display will show '121°C WRAPPED + DRY' on the top line, and initially 'VACUUM ON' on the bottom line. The pressure (kPa), displayed in the bottom right hand corner, should be steadily decreasing.

- d After approximately four minutes from start of cycle, adjust V5 (clockwise to increase) on control board (Fig. 3.4) so that the autoclave kPa display reading matches the digital display on the data-recorder.

Note: The autoclave display can only indicate in steps of 2 kPa, therefore it has to be adjusted to the nearest 1 kPa of the data recorder reading, rounded up or down as required.

- e During heating to 121°C check that air vent valve solenoid operates at approximately 104 kPa and that steam/water then flows out of the exhaust tube in the reservoir manifold.
- f Make sure the door pressure lock engages before the pressure reaches 120 kPa. When door pressure lock engages, check door pressure indicator (Fig.2.1a) changes from full green to full red when viewed horizontally and level with the indicator.
- g Make sure that there are no audible or visible leaks.
- h When the temperature has stabilized in the 'sterilization' phase, adjust V1 (clockwise to increase) on control board (Fig. 3.4), until as close as possible to 122°C is indicated on the chart recorder.

Notes:

- (i) If the temperature trace has a 'sawtooth' waveform, calibrate the peaks to 122°C. **The temperature trace must always be above 121°C.**
- (ii) The autoclave display is not important at this stage.
- i When the temperature setting is correct, check the autoclave process display. If necessary, match the display temperature to the temperature shown on the chart recorder by adjusting V3 (anti-clockwise to increase) on control board (Fig 3.4).
- j Push switch SW1 (Fig.3.3). A bleep should be heard and the temperature will increase. Wait until the trace on the chart recorder has stabilized in the 'sterilization' phase.
- k Adjust V2 (anti-clockwise to increase) on control board (Fig. 3.4), until as close as possible to 135°C is indicated on the chart recorder.

Notes:

- (i) If the temperature trace has a 'sawtooth' waveform, calibrate the peaks to 135°C. **The temperature trace must always be above 134°C.**
- (ii) The autoclave display is not important at this stage.

PART 3 MAINTENANCE

- l When the temperature setting is correct, check the autoclave process display. If necessary, match the display temperature to the temperature shown on the chart recorder by adjusting of V4 (clockwise to increase) on control board (Fig. 3.4).
- m Check that the autoclave process display corresponds with the temperature/pressure settings shown in the table below. If necessary, calibrate the autoclave process display by making small adjustments of V6 (clockwise to increase) on control board (Fig. 3.4).

Temperature/Pressure Settings

Temperature Display (°C) (kPa)	Chart Recorder Pressure trace DisplayPressure	Set Autoclave (adjust V6) to
All pressures are absolute and are measured in kPa		
121.0	205.0	204/206
121.5	208.1	208/210
122.0	211.3	210/212
122.5	214.7	214/216
123.0	218.0	216/218
123.5	221.4	220/222
124.0	225.0	224/226
134.0	304.6	302/304
134.5	309.3	308/310
135.0	313.9	312/314
135.5	318.5	318/320
136.0	323.1	322/324
136.5	327.8	326/328
137.0	332.4	332/334

- n Push switch SW1 (Fig.3.3) to decrease temperature to 121°C and allow to stabilize for a minimum of five minutes.
- o Make sure that the temperature calibration, as shown on the chart recorder, is still as specified in para.63h. If adjustment is required, proceed as detailed in para.63h.
- p Check the autoclave display and make sure that it corresponds to the temperature shown in the 'Temperature/Pressure Settings' table in para.63m.

If calibration of the autoclave display is required, make small adjustments to V6 (clockwise to increase) on control board (Fig. 3.4).

- q Press switch SW1 (Fig.3.3) to return to 134°C and allow to stabilise for 5 minutes, re-check temperature and pressure calibration. If necessary, re-calibrate as detailed in paras.63k to 63p.
- r On completion of calibration, seal potentiometers V1, V2, V3, V4, V5 and V6 on control board with a small quantity of anti-tamper sealant (Part No.670678) between the adjuster screw and the plastic body (not in the screw slots).

Note: If calibration of the autoclave cannot be achieved using the calibration procedure, replace the control board and repeat, the calibration procedure.

Pressure relief valve test

WARNING
During testing, high pressure steam will be released from the pressure relief valve. Ensure safety of all personnel.

64 The pressure relief valve should be tested every 12 months or at service intervals to ensure free movement of parts. To test the pressure relief valve, proceed as follows:

Note: The pressure relief valve is set to operate at 262kPa (gauge) but is allowed an over -pressure margin of 10% maximum (i.e. 288.2kPa (gauge)). If dealing with absolute pressure readings, subtract local atmospheric pressure to obtain gauge values.

- a Calibrate the autoclave as detailed in para.57 onwards and make sure that it is sterilizing at 134°C.
- b Whilst in calibration mode press-and-hold switch SW3. This will operate the heater element until the switch is released.
- c The temperature and pressure should increase until, at approximately 345 kPa (absolute) as shown on the chart recorder, the pressure relief safety valve operates.
- d Release switch SW3.

PART 3 MAINTENANCE

Band heater calibration (Fig. 3.4)

65 Carry out band heater calibration whilst in calibration mode as follows:

Notes:

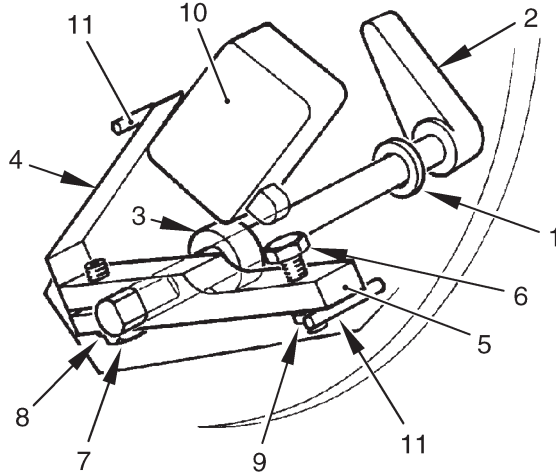
- (i) A half-turn of V7 (Fig.3.4) clockwise or anticlockwise, results in approximately 3°C change of temperature.
 - (ii) The time period between successive temperature peaks is approximately three minutes.
 - (iii) The band heater must be set during the first 15 minutes of 'drying'; an internal timer switches the heater off for the last five minutes of 'drying'.
- a Press switch SW2 (Fig.3.3). This will cause the chamber to discharge to reservoir and then automatically start a 'drying' phase for 20 minutes.
 - b When the 'drying' phase has started, observe the band heater temperature as shown on the chart recorder (see para 62b for position of thermocouple). The temperature peaks must be between 154 and 158°C. If necessary, adjust V7 on control board (Fig. 3.4).
 - c When the band heater temperature has been satisfactorily set wait until the calibration cycle has ended, stop the chart recorder.
 - d Seal V7 on control board (Fig.3.4) with a small quantity of anti-tamper sealant (Part No.670678) between the adjuster screw and the body, not in the screw slot.

Functional test

66 Carry out a functional test as follows:

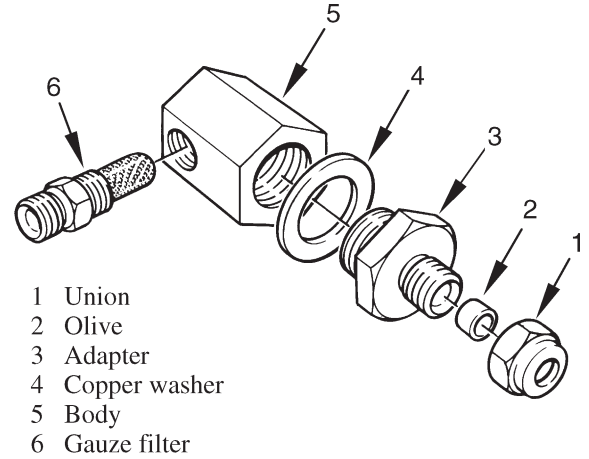
- a Close the autoclave door and press switch SW1 (Fig.3.3) to select a 134°C POROUS + DRY cycle. Make sure that temperature recorded on the chart recorder is within 134°C to 137°C during the sterilizing phase.
- b On completion remove the chart recording of the calibration and the functional test.
- c Remove the temperature and pressure probes and refit covers to ports (Fig.2.4 items 23 and 22).
- d Refit cover to autoclave.

PART 3 MAINTENANCE



- | | |
|------------------------------|----------------|
| 1 Nylon washer | 7 Clamp screw |
| 2 Actuator lever | 8 Washer |
| 3 Nylon washer | 9 Nut |
| 4 Leaf spring | 10 Microswitch |
| 5 Microswitch actuator lever | 11 Limit stops |
| 6 Striker screw | |

Fig. 3.1 Door Interlock Microswitch



- | |
|-----------------|
| 1 Union |
| 2 Olive |
| 3 Adapter |
| 4 Copper washer |
| 5 Body |
| 6 Gauze filter |

Fig. 3.2 Discharge Line Filter

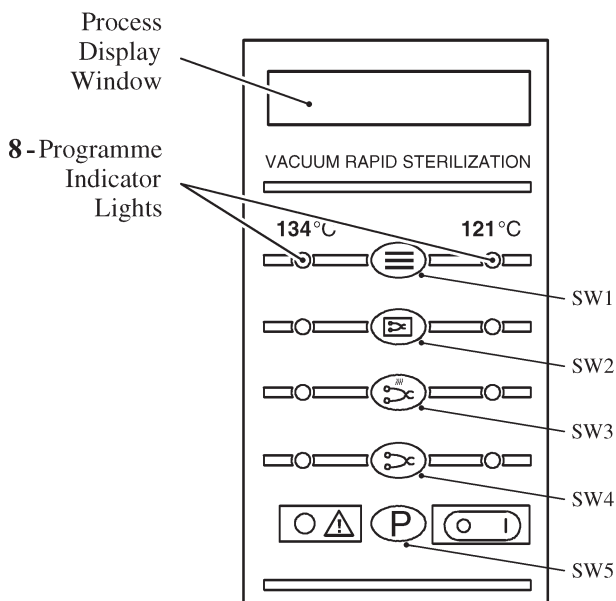
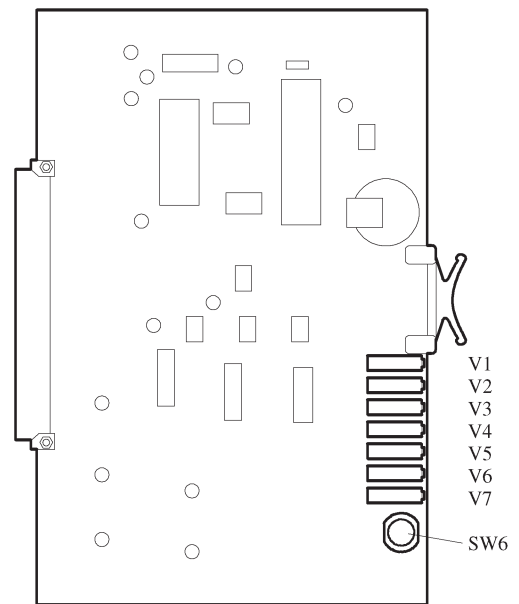


Fig. 3.3 Control Panel and Switch Identities



- | | |
|-----|---------------------------|
| V1 | (R11) Channel A-Zero |
| V2 | (R13) Channel A-Span |
| V3 | (R21) Channel B-Zero |
| V4 | (R23) Channel B-Span |
| V5 | (R30) Pressure-Zero |
| V6 | (R36) Pressure-Span |
| V7 | (R49) Aux Heater Setpoint |
| SW6 | Engineering Switch |

Fig. 3.4 Control Board Adjustment

PART 3 MAINTENANCE

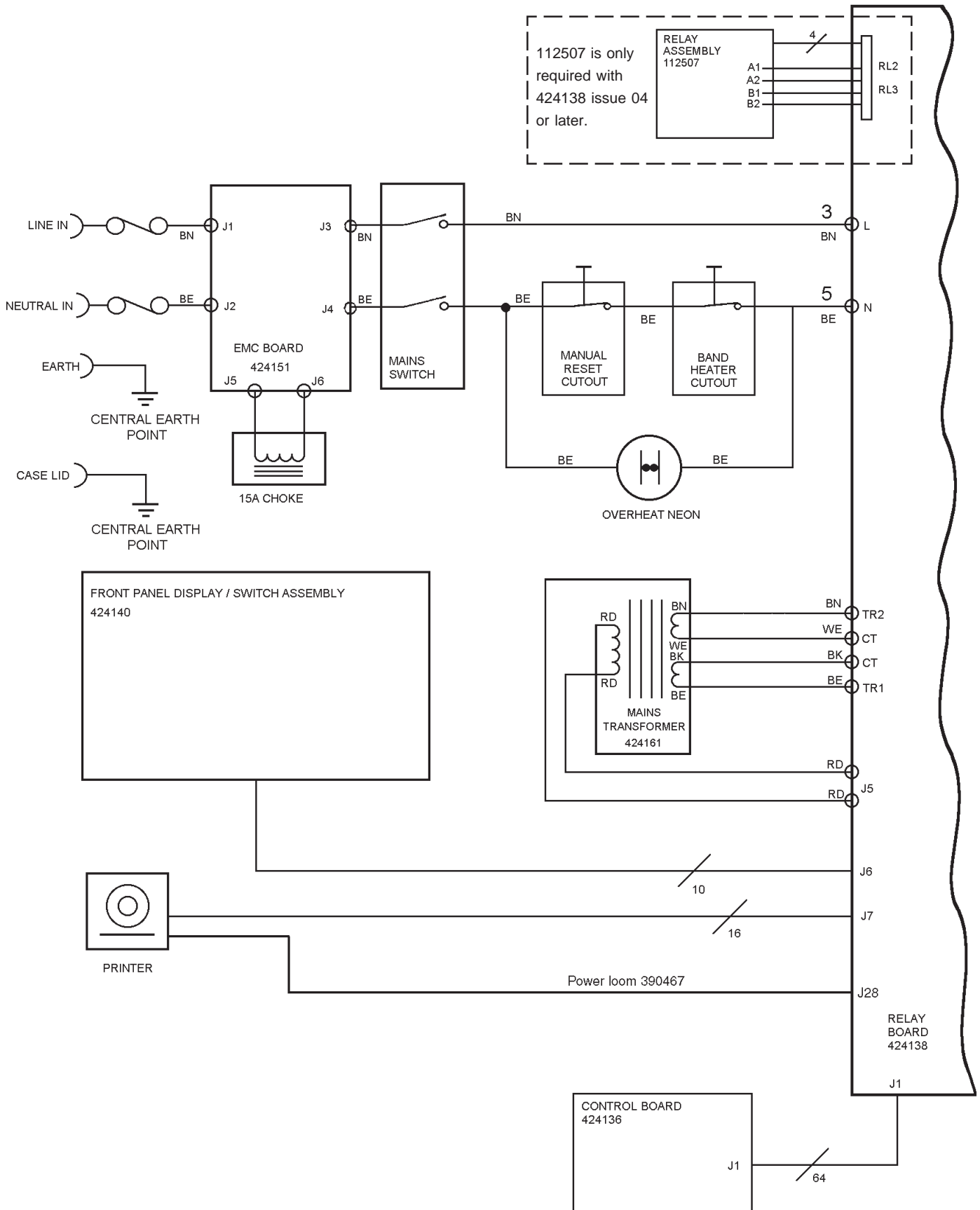


Fig. 3.5 SES 2000 vacuum autoclave: System Circuit Diagram (Sheet 1)

PART 3 MAINTENANCE

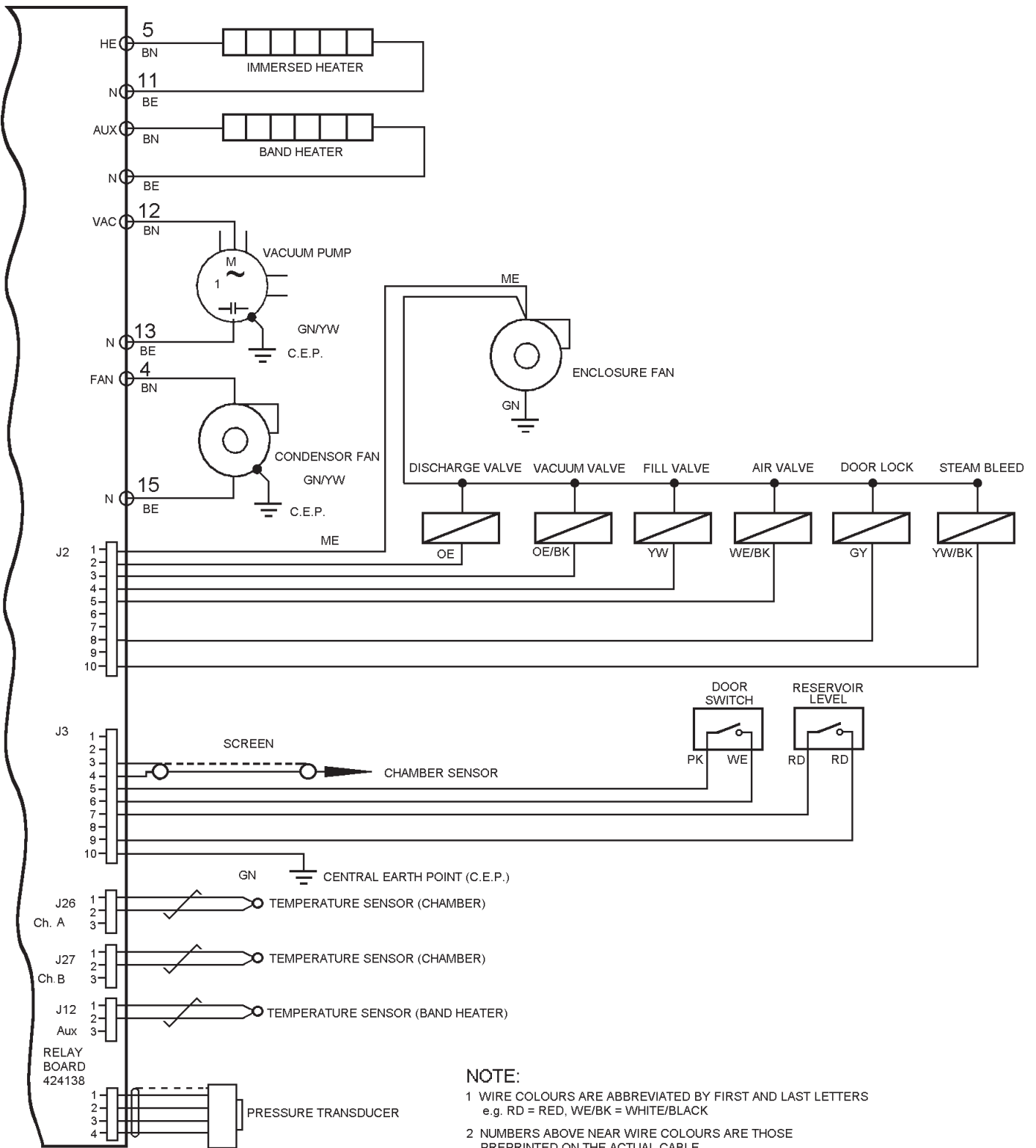


Fig. 3.5 SES 2000 vacuum autoclave: System Circuit Diagram (Sheet 2)

PART 3 MAINTENANCE

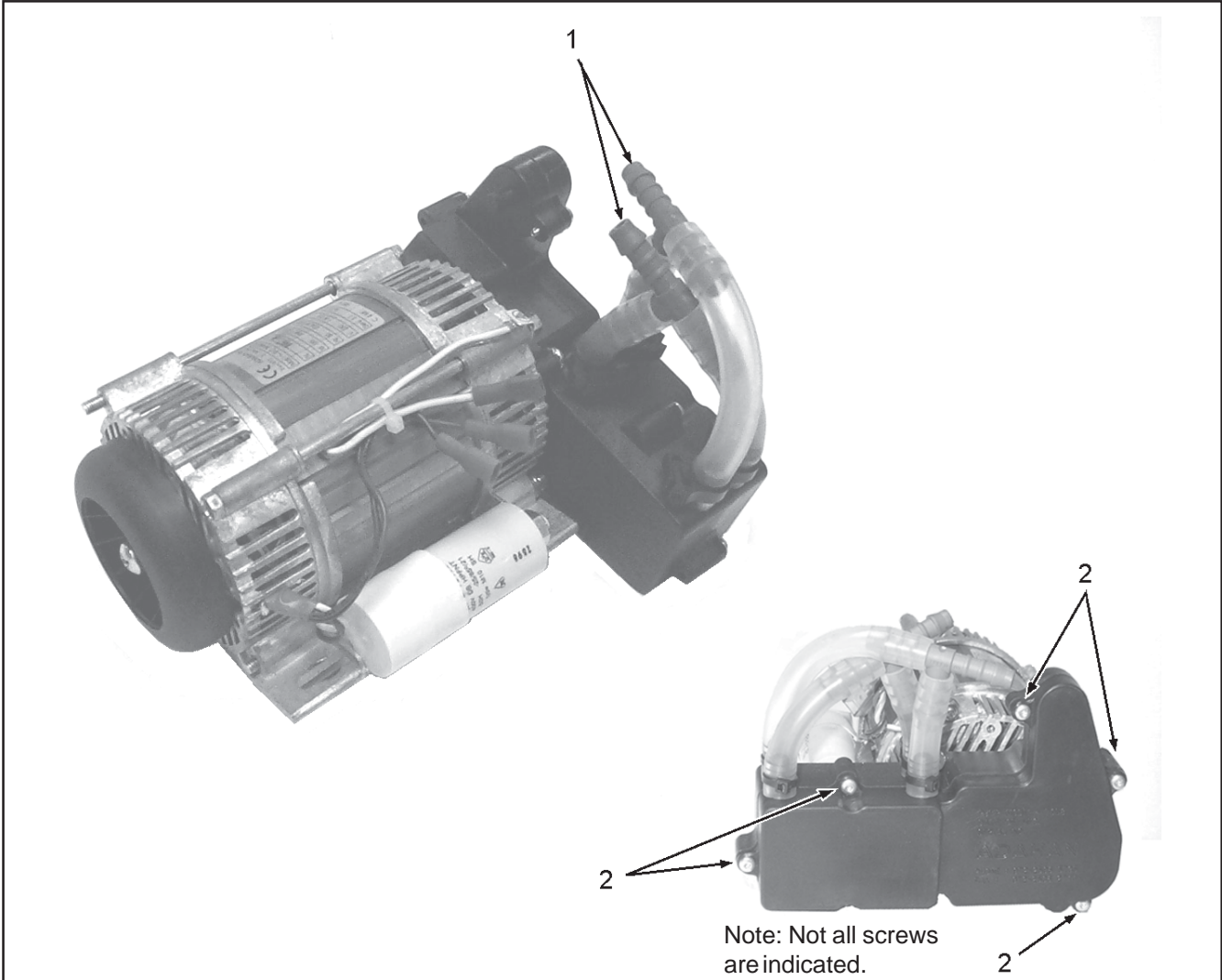


Fig. 3.6 Piston vacuum pump (as fitted to some autoclaves) no longer available.

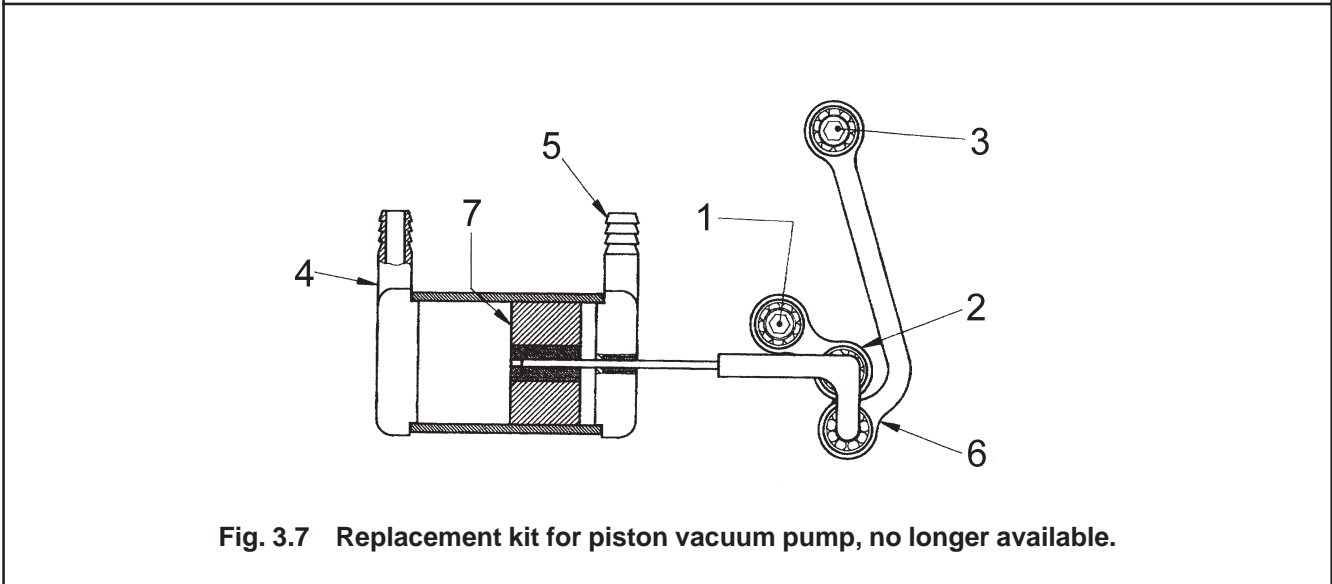
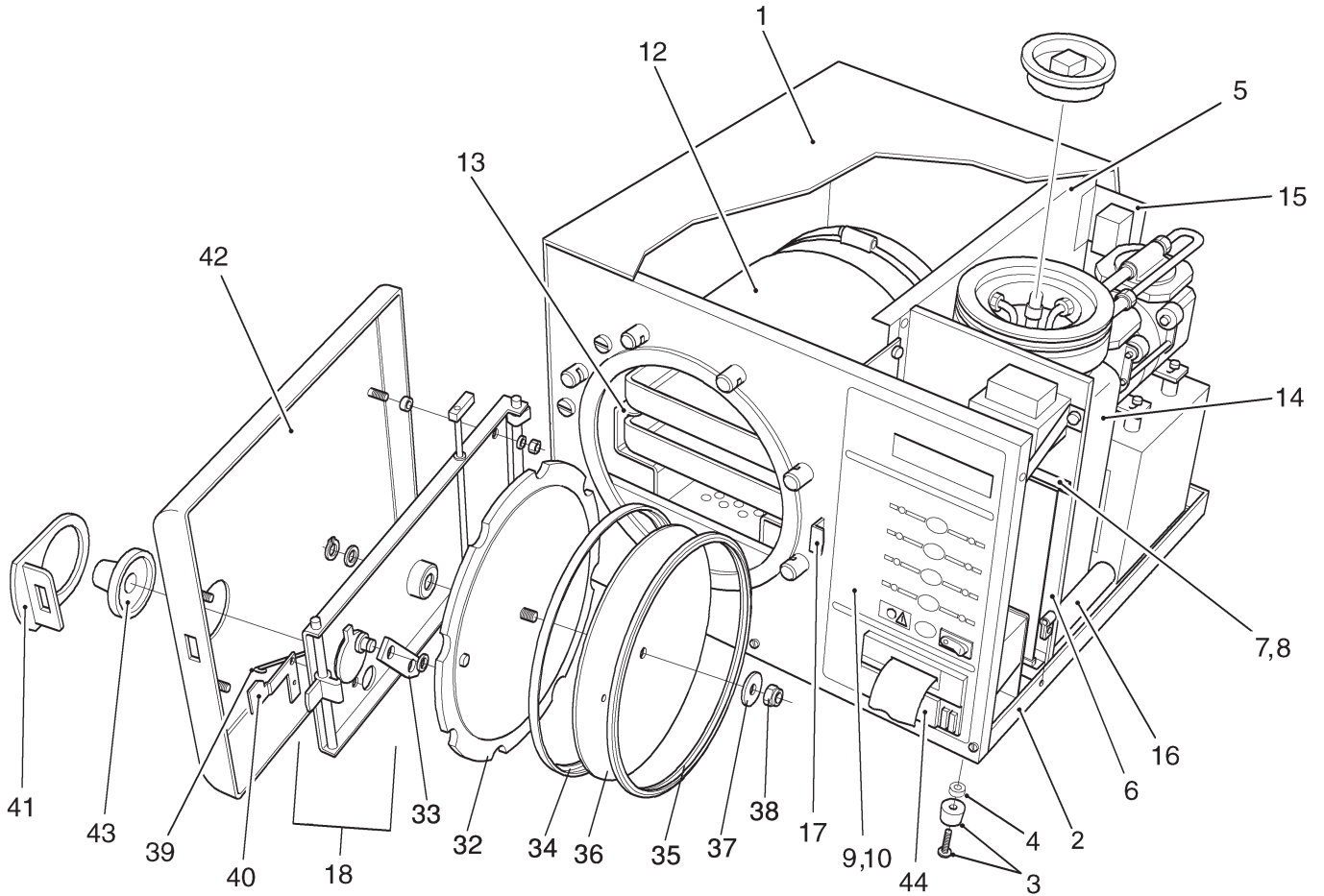


Fig. 3.7 Replacement kit for piston vacuum pump, no longer available.

PART 4 ILLUSTRATED PARTS LIST

PARTS LIST 1: GENERAL SPARES



NOTE: Change of parts for Door, Actuator lever assembly and Washer.

Note when changing a door (424280*) ensure the following parts are used:

Door 490017, Washer 112872 and current issue** Lever 427104.

The washer specified above is thinner than the original washer (307231).

* Different to door 490017 in that there is a recess in it adjacent to Lever 427104 when door closed. If door 424280 is already fitted the washer and lever will already be correct.

** The current issue Lever can be identified as the raised boss of the lever is now facing **out** and not **in**.

PART 4 ILLUSTRATED PARTS LIST

PARTS LIST 1: GENERAL SPARES

Item No	Part No Standard Long	Description	Qty Per Unit	Recommended Holding Per Unit Per Year
1	424117	. Top cover	1	-
2	424168	. Chassis	1	-
*	307267	. . Pipe clamp	1	-
*	111928#	. . Screw, self tapping (1/2")	4	4
3	480301	. . Foot and screw assy	4	-
4		380045 . . Spacer	2	-
*	301136	. . Nut, spire	4	-
*	490202	. . Chamber, support	1	-
*	307223	. . . Washer, shakeproof, M5	5	-
*	307224	. . . Nut, M5	2	-
*	604994	. Label, earth	3	-
5	424169	. Dividing panel	1	-
*	380032	. . Spacer	2	-
6	424204	. Sub-dividing panel	1	-
7	424172	. . PCB support	1	-
8	696643	. . PCB slide	1	-
*	300775	. . Pop Rivets	4	-
9	424109	. Front panel (without printer)	1	-
10	424108	. Front panel (with printer)	1	-
12		. Pressure chamber assy (See Parts List 2)	1	-
13	490228	490178 . Carrier assy, tray	1	-
*	424392	424393 . . Splash barrier	1	-
*	301409	. . Drip tray	1	-
14	424266	. Reservoir assy	1	-
*	424127	. . Reservoir	1	-
*	424221	. . Drain tube	1	-
*	424165	. . Float sensor	1	1
*	424220	. . Fill pipe	1	-
*	424261	. . Filter	1	1
*	424129	. . Manifold	1	-
*	424128	. . Condensing coil	1	-
15	424191	. Bracket, thermostat manual reset	1	-
*	307249	. . Screw, pan hd, M4 x 8	11	-
*	307163	. . Washer, shakeproof, M4	11	-
16	424233	. Conduit	1	-
*	427005	. Door post	8	-
*	307225	. . Washer, shakeproof, M8	8	-
*	307221	. . Nut, M8	8	-
17	427010	. Door latch	1	-
*	307249	. . Washer, shakeproof, M5	1	-
*	307163	. . Screw, skt hd, cap, M5	2	-

Was 307137 Screw, self tapping (3/8")

* Not shown

Continued

PART 4 ILLUSTRATED PARTS LIST
PARTS LIST 1: GENERAL SPARES

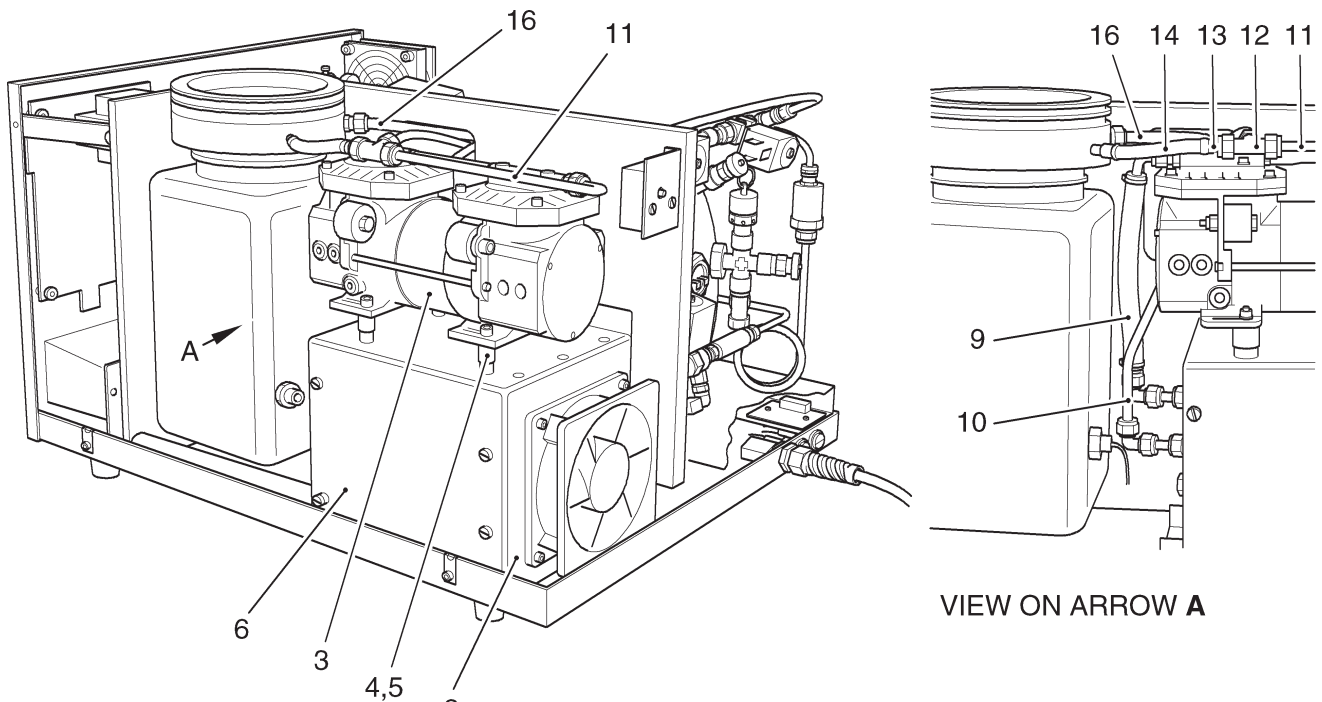
Item No	Part No		Description	Qty Per Unit	Recommended Holding Per Unit Per Year
	Standard	Long			
18	424116		. Door assy	1	-
*	424102		. . Door beam assy	1	-
*	424106		. . Door latch	1	-
*	427023		. . Wire, spring	2	-
*	427009		. . Pin, pivot	2	-
*	427012		. . Block, hinge	2	-
*	307271		. . Washer, nylon	3	-
*	427007		. . Spindle assy	1	-
*	427064		. . Washer, anti-friction	1	-
*	424124		. . Knob, door	1	1
*	301872		. . Washer, nylon	1	-
*	307202		. . Screw	1	-
*	307215		. . Washer, plain, M4	A/R	-
*	424179		. . Circlip	2	2
*	424118		. . Spindle assy	1	-
*	307231		. . Nylon washer	1	-
*	380044		. . Thick nylon washer	1	-
*	307157		. . Nut, M3	1	-
*	710592		. . Screw, btn, hd, M3 x 16	1	-
*	427020		. . Lever	1	-
*	307247		. . Screw, hex hd, M3 x 8	1	-
*	307159		. . M3 shakeproof washer	1	-
32	424280**		. Door assy, pressure	1	-
33	427008		. Link	1	-
*	307233		. . Circlip	3	3
*	307269		. . Washer, spring	1	-
34	424238		. Seal retaining rim	1	-
35	427037		. Seal	1	1
36	427015		. Retaining disc	1	-
37	427090		. Washer, seal	1	1
38	307232#		. Nut, Aerotight	1	1
39	424114		. Wire	1	-
40	424103		. Flag	1	-
*	424178		. . Pushnut	1	-
*	712924		. . Nylon washer	1	-
41	424126		. Plate, escutcheon	1	1
42	424119		. Cover, door	1	-
*	427089		. . Spacer, brass	4	-
*	307028		. . Washer, shakeproof, M6	4	-
*	307253		. . Nut, M6	4	-
43	424125		. Knob, outer door	1	1
44	490291		. Printer	1	-
*	424242		. . Printer bracket	1	-
*	307249		. . M4 x 8 Screw	1	-
*	307163		. . M4 shakeproof washer	1	-

Now replaced by M6 spring washer (710721) and M6 nut (710372).

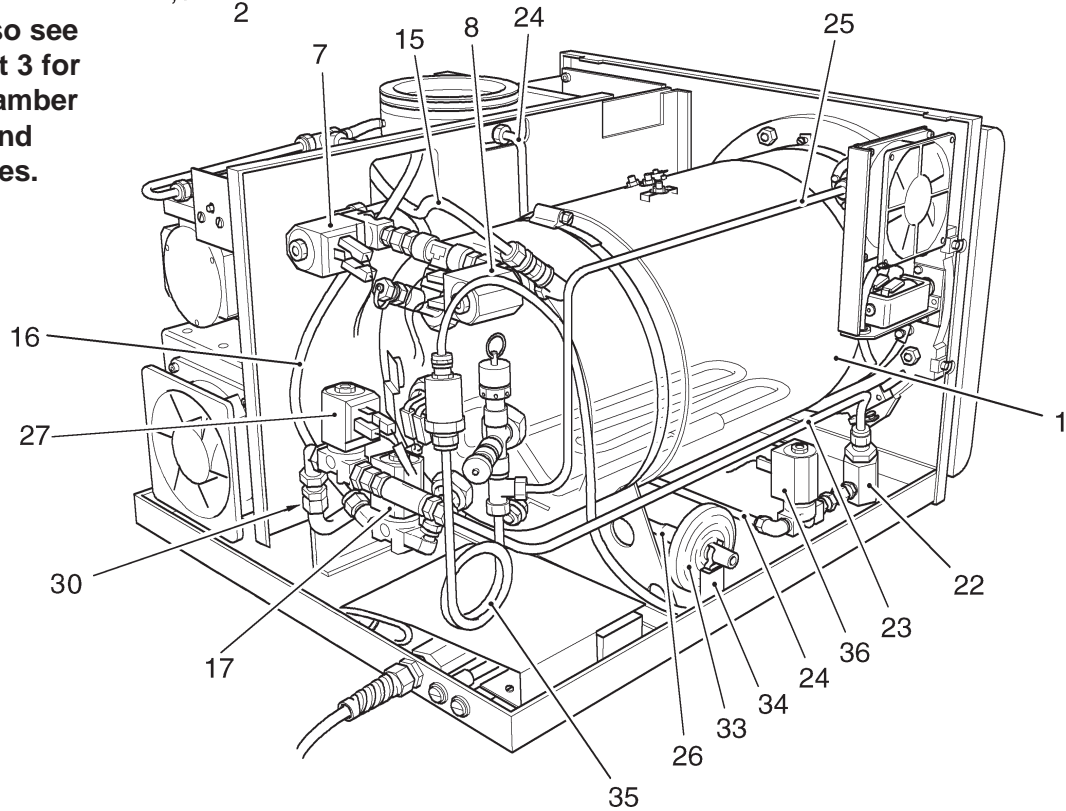
* Not shown ** See note on page 41

PART 4 ILLUSTRATED PARTS LIST

PARTS LIST 2: PIPES AND VALVES



**Note: Also see
Parts List 3 for
other chamber
fittings and
assemblies.**



PART 4 ILLUSTRATED PARTS LIST

PARTS LIST 2: PIPES AND VALVES

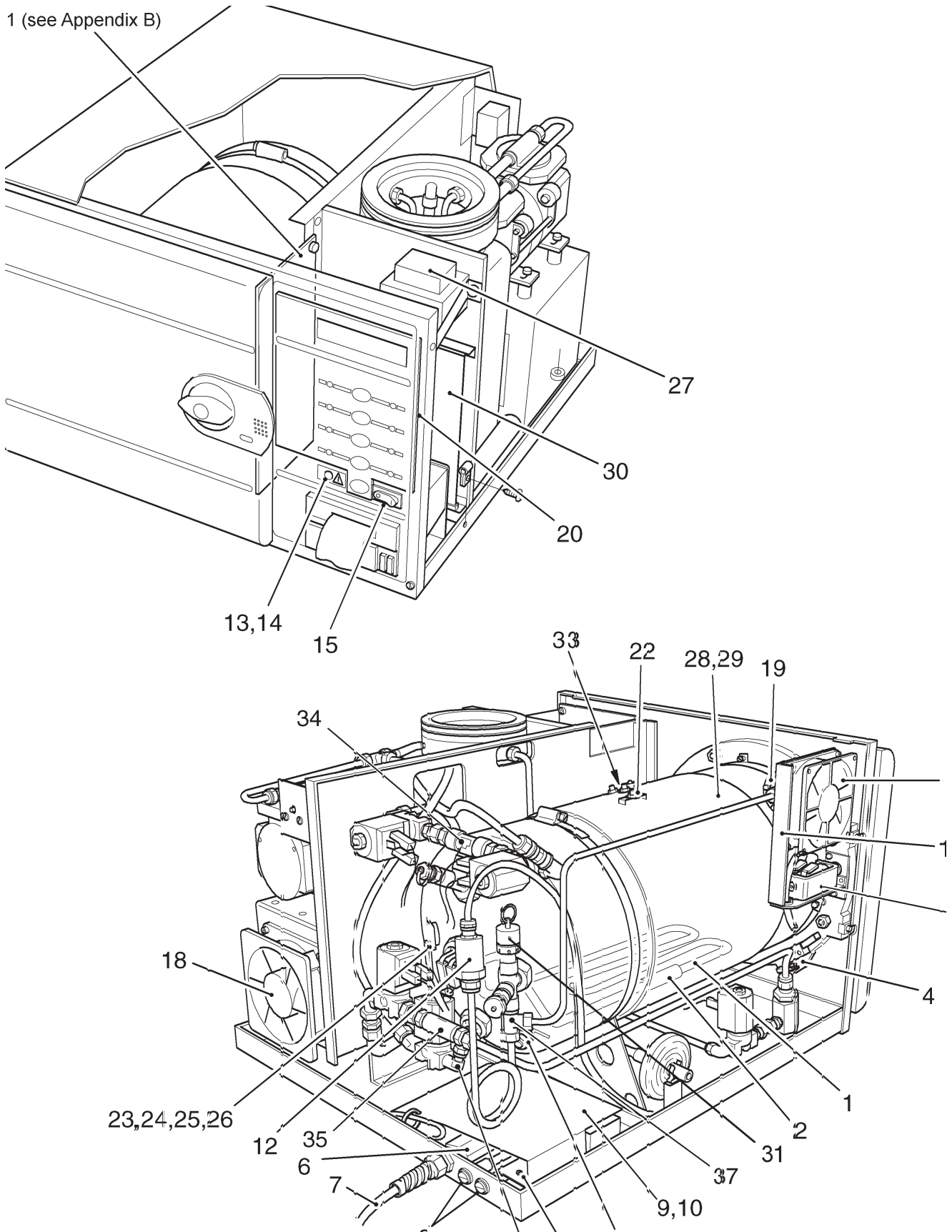
Item No	Part No		Description	Qty	Recommended
	Standard	Long		Per	Holding Per Unit
				Unit	Per Year
-			Pressure chamber assy	-	-
1	490040	490117	. Chamber	1	-
*	380040		. . Chamber clamp	1	-
*	709924		. . Screw, pan hd, M4 x 12	2	-
*	307163		. . Washer, shakeproof, M4	4	-
2	424324		. Condenser	1	-
*	710119		. . Screw, pan hd, M5 x 10	7	-
*	710733		. . Washer, shakeproof, M5	8	-
3	424152		. Vacuum pump (diaphragm type)	1	-
*	709863		. . Washer, M6	4	-
*	710412		. . Screw, hex.hd, M6 x 35	2	-
*	300832		. . Foot	2	-
*	713963		. . Washer, shakeproof, M6	2	-
*	710372		. . Nut, M6	2	-
*	424335		. . Inline filter	1	-
**	759584		. . . Diaphragm and valve repair kit	-	-
**	111372		. . . Piston pump to Diaphragm pump retrofit kit	-	-
**	759792		. . . Diaphragm pump head assy.	-	-
4	733587#		. AVA mount	4	-
5	427089		. Spacer	4	-
6	424265		. Cover assy, condenser	1	-
7	424246	424211	. 'Vacuum' solenoid valve	1	-
8	424286		. 'Steam bleed' solenoid valve	1	-
9	424301#		. Pipe, pump to condenser	1	-
10	424224#	424213#	. Pipe, 'Vacuum' sol. valve to cond'r1	-	-
11	424219#		. Pipe, pump to reservoir (copper)	1	-
12	301013#		. Tee	1	-
13	424289#		. Pipe, tee to reservoir	1	-
14	424290#		. Pipe, silicone, pump to manifold	1	-
15	424287#		. Pipe, 'air bleed' valve to pump	1	-
16	424266	424225	. Pipe, nylon 'Water fill'	1	-
17	424209		. Water Fill' solenoid valve assy	1	-
22	424271		. Filter, water	1	1
23	424222	424214	. Pipe, 'Y' fitting to filter assy	1	-
24	424216		. Pipe 'discharge' solenoid valve to reservoir	1	-
25	424223	424215	. Pipe, pressure lock to chamber tee	1	-
26	424247		. Pipe, 'air in' solenoid valve to bacterial filter	1	-
27	424210		. Air-in solenoid valve assy	1	-
30	424306		. . Assy. non-return valve	1	-
33	713580		. Bacterial filter	1	3
34	490394		. Mount assy, filter	1	-
35	424217		. Transducer coil	1	-
36	424208		. Water discharge solenoid valve	1	-
*	306234		. Hydraulic sealant	As reqd	-
*	301600		. Tape PTFE	As reqd	-
*	670170		. Oil Hellerie	As reqd	-

* Not shown # These parts are not required if the piston pump is, or has been, retro fitted.

PART 4 ILLUSTRATED PARTS LIST

PARTS LIST 3: HEATER AND PROCESS CONTROLS

1 (see Appendix B)



PART 4 ILLUSTRATED PARTS LIST
PARTS LIST 3: HEATER AND PROCESS CONTROLS

Item No	Part No		Description	Qty Per Unit	Recommended Holding Per Unit Per Year
	Standard	Long			
1	412012		. Heating element (230V, 2kW)	1	-
		416220	. Heating element (230V, 2.75kW)	1	-
*	416149		. . Clamp, thermostat sensor bulb	1	-
2	490020		. Manual reset overheat thermostat	1	-
3	380001	301890	. Holder, fuse	2	-
*	380003	301871	. . Fuse 230V (10A / 15A)	2	2
4	301162		. Door Microswitch Assy.	1	1
*	307231**		. . Washer, nylon	1	-
*	427104**		. . Actuator lever assy	1	-
*	380044		. . Washer, nylon	1	-
*	427022		. . Leaf spring	1	-
*	427020		. . Lever	1	-
*	307247		. . Screw, hex hd, M3 x 8	1	-
*	307159		. . Washer, shakeproof, M3	1	-
*	307157		. . Nut, M3	1	-
5	480314		. Sensor assy, water level	1	-
*	301806		. . Washer, shouldered	1	1
*	301807		. . Bush, silicone	1	1
*	425124		. . Bush, insulation	1	1
*	425121		. . Water level body	1	-
*	307044		. . Nut, 2BA	1	-
*	307061		. . Washer, 2BA	2	-
*	307112		. . 2BA shakeproof washer	2	-
6	380012		. Terminal block	1	-
*	307249		. Screw, pan hd, M4 x 8	13	-
7	710894		. Cable clamp	1	-
*	490080		. . Mains cable 230V, UK, or,	1	-
*	490081		. . Mains cable 230V	1	-
*	710897		. . Nut	1	-
*	307163		. Washer, shakeproof, M4	19	-
*	307161		. Nut, M4	7	-
*	693640		. Metway Clamp	2	-
*	307215		. Washer, brass	4	-
8	424156		. EMC board (see Appendix C)	1	-
*	713932		. . Spacer	2	-
9	424190		. EMC cover	1	-
10	307231		. Nylon washer	2	-
*	380034		. Cable saddle	8	-
*	380033		. Cable tie	1	-
*	424145		. Mains loom	1	-
*	424146		. Signal loom	1	-
12	424157		. Pressure transducer	1	-

* Not shown

** See note on page 41

Continued

PART 4 ILLUSTRATED PARTS LIST

PARTS LIST 3: HEATER AND PROCESS CONTROLS

Item No	Part No		Description	Qty Per Unit	Recommended Holding Per Unit Per Year
	Standard	Long			
13	301127		. Neon, overheat	1	-
14*	490306		. . Neon plate	1	-
*	301862		. . Spacer	7	-
15	380000		. Switch, ON/OFF	1	1
16	424308		. Fan assy	1	-
17	424258		. Support, door lock/fan	1	-
*	710210		. . Screw, soc hd, M4 x 12	4	-
*	696583		. . Grommet	1	-
18	424162		. Fan assy	1	-
*	710129		. . Screw, soc hd, M4 x 16	4	-
*	307163		. . Washer, shakeproof, M4	4	-
19	427035		. Lock, pressure	1	-
*	307218		. . Bolt, M5 x 10	2	-
*	427060		. . Bolt, interlock	1	-
20	424140		. Front panel PCB	1	-
*	301796		. . Spacer	10	-
*	301862		. . Spacer	6	-
21	424138		. Relay board, see Appendix B	1	-
*	307152		. . Screw, pan hd, M4 x 6	2	-
*	390371		. . Fuse, F5A, 250V (F4 Pump)	1	1
*	301797		. . Fuse, T2A, 250V (Fan F2)	1	1
*	696207		. . Fuse, T3.15A**, 250V (F1 Txr)	1	1
*	390467#		. . Printer lead	1	-
22	424239		. Temperature sensor, band heater	1	1
*	424228		. . Chamber fitting, sensor	1	-
23	424240		. Sensor, chamber temperature	2	1
24	424250		. Sensor pocket	1	-
25	424260		. Spring	1	-
26	424174		. Clamp plate	1	-
*	695776		. Cable tie	A/R	-
27	424161		. Transformer	1	-
*	424245		. . Strap, securing	1	-
*	424171		. . Nuts, thumb, nylon	14	2
*	744039		. . Cable-tie	1	-
*	424245		. Strap	1	-
*	710492		. Screw, csk hd, M3 x 10	1	-
*	490292		. Ribbon cable	1	-
*	425144		. Earth wire	1	-
*	695777		. Cable tie	2	-
*	380072		. Ferrite clamp	1	-
28	424164	424182	. Band heater	1	-
29	424259		. Cover, band heater	1	-
*	307046		. . Nut, 4BA	1	-

* Not shown

** was T2A, T3.15A now preferred

Continued

PART 4 ILLUSTRATED PARTS LIST

PARTS LIST 3: HEATER AND PROCESS CONTROLS

Item No	Part No		Description	Qty Per Unit	Recommended Holding Per Unit Per Year
	Standard	Long			
30	424424 ¹	424425 ¹	. Control PCB (A)	1	-
*	490334		. Ribbon cable, printer	1	-
*	380073		. Ferrite clamp, printer	1	-
*	695777		. Cable tie	1	-
31	301739		. Safety pressure relief valve	1	1
*	427078		. . Safety valve chamber fitting	1	-
*	424368	not reqd.	. Sensor cover	1	-
32	490025		. Electric door bolt solenoid	1	-
*	712924		. . Washer nylon	2	-
*	427060		. . Interlock bolt	1	-
*	307152		. . M4 x 6 pan head screw	2	-
*	307163		. . M4 shakeproof washer	4	-
*	307249		. . M4 x 8 Pand head screw	2	-
33	759647		. . Band heater overheat cutout	1	-
*	424444		. Calibration spring clip	1	-
Miscellaneous spares fittings					
34	490473		Double 'T' piece	-	-
35	490449		'Y' fitting	-	-
36	380008		Elbow	-	-
37	490472		Cross piece assembly	-	-
*	380020		. 1/4" Plug	-	-
*	391132		. 1/4" Washer	-	-
*	427031		Chamber fittings nut	-	-
*	427041		Copper washer for chamber fittings	-	-
*	427030		Chamber fittings (top and bottom)	-	-
*	424186		Basic valve assembly	-	-

Printer lead-only required for Relay Board 424138 printed 'Iss D' (Issue D) or later

These parts are not required if the piston pump is, or has been, retro fitted.

* Not shown

** NOTE: Printer lead Part No. 390467 is required for Relay Board (424138) printed 'Iss D' (Issue D) or later."

¹ When ordering a new control board (part number 424424 for standard or 424425 for long) it is important to determine what version of software is driving the machine. The Version state of software for each particular Autoclave will be displayed momentarily upon switching ON the Autoclave and on later versions of the control board it is also printed on the EPROM on the board. New boards will be supplied with software version 5.0 (or later). If an earlier version of software is fitted to the Autoclave then the EPROM from the original Control PCB must be fitted to the new Control PCB. (Also see Information sheet No.00010699 supplied with the new board).

**APPENDIX A
Autoclave Printer**

INTRODUCTION

This Appendix contains operating and routine maintenance information for the autoclave printer.

Printer output information:

Machine type SES Vacuum LS3
 Serial number Nine character code
 Cycle type e.g. 134°C no drying
 Time and date started At hh:mm:ss On dd:mm:yy
 Counter reading Five digits with leading zeros
 Time/temp/pressure information Information prefixed by a three letter code that describes the stage reached during the cycle.

Cycle ended message

Cycle Stage Abbreviations :

TPV End of first or second vacuum pulse
 TPP End of first steam pulse
 TSS Start of sterilization
 TSE End of sterilization
 TDS Start of drying phase
 TDE End of drying phase

Error and Error messages :

If an error occurs during the cycle, it is recorded with date and time on the printout and the message CYCLE FAILED. Errors are designated by error codes as detailed in Section 2 Error Code Table. (N.B. These error codes will generally require investigation by an Eschmann trained engineer).

Printer Front Panel Controls (Fig. A1)

The following front panel controls are provided:

- a Door Latch. To open door (A1-1) push door latch (A1-2) sideways, in direction of arrow, and pull door open to expose paper roll (A1-4).
- b Paper Feed Button. Inoperative until the sterilizer mains on/off switch is 'on'.
- c Press lower part of paper feed button (A1-3) to activate paper feed, which will continue for as long as the button is pressed.

Paper Roll Renewal (Figs. A1 and A2)

Caution

The quality and size of paper rolls used in the printer, can only be supplied by Eschmann Equipment. Do not use alternative paper rolls.

Renew paper roll as follows:

- a Open autoclave chamber door to provide access.
- b Push door latch button (A1-2) sideways, in direction of arrow, and pull door (A1-1) open to expose paper roll (A1-4).
- c If any paper remains in printer, tear end off against paper tear bar (A1-8) and carefully withdraw the remaining paper from the rear of printer mechanism (A1-5).
- d Compress paper roll spring-loaded retainer button (A1-6) and withdraw empty paper spool from spindle.
- e Take new roll of paper, separate paper end from the roll. Remove any damaged or gummed part of the paper.
- f Press paper roll spring-loaded retainer button (A1-6) and locate new paper roll on spindle with paper unreeling anticlockwise as seen from open end of spindle (Fig. A1).
- g Using scissors, trim end of paper roll at an angle (Fig. A2) and insert this end of paper into paper input slot (A2-1). Press paper feed actuator arm (A1-7) until mechanism grips paper and pulls it through to front of printer door.
- h Turn paper roll by hand to take-up slack paper.
- i Close printer door. Check paper feed, by pressing paper feed button (A1-3) until end of paper is clear of tear bar. Ensure that paper runs freely from printer.

**APPENDIX A
Autoclave Printer**

Ribbon Cartridge Renewal (Figs. A3 and A4)

Renew ribbon cartridge as follows:

- a Remove paper roll (see above).
- b Support door with left hand and press upwards with right hand on bottom of printer mechanism chassis (Fig. A3) and separate chassis from door.

Caution

Do not pull printer mechanism chassis from door until catch has been released.

- c Leaving printer door fully open, expose printer mechanism and ribbon cartridge (Fig. A4).
- d Pinch the end of ribbon cartridge marked 'PUSH' (A4-1) and remove cartridge.
- e Fit new cartridge checking that left-hand side of cartridge is correctly located on drive shaft, and carefully press cartridge into place.
- f Ensure ribbon is taut. If necessary, tighten ribbon by turning faceted disc (A4-2) on cartridge, clockwise, using finger or fingernail.
- g Fit paper roll as described above.

Setting Date and Time

Set the date and time as detailed in Section 3 para.50

Spares Pack

A spares pack is available containing 5 paper rolls and 2 ribbon cartridges is available from Eschmann Equipment under catalogue number 87-034-05.

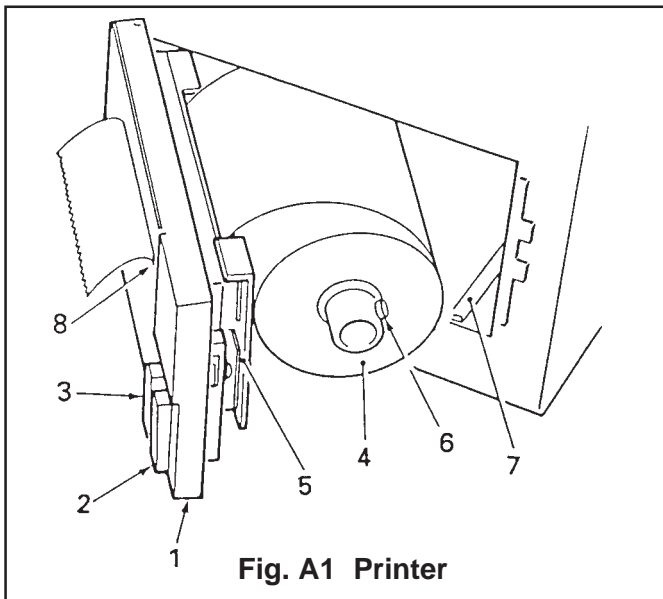


Fig. A1 Printer

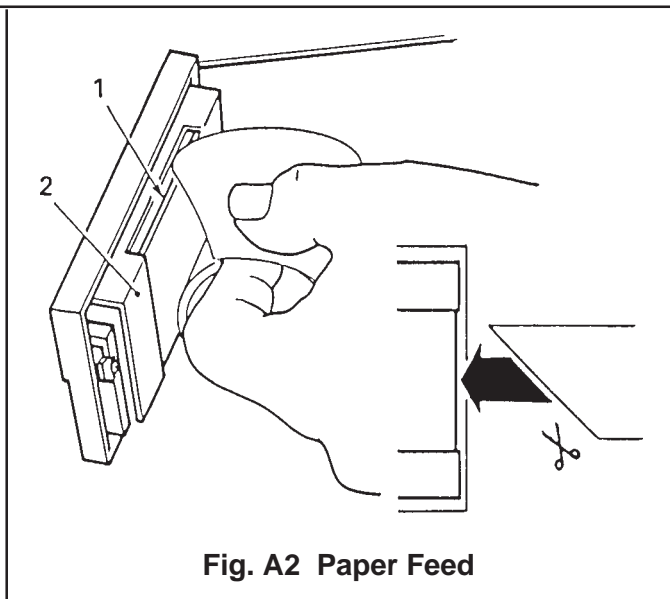


Fig. A2 Paper Feed

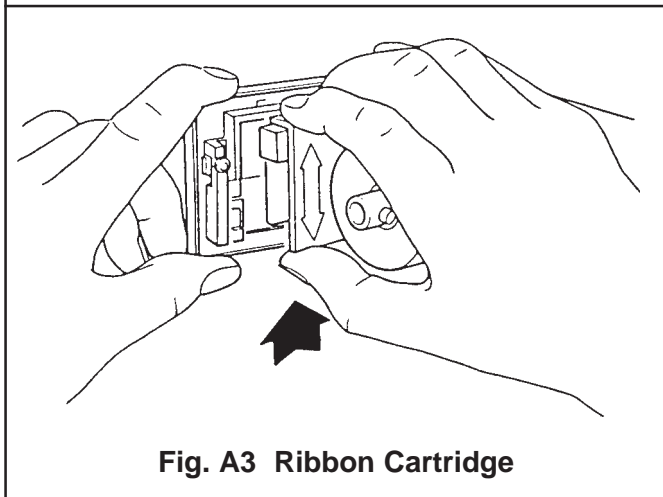


Fig. A3 Ribbon Cartridge

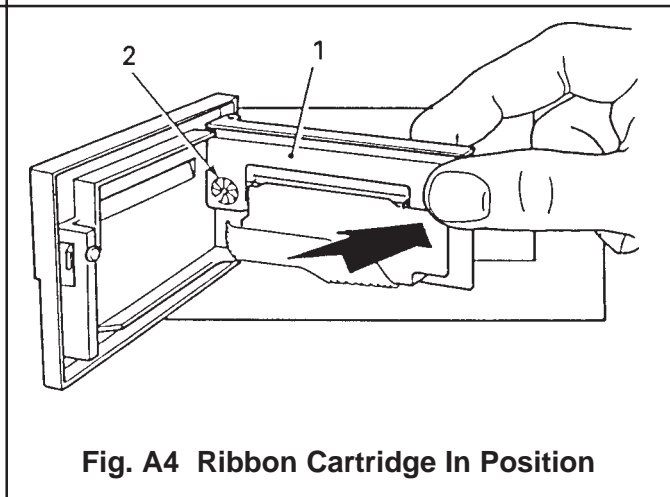


Fig. A4 Ribbon Cartridge In Position

APPENDIX B

PCA 424138 and Relay Assembly 112507 modification November 2004

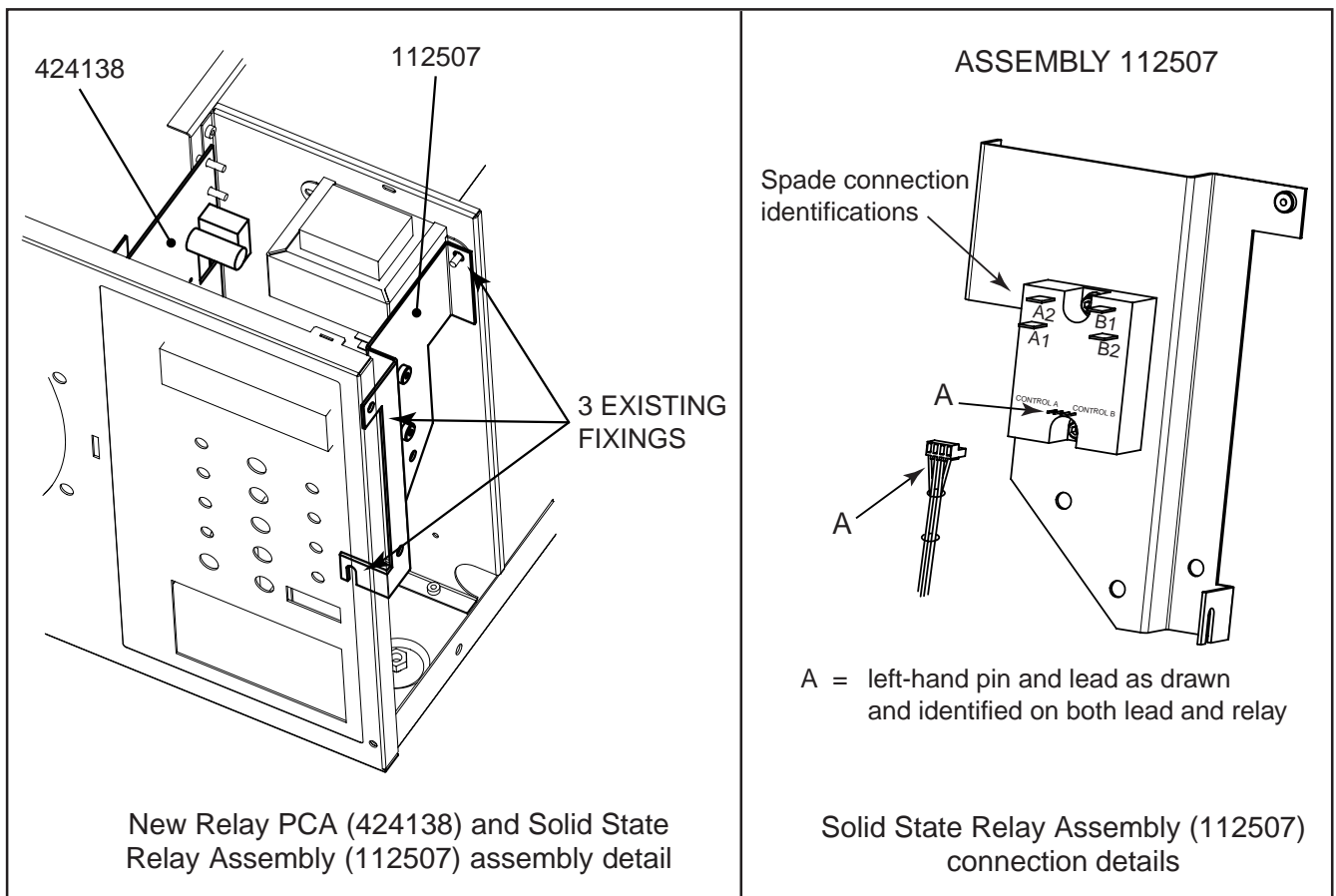
SS Relay Board 424138 issue 03 was modified in November 2004 to issue 04. 424138 issue 04 has an attached loom that connects to a new Solid State Relay Assembly (112507). Solid State Relay Assembly (112507) switches power for the Immersion Heater and the Band Heater only.

424138 issue 04 (or later) and its associated assembly 112507 are direct replacements for 424138 issue 03 (or earlier) which will become obsolete. From November 2004 any issue 03 (or earlier) versions of 424138 that need replacement should be replaced with a 424138 issue 04 (or later) and a Solid State Relay Assembly (112507).

The loom attached to 424138 issue 04 (or later) has four spade connectors (A1, A2, B1 and B2) and a 4-way connector (one lead labelled A). These all connect to the new Solid State Relay Assembly (112507) and the relay connections are clearly marked with matching identifications A1, A2, B1, and B2 and Control A (see orientation of plug in the illustration below).

Removal and replacement of 424138 issue 03 is detailed within this manual, removal and replacement of issue 04 is similar except assembly 112507 will need to be removed first and replaced last (breaking and making connections on 112507 as required). 112507 utilises existing fixings as identified in the illustration below.

Should a fault develop in 112507 (e.g. Immersion heater not working but no fault can be found in wiring, fuses or other components etc.) it can be replaced easily without disturbing other components. The assembly 112507 should be replaced as a complete assembly, do not attempt to replace the relay only. When replacing 112507 ensure all connections to it have been made before assembling back into the autoclave and securing it in place. After final assembly ensure the normal autoclave tests are performed to check function.



APPENDIX C

New fittings for EMC board January 2005

The fitting of the choke which is part of the EMC board has been changed. Without using the mounting plate and parts shown below, chokes with the new fitting cannot be used in units that have the old chassis (i.e. a chassis without the two new hank bushes that align with the two fixing holes on the base of the choke).

The drawing and information shown below detail all the parts required and the fitting instructions to enable the new choke to be fitted to an old chassis.

If the unit has a chassis with the new hank nuts the choke is fitted to the chassis with:

- 2 - M3 x 6mm Pan head screw (part number 391086)
- 2 - M3 shakeproof washers (part number 307159)

Note: The items 1, 3, 4 and 5 below are not required.

Item	Part No.	Description	Qty.
1	112701	Mounting plate	1
2	n.a.	Choke (part of EMC board 424156)	1
3	380044	Spacer	2
4	709860	M3 washer	2
5	710390	M3 nut (Nyloc)	2

n.a.=not applicable

Assembly notes:
 If fitted remove the double sided tape from the base of the choke (item 2).
 Fix mounting plate to chassis with:
 2 x M4 x 6mm Pan head screws (Part No. 307152)
 and 2 x M4 washers (Part No. 710731).
 Fit choke onto mounting plate with spacers, nuts and washers as shown in illustration.

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