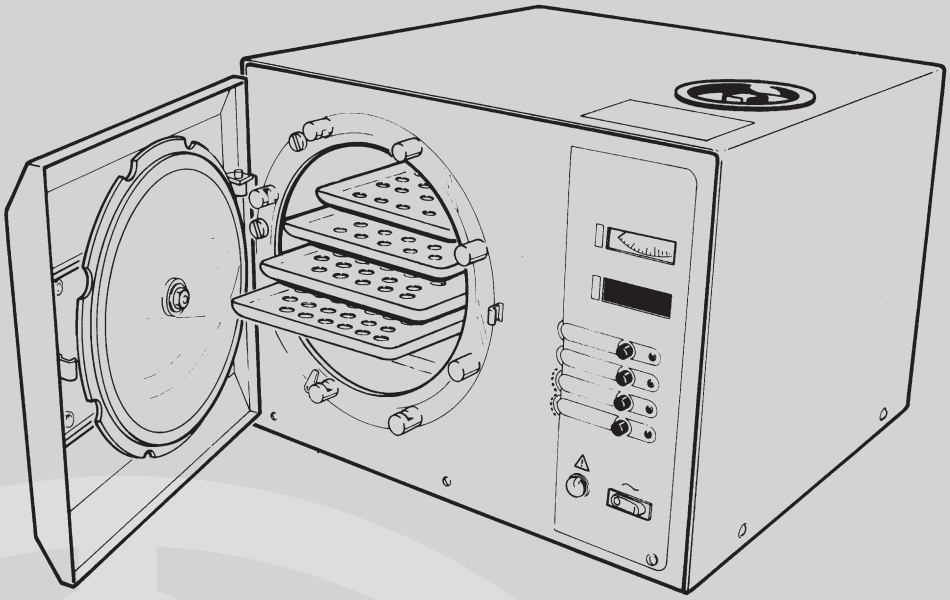
ESCHMANN

SES LS3

AUTOCLAVE



Technical Manual

699346

ST-TM4e

Technical Manual

Read these Instructions before use

Keep these Instructions in a safe convenient place for future reference. Read in conjunction with the Publications detailed on page 8.

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 enquires, please quote the Model and Serial Number of your autoclave.

For further information visit www.eschmann.co.uk

All correspondence relating to the after sales service of Eschmann Equipment to be addressed to :

UK Customers

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Overseas Customers

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

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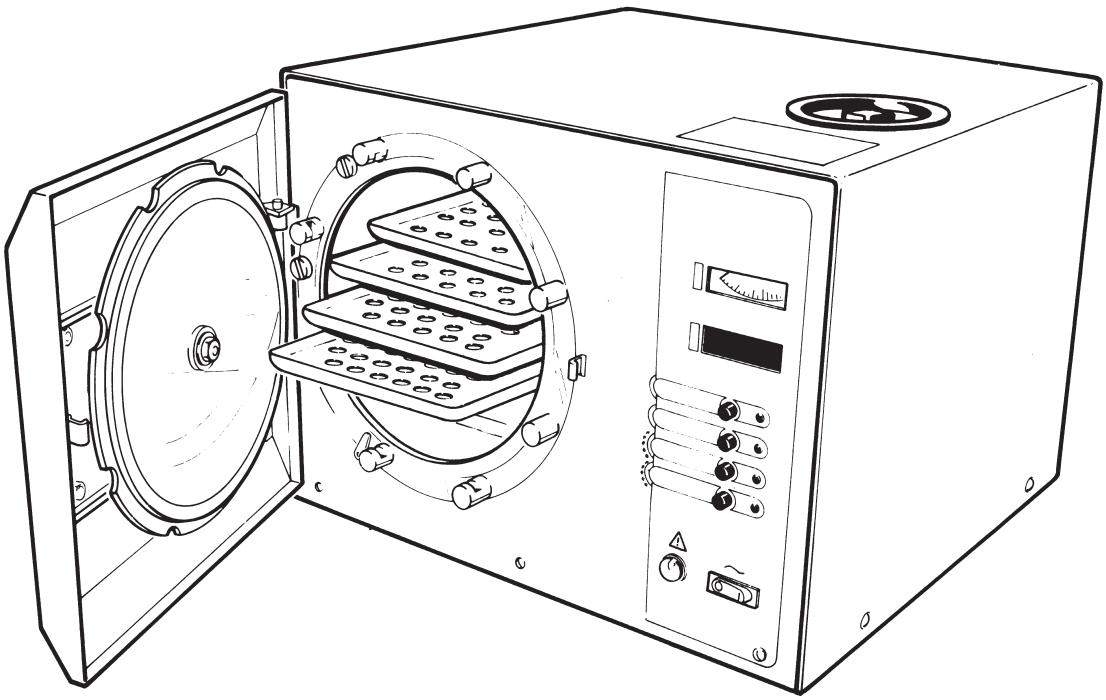


Fig. 1 Little Sister 3 Autoclave

TECHNICAL DATA (Standard)

Electrical Data

Supply ..... 240V, or 220V, or 110V a.c., 50/60 Hz

Loading

- 240V ..... 2kW at 8.4A
- 220V ..... 2kW at 9.0A
- 110v ..... 1.3kW at 11.5A

Fuses

240V	F10A, 1 in (x2)	F400mA, 20mm (xl)
220V	F13A, 1 in (x2)	F400mA, 20mm (xl)
110V	F16A, 1¼ in (x2)	F800mA, 20mm (xl)
Controller board	F2A, 20mm	

Safety Category ..... Type 'B' (as defined by IEC601-1)

~ ..... For use with alternating current

Sterilizing Data

Sterilizing time ..... At 134/138°C - 3 minutes 20 sec
At 121/124°C - 15 minutes

Typical overall time (without drying) ..... At 134°C- 13 minutes) At 121°C - 24 minutes) 2kW

Drying time (when selected) ..... Up to 17 minutes after sterilizing

Operating pressure ..... 138°C-2.40 bar (34.80 lbf/in^2)
134°C-2.03 bar (29.51 lbf/in^2)
124°C-1.25 bar (18.17 lbf/in^2)
121°C-1.04 bar (15.12 lbf/in^2)

Water reservoir capacity ..... 2.0 litre (3.5 pint)

Dimensions and Weights

Dimensions (W x D x H) ..... 460mm (18.12in) x 461 mm (18.16in) x 360mm (14.18in)

Chamber ..... 200mm (7.88in) Diameter x 348mm (13.7in) Length max.

Trays (L x W x D) ..... 282.6mm (11.13in) x 183mm (7.2in) x 17mm (0.67in)

Weight (approx)

- Net ..... 27.5 kg (61 lb)
- Shipping ..... 32.0 kg (71 lb)
- Tray loading ..... 2.0 kg (4.4 lb) per tray

Symbols

~ ..... For use with alternating current

⚠ ..... Hazard warning (overheating)

134°C ..... Sterilizing cycle without drying phase

134°C ..... Sterilizing cycle with drying phase

TECHNICAL DATA (Long)

Electrical Data

Supply ..... 240V, or 220V a.c. 50/60 Hz

Loading
- 240V ..... 2.75kW at 11.5A
- 220V ..... 2.75kW at 12.5A

Fuses

240V	F13A, 1 in (x2)	F400mA, 20mm (xl)
220V	F13A, 1 in (x2)	F400mA, 20mm (xl)
Controller board	F2A, 20mm	

Safety Category ..... Type 'B' (conforms to BS5724 and IEC601-1)

~ ..... For use with alternating current only

Sterilizing Data

Sterilizing time ..... At 134/138°C -3 minutes 20 sec
At 121/124°C - 15 minutes

Typical overall time ..... At 134°C - 13 minutes) 2.75kW
(without drying) At 121°C - 24 minutes)

Drying time ..... Up to 17 minutes after sterilizing cycle
(when selected)

Operating pressure ..... 138°C-2.40 bar
134°C-2.03 bar
124°C-1.25 bar
121°C-1.04 bar

Water reservoir capacity ..... 2.0 litre

Dimensions and Weights

Overall (L xW x D) ..... 650mm x 460mm x 360mm

Chamber ..... 200mm Diameter x 500mm Depth

Trays (L xW x D) ..... 457mm x 180mm x 24mm

Weight (approx)
- Net ..... 35.5 kg
- Shipping ..... 40.0 kg
- Tray loading ..... 3.0 kg per tray

Symbols

~ ..... For use with alternating current

⚠ ..... Hazard warning (overheating)

134°C ..... Sterilizing cycle without drying phase

134°C ..... Sterilizing cycle with drying phase

INTRODUCTION

GENERAL

1. This publication contains technical description and maintenance procedures for the SES Little Sister 3 autoclave.

2. Separate installation and user's instructions are contained in the SES Little Sister 3 Operator's Handbook (Publication No. ST-0H3).

3. The SES Little Sister 3 is a portable electrically operated steam autoclave suitable for the sterilization of unwrapped metal instruments and utensils.

4. The sterilizing cycle proceeds automatically once it has been initiated by pressing a single programme selection button.

ASSOCIATED PUBLICATION

5. SES Little Sister 3 Operator's Handbook ST-0H3

NOTE TO READERS

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

SERVICING

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

DO KEEP INSTRUCTION AND SERVICE MANUALS READILY ACCESSIBLE FOR REFERENCE PURPOSES PRIOR TO AND DURING OPERATION, CLEANING, STERILIZING AND SERVICING THE EQUIPMENT.

NOTE: CONTAMINATED DOOR SEAL

When using lubricated dental hand pieces, the reservoir water should be changed every week to obviate contamination of the door seal and other rubber components used in the pressure system. (e.g. safety valve seals and pressure door lock diaphragms).

TECHNICAL DESCRIPTION

GENERAL

1. The SES Little Sister 3 is a portable steam autoclave heated by a single element and can be manufactured to suit any of the mains supplies indicated under TECHNICAL DATA.

2. The unit is electronically controlled and offers a selection of sterilizing programmes as follows:

134°C without drying
121°C without drying
134°C with drying
121°C with drying

For sterilizing pressures and sterilizing/drying times refer to TECHNICAL DATA.

3. The required sterilizing programme is selected and initiated by pressing the appropriate programme button on the front panel of the unit, following which the sterilizing/drying cycle proceeds automatically until complete.

4. Indication of cycle status is provided by a digital display. If an error should occur during a cycle this also is indicated by digital display.

OPERATING FEATURES

5. The following pieces of equipment, designed for control and/or protection, are incorporated in the SES Little Sister 3:

(1) PRESSURE GAUGE (Fig. 3 item 3). This is used to indicate pressure inside chamber.

(2) PROCESS DISPLAY WINDOW (Fig. 2 item 2). The digital display indicates temperature inside chamber and also provides simple messages for the user which indicate stages through the cycle and error conditions, should any occur.

(3) FOUR PROGRAMME SELECTOR BUTTONS (Fig. 4 item 15). These are used to select and initiate a particular cycle. They can also be used to place the autoclave in the 'Demonstration' or 'Engineering' mode as described later.

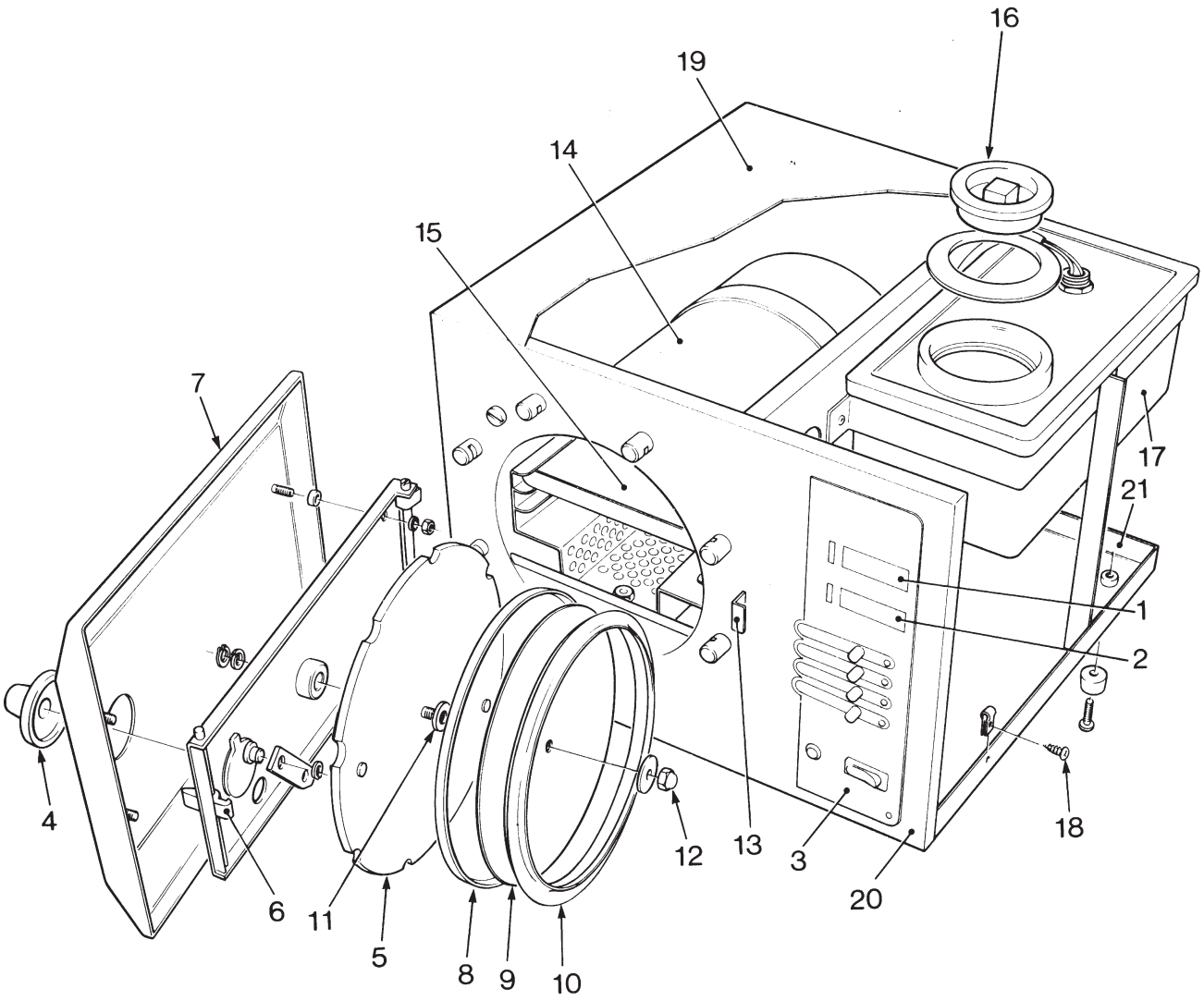
(4) ORANGE LIGHT EMITTING DIODES (LED's) (Fig. 4 item 16). There are four LED's and these are used primarily to indicate the point at which the required sterilizing cycle can be selected and initiated and, when this has been done, to indicate which particular cycle is in progress.

(5) POWER ON/OFF SWITCH (Fig. 4 item 17). This switch controls mains power supply to the unit.

(6) OVERHEAT WARNING LAMP (Fig. 4 item 18). The illumination of this red lamp indicates that the protective thermal fuse (Fig. 4 item 7) has operated.

(7) DOOR LATCHING HANDLE (Fig. 2 item 4). This handle operates the door mechanism to secure the door in the locked position against the chamber mouth.

(8) DOOR SECONDARY LATCH (Fig. 2 item 6). This engages a safety catch to ensure the door does not fly open should there be a slight residual pressure in the chamber when the door latching handle is operated. It is also used to retain the door slightly open during the drying part of the cycle.



1. Pressure display window
2. Process display window
3. Control panel
4. Door latching handle
5. Pressure door
6. Secondary door latch
7. Door cover
8. Seal spinning
9. Seal retaining disc
10. Door seal
11. 'O'-ring
12. Aerotight nut
13. Door safety catch
14. Pressure chamber
15. Work tray
16. Reservoir access cover
17. Reservoir
18. Cover screw (self-tapping)
19. Unit cover
20. Front panel
21. Chassis

Fig. 2 Little Sister 3 Autoclave - general view and door mechanism

TECHNICAL DESCRIPTION (contd)

(9) DOOR INTERLOCK SWITCH (Fig. 4 item 6). This is used to signal to the controller that the door is correctly closed. This is operated via a simple adjustable mechanism and should operate just as the door becomes fully closed.

(10) PRESSURE DOOR LOCK (Fig. 3 item 7). 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 lb/in^2). The device comprises a spring-loaded plunger driven by the chamber pressure via a rubber diaphragm.

(11) SOLENOID DOOR LOCK (Fig. 4 item 25). This prevents the door being opened inadvertently by the operator, once the cycle has been started. The lock holds the door closed until sterilizing cycle is complete. It will also retain the door closed under all fault conditions. Since absence of power to the unit constitutes a 'fault' this also means that the unit power switch must be switched 'on' in order to open the door.

Note: If it is necessary to override the electrical door lock to clear an error code, this is done by switching off the power switch then, after a few seconds, switching it back on again while holding in any one of the programme selector buttons on the front panel.

(12) WATER RESERVOIR (Fig. 2 item 17). This is used to hold distilled, deionized or purified water before being admitted to the chamber via the water fill valve and to receive the hot water and steam vapour emitted from the chamber towards the end of the cycle, via the discharge valve.

(13) RESERVOIR FLOAT SWITCH (Fig. 3 item 12). The water reservoir is fitted with a float switch which will prevent the cycle being started if there is insufficient water in the reservoir to complete a chamber fill. 'LoH2O' will be displayed should this occur.

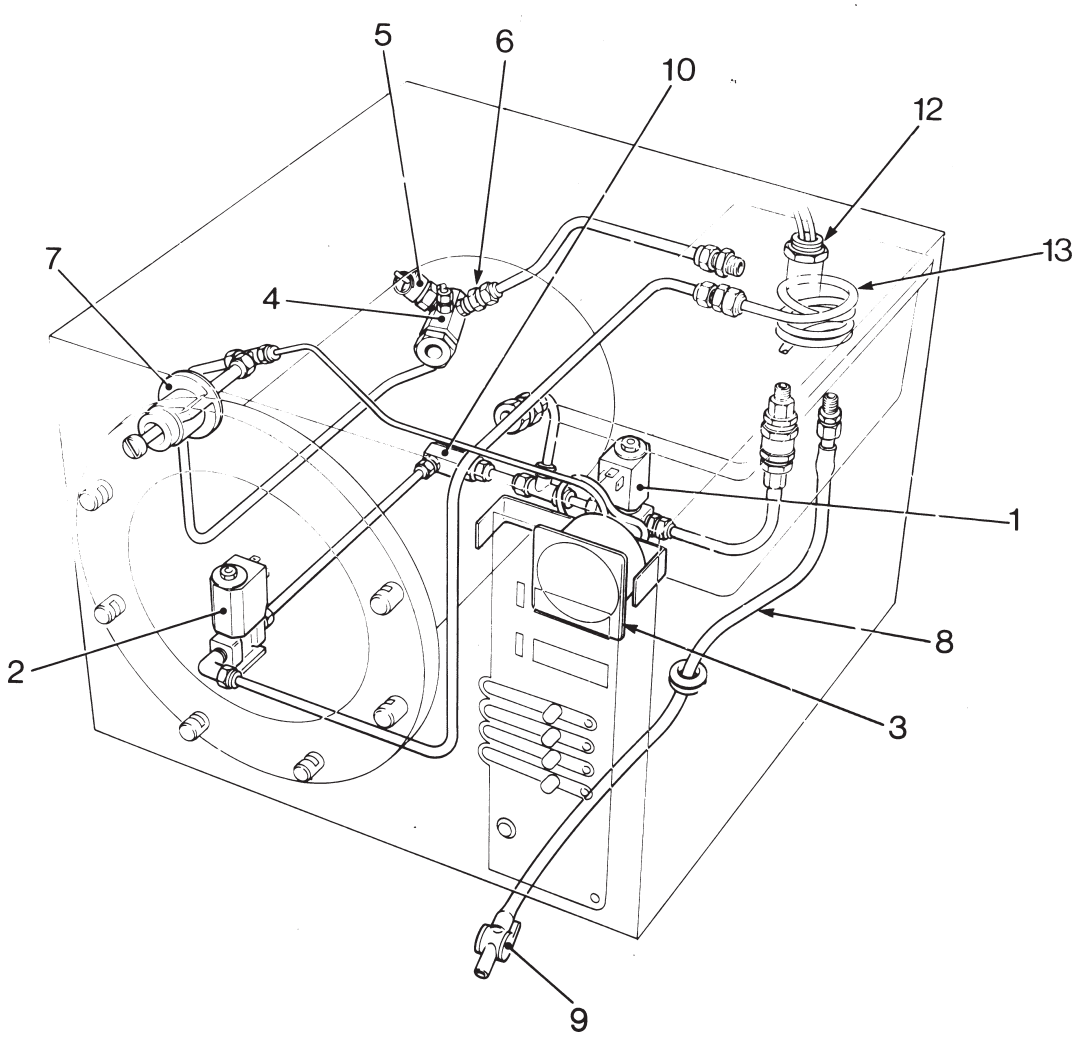
(14) HEATING ELEMENT (Fig. 4 item 1). This consists of a single immersion type element inside the chamber. This is rated at 2.75kW on 200/240V a.c. and is controlled via the solid state relay and heater thermostat (see Electrical Data - Loading).

(15) SOLID STATE RELAY (Fig. 4 item 24). This is switched on and off by the controller as necessary and is the means of controlling the heater output. The solid state relay is mounted on the internal bulkhead on a PCB and is rated at least 25A, 400V (repetitive reverse blocking voltage) or such as to be suitable for use on a 240V a.c. supply.

(16) MECHANICAL RELAY (Fig. 4 item 8). This relay isolates the heater circuit from the electrical supply prior to cycle start and following cycle completion, to give additional protection.

(17) HEATER CUT-OUT (Fig. 4 items 22 and 23). The heater cut-out is connected in series with a heater thermostat and the solid state relay to the heating element. It is operated by a fluid-filled capsule clamped to the heating element which will cause the cut-out device to operate if heater surface temperature exceeds approximately 250°C. The cut-out is of the manual reset type and will thus remake electrically if the reset button at the rear of the cabinet is pressed, when the temperature has dropped. This device is used to protect the heater and the autoclave.

(18) HEATER CYCLING THERMOSTAT (Fig. 4 items 2 and 3). This thermostat is connected in series with a solid state relay to the heating element. It is operated by a fluid-filled capsule clamped to the heating element which will cause the thermostat switch to operate if the heater surface temperature exceeds approximately 175°C. The thermostat switch is of the self-resetting type and will thus remake when the temperature drops. Operation of the heater cycling thermostat during the drying phase of the cycle is quite normal.



1.	Water fill valve	8.	Reservoir drain tube
2.	Discharge valve	9.	Drain tap
3.	Pressure gauge	10.	Filter unit
4.	Chamber manifold	11.	Non-return valve
5.	Safety valve	12.	Reservoir float switch
6.	Test Valve	13.	Coil
7.	Pressure door lock		

Fig. 3 Little Sister 3 Autoclave - pipelines and valves

TECHNICAL DESCRIPTION (contd)

(19) FUSIBLE LINK (Fig. 4 item 7). This is connected so as to remove power from the heater if a serious overheating condition should occur. Note however that operation of this device is unlikely to occur since the heating element is already protected by the heater cut-out. The fusible link thus acts as a 'last resort' device and is non-resetting.

(20) FUSES. The unit is provided with four fuses as follows:

(a) Three fuses on the rear panel of the cabinet (Fig. 4 items 9 and 10) rated as shown under TECHNICAL DATA. The two larger fuses are connected into the supply lines to the unit. The small fuse protects the primary circuit of the transformer.

(b) A fourth fuse, situated on the printed circuit board (Fig. 5 item 5) and rated at 2A, protects the secondary circuit of the transformer and parts of the controller.

(21) TRANSFORMER (Fig. 4 item 11). This converts the incoming mains voltage to 20V a.c. to operate the controller and the water fill and discharge valves. It is rated at 20VA. A thermal fuse is fitted in the secondary winding, this is not resettable and therefore a new transformer would be required. CHECK FOR SHORT CIRCUIT BEFORE FITTING.

(22) WATER FILL VALVE (Fig. 3 item 1). This valve is used to control the water filling sequence. It is electrically operated from a 24V d.c. supply which is generated and signalled from the controller.

(23) DISCHARGE VALVE (Fig. 3 item 2). This valve is used principally at the end of the sterilizing cycle to allow water and steam from the chamber to pass back into the reservoir. It is also operated at various other times during the cycle. The valve is electrically operated from a 24V d.c. supply generated within the controller.

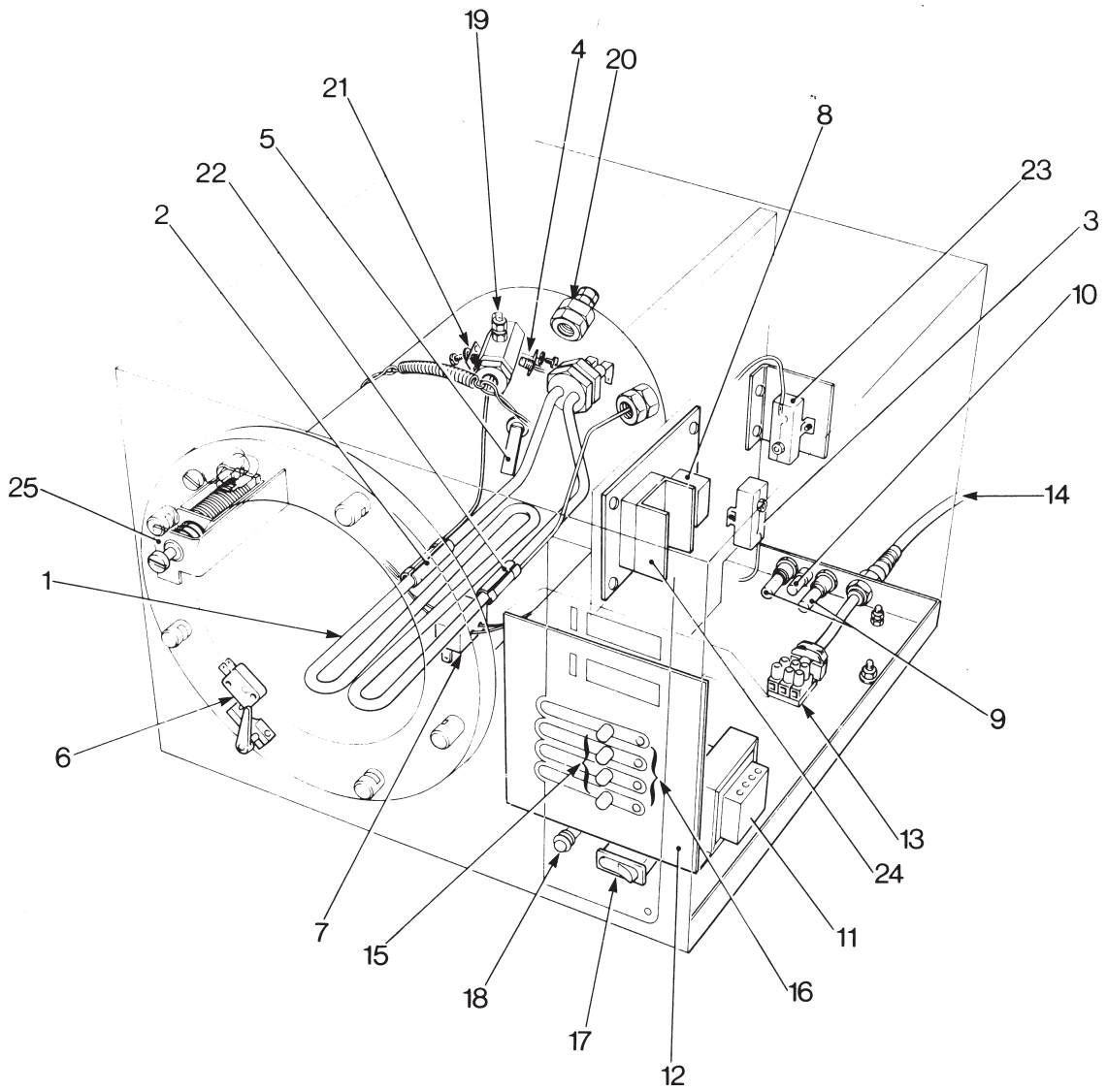
(24) AIR VALVE (Fig. 3 item 6). At the start of any cycle the chamber is full of air and for a satisfactory result almost all of this has to be removed. In the SES Little Sister 3 this is accomplished by means of a small air valve. This valve contains a ball and spring which allows air displaced by the steam generated in the chamber to pass out into the reservoir. Once steam starts to pass by the ball, 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.

(25) SAFETY VALVE (Fig. 3 item 5). This is mounted on the manifold at the rear of the chamber and is factory set to lift at 2.6 bar in order to release excess pressure from within the chamber. It is a primary safety device and should not be readjusted.

(26) TEMPERATURE SENSOR (Fig. 4 item 4). This is used to sense the chamber temperature and is mounted on the manifold in a position where it is exposed to a small volume of steam bled through the air valve. The temperature sensor comprises a small electronic circuit (Analogue Devices type AD590JH) which produces a current proportional to temperature. This device with its associated leads, mounting plate, spring and connector together form a single assembly. The sensor is used to control the temperature within the chamber.

(27) TEMPERATURE SENSOR (Fig. 4 item 21). This is the same device as described under sub-para. (26) and senses the chamber temperature in the same manner. This sensor, however, is used to display the chamber temperature and has no control function.

Note: Items 4 and 21 of Fig. 4 are identical. It is their point of connection on the controller board which determines either control or display function.



1. Heating element
2. Sensor (cycling thermostat)
3. Switch (cycling thermostat)
4. Temperature sensor (chamber control)
5. Water level sensor
6. Door interlock microswitch
7. Thermal fuse
8. Mechanical relay
9. Fuses (10A, 13A or 20A)
10. Fuse (400mA or 800mA)
11. Transformer
12. PCB (controller)
13. Terminal block
14. Power supply cable
15. Programme selector buttons
16. Light emitting diodes (LED's)
17. Power on/off switch
18. Overheat warning lamp
19. Thermocouple entry port
20. Test Port
21. Temperature sensor (display)
22. Sensor (heater cut-out)
23. Switch (heater cut-out)
24. Solid state relay
25. Solenoid door lock

Fig. 4 Little Sister 3 - Heater and process controls

TECHNICAL DESCRIPTION (contd)

(28) THERMOCOUPLE ENTRY PORT (Fig. 4 items 19 and 20). This can be used to introduce a thermocouple into the chamber 'drain line' to allow the operating temperature to be measured and adjusted if necessary. To ensure probe is not touching the capillary tube or the' bottom of the hole, withdraw probe approximately 3mm from the stop position.

(29) WATER DRAIN PIPE (Fig. 3 items 8 and 9). This provides a convenient means of emptying the reservoir for cleaning or prior to transportation.

(30) CONTROLLER (Fig. 4 item 12). The SES Little Sister 3 is provided with a fully integrated microprocessor-based controller. The controller handles every aspect of management of the machine which includes operation and control of the digital display, the light emitting diodes and response to the programme selection push buttons. The controller receives information from the temperature sensor and from the door interlock switch and is able to detect a variety of errors and the times relative to the cycle run when these occur. In addition to controlling the autoclave in the user mode, the controller also supports a 'demonstration' and an 'engineering' mode (see SPECIAL OPERATING MODES). The controller operates the heater via the solid state relay and also controls the operation of the water fill and discharge valves. A detailed knowledge of the operation of the controller is not necessary in order to service the autoclave; it is best regarded as a replaceable sub-assembly and should only be changed as a last resort.

(31) CYCLE COUNTER. The cycle counter displays the number of completed cycles to date for three seconds when power is first switched on, then for one second every fifteen seconds at other times. After commencement of a cycle the counter display will include that cycle in the total count.

DESCRIPTION OF OPERATION CYCLE

6. A detailed knowledge of every aspect of the operation of the SES Little Sister 3 is not necessary in order to be able to repair it effectively; nevertheless, a basic understanding of the various processes of the unit operation which take place during a cycle can be useful.

Unit Operation

7. Power to the unit is switched on by selecting the power switch '0-I' to 'I', there now follows a single high-pitched audible signal accompanied by the display 'test door' flashing. Alternatively open door to proceed, 'LS3' will now be displayed followed by 'door'. If the door is not closed the display will show 'LS3' then 'door' when power is switched on.

8. After the work trays have been placed in the chamber and the door closed, the discharge valve is opened, 'rEAdy' is displayed and LED's on the programme selector panel flash on and off to indicate that a programme from those available* can now be selected and initiated by pressing one of the programme selector buttons.

** The unit is normally preset to offer a choice of two programmes at 134°C. This unit can be customised to suit the sterilizing requirements. (i.e. single temperature, part or whole programme).*

9. When the door is closed, with power switched on, this is sensed by the controller via the door interlock switch. If any attempt is made to open the door once the cycle has commenced, the error display 'Err 2' will appear, accompanied by an audible signal. Under these circumstances it is necessary to secure the door and cancel 'Err 2' display (see para. 25) and then re-start cycle.

TECHNICAL DESCRIPTION (contd)

10. On selecting the programme, 'StArt' will be displayed indicating that the cycle has commenced, then once the chamber has started to fill with distilled water from the reservoir, this will be superseded by the display 'FILL'.

11. Provided all conditions are satisfactory, the computer will set-up various parameters corresponding to the cycle selected and will switch-on the heater.

12. Control of the heater is via a sophisticated control 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 interpret temperatures below 92°C; hence the symbol 'HEAt' will appear and remain on display until a temperature of 92°C is reached.

13. Temperatures are displayed to a resolution of 0.5°C and measured to 0.1°C. In addition, the computer employs signal averaging techniques to ensure a stable, accurate display. If the chamber is very hot at the start of a cycle, the computer will allow it to cool for a short time before the heater is switched on. In such a case the display will remain blank until this process is complete. This is to ensure that the 'loss of water' detection system can operate correctly.

14. Control of the cycle is now fully automatic with temperature information being collected via the temperature sensor. Timing is controlled by the microcomputer and cycle times cannot be adjusted. By comparing measured values with known time/temperature relationships, the controller is able to detect faults such as lack of water at the start of the cycle or loss of water and steam during the process, and it will indicate such problems by the displays 'LoH2O', 'Err 3' or 'Err 4' respectively accompanied by an audible warning signal.

15. To ensure efficient sterilization, the SES Little Sister 3 is designed to operate at temperatures slightly above the minimum recommended. Hence, the operating temperature for the 121°C cycle is set to 122.5°C, while for the 134°C cycle it is set to 135.5°C.

16. As the cycle enters the sterilizing phase the display shows an 'S' (flashing) as a prefix to the displayed temperature. At the end of the sterilizing phase the heater is turned off and the discharge valve is opened. *At this point, a certain amount of noise from the reservoir is quite normal.*

17. Once the controller detects that chamber temperature has fallen to a safe level, the flashing display 'End' appears and an audible signal sounds to indicate that the cycle is complete. When the chamber door is opened in order to remove the work the display will show 'door'.

18. Notice that 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. The controller acts in an 'intelligent' manner to ensure a satisfactory sterilization cycle even when these factors vary over wide ranges.

19. If a cycle employing a drying phase is selected, operation to the end of the sterilizing phase is as described above. After discharge of steam and water back into the reservoir, however, the display 'dry' appears accompanied by a rapid intermittent audible signal over a two second period to indicate the commencement of the drying phase. At this point the operator should first open the chamber door then push it towards the closed position again until it just rests lightly against the door safety catch. This leaves a sufficient gap to allow vapour to escape. Opening the door in this way is not essential since the discharge valve does offer a path for vapour to escape. It will, however, result in a much better drying performance.

TECHNICAL DESCRIPTION (contd)

20. The drying phase is about 17 minutes during which the heater is operated at low power. Operation of the heater cycling thermostat is quite normal during this period. At the end of the drying phase the display 'End' will appear for approximately 10 seconds, followed by 'door' assuming that the door has been opened, as described in para. 19, to assist drying.

DISPLAY MESSAGES

21. Throughout a given cycle the following symbols will appear as a digital display:

DISPLAY		INTERPRETATION
test door	-	Door closed. Open and close door to proceed
door	-	Chamber door open
count (followed by number)	-	* Number of completed cycles
rEAdy	-	Programme can now be selected
StArt	-	Programme selected and cycle started
count (followed by number)	-	* This cycle added to cycle count
FILL	-	Chamber being filled
HEAt	-	Initial heating (Chamber temperature below 92°C)
92-136	-	Heating to sterilizing stage
S-135.5	-	'S' flashing, sterilizing and timing started
cond	-	Condensing (steam discharged)
dry	-	+ Drying
End	-	Cycle complete

* Cycle count will appear briefly at fifteen second intervals throughout the cycle.
\+ If programme 'with drying' is selected.

ERROR INDICATION

General

22. If an error should occur during a cycle, one of the following error code symbols will be displayed:

ERROR DISPLAY		CAUSE
# 'ELECt'		Temporary failure of mains supply to unit
Err2		Attempt made to open door after cycle has started
LoH2O		Insufficient water in reservoir
Err 3		Water failed to fill chamber
Err 4		Water loss during sterilizing stage
Err 5		Heater not working
Err 6 to	)	Temperature parameters outside limits
Err9	)	for control and display
A		Temperature sensor malfunction

\# Note: The display 'ELECt' could also occur at any time after switching-on power, if the power supply has been interrupted and then restored.

TECHNICAL DESCRIPTION (contd)

23. If an error occurs during a cycle, the microcomputer will cause the cycle to be cancelled. Refer to FAULT DIAGNOSIS for remedial procedure. Refer also under SPECIAL OPERATING MODES 'Errors and Error Clearing' (para 56).

Overheating

24. In the unlikely event of overheating, the red indicator warning lamp marked ⚠ on the front panel will illuminate and the heating element will be switched-off automatically by a thermal cut-out device. Refer to FAULT DIAGNOSIS. Power is restored by operating the 'PRESS TO RESET' button at the rear of the cabinet after the unit has cooled down to approximately 220°C.

Note: Maximum chamber temperature on overheat is 250°C.

MAINTENANCE

WARNING (1) ALWAYS switch-off and disconnect mains power supply before removing unit casing, or carrying-out maintenance procedures.

(2) Check that chamber is at atmospheric pressure before opening to remove components.

FAULT DIAGNOSIS

25. The following table sets out a number of typical 'faults' which could occur and indicates the likely causes and how to rectify them. For maintenance procedures refer to para. 26 and onwards.

TABLE 1

Note: Cross references in 'REMEDY' column are to relevant paragraphs under 'Part replacement and adjustment'.

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
	(d) Fusible link blown	(d) Replace fusible link
	(e) Transformer failed	(e) Check transformer secondary voltage (20V, a.c. rms). Replace transformer if output is zero (para 31).
	(f) Short circuit on 24V circuit	(f) Check sensor, fill valve, vent valve etc. for short circuit. Replace where necessary.

Note: Blown fuses are symptomatic of further problems. Always investigate the reason for any fuse blowing, but bear in mind that fuses can 'age' over a long period and blow for no apparent reason.

MAINTENANCE (contd)

TABLE 1 (contd)

	FAULT	POSSIBLE CAUSE	REMEDY
(2)	Door cannot be opened	(a) Pressure door lock jammed.	(a) Adjust or replace pressure door lock (para 33). To open chamber door, push pressure locking bolt back with a thin blade if spring is faulty. If spring has seized, disconnect body from unit (para 33) and pull it backward so that locking bolt clears the door.
		(b) Pressure in chamber	(b) Switch-on power and thereby release pressure in chamber.
		(c) Chamber with vacuum	(c) As (b) to open door then clean or replace air valve (para 34)
		(d) Solenoid door lock inoperative when unit 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 36)
(3)	Chamber will not fill and 'LoH2O' displayed	(a) No water in reservoir	(a) Fill reservoir
		(b) Water fill valve or associated pipes blocked	(b) Empty reservoir, strip pipework and clean. Clean reservoir. Refill with distilled water.
		(c) Air valve stuck in closed position	(c) Replace air valve (para 34)
		(d) Air lock in water feed pipe from reservoir	(d) If surface tension breaker missing - fit new one.
(4)	Display still shows 'test door' after door 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 not correctly closed	(c) Close door
		(d) Door interlock microswitch out of adjustment	(d) Adjust switch lever position, or fit new microswitch if adjustment seems to be correct (para 35)
(5)	Display 'Err 2' shows	(a) Attempt made to open door after cycle has started	(a) Cancel error (para 57) and restart cycle
(6)	Safety valve operates even though temp. is below 136°C (See also under (16))	(a) Air valve sticking	(a) Clean or replace air valve (para 34)
		(b) Safety valve fault	(b) Fit new safety valve
		(c) Check calibration of 134°C cycle	(c) See ROUTINE CALIBRATION PROCEDURE (para 60)
		(d) Re-calibration needed	(d) As (c) above
		(e) Temperature sensor fault	(e) Fit new temperature sensor (para 38)
		(f) Controller fault	(f) Fit new controller (para 32)

MAINTENANCE (contd)

TABLE 1 (contd)

	FAULT		POSSIBLE CAUSE		REMEDY
(7)	'Err 3' displayed before sterilizing temp. reached	(a)	No water in chamber and/or air valve sticking	(a)	Ensure chamber water level sensor is clear of obstructions. Also, ensure sensor is not dirty or corroded. See also 6(a)
		(b)	Water fill valve is leaking	(b)	Drain reservoir and fit new water fill valve (para 39)
		(c)	Discharge valve leaking	(c)	Strip and clean discharge valve or fit a new one (para 39)
		(d)	Chamber water level sensor fault	(d)	Fit new water level sensor
		(e)	Wiring loom fault	(e)	Check terminations
		(f)	Non-return valve sticking	(f)	Replace NRV
(8)	'Err 4' displayed after sterilizing temperature reached	(a)	Steam leak	(a)	Carefully check for steam leak and rectify
		(b)	Water fill valve leaking	(b)	As for 7(b)
		(c)	Discharge valve leaking	(c)	As for 7(c)
		(d)	Temperature sensor fault	(d)	As for 10(e)
(9)	'Err 5' displayed	(a)	Manual reset thermostat operated or open circuit	(a)	Press button to reset. Check for electrical continuity at ambient temp.
		(b)	Solid state relay failed (No voltage across heater)	(b)	Fit new solid state relay (para 41)
		(c)	Heater failed open circuit	(c)	Fit new heater if resistance of element is not approx 30Ω
		(d)	Voltage regulator not properly mounted, or loose	(d)	Secure voltage regulator (para 44)
		(e)	Controller fault	(e)	Fit new controller (para 32)
		(f)	Chamber water level sensor short circuit	(f)	Investigate. See 7(a)
(10)	Temperature differs from measured value and display shows 'Err 6' to 'Err 9'	(a)	Recalibration required	(a)	Follow ROUTINE CALIBRATION PROCEDURE (para 60)
		(b)	Airvalve partially blocked	(b)	Clean or fit new air valve (para 34)
		(c)	Controller fault	(c)	As for 9(d)
		(d)	Voltage regulator not properly mounted, or loose	(d)	As for 9(c)
	or 'A'	(e)	Temperature sensor fault	(e)	Fit new temperature sensor (para 38) and recalibrate (para 60)
(11)	No discharge of steam/water at end of cycle	(a)	Discharge valve fault	(a)	Test valve, using 'Engineering Mode'. Replace if faulty
		(b)	Wiring fault	(b)	Ensure connections to discharge valve are sound
		(c)	Blockage in discharge line	(c)	Strip pipework and clean
		(d)	Controller fault	(d)	Replace controller (para 32)
		(e)	Filter blocked	(e)	Clean or replace filter (para 47)

MAINTENANCE (contd)

TABLE 1 (contd)

FAULT	POSSIBLE CAUSE	REMEDY
(12) Cycle time excessive compared with usual value	(a) Low mains voltage	(a) Check supply to autoclave
	(b) Autoclave overloaded	(b) Avoid overloading. Maximum load is 7kg
	(c) Slow discharge at end of cycle	(c) See (11) (c) and (e)
(13) Imperfect display when first switching on power	(a) Controller failed to re-set properly	(a) Switch-off power, wait for approx 5 seconds and switch on again
	(b) Controller fault	(b) Replace controller (para 32)
(14) Display shows 'ELECt'	(a) Temporary mains failure during cycle	(a) Carry out error cancellation procedure (para 57) then re-select and re-start cycle
(15) Leakage of water from chamber door and 'E4' displayed	(a) Door gasket not sealing correctly	(a) Clean mating surface and gasket around door with a soapy cloth. If leakage persists, replace gasket
	(b) Check centre nut and seal	(b) Replace silicone washer, (Fig. 4 item 11)
(16) Safety valve leaks (See also under (6))	(a) Dirt on valve seat	(a) With low pressure in chamber CAREFULLY operate valve by hand. If leakage persists, replace safety valve
	(b) Check pressure gauge display to see if sterilizing temperature is set too high	(b) Re-calibrate controller (para 60)
	(c) Air valve sticking	(c) See 6(a)
(17) Excessive noise from reservoir during discharge	(a) Positioning of discharge line in reservoir incorrect	(a) Bend discharge line to make discharge hit wall of reservoir
(18) Fusible link blows and overheat warning lamp illuminates	(a) Failure of heater cut-out	(a) Replace heater cut-out (para 37)
	(b) Mechanical relay fault	(b) Check operation. If faulty, replace relay unit (para 42)
	(c) Heater cycling thermostat faulty	(c) Check operation (i.e. contacts should be open with heater 'ON' in Engineering Mode). If faulty replace thermostat unit (para 37)
	(d) Failure of component in solid state relay	(d) Change solid state relay (para 41)
	(e) Fusible link fault (These can age with use)	(e) Replace fusible link (para 30)

MAINTENANCE (contd)

TABLE 1 (contd)

FAULT	POSSIBLE CAUSE	REMEDY
(19) Pressure gauge reads incorrectly (too high or too low)	(a) Gauge fault	(a) Adjust against a known pressure source, or replace pressure gauge (para 43)
	(b) If gauge reads high - air valve sticking	(b) Clean or replace air valve (para 34). Check temperature calibration
	(c) If gauge reads low - thermocouple calibration faulty	(c) Check temperature with - thermocouple recalibration (para 60)
(20) Door stiff to open	(a) Door mechanism needs lubricating	(a) Add a few drops of oil on hinge pivots
	(b) Gasket mating surfaces sticking	(b) As for (15) (a)

WARNING (1) ALWAYS switch-off and disconnect mains power supply before removing unit casing, or carrying-out maintenance procedures.

(2) Check that chamber is at atmospheric pressure before opening to remove components.

REMOVING COVER (Fig. 2 item 19)

26. To remove SES Little Sister 3 cover:

(1) Unscrew and remove the four cover screws (two on each side) from the casing lower edge.

(2) Remove reservoir cover.

(3) With unit facing towards you, remove the cover - lifting it from the rear of the unit first.

CAUTION: An earth lead is connected between the terminal block and the earth stud attached inside the rear of the cover. Detach one end of this earth lead before removing the cover completely.

REFITTING COVER (Fig. 2 item 19)

27. To refit SES Little Sister 3 casing:

(1) Re-attach the earth lead between the terminal block and the earth stud inside the rear panel of the cover.

(2) Carefully locate the front upper flange of the cover in the small gap between the stainless steel dividing plate and the front panel of the unit, then press the cover down in position.

(3) Refit the four cover screws and the reservoir cover.

PART REPLACEMENT AND ADJUSTMENT

FUSES

WARNING: Switch off unit and disconnect mains power supply before replacing a fuse.

MAINTENANCE (contd)

28. Three fuses are mounted at the rear of the cabinet. Two of these (Fig. 4 item 9) are fitted in the power supply lines to the autoclave, while the third (Fig. 4 item 10) protects the primary circuit of the transformer. To extract any of these fuses insert a screwdriver or small coin in the slot of the fuse cap and twist it counter-clockwise. Having inspected/replaced a fuse, reverse the above procedure to re-secure the fuse cap.

29. The controller board carries a fourth fuse (Fig. 5 item 5), to protect the secondary circuit of the transformer and parts of the controllers. To gain access to this fuse, remove the cabinet top cover (para 26). Refer to Technical Data for fuse type and rating.

FUSIBLE LINK (Fig. 4 item 7)

30. Detach the two female push-on connectors. Unhook one end of mounting spring and remove fusible link assembly. Fit replacement in reverse order and ensure that fusible link body is located at the bottom of the chamber about half way between the front and the back.

TRANSFORMER (Fig. 4 item 11)

31. Detach the transformer connections, noting carefully the position of each one. Remove the transformer securing nuts and bolts. The replacement transformer ideally should be an identical unit but, in an emergency, fit any double wound transformer having a primary voltage rating corresponding to the local supply and a secondary rated at 20V, a.c., (rms). The transformer must be rated at 20VA. To install replacement transformer, reverse the removal procedure.

CONTROLLER (Fig. 4 item 12)

32. Remove the two loom plugs and the two sensor plugs connecting the controller to the remainder of the unit. Note, particularly, the way in which they are mated with the male pins on the controller board. Remove the four nuts securing the board and ease it gently away, taking care not to strain the lead from the controller to the voltage regulator which is mounted on the steel dividing panel with a nut and bolt. Remove the fastening and lift out the controller and regulator, complete. To fit replacement, reverse the removal procedure. When mounting the voltage regulator, it is important to coat mating surface with a thin layer of zinc oxide based heat transfer compound and to ensure that the bolt is well tightened. When tightening the controller board securing nuts, ensure that control switches do not foul the holes in the front panel through which they protrude.

Note: (1) Avoid overtightening nylon nuts securing controller.
(2) When a new controller is fitted, it will be necessary to recalibrate it to suit the temperature sensor fitted in the machine (see under ROUTINE CALIBRATION PROCEDURE).

PRESSURE DOOR LOCK (Fig. 3 item 7)

33. 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 original or replacement pressure lock unit, proceed as follows:

MAINTENANCE (contd)

(1) Apply a drop of 'Loctite 542' thread lock 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.

(2) Attach and secure plumbing connection.

(3) Apply a smear of silicone compound (MS4) to shaft only of locking bolt, avoiding the thread.

(4) Insert locking bolt into front of lock body and screw it into piston thread until bolt head stands ½mm clear of cabinet front plate. Ensure that bolt is free to move in and out easily.

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

AIR VALVE (Fig. 3 item 6)

34. The air valve is mounted in the manifold at the rear of the sterilizing chamber. To remove the air valve:

(1) Remove plumbing connection on reservoir side.
Note: Hold large hexagon body stationary while removing the pipe nut

(2) Use the small hexagon body to unscrew valve from manifold. IMPORTANT: Do not disturb the relationship between the large and small hexagons as this will upset the spring calibration inside the valve.

(3) When fitting replacement valve, use PTFE tape to make a leakproof joint.

Note: (1) It is considered best to renew any air valve which is suspected of unsatisfactory performance.

(2) In an emergency, or where it is known that the valve has been subjected to sticky materials, it may be washed in a solvent such as white spirit, methylated spirit or paraffin.

DOOR INTERLOCK SWITCH (Fig. 4 item 6)

35. The door interlock microswitch is operated via an actuator lever assembly. To renew the microswitch actuator lever and/or adjust the operating position proceed as follows:

(1) Apply a smear of silicone grease (MS4) to both sides of nylon washer (pt.no. 307231) and position on spindle of actuator level (427104).

(2) Apply a little silicone grease on spindle of lever assembly and slide the assembly through the front panel. Apply a smear of silicone grease to both sides of nylon washer (340044) and locate the washer on protruding end of spindle, at back of neck ring.

(3) Assemble leaf spring (427022) to lever (427020) with hex. head screw (307247) and washer (307159). Fit the hex. head screw to scalloped side of lever, and fit nut (307157) to the screw.

(4) Position the lever assembly on end of actuator lever assembly and tighten hexagonal headed screw.

Note:
(a) Ensure spring is in correct position and correctly adjusted to keep the lever clear of switch.
(b) While tightening the screw, twist the levers apart to ensure that any slack between the flats on the spindle and lever is in its worse condition.

(5) Set the microswitch lever assembly by closing the door and inserting a 0.125mm shim between switch body and head of hexagonal headed screw. Turn door knob to lock door. Using 5BA spanner, adjust hexagonal headed screw until screw head touches shim and tighten locking nut.

MAINTENANCE (contd)

(6) Open door to remove shim, then close door and check that microswitch operates correctly.

SOLENOID DOOR LOCK

36. Maintenance procedures will depend upon whether the malfunction is purely mechanical (e.g. bolt or return spring sticking) or due to solenoid unit failure. Proceed as follows: Disconnect mains power, then,

(1) To remove locking bolt, compress the spring with a suitable implement and open the cabinet door. This provides access to the screw slotted bolt head.

(2) 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.

(3) Before refitting or replacing the locking bolt apply a little 'Loctite 542' threadlock to the thread of the solenoid plunger.

IMPORTANT: Ensure that the nylon washer is refitted in the correct position.

(4) To remove the solenoid unit, should this be necessary, proceed as in (1) and (2) above, detach the electrical connector from the solenoid coil, then remove the solenoid bracket fixing screws from the chamber head ring. Fit replacement unit by reversing the removal procedure.

HEATER CUT-OUT OR CYCLING THERMOSTAT (Fig. 4 items 2 and 3)

37. To remove and replace heater cut-out or cycling thermostat, proceed as follows:

(1) Detach electrical connections from cut-out/thermostat switch unit.

(2) Situated inside the chamber beneath the tray carrier is the clamp which secures cut-out/thermostat sensor to the heater; carefully remove the clamp.

(3) Disconnect cut-out/thermostat switch body from its mounting (2 screws), then carefully unscrew gland from rear of chamber port or manifold through which the capillary tube, connecting sensor to switch unit passes.

(4) To fit replacement cut-out/thermostat, reverse the procedure described for removal. Note that it is necessary to use PTFE tape or a suitable sealing compound to make the joint between the gland and the chamber fitting.

WARNING: Do not kink capillary tube.

TEMPERATURE SENSOR(S) (Fig. 4 item 4)

38. To remove either sensor, slide the sensor assembly out of the manifold at rear of chamber then, carefully noting wire colour positions at plug (marked OA and lA on controller board) (i.e. red wire towards edge of controller board in each case) remove plug from controller board. When fitting replacement unit, first clean off old compound from sensor and mounting slot, then coat the end of the sensor with a thin layer of zinc oxide-based heat transfer compound and ensure that no dirt or grit enters the mounting slot.

Note: When a new temperature sensor is fitted it will usually be found necessary to make some small adjustments to VR1, VR2, VR3 and VR4 on the controller board (see CONTROLLER SETTING). In addition, recalibration should be carried out (see ROUTINE CALIBRATION PROCEDURE, para 60).

MAINTENANCE (contd)

FILL AND DISCHARGE VALVES (Fig. 3 items 1 and 2)

39. To remove and replace the fill and discharge valves proceed as follows:

(1) Detach electrical connections from valve and release plumbing connections at each side.

(2) Note carefully the direction in which the valve is mounted (Port 1 pipe to chamber pressure side).

(3) Remove pipework from valve, then remove securing screws.

(4) Examine the unit. If the valve coil only has failed (e.g. short-circuiting) it can be renewed. The valve can also be stripped and cleaned, although care must be taken to ensure no damage is caused to valve seat or rubber sealing plunger.

CAUTION: Do not lose small internal springs in plunger.

(5) Fit new or refurbished valve in exactly the same way as the original one, making connections as noted in (2).

RESERVOIR FLOAT SWITCH (Fig. 3 item 12)

40. Detach bullet type connectors located on dividing panel and unscrew nylon nut to release float switch from reservoir cover. Fit replacement float switch assembly by reversing the removal procedure.

SOLID STATE RELAY (Fig. 4 item 24)

41. Remove electrical connections from relay board carefully marking their respective attachment positions. Unfasten four screws to remove relay board from dividing panel, then unfasten four screws from behind the board in order to release the solid state relay unit, together with its heat sink. Unfasten and remove the heat sink. When fitting a replacement relay unit, coat the face which mates with the heat sink with a thin layer of zinc oxide based heat transfer compound, having first cleaned-off old compound if re-using the original heat sink. Fit heat sink to new relay unit, relay to board and board to autoclave dividing panel by reversing the disassembly procedure. Re-attach electrical connections (Fig. 8 - System circuit diagram).

MECHANICAL RELAY (Fig. 4 item 8)

42. To remove mechanical relay unit snip off the plastic cable tie then unplug the relay unit from the relay board. When fitting replacement relay unit, fit a new cable tie.

HEATER (Fig. 4 item 1)

43. To replace heater, proceed as follows:

(1) Remove electrical connections from heater terminals.

(2) Remove sterilizing tray carrier and unbolt and remove element quick release bracket from inside chamber together with heater cut-out and thermostat and sensor clips.

CAUTION: Avoid kinking the capillary tube.

(3) Unscrew and remove large nut from heater mounting boss at rear of chamber.

MAINTENANCE (contd)

(4) Extract heater unit via chamber mouth.

(5) Fit replacement heater by reversing order of removal procedure.

IMPORTANT: Ensure heater is horizontal when fitted and that nut is fully tightened, to avoid leaks.

1. Audible warning device
2. Button 'E'
3. EPROM
4. Voltage regulator
5. Fuse F1 (2A)

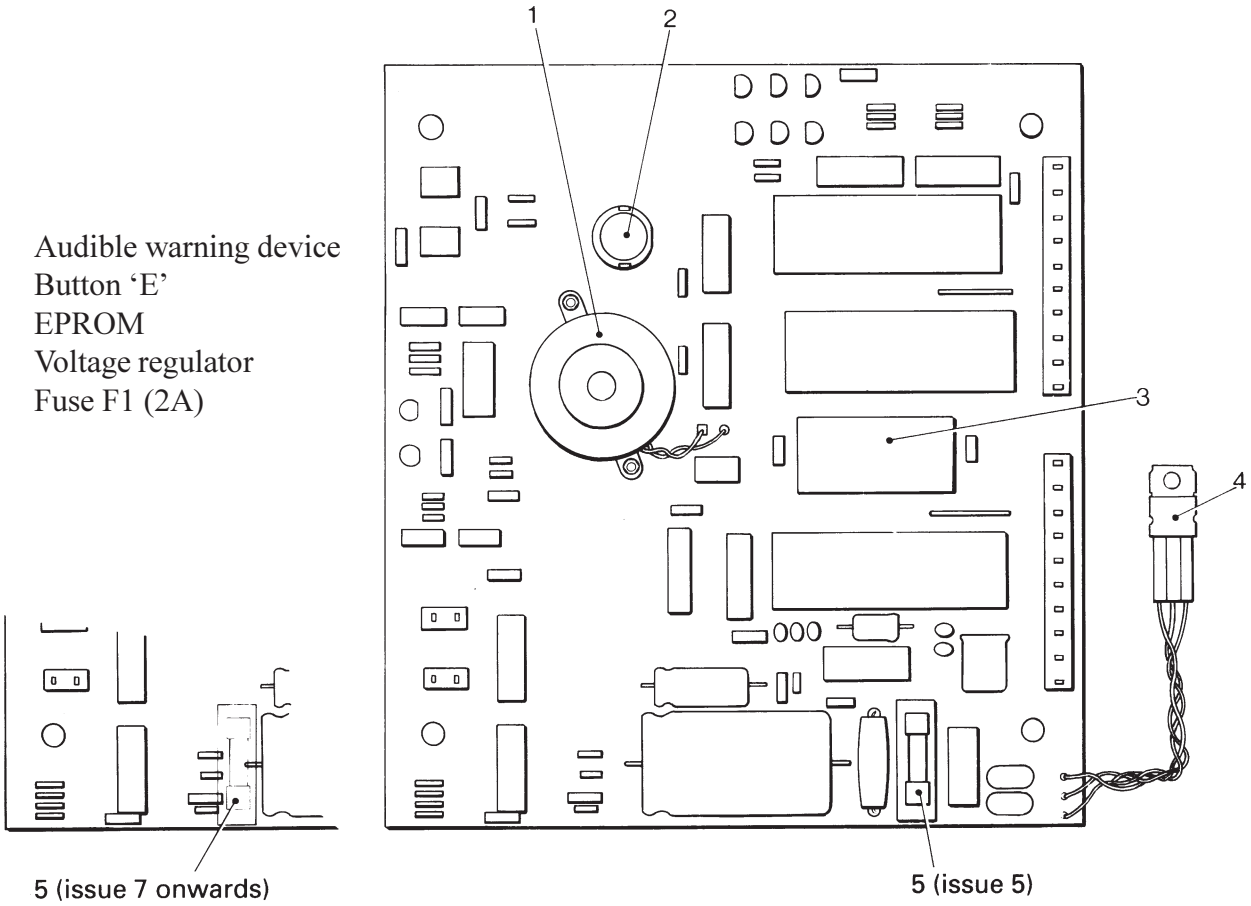


Fig. 5 Controller board (see also Fig. 4 items 15 and 16 for reverse side of board)

VOLTAGE REGULATOR (Fig. 5 item 4)

44. The voltage regulator forms part of the controller assembly and must be mounted so that it makes good thermal contact with the steel partition (see para 30). The leads to the voltage regulator are easily broken and if one should snap off at the body of the unit, it can be replaced by a standard 7805 voltage regulator. This avoids the need to change the entire controller. In such a case some re-adjustment of the calibration will be required.

DOOR SEAL (Fig. 2 item 10)

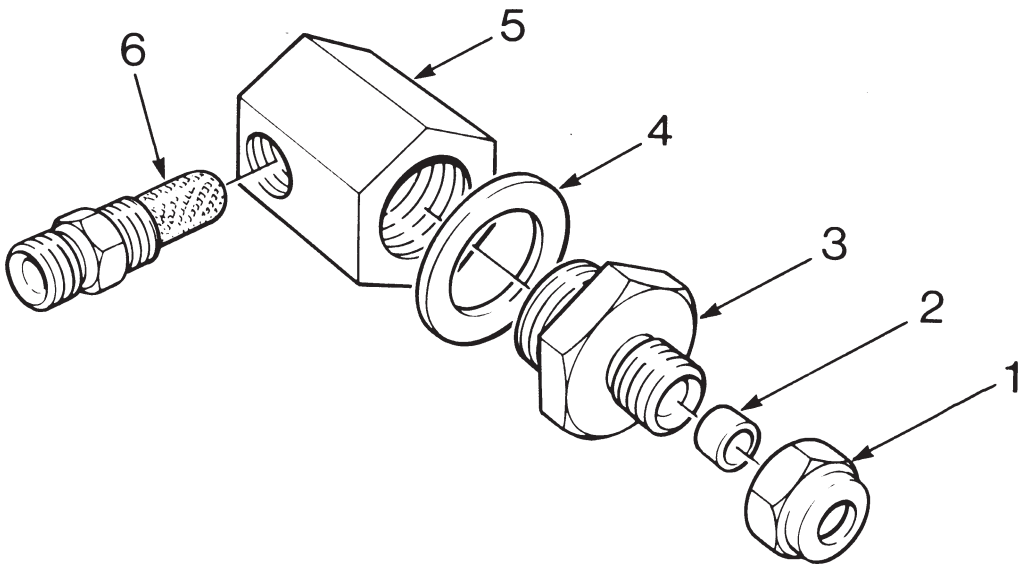
45. Open chamber door and remove central aerotight nut, stainless steel washer, silicone washer, retaining plate and door seal. When fitting a new door seal ensure the nut is tight.

MAINTENANCE (contd)

PRESSURE GAUGE (Fig. 3 item 3)

46. Ensure chamber is at atmospheric pressure and remove plumbing connection from rear of gauge. Disconnect bracket from panel by removing two nuts, spring washers and nylon spacers. Note that when fitting gauge, the spacers must be replaced between gauge and bracket. Gauge calibration is possible by rotating the calibration screw at the rear of the gauge, but this should only be carried out when the chamber is at working pressure on a verified 134°C.

CAUTION: When re-calibrating pressure gauge, it is important that the calibrating screw should not be rotated more than a few degrees in either direction. Permanent damage to the mechanism could result if this caution is ignored.



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

Fig. 6 Filter unit - disassembly

DISCHARGE LINE FILTER (Fig. 3 item 10 and Fig. 6)

47. The filter in the discharge line should be removed and cleaned approximately every 12 months. Proceed as follows:

(1) Ensure all water has been discharged from chamber back into the reservoir and switch-off unit.

(2) Remove filter assembly from discharge line, disassemble components and rinse clean all parts, using DISTILLED WATER ONLY.

(3) Allow components to dry, then reassemble filter unit. Ensure that copper washer is correctly positioned with bevel side of washer against filter body. If washer is damaged in any way - renew it.

MAINTENANCE (contd)

SPECIAL OPERATING MODES

Demonstration Mode

48. The demonstration mode provides a selection of the available display messages for use at exhibitions and for customer education in whatever language has been selected. To enter this mode proceed as follows:

(1) Switch off power.

(2) Push and hold-in the 134°C and 121°C (without drying) programme buttons and switch on power.

(3) Release programme buttons when messages start to appear.

(4) For the Little Sister 3 Autoclave, display messages are as follows:

LS3	)
Door	)
#count (followed by number)	)
rEAdy	)
StArt	)
count (followed by number)	) Operating Mode
FILL	)
HEAt	)
cond	)
dry	)
End	)
Engin	Engineering Mode
RECaLib	Recalibration Mode
SETup	Set-up Mode

#Random appearance in demonstration Mode.

Note: The message for service is set at 1500 cycles. The display is ‘Ser’ which replaces the count display, but does not prohibit the use of the autoclave. However, it reminds the user to arrange a service as the display can only be cancelled by the engineer going into the engineering mode. The autoclave will retain the total cycle count when ‘Ser’ is cancelled.

The following language messages are used for service:

LANGUAGE	DISPLAY		SERVICE DISPLAY
English	count	When service is due this will change to	Ser
French	addit		Ser
German	addit		tech
Italian	conta		help
Spanish	conta		stec
Portuguese	cont		asst

49. To exit the demonstration mode, simply switch off power to the unit, then switch on again.

MAINTENANCE (contd)

Engineering Mode

50. To enter the Engineering Mode proceed as follows:

(1) Switch off power.

(2) Push and hold-in the 134°C and 121°C 'with drying' programme buttons (i.e. the bottom two buttons) and switch on power again.

(3) Release programme buttons when messages start to appear. The messages, in order are: 8.8.8.8.8. with a continuous audible signal and all programme selection LED's illuminated, followed by 'count', then the accumulative number of completed cycles, then the error code (see para. 55) for the last error stored in memory (which is then deleted) and finally 'Engin'.

Note: In the Engineering Mode the display will read 'Engin' unless the heater is on and steam is produced, in which case the normal temperature display will show.

51. In the Engineering Mode the programme selector buttons and programme indicator LED's function as follows:

(1) Button 134°C (without drying). Press to check chamber discharge valve function. If the valve is working the valve solenoid will be heard to click.

(2) Button 121°C (without drying). Press to check water fill valve function. By opening chamber door the water can be seen to flow into the chamber.

Note: Only one of the valves can be energised at a time.

(3) Button 121°C (with drying). To switch on heater, press and hold in this button until 'HEAt' or (if hot) temperature display appears, then release. To switch off heater, press and hold in this button again until 'Engin' display appears, then release it.

(4) Programme '134°C without drying' LED will illuminate if door switch closes.

(5) Programme '134°C with drying' LED will illuminate if chamber water level sensor is immersed.

Note: If unit cover is removed (para 26) this condition can be simulated by wetting a finger and placing it between chamber exterior wall and the temperature sensor connection where it enters the chamber.

(6) Programme '121°C without drying' LED will illuminate if reservoir float switch is covered. Refer also to TEST PROCEDURES (para 66 and 67) for which the Engineering Mode must be selected.

52. To exit Engineering Mode, simply switch off power to the unit, then switch on again.

MAINTENANCE (contd)

SPECIAL OPERATING MODES

Set-up Mode

53. This mode enables the Little Sister 3 to be 'customised'. To establish a programme temperature or to select a language option proceed as follows:

(1) Switch off the power switch.

(2) With cover removed, push and hold in button E (Fig. 5 item 2)

(3) With button E held in, switch on power again.

(4) The display 'set up' will appear and a long 'bleep' will sound.

54. Temperature and language options will now be displayed as a menu from which to select. As each option appears it must be either selected or rejected. To select a displayed option press the top programme selector button (134°C without drying); to reject an option, press the second button 121°C without drying). A typical temperature set up sequence is as follows:

Option	Action
134°C	Press top button to accept
121°C	Press second button to reject
134°C DRY	Accept
121°C DRY	Reject
RES 1.0°C	Reject
RES 0.5°C	Reject
RES 0.1°C	Accept
ENG	Accept
AUTOC	Accept
EOC 0	Reject
EOC 2	Reject
EOC 4	Accept

Where:

ENG	= Language
RES	= Degree of resolution
AUTOC	= Autocheck required
EOC 0	=) Number of 'bleeps'
EOC 2	=) at end of cycle
EOC 4	=)

To change any options the complete procedure must be carried out (i.e. temperature, language, autocheck, resolution and end-of-cycle 'bleep' count).

55. To change language options re-start procedure as from para 53 (1) to (4), then re-select temperature parameters as presented in sequence on the menu. Finally, select one language from those presented in sequence. Again, press 134°C without drying programme button to accept or press 121°C without drying programme button to reject. At the time of preparing this issue of the LS3 Technical Manual the selection of languages is as follows:

English, Spanish, Italian, Portuguese, French or German.

Note: The language options will continue to be displayed in sequence repeatedly, until one of those languages is accepted.

MAINTENANCE (contd)

Errors and Error Clearing

56. Various situations can give rise to an error code being displayed. Any error is stored in the internal memory of the micro-computer. The autoclave is automatically 'locked' out of action until the error has been cleared. The area of error is stored for service engineering and indicated *briefly* by the display of one of the error codes shown below on entering the *'Engineering Mode' (para 50). This will only be displayed once as entering the 'Engineering Mode' also cancels the message.

Error Code	Interpretation
Err 2	Door opened after cycle has commenced
E3	Water failed to fill chamber to sensor level
E4	Water loss during sterilizing stage
E5	Heater not working
E6 to)	Temperature parameters are outside the set limits for the
E9)	control and display
A	Temperature sensor malfunction

*Note: These errors codes are displayed during the course of normal operation (see ERROR INDICATION, para 22).

57. Once the fault has been corrected, to clear an error from the microcomputer memory proceed as follows:

(1) Switch off power to the unit.

(2) Push and hold in any one of the programme selector buttons (*not* button 'E') and switch on power again.

(3) Release programme selector button after one or two seconds.

Special button usage

58. At any time during normal operation of the autoclave, when the heater is operating and the temperature display is showing, pushing any button will 'switch' the display to the control sensor and 'c' will be displayed on the far left position for as long as the button is held depressed. This feature enables a check to be made on the control temperature in relation to the display temperature.

Autocheck

59. When the Autocheck feature is selected and the sterilizing phase has been reached a check is made to ensure that the temperature recorded on each sensor does not go outside specific limits for the cycle selected. Should this happen, the appropriate error code from E6 to E9 will be displayed (see para 55).

Note: This is independent of the sensor integrity check system which always functions, irrespective of autocheck being selected or not.

MAINTENANCE (contd)

ROUTINE CALIBRATION PROCEDURE

60. The SES Little Sister 3 will retain its calibration well over long periods of time but, occasionally, re-calibration is necessary. This procedure should be carried out whenever a routine temperature calibration is required and as part of any major maintenance operation. It should also be carried out following the replacement of:

(1) Controller board (calibration has been 'factory set').
(2) Temperature sensor(s).

It is recommended that the calibration be checked at least EVERY TWELVE MONTHS, or more often if the unit is heavily used or if local codes of practice require it. The chamber temperature should be measured using a thermocouple connected to a temperature indicator of known good accuracy. In the factory a chart recorder is used.

61. It is assumed that the autoclave is working correctly and that a routine temperature calibration is required. Should the control screws on the controller have been seriously maladjusted, the controller must also be re-set, as described under CONTROLLER SETTING.

62. It is particularly important that the conditions are satisfied before calibration is attempted:

(1) There must be no steam leaks.

(2) The air valve closes at between 99°C and 104°C.

(3) The door pressure lock engages at 200 mbar (3 lbf/in^2).

(4) In addition, the autoclave should have been run sufficiently to become thoroughly warm. An autoclave with suspect calibration should only be run using the calibration procedure detailed below.

63. The Little Sister 3 control programme contains a special calibration sequence to ensure accurate calibration in the shortest possible time. Do not attempt to set-up the autoclave by carrying out normal sterilization cycles. It is important to proceed methodically.

64. To calibrate the Little Sister 3 proceed as follows:

(1) Insert thermocouple probe into Twinlock adapter on manifold (Fig. 4 item 19) until it reaches the bottom of the hole, ensuring that the probe penetrates the centre of both '0' rings.

CAUTION: Do not use a sharpened probe.

(2) Switch on power to the unit while depressing the '121°C without drying' and '134°C with drying' buttons simultaneously. The display 'CALib' will appear and the solenoid door lock will engage. 'FILL' will be displayed for approximately 150 seconds followed by 'HEAt' as the heater is switched on. Switch on chart recorder. The autoclave temperature will increase automatically until it reaches the sterilizing temperature of 121°C. While this is taking place check items (1), (2) and (3) para 62, also that the solenoid door lock has engaged and that the pressure gauge is registering with increased temperatures (1.10 bar at 121°C).

(3) When sterilizing temperature has been achieved and the autoclave has been in the sterilizing mode for 5 to 6 minutes, calibrate to 122.5°C mean, with a tolerance of + or - 0.25°C on the chart recorder by adjusting VR1 on the controller board (clockwise to increase temperature).

MAINTENANCE (contd)

Note: Issue 7 only (Marked top L.H. corner)

(a) Turn VR1 and VR3 counter-clockwise to increase temperature and VR2 and VR4 clockwise to increase temperature. Revert to original instructions for 'issue 8'.

(b) The temperature display on the Little Sister 3 will not change when the control is adjusted as this is independent (see para 64 (5) and (7) to adjust display).

(4) Adjust VR1 on the controller until 122.5°C as shown on the chart recorder is achieved, ignoring any display readings at this stage. Adjust the control a little at a time and observe the effect after each adjustment. Once this setting is correct press any one of the three lowest programme buttons on the control panel and hold-in while observing the display.

CAUTION: Do not press the '134°C without drying' button.

A small letter 'c' appearing against the temperature displayed indicates that this is the control temperature. The display should now read similar values to those being shown on the chart recorder.

(5) Release the programme button on the front panel and again observe the reading on the display. Carefully adjust VR3 (top outer) until the display reads the same as the chart recorder. At this stage depressing and holding in any of the lowest programme buttons should have very little effect on what is displayed.

(6) Depress the top button until a 'bleep' is heard. The temperature will increase to approximately 135.5°C. Wait until the chart recorder trace stabilizes. Adjust VR2 (lower inner) carefully, counter-clockwise to increase, until the recorder trace indicates 135.5°C +0.5°C -0.25°C. Depressing any one of the lowest three programme buttons should again show good agreement between the displayed value and the chart recorder.

(7) Release the programme button and adjust VR4 (top inner) until the display reads correctly. These last two adjustments must be completed before two 'bleeps' sound (i.e. within approximately three minutes) since the temperature will drop back to 122.5°C after the 134°C cycle has been completed. Assuming that the temperature exceeded 134°C for at least 3.25 minutes, the calibration is now complete.

Note: The temperature can be increased to 134°C for a further 3.5 minutes at any time after the temperature starts to drop by pressing the upper 134 button.

(8) Check that the pressure gauge is reading between 2.2 bar and 2.4 bar at 135.5°C. If necessary, re-calibrate gauge. If gauge is re-calibrated re-check the pressure reading at 121°C.

(9) If the temperature is within +0.5°C of 122.5°C then the controller calibration can be assumed correct.

(10) As a calibration check: Continue the sterilizing cycle at 121°C for a minimum of four minutes, ensuring that no further adjustments are made to the variable resistors VR1, VR2, VR3 and VR4, then depress the '134°C without drying' programme button and allow temperature to increase to 135.5°C +0.5°C -0.25°C. Seal the variable resistors VR1, VR2, VR3 and VR4 and mark the top of the top sensor plug (positioned at Al on the board) with a suitable medium.

Note: Should it prove impossible to calibrate the controller board using the above calibration method, it is advisable to change the board.

MAINTENANCE (contd)

(11) Remove temperature probe and refit Twinlock adaptor nut.

CONTROLLER SETTING (Refer to Fig. 5)

CAUTION: This procedure is NOT intended for regular use and should only be attempted in extreme circumstances and then only if the correct equipment and expertise are available.

65. The following equipment is required:

(1) Digital multimeter (DVM) (0 to 20V and 0 to 2V ranges) - capable of resolving lmV on the 0 to 2V range and l0mV on the 0 to 20V range.

(2) Multi-turn linear potentiometer fitted with approximately 0.5m twin lead terminating in 0.2 in. spacing female Molex push-on connector, capable of presenting resistances in the range 0 to 20K.

66. This procedure should only be undertaken if controller calibration is irretrievably lost. It is essential that final adjustments to the operating temperatures are made as described under ROUTINE CALIBRATION PROCEDURE after the procedure detailed below has been completed.

67. To set controller, proceed as follows:

(1) Switch off power to the autoclave, wait a few seconds and switch it back on. This will open the discharge valve.

Once the chamber is empty of water and steam **switch off the autoclave and remove the plug from the mains**. Now pull off one of the heater push-on connectors (make sure it does not short on any metalwork). Disconnect both the temperature sensors from the main board but leave everything else connected.

(2) Do not remove the board from the machine. Connect the small socket from the LS3 ‘test box’ (tool no. 1673) in place of the sensor 0A (it does not matter which way round the socket goes on). Connect a digital voltmeter (DVM) to the socket on the side of the testbox and set it to a range where it can resolve 1mV (0.001V).

(3) Switch on the sterilizer and select ‘Engineering Mode’. Switch the heater on (it will not actually come on because it is disconnected but the display will read ‘HEAt’ or a temperature.

(4) Adjust the control on the test box until the voltmeter reads 0.371V. Adjust VR1 until the display reads ‘100’.

(5) Change the test box control until the voltmeter reads 0.412V. Adjust VR2 until the display reads ‘140’.

(6) Repeat sub para (4) and (5) above in sequence until the specified conditions are reached. Only adjust VR1 at the low ‘temperature’ and VR2 at the high end. Once the settings are correct **switch off**, disconnect the test box from the board, reconnect the test box to board at 1.A. Re-calibrate the board using VR3 and VR4. Switch off and unplug from mains. Reconnect the sensors, ensuring the marked plug goes to 1.A socket.

Reconnect heater. Plug in and re-calibrate.

MAINTENANCE (contd)

TEST PROCEDURES

SAFETY VALVE (Fig. 3 item 5 and Fig. 7b)

Functional Test

68. The safety valve (part no. 301739) should be tested every 4 months to ensure free movement of parts. This should be carried out by operating the easing gear (turning the split ring and plunger assembly) when the valve is under a pressure of not less than 75% of the set pressure.

WARNING: During testing, ensure safety of all personnel.

Full Functional Test

69. The safety valve should be checked every 12 months for correct function and test of set pressure, full flow and reseat pressures.

70. Particular care should be taken with the use of sealing compounds and PTFE tape to ensure that they do not enter the valve.

71. It is recommended that adjustments, maintenance and repair of safety valves should only be carried out by Eschmann personnel or accredited agents.

72. Removal and installation of the valve is a straightforward procedure, but on installation, wrap PTFE tape around the valve threaded pipe fitting.

Safety valve test

73. To test the safety valve, proceed as follows:

(1) Refer to ROUTINE CALIBRATION PROCEDURE and carry out the instructions set out in para 62(2) and run the autoclave up to 134°C.

(2) As soon as 134°C is achieved, switch off power at the power ON/OFF switch.

(3) Refer to para 49 and enter the ‘Engineering Mode’.

(4) Switch on the heater by pressing and holding-in the ‘121°C with drying’ programme button.

(5) With the heater switched on, the temperature will rise without any control from the microcomputer. The safety valve will start to bleed at 138.5°C reading on the chart recorder. Temperature will rise to the range 140°C-141°C and the safety valve will be on full flow.

74. To cancel the safety valve test, switch off power via the power ON/OFF switch for 3 or 4 seconds, then switch on power again. This procedure will vent all pressure and water to the reservoir.

CAUTION: Ensure that the reservoir access cover is fitted Fig. 2 (item 16)

MAINTENANCE (contd)

OVERHEAT CUT-OUT

75. To carry out this test the microcomputer together with the heater cycling thermostat will have to be overridden. Procedure is as follows:

(1) Carefully noting their respective positions disconnect the spade connectors from the heater cycling thermostat cut-out switch (Fig. 4 item 3) and interconnect the two wires with a compatible insulated double connector.

(2) Refer to para 49 and enter the 'Engineering Mode'.

(3) With power switched on the heater cut-out will operate to disconnect power from the heater when heater temperature reaches 250°C (the pre-set cut-out temperature).

Note: Heater temperature will continue to rise a little after the cut-out has operated due to residual power in the heater. The cut-out temperature setting allows for this.

(4) To reset the cut-out, allow sufficient time for temperature to cool down to approximately 220°C, then press the PRESS TO RESET button on the cut-out switch box (Fig. 4 item 23).

(5) To exit the 'Engineering Mode', simply switch-off power to the unit, then switch on again.

(6) Reconnect spade connectors to heater cycling thermostat cut-out switch (detached at stage (1)) on completion of test.

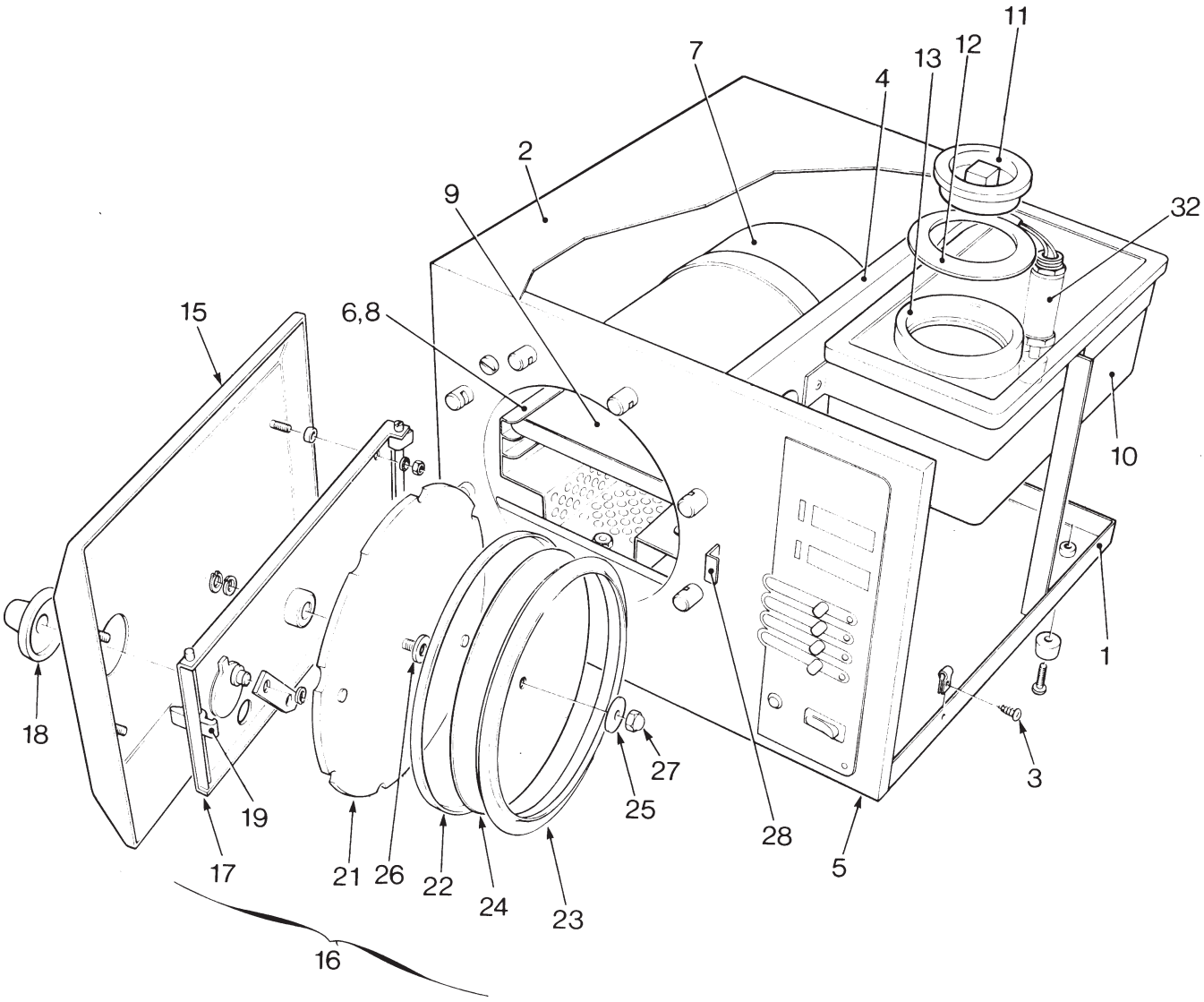


Fig. 7a Little Sister 3 Autoclave - spares items general

ILLUSTRATED SPARES LIST

Fig. 7a Item	Part No.	Description	No. off	Recommended spares**
	-	SES LS3 autoclave, wired to suit 240V, or 220V, or 110V a.c., 50/60Hz supply	-	-
1	490062	· Chassis	1	-
2	490109	· Top cover	1	-
3	307137	· Screw, self-tapping	4	4
4	490063	· Dividing panel	1	-
5	490035	· Front panel	1	-
6	490228	· Carrier assy. tray, quick release	1	-
7	490013	· Pressure chamber assy.(See fig.7b and 7c)	1	-
8	490044	· Carrier assembly, tray	1	-
9	416161	· Tray	4	-
10	480313	· Reservoir assy.	1	-
11	475872	· Reservoir aperture cover	1	-
12	425165	· Ring, self-adhesive	1	-
13	425141	· Ring, seal, silicone	1	-
14#	480301	· Foot, c/w fixing screw	4	-
15	490043	· Door cover assy.	1	-
16	480315	· Door assy.	1	-
17	427100	· · Door beam assy.	1	-
18	490076	· · Door knob	1	-
19	427011	· Door secondary latch	1	-
20#	427023	· · Spring, secondary latch	1	-
21	427085	· · Door, pressure assy.	1	-
22	427016	· · Seal spinning	1	-
23	427037	· · Door seal (gasket)	1	1
24	427015	· · Retaining disc, seal	1	-
25	427090	· · Seal washer, steel	1	1
26	713651	· · ‘O’-ring	1	1
27	307232	· · Aerotight nut	1	1
28	427010	· Safety catch, door	1	-
29#	490149	· Tray lifter	1	-
30#	301409	· Drip tray	1	-
31#	425188	· Accessory pack containing: 4 off each, cups and spacers for cabinet feet	1	-
32#	490112	·Float switch, reservoir	1	-

Not illustrated

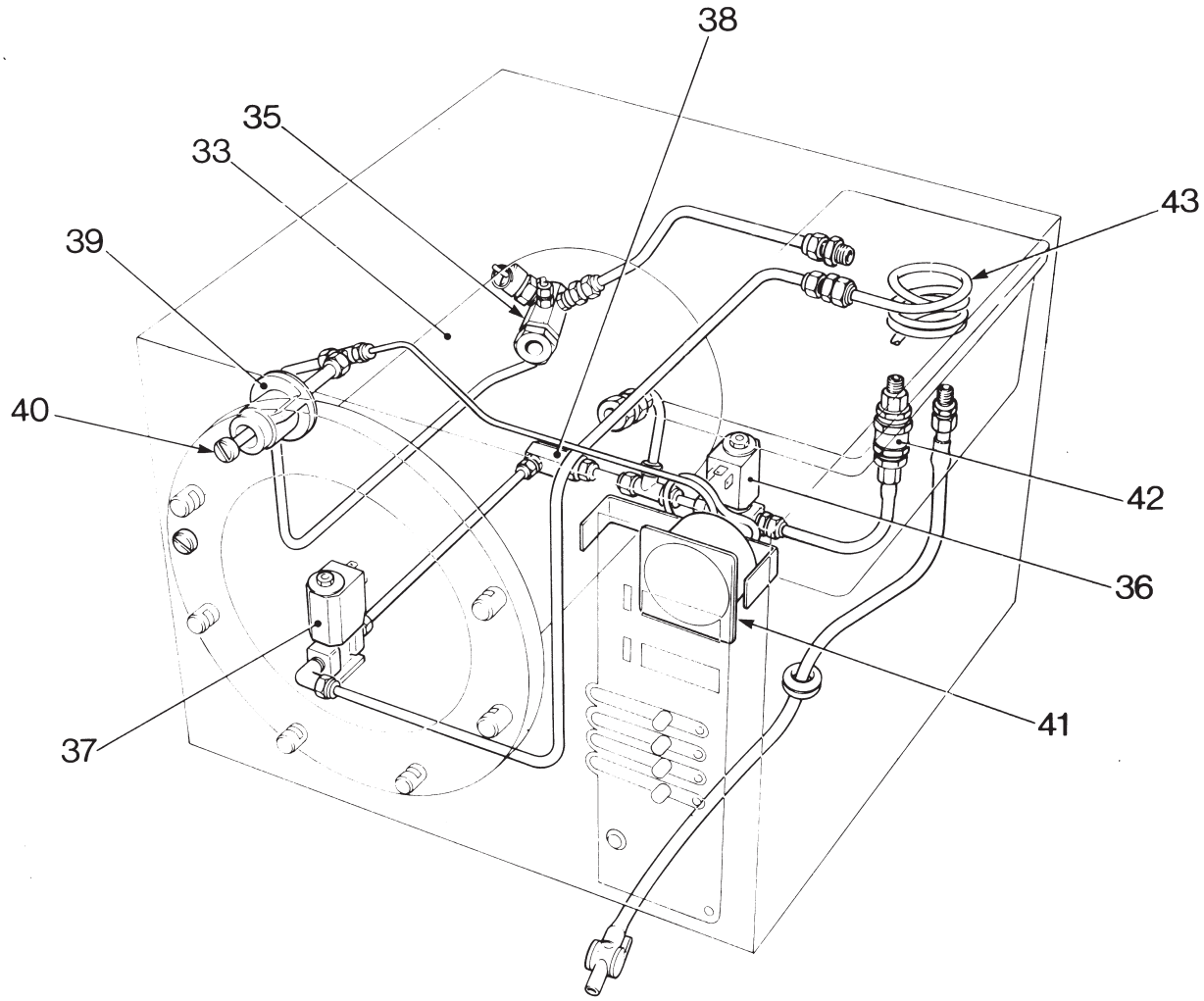


Fig. 7b Little Sister 3 Autoclave - spares items (pipelines and valves)

ILLUSTRATED SPARES LIST

Fig. 7b Item	Part No.	Description	No. off	Recommended spares**
-	-	· Pressure chamber assy. (see also Fig. 7c)	-	-
33	490040	· · Chamber	1	-
34	480311	· · Water fill pipe assy.	1	-
35	480316	· · Manifold, assy, incorporating	1	-
-	490041	· · · Manifold	1	-
-	301349	· · · Test plug	1	-
-	301739	· · · Safety valve	1	-
-	301625	· · · Coupling	1	-
-	425176	· · · Vent valve, air	1	-
36	490047	· Valve, solenoid (waterfill)	1	1
37	490048	· Valve, solenoid (discharge)	1	1
38	490049	· Filter	1	1
39	427035	· Pressure lock	1	-
40	427060	· Bolt, locking	1	-
41	490010	· Pressure gauge	1	-
42	490111	· Non-return valve	1	-
43	490157	· Coil	1	-

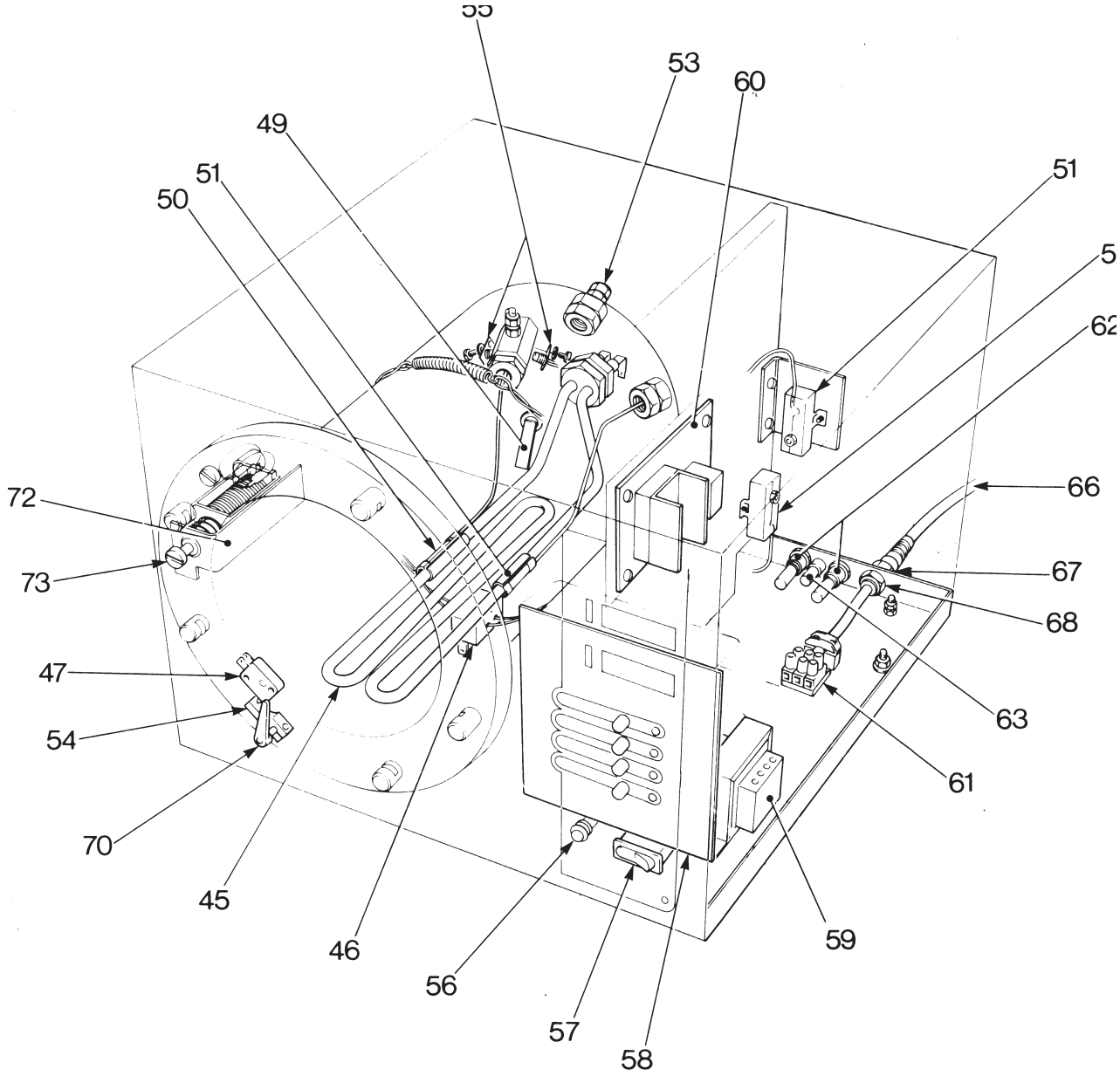


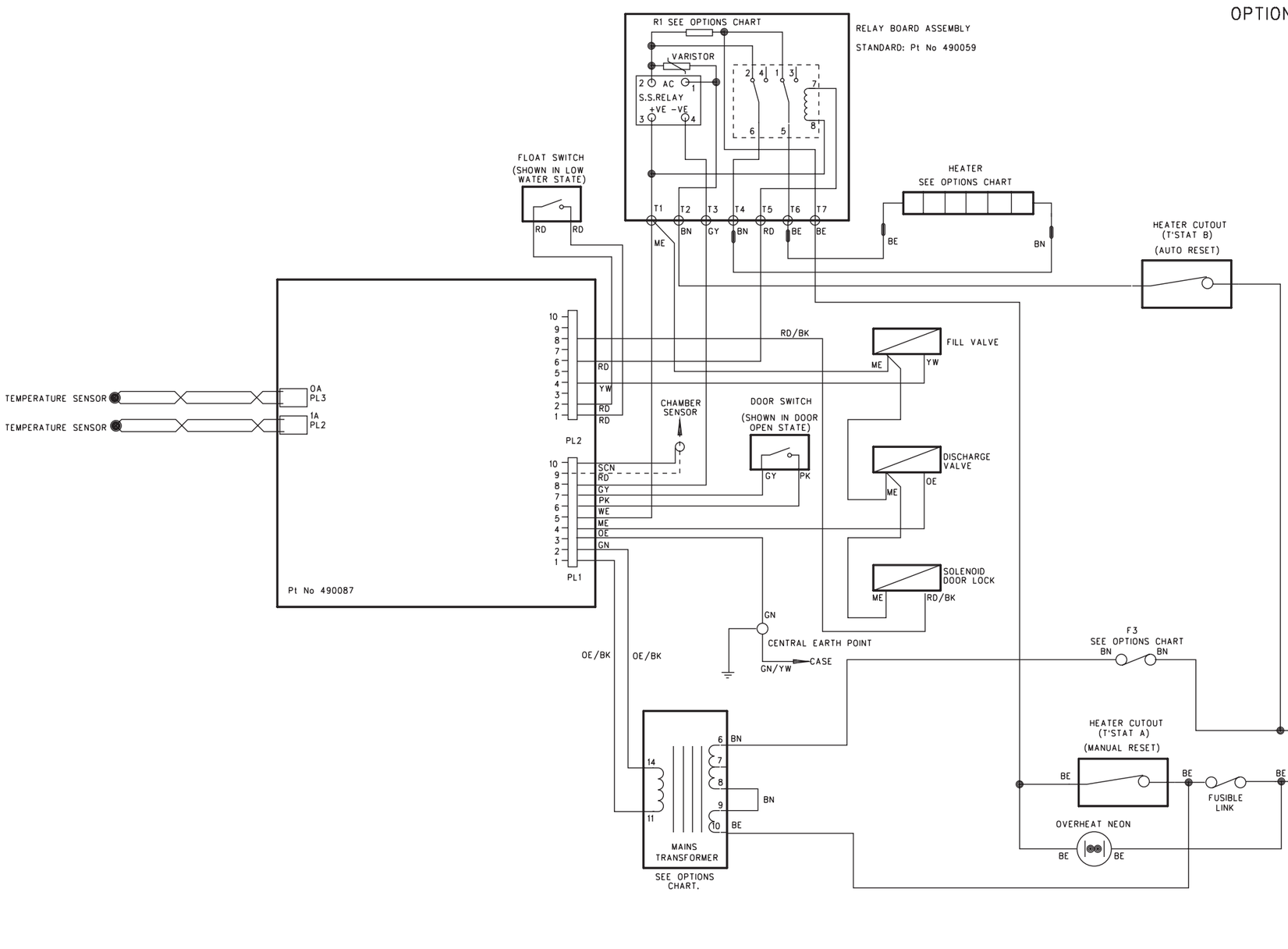
Fig. 7c Little Sister 3 Autoclave - spares items (heater and process controls)

ILLUSTRATED SPARES LIST

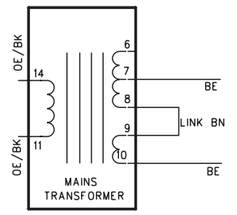
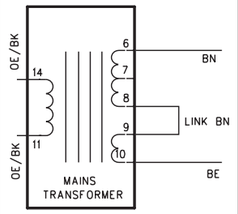
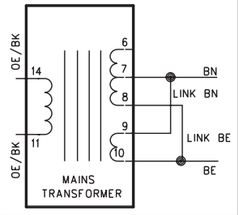
Fig. 7c Item	Part No.	Description	No. off	Recommended spares**
-	-	· Pressure chamber assy. (contd)	-	-
45	-	· · Heating element	1	-
-	412004	240V, 2.75kW		
-	-	220V, 2.75kW	-	-
-	421006	110V, 1.3kW		
46	425114	· · Thermal fuse	1	1
47	301162	· · Microswitch	1	1
48#	427021	· · Stop pin, microswitch	2	-
49#	480314	· · Sensor, water level, assy, including:	1	-
	301806	· · · Shouldered washer	1	1
	301807	· · · Rubber bush	1	1
	425124	· · · Insulation bush	1	1
	425121	· · · Water level body	1	1
50	380026	· · Thermostat assy, heater cycling	1	-
51	490020	· · Thermostat assy, heater cut-out	1	-
52	416149	· · Clamp, thermostat sensor bulb	2	-
53	301349	· · Test plug, Twinlock	1	-
54	427020	· Actuator arm, microswitch	1	-
55	427039	· Sensor, temperature	2	2
56	301127	· Lamp, neon, red (overheat)	1	-
57	380000	· Power switch, on/off	1	-
58	490087	· Controller board assy	1	-
	-	· · Fuse, F2A 20mm	1	1
59	301645	· Transformer	1	-
60	490059	· Relay board assy, including	1	-
61	380012	· Terminal block	1	-
62	380001	· Fuse holder, large	2	-
63	301814	· Fuse holder, small	1	-
64#	-	· Fuse	2	2
-	380003	F10A for 240V		
-	-	F13A for 220V		
-	111940	F16A for 110V		
65#	-	· Fuse		
-	696181	F400mA, for 240V and 220V	-	-
-	-	F800mA, for 110V		
66	490080	· Cable, power supply, assy. (inc. fused plug)	1	-
67	710849	· Clamp, cable	1	-
68	710897	· Nut, cable clamp	1	-
69#	427022	· Leaf spring, microswitch actuator arm	1	-
70	427104	· Lever assy, microswitch	1	1
71#	425170	· Surface tension breaker	1	-
72	490025	· Solenoid door lock	1	-
73	427060	· Bolt, locking	1	-

Not illustrated

** The spares holding column indicates recommended spares for one unit of equipment for one year only.



OPTIONS CHART

VOLTAGE RATING	F1	F2	F3	R1	OVERHEAT NEON	HEATER	TRANSFORMER TAPPINGS
200/220V	F13A	F13A	F400mA	100K	240V TYPE	STD 2kW	
230/240V	F10A	F10A	F400mA	100K	240V TYPE	STD 2kW	
110/120V	F16A	F16A	F800mA	47K	110V TYPE	1.4kW	

WIRE COLOURS	
ABBREVATION	COLOUR
BK	BLACK
BN	BROWN
RD	RED
OE	ORANGE
YW	YELLOW
GN	GREEN
GN/YW	GREEN/YELLOW
BE	BLUE
ME	MAUVE
GY	GREY
WE	WHITE
PK	PINK
RD/BK	RED/BLACK

DENOTES TAGGED WIRE FOR IDENTIFICATION

Fig. 8 Little Sister 3 Autoclave - System circuit diagram