tuttnauer
Sterilization & Infection Control Products

TECHNICIAN MANUAL

Electronic Table - top
Pre and Post Vacuum Autoclaves
models 2540 & 3870 EHS

CE 0123

Cat. No. *MAN205-0063-005E Rev. D*

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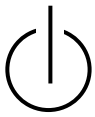
1 INTRODUCTION

This Technician's Manual, together with the Operator's Manual, forms the complete set of Operation and Maintenance instructions for the EHS pre and post vacuum autoclave. This manual is intended for the use of the technician. It is strongly recommended that only qualified and Tuttnauer factory trained personnel service this autoclave and do so in accordance with the instructions in this manual. Any unauthorized service may result in the invalidation of the manufacturer's warranty.

2 SYMBOL DESCRIPTION



Stand by

Caution! Consult accompanying documents

Caution! Hot surface.

Caution! Hot steam.

Protective earth (Ground)

3 INSTALLATION INSTRUCTIONS

For proper operation, these are the required utilities that need to be supplied for each model EHS:

3.1 Site requirements for installation of a 2540 EHS

Caution

The sterilizer must be placed on a rigid and leveled surface and must be able to hold the weight of the device and loaded material.

1. Counter top able to support a minimum 200 lb. * (the unit is shipped with a suitable stand - 26”W x 33”D x 34”H)

2. Counter space minimum 20”W x 32”D x 20”H * (see unit dimensions below)

3. City water supply 15 - 58 psi with shut off valve having ½" NPT male end.

   Higher rates of pressure will require the installation of a pressure reducer (58 psi max).

   A regulator and pressure gauge are supplied with the unit

   The minimum flow rate required is 0.66 gal/min. (2.5 lit./min.).

   Installation of the valve should be 2" above counter height at the rear of the unit.

4. Mineral Free water supply 7 - 30 psi with shut off valve and ½" NPT male end.

   Higher rates of pressure will require the installation of a pressure reducer.

   A regulator and pressure gauge are supplied with the unit

   The minimum rate of flow is 0.26 gal/min (1 lit/min).

   Installation of the valve should be 2" above counter height at the rear of the unit. * (an optional R.O. water system is available).

5. Electrical power 20A – 208V single phase. Connection required; flush mount receptacle 6-20R, within 1 foot of the rear of the unit.

6. Drainage should be to a 4” high 4” diameter air break, reducing down to a 1 ½” vented line with a trap. All drainage components must be able to withstand a non-continuous temperature of 140°F (60°C). Drain opening should be within 1 foot of the rear of the unit and no higher than 16” above the floor. The use of two ½”x 6" Milford Type Copper Coated Hangers is required for the positioning of the two drain hoses over the center of the air break and a 4” metal worm gear clamp to secure the hangers. The hangers will need to be bent at a 90º angle to allow for proper positioning and securing with the clamp. * (see attached drawing)

3.2 Site requirements for installation of a 3870 EHS

Caution
The sterilizer must be placed on a rigid and leveled surface and must be able to hold the weight of the device and loaded material.

1. Counter top able to support a minimum 400 lb. * (the unit is shipped with a suitable stand - 26”W x 33”D x 34”H)

2. Counter space minimum 26”W x 39”D x 24”H * (see unit dimensions below)

3. City water supply 15 - 58 psi with shut off valve having ½" NPT male end.

   Higher rates of pressure will require the installation of a pressure reducer (58 psi max).

   A regulator and pressure gauge are supplied with the unit

   The minimum flow rate required is 0.66 gal/min. (2.5 lit./min.).

   Installation of the valve should be 2" above counter height at the rear of the unit.

4. Mineral Free water supply 7 - 30 psi with shut off valve and ½" NPT male end.

   Higher rates of pressure will require the installation of a pressure reducer.

   A regulator and pressure gauge are supplied with the unit

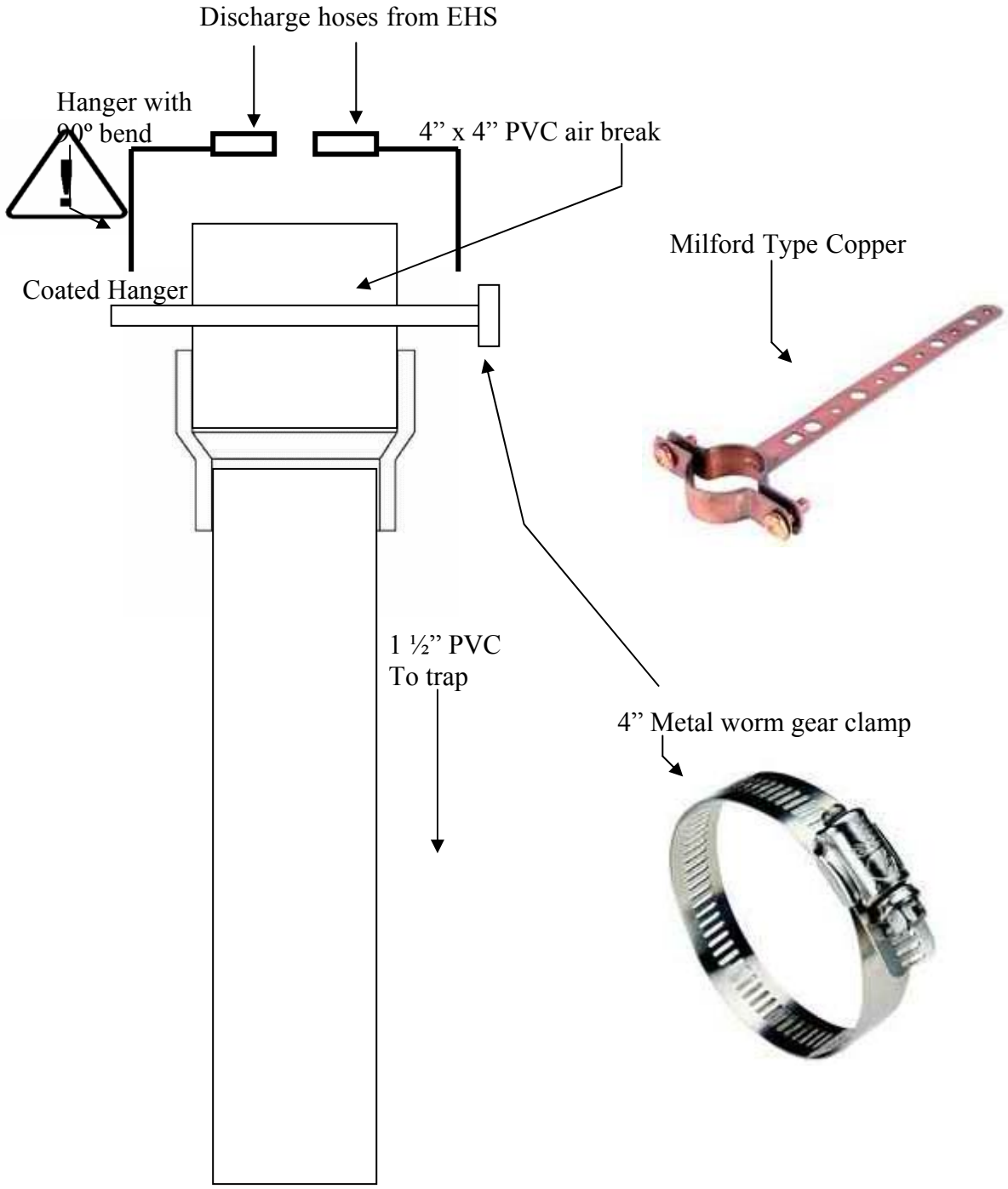
   The minimum rate of flow is 0.26 gal/min (1 lit/min).

   Installation of the valve should be 2" above counter height at the rear of the unit. * (an optional R.O. water system is available).

5. Electrical power 20A - 208V three phase, three power lines plus a ground. Connection required; flush mount receptacle or drop line with NEMA # L15-20R, this is a twist lock connector, within 1 foot of the rear of the unit.

6. Drainage should be to a 4” high 4” diameter air break, reducing down to a 1 ½” vented line with a trap. All drainage components must be able to withstand a non-continuous temperature of 140°F (60°C). Drain opening should be within 1 foot of the rear of the unit and no higher than 16” above the floor. The use of two ½”x 6" Milford Type Copper Coated Hangers is required for the positioning of the two drain hoses over the center of the air break and a 4” metal worm gear clamp to secure the hangers. The hangers will need to be bent at a 90º angle to allow for proper positioning and securing with the clamp. * (see attached drawing)

3.3 Suggested Site Drain Drawing



Caution!

Wastewater should be brought into the public sewage network in accordance with the local rules or requirement i.e. only non-hazardous liquids shall be disposed of in public sewage!

Network and connection should comply with the devices consumption, local installation and safety rules and regulations.

3.4 Electrical Specifications

Property	*Value*	
	2540	*3870*
Heaters Power	3000W	6000W
Total Power	3200W	6200W
Voltage (V)	1 ph / 208	3 ph / 208
Amperage (A)	15	15
Frequency (Hz)	50/60	50/60
Protection against electrical shock	Class I (IEC 60601-1)	

Note: In order to avoid any injury by electrical hazard, it is recommended that a ground fault protection device be installed in the electrical panel feeding the autoclave (local codes may make this mandatory).

3.5 Placing the Autoclave

Set the rear legs so that the chamber pitches down in the front at a rate of 1/8" per foot. This ensures that water is completely drained out of the chamber through the opening at the bottom front of the chamber. To check, pour a glass of water into the bottom rear of the autoclave and observe the water flow out of the chamber.

NOTE: Keep the back and the sides of the autoclave approximately 1" (25 mm) away from the wall to allow ventilation. It is recommended that enough space be left around the autoclave to give a technician access for servicing the machine.

3.6 Connections to Utility Supplies

Using the ½" hoses and washers supplied with the unit

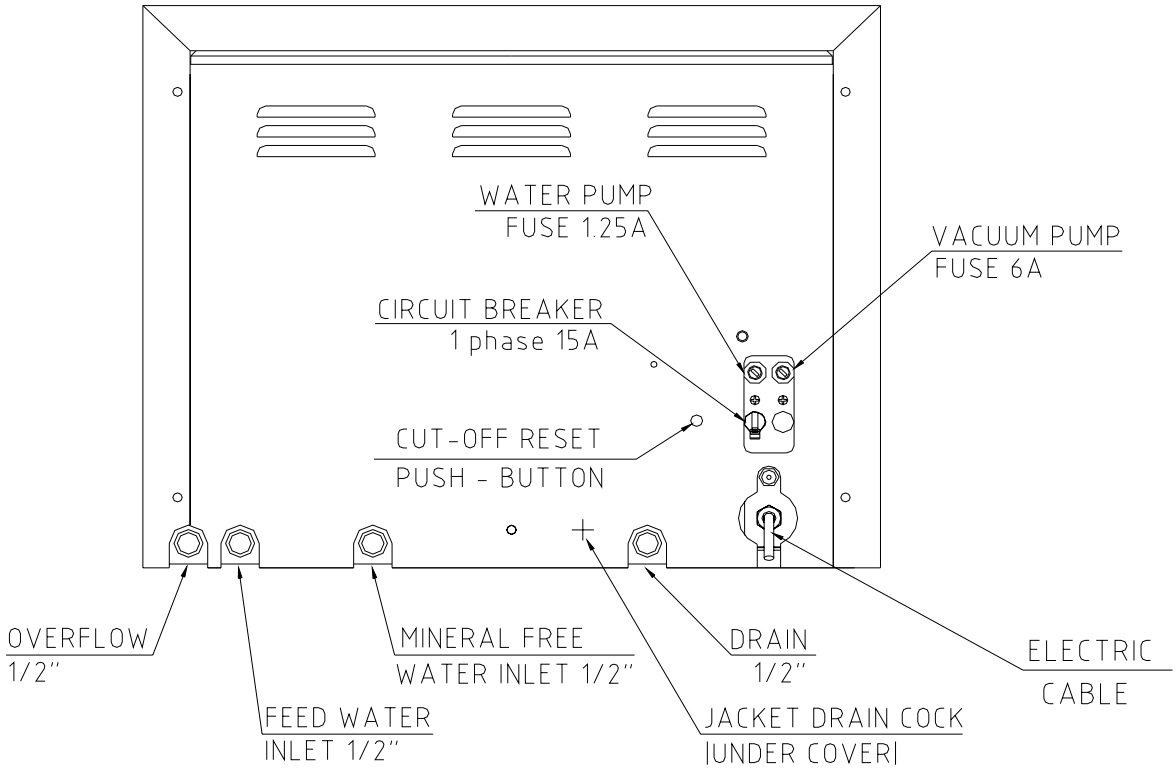
1. Connect the tap water inlet on the back of the autoclave to the feed-water supply (city water supply).
2. Connect the mineral -free water inlet on the back of the autoclave to a source of mineral-free water.
3. Connect the exhaust outlet on the back of the autoclave (using the black hose supplied with the unit) to a suitable drain as described above. Be sure to observe local codes for discharge of this type.

   Note:
   The drain hose from the exhaust outlet must be fixed very securely to the drain, ensuring that when steam and water are exhausted the hose is not allowed to recoil and cause injury to personnel.
4. Connect the reservoir overflow on the back of the autoclave to a suitable drain as described above.
5. Plug the power cord into the supply socket.

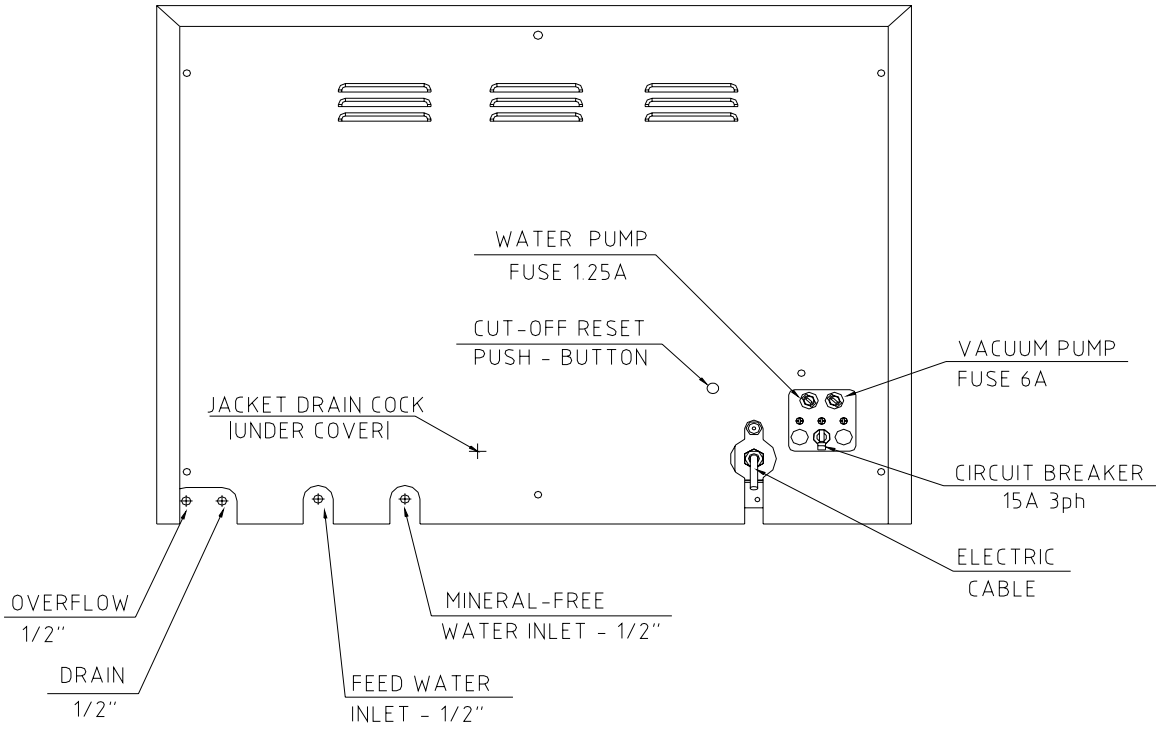
Attention! The pressure of the jacket does not decrease when the equipment is turned off.

REAR VIEW

MODEL 2540 EHS
REAR VIEW



MODEL 3870EHS
REAR VIEW



3.7 Installation Tests

At the time of installation, before the autoclave can be okayed for daily operation the service technician needs to perform the following preliminary checks:

- **Integrity check:** perform a visual check to verify that there are no dents, scratches or broken components on the autoclave
- **The leakage current check:** test the precise operation of the earth leakage relay
- **Ground check:** test the continuity of the grounding connection
- **Power supply check:** check that proper power is being supplied to the machine. See sec. 3.4.
- **Pitch check:** confirm that the autoclave has a downward pitch back to front of 1/8" per foot. (see sec. 3.5)
- **Exhaust and Feed hose check:** ensure that all hoses are free flowing and not restricted.
- **Water Pressure Check:** verify that the city water pressure into the unit is between 15 - 58 psi. Verify that the mineral free water pressure into the unit is between 7 - 30 psi.
- **Door check:** ensure that the door locking mechanism is functioning properly
- **Reset the Unit:** turn power off using the green power button at the bottom of the front panel, press and hold the Sel. Cycle button on the keypad, turn power on, continue to hold the Sel. Cycle button until the message *Program Wait* appears on the screen.
- **Atmospheric Pressure check:** the unit is set from the factory at 14.5 psia, this is atmospheric pressure at sea level. If the unit is located more that 500 ft above or below sea level then the Atmos. Press parameter must be set, see sec 8.2.17
- **Safety Valve check:** test the safety valve as per the instructions in sec 8.6 of the Operator's Manual
- **Cycle check:** run a B&D Test to ensure that all systems in the unit are functioning properly.

After the above steps are performed, the autoclave is ready for daily operation

3.8 Water Quality

3.8.1 Built-in Steam Generator

The distilled or mineral – free water supplied to the steam generator shall be according to the table below:

A Reverse Osmosis system meeting the qualifications below may be used to provide water for the steam generator. The better the quality of the water, the better performance, the less maintenance and the longer the life of the autoclave.

Mineral Free Water qualifications
(In compliance with ISO 11134 and ISO 13683)

Evaporate residue	*≤ 15 mg/l*
Silica	*≤ 2 mg/l*
Iron	*≤ 0.2mg/l*
Cadmium	*≤ 0.005 mg/l*
Lead	*≤ 0.05 mg/l*
Rest of heavy metals	*≤ 0.1 mg/l*
Chloride	*≤ 3 mg/l*
Phosphate	*≤ 0.5 mg/l*
Conductivity	*≤ 50 µs/cm*
pH	*6.5 to 8*
Appearance	*Colorless, clean, without sediment*
Hardness	*≤ 0.1 mmol/l*

Attention:
The use of water in the autoclave that does not comply with the table above may have severe impact on the working life of the sterilizer and can invalidate the manufacturer's warranty.

The suitability of the mineral free water to be used should be verified by testing in accordance with the above table; at an authorized laboratory using acknowledged analytical methods. We recommend testing the water quality once a month.

3.8.2 Water for the Vacuum System and the Drain Cooling

The feed water supplied, typically from a public water system, to the liquid ring vacuum pump must meet the following requirements:

- Hardness: 0.7 - 2 mmol/l.
- Water temperature: shall not exceed 59°F (15°C).

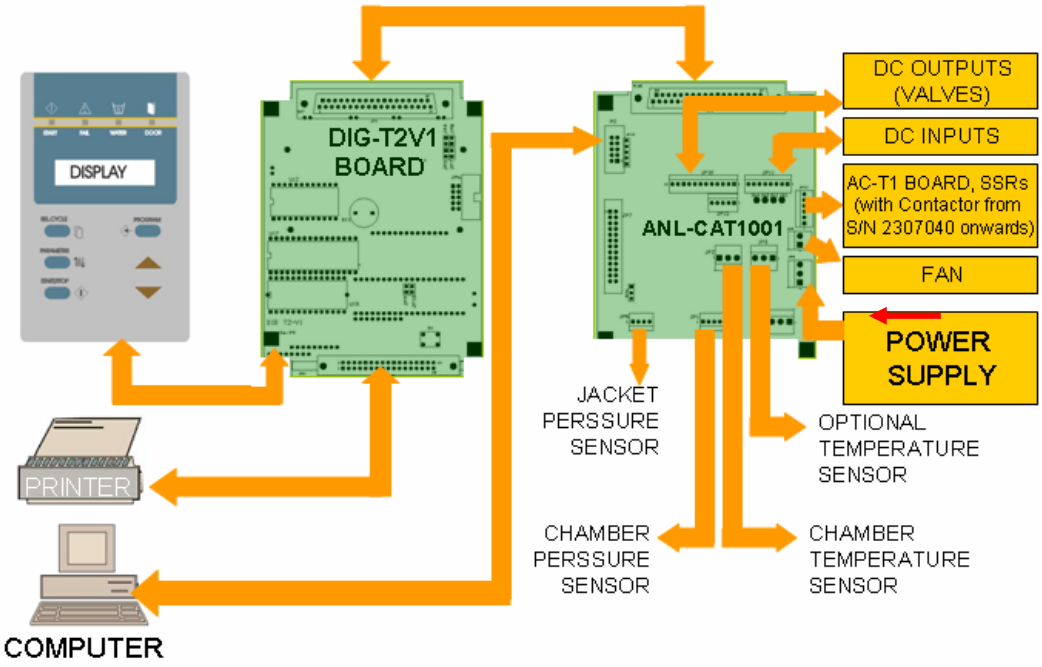
Note: ***The use of hard water in the vacuum pump may invalidate the warranty for the vacuum pump, since it can cause blocking of the rotor, which can damage the pump.***

4 DESCRIPTION OF THE CONTROL SYSTEM.

4.1 System Summary

The hardware portion of the control system consists of a keyboard and 3 additional electronic boards designed specifically to match the requirements of the EHS autoclave. The main board is the digital board, DIG-T2, which contains the microprocessor and is responsible for controlling the system. The analog board, ANL-T2, interfaces with the DIG-T2 board and the various system components processing signals traveling to and from these areas. The AC-T1 board consists of AC power filters and drivers for the AC components in the system. DC power (12V and 5V) for all the DC components is supplied by a switching type power supply. In addition the system is capable of direct communication with a printer over a parallel interface and/or a PC via an RS 232 port (for more detail see individual descriptions below).

CONTROL SYSTEM BLOCK – DIAGRAM



The following paragraph applies only to the 3870EHS

From S/N 2307040, a Varistor is connected, in parallel, to each of the SSR's contacts, in order to decrease the voltage spikes, caused by the operation of the power devices (pumps and heating elements).

In the 3 phase system (in our case, the 3870EHS) the current, to the heating elements, is supplied via a contactor. A "CUT OFF" thermostat is connected to the contactor's coil. If the temperature of the heating elements exceeds the alarm value, the "CUT OFF" thermostat disconnects the contactor coil, the contactor's contacts open ("off" position) and the heating elements are disconnected from the electrical power.

4.2 Keyboard

The keyboard is mounted to and directly connected to the DIG-T2 board and functions as an MMI (Man-Machine Interface). The keypad serves as a control panel containing the command and programming keys. It also includes an LCD display with two rows of 16 characters for cycle progress updates and error messages. In addition it contains the following light indicators:

- START (autoclave in process),
- FAIL (the process failed),
- WATER (no water in the reservoir),
- DOOR (blinks with buzzer sound when START is pressed and the door is not closed).

For more detail on the control keys and error messages please see the EHS Operators Manual

4.3 Digital Board DIG - T2

The digital board contains the microprocessor that runs the system software program and controls all the functions of the EHS autoclave. It is connected to the Keypad and digital display for interactive communication with the operator. It is also connected to the ANL-T2 analog board for communication with the rest of the EHS autoclave. In addition the DIG-T2 board has PC and printer communication abilities.

- The digital board is connected to the keypad and the ANL-T2 analog board via ribbon cables.

  The DIG-T2 board receives human commands through the Keypad and transmits visual information back, through the Keypad display

  The DIG-T2 board receives sensory information, from system sensors, in the form of digital signals through the ANL-T2 board. It also transmits operational commands, in the form of digital signals, to the various system components through the ANL-T2 board. Power for the DIG-T2 is provided by the ribbon cable connected to the ANL-T2

- The digital board also contains a parallel printer port for connection to a proprietary printer. The printer is connected directly to this board through connector DS1 via a ribbon cable. The printer receives data and operating voltage directly from this connector.

- The PC interface establishes two-way communication between the DIG-T2 board and a stand-alone personal computer, utilizing proprietary software. This communication is via a connector located on the ANL-T2 board and ribbon cable leading to an external connector on the front panel.

- On the board, are three types of memories:

  1) EPROM memory (U15) for storing the program codes.

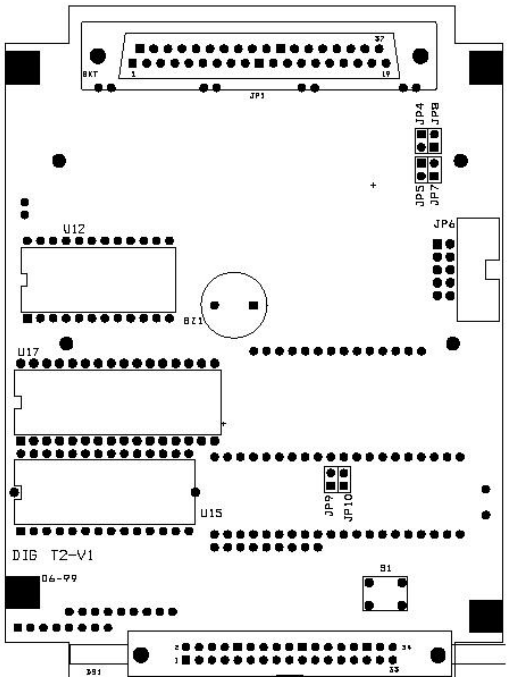
  2) RAM memory (U9) with a capacity of 64KB for the storage of temporary data during the running of the program that is located on the opposite side. This information is only for general knowledge.

3) FLASH memory (U17) serves as a non-volatile memory, enabling the system to change follow-up tables during running of program codes, and ensuring this data is not lost in case of power failure.

— The board contains a Real Time Clock element (U12), which serves as a clock to the system. It includes a back-up battery, which ensures that the clock runs continuously even when the autoclave is not powered.
— The back-up battery RAM includes a 113-byte memory component for storing the parameters currently in use.
— The board contains a solid-state component (U18) that acts as a system watchdog. This component detects any faulty situation while the program code is running. It forces the micro-controller to recheck system inputs every 1.5 seconds, this prevents the software from becoming stuck in a program loop, that would lead to the software crashing and a loss of control of the machine.

The layout of the DIG-T2 board components is provided below

DIG- T2 BOARD



— The system provides two types of communication with PC software, RS232 and RS485. Jumpers on the DIG-T2 board need to be set differently for each type. The default is RS232 (see also ANL-T2 board):

1. RS232 – JP4, JP5, JP9 are closed. RS232 allows a single communications port on the computer to communicate with a single EHS autoclave.
2. RS485 – JP7, JP8, JP10 are closed. RS485 allows a single communications port, with RS485 capability, to communicate with multiple EHS autoclaves daisy chained together.

— The system is equipped with a hardware-reset switch (S1).

4.4 Analog Board ANL-T2

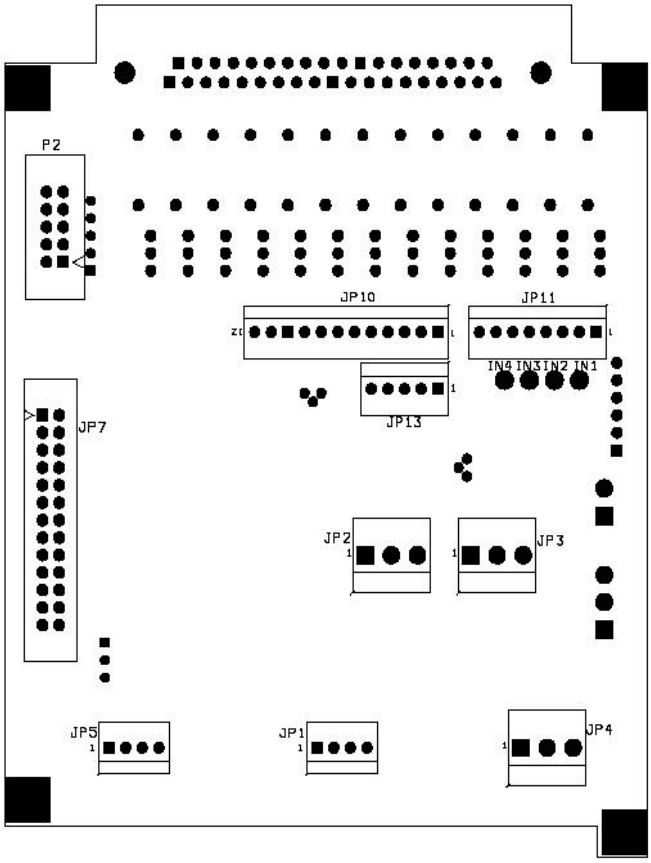
The analog board contains the DC power transistors that drive the valves, heaters and pumps. It contains the sensor circuits that decode the information from the temperature and pressure sensors before passing that information on to the DIG-T2 board. All the systems electronic components are connected through the ANL-T2 board. The analog board is connected to the AC-T1 board that controls the AC voltage devices. The power supply supplies 12 VDC and 5 VDC to the analog board and the ANL-T2 distributes that power to the remaining electronic components.

- JP1 & JP5 are connected to the two MPX2200 pressure sensors that measure the chamber & jacket pressure.
- JP2 receives the digital input from the PT-100 temperature sensor
- JP8 is connected to the Power Supply and receives the 12VDC and the 5VDC.
- JP6 provides a connection to the DIG-T2 board
- JP7 provides a connection for the Test Point board needed in troubleshooting.
- JP9 provides control for the cooling fan
- JP10 connects the DC output drivers to the solenoid valves.
- JP11 is connected to the various digital inputs, such as the water electrodes, door switch, float switches, etc.
- JP12 is directly connected to the SSR controlling the heaters. It also provides a digital connection to the AC_T1F board, which controls the water and vacuum pumps and the steam valve.
- JP13 is not applicable in the EHS Machine.
- JP14 is not applicable in the EHS Machine.
- JP15 is used to match the communication connector configuration to either RS232 or RS485. The default is RS232 (see also DIG-T2 board):
    1. RS232 – JP15, short pins 2 & 3, 4 & 5.
    2. RS485 – JP15, short pins 1 & 2, 3 & 4.
- P2 provides a link to the serial port on the front of the unit, via a ribbon cable.

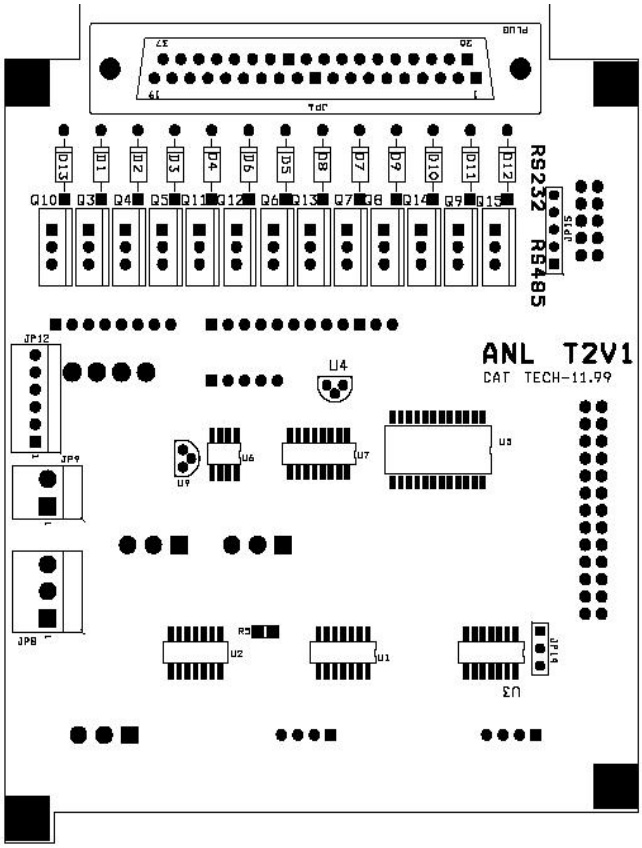
Layout diagram of the ANL-T2 is provided below.

ANL- T2 BOARD

Top View



Bottom View



4.5 AC - Board - AC-T1

The AC-T1 board provides AC filtering to protect the power supply and the control system from voltage spikes. This board contains the AC voltage drivers that control the AC devices in the system. This is done by accepting command signals indirectly from the DIG-T2 board through the ANL-T2 analog board and then turning the devices on or off.

The AC-T1 board includes:

— A filter circuit utilizing the L1C5 isolation transformer.

— JP2 provides filtered power to the power supply.

— Three 230/115 VAC triac control circuits. These are the AC drivers used in controlling the water and vacuum pumps and the steam valve.

— The maximum amperage this board is capable of controlling is 6A.

— Spike protection is provided by three components, RV1, RV2 and RV3. These components provide a resistibility proportional to the spike level. The resistibility decreases when the spike level increases, so that the current will be transferred to the ground instead of damaging the autoclave's system.

— JP1 is the control signal input from the ANL-T2 board

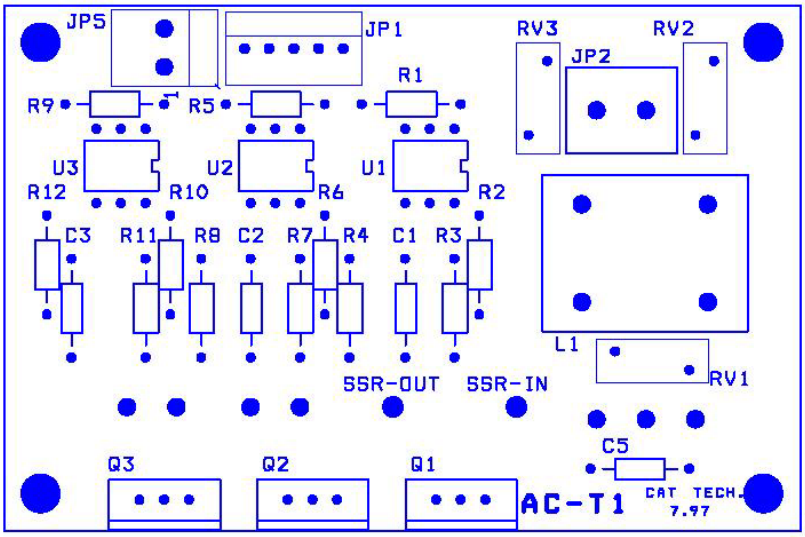
— JP3 is the AC input connector.

— JP4 is the output to the steam valve if an AC valve is used

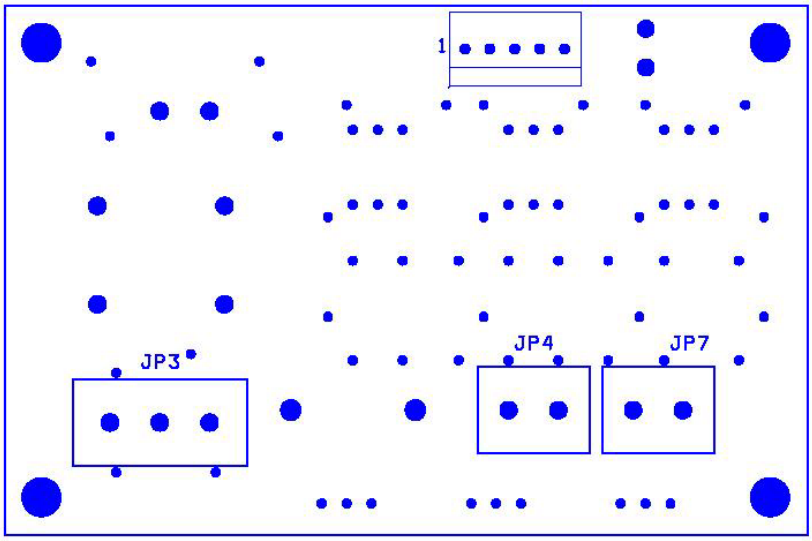
— JP7 is the output to the water and vacuum pumps

AC-T1 BOARD

Top View



Bottom View



5 CALIBRATION OF PRESSURE AND TEMPERATURE

5.1 Calibration Overview

The calibration of temperature and pressure is performed digitally. This system does not have adjustment pots. All calibrations are preformed through the keypad. The calibration procedure is identical on all EHS models.

The electronic temperature and pressure measuring circuits built into the EHS are designed with components having 1% accuracy.

The pressure circuit produces a linear output and has an electrical output range of 100mv - 2400mv, which corresponds to a pressure range of 0 - 58 psia.

The temperature circuit also produces a linear output and has an electrical output range of 100mv - 2400mv, which corresponds to a temperature range of 68°F (20°C) - 302°F (150°C).

The temperature and pressure circuits provide analog input voltages that are converted to digital signals by the A/D converter. The performance of the Analog to Digital converter (A/D) is limited for values greater than 2400mv or less than 100mv.

The system has a non-volatile memory in which the offset and gain data of the sensors are stored, as well as any error compensation factors that are calculated. Storage in the no-volatile memory means that even if the main power is turned off the information is saved for use the next time the machine is run.

Calibration is performed by entering data through the keypad or a stand-alone computer when the PC communication port is used.

5.2 Calibration Theory - Error Compensation:

The system's error compensation is based on a calculation involving two points. These points represent the low and high end of the autoclaves operating temperature or pressure range.
Each point has two values; one value is the "A" actual (measured) reading of either temperature or pressure (from a PT simulator, independent thermometer or pressure gauge). The other value is the "R" the reading from the autoclave's digital display of either temperature or pressure. By entering these values into the unit through the keypad the system is able to calculate a compensation factor that will correct the digital display and allow it to accurately return the actual temperature or pressure.

Note: The two points that are selected will define the range of the error compensation. Although points above and below are not part of the compensation, the calibration produces a linear compensation and these values will be accurate.

Note: The temperature can be calibrated in either °F or °C, depending on what units the machine is set to display.

Note: The pressure calculations are always done in Absolute pressure (Absolute pressure = atmospheric pressure + 14.5)

The calibration steps that follow will allow you to automatically correct the displayed temperature and pressure so it accurately reflects the actual temperature and pressure. All you need do is input the appropriate data (actual and displayed values) into the system through the keypad and the on board computer will do the rest.

Note: It is necessary to know the actual and displayed values prior to entering the calibration mode.

5.3 Equipment needed for calibration

— A PT100 simulator

— Saturated Steam Table (para 7)

5.4 Calibration Procedure

Calibration consists of three (3) parts and needs to be preformed in the following order. It is <u>not</u> advisable to perform only a partial calibration

1. Check that the atmospheric pressure parameter is set correctly (see sec 8.2.17)
2. Collect and enter temperature data
3. Collect and enter pressure data

5.4.1 Connecting the test equipment

Remove the outer cabinet
Disconnect the PT100 temperature sensor from the JP2 connector on the ANL_T2 board
Connect the PT100 simulator to JP2

5.4.2 Collecting and entering temperature data

When collecting data, keep in mind that "A" is always the actual temperature and "R" is always what is being displayed on the digital screen of the autoclave.
Once in the calibration mode, the calibration screen will look similar to this:

Upper Row: **A 140.0** **R 140.0** (lower temp reading °F)

Lower Row: **A 266.0** **R 266.0** (higher temp reading °F)

When entering data, remember that the upper row will represent the lower temperature of the chamber and the bottom row will represent the higher temperature of the chamber.

5.4.2.1 Collecting temperature data

— Select the low setting on the PT100 simulator (it is suggested to use 158°F)

This will be the "A" value for the upper row.

— Record the temperature displayed on the screen (there can be a slight delay in updating the screen when changing values on the PT100 simulator)

This will be the "R" value for the upper row.

— Repeat this procedure for the high setting using the PT100 simulator (it is suggested to use 266°F)

These values will be for the bottom row

— Once the data is collected disconnect the PT100 simulator from JP2 and reconnect the PT100.

5.4.2.2 Entering temperature data

Access the calibration mode as described in para 5.4.4.

— The cursor will appear flashing under the value for "A" in the upper row.

— Using the UP/DN arrow keys, enter the value for "A". This will be the first temperature value that the PT100 simulator was set for.

— Press the PROGRAM key to advance to the next value.

— The cursor on the upper row will move one position to "R"; now enter the first temperature value recorded from the display

— Press the PROGRAM key to advance to the next value that will be in the bottom row.

— The cursor will be positioned under the value for "A" in the bottom row.

— Enter the value for "A". This will be the second temperature value that the PT100 simulator was set for.

— Press the PROGRAM key to advance to the next value.

— The cursor on the bottom row will move one position to "R". Now enter the second temperature value recorded from the display

— Press the *PROGRAM* key one final time.

If PROGRAM WAIT has not been displayed then continue to press the *PROGRAM* key until it appears.

After a brief period the unit will return to a Ready state

5.4.3 Collecting and entering pressure data

When collecting data, keep in mind that "A" is always the actual pressure and "R" is always what is being displayed on the digital screen of the autoclave. Under normal circumstances calibration only needs to be done at the high end of the pressure range.
Once in the calibration mode, the calibration screen will look similar to this:

Upper Row: **A 15** **R 15** (atmospheric pressure reading)

Lower Row: **A 45** **R 45** (high pressure reading)

When entering data, remember that the upper row represents atmospheric pressure and the bottom row represents the high pressure of the chamber. And that all entrees are in **absolute pressure**.

"If the display reads a chamber pressure of 00, with the door of the autoclave open, then proceed directly to 5.4.3.2.

If the reading is not 00 then proceed as follows.

5.4.3.1 Atmospheric pressure calibration

Set the Atmospheric pressure parameter (see 8.2.17)

— If the read out on the display is at least 1psi above or 1Ih below 00 then access the calibration mode as described in para 5.4.4

The cursor will appear flashing under the value for "A" in the upper row.

— Press the Program key to advance to the next value "R" in the upper row

— Using the UP/DN arrow keys raise the value of "R" if the display reads high. Lower the value of "R" if the display reads low.

(Example: if the display reads 2 psi, then raise the value of "R" by 2; if it reads 2Ih then lower the value of "R" by 2)

— Press the program key until PROGRAM WAIT is displayed. The autoclave will recalibrate and return to the Ready state.

— If the display now reads 00, with the door of the autoclave open, then continue on to sec 5.4.3.2"

5.4.3.2 Collecting pressure data

— Select a program with a sterilization temperature of 273 °F (134 °C), make sure the door is closed securely and press START.

— Let the unit cycle to maximum pressure that will be reached once the unit has entered the sterilization mode.

— Record the temperature and pressure from the digital display.

— Abort the cycle by pressing the STOP key.

— Consult the Saturated Steam Table for the Absolute pressure that corresponds to the temperature recorded in the previous step and record that value.

— Add 14.5 to the pressure reading from the digital display and record this value

5.4.3.3 Entering pressure data

Access the calibration mode as described in para 5.4.4.

— The cursor will appear flashing under the value for "A" in the upper row.

— Press the *PROGRAM* key to advance to the next value.

— The cursor on the upper row will move one position to "R".

— Press the *PROGRAM* key to advance to the next value that will be in the bottom row.

— The cursor will be positioned under the value for "A" in the bottom row.

— Enter the value for "A". This will be the value of absolute pressure recorded from the Saturated Steam Table

— Press the *PROGRAM* key to advance to the next value.

— The cursor on the bottom row will move one position to “R”; now enter the pressure value recorded from the digital display to which you have already added 14.5.

— Press the *PROGRAM* key one final time

If PROGRAM WAIT has not been displayed then continue to press the *PROGRAM key* until it appears.

After a brief period the unit will return to a Ready state

This completes the calibration procedure for temperature e and pressure. A sterilization cycle should be performed to verify that the system is calibrated and running properly.

5.4.4 Accessing the calibration mode

— With the unit turned on press the *PROGRAM* key.

— Pressing the *PROGRAM* key will bring you to its first function of setting the system's date the time.

— Setting the date and time can be bypassed by pressing the PROGRAM key six times.

— On the seventh press of the *PROGRAM* key **CODE: ØØØ** will be displayed.

— Advance the code to 011 by pressing the *UP* arrow key (this is a technician level code) then press the *PROGRAM* key.

— Continue pressing the program key until **CALIB CODE: 1ØØ** is displayed.

— Using the *UP* arrow key select **CALIB CODE: 107**.

— Press the *PROGRAM* key again until **Program Wait** is displayed, this is an intermediate calibration phase. Once the program wait is completed TEMP **CAL: ØØØ** will be displayed.

— Using the *UP* arrow key advance to **TEMP CAL: ØØ1**

— Press the *PROGRAM* key again. This is the Temperature Calibration mode and the data is ready to be entered

— Press the *PROGRAM* key one additional time and the display will show **PRESS CAL: ØØØ**.

— Using the *UP* arrow key advance to **PRESS CAL: ØØ1**

— Press the *PROGRAM* key again. This is the Pressure Calibration mode and the data is ready to be entered

6 TESTING AND RESETTING

6.1 Test Points

These test points are provided to assist in trouble shooting the autoclave. A test point board is needed to be able to read these test points.

NU TP	FUNCTION		VALVE
TP1	GND		
TP2	+5V DC		
TP3	+12V DC		
TP4	OUTPUT	HEATERS	0V-Off; 5V-On
TP5	OUTPUT	VACUUM PUMP	0V-Off; 5V-On
TP6	——		——
TP7	OUTPUT	AIR INLET VALVE (43)	0V –CLOSE; 5V-OPEN
TP8	OUTPUT	VACUUM VALVE (52)	0V –CLOSE; 5V-OPEN
TP9	OUTPUT	MINERAL FREE WATER TO RESERVOIR (21)	0V-Off; 5V-On
TP10	OUTPUT	WATER TO VAC PUMP (15)	0V-Off; 5V-On
TP11	——		——
TP12	OUTPUT	STEAM TO CHAMBER (93)	0V –CLOSE; 5V-OPEN
TP13	OUTPUT	SLOW EXHAUST (74)	0V –CLOSE; 5V-OPEN
TP14	OUTPUT	DRAIN COOLING WATER (13)	0V-Off; 5V-On
TP15	OUTPUT	WATER TO VAC PUMP RES. (14)	0V-Off; 5V-On
TP16	OUTPUT	FAST EXHAUST (73)	0V –CLOSE; 5V-OPEN
TP17	OUTPUT	WATER PUMP	0V-Off; 5V-On
TP18	——		——
TP19	——		——
TP20	——		——
TP21	INPUT	TEMPERATURE-1 (PT100)	273ºF = 1.97V
TP22	INPUT	JACKET PRESSURE	29.4 psi = 2.031V
TP23	——		——
TP24	INPUT	CHAMBER PRESSURE	29.4 psi = 2.031V
TP25	INPUT	LOW WATER ELECTRODE	0V = SATISFIED
			2.5V = NOT SATISFIED
TP26	INPUT	HIGH WATER ELECTRODE	0V = SATISFIED
			2.5V = NOT SATISFIED

6.2 In – Out Test mode:

To enter the test mode –

- Turn off the main power switch
- While pressing and holding the UP arrow key, turn on the main power switch.

The output test starts immediately
Each output (valves, heaters, pumps), will be activated and the name of that device will be displayed.
To switch from one output to another, press the UP arrow key.
When all the outputs have been tested the input tests will begin again.
To leave the In – Out test mode, turn off the main power switch.

DISPLAYED NOTICE	ITEM ACTIVATED	REMARKS
Heaters ON	Heating Elements	Heating elements are activated.
Pump On	Vacuum pump	Pump is operating only if there is water in the vacuum pump reservoir
Water ON	Water pump for jacket	ULKA water PUMP operates.
Air On	Air valve (43)	Air valve is open.
Water Res On	Mineral free water reservoir valve (21)	Water valve to mineral free reservoir is open.
Exh Res On	Vacuum exhaust valve (52)	Vacuum exhaust valve is open.
Steam On	Steam valve (93)	Steam valve from jacket to chamber is open.
Vacum Wtr On	Water valve (15)	Water valve from reservoir to vacuum pump is open.
Door Lock ON	Door locking solenoid	Door locking solenoid is activated (retracted). (only on units with an electric door lock)
Slow Ex On	Slow Exhaust valve (74)	Slow exhaust valve is open.
Exh Drain On	Fast Exhaust valve (73)	Fast Exhaust valve from chamber to drain is open
Cool wtr On	Cooling water valve (13)	Exhaust Cooling water valve is open
Electrd –h 0	High water level electrode	Electrode senses water in the jacket
Electrd –h 255		Electrode does not sense water in the jacket and activates the water pump

(continued on next page)

DISPLAYED NOTICE	ITEM ACTIVATED	REMARKS
Electrd –l 0	Low water level electrode	Electrode senses water above minimum level in the jacket
Electrd –l 255		Electrode does sense water above minimum level in the jacket and disconnects heating elements
Door Sw "0"	Door switch	Door switch activated
Door Sw "1"		Door switch not activated
Float -l "0"	Lower mineral free float switch. (move the float switch and verify that it operates)	Float switch senses water
Float -l "1"		Float switch does not sense water and stops operation of water pump
Float –H "0"	Upper mineral free float switch. (move the float switch and verify that it operates)	Float switch senses water and closes valve 21
Float –H "1"		Float switch does not sense water and opens valve 21

6.3 Resetting the Autoclave:

Whenever it becomes necessary to restore the system to normal operation, the system must be reset. This will remove corrupted data from memory and restore a healthy program. On occasion other situations require that a reset be preformed, they are as follows:

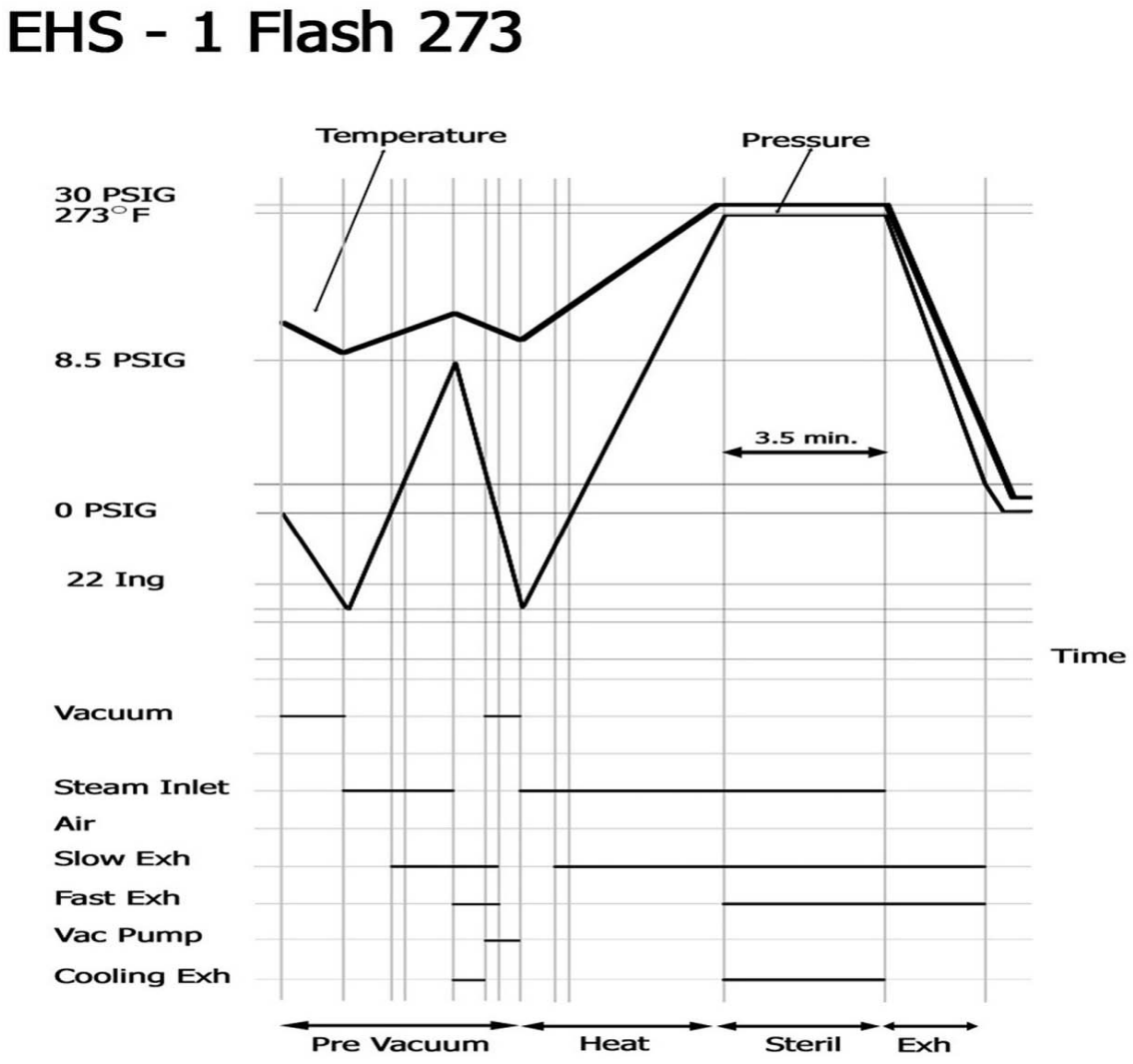
- When the machine is operated for the first time
- If the machine has been sitting unused for a long period of time.
- When the cycle has not been completed, as a result of a power failure or manual stop

To reset the system; proceed as follows:

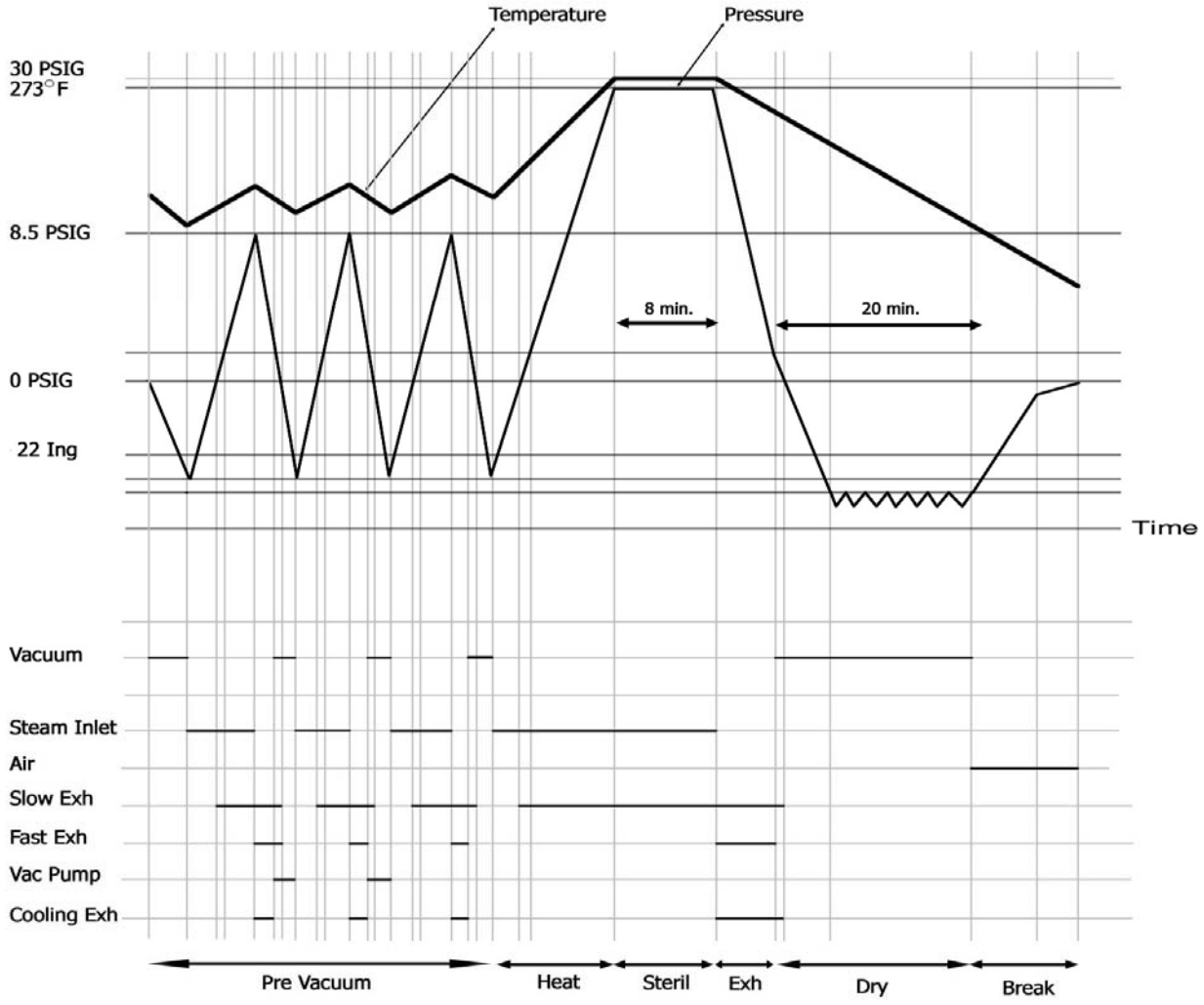
Turn power off using the green power button at the bottom of the front panel, press and hold the Sel. Cycle button on the keypad, turn power on, continue to hold the Sel. Cycle button until **program wait** appears on the screen then release.

After resetting, the autoclave will be in the stand-by mode

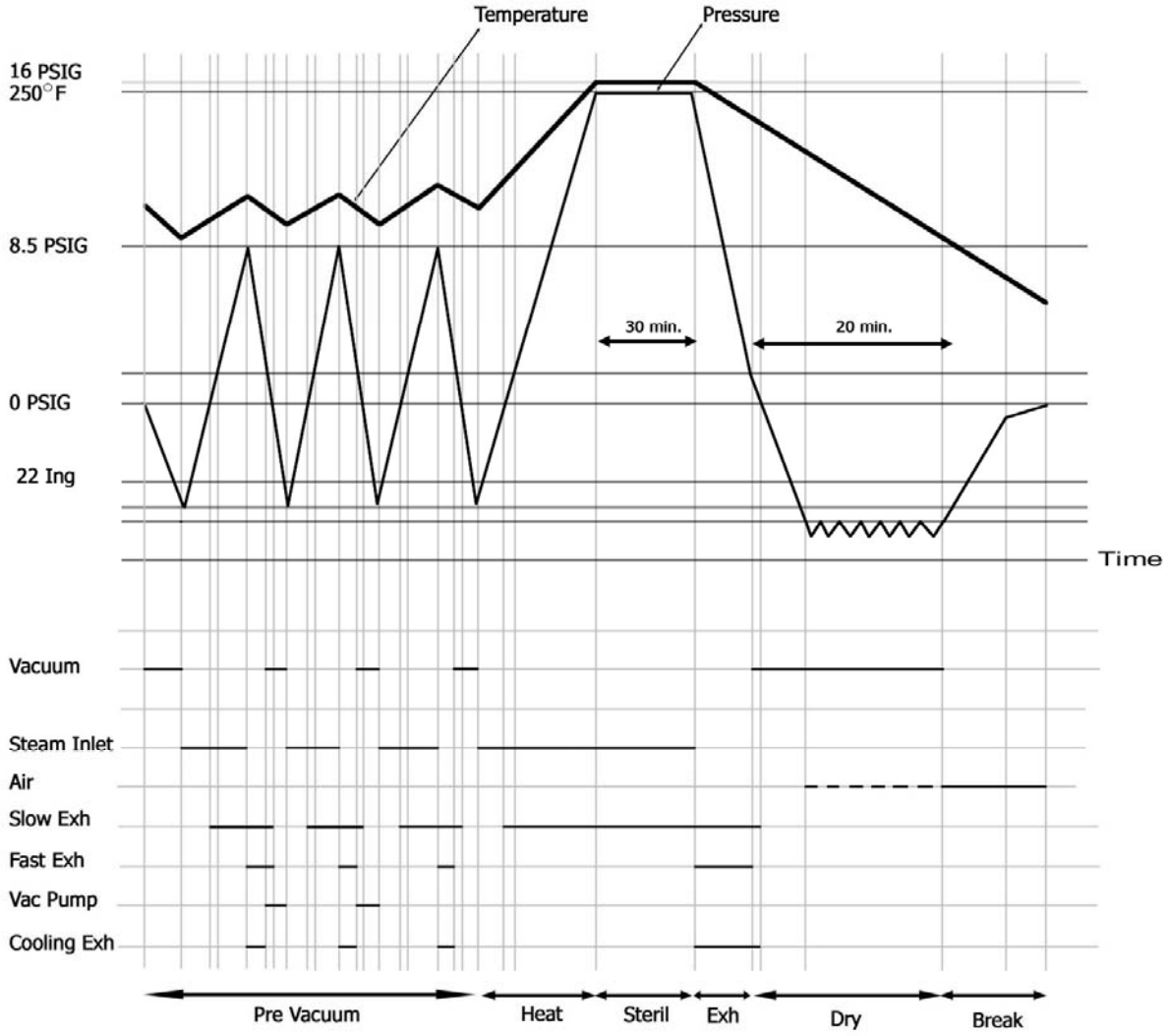
6.4 Input Output Graph:



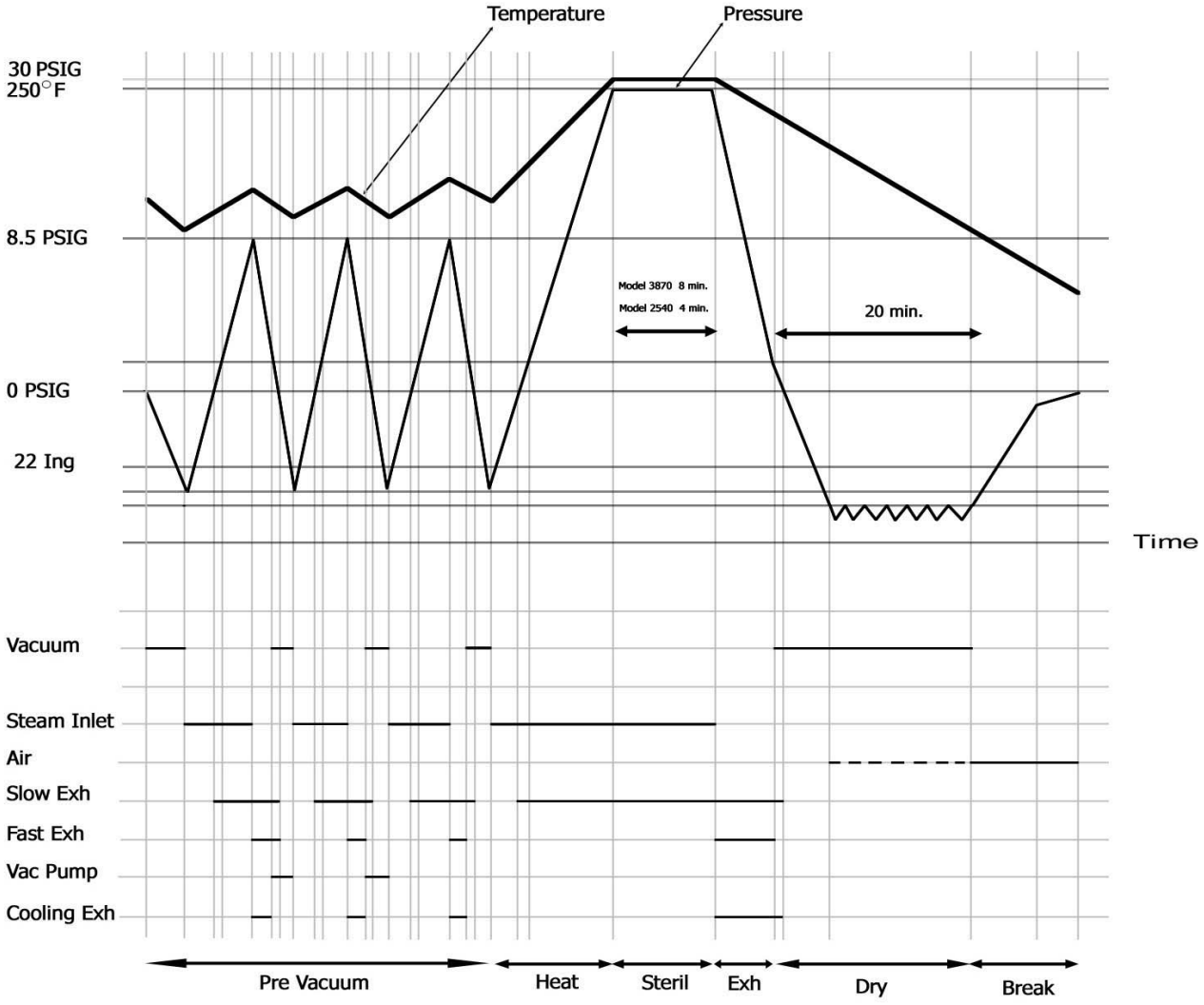
EHS - 2 WDry 273



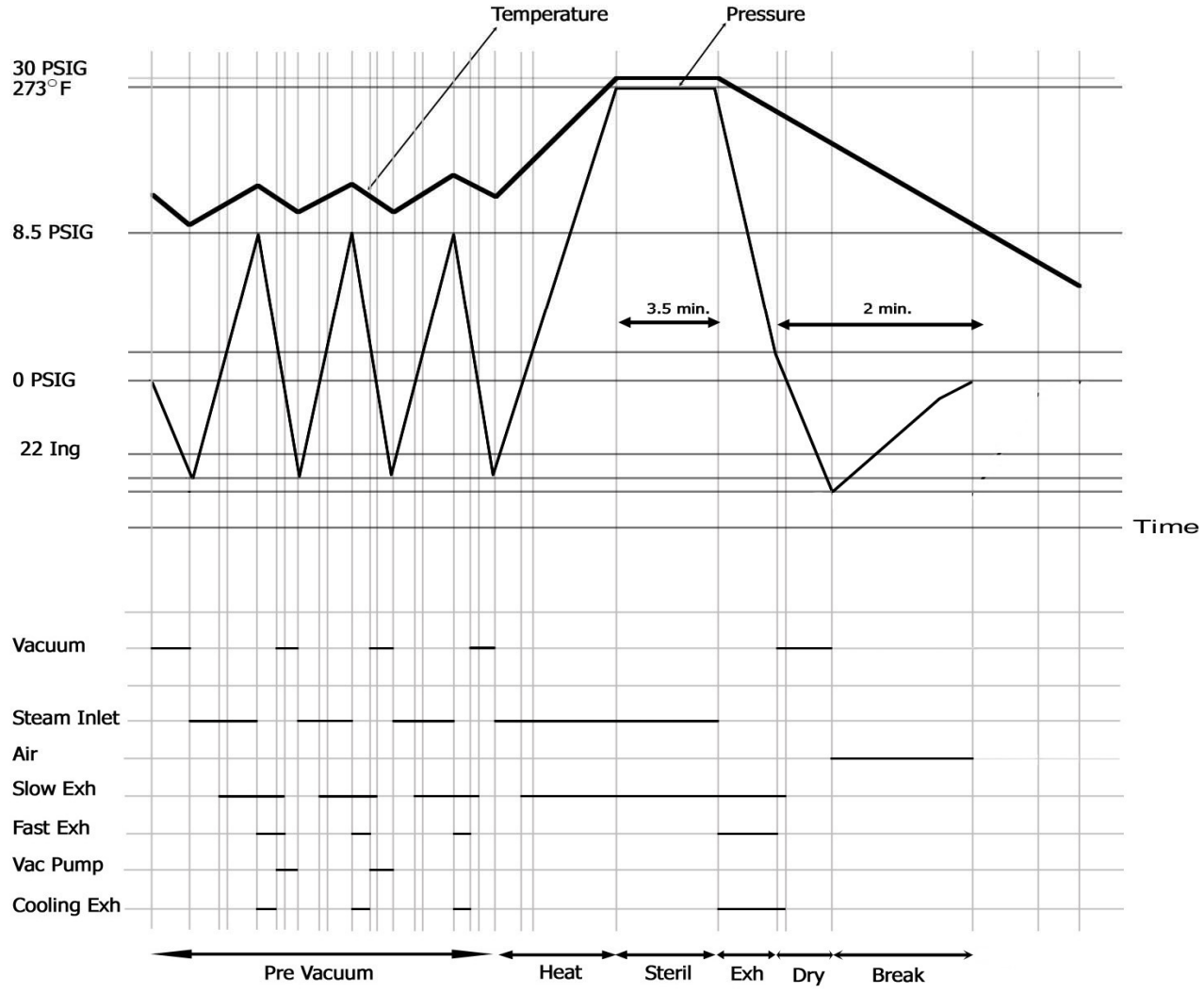
EHS - 3 WDry 250



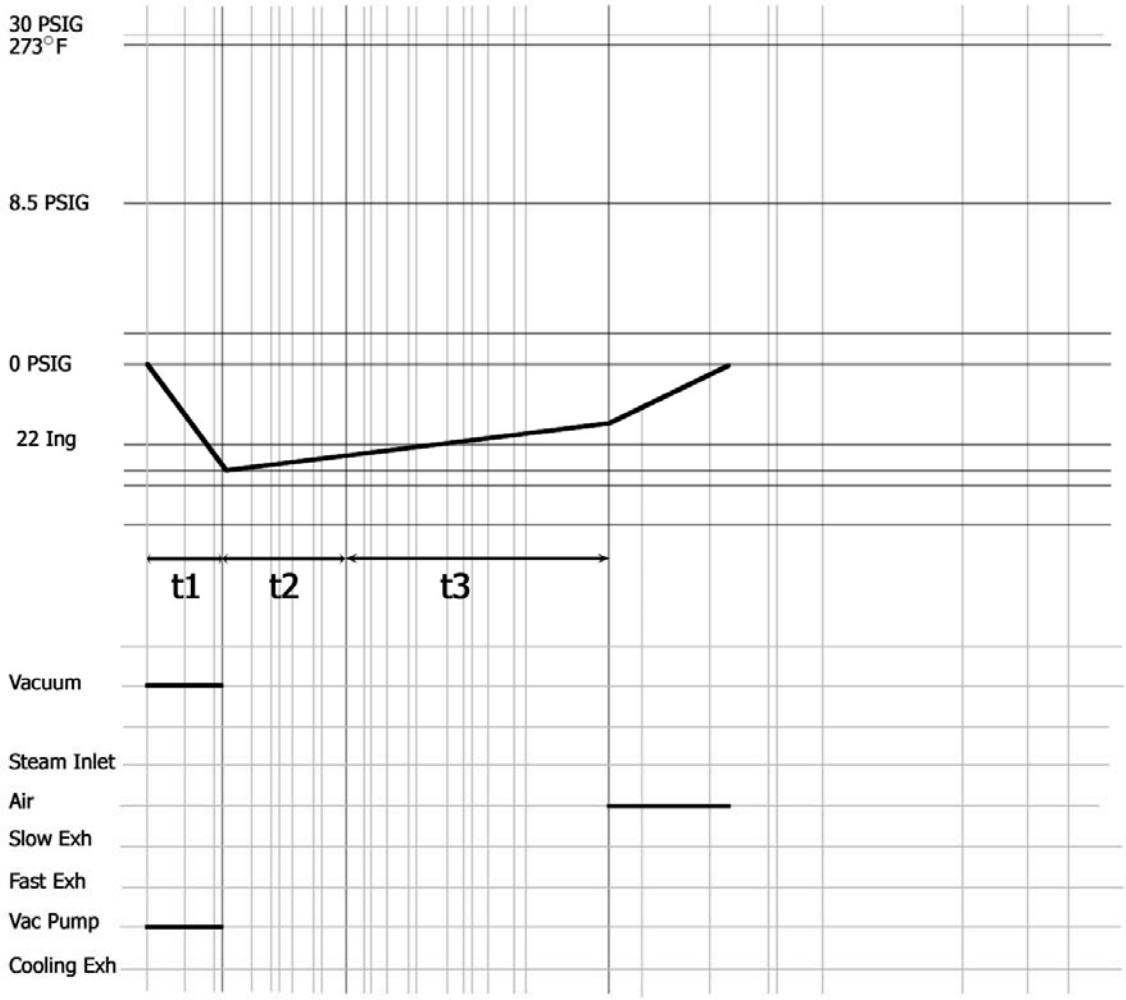
EHS - 4 WDry 273



EHS - 5 B&D Test


Temperature
Pressure
30 PSIG
273°F
8.5 PSIG
3.5 min.
2 min.
0 PSIG
22 Ing
Time
Vacuum
Steam Inlet
Air
Slow Exh
Fast Exh
Vac Pump
Cooling Exh
Pre Vacuum
Heat
Steril
Exh
Dry
Break

EHS - 6 Vacuum Test



7 PROPERTIES OF SATURATED STEAM

(From Baumiester & Marks "Standard Handbook for Mechanical Engineers" 7th Edition)

Gauge Pressure	Absolute Pressure	Temp °F
0	*14.7*	212.00
1	*15*	213.03
2	*16*	216.32
3	*17*	217.44
4	*18*	222.41
5	*19*	225.24
6	*20*	227.96
7	*21*	230.57
8	*22*	233.07
9	*23*	235.49
10	*24*	237.82
11	*25*	240.07
12	*26*	242.25
13	*27*	244.36
14	*28*	246.41
15	*29*	248.40
16	*30*	250.33
17	*31*	252.22
18	*32*	254.05
19	*33*	255.84
20	*34*	257.08
21	*35*	259.28
22	*36*	260.95
23	*37*	262.57
24	*38*	264.16
25	*39*	265.72
26	*40*	267.25
27	*41*	268.74
28	*42*	270.21
29	*43*	271.64
30	*44*	273.05

Gauge Pressure	Absolute Pressure	Temp °F
31	*45*	274.44
32	*46*	275.80
33	*47*	277.13
34	*48*	278.45
35	*49*	279.74
36	*50*	281.01
37	*51*	282.26
38	*52*	283.49
39	*53*	284.70
40	*54*	285.90
41	*55*	287.07
42	*56*	288.23
43	*57*	289.37
44	*58*	290.50
45	*59*	291.61
46	*60*	292.71
47	*61*	293.79
48	*62*	294.85
49	*63*	295.90
50	*64*	296.94
51	65	297.97
52	*66*	298.99
53	*67*	299.99
54	*68*	300.98
55	*69*	301.96
56	*70*	302.92
57	*71*	303.88
58	*72*	304.83
59	*73*	305.76
60	*74*	306.68

8 SOFTWARE PROGRAMMING PARAMETERS

8.1 General

The software version that runs the control system of the EHS autoclave can be found by turning the unit on and watching the display. The version number is also printed if a printer is installed.

The software contains a table of parameters of which some of them define the autoclave, and some of them define the processes in the autoclave. This section of the manual describes the parameters and how they control the software.

8.2 Changing Parameters

An access code is needed to change any parameters other than the date and time.

Two access codes are currently available and each one gives a different level of access.

Access code 1 – This is the first level of access. This code enables changing of the sterilization time, sterilization temperature and the drying time. This level of access is suitable for a senior office person in the medical facility.

Access code 13 – This is the second level of access. This code is for the technician and allows access to make changes such as calibrations.

To change the parameters listed below, proceed as follows:

a. Select the program cycle, to be modified, by pressing the *SEL.CYCLE* key.

b. Press the *PROGRAM* key until **CODE: ∅∅∅** appears

c. Using the *UP/DN* keys enter the access code for the level of access desired. (i.e. CODE:013)

d. Select the parameter to be modified, by pressing the *PROGRAM* key until the parameter name appears on the display.

e. Set the desired data by means of the *UP/DN* keys.

f. Pressing the *PROGRAM* key will enter the modified data into memory, and move to the next parameter.

g. When finished press the *PROGRAM* key until the message **PROGRAM WAIT** appears. The software is reprogramming itself with the modifications that were made.

Note: Each of the 6 program cycles has a set of the following parameters. Changing a specific parameter in one program will **not** change it any other program.

Listed below are all the available parameters for the EHS. Each section describes the parameter, shows the access code required to be able to make modifications, it shows the minimum and maximum allowed values and the increments (resolution) by which these values can be changed. Also included are the pre-set values of the parameters for each cycle.

Note: If a parameter is modified the only way to return to the original value is to manually reenter it.

8.2.1 SteTemp – Temperature required for sterilization

This parameter will set the desired temperature for sterilization

Access Code - 1
Resolution - 1ºF
Minimum value - 250ºF
Maximum value - 280ºF

Default Values

Cycle	1	2	3	4	5	6
Value	273	273	250	273	273	-

8.2.2 Ster Time – Time required for sterilization

This parameter will set the time desired for sterilization

Access code - 1
Resolution - 1 minute
Minimum value - 3 minute
Maximum value - 59 minutes

Default Values

Cycle		1	2	3	4	5	6
Value	**2540**	3.5	8	30	4	3.5	-
	3870	3.5	8	30	8	3.5	-

8.2.3 Dry Time – Time required for drying

This parameter will set the time desired for drying

Access Code - 1
Resolution - 1 minute
Minimum Value - Ø minutes
Maximum Value - 59 minutes

Default Values

Cycle	1	2	3	4	5	6
Value	0	20	20	20	2	-

8.2.4 HeatT.O. – Sterilization temperature time out

This parameter will set the maximum time allowed, from the beginning of the cycle, for the chamber to reach sterilization temperature. When the HeatT.O is exceeded, the program aborts with the message '**Low Heat'**.

Access Code - 13
Resolution - 30 seconds
Minimum Value - 1200 seconds
Maximum Value - 3180 seconds

Default Values

Cycle	1	2	3	4	5	6
Value	3000	3000	3000	3000	3000	0

8.2.5 Ex.Mode – Rate of steam discharge during the exhaust stage

This parameter sets the rate at which steam is discharged during the exhaust stage.

Access Code - 13
Resolution - 1
Value - 1 or 4
Fast Exhaust = 1
Slow Exhaust = 4

Default Values

Cycle	1	2	3	4	5	6
Value	1	1	1	1	1	1

8.2.6 End Temp – Cycle End Temperature

This parameter sets the finish temperature of the exhaust stage. The unit will signal a Cycle End only when the exhaust timer has reached zero and the unit is below the **End Temp.** This also indicates the proper time to open the door and unload the chamber.

Access Code - 13
Resolution - 1ºF
Minimum Value - 104ºF
Maximum value - 280ºF

Default Values

Cycle	1	2	3	4	5	6
Value	273	273	250	273	273	280

8.2.7 Puls num – .No. of vacuum pulses in the prevacuum stage

This parameter sets the number of vacuum pulses during the prevacuum stage.

Access Code - 13
Resolution - 1
Minimum Value - 1
Maximum Value - 7

Default Value

Cycle	1	2	3	4	5	6
Value	2	4	4	4	4	1

8.2.8 Vac dip1 – Vacuum value of the first vacuum pulse

This parameter sets the value of the vacuum that pulse no.1 needs to achieve in the prevacuum stage. This parameter is expressed in psia (atmospheric pressure at sea level is = 14.7psia). A psia lower than 14.7 indicates a vacuum. (During a cycle the autoclave displays vacuum as Ih (inches of mercury). 29.93 Ih = 14.7 psia (atmospheric pressure at sea level))

Access Code - 13
Resolution - .1 psi
Minimum Value - 1 psia
Maximum Value - 13 psia

Default Value

Cycle	1	2	3	4	5	6
Value	2.9	3.7	3.7	3.7	2.9	2.7

8.2.9 Vac dip2 – Vacuum value of each of the remaining pulses

This parameter sets the value of the vacuum that the remaining pulses (starting from pulse no. 2) need to achieve in the prevacuum stage. This parameter is expressed in psia (atmospheric pressure at sea level is = 14.7psia). A psia lower than 14.7 indicates a vacuum. (During a cycle the autoclave displays vacuum as Ih (inches of mercury). 29.93 Ih = 14.7 psia (atmospheric pressure at sea level))

Access Code - 13
Resolution - 0.1 psi
Minimum Value - 1 psia
Maximum Value - 13 psia

Default Values

Cycle	1	2	3	4	5	6
Value	2.9	3.7	3.7	3.7	2.9	2.7

8.2.10 VacTime1 – Waiting time at the end of the first pulse

This parameter sets the wait time at the end of the first vacuum pulse, during the prevacuum stage. After reaching **VacDip1**, there is a waiting time to allow the unit to stabilize. This time is defined as **VacTime1** and during this time the vacuum system continues working.

Access Code - 13
Resolution - 1 second
Minimum Value - 3 seconds
Maximum Value - 1800 seconds (30 minutes)

Default Values

Cycle	1	2	3	4	5	6
Value	3	3	3	3	3	3

8.2.11 VacTime2 – Waiting time at the end of each of the remaining pulses

This parameter sets the wait time at the end of each of the remaining vacuum pulses, during the prevacuum stage. After reaching **VacDip2**, there is a waiting time to allow the unit to stabilize. This time is defined as **VacTime2** and during this time the vacuum system continues working.

Access Code - 13
Resolution - 1 second
Minimum Value - 3 seconds
Maximum Value - 1800 seconds (30 minutes)

Default Values

Cycle	1	2	3	4	5	6
Value	3	3	3	3	3	3

8.2.12 WtrResTime – Timed extension for pumping mineral free water

This parameter sets the length of time to continue pumping mineral free water into the steam generator after the upper electrode senses water.

This is necessary to prevent a situation where the water pump would cycle on and off as the water level rises and falls around the upper water-sensing electrode.

Access Code - 13
Resolution - 1 minute
Minimum Value - Ø minutes
Maximum Value - 90 minutes

Default Values

Cycle	1	2	3	4	5	6
Value	5	5	5	5	5	5

8.2.13 limitP add – defines the upper limit of the pressure in the jacket

This parameter is designed as a safety measure that defines the maximum pressure in the jacket during heating and sterilization stages. The maximum working pressure in he jacket is defined as the pressure that correlates to the sterilization temperature + 5.4°F. Parameter **limitP add** allows to increase the pressure above the maximum working pressure and defines the value of this pressure.

Caution:

Setting this parameter to 4 psi may cause the Pressure Switch and / or the Safety Valve to be activated."

Example:

If the sterilization temperature is 273°F, the maximum pressure will be 34 psig that correlates to 278.4°F (273°F + 5.4°F). If **limitP add** is 2 the maximum allowable pressure will be 36. If the pressure reaches the upper limit as defined by **limitP add** (i.e. 36 in our example) the heating element will be switched off and the pressure will begin to decrease. When the pressure decreases below the maximum allowable pressure, the heating element will be switched on again.

Access Code - 13
Resolution - 0.1 psi
Minimum Value - Ø psi
Maximum Value - 4 psi

Default Values

Cycle	1	2	3	4	5	6
Value	0	0	0	0	0	0

8.2.14 Calib Code – Calibration Code 107

This parameter is used to set the calibration code. The correct code is needed to calibrate the autoclave. After calibration the code should be set back to the default value (100) to prevent any unqualified person from altering the calibration

Access Code - 13
Resolution - 1
Minimum Value - 0
Maximum Value - 255

Default Values

Cycle	1	2	3	4	5	6
Value	100	100	100	100	100	100

8.2.15 ReqPrs+ - Overrides the pressure calculated for sterilization

This parameter is used to insure that during sterilization the temperature is correctly maintained. It does this by raising the value of the sterilization pressure necessary to maintain a sterilization temperature. The sterilization pressure is calculated by the unit based upon the **SteTemp** parameter.

For example; if the required temperature is 250ºF, the required pressure calculated by the program is 16 psig.

This pressure can be increased by changing the value of **ReqPrs+**. If this value is set to ø, the system will be maintained at 16 psig during the sterilization stage if this value is set to 1.5, the system will be maintained at 17.5 psig in the sterilization stage.

Access Code - 13
Resolution - 0.1 psi
Minimum Value - Ø
Maximum Value - 3 psi

Default Values

Cycle	1	2	3	4	5	6
Value	0.8	0.8	0.6	0.8	0.8	0

8.2.16 Dry Vac – Pressure during the Dry Stage

This parameter is intended to control the vacuum pressure during the Drying Stage. It does this by opening and closing the Air Inlet Valve. In all cases the vacuum pump runs continuously and the Jacket is heated until the end of the Dry stage, as set by the **Dry time** parameter.

This parameter is expressed in kpa, where 1 kpa = 0.145 psia

Access Code - 13
Resolution - 1 kpa
Minimum Value - 0 kpa
Maximum Value - 90 kpa

If **Dry Vac** = 0, the Air Inlet Valve will be closed during the Dry Stage.

If **Dry Vac** is between 1 & 5, the Air Inlet Valve will be operated in a shoot mode, 30 seconds open and 30 seconds closed. This process will begin 4 minutes after the start of the Dry Stage and continue until the Dry stage is completed

If **Dry Vac** ≥6, the Air Inlet Valve will be used to regulate the pressure during the Dry Stage so that the value of the pressure will not fall below the Dry Vac value. E.g., if Dry Vac = 20 (1 kpa = 0.145 psia), then when the pressure reaches 2.9 psia, the air valve will open and remain open until the pressure rises to 3.6 psia at which point is will close again. When the pressure drops back to 2.9psia, the valve opens again to allow the pressure to rise. This process continues until the end of the Dry stage. In this example the pressure fluctuates between 2.9 psia and 3.6 psia. The Air Inlet Valve is not working in a shoot mode, but it opens and closes around the requested Dry Vac value.

Default Values

Cycle	1	2	3	4	5	6
Value	5	5	5	5	5	1

8.2.17 Atmos. Press – Atmospheric Pressure

This parameter tells the unit the atmospheric pressure of the location in which it is installed. The pressure entered must be with in 5% of the actual atmospheric pressure for that location. Unlike the other parameters you only need to enter this parameter once in any one cycle and all cycles will be updated.

This value can easily be calculated by knowing the altitude of your location. The atmospheric pressure at Sea Level is 14.5 psia. For every 100m above sea level, the atmospheric pressure drops 0.14 psia, and for every 100m below sea level, the atmospheric pressure increases 0.14 psia.

Changes in pressure do to weather will not affect the accuracy of this unit.

Access Code - 13
Resolution - 0.1 psi
Minimum Value - 8 psia (for +4500m)
Maximum Value - 15.7 psia (for –800m)

Default Values

Cycle	1	2	3	4	5	6
Value	14.5	14.5	14.5	14.5	14.5	14.5

8.2.18 PulsPress – pulse pressure during pre-vacuum stage.

This parameter is used to set the maximum pressure in each pulse of the pre-vacuum stage. This parameter is expressed in psia. During St.By (Stand By) and while running a cycle the display shows pressure in psig. (Psig + 14.5 equals psia).

Access Code – 13
Resolution – 1 psi
Minimum Value – 7 psia
Maximum Value – 30 psia

Default Values

Cycle	1	2	3	4	5	6
Value	22	23.5	23.5	23.5	23.5	23.5

8.2.19 Heat Step – sterile temperature overshoot control

This parameter is used to reduce overshoot of the sterilization temperature by controlling the sterilization pressure. The sterilization pressure is calculated by the unit based upon the **SteTemp** parameter. When the cycle starts the heating rate in the chamber is constant until the pressure in the chamber reaches the sterilization pressure minus the **Heat Step.** From this point on heating is performed in pulses. Each pulse lasts 15 seconds and increases the pressure in the chamber by a small amount until the proper sterilization pressure is reached.

Access Code – 13
Resolution – 0.1 psi
Minimum Value – 0.1 psi
Maximum Value – 2 psi

Default Values

Cycle	1	2	3	4	5	6
Value	0.7	0.7	0.7	0.7	0.7	0.4

8.2.20 PresInPsig – selects the pressure display units.

This parameter sets the units of pressure that are printed by the printer and used on the digital display during St.By (Stand By) and while running a cycle. The two choices are psia (absolute pressure) or psig / InHg (gauge pressure and inches of mercury) Changing this parameter does not effect the units of calibration used in any other parameter.

Access Code – 13
Resolution – 1
Pressure is displayed in
Psig and vacuum in InHg – 1
Pressure is displayed in psia – 0

Default Values

Cycle	1	2	3	4	5	6
Value	1	1	1	1	1	1

8.2.21 TempInC – selects the temperature units.

This parameter sets the units of temperature that are used by the autoclave.

Access Code – 13
Resolution – 1
Temperature is displayed in °C – 1
Temperature is displayed in °F – 0

Default Values

Cycle	1	2	3	4	5	6
Value	0	0	0	0	0	0

8.2.22 Flash – Heating over-pressure control

This parameter is designed to regulate over pressure during the heat up stage. The system constantly monitors the temperature and pressure and compares both values to the Saturated Steam Curve. If the pressure is found to exceed the corresponding temperature by more than 0.7 psi then the fast exhaust valve is opened for 1 second in an attempt to realign the temperature and pressure. The system will wait 15 seconds and check temperature and pressure again. If needed the fast exhaust will be opened again for 1 second. This process will continue until the temperature and pressure are correctly aligned.

Access Code – 13
Resolution – 1
Value – 0 or 1
If Flash = 0 This feature is not activated.
If Flash = 1 This feature is activated.

Default Values

Cycle	1	2	3	4	5	6
Value	1	1	1	1	0	0

8.2.23 Auto. Num – Autoclave Identification number

This parameter is used to set the identification number relative to other autoclaves in the facility. This number only appears on the printout of a unit with a printer installed. It enables the operator to link the printout with a specific autoclave. This parameter need only be set once, while in any of the 6 programs.

Access Code – 13
Resolution – 1
Minimum Value – 1
Maximum Value – 99

9 MAINTENANCE AND REPLACEMENT PROCEDURES

9.1 Safety Tests after Repair

ATTENTION!

After every repair or dismantling of the enclosure, it is recommended that the following tests be performed:

1. Enclosure Current Leakage Test.

   The test should be performed using a Megger. Make sure the autoclave is unplugged. The electrical potential of the testing instrument should be 500V. The insulation resistance should be at least 2 MΩ.

   The test is successful if there was no leakage.

2. **Protective Earth Impedance Test**

   The test should be performed using an Ohmmeter. Make sure the autoclave is unplugged from the wall outlet. Next measure the resistance between the grounding screw on the rear plate (or any other unpainted metallic part) and the grounding pin of the power cord plug. The resistance should not exceed 0.3 Ω, a high resistance would indicate a faulty ground connection.

9.2 Removing the Autoclave's Outer Covers

Caution!

Before starting, disconnect the instrument from the power source and ensure that there is no pressure in the chamber or jacket.

Allow the autoclave to cool before removing outer covers.

1. Remove the screws holding the rear cover (1).
2. Remove the screws holding the cover to the base (2).
3. Dismantle the air filter from the service opening cover (3).
   3.1. Remove the screws holding the filter cover.
   3.2 Disconnect the filter from the silicone tube
4. Remove the grounding wires from the cover.
5. Pull the cover upwards.

Note:

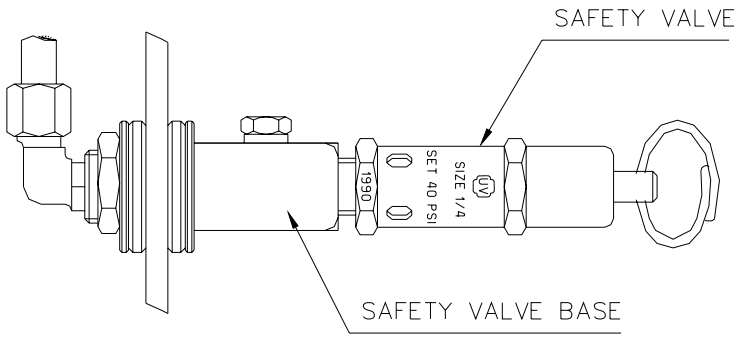
The following picture refers to model 2540

9.3 Replacing the Safety Valve

The safety valve is installed to protect the Jacket from over pressurizing should all the electrical controls fail.

Caution!
Before starting, be sure that the electric cord is disconnected and that there is no pressure in the chamber or jacket.

1. Take off the autoclave cover (see para. 9.2 **"**Removing the Autoclave's Outer Covers**"**).
2. Remove the water reservoir gasket.
3. Unscrew the safety valve and remove it from the safety valve base.
4. Replace the valve with a new safety valve (install only an original equipment replacement!). Use a hydraulic sealant to seal the threads to ensure that the assembly is leak free.
5. Perform one cycle and verify that the valve operates correctly.



9.4 Replacing the DIG-T2 board

The DIG-T2 board contains the software program and controls all the functions of the autoclave. See sec 4.3.

Caution!
Make sure that the power cord is disconnected!
Allow the chamber and jacket to cool before removing outer covers.

Refer to the picture below when following this procedure.

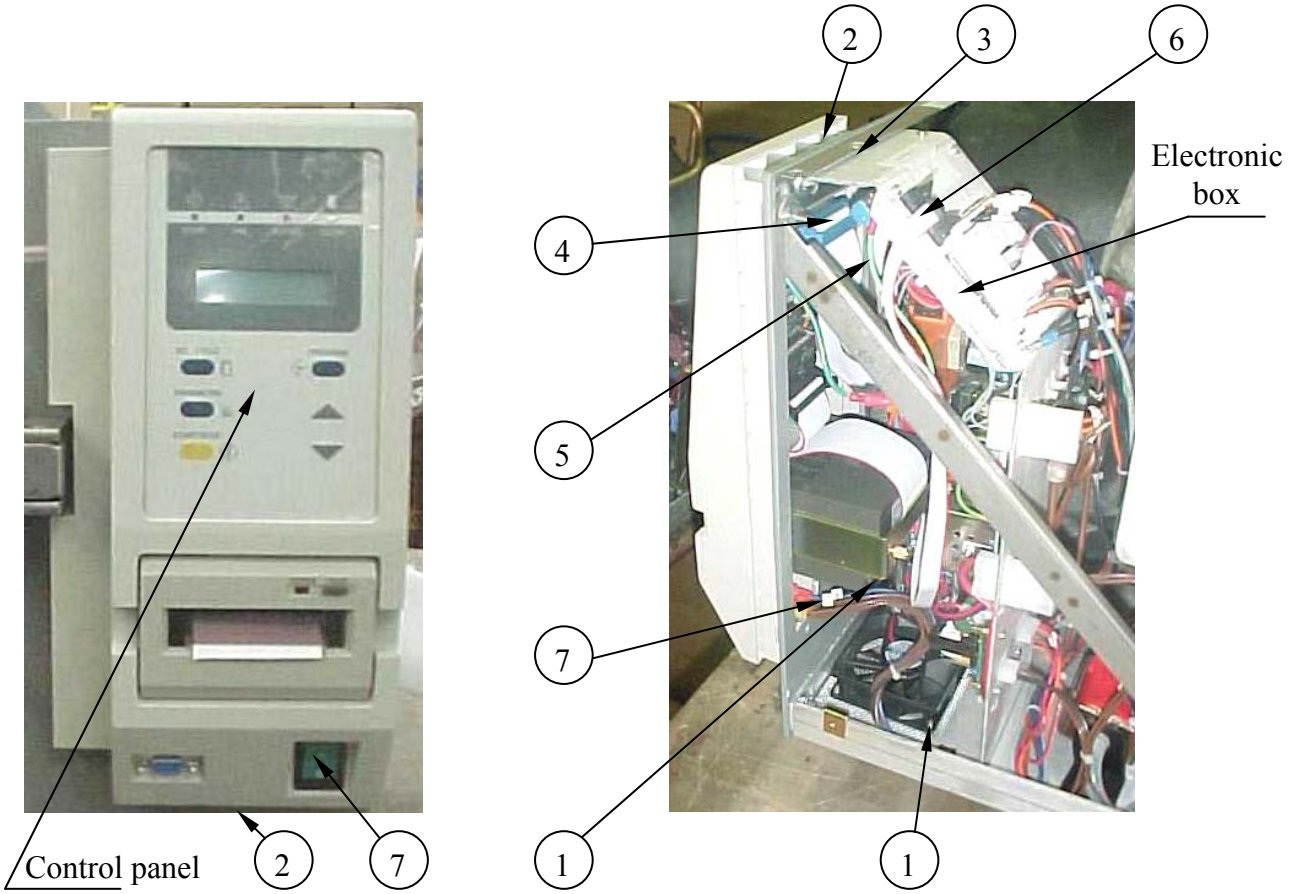
1. Take off the autoclave cover (see para. 9.2 "Removing the Outer Covers of the Autoclave").
2. On model 3870 disconnect the flat cable from the printer.
3. Disconnect the flat cable from JP1-DIG-T2 to JP1 ANL-T2 (4).
4. Disconnect the flat cable from the PC port to P1-ANL-T2 (6).
5. Disconnect the green grounding cable (5).
6. Remove the screws that connect the plastic panel, housing the DIG-T2 board, to the autoclave (2).
7. Disconnect the main switch (7).
8. Remove the DIG-T2 and keypad from the plastic panel.
9. Disconnect the DIG-T2 from the keypad.
10. Install a new DIG-T2 to the keypad and reinstall it into the plastic housing
11. Follow the previous instructions in reverse to reassemble the unit

9.5 Replacing the Electronics Box

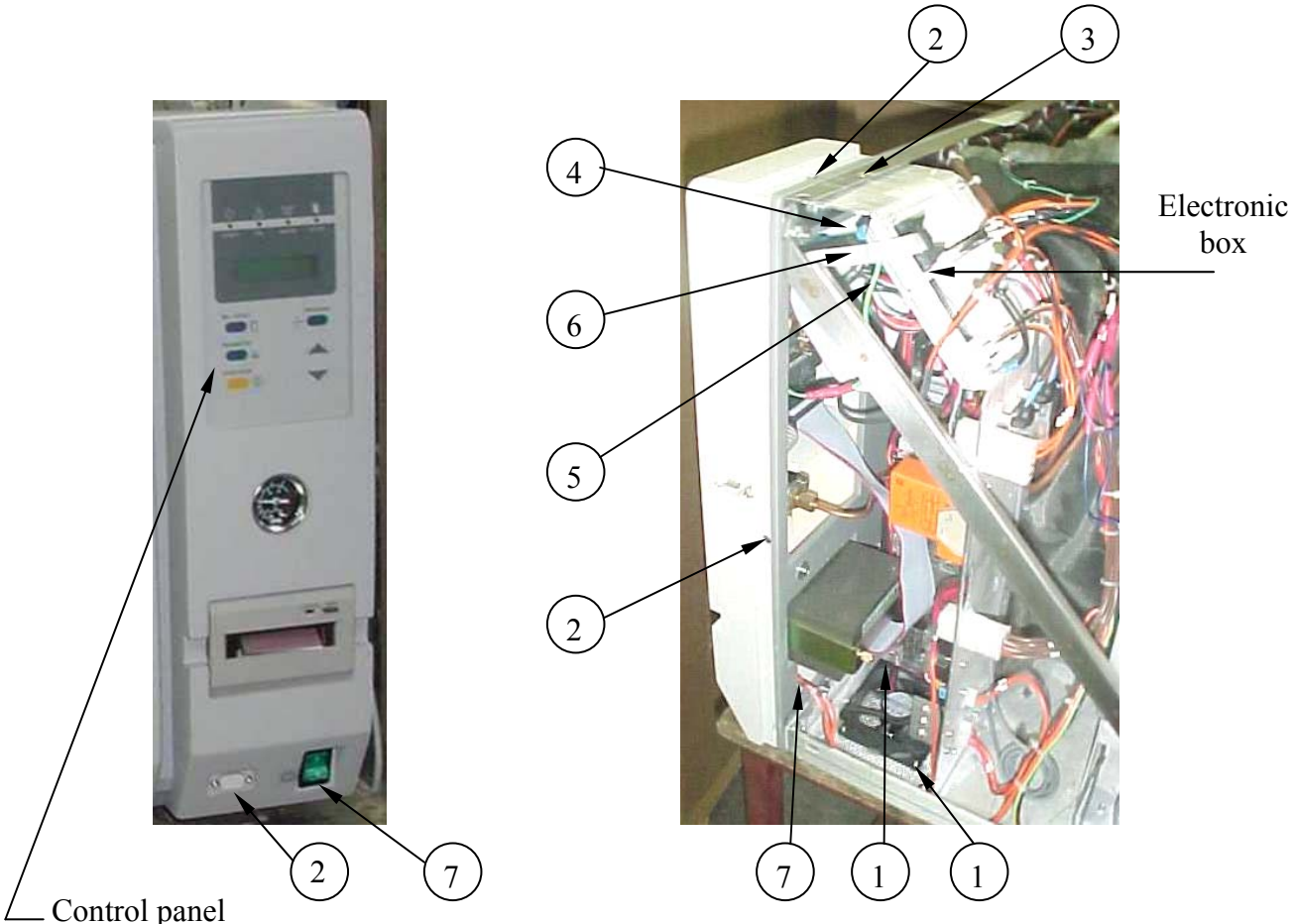
Caution!
Make sure that the power cord is disconnected!
Allow the chamber and jacket to cool before removing outer covers.

Refer to the picture below when following this procedure.

1. Take off the autoclave cover (see para. 9.2 **"**Removing the Outer Covers of the Autoclave**"**).
2. Remove the screws from the bottom and top of the electronic box (1, 3).
3. Disconnect all the electric system connectors connecting the electronic box to the base (including the MPX connectors).
4. Remove electronics box and replace with new one.
5. Re-assemble the instrument. Verify that the grounding connections are connected correctly.
6. Test any cycle and verify that the autoclave operates as required.



Electronic box: 2540



Electronic box: 3870

9.5 Drain Valve Repair

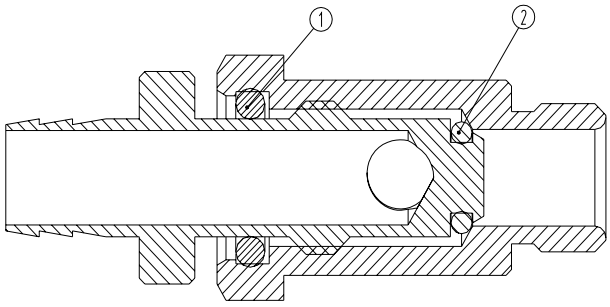
There are two drain valves on the front of the autoclave. One drains the mineral free water from the front section of the reservoir and the other drains the vacuum pump water from the back section of the reservoir.

Caution!

Before starting, disconnect the instrument from the power source and ensure that there is no pressure in the chamber or jacket.
Allow the autoclave to cool before removing outer covers.

9.5.1 Replacing the O rings

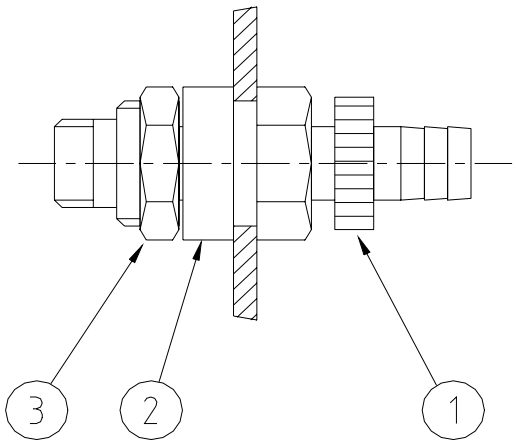
1. Open the manual drain cock on the front of the machine and drain any water left in the reservoir
2. Continue turning the drain cock in a counterclockwise direction. Some resistance will be felt, but eventually the drain cock assembly will come out.
3. Replace the two O rings on the drain cock (see drawing).
4. Reinstall the drain cock in the drain valve body by turning clockwise.
5. After a few turns press the large O ring (1) into the recess on the drain valve body.
6. Continue turning clockwise until the drain cock is seated.



Item	Cat No.
1	SRV000-0224
2	SRV000-0232

9.5.2 Replacing the drain valve assembly

1. Take off the autoclave cover (see para. 9.2 **"**Removing the Outer Covers of the Autoclave**"**).
2. Disconnect the drain tube from the valve, using a 9/16**"** wrench.
3. Remove the nut (3) and the "ring for drain valve" (2).
4. Remove the drain valve (1) from the panel.
5. Install a new valve according to the drawing below.
6. Verify that there is no leakage.



CMT240-0020 CMT240-0003 VLV170-0066

9.6 Replacing the Pressure Gauge

Caution!

Before starting, disconnect the instrument from the power source and ensure that there is no pressure in the autoclave's chamber and jacket.

9.6.1 Model 2540

1. Take off the door cover (see para. 9.18 Replacement of the Door Cover).
2. Remove the pressure gauge from the door by unscrewing it from the door
3. Install the new pressure gauge using Teflon tape to seal the threads. Verify that the gauge's tube does not protrude from the doors inner surface.
4. Operate the autoclave and verify that there are no leaks.
5. Reinstall the door cover.

9.6.2 Model 3870

The gauge is located in the plastic housing adjacent to the door and directly in front of the electronic box.

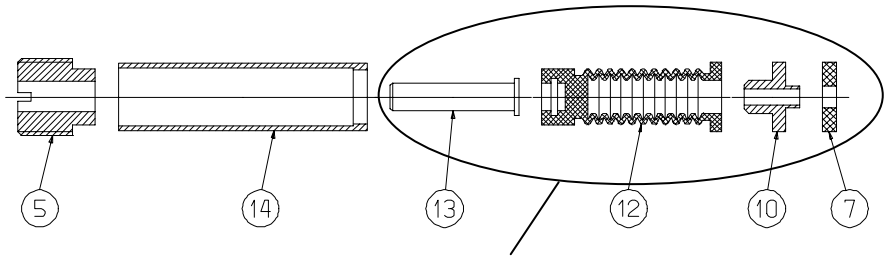
1. Take off the autoclave cover (see para. 9.2 "Removing the Autoclave's Outer Covers").
2. Disconnect the copper tube at the back of the gauge.
3. Remove the pressure gauge.
4. Install the new pressure gauge.
5. Reconnect the copper tube. (The copper tube uses a compression fitting so no Teflon tape is needed).
6. Operate the autoclave and verify that there are no leaks
7. Reassemble the autoclave's cover

9.7 Replacing the Door Bellows (Located in the door bridge)

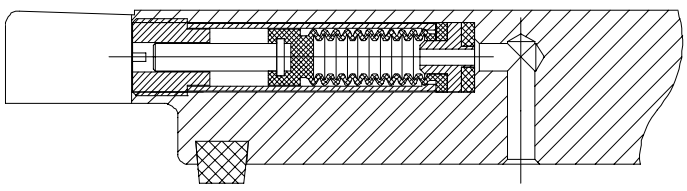
The door bellows is designed to work with the closing device providing a double lock that keeps the door closed while there is pressure inside the chamber.

Caution!
Before starting, disconnect the instrument from the power source and ensure that there is no pressure in the autoclave's chamber.

1. Open the door.
2. Unscrew and remove the locking bolt (5).
3. Remove the Bellows assembly, using one of these two methods
   - 3.1 Blow compressed air into the steam inlet hole on the inner surface of the door. This will cause the Bellows Assembly to pop out.
   - 3.2 Gently pull out the door safety device locking pin (13). And using a bellows extraction tool, remove the bellows assembly.
4. It is possible that the washers (7, 10) will be stuck - if so, again use compressed air to blow them out or the bellow extraction tool to remove them.
5. Insert a new Door Bellows Kit (13,12,10,7) into the original brass sleeve (14), making sure to insert the kit into the narrower end of the sleeve. (No lubrication or cleaning is required.)
6. Insert the locking bolt (5) into the sleeve, making sure that the collar on the bolt fits into the sleeve.
7. Reinstall the completed assembly into the door bridge.
8. Tighten the locking bolt (5), it need not be super tight, just tight enough to properly seat the rear washer (7).
9. Run a test cycle and check for leaking.



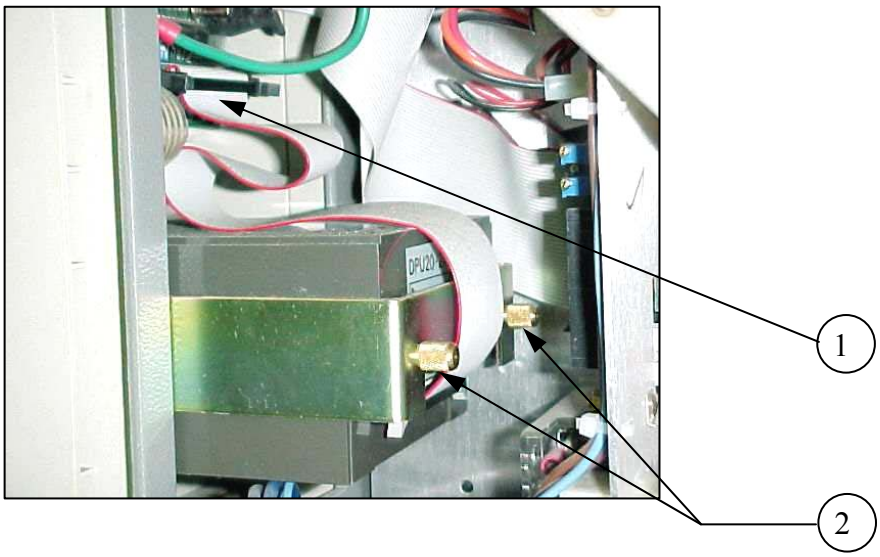
LOK240-0026 LOK240-0025 LOK240-0022



9.8 Replacing the Printer

Caution!
Before starting, disconnect the instrument from the power source.

1. Take off the autoclave cover (see para. 9.2 **"**Removing the Autoclave's Outer Covers**"**).
3. Disconnect the flat cable (1) connecting the printer to the DIG-T2 board.
4. Unscrew the two screws (2) fastening the printer to the panel.
5. Remove the printer and install the new one.
6. Verify that the printer is working by performing a self-test. This is done by pressing and holding the printer feed button and turning on the autoclave.
7. Run a cycle and verify that the printer operates correctly.



9.9 Replacing the Door Switch

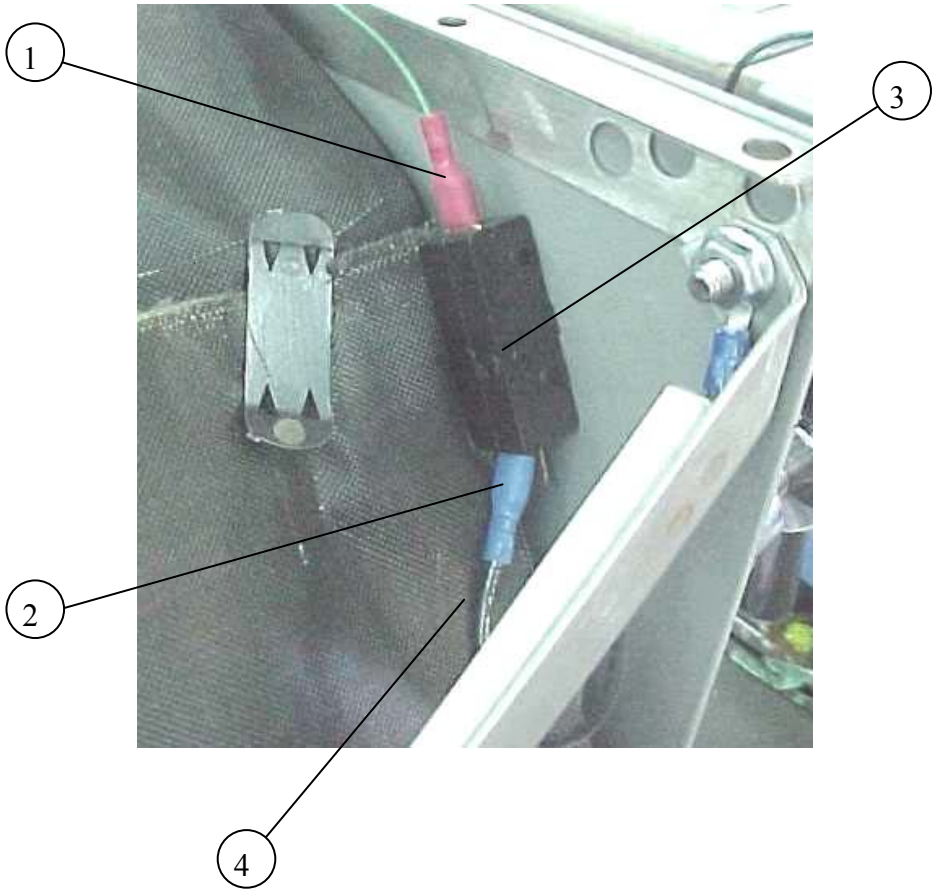
The door switch is designed to ensure that the door is properly closed before and during a cycle.

Caution!
Before starting, disconnect the instrument from the power source and ensure that there is no pressure in the autoclave's chamber.

1. Take off the autoclave cover (see para. 9.2 "Removing the Autoclave's Outer Covers").
2. Disconnect the wires from the door microswitch.
3. Remove the microswitch and replace it with a new one.
4. Reconnect the black ground wire (2) to the microswitch.
5. Test the connection with an ohmmeter. Connect the ohmmeter to the common terminal of the microswitch (1) and chassis ground. In the "door open" position the ohmmeter should show no continuity and in "door close" position the ohmmeter should show a complete circuit.

   5.1 If it fails the test then check that the ground wire is connected to the correct terminal. If it is then replace the microswitch.

   5.2 If it passes the test then connect the green wire from the electronic box to the common terminal (1) of the switch



9.10 Replacing the circuit breaker

Caution!

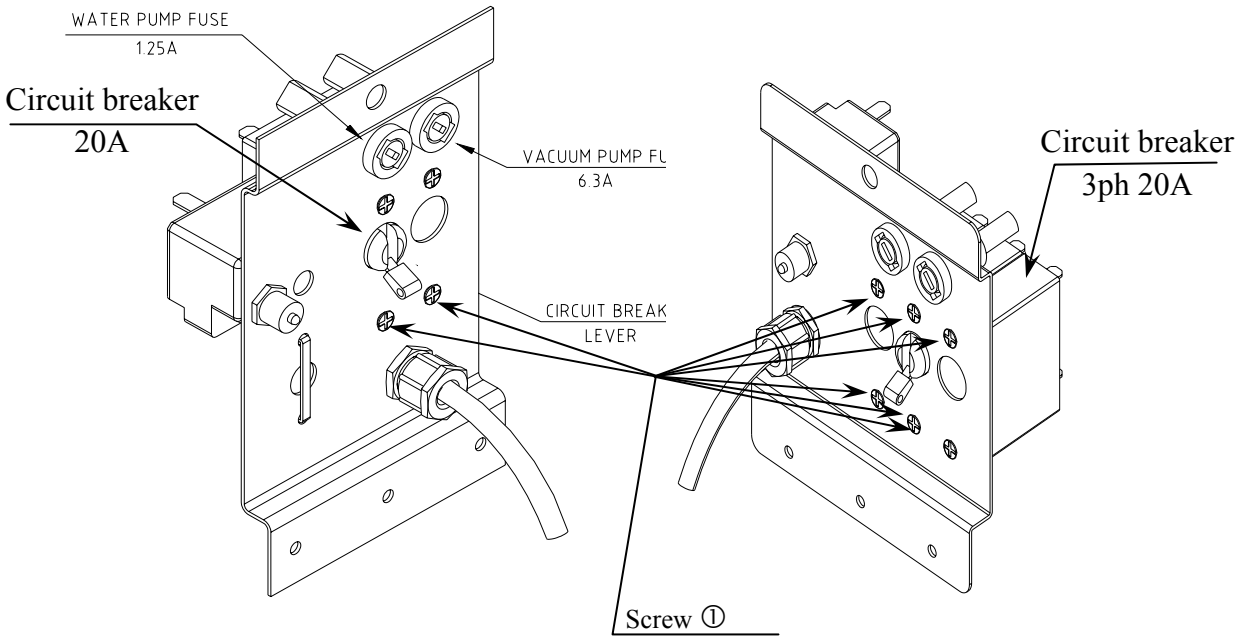
Before starting, disconnect the instrument from the power source.

1. Take off the autoclave cover (see para. 9.2 **"**Removing the Autoclave's Outer Covers**"**).
2. Disconnect the wires from the circuit breaker.
3. Remove the screws (1) connecting the circuit breaker to the panel.
4. Replace the circuit breaker with a new one.
5. Reconnect the electrical wires.
6. Reassemble the cover.
7. Turn on the autoclave and verify it operates correctly.
8. Move the circuit breaker's lever to the "tripped" position and verify that the autoclave turns off.

Make sure that the correct circuit breaker is installed as specified below:

Model 2540 - 1 circuit breaker - 20A

Model 3870 - 1 circuit breaker - 3 phase 20A.



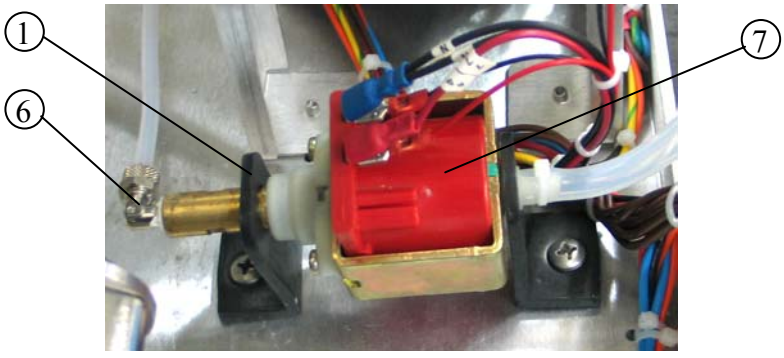
Model 2540 EHS **Model 3870 EHS**

9.11 Replacing the water pump

The water pump supplies mineral - free water to the jacket of the autoclave from the front compartment of the reservoir. This water is used by the steam generator to produce steam for sterilization.
The pump is protected from running dry and burning out, by the float switch mounted in the lower part of the front reservoir compartment.

Caution!
Before starting, disconnect the instrument from the power source and ensure that there is no pressure in the autoclave's chamber and jacket.

1. Take off the autoclave cover (see para. 9.2 **"**Removing the Autoclave's Outer Covers**"**).
2. Disconnect the wires from the pump
3. Empty the water reservoir, by using the drain value on the front of the autoclave.
4. Disconnect the piping from the pump.
5. Remove the pump from the rubber shock absorbers. (If the rubber shock absorbers are damaged, replace them also).
6. Replace the damaged pump with a new pump.
7. Reconnect wiring and piping.
8. Turn on the autoclave and verify it operates correctly and none of the connections are leaking
9. Reassemble the cover.



No.	Description	2540	3870
1	Rubber shock absorber	SKR203-0006	SKR203-0006
6	1/8 elbow connection to Teflon 6x4mm tube	—	FIT100-0012
	1/4 straight connection to Teflon 6x4mm tube	FIT100-0009	—
7	ULKA water pump	PUM055-0010	PUM055-0010

9.12 Pressure Switch

The Pressure Switch is designed as a safety device, limiting over-pressure in the steam generator.

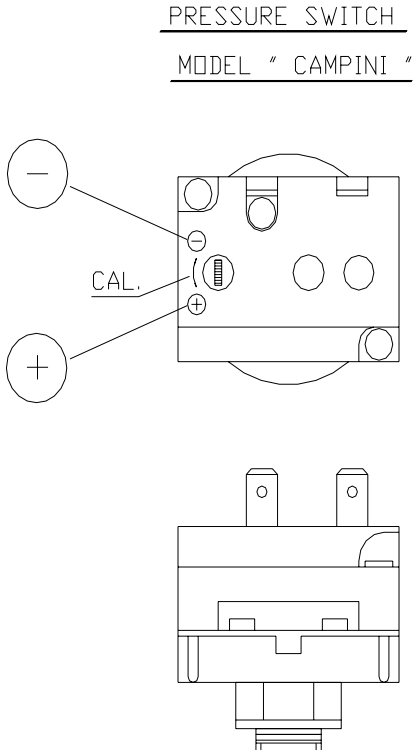
It is set to a pressure of 38 psig which is about 2 psi above the working pressure of the generator.

The pressure switch is factory set and it should **not** be adjusted in the field. **Doing so will void the warranty**.

To replace the pressure switch perform the following steps:

Caution!
Before starting, disconnect the instrument from the power source and ensure that there is no pressure in the chamber or jacket.

1. Remove the rear cover.
2. Disconnect the wires from the pressure switch.
3. Disconnect the pressure switch from the copper tube and replace it with a new one.
4. Reconnect the wires and reassemble the rear cover.
5. To verify that the autoclave operates as required perform a 274°F cycle.

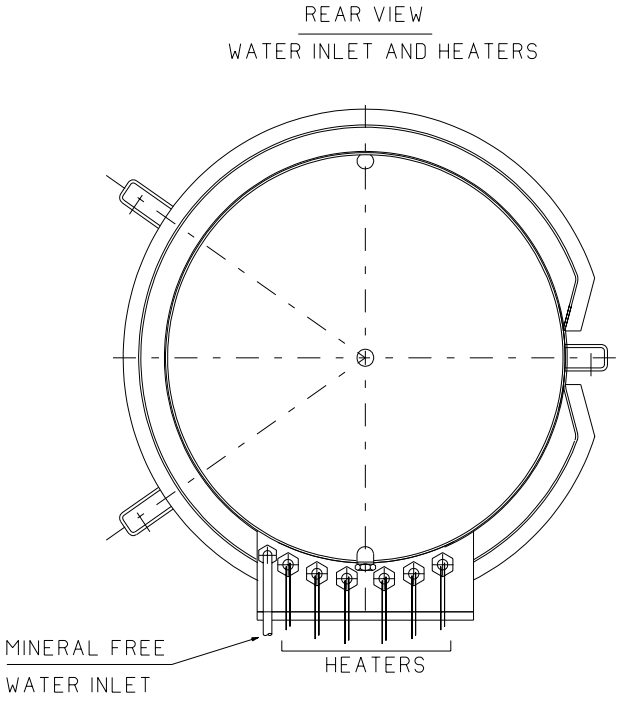


9.13 The Heaters

The autoclave contains internal submerged heaters, mounted at the bottom back side of the jacket (see drawing below). Model 2540 has three (3) 1000W / 208V heaters. Model 3870 has six (6) 1000W / 208V heaters.
To replace heaters proceed as follows:

Caution!
Before starting, disconnect the instrument from the power source and ensure that there is no pressure in the autoclave's chamber and jacket.

1. Remove the rear cover plate by unscrewing the screws.
2. Discharge any steam pressure and drain the water from the jacket by gradually opening the drain valve (at the back of the unit). Wait until all the water has drained from the jacket. (see sec 9.17)
3. Disconnect the electrical leads for each heater from the heater terminal block.
4. Remove the heater by unscrewing and pulling it out from the jacket bushing.
5. Replace the heater with the new one, use Teflon on the thread to seal it. Tighten the heater to prevent leaking.
6. Connect the wires of the new heater to the terminal block.
7 Close the drain valve.
8. Connect the autoclave to the power source.
9. Turn the main switch to ON and check that the steam generator heats up correctly. Check also for any leaking by the heaters
10. Replace the rear panel



9.14 The Dual Compartment Water Reservoir

9.14.1 Description

The dual compartment water reservoir is one unit with a wall separating the two compartments.

The front compartment holds the mineral free water required for the generation of steam in the jacket. Water enters at the top through a control valve from an external mineral-free water source. At the bottom is an outlet to the water pump which feeds water to the jacket. An additional outlet at the bottom connects the reservoir to a manual drain valve located on the front of the autoclave. A float switch mounted on the front wall of the reservoir controls the flow of water into the reservoir and a second float below it ensures that the water pump does not run if the compartment is empty

The second compartment supplies feed water to the vacuum pump. Water enters at the top through a control valve from a public water source. An additional outlet at the bottom connects the reservoir to a manual drain valve located on the front of the autoclave. A float switch mounted on the rear wall of the reservoir controls the flow of water into the reservoir and a second float below it ensures that the vacuum pump does not run if the compartment is empty

The reservoir is also provided with an overflow drain. This is a simple conduit mounted on the upper side of the rear wall, which directs excess water to the drain.

Also attached to the rear wall of the reservoir is a flexible tubing connected to the aeration inlet of the vacuum pump.

9.14.2 Replacement

It is possible to replace individual damaged components on the reservoir. It is not necessary to replace the entire reservoir, however, if a complete replacement is needed follow the steps below.

Caution!
Before starting, disconnect the instrument from the power source and ensure that there is no pressure in the autoclave's chamber and jacket.

1. Drain the reservoir from the two manual drains on the front of the autoclave.
2. Take off the autoclave cover (see para. 9.2 **"**Removing the Autoclave's Outer Covers**"**).
3. Disconnect the wires to the float switches on the reservoir.
4. Disconnect any copper or plastic tubing going to the reservoir.
5. Disconnect any solenoid valves going to the reservoir.
6. Drill out the pop rivets holding the legs of the reservoir to the chassis.
7. Remove the reservoir from the autoclave.
8. Transfer any items still attached to the old reservoir, to the new reservoir. Replace any items that may be defective.
9. Place the new reservoir in position on the chassis and pop rivet the legs in place with a 3/16 pop rivet. As an alternative place a #10 machine screw from the bottom up through the chassis and leg and secure with a nut and washer on top.
10. Reconnect any wiring and tubing that had been disconnected earlier.
11. Turn on the autoclave and allow both compartments to fill with water. Verify that there are no leaks and that the autoclave is operating correctly
12. Reassemble the outer cover.

9.15 The Water Sensing Electrodes

The two electrodes that control the water level of the jacket are located in a stainless steel bottle, or housing, connected to the rear of the autoclave. The housing is connected to the jacket by upper and lower copper tubes, which allows the jacket water to flow in and out of the housing. The water level in the housing will be identical to the water level in the jacket.

The High Electrode, which is physically higher when looking at the top of the housing, determines the operational water level in the jacket.

The Low Electrode, which is physically lower when looking at the top of the housing, protects the heaters by switching them off when there is too little water in the jacket.

To clean or replace the electrodes proceed as follows (refer to drawings on the next page:

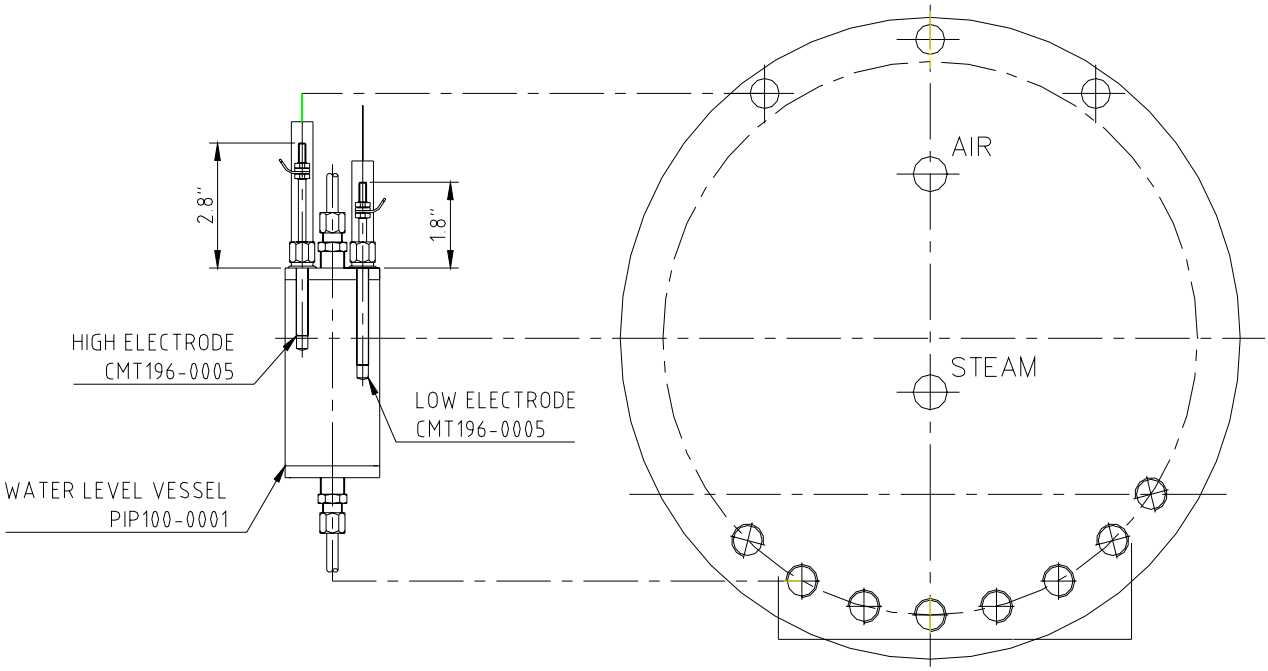
Caution!
Before starting, ensure the electric cord is disconnected and there is no pressure in the chamber or jacket.

1. Take off the autoclave cover (see para. 9.2 **"**Removing the Autoclave's Outer Covers**"**).
2. Discharge the steam pressure and drain the water from the jacket by opening the water drain valve located at the rear of the autoclave. (See sec 9.17)
3. Remove the electrical connections from the terminals of the electrodes. Mark the wires for each electrode to avoid miss wiring when reinstalling the electrodes.
4. Unscrew the locking nut and remove the electrode from the top of the housing.
5. Replace the electrode with a new one or reinstall the same electrode after cleaning.

    5.1 To clean the electrode use a damp cloth or sponge. A mild soapy solution may be used, rinse thoroughly. **DO NOT** use any harsh chemicals

    5.2 When positioning the new electrode, make sure to position the high electrode tip so it is in line with the center of the chamber. Position the low electrode so that it's tip is approximately 1", but not les than 1", lower than the high electrode tip.
6. Tighten the locking nut to prevent any steam or water from leaking out.
7. Reconnect the electrical wires to the electrode terminals. Making sure to connect the correct wire to the proper electrode. If these connections are reversed, the steam generator will not heat.
8. Close the drain valve and turn the autoclave on. The unit will automatically fill with water. Observe that the unit is heating. Wait for the unit to reach 30 psig, then check for leaks around the locking nuts.
9. Reassemble the cover.

Water Electrodes Housing



9.16 The Vacuum Pump

9.16.1 Description

To produce the vacuum needed in the prevacuum and drying stages, the autoclave is equipped with a liquid ring pump. This pump is suitable for continuous operation, and achieving a high vacuum necessary for proper operation. To produce the needed vacuum the pump draws water from the reserve in the rear compartment of the water reservoir. There is a minimum Water Quality requirement for the pump to ensure trouble free operation (ref. par. 3.8.2.)

A float switch is mounted to the lower rear wall of the reservoir to prevent the pump from running when there is no water in the reservoir.

9.16.2 Replacing the vacuum pump

Caution!

Before starting, disconnect the instrument from the power source and ensure that there is no pressure in the autoclave's chamber and jacket.

For location of inlets and outlet of the pump, refer to drawing on the next page

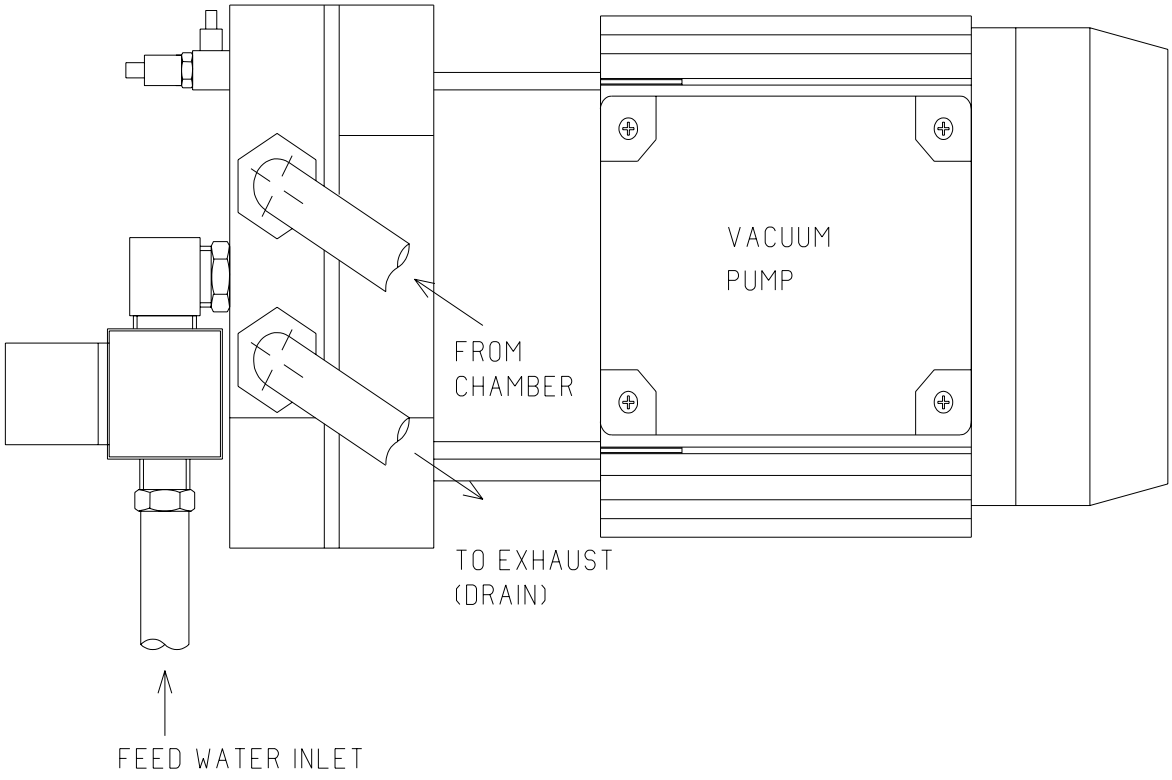
1. Take off the autoclave cover (see para. 9.2 "Removing the Outer Covers of the Autoclave").
2. Close the external Feed Water Supply valve going to the back of the autoclave. Count the number of turns and mark it down for use at the end of this procedure.
3. Drain the water from the reservoir, using the manual drain on the front of the machine.
4. Disconnect the electrical wires from the pump. Note the location of the wires for later use.
5. Disconnect any plumbing. Note the location of the plumbing connections for later use.
6. Replace the pump.
7. Reconnect the wires and piping previously removed.

Caution

Ensure that the protective earth ground of the vacuum pump is reconnected before power is turned on.

8. Open the external Feed Water Supply valve going to the back of the autoclave. Make sure to open it the same number of turns as had been counted earlier. Allow the rear compartment of the reservoir to fill.
9. Turn on the power and observe that the reservoir fills properly. Run a sterilization cycle to verify that the pump performs correctly, without leaking.
10. Reassemble the cover.

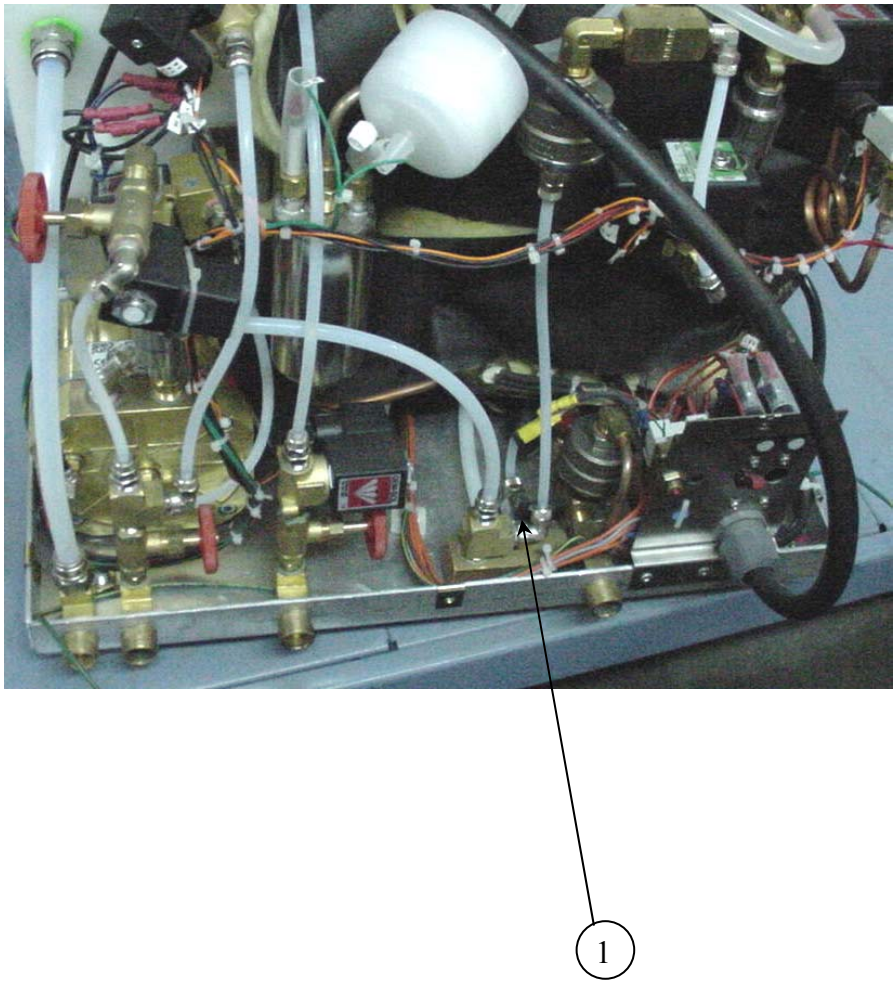
"SPECK" LIQUID RING VACUUM PUMP



9.17 Draining the Jacket

Caution
Before starting, ensure that the electric cord is disconnected and there is no pressure in the chamber or jacket.

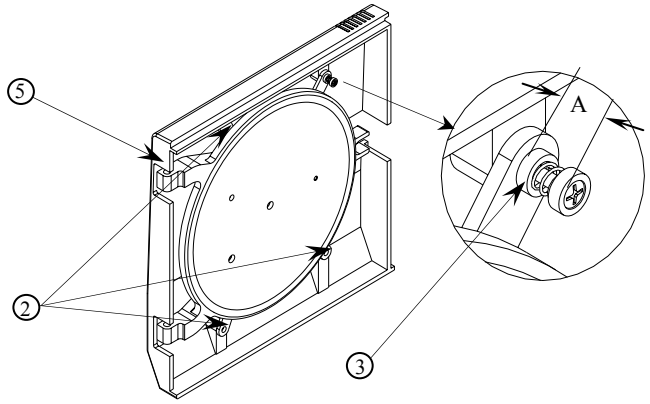
1. Turn off the main switch.
2. Remove the rear cover.
3. Turn the valve handle (1) 1/4 turn and the jacket will begin to drain.
4. Close the valve, and re-assemble the rear cover



9.18 Replacement of the Door Cover

Caution:
Before starting, be sure that the electric cord is disconnected from the power source and that there is no pressure in the autoclave chamber.

1. Unscrew the four screws attaching the door cover and remove the door cover. Note that the screw that activates the door microswitch includes two washers and a spring, be careful not to lose them.
2. Position the new cover and screw in three screws (2).
3. Assemble and install the door microswitch activator. Insert screw (1) through washers (3) and spring (4) and screw into the door until dimension A is approximately 15 mm.
4. Before proceeding, make certain that the door gasket is in good condition. Perform final adjustment of the door microswitch activator as follows:
   - 4.1 Press the microswitch and listen to hear it click. The clicking sound indicates that the microswitch has been activated.
   - 4.2 Close the door until the closing device feels tight, also verifying that the microswitch click was heard.
   - 4.3 If the microswitch does not click then unscrew the screw (1) one turn counter- clockwise and check again. Repeat until the microswitch click is heard.
   - 4.4 Turn the main power back on.
   - 4.5 Close the door until the closing device feels tight, but do not over tighten. Make sure a click is heard.
   - 4.6 Select a steam cycle and run the autoclave. Check that there is no steam or pressure leak around the door.
     - 4.6.1 If there is a leak then tighten the door slightly.
     - 4.6.2 If the door-open indicator sounds and the door LED lights then repeat step 4.3



No.	Description	Model	Cat. No.
2	Screw	Both models	BOL191-0140
5	Door cover	2540	POL066-0002
		3870	POL065-0003
	Spacer kit 1 + 3 + 4	Both models	CT312036

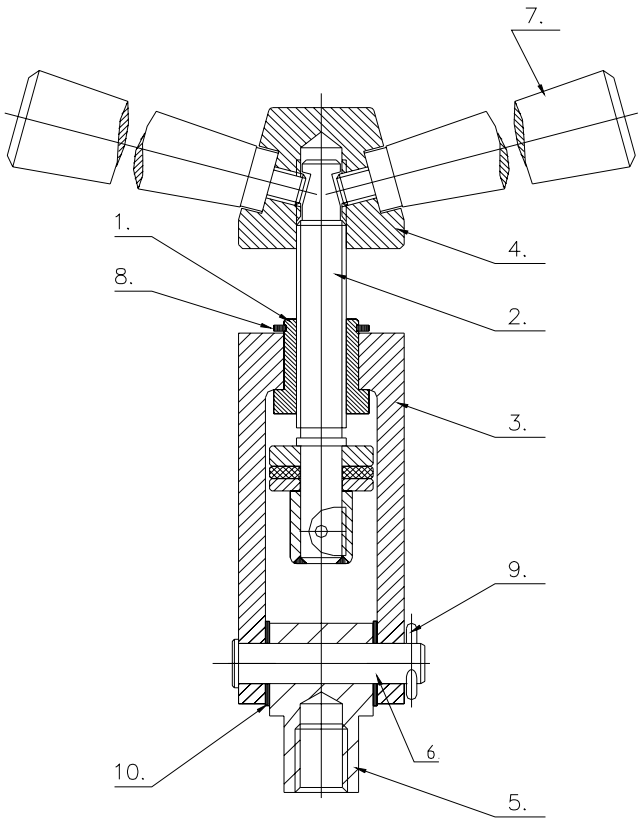
9.19 Replacing the Closing Device

Caution:

Before starting, verify that there is no pressure in the autoclave chamber.

1. Remove the "C" clip (9) from the bottom of the door locking pin (6). Newer models will have a cotter pin.
2. Remove the locking pin (6) by pulling it up out of its position.
3. Remove the closing device assembly. Be careful not to lose the two Teflon disks (10) resting on the top and bottom of the lock housing axe (5).
4. Position the new closing device on the lock housing axe (5), making sure that the Teflon disks (10) are in between the lock housing axe (5) and the screw housing (3).
5. Insert the pin (6).
6. Replace the "C" clip or cotter pin (9).

CLOSING DEVICE



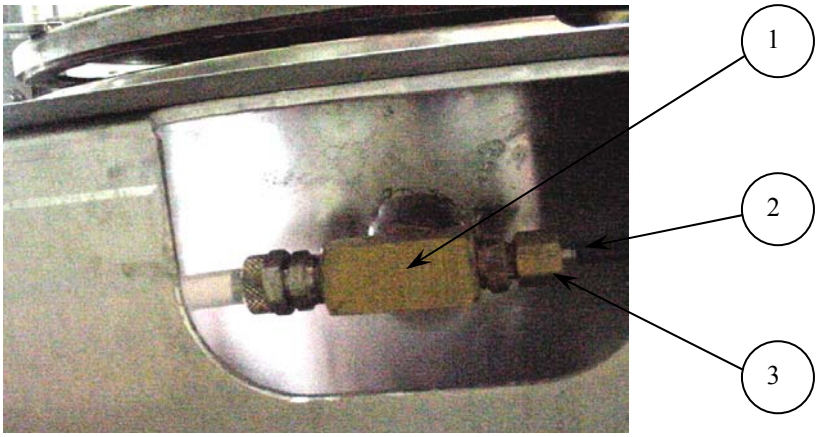
No.	Description	No.	Description
1	Bushing	6	Door locking device pin
2	Door tightening bolt assembly	7	Bakelite handle
3	Locking screw housing	8	Closing bridge "c" clip
4	Locking base	9	Cotter pin
5	Locking housing axe	10	Teflon disk

9.20 PT100 Temperature Sensor Replacement

The temperature sensor is located below the chamber at the front. It is mounted in a fitting (1) that is part of the chamber drain system (see picture below).

Caution!
Before starting, disconnect the instrument from the power source and ensure that there is no pressure in the autoclave's chamber and jacket.

1. Take off the autoclave cover (see para. 9.2 "Removing the Outer Covers of the Autoclave").
2. Unscrew the nut (3) attaching the sensor (2) to the fitting (1).
3. Remove the sensor from the fitting.
4. Disconnect the sensor's wire (4) from the electronic box and remove the sensor from the autoclave.
5. Install a new sensor. Ensure that the tip of the sensor is positioned at, but not past the center of the nipple attached to the chamber. Any other positioning will result in an inaccurate reading.
6. Connect the sensor's wire to the electronic box.
7. Reassemble the cover.
8. After any replacement or repositioning recalibrating the machine is necessary (see sec 5)



10 TROUBLESHOOTING

10.1 Preliminary Check

Before performing any troubleshooting operation and before removing the autoclave's cover, check the following:

1. Electrical power: Verify that:
   a. Power supply is 1ph/208 VAC for model 2540 and 3ph/208 VAC for model 3870.
   b. It has an earth wire.
2. Mineral free water: ½" connection. Water pressure, after the pressure reducer (as indicated on the pressure reducer's gauge) must be 7-30 psi.
3. City water: ½" connection. Water pressure, after the pressure reducer (as indicated on the pressure reducer's gauge) must be 15-58 psi.
4. Drain: The drain tube must be connected directly to the sewage. It must be straight and not elevated to any degree. The drain opening should be within 1 foot of the rear of the unit and no higher than 16" above the floor.

In order to locate any malfunctioning component perform the "in-out test" this test enables the technician to activate most of the components and test the analog and digital inputs, This enables the technician to verify whether the problem is caused by an end item, by the control system or by any other reason.

Before any operation or test on the autoclave perform a visual check for loose parts or for signs of over-heating and burnt components.

10.1.1 Manual Valves

There are four (4) manual control valves (see piping diagram) and the technician must verify that they are open as instructed below.

There is one manual control valve on the incoming mineral free water line.

There are two valves on the feed water line and there is one valve that acts as a bypass to the steam trap.

The three incoming waterline valves are used to regulate flow and should be opened 2 –3 full turns. One controls feed water flow to the vacuum pump reservoir, one controls flow to the mineral free water reservoir and one controls flow of feed water for cooling the exhaust drain. (Since the majority of drains are made of PVC pipe the exhaust temp needs to remain below 140ºF. the cooling water valve is used to maintain drain temperatures well below 140ºF.

The steam trap bypass valve is used to control steam escaping from the chamber and should be open ¼ - ½ turn. Restricting the flow of steam too much or too little will result in a system failure.

To set or check the valves, close them fully make an indicator mark if one is not present and open the proper number of turns.

10. TROUBLESHOOTING (cont.)

10.2 Preliminary Troubleshooting

Symptom	*Possible cause check-up and tests*	*Corrections*
1. "Low temp" is displayed	1.1 Low temperature and low pressure. 1.1.1 Check leakage from the chamber or from the jacket. 1.1.2 Faulty heating element. 1.1.3 Faulty pressure switch. 1.1.4 On model 2540 only: 1.1.4.1 Cut-off thermostat disconnects the heating element. 1.1.5 On model 3870 only: 1.1.5.1 Cut-off thermostat disconnects command to the contactor that disconnects the heating element. 1.1.5.2 The contactor is disconnected. 1.1.5.3 Faulty contactor. 1.1.6 Lower water level electrode does not sense water. Possible cause: 1.1.6.1 Contaminated electrode. 1.1.6.2 Faulty electrode. 1.1.6.3 Electrode disconnected. 1.1.6.4 Low or no water inlet and water pump operates too often. 1.1.6.4.1 Water inlet pipe to the chamber is clogged. 1.1.6.4.2 Faulty water pump. 1.1.6.4.3 Water-inlet Non-return valve is stuck.	1.1.1 Fix leakage. 1.1.2 Replaces the faulty heating elements. 1.1.3 Replace the faulty pressure switch. 1.1.4.1 Reset the cut-off thermostat. If it does not help – replace it. 1.1.5.1 Reset the cut-off thermostat. If it does not help – replace it. 1.1.5.2 Fix connection. 1.1.5.3 Replace faulty contactor. 1.1.6.1 Clean the contaminated electrode. 1.1.6.2 Replace faulty electrode. 1.1.6.3 Fix electrode electrical connections. 1.1.6.4.1 Clean clogged piping. 1.1.6.4.2 Replace water pump. 1.1.6.4.3 Replace non-return valve.

Symptom	*Possible cause check-up and tests*	*Corrections*
1. "Low temp" is displayed (cont.)	1.2. High pressure and low temperature Water is not discharged from the chamber. Possible cause: 1.2.1 Steam trap clogged. 1.2.2 Exhaust drain pipe clogged. 1.2.3 Steam trap by-pass (needle valve) is too closed. 1.2.4 Slow exhaust valve (74) does not open 1.3 Temperature and/or pressure are not calibrated.	 1.2.1 Clean or replace clogged steam trap. 1.2.2 Clean clogged pipe. 1.2.3 Close needle valve completely and open half a turn. 1.2.4 See item 10.4.31. 1.3 Calibrate temperature and/or pressure.
2. "High press" is displayed.	2.1 Pressure is high and temperature is low. 2.1.1 Slow exhaust or drain lines are clogged due to: 2.1.1.1 Clogged steam trap. 2.1.1.2 Needle valve, of the slow exh by-pass, is closed. 2.1.1.3 Outlet or slow exh to drain pipes are clogged. 2.1.1.4 Slow exhaust valve (74) is stuck closed. 2.2 Pressure and temperature are high. 2.2.1 Heating elements operate constantly due to: 2.2.1.1 Faulty Solid State Relay (SSR) (located in the electronic box). 2.2.1.2 Faulty digital board DIG-T2 (located in the electronic box). 2.2.1.1 Faulty analogue board ANL-T2 (located in the electronic box).	 2.1.1.1 Replace clogged steam trap. 2.1.1.2 Close needle valve completely and open half a turn. 2.1.1.3 Clean clogged pipes. 2.1.14 See item 10.4.31. 2.2.1.1 Replace faulty relay. 2.2.1.1 Replace faulty board. 2.2.1.1 Replace faulty board.

Symptom	*Possible cause check-up and tests*	*Corrections*
3. "Low press" is displayed	3.1 Pressure and temperature are low.	
	3.1.1 Leakage from the chamber or from the jacket.	3.1.1 Fix leakage from chamber and jacket.
	3.1.2 Faulty heating element.	3.1.2 Replace the faulty heating element.
	3.1.3 Pressure switch faulty or adjusted to low pressure.	3.1.3 Replace the pressure switch.
	3.1.4 On model 2540 only:	
	3.1.4.1 Cut-off thermostat disconnects the heating element.	3.1.4.1 Reset the cut-off thermostat. If it does not help – replace it.
	3.1.5 On model 3870 only:	
	3.1.5.1 Cut-off thermostat disconnects command to the contactor that disconnects the heating element.	3.1.5.1 Reset the cut-off thermostat. If it does not help – replace it.
	3.1.5.2 The contactor is disconnected.	3.1.5.2 Fix connection.
	3.1.5.3 Faulty contactor.	3.1.5.3 Replace faulty contactor.
	3.1.6 Lower water level electrode does not sense water. Possible cause:	
	3.1.6.1 Contaminated electrode.	3.1.6.1 Clean the contaminated electrode.
	3.1.6.2 Faulty electrode.	3.1.6.2 Replace faulty electrode.
	3.1.6.3 Electrode disconnected.	3.1.6.3 Fix electrode electrical connections.
	3.1.6.4 Low or no water inlet and water pump operates too often.	
	3.1.6.4.1 Water inlet pipe to the chamber is clogged.	3.1.6.4.1 Clean clogged piping.
	3.1.6.4.2 Faulty water pump.	3.1.6.4.2 Replace water pump.
	3.1.6.4.3 Non-return valve on water inlet pipe is stuck.	3.1.6.4.3 Replace non-return valve.
	3.1.7 Faulty water pump.	3.1.7 Replace faulty water pump.
	3.1.8 Water inlet pipe and/or filter are clogged.	3.1.8 Clean clogged pipe and/or filter.

Symptom	*Possible cause check-up and tests*	*Corrections*
3. "Low press" is displayed (cont.)	3.2. Low pressure and high temperature. 3.2.1 Exhaust or slow exhaust outlets are leaking. 3.2.2 Temperature or pressure are not calibrated. 3.2.3 Air inlet valve (43) is stuck open. 3.2.4 Vacuum valve (52) is stuck open. 3.2.5 Fast exhaust valve (73) is stuck open. 3.2.6 Slow exhaust valve (74) is stuck open. 3.2.7 Steam valve (93) is stuck open.	3.2.1 Fix leakage. 3.2.2 Calibrate pressure and/or temperature (as appropriate). 3.2.3 See item 10.4.8. 3.2.4 See item 10.4.3. 3.2.5 See item 10.4.35. 3.2.6 See item 10.4.30. 3.2.7 See item 10.4.29.
4. "High temp" is displayed.	4.1 High temperature and low pressure. 4.1.1 Steam trap is leaking. 4.1.2 Needle valve of the steam trap is leaking. 4.1.3 Temperature sensor (PT100) is faulty. 4.1.4 Pressure sensor is faulty. 4.1.5 Temperature or pressure are not calibrated. 4.1.6 Exhaust line, chamber or jacket are leaking. 4.17 Faulty steam trap. 4.1.8 needle valve open 4.2 Pressure and temperature are high. 4.2.1 Heating elements operate constantly due to: 4.2.1.1 Faulty Solid State Relay (SSR) (located in the electronic box). 4.2.1.2 Faulty digital board DIG-T2 (located in the electronic box). 4.2.1.3 Faulty analogue board ANL-T2 (located in the electronic box).	4.1.1 Replace faulty steam trap. 4.1.2 Replace faulty needle valve. 4.1.3 Replace faulty temperature sensor. 4.1.4 Replace faulty pressure sensor. 4.1.5 Calibrate temperature and/or pressure as appropriate. 4.1.6 Fix leakage. 4.1.7 Replace faulty steam trap. 4.1.8 Close needle valve completely and open half a turn. 4.2.1.1 Replace faulty Solid State Relay (SSR). 4.2.1.2 Replace faulty board. 4.2.1.3 Replace faulty board.

Symptom	*Possible cause check-up and tests*	*Corrections*
5. "Low heat" is displayed.	5.1 piping leaking. 5.2 Faulty heating elements. 5.3 Faulty pressure switch. 5.4 Faulty cut-off thermostat (on model 3870). 5.5 Lower electrode does not sense water. 5.5.1 Faulty electrode. 5.5.2 Faulty water pump. 5.5.3 Water inlet pipe to the jacket is clogged. 5.5.4 Air inlet valve (43) is stuck open. 5.5.5 Vacuum valve (52) is stuck open. 5.5.6 Fast exhaust valve (73) is stuck open. 5.5.7 Slow exhaust valve (74) is stuck open. 5.5.8 Steam valve (93) is stuck open.	5.1 Fix leakage. 5.2 Replace heating element. 5.3 Replace faulty pressure switch. 5.4 Replace faulty cut-off thermostat. 5.5.1 Replace faulty electrode. 5.5.2 Replace faulty water pump. 5.5.3 Clean clogged pipes. 5.5.4 See item 10.4.8. 5.5.5 See item 10.4.3. 5.5.6 See item 10.4.35. 5.5.7 See item 10.4.30. 5.5.8 See item 10.4.29
6. "Add water" is displayed.	6.1 Faulty mineral free water supply. 6.2 Pressure of mineral free water source is low. 6.3 Mineral free water inlet line is clogged. 6.4 Mineral free water inlet valve (21) is stuck. 6.5 Float in mineral free water reservoir is faulty.	6.1 Fix mineral free water supply.. 6.2 Fix pressure of mineral free water source. 6.3 Clean clogged inlet. 6.4 Replace stuck valve. 6.5 Replace faulty float.

10. TROUBLESHOOTING (cont.)

10.2 Preliminary Troubleshooting *(cont.)*

Symptom	*Possible cause check-up and tests*	*Corrections*
7. "Low vacuum" is displayed.	7.1 Chamber is leaking.	7.1 fix leakage.
	7.2 Faulty vacuum pump.	7.2 replace faulty vacuum pump/
	7.3 Vacuum piping is leaking.	7.3 fix leaking piping.
	7.4 Non-return valve is stuck.	7.4 replace stuck non-return valve
	7.5 Vacuum valve (52) does not open during vacuum stage due to:	
	7.5.1 Faulty coil or plunger.	7.5.1 Replace faulty coil and/or plunger.
	7.5.2 Pump disconnected.	7.5.2 Fix disconnection.
	7.5.3 Faulty digital board DIG-T2 (located in the electronic box).	7.5.3 Replace faulty board.
	7.5.4 Faulty analogue board ANL-T2 (located in the electronic box).	7.5.4 Replace faulty board.
	7.5.5 Air inlet valve (43) leaks or is stuck open.	7.5.5 See item 10.4.8.
	7.5.6 Fast exhaust valve (73) leaks or is stuck open.	7.5.6 See item 10.4.35.
	7.5.7 Slow exhaust valve (74) leaks or is stuck open.	7.5.7 See item 10.4.30.
	7.5.8 Steam valve (93) leaks or is stuck open.	7.5.8 See item 10.4.29

10. TROUBLESHOOTING

10.3 Pre-process malfunction

If the malfunction is possibly caused by the electronic system, the following should be performed prior to any corrective action:

Clean the grid under the fan with compressed air. This should be done from inside so debris will be blown outwards.
Clean the entire electronic box with compressed air. (dirt can be conductive and possibly causing a short in the circuit)

Symptom	*Possible cause check-up and tests*	*Corrections*
1. No response when the system is turned on	1.1 Check that the main power is turned on, the power cord and the connections to the circuit breaker. 1.2 Check the circuit breaker. If it is tripped, there is possibly a short-circuit. 1.3 Check the AC voltages. — The input voltage comes from the circuit breaker to the On/Off switch then to the AC-T1 board – See the Electrical Wiring Diagram. The voltage must be 208 VAC. — With a multimeter check from pin 3 at the AC-INPUT connector (JP3), on the AC-T1 board, to pins 1 and 2. — Turn on the power. The reading must be the same as the voltage coming from the wall outlet for the machine. If not: — The On/Off Rocker switch contacts may be loose. — The electrical circuit supplying the unit may not be able to handle the load.	1.1 Replace damaged cord or repair faulty connections. 1.2 Reset the circuit breaker and observe if it trips again, if so check for a short circuit. 1.3 — Replace the On/Off Rocker switch. — Have the facilities electrical circuit upgraded.

Symptom	*Possible cause check-up and tests*	*Corrections*
1. (cont.)	— Check for AC power at the JP2 connector on the AC-T1 board — Check for power at the AC input to the power supply	
	1.4 Check the DC voltages supplied to the system. — Connect the Test Point board to the JP7 connector on the ANL-T2 board. — Connect the negative probe of a multimeter to TP1 on the test board. — With the positive probe check TP2 for +5V DC, an acceptable range is 4.9 – 5.3V — With the positive probe check TP3 for +12V DC, an acceptable range is 10.8 – 12.5V — If either voltage is incorrect or missing, then remove the output connector from the power supply and recheck at the power supply connector. — If the voltages are with in range then reconnect the output connector and proceed — Turn off the power and disconnect all connectors except JP8 from the ANL-T2 board. Inspect all cables for loose connectors and all connectors for bent pins.	1.4 — If the DC voltages at the power supply connector are incorrect or missing, with the load disconnected, then replace the power supply. — Replace faulty cables. — Fix damaged connectors — If voltages are missing or incorrect then replace the ANL-T2 board

Symptom	*Possible cause check-up and tests*	*Corrections*
1. (cont.)	— Turn the power back on and check for 5V and 12V on the Test Point board, if voltages are okay, then one connector at a time reconnect the connector and test the voltage. Each time turning the power off before reconnecting. — If a cable or connector causes a problem, but the cable or connector are, good then proceed down the line to the device attached to the other end of the cable or connector and continue with the previous step. The problem could be with any one of the external devices connected to the system (valves, sensors, etc.) or another electronic board. 1.5 Check the grounding — Connect the negative probe of the multimeter to TP1 on the Test Point board. — Using the positive probe check the voltage at various grounding points on the autoclave, on the ANL-T2 and DIG-T2 boards, on the enclosure of the electric box and the main grounding screw of the machine.	— Repair or replace the faulty item. 1.5 — Tighten loose screws. — Reconnect grounding cable.

Symptom	*Possible cause check-up and tests*	*Corrections*
1. (cont.)	— The voltage reading must be less than 5mV. A higher voltage may indicate that the ANL-T2 board fastening screws are loose or that the power supply grounding cable is loose.	
2. System is on and display is not lit.	2.1 If the other functions are OK, the display is probably damaged.	2.1 Replace DIG-T2 board
3. System on and erroneous or fragmented digits.	3.1 DIG-T2 board is faulty.	3.1 Replace DIG-T2 board.
4. No response from one of the keys.	4.1 Keyboard is faulty. 4.2 DIG-T2 board is faulty.	4.1 Replace the keyboard. 4.2 Replace the DIG-T2 board.
5. The displayed readout for the atmospheric pressure, when the door of the chamber is open, does not conform to the actual absolute pressure.	5.1 Check if the displayed value is near the atmospheric pressure. 5.2 If after setting the Atmos.Press parameter the displayed value is significantly different from the atmospheric pressure there is a problem with the pressure sensor.	5.1 Check that the Atmos.Press parameter (sec 8.2.17) is set to the correct atmospheric pressure. 5.2 The sensor is faulty. Replace sensor.

Symptom	*Possible cause check-up and tests*	*Corrections*
6. Pressing the START key does not start the process and the error message ADD WATER is displayed despite the water reservoir being full.	6.1 Incorrect reading of the reservoir float switch position.	6.1 See symptom 20 in para. 10.4.
7. Unit will not heat but display is on (except during vacuum test).	7.1 Check that the electrodes are sensing water in the jacket	7.1 make sure water pump is working. Make sure electrode wires are connected

10. TROUBLESHOOTING (cont.)

10.4 In Process Malfunction

Symptom	*Possible cause check-up and tests*	*Corrections*
1. Message DOOR UNLOCK is displayed during the heating stage, although the door is closed.	1.1 As the pressure in the chamber rises during the heat up stage it presses outward on the door. This can cause the door switch to be released and cause the system to think the door is opened.	1.1 Close the door more tightly or readjust the door switch to activate earlier.
2. The fast exhaust operation is too slow	2.1 Fast exhaust valve (73) is faulty or the discharge line from the chamber to drain is clogged or the no return valve is faulty. 2.2 Strainer is clogged	2.1 Check the valve as per para 10.4 sections 35 & 36. Replace either the fast exhaust valve (73), no return valve or clean the drain line as needed. 2.2 Clean clogged strainer.

Symptom	*Possible cause check-up and tests*	*Corrections*
3. Vacuum valve (52) is always open (3870 has 2 valves #52 working together).	The problem may be a mechanical failure of the valve, the valve driver located on the ANL-T2 board or the control circuit on the DIG-T2 board.	
	3.1 Check TP8. If the voltage is higher than 4V and the valve is open, then the DIG-T2 board is faulty. If the voltage at TP8 is <1VDC and the valve is open, the problem is not the DIG-T2, but some other element of the system.	3.1 Replace the DIG-T2 board.
	3.2 Check the connection between the connector JP10 - 4 and the valve for a ground short.	3.2 Fix the connections.
	3.3 Remove the cover protecting the terminals of the coil and check the voltage across the coil when the solenoid is connected. If the coil voltage is less than 2V and the valve is open, there is a mechanical problem.	3.3 Disassemble the valve and check that the plunger is free to move and that the seat is clean and free from debris.
	3.4 If the voltage across the coil is higher than 10VDC, then the ANL-T2 board is faulty.	3.4 Replace the ANL-T2 board**.**

Symptom	***Possible cause check-up and tests***	*Corrections*
4. Vacuum valve (52) is always closed (3870 has 2 valves #52 working together).	The problem may be caused by the mechanical part of the valve or the driver located on the ANL-T2 board or the control circuit on the DIG-T2 board.	
	4.1 Check TP8. If the voltage is constantly <1VDC, while the valve is supposed to be open, then the problem is on DIG-T2 board.	4.1 Replace the DIG-T2 board.
	4.2 Check the connection between connector JP10 - 4 and the valve for an open circuit.	4.2 Fix the connections.
	4.3 Check the coil input voltage with the solenoid connected to the valve. If the voltage is higher than 10VDC and the valve does not open, then the solenoid or the mechanical part of the valve are faulty.	4.3 Disassemble the valve and check that the plunger is free to move and that the seat is clean and free from debris.
	4.4 Take an ohm reading across the solenoid coil, a 10W coil is 14-15 ohms and a 12W coil is 9-10 ohms. An incorrect ohm reading means the coil is faulty. Check from the coil terminal to the ground terminal, any reading other than 0VDC means the coil is faulty.	4.4 Replace the coil

Symptom	*Possible cause check-up and tests*	*Corrections*
5. Water inlet valve (21) to mineral free reservoir is always open	The problem may be a mechanical failure of the valve, the valve driver located on the ANL-T2 board or the control circuit on the DIG-T2 board.	
	5.1 Check TP9. If the voltage is higher than 4V and the valve is open, then the DIG-T2 board is faulty. If the voltage at TP9 is <1VDC and the valve is open, the problem is not the DIG-T2, but some other element of the system.	5.1 Replace the DIG-T2 board.
	5.2 Check the connection between the connector JP10 - 5 and the valve for a ground short.	5.2 Fix the connections.
	5.3 Remove the cover protecting the terminals of the coil and check the voltage across the coil when the solenoid is connected. If the coil voltage is less than 2V and the valve is open, there is a mechanical problem.	5.3 Disassemble the valve and check that the plunger is free to move and that the seat is clean and free from debris.
	5.4 If the voltage across the coil is higher than 10VDC, then the ANL-T2 board is faulty.	5.4 Replace the ANL-T2 board.

Symptom	*Possible cause check-up and tests*	*Corrections*
6. Water inlet valve (21) to mineral free reservoir is always closed	The problem may be caused by the mechanical part of the valve or the driver located on the ANL-T2 board or the control circuit on the DIG-T2 board.	
	6.1 Check TP9. If the voltage is constantly <1VDC, while the valve is supposed to be open, then the problem is on DIG-T2 board.	6.1 Replace the DIG-T2 board.
	6.2 Check the connection between connector JP10 - 5 and the valve for an open circuit.	6.2 Fix the connections.
	6.3 Check the coil input voltage with the solenoid connected to the valve. If the voltage is higher than 10VDC and the valve does not open, then the solenoid or the mechanical part of the valve are faulty.	6.3 Disassemble the valve and check that the plunger is free to move and that the seat is clean and free from debris.
	6.4 Take an ohm reading across the solenoid coil, a 10W coil is 14-15 ohms and a 12W coil is 9-10 ohms. An incorrect ohm reading means the coil is faulty. Check from the coil terminal to the ground terminal, any reading other than 0VDC means the coil is faulty.	6.4 Replace the coil.

Symptom	*Possible cause check-up and tests*	*Corrections*
7. Air valve (43) is always closed.	The problem may be caused by the mechanical part of the valve or the driver located on the ANL-T2 board or the control circuit on the DIG-T2 board.	
	7.1 Check TP7. If the voltage is constantly <1VDC, while the valve is supposed to be open, then the problem is on DIG-T2 board.	7.1 Replace the DIG-T2 board.
	7.2 Check the connection between connector JP10 - 3 and the valve.	7.2 Fix the connections.
	7.3 Check the coil input voltage with the solenoid connected to the valve. If the voltage is higher than 10VDC and the valve does not open, then the solenoid or the mechanical part of the valve are faulty.	7.3 Disassemble the valve and check that the plunger is free to move and that the seat is clean and free from debris.
	7.4 Take an ohm reading across the solenoid coil, a 10W coil is 14-15 ohms and a 12W coil is 9-10 ohms. An incorrect ohm reading means the coil is faulty. Check from the coil terminal to the ground terminal, any reading other than 0VDC means the coil is faulty.	7.4 Replace the coil.

Symptom	*Possible cause check-up and tests*	*Corrections*
8. Air valve (43) is always open.	The problem may be a mechanical failure of the valve, the valve driver located on the ANL-T2 board or the control circuit on the DIG-T2 board.	
	8.1 Check TP7. If the voltage is higher than 4V and the valve is open, then the DIG-T2 board is faulty. If the voltage at TP7 is <1VDC and the valve is open, the problem is not the DIG-T2, but some other element of the system.	8.1 Replace the DIG-T2 board.
	8.2 Check the connection between the connector JP10 - 3 and the valve for a ground short.	8.2 Fix the connections.
	8.3 Remove the cover protecting the terminals of the coil and check the voltage across the coil when the solenoid is connected. If the coil voltage is less than 2V and the valve is open, there is a mechanical problem.	8.3 Disassemble the valve and check that the plunger is free to move and that the seat is clean and free from debris.
	8.4 If the voltage across the coil is higher than 10VDC, then the ANL-T2 board is faulty.	8.4 Replace the ANL-T2 board.

Symptom	*Possible cause check-up and tests*	*Corrections*
9. Heating elements are permanently activated.	This can be the result of a failure of the control circuit on the DIG-T2 board or of the heating elements driver on the ANL-T2 board or the Solid State Relay.	
	9.1 Check TP4. if the voltage is higher than 4VDC the problem is on DIG-T2 board.	9.1 Replace DIG-T2 board.
	9.2 If the voltage at TP4 is <1VDC the problem could be either the ANL-T2 or the SSR. Turn power off and remove the wire from terminal 4 of the SSR. Turn the power back on. If the heaters remain off then the problem is with the ANL-T2.	9.2 Replace ANL-T2 board.
	9.3 If the heaters come back on the problem is with the SSR.	9.3 Test the SSR (see symptom 34)
10. Heating elements will not heat the jacket, but the display is on.	10.1 Check for the proper voltage across the output terminals of the circuit breaker.	10.1 If an incorrect voltage is seen then check across the input terminals of the circuit breaker and the output from the wall outlet
	10.2 With TP4 at or above 4 VDC check for correct voltage across the terminals of the heater element terminal block located next to the main circuit breaker. The 2540 has two terminals and the 3870 has three terminals. The correct voltage should be seen across all combinations of any two terminals.	10.2 If correct voltages are seen across all terminals on the block then the problem is with the heater elements. Disconnect the heaters and take an ohm reading across the heater. A proper reading for each element would be 43 ohms for a 208 volt heater or 53 ohms for a 230 volt heater (+/- 10%).

Symptom	*Possible cause check-up and tests*	*Corrections*
10. Heating elements will not heat the jacket, but the display is on. (cont)	10.3 If no voltage is seen at the terminal block then check if the Cut-Off thermostat is open. If the voltage at TP4 is always <1VDC then check if the electrodes are sensing water in the jacket. If they are, then the problem is the DIG-T2 board. If the voltage at TP4 is higher than 4VDC the problem could be with either the ANL-T2, the SSR, the pressure switch or the Cut-Off thermostat. 10.4 On model 2540 only: 10.4.1 Cut-off thermostat disconnects the heating element. 10.5 On model 3870 only: 10.5.1 Cut-off thermostat disconnects command to the contactor that disconnects the heating element. 10.5.2 The contactor is disconnected. 10.5.3 Faulty contactor.	10.3.1 Reset or replace the Cut-Off thermostat. 10.3.2 make sure the water pump is working. Make sure that the wires are connected to the electrodes. Check electrode assembly sec 9.16. 10.3.3 Replace the DIG-T2 board 10.3.4 If the Pressure Switch is open replace it (**DO NOT** attempt to adjust this device). 10.3.5 Check the SSR (see symptom 34). 10.3.6 If all the preceding tests are good then replace the ANL-T2 board 10.4.1 Reset the cut-off thermostat. If it does not help – replace it. 10.5.1 Reset the cut-off thermostat. If it does not 10.5.2 Fix connection. 10.5.3 Replace faulty contactor.
11. The vacuum pump works continuously	The problem may be a failure of the control circuit on the DIG-T2 board or the driver on the AC-T1 board. 11.1 Check TP5. If the voltage is higher than 4V then the DIG-T2 board is faulty. 11.2 If the voltage at TP5 is <1VDC the problem is either the AC-T1 board or the ANL-T2 board. Turn off the power and remove the JP1 connector on the AC-T1, turn the power back on.	11.1 Replace the DIG-T2 board. 11.2 With the JP1 removed if the pump continues to run then replace the AC-T1 board. If the pump stops then replace the ANL-T2

Symptom	*Possible cause check-up and tests*	*Corrections*
12. Vacuum pump does not work.	12.1 Check that the vacuum pump reservoir is full and tap water will flow in freely.	12.1 Correct any problem with the tap water inlet
	12.2 The lower float in the vacuum pump reservoir may be faulty, stopping the pump.	12.2 Replace faulty float switch.
	12.3 Check the fuse at the rear of the unit.	12.3 Replace blown fuse.
	12.4 With the power off, check if the pump is free to rotate. Do this by inserting a flat blade screwdriver into the center of the rear bell housing engaging a slotted screw that is present there. Apply moderate force, if the pump will not rotate then continue increasing force until the pump rotates freely.	12.4 If the pump will not rotate feely then replace the pump
	12.5 Check TP5 if the voltage is constantly <1VDC then the problem in on the DIG-T2 board.	12.5 Replace the DIG-T2 board
	12.6 If the voltage at TP5 is higher than 4DC, then remove the JP7 connector and check the output of JP7-1 on the AC-T1 board to ground.	12.6 If approximately 120VAC is present then the pump is faulty and should be replaced. If no voltage is present then replaced the AC-T1 board.
	12.7 If the pump has over heated the thermal protector will activate and stop the pump, this can be due to a clogged or malfunctioning chamber filter screen, vacuum pump feed water valve (15) or chamber vacuum valve (52).	12.7 Clear any clog and / or replace the filter or valve. Once the pump has cooled it will start working again.

Symptom	*Possible cause check-up and tests*	*Corrections*
13. The displayed temperature permanently indicates a temperature higher than 284ºF or T1CUT is displayed.	13.1 Check that the connector of the sensor is properly plugged into JP2 on the ANL-T2 board. 13.2 Check that the wires and connector are in good condition. 13.3 Disconnect the PT100 from the connector and check its resistance. At 32ºF the resistance across the two wires of the sensor should read 100 Ω. The resistance at higher temperature can be calculated by adding 0.2 ohms for each degree F. 13.4 Plug the PT100 simulator into the JP2 connector and try the various temperature selections.	13.1 Unplug and replug in the connector making sure good contact is made 13.2 Fix the connections 13.3 If the resistance does not correlate with the temperature, replace the temperature sensor. 13.4 If the display does not match the selections on the PT100 simulator then calibrate the temp. If unsuccessful then replace the ANL-T2
14. The displayed temperature permanently indicates a temperature less than 54°F, although chamber temperature is high.	14.1 Check that the connector of the sensor is properly plugged into JP2 on the ANL-T2 board. 14.2 Check that the wires and connector are in good condition. 14.3 Disconnect the PT100 from the connector and check its resistance. At 32ºF the resistance across the two wires of the sensor should read 100 ohms. The resistance at higher temperature can be calculated by adding 0.2 ohms for each degree F.	14.1 Unplug and replug in the connector making sure good contact is made 14.2 Fix the connections 14.3 If the resistance does not correlate with the temperature, replace the temperature sensor.

Symptom	*Possible cause check-up and tests*	*Corrections*
14. (cont)	14.4 Plug the PT100 simulator into the JP2 connector and try the various temperature selections.	14.4 If the display does not match the selections on the PT100 simulator then calibrate the temp. If unsuccessful than replace the ANL-T2
15. The displayed temperature is significantly different from the actual temperature.	15.1 Check that the connector of the sensor is properly plugged into JP2 on the ANL-T2 board. 15.2 Check the positioning of the PT100 (see sec 9.20) If the positioning is correct then the PT100 sensor is faulty. 15.3 The difference in the displayed temperature when the PT100 simulator is connected is similar, in magnitude and direction, to the difference in the displayed temperature when the PT100 sensor is connected. 15.4 System cannot be calibrated.	15.1 Unplug and replug in the connector making sure good contact is made 15.2 Replace the PT100 sensor 15.3 Calibrate the system. (see para 5) 15.4 Replace ANL-T2 board and calibrate the system.(see para 5)
16. The displayed pressure of the chamber pressure permanently indicates a pressure over 50 psi.	16.1 Check that the connector of the sensor is properly plugged into JP1 on the ANL-T2 board. 16.2 Check that the wires and connector are in good condition. 16.3 The pressure sensor is defective. 16.4 The pressure measuring circuit on ANL-T2 board is defective.	16.1 Unplug and replug in the connector making sure good contact is made 16.2 Fix the connections 16.3 Replace the pressure sensor and calibrate (see para 5). 16.4 Replace the ANL-T2 and calibrate (see para 5).

Symptom	*Possible cause check-up and tests*	*Corrections*
17. The displayed pressure of the chamber permanently indicates a pressure less than 7.3 psi.	17.1 Check that the connector of the sensor is properly plugged into JP1 on the ANL-T2 board. 17.2 Check that the wires and connector are in good condition. 17.3 The pressure sensor is defective. 17.4 The pressure measuring circuit on ANL-T2 board is defective.	17.1 Unplug and replug in the connector making sure good contact is made 17.2 Fix the connections 17.3 Replace the pressure sensor and calibrate (see para 5). 17.4 Replace the ANL-T2 and calibrate (see para 5).
18. The displayed pressure is significantly different from the actual pressure.	18.1 Check that the connector of the sensor is properly plugged into JP1 on the ANL-T2 board. 18.2 The system is out of calibration 18.3 The pressure sensor is contaminated with dirt or is defective. 18.4 The pressure measuring circuit on ANL-T2 board is defective.	18.1 Unplug and replug in the connector making sure good contact is made 18.2 Calibrate the system (see para 5) 18.3 Clean or replace the pressure sensor and calibrate (see para 5). 18.4 Replace the ANL-T2 and calibrate (see para 5).
19. The electrode senses water in the jacket, but the jacket is empty.	19.1 Check if the wire connected to the electrode is shorted to ground. 19.2 Check if the electrode is shorted to ground. 19.3 The electrode is dirty. 19.4 If there is no short to ground then the ANL-T2 board is bad.	19.1 Fix the connections. 19.2 Replace the electrode 19.3 Clean the electrode with alcohol and check that the quality of the water used in the jacket is as specified in the manual. 19.4 Replace ANL- T2 board.

10. TROUBLESHOOTING (cont.)
10.4 In Process Malfunction (cont.)

Symptom	*Possible cause check-up and tests*	*Corrections*
20. The float switch in the water reservoir is always ON or OFF.	20.1 Check if the float moves up and down freely. 20.2 Check that the wires and connectors at the float and the connector at JP11 and JP12 on the ANL-T2 and the four pin DC connector plugged into the back of the electronic box are connected securely. 20.3 Disconnect the wires of the float switch and check with an ohmmeter. Move the switch up and down and observe that the meter shows an open and closed circuit 20.4 If previous checks are OK the problem could be on the ANL-T2 or DIG-T2 boards.	20.1 If the float will not move freely then replace it 20.2 Unplug and replug the connectors to insure a good connection. Fix and broken wires. 20.3 If the float movement does not show a change in the meter reading then replace the float. 20.4.1 Unplug the FC37P cable connecting the ANL-T2 and the DIG-T2. Inspect all connectors for bent pins. Make sure the flat cable's connectors are in good condition. Reconnect the cable. 20.4.2 Replace the ANL-T2 board 20.4.3 Replace the DIG-T2

10. TROUBLESHOOTING (cont.)
10.4 In Process Malfunction (cont.)

Symptom	*Possible cause check-up and tests*	*Corrections*
21. The electrode does not sense water in the jacket, but the jacket is full.	21.1 Electrode is not clean.	21.1 Clean the electrode with alcohol and check that the quality of the water used in the jacket is as specified in the manual.
	21.2 Disconnect the electrode. The displayed number should be approx. 255. Short-circuit the electrode by touching the electrode housing with the wire of the disconnected electrode. The displayed number should be "0". If so – the electrode is faulty.	21.2 Fix the connections.
	21.3 Check for an open in the wire connecting the electrode to the ANL-T2 board at the JP11 connector.	21.3 Replace the faulty electrode.
	21.4 If there is no open in the circuit then the ANL-T2 board is damaged.	21.4 Replace ANL- T2 board.
22. Steam leaks from around the door.	22.1 Make sure the door is closed tightly 22.2 Check if the gasket is clean and smooth. 22.3 Make sure the gasket is installed correctly. 22.4 Check the door bellows.	22.1 Increase tightness if leaking occurs. 22.2 Clean the gasket or replace 22.3 The thicker part of the gasket fits into the door groove first 22.4 If the leaking occurs in the area of the locking device, it is most likely coming from the door bellows.
23. The door bellows locking mechanism does not lock the door at a pressure of 6 psig.	23.1 The door bellows locking mechanism is faulty.	23.1 Replace the door bellows

Symptom	***Possible cause check-up and tests***	***Corrections***
24. Water valve (15) to vacuum pump is always open.	The problem may be a mechanical failure of the valve, the valve driver located on the ANL-T2 board or the control circuit on the DIG-T2 board.	
	24.1 Check TP10. If the voltage is higher than 4V and the valve is open, then the DIG-T2 board is faulty. If the voltage at TP10 is <1VDC and the valve is open, the problem is not the DIG-T2, but some other element of the system.	24.1 Replace the DIG-T2 board.
	24.2 Check the connection between the connector JP10 - 6 and the valve for a ground short.	24.2 Fix the connections.
	24.3 Remove the cover protecting the terminals of the coil and check the voltage across the coil when the solenoid is connected. If the coil voltage is less than 2V and the valve is open, there is a mechanical problem.	24.3 Disassemble the valve and check that the plunger is free to move and that the seat is clean and free from debris.
	24.4 If the voltage across the coil is higher than 10VDC, then the ANL-T2 board is faulty.	24.4 Replace the ANL-T2 board.

Symptom	*Possible cause check-up and tests*	*Corrections*
25. Water valve (15) to vacuum pump is always closed.	The problem may be caused by the mechanical part of the valve or the driver located on the ANL-T2 board or the control circuit on the DIG-T2 board.	
	25.1 Check TP10. If the voltage is constantly <1VDC, while the valve is supposed to be open, then the problem is on DIG-T2 board.	25.1 Replace the DIG-T2 board.
	25.2 Check the connection between connector JP10 - 6 and the valve for an open circuit.	25.2 Fix the connections.
	25.3 Check the coil input voltage with the solenoid connected to the valve. If the voltage is higher than 10VDC and the valve does not open, then the solenoid or the mechanical part of the valve are faulty.	25.3 Disassemble the valve and check that the plunger is free to move and that the seat is clean and free from debris.
	25.4 Take an ohm reading across the solenoid coil, a 10W coil is 14-15 ohms and a 12W coil is 9-10 ohms. An incorrect ohm reading means the coil is faulty. Check from the coil terminal to the ground terminal, any reading other than 0VDC means the coil is faulty.	25.4 Replace the coil.

Symptom	*Possible cause check-up and tests*	*Corrections*
26. Water pump does not operate.	26.1 Check that the water pump reservoir is full and mineral free water will flow in freely.	26.1 Correct any problem with the mineral free water inlet
	26.2 Check the fuse at the rear of the unit.	26.2 Replace blown fuse.
	26.3 Check TP17 if the voltage is constantly <1VDC then the problem is on the DIG-T2 board.	26.3 Replace the DIG-T2 board
	26.4 If the voltage at TP17 is higher than 4DC, then remove the JP7 connector and check the output of JP7-2 on the AC-T1 board to ground.	26.4 If approximately 120VAC is present then the pump is faulty and should be replaced. If no voltage is present then replaced the AC-T1 board.
	26.5 The pump has stopped due to a clogged water pump filter	26.5 Clear any clog and / or replace the filter.
	26.6 The lower float in the vacuum pump reservoir may be faulty, stopping the pump.	26.6 Replace faulty float switch.
27. Water pump is always on	The problem may be a failure of the control circuit on the DIG-T2 board or the driver on the AC-T1 board.	
	27.1 Check TP17. If the voltage is higher than 4V then the DIG-T2 board is faulty.	27.1 Replace the DIG-T2 board.
	27.2 If the voltage at TP17 is <1VDC the problem is either the AC-T1 board or the ANL-T2 board. Turn off power and remove the JP1 connector on the AC-T1, turn power back on	27.2 With the JP1 removed if the pump continues running then replace the AC-T1 board. If it stops then replace the ANL-T2
	27.3 Upper level electrode control wire is disconnected or electrode does not sense water (see sec 10.4.21).	27.3 Fix connection.

Symptom	*Possible cause check-up and tests*	*Corrections*
28. Steam valve (93) is always closed	The problem may be caused by the mechanical part of the valve or the driver located on the ANL-T2 board or the control circuit on the DIG-T2 board.	
	28.1 Check TP12. If the voltage is constantly <1VDC, while the valve is supposed to be open, then the problem is on DIG-T2 board.	28.1 Replace the DIG-T2 board.
	28.2 Check the connection between connector JP10 - 8 and the valve for an open circuit.	28.2 Fix the connections.
	28.3 Check the coil input voltage with the solenoid connected to the valve. If the voltage is higher than 10VDC and the valve does not open, then the solenoid or the mechanical part of the valve are faulty.	28.3 Disassemble the valve and check that the plunger is free to move and that the seat is clean and free from debris.
	28.4 Take an ohm reading across the solenoid coil, a 10W coil is 14-15 ohms and a 12W coil is 9-10 ohms. An incorrect ohm reading means the coil is faulty. Check from the coil terminal to the ground terminal, any reading other than 0VDC means the coil is faulty.	28.4 Replace the coil.

Symptom	*Possible cause check-up and tests*	*Corrections*
29. Steam valve (93) is always open.	The problem may be a mechanical failure of the valve, the valve driver located on the ANL-T2 board or the control circuit on the DIG-T2 board.	
	29.1 Check TP12. If the voltage is higher than 4V and the valve is open, then the DIG-T2 board is faulty. If the voltage at TP7 is <1VDC and the valve is open, the problem is not the DIG-T2, but some other element of the system.	29.1 Replace the DIG-T2 board.
	29.2 Check the connection between the connector JP10 – 8 and the valve for a ground short.	29.2 Fix the connections.
	29.3 Remove the cover protecting the terminals of the coil and check the voltage across the coil when the solenoid is connected. If the coil voltage is less than 2V and the valve is open, there is a mechanical problem.	29.3 Disassemble the valve and check that the plunger is free to move and that the seat is clean and free from debris.
	29.4 If the voltage across the coil is higher than 10VDC, then the ANL-T2 board is faulty.	29.4 Replace the ANL-T2 board.

Symptom	*Possible cause check-up and tests*	*Corrections*
30. Slow exhaust valve (74) is always open.	The problem may be a mechanical failure of the valve, the valve driver located on the ANL-T2 board or the control circuit on the DIG-T2 board.	
	30.1 Check TP13. If the voltage is higher than 4V and the valve is open, then the DIG-T2 board is faulty.	30.1 Replace the DIG-T2 board.
	If the voltage at TP13 is <1VDC and the valve is open, the problem is not the DIG-T2, but some other element of the system.	
	30.2 Check the connection between the connector JP10 - 9 and the valve for a ground short.	30.2 Fix the connections.
	30.3 Remove the cover protecting the terminals of the coil and check the voltage across the coil when the solenoid is connected. If the coil voltage is less than 2V and the valve is open, there is a mechanical problem.	30.3 Disassemble the valve and check that the plunger is free to move and that the seat is clean and free from debris.
	30.4 If the voltage across the coil is higher than 10VDC, then the ANL-T2 board is faulty.	30.4 Replace the ANL-T2 board.

Symptom	*Possible cause check-up and tests*	*Corrections*
31. Slow exhaust valve (74) is always close	The problem may be caused by the mechanical part of the valve or the driver located on the ANL-T2 board or the control circuit on the DIG-T2 board.	
	31.1 Check TP10. If the voltage is constantly <1VDC, while the valve is supposed to be open, then the problem is on DIG-T2 board.	31.1 Replace the DIG-T2 board.
	31.2 Check the connection between connector JP10 - 9 and the valve.	31.2 Fix the connections.
	31.3 Check the coil input voltage with the solenoid connected to the valve. If the voltage is higher than 10VDC and the valve does not open, then the solenoid or the mechanical part of the valve are faulty.	31.3 Disassemble the valve and check that the plunger is free to move and that the seat is clean and free from debris.
	31.4 Take an ohm reading across the solenoid coil, a 10W coil is 14-15 ohms and a 12W coil is 9-10 ohms. An incorrect ohm reading means the coil is faulty. Check from the coil terminal to the ground terminal, any reading other than 0VDC means the coil is faulty.	31.4 Replace the coil.

Symptom	*Possible cause check-up and tests*	*Corrections*
32. The autoclave is not drying properly.	32.1 Check water level in the vacuum pump water reservoir	32.1 Ensure that water flows freely through the feed water valve (14) into the rear section of the reservoir
	32.2 Check that the vacuum pump valve (15) is allowing water to flow to the pump	32.2 See symptoms 24 & 25.
	32.3 Check the vacuum valve (52) is open allowing the pump to draw from the chamber.	32.3 See symptoms 3 & 4
	32.4 Check the vacuum pump. With an independent gauge, installed in the door port, verify that the pump is pulling a vacuum of approximately 22 inches of mercury.	32.4 Replace the pump.
	32.5 Check that the load's weight does not exceed the maximum recommended weight: Maximum solid load: 2540 – 13.2 lb, 3870 – 44.1 lb Maximum porous load: 2540 – 4.4 lb, 3870 – 15.5 lb	32.5 Reload the autoclave according to recommendations.
33. High Pres is displayed on the screen.	33.1 By-pass needle valve of the steam trap is clogged (see piping diagram).	33.1 Clean by-pass needle valve.

Symptom	*Possible cause check-up and tests*	*Corrections*
34. Testing the Solid State Relay	34.1 Unplug the unit & remove the Outer Cabinet Label then remove the four wires connected to the SSR. Using an ohmmeter, check for a short circuit between terminals 3 & 4 and 1& 2 and 3&1 and 4&2 and 3 & 2 and 4 & 1. Make sure there are no direct shorts.	34.1 If a direct short is found in the SSR then replace it.
	34.2 Next, using an ohmmeter, check for an open between terminals 1 & 2, be sure to reverse the meter leads and check in the opposite direction. Repeat the procedure for terminals 3 & 4.	34.2 If an open is found then replace the SSR.
	34.3 Plug the unit in & Turn the unit on Make sure the autoclave is sitting idle, no cycle is running. If necessary abort any cycle that may not have been completed. The heaters will automatically be on when the unit is turned on. Press the PROGRAM KEY to display the date and time, this will turn the heaters off. Take a DC voltage reading from terminal 3 on the SSR to ground. With the heaters in the OFF mode there should be a voltage reading between +3.5 and +5 VDC. Repeat this procedure with terminal 4 and you should have the same reading. Reading between +3.5 and +5 VDC indicates that the SSR is not turned on.	34.3.1 If terminal 3 does not read between +3.5 and +5 VDC then check if the Power Supply is properly supplying these voltages. 34.3.2 If terminal 4 does not read the correct voltage then, unplug the unit and remove the wire on terminal 4. Turn the power back on and recheck terminal 4. If the reading is still not correct then replace the SSR. If the reading is correct then check continuity between the terminal 4 wire and the appropriate connector: (unplug the unit when taking this reading)

Symptom	*Possible cause check-up and tests*	*Corrections*
34 Testing the Solid State Relay (cont)	34.4.1 For 220 volt units (single or three phase), with the device in question in the OFF mode (pressing the PROGRAM KEY to display the date and time will turn the heaters off) a voltage reading from terminal 1 to ground will read approximately 110 VAC. A reading from terminal 2 to ground will read approximately 110 VAC. A reading across terminals 1 & 2 should show 208VAC.	34.4.1 If terminals 1 and 2 do not each read approximately 110 volts to ground then there is a problem with the line voltage wiring going to the SSR
	34.4.2 If a voltage of 208 volts is not present across terminals 1 & 2 then unplug the unit and remove the wires. Plug the unit back in and carefully take a reading across the wires	34.4.2 If a voltage of 208 volts is present then the SSR needs to be replaced. If the voltage is still incorrect then the problem is with the line voltage wiring going to the SSR.
	34.4.3 With the device in the ON mode a voltage reading from terminal 1 to ground will read approximately 110 volts AC. A reading from terminal 2 to ground will read approximately 110 volts AC. A reading across terminals 1 & 2 should show a voltage near 0 volts AC	34.4.3 If terminals 1 & 2 do not read approximately 110 volts to ground then there is a problem with the line voltage wiring going to the SSR. If the voltage reading across terminals 1 and 2 is higher than 5 volts then replace the SSR.

Symptom	*Possible cause check-up and tests*	*Corrections*
35. Fast Exhaust valve (73) is always open.	The problem may be a mechanical failure of the valve, the valve driver located on the ANL-T2 board or the control circuit on the DIG-T2 board.	
	35.1 Check the connection between the connector JP10 - 12 and the valve for a ground short.	35.1 Fix the connections.
	35.2 Remove the cover protecting the terminals of the coil and check the voltage across the coil when the solenoid is connected. If the coil voltage is less than 2V and the valve is open, there is a mechanical problem.	35.2 Disassemble the valve and check that the plunger is free to move and that the seat is clean and free from debris.
	35.3 If the voltage across the coil is higher than 10VDC, then the ANL-T2 or the DIG-T2 board are faulty.	35.3 First replace the ANL-T2 board, if that does not solve the problem then replace the DIG-T2.

Symptom	*Possible cause check-up and tests*	*Corrections*
36. Fast Exhaust valve (73) is always closed.	The problem may be caused by the mechanical part of the valve or the driver located on the ANL-T2 board or the control circuit on the DIG-T2 board.	
	36.1 Check the connection between connector JP10 - 12 and the valve for an open circuit.	36.1 Fix the connections.
	36.2 Check the coil input voltage with the solenoid connected to the valve. If the voltage is higher than 10VDC and the valve does not open, then the solenoid or the mechanical part of the valve are faulty.	36.2 Disassemble the valve and check that the plunger is free to move and that the seat is clean and free from debris.
	36.3 Take an ohm reading across the solenoid coil, a 10W coil is 14-15 ohms and a 12W coil is 9-10 ohms. An incorrect ohm reading means the coil is faulty. Check from the coil terminal to the ground terminal, any reading other than 0VDC means the coil is faulty.	36.3 Replace the coil

10. TROUBLESHOOTING (cont.)

10.5 Mechanical malfunction

Symptom	*Possible cause check-up and tests*	*Corrections*
1. The safety valve does not release pressure when the blow-off test is performed.	1.1 Check for a clog in the line leading to the Safety valve. 1.2 Safety relief valve is faulty	1.1 Remove any blockage from the valve or the line 1.2 If it does not help – replace the faulty valve.
2. Safety relief valve opens at a pressure lower than what is specified for the valve.	2.1 The seat of the valve has become dirty from a mineral build up. 2.2 Safety relief valve is faulty.	2.1 Replace the valve and check the quality of the mineral free water. 2.2 Replace relief valve
3. Safety relief valve opens at pressure that is higher (more than 10%) than what is specified for the valve.	3.1 Safety relief valve is faulty.	3.1 Replace the safety valve
4. Safety relief valve does not close within 2-3 seconds.	4.1 Safety relief valve is faulty.	4.1 Replace the safety valve
5. Safety relief valve leaks constantly.	5.1 Safety relief valve is faulty.	5.1 Replace the safety valve and check the quality of the mineral free water.
6. Vibration occurs during the operation of the pump.	6.1 Pump's rubber legs are loose or damaged.	6.1 Tighten or replace the rubber legs.

Symptom	*Possible cause check-up and tests*	*Corrections*
7. The process is aborted by a "Low Pres" failure in the prevacuum stage (see also section 10.2 item 3)	7.1 Check if there is steam in the jacket, by carefully pulling the ring of the safety valve. 7.2 The heating elements are not producing enough power.	7.1 Check that the steam valve (93) from jacket to chamber is clear and functioning properly. 7.2 Replace the faulty heating element.
8. Prevacuum stage is not satisfactory	8.1 Check for a vacuum leak, use program 6. If maximum vacuum is reached but is not maintained the problem is a faulty door seal, leaking valves, leaky pipefittings or damaged piping. 8.2 Check the vacuum pump outlets. 8.3 Check the water supply to vacuum pump. 8.4 Check the vacuum valve. 8.5 Check if the vacuum path is blocked 8.6 check that the pump is receiving the correct voltage.	8.1 Replace the faulty seal clean valves and tighten pipefittings Replace the damaged piping. 8.2 If there is no vacuum at the outlet, repair or replace the pump. 8.3 Fix water supply to the pump. 8.4 Repair or replace a faulty valve. 8.5 Remove any blockage in the pipes or valves 8.6 Correct any voltage problem.

10. TROUBLESHOOTING (cont.)

10.6 Water pump malfunction

Symptom	*Possible cause check-up and tests*	*Corrections*
1. Water pump is operating but no water is flowing or the rate is too slow.	Check pipes connecting the water reservoir, filter and water pump. 1.1 There is an air pocket at the pump inlet. 1.2 Pipe is clogged. 1.3 Filter is clogged	 1.1 Disconnect the pipe from the pump, let water flow to remove the air pocket, and then reconnect the pipe. 1.2 Clean pipe. 1.3 Clean the filter
2. Pump does not work.	See section 10.4.26	See section 10.4.26
3. The pump works continuously.	See section 10.4.27	See section 10.4.27
4. Water does not exit the chamber.	4.1 The filter screen located on the side of the autoclave may be clogged. 4.2 The fast exhaust valve (73) may be clogged or defective. 4.3 The exhaust line may be clogged 4.4 The no-return valve may be defective.	4.1 Clean the filter screen. Use caution the filter cap may be HOT! 4.2 Check out the valve according to section 10.4.4 and 10.4.36 4.3 Check the line and clear any obstruction. 4.4 Replace the no-return valve.

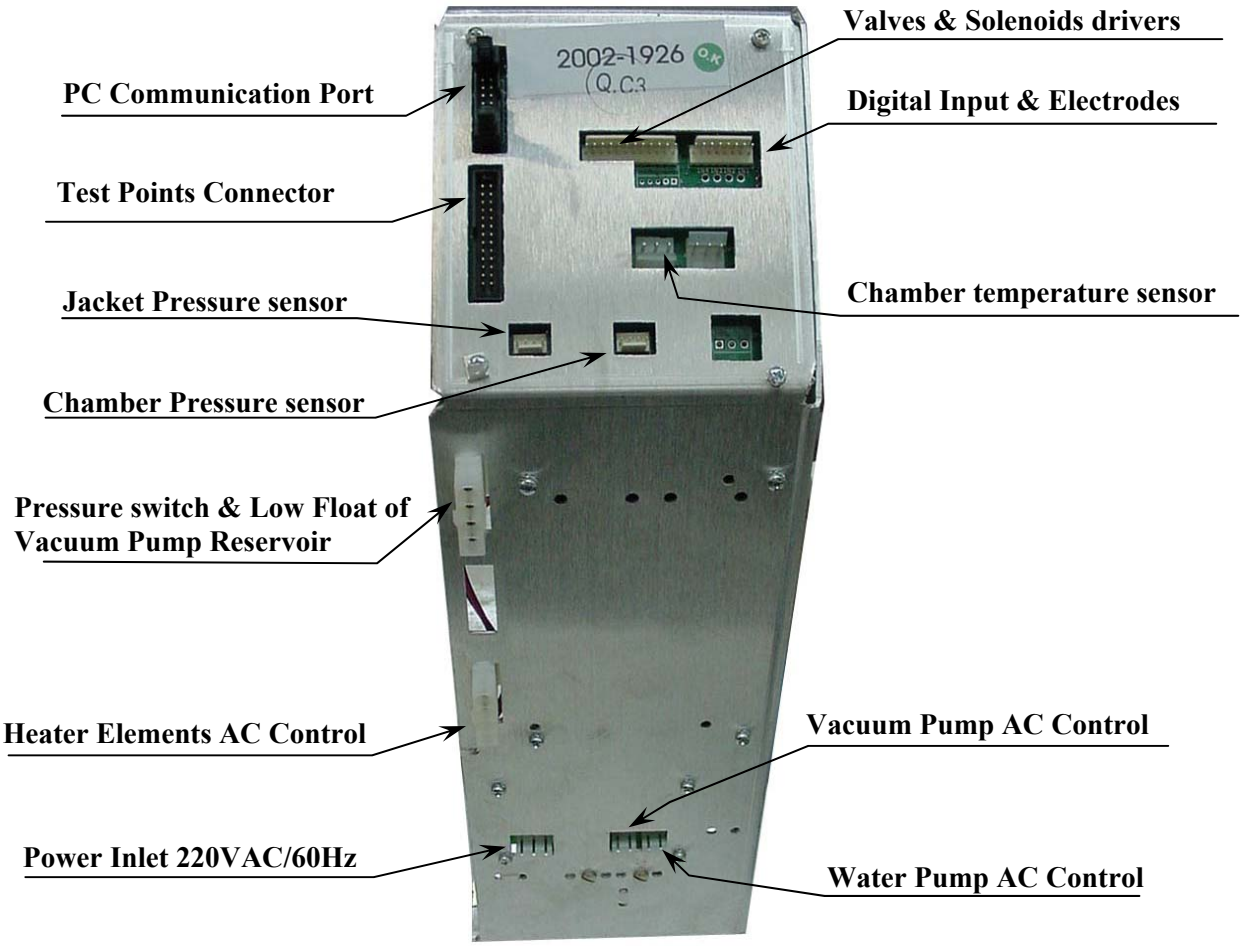
11 SPARE PARTS LIST

No.	DESCRIPTION	2540 EHS	3870 EHS
1.	Gauge, Pressure, Steam, -30+60 psi, 1.5"	GAU029-0009	GAU029-0009
2.	Switch, Rocker, 16A	ELE035-0012	ELE035-0012
3.	Circuit breaker 3-PH, 20A, Carlingswitch	——	ELE035-0053
4.	Circuit Breaker, 1-PH, 25A, Carlingswitch	ELE035-0060	——
5.	Thermostat, CUT-OFF, Campini	THE005-0008	THE005-0008
6.	Gasket, Door	GAS080-0003	GAS080-0004
7.	Reservoir, Water	RES075-0004	RES075-0004
8.	Reservoir, Water, Assembly	CMT240-0056	CMT387-0002
9.	Gasket, Silicone, Water Reservoir	GAS080-0007	GAS080-0007
10.	Switch, Float, Mini, MFS21-E-1, Riko	THE007-0001	THE007-0001
11.	Float, Water Level, LS303-51	THE007-0003	THE007-0003
12.	Fuse Holder, Mini, 1/4*32	ELE035-0002	ELE035-0002
13.	Fuse, Slow Blow, 1.25A, 1/4"*32	ELE035-0055	ELE035-0055
14.	Holder, Safety Valve, E/M	CMT100-0002	CMT100-0002
15.	Air Jet, M/E, Black	CMT100-0006	CMT100-0006
16.	Valve, Safety, Steam 1/4"-40 psi (ASME)	SVL029-0004	SVL029-0004
17.	Water Level Electrode, Housing, EHS	PIP100-0001	PIP100-0001
18.	Electrode, Water Level, Assembly	CMT196-0005	CMT196-0005
19.	Steam Trap, 1/4, Spirax-Sarco	——	ARM100-0057
20.	Valve, Solenoid 1/4"x4.5	SOL026-0005	SOL026-0005
21.	Valve, Solenoid 1/4"x3	SOL026-0004	SOL026-0004
22.	Valve, Solenoid 1/4"x6	SOL026-0006	SOL026-0006
23.	Valve, Drain, Sag.	VLV170-0066	VLV170-0066
24.	O-Ring, 10 x 2.5, drain valve	SRV000-0224	SRV000-0224
25.	O-Ring, 6 x 2, drain valve	SRV000-0232	SRV000-0232
26.	Nut, 3/8 BSP, Water Reservoir	CMT240-0020	CMT240-0020
27.	Spacer for Drain Valve, Brass	CMT240-0003	CMT240-0003
28.	Valve, Needle, 1/4", Bronze	VLV170-0022	VLV170-0022
29.	Plunger 1/4", Solenoid 1.6-4	SOL026-0015	SOL026-0015
30.	Plunger 1/4", Solenoid 6	SOL026-0016	SOL026-0016

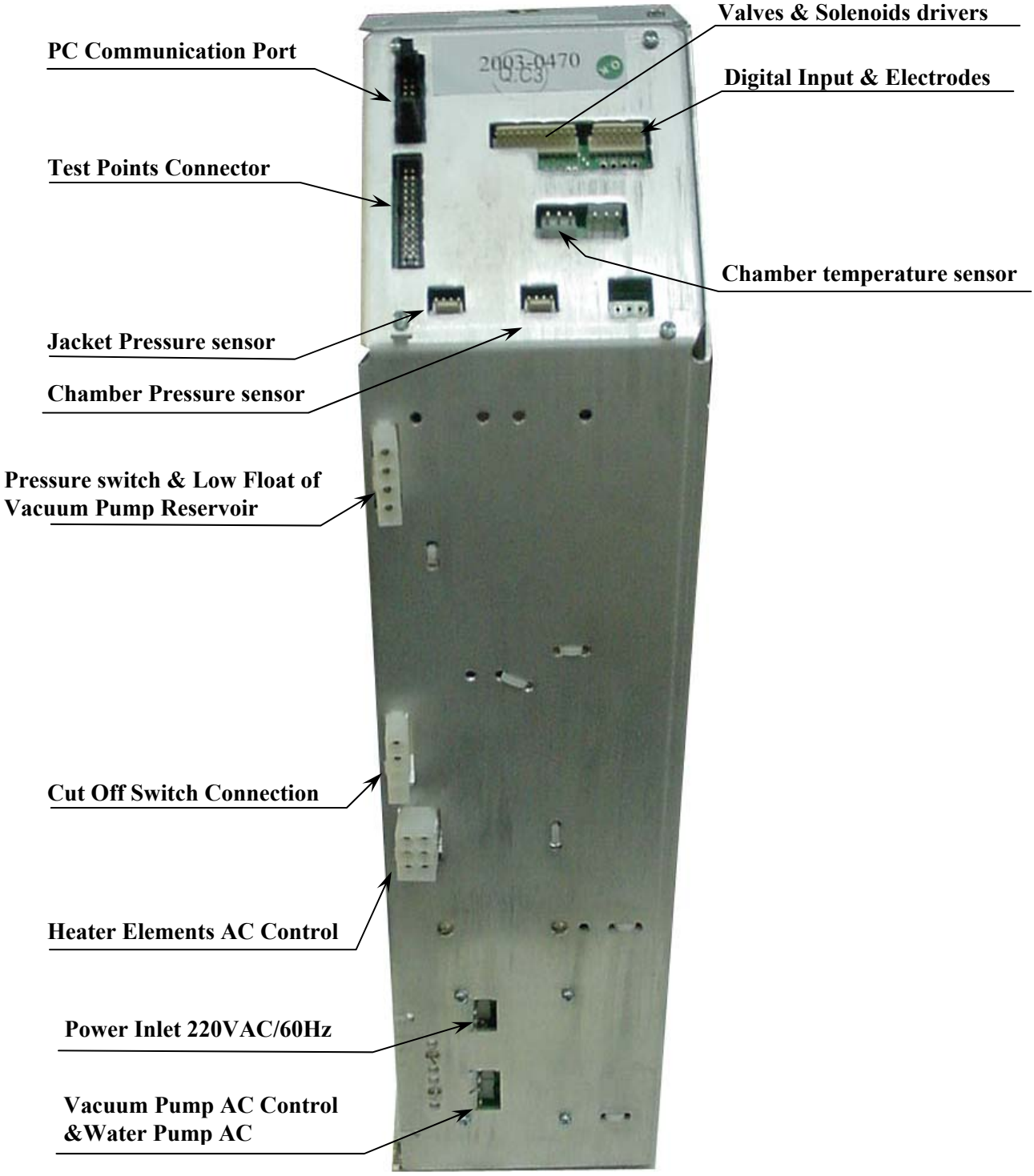
No.	DESCRIPTION	2540 EHS	3870 EHS
31.	Valve, Manual Ball, Mini, 1/4"	VLV170- 0055	VLV170- 0055
32.	Pump, Water, EX7, 220v, Ulka	PUM055-0010	PUM055-0010
33.	Pump, Vacuum, Water Ring, V6, 110V, Speck	PUM057-0000	PUM057-0000
34.	Valve, Solenoid, 12VDC-12W, ASCO	SOL026-0023	SOL026-0023
35.	Switch, Pressure, TY85, Campini	THE005-0006	THE005-0006
36.	Microswitch, E13-00M, 15A, 125/250VAC, 3/4HP, Cheery	ELE036-0001	ELE036-0001
37.	Sensor, Temperature, PT100, 5X80	THE003-0013	THE003-0013
38.	Cover, Door	POL066-0002	POL065-0003
39.	TTA Door Spring Housing	ELE036-0009	ELE036-0009
40.	Spring for TTA Door Locking M.Sw.	SPR177-0012	SPR177-0012
41.	Cover, Reservoir, Water, Superp.	POL067-0004	POL067-0004
42.	Outer cover	COV254-0002	COV387-0015
43.	Rear cover	RCV254-0009	RCV387-0002
44.	Cover, Printer Opening, Superp.	POL067-0002	POL067-0002
45.	Transducer, Pressure, MPX 2200 AP	THE006-0003	THE006-0003
46.	Power Supply, PM65-23A	ELE035-0032	ELE035-0032
47.	Relay, Solid State, 25A/230V	CTP201-0065	——
48.	Relay, Solid State, 25A/480A	——	CTP201-0093
49.	Board ,Full ,ANL-T2V1	CTP201-0119	CTP201-0119
50.	Board, Electronic, Digital, DIG-T2VI, With Keypad ,E-Type	CTP201-0102	CTP201-0102
51.	Board, Electronic, AC-T1, Full	CTP201-0096	CTP201-0096
52.	Fan, Axial, 12VDC, 80mm	CTP201-0000	CTP201-0000
53.	Capacitor, 2.2MF, 400V	ELE041-0001	ELE041-0001
54.	Heating Element, 230V, 3/8*350	HEA015-0003	——
55.	Heating Element, 230v, 3/8*450	——	HEA015-0005
56.	Cable, Flat, 37P,25cm, DIG T-2 TO ANL-T2	CTP201-0083	CTP201-0083
57.	Cable, Flat, 9P, 56cm, ANL-T2 to RS232	CTP201-0084	CTP201-0084
58.	Leg, Front, Long, TTA	WHE070-0013	WHE070-0013
59.	Cable, Flat, Printer, 25CM, 34P	WIR040-0070	WIR040-0070
60.	Leg, Rear	CMT254-0003	CMT254-0003

No.	DESCRIPTION	2540 EHS	3870 EHS
61.	Check Valve, Spring Disk, 1/4", St.St., Mondeo	ARM172-0007	ARM172-0007
62.	Strainer, water, Y type, 1/4", 192, Itap	FIL176-0028	FIL176-0028
63.	Shock Absorber, 9/12, 6mm, V6, V30	SKR203-0003	SKR203-0003
64.	Shock Absorber, ULKA Pump	SKR203-0006	SKR203-0006
65.	Filter, Water, PVC	FIL175-0020	FIL175-0020
66.	Disc, Silicone, Door Bellows	GAS080-0006	GAS080-0006
67.	Bellows, Door Lock	GAS080-0020	GAS080-0020
68.	Tightening Bolt, Door Locking Bellows	LOK240-0026	LOK240-0026
69.	Housing, Door Locking Bellows	LOK240-0025	LOK240-0025
70.	Membrane pin	L0K240-0023	L0K240-0023
71.	Inner bushing for bellow	CMT067-0002	CMT067-0002
72.	Keypad panel	CTP210-0102	CTP210-0102
73.	Bolt, Door Tightening, Assy.	LOK240-0036	LOK387-0007
74.	Handle, Door, Bakelite	HAN071-0003	HAN071-0006
75.	Washer, Ocolon, Door Tightening Bolt	LOK240-0017	LOK387-0017
76.	Bushing (1) + Locking screw housing (3) + Closing bridge “c” clip (8)	LOK240-0002	LOK387-0002
77.	Locking Unit, Door, Assembly	LOK240-0001	LOK387-0032
78.	Cover, RS232 Opening, Superp.	POL067-0003	POL067-0003
79.	Cover, Validation Port	POL065-0006	——

EXTERNAL CONNECTION OF THE 2540EHS AUTOCLAVES ELECTRONICS BOX

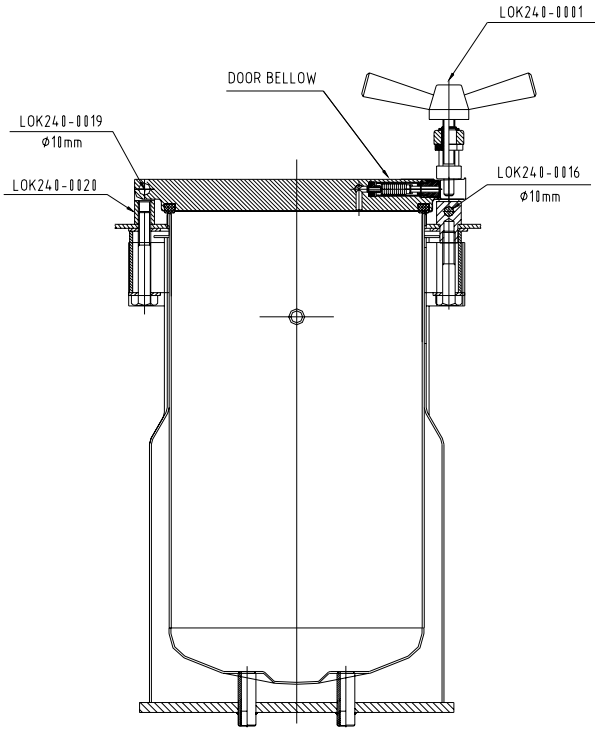


EXTERNAL CONNECTION OF THE 3870EHS AUTOCLAVES ELECTRONICS BOX

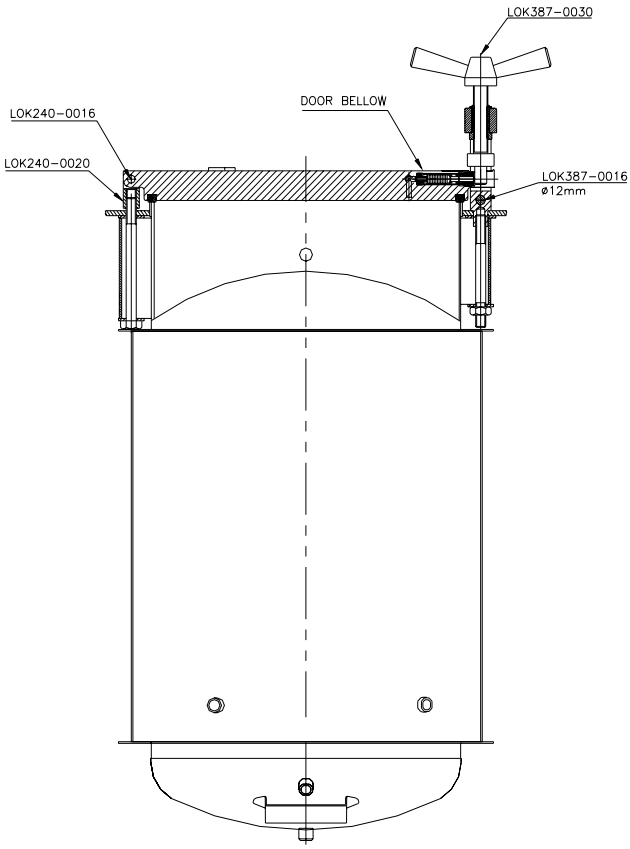


VESSEL ASSEMBLY

Model 2540 EHS

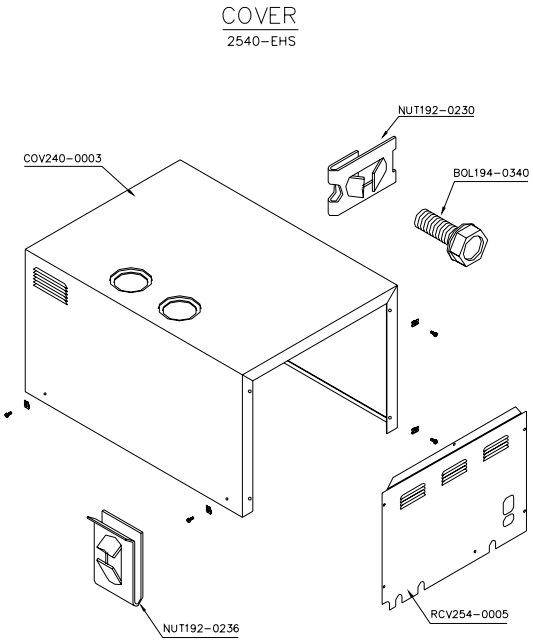


Model 3870 EHS

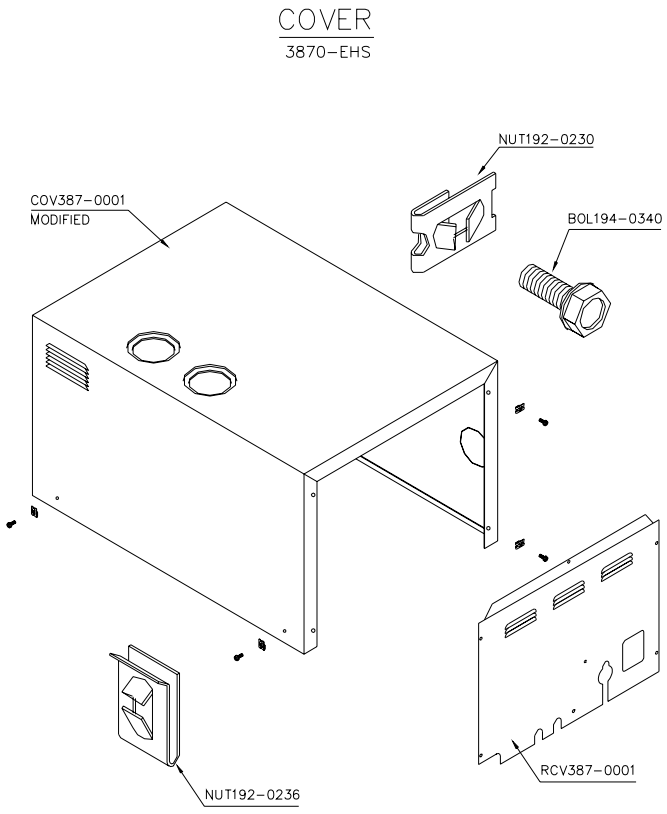


OUTER CABINET – ASSEMBLY

Model 2540 EHS

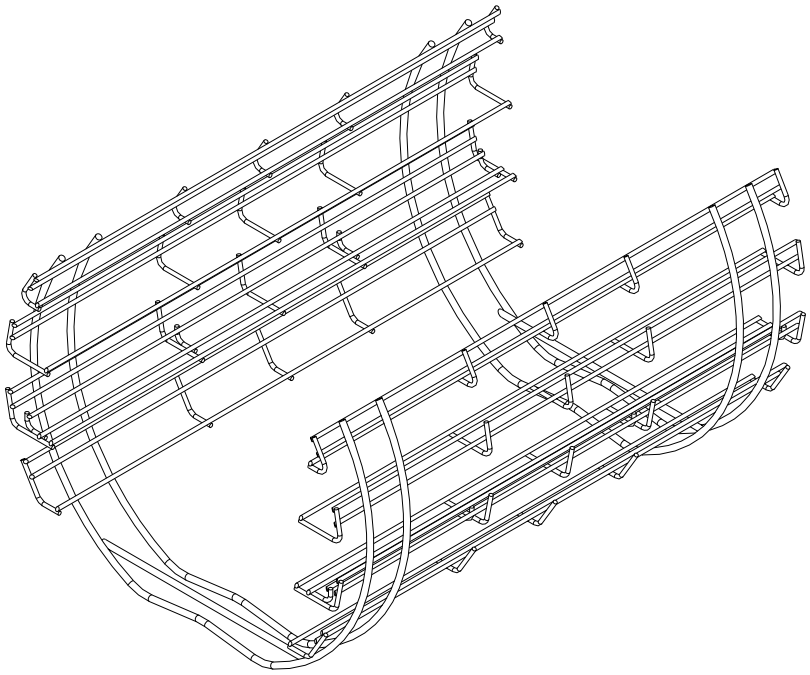


Model 3870 EHS

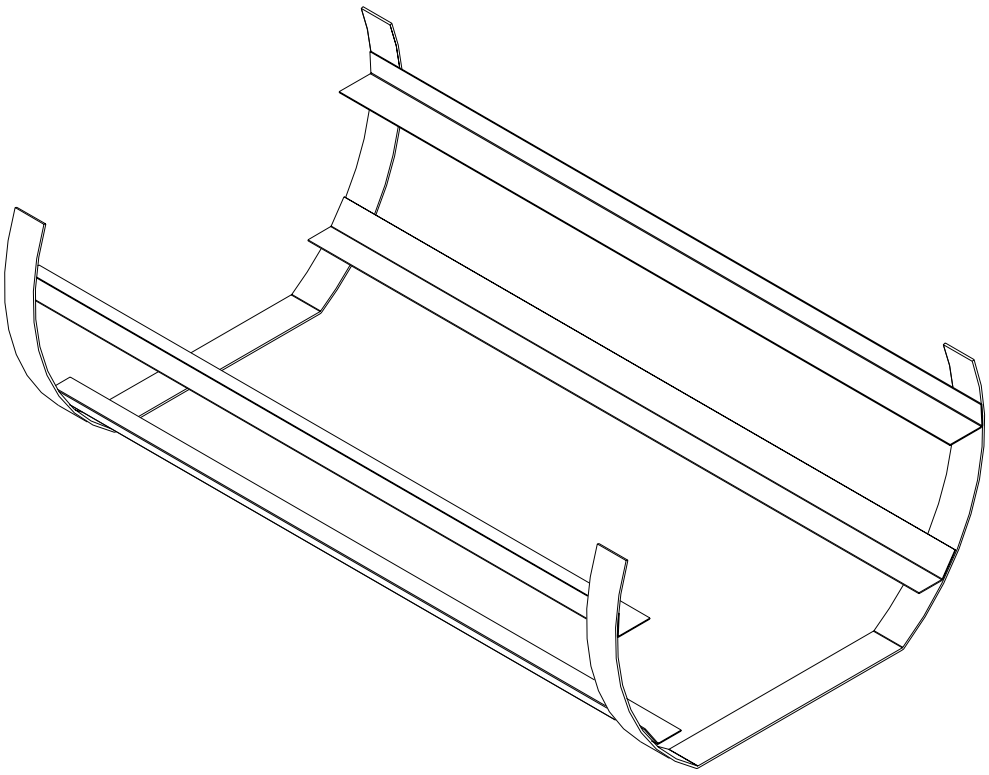


TRAY HOLDER

For model 2540 (*TRH254-0009)*

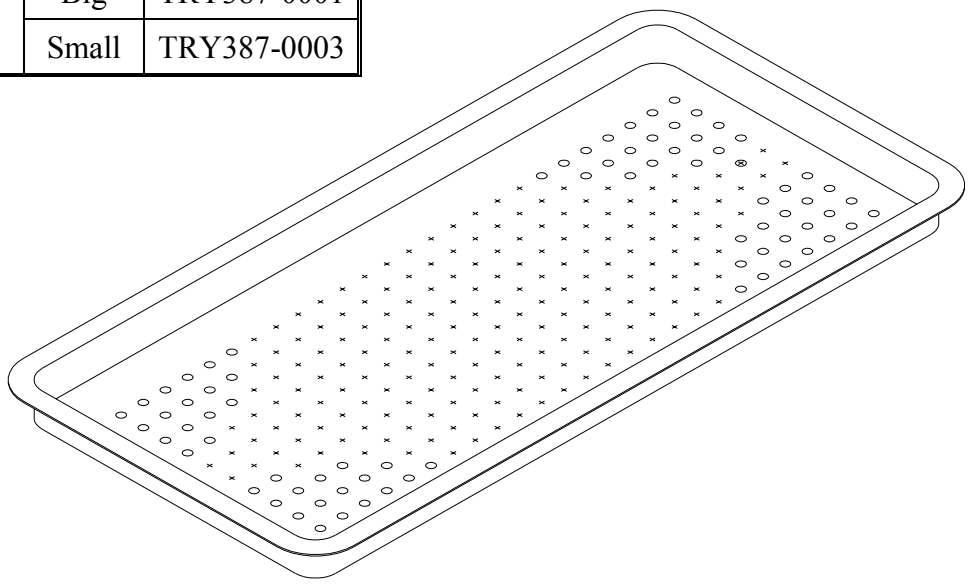


For model 3870 (*TRH387-0001)*

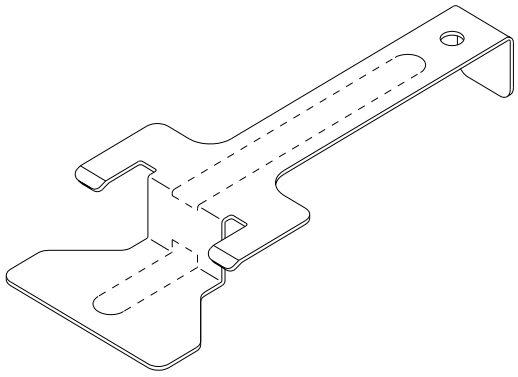


TRAY

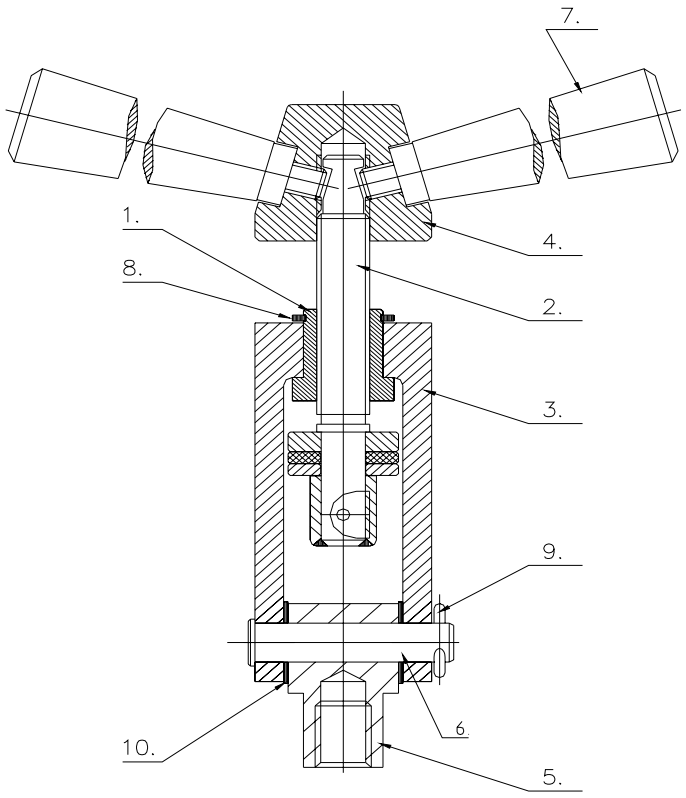
MODEL	SIZE	CAT. No.
2540		TRY240-0001
3870	Big	TRY387-0001
	Small	TRY387-0003



TRAY HANDLE (CMT240-0001)



DOOR TIGHTENING BOLT – ASSEMBLY



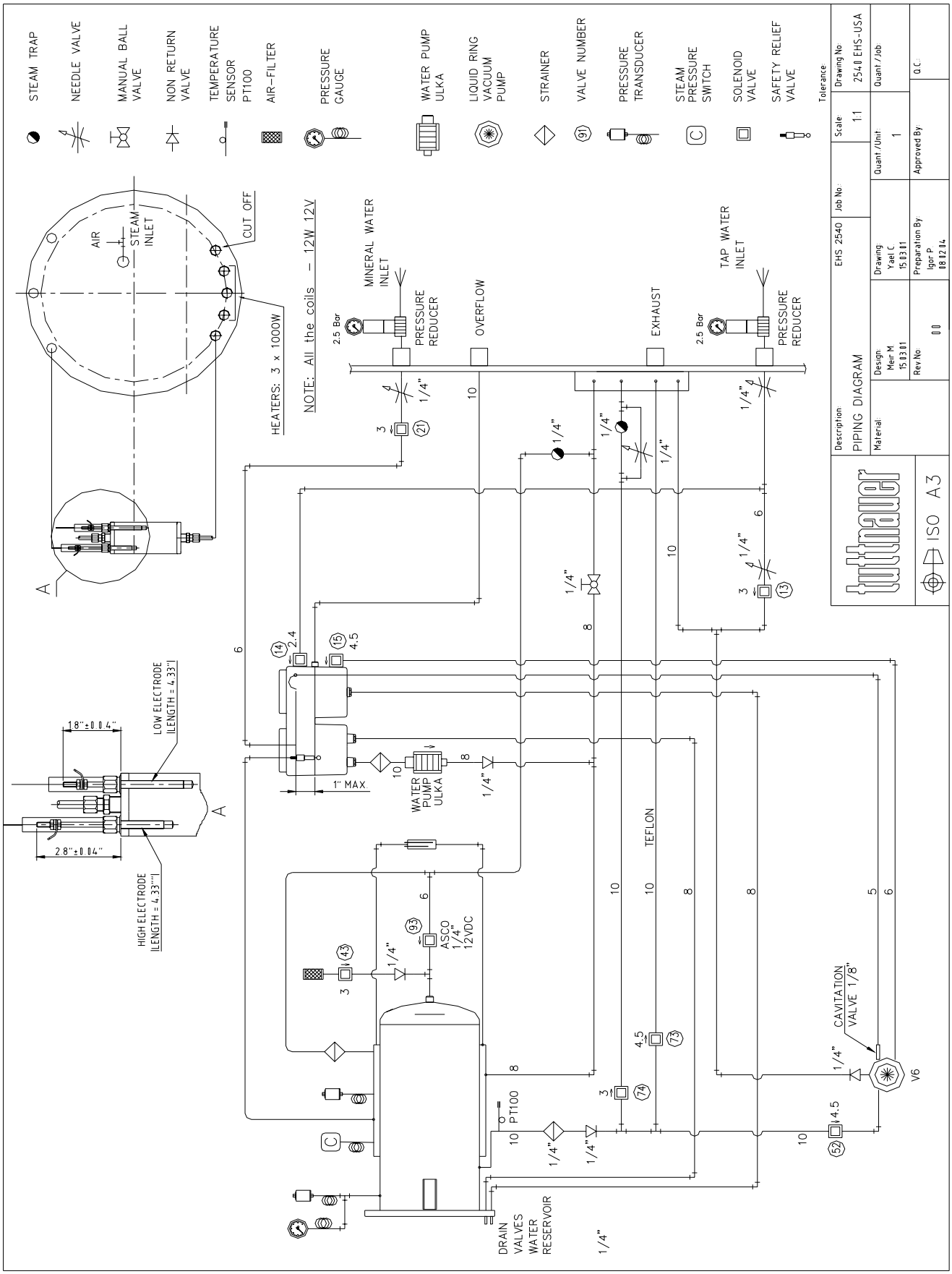
No.	Description	Cat. No.	
		2540	3870
1	Bushing	LOK240-0003	LOK387-0003
2	Door tightening bolt assembly	LOK240-0036	LOK387-0007
3	Locking screw housing	LOK240-0005	LOK387-0006
4	Locking base	LOK240-0012	LOK387-0012
5	Locking housing axe	LOK240-0014	LOK387-0014
6	Door locking device pin	LOK240-0019	LOK387-0016
7	Bakelite handle	HAN071-0003	HAN071-0006
8	Closing bridge “c” clip	NUT193-0339	NUT193-0300
9	Cotter pin	LOK692-0039	LOK692-0039
10	Okolon disc	LOK240-0017	LOK387-0017
	Bushing (1) + Locking screw housing (3) + Closing bridge “c” clip (8)	LOK240-0020	LOK387-0029
	Door tightening bolt – assembly	LOK240-0001	LOK387-0030

12 VALVES NUMBERING

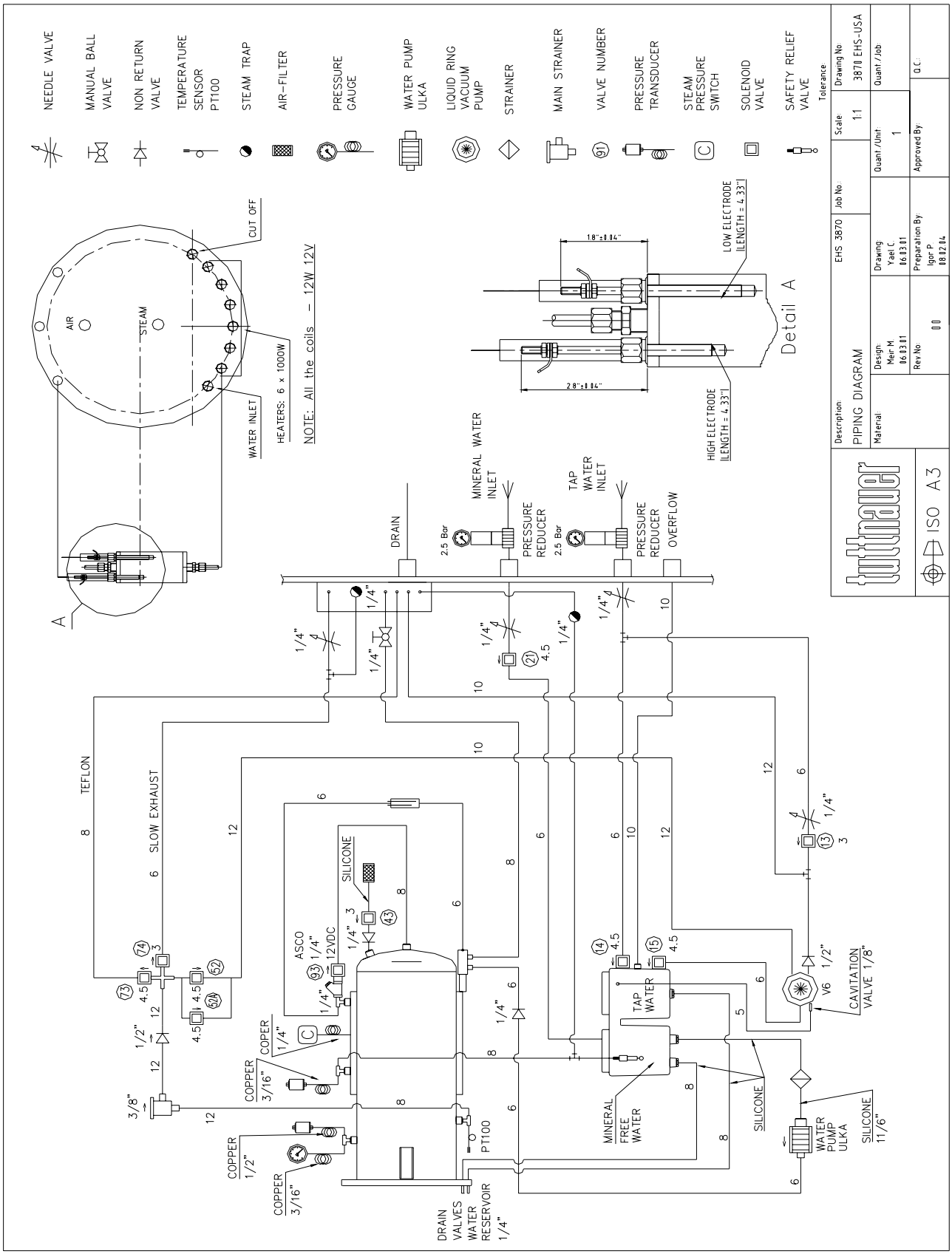
The valves in the drawing and the manual are numbered according to their function. The following list includes all the valve numbers that are in use in this manual

			Size mm	
			2540	3870
1.	FEED WATER	13. Feed water – cool fast exhaust 14. Feed water – to reservoir 15. Feed water – to vacuum pump	3 2.4 4.5	3 4.5 4.5
2.	MINERAL FREE WATER	21. Mineral free water - inlet	3	4.5
4.	AIR	43. Filtered air - inlet	3	3
5.	VACUUM	52. Vacuum - to pump	4.5	4.5
7.	EXHAUST	73. Fast exhaust 74. Slow exhaust	4.5 3	4.5 3
9.	STEAM	93. Steam – to chamber	ASCO 1/4" 12VDC	ASCO 1/4" 12VDC

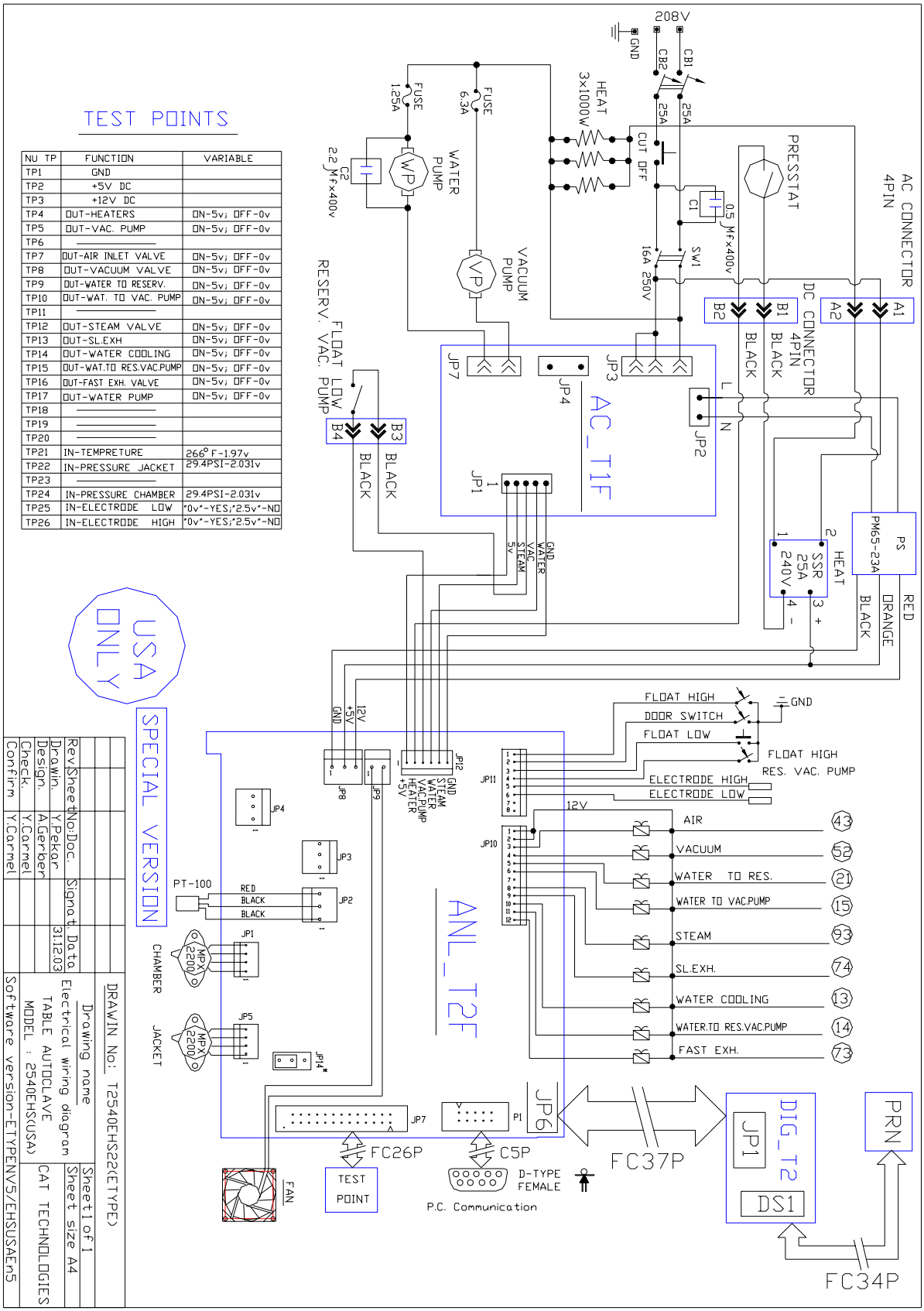
PIPING DRAWING FOR 2540 EHS



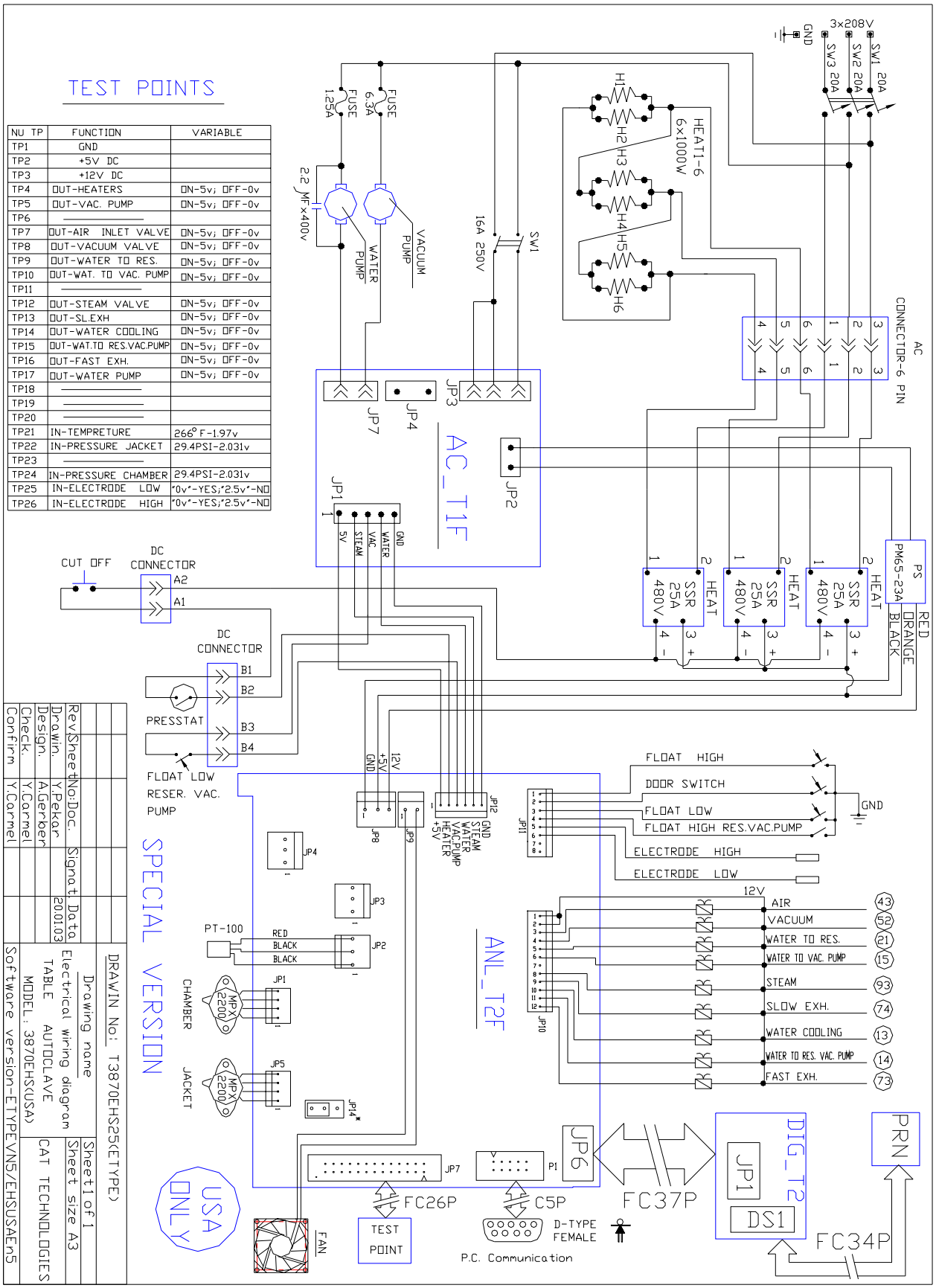
PIPING DRAWING FOR 3870 EHS



ELECTRICAL DRAWING FOR 2540 EHS



ELECTRICAL DRAWING FOR 3870 EHS (TILL S/N 2307039)



ELECTRICAL DRAWING FOR 3870 EHS (AFTER S/N 2307040)