Operation & Maintenance Manual

Front Loading Priorclave with Vertical Power Door Electrically Heated

Introduction

Priorclave autoclaves are a range of general-purpose laboratory autoclaves intended primarily for media preparation, the making safe of ordinary laboratory and pathological waste and other apparatus sterilisation purposes. The autoclaves are manufactured to a high standard and feature a number of patented innovative design features. The sophisticated **TACTROL** microprocessor control system provides a very simple method of setting even the most complex cycles. The machines have been designed from the outset for easy and safe operation and maintenance.

Properly looked after your autoclave should give years of valuable and trouble free service.

Priorclave Service

Serial Number:

Date of Manufacture:

Software Version:

Please quote the above when asking for parts or service:

PRIORCLAVE LIMITED

129 /131 Nathan Way
West Thamesmead Business Park
London
SE28 0AB

Telephone: +44 (0)208-316-6620
Fax: +44 (0)208-855-0616

E-mail: service@priorclave.co.uk
Website: www.priorclave.co.uk

or your local distributor:

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Important Notices

Priorclave Pressure Vessels and Autoclaves are manufactured according to BS2646 Part 1 (1993). It is recommended that the user/operator ensures that the autoclave is installed, operated, maintained and tested according to parts 2,3,4 & 5 of this standard for safe and effective use and that an adequate logging record of operation and maintenance be established.

Before despatch from our works all Priorclaves are subjected to rigorous electrical safety tests to the appropriate standards. Should you or your contractors carry out further insulation and flash tests as part of your internal procedures please disconnect the switch mode power supply before testing. Failure to do so will result in a test failure and may lead to corruption of the microprocessor memory which cannot be covered by our warranty.

Safety

If you are unclear about any aspects of this manual, the use and operation of the autoclave or your autoclave process please contact Priorclave or your authorised Priorclave dealer before proceeding.

Always wear gloves a facemask and adequate protective clothing when unloading an autoclave and ensure that the workload does not exceed safe limits.

Priorclave are pleased provide training for operators in the use of their autoclaves at a small extra charge.

Risk of injury from powered moving parts

The power door lifting and clamping mechanism is very powerful and great caution should be exercised when in the proximity of this system. Adjustments or repairs must only be carried out by fully trained personnel.

Thermal Lock

The safety Thermal Lock (80^{o}C door retention device) has been set in accordance with the load and procedure defined in paras. 3.3.3.2.3 and 3.3.3.3 of BS2646 Part 5:1993.

The relatively light load defined under this procedure may not be appropriate to the load to be autoclaved in your Priorclave. Therefore, to ensure compliance with Health & Safety Executive Guidance Note PM73 ‘Safety at Autoclaves’ and to avoid possible injury you are strongly advised to have your autoclave with its normal working load formally validated, and the thermal lock set up accordingly by properly trained personnel.

Stainless Steel Pressure Vessels.

Vessels are manufactured from grade 316L stabilised stainless steel (also known as 316 S.11 or EU grade 1.4404), designed built and tested in accordance with BS5500 category 3 as required by BS2646 Part 1. Grade 316 stainless steel is employed to reduce the corrosive effects of substances such as hydroxides and chlorine. However we recommend that the interior of the vessel is kept free of such potentially harmful substances and is regularly cleaned out with soft water. The use of chlorine based or other aggressive cleaners is not recommended. Exposure to such chemicals could damage the surface finish and the integrity of the pressure vessel and door. Care should also be taken not to routinely introduce such chemicals where they are used to pre-wash items that form part of the load. In such cases the items should be thoroughly rinsed before autoclaving.

During manufacture of the pressure vessel it is necessary to use carbon steel tools and, although every effort is made to remove any residual internal contamination, some carbon steel pickup or traces may become evident during use as small particles of rust. These are not a cause for concern and will not affect the integrity of the pressure vessel in any way. These can easily be removed with a nylon type scouring pad. As noted above the use of aggressive cleaners is not recommended.

Product Life

Due to fatigue occurring in normal use the life of all pressure vessels is finite regardless of corrosion, erosion or other damage. Using a calculation from BS3970, and assuming an average autoclaving cycle time of 2.5 hours this gives the autoclave vessel a projected fatigue life of 10,000 operating cycles. The lifespan of the autoclave will obviously depend upon frequency of use, but for example (based on a 365 day working year) if the autoclave is used two or four times per day this gives a working life of 13.6 to 6.8 years respectively. Your own usage of the autoclave should be considered to determine the actual lifespan of the autoclave.

Cleaning

This equipment contains sensitive electrical equipment. Although designed to withstand laboratory conditions it is not designed for wet cleaning. Cleaning this equipment by hosing down may cause damage, invalidating the warranty, and may cause an electrocution hazard.

External cleaning should be carried out with a damp cloth or with proprietary, non-abrasive cleaners.

Servicing and Maintenance of Priorclave Autoclaves

Priorclave Laboratory Autoclaves are complex pressure systems designed and built to special regulations and as such should only be serviced or maintained by properly trained personnel. Priorclave Ltd. cannot be held responsible for hazards or damage resulting from work carried out on the pressure system by untrained or unauthorised personnel. If in doubt please contact Priorclave Service or your nearest authorised dealership.

CE Marking

The CE mark applied to this autoclave is applied in relation to the EMC (Electromagnetic Compatibility) directive and the Low Voltage directive of the European Community. This indicates that this Priorclave autoclave meets the following technical standards :

- **EN50081-1**
  Electromagnetic Compatibility. Generic Emission Standard. Residential, Commercial & Light Industry.
- **EN50082-1**
  Electromagnetic Compatibility. Generic Immunity Standard. Residential, Commercial & Light Industry.
- **BS EN 61010-1: 1993**
  Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use.
- **BS EN 61010-2-041: 1996**
  Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use; Part 2-041, Particular Requirements for Autoclaves using Steam for the treatment of Medical Materials and for Laboratory Processes.
- **EN 46001: 1997**
  If used for the sterilisation of medical equipment within the scope of the Medical Devices Directive the CE mark is applicable to this directive. If using this equipment for the sterilisation of medical equipment your attention is drawn to the need for the consideration of the standards that may be applicable to the type of equipment to be sterilised. If in doubt consult the manufacturer. In all cases autoclaves used for the sterilisation of medical devices must be validated in accordance with EN554 before use. This product is manufactured in accordance with EN46001.

Pressure vessels

- **PD5500 2000**
  Unfired fusion welded pressure vessels
- **BS2646 1996**
  Autoclaves for sterilisation in laboratories
- **BS3970 1990**
  Sterilising and disinfecting equipment for medical products

Conformity assessment modules B1 + D of the European Pressure equipment directive have been applied to ensure compliance with the essential safety requirements.

A “Declaration of Conformity” in accordance with the above standards has been made and is on file at:

Priorclave Ltd.
129 /131 Nathan Way
West Thamesmead Business Park
London SE28 0AB

Environmental Conditions

This equipment has been designed for safe operation within the following environmental conditions:

- Indoor Use.
- Altitude up to 2,000 M. (See Appendix B - Steam Table for special conditions affecting calibration for operation at elevated altitudes).

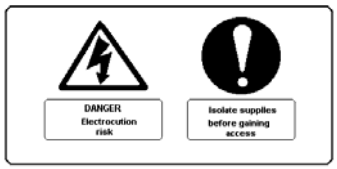
- Temperatures between 5°C and 27°C.
  The Tactrol control system of your Priorclave has been designed and tested to comply with the temperature requirements of IEC 68.2.4 and BS2011 part 2.1DA, and gives satisfactory performance in accordance with those Standards at 40ºC.
  However, as this equipment is mounted into a compartment fitted to heat generating equipment, the maximum room temperature during autoclave operation should not exceed 27ºC.
  Temperatures in excess of this will cause the cold junction compensator circuits to malfunction and result in sterilisation failure.
  N.B. Excessive room temperatures will, in the case of air-cooled units, also affect cooling speeds and prolong overall process times
- Maximum Relative Humidity of 85% at any temperature between 5°C and 40°C.
- Mains Supply Voltage Variations not exceeding +/-10% of that shown on the Serial Plate.

Electromagnetic Interference

This equipment has been designed to comply with the requirements for immunity from electromagnetic interference under normal conditions of use. Care should be taken when siting the equipment however, to avoid interference from potential extreme sources of interference such as MR scanners or x-ray equipment.

Hazard Statement

Electrical Hazard Stickers



When this sticker has been placed on a removable panel the power must be switched off before the panel is removed. There may be a number of areas behind the labelled panel that constitute an electrical shock hazard. All such panels are service access panels only and should not be removed unless there is a full understanding of the equipment.

Mechanical Hazard Sticker

When this sticker has been placed on a removable panel the power must be switched off before the panel is removed. There may be a number of areas behind the labelled panel that constitute a mechanical hazard. All such panels are service access panels only and should not be removed unless there is a full understanding of the equipment.

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Layout Diagram

Control Panel (For detail see control panel layout diagram)

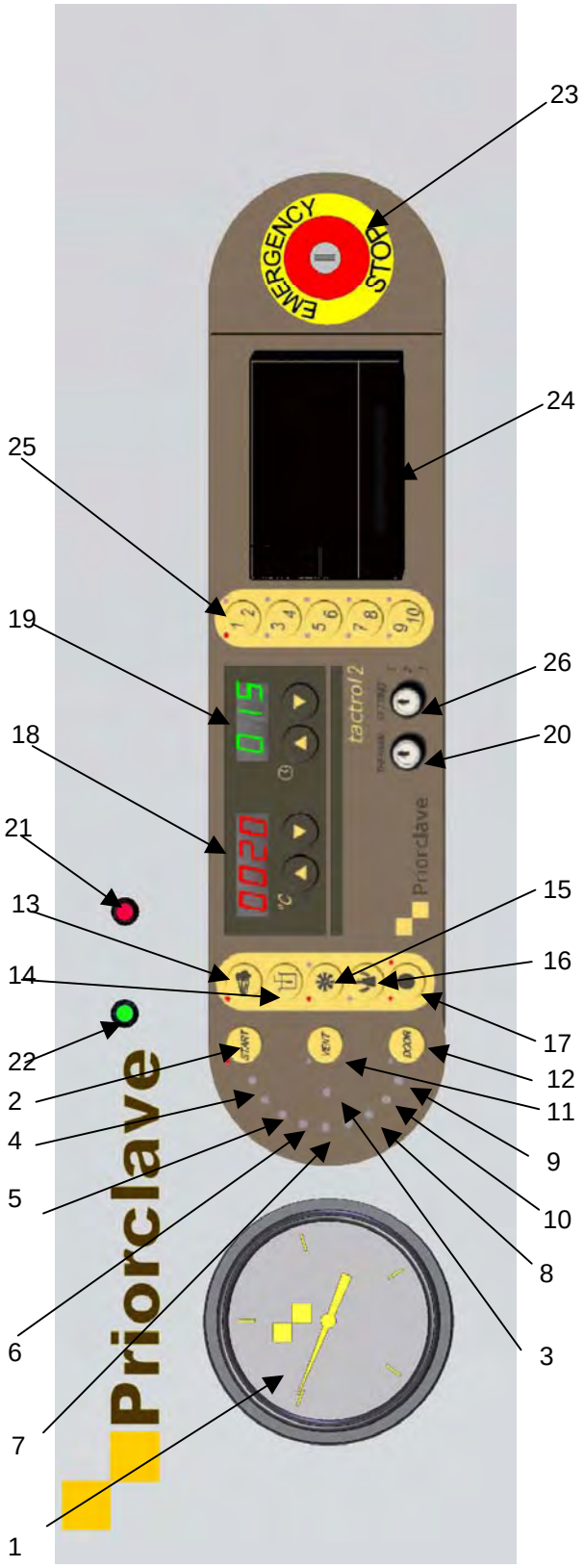
Emergency Stop Button for Power Door Mechanism

Outer Door Cover

Access to Cable Ports

Hydraulic System, Vacuum System and Steam Generator (if fitted)

Control Panel Layout Diagram



Key

1. Chamber Pressure Gauge
2. Start Button/Indicator
3. Pre-Cycle Vacuum Indicator
4. Heat Indicators
5. Freesteam Indicator
6. Heat-up to Process Indicator
7. Process Indicator
8. Cooling Indicators
9. Complete Indicator
10. Media Warming Indicator
11. Vent Button/Indicator
12. Door Button/Indicator
13. Freesteam Select Button/Indicator
14. Load Sensed Process Timing Select Button/Indicator (optional)
15. Cooling Select Button/Indicator
16. Media Warming Select Button/Indicator
17. Vacuum Select Button/Indicator (optional)
18. Temperature Display/Setting
19. Timer Display/Setting
20. Thermal Lock Key-switch
21. Door Control System Fault Indicator
22. Door Cover Unlocked Indicator
23. Door Mechanism Emergency Stop Button

Optional Fittings

24. Printer
25. 5/10 Program Memory Buttons/Indicators
26. Setting Lock Key-switch

Operating Summary

N.B. Before proceeding please check the specification sheet included with this manual to establish which options and accessories, if any, are fitted to your Priorclave. This will determine whether you will need to read the instructions for these options later in this manual.

Check the electricity and water supplies are **ON**.

Press and release the '**Door**' button on the control panel. There will be a bleep and the message '**hoLd**' will be displayed in the timer display. Wait for a short time until the timer display returns to normal, there is another bleep and the '**Door**' indicator illuminates.

1) Check that the pressure gauge is reading zero and you may now press and release the '**Door**' button to start the door opening sequence. The outer door cover must be kept **closed** or the door will not operate.

2) The door will now go through its opening sequence behind the outer cover.

3) Once the door has fully opened, press and release the '**Door**' button again to release the outer cover locking solenoid. When the cover is ready to open the Outer Door Locked control panel LED will illuminate. Do **NOT** try to force the outer cover open when locked.

4) Top up with water if necessary to just below the level of the weir or if an automatic water-fill system is fitted, allow the autoclave to fill automatically to this level.

5) Load the autoclave with baskets or containers.

6) Set the temperature as required using the **up/down** keys.

7) Set the process time as required using the **up/down** keys.

8) Set / select other functions i.e. free-steam, rapid cooling etc., as required and if fitted.

9) Carefully close the outer door cover.

10) Press and release the '**Door**' button to start the door closing sequence. The door will now lift into place and lock behind the outer door cover.

11) Wait a few seconds for the '**Start**' indicator to illuminate, and press the '**Start**' button to begin the cycle.

Cycle Abort and Thermal Lock Override

Aborting a cycle

To abort the cycle at any stage press the '**Start'** Button.

Thermal Lock Override

First abort the cycle as above. After checking that there is no pressure within the autoclave turn the thermal lock key to the right and hold it there. Then press the '**Door**' button once, keeping the thermal lock key held over. Wait during the **'hoLd'** display until the '**Door**' indicator illuminates. Keep the key held and press the '**Door**' button to unlock the door. The key-switch can now be released. If the key is released at any stage the procedure must be repeated to open the door and reset the display.

Preparing Your Priorclave for Use for the First Time

Unpack the autoclave and check against the delivery note that all items ordered have been delivered.

Any shortages or damage must be reported to Priorclave Limited within 7 days of delivery.

Positioning

When positioning the autoclave consideration should be given to proper access for servicing and maintenance purposes. Space must also be allowed for pipework and electrical connections.

The autoclave has castors fitted to allow positioning and should ideally be positioned within easy reach of a suitable isolatable electrical supply and drain. See Installation.

All autoclaves during their process cycle will release steam and heat, and this should be taken into consideration when choosing a site in your laboratory in which to install your autoclave

Provision of Space and Access for Accessories

Autoclaves with drain condensers

Drain condensers are fitted to the rear panel of front loading autoclaves, and require sufficient space to be allowed for pipework to enter the condenser. Drain condensers for top loading autoclaves are supplied as separate units and consideration should be given to where the condenser is to be located as it may not be practical to site this to the rear of the autoclave. Drain condensers may operate at high temperature depending on final settings, and effectiveness of the cooling water supply. Consideration should be given to heat hazards when deciding on the location of a condenser.

When all pipework is complete the condenser will occupy a space of approximately 300 x 500mm.

Autoclaves with exhaust filtration

The location of exhaust filters will vary according to the individual specification of the autoclave. In the case of rectangular vessel autoclave the filter is usually fitted inside the autoclave vessel, and in such cases further consideration of the filter location is not necessary.

In the case of top loading and smaller front loading autoclaves it is not possible to locate the filter inside the vessel due to space constraints and limitations of currently available filter mediums. It is then necessary for the filter to be located in a separate pressure vessel outside of the autoclave. External exhaust filter housings are located to the upper rear of the autoclave, and protrude from the left-hand side as viewed from the front of the autoclave by up to 200mm. In normal circumstances the filter housing will fit into the 300mm space already provided to the rear of the autoclave. Special arrangements for the location of exhaust filters can be made on request.

It is normal for exhaust filter housing to reach temperatures in excess of 100^{o}C, therefore consideration should be given to heat hazards when deciding on the location of an autoclave with an exhaust filter. Provision should be made to protect personnel from heat hazards whist maintaining adequate access for filter replacement. A minimum height of 500mm is required above the top of the filter housing for replacement of the filter.

Provision should be made to guard or insulate pipes exiting the autoclave where these may present a heat hazard.

Installation

Electrical

To connect your Priorclave to the power supply simply connect a suitable cable from your isolator to the isolator on the back of the autoclave. In many cases the isolator will already be connected via a suitable cable and plug. In these cases connect this plug to the matching socket which should be available on your wall.

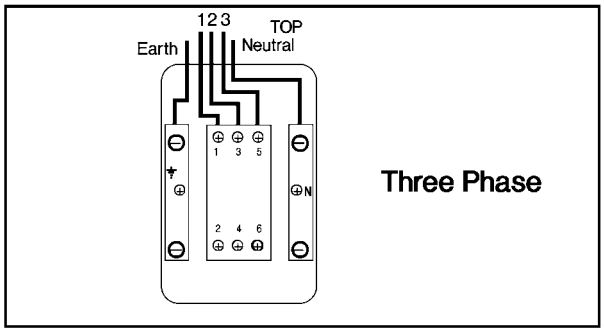
The electrical supply as per the required specification should be terminated in an industrial socket to BS 4343 (IEC/EN 60309-2) which should be located on the wall to the rear of the autoclave within 2 metres of the connection to the autoclave. The socket should be of the 3P + N & E type rated at 16, 32 or 63 Amps

dependent upon the autoclave specification. If not provided as part of the industrial socket a suitable means of isolation is required to be located in a position where it can easily be accessed to terminate power to the autoclave when necessary. The socket and isolator should be installed and tested in accordance with the IEEE Wiring Regulations Sixteenth Edition. If existing electrical services from a previous installation are used this should be examined and tested in accordance with the above regulations by a qualified electrician. If installation is ordered the autoclave is supplied with a plug suitable for connecting to a socket of the above specification. This is connected by a 3 metre flexible cable to the rear of the autoclave. It is important to note that the earth bonding of the plug and cable arrangement is tested before dispatch from the factory, if it is necessary to remove the plug to make alternative arrangements for connection the installation will require re-testing.

If a cable and plug are not fitted then your Priorclave can be wired as shown in the diagram below.

N.B. If a cable has been fitted to the autoclave there should be no need for any further electrical installation.

The power supply should be a 3 phase and neutral isolated supply, rated at 15 Amps per phase and connected to the isolator as in diagram (B). Sufficient length of cable should be used to allow the autoclave to be pulled out and worked on from the back if necessary. The cable used to the earth line and neutral feeds should be capable of carrying the per phase amperage of the supply. The neutral line must be nominally at earth potential and must **NOT** be fused. This equipment must be earthed.



Drainage and Exhaust Gas Ventilation

The various inlets and outlets are situated at the back of the autoclave and are labelled with their individual functions. Within the space constraints of the autoclave cabinet, where possible drains and inlets have been combined to reduce the number of connections required. Please read the following guidance before proceeding with connection to drains and water supplies.

General

Autoclaves used for processing laboratory waste must be provided with a drainage connection as described below. This is a requirement of British Standard 2646. A connection will also be required if the autoclave is fitted with any freesteaming or vacuum options as significant amounts of steam will be released from the autoclave at different stages of the cycle. The hazard groups below are as defined by the Advisory Committee on Dangerous pathogens as published in *Categorisation of Pathogens According to Hazard and Categories of Containment.*

Extract from BS2646 Part 2 1990

7.2 Drainage system

"The drainage system from the autoclave should prevent dispersion of splashes and steam into the working area. For autoclaves designed for a make-safe process, discharge should be directed to a sealed discharge system; the system should lead by direct connection to a building drain or catchment tank.

An open tun dish is not suitable for the discharge line of a laboratory autoclave, which is to be used for a make-safe process.

The sealed discharge system should be vented to a high level by a pipe not less than 30mm diameter. The vent pipe should be directed outside the building. Steam should not emit from the vent pipe."

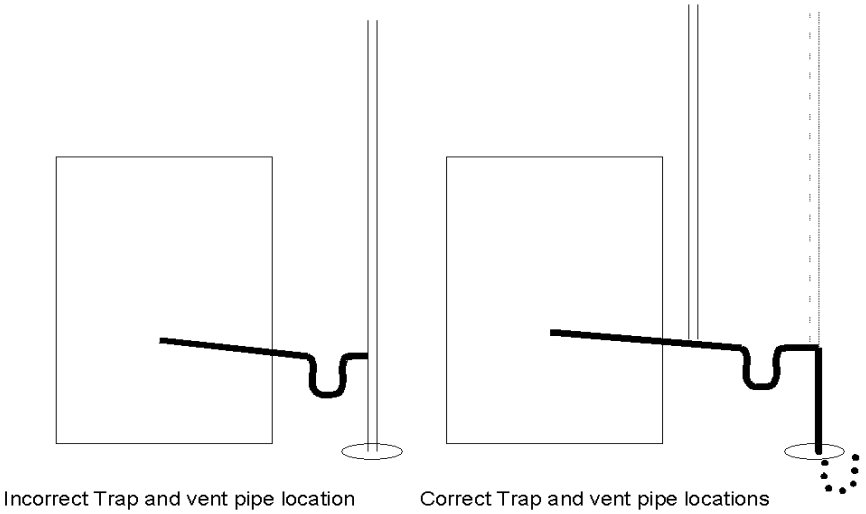
From Scope of BS2646

"This Part of BS2646 gives guidance on the planning for, and installation in laboratories of, autoclaves for the sterilisation of materials and equipment, including those which may be contaminated with organisms categorised as Hazard Groups 1, 2 or 3. It does not cover the installation of autoclaves used for material

contaminated with organisms categorised as Hazard Group 4, for which complete containment of condensate is considered to be essential."

A further comment in a later clause adds…

"In certain circumstances, e.g. special research activities involving high concentration and/or large volumes of agents in Hazard group 3, additional safeguards may be required. The advice of the Health



Incorrect Trap and vent pipe location Correct Trap and vent pipe locations

and Safety Executive should be sought in each such case. Further containment than that detailed above, (Generally as described below in this case.) *filtration or heat treatment of discharge is only necessary for autoclaves used to process material contaminated with organisms in Hazard Group 4."*

In case of any doubt the full text of BS2646 should be consulted.

The autoclave requires a sealed connection to a trapped building drain. This drain should be provided with a heat resistant vent pipe of 30mm minimum diameter vented freely to atmosphere at a safe location outside the building. Care must be taken in the design of the drainage connection to ensure that an air break will be preserved at all times to prevent the autoclave from sucking water back from the drain as it cools. Excessive back pressure produced by restrictions in the vent pipe may impair the function of the autoclave. Note that at some stages of the cycle the autoclave may discharge steam under pressure, and if vent flow is inadequate steam may be forced to exit via other interconnected drains.

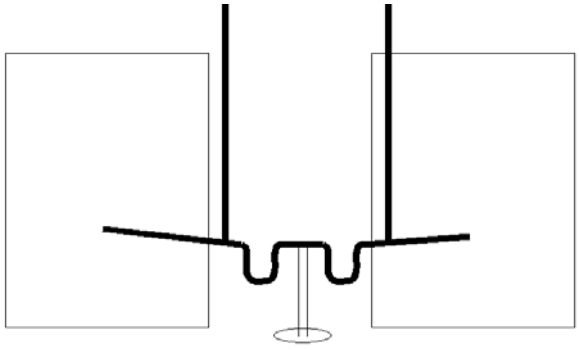
If possible it is always advisable to connect the autoclave to a drain to cut down on the amount of steam discharged into the laboratory. A compression fitting should be incorporated in the drainpipe in an easily accessible location to enable easy disconnection for maintenance purposes.

All drain piping should head downward towards the drain to prevent water collecting in the pipe.

Attention should be paid to the material of the vent pipe as steam and water discharged from the autoclave can be at temperatures in excess of 100^{o}C. In the case of autoclaves with pulsed freesteaming, vacuum drying, and vacuum cooling it may be advisable to fit a drain condenser to cool the autoclave discharge, and condense the steam.

The drain and vent pipe should be in place prior to commencement of installation by Priorclave. It will then be possible to make connections from the autoclave directly into the drainage services provided.

The point where connection from the autoclave to the drainage system is made should be within 2 metres of the autoclave. The location of individual connections is shown on the installation drawings.



If two autoclaves share a common drain separate vent pipes and traps are required to prevent cross flow of steam and water

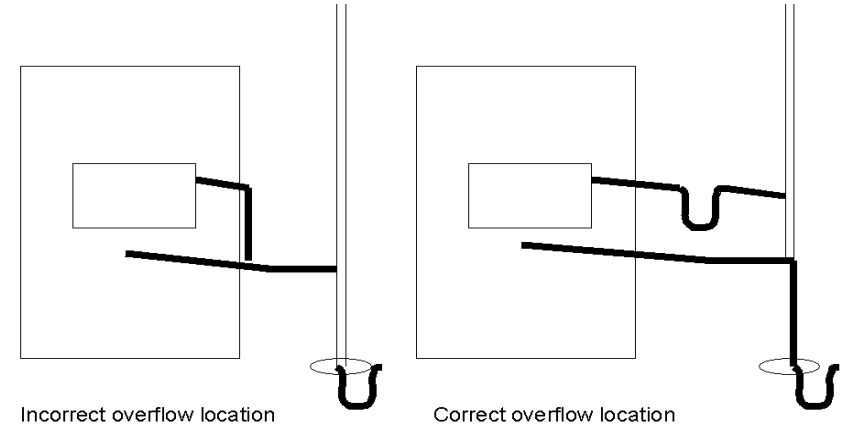
Multiple autoclaves in a single location

If more than one autoclave is to be installed at a single location then the services described need to be provided for each autoclave. If more than one autoclave is utilising the same drain and/or vent arrangement, then there may be problems due to cross flow of effluent between autoclaves. For example if one autoclave is being loaded by the

operator whilst the other is in the freesteaming stage, then it may be possible for hot air and steam being discharged by one autoclave to enter the other presenting a hazard to the operator. If common services are to be shared it is essential that these are sufficiently isolated from one another to prevent cross flow.

Safety Valve

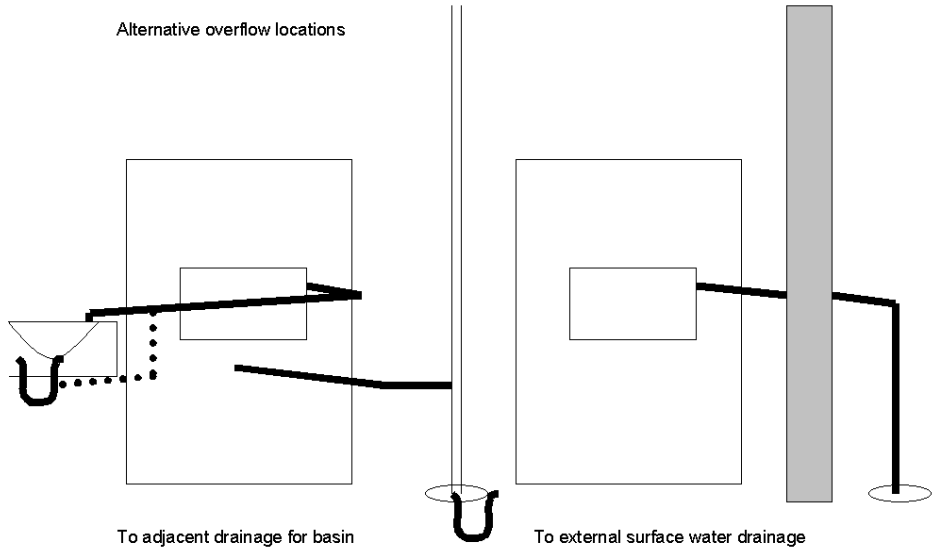
All autoclaves are fitted with an over pressure safety valve to protect the autoclave from over pressurisation. This valve will emit large volumes of steam in the event of the autoclave exceeding its maximum working pressure. It is a requirement during safety valve function, and routine testing to be able to see and hear if the safety valve has operated. It is Priorclave's preferred policy to direct the safety valve outlet to discharge to the floor at the rear of the autoclave. Some establishments prefer safety valve outlets to be piped to a high level outside the building. If this is required the pipework for this should be provided, and terminated within 1 metre of the safety valve discharge point at the rear of the autoclave. All safety valve pipework should be DN25. A drainage point should be provided at the lowest point of the safety valve pipework. This should be a pipe of approximately 6mm ID, and should be positioned to discharge into a suitable receptacle to the rear of the autoclave. No valve should be fitted to this drainage point thereby allowing it to act as a "tell tale" indicating if the safety valve is operating. Under no circumstances must any isolating valve be fitted to the safety valve pipework. External pipework must be



designed to be self draining, and under no circumstances should water be able to collect in a trap, which could freeze in cold weather. See also BS3970 part 1 1990, sections 7.2.4 and 7.2.5.

Autoclaves with water tanks and drip trays

A separate drain is required for the connection of water tank and drip tray outlets. This may be a common connection to the same drainage system as above, but in such cases a sufficient level of isolation (such as a deep trap) is required to prevent the cross flow of steam between the drains. The drip tray and water tank overflow can be connected to an open tundish if desired. This has the advantage of making any discharge from the overflow visible, which is in accordance with water bylaws.



Water Supplies and Back-flow Prevention

The Water Supply (Water Fittings) regulations 1999

Note: The fluid categories below relate only to the above regulations, and are in no way connected with the containment categories previously discussed with reference to drainage and containment of pathogens.

It is mandatory that the completed installation complies with the Water Supply (Water Fittings) regulations 1999 – SI No 1148. This will be dependent on factors outside of the autoclave such as the layout of the water supply provided. The location and usage of the autoclave will determine the fluid category for which back-flow prevention measures are to be taken, however it is suggested in the guidance notes to the above regulations that all laboratories in industrial and commercial installations are considered category 5. Prevention measures suitable for fluids in this category may therefore need to be considered.

The back-flow prevention measures already provided within the autoclave are as follows:

Autoclaves with Automatic Water Fill Systems and Liquid Ring Vacuum Pumps

Water is fed to the autoclave vessel and vacuum pump via a header tank with air gap and circular overflow, which is classified type AF. This alone will provide back-flow prevention measures suitable for fluids up to category 4. Provided that the supply to the autoclave is delivered via a header tank with similar prevention means elsewhere in the building the installation will form an air gap with interposed cistern of type AUK, which is suitable for fluids up to category 5. Separate header tanks for each of these functions are provided allowing the automatic water fill tank to be fed from a treated water supply, and the vacuum pump to be fed from an untreated supply to economize on the use of treated water if required. Considerations for the use of treated water are discussed later.

Autoclaves with Water Cooled Condensers and Water Jackets

For installations falling into lower fluid categories it will be possible to use mechanical means to prevent back flow such as a verifiable single, or non-verifiable double check valve. For higher fluid categories non-mechanical means such as break tanks must be applied. Due to the pressure and flow rates required for the condensers to work effectively it is not practical to provide header tanks locally to the autoclave. The condenser and or jacket will work more effectively when more cooling water flow is achieved across the condenser, therefore the more head of water that can be provided the better.

Arrangements to meet the back-flow prevention requirements will therefore need to be made at a high level. If a water feed from a suitable header tank arrangement to satisfy the regulations cannot be provided it will be necessary to take other measure such as the provision of a break tank and pump arrangement locally to the autoclave.

General

All water supplies should be terminated on the wall to the rear of the autoclave, at a point within one metre of the point of connection to the autoclave. (See installation drawing.)

In hard water areas it will be necessary to use softened water for the supplies to the autoclave to prevent scaling of the autoclave vessel and heating elements. Hard water can also reduce the life span of liquid ring vacuum pumps and drain condensers when fitted, however the cost of supplying treated water to these may be considered prohibitive, and if this is the case, then a second water supply will be required. If the autoclave is to be connected to a distilled or de-mineralised water supply care should be taken to guard against the corrosion of copper pipework due to excessive purity of the water supply. The water level detection system of most autoclaves is operated on a conductivity-based system, due to this feed water requires a minimum conductivity level of 10-15 micro Seimens.

Autoclaves with an automatic water fill system require a DN15 water supply terminated in an appliance tap with a suitable connector for a standard appliance hose.

Autoclaves with liquid ring vacuum pumps require a further DN15 water supply terminated in a 1/2” BSP/DN15 compression fitting.

Autoclaves with drain condensers require a water supply for the condenser. The size of connection for this will vary depending upon the specification for the individual autoclave. In most cases a supply in DN20 will suffice, however in some cases expanding up from a DN15 supply locally in the area of the autoclave may not provide a sufficient water flow to reduce the autoclave discharge to the desired temperature.

Consideration should be given to the discharge from the Vent and Safety Valve outlets, which should be directed in such a way as to not cause a hazard. This will be determined by the location of the autoclave.

Initial Commissioning

Priorclave Autoclaves are given a full operational test before leaving the factory and as such arrive ready for immediate use after installation. It is advisable however to run a simple cycle with the autoclave empty before processing a working load to check that no problems have arisen during transport.

If commissioning has been ordered with the autoclave this will be carried out by a Priorclave technician otherwise follow this simple procedure to check the operation of your Priorclave.

1) Check the electricity supply is **ON** and that, if required, the water supply is connected and on.

2) Switch on the power at the isolator at the back of the autoclave (for position see diagrams above). All indicators will light momentarily and a sounder will bleep. This enables the indicators to be checked. The **low water** indicator should now be lit.

3) As you are powering up the autoclave for the first time, the autoclave will be in a low water condition and the error code **F004** will show in the temperature display. You may ignore this at this stage as opening the autoclave and filling it with water will reset this error.

4) Press and release the '**Door**' button on the control panel. There will be a bleep. Wait for a short time (around 20 seconds)until there is another bleep and the '**Door**' indicator illuminates.

5) Check that the pressure gauge is reading zero and you may now press and release the '**Door**' button to start the door opening sequence. The outer door cover must be kept **closed** or the door will not operate.

6) The door will now go through its opening sequence behind the outer cover.

7) Once the door has fully opened, press and release the '**Door**' button again to release the outer cover locking solenoid. When the cover is ready to open the Outer Door Locked control panel LED will illuminate. Do **NOT** try to force the outer cover open when locked.

8) The autoclave uses immersion heaters in a reservoir of water behind the weir at the bottom of the autoclave to raise steam. The heater is protected from boiling dry by a low water cut-out. If the water level falls below the sensor the autoclave shuts down, the **low water** warning indicator is lit and fault code **F004** is shown in the temperature display.

9) In hard water areas distilled water must be used to prevent scale from forming in the autoclave; when the autoclave is new, however, some tap water may need to be added until the **low water** lamp is extinguished as the low water cut out is operated by the water's conductivity.

10) The reservoir should be filled with water to a level just below the weir. If an automatic water-fill system is fitted to the autoclave this will activate once the door has been opened. Water will be allowed into the autoclave until the correct level is sensed by the float switch at the front of the autoclave.

11) Set the temperature to 121^{o}C and the process time to 15 minutes using the arrows under the displays.

12) Carefully close the outer door cover.

13) Press and release the '**Door**' button to start the door closing sequence. The door will now lift into place and lock behind the outer door cover.

14) Wait a few seconds for the '**Start**' indicator to illuminate, and press the '**Start**' button to begin the cycle.

15) During the cycle, check that there are no problems during heat-up and process.

Following successful completion of the commissioning cycle your Priorclave is ready to process its first working load.

Please refer to the **Operation** section later in this manual before running your first working load as this gives further details on operation of the autoclave and on the control options which may be fitted

If you experience any problems during this procedure please contact Priorclave service or your local agent.

Full Commissioning and Performance Qualification

If you are having the unit commissioned by a Priorclave technician this will be a simple matter of checking for correct installation, checking that all functions are operating correctly, and familiarising you with the autoclave. There are, however some benefits that can be gained from having your Priorclave commissioned to suit your particular loads and requirements. Some examples of settings that can be optimised during commissioning, and the advantages these can provide are listed below.

- Establishing optimum freesteam temperatures for effective air displacement.
- Establishing optimum freesteam time for effective air displacement, whilst eliminating unnecessary time and energy consumption.
- Establishing optimum process time and temperature to ensure complete sterilisation, whilst maintaining minimum cycle time and energy consumption.
- Setting thermal lock release temperature to suit your particular load, to eliminate unnecessary cooling time whilst ensuring safety.

If you feel that any, or all of the above would be of use to you then please contact Priorclave Service.

Operation

Before using your Priorclave for the first time check that the circuit breakers and isolator (at the back of the autoclave) are switched on. If your autoclave is fitted with vacuum options, or a steam and Water Jacket also ensure that the water supply is switched on.

ATTENTION

Before proceeding please check the specification sheet at the front of this manual to establish which options and accessories, if any, are fitted to your Priorclave. This will determine whether you will need to read the instructions for these options later in this manual.

Opening the Pressure Door.

1) Switch on the power at the isolator. All indicators will light momentarily and a sounder will bleep. This is to enable the indicators to be checked. The **start** indicator should now be lit. Press and release the **door** button, which will bleep, and wait for a short time (about 20 seconds) until the **door** indicator illuminates and the sounder bleeps again. During the waiting time the temperature display will show **hoLd,** confirming that the autoclave is waiting during its safety delay. Check that the pressure gauge is reading zero and you may now press and release the **door** button to start the door opening sequence. The outer door cover must be kept **closed** or the door will not operate. (The **vent** button will light when the **door** button is pressed and remain lit after the door is opened.)

2) The door will now go through its opening sequence behind the outer cover.

Do **NOT** try to force the outer cover open when locked as this will damage the locking mechanism and make the whole door system inactive.

If at any point the **Red** LED above the control panel is lit then there has been a failure in the door opening control system. Do not attempt to rectify this yourself. Please call Priorclave service or your local service agent immediately.

3) Once the door has fully opened, press and release the **door** button again to release the outer cover locking solenoid. Once the locking bolt is released the **green** LED on the control panel will light showing that the cover is ready to open. This will release for a short period only (5-10 seconds) to protect the locking solenoid. If the outer cover is not released in time then pressing the **door** button again will release it.

Care should be taken when opening the cover as steam may be released. Heatproof gloves and a face-shield should always be worn when unloading autoclaves.

4) Checking Water Level.

The autoclave uses immersion heaters in a reservoir of water behind the vessel weir plate to raise steam. The heaters are protected from boiling dry by a low water cut-out. If the water level falls below the sensor the autoclave shuts down, the **low water** warning is lit and fault code **F004** is shown in the temperature display.

The reservoir should be filled with water to a level just below the weir at the front of the autoclave.

If your autoclave is fitted with an automatic water-filling system then the autoclave will begin to fill with water to the correct water level as soon as the lid is opened.

In hard water areas softened water must be used to prevent scale from forming in the autoclave. On manually filled autoclaves distilled water can be used but when the autoclave is new, some tap water may need to be added until the **low water** warning goes out as the low water cut-out is operated by the water's conductivity.

NOTE: Great care should be taken to ensure that the insulated part of the low water sensor is clean (see diagram in Maintenance section) as a build up of contamination here will prevent the low water cut-out from working and could lead to heater damage.

Loading.

5) The autoclave can now be loaded with the items to be sterilised either directly onto the shelves, in baskets, or watertight discard containers in the case of waste loads which may leak liquids when autoclaved.

ATTENTION

If fitted the centre shelf is retained at the back to prevent tipping when extended and is prevented from being accidentally removed by pulling forwards. To remove this shelf lift it at the front and gently push it back until the anti-tip catches are released from the back of the runners.

Care should be taken when loading the baskets or containers not to pack them too tightly with material. Ample room must be allowed for steam to penetrate the load properly or full sterilisation will not be achieved. When using autoclave bags these should be left open with the top of the bag rolled outwards, exposing the load to the steam inside the pressure vessel. Care should also be taken that the contents of bags and containers are not able to spill over into the body of the autoclave vessel. Any such spillage could block pipes and valves and will not be covered by the warranty.

Tests have shown that the depth of un-perforated discard containers should be no greater than 180mm (7") for effective air displacement from the load. Suitable containers are available from Priorclave.

Settings.

6) Once the autoclave has been satisfactorily loaded the controls should be set for the process cycle that you require.

If your autoclave has a setting lock fitted this must be set to **position 3**.

Sterilising Temperature & Time Settings.

The Medical Research Council has recommended the following temperatures and times as being sufficient for complete sterilisation in autoclaves:

126^{o}C for 10 minutes.
121^{o}C for 15 minutes.
115^{o}C for 30 minutes.

These temperatures and times relate of course to load temperatures and the aim in setting a cycle should be to achieve one of the above criteria in the coldest part of the load. Some loads however are sensitive to elevated temperatures for prolonged periods, making full achievement of the above impractical. However the disinfection of such loads after a short cycle, without necessarily reaching full Sterilising Temperature, is usually sufficient for most purposes.

Should you require a more precise method then the optional **Load Sensed Process Timing** may be of assistance for certain load types. If your autoclave is fitted with this option please refer to the instructions later in this manual.

Since there is a time and temperature 'lag' between the temperature controller probe and the load, this should be compensated for either by increasing temperature or process time, or by including in the cycle a period of free steaming with the vent open at 100^{o}C. This can be achieved by pressing in the **vent** button manually and releasing it manually. Alternatively, the **Automatic Freesteaming** function can carry out this process automatically if the option is selected.

If you have an interest in any of the options mentioned above, which can quite easily be retrofitted; please contact Priorclave Technical Services Department. - (0)20 8316 6620

In conclusion, when setting up the autoclaving cycle a large safety margin should be allowed within the settings.

Performance Qualification testing can determine more precise settings.

Setting the process time.

The process timer can be set to a time up to 999 minutes. Simply pressing the time up/down buttons sets the time required. The set time is displayed until the set temperature is reached, then the process time begins counting down to zero in increments of one minute.

Setting process temperature.

Pressing either the up or down button momentarily causes the current set temperature to be displayed. Subsequent use of the up/down buttons changes the set temperature. If no keys are pressed for a short time, the display returns to showing the current chamber temperature.

Selecting other functions.

The function select keys may be used to switch the Media Warming Option, and optional functions such as **Rapid Cooling**, on or off at any time other than when a cycle is running. An indicator illuminates to show that a function has been selected. If **Automatic Timed Freesteaming**, **Vacuum Options** or **Load Sensed Process Timing** are not fitted pressing the appropriate key will result in a visual and audible fault being signalled and the function will not be selected.

Possible selections are:

Rapid Cooling

The autoclave is cooled by powerful fans below the vessel, which direct cool air over it.

If selected by using the **cooling** button, the cooling fan will switch on automatically during the cooling stage of the cycle. There are three possible settings for rapid cooling, and these operate as follows:

Off - No indicators lit.
The cooling fan does not operate at all during the cycle.

Immediate start - Left hand indicator lit. - 1 press of the **cooling** button.
The cooling fan starts as soon as the cooling stage is reached.

Delayed start - Both indicators lit. - 2 presses of the **cooling** button.
The cooling fan starts after the autoclave chamber has cooled to 100°C. This setting is useful when autoclaving some fluid loads, as bringing the cooling fan on at temperatures above 100°C may reduce the chamber pressure too rapidly, causing the load to boil.

In both cases the fan will switch off automatically when the cycle has reached the complete stage.

Automatic Free-Steaming

What is freesteaming?

Incorporating a period of freesteaming into a cycle can improve air removal in difficult loads and/or reduce temperature lag between the load and the autoclave, reducing process time at higher temperatures. Freesteaming introduces a stage during heating up to process temperature, when a solenoid valve at the rear of the autoclave is opened for a pre-set time. The valve opens at a factory set temperature of just above 100°C and is held open for the time set as detailed below. During this time steam is being generated in the chamber in large volumes and this creates turbulence as it passes through the load before escaping through the valve. It is this turbulence that can assist with air removal.

Setting the freesteam time.

If freesteaming is required this is selected by pressing the **freesteam** button. The indicator lights up to show that freesteaming is selected. The time display will now flash indicating that the freesteam time, not the process time, is currently being displayed. The freesteam time can now be set (in minutes) using the up/down buttons. If no further changes are made for a short time the display stops flashing, and reverts to showing process time. If you wish to check the freesteam time or make further changes then freesteaming should be deselected, then reselected.

Freesteam temperature setting.

If your autoclave is equipped with timed freesteaming, this will commence at a temperature slightly above 100°C, which has been set at the time of manufacture. If required qualified personnel may increase this temperature, and the turbulence caused by the escaping steam pressure can further assist with air removal. It is desirable however to connect the autoclave to a drain and vent pipe (as described in Installation), as the release of pressurised steam into the laboratory should be avoided.

Pulsed Freesteaming (Optional Fitting)

With certain loads and in certain situations the efficiency of the freesteaming process can be improved by pulsing. If this option is fitted to your autoclave then freesteaming commences as described above but at a higher temperature (usually about 112°C). Instead of remaining open for the entire freesteaming period the vent valve shuts off at a lower temperature (usually about 107°C). The autoclave then heats up again to the temperature at which the vent valve opens again. The autoclave will continue this cycle for the time set when selecting freesteaming. This continual pulsing of steam out of the autoclave creates considerable turbulence within the autoclave, helping to draw trapped air out of the load.

All Priorclaves fitted with freesteaming can be configured for pulsing by qualified personnel, however connection to a drain and vent pipe as described in Installation is essential.

Load Sensed Process Timing (Optional Fitting)

Function

If this option is fitted, the autoclave will be provided with an additional thermocouple. This is a PTFE coated stainless steel armoured probe, which can be positioned in the load, ideally in the coolest part. When this option is selected, the autoclave will heat to the set chamber temperature as normal. However, when the set temperature is reached the process time will not begin to count down until the load temperature, as sensed by the additional thermocouple, reaches a temperature just below the set chamber temperature. The cycle will then proceed in the usual manner.

Purpose

The use of load sensed process timing can greatly assist with the sterilisation of certain types of difficult dense loads, such as large baskets of bottle caps, pipette tips or animal feed, by ensuring that the load reaches set temperature. The system is also very effective for bagged plastic waste loads, however as these tend to melt down around the probe, consumption of probes can be high. For this type of use load validation may prove to be more successful and economical in the long term.

Displaying Load Sense Probe Temperature

For programs with load sensed process timing selected/enabled, pressing the load sense button when a cycle is running, or the key-switch (if fitted) is not in position 3 causes the current load probe temperature to be displayed in the temperature display. The display flashes whilst the load probe temperature is being displayed.

Load Sense Probe Positioning

The probe should be positioned in what is anticipated to be the slowest part of the load to heat for example the centre of a large densely packed load, or the largest of a group of filled bottles. This is important, as there may be large variations in temperature distribution throughout the load.

NOTE: Temperature variations can be reduced by the use of timed free steaming (see above).

Load Sense Thermocouples

The load sensed process timing option utilises a thermocouple connected directly to the main processor board via a plug and socket connector for ease of replacement.

Replacement thermocouples are available from Priorclave.

See **Maintenance** for details on thermocouple replacement.

Media Warming

If this highly useful feature is selected the autoclave will cool to a factory pre-set temperature of 45°C. The temperature will then cycle between approximately 45° to 55°C until the door is opened. This allows, for example, nutrient media to be held as a liquid until it is needed.

Delayed Start Time

The autoclave can be set before a cycle to start at a pre-set time.

To access this settings turn & hold the thermal lock key in the override position. Press the time up or down keys. Release the thermal lock key. **1** is displayed on the temperature display, by default **0** will displayed on the time display. The temperature display now shows the number of a list of

operating parameters, the value for the parameter is shown in the time display. Scroll through the list of available parameters using the temperature up/down keys.

After no keys are pressed for eight seconds the display returns to normal.

The function of these settings is as follows:

	Temp. Display	Time Display	Function	Action
	1	0-24	Delayed Start Time Hour +	Enter required Start time hour (24 hour clock)
	2	0-60	Delayed Start time Minute +	Enter required Start time minute
	3	0/1	Start Delay Select On/Off +	0= OFF 1= ON
+	The time is set in real time, therefore the clock has to be correctly set for this to work properly. After one delayed start operation, delayed start automatically switches off, and the autoclave returns to normal operation.			

For instructions for setting the clock time and for other operator settings please refer to the section **Changing Date & Time** later in this manual.

Vacuum Options (Optional Fitting)

N.B. It is strongly recommended that to achieve optimum performance from Priorclaves fitted with vacuum options that commissioning and/or load validation tests are carried out by a trained Priorclave engineer. If no particular programs have been specified your autoclave will be factory set with the following programs:

- **Program 1: Non vacuum Cycle**
- **Program 2: Pre-Cycle Vacuum and Vacuum Cooling**
- **Program 3: Pre-Cycle Vacuum and Vacuum Drying (if specified, otherwise as program 2**)

Pre-Cycle Vacuum

The pre-cycle vacuum is selected using the function select key on the control panel. With the left-hand indicator lit the Pre-Cycle Vacuum is selected. With the Pre-Cycle Vacuum selected a vacuum pump will run at the beginning of the cycle, removing much of the air from the autoclave and load. At a pre-set level of vacuum the control system switches off the pump and the normal cycle begins. If set at commissioning a number of vacuum stages will be performed, with heating stages in between. Pre cycle vacuum is essential when autoclaving loads containing densely packed porous material.

Vacuum Cooling - Suitable for Non Media Loads Only

If fitted along with Vacuum Drying this option must be selected for attachment to a particular program in the control software during commissioning.

A vacuum cooling cycle can be selected by means of the function select key. With the option selected the right-hand lamp will illuminate. When this option is fitted it can be run along with or separately from a Pre-Cycle Vacuum. With the option selected, at the end of the process dwell time the autoclave vent is opened and the autoclave cools to a pre-set temperature with the air-cooling fan(s) operating. When the pre-set temperature is reached the cooling fan(s) continue to run and a partial vacuum is drawn. This has the effect of evaporating liquid on the load causing it to cool rapidly. After a pre-set time air is admitted to the vessel and this process is repeated a number of times. At the end of this stage the autoclave passes immediately to cycle complete.

Post cycle vacuum cooling **must not** be selected if the load contains bottled liquids, regardless of how these are contained. All liquids in the load will be evaporated. Sealed containers of liquid will explode. Unexploded containers will be in a dangerously unstable condition when removed.

Drying Cycle - Suitable for Non Media Loads Only (Optional Fitting)

This option must be selected for attachment to a particular program in the control software during commissioning.

A drying cycle can be selected by means of the function select key within a program pre-designated as a drying program. With the option selected the right-hand lamp will illuminate. When this option is fitted it can be run along with or separately from a Pre-Cycle Vacuum. With the option selected, at the end of the process dwell time the water charge is drained under pressure from the autoclave, and the autoclave cools to a pre-set temperature. When this temperature is reached a partial vacuum is drawn and heaters attached to the outside of the autoclave vessel are switched on. This has the effect of evaporating liquid on the load. After a pre-set time air is admitted to the vessel and this process is repeated a number of times. At the end of this stage the autoclave passes immediately to cycle complete.

Post cycle drying **must not** be selected if the load contains bottled liquids, regardless of how these are contained. All liquids in the load will be evaporated. Sealed containers of liquid will explode. Unexploded containers will be in a dangerously unstable condition when removed.

Closing the pressure door.

7) Once you have set up the cycle parameters carefully lift the outer safety cover into place. It should latch automatically when properly closed.

With the safety cover fully closed press the door button on the control panel. The pressure door will now be lifted lift into place by the hydraulic ram. Once the door is in place the heavy side clamps will close on the pressure door forcing it against the vessel seal. This process takes approximately six seconds.

Once the pressure door is locked the unique 'over centre' locking geometry ensures that the door will remain locked in position even in the case of total loss of hydraulic pressure.

If at any point the **Red** LED above the control panel is lit then there has been a failure in the door opening control system. Do not attempt to rectify this yourself. Please call Priorclave service or your local service agent immediately.

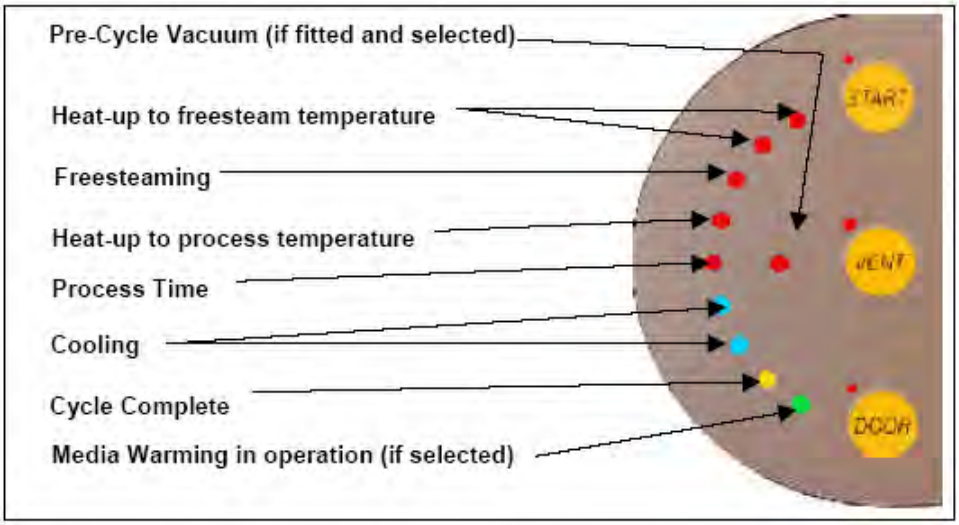
The door cannot open unless the outer cover is closed and **locked** in place and the control system indicated that the autoclave vessel is at a safe pressure and temperature to allow opening. Additionally, should a failure of these systems occur the nature of the mechanism ensures that the door remains constrained by the locking clamps even when opened so that any excess pressure and steam will be released around the sides of the door plate.

Starting a cycle.

8) Ensure the door is properly secured and the **start** indicator is illuminated. To start the cycle simply press the **start** button. The first light of the cycle status indicator bar will illuminate and the autoclave will now gradually heat up to process temperature. On vacuum cycles the Pre-Cycle Vacuum indicator will light up. The cycle status indicator will also advance through its stages to give 'at a glance' indication of the cycle's progress.

Once a cycle has been started the function selection settings cannot be changed; attempting to do so will cause a fault to be signalled. If changes are required the cycle should be aborted by pressing the **start** button again.

Pressing the Freesteam Button  during the freesteam part of the cycle will give an indication of



free steam time remaining as a flashing display in the timer window.

On Priorclaves not fitted with the setting lock key-switch changes can be made to the process time and temperature settings once a cycle has started. At the end of the cycle the time setting will reset to its original setting.

Vent button.

9) The **vent** button may be used at any stage during the cycle. When used it opens a large bore solenoid vent valve at the back of the machine. It may be left open for free steaming to achieve better steam penetration of the load if **Automatic Freesteaming** has not been selected. Care should be taken with this manual method however as failing to switch the **vent** off will eventually cause the autoclave to run dry, aborting the cycle. It may also be used with certain loads as a means of rapidly venting the autoclave. If used for manual free steaming the **vent** button must be manually released before pressure will build up and process temperature can be achieved.

Care should be taken if using the vent button when the autoclave is pressurised. Venting of the autoclave under these circumstances with a liquid load may lead to the load boiling over and glassware may be broken.

During the process time.

10) Once set temperature is reached, the process time will begin to count down and the process indicator will illuminate. If the Load Sensed Process Timing Option is fitted and selected there may be a delay between the autoclave reaching set point and commencement of the process time whilst the load reaches set temperature.

During the process time a check should be made that there is correct correlation between temperature and pressure readings on the control panel. A steam table is included at the back of this manual for this purpose. The check should be made to ensure that air has been properly purged from the autoclave. Generally, a pressure reading higher than would be expected will indicate entrapped air in the autoclave.

If for any reason the temperature is forced outside of a pre-set band, or power to the autoclave is removed during the process time, the cycle will abort and the fault indicator will illuminate and a fault code of either **F005** or **F006** will be shown in the temperature indicator. This is to ensure that loads that have not been subjected to the required cycle parameters are not assumed to have been processed correctly. The fault condition is cancelled by:

If no setting lock keyswitch is fitted:
pressing the reset button on the top right hand side of the back of the autoclave,

or

If a setting lock is fitted:
turning the setting lock key to the enable position and then to the disable position. If the lock was in the enable condition when the fault occurred, then it must first be turned to the disable position.

Cooling.

11) After completion of the process time the autoclave moves into the cooling part of its cycle, and this is shown on the cycle status indicator in blue. If **Cooling** has been selected this will be switched on automatically according to the cooling strategy selected. Otherwise cooling will be by convection.

Thermal lock.

12) Under normal circumstances the autoclave cannot be opened until the temperature of the load simulator probe, which has a cooling rate assimilated to a bottle of fluid, has fallen below 80^{o}C at which point the yellow bar on the cycle status indicator will illuminate. The temperature shown by the temperature indicator will be significantly below 80^{o}C as this measures the temperature in the open chamber space. Pressing the door button before the thermal lock has released causes a fault to be signalled. The temperature at which the thermal lock operates is factory set. This can be reset but must only be done following commissioning by qualified personnel. The thermal lock can be overridden using the key-switch on the control panel. The keys for this switch are provided in this manual.

Overriding the thermal lock will cause the main vent to open. Great care should be exercised when using the key-switch since liquid loads could boil over if vented at elevated pressures.

There are circumstances, however when quicker access to the load is required. When this is necessary, first abort the cycle by pressing the start button. Then turn the key into its horizontal position and holding it in this position, press the **door** button and wait while the **hoLd** message is displayed until the **door** lamp illuminates. Finally press the **door** button to release the door lock. The thermal lock key can now be released. If the key is released before this stage then the **hoLd** display will not reset and the autoclave cannot be opened. To reset the display, repeat the above procedure and open the autoclave.

Great care should be exercised when using the Thermal Lock Override, especially with liquid loads. Even at temperatures below 100°C a liquid load in sealable glass containers will not be safe. For the above reasons only responsible personnel should keep the Thermal Lock Override key in a safe place away from the autoclave.

Under certain cycle abort or failure conditions the thermal safety lock can latch in the locked condition. This is because the control system will always go to the safest condition if there is any uncertainty about the cycle end circumstances. To overcome this simply go through the door open or close procedure using the thermal lock override key. Operation will return to normal as soon as the next cycle is completed satisfactorily

Cycle complete.

13) When cooling to the 'thermal lock deactivation temperature' is complete, the **complete** indicator will illuminate, and the autoclave will emit a bleep for a short time (about 10 seconds). If the Cooling System is selected it will automatically switch off at this point. The autoclave is now ready to open and unload.

Media Warming.

14) If this has been selected, the autoclave will remain at the pre-set temperature after the cycle is complete, until the door is opened or the cycle otherwise aborted.

15) Opening the autoclave to unload and re-load for the next cycle is simply a repetition of steps 1-3.

Aborting a Cycle

On occasions it may be necessary to abort a cycle before its completion. In order to do this, simply press the **start** button.

Operation with Options & Accessories

The following descriptions detail how to operate and gain maximum benefit from the options and accessories that may be fitted to your Priorclave.

Multi Program Memory Options

When this option is fitted, five program number keys are provided to the right of the control panel, each with two indicators. The indicators on the left are for programs 1 to 5 and those on the right for programs 6 to 10. If the Priorclave has been specified with a five program memory only the first five programs will be active. As each program number is selected, the indicator illuminates and the previously selected indicator is cancelled. Pressing the select button toggles between the two program numbers shown on the button.

When the program memory option is fitted a three-position setting lock keyswitch is fitted. These setting positions allow different levels of access to settings as follows.

Position 1. Only the currently selected program can be run. Program settings cannot be changed.

Position 2. All programs can be selected and run. Program settings cannot be changed.

Position 3. All programs can be selected and run. Program settings can be changed freely.

NOTE: The setting lock key can only be removed in positions 1 and 2.

Programming of settings is the same as with the standard machine, but the required program number should be selected before setting. The settings entered can then be recalled for subsequent use by simply reselecting that program number.

Setting Lock Keyswitch Option

Fitted on Priorclaves without program memory to give an optional level of security this keyswitch has two settings only, which are equivalent to positions 1 & 3 above. The key can only be removed in position 1.

Printer

The printer if fitted is mounted on the right hand side of the control panel. This provides a useful record of the cycle as well as an indication if any faults have occurred. The information printed is as follows:

USER NAME (if provided at time of ordering)

DEPARTMENT (if provided at time of ordering)

AUTOCLAVE SERIAL NUMBER

DATE

CYCLE NUMBER

PROGRAM NUMBER (if multi-program memory option fitted)

TEMPERATURE AND TIME AT CYCLE START (time is set to G.M.T)

TEMPERATURE AND TIME AT END OF FREESTEAMING

TEMPERATURE AND TIME AT START OF PROCESS TIME

The temperature and time are then recorded at pre-set time intervals, until the end of the process time.

TEMPERATURE AND TIME AT END OF PROCESS TIME

TEMPERATURE AND TIME AT CYCLE COMPLETE.

CYCLE PASS/FAIL/ABORT

(Fail means that a fault signal has occurred during the cycle or that the cycle was aborted. See - Warning Indicators)

The above information will be printed in the order listed, allowing the information to be read as it is printed.

Power On Self Test

The self test procedure is initiated by applying power to the printer while the paper feed button is depressed. When the paper feed button is released a test print will be produced.

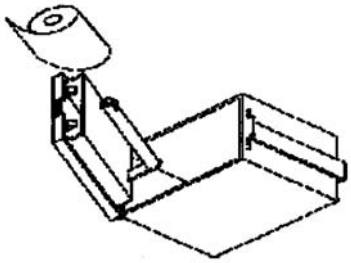
Replacing Paper Roll

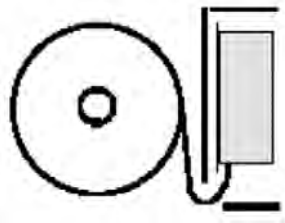
Access to the printer for changing the paper roll is provided by a hinged front panel. The spring-loaded catch on the left-hand side of the printer front panel should be depressed to release the front panel.

The paper roll carrier is mounted on the rear of the printer front panel and will swing out from the main body for ease of roll changing.

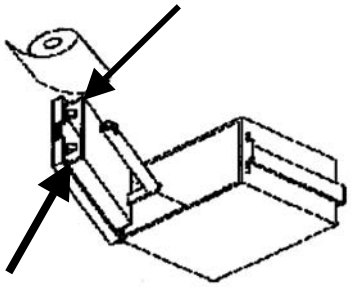
Use the correct paper. Suitable paper is available from Priorclave Service or your local agent.

Changing Printer Ribbon





Correct Paper Path



Ribbon fitting detail

With the door of the printer open gently squeeze the plastic cover inside the printer door at the points shown in the diagram. The outer door cover should come away (some gentle twisting may be required) exposing the print ribbon mounting plate as shown above.

The old print ribbon can be lifted out and a new one put in its place. If necessary take up any slack on the ribbon with the tensioning wheel.

The paper should pass between the ribbon and the bottom of the ribbon cassette.

The two parts of the door can now be pushed together and will click into position.

Chart Recorder

If fitted, the recorder power input is connected directly to the autoclave in such a way that the recorder will only operate during the autoclave cycle, i.e. from the pressing of the start button to cycle complete. At this time power to the recorder is cut. Unless otherwise specified, single channel units record the temperature of a fixed thermocouple probe, and in the case of two channel units the second channel records the temperature of the load probe.

For more details on individual recorder function and operation please refer to the manufacturer's manual supplied with the autoclave.

Heater Over-Temperature Protection

(Fitted as an optional extra in addition to the standard microprocessor based overheat function)

This device acts as secondary protection against the autoclave boiling dry and damaging the heating elements in the event of failure of the low water sensing system. Should the heater elements ever exceed a temperature of 150^{o}C the heating circuit will be switched off and the **O/HEAT** warning indicator will illuminate. A fault code of **F003** will be shown in the temperature display.

Should this occur, then the autoclave should be switched off and allowed to cool to a safe temperature and pressure before opening for examination of the water level.

The fault indication can be cancelled as described in the Faults section. To re-run the autoclave it should be sufficient to top up with water to the correct level. However the low water system should be checked for faults as soon as possible and cleaned or repaired as necessary. (See Maintenance section.)

The overheat is activated by a thermocouple mounted on one of the heating elements inside the autoclave. This is coupled directly to the main processor board, and the overheat temperature is factory set.

Automatic Waterfill Option

Fitted as standard to Priorclaves with Vacuum Drying, and as an option on other models this option consists of a water tank mounted inside the autoclave (or in some models mounted on the back of the autoclave). The water tank is fitted with a float valve set at the optimum fill level. Whilst the autoclave door is open during loading and unloading a solenoid valve is opened and water flows into the autoclave vessel from the water tank until a level is reached. During normal operation only small amounts of water will need to be replaced, however when first filling the autoclave or whilst filling after cleaning, more time will be required.

Internal Validation System

If fitted this system continuously monitors the performance of the temperature reading and control system with reference to an internal reference standard. If any problem is detected with the system the autoclave is stopped and a fault is signalled. (See Warning Indicators and Fault Codes for details.)

Air Intake Filter

When fitted to the autoclave this system ensures that air drawn into the autoclave during the cooling stage of the cycle is first passed through a bacteriological air filter. This filter is fitted at the back of the autoclave.

Vent Filter (Externally Mounted)

When fitted to the autoclave this system passes all autoclave discharge through a filter fitted inside a pressurisable stainless steel housing. At the end of the cycle any unfiltered condensate from the filter housing is returned to the autoclave. The correct operation and effectiveness of the filter system should be regularly checked. Please refer to the manufacturers instructions enclosed with this manual.

Vent Filter (Internally Mounted)

When fitted to the autoclave all exhaust gases discharge through a filter fitted inside the autoclave chamber. The filter can easily be removed by pushing and twisting until it is released from its mounting. The filter should only be removed from the autoclave after a successful sterilising cycle so as to prevent contamination. The correct operation and effectiveness of the filter should be regularly checked. Please refer to the manufacturers instructions enclosed with this manual.

Loading Trolley

When supplied and unless previously specified otherwise the loading trolley is manufactured for loading the lower shelf of the autoclave. The trolley is fitted with locking rear wheels, which **MUST** be locked when loading or unloading. If a loading cassette is supplied with the trolley the front wheels of the cassette are automatically held by a latch at the front of the trolley. To allow the cassette to roll off of the trolley simply release the catch with the catch release at the back of the trolley.

Adjustable Height Loading Trolley

When supplied the adjustable loading trolley loading trolley is manufactured as above but with it's height adjustable by use of a manual hydraulic mechanism. The trolley is fitted with locking rear wheels, which **MUST** be locked when loading or unloading. If a loading cassette is supplied with the trolley the front wheels of the cassette are automatically held by a latch at the front of the trolley. To allow the cassette to roll off of the trolley simply release the catch with the catch release at the back of the trolley.

Media Cooling

If the autoclave is fitted with the optional media cooling option and is run on a program where this has been activated the system will operate automatically. During cooling the autoclave gauge will show that a vacuum has been drawn. This is a normal part of the operation of this system and the autoclave will complete its cycle in the usual way without further intervention.

Changing Date & Time

A number of additional control system settings can be accessed via a “Hidden Menu”.

To access these settings turn & hold the thermal lock key in the override position. Press the time up or down keys. Release the thermal lock key. **1** is displayed on the temperature display, by default **0** will displayed on the time display. The temperature display now shows the number of a list of operating parameters, the value for the parameter is shown in the time display. Scroll through the list of available parameters using the temperature up/down keys.

After no keys are pressed for eight seconds the display returns to normal.

The function of these settings is as follows:

	Temp. Display	**Time Display**	**Function**	**Action**
		The autoclave can be set for the cycle to start after a pre-programmed delay, for example to allow a media preparation cycle to complete shortly prior to the start of the working day. Setting the value of parameter 1 to 1 in the time display switches delayed start on.		
	1	0-24	Delayed Start Time Hour +	Enter required Start time hour (24 hour clock)
	2	0-60	Delayed Start time Minute +	Enter required Start time minute
	3	0/1	Start Delay Select On/Off +	1= ON 0= OFF
*	4	0-999	Print Interval	Enter time (minutes)between printing during process time (0= printer disabled)
	5		Year Setting	Enter Year
	6		Month Setting	Enter Month
	7		Date Setting	Enter Day of month
	8		Hour Setting	Enter Hour (24 Hr Clock)
	9		Minute Setting	Enter Minute
	10		Second Setting	Enter Second.
			Scroll back up to parameter 1 to confirm the new or current time settings.	
	11		Not Currently Used	

+ The time is set in real time, therefore the clock has to be correctly set for this to work properly.

After one delayed start operation, delayed start automatically switches off, and the autoclave returns to normal operation.

* **Models fitted with 5 or 10 Program Memory**

Setting marked ***** are program number related, and therefore should you wish to use different values for these in different programs this can be done by changing the value when the correct program is selected.

Warning Indicators and Fault Codes

On the control panel there are a series of 'hidden until active' warning indicators. Some of these indicators will appear in conjunction with a fault code in the temperature display. The meaning of these warnings, why they appear, and what to do when they appear, is as follows.

SERVICE

This means that 500 cycles, or six months have passed since the autoclave was last serviced. The engineer will cancel the message when the autoclave is serviced.

WATER + FAULT CODE F004

The water level has fallen below the minimum level and must be topped up before the autoclave can be run. The warning will automatically cancel when the door is opened and the water level is topped up. The low water condition may have caused a running cycle to abort, and the load may need to be autoclaved again.

O/HEAT + FAULT CODE F003

If fitted, the heater over-temperature protection thermocouple may have sensed that the heating element became too hot. This is probably due to a low water condition, which was not sensed by the low water probe. The water level and the condition of the probe (see Maintenance) should be checked before attempting to use the autoclave again.

If heater over protection is not fitted then the over heat cut out will only operate under extreme conditions, such as a failure of the temperature control system. The next attempt to run the autoclave should be closely observed and if problems persist contact Priorclave Service.

FAULT + FAULT CODES F000, F002, F005, F006, F007, F008, F009, F010 & F011

The fault indicator illuminates under conditions that may invalidate the autoclaving process, and may result in the load requiring to be autoclaved again. The fault condition will be triggered by any of the following:

F006 Power to the autoclave being interrupted when a cycle is in the heating or process dwell stage of the cycle.

F005 The chamber temperature falling below the set temperature by more than 3^{o}C during the process dwell time.

F002 Failure of the temperature control, display, or load simulator thermocouple.

F000 If your autoclave is fitted with the optional self-validation system, an error in the temperature measurement system is signalled by fault code **F000**. Usually this would mean that a critical error has developed in the temperature measurement system, however, as the detection system is extremely sensitive it is possible that it may be triggered by fluctuations in the electrical power supply. If fault code **F000** appears it may be cleared by the method described below. If the fault code will not clear, or continues to re-appear then the user cannot correct the fault. In such a case please contact Priorclave service or your local Priorclave approved service agent.

F007 Vacuum stage timeout (loop break). The autoclave has not achieved the pre-set level of vacuum during the Pre-cycle vacuum stage during the pre-set time.

F008 Heating stage timeout. The autoclave has not reached process temperature within the Pre-set time.

F009 Vacuum cooling set-point not achieved. The autoclave has not achieved a low enough level of vacuum during the post cycle vacuum stage (Vacuum Cooling or Drying Cycle)

F010 Air detector input activated. If fitted the air detector system has detected an over pressure condition symptomatic of excess air remaining in the load.

F011 Printer Timeout / Malfunction. The control system has nor received confirmation from the printer within its pre-set timeout.

F012 Door micro-switch fault. If a door micro-switch opens during a cycle this fault code is displayed

LOCK

This warning will light when the thermal lock keyswitch is in the override position.

LOAD + FAULT CODE F001

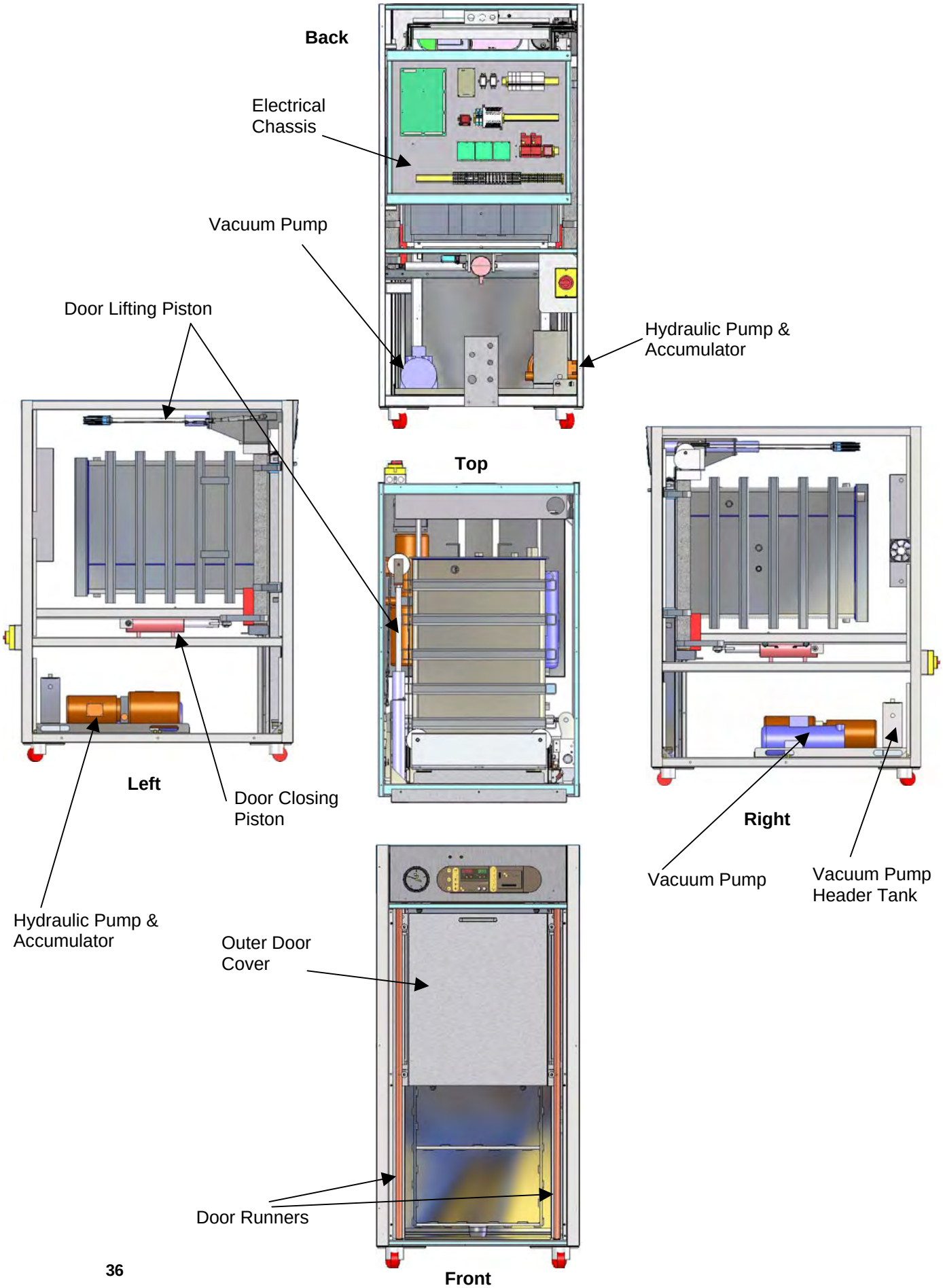
This warning is activated in the event of the failure of the load sensing thermocouple. If the autoclave is fitted with load sensed process timing, this should be deselected to enable the autoclave to run without this feature. The thermocouple should be replaced as soon as possible. Great care should be taken to ensure that loads which would ordinarily be autoclaved with load sensed process timing are adequately sterilised.

CANCELLING FAULT MESSAGES

The fault messages are cancelled by first correcting the source of the original fault, then turning the setting lock key switch to position 3. If a key-switch is not fitted they are cancelled by pressing the reset button.

If 2 or more faults occur at the same time, the one with the highest priority is displayed. (F000 is the highest priority and F012 is the lowest.) If a higher priority fault is cleared it will be replaced by the next active fault, unless this too is cleared by the same action.

Principle Components – Layout & Locations



Maintenance

Before carrying out any maintenance work check the autoclave for any visual signs of materials which may be contaminated or damaged. Should any such matter be apparent contact the relevant person of authority before proceeding.

Do not carry out any work unless you are competent to do so. Items in this section marked with * are those which require a level of competence as incorrect maintenance or fitting could lead to a safety hazard.

DISCONNECT or **ISOLATE** the machine from mains power supply before removing any panels or commencing any maintenance work.

Ensure that any electrically locked doors or canopies are open before disconnecting power.

We fully recommend that a qualified technician regularly services an autoclave of this complexity and the details given here reflect this. The instructions given here are mostly confined to maintenance operations that can be carried out by the autoclave user on a routine basis.

IN THE EVENT OF ANY DIFFICULTY or doubt about any maintenance or service procedure contact Priorclave Limited or your nearest Priorclave approved agent or supplier immediately.

N.B. Access to the inside of the autoclave frame must be restricted to trained and authorised personnel only. This area can be dangerous with access to electrical connections and moving parts of the autoclave door mechanism.

Weekly Maintenance

Vessel Cleaning

Check the front of the machine and the inside walls of the pressure vessel for general cleanliness, particularly around operating parts and switchgear. Under no circumstances should an abrasive or chemically aggressive cleaner be used on the pressure vessel. The use of chlorine or hydroxide based cleaners is not recommended (see notices at the beginning of this manual).

Gasket

To prolong the life of the sealing gasket it is advisable to lubricate the sealing faces. This is carried out with the pressure door in the open position by applying high melting point grease to the exposed surfaces of the gasket, after cleaning the gasket and inspecting for damage. A silicone grease such as high vacuum grease is ideal for this purpose.

Door Operation

Check that the door closure system is opening and closing without undue noise. Visually inspect the gasket for any signs of abrasion on wear from the door operation.

Check that the outer safety cover is running smoothly and latches firmly into place when closed. If you encounter any problems or difficulties, contact Priorclave Service immediately. Do not attempt to remedy any difficulties yourself.

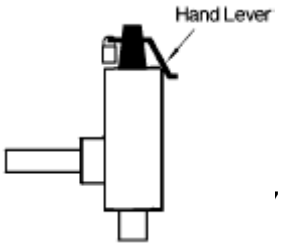
Warning! – It is dangerous to operate the power door with the autoclave access panels removed.

Drainage

If the autoclave has been plumbed directly into a drain using tubing, this should be checked for any signs of blockage, obstruction or damage. Also ensure that both ends of the tube are connected as originally intended. Check for any obstruction to the safety valve outlets, which must remain exposed and unconnected to any form of drainage at all times.

Safety Valve *

The safety valve should be periodically checked for freedom of movement. This can be done without the need for removing panels from the machine, as the hand lever of the valve may be accessed from



above the back of the autoclave. When the autoclave is at working pressure, keeping well clear of the safety valve outlet, lift the hand lever and check for a free flow of steam from the outlet pipe. If steam does not flow the valve should be replaced or serviced by a qualified person immediately. After releasing the lever ensure that the steam flow stops fully.

Monthly Maintenance

To be carried out in addition to weekly maintenance programme.

Door System

Inspect the visible parts of the door cables for any signs of wear.

Warning! – It is dangerous to operate the power door with the autoclave access panels removed.

General Operation

The general operation and performance of the autoclave should be observed frequently, and any fault or defect reported or rectified immediately, and entered into the notes section of the operating manual. (This will assist the service engineer in locating any persistent fault and reporting it to the manufacturer.)

Vacuum Pump and Water Pump

The correct operation of these should be checked regularly. Please refer to the manufacturers manuals for these pumps.

Water Header Tank(s)

The condition of the float valve tank and its various connections should be periodically checked and cleaned if necessary. Particular attention should be paid to ensuring that there are no restrictions to the tank overflow. In hard water areas the function of any anti-scaling device fitted to the water supply should be tested.

Quarterly Maintenance

Door Mechanism*

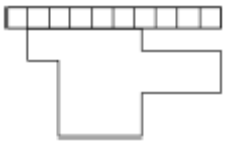
The pressure door parts and cables should be cleaned and lubricated with high melting point grease.

In addition the cantilever and column bearings and pulley pivot points should be checked cleaned and lubricated with high melting point grease.

The door clamping mechanism should be inspected and adjusted as necessary.

The hydraulic pump reservoir oil level should also be checked at the level topped up if necessary.

Automatic Air Purge Valve *



It is advisable to replace the expanding switching element and other sealing parts contained in this unit on a regular basis, in order to prevent build up of foreign matter which may impair the operation of the unit. The air purge valve is situated to the rear of the pressure vessel just below the top. To remove the parts for replacement simply unscrew the top cap of the unit and remove. Re-assemble the unit as per the instructions in the repair kit (available from Priorclave Limited or local agent). Should the top cap prove particularly tight the complete valve should be removed from the pressure vessel and the body gripped in a vice to remove the cap, as excessive localised pressure could damage the pressure vessel. Care should be taken when refitting the valve to the pressure vessel that all gaskets etc., are replaced in the correct position and the unit should be checked for leaks when first re-pressurised.

Microswitches *

To ensure the reliable operation of the autoclave the internal microswitches should be regularly cleaned and checked.

Locking Solenoids *

With the Autoclave front cover open, check the locking catch and solenoid for freedom of movement. If necessary the screws should be tightened and the solenoid re-aligned with the catch.

Filters (If fitted)

The condition of air intake and exhaust filters should be inspected regularly. These filters should be sterilised (they can be autoclaved) on a regular basis.

Hydraulic Hoses *

The joints and connections on the hydraulic hoses should be inspected for signs of wear and leakage.

Annual Maintenance

Hydraulic Oil*

The condition of the hydraulic system and the oil in it should be checked annually and the oil changed and filters replaced as necessary.

General Maintenance

Access to control components *

The control components are mounted onto a hinged chassis in the upper back of the autoclave..

N.B. Access behind the autoclave panels must restricted to trained and authorised personnel only. This area can be dangerous with access to electrical connections and moving parts of the autoclave door mechanism.

Checking Temperature Control and Pressure Gauge *

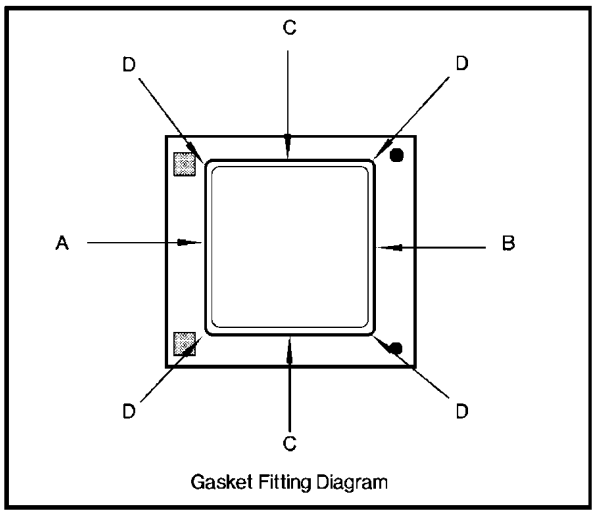
Should a constant deviation from the values shown in the steam table (appendix B) be apparent in these instruments first follow the relevant procedures in the fault-finding table (appendix A). With all of these possible causes eliminated, proceed to check the gauges as follows:

First, place a thermocouple probe connected to a digital thermometer or chart recorder of known accuracy onto the Temperature Controller Probe. Then set the machine and run through a standard cycle. When the process time has commenced check the reading shown by the temperature display against that of the thermometer or recorder. Should there be a disparity of readings in the order of that previously noted then it is likely that the Temperature Controller is at fault and needs resetting.

If only negligible temperature disparity is apparent, however, and the steam pressure is still varying from the expected value by the amount noted previously, then the pressure gauge is probably faulty and in need of replacement.

N.B. the pressure gauges and control system fitted to Priorclaves are extremely reliable instruments and as such are unlikely to produce false readings. Therefore it is more likely that any deviation from the values given in the steam table is caused by incorrect air purging etc.

Fitting A New Door Gasket*



Gasket Fitting Diagram

When it becomes necessary to replace the gasket, simply remove the old gasket by pulling it out of the groove in the pressure vessel body.

Using an abrasive pad clean out the groove and wipe away any residue with a cloth. Locate the joint in the new gasket and press this part of the gasket firmly into the part of the groove closest to the hinge, marked A on the diagram.

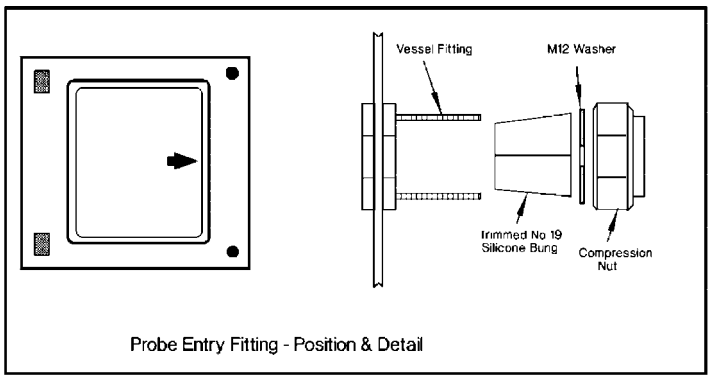
Find the opposite centre line of the gasket and press firmly into the point marked B on the diagram, ensure that there is an even amount of gasket each side of points A and B. Press the gasket into the points marked C, again ensuring that there is an even amount of gasket between all 4 points.

Press the gasket into the four points marked D. Finally press in the remaining points taking care not to cut the gasket on the header ring. Once the gasket is fully fitted smear the top surfaces with high temperature silicone grease if required, and smooth out any lumps, applying pressure in a circular motion around the gasket.

With the new gasket properly fitted, it may now be necessary to follow the door adjustment procedure Please note however that the gasket will bed down considerably when the autoclave is first used.

NB. After changing a door gasket it is necessary to check that any adjustments that may have been made to the door positioning and microswitch settings during the lifetime of the previous gasket are re-adjusted. These procedures are best carried out by a Priorclave trained technician.

Fitting a New Wandering Thermocouple*

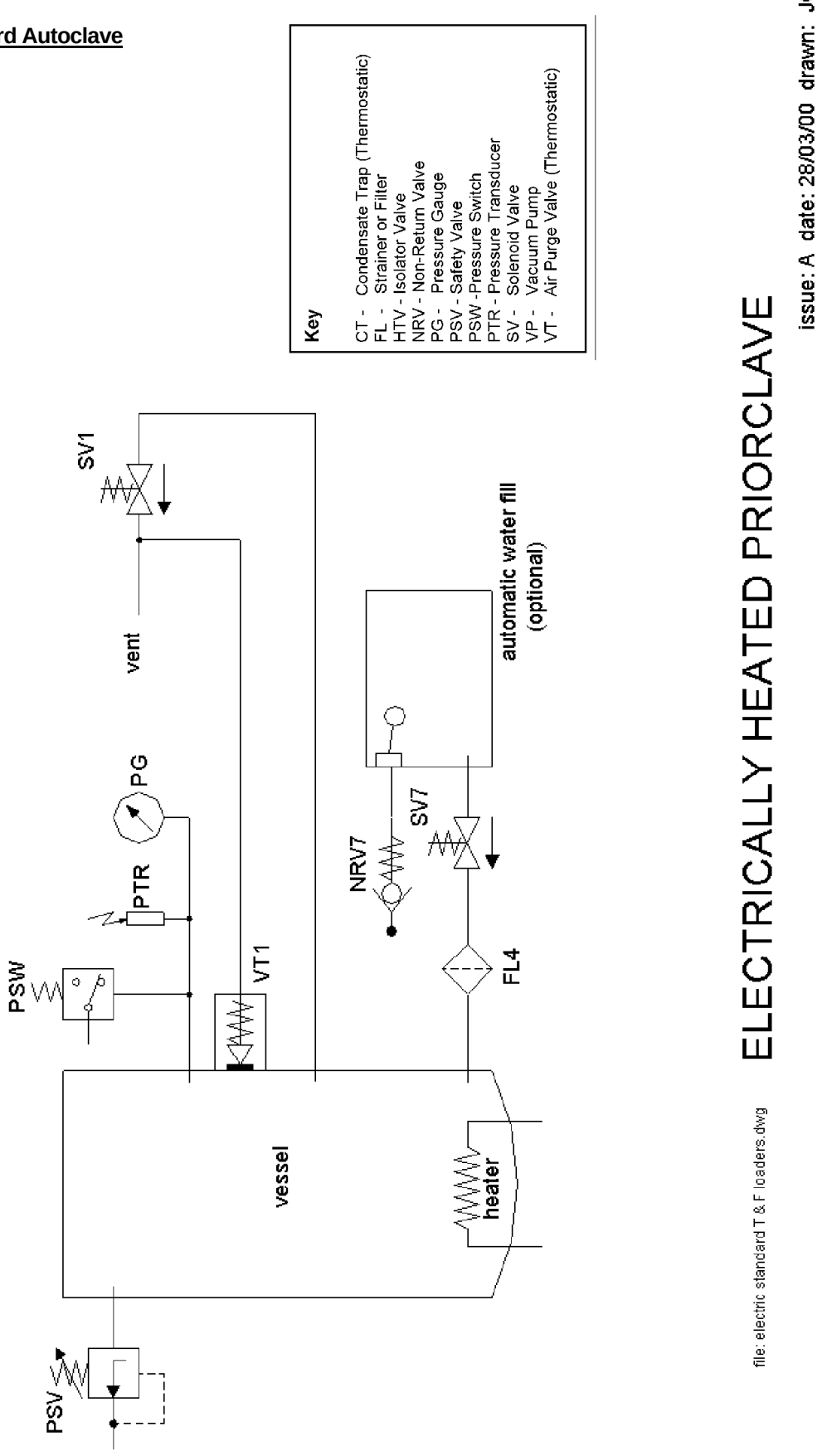


Probe Entry Fitting - Position & Detail

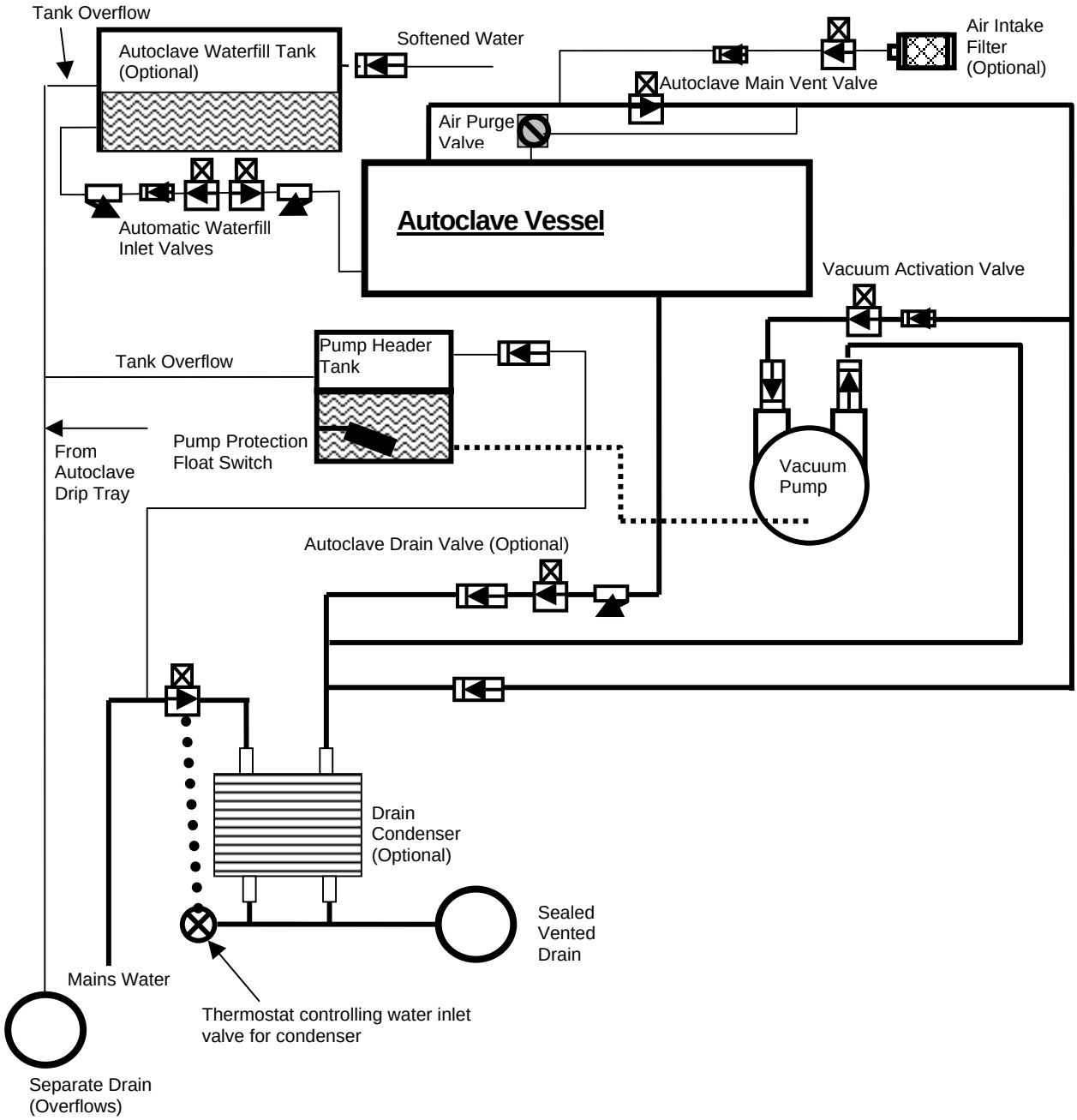
The thermocouple passes through an entry gland located in the right hand side of the pressure vessel, which is accessed by removing the patch panel. To remove the old thermocouple undo and remove the compression nut from the fitting (see diagram). From the inside of the pressure vessel push out the silicone rubber bung from the fitting, using a suitable blunt instrument and remove it from the thermocouple. It may be necessary to re-slit the bung to do this. Place the nut washer and bung in position on the new thermocouple and re-fit. It is advisable to apply some silicone sealant (such as bath sealant) to the joint to assist sealing. The joint should be checked for leaks when the autoclave is first pressurised. Replacement bungs are available from Priorclave, or alternatively use a silicone rubber bung and trim the top end by about 5mm.

Pipework Schematics

Standard Autoclave



Autoclaves with liquid ring vacuum pump



Autoclaves with Liquid Ring Vacuum Pumps

Key:

Solenoid Valve Check Valve Strainer

15mm Tubing:

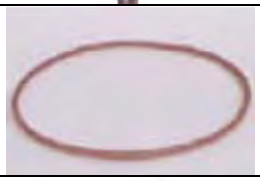
22/28mm Tubing:

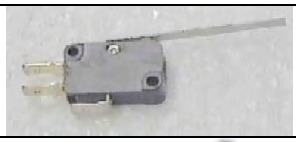
Clear Plastic Small Bore Tubing:

Spares List.

A full selection of spares are available from Priorclave Service or your local Priorclave dealer. Please give your autoclave serial number when ordering parts.

A selection of the more commonly used parts is listed below:

Description	Part Number	
Air Intake Filter	AFL/ACS/SML	
Water Level Float Switch	FLS/ACS/316	
Gasket	GAS/RSC/230	
Heating Element 3.5 kW	HTR/ACS/HOR	
Setting Lock Keyswitch	KEY/SLK/001	
Thermal Lock Keyswitch	KEY/TLK/002	
Low Water Probe Electrode	LWP/ACS/00C	
Single Pole Circuit Breaker 6A	MCB/ACS/006	
3 Pole Circuit Breaker 32A	MCB/ACS/032	

Door Lock Microswitch	MSA/CAN/VER	
Door Roller Microswitch	MSA/RSC/ROL	
Door Microswitch	MSA/RSC/SBT	
Wandering Thermocouple Probe	PRB/ACS/004	
Pressure Gauge	PSG/ACS/001	
Pressure Switch	PSS/SWI/001	
Large Cable Port Bung	SBG/ACS/022	
Small Cable Port Bung	SGB/ACS/015	
Door Locking Solenoid	SOL/QCS/001	
Steam Generator Pressure stat	Special Item	
Safety Valve (½”) 4.5 Bar (Steam Generator)	Special Order	

15mm (½") Strainer	STR/ACS/015	
22mm(¾") Strainer	STR/ACS/022	
Output Card	TAC/OPT/001	
15mm (1/2 in BSP) Non Return Valve	VNR/ACS/015	
22mm (3/4 in BSP) Non Return Valve	VNR/ACS/022	
28mm (1 in BSP) Non-Return Valve	VNR/ACS/028	
Air Purge Valve (Complete)	VPC/ACS/001	
Air Purge Valve Element	VPE/ACS/002	
Safety Valve Complete	VSC/ACS/022	
15mm (1/2 in) Solenoid Valve	VVC/ACS/001	
22mm (3/4 in BSP) Solenoid Valve	VVC/ACS/022	

Vent Valve 28mm (1in BSP)	VVC/RSC/028	
Printer Ribbon Cassette	ZZZ/RIB/002	
Printer Paper Roll	ZZZ/ROL/005	

Notes

Appendix A - Fault Finding & Rectification Guide

Symptom	Possible Cause	Possible Solution
No Power	- Power switched off at isolator	- Check
	- Circuit Breaker Tripped	- Reset and check cause
	- Electrical Failure	- Call Engineer
Cycle does not commence when start button is pressed (Fault indicator flashes)	- Door is not closed correctly	- Open & Re-close. Check outer cover is correctly closed.
	- Microswitch Failure	- Check Microswitches
Low Water Indicator (F004) stays lit when correct water level is achieved	- Low Water Conductivity i.e. Distilled water	- Add Tap Water
	- Probe dirty, damaged or removed	- Visually check probe. Clean/Replace as necessary
	- Wiring connections loose or damaged	- Check connections to probe and main control board.
Heating slow or not apparent	- Temperature incorrectly set	- Check setting & reset if necessary
	- Circuit Breaker Tripped out	- Check Circuit Breaker position. Check cause of trip & reset if necessary.
	- Heater(s) Failed	- Check & Replace as necessary. Check Low Water Probe.
	- Heaters Overfurred	- Check & Replace as necessary.
	- Fault in control circuit.	- Check all connections, output board function & thermal cut-out(s).
Autoclave does not pressurise	- Vent button in open position	- Check Vent Indicator
	- Freesteam time not completed (if option is fitted)	- Check Cycle Progress Indicator Display
	- Air purge valve failure	- Check and replace internal parts or valve.
	- Vent Valve stuck open	- Check & Replace if necessary
	- Safety Valve stuck open	- Check for obstructions on lifting handle.
	- Door incorrectly closed	- Check door position and microswitch setting

Symptom	Possible Cause	Possible Solution
Incorrect Temperature/Pressure Correlation	Air not fully purged. Due to :	
	- Incorrect Load Packing	- Re-Load and re-start cycle with (more) freesteaming.
	- Faulty Air Purge Valve	- Check & Replace if necessary
	- Faulty Controller or Gauge	- Check function and calibration
Safety Valve opening	- Temperature set too high	- Check Temperature Setting
	- Contactor Failure	- Check & Replace if necessary.
	- Safety Valve Faulty	- Check the lock on the valve is intact and has not been tampered with and that the lifting handle is not obstructed. Check the pressure shown on the gauge is above 2.2 Bar. If not replace the valve.
	- Output board Failure	- Check & Replace if necessary.
Door will not open once Autoclave has cooled to 80°C	- Thermal Lock Temperature not yet reached in Load Simulator	- **WAIT.** Thermal Lock is set to Load and not Chamber temperature.
Door does not open when door button is pressed	- Safety delay not completed	- Wait while **'hoLd'** is displayed in the temperature display
	- Thermal Lock Temperature not yet reached in load simulator	- Check Cycle Complete indicator is lit on cycle progress display.
	- Faulty Door system	- Check Door Fault Indicator Lamp and Door Functions.
	- Thermal Lock previously overridden	- Use thermal lock key to open door. Normal function will return after a complete cycle has been run.
Fault Indication will not go out	- Fault not Re-set. (Refer to list of Fault Codes)	- Fault not Re-set. (Refer to list of Fault Codes)

If in any doubt about any of the above procedures do not hesitate to call Priorclave Service on:

+44 (0)20 8316 6620

or your nearest Priorclave approved service agent

Appendix B - Steam Table

Autoclaves

Temperature (°C)	Pressure (Bar)
100	0.00
105	0.20
110	0.43
115	0.69
120	0.99
121	1.06
122	1.13
124	1.25
126	1.35
128	1.55
130	1.70
132	1.86
134	2.04
136	2.21
138	2.40
140	2.60

Steam Generators (where fitted)

Temperature (°C)	Pressure (Bar)
140	2.6
142	2.8
144	3.0
146	3.2
147.5	3.4
150	3.6
152	3.8
153.5	4.0
155	4.4

Correct Correlation between Temperature and Pressure shows correct operation of the autoclave and that air purging is satisfactory.

NB.

This table is accurate at sea level and at moderate altitudes will be sufficiently accurate for its intended purpose. However, at higher altitudes the pressures indicated will be slightly higher than those shown above.

Appendix C - Wiring Diagrams

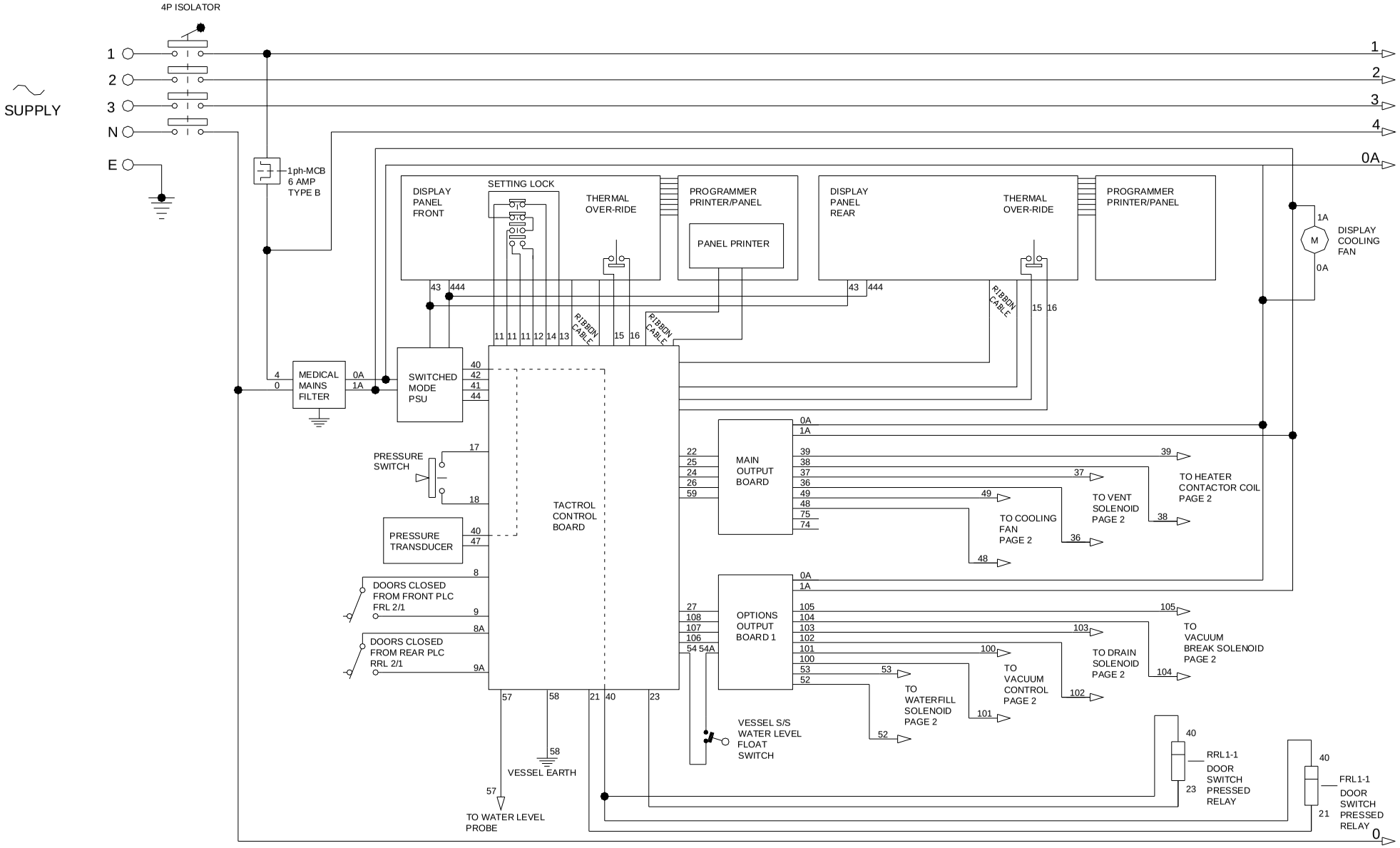
Output Board Designations

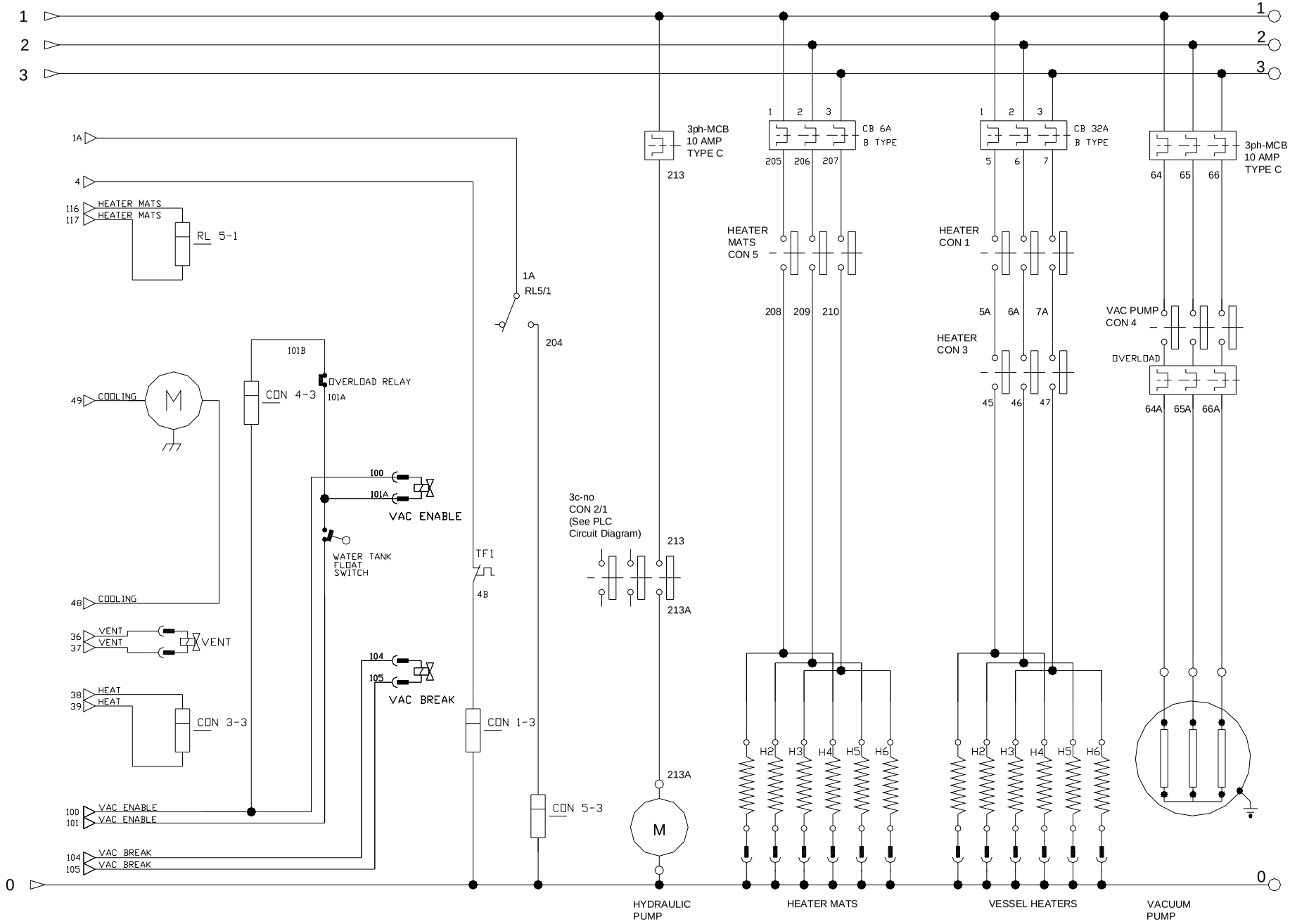
Output Board 1

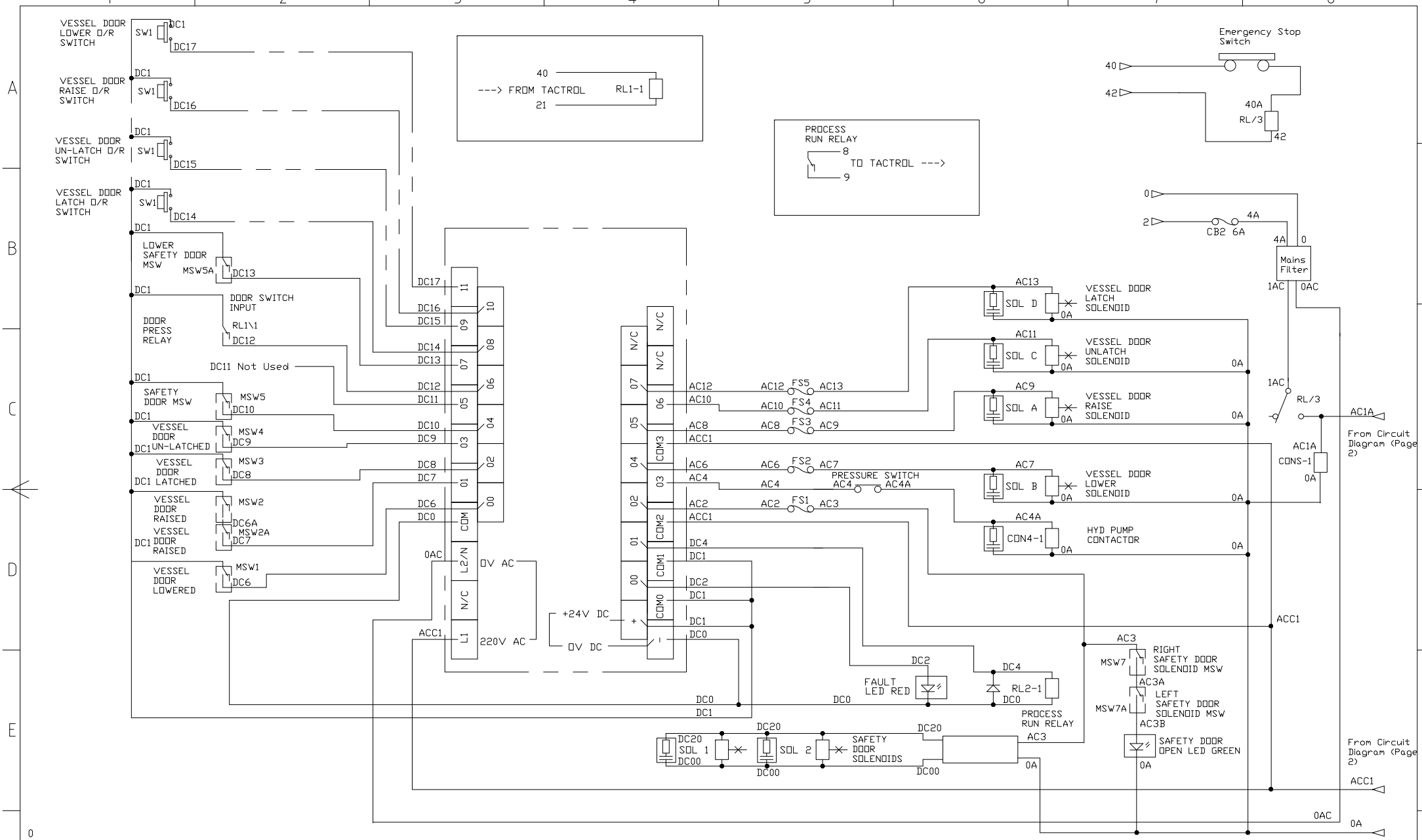
IN		OUT	FUNCTION
	1		
	2		
	3		
	4		

Output Board 2

IN		OUT	FUNCTION
	1		
	2		
	3		
	4		


4P ISOLATOR
SUPPLY
1
2
3
N
E
1ph-MCB
6 AMP
TYPE B
DISPLAY
PANEL
FRONT
SETTING LOCK
THERMAL
OVER-RIDE
PROGRAMMER
PRINTER/PANEL
PANEL PRINTER
DISPLAY
PANEL
REAR
THERMAL
OVER-RIDE
PROGRAMMER
PRINTER/PANEL
DISPLAY
COOLING
FAN
RIBBON
CABLE
MEDICAL
MAINS
FILTER
SWITCHED
MODE
PSU
PRESSURE
SWITCH
PRESSURE
TRANSDUCER
TACTROL
CONTROL
BOARD
DOORS CLOSED
FROM FRONT PLC
FRL 2/1
DOORS CLOSED
FROM REAR PLC
RRL 2/1
MAIN
OUTPUT
BOARD
OPTIONS
OUTPUT
BOARD 1
TO HEATER
CONTACTOR COIL
PAGE 2
TO VENT
SOLENOID
PAGE 2
TO COOLING
FAN
PAGE 2
TO DRAIN
SOLENOID
PAGE 2
TO
VACUUM
BREAK SOLENOID
PAGE 2
TO
VACUUM
CONTROL
PAGE 2
TO
WATERFILL
SOLENOID
PAGE 2
VESSEL S/S
WATER LEVEL
FLOAT
SWITCH
VESSEL EARTH
TO WATER LEVEL
PROBE
RRL1-1
DOOR
SWITCH
PRESSED
RELAY
FRL1-1
DOOR
SWITCH
PRESSED
RELAY
0A
1A
0


1
2
3
0
1A
4
116
117
HEATER MATS
HEATER MATS
RL 5-1
49
COOLING
M
48
COOLING
36
37
VENT
VENT
VENT
38
39
HEAT
HEAT
CON 3-3
100
101
VAC ENABLE
VAC ENABLE
104
105
VAC BREAK
VAC BREAK
101B
CON 4-3
OVERLOAD RELAY
101A
100
101A
VAC ENABLE
WATER TANK
FLOAT
SWITCH
1A
RL5/1
204
TF1
4B
CON 1-3
CON 5-3
3c-no
CON 2/1
(See PLC
Circuit Diagram)
213
213A
213A
M
HYDRAULIC
PUMP
3ph-MCB
10 AMP
TYPE C
213
1 2 3
CB 6A
B TYPE
205 206 207
HEATER
MATS
CON 5
208 209 210
H2 H3 H4 H5 H6
HEATER MATS
1 2 3
CB 32A
B TYPE
5 6 7
HEATER
CON 1
5A 6A 7A
HEATER
CON 3
45 46 47
H2 H3 H4 H5 H6
VESSEL HEATERS
3ph-MCB
10 AMP
TYPE C
64 65 66
VAC PUMP
CON 4
OVERLOAD
64A 65A 66A
VACUUM
PUMP



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REVISION NUMBER	DRAWN BY	CHECKED_BY	TITLE	DATE	SCALE
	T.C	D.L	Circuit Diagram PS/RSV/EH450 PAC3083	04/06/09	
	MAT:-		FILENAME Priorclave Power Door Autoclaves Circuit Diagram Page 3 -. PLC Diagram		
	GEN'TOL		DRAWING_NUMBER	SHEET 3 OF 3	

Appendix D – Specification Tables

Model:	PS/RSV/EH230	PS/RSV/EH350
Dimensions		
Chamber dimensions (wxdxh)	580x650x675mm	580x950x675mm
Working dimensions (wxdxh)	580x600x600mm	580x900x600mm
Capacity	209 Litres	313L
Outside dimensions (wxdxh)	830x1100x1880mm	830x1400x1880mm
Minimum Installation Area Required (wxd)	830x1300mm	830x1600mm
Recommended space required for service access.	1M to each side *Where autoclave cannot be pulled forward for service access to sides*	
Weight		
Unloaded	850kG	950kG
With water charge	880kG	980kG
Door	60kG	60kG
Pressure Vessel	250kG	350kG
Electrical		
Power Supply Required	400V 50/60Hz 3 Phase with Neutral and Earth. 21kW, 30A/phase.	
Steam		
Steam Supply Required	Not Required	
Water Supply		
Automatic Waterfill System (if fitted)	Soft or softened water. 15mm BSP. 20psi	
Optional Condenser	28mm BSP 60psi	
Air Supply		
Air Supply required	Models with Air Ballasting from an external supply (PC/ABC/000): 100psi Dry Oil-Free	
Drainage		
Main Drain Connection	28mm BSP	
Secondary Drain Connections	15mm BSP	
Max. Sound Level		
Without Vacuum Pump	Approx. 30db @ 1M	
With Vacuum Pump	Approx. 75db @ 1M	
Max. Heat Emission - Full Cycle		
Average (Standard cycle)	10.5kW per cycle	
For other cycles	((21hx10.5p)x0.75)/t) kW/Hour Where: h = heat-up time (hrs), p = process time (hrs), t = Total cycle* (hrs) * to thermal lock temperature	

Appendix E – Other Items Fitted

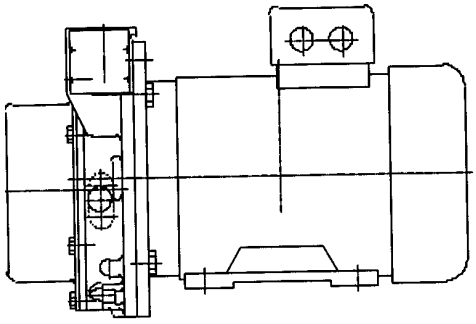
STERLING

Extracts from Sterling Fluid Systems (UK) Ltd Manual.

Document No.....: BA 26397-EN-OO File .....: VFLEM2de-.doc Date : 28.08.2001	Sterling Fluid (UK) Systems Limited Atlantic Street, Altrincham, Cheshire, WA14 5DH, England.

LEM. 26 251,

LEL. 91 -251



Single–stage liquid ring vacuum pumps in compact design

Operating instructions

To be strictly observed

Contents

Please be aware of your responsibility for your fellow men when working at the pump or the pump unit!

Attention: This pump or this pump unit, respectively maybe mounted and put into operation by qualified technical personnel only and these operating Instructions and the effective regulations have strictly to be observed. If you do not pay attention to these operating Instructions,

- **danger** may be created for you or your colleagues,
- **the pump** or **the pump unit** may be **damaged**,
- **the manufacturer is not liable** for damages resulting from this non-observance!

1.0 Safety

This operating manual gives basic instructions which are to be observed during installation, operation and maintenance of the pump. It is therefore imperative that this manual is read by the responsible personnel/operator prior to assembly and commissioning. It is always to be kept available at the installation site.

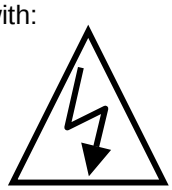
It is not only the general safety instructions contained under this chapter Safety to be observed, but also the specific information provided under the other chapters.

1.1 Identification of safety prescriptions in the operation instructions

Safety prescriptions given in these operation instructions, non compliance with which would affect safety are identified by the following symbol:

Danger symbol as per DIN 4844-W9
(ISO 3864 -B.3.1)

or in case of warning of electrical voltage with:



Danger symbol as per DIN 4844 W-8
(ISO 3864 -B.3.6)

The word

ATTENTION

identifies the safety regulations whose non compliance may cause danger for the machine and its function. It is imperative that signs affixed to the machine, e.g.

- arrow indicating the direction of rotation
- symbols indicating fluid connections
- type plate

must be observed and kept legible.

1.2 Qualification and training of personnel

The personnel responsible for operation, maintenance, inspection and assembly must be adequately qualified. Scope of responsibility and supervision of the personnel must be exactly defined by the plant operator. If the staff does not have the necessary knowledge, they must be trained and instructed which may be performed by the machine manufacturer or supplier on behalf of the plant operator. Moreover, the plant operator is to make sure that the contents of the operation instructions are fully understood.

1.3 Hazards in case of non compliance with the safety instructions

Non compliance with the safety instructions may produce a risk to the personnel as well as to the environment and the machine and results in a loss of any right to claim damages.

For example non-compliance may involve the following hazards:

- failure of important functions of the machine/plant
- failure of specified procedures of maintenance and repair
- exposure of people to electrical, mechanical and chemical hazards
- endangering the environment owing to hazardous substances being released

1.4 Compliance with regulations pertaining to safety at work

When operating the pump the safety instructions contained in this manual, the relevant national accident prevention regulations and any other service and safety instructions issued by the plant operator are to be observed.

1.5 Safety instructions relevant for operation

If hot or cold machine components involve hazards, they must be guarded by the user against accidental contact.

Guards for moving parts (eg. couplings) must not be removed from the machine while in operation.

Any leakage of hazardous (e.g. explosive, toxic, hot) fluids (e.g. from the shaft seal) must be drained away so as to prevent any risk occurring to persons or the environment. Statutory regulations are to be complied with.

Hazards resulting from electricity are to be precluded by the user (see for example the VDE specifications and the bye-laws of the local power supply utilities).

1.6 Safety instructions relevant for maintenance, inspection and assembly work

It shall be the plant operator's responsibility to ensure that all maintenance, inspection and assembly work is performed by authorised personnel who have adequately familiarised themselves with the subject matter by studying this manual in detail.

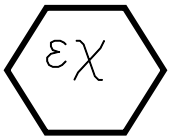
Any work on the machine shall only be performed when it is at a standstill. It is imperative that the procedure for shutting down the machine described in this manual is to be followed.

Pumps and pump units which convey hazardous media must be decontaminated.

On completion of work all safety and protective facilities must be re-installed and made operative again. Prior to re-starting the machine, the instructions listed under "first commissioning" are to be observed.

1.7 Safety instructions for the use in areas with explosion hazard

In this paragraph information are given for an operation in areas with explosion hazard.



1.7.1 Arrangement of the units

If the pump is completed with other mechanical or electrical components to one unit, the complete unit may be considered only as device category according to the directive 94/9/EC which is fulfilled by all used components.

Note:

This instruction gets special meaning when using pumps which are corresponding to a device category according to the directive 94/9/EC, however, are driven by a motor which does not meet these criteria. Then it might be that the pump has been provided with the EX-sign but the unit must not be used in areas with explosion hazard due to the non EX-admitted motor. So the operator has always to pay attention to the conformity with the directive 94/9/EC of all used components of the pump unit.

1.7.2 Execution of coupling guards for shaft couplings

Coupling guards which shall be used in areas with explosion hazard have to fulfil the following criteria:

non sparking material e.g. brass has to be used or

steel plate constructions have to be used, which are executed in a way that with faults to be foreseen (e.g. deformation by stepping on the coupling guard) a mechanical contact of the rotating parts is impossible.

1.7.3 Surveillance of technical parameters

When using pumps in areas with explosion hazard the operator has to check regularly the following parameters:

- leakage of the shaft seals
- if necessary bearing temperatures
- liquid level in the pump during commissioning
- for pumps with magnetic coupling the temperature of the electrically conductive isolation

shroud has to be controlled

The operator has to ensure that the pump, with abnormal conditions, will be taken out of operation / not be taken again in operation at short notice. The advice regarding operation and maintenance given in this operation manual have to be kept to.

Particular information concerning the surface temperatures of the pump are given later in this operation manual.

1.7.4 Avoidance of sparks caused by exterior impact effect

The operator has to ensure that with an operation of the machine in areas with explosion hazard no exterior impact effect to the machine casing may create sparks.

1.8 Unauthorised alterations and production of spare parts

Any unauthorised modification of the machine will result in an exemption of Sterling SIHI from any liability. In such cases the operator of the machine takes over the responsibility for the safe operation.

Using spare parts and accessories authorised by the manufacturer is in the interest of safety. Use of other parts may exempt the manufacturer from any liability.

1.9 Unauthorised mode of operation

The reliability of the machine delivered will only be guaranteed if it is used in the manner intended and in accordance with the instructions of this manual. The specified limit values must not be exceeded under any circumstances.

1.10 Warranty / guarantee

Sterling SIHI guarantee for a longterm, satisfactory operation if

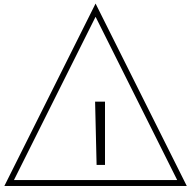
- the pump is installed and operated in compliance with these instructions and under conditions approved by Sterling SIHI.
- modifications only will be carried out with Sterling SIHI's agreement.

2.0 Application

Liquid ring vacuum pumps and compressors are used to deliver and compress gases and vapours. It is also possible to handle little flows of liquid.

The pump is to be applied only for the operating conditions stated by the orderer and confirmed by the supplier. Guarantee is assumed within the scope of our conditions of sale and delivery.

2.1 Warning of misuse



You may use the pump only for the approved operating conditions as otherwise hazards for people and environment may occur.

2.2 Construction and mode of operation

The pump operates according to the liquid ring principle. The vane wheel impeller is arranged eccentrically in the circular pump casing. It transfers the drive power to a liquid ring that forms concentrically to the casing when starting up the pump. This arrangement causes the liquid to leave and to enter piston-like the vane wheel impeller cells. In the area of the leaving liquid ring the vane wheel impeller cells get filled with the gas to be handled via a suction opening. In the area where the liquid ring enters the vane wheel impeller cells the gas will be compressed and pushed out via a discharge opening.

During operation the pump must continuously be supplied with service liquid, normally water. This liquid serves to eliminate the heat resulting from the gas compression, which is taken up to a great extent by the liquid ring and to replenish the liquid ring, because part of the liquid is leaving the pump together with the gas. The reuse of the liquid as service liquid is possible.extent by the liquid ring and to replenish the liquid ring, because part of the liquid is leaving the pump together with the gas. The reuse of the liquid as service liquid is possible.

2.3 Technical limits of operation

Pay attention to the following operation limits.

ATTENTION

The limit values are shown later in the manual:

- Max. temperature of the medium handled
- Max. temperature, max. viscosity and max. density of service liquid
- Max. permissible discharge pressure and max.permissible pressure difference
- Max. speed

ATTENTION

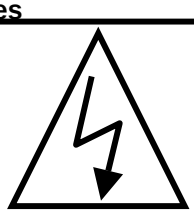
Avoid the following conditions when using the liquid ring vacuum pump:

- The combination of several limiting values
- Frequent switching operations (max. 5 - 10 per hour
- Pressure jumps of the gas
- Temperature jumps of the gas or of the service liquid

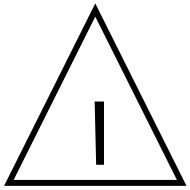
3.0 Putting into operation and out of operation

The work described in this chapter must be carried out by trained skilled staff only.

3.1 Safety measures



- Electrical connections are to be carried out according to the regulations of the local public utilities and to the ELexV standards. Furthermore the ex-rules of the BG chemistry are to be observed.
- Only correspondingly authorised personnel may carry out the work at the electrical installation.



- Fill the pump properly.
- Check the sense of rotation only when the pump is filled.
- In case of handling explosive, toxic, hot or aggressive media it must be ensured that persons and environment are not endangered.
- When handling easily inflammable gases consider the possible generation of explosive gas/air mixtures; if necessary, the pump is to be flushed with inert gas.
- The pump may be operated only if a continuous supply of service liquid is secured.

3.2 Filling and emptying

Before the first start-up the pump must be filled with service liquid.

The filling with service liquid is made via the make-up liquid connection (shut-off valve). When starting-up the pump the liquid level in the pump must not exceed shaft height .

The pump can be emptied through the drain connection Mind that there may be dead spaces within the pump, in which sediment of service liquid can remain. Because of this flush the pump before disassembly, especially when using toxic media.

3.3 Electrical connection

The motor has to be connected according to the circuit diagram in the terminal box.

3.4 Connection and verification of accessories and control devices

The connection and the verification of the control devices and of the accessories have to be made in accordance with the attached operating instructions of the different apparatus.

3.5 Verification before switching-on

ATTENTION

- The pump never must run dry.
- Fill the pump with service liquid before the first start-up.
- The liquid level shall not exceed the shaft height.
- Never start-up the pump when the discharge side is closed.

3.6 Control of sense of rotation

The sense of rotation has to be checked by short-time switching on the motor the arrow at the pump casing indicates the sense of rotation)

3.7 Putting into operation

For putting into operation proceed as follows:

1. Switch on the motor.

2. Open the shut-off valve for the service liquid.

3.8 Putting out of operation

For putting out of operation proceed as follows:

1. Close the shut-off valve for the service liquid.

2. Ventilate the suction chamber.

3. Switch off the motor.

ATTENTION

If there is the risk of freezing, drain the pump, the liquid separator and the pipelines. The pump has to be preserved should it be stopped for a longer period of time.

4.0 Maintenance, disassembly, assembly

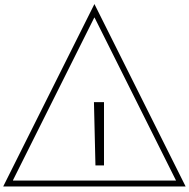
The work described in this chapter must be carried out by trained skilled staff only.

Work on electrical connections must be carried out by authorised skilled staff only.

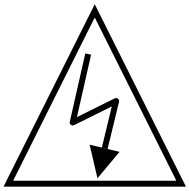
4.1 Preconditions

The pump respectively the pump unit has been put out of operation according to the instructions of chapter 3.

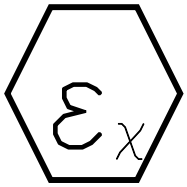
4.2 Safety measures



- When mounting and dismounting the pump observe especially that no toxic or aggressive media can escape from open lines. Secure the shut-off devices against unauthorised operating.
- Drain the pump before disassembly out of the plant. After the draining liquid residuals remain in the pump which must be removed by flushing the pump with a suitable liquid.



- The electrical connections must be connected and disconnected only after removal of corresponding fuses.



LEM: For motors of the protection type EEx e ll T3 the following instructions are to be observed:

In case of repair, e.g. disassembly of the mechanical seal, it is admissible that the service personnel of Sterling SIHI or of the customer dismounts the pump casing (here corresponding with the motor flange) from the motor.

However, it is a basic requirement that no modifications are carried out at the motor electric (winding, terminal box).

4.3 Maintenance

The pump requires only little maintenance. However following points must be observed:

- **LEM:**

  The antifriction bearings of the motor have permanent lubrication. The grease portion filled in by the motor supplier, according to experience, will be sufficient for several years.

- The mechanical seal do not require any maintenance. With normal operation leakages can occur only after several 1.000 operation hours, if the wear parts are worn out.
- In case of danger of freezing the pump, liquid separator and pipelines are to be drained. The pump must be preserved.
- In case strongly calcareous water is used as service liquid, the pump must be opened at least at intervals of a half-year and the calcareous deposit must be removed.
- The calcareous deposits can be avoided, if the service liquid is prepared by a suitable agent. The measures to be taken depend on operation time and water quality.
- In case the pump has not been into operation for a longer period of time, it must be drained and preserved, if necessary.
- As contamination accumulates in the pump and in the liquid separator, those are to be cleaned at corresponding intervals.

4.4 Notes

4.4.1 Assembly tools

For the disassembly and assembly of the pump we recommend the following special tools: Extractor for the vane wheel impeller (easy to make or available as accessory) and socket wrench for tie bolts (LEM. 26/51).

4.4.2 Sealing surfaces and centrings

ATTENTION

All parts of the pump, especially the sealing surfaces and centrings are to be treated carefully.

4.4.3 Spare parts

When ordering spare parts indicate the item No. of the part, pump type and pump No. (see annex or type plate). Typical spare parts are marked with a frame in the sectional drawing.

After dismantling the vane wheel impeller 23.50 always install a new tolerance sleeve 53.10 before re-assembly.

4.4.4 Motor specification

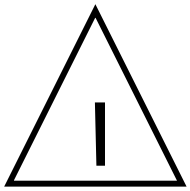
The electrical data of the motor can be taken from the motor type plate.

LEM: When ordering spare parts indicate pump type and pump No. (see annex).

4.4.5 Sectional drawings

The disassembly and assembly can be carried out acc. to the written description and to the sectional drawing (see annex).

4.5 Disassembly



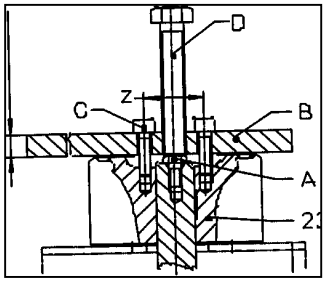
Pay attention, especially when using dangerous media, that also after careful flushing of the pump residuals of the medium or of the service liquid can remain in dead spaces of the pump.

4.5.1 Preparation of the disassembly

Proceed according to the following checklist:

1. Switch the power supply of the motor free from tension.
2. Disconnect the motor.
3. Drain the installation at least within the pump area, i.e. between the gates at suction and discharge side.
4. If necessary, disconnect existing measuring probes or control instruments respectively and dismount them.
5. Drain the pump.
6. Dismount the pump unit out of the plant.
7. If necessary, flush the pump.

4.5.2 Disassembly of the pump



Proceed as follows:

LEM:

1. Remove the cover 16.10.

2. With extractor, as shown, withdraw the vane wheel impeller from the shaft.

Subsequently take the tolerance sleeve 53.10 out of the bore of

the vane wheel impeller 23.50.

3. Separate the guide disk 13.70 from the vacuum casing 10.10.

   If necessary, remove the valve plate 75.11 and the protection plate 58.01.

   Remove the rotating part of the mechanical seal 43.30 by rotary motion from the shaft end of the motor (LEM. 91-251).

	A	C	D	z
LE.26/51	M8 x 15	M8 x 30	M16 x 90	39
LE. 91/126	M10 x 20	M8 x 35	M16 x 90	45
LE. 161	M12 x 25	M8x45	M16x90	66
LE. 251	M12 x 25	M8x35	M16x90	80

(8 = fiat-bar steel)

4. Separate the vacuum casing from the motor 80.00 (LEM. 26/51: for that purpose remove the ventilator cover of the motor and loosen the motor clamping screws}. The rotating part of the mechanical seal 43.30 can be drawn from the motor shaft end together with the casing (LEM. 26/51}. Remove the stationary ring of the mechanical seal 43.30, if worn out also the O-ring 41.20 and the radial sealing ring 42.10 out of the casing 10.10.

4.6 Assembly

4.6.1 Preparation for Assembly

1. Clean carefully all pump parts Pay attention that the sealing surfaces have no grooves and that the guide disk is plane. If necessary, the guide disk must be smoothed on a levelling plate by means of abrasive cloth.
2. Coat the running surface of the guide disk as well as all threads and fittings (except the sealing fittings} with Molykote slide paste.
3. Provide the sealing surfaces with sealing compound shortly before jointing (last sign of the pump code

   "0" liquid
   "4" Teflon
   "7" Teflon / O-ring

   In general the liquid sealing compound Epple 33 is used for grey cast iron parts and Silastik for stainless steel parts.
4. During assembly no foreign substances and no superfluous sealing compound must enter the pump.
5. Use jaws when clamping parts for assembly.

4.6.2 Tightening torques

When tightening the screws and nuts the following tightening torques must be observed:

thread	M5	M6	M8	M 10	M 12
tightening torque	6,5 Nm	8,5 Nm	12 Nm	25 Nm	40 Nm

4.6.3 Assembly of the pump

Proceed as follows:

(Pay attention to the sectional drawings!}

LEM. 26 251:

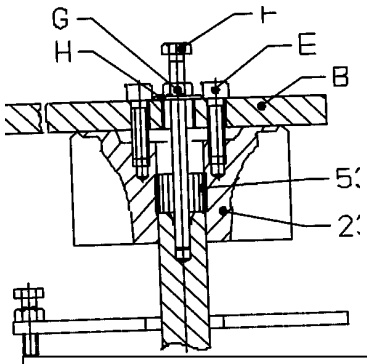
1. Insert radial seal ring 42.10 into the vacuum casing 10.10. Press the stationary ring of the mechanical seal 43.30 into the bore of the casing.
2. Fasten the casing 10.10 to the motor 80.00.
3. Slip the rotating parts of the mechanical seal 43.30 on the motor shaft end 80.00.

4. Put the O-ring 41.20 into the groove. Connect the valve plate 75.11 and the protection plate 58.01 with the guide disk 13.70 (secure the screws, e.g. with Loctite 222} or put the valve balls 75.40 into the bores of the casing 10.10.

5. Coat the sealing faces of the casing 10.10 with sealing liquid compound. Fasten the guide disk 13.70 to the vacuum casing 10.10. If necessary put on a spacer to the motor shaft end..

6. For fastening of the vane wheel impeller 23.50 and adjustment of front gap firstly it is necessary to tighten the guide disk 13.70 to the casing.

7. Now slip the vane wheel impeller 23.50, with the tolerance sleeve 53.10 inserted, on the motor shaft end 80.00. Press the vane wheel impeller 23.50 on the shaft end until the required distance of the gap between vane wheel impeller 23.50 and guide will be achieved (see sketch).



Front Gap: **0,10 – 0,12** mm

	E	F	G
LE. 26/ 51	M8 x 30	M8 x 100	M8
LE. 91/126	M8 x 35	M10 x 105	M 10
LE. 161	M8 x 45	M12 x 140	M12
LE. 251	M8 x 25	M12 x 140	M 12

(B = fiat-bar steel, H = disk, min. outer-0 20)

8. Loosen the guide disk 13.70. Insert a Teflon sealing string (01 mm) in the V-groove of the cover 16.10. Fasten the cover 16.10 on the guide disk 13.70.

9. Tighten steadily the hexagonal screws 90.10 crosswise.

4.7 Test Work

ATTENTION

Do not turn the pump unnecessary without liquid.

After assembly the following test work must be carried out:

1. Check the easy running of pump by rotating the motor fan.

   In case the pump should be jammed tight, probably the vane wheel impeller is incorrectly adjusted. The fault must be eliminated.

2. Carry out a hydrostatic pressure test with 3 bar (hydraulic test).

   Drain the pump.

3. Carry out a leakage test (with foaming media).

5.0 Help in case of trouble

Trouble elimination must be carried out by trained skilled staff only.

5.1 Preconditions

Precondition for a proper operation of the pump is the observance of the instructions for installation and starting-up of the pump given previously.

The different modes of operation of the pump are described earlier.

5.2 Trouble, causes and elimination

Trouble	Cause	Elimination
Suction volume flow of the pump not sufficient	Suction line is leaky.	Check the flange connections and retighten them. If necessary the seal has to be replaced.
	Decrease of the suction volume flow by increased service liquid temperature (Values indicated in the catalogue are related to water of 15 °C)	Regulate the temperature of the service liquid by increasing the make-up liquid flow or by increasing the cooling liquid flow in the heat exchanger.
	Forming of deposits in the pump	Check the pump for contamination and deposits. Clean the pump. If necessary, take precautions.
Pump causes creaking noise(cavitation)	The pump runs at considerably lower suction pressures than indicated in the catalogue.	Connect the protection against cavitation
	The service liquid temperature is higher than determined in the annex.	Regulate the temperature of the service liquid by increasing the make-up liquid flow or by increasing the cooling liquid flow in the heat exchanger.
Escape of liquid between motor and pump	Mechanical seal is leaky	Change the mechanical seal(assembly and disassembly according to chapter 4).
Liquid at the gas outlet	Make-up liquid flow F too Qreat	Throttle the make-up liquid flow.
	Drain liquid flow A too small, overflow clogged	Check the overflow for sufficient passage, eliminate the clogging.

6.0 Technical data

6.1 Catalogue data of the pump

In the annex are indicated the operating data of the liquid ring vacuum pump according to the conditions stated in the catalogue (gas handled: air at 20 °C, service liquid: water at 15 °C).

6.2 Make-up liquid flow

In the annex are stated the make-up liquid flows F for combined operation (KB) and for the make-up liquid operation (FB) when using water as service liquid.

The make-up liquid flows indicated in the column differences in temperature are applicable to the compression of dry gases. If condensing vapours are compressed, the make-up liquid flows shall be increased because of the condensation heat to be dissipated additionally.

6.3 Limiting operating data

Pump type	unit	LEM 26 / 51	LEM 91/1261 LEL 91/126	LEM 161 LEL 161	LEM 251 LEL 251
min. suction pressure	mbar	33			
admissible discharge overpressure	bar	0,3	LEM 0,3 / LEL 0,5		
adm. pressure difference between max.	mbar	1100	LEM 1100 / LEL 1500		
suction and discharge side min.		200	200		
max. gas inlet temperature dry	°C	200			
vapour saturated	°C	100			
max. speed	rpm	3600		1750	
service liquid temperature max.	°C	80			
min.	°C	10			
max. service liquid density	kg/m3	1200			
max. service liquid viscosity	mm2/s	4			

Absolute pressures [mbar]

Overpressures [bar]

Table 6.3: Limiting operating data

ATTENTION

The surface temperatures at the external pump components result from the temperatures of the pumping medium or of the service liquid. Dependent on the existing operating conditions the increase in temperature of the service liquid may be about 5 -20 K when passing through the pump.

6.4 Admissible branch load

	Forces Fx, Fy, Fz [N]	Moments Mx, My, Mz [Nm]
LEM. 26/51:	50	15
LEM / LEL 91/126 A.:	50, 50, 80	15, 15,50
LEM / LEL 91/126 C.:	100,100, 160	30,30, 100
LEM / LEL 161:	100, 100, 160	30,30,100
LEM / LEL 251 :	160, 160, 220	50,50, 140

6.5 Type codes

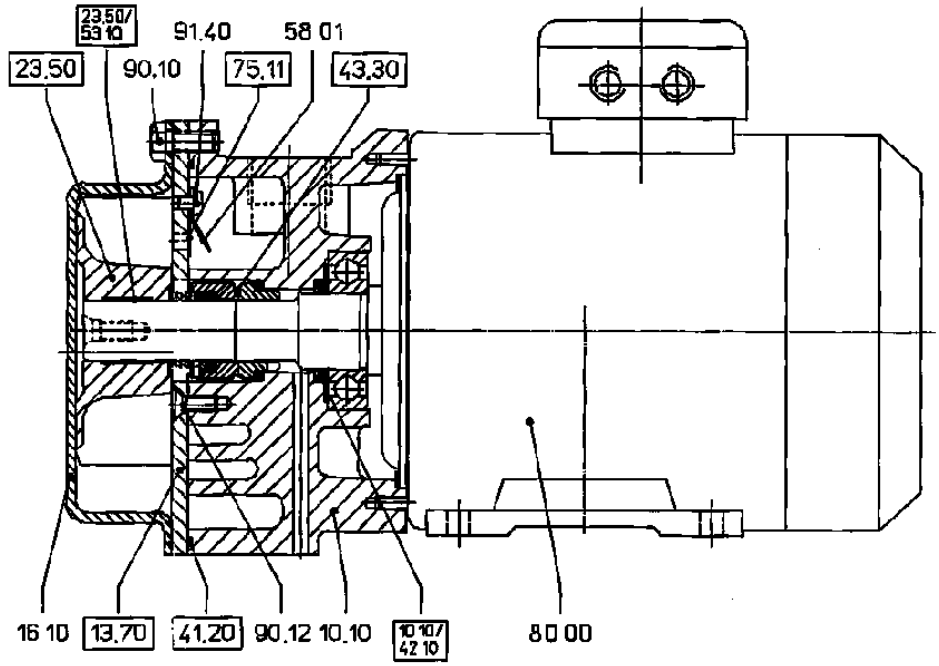
The following table explains the Sterling SIHI-type code (extract from the standard delivery programme).

series + size	hydraulics + bearings	shaft sealing	material design	casing seal	motor designation
	A. hydraulics A C. hydraulics A with flange connection .Z two grease lubricated antifriction bearings arranged in the motor .B as .Z, but arranged in the motor carrier	AAE standard mechanical seal AA1 O-rings Perbunan as ME, but O-rings Viton B3N mechanical seal O-rings Perbunan BLU mechanical seal O-rings Viton	OA main parts of GG 4B main parts of Cr Ni Mo cast steel	0 liquid sealing 7 O-rings, Teflon cord	
LEM 26	AZ	AAE, AA1	OA,4B	7	AW,BW
LEM 51					
LEM 91 - 126 - 161	AZ, CZ	AAE, M1, B3N	OA,4B	0, 7	HW,JW FW,GW
LEL 91 ----' 126 - 161	AB,CB				ES,FS FS FS,GS
LEM 251	CZ	B3N,BLU	OA,4B	7	AW,BW
LEL 251	GB				GS

Annex

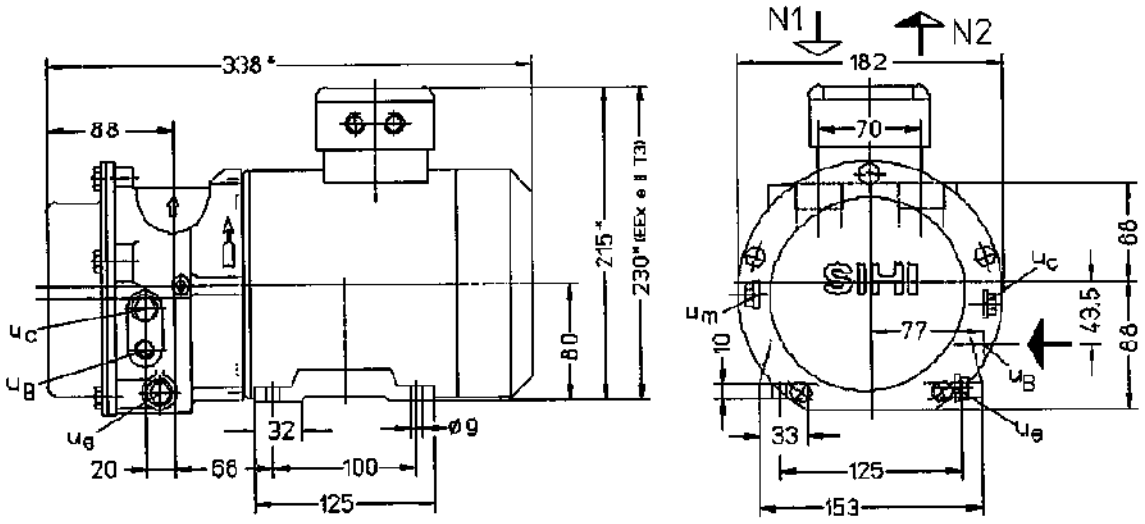
-Sectional drawings

LEM. 26/51:



-Dimension tables

Dimensional table LEM 26



* dimensions dependent on the motor make

	electric motor IP 55			
	size	kW		weight
		50 Hz	60 Hz	abt. kg
LEM 26	80	0,75	1,1	21

N 1 = gas inlet G 1
N 2 = gas outlet G 1
u_B = connection for service liquid G ¼
u_c = connection for protection against cavitation G ¼
u_e = connection for drainage G ¼
u_m = connection for pressure gauge G ¼

-Operating data, make-up water flows

Operating data for different speeds for handling of dry and water vapor saturated air

Vacuum pump	Speed	Suction volume flow in m³/h and power absorption in kW at a suction pressure of:																max. fresh water need	pumping medium
		33 mbar		40 mbar		60 mbar		80 mbar		120 mbar		200 mbar		400 mbar		800 mbar			
	rpm	m³/h	kW	m³/h	kW	m³/h	kW	m³/h	kW	m³/h	kW	m³/h	kW	m³/h	kW	m³/h	kW	m³/h	
LEM 26	2900	3	0.52	7	0.54	14	0.57	17	0.60	21	0.65	25	0.7	26	0.7	24	0.52	0.39	1
		6		11		19		21		24		27		27		24			2
	3500	3	0.8	7	0.8	17	0.85	21	0.90	26	1.0	34	1.05	35	1.1	31	0.85	0.39	1
		6		11		23		27		32		37		36		32			2

The operating data are applicable under the following conditions:
Pumping medium 1) dry air 20°C
2) water vapor saturated air 20°C
Service liquid Water 15°C
Compression pressure 1013 mbar (atmospheric pressure)
The suction volume flow is applied to the suction pressure
Tolerances of the operating data 10%
max. fresh water need with lowest suction pressure

Fresh water flow [m³/h] for different speeds and temperature differences between service water inlet- and fresh water temperature

KB : required fresh water flow [m³/h] FB: Operating water flow (m³/h)

Suction pressure in [mbar]		33				120				200				400			
		KB				KB				KB				KB			
Vacuum pump	Speed	Temperature difference [°C]			FB	Temperature difference [°C]			FB	Temperature difference [°C]			FB	Temperature difference [°C]			FB
	[rpm]	10	5	2		10	5	2		10	5	2		10	5	2	
LEM	2900	0.04	0.07	0.14	0,39	0.05	0.09	0.16	0,36	0.05	0.09	0.15	0,3	0.05	0.08	0.14	0,28
26	3500	0.06	0.10	0.18		0.07	0.11	0.19		0.07	0.11	0.18		0.07	0.11	0.18	