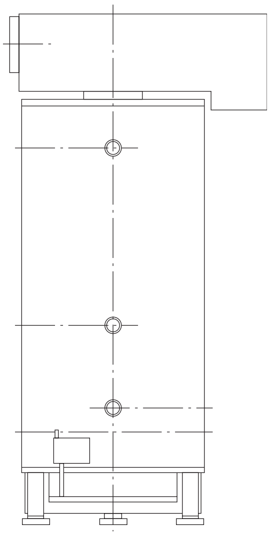

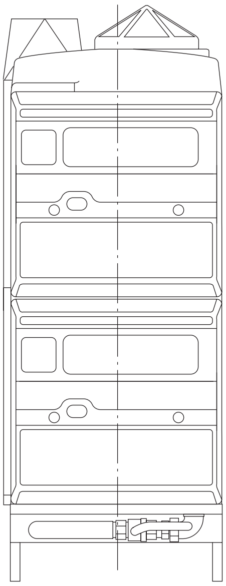

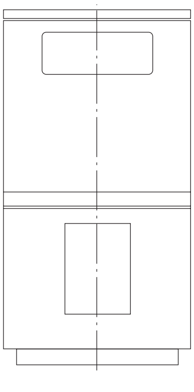

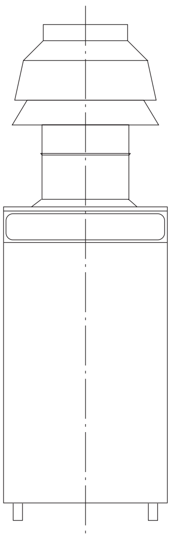

PORTLAND PRESSURISATION UNIT FOR LTHW, MTHW AND CHILLED PRESSURISED WATER SYSTEMS 1.0 TO 2.8 BAR AND 2.8 TO 6.0 BAR COLD FILL PRESSURES

INSTALLATION, COMMISSIONING AND SERVICING INSTRUCTIONS

IMPORTANT NOTE

THESE INSTRUCTIONS MUST BE READ AND UNDERSTOOD BEFORE INSTALLING, COMMISSIONING, OPERATING OR SERVICING EQUIPMENT

Hamworthy

HEATING & HOT WATER PRODUCTS

Customer Services

Technical Enquiries **01202 662527/662528**

To supplement the detailed technical brochures, technical advice on the application and use of products in the Hamworthy Heating range is available from our technical team in Poole and our accredited agents.

Site Assembly **01202 662555**

Hamworthy offer a service of site assembly for many of our products in instances where plant room area is restricted. Using our trained staff we offer a higher quality of build and assurance of a boiler built and tested by the manufacturer.

Commissioning **01202 662555**

Commissioning of equipment by our own engineers, accredited agents or specialist sub – contractors will ensure the equipment is operating safely and efficiently.

Maintenance Agreements **01202 662555**

Regular routine servicing of equipment by Hamworthy service engineers inspects the safety and integrity of the plant, reducing the risk of failure and improving performance and efficiency. Maintenance agreements enable our customers to plan and budget more efficiently.

Breakdown service, repair, replacement **01202 662555**

Hamworthy provide a rapid response breakdown, repair or replacement service through head office at Poole and accredited agents throughout the UK.

Spare Parts **01202 662525**

A comprehensive spare parts service is operated from our factory in Poole, providing replacement parts for both current and discontinued products. Delivery of parts and components is normally from stock within seven days. However, a next day delivery service is available for breakdowns and emergencies.

PORTLAND PRESSURISATION UNIT FOR LTHW, MTHW AND CHILLED PRESSURISED WATER SYSTEMS 1.0 TO 2.8 BAR AND 2.8 TO 6.0 BAR COLD FILL PRESSURES

INSTALLATION, COMMISSIONING AND SERVICING INSTRUCTIONS

NOTE: THESE INSTRUCTIONS SHOULD BE READ AND UNDERSTOOD BEFORE ATTEMPTING TO INSTALL, COMMISSION OR OPERATE THIS UNIT.

THE PORTLAND PRESSURISATION UNIT IS INTENDED FOR USE ONLY IN COMMERCIAL/ LIGHT INDUSTRIAL APPLICATIONS

THIS PRESSURISATION UNIT COMPLIES WITH THE ESSENTIAL REQUIREMENTS OF THE MACHINERY DIRECTIVE 89/392/EEC AMENDED BY 91/368/EEC, THE LOW VOLTAGE DIRECTIVE 73/23/EEC AMENDED BY 93/68/EEC AND THE ELECTROMAGNETIC COMPATIBILITY DIRECTIVE 89/336/EEC AMENDED BY 91/263/EEC AND 92/31/EEC.

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APPENDIX A - PORTLAND PRESSURISATION UNIT WIRING DIAGRAMS

1.0 INTRODUCTION

1.1 The Hamworthy Portland range of pressurisation units are designed to maintain the minimum pressure requirement of modern low/medium temperature, hot water sealed systems, and also the constant pressure requirement of chiller systems. The pressurisation units also provide replacement water for losses from both hot and cold sealed systems.

Note! The pressurisation unit is not to be used for the initial filling of the system.

1.2 The pressurisation units incorporate comprehensive safety circuits to shut down the boiler or chiller and the pressurisation unit itself in the event of a fault, ensuring the system operates within health and safety requirements at all times. Also incorporated is the facility for remote fault indication, allowing rapid response and rectification.

1.3 The Portland consists of a robust, plastic coated, sheet steel cabinet with removable door and top access panel. The door incorporates a seal to prevent water ingress and reduce noise emissions from the unit during operation.

Housed in the lower cabinet compartment are the pump(s), connecting pipework and flow and pressure controls. In the upper, rear compartment is the header tank, with ball float valve and water level switch. In the upper, front compartment is the unit's control system with drop-down fascia for ease of access.

1.4 Portland range options:-

1) Single or dual pump. Dual pump units include automatic pump changeover on duty pump failure.

2) Standard or advanced controls. Advanced controls include full mimic fascia with pump control switches, audible low water alarm, and system fault volt free contact signalling.

3) Single or twin system. Twin system units include additional system pipework connections, separate safety circuits and alarm signals for both systems and full mimic fascia (advanced controls only).

4) Frost protection. Including frost thermostat, panel heater fitted inside the cabinet and trace heating tape for local external pipework.

1.5 The HPS 2.8 unit and its matching expansion vessel are factory pre-set to suit a set of commonly encountered system conditions. The pre-set conditions are listed in Figure 1. Minimal commissioning checks are required if the site application falls within these values. See section **7.0 COMMISSIONING** for details.

2.0 TECHNICAL DATA

2.1 Overall dimensions are shown in Figure 2.

2.2 Performance and general data is shown in Figure 1.

2.3 Screw threads: All screw threads used in the Portland pressurisation unit conform to the following:-

ISO 7/1 or **ISO 228/1** for pipe threads where applicable.
ISO 262 for all general screw threads.

3.0 SEALED SYSTEM FUNCTION

Figure 3 shows the layout of a typical sealed system.

3.1 Terminology

1) Expansion vessel charge pressure - the gas pressure in the expansion vessel with the water connection open to atmosphere.

2) System cold fill pressure - the water pressure in the system that the pressurisation unit is set to maintain.

3.2 Heating application.

The system expansion vessel charge pressure is set to the cold fill pressure. Thus, before operation of the boiler, with the system at the cold fill pressure, the expansion vessel is empty of water. (See Figure 4).

As the system heats up, due to boiler operation, the expanded volume is absorbed by the expansion vessel. A small pressure rise occurs (Boyle's Law) which the expansion vessel is designed to accommodate.

When the system cools the pressure drops, and if there has been some fluid loss the pressurisation unit replaces the lost water to maintain the system cold fill pressure.

3.3 Chiller application.

The system expansion vessel charge pressure is set to 0.35bar (5.0psi) below the cold fill pressure. Thus before operation of the chiller, with the system at the cold fill pressure, the expansion vessel is partially filled with water. (See Figure 5).

As the chiller operates, the water cools and contracts, pulling water from the system expansion vessel and causing a drop in system pressure. The pressurisation unit operates to maintain the system cold fill pressure.

When the system warms to ambient temperature, the water expands and is absorbed by the expansion vessel. The system pressure rises.

Figure 1 - Performance and General Data.

Minimum cold fill pressure bar	1.0	2.8
Maximum cold fill pressure bar	2.8	6.0
Maximum operating pressure bar	8.0	8.0
Maximum water flow rate @ maximum cold fill pressure l/min	12	8
Weight kg	Single pump unit - 70 Double pump unit - 80	
Noise emissions dBA (At unit centreline, 1 m from front)	< 70	
ELECTRICAL DATA		
Electrical supply	230V ~ 50 Hz	
Power rating W	600	1400
Safety circuit and volt free contact rating	240V ~ 50 Hz 3A resistive, 0.8A inductive	
FACTORY PRESET VALUES		
Pressure reducing valve bar	1.8	4.0
System low pressure switch bar	1.5	3.7
System high pressure switch bar	3.65	5.35
Expansion vessel charge pressure bar	1.7	
To suit system conditions *		
Maximum water flow temp EC	82	-
Maximum static height m	16.5	-
Minimum system maximum operating pressure bar	3.3	-

* **Note!** If site application falls outside these values or a HPS 6.0 unit is being installed the pressurisation unit will require full commissioning. See section **7.0 COMMISSIONING** for details.

4.0 OPERATION OF THE PRESSURISATION UNIT

Figure 6 shows the schematic layout of the Portland and optional components.

4.1 Standard unit operation.

4.1.1 A drop in system pressure due to, for example, loss of water, will cause water stored in the unit's accumulator to flow through the unit's pressure reducing valve, into the system, to maintain the cold fill pressure.

If the water loss is greater than the volume of the accumulator, the pump pressure switch will operate the pump to recharge the accumulator to 2.8bar or 6.0bar (depending on model). When the pump pressure switch is satisfied the pump stops. A ~230V 'normal pressure' signal can be derived at terminal '22' (see Figure 7).

4.1.2 Safety functions:-

1) **High system pressure** due to, for example, failure of the system expansion vessel or the unit's pressure reducing valve, will cause the boiler/chiller safety circuit to be interrupted, shutting down the boiler/chiller. A 'high-pressure' alarm signal, derived from the safety circuit, can be obtained at terminal '8' (see Figure 7).

2) **Low system pressure** due to, for example, pump failure, a system water loss in excess of the maximum flow rate of the pump (see Figure 1) or a low water condition (see below), will cause the boiler/ chiller safety circuit to be interrupted, shutting down the boiler/chiller. A 'low-pressure' alarm signal, derived from the safety circuit can be obtained at terminal '7' (see Figure 7)

3) **Low water level** in the unit's header tank due to, for example, failure of the mains water supply or a system leak rate greater than the header tank make up water flow rate, will cause the unit's pump to be shut down. This condition could lead to a low system pressure condition if there is a system water leak.

Note! The cause of the abnormal condition should be investigated. All of the safety functions automatically reset when the abnormal condition is removed.

4.2 Double pump option operation.

These pressurisation units have the additional function of automatic changeover to the standby pump on failure of the duty pump. If the pump pressure switch is not satisfied within 10 seconds of the duty pump starting then operation, switches to the standby pump and the 'duty pump failed' neon on the unit's fascia illuminates. Manual operation of the 'pump reset' switch on the unit's fascia will switch operation back to the duty pump.

Note! The cause of the pump failure must be investigated before resetting to duty pump.

4.3 Advanced controls option operation.

4.3.1 Additional functions:-

1) **Hand/Off/Auto switch -** In 'auto' mode the pressurisation unit operates as described in section 4.1.1. In 'hand' mode the pump pressure switch is overridden, thus the pump will run continuously whilst the switch is in the 'hand' position. However, a 'high system pressure' or 'low water' condition will disable the pump in both auto and hand modes.

2) **Boiler and chiller safety circuits -** Separate boiler and chiller safety circuits are provided. The boiler safety circuit will shut down the boiler in the event of high system pressure, low system pressure and low water. The safety circuit will shut down the chiller in the event of low system pressure only. The safety circuits are rated at 230V~3A resistive load or 0.8A inductive load. See Figure 8 and Figure 9 for wiring details.

3) **Volt free contacts -** These are provided for high system pressure, low system pressure, low water and duty pump failed (double pump units only) signals. The volt free contacts are rated at 230V~3A resistive load, or 0.8A inductive load. See Figure 8 and Figure 9 for wiring details.

4) **Full mimic fascia** - Includes neon indicators for all pressurisation unit and system conditions.

5) **Low water buzzer -** In the event of a header tank low water condition an alarm buzzer will sound. The buzzer can be silenced by manual actuation of the alarm mute button on the unit's fascia.

6) **Pump selector switch** (double pump units only) - This switch enables either pump to be set as the duty pump to allow equal run time on each pump. Pump changeover occurs as described in section 4.2.

7) **Hours run meter** - Displays the pump hours run. A double pump unit has an hours run meter for each pump.

4.3.2 Safety functions:-

1) A high system pressure condition will operate the 'high system pressure' volt free contact, interrupt the boiler safety circuit and disable operation of the pump. The 'high system pressure' neon indicator on the fascia will illuminate.

2) A low system pressure condition will operate the 'low system pressure' volt free contact and disable both the boiler and chiller safety circuits. The 'low system pressure' neon indicator on the fascia will illuminate.

3) A header tank low water condition will operate the 'low water' volt free contact, interrupt the boiler safety circuit and disable operation of the pump. The 'low water' neon indicator on the fascia will illuminate and the alarm buzzer will sound.

4) A duty pump failed condition (double pump units only) will additionally operate the 'duty pump failed' volt free contact.

4.4 Twin system option operation.

4.4.1 Twin system pressurisation units have system connections on both sides of the cabinet. The left hand connections are designated system 'A' and the right hand, system 'B'. If the pressurisation unit is for use on one heating system and one chiller system, the heating system must be connected to the 'A' connections.

The pressurisation unit functions to maintain the same cold fill pressure in both systems. The system working pressure of the individual systems is determined by the size and charge pressure of the system expansion vessels. If in doubt refer to Hamworthy Heating Ltd for sizing information.

The two non-return valves (see Figure 6) act to prevent backflow from one system at high pressure to the other at a lower pressure.

4.4.2 The controls are identical to those of the single system units, but with the addition of extra controls to monitor the second system.

Standard controls units have an additional boiler/ chiller safety circuit to monitor system 'B'. High and low system pressure signals derived from the system 'B' safety circuit can also be obtained. See Figure 10 for wiring details.

Advanced controls units have additional separate boiler and chiller safety circuits, and high and low system pressure volt free contacts to monitor system 'B'. See Figure 11 and Figure 12 for wiring details.

These additional controls operate identically to those of the single system units as previously described.

5.0 GENERAL REQUIREMENTS

5.1 Related documents.

Pressure Systems and Transportable Gas Containers Regulations 1989.

It is law that pressure system appliances are installed by competent persons in accordance with the above regulations. Failure to install appliances correctly could lead to prosecution. It is in your own interest and that of safety, to ensure that this law is complied with.

The installation of the pressurisation unit and expansion vessel MUST be in accordance with the relevant requirements of the Pressure System Regulations, Building Regulations, IEE Regulations and the bylaws of the local water undertaking.

It should also be in accordance with any requirements of the local authority and the relevant recommendations of the following documents:-

BS6644: Installation of Gas Fired Hot Water Boilers - 60kW to 2MW.

BS799: Specification for Oil Burning Equipment.

BS6880 Part 1, 2 and 3: Code of practice for low temperature hot water heating systems of output greater than 45kW.

BS7074: Application, selection and installation of expansion vessels and ancillary equipment for sealed water system.

Part 2: Code of Practice for low and medium temperature hot water heating systems.

Part 3: Code of Practice for chilled and condenser systems.

BS6759 Part 1 (ISO 4126): Specification for safety valves for steam and hot water.

BS3456 (CEE10 Part 1, CEE11 Part 1): Safety of household and similar electrical appliances.

HSE Guidance note PM5 - Automatically controlled steam and hot water boilers.

5.2 Mains water connections.

All connections to the local water main must comply with WRC Regulations including any local requirements. **The system temporary fill connection must be as per water supply bylaws, and must be removed after initial filling.**

Note! The pressurisation unit must not be used to initially fill the system.

5.3 Expansion Vessels.

System expansion vessels must be constructed to BS4814 or BS6144.

The required expansion vessel size is detailed in the Portland Unit contract documents. If these are not available refer to section 12.0 SYSTEM CALCULATIONS, otherwise if in any doubt contact Hamworthy Heating Limited for comprehensive system sizing information.

Hamworthy Heating Ltd can supply a range of expansion vessels with volumes ranging from 8 to 2000 litres, rated at 100°C and 8 or 10 bar maximum working pressure. Figure 13 lists the range of vessels available.

Hamworthy Heating Limited expansion vessels are supplied with a charge pressure of 1.7 bar to minimise commissioning on applications falling within the parameters detailed in Figure 1.

Expansion vessels are commonly fitted with EPDM or butyl rubber diaphragms. These materials are suitable for use with pure water and antifreeze contents of up to 15%. For higher antifreeze contents (up to 40%) a nitrile rubber diaphragm must be specified. Consult Hamworthy Heating Limited for details.

5.4 Safety relief valve.

The system safety relief valve must comply with BS6759 part 1, and be sized and installed in accordance with BS6644 and BS7074.

5.5 Frost protection.

If conditions within the boiler house are likely to fall below freezing, an optional kit can be fitted to the pressurisation unit, to heat the inside of the unit and also local, external pipework to prevent freezing. Consult Hamworthy Heating Limited for details.

6.0 INSTALLATION

6.1 Handling.

The pressurisation unit is supplied bolted onto a wooden pallet, inside a robust cardboard carton.

The unit should be transported to its point of installation, by fork lift or sack truck, whilst still in its packaging. Then the carton can be removed and the unit unbolted from its pallet.

To unbolt from the pallet remove the unit's door by turning the ¼ turn latch. The packing bolts can be accessed through the 2 holes in the units base plinth.

Slide the unit backwards to disengage the rear packing bracket, and walk the unit carefully off the pallet and into position.

Note! Retain the packing bracket if the unit is to be bolted in position.

6.2 Location.

The recommended minimum clearances around the pressurisation unit are detailed in Figure 2.

The pressurisation unit is designed for base mounting only. If it is required to mount the unit on a wall, a suitable mounting cradle must be firmly attached to the wall, taking into account the canti-lever forces. (See Figure 1 for unit weights).

If the unit is to be fixed in position, the 2 fixing holes in the base plinth and the packing bracket (see section 6.1) are utilised. Refer to Figure 2 for fixing hole positions. The packing bracket is first fixed to the floor and the unit lifted over it and then slid forwards to engage the bracket in the unit's plinth. **Note!** The minimum rear clearance must be allowed for. The front 2 fixings can then be applied.

If a finished floor screed is to be applied when all mechanical services are complete, it is advisable to mount the pressurisation unit and expansion vessel (s) on a concrete plinth.

6.3 Pipework Connections.

Figure 14 shows a schematic layout of the Portland unit pipework connections.

1) Mains water connection.

The Portland unit is fitted with a type ‘A’ air gap device to BS6281 part 1 : 1992. The unit can therefore be connected directly to the water main without the need for an intermediate break tank.

To obtain access to the header tank remove the 2 black snap in plugs in the top access panel. Undo the 2 captive screws exposed and lift off the panel.

The 15mm water supply connection must conform to all local WRC regulations. The ball float valve is suitable for direct connection with a 15mm copper compression fitting. The mains connection position is shown in Figure 2.

Note! Ensure correct ball float valve orientation when the pipework is installed.

The Portland unit is fitted with a high pressure BS1212 part 2 ball float valve. When connected to a low-pressure water supply a slow fill rate may be observed, which could lead to nuisance low water shutdowns. In this situation Hamworthy Heating recommend the replacement of the ball valve assembly with a low-pressure version.

2) Overflow connection.

The Portland unit header tank is fitted with a 22mm plastic, female connection. This should be piped away to a position where it will cause a nuisance and ensure an overflow condition can be noticed and corrected. If in doubt consult water bylaws.

3) System connection.

The Portland unit must be connected to the system by an antigravity loop (see Figure 14). The units system connection is Rc¾ BSP, and its position is shown in Figure 2.

The antigravity loop (see Figure 14) must be made in pipework no smaller than the expansion vessel connection, and have a minimum height of 2 metres. It should include a lockshield (or lockable) valve at the system connection point for servicing. An automatic air vent must be fitted at the highest point of the loop.

The antigravity loop must not be lagged, but can be fitted with trace heating tape to prevent freezing (see section **5.5** Frost protection).

If the system return water temperature is likely to exceed 100°C, an intermediate storage vessel must be installed in the downward leg of the antigravity loop (see Figure 14). The storage vessel volume should be 8% of the installed expansion vessel volume. Consult Hamworthy Heating Limited for details.

Twin system models - the left hand connections are for system ‘A’ and the right hand for system ‘B’. If a combination of heating and chiller systems are to be connected, the heating system must be system ‘A’.

The pipework and fittings must be pressure tested to 1½ times the safety valve lift pressure.

4) Expansion vessel connection.

The Portland unit has a Rc¾ BSP connection for the expansion vessel. See Figure 2 for the connection position.

The pipework used must be no smaller than the expansion vessel connection. If copper tube is used, sufficient protection should be provided to prevent damage to the pipework.

The pipework must include a lockshield (or lockable) valve and a drain valve (see Figure 14) to allow the expansion vessel to be drained for servicing.

The pipework and fittings must be pressure tested to 1½ times the safety valve lift pressure.

6.4 Electrical connection.

All wiring to the Portland unit must be in accordance with the IEE regulations, and any local regulations which apply. **Note! If in any doubt a qualified electrician should be consulted.**

The site wiring terminals are shown in Figures as follows:-

Figure 7 - Single/double pump, standard controls units.
Figure 8 - Single pump, advanced controls units.
Figure 9 - Double pump, advanced controls units.
Figure 10 - Single/double pump, standard controls, twin system units.
Figure 11 - Single pump, advanced controls, twin system units.
Figure 12 - Double pump, advanced controls, twin system units.

Note! Full Portland unit schematic wiring diagrams are included in appendix A, for further reference.

4 off 20mm diameter knockouts are provided on each side of the Portland unit for electrical cable entry.

1) Mains supply.

The electrical mains connection must be via a double pole, fused isolator with a contact separation of at least 3mm in both poles. The isolator must be rated at 20A and be positioned local to the Portland unit.

Note! The electrical supply must not be interrupted by any time clock controls, etc.

2) Boiler/chiller safety circuits.

These volt free circuits will interrupt a boiler/chiller control signal, in order to shut down the boiler or chiller system in the event of a system fault condition.

The boiler/chiller control system must be designed such that manual resetting is required after a system fault condition.

The circuits are rated at 230V~50Hz, 3A resistive load or 0.8A inductive load.

Twin system units have individual safety circuits for each system.

Provision must be made to enable the safety circuit to be electrically isolated.

3) Alarm signals.

Standard controls units:-

The normal pressure signal is a 230V~50Hz signal.

The ‘high’ and ‘low’ system pressure signals are derived from the boiler/chiller safety circuit. Thus they will be in the form of the boiler/chiller control signal, e.g. 230V~, 5V, etc.

Advanced controls units:-

The alarm signal volt free contacts are rated at 240V~50Hz, 3A resistive load or 0.8A inductive load.

Provision must be made to enable the volt free contacts to be electrically isolated.

7.0 COMMISSIONING

All HPS 2.8 units are supplied factory set and tested to suit the system parameters shown in Figure 1.

If the site application falls within these parameters the HPS 2.8 unit will require minimal commissioning checks. The required commissioning checks are those items in the sequence of operations marked with an asterisk.

All other systems will require full commissioning.

The system settings are detailed in the contract documents. If in any doubt consult Hamworthy Heating Limited.

Note! It is recommended that commissioning is carried out in the sequence shown.

Refer to Figure 15 for the internal layout of the Portland unit.

7.1* Mechanical installation.

Check that the Portland unit and expansion vessel(s) have been installed correctly, as detailed in section 6.3: Pipework connections. Check also that all lockshield or lockable valves are closed.

7.2* System flushing.

Ensure that the system has been flushed and all foreign matter has been removed, including pipe scale. **Note!** Should this material come into contact with the expansion vessel diaphragm it could result in premature failure of the expansion vessel assembly.

7.3* Electrical Installation.

Note! Before working on the Portland unit ensure that all electrical circuits connected to it are isolated. Remove the unit's door by turning the ¼ turn latch. Drop the hinged fascia and check that the electrical connections are correct (refer to section 6.4: Electrical connection).

Check, and set if necessary, the pump contactor overload(s) settings. The setting must match the Full Load Current rating on the pump's data plate.

Remove the 2A control fuse (on the fascia) and the pump fuse(s) (on the terminal rail next to the pump contractors).

7.4* System expansion vessel.

To set or check the expansion vessel charge pressure, the lockshield valve between the Portland unit and the vessel must be closed. The drain cock fitted on the base of the expansion vessel must be open to allow any water in the vessel to escape.

A suitable gauge should be used to check the charge pressure. Generally a Schrader ‘car type’ valve is fitted near the top of the expansion vessel.

If the charge pressure is too high, it can be reduced by depressing the centre of the Schrader valve or by using a pressure gauge with an integral air release valve.

If the charge pressure is too low, an **oil free** compressor or nitrogen bottle supply can be utilised. A car foot pump can be used if the pressure change is small, otherwise it is not recommended.

Note! In a heating system the charge pressure and the cold fill pressure are the same. However, to allow for pressure gauge inaccuracy it is recommended that the charge pressure be set to 0.1bar less than the cold fill pressure.

When the correct pressure is set, the Schrader valve protective cap must be replaced.

Check the integrity of the pipework. Ensure the lockshield valve between the Portland unit and the expansion vessel is open and the drain valve is closed. Ensure the air purge plug is fitted (near the top of the expansion vessel).

Note! Twin system applications - carry out these operations on both system expansion vessels.

7.5* Accumulator.

The Portland unit's internal accumulator is factory set and must not be adjusted. However, the accumulator charge pressure can be checked as detailed in section 7.4.

Note! The pressurisation unit must be drained and open to atmosphere to take the charge pressure reading.

Settings:- HPS 2.8 - 1.5bar
HPS 6.0 - 4.0bar

Ensure the dust cap and shield are replaced after the check is made.

7.6* Break tank.

Remove the top access panel by removing the 2 black snap in plugs and unfastening the captive screws exposed.

Open the mains water inlet valve and check that the ball float valve operates correctly.

Ensure that the pump isolating valve(s) is open (handle/slot on valve in line with flow). Check that the pump(s) are primed by loosening the priming plug on the pump casing.

Ensure that the system has been filled and open the system isolating valve.

7.7* Pump pressure switch.

Ensure that the electrical mains supply is isolated. Insert the control and pump fuses.

If the unit has the advanced control option, set the ‘hand/off/auto’ switch to the ‘auto’ position. Switch on the power supply; the unit will operate.

Check the operation of the pump pressure switch by observing the pump pressure gauge (on twin system units the pump pressure gauge is mounted in a bracket beneath the controls) as the pump cuts in and out. The cut in and cut out pressures should approximate the settings listed in Figure 16.

Figure 16 - Pump pressure switch settings

Model	Cut in pressure	Cut out pressure
HPS 2.8	2.8bar	3.1bar
HPS 6.0	5.8bar	6.2bar

Check operation of the 'low water' switch by depressing the black float mounted in the header tank. The pump will stop running and on advanced controls units the 'low water' indicator will illuminate and the 'low water' alarm will sound. Press the 'alarm mute' button to silence the alarm. On releasing the float switch the 'low water' indicator will be extinguished and the pump will run.

If a double pump unit is fitted it is likely that during this initial charging cycle, the pump changeover circuit will operate. When the pump's cycling frequency has reduced, press the 'pump reset' button (on the fascia) to reset the duty pump.

7.8 System pressure switch.

Ensure the boiler/chiller safety circuit(s) are isolated.

Note! Units with advanced controls option - the system pressure switch contacts are LIVE! Take care to avoid the contacts whilst adjusting the switch.

Remove the green cover from the system pressure switch, by unfastening the screw at the top, to gain access to the setting adjusting screws.

The left hand indicator on the front of the switch shows the low pressure setting, the right hand indicator shows the high pressure setting.

Isolate the unit from the system by closing the system isolating valve. Turn the adjusting screw on the pressure reducing valve fully anti-clockwise. Open the drain cock in the expansion vessel line to initiate a small leak.

Note! The unit should be allowed to cycle whilst setting the system pressure switch.

7.8.1 Low pressure setting.

Connect a continuity tester across terminals 5 and 7 on the units terminal rail.

Note! The unit is live. Take care to avoid contact with the grey terminals.

With the system pressure gauge reading zero there should be continuity between terminals 5 and 7.

Increase the pressure to the low pressure setting (cold fill pressure minus 0.3bar) on the system pressure gauge, by turning the adjusting screw on the pressure reducing valve clockwise.

Adjust the **front** adjusting screw on the pressure switch, with a 4 BA open-ended spanner or similar, until continuity across terminals 5 and 7 is lost.

Note! Do not force the adjusting screw. The pressure switch will not allow the low-pressure setting to be higher than the high-pressure setting. If necessary adjust the **rear** adjusting screw to increase the high-pressure setting.

7.8.2 High pressure setting.

Connect the continuity tester across terminals 5 and 8. There should be no continuity at the cold fill pressure.

Increase the pressure to the high pressure setting (hot working pressure plus 0.35bar) on the system pressure gauge by turning the adjusting screw on the pressure reducing valve clockwise.

If the unit cannot attain the required pressure, reduce the leak through the drain valve. If the pressure is still too low, connect the unit to the water main via the WRC approved quick fill connection to achieve the required pressure. Alternatively a 'Rigid' type hydraulic tester can be used.

Adjust the **rear** adjusting screw on the pressure switch, until continuity is made across terminals 5 and 8.

Replace the system pressure switch cover.

Reconnect the boiler/chiller safety circuit to the unit.

7.8.3 Advanced controls option.

A continuity tester is not required.

At zero pressure the 'low-pressure' indicator on the fascia will be illuminated.

When the required low-pressure setting on the switch is achieved the 'low-pressure' indicator will be extinguished.

When the required high-pressure setting on the switch is achieved the 'high-pressure' indicator on the fascia will illuminate.

7.8.4 Twin system option.

The sequence of operations is repeated for both system pressure switches.

The left hand switch is for the left hand system (system A), the right hand switch is for the right hand system (system B).

Terminals 5A, 7A and 8A are used for the continuity tests on system A, terminals 5B, 7B and 8B are used for the continuity tests on system B.

7.9 Pressure reducing valve.

Ensure the drain cock in the expansion vessel line is slightly open to initiate a small leak.

Adjust the adjusting screw on the pressure reducing valve until the required cold fill pressure is observed on the system pressure gauge on the unit's fascia.

Ensure the drain cock is closed and open the system isolating valve.

7.10* Safety and alarm circuits.

Once the above procedure is correctly completed the boilers/chillers can be switched on.

Ensure that the boiler/chiller safety circuit(s) shut down the boilers or chillers and that the alarm systems operate as required.

7.11* Setting information.

When the unit has been commissioned the relevant setting information should be entered on the schematic diagram on the inside of the Portland unit's door for future reference.

Replace the top access panel and the door.

8.0 FAULT FINDING

General fault finding is shown in Figure 17. If the Portland unit still does not operate satisfactorily, consult your local office of Hamworthy Heating for assistance.

9.0 SERVICING SCHEDULE

By law the whole pressurised system must be serviced by a competent person in accordance with the Pressurised Systems and Transportable Gas Containers Regulations 1989.

The following is a recommended servicing schedule for the Portland unit and expansion vessel. If remedial action is required, refer to section 10: SERVICING AND REPLACEMENT OF COMPONENTS. If in doubt consult Hamworthy Heating.

9.1 At 6 monthly intervals:-

1) Check the expansion vessel charge pressure, as described in section 7.4. A significant drop in charge pressure could be due to a faulty vessel diaphragm; replacement of diaphragm should be considered. See section 10.8.

2) Check the accumulator charge pressure, as described in section 7.5. A significant drop in charge pressure could be due to a failure of the vessel; replacement of the entire accumulator should be considered. See section 10.4.

3) Briefly run the pump(s) to check for rotor seizure. This could occur if the pumps do not run for extended periods.

This can be accomplished by slightly opening the expansion vessel drain valve to initiate a leak. To run the standby pump on double pump units, close the union ball valve on the duty pump outlet. The pump changeover circuit will operate and the standby pump will run. Open the duty pump union ball valve and press the pump reset button on the fascia to reset to the duty pump. **Note!** Ensure that the drain valve is closed after this operation.

On advanced controls units the pump(s) can simply be run by setting the ‘hand/off/auto’ switch to ‘hand’. To run the standby pump (on double pump units) change over the ‘pump select’ switch. **Note!** Ensure that the ‘hand/off/auto’ switch is returned to ‘auto’ after this operation.

9.2 At 12 monthly intervals additionally:-

1) Remove the top access panel and unscrew and clean the pump strainer(s). Ensure the strainers are refitted. **Note!** Ensure that tank residue does not enter the pump inlet during this operation.

2) Check the ball float valve diaphragm seat for integrity and replace if necessary. Also check the plastic float for soundness.

3) Check the expansion vessel and accumulator for signs of external corrosion. If any deterioration is observed then it is recommended that the frequency of inspection be increased.

4) Check the operation of the boiler/chiller safety circuit(s) and also the alarm circuits if utilised.

9.3 A 4 yearly intervals additionally:-

1) Remove the expansion vessel diaphragm as described in section 10.8 and inspect for wear/ageing.

Inspect the internal surface of the vessel for corrosion.

Significant corrosion can lead to failure of the vessel; replacement of the entire vessel should be considered.

If necessary replace the diaphragm as described in section 10.8.

10.0 SERVICING AND REPLACEMENT OF COMPONENTS

Note! When servicing or replacing Portland unit pressure system components, electrically isolate the unit and close the system and expansion vessel isolating valves. Isolate the mains water supply to the unit's header tank. Drain the Portland unit utilising the internal drain valve(s).

When remaking screwed connections use a thread sealant (see Section 11: RECOMMENDED SPARES).

10.1 Pump.

10.1.1 To free a seized pump impeller, first electrically isolate the unit and remove the door. Remove the pump's fan cover to expose the cooling fan, and work it backwards and forwards gently to clear the impeller. If this is not possible the pump will have to be removed and stripped for inspection.

10.1.2 To remove a pump, first follow the procedure detailed in section 10.0. Disconnect the electrical cable from the pump, taking note of the conductor positions.

Close the union ball valve on the pump outlet and unscrew the union. Allow the disconnected pipework to hang to one side. Disconnect the pump inlet flexible hose from the header tank. Unbolt the pump from the base plinth and remove. Unscrew the pipe fittings from the pump inlet and outlet connections.

Refitting of the pump is a reverse of the above procedure. To restart the Portland unit follow steps 7.1, 7.3, 7.6 and 7.7 of the commissioning procedure in section 7.0.

10.2 Non-return valve.

To remove a non-return valve, first follow the procedure detailed in section 10.0. Close the union ball valve on the non-return valve outlet and unscrew the union. Allow the disconnected pipework to hang to one side. Unscrew the union from the non-return valve and then unscrew the non-return valve.

Clean the valve seat, or if the seat shows signs of wear or damage replace the non-return valve.

Refitting of the non-return valve is a reverse of the above procedure. To restart the Portland unit follow steps 7.1, 7.6 and 7.7 of the commissioning procedure in section 7.0.

10.3 Pressure reducing valve.

10.3.1 To service the pressure reducing valve, first follow the procedure detailed in section 10.0. Unscrew the plastic part of the pressure reducing valve and remove with the spring. Carefully pull out the internal cartridge with a pair of pliers applied to the central bolt head.

Clean the valve strainer and seat. If the seat shows signs of wear/damage the pressure reducing valve will require replacement.

Re-assembly is a reverse of the above procedure. Ensure that the strainer is refitted. To restart the Portland unit follow steps 7.1, 7.6, 7.7 and 7.9 of the commissioning procedure in section 7.0.

10.3.2 To remove the pressure reducing valve, first follow the procedure detailed in section 10.0. Disconnect the flexible hose(s) from the pressure reducing valve outlet and then unscrew the remaining pipework from the valve's outlet.

Unscrew and remove the accumulator using a suitable strap wrench.

Unscrew the elbow, on the pressure reducing valve inlet, from the pump manifold through a quarter turn. Unscrew the pressure reducing valve. Fully unscrew the elbow from the pump manifold before reassembly.

Re-assembly is a reverse of the above procedure. To restart the Portland unit, follow steps 7.1, 7.6, 7.7 and 7.9 of the commissioning procedure in section 7.0.

10.4 Accumulator

To remove the accumulator, first follow the procedure detailed in section 10.0. Unscrew the accumulator using a suitable strap wrench.

Re-assembly is a reverse of the above procedure. To restart the Portland unit follow steps 7.1, 7.5 and 7.6 of the commissioning procedure in section 7.0.

10.5 Pump pressure switch.

To remove the pump pressure switch, first follow the procedure detailed in section 10.0.

10.5.1 HPS 2.8 units.

Disconnect the pump pressure switch electrical cable from the control panel (see Appendix A for full wiring diagram details).

Unscrew the pump pressure switch from the pump manifold.

Re-assembly is a reverse of the above procedure. To restart the Portland unit follow steps 7.1, 7.6 and 7.7 of the commissioning procedure in section 7.0.

10.5.2 HPS 6.0 units.

Remove the plastic cover from the pump pressure switch and disconnect the electrical cable.

Unscrew the tubing connection from the switch's pressure connection. Unscrew the switch bracket from the cabinet and remove. Unscrew the tubing connection adapter fitting from the switch.

Attach the replacement switch to its bracket with the 2 screws provided. Screw the tubing connection adapter to the switch. Fit the bracket to the cabinet and attach the tubing connection.

Remove the plastic cover from the switch and connect the electrical cable (see Appendix A for full wiring diagram details). Replace the cover. Set the pressure setting on the switch's indicator to 6.0bar with the ‘P’ adjusting screw. Set the ‘DP’ adjusting screw to the 9 o'clock position.

To restart the Portland unit follow steps 7.1, 7.6 and 7.7 of the commissioning procedure in section 7.0. If necessary adjust the set point ‘P’ and the differential ‘DP’ to obtain the correct pump cut in and cut out pressures.

10.6 System pressure switch.

To remove the system pressure switch, first follow the procedure detailed in section 10.0.

Remove the pressure switch cover and disconnect the electrical cable. **Note!** Ensure all electrical supplies to the unit are isolated.

Unscrew the tubing connection from the switch's pressure connection. Unscrew the switch from the cabinet and remove. Unscrew the tubing connection adapter fitting from the switch.

Re-assembly is a reverse of the above procedure. Refer to Appendix A for electrical connection details. To restart the Portland unit follow steps 7.1, 7.6 and 7.8 of the commissioning procedure in section 7.0.

10.7 Control system.

Before carrying out any work on the control system, always isolate **all** electrical supplies to the Portland unit. **Note! If in any doubt consult a qualified electrician.**

Full Portland unit electrical wiring diagrams are included in Appendix A.

10.7.1 Replacing fuses.

The control fuse is located on the Portland unit fascia. A 2A, 20mm x 5 dia fuse is required (see Section 11: RECOMMENDED SPARES).

The pump fuse(s) are located inside the control housing, on the terminal rail. A 10A, 20mm x 5 dia motor rated fuse is required (see Section 11: RECOMMENDED SPARES).

Note! Investigate the cause before replacing any fuses.

10.7.2 Pump overload relay.

The pump overload relay(s) are located inside the controls housing on the terminal rail.

To reset a tripped overload press the red button on the relay.

Note! The cause of the tripped overload must be investigated before resetting.

10.8 System expansion vessel.

To replace the system expansion vessel diaphragm - Turn off the boiler/chiller and electrically isolate the Portland unit.

Close the system isolating valve and isolate the mains water supply to the unit's header tank.

Drain the Portland unit and the expansion vessel. **Note!** Leave the drain cock open. Disconnect the expansion vessel pipework.

Unscrew the diaphragm top connection (normally a brass nut at the opposite end to the water entry). Remove the bolts from the flange at the base of the vessel and remove the diaphragm.

To replace the diaphragm drop a R½ BSP plug fixed to a line of string or wire down through the top connection hole. Screw the plug lightly into the diaphragm top connection and pull it up through the expansion vessel.

Lockup the diaphragm top connection and tighten the water connection flange screws. **Note!** Ensure that the diaphragm is not twisted. Reconnect the expansion vessel pipework.

To restart the system follow steps 7.1, 7.4 and 7.6 of the commissioning procedure in section 7.0.

11.0 HAMWORTHY HEATING RECOMMENDED SPARES

11.1 HPS 2.8 Unit

	Part No.
Pump	530905032
Rc½ BSP Non-return valve	531911009
Accumulator	532712050
System pressure switch	533901041
Pump pressure switch	533901130
Rc½ BSP pressure reducing valve	531902001
Water level float switch	533901036
Rc½ BSP strainer	539920003
2A control fuse	747225834
10A pump fuse	533901131
4 pole relay	747247523
Perma-bond pipe sealant	

11.2 HPS 6.0 Unit

Pump	530905033
Pump pressure switch	533901040
System pressure switch	533901044
Otherwise as for HPS 2.8 unit above	

NOTE! For any service/replacement parts the unit Serial No. (on the Data Plate inside the unit) MUST be quoted.

For service or spares please refer to the inside front cover of this guide.

12.0 SYSTEM CALCULATIONS

12.1 Calculation sheets for both heating and chiller systems can be found in Figure 18, and Figure 19. These figures also include example calculation.

12.2 Calculation notes.

12.2.1 System volume - If the system volume is not known then the following rule of thumb can be applied:

Heating systems - 10 litres/kW of installed boiler power.
e.g. Boiler = 200 kW
System volume = 200 x 10
= 2000 litres.

Chiller systems - 20 litres/kW of installed chiller power.

e.g. Chiller = 50 kW
System volume = 50 x 20
= 1000 litres

12.2.2 System static height - The height from the base of the system expansion vessel to the highest point in the system.

12.2.3 Maximum system working pressure - Based on the pressure rating of the weakest component in the system. The static pressure at the point where the component is fitted in the system should be taken into account, especially if the system is a rooftop installation.

12.2.4 Cold fill pressure - When sizing for a twin system pressurisation unit, calculate the required cold fill pressure for both systems. The highest of the two pressures is then the cold fill pressure setting for the pressurisation unit and is used in the rest of the sizing.

Figure 2 – Overall Dimensions.

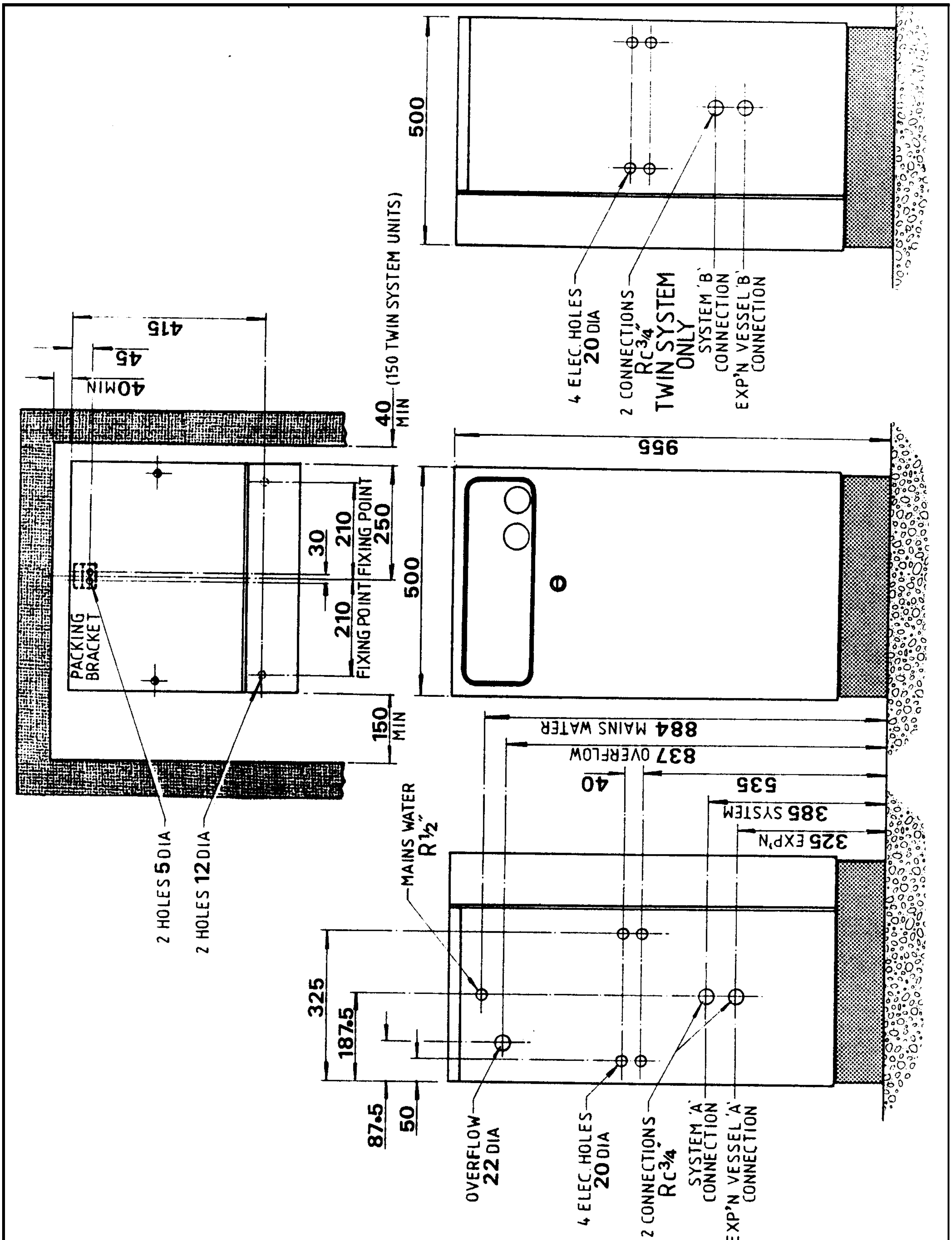


Figure 3 – Typical Sealed System Schematic

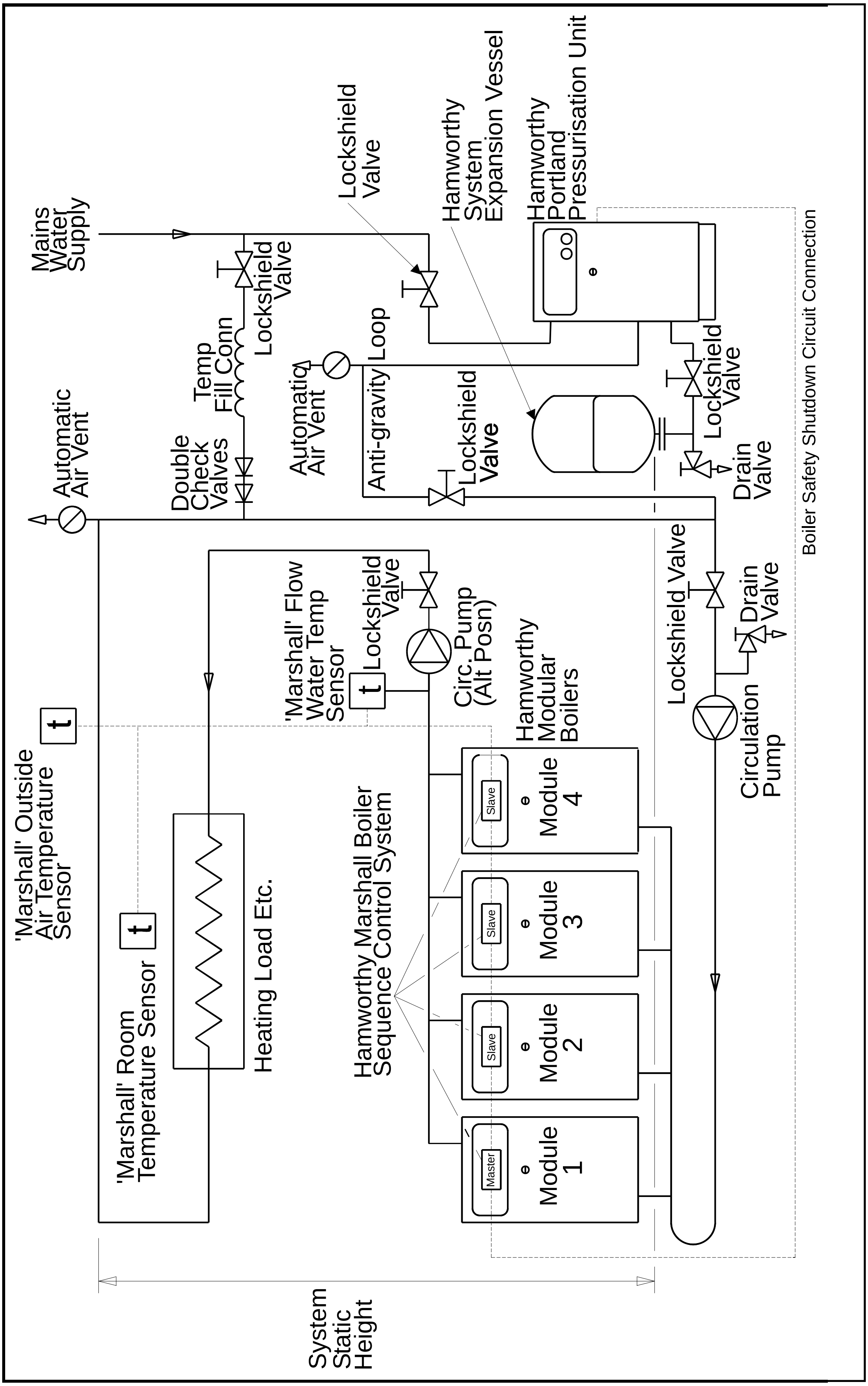
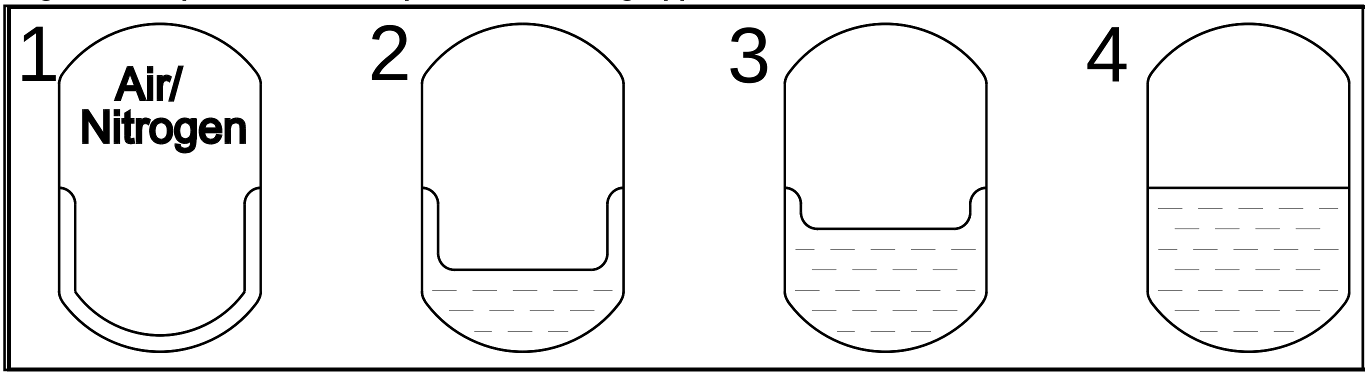


Figure 4 – Expansion Vessel Operation – Heating Application.



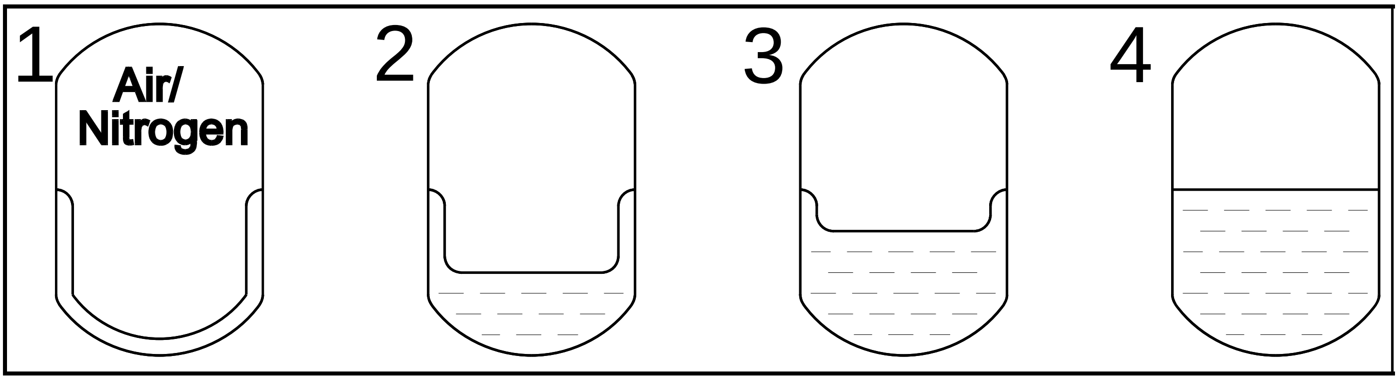
1. Diaphragm position at the cold fill / charge pressure. The vessel is empty of system fluid.

2. Diaphragm position at the hot working pressure. The system volume has expanded due to the temperature rise. The gas in the vessel is compressed. Acceptance factor = 0.35 maximum (recommended).

3. Diaphragm position at high system pressure. The boiler system is shut down by the system pressure switch.

4. Diaphragm at the safety valve lift pressure. Caused by boiler temperature limiter failure for example. Acceptance factor = 0.5 maximum (recommended).

Figure 5 – Expansion Vessel Operation – Chiller Application.



1. Diaphragm position at the charge pressure. The charge pressure is 0.35 bar less than the cold fill pressure. The vessel is empty of system fluid.

2. Diaphragm position at the cold fill pressure. As the chiller operates the system fluid contracts due to the drop in temperature. The pressurisation unit operates to maintain the system at the cold fill pressure. The gas in the vessel is compressed to equalise the system pressure.

3. Diaphragm position at the maximum ambient temperature. When the chiller is switched off the system water expands due to the rise in system temperature to ambient. The gas in the vessel is compressed. Acceptance factor = 0.35 maximum (recommended).

4. Diaphragm at the safety valve lift pressure. Acceptance factor = 0.5 maximum (recommended).

Figure 6 – Schematic Diagram of Portland Unit Including Op-

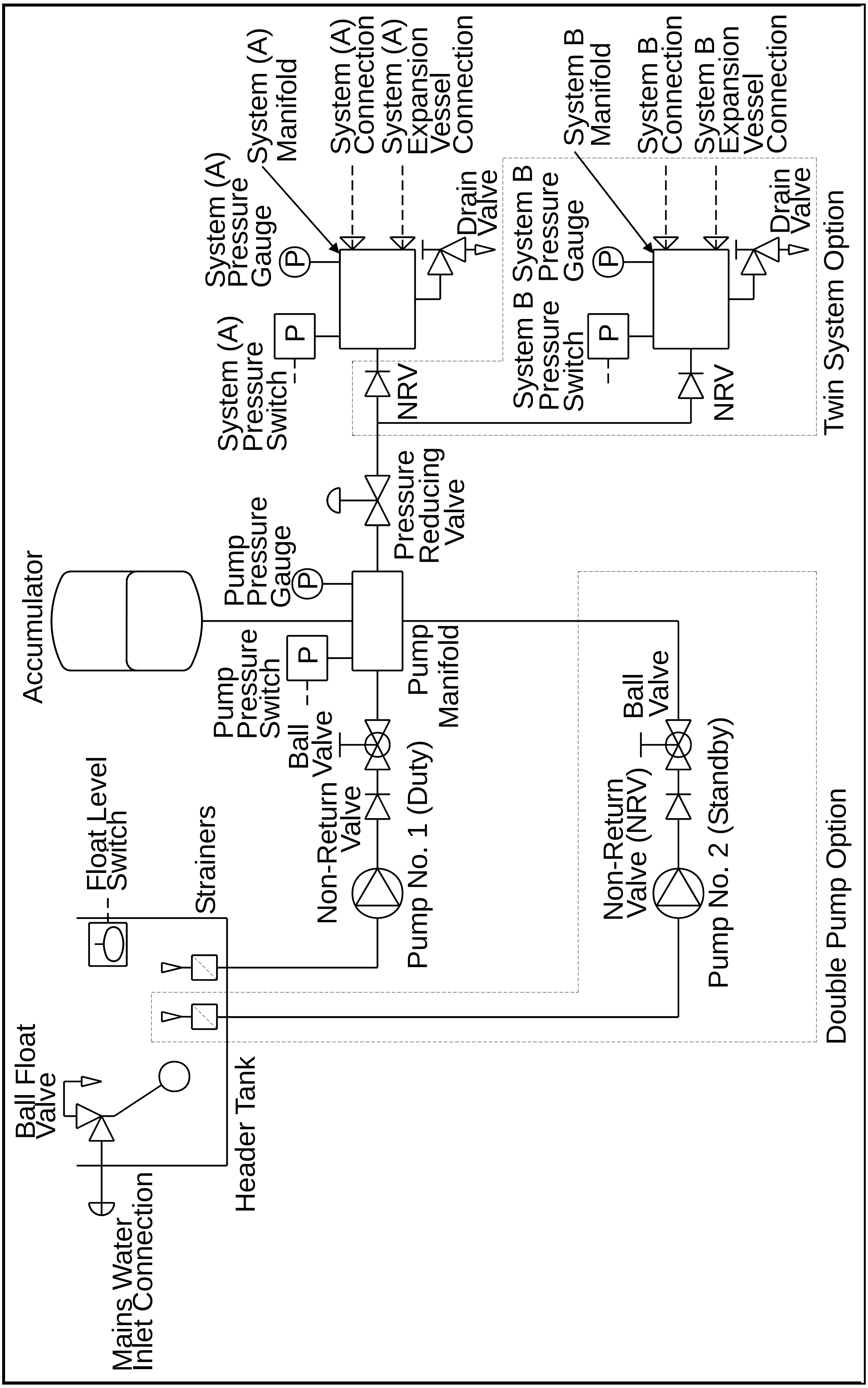
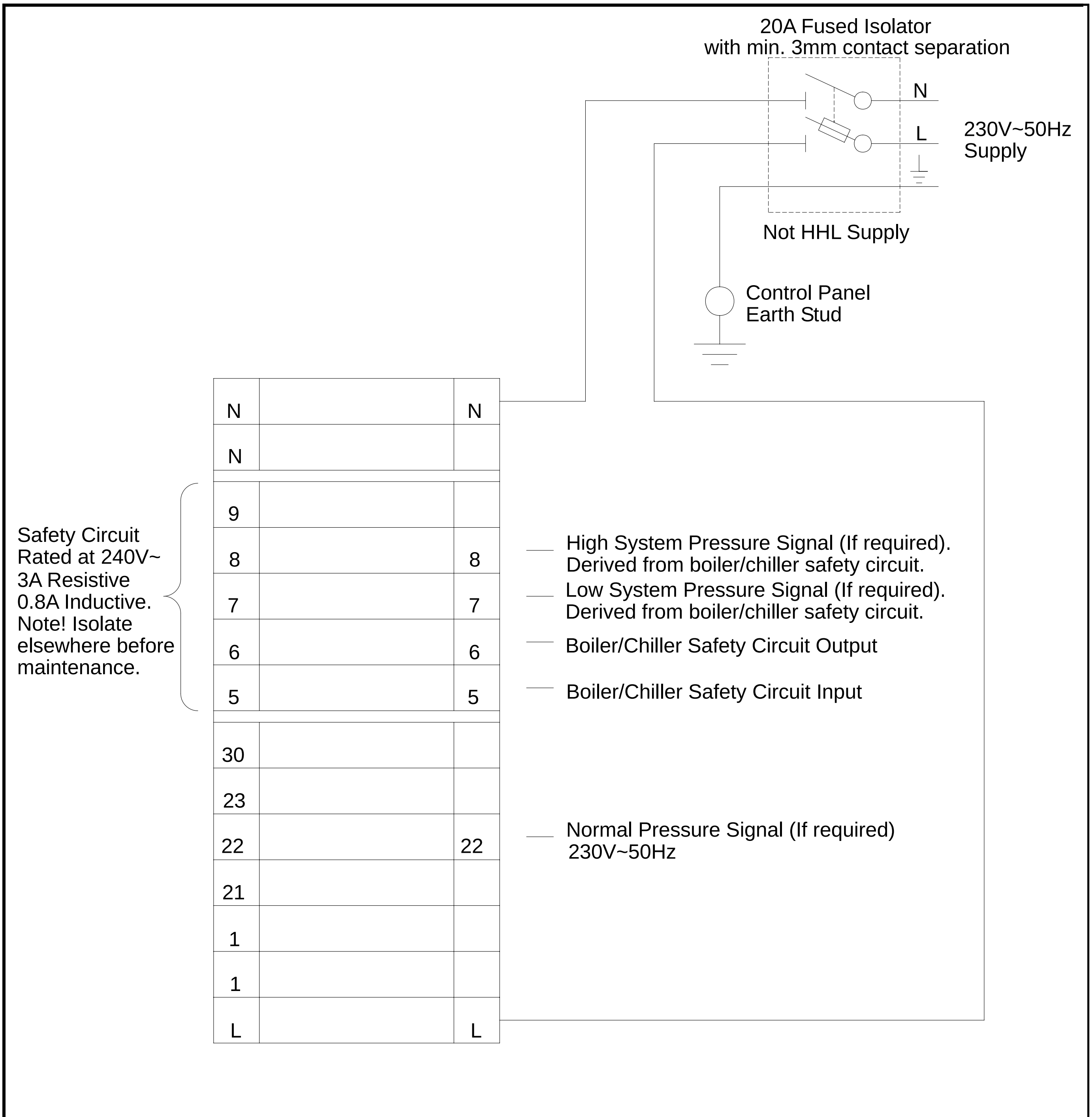
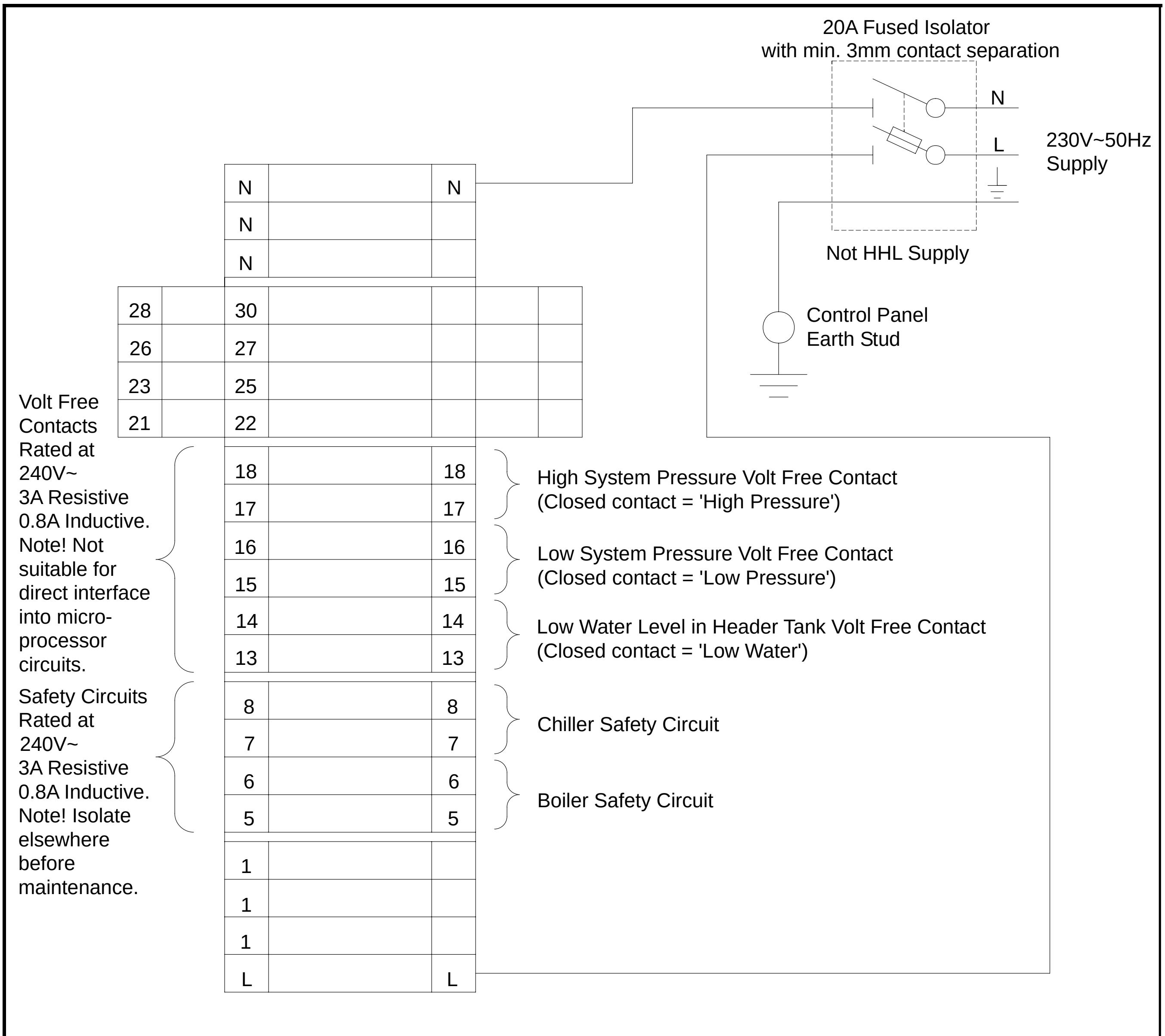


Figure 7 – Site Wiring Terminals – Single/Double Pump, Standard



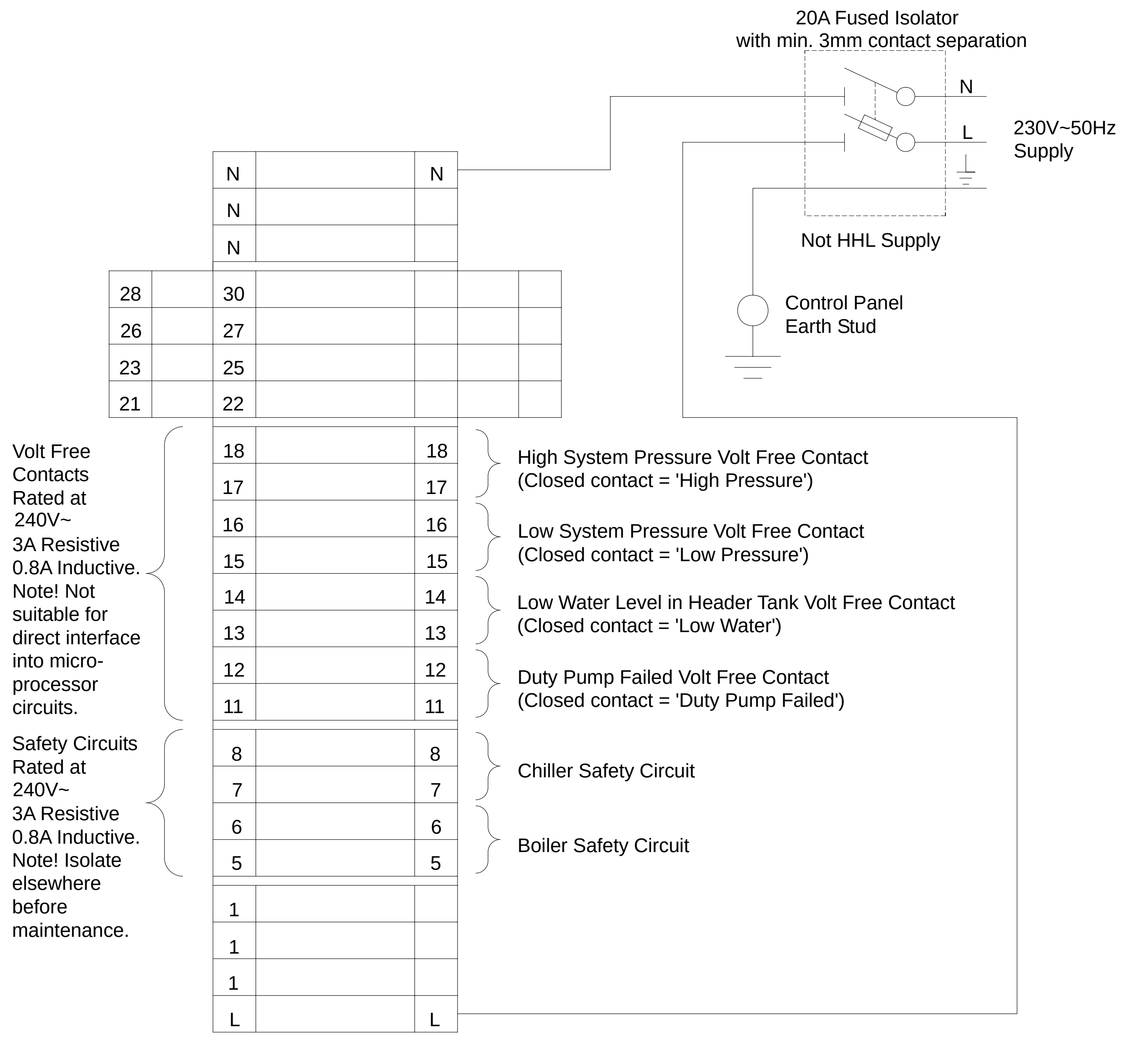
IF IN ANY DOUBT CONSULT A QUALIFIED ELECTRICIAN

Figure 8 – Site Wiring Terminals – Single Pump, Advanced Controls



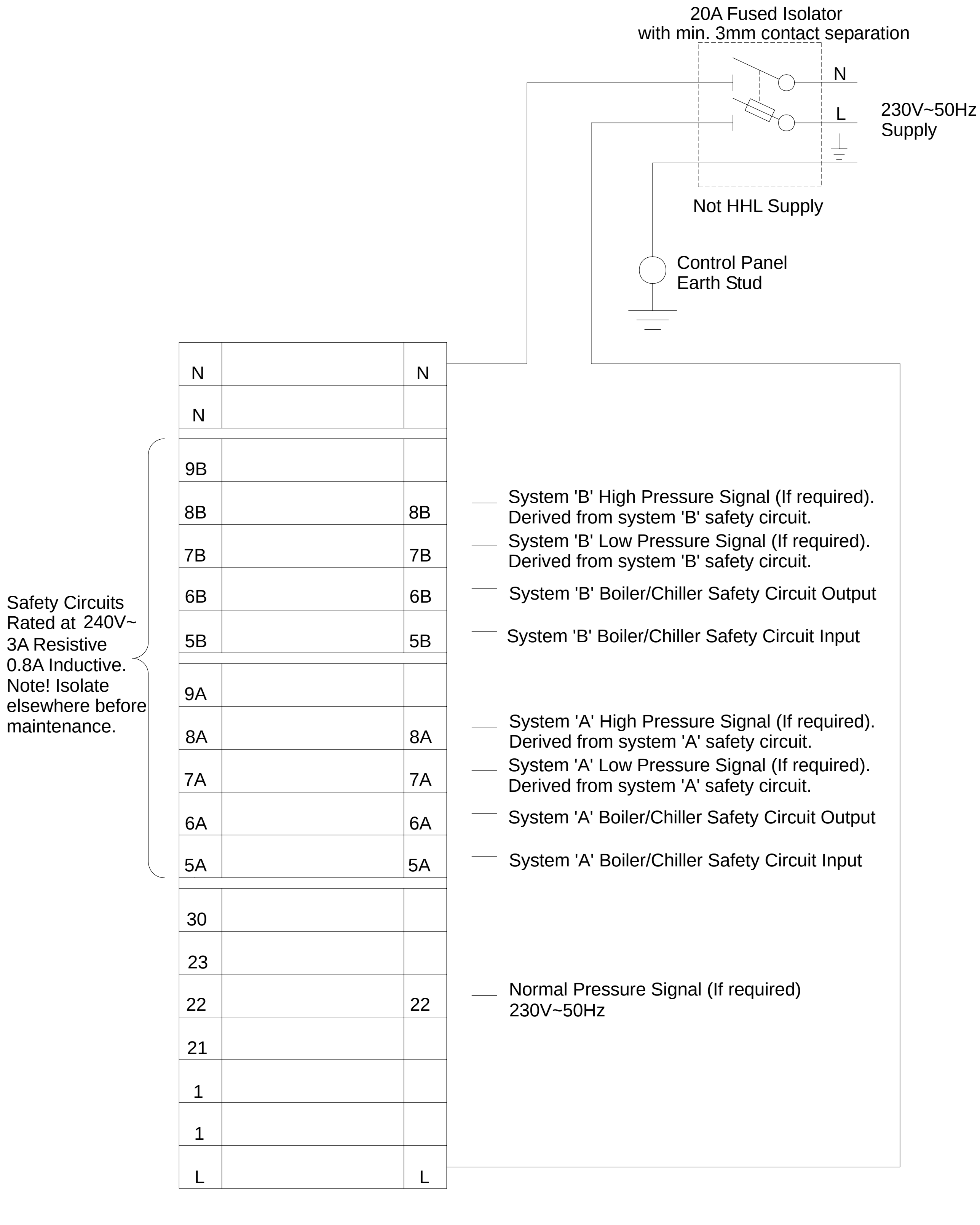
IF IN ANY DOUBT CONSULT A QUALIFIED ELECTRICIAN

Figure 9 – Site Wiring Terminals – Double Pump, Advanced Controls



IF IN ANY DOUBT CONSULT A QUALIFIED ELECTRICIAN

Figure 10 – Site Wiring Terminals – Single/Double Pump, Standard Controls, Twin System



IF IN ANY DOUBT CONSULT A QUALIFIED ELECTRICIAN

Figure 11 – Site Wiring Terminals – Single Pump, Advanced Controls, Twin System Unit.

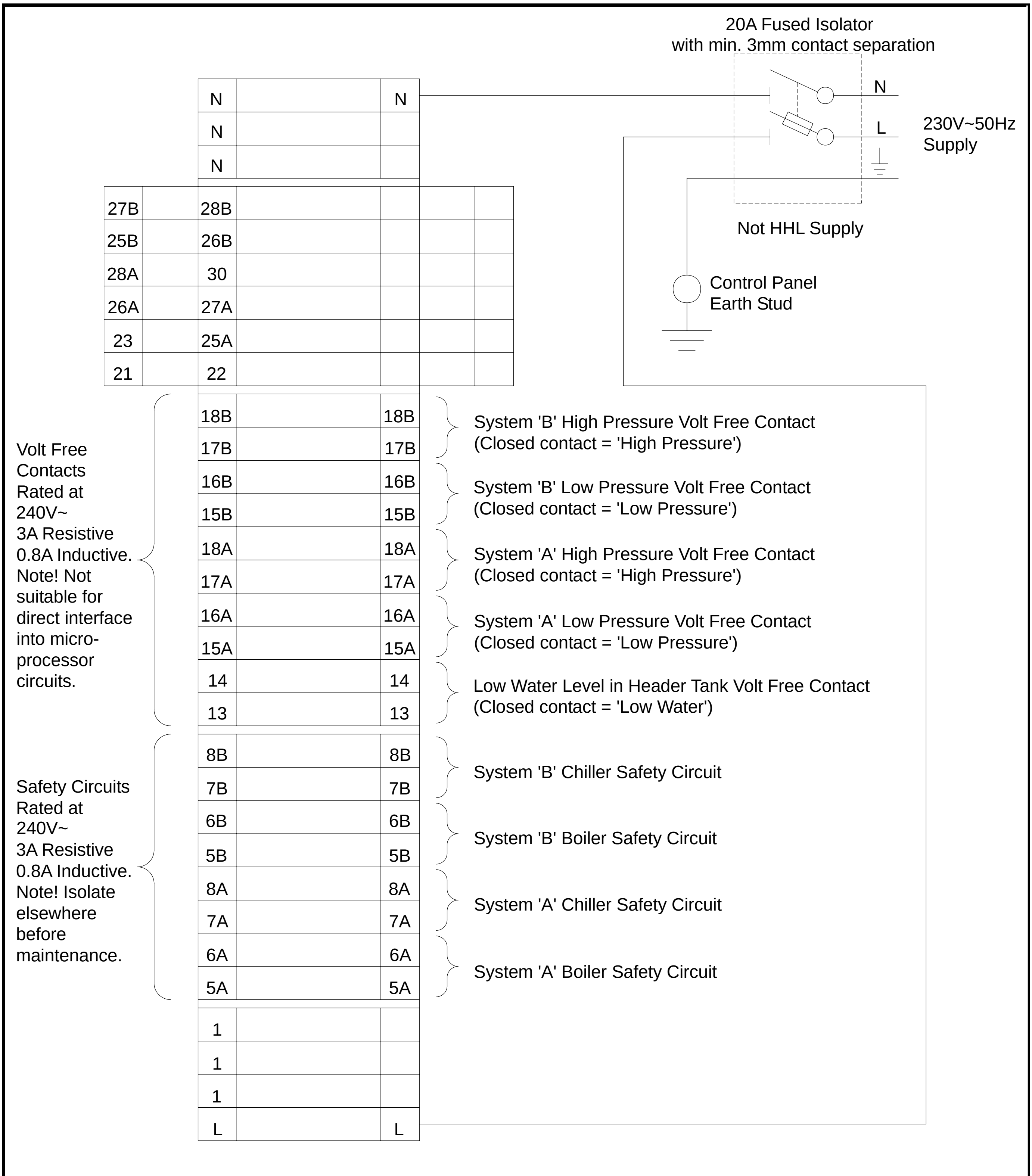


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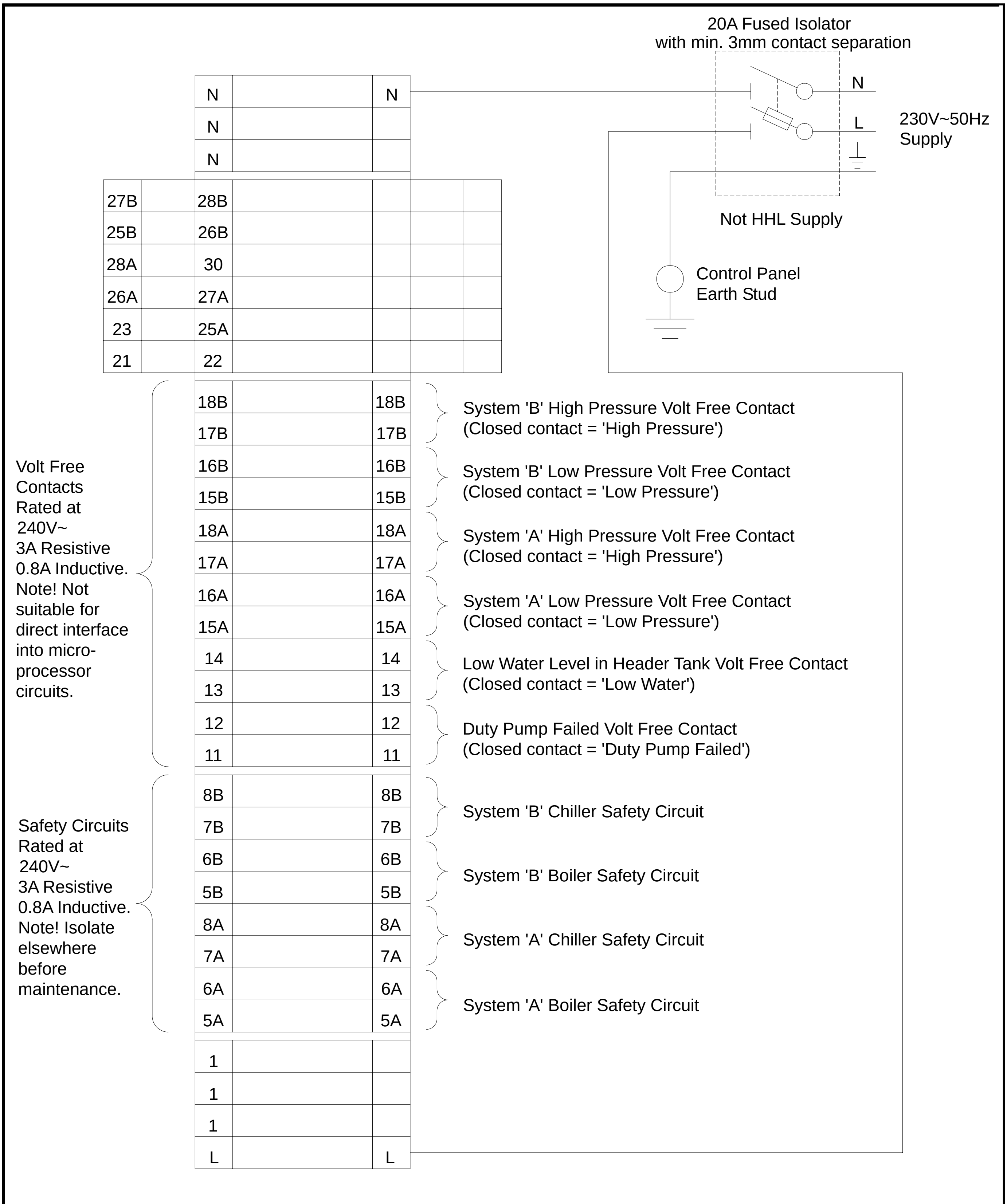
Figure 12 – Site Wiring Terminals – Double Pump, Advanced Controls, Twin System Unit.



IF IN ANY DOUBT CONSULT A QUALIFIED ELECTRICIAN

Figure 13 – Hamworthy Heating Limited Range of Expansion Vessels.

SALES REF NO.	HAMWORTHY PART NO.	TYPE	TOTAL VOL. LITRES	DIAPHRAGM PART NO.	CONNECTION DETAILS	WT kgs
HOT WATER/CHILLER APPLICATIONS - EPDM DIAPHRAGM (0-100°C MAX)						
HAF 60V	532712002	VERTICAL	60	532712030	R1 BSPT MI	13
HAF 80V	532712003	VERTICAL	80	532712031	R1 BSPT MI	14
HAF 100V	532712004	VERTICAL	100	532712032	R1¼ BSPT MI	15
HAF 200V	532712005	VERTICAL	200	532712033	R1¼ BSPT MI	40
HAF 300V	532712006	VERTICAL	300	532712034	R1¼ BSPT MI	50
HAF 500V	532712007	VERTICAL	500	532712035	R1¼ BSPT MI	80
HAF 750V	532712008	VERTICAL	750	532712036	R1½ BSPT MI	120
HAF 1000V	532712009	VERTICAL	1000	532712037	R1½ BSPT MI	150
HAF 1200V	*	VERTICAL	1200	*	R1½ BSPT MI	530
HAF 1600V	*	VERTICAL	1600	*	R1½ BSPT MI	10
HAF 2000V	*	VERTICAL	2000	*	R1½ BSPT MI	700
* REFER TO HAMWORTHY HEATING						
HAF 8	532712056	H/V	8		R¾ BSPT MI	
HAF 16	532712057	H/V	16		R¾ BSPT MI	
HAF 25H	532712010	HORIZONTAL	25	532712029	R1 BSPT MI	5
HAF 60H	532712011	HORIZONTAL	60	532712030	R1 BSPT MI	14
HAF 80H	532712012	HORIZONTAL	80	532712031	R1 BSPT MI	15
HAF 100H	532712013	HORIZONTAL	100	532712032	R1¼ BSPT MI	16
HAF 200H	532712014	HORIZONTAL	200	532712033	R1¼ BSPT MI	41
HAF 300H	532712015	HORIZONTAL	300	532712034	R1¼ BSPT MI	51

Figure 14 – Schematic Layout of System Pipework Connections.

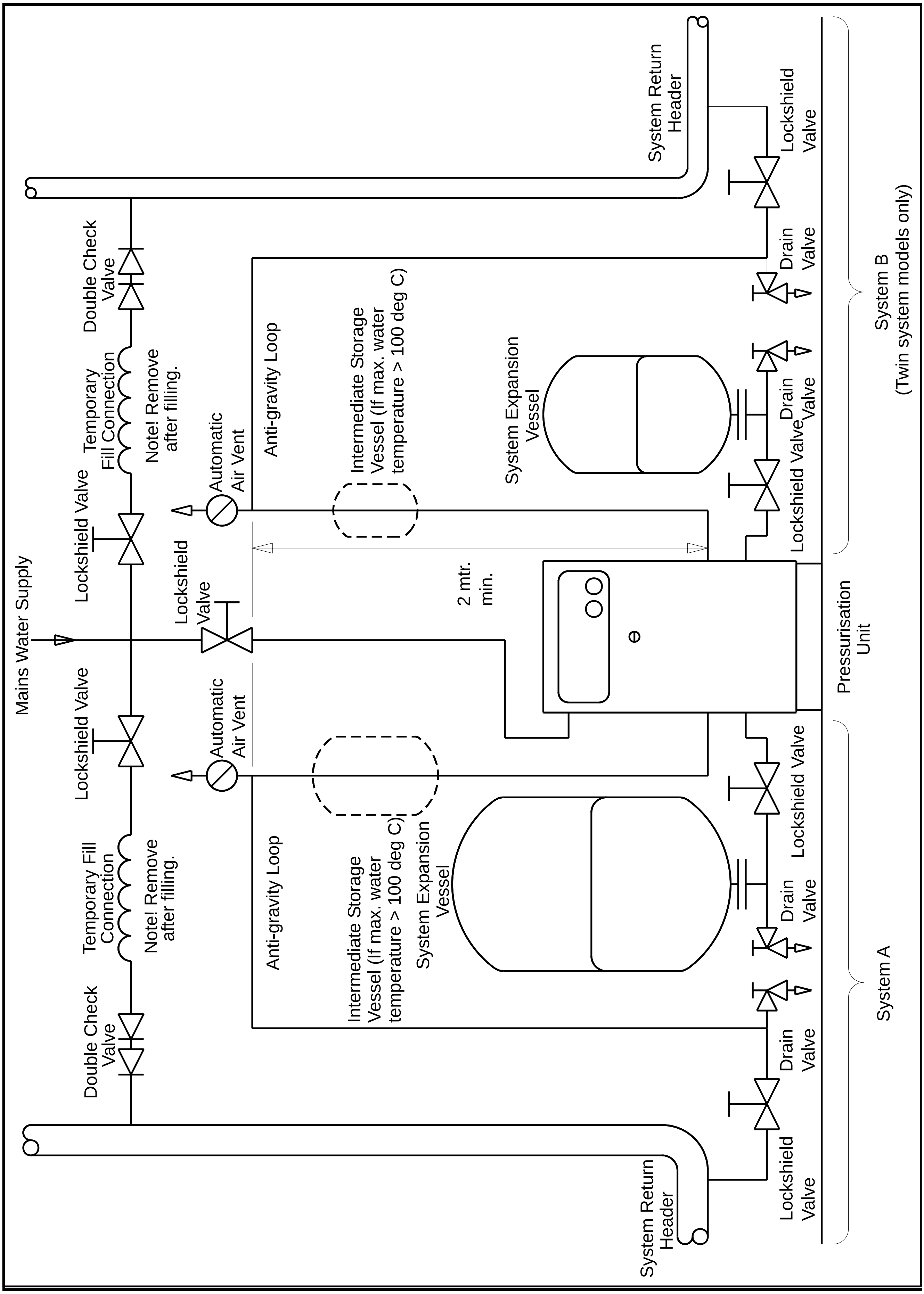


Figure 15 – Internal Layout of Typical Portland Units.

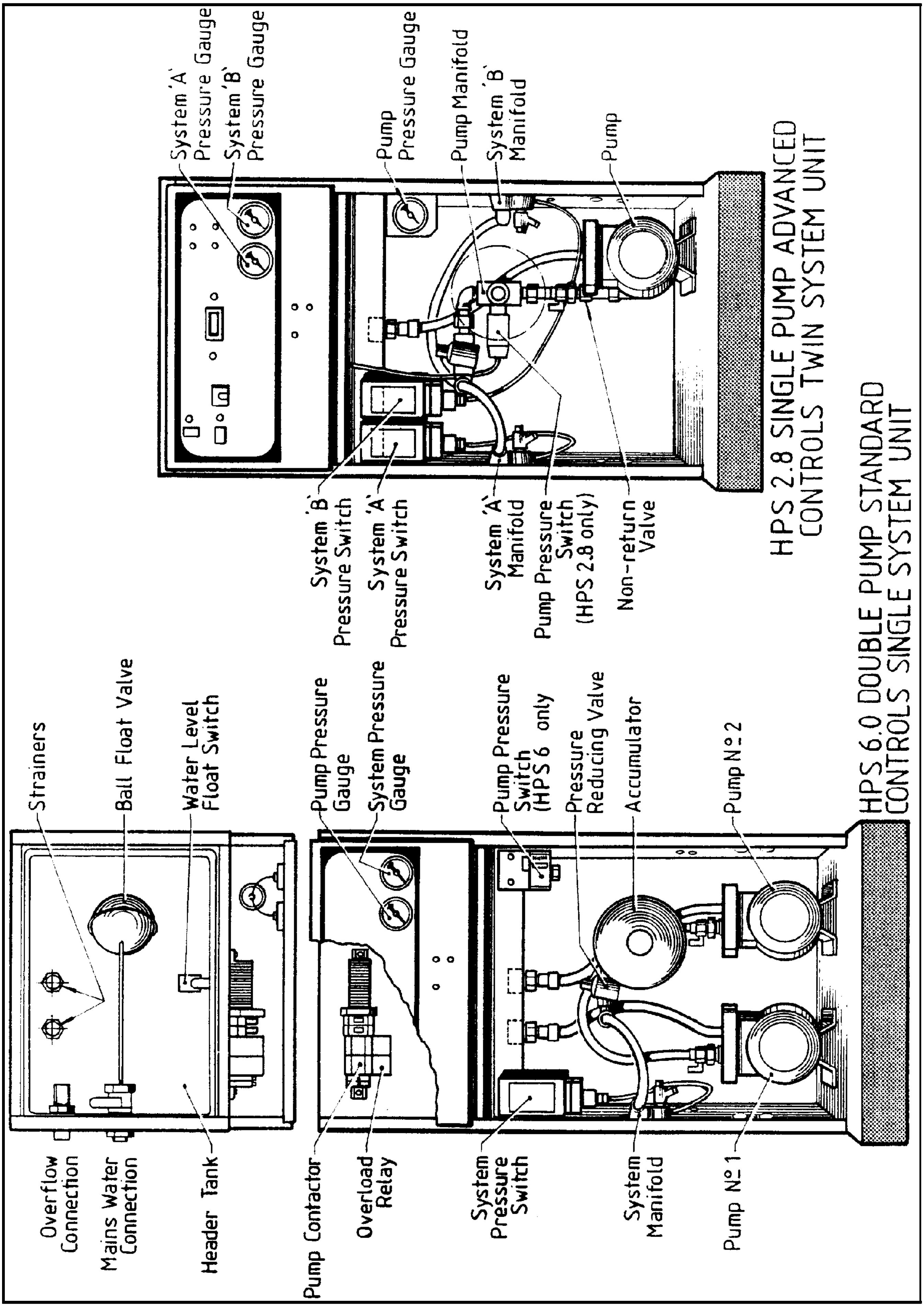


Figure 17(a) – General Fault Finding (Sheet 1 of 2).

	No power to unit	Check at source
	Pump fuse blown	Replace fuse (see Section 10.7) **Note!** Investigate cause of blown fuse before restarting unit.
	Pump overload relay tripped	Reset overload relay (see Section 10.7) **Note!** Investigate cause before restarting unit.
	Control fuse blown	Replace fuse (see Section 10.7) **Note!** Investigate cause of blown fuse before restarting unit.
	Header tank empty	Check ball float valve and mains water supply.
	Pump pressure switch set incorrectly (HPS 6.0 only)	Adjust pump pressure switch (see Section 10.5.2).
	Faulty pump pressure switch	Replace pump pressure switch (see Section 10.5).
	Faulty float switch	Replace float switch.
	Pump seized or faulty	Service or replace pump (see Section 10.1).
Pump runs but does not build up pressure.	Pump outlet union valve closed	Open valve.
	Pump not primed	Prime pump (see Section 7.6)
	Strainer blocked	Clean strainer (see Section 9.2.1)
Pump cuts in and out rapidly (hunting)	Pump pressure switch differential too low (HPS 6.0 only)	Reset pump pressure switch differential (see Section 10.5.2).
	Accumulator charge pressure incorrect	Reset accumulator charge pressure (see Section 7.5).
	Accumulator faulty	Replace accumulator (see Section 10.4).
	Non return valve not sealing correctly	Clean valve seat or replace valve if necessary (see Section 10.2).
Pump runs continuously	Pump pressure switch set too high (HPS 6.0 only)	Reset pump pressure switch (see Section 10.5.2).
	Pump pressure switch faulty	Replace pump pressure switch (see Section 10.5).
	Pressure reducing valve faulty	Service or replace pressure reducing valve (see Section 10.3).

Figure 17(b) – General Fault Finding (Sheet 2 of 2).

Cold fill pressure incorrect when pump cuts out	Pressure reducing valve setting incorrect.	Adjust pressure reducing valve setting (see Section 7.9).
	Pressure reducing valve strainer blocked	Service pressure reducing valve (see Section 10.3.1).
Maximum system working pressure too high	System cold fill pressure set too high.	Adjust pressure reducing valve setting (see Section 7.9)
	Pressure reducing valve not seating correctly	Service pressure reducing valve (see Section 10.3.1)
	System expansion vessel charge pressure too high	Adjust charge pressure (see Section 7.4).
	System expansion vessel volume too low	Determine correct expansion vessel volume, from contract documents or refer to Section 12: SYSTEM CALCULATIONS or if in any doubt contact Hamworthy Heating Ltd for sizing information. Replace expansion vessel or install additional vessel to obtain correct vessel volume.
	System expansion vessel faulty	Replace expansion vessel diaphragm (see Section 10.8).
System pressure runs consistently at cold fill pres-	Small system leak	Trace leak and ensure system is sound.

Figure 18 – Heating System Calculation Sheet.

Calculation				Example
System Parameters				Example
1) System water content -	V_s =	___	litres	V_s = 2000 litres
2) Maximum system water flow temperature -	t_f =	___	°C	t_f = 105 °C
3) System static head -	p_h =	___	meters	p_h = 22 m
4) Maximum system working pressure -	p_w =	___	bar	p_w = 8 bar
5) System antifreeze content -	r_a =	___	%	r_a = 10 %
Calculations				
6) Cold fill pressure ,p_f - $p_f = \frac{p_h}{10.2} + 0.2 + p_v{}^* = \frac{\text{___}}{10.2} + 0.2 + \text{___}$	p_f =	___	bar	$p_f = \frac{22}{10.2} + 0.2 + 1.20 = 3.56$ bar
7) Expansion vessel charge pressure ,p_c - $p_c = p_f - 0.1 = \text{___} - 0.1$	p_c =	___	bar	p_c = 3.56 - 0.1 = 3.46 bar
8) Expansion factor ,e_t - $e_t = \frac{(100 - r_a) \times e_w{}^* + r_a \times e_a{}^*}{100}$ $e_t = \frac{(100 - \text{___}) \times \text{___} + \text{___} \times \text{___}}{100}$	e_t =	___		$e_t = \frac{(100 - 10) \times 0.048 + 10 \times 0.087}{100}$ e_t = 0.0519
9) Expanded volume ,V_e - $V_e = V_s \times e_t = \text{___} \times \text{___}$	V_e =	___	litres	V_e = 2000 x 0.0519 = 103.8 litres
10) Calculated expansion vessel volume ,V_v - $V_v = \frac{V_e}{a_v} = \frac{\text{___}}{0.35}$	V_v =	___	litres	$V_v = \frac{103.8}{0.35} = 297$ litres

* Value at maximum system flow temperature ,t_f from table below.

Maximum system flow temperature ,t_f (°C)	70	75	80	82	85	90	95	100	105	110	115	120
Vapour Pressure , p_v (bar)	0	0	0	0	0.10	0.35	0.60	0.90	1.20	1.55	1.90	2.35
Water expansion factor ,e_w	0.023	0.026	0.029	0.031	0.033	0.036	0.040	0.044	0.048	0.052	0.056	0.060
Antifreeze expansion factor ,e_a	0.061	0.064	0.068	0.069	0.071	0.075	0.079	0.083	0.087	0.090	0.094	0.098

Calculation				Example
Calculations continued				Example continued
11) Actual fitted expansion vessel volume ,V_{va} -	V_{va}=	___	litres	V_{va} = 300 litres
12) Actual expansion vessel acceptance factor ,a_{va} - $a_{va} = \frac{V_e}{V_{va}} = \frac{\text{___}}{\text{___}}$	a_{va}=	___		$a_{va} = \frac{103.8}{300} = 0.346$
13) Actual working pressure ,p_{wa} - $p_{wa} = \frac{p_f + a_{va}}{1 - a_{va}} = \frac{\text{___} + \text{___}}{1 - \text{___}}$ Note! If $p_{wa} > p_w$ then increase expansion vessel volume ,V_{va} and recalculate from step 11)	p_{wa}=	___	bar	$p_{wa} = \frac{3.56 + 0.346}{1 - 0.346} = 5.97$ bar
14) Safety valve lift pressure ,p_s - $p_s = p_{wa} + 0.7 = \text{___} + 0.7$	p_s =	___	bar	p_s = 5.97 + 0.7 = 6.67 bar
15) Expansion vessel acceptance factor at safety valve lift pressure ,a_s - $a_s = \frac{p_s - p_f}{p_s + 1} = \frac{\text{___} - \text{___}}{\text{___} + 1}$ Note! If $a_s > 0.5$ then increase expansion vessel volume ,V_{va} and recalculate from step 11)	a_s =	___		$a_s = \frac{6.67 - 3.56}{6.67 + 1} = 0.405$
16) System pressure switch low pressure setting ,p_{sl} - $p_{sl} = p_f - 0.3 = \text{___} - 0.3$	p_{sl} =	___	bar	p_{sl} = 3.56 - 0.3 = 3.26 bar
17) System pressure switch high pressure setting ,p_{sh} - $p_{sh} = p_{wa} - 0.35 = \text{___} - 0.35$	p_{sh} =	___	bar	p_{sh} = 6.67 - 0.35 = 6.32 bar
18) Intermediate expansion vessel volume ,V_i - (If t_f < 100 °C) $V_i = V_s \times 0.08 = \text{___} \times 0.08$	V_i =	___	litres	V_i = 2000 x 0.08 = 160 litres

Figure 19 – Chiller System Calculation Sheet.

System Parameters

1) System water content - V_s = ____ litres
2) Maximum ambient temperature - t_a = ____ °C
3) System static head - p_h = ____ meters
4) Maximum system working pressure - p_w = ____ bar
5) System antifreeze content - r_a = ____ %

Example

V_s = 1000 litres
t_a = 25 °C
p_h = 15 m
p_w = 3.6 bar
r_a = 25 %

Calculations

6) Cold fill pressure , p_f -

$p_f = \frac{p_h}{10.2} + 0.2 = \frac{\text{____}}{10.2} + 0.2$ p_f = ____ bar

Example: $p_f = \frac{15}{10.2} + 0.2 = 1.67$ bar

7) Expansion vessel charge pressure , p_c -

$p_c = p_f - 0.35$ = ____ - 0.35 p_c = ____ bar

Example: p_c = 1.67 - 0.35 = 1.32 bar

8) Expansion factor , e_t -

$e_t = \frac{(100 - r_a) \times e_w^* + r_a \times e_a^*}{100}$

$e_t = \frac{(100 - \text{____}) \times \text{____} + \text{____} \times \text{____}}{100}$ e_t = ____

Example: $e_t = \frac{(100 - 25) \times 0.0030 + 25 \times 0.0298}{100}$

e_t = 0.0097

9) Expanded volume , V_e -

$V_e = V_s \times e_t$ = ____ x ____ V_e = ____ litres

Example: V_e = 1000 x 0.0097 = 9.7 litres

10) Calculated expansion vessel volume , V_v -

$V_v = \frac{V_e}{a_v} = \frac{\text{____}}{0.35}$ V_v = ____ litres

Example: $V_v = \frac{9.7}{0.35} = 27.7$ litres

* Value at maximum ambient temperature , t_a from table below.

Maximum ambient temperature , t_a (°C)	7.5	10.0	12.5	15.0	17.5	20.0	22.5	25.0	27.5	30.0	32.5
Water expansion factor , e_w	0.0002	0.0003	0.0007	0.0010	0.0014	0.0018	0.0024	0.0030	0.0037	0.0044	0.0052
Antifreeze expansion factor , e_a	0.0169	0.0188	0.0206	0.0224	0.0242	0.0261	0.0279	0.0298	0.0316	0.0330	0.0345

Calculations continued

11) Actual fitted expansion vessel volume , V_{va} - V_{va} = ____ litres

Example continued: V_{va} = 60 litres

12) Actual expansion vessel acceptance factor , a_{va} -

$a_{va} = \frac{0.35}{p_f + 1} + \frac{V_e}{V_{va}} = \frac{0.35}{\text{____} + 1} + \frac{\text{____}}{\text{____}}$ a_{va} = ____

Example: $a_{va} = \frac{0.35}{1.67 + 1} + \frac{9.7}{60} = 0.293$

13) Actual working pressure , p_{wa} -

$p_{wa} = \frac{p_c + a_{va}}{1 - a_{va}} = \frac{\text{____} + \text{____}}{1 - \text{____}}$ p_{wa} = ____ bar

Example: $p_{wa} = \frac{1.32 + 0.293}{1 - 0.293} = 2.28$ bar

Note! If $p_{wa} > p_w$ then increase expansion vessel volume , V_{va} and recalculate from step 11)

14) Safety valve lift pressure , p_s -

$p_s = p_{wa} + 0.7$ = ____ + 0.7 p_s = ____ bar

Example: p_s = 2.28 + 0.7 = 2.98 bar

15) Expansion vessel acceptance factor at safety valve lift pressure , a_s -

$a_s = \frac{p_s - p_c}{p_s + 1} = \frac{\text{____} - \text{____}}{\text{____} + 1}$ a_s = ____

Example: $a_s = \frac{2.98 - 1.32}{2.98 + 1} = 0.417$

Note! If a_s > 0.5 then increase expansion vessel volume , V_{va} and recalculate from step 11)

16) System pressure switch low pressure setting , p_{sl} -

$p_{sl} = p_f - 0.3$ = ____ - 0.3 p_{sl} = ____ bar

Example: p_{sl} = 1.67 - 0.3 = 1.37 bar

17) System pressure switch high pressure setting , p_{sh} -

$p_{sh} = p_{wa} + 0.35$ = ____ + 0.35 p_{sh} = ____ bar

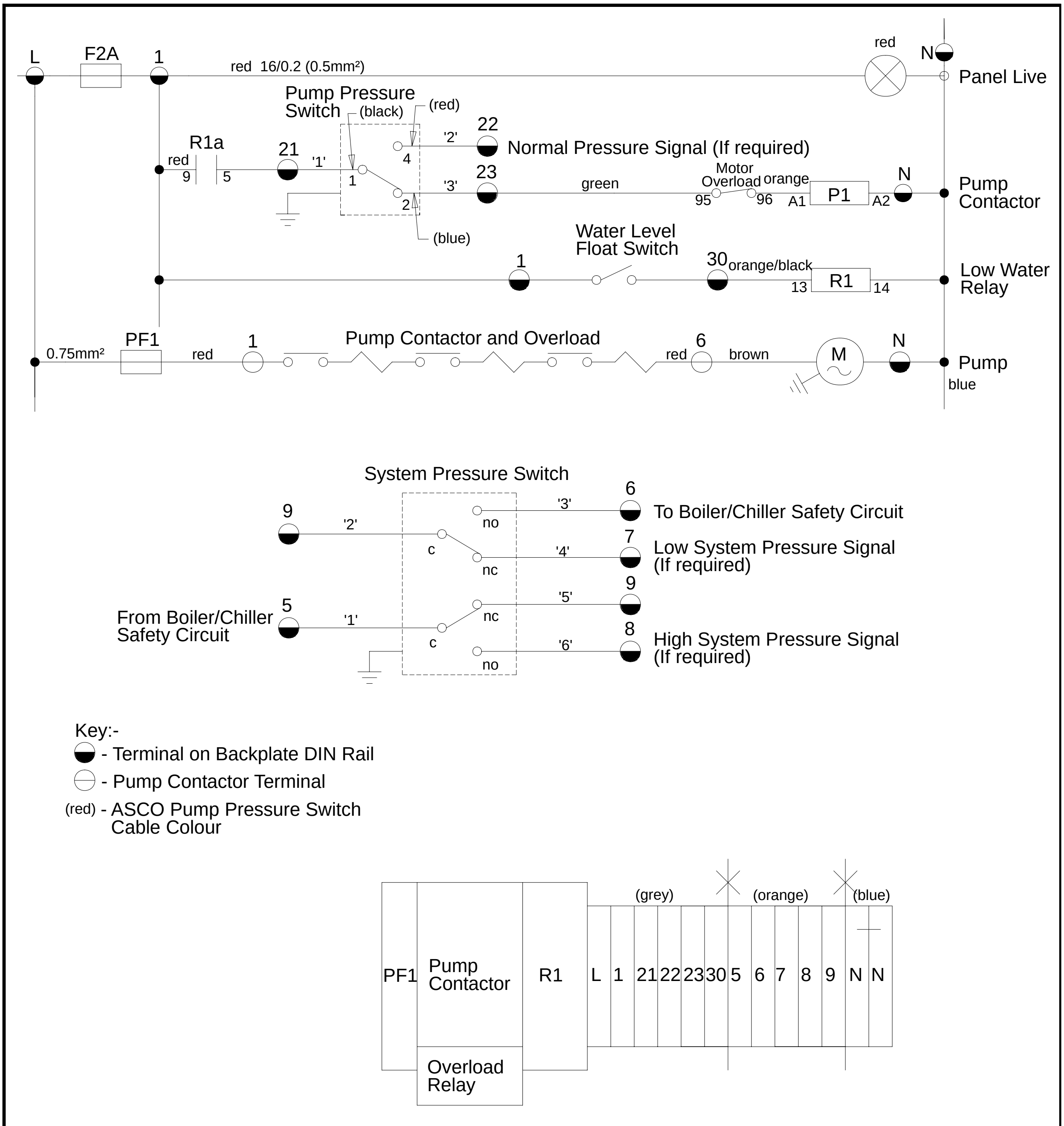
Example: p_{sh} = 2.28 + 0.35 = 2.63 bar

APPENDIX A

PORTLAND UNIT WIRING DIAGRAMS

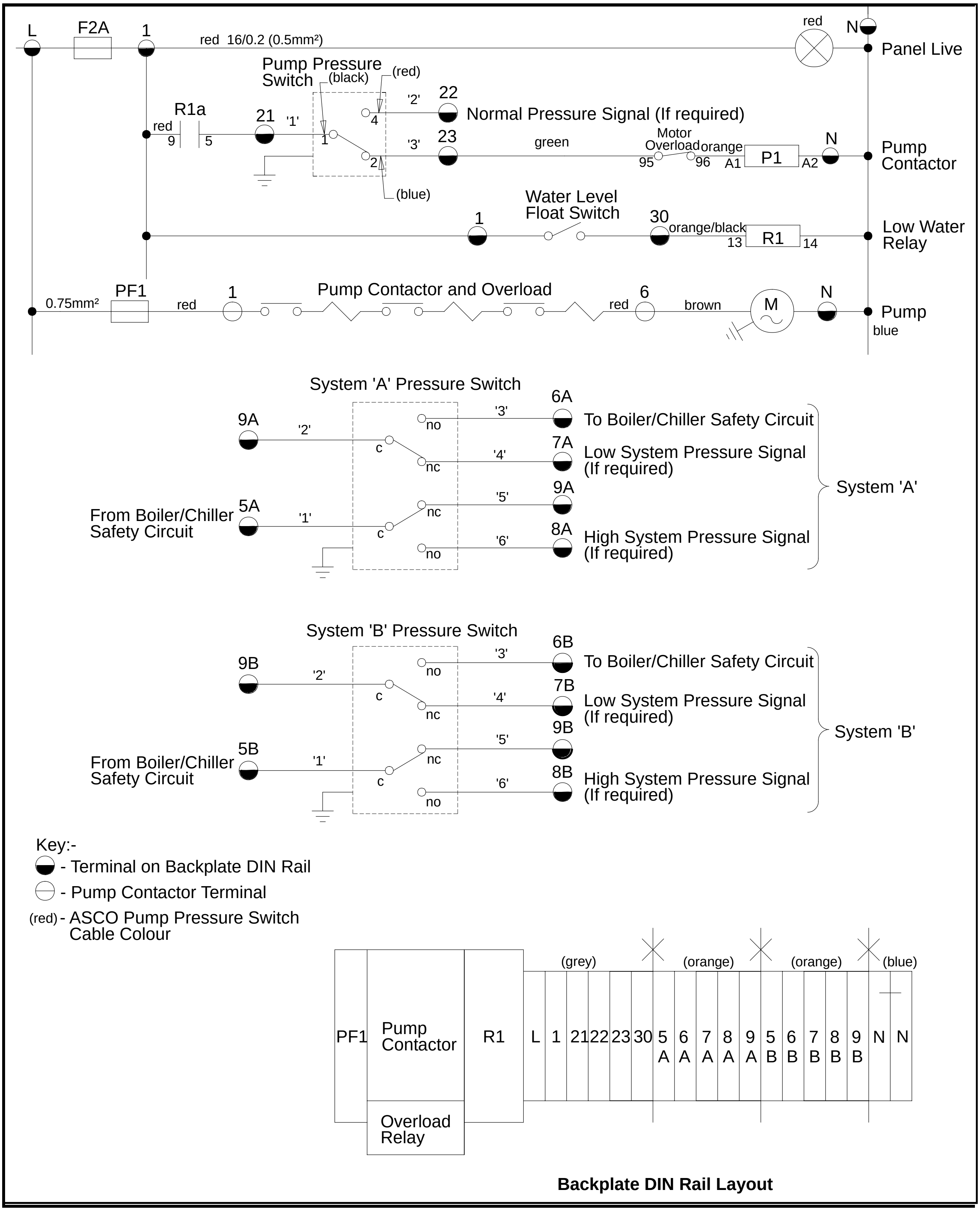
Contents **Page**

Figure A1 – Wiring Diagram – Single Pump, Standard Controls Unit.



Backplate DIN Rail Layout

Figure A2 – Wiring Diagram – Single Pump, Standard Controls, Twin System



Backplate DIN Rail Layout

Figure A3 – Wiring Diagram – Single Pump, Advanced Controls Unit.

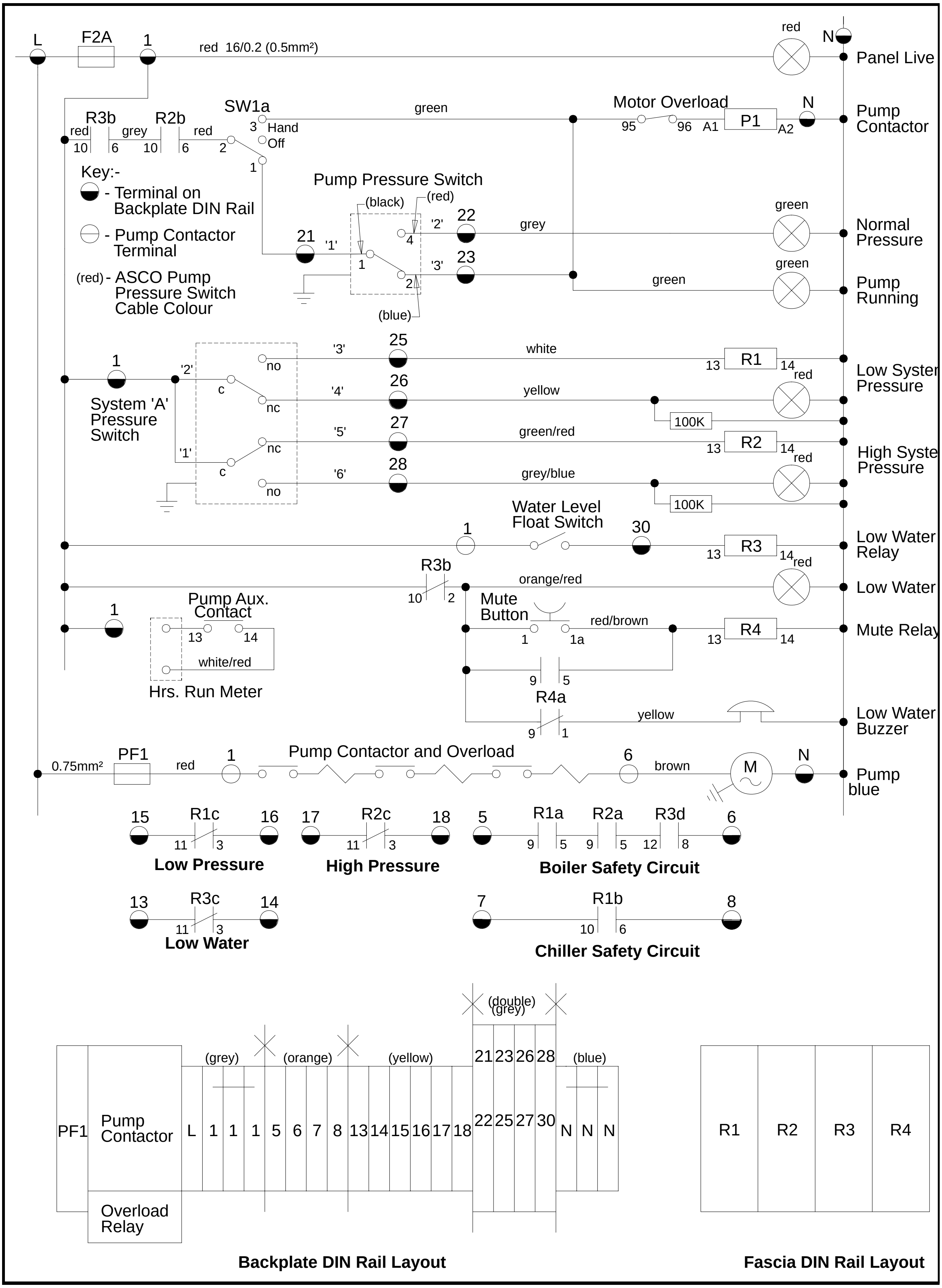


Figure A4(a) – Wiring Diagram – Single Pump, Advanced Controls, Twin System Unit

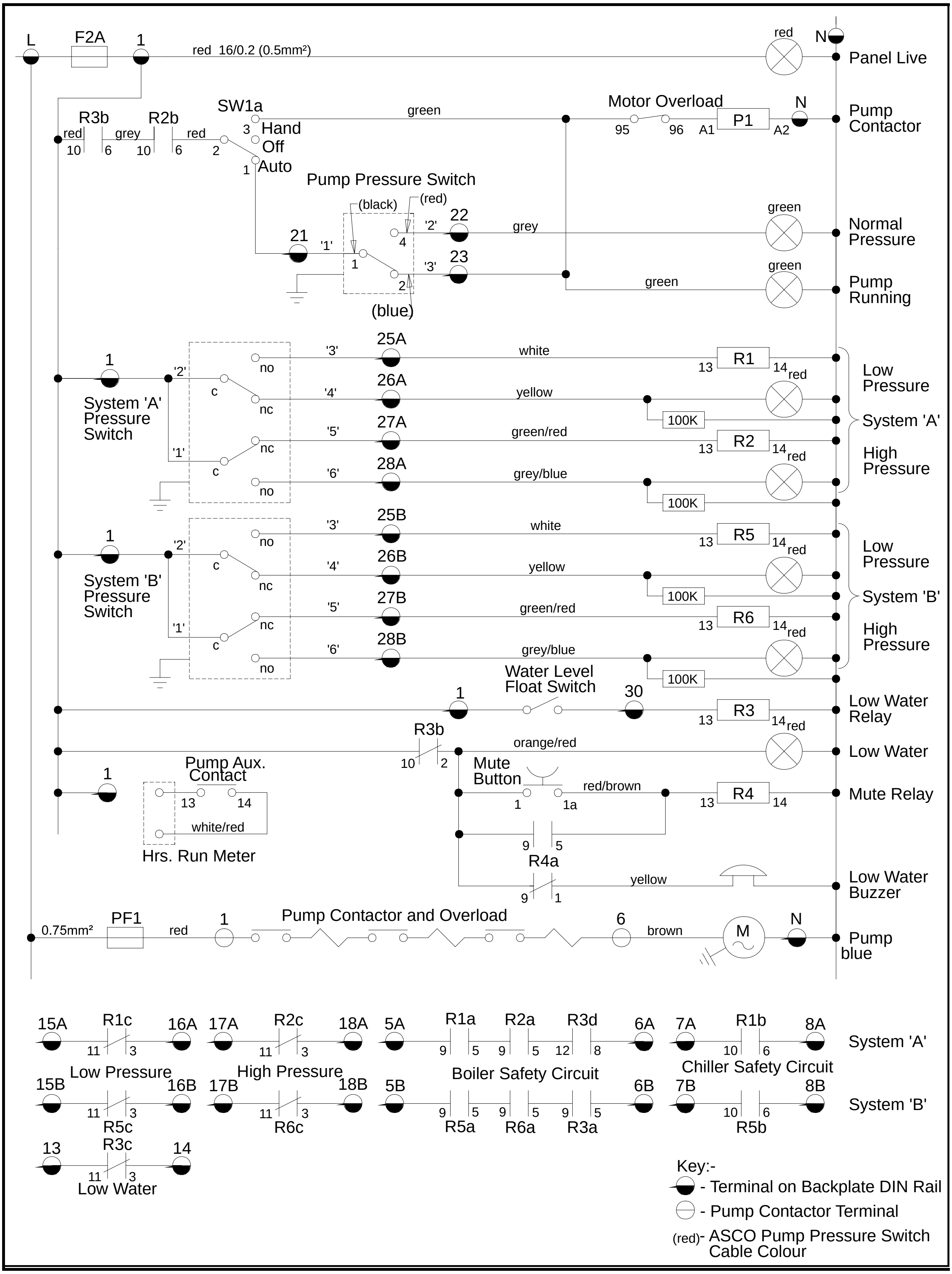
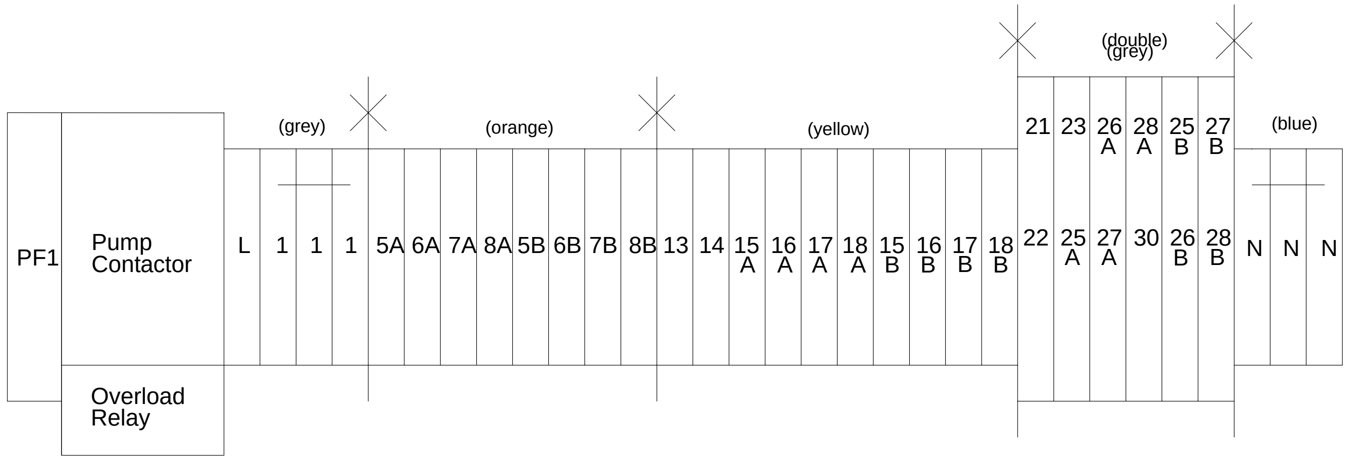
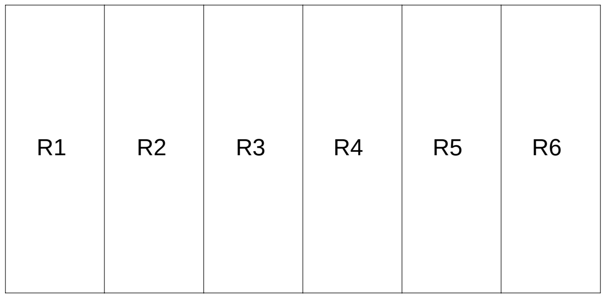


Figure A4(b) – Wiring Diagram – Single Pump, Advanced Controls, Twin System Unit (Page 2 of 2).



Backplate DIN Rail Layout



Fascia DIN Rail Layout

Figure A5 – Wiring Diagram – Double Pump, Standard Controls Unit.

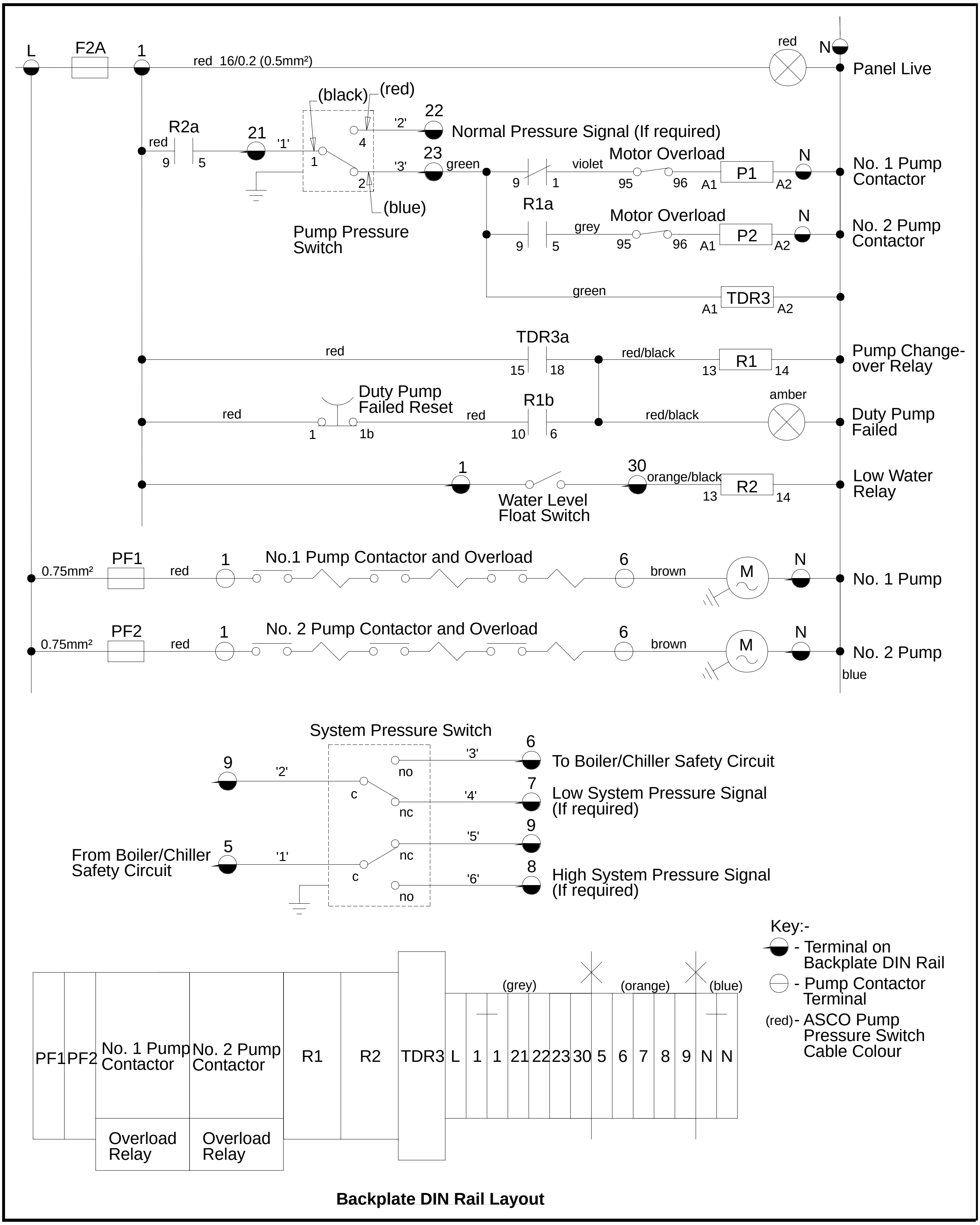


Figure A6(a) – Wiring Diagram – Double Pump, Standard Controls, Twin System Unit (Page 1 of 2).

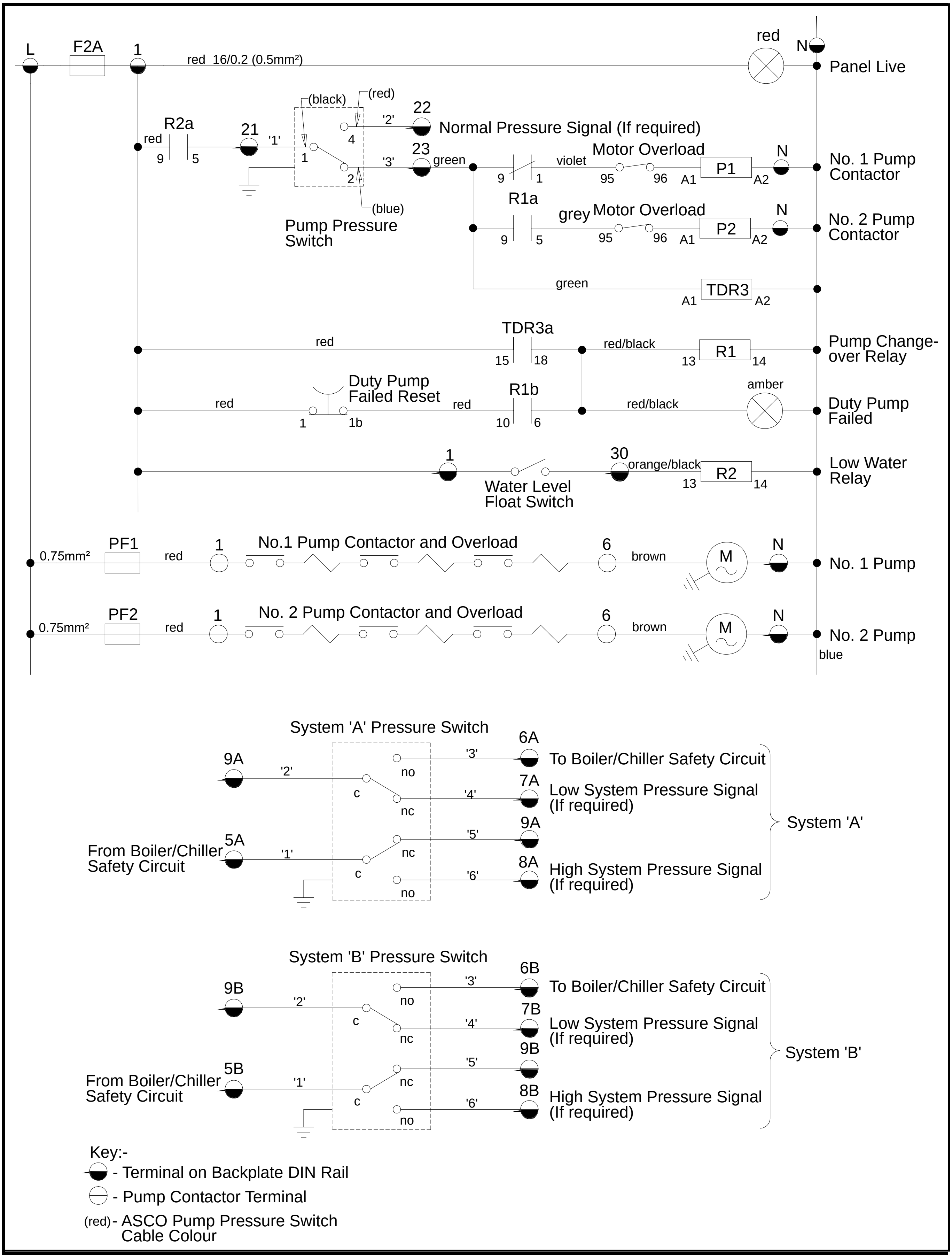
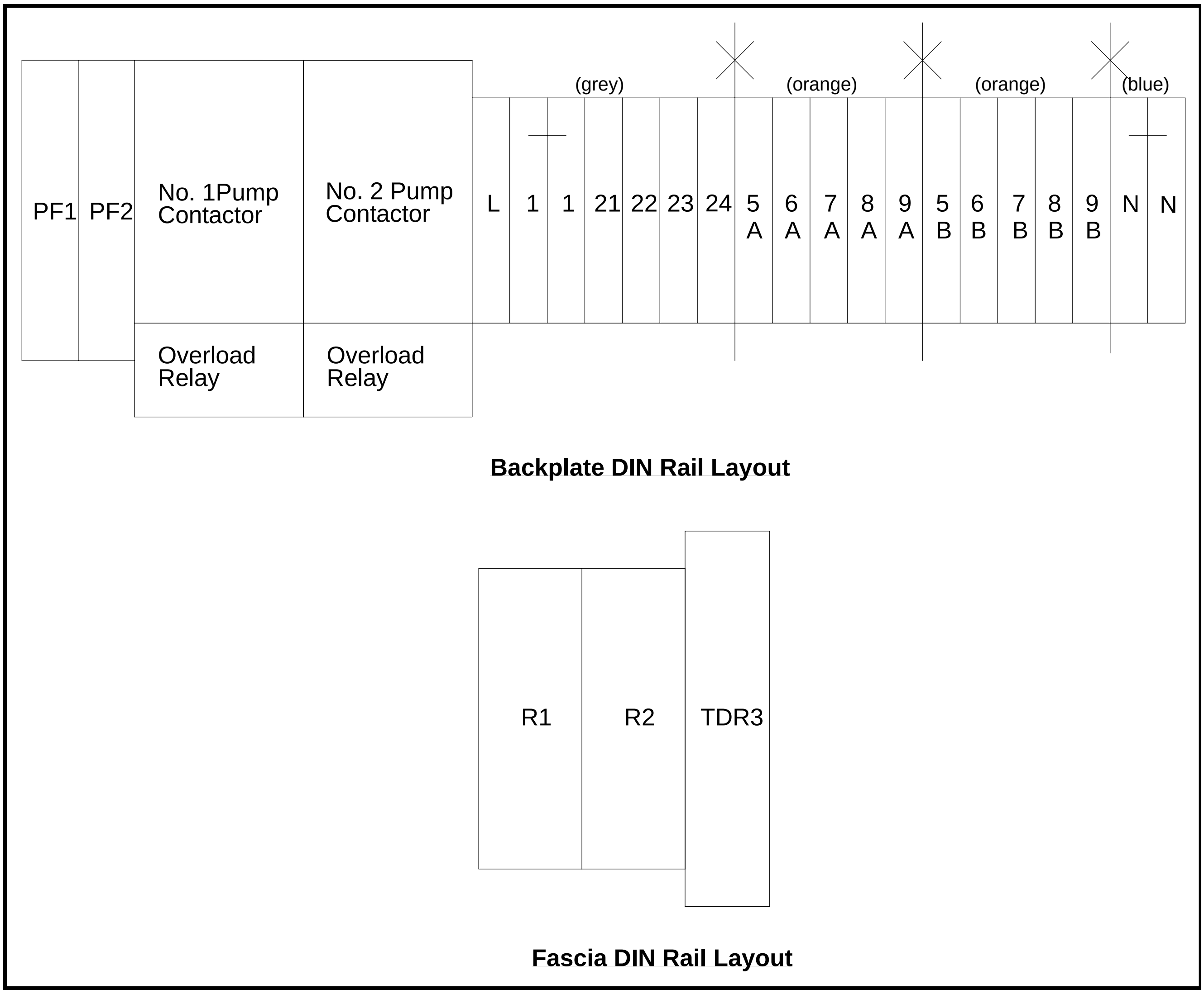


Figure A6(b) – Wiring Diagram – Double Pump, Standard Controls, Twin System Unit (Page 2 of 2).



Backplate DIN Rail Layout

Fascia DIN Rail Layout

Figure A7(a) – Wiring Diagram – Double Pump, Advanced Controls Unit (Page 1 of 2).

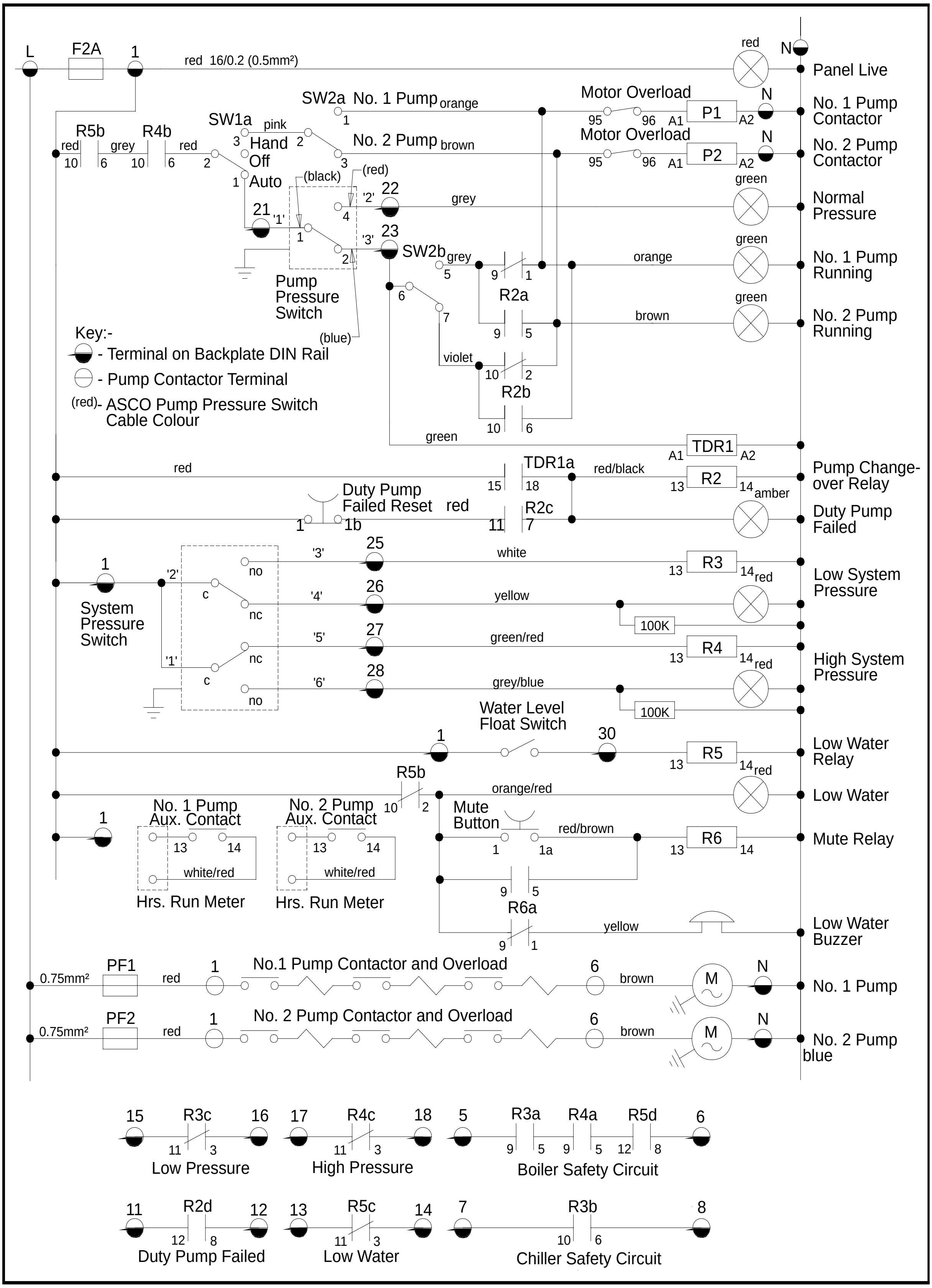


Figure A7(b) – Wiring Diagram – Double Pump, Advanced Controls Unit (Page 2 of 2).

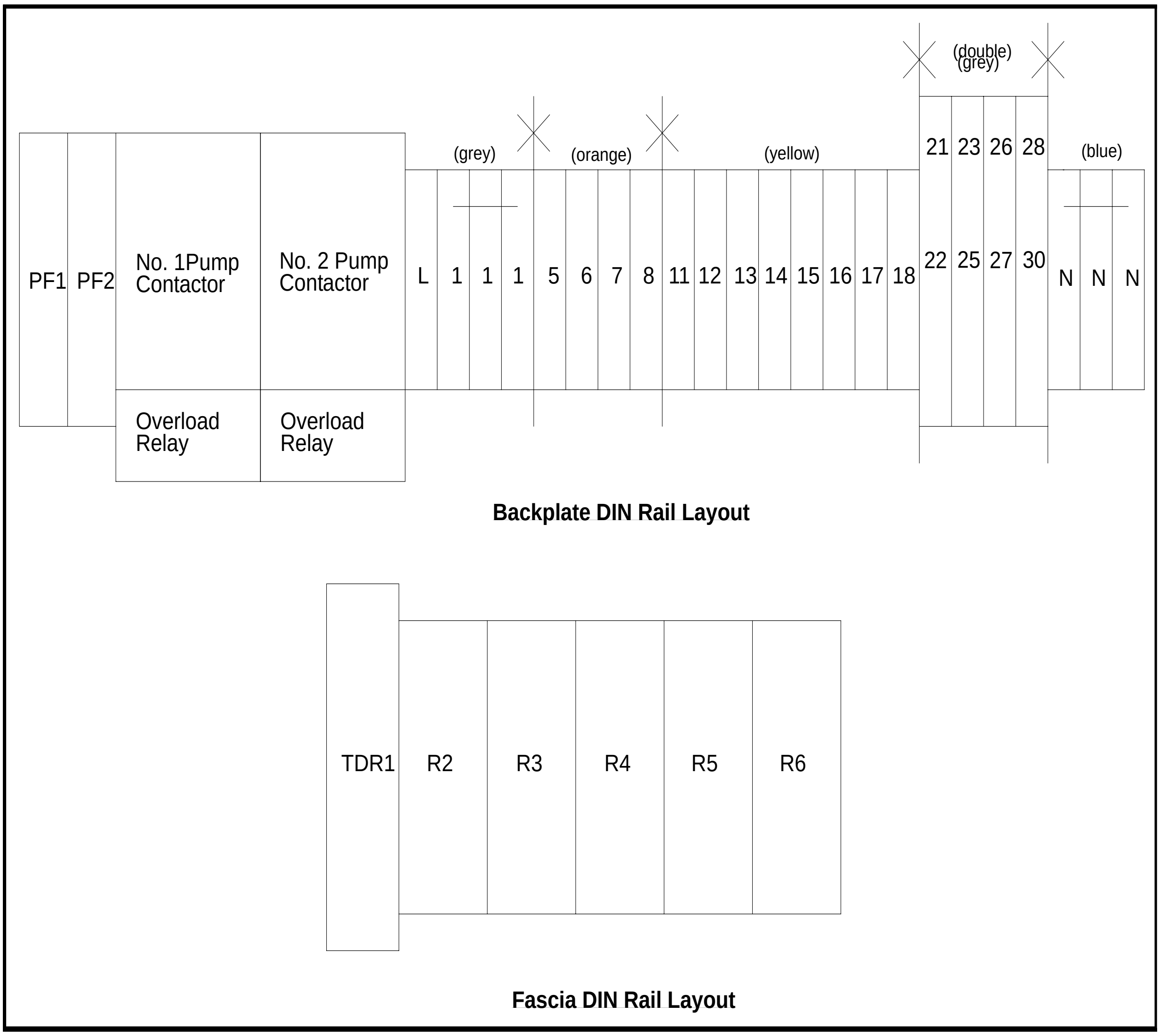


Figure A8(a) – Wiring Diagram – Double Pump, Advanced Controls, Twin System Unit (Page 1

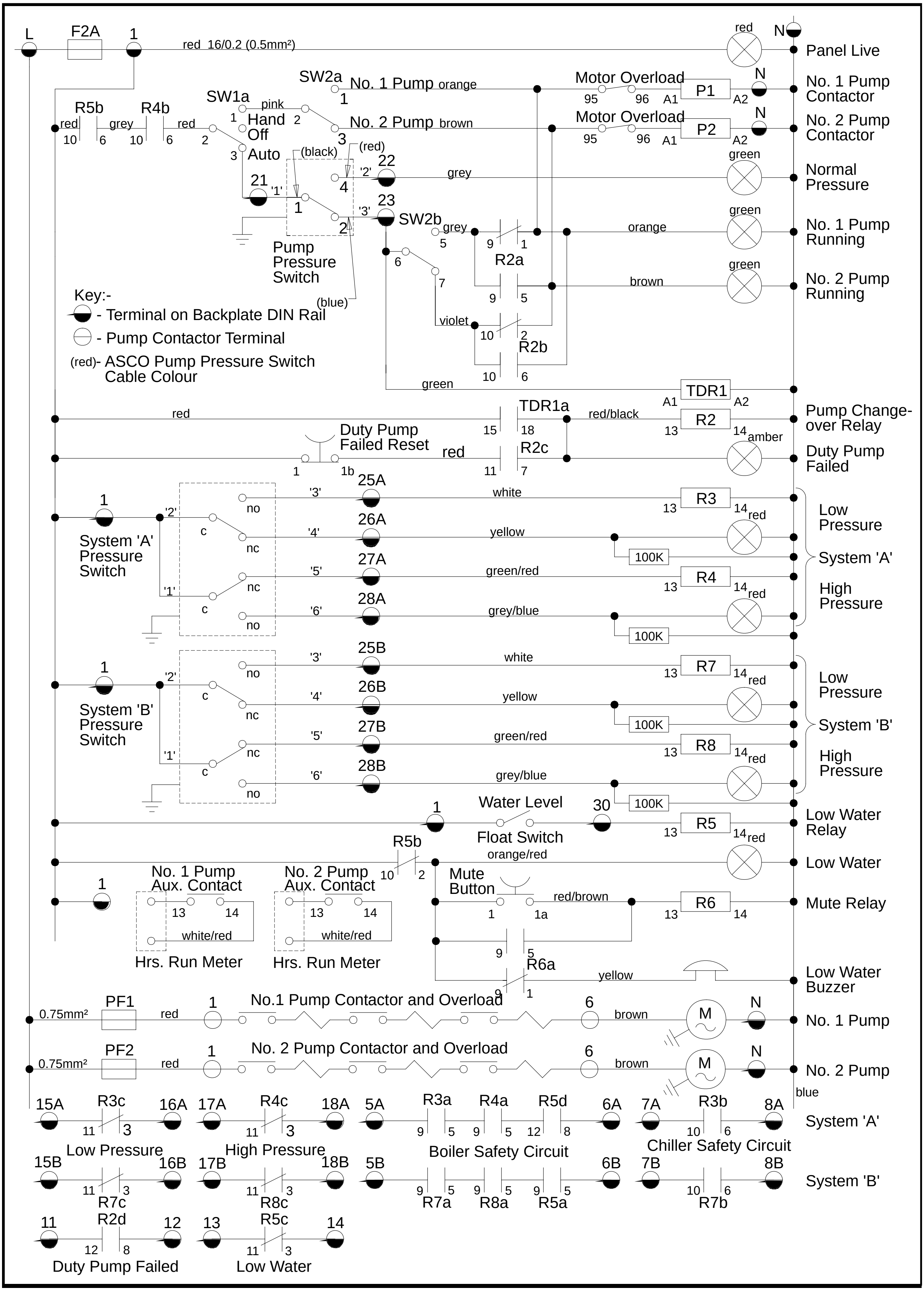
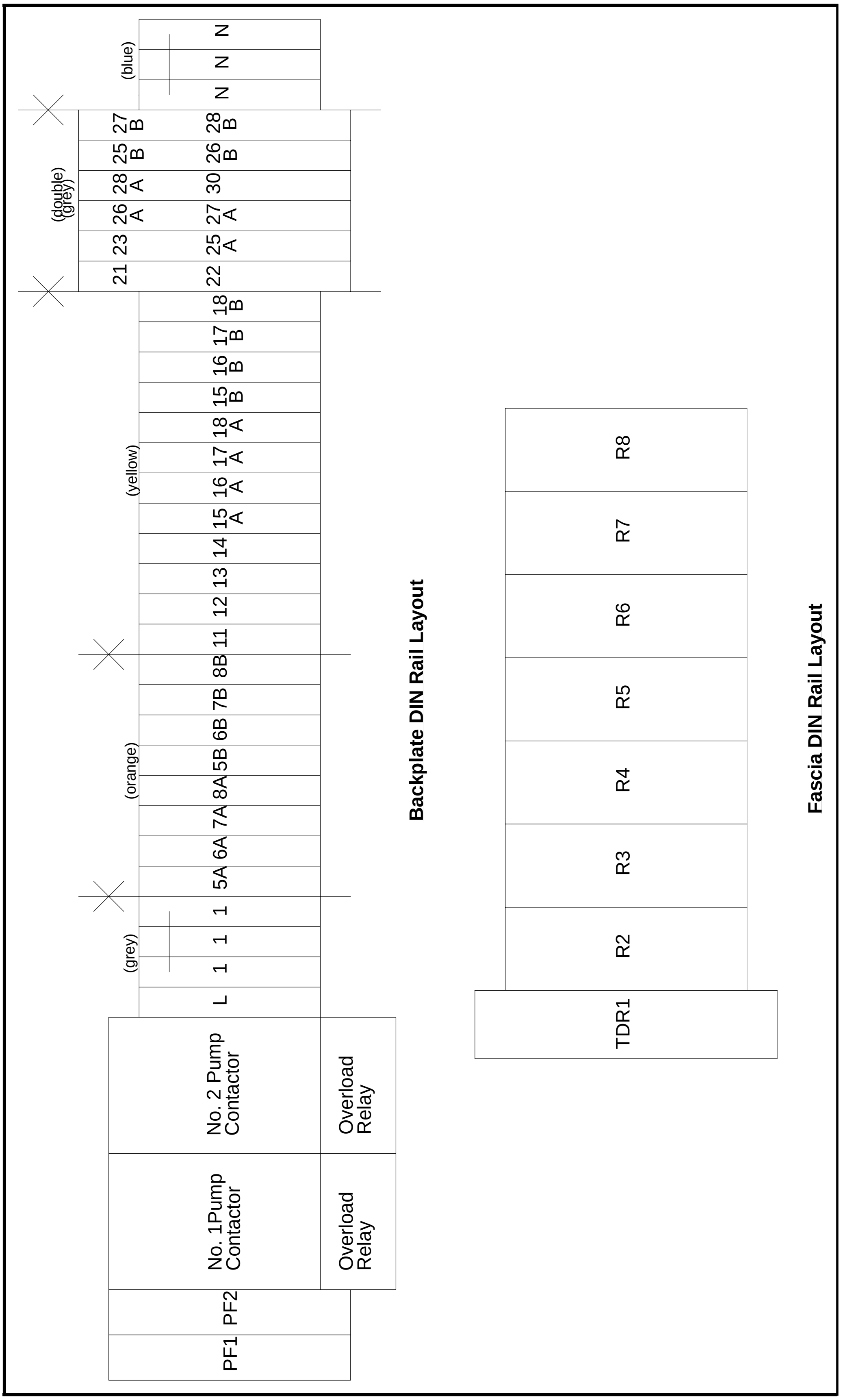


Figure A8(b) – Wiring Diagram – Double Pump, Advanced Controls, Twin System Unit (Page 2 of 2).



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