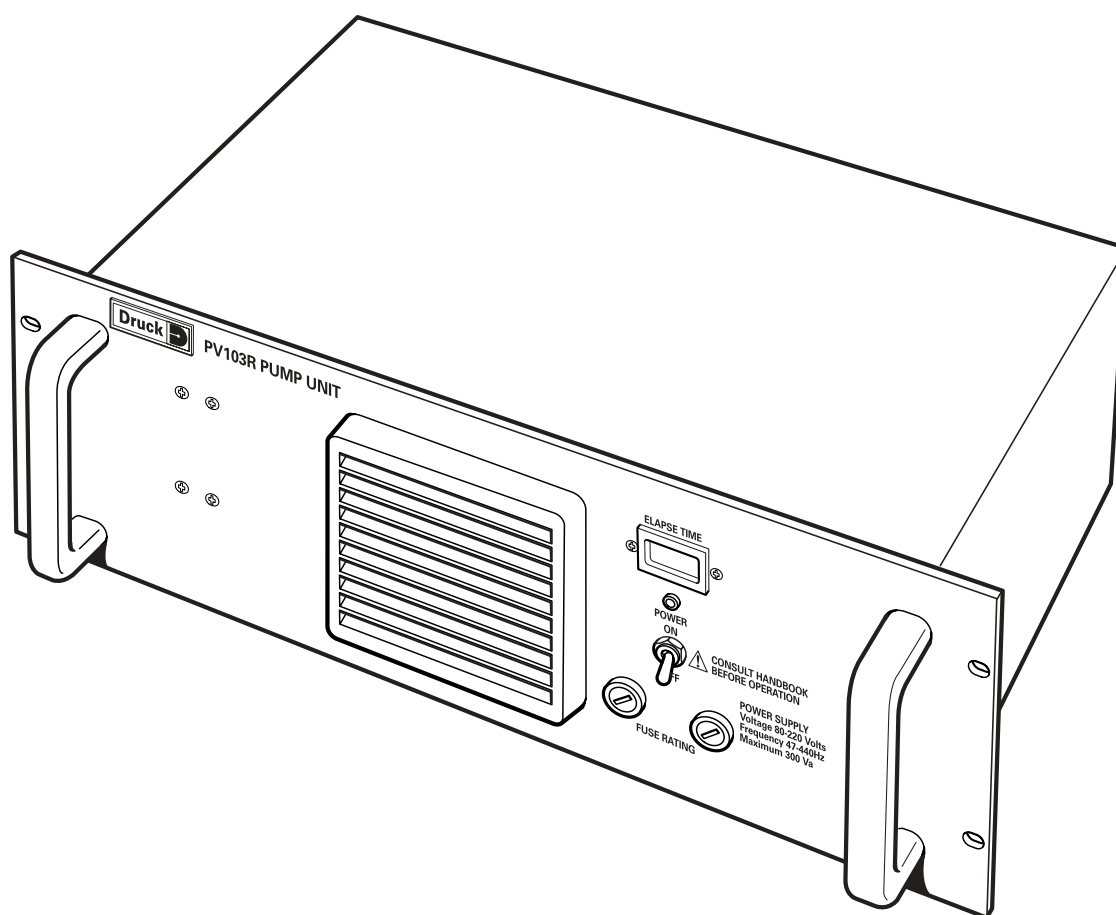


Druck PV 103R Pump unit

Service manual K232



INTRODUCTION

Purpose

This technical manual provides servicing instructions and a parts list to an intermediate level of maintenance for the Druck PV 103 pump units.

Scope

This technical manual contains a constructional description, a functional description explaining the theory of operation, servicing, replacing parts and testing procedures. An illustration parts list details the parts that can be replaced. The test equipment and special tools required for the recommended maintenance level are listed. A supplementary servicing chapter describes procedures to update older units to the latest build standard.

Associated Druck Documents:

K141 - PV 103R User Manual

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GLOSSARY

Terminology

The terminology used in this manual is specific and individual interpretation must not be introduced.
The terms are defined as follows:

Adjust:

To bring to a more satisfactory state; to manipulate controls, levers, linkages, etc. to return equipment from an out-of-tolerance condition to an in-tolerance condition.

Align:

To bring into line; to line up; to bring into precise adjustment, correct relative position or coincidence.

Assemble:

To fit and secure together the several parts of; to make or form by combining parts.

Calibrate:

To determine accuracy, deviation or variation by special measurement or by comparison with a standard.

Check:

Make a comparison of a measure of time, pressure, temperature, resistance, dimension or other quality with a known figure for that measurement.

Disconnect:

To detach the connection between; to separate keyed or matched equipment parts.

Dismantle:

To take apart to the level of the next smaller unit or down to all removable parts.

Ensure:

To confirm that a proper condition exists; to find out with certainty.

Examine:

To perform a critical visual observation or check for specific conditions; to test the condition of.

Fit:

Correctly attach one item to another.

Inspect:

Review the work carried out by Specialists to ensure it has been performed satisfactorily.

Install:

To perform operations necessary to properly fit an equipment unit into the next larger assembly or system.

Maintain:

To hold or keep in any particular state or condition especially in a state of efficiency or validity.

Operate:

Ensure that an item or system functions correctly as far as possible without the use of test equipment or reference to measurement.

Readjust:

To adjust again; to move back to a specified condition; to bring back to an in-tolerance condition.

Reconnect:

To rejoin or refasten that which has been separated.

Refit:

Fit an item which has previously been removed.

Terminology (continued)

Remove:

To perform operations necessary to take an equipment unit out of the next larger assembly or system. To take off or eliminate. To take or move away.

Repair:

To restore damaged, worn out or malfunctioning equipment to a serviceable, usable or operable condition.

Replace:

Remove an item and fit a new or a serviced item.

Reset:

To put back into a desired position, adjustment or condition.

Service:

To perform such operations as cleaning, lubricating and replenishing to prepare for use.

Test:

Ascertain by using the appropriate test equipment that a component or system functions correctly.

Abbreviations

The following abbreviations are used in this manual; the abbreviations are the same in the singular and plural.

A	Ampere
abs	Absolute
a.c.	Alternating current
ALT	Altitude
CAS	Calibrated airspeed
d.c.	Direct current
e.g.	For example
EOC	End of conversion
EPR	Engine pressure ratio
EPROM	Electrically programmable read only memory
etc.	And so on
Fig.	Figure
ft	Foot
g	Gauge
Hg	Mercury
Hz	Hertz
IAS	Indicated airspeed
i.e.	That is
IEEE 488	Institute of Electrical and Electronic Engineers standard 488 data
in	Inch
kg	Kilogram
LED	Light emitting diode
(M)	Magnesium alloy
m	Metre
mA	Milliampere
max	Maximum
mbar	Millibar
min	Minute or minimum
mm	Millimetre
mV	Millivolts
No.	Number
N.m.	Newton metre
Para.	Paragraph
Ps	Static pressure
psi	Pounds per square inch
Pt	Total pressure
Qc	Differential pressure Ps/Pt
QFE	Local atmospheric pressure
QNH	Barometric pressure at sea level
ROC	Rate of climb
SCPI	Standard commands for programmable instruments
TAS	True airspeed
TE	Test equipment
V	Volts
Vc	Calibrated velocity
Vt	True velocity
+ve	Positive
-ve	Negative
°C	Degrees Celsius

Chapter 1

Description

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INTRODUCTION

1. Since the introduction of the PV 103 in March 1994 there have been four build standards. With all four build standards there are two variants, the rack and flightline. Each standard has improved either the performance and reliability or extended the servicing period.
2. The PV 103R rack-mounted variant provides pressure and vacuum supplies for use with other rack-mounted equipment (such as the ADTS 405) as part of an instrument and air data component servicing and testing facility. Alternatively the unit can be fitted in a trolley as part of a mobile air data test system.

Note: *The suffix R was added in 1998 to show the difference between the two variants.*

3. The PV 103 flightline variant is part of the ADTS 405F air data test system providing complete pressure and vacuum measuring and control for on-aircraft sense and leak testing and functional tests of air data instruments, components and systems. The ADTS 405F comprises an electronics rack (ADTS 405) and pump rack (PV 103) enclosed in a high density, polyethylene case. The operating details and service information for these flightline units are contained on Druck publications K114 ADTS 405 User Manual and K228 ADTS 405 Service Manual.

Build Standard 1

4. The first standard uses a compact custom pump assembly based on a brushless d.c. motor, custom crankcase and eccentric driving four rocking PTFE sealed piston, cylinder and flap valve assemblies. The pressure/vacuum output connect to Vacuum (1) and Vacuum (2) and to Pressure all located on the rear panel.

Brief Description

5. The pump consists of an electric motor driving a pump and controlled by a controller PCB. The rack is cooled by an electric fan. A power supply unit produces electrical power for the motor circuit, fan and circuits to the electronics rack. The power supply switch, elapsed time indicator and fuses are located on the front panel of the rack.
6. The pump is driven by a brushless DC motor, Hall effect sensors provide feedback to the motor drive circuits. The power supply unit receives power through a switch and fuse to produce 24 V DC for the motor drive circuits and the power indicator.
7. The pump consists of four reciprocating pistons on a central eccentric. One piston head is configured for pressure and the other three for vacuum. Reed valves in the piston heads control the direction of air flow. One of the vacuum heads provides an initial (rough) vacuum that in turn feeds the other two vacuum heads.
8. Air from the pressure head passes through a copper cooling coil located behind the front panel air intake grill. Any moisture in the cooled air condenses, a coalescing filter bowl traps the condensed moisture. A constant air bleed forces the discharge of condensed moisture (water) through a needle restrictor to the water drain pipe.

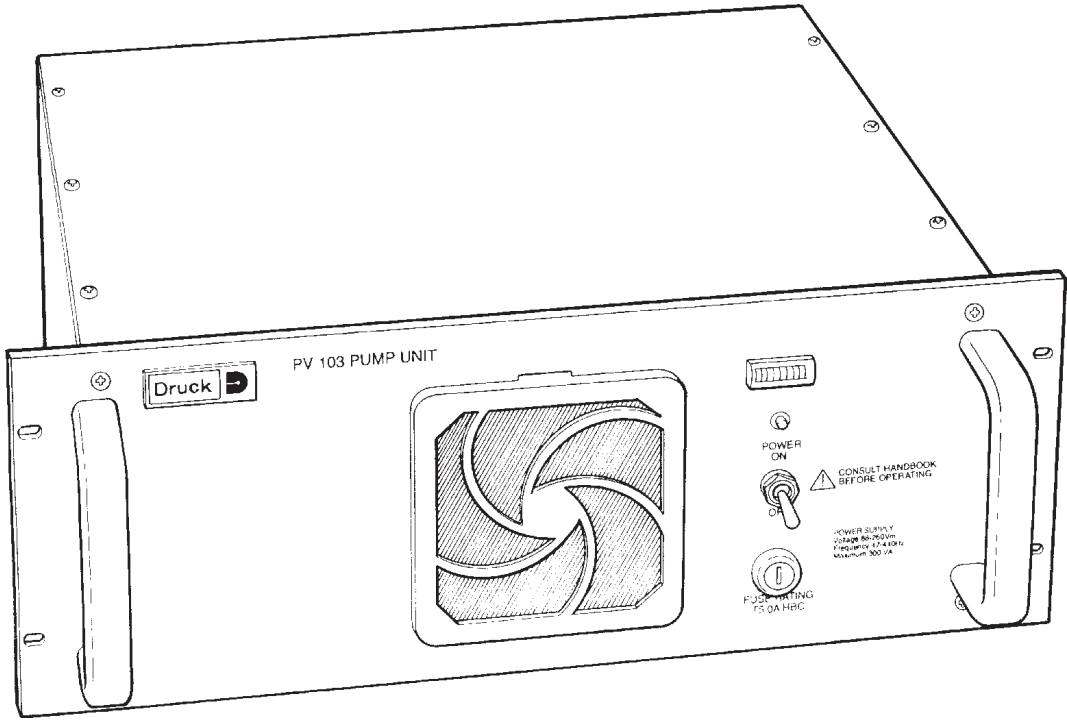


Figure 1-1 Build standard 1, General view

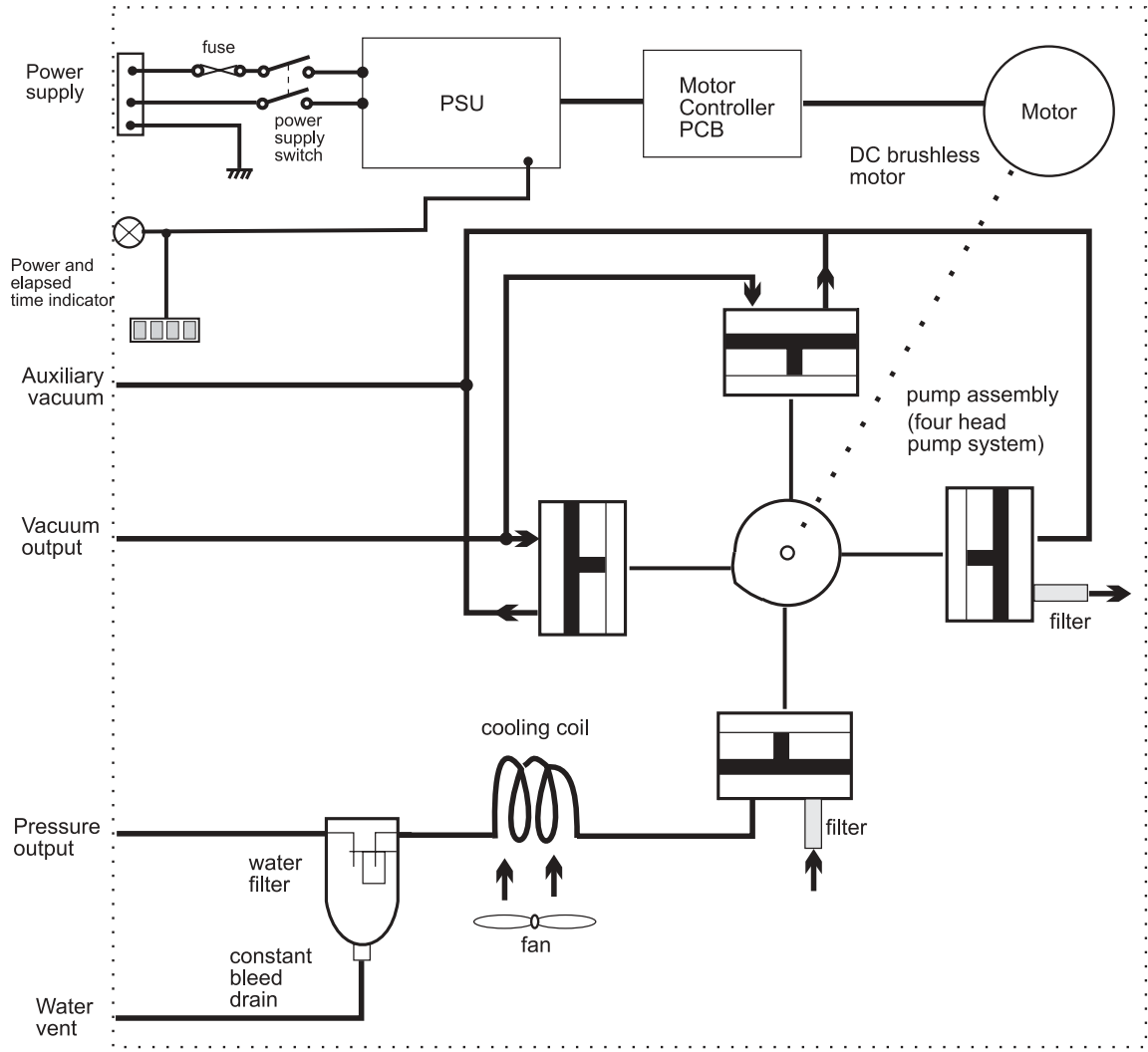
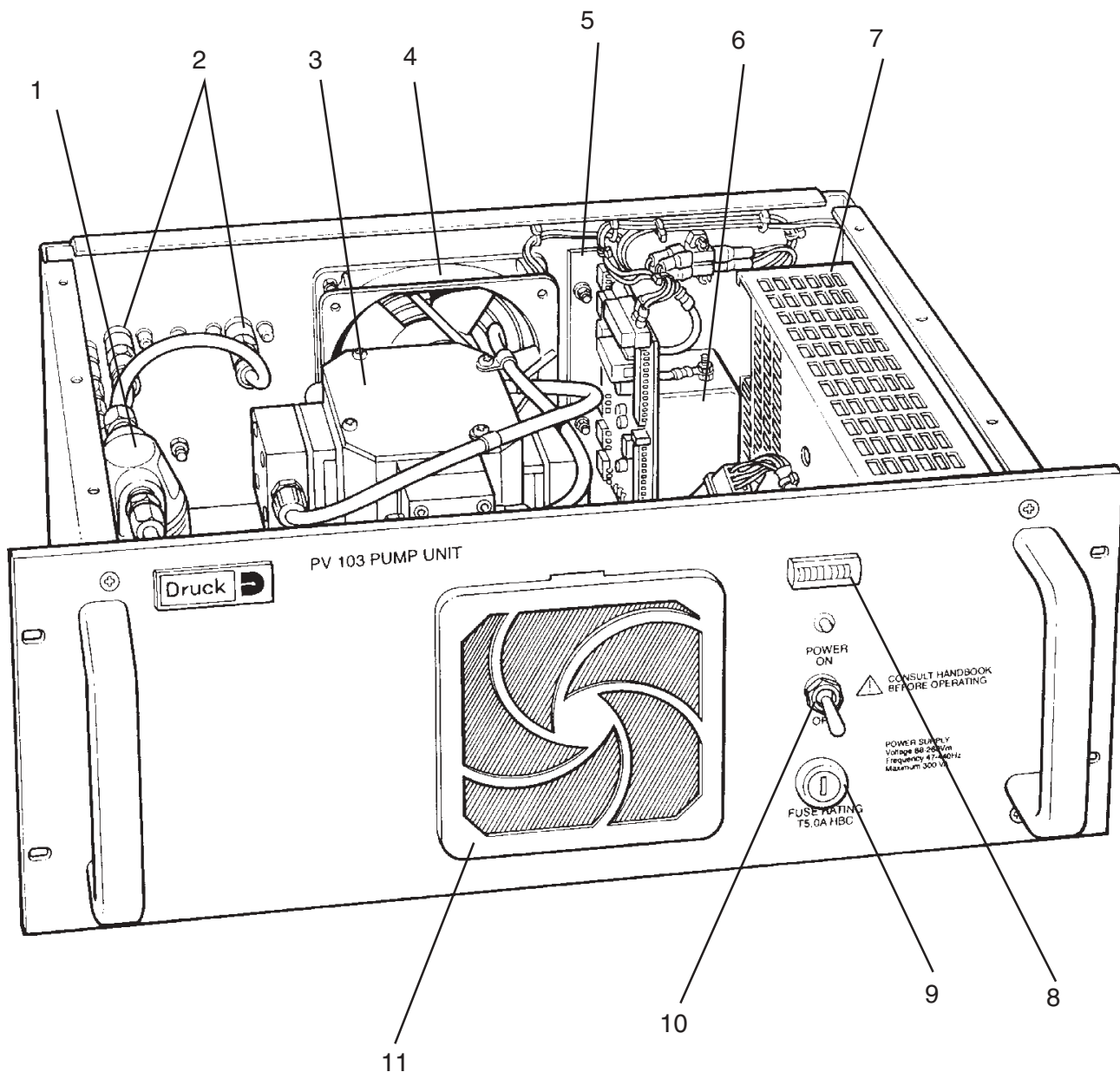


Figure 1-2 Build standard 1, Schematic Diagram



- | | | | |
|---|-------------------------------|----|------------------------|
| 1 | Water drain filter | 7 | Power supply unit |
| 2 | Pneumatic output connections | 8 | Elapsed time indicator |
| 3 | Pump and Motor assembly | 9 | Fuse holder |
| 4 | Fan assembly | 10 | Switch |
| 5 | Motor controller PCB | 11 | Filter |
| 6 | Power supply filter connector | | |

Figure 1-3 Build standard 1, Internal view

Input

Output

Dimensions

Environment

Position of the unit

The unit must only be operated with the front panel in the vertical position.

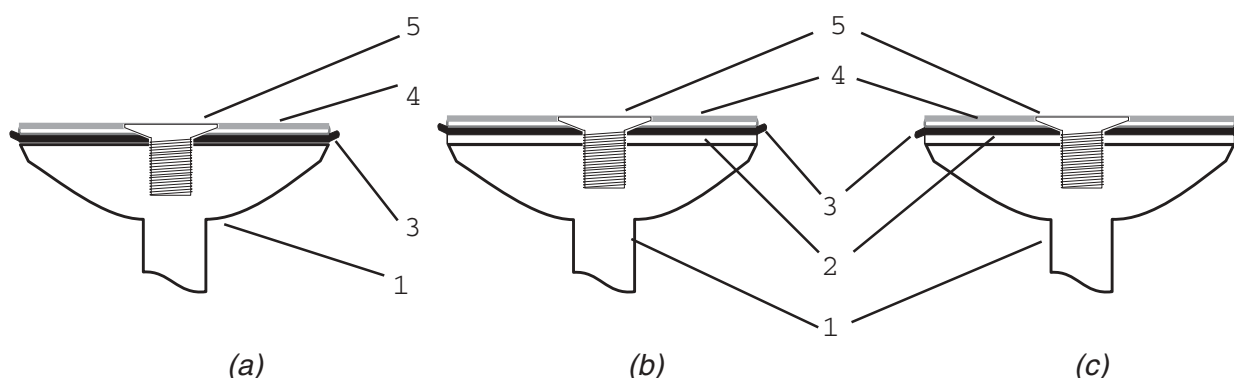
Note: *The unit must not be operated in any other position because an internal water drain will be inverted.*

Calibration and adjustments..... not required

Build Standard 2

10. The second standard included improvements in materials and assembly methods that had been well proven during design/development of the military versions. A improved power supply included an upgraded motor control PCB. When this unit is used with an ADTS 405 the speed of the motor is controlled by the mode selection of the ADTS 405. During measurement mode the motor speed slows to reduce noise output and wear. An additional 15-way D-type connector was fitted to the rear panel to connect to the ADTS 405 mode selection.

11. Build standard 2 introduced a profiled spacer on the piston crown enabling the piston seals to be reversed for more effective vacuum generation. A new style of cylinder, with hard anodising and high polish, improved seal wear and reduced leakage. To keep stroke lengths correct a similar profile spacer is used on the pressure piston. Improvements to piston alignment with the piston seal changes has increased the servicing interval to 3000 hours. The output pressures can be sustained at 3.5 bar and 20 mbar absolute.



*Piston head for pumps
of build standard 1*

Piston head for pumps of build standard 2

- 1 Connecting rod
- 2 Spacer
- 3 Piston seal

- 4 Retainer
- 5 Central countersunk screw

12. Noise reduction has been achieved by increasing the filter area of the pressure air intake; air is drawn from inside the crankcase through an end-mounted porous plate. A robust three-axis anti-vibration mounting reduces the effects of external vibration. Originally designed and developed for the ADTS 405F, this mounting fits into a surface mounting adaptor cradle.

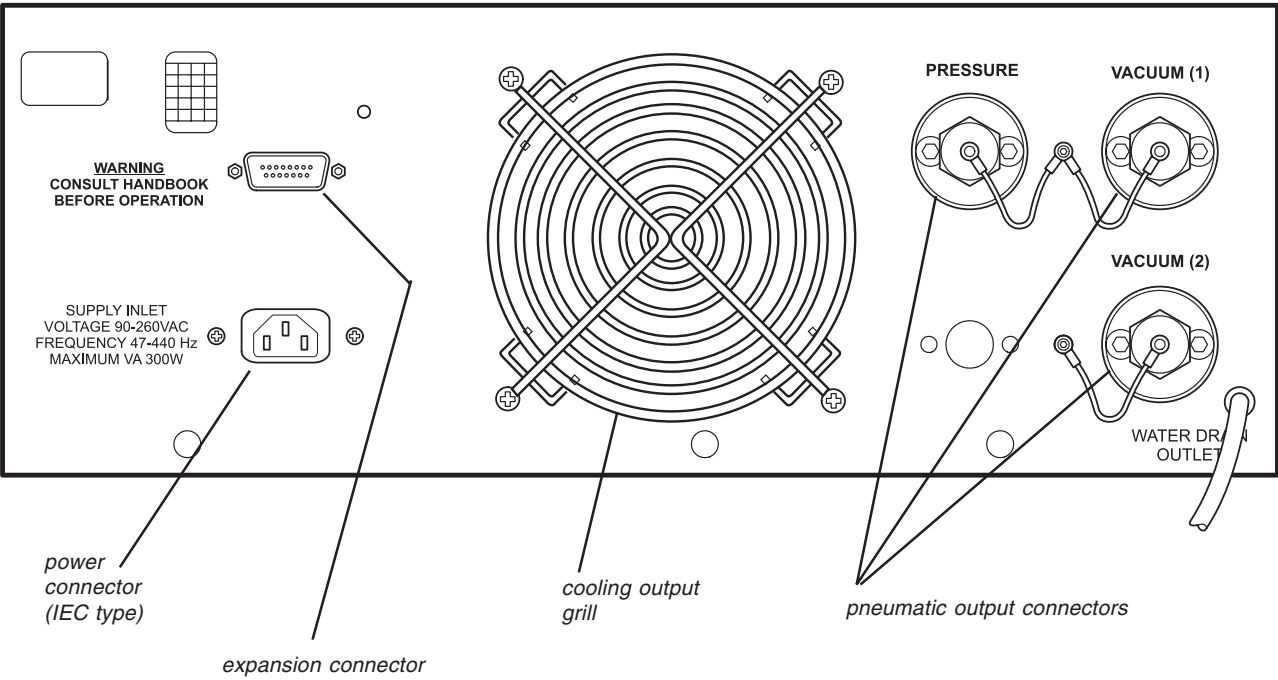


Figure 1-4 Build standard 2, Rear Panel

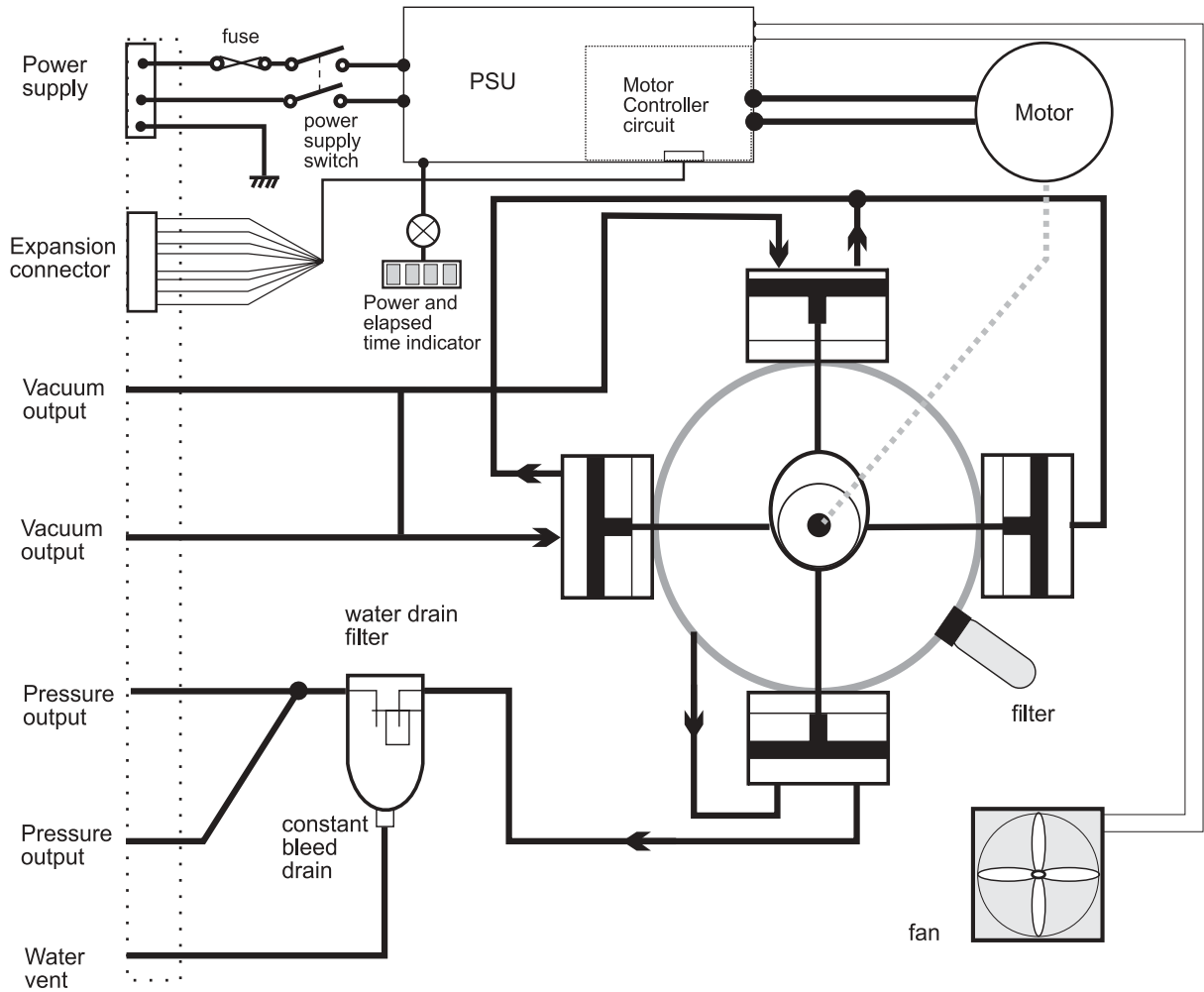


Figure 1-5 Build standard 2, Schematic Diagram

Specification Build standard 2
13.

Input

Power supply
..... 90 - 230 Vac 50 - 60 Hz (nominal)
..... 110 Vac, 400 Hz (nominal)
..... continuous rating 300 VA

Output

Pressure (min) 3.5 bar abs (100 inHg abs)
Airspeed rate 1 Mach/min up to 550 knots
..... (into a volume of 10 litres {600 cu in})
..... 900 knots/min up to 850 knots
..... (into a volume of 2 litres {120 cu in})
Vacuum (max) 20 mbar abs/0.49 inHg abs (85,000 ft)
Altitude rate 6,000 ft/min rate of climb to 55,000 ft
..... (into a volume of 17 litres {1000 cu in})
..... 15,000 ft/min rate of climb to 85,000 ft
..... (into a volume of 4 litres {240 cu in})

Note: *The vacuum performance is the combined output of Vacuum (1) and Vacuum (2), these are internally linked.*

Dimensions

width 483 mm {19 in}
height 178 mm {7 in}
depth 266 mm {10.5 in}
weight 9.5kg {21 lbs}

Environment

Temperature -10°C to +50°C (14°F to 122°F)
(continuous operation)

Position of the unit

The unit must only be operated with the front panel in the vertical position.

Note: *The unit must not be operated in any other position because an internal water drain will be inverted.*

Calibration and adjustments not required

Build Standard 3

14. This standard includes a completely revised chassis design, new cooler and water drain assembly and a water release valve. In this standard two improvements were made that increased efficiency:

- The replacement of the copper cooling coil with a compact cooler block. Heat is dissipated through the block and then to the chassis. The block contains a stainless steel knitmesh proving a large cooling area for the flow of air.
- The existing water trap/discharge system required a constant bleed of air, this affected the efficiency of the pump. To improve pumping efficiency a release valve, style regulator only purges the water drain filter when the pump back pressure rises to 3.5 bar gauge. At power-down, an energised-closed solenoid valve opens discharging air from the pressure head. This also prevents pump stall on restart with too much back pressure.

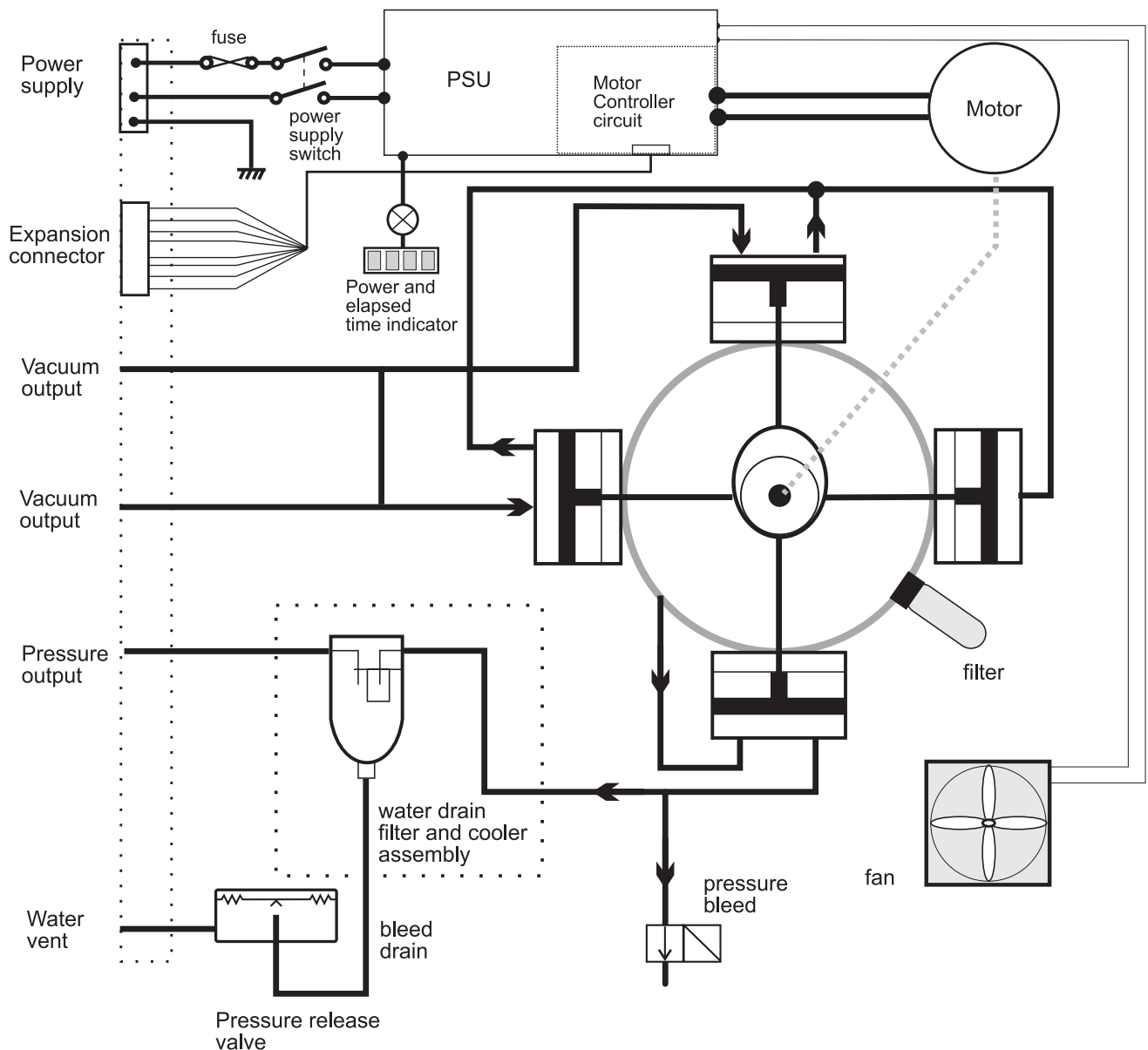


Figure 1-6 Build standard 3, Schematic Diagram

Specification Build standard 3
15.

Input

Power supply	
.....	90 - 230 Vac 50 - 60 Hz (nominal)
.....	110 Vac, 400 Hz (nominal)
.....	continuous rating 300 VA

Output

Pressure (min)	3.5 bar abs (100 inHg abs)
Airspeed rate	 1 Mach/min up to 550 knots
.....	(into a volume of 10 litres {600 cu in})
.....	900 knots/min up to 850 knots
.....	(into a volume of 2 litres {120 cu in})
Vacuum (max)	 20 mbar abs/0.49 inHg abs (85,000 ft)
Altitude rate	 6,000 ft/min rate of climb to 55,000 ft
.....	(into a volume of 17 litres {1000 cu in})
.....	15,000 ft/min rate of climb to 85,000 ft
.....	(into a volume of 4 litres {240 cu in})

Note: *The vacuum performance is the combined output of Vacuum (1) and Vacuum (2), these are internally linked.*

Dimensions

width	 483 mm {19 in}
height	 178 mm {7 in}
depth	 266 mm {10.5 in}
weight	 9.5kg {21 lbs}

Environment

Temperature	 -10°C to +50°C (14°F to 122°F)
(continuous operation)	

Position of the unit

The unit must only be operated with the front panel in the vertical position.

Note: *The unit must not be operated in any other position because an internal water drain will be inverted.*

Calibration and adjustments	 not required
-----------------------------	--------------------

Build Standard 4

16. This build standard replaces obsolete parts and improves on the revised chassis design, new cooler and water drain assembly and a water release valve of build standard 3. In this standard, improvements were made that increased efficiency:

- The main improvement combines the cooler and water drain into one assembly with a compact cooler block. Heat is dissipated through the block and then to the chassis. A reduced number of pipe interconnections reduces the potential leak paths. Both changes improve pumping efficiency.
- A pressure release valve, in the regulator, only purges the water drain filter when the pump's back pressure rises to 3.5 bar gauge. At power-down, an energised-closed solenoid valve opens discharging air from the pressure head.

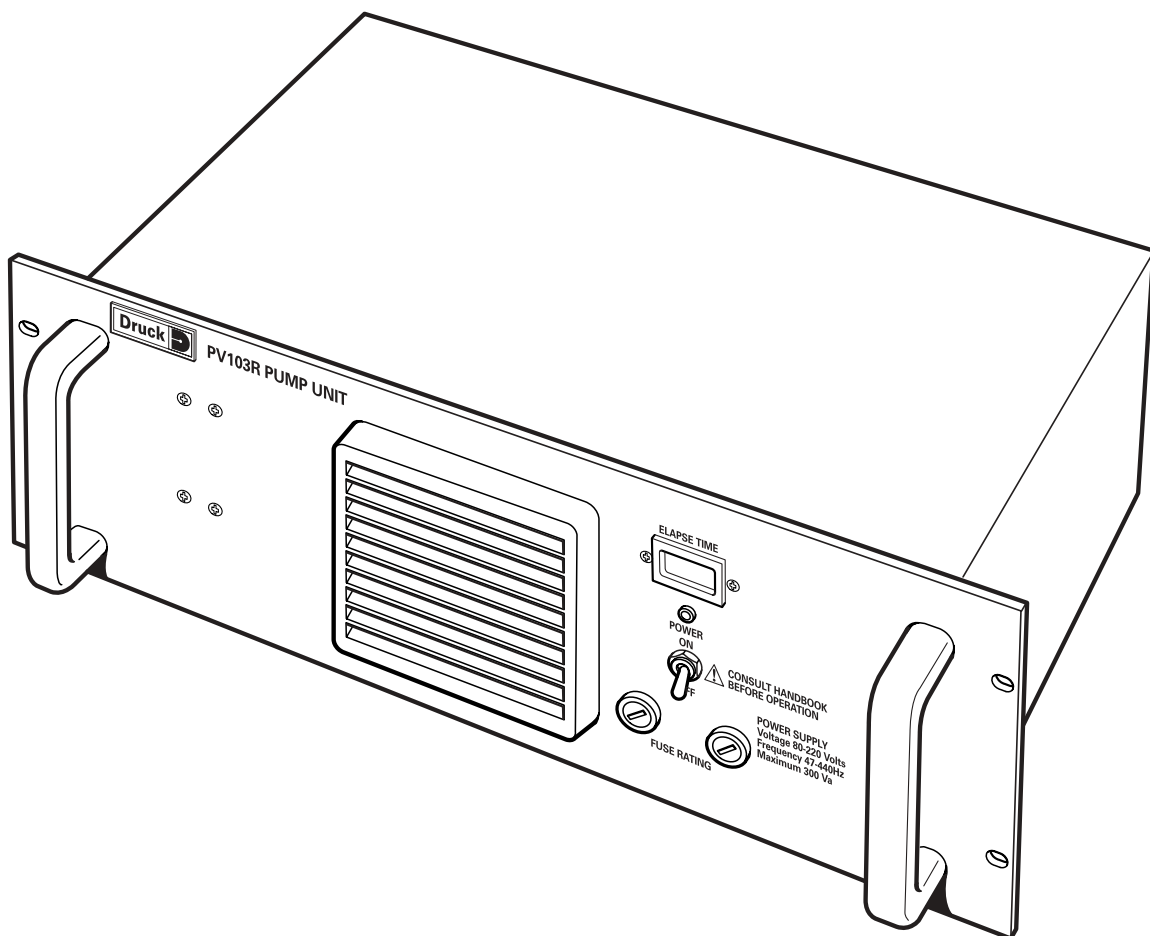


Figure 1-7 Build standard 4, General view

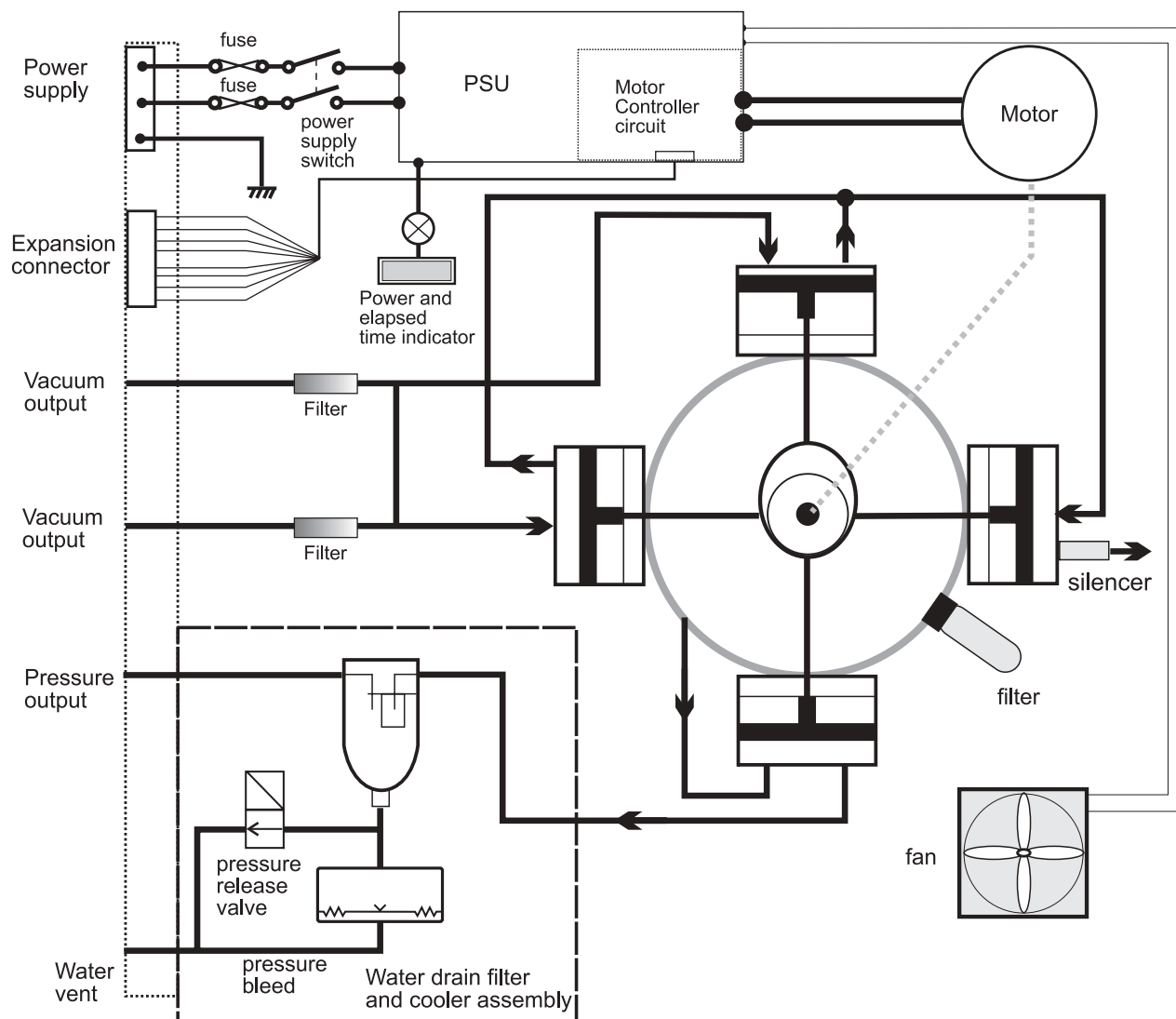
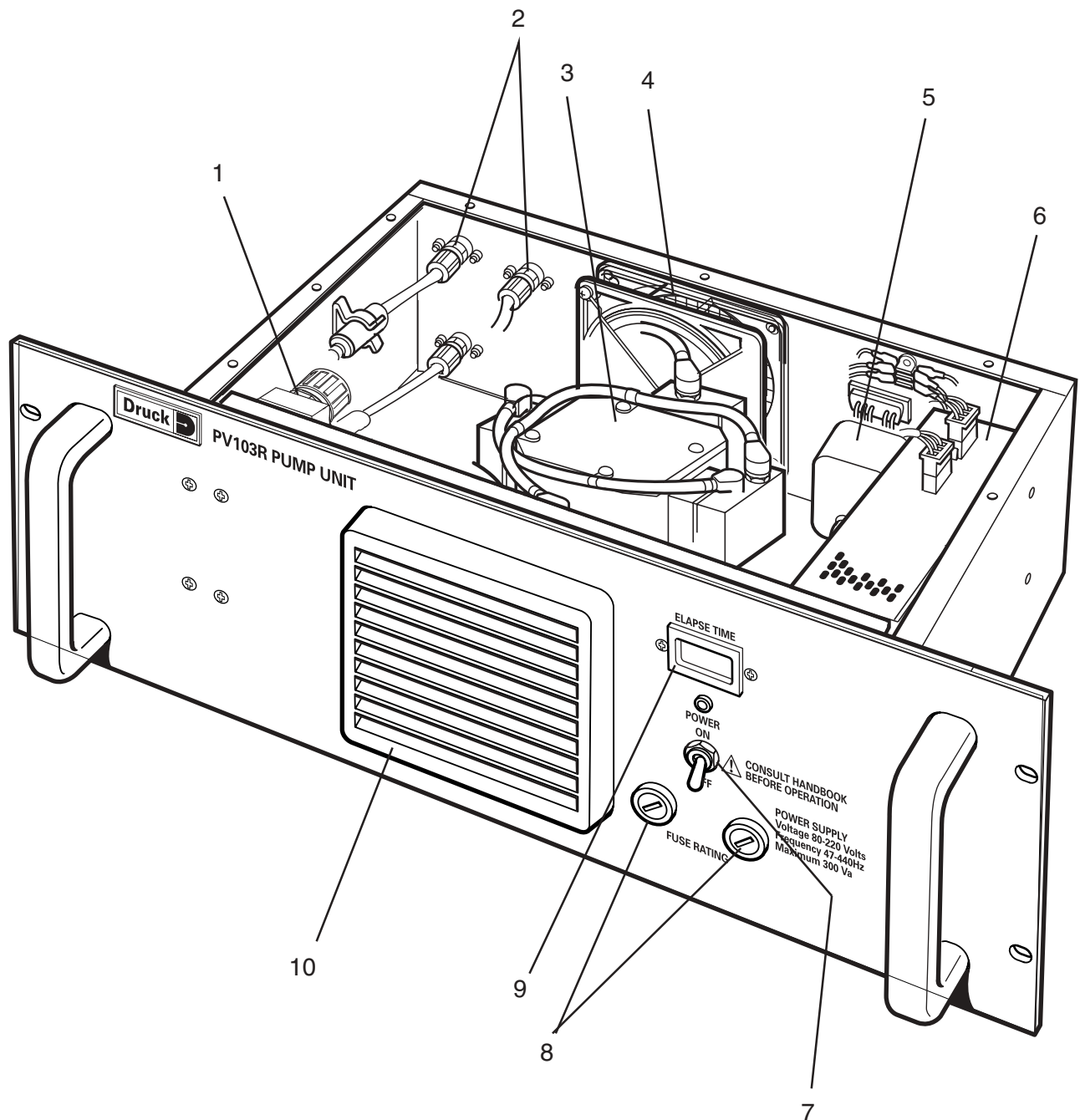


Figure 1-8 Build standard 4, Schematic Diagram



- | | | | |
|---|-------------------------------|----|------------------------|
| 1 | Water trap/cooler assembly | 6 | Power supply unit |
| 2 | Pneumatic output connections | 7 | Switch |
| 3 | Pump and Motor assembly | 8 | Fuse holder |
| 4 | Fan assembly | 9 | Elapsed time indicator |
| 5 | Power supply filter connector | 10 | Filter |

Figure 1-9 Build standard 4, Internal view

Specification Build standard 4
17.

Input

Power supply 88 - 260 Vac 47 - 440 Hz (nominal)
..... continuous rating 300 VA

Output

Pressure (max) 3.5 bar gauge (100 inHg gauge)
Airspeed rate 1 Mach/min up to 550 knots
..... (into a volume of 10 litres {600 cu in})
..... 900 knots/min up to 850 knots
..... (into a volume of 2 litres {120 cu in})
Vacuum (max) 20 mbar abs/0.49 inHg abs (85,000 ft)
Altitude rate 6,000 ft/min rate of climb to 55,000 ft
..... (into a volume of 17 litres {1000 cu in})
..... 15,000 ft/min rate of climb to 85,000 ft
..... (into a volume of 4 litres {240 cu in})

Note: *The vacuum performance is the combined output of Vacuum (1) and Vacuum (2).*

Dimensions

width 483 mm {19 in}
height 178 mm {7 in}
depth 266 mm {10.5 in}
weight 9.5kg {21 lbs}

Environment

Temperature -10°C to +50°C (14°F to 122°F)
(continuous operation)

Position of the unit

The unit must only be operated with the front panel in the vertical position.

Note: *The unit must not be operated in any other position because an internal water drain will be inverted.*

Calibration and adjustments not required

Chapter 2

Scheduled Servicing

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3000 Hours	2.3

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Cylinder head	2-5
Piston head	2-6

1 SERVICING

WARNING: VOLTAGES IN EXCESS OF 30 VOLTS (RMS) AC OR 50 VOLTS DC, IN CERTAIN CIRCUMSTANCES CAN BE LETHAL. CARE MUST BE TAKEN WHEN WORKING ON LIVE, EXPOSED CONDUCTORS.

General

1. Absolute cleanliness of the work area, tools and equipment must be observed. Expendable items must be discarded.
2. Disconnect and remove all the electrical and pneumatic connections.

Cover

3. Unscrew and remove the ten screws and shakeproof washers securing the cover to the chassis. Slide cover off to the rear.

2 MAINTENANCE

General

1. To maintain the unit in a safe and serviceable condition carry out the following scheduled maintenance procedures.

2.1 SCHEDULED PROCEDURES

The scheduled maintenance procedures are carried out at 1000 and 3000 hours recorded on the elapsed time indicator on the front panel of the unit. The recommended period of servicing is based on a temperate environment. If the unit is used in an environment with higher humidity or higher levels of dust the periodicity must be increased accordingly. Consult DRUCK if there is any doubt.

2.2 1000 Hours

WARNING: DISCONNECT THE POWER SUPPLY BEFORE PROCEEDING WITH MAINTENANCE.

Every 1000 hours, replace the following components:

- Bulkhead fittings
- Water drain filter - internal
- Pneumatic filters - (mufflers) internal

Bulkhead Fittings BS1, BS2 and BS3 (Fig. 2-1)

The pneumatic output connectors consist of bulkhead fitting with an integral wire knitmesh filter and, located in a small groove, an o-ring seal. The bulkhead fittings are secured by two screws to the front or rear panels. The pneumatic output pipe connects to the bulkhead fitting by a union nut and a union screwed into the bore of the bulkhead fitting.

The small o-ring located in the groove of each bulkhead fitting requires regular inspection for damage and, if necessary, replacement.

Note: *BS4 bulkhead fittings have an integral o-ring seal, should this become damaged the bulkhead fitting must be replaced.*

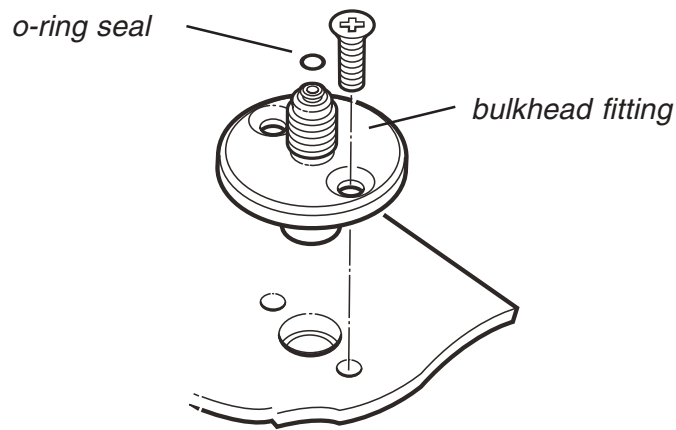


Fig. 2-1 Bulkhead fitting

Procedure

Build standard 1, 2 and 3

- (1) Unscrew the union nut, disconnect the pneumatic output pipe and collect the bonded seal.
- (2) Unscrew the two screws securing the bulkhead fitting, remove the bulkhead fitting.
- (3) Inspect and clean the bulkhead fitting wire knitmesh filter and, if necessary, replace the bulkhead fitting. Refit the bulkhead fitting and secure with the two screws.
- (4) Fit a new bonded seal and refit the union to the bulkhead fitting.
- (5) Locate the pneumatic output pipe on the union and secure with the union nut.

Water Drain Filter (Fig. 2-2)

Build standard 1 and 2

This unit contains a constant-bleed water drain producing a small flow of exhaust air. The exhaust air must be checked when the pumps are running. Replace the water drain filter as follows:

- (1) Disconnect the drain pipe to the water drain filter.
- (2) Cut the tyrap securing the water drain filter. Unscrew the clear nylon bowl from the water drain filter body.
- (3) Remove the clear plastic drain pipe from the clear nylon bowl and replace the drain inserted in the bowl. Refit the clear plastic drain pipe to the nylon bowl.
- (4) Replace the filter element and refit the clear nylon bowl to the water drain filter body. Secure the assembled water drain filter with a tyrap.
- (5) Carry out a standard serviceability test detailed in Chapter 5.

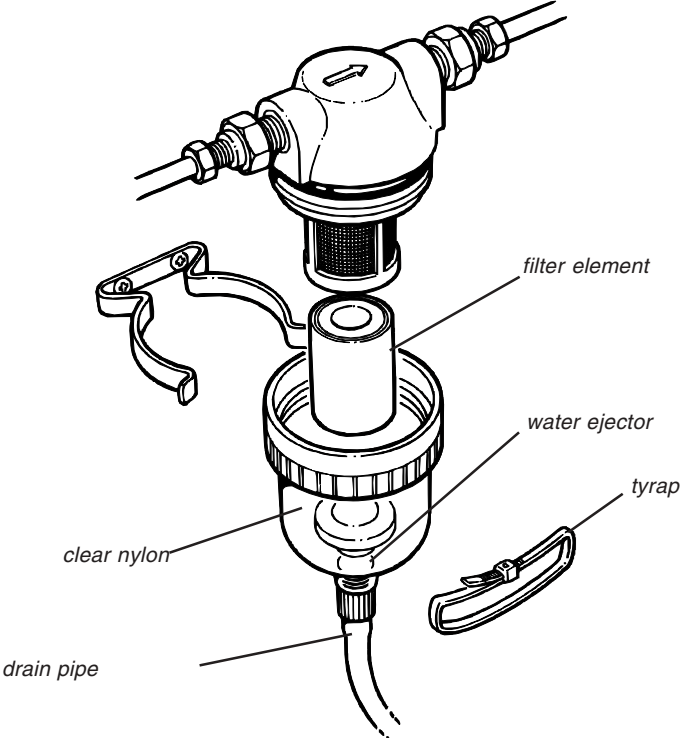


Fig. 2-2 Water drain filter, build standard 1 and 2

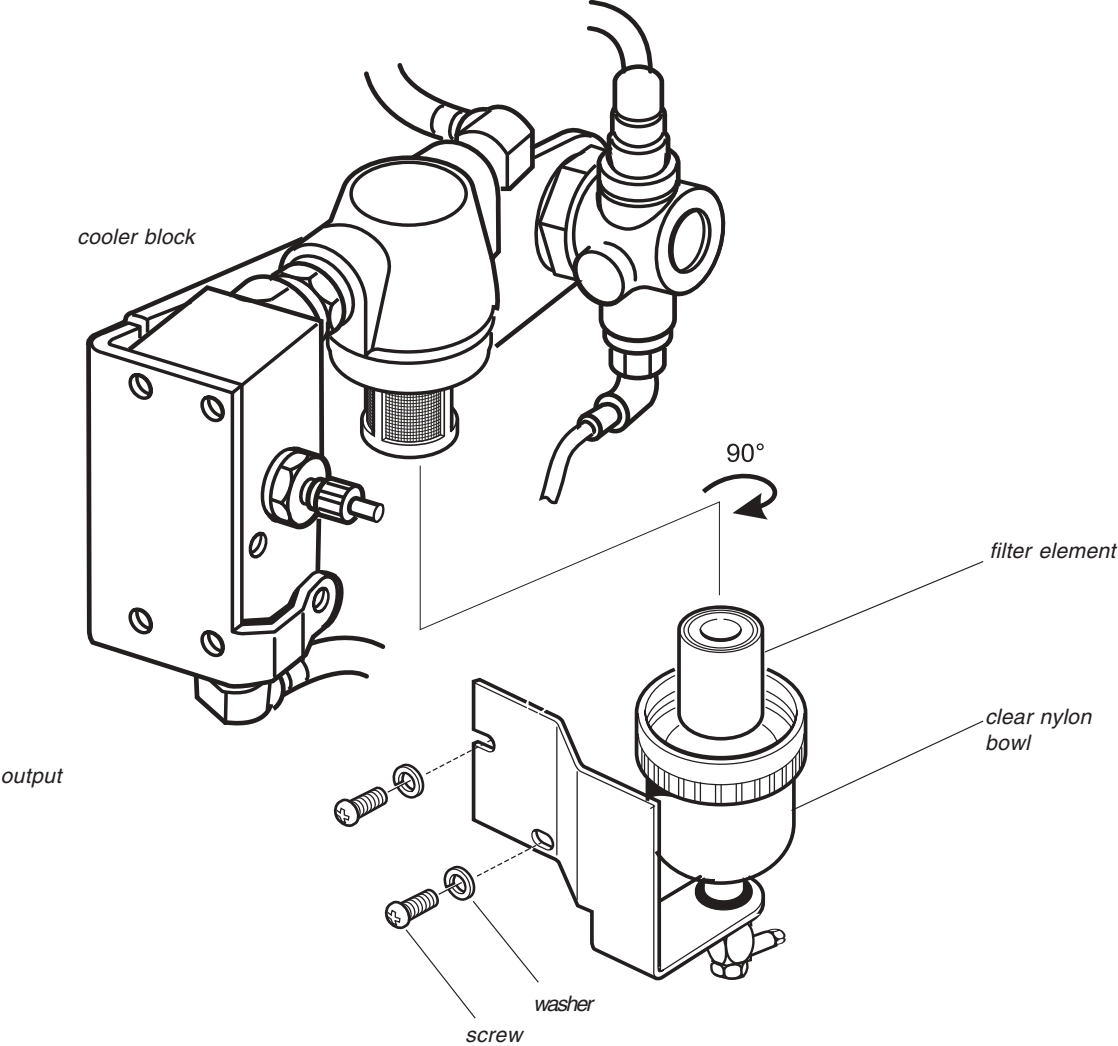


Fig. 2-3 Water/cooler trap assembly, build standard 3

Water/cooler trap assembly (Fig.2-4, BS 3)

Procedure

- (1) Unscrew and remove the two screws and washers securing the bracket to the cooler block.
- (2) Disconnect the drain pipe from the clear nylon bowl, unscrew and remove the clear nylon bowl and collect the filter.
- (3) Fit a new filter, screw the clear nylon bowl into the filter body. Connect the drain pipe to the clear nylon bowl.
- (4) Secure the bracket with the two screws and washers.
- (5) Carry out a standard serviceability test detailed in Chapter 5.

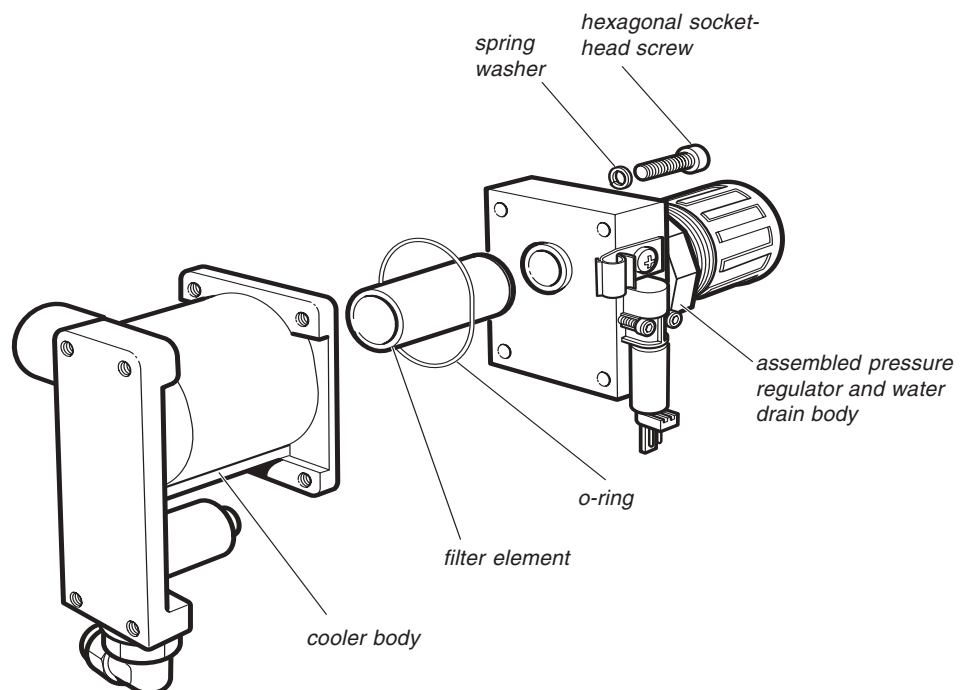


Fig. 2-4 Water/cooler trap assembly, build standard 4

Water/cooler trap assembly (BS 4)

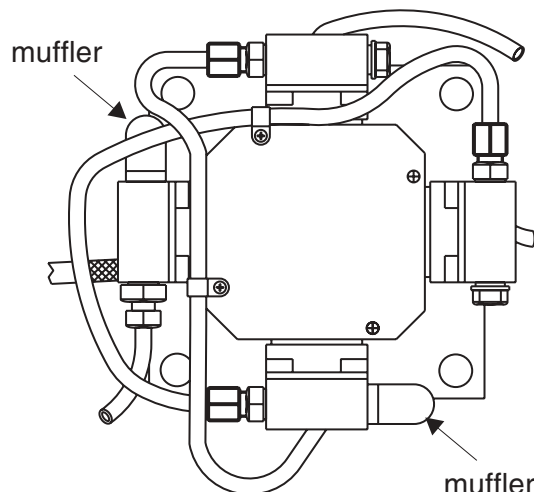
- (1) Unscrew and remove the four hexagonal, socket-head screws and four spring washers. Carefully separate the assembled pressure regulator and water drain body from the cooler body attached to the front panel.
- (2) Replace the filter element, make sure the o-ring fits correctly and refit the assembled pressure regulator and water drain body to the cooler body. Secure the assembled water drain with the four hexagonal, socket-head screws and four spring washers.

Pneumatic Filters

BS1

- (1) Two of the four pump heads are filtered by high density polythene porous plastic silencers (mufflers). The pressure pump head has two intake mufflers, used as filters, and the initial vacuum head has one discharge muffler used as a silencer.
- (2) Unscrew the existing mufflers and screw the new mufflers hand-tight.

Note: *Over-tightening could damage the muffler threads.*

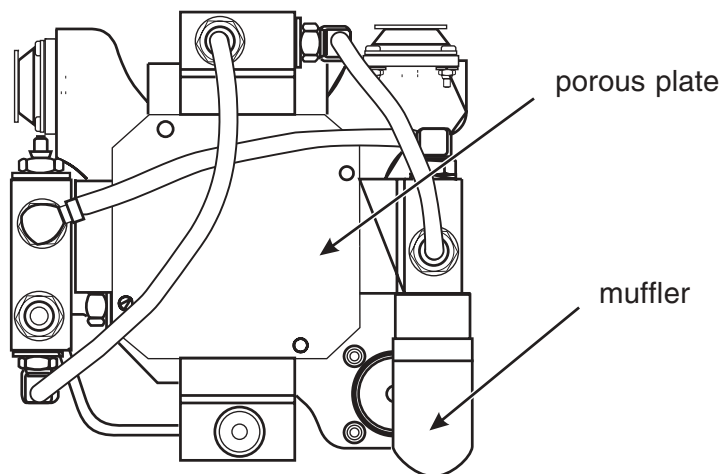


BS2, BS3 and BS4

- (1) An end-mounted porous plate fitted to the crankcase provides the pressure air intake filter, the pressure pump draws air from inside the crankcase. The initial vacuum head has one discharge muffler used as a silencer.
- (2) Unscrew the existing muffler and screw the new muffler hand-tight.

Note: *Over-tightening could damage the muffler threads.*

- (3) Unscrew the four screws and washers securing the porous plate to the crankcase. Fit a new porous plate and secure with the four screws and washers.



BS3 and BS4

- (1) Two in-line filters connect in the vacuum output pipes.
- (2) Disconnect the pipe from each end of the in-line filter by releasing the clip. Connect a new filter and secure with the clips for each filter.

Completion

- (1) Refit the cover and reconnect the external pipes and connectors.

2.2 3000 Hours

WARNING:DISCONNECT THE POWER SUPPLY BEFORE PROCEEDING WITH MAINTENANCE.

Every 3000 hours, replace the following components:

- Piston seals.
- Cylinder head o-ring seals.

Preparation

1. Absolute cleanliness of the work area, tools and equipment must be observed. Expendable items must be discarded.
2. Disconnect and remove all the electrical and pneumatic connections.

Cover

3. Unscrew and remove the ten screws and shakeproof washers securing the cover to the chassis. Slide cover off to the rear.

Cylinder head (Fig. 2-6)

4. The four pump piston heads are identical in construction but with the pressure piston seal facing outwards. The o-ring seal locate in grooves in the cylinder head, hexagonal socket-head bolts secure the cylinder head to the pump body. Interposed between the cylinder head and pump body are valve plates and a spacer. Grooves in the plates locate on the spacer allowing the correct air flow.

Procedure (Fig. 2-6)

5.

Note: *The procedure is the same for each of the four pump cylinder heads.*

- (1) Unscrew and remove the four hexagonal socket-head bolts (9) securing the cylinder head (7). Collect a plain washer (8) from each hexagonal socket-head bolt (9).

Note: *Some cylinder heads may have one or more shims fitted, these are matched items.*

- (2) Remove the cylinder head complete with valve plates (3 and 5) and spacer (4). Record the number and position of any shims for use in assembly.

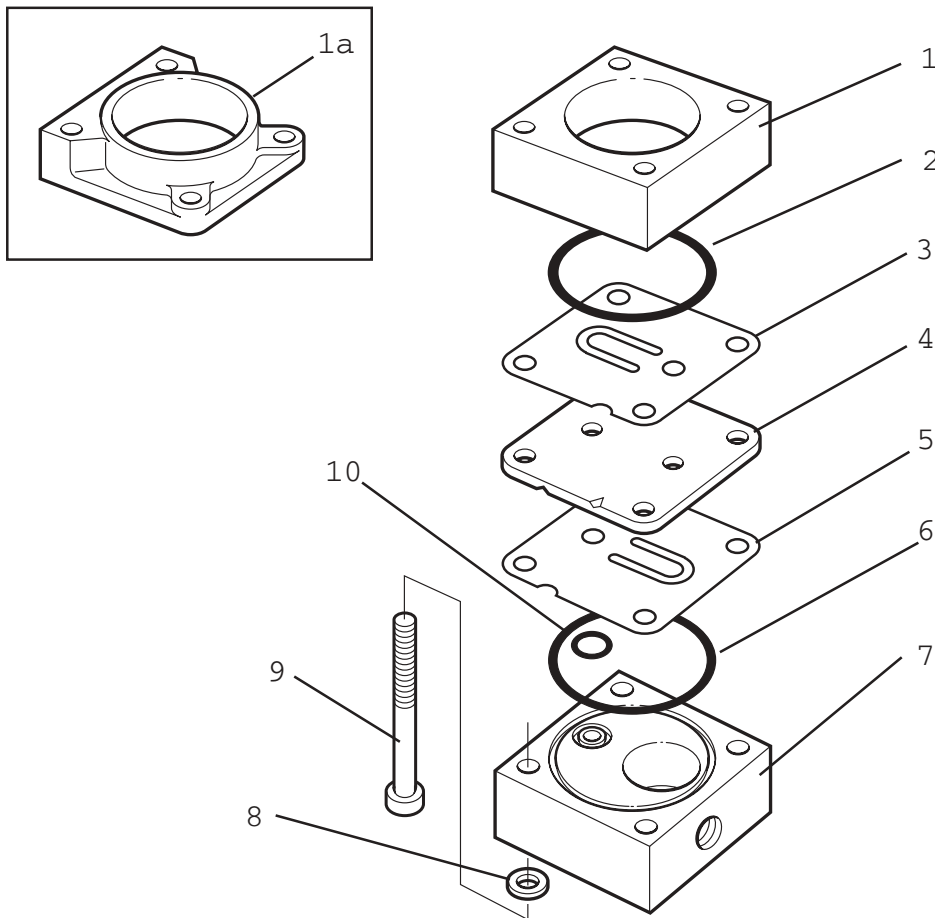
Note: *Inspect the cylinder block for distortion and cracks. Inspect the bore of the cylinder block scoring or damage. Replace any cylinder that fails inspection.*

- (3) Rotate by hand the pump to access the piston head. Unscrew and remove the central countersunk screw (Fig. 2-7, item 5), remove the piston seal (Fig. 2-7, item 3) and retainer (Fig. 2-7, item 4).

Note: *Piston seals must be preformed in accordance with instructions in the seal kit [see Fig. 2-10].*

- (4) Replace the preformed piston seal (Fig.2-7, item 3) on the retainer.

Note: *The piston seal faces outwards on the pressure piston head and inwards on the vacuum piston heads. On earlier units with cylinders of the style shown in (Fig. 2-6, item 1a) all seals point outwards [see Fig. 2-7 (a)].*



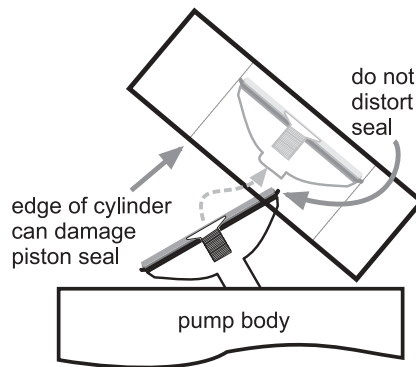
1	Cylinder	2	O-ring seal
1a	Cylinder (earlier pumps)	4	Spacer
3	Valve plate	6	O-ring seal
5	Valve plate	8	Plain washer
7	Cylinder head	10	O-ring seal
9	Hexagonal socket-head bolt		

Fig. 2-6 Cylinder head

- (5) Apply Loctite grade 222 to the threads of the central countersunk screw (Fig. 2-5, Item 5). Locate the assembled piston seal (Fig. 2-7, Item 3) and retainer (Fig. 2-7, Item 4) on the connecting rod (Fig. 2-7, Item 1) and secure with the central countersunk screw (Fig. 2-7, Item 5).

Note: *The head of the central countersunk screw must not protrude above the rim of the retainer.*

- (6) Fit a new o-ring seal (2) to the inner bore of the cylinder (1). The next step is to fit the cylinder over the piston head, the piston seal can be damaged if the fitting is not carried out with great care. The recommended method is as follows:
- i Move the piston head to top dead centre and then to one side, position the cylinder (1) at an angle to the piston head.



- ii Carefully move the cylinder over the piston head making sure the piston seal is not distorted. Carefully push the cylinder over the piston head until it is fully inserted making sure the piston seal is not distorted and is formed in the correct way (see above).
- iii Align the holes of the cylinder with the threaded holes of the pump body.

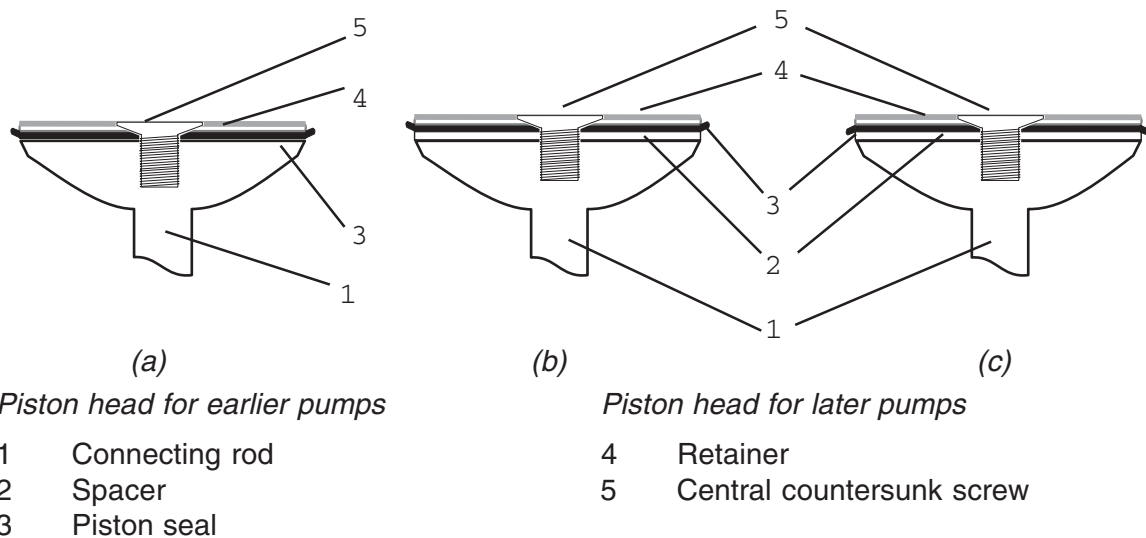


Fig. 2-7 Piston head

- (7) Before assembly, check the valve plates (3 and 5) and spacer (4) remove any dirt by polishing. Assemble a valve plate (3 and 5) on each side of the spacer (4), locating each plate on the keys on the spacer. Refit any shims in the recorded position. Fit a new o-ring seal (6) to the mating face of the cylinder head (7). Fit a new small o-ring seal (10) to the recess of the cylinder head (7).
- (8) Locate the cylinder head (7) complete with valve plates and spacer over the cylinder (1) and loosely retain with the four hexagonal socket-head bolts (9) and washers (8).
- (9) Carefully rotate by hand the pump and, if necessary, reposition the assembled cylinder head for the smoothest rotation. Tighten the four hexagonal socket-head bolts (9) in turn and diagonally.
- (10) Repeat the procedure steps (1) to (9) for all four cylinder heads.
- (11) Slowly rotate the pump by hand to make sure the pump rotates smoothly.
- (12) If necessary, readjust a cylinder head to produce a smooth rotation or reduce the noise, as detailed in step (9).

Completion

- 6. (1) Refit the cover and reconnect the external pipes and connectors.
- (2) Test the pump as detailed the Standard Serviceability Test in Chapter 5.

Chapter 3

Supplementary Servicing

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3.1 General

This section contains procedures to replace an obsolete component or to upgrade the unit to a higher build standard.

Use suitably qualified personnel and good engineering practice for all the procedures. Absolute cleanliness must be maintained in the work area.

3.2 Servicing supplement

The following is additional information that is intended to assist in the servicing procedures.

Build standard 1

Power supply unit and motor controller PCB

These two components were upgraded and the originals are now obsolete. It is possible to use an original PSU with an upgraded motor controller PCB, and vice versa; it requires a change of the electrical loom to achieve this type of replacement. The following instructions detail the necessary replacement procedures.

Motor controller PCB

To replace the original type with the upgraded PCB proceed as follows:

1. Disconnect the 8-way and 3-way connectors from the pump/motor assembly.
2. Disconnect and discard the cable loom with the 7-way Molex socket, at one end (PSU), and to the 2-way terminal block and the terminal block at the top of the motor controller PCB at the other.
3. Remove and discard the motor controller PCB.

Fitting the new motor controller PCB

1. If necessary, from the top fixing hole for the old motor controller PCB measure 60 mm vertically down the rear panel and mark for drilling. Using a 3.5 mm drill bit, drill a hole in the marked position.
2. Fit the new motor controller PCB and secure using the two M3 x 6 mm pozidrive, panhead screws and shakeproof washers.
3. Refer to the new component list on page 3-6 and to figure 3-1 to produce a new cable loom.
4. Connect the new cable loom to the Molex socket on the PSU.
5. Connect the 1/4 Faston, red wire, connector to the +24 V on the motor controller PCB. Connect the 1/4 Faston, black wire, connector to the 0 V on the motor controller PCB. Connect the two push-on terminals to the 2-way terminal block, observe the colour coding.
6. Carry out a standard serviceability test detailed in Chapter 5.

Power supply unit

To replace the original type with the upgraded PSU proceed as follows:

1. Disconnect the 5-way and 8-way connectors from the pump/motor assembly.
2. Disconnect the 3-way and 7-way Molex power supply sockets from the PSU.
3. Remove and discard the PSU.
4. Using a new 4-way Molex connector (Fig.3-2), remove the red wire (terminal 3) from the 7-way connector and insert it into terminal 3. Repeat this procedure for the black wire (terminal 4) inserting it into terminal 4 of the new 4-way Molex connector.
5. Connect the two red wires from the 7-way connector terminals 1 and 2 to the red flying cable from the new PSU. Connect the three black wires from the 7-way connector terminals 5, 6 and 7 to the black flying cable from the new PSU.
6. Temporarily position the new PSU in the pump unit case. Connect the 5-way connector to CON1 and the 4-way connector to CON 2 on the new PSU.

CAUTION: The M3 screws securing the PSU must not be longer than 6 mm. Longer screws damage the internal PCB and components.

7. Locate and secure the new PSU to the pump unit case with the correct screws and washers.
8. Connect the 8-way connector and the 3-way connector on the new PSU.

Fitting the new type PSU and motor controller PCB (continued)

9. Carry out a standard serviceability test detailed in Chapter 5.

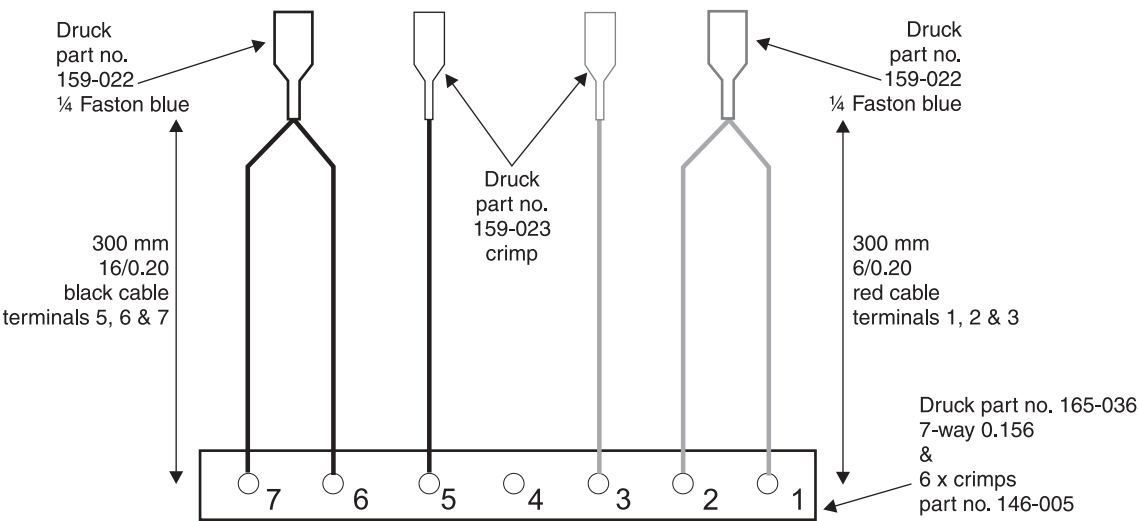


Fig. 3-1 Motor controller cable loom

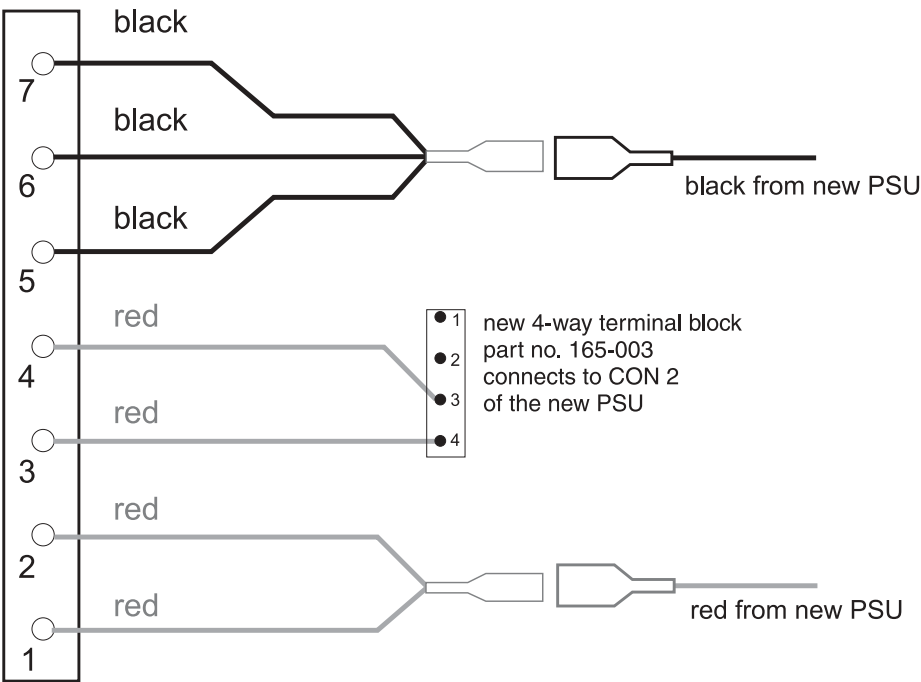


Fig. 3-2 New PSU and motor controller cable loom

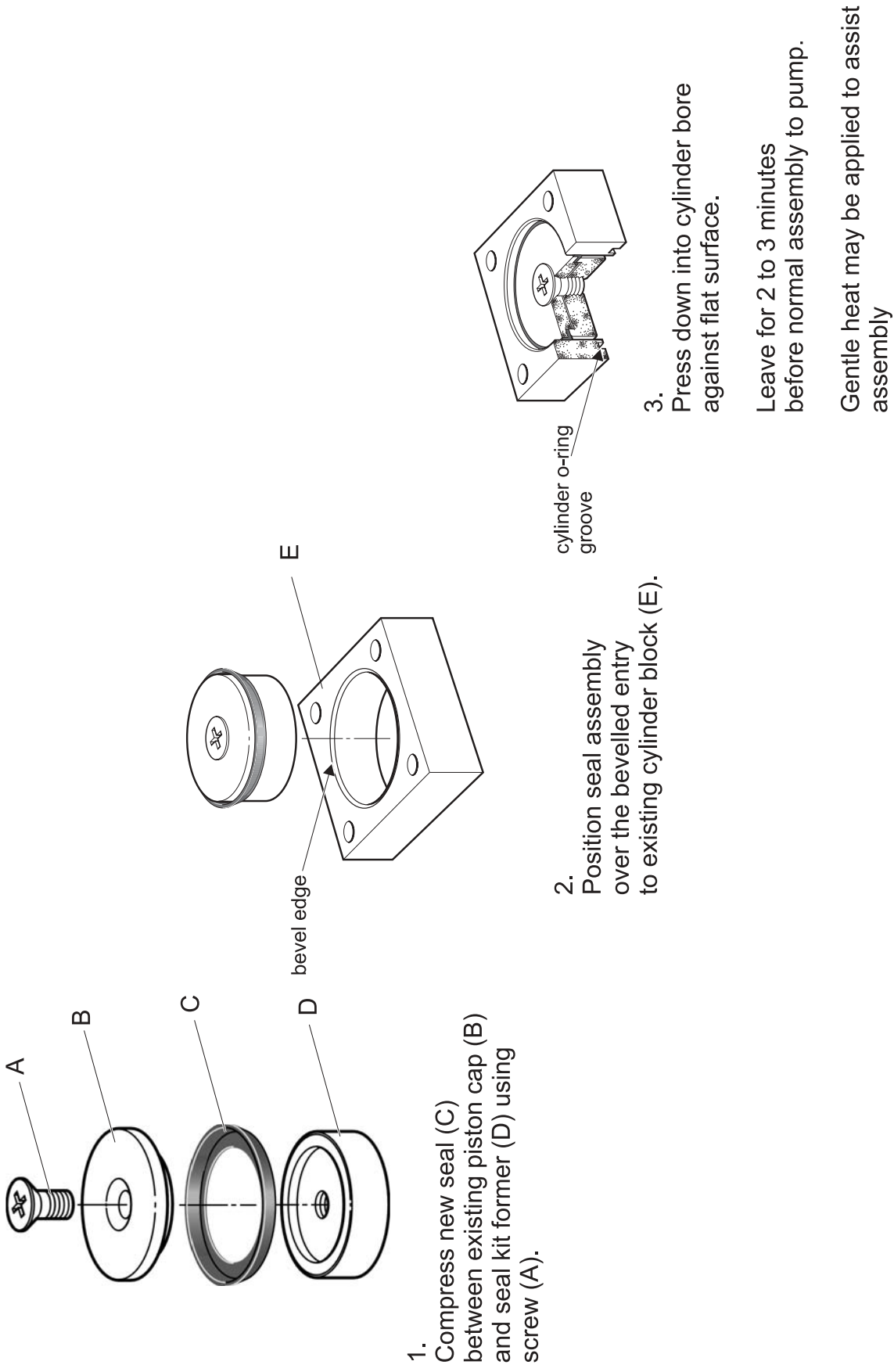


Fig. 3-3 Piston seal replacement techniques

3.3 Build standard conversions

This section provides instructions to convert the water drain trap assembly of old build standards to the water/cooler assembly of the latest build standard.

BS 1 to BS 4 (Fig 2-2 and 2-4)

New component list

Item/ Ref.	Description	Manufacturer's Part Number	QTY
3-10a†	.Cooling assembly, water trap [post MOD 04]		ref
- †	..Body, cooler	AS405-17-1728M1	1
- †	..Valve, pressure release	AS405-18-1728M1	1
- †	.Screw, M4x 30	-	4
- †	.Pipe assembly	-	1
- †	.Cable looms, assembly [set of 5 looms]	AS405-24-1728M1 see fig.3-5 to manufacture cable	1

Redundant component list

Item/ Ref.	Description	Manufacturer's Part Number	QTY
1-10	.Housing,mist filter [OBSOLETE pre MOD 04]	401-022	NP
-	Coil, cooling [OBSOLETE pre MOD 04]	-	NP
-	.Pipe assembly [OBSOLETE pre MOD 04]	-	NP

Procedure

1. Unscrew and disconnect the output union and the input union of the water drain trap.
2. Cut the tyrap securing the water drain filter.
3. Release the water drain trap from the spring clip, remove the drain pipe from the clear nylon bowl. Discard the water drain trap. Unscrew and remove the two screws securing the spring clip, discard the screws and spring clip.
4. Unscrew and remove the clips retaining the cooling coil. Discard the cooling coil and clips.
5. Disconnect the pressure output pipe from the pump head. Remove and discard the pipes and cooling coil.
6. Front panel
Note: Take appropriate precautions to prevent swarf contamination of the unit from the following procedure. [Service tip - turn unit upside down when drilling.]
 Mark out the front panel using the dimensions detailed in figure 3-4. Drill four M3 holes in the front panel.
7. Locate the new water cooler assembly and secure to the front panel with the four screws and washers.
8. Connect the wires for the pressure bleed valve solenoid on the water/cooler assembly as detailed in Figure 3-5.
9. Connect the new pressure output pipe to the output port of the pump head. Connect the other end to the input connection of the water/cooler assembly.

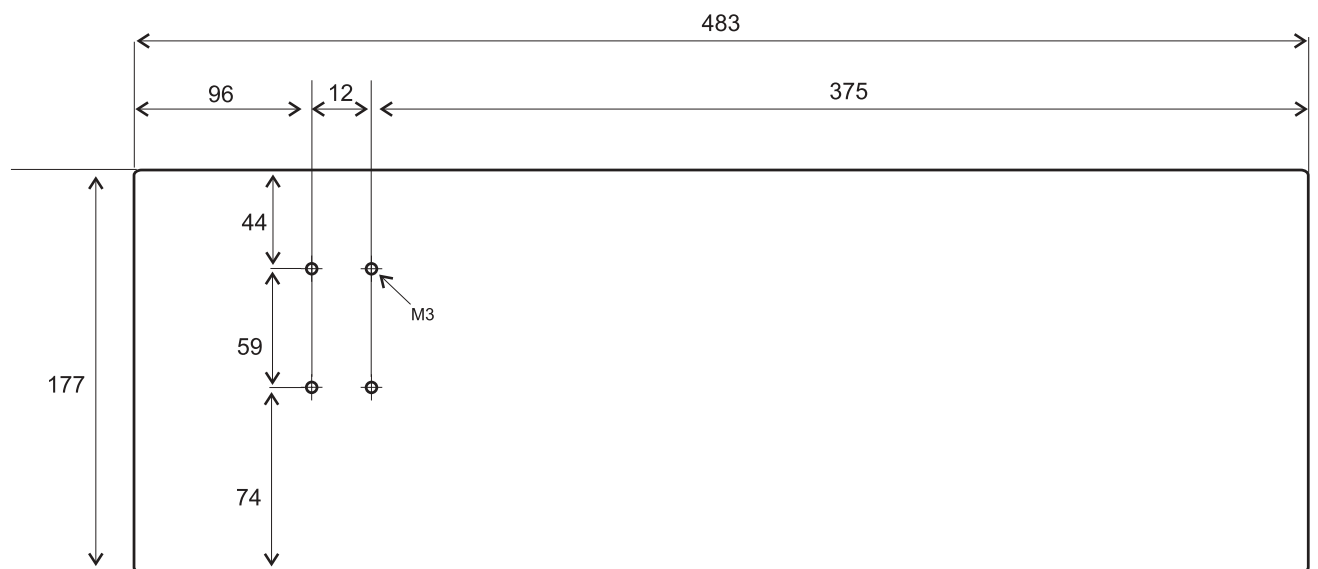
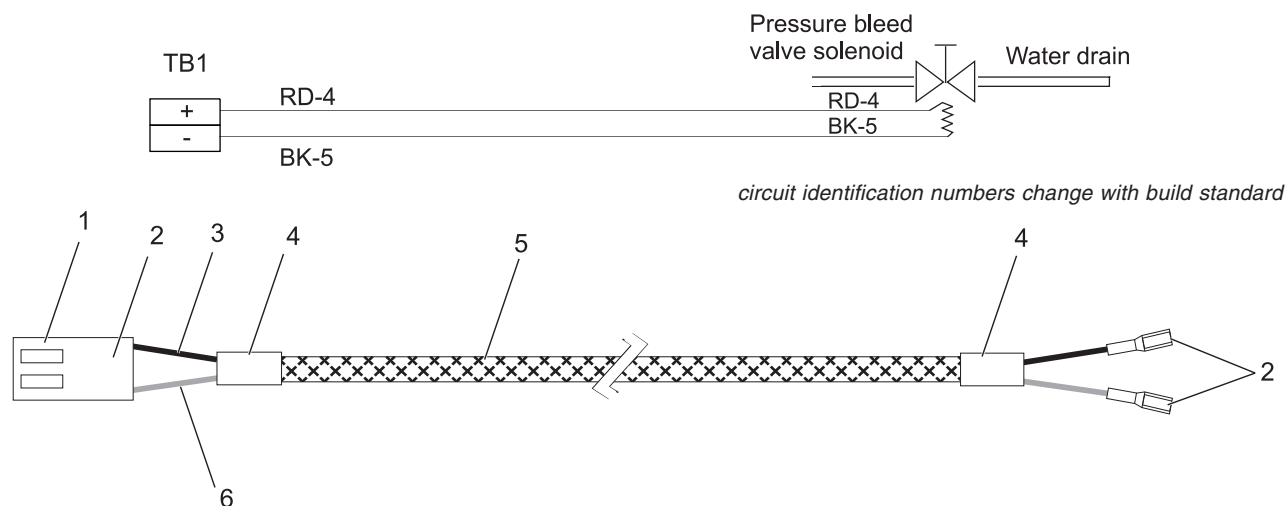


Figure 3-4 Front panel drilling dimensions



Item	Description	part no.	qty	Item	Description	part no.	qty
1	Housing, Molex	165-019	1	4	Sleeve	208-167	1
2	Crimp	164-004	4	5	Braid	208-339	a/r
3	Cable, black	192-073	a/r	6	Cable, red	192-078	a/r

Item	Manufacturer	part no.	Item	Manufacturer	part no.
1	Molex	22-01-2025	4	Raychem	CGAT-6/2-1.2m
2	Molex	08-55-0111	5	Hellerman	Helagain 3 mm grey
	or	08-56-0115	6	Druck	192-078
3	Druck	192-073			

Figure 3-5 Water/cooler assembly new wires

- Connect the new pipe to the output union of the water drain trap and the output connection of the rear panel. Connect the water drain pipe, make sure the other end locates in the grommet for correct venting of the water/cooler assembly.
- Carry out an inspection of the unit look for loose connections and/or disturbance of the internal components.
- Carry out a Standard Serviceability Test detailed in Chapter 5.

BS 2 to BS 4 (Fig 2-2 and 2-4)

New component list

Item/ Ref.	Description	Manufacturer's Part Number	QTY
3-10a†	.Cooling assembly, water trap [post MOD 04]		ref
- †	..Body, cooler	AS405-17-1728M1	1
- †	..Valve, pressure release	AS405-18-1728M1	1
- †	.Screw, M4x 30	-	4
- †	.Pipe assembly	-	1
- †	.Cable looms, assembly [set of 5 looms]	AS405-24-1728M1 see fig.3-5 to manufacture cable	1

Redundant component list

Item/ Ref.	Description	Manufacturer's Part Number	QTY
2-10	.Filter, water drain [OBSOLETE pre MOD 04]	ADTS405-1728-17-M0	NP
- †	.Pipe assembly [OBSOLETE pre MOD 04]	-	NP

Procedure

1. Unscrew and disconnect the right-angled output union from the pressure output of the pump/motor assembly and collect the bonded seal.
2. Cut the tyrap securing the water drain filter.
3. Release the water drain trap from the spring clip, remove the drain pipe from the clear nylon bowl. Discard the water drain trap. Unscrew and remove the two screws securing the spring clip, discard the screws and spring clip.
4. Unscrew and remove the clips retaining the cooling coil. Discard the cooling coil and clips.
5. Front panel
Note: Take appropriate precautions to prevent swarf contamination of the unit from the following procedure. [Service tip - turn unit upside down when drilling.]
Mark out the front panel using the dimensions detailed in figure 3-4. Drill four M3 holes in the front panel.
6. Locate the new water cooler assembly and secure to the front panel with the four screws and washers.
7. Connect the wires for the pressure bleed valve solenoid on the water/cooler assembly as detailed in Figure 3-5.
8. Connect the new pressure output pipe to the output port of the pump head. Connect the other end to the input connection of the water/cooler assembly.
9. Connect the new pipe to the output union of the water drain trap and the output connection of the rear panel. Connect the water drain pipe, make sure the other end locates in the grommet for correct venting of the water/cooler assembly.
10. Carry out an inspection of the unit look for loose connections and/or disturbance of the internal components.
11. Carry out a Standard Serviceability Test detailed in Chapter 5.

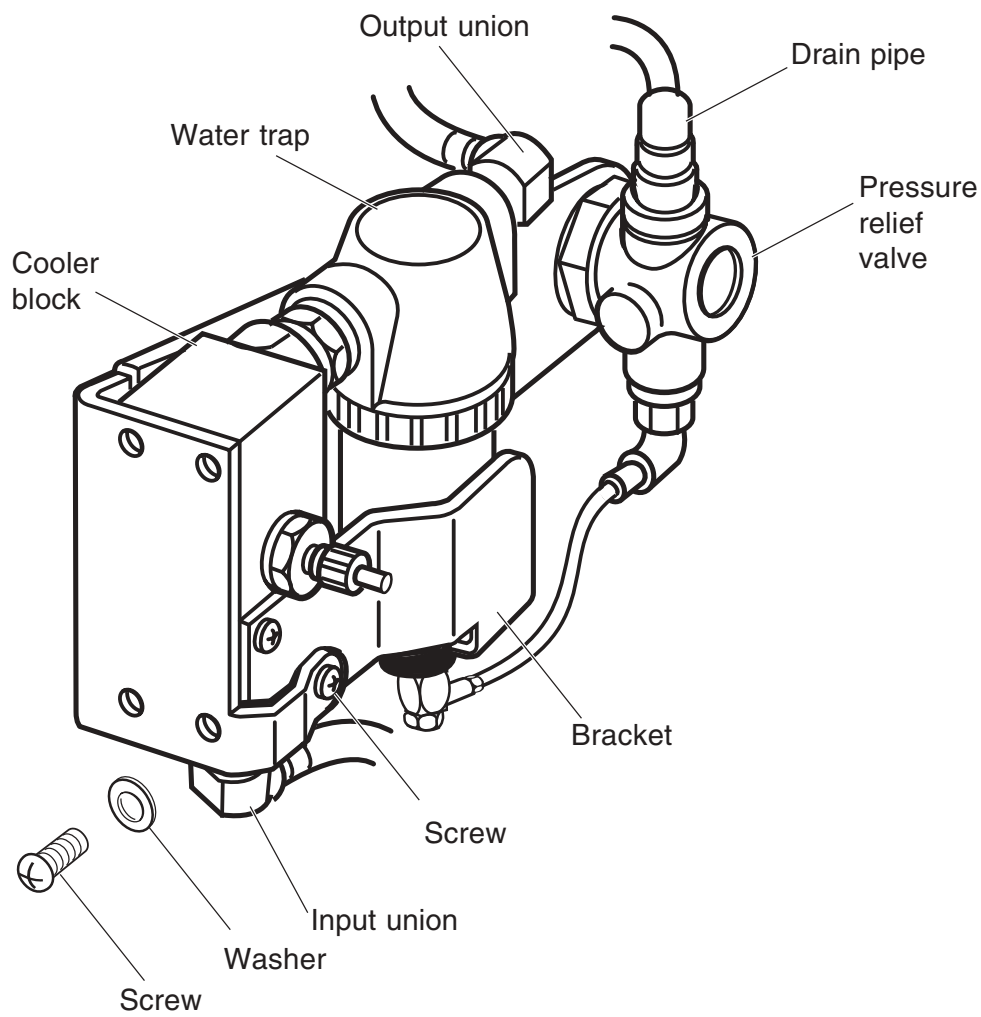


Figure 3-6 BS 3 Water/cooler trap assembly

BS 3 to BS 4 (Fig 3-5)

New component list

Item/ Ref.	Description	Manufacturer's Part Number	QTY
3-10a†	.Cooling assembly, water trap post MOD 04	AS405-17-1728M1	1
- †	.Cable looms, assembly [set of 5 looms]	AS405-24-1728M1 see fig.3-5 to manufacture cable	1

Redundant component list

Item/ Ref.	Description	Manufacturer's Part Number	QTY
3-10	.Valve, pressure relief [OBSOLETE pre MOD 04]	ADTS405-1728-18-M0	NP
-11	.Filter, water drain [OBSOLETE pre MOD 04]	ADTS405-1728-17-M0	NP
-12	.Solenoid, pressure bleed valve [OBSOLETE pre MOD 04]	401-207	NP

BS 3 to BS 4 (Fig 3-5) [continued]

Procedure

1. Unscrew and disconnect the right-angled output union from the pressure output of the pump/motor assembly and collect the bonded seal.
2. Unscrew and disconnect the right-angled input union from the bottom of the water cooler block and collect the bonded seal.
3. Unscrew and disconnect the right-angled output union and collect the bonded seal.
4. Withdraw the drain pipe from the rear panel grommet.
5. Unscrew and remove the four screws and washers securing the assembly to the chassis of the unit. Remove the assembly and discard.
6. Disconnect the two cables to the pressure bleed valve. Unscrew and remove the two screws and washers securing the dump valve to the chassis of the pump unit.
7. Remove and discard the dump valve.
8. Disconnect, remove and discard the existing pressure bleed valve cable loom.
9. Locate the new water cooler assembly and secure to the front panel with the four screws and washers.
10. Connect the wires for the pressure bleed valve solenoid on the water/cooler assembly as detailed in Figure 3-6.
11. Connect the new pressure output pipe to the output port of the pump head. Connect the other end to the input connection of the water/cooler assembly.
12. Connect the new pipe to the output union of the water drain trap and the output connection of the rear panel. Connect the water drain pipe, make sure the other end locates in the grommet for correct venting of the water/cooler assembly.
13. Carry out an inspection of the unit look for loose connections and/or disturbance of the internal components.
14. Carry out a Standard Serviceability Test detailed in Chapter 5.

Chapter 4

Replacing Parts

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4 REPLACING PARTS

4.1 DISMANTLING

General

1. Disconnect the power supply from the pump unit before dismantling. Unscrew and remove the screws securing the top panel to gain access to the components.
2. Chapter 6 contains part numbers and details of all the replacement parts described in this chapter.

4.2 Power Supply Unit

1. Release the pump/motor assembly cable from the clamp on top of the PSU. Disconnect the two connectors on top of the PSU.
2. Unscrew and remove the four screws securing the PSU to the rear panel.
3. Carefully remove the PSU from the pump rack and disconnect the cable connectors on the PSU.

4.3 Motor Controller PCB

BS1

1. Note the connections to the PCB and then disconnect the cables.
2. Unscrew and remove the two screws securing the PCB bracket to the rear panel.

BS2, BS3 and 4

1. To access the PCB, remove the PSU as detailed in paragraph 4.2 above.
2. Unscrew and remove the screws securing the cover of the PSU and remove the PCB.

4.4 Pump and Motor Assembly

1. Disconnect the two vacuum and one pressure output pipes with the swivel right-angle fittings on the cylinder heads of the pump.
Note: *On earlier pump/motor assemblies, output pipes are pipe-compressing nut unions.*
2. Release the cable loom from the cable clamp and disconnect the two electrical connectors from the PSU.

BS1

3. Unscrew the four nuts securing pump and motor assembly to the mounting pillars, then remove the nuts and washers.
4. Carefully remove the pump and motor assembly from the chassis.

BS2, BS3 and 4

5. Unscrew the four nuts bolts and washers securing the pump and motor assembly and bracket to the chassis.
6. Carefully remove the pump and motor assembly from the bracket.
7. Unscrew the three nuts, bolts and washers securing the pump and motor assembly in the bracket and separate the pump and motor assembly and bracket.

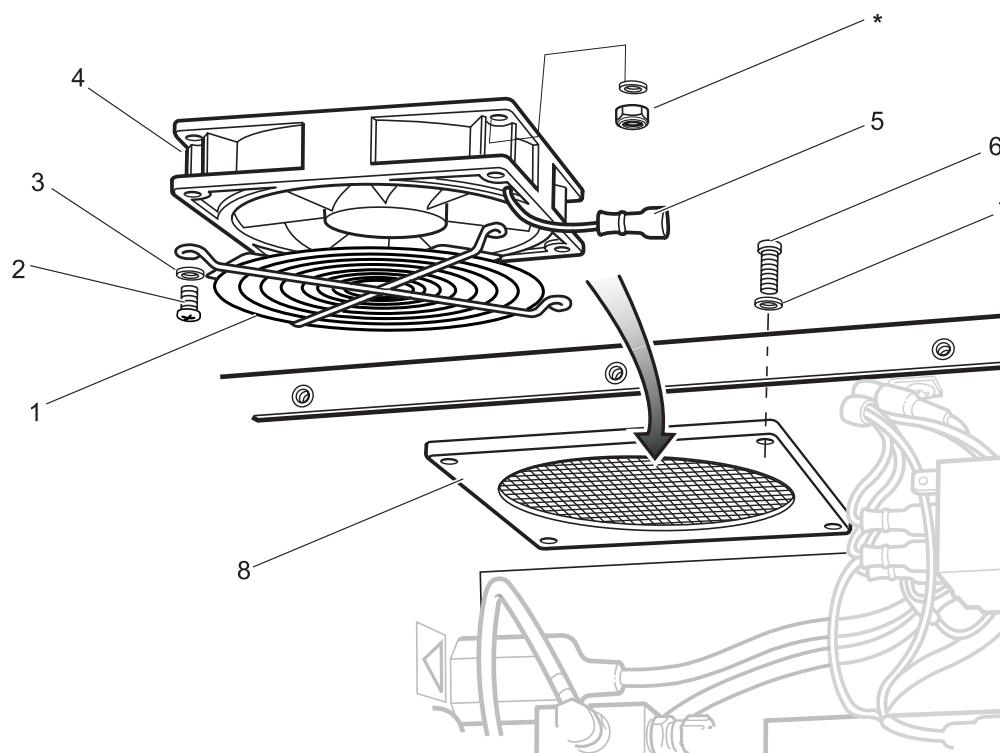


Figure 4-1 Fan assembly BS1, BS2, BS3 and 4

4.5 Fan filter

1. Using a screwdriver carefully lever frame of the filter and remove the frame and filter from the front panel.

4.6 Fan assembly

1. Remove the fan filter from the front panel of the unit as detailed in paragraph 4.5 above.
2. Disconnect the two power supply cable connectors (5) from the terminal block.
3. Unscrew and remove the four screws and washers securing the fan to the rear panel. Unscrew and remove the four screws and washers securing the fan grill to the inner flange of the fan.

4.7 Elapsed time indicator

BS1 and 2

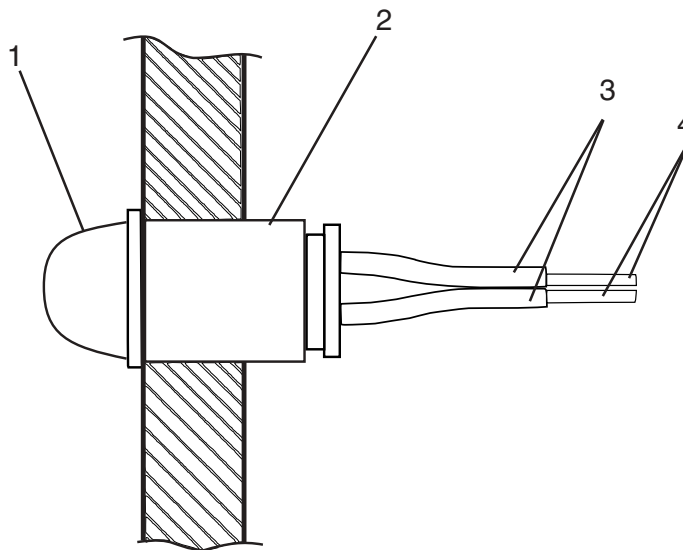
1. Disconnect the two wires, push out the ETI.

BS3 and 4

2. Disconnect the two connections at the rear of the ETI. Unscrew the two securing screws, nuts and four washers and remove the ETI.

4.8 Switch

1. Take note of the wires and terminations connected to the switch. Disconnect the wires to the switch. Unscrew and remove the retaining nut securing the switch to the front panel, remove the switch and collect the washer.



- | | | | | | | | |
|---|-----|---|----------------|---|-------------------|---|--------|
| 1 | LED | 2 | Locking collar | 3 | Insulating sleeve | 4 | Cables |
|---|-----|---|----------------|---|-------------------|---|--------|

Figure 4-2 LED assembly

4.9 LED assembly

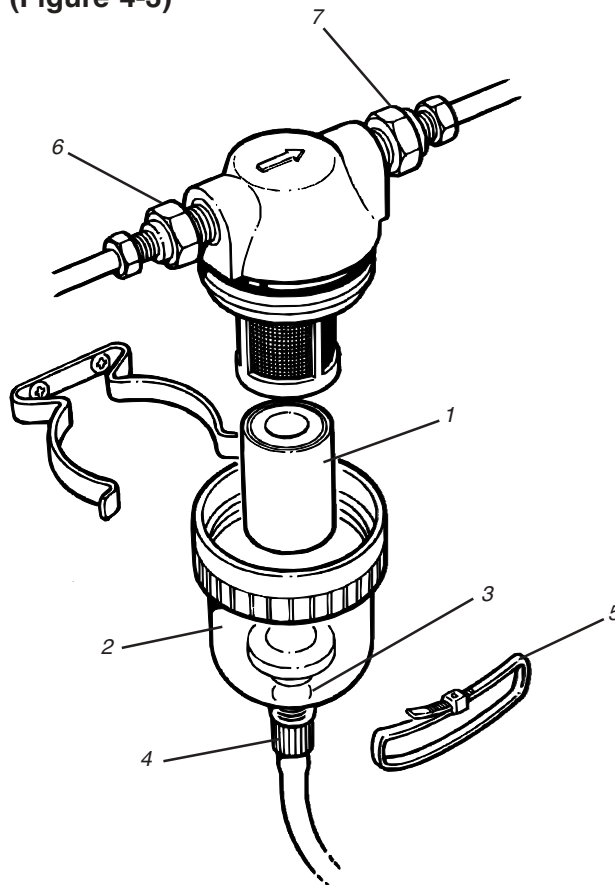
1. Remove the insulating sleeve (3) from the rear of the assembly (1).
2. Note and record the colours of the cable to the positive and negative cables (4) of the LED assembly. Unsolder the two cables (4).
3. Push out the locking collar (2) and then the push the LED assembly out of the front panel.

4.10 Pressure relief valve (BS 3)

1. Disconnect the two pipes to the pressure relief valve. Unscrew the retaining nut and washer and remove the pressure relief valve.

4.14 Water drain filter (Figure 4-3)

BS 1 and 2

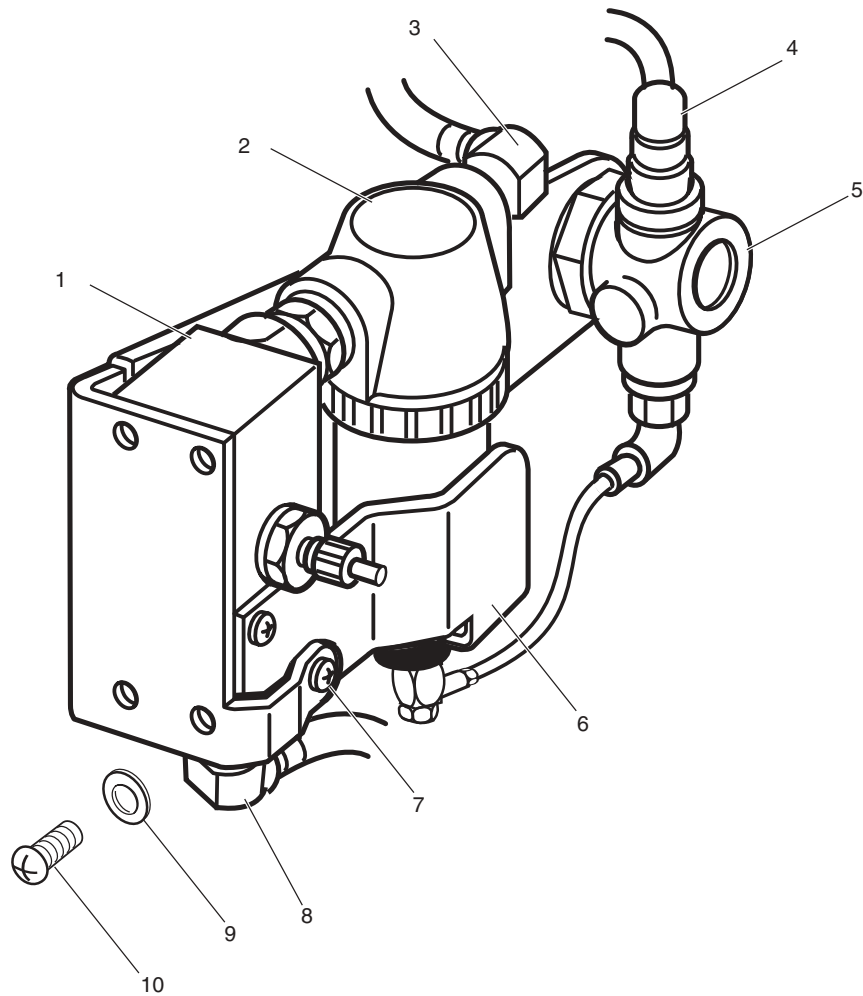


- | | | | |
|---|----------------|---|------------------|
| 1 | Filter element | 2 | Clear nylon bowl |
| 3 | Water ejector | 4 | Drain pipe |
| 5 | Tyrap | 6 | Input union |
| 7 | Output union | | |

Figure 4-3 Water drain filter

1. Unscrew and disconnect the output union (7) and the input union (6).
2. Cut the tyrap (5) securing the water drain filter.
3. Remove the unit from the spring clip.

4.15 Water/cooler trap assembly



1	Cooler block	2	Water trap
3	Output union	4	Drain pipe
5	Pressure relief valve	6	Bracket
7	Screw	8	Input union
9	Washer	10	Screw

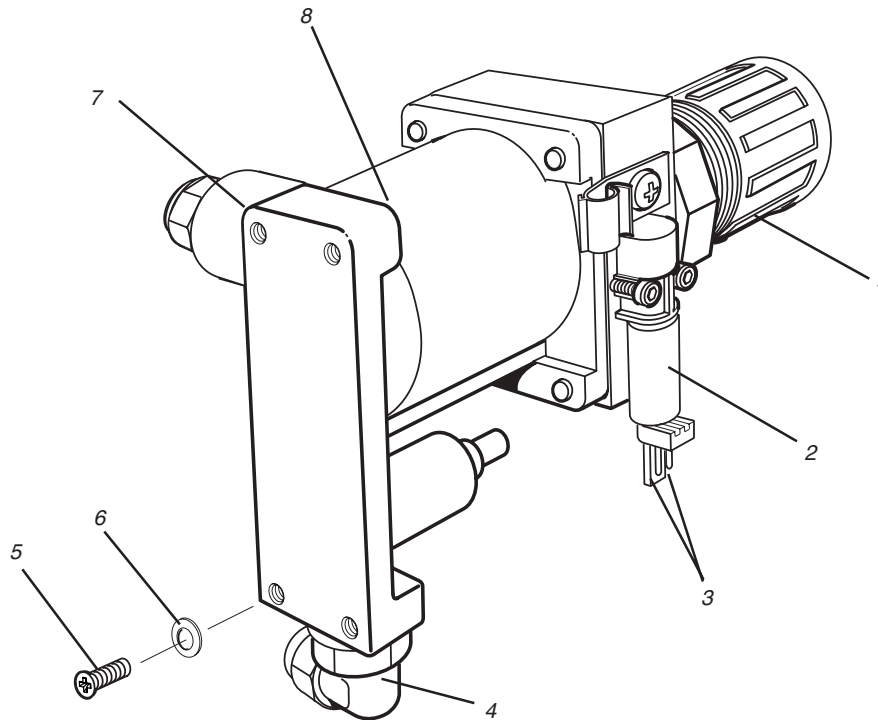
Figure 4-4 Water/cooler trap assembly, build standard 3

- (1) Unscrew and remove the four screws (10) and washers (9) securing the assembly to the front panel.
- (2) Disconnect the output union (3), input union (8) and drain pipe (4).
- (3) Remove the assembly from unit.

4.13 Cooler/water trap assembly (Figure 4-5)

BS 4

1. Unscrew and disconnect the right-angled, input pipe (4) and collect the bonded seal.
2. Unscrew and remove the four screws and washers (5) securing the assembly to the front panel of the unit.
3. Disconnect the release valve connections (3).
4. Disconnect the water drain and the output pipe (7).
5. Remove the assembly from the unit.



- | | | | |
|---|---------------------------|---|------------------------|
| 1 | Pressure regulator | 2 | Pressure release valve |
| 3 | Release valve connections | 4 | Input pipe |
| 5 | Screw | 6 | Washer |
| 7 | Output pipe | 8 | Cooler block |

Figure 4-5 Water/cooler trap assembly

4.14 Dump valve solenoid

BS 3

1. Disconnect the two cables to the dump valve. Unscrew and remove the two screws and washers securing the valve to the chassis of the pump unit.
2. Unscrew and disconnect the unions of the input and output pipes.

4.15 Cylinder block

1. Remove the pump/motor assembly as described in para. 4.4.
2. Dismantle the pump/motor assembly as described in Chapter 2 para. 2.2.

Note: *The procedure is the same for each of the four pump cylinder heads.*

3. Unscrew and remove the four hexagonal socket-head bolts (9) securing the cylinder head (7). Collect a plain washer (8) from each hexagonal socket-head bolt (9).

Note: *Some cylinder heads may have one or more shims fitted these are matched items.*

4. Remove the cylinder head complete with valve plates (3 and 5) and spacer (4). Record the number and position of any shims for use in assembly.

4.16 Anti-vibration mounting

1. Remove pump/motor assembly as detailed in paragraph 4.5.

BS 1

2. Remove the two halves of the anti-vibration mounting from the mounting flange of the pump/motor assembly.

BS 2, 3 and 4

3. Unscrew and remove four nuts, bolts and washers securing the anti-vibration mounting in the bracket.
4. Repeat the procedure for all the anti-vibration mountings.

3.17 Power supply filter connector

BS 1 and 2

1. Disconnect the output cables of the power supply filter connector at the fuse, terminal block and earth (ground) connection.
2. Unscrew and remove the four screws and washers securing the power supply filter connector from the rear panel.

BS 3 and 4

3. Disconnect the output cables of the power supply filter connector at the fuses and earth (ground) connection.
4. Unscrew and remove the four screws and washers securing the power supply filter connector from the rear panel.

4.18 ASSEMBLING

4.19 Power supply filter connector

BS1 and 2

1. Locate the power supply filter connector on the rear panel and secure with the four screws and washers.
2. Connect the output cables of the power supply filter connector to the fuse, terminal block and earth (ground) connection.

BS 3 and 4

3. Locate the power supply filter connector on the rear panel and secure with the four screws and washers.
4. Connect the output cables of the power supply filter connector to the two fuses (live and neutral) and earth (ground) connection.

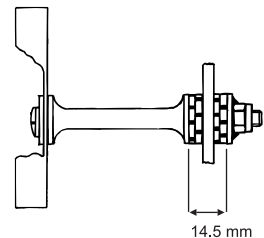
4.20 Anti-vibration mounting

BS 1

1. Fit the two halves of the anti-vibration mounting in the pump/motor flange mounting. Repeat the procedure for all the anti-vibration mountings.

BS 2, 3 and 4

2. Fit the new anti-vibration mounting in the bracket and secure with four nuts, bolts and washers. Tighten to the correct dimension.
3. Repeat the procedure for all the anti-vibration mountings.
4. Refit the pump/motor assembly as detailed in paragraph 4.13.



4.21 Cylinder block

1. Carry out the procedures detailed in Chapter 2, 3000 hour servicing fitting new cylinder block and replacing the piston seals.

4.22 Dump valve solenoid (BS 3)

1. Connect the input and output pipes to the valve and tighten the unions. Locate the valve on the pump unit chassis and secure with the two screws and washers.
2. Connect the two cables to the dump valve.

4.23 Water/cooler trap assembly (BS4) Fig. 4-5

1. Reconnect the water drain and output pipe (7). Reconnect the release valve connections (3).
2. Refit the assembly and secure with the four screws (5) and washers(6). Fit a new bonded seal and reconnect the right-angled, input pipe (4).

4.24 Water/cooler trap assembly (BS 3) Fig. 4-4

1. Reconnect the drain pipe (4), output union (3) and input union (8).
2. Refit the assembly and secure with the four screws (10) and washers (9).

4.25 Water drain filter (BS1 and 2) Fig. 4-3

1. Locate the water drain filter in the spring clip and secure with the tyrap (5). Connect the input and output unions (6 and 7) to the water drain filter.
2. Connect the drain pipe (4) to the clear nylon bowl (2).

Note: On build standard 1 and 2 a constant flow of air comes from the water drain pipe this requires checking after assembly.

4.26 Pressure relief valve (BS3) Fig. 4-4

1. Locate the pressure relief valve in the bracket and secure with the retaining nut and washer. Connect the two pipes to the pressure relief valve.

4.27 LED assembly

1. Locate the LED (1) in the front panel. Locate the insulating sleeve (3) over each wire.
2. Using the colour code recorded on removal, solder the two wires (3) to the positive and negative connection wires of the LED assembly.

Note: *The long wire of the LED assembly connects to the positive supply.*

3. Push the insulating sleeve (3) over the solder connections.

4.28 Switch

1. Locate the switch in the front panel and secure with the washer and retaining nut. Connect the the two wires to the correct (previously noted) terminals.

4.29 Elapsed time indicator

BS 3 and 4

1. Fit the elapsed time indicator in the front panel and secure with the two screws.
2. Connect the plug to the elapsed time indicator.

BS 1 and 2

3. Push the elapsed time indicator firmly into the front panel and connect the two wires.

4.30 Fan assembly Fig. 4-1

1. Locate the fan assembly in the rear panel and secure with the four screws and spring washers. Connect the two power supply cables to the terminal block.

4.31 Fan filter Fig. 4-1

1. Locate a new filter in the frame. Place the assembled fan filter on the front panel and press firmly to secure.

4.32 Pump and Motor Assembly

BS 1

1. Make sure that the anti-vibration mountings are correctly fitted. Locate the pump/motor assembly on the four pillars and secure with the four nuts, bolts and washers.
2. Connect the output pressure pipe and the two vacuum output pipes to the corresponding cylinder heads.
3. Connect the two electrical connectors to the PSU and secure the cable with the cable clamp.

BS 2, 3 and 4

4. Locate the pump/motor assembly in the bracket and secure with the three nuts, bolts and washers.
5. Fit the assembled bracket and pump/motor assembly in the chassis and align the holes with the mounting pillar. Secure with the four nuts, bolts and washers.

BS 1, 2, 3 and 4

6. Connect the earth cable using the nut, bolt and washer.
7. Connect the two plugs from the power supply and controller unit and secure the cable in the cable clamp.

8. Connect the vacuum pipe to the vacuum output connector.
9. Connect the vacuum pipe, at the top of the pump, to the other vacuum output connector.
10. Fit a new bonded seal to the pressure output pipe and connect to the water drain filter.

4.15 Motor Controller PCB

BS 2, 3 and 4

1. Locate the PCB in the PSU and secure the cover of the PSU with screws and washers.
2. Assemble the PSU as detailed in paragraph 4.16 below.

BS 1

3. Carry out the procedure detailed in the servicing supplement in Chapter 2 to fit a replacement motor controller PCB.

4.16 Power Supply Unit

BS 1

1. Carry out the procedure detailed in the servicing supplement in Chapter 2 to fit a replacement PSU.

BS 2, 3 and 4

2. Connect the cable to the PSU and align the fixing holes of the PSU with the corresponding holes in the rear panel.
3. Secure the PSU with the four screws and washers.
4. Connect the two electrical connectors to the PSU and secure the cable with the cable clamp.

4.17 Completion

1. After completion carry out a standard serviceability test detailed Chapter 5.

Chapter 5

Testing

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5 TESTING

5.1 Standard Serviceability Test

Test equipment description

- * Pressure gauge to measure pump output: pressure to 4.0 bar gauge
 vacuum to 20 mbar absolute
- * 7/16" UNC 37° flare (AN4) adaptor
- * 9/16" UNC 37° flare (AN6) adaptor

- (1) Apply power and check that the motor can be heard. Check that the cooling fans operate.

Note: *On BS 3 and 4 units a default setting can be made so that the cooling fans operate on connection of the power supply. When using the 15-way expansion port connector applying 24 V to pin 8 (+ve) and pin 15 (-ve) also causes the cooling fans to operate.*

- (2) Check that there is no excessive or abnormal mechanical noise.
- (3) Switch off and connect a pressure gauge and, if necessary, an adaptor to the pressure or vacuum outlet.
- (4) Switch on and measure the pressure and vacuum outlet:

BS1 and 2

- Pressure outlet between 2.5 and 2.9 bar gauge (36.3 to 42 psi gauge).

BS3 and 4

- Pressure outlet between 3.4 and 3.8 bar gauge (49.3 to 55.1 psi gauge).
- Vacuum outlet pressure less than 20 mbar abs.

Note: *When new piston seals have been fitted, the pump may have to run for a few hours before achieving this performance.*

- (5) Switch off and disconnect the pressure gauge and the adaptor.

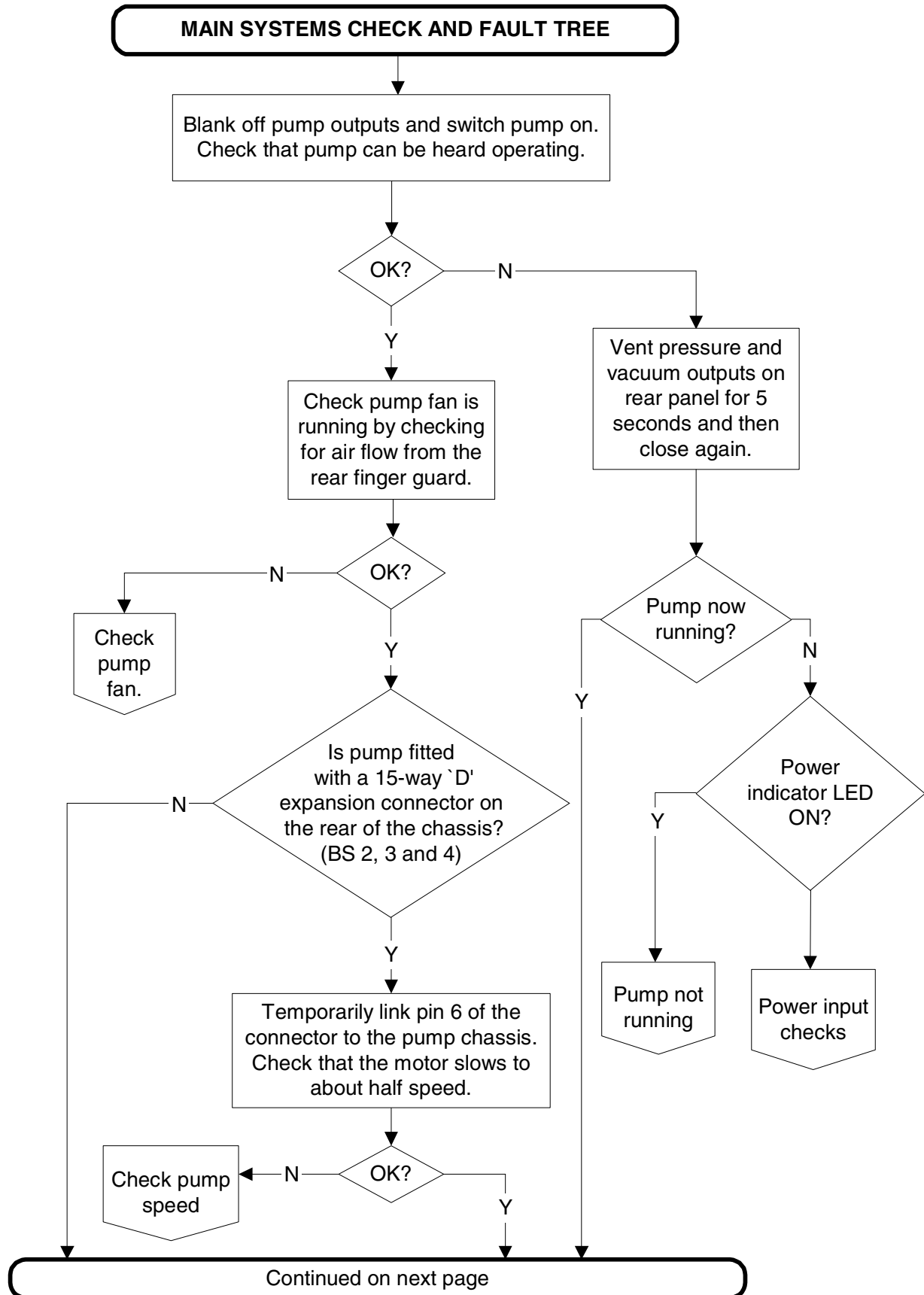
5.2 Fault Finding

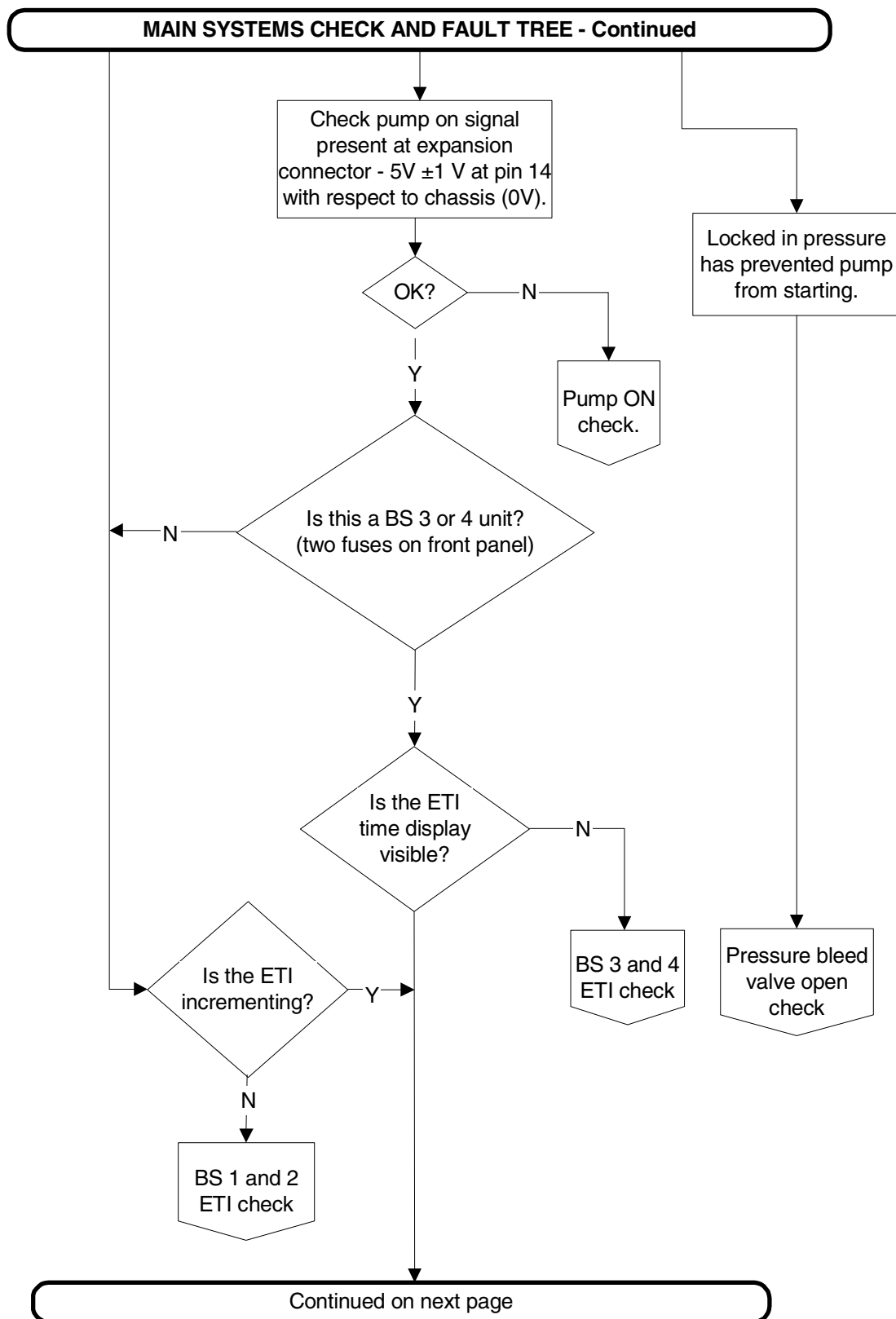
Limited fault finding and rectification can be carried out in the following procedures.

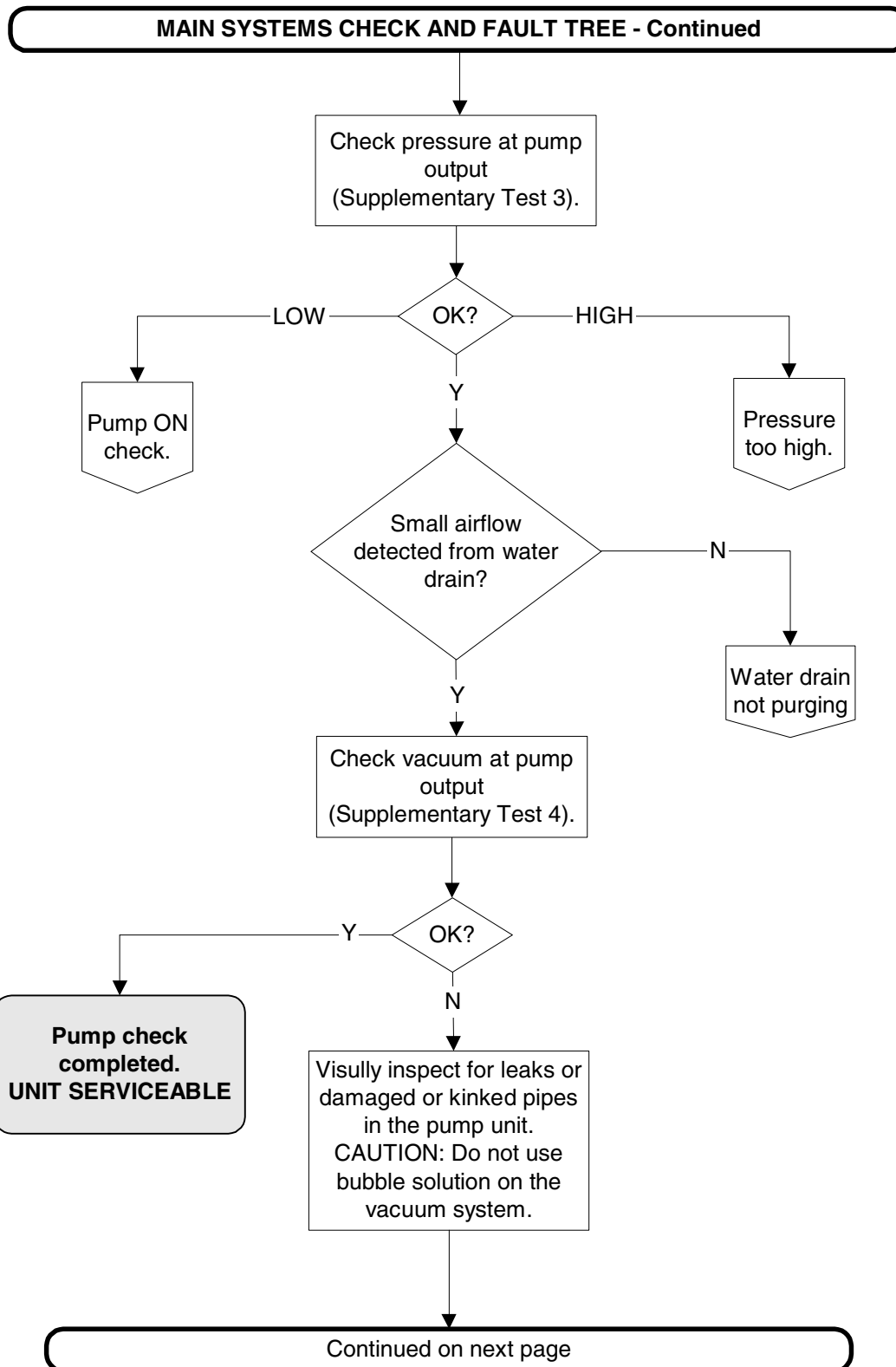
WARNING: **DISCONNECT THE POWER SUPPLY BEFORE PROCEEDING WITH MAINTENANCE.**

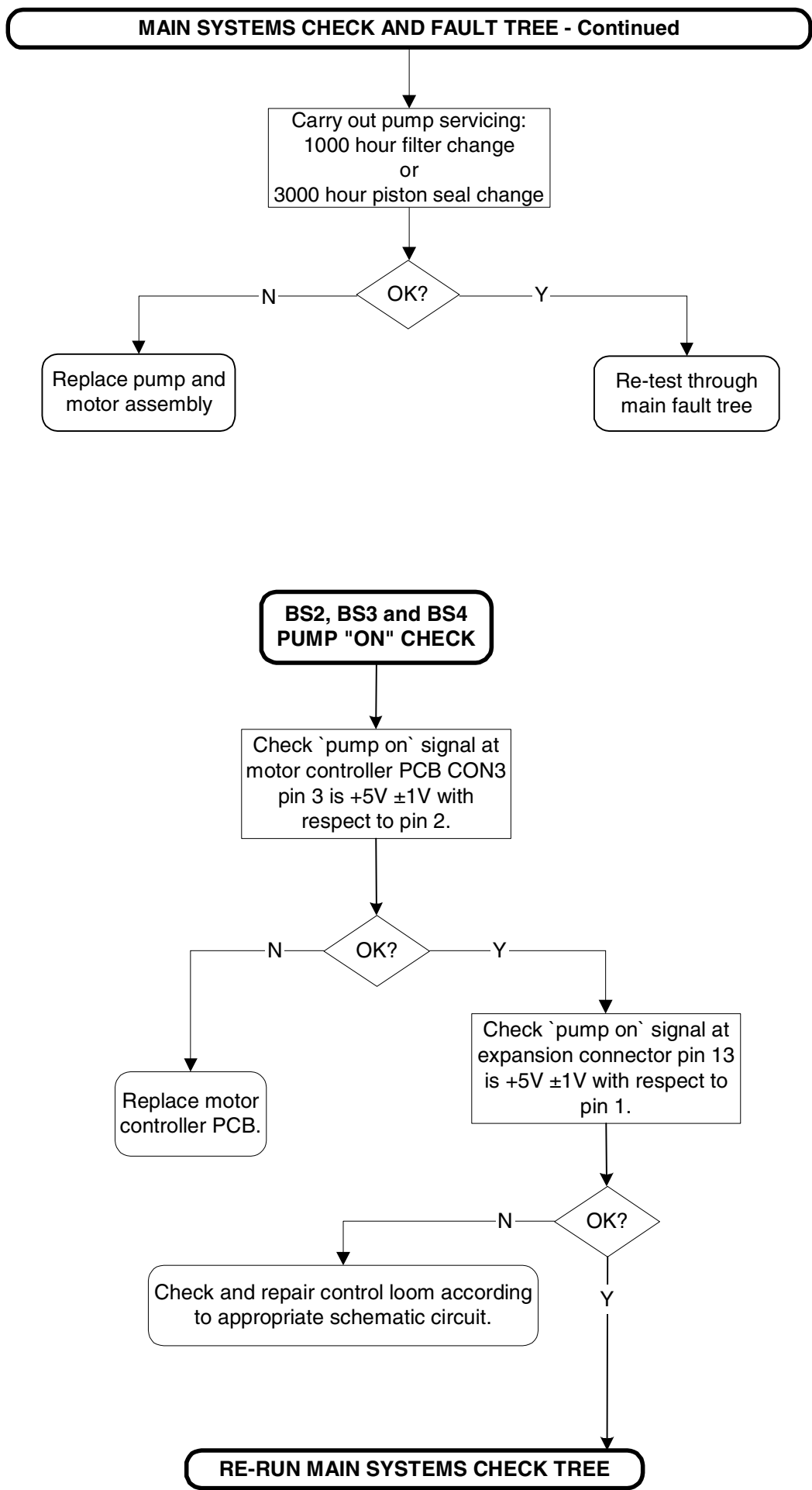
Procedure

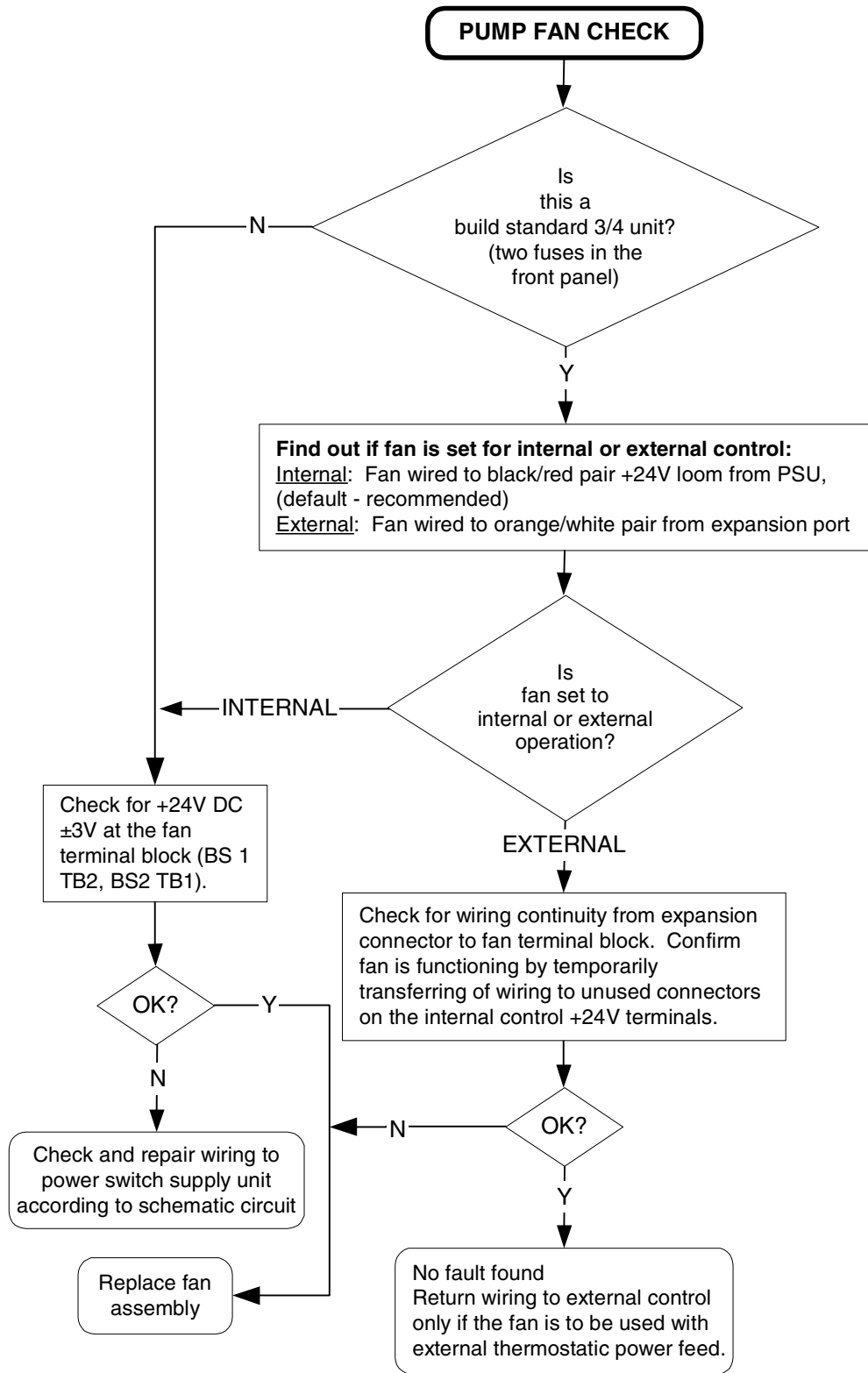
These procedures must be used in conjunction with the instructions and procedures in this chapter.



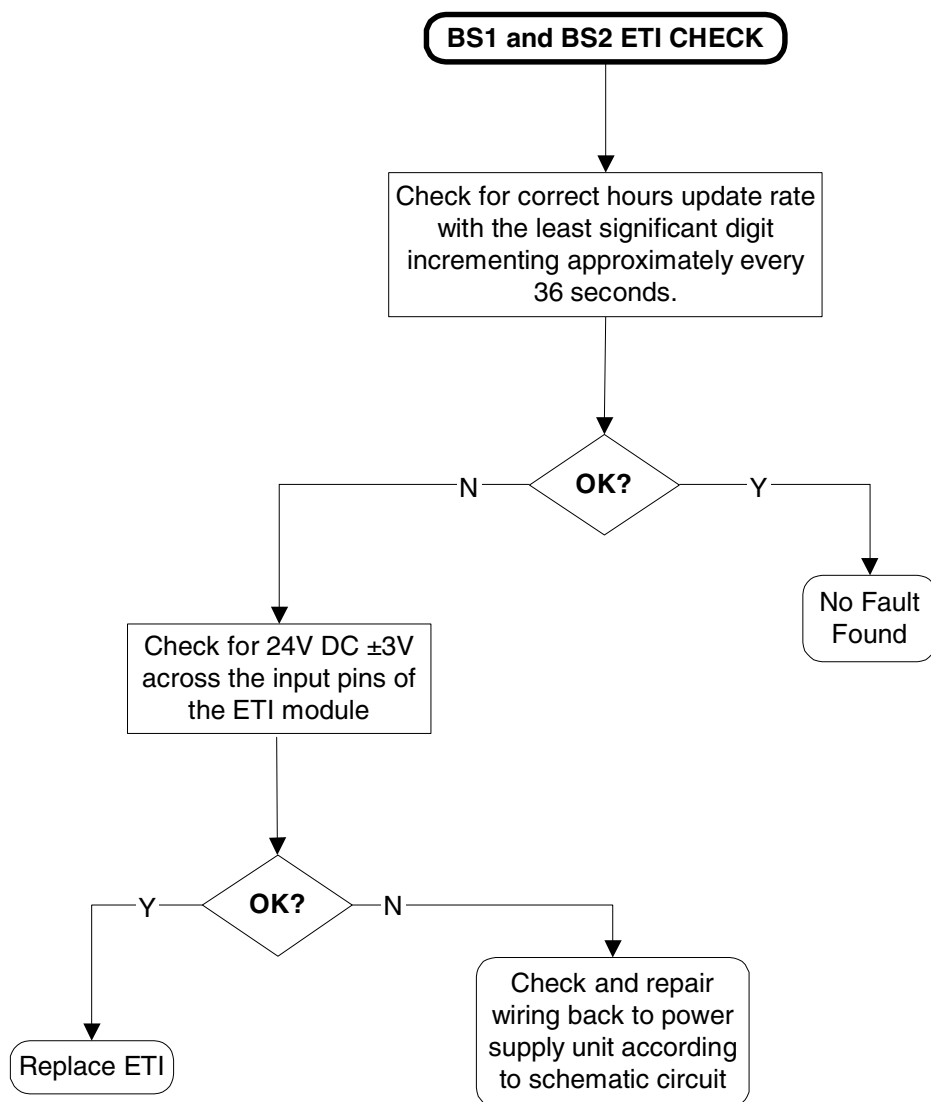




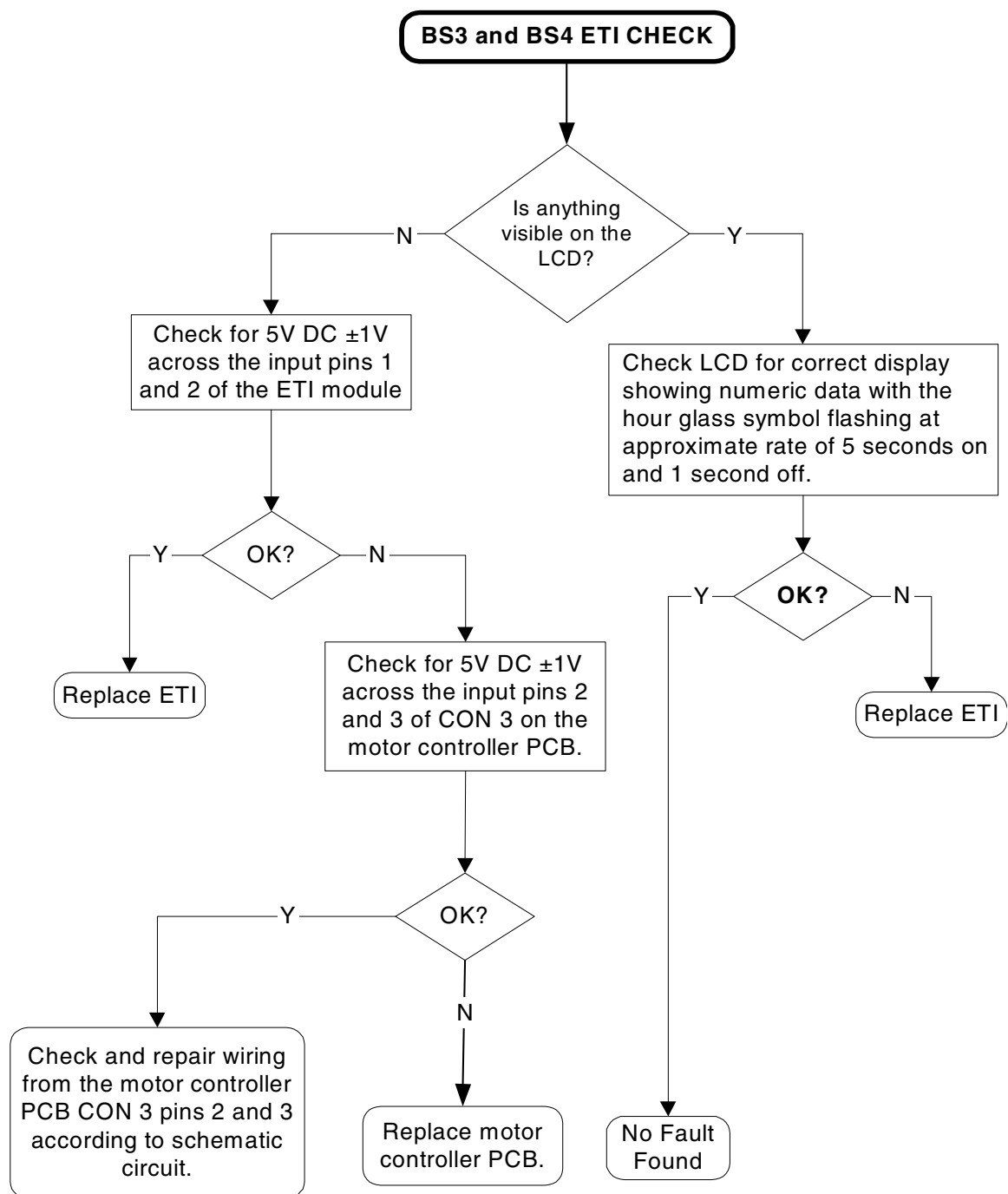




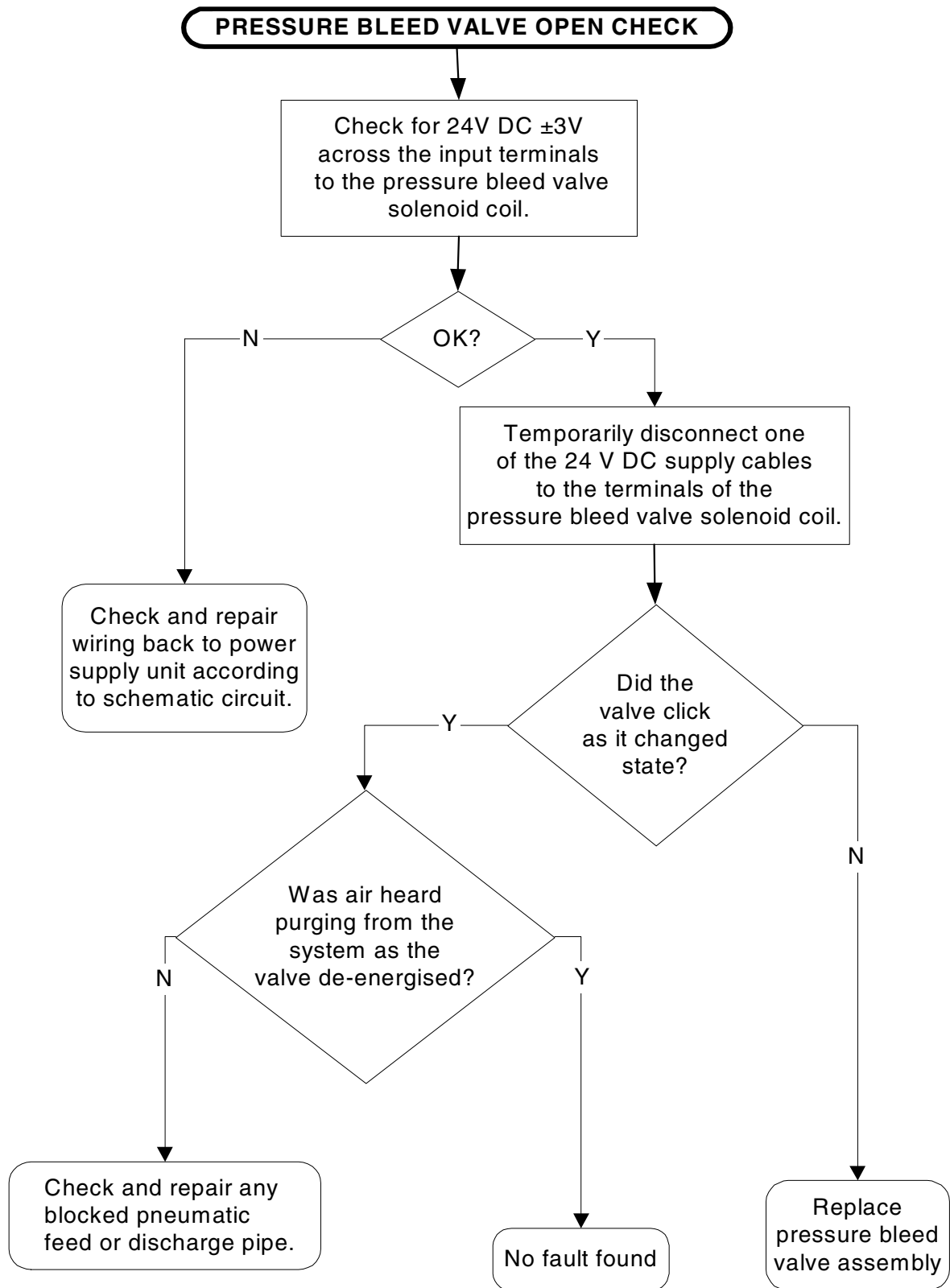
RE-RUN MAIN SYSTEMS CHECK TREE



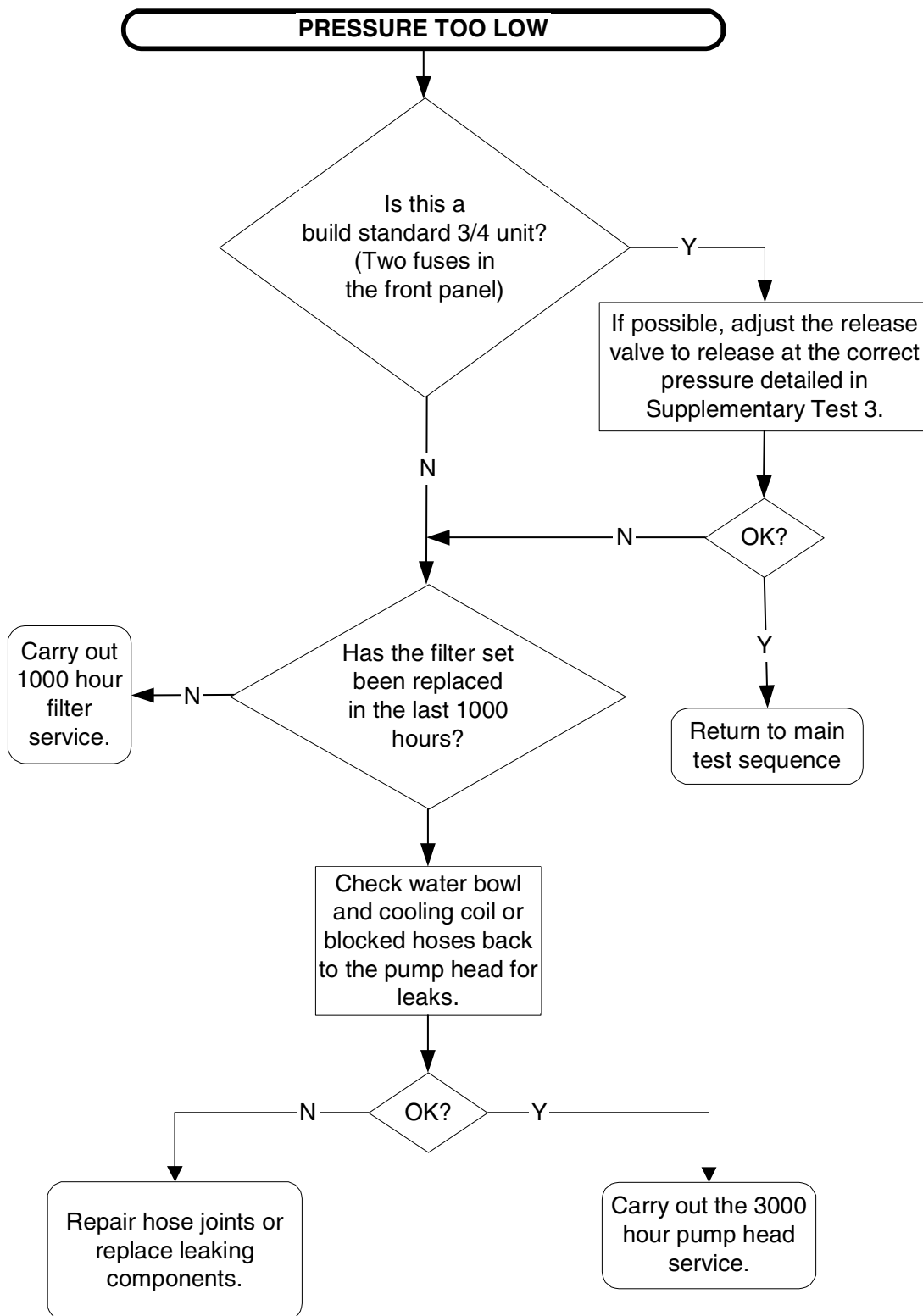
RE-RUN MAIN SYSTEMS CHECK TREE



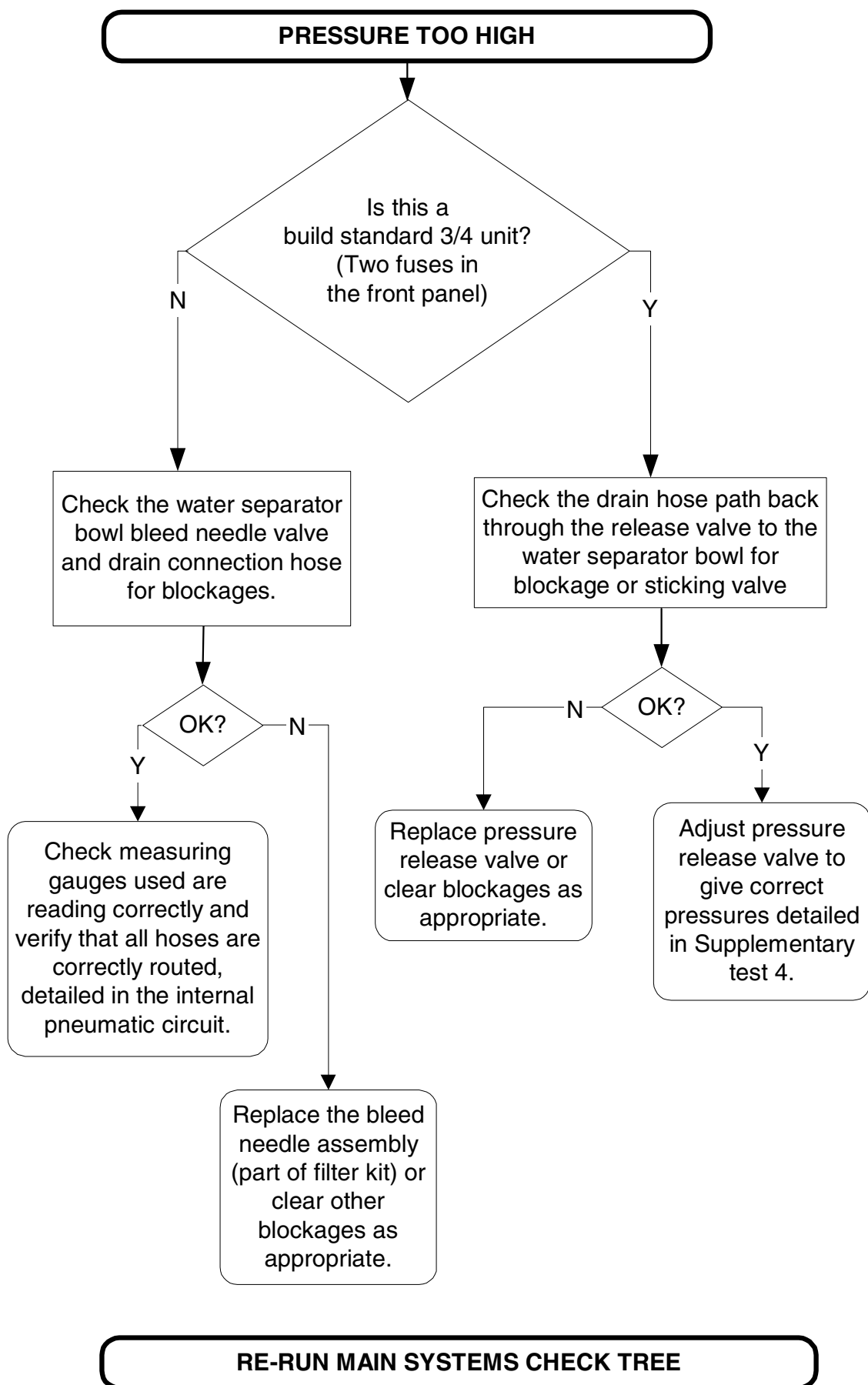
RE-RUN MAIN SYSTEMS CHECK TREE

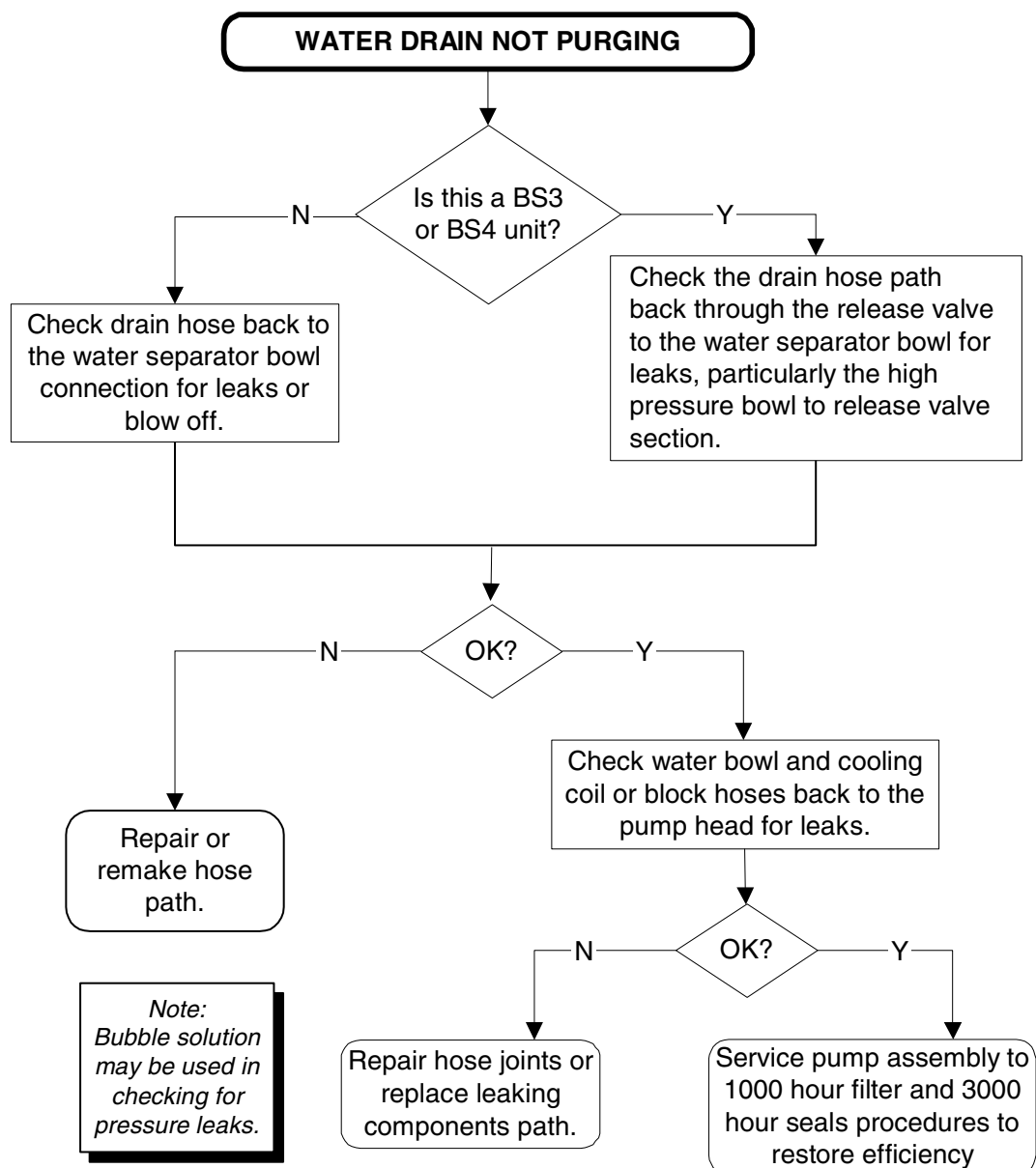


RE-RUN MAIN SYSTEMS CHECK TREE

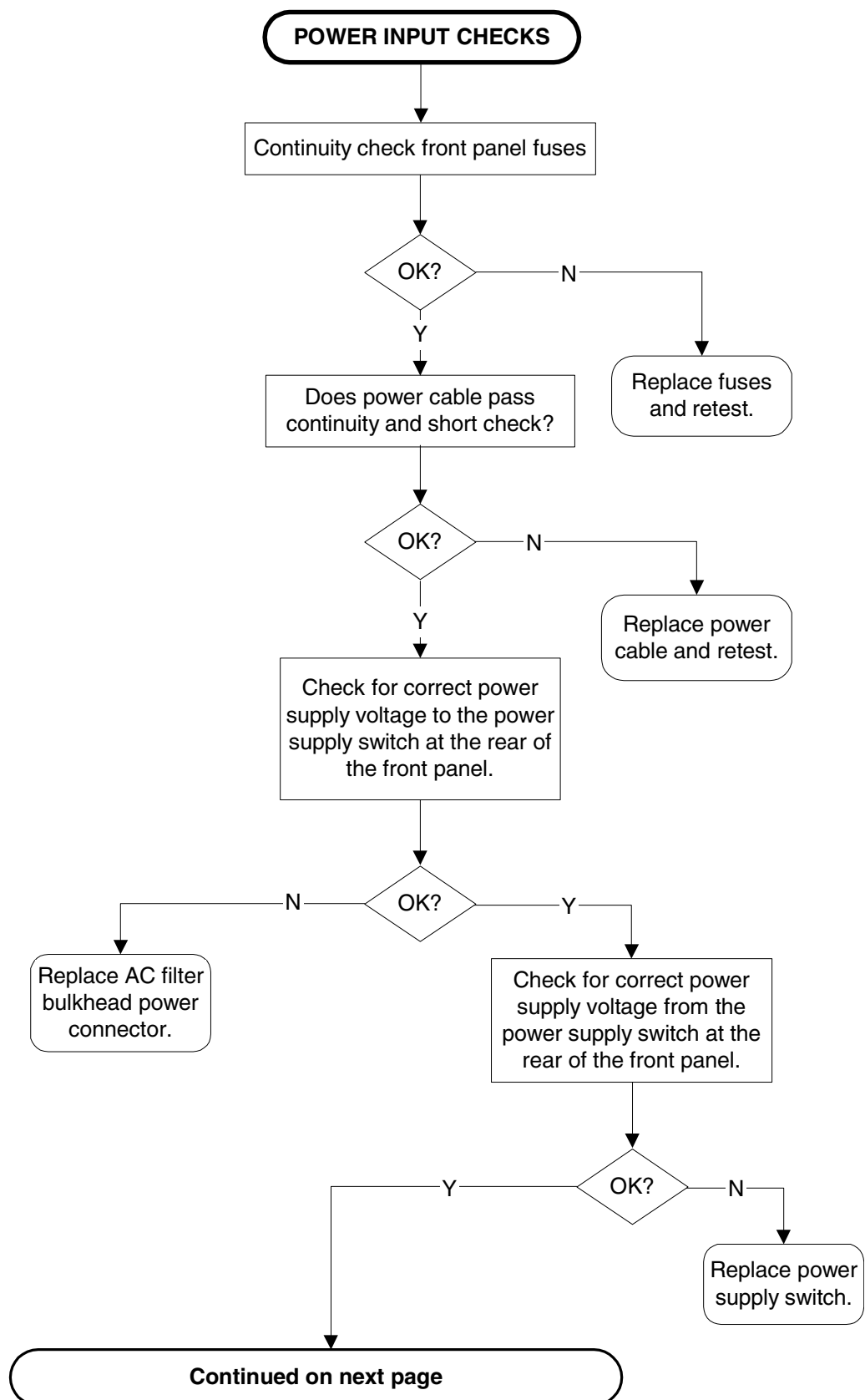


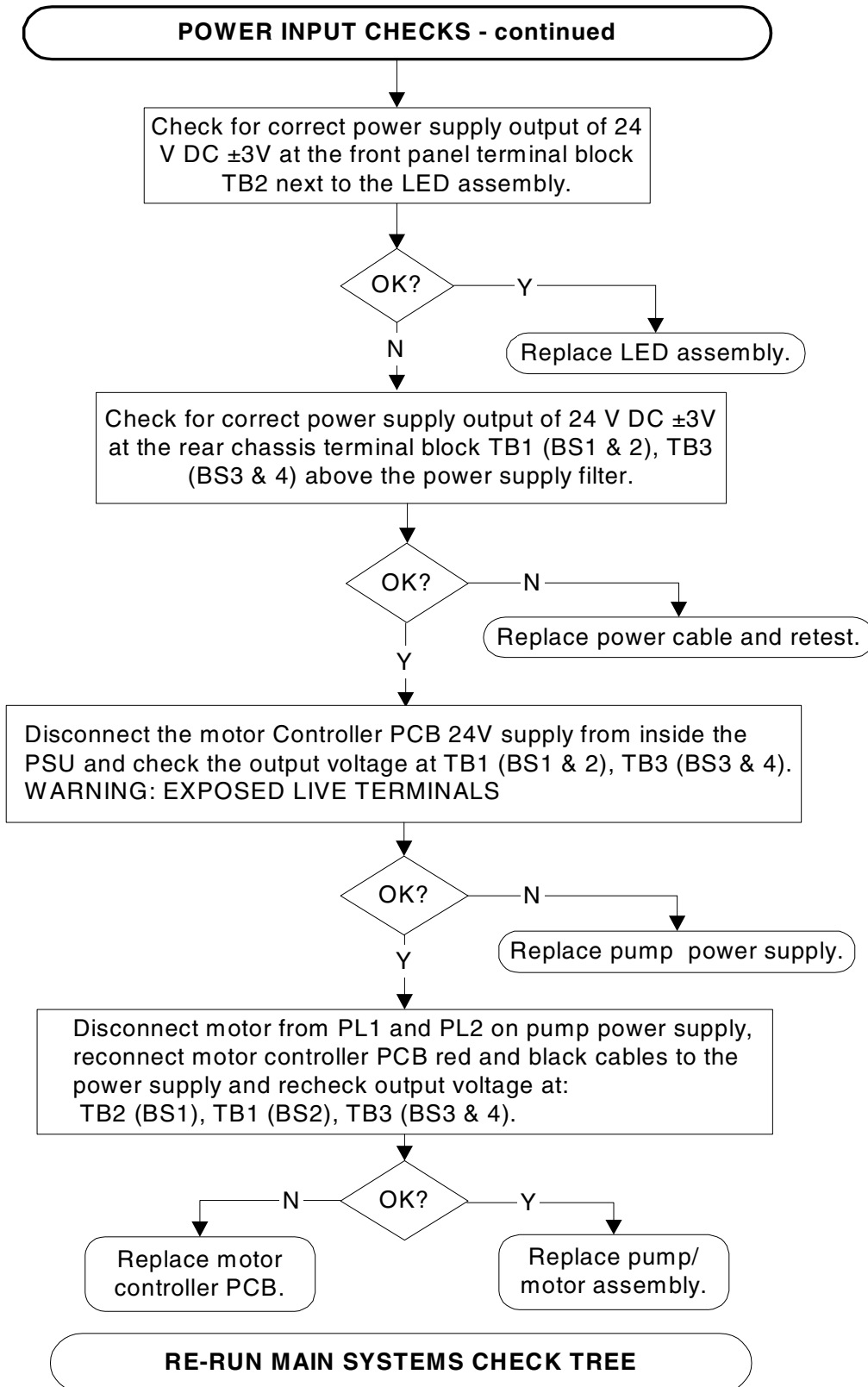
RE-RUN MAIN SYSTEMS CHECK TREE

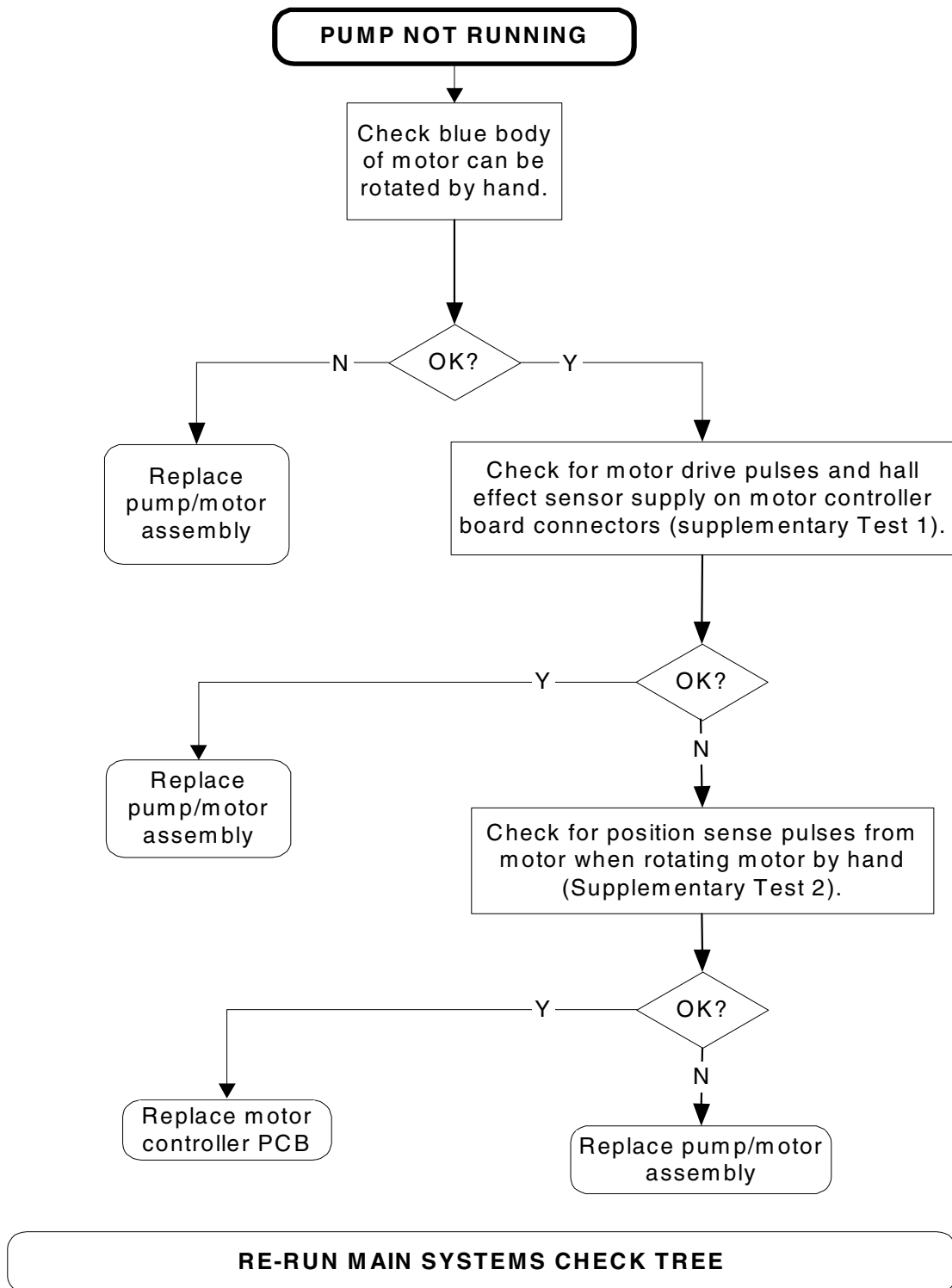


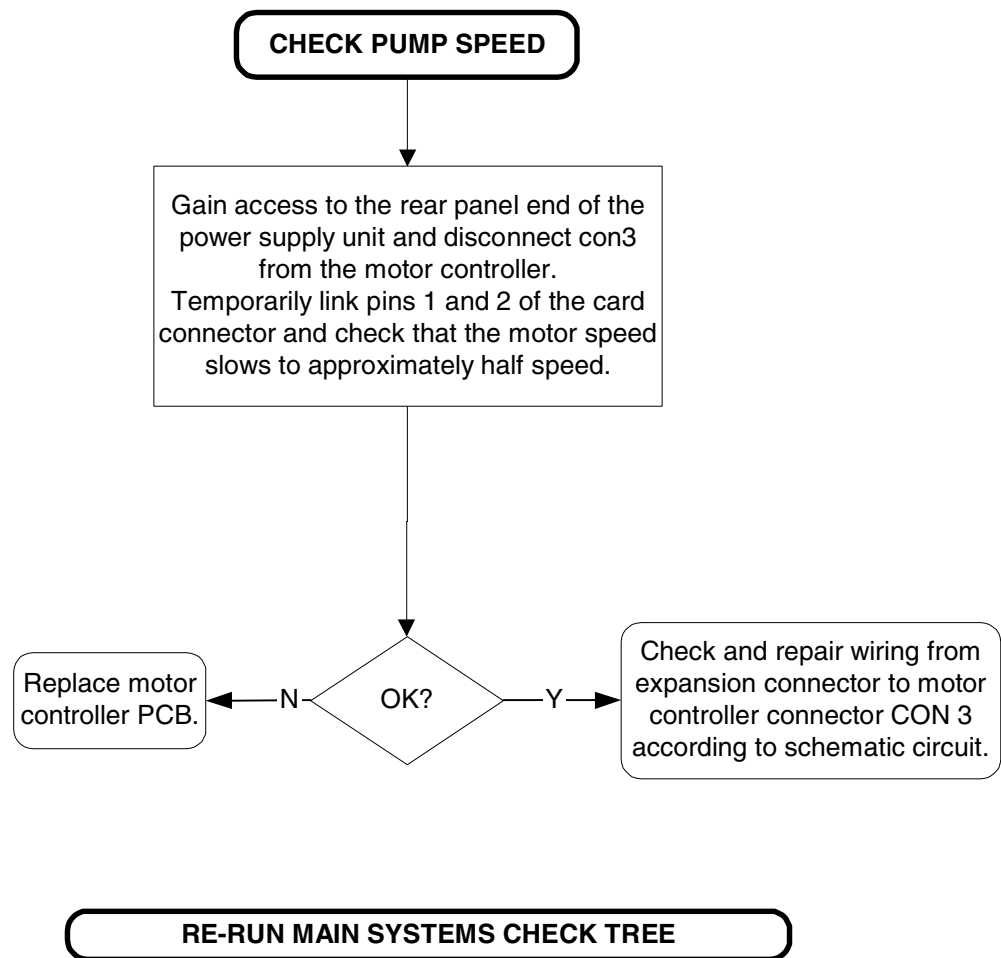


RE-RUN MAIN SYSTEMS CHECK TREE









5.3 Supplementary Tests

TEST 1:

Check for motor drive pulses and Hall sensor supply from controller board connectors

- a. Remove power.
- b. Disconnect PL1 (motor drive loom) from pump power supply (Figure 5-1).
- c. Apply power. Using the DVM, check on pump power supply (Figure 5-1) for 5V DC ± 0.5 V between PL2 pin 2 (red) and pin 7 (black). PL2 is the 8-pin connector clipped into the side of the PSU.
- d. With PL1 still disconnected, check using DVM on PL1 (power supply side) between pins 1, 2 and 3 in turn (+) and chassis (0V) while slowly rotating the motor by hand. Check that the voltage on each pin cycles between 0V and 24 V (21V to 27V) with 2 cycles per revolution of the motor.
- e. Remove power. The unit must pass both tests c. and d. above.
- f. Return to the PUMP NOT RUNNING flow chart.

TEST 2:

Check for position sense pulses from the motor when rotating by hand

- a. Remove power.
- b. Disconnect PL1 (motor drive) from pump power supply (Figure 5-1).
- c. Apply power and, using the DVM, check for pulses on PL2 between pins 3 (white), 4 (green) and 8 (grey) and chassis (0V) while slowly rotating the motor by hand. Each of the pin voltages should cycle between 0V and 5 V ± 1 V twice for each complete revolution of the motor.
- d. Remove power.
- e. Return to the PUMP NOT RUNNING flow chart.

TEST 3:

Check pump output pressure

- a. Remove power.
- b. Connect a gauge (0 to 4 bar gauge range) to the pressure output port at the rear of the pump.
- c. Switch the pump on and check for the following pressure:
Build standard 1 and 2
to 2.5 to 2.9 bar gauge (36.3 to 42 psi gauge) fitted with the bleed needle type water drain.
Build standard 3 and 4
to 3.4 to 3.8 bar gauge (49.3 to 55.1 psi gauge) fitted with the release valve type water drain.
- d. Remove power and disconnect the gauge and fit a blanking cap to the output port. Return to the MAIN SYSTEMS CHECK flow chart.

Check pump output vacuum

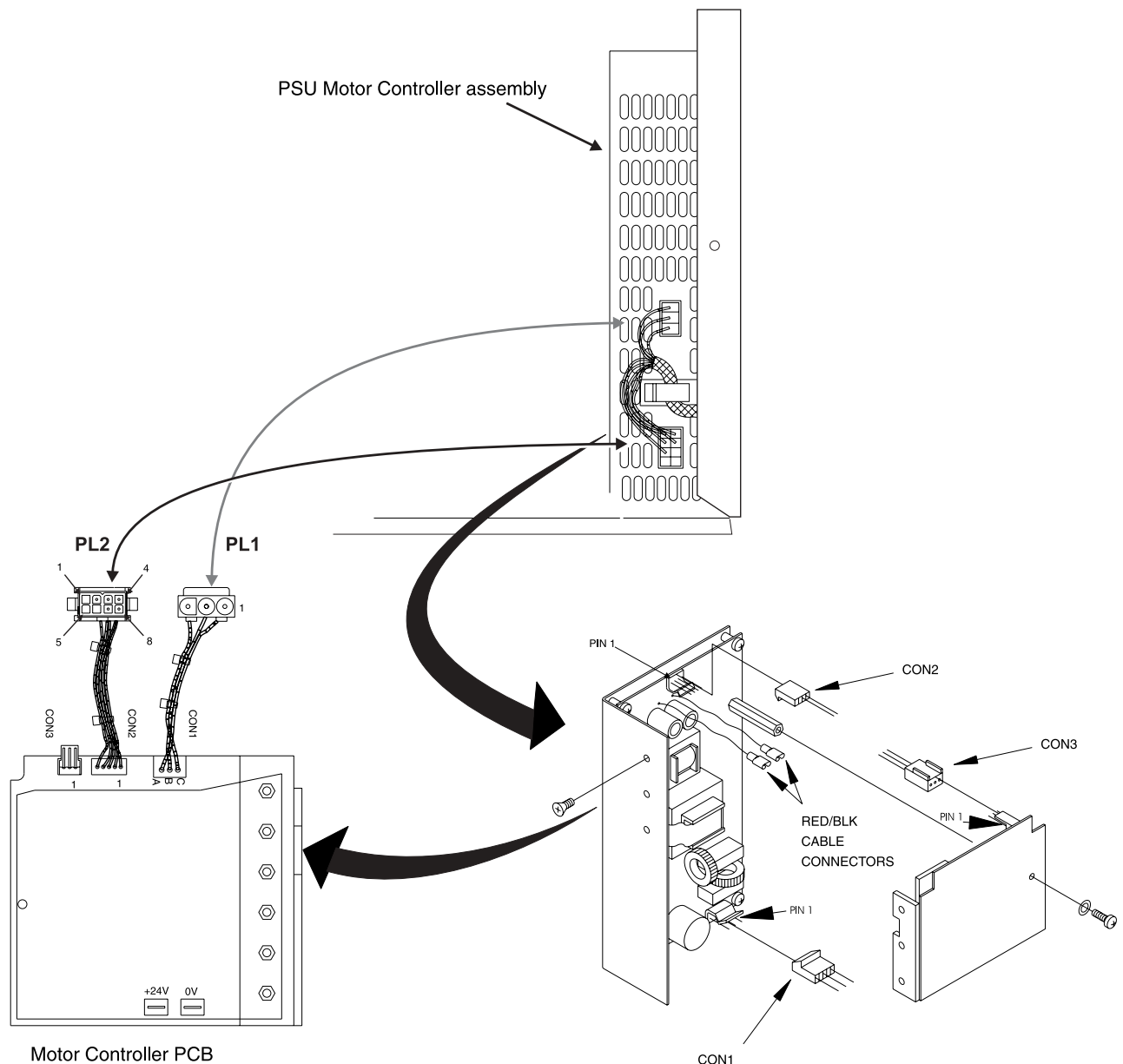


Figure 5-1 PSU and Motor controller PCB connections

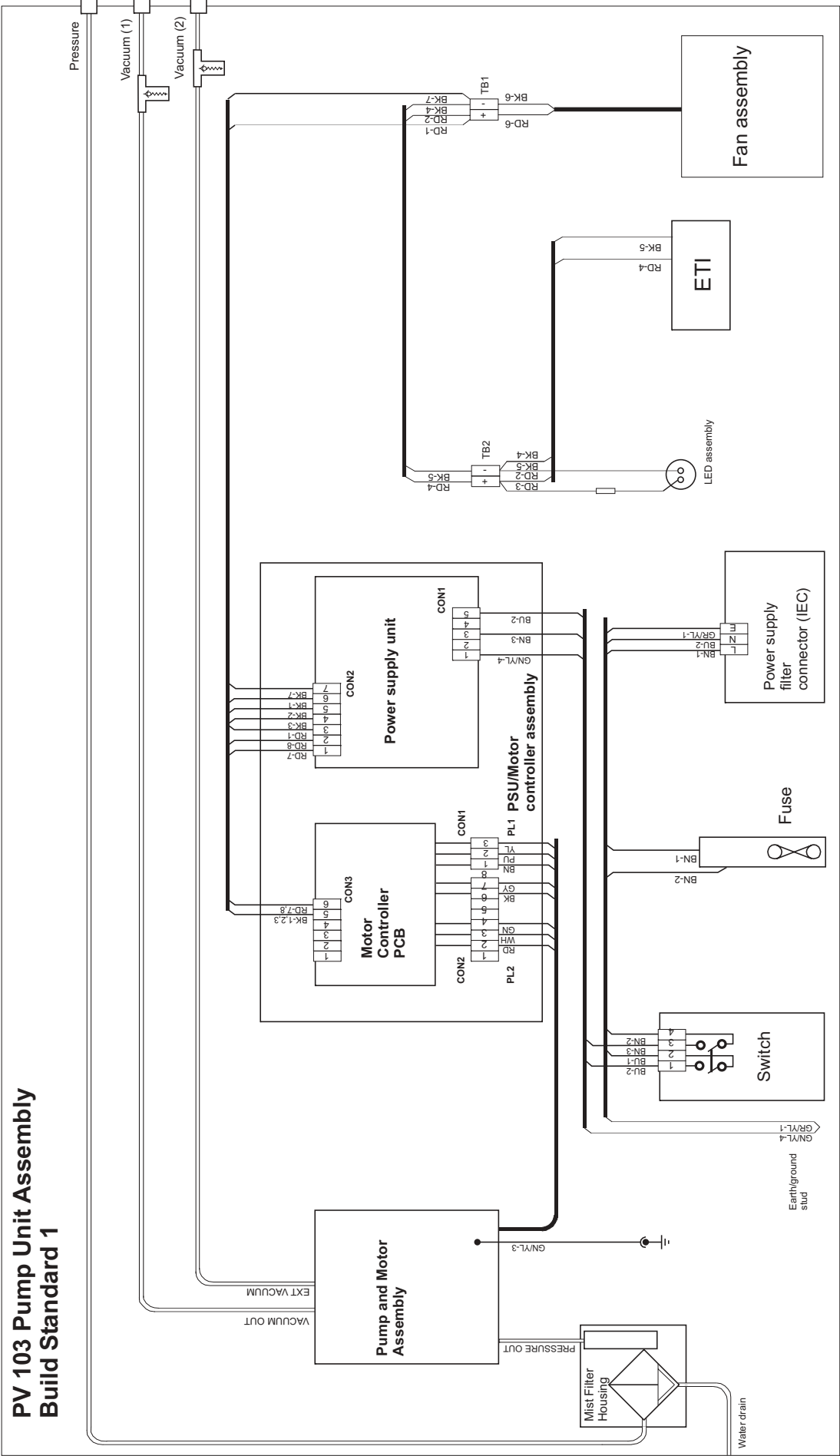


Figure 5-2 BS1 Wiring diagram

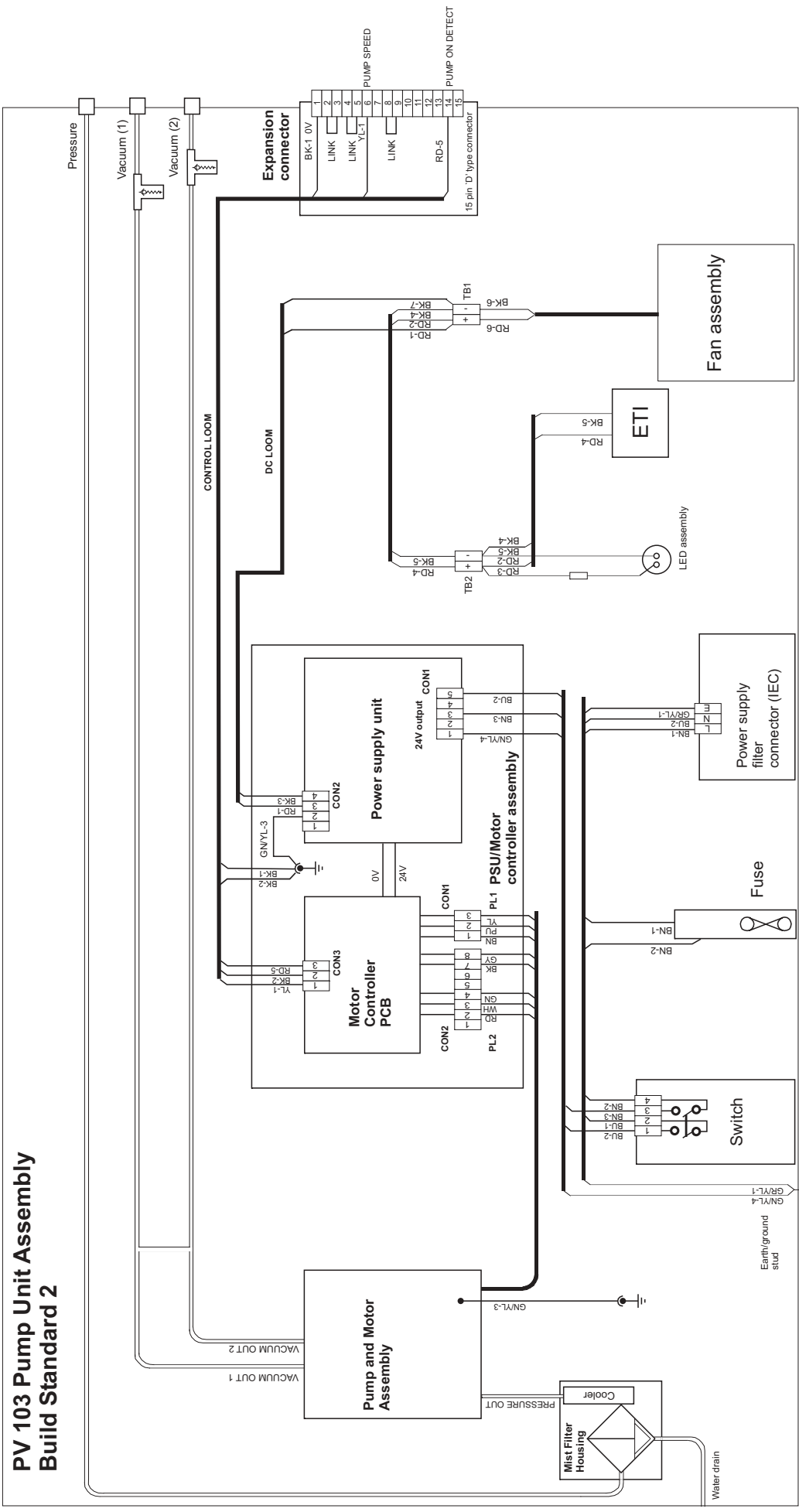


Figure 5-3 BS2 Wiring diagram

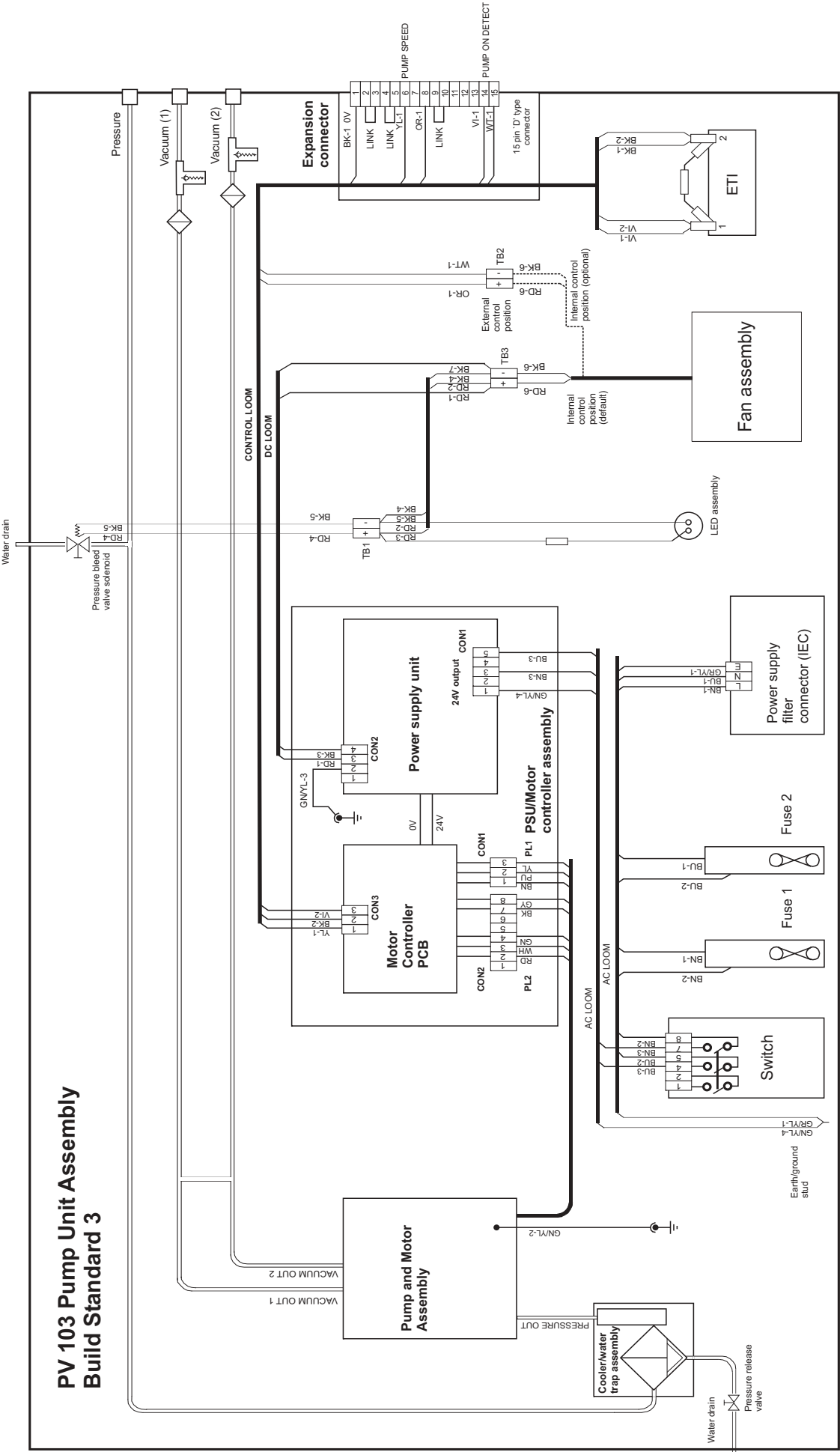


Figure 5-4 BS3 Wiring diagram

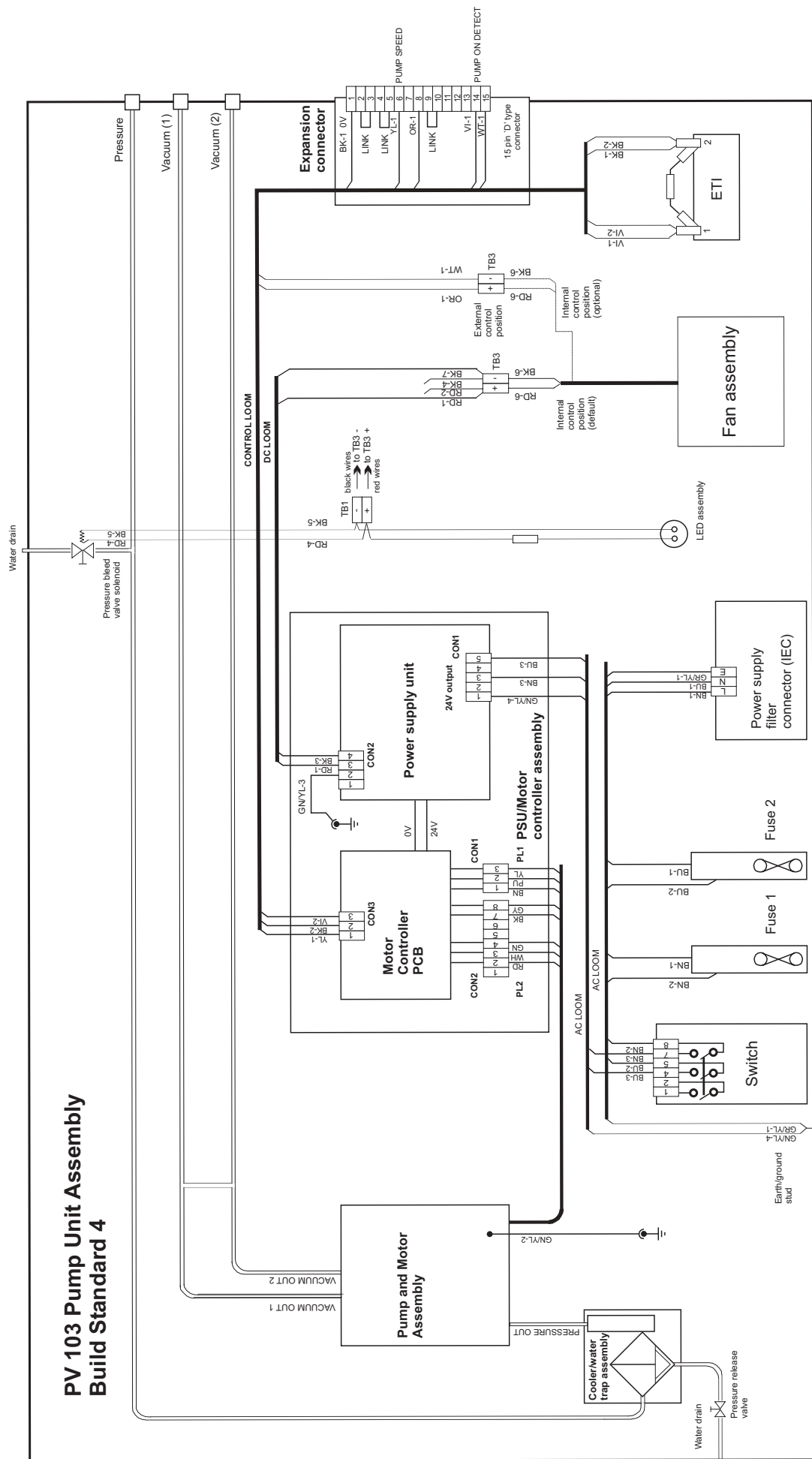


Figure 5-5 BS4 Wiring diagram

Chapter 6

Illustrated Parts List

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Illustrated Parts List

6.1 Introduction

1. The purpose of this list is to itemise the parts that comprise the unit. It is intended for use in provisioning, requisitioning and storing replacement parts.
2. In general, parts are listed in order of disassembly, and are indented to show their relationship to the next higher assembly.
3. Numerical indexes are provided to assist in locating part numbers in the Parts List.
4. Items that are non-procurable are indicated in the QTY column by the letters NP. Items that are for reference are indicated by the letters ref. Items that are not illustrated have a † symbol next the item/ref number.

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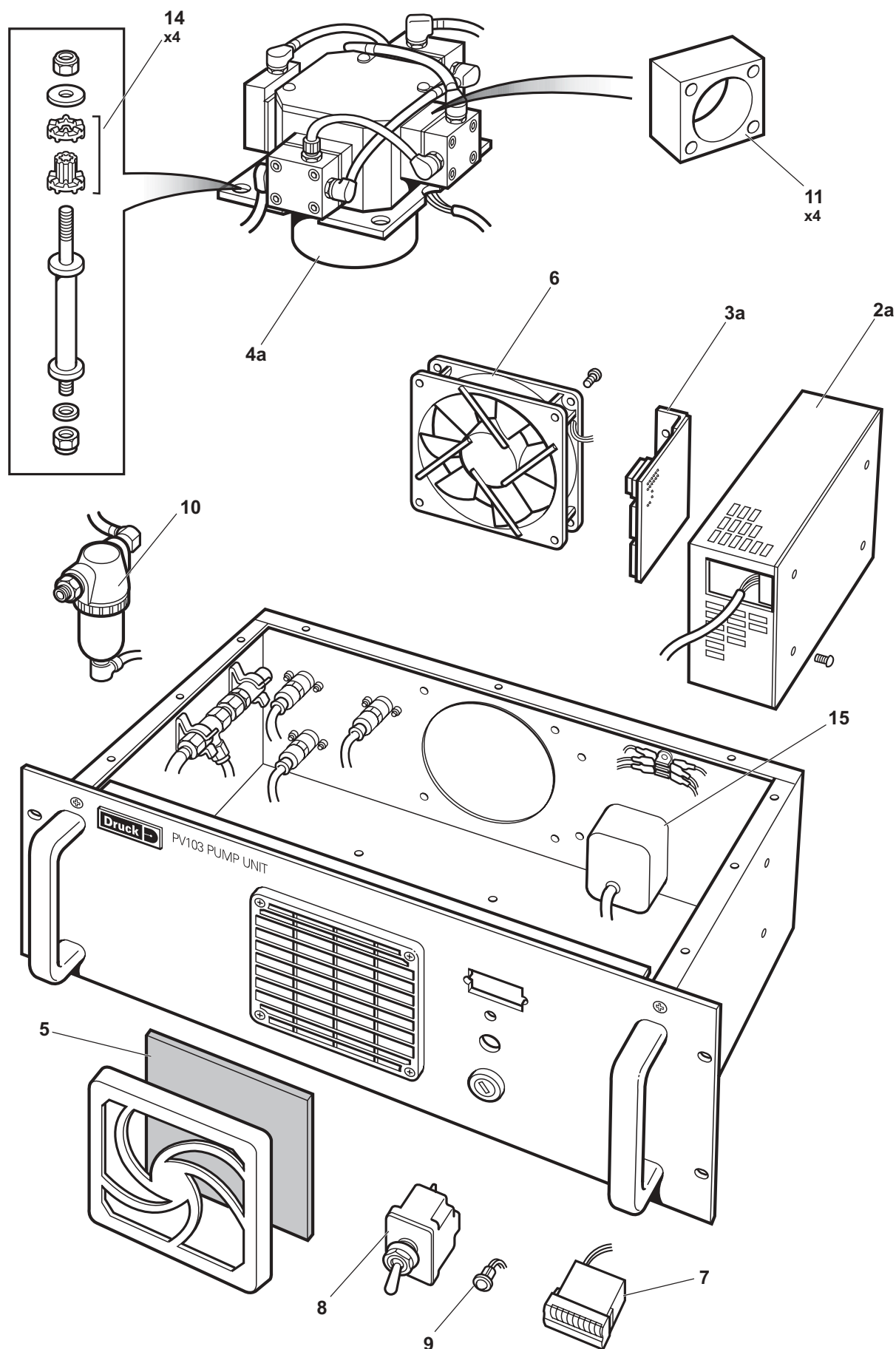


Figure 6-1 PV103 BS1

6.2 Parts Lists Build Standards 1, 2, 3 and 4

Item/ Ref.	Description	Manufacturer's Part Number	QTY
1-1	Pump unit PV103 [Build standard 1] [OBSOLETE superseded by BS4]	IA2127-1-V0	ref
-2†	.PSU, (Mod 00) [superseded by item 2a]	ADTS405-1728-86-M0	NP
-2a	.PSU, (Mod 01) [supersedes item 2]	ADTS405-1728-73-M1	1
-3†	.Controller, motor speed [superseded by item 3a]	ADTS405-1728-74-M0	NP
-3a	.Controller, motor speed [supersedes item 3] (matched with item 2a)	ADTS405-1728-74-M1	1
-4	.Pump and Motor Assembly [OBSOLETE superseded by item 4-3]	-	NP
-5	.Filter, fan [OBSOLETE superseded by item 4-8]	-	NP
-6	.Fan assembly	ADTS405-1728-77-M0	1
-7	.Indicator, elapsed time	ADTS405-1728-82-M0	1
-8	.Switch	ADTS405-1729-92-M0	1
-9	. LED and Clip	ADTS405-1729-91-M0	1
-10	Housing, mist filter [OBSOLETE (pre mod 04) superseded by item 4-10]	-	NP
-11	Block, cylinder [set of 4] [OBSOLETE]	-	NP
-12	Fitting, bulkhead AN6 [OBSOLETE -see fig 2 item 19]	-	NP
-13	Fitting, bulkhead AN4 [OBSOLETE -see fig 2 item 20]	-	NP
-14	Mounting, antivibration	ADTS405-1728-16-M0	4
-14a †	Item deleted	-	-
-15	.Connector, filter, power supply * * *	ADTS405-1728-07-M0	1
Servicing kits and ancilliary equipment			
-16†	Kit, fuse/o-ring	ADTS405-1728-36-M0	1
-17†	. Fuse T5.0A/250V HBC 20 mm	-	NP
-18†	Kit, pump seals	ADTS405-1728-63-M0	1
-19†	Kit, hose [OBSOLETE] (see item 5.2 in list of accessories)		NP
-20	.Kit, pneumatic * * * * *	ADTS405-1728-21-M0	1

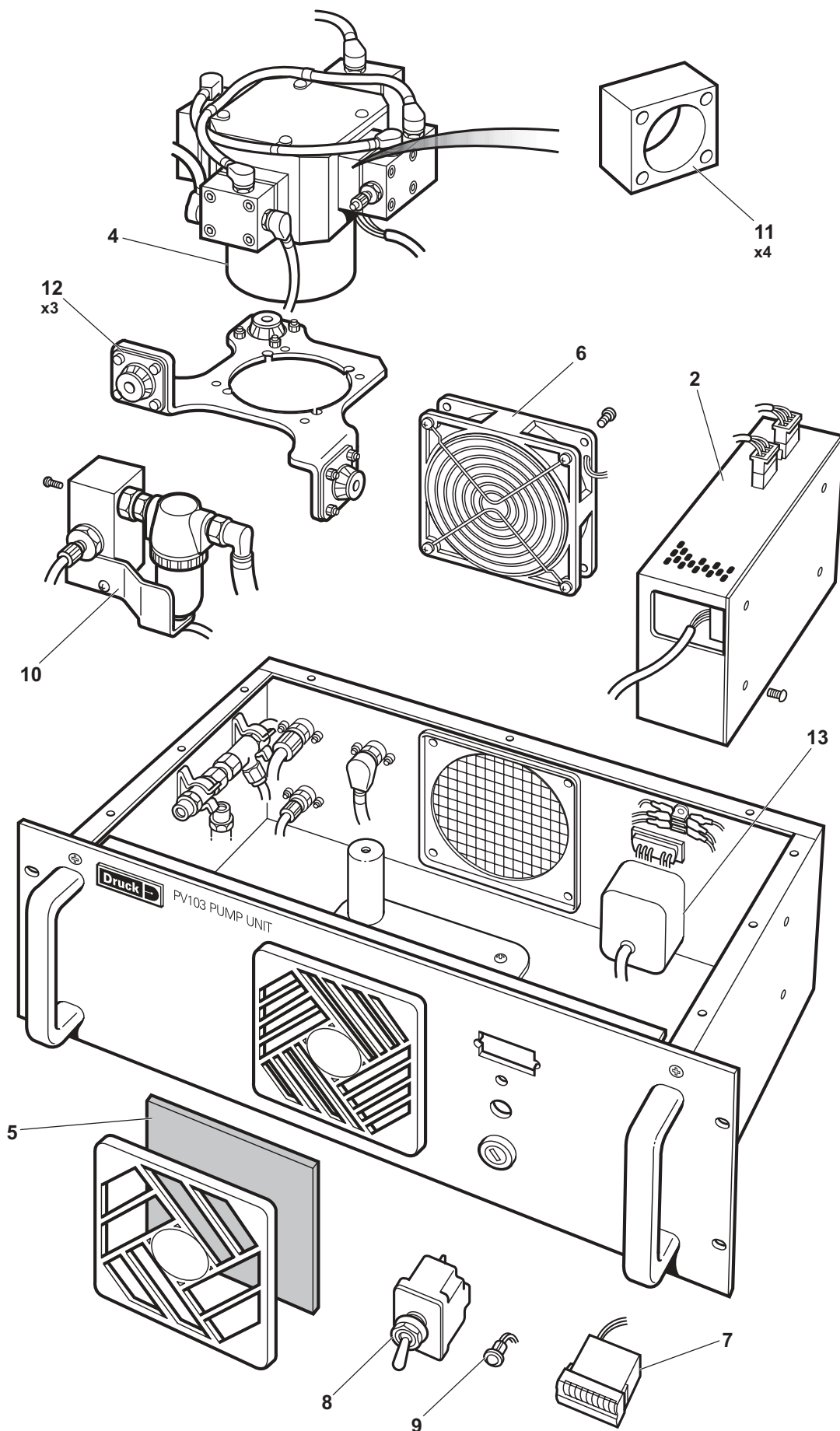


Figure 6-2 PV103 BS2

Item/ Ref.	Description	Manufacturer's Part Number	QTY
2-1	Pump unit PV103 [Build standard 2] [OBSOLETE superseded by BS4]	IA2127-1-V1	ref
-2	.PSU, Pump Universal AC	ADTS405-1728-86-M0	1
-3	..Controller, Motor, PCB	ADTS405-1728-74-M1	1
-4	.Pump and Motor Assembly [OBSOLETE superseded by item 4-3, (matched with item 4-10)]	ADTS405-1728-85-M0	NP
-5	.Filter, fan (part of item 19)	-	1
-6	.Fan assembly	ADTS405-1728-77-M0	1
-7	.Indicator, elapsed time	ADTS405-1728-82-M0	1
-8	.Switch	ADTS405-1729-92-M0	1
-9	. LED and clip	ADTS405-1729-91-M0	1
-10	.Filter, water drain [OBSOLETE pre MOD 04 superseded by item 4-10]	ADTS405-1728-17-M0	NP
-11	.Block, cylinder [set of 4]	ADTS405-1728-14-M0	1
-12	.Mounting, antivibration [set of 3]	ADTS405-1728-15-M0	1
-13	.Connector, filter, power supply	ADTS405-1728-07-M0	1
* * *			
Servicing kits and ancilliary equipment			
-14†	Kit, fuse/o-ring	ADTS405F-1728-36-M0	1
-15†	. Fuse T5.0A/250V HBC, 20 mm	-	NP
-16†	Kit, pump seals	ADTS405-1728-63-M0	1
-17†	Kit, hose [OBSOLETE] (see items 5-2 and 5-3 in list of accessories)	-	NP
-18†	Kit, bulkhead fitting [OBSOLETE superseded by item 4-18]	ADTS405-1728-64-M0	NP
-19†	Kit, filter (see item 4-18 for details)	ADTS405-1728-09-M0	NP
-20†	Kit, pneumatic	ADTS405-1728-21-M0	1
* * * * *			

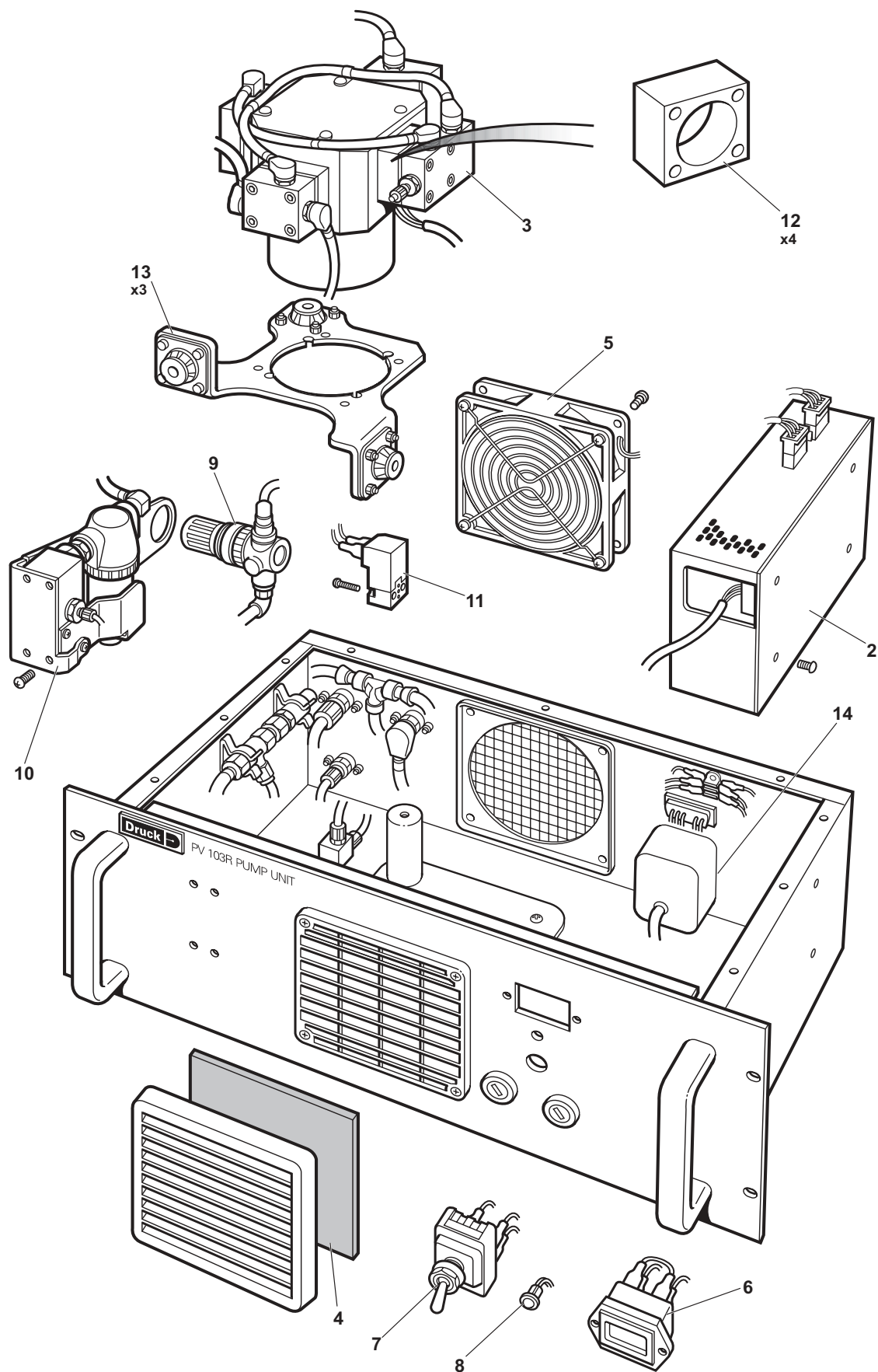


Figure 6-3PV103 BS3

Item/ Ref.	Description	Manufacturer's Part Number	QTY
3-1	Pump unit PV103 [Build standard 3] [OBSOLETE pre MOD 04]	ADTS405-1728-62-M1	ref
-2	.PSU and controller, Pump Universal AC	ADTS405-1728-86-M0	1
-3	.Pump and Motor Assembly	ADTS405-1728-85-M1	1
-4	.Filter, fan (part of item 19)	-	1
-5	.Fan assembly	ADTS405-1728-79-M0	1
-6	.Elapsed time indicator	ADTS405-1728-81-M0	1
-7	.Switch	ADTS405-1728-92-M0	1
-8	. LED and clip	ADTS405-1728-91-M0	1
-9	.Valve, pressure relief [OBSOLETE pre MOD 04]	ADTS405-1728-18-M0	NP
-9a†	.Cooling assembly, water trap post MOD 04	ADTS405-1728-18-M1	1
-10	.Filter, water drain [OBSOLETE pre MOD 04]	ADTS405-1728-17-M0	NP
-10a†	.Filter, water drain post MOD 04	ADTS405-1728-17-M1	1
-11	.Solenoid, dump valve [OBSOLETE pre MOD 04]	ADTS405-1728-05-M0	NP
-12	.Block, cylinder [set of 4]	ADTS405-1728-14-M0	1
-13	.Mounting, antivibration [set of 3]	ADTS405-1728-15-M0	1
-14	.Connector, filter, power supply	ADTS405-1728-07-M0	1
* * *			
Servicing kits and ancilliary equipment			
-15†	Kit, fuse/o-ring	ADTS405-1728-36-M0	1
-16†	. Fuse T5.0A/250V HBC, 20 mm	-	NP
-17†	Kit, pump seals	ADTS405-1728-63-M0	1
-18†	Kit, hose [OBSOLETE] (see item 5-2 in list of accessories)	-	NP
-19†	Kit, filter (see item 4-18 for details)	ADTS405-1728-09-M0	1
-20†	Kit, pneumatic	ADTS405-1728-21-M0	1
* * * * *			

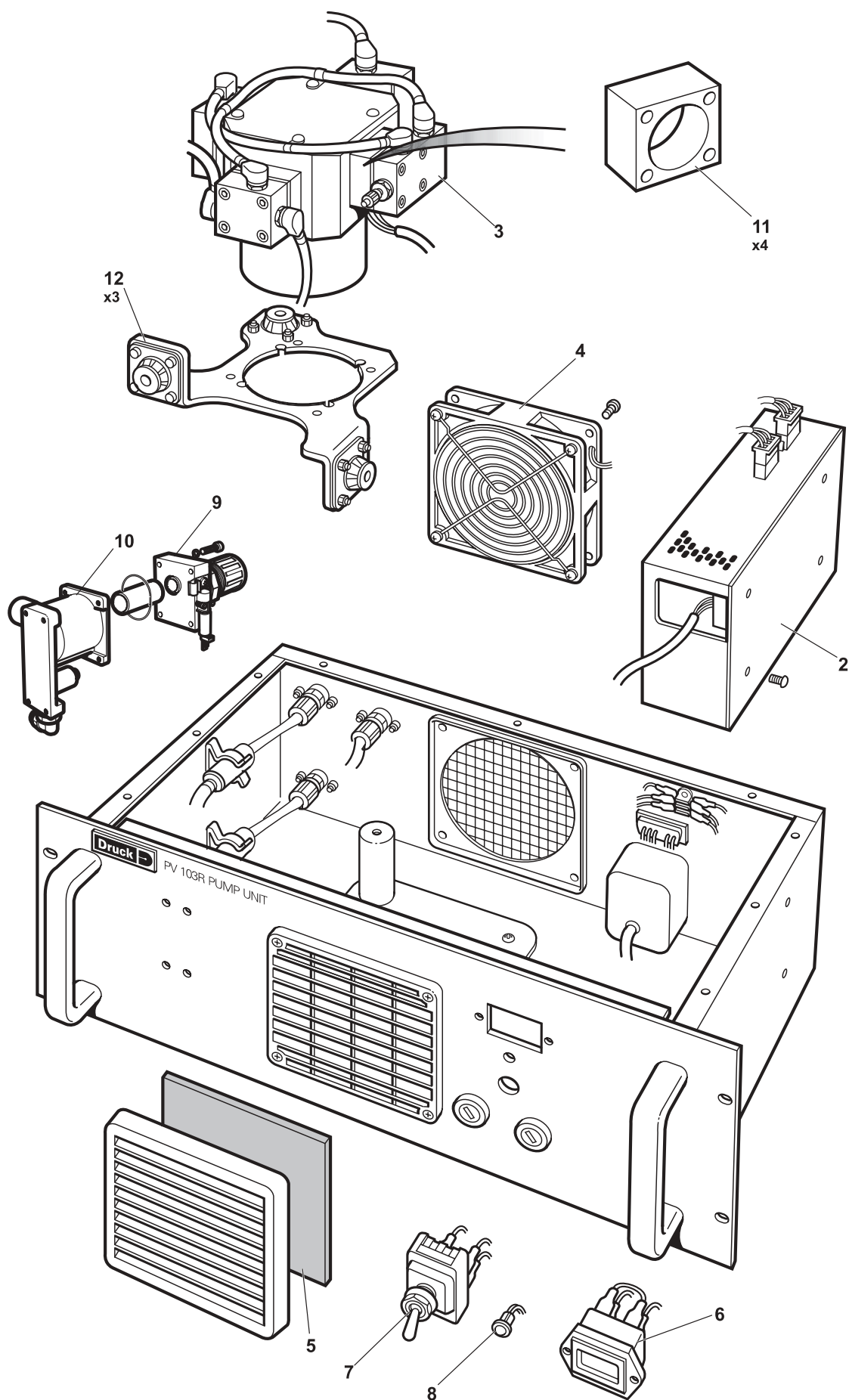


Figure 6-4 PV103 BS4

Item/ Ref.	Description	Manufacturer's Part Number	QTY
4-1	Pump unit PV103 [Build standard 4]	PV103R	ref
-2	. PSU and controller	ADTS405-1728-86-M0	1
-3	. Pump assembly Pressure/vacuum	ADTS405-1728-85-M1	1
-4	. Fan assembly	ADTS405-1728-79-M0	1
-5	. Filter, vent [part of item 18]	-	1
-6	. Indicator, elapsed time	ADTS405-1728-81-M0	1
-7	. Switch, ON/OFF	ADTS405-1728-92-M0	1
-8	. LED and clip	ADTS405-1728-91-M0	1
-9	. Valve, pressure release	ADTS405-1728-18-M1	1
-10	. Water trap	ADTS405-1728-17-M1	1
-11	. Block, cylinder [set of 4]	ADTS405-1728-14-M0	1
-12	. Mounting, antivibration [set of 3]	ADTS405-1728-15-M0	1
-13	. Connector, filter, power supply	ADTS405-1728-07-M0	1
* * *			
Servicing kits and ancilliary equipment			
-14†	Kit, fuse/o-ring	ADTS405-1728-36-M0	1
-15†	. Fuse T5.0A/250V HBC, 20 mm	-	NP
-16†	Kit, pump seals	ADTS405-1728-63-M0	1
-17†	Kit, hose [OBSOLETE] (see items 5-2 and 5-3 in list of accessories)	-	NP
-18†	Kit, filter	ADTS405-1728-09-M0	1
-19†	. Muffler	-	1
-20†	. Adaptor	-	1
-21†	. Plate, cover	-	1
-22†	. Fitting, bulkhead AN6	-	2
-23†	. Fitting, bulkhead AN4	-	1
-24†	. Filter, in-line	-	2
-25†	. Element, water mist	-	1
-26†	Kit, pneumatic	ADTS405-1728-21-M0	1
* * * * *			

List of Accessories

Item/ Ref.	Description	Manufacturer's Part Number	QTY
5-1 †	.Accessory Bag	ADTS405F-1728-39-M0	1
-2 †	.Kit, Hose	ADTS405F-1728-49-M0	1
-3 †	Cable Assembly, Expansion port, 2M	ADTS405F-1728-32-M0	1
	* * * * *		

6 Index of Part Numbers

Part Number	Figure and item number	Part Number	Figure and item number
IA2127-1-V0	1-1	ADTS405-1728-73-M1	1-2a
IA2127-1-V1	2-1	ADTS405-1728-74-M0	1-3
ADTS405-1728-05-M0	3-11	ADTS405-1728-74-M1	1-3a 2-3 3-2
ADTS405-1728-07-M0	1-15 2-13 3-14 4-13	ADTS405-1728-77-M0	1-6 2-6
ADTS405-1728-09-M0	2-19 3-19 4-18	ADTS405-1728-79-M0	3-5 4-4
ADTS405F-1728-14-M0	1-11 2-11 3-12 4-11	ADTS405-1728-81-M0	3-6 4-6
ADTS405-1728-15-M0	2-12 3-13 4-12	ADTS405-1728-82-M0	1-7 2-7
ADTS405-1728-16-M0	1-14	ADTS405F-1728-85-M0	2-4
ADTS405-1728-17-M0	2-10 3-10	ADTS405-1728-85-M1	3-3 4-3
ADTS405-1728-17-M1	3-10a 4-10	ADTS405-1728-86-M0	1-2 2-2 3-2 4-2
ADTS405-1728-18-M0	3-9	ADTS405-1728-91-M0	1-9 2-9 3-8 4-8
ADTS405-1728-18-M1	3-9a 4-9	ADTS405-1728-92-M0	1-8 2-8 3-7 4-7
ADTS405F-1728-21-M0	1-20 2-20 3-20 4-26	PV103R	4-1
ADTS405-1728-32-M0	5-3		
ADTS405F-1728-36-M0	1-16 2-14 3-15 4-14		
ADTS405F-1728-39-M0	5-1		
ADTS405F-1728-49-M0	5-2		
ADTS405-1728-62-M1	3-1		
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