

Medical Vacuum Plant - British Standard



PRECISION UK Ltd 

HTM02-01 TRIPLEX MEDICAL VACUUM PLANT

INSTALLATION, OPERATION & MAINTENANCE MANUAL



VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Matthew Dean	28/10/2015			
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INTRODUCTION

The CPX triplex medical vacuum plant shall conform to United Kingdom Department of Health (DoH) HTM 02-01 and NHS Model Engineering C11. The medical vacuum plant is manufactured in the UK under ISO13485:2003 quality management system. The entire system shall be duplexed such that any single functional component failure will not affect the integrity of the medical vacuum system.

Catalogue Number: MV-XXXX-T



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If any serious incident has occurred in relation to this device, it should be reported to the manufacturer and the competent authority of the Member State in which the user and/or patient is established.

Intended Use

The intended purpose of the medical gas pipeline system is for the channeling of gases for removal or eventual infusion, administration, or introduction to the body. The medical vacuum plant is intended to be used as a reliable source of suction throughout the healthcare facility via the medical gas pipeline system. Medical vacuums are used in many areas of the hospital including operating theatres, critical care units, Coronary and Neonatal Care Units, Delivery, Emergency Departments and Patient wards.

SAFETY

Qualified Personnel

Qualified personnel are people who, due to their training, experience, instruction, and their knowledge of the relevant standards, can competently undertake the work required for the installation, operation, and maintenance of this product.

General

This equipment should be installed, operated, and maintained by personnel who are suitably trained, are fully conversant with HTM 02-01 and are familiar with this product.

Medical Gases

No attempt should be made to use or modify this equipment for use with a gas other than as identified.

This equipment should not be operated at pressures exceeding those stated in HTM 02-01 and this manual.

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Electrical

All electrical work must be carried out by qualified people. Connection cables must be selected according to the type of use and to the relevant voltage and current levels associated with the plant. Connect the plant in accordance with the circuit diagrams and any local wiring regulations. If you have any reservations about works to be carried out contact the manufacturer.

WARNING LABELS



LOW VOLTAGE



BIOHAZARD

SYSTEM DESCRIPTION

The CPX triplex medical vacuum plant consists of:

Vacuum Receivers

2 or more vertical Vacuum Receiver fitted with Drain Valves and Vacuum Gauges

Vacuum Pump Module

The three vacuum pumps shall be oil lubricated, rotary sliding vane and air cooled, suitable for both continuous and frequent start/stop operation. The vacuum pump shall be directly driven by a 360 - 450V, 3 phase, 50Hz (60Hz available on request) TEFC electric motor. The vacuum pump module comprises of a specified number of these pumps and associated control panels. Options include alternative plant formats designed to suit customer requirements. Acoustic canopies are available to further reduce noise emissions.

Control system.

Vacuum pump control panel incorporate digital display of outlet vacuum pressure Accurate to within +-2%, contactors, overloads, ammeter and digital hour meter. The unit also indicates via the digital display mains power on, control circuit failed(plant Fault), Overload

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tripped (Plant Fault) Failure to respond (plant fault) the panel also provides BMS volt free contacts for as compressor running signal.

Plant control panel control the operation of the whole system and ensures it matches demand. The panel incorporates a central control, which can operate up to four pumps, a pressure transducer controls the cut in and cut out of the compressors.

The unit also displays mains supply on, pump called for, pump operating, pressure (digital display) and plant services.

The panel incorporates the plant alarm interface which provides volt free contacts to a centralised alarm system as well as BMS contacts for the following:- Plant Fault, Plant Emergency and Pressure Fault.

Duplex Bacteria Filter Module

The duplex filter system shall incorporate a high efficiency filter element. The filter elements shall not have penetration levels not exceeding 0.005% when tested by sodium flame method in accordance with BS 3928:1969

The duplex bacteria filter shall incorporate a replaceable filter element, a differential pressure gauge and drain tap, as well as manual valves to isolate the filter during maintenance without losing supply. The duplex bacteria filters shall be housed upon the horizontal vessel for package format vacuum plant and or as a separate sub assembly for module format vacuum plant.

KEY FEATURES

The CPX triplex medical vacuum plant has several key features which set it above the operational requirements of HTM02-01. The main feature is the digital display which not only provides a visual indication of the status of the plant it also provides a live reading of the pressure within the system with an accuracy of +/- 2%. The Digital display allows the engineer to set the pressures the pumps will cut in and cut out and adjust the alarm setting for the pressure in the pipeline. The display also allows you to select the duty pumps or if they shall auto cycle the auto cycle will change the duty each time the plant starts to minimise wear on any particular pump.

SYSTEM OPERATION

The Duty Pumps(s) Maintain pressure in the receiver between 500 and 650mm/Hg, if the Duty Pumps(s) fail or cannot cope with the System demand, the Standby Pump(s) will start at 475mm/Hg.

In the event of All pumps failing to start the Plant Emergency Switch will Activate at 420mm/Hg,

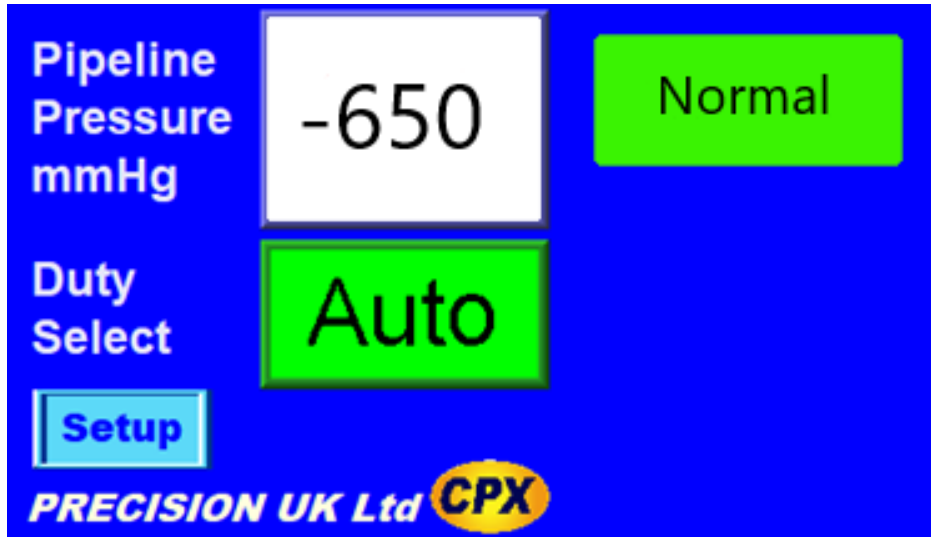
INITIAL POWERING UP

- Check pump oil levels are O.K. top up if necessary.
- Switch the Auto/Manual Switch to Manual, this will ensure the pump starts immediately.
- Switch the isolator on pump number 1 starter to the on position.
- Quickly note the direction of rotation of the pump number 1 and switch the isolator off again.
- Put the Auto/Manual Switch to Auto Position.
- If rotation is incorrect swap round two of the incoming phases to the panel (do not alter any of the wiring inside the panel).
- Repeat for pump number 2 & 3.
- Once it is established that all pumps are rotating in the correct direction the plant can be brought online after a few initial checks: -
 1. Ensure that the pump isolation valves are all in the open position.
 2. Ensure that one set of bacterial filters is valved open as duty and the other closed for standby.
 3. Ensure that the drain valves at the base of the vessels are closed.
 4. Ensure that all pipework connected to the plant is appropriate.
 5. On the center 'control panel' ensure that the Duty selector switch is in the auto position. This is the default position and will cycle the duty pump every time a pump is called to run.
- Switch all the pump isolators to the on position. One of the pumps will start to run shortly followed by the Standbys.
- All pumps will run until a pressure of 660mmHg is achieved.
- If any Fault indicators are still illuminated after start up simply press reset this will only occur after initial start-up depending how long the system takes to pressurize

The plant can now be left to operate normally.

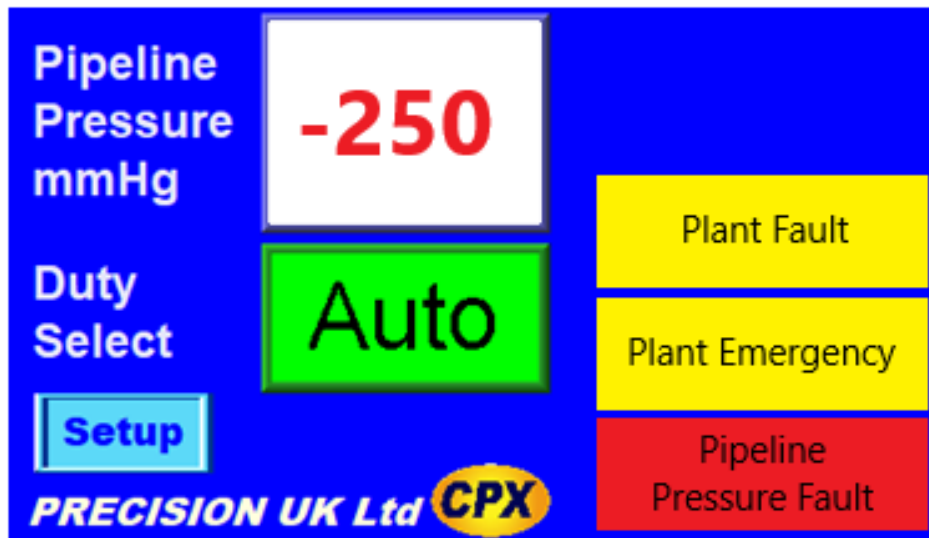
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Control PLC Touchscreen Setup Main screen In Normal Condition



- Pipeline Pressure mmHg: - Displays the receiver pressure in mmHg.
- Duty Select (Green Auto): - Duty Select switch Press and hold for one second to select Pumps 1,2 as duty colour will change yellow and display 1. Press again for 2 and again for 3 one more press will return to Auto.
- Setup: - Press to enter Setup Screen (See Below)
- Green Normal: - Top right not shown in image displays in the absence of any faults.

Main screen In Alarm Condition

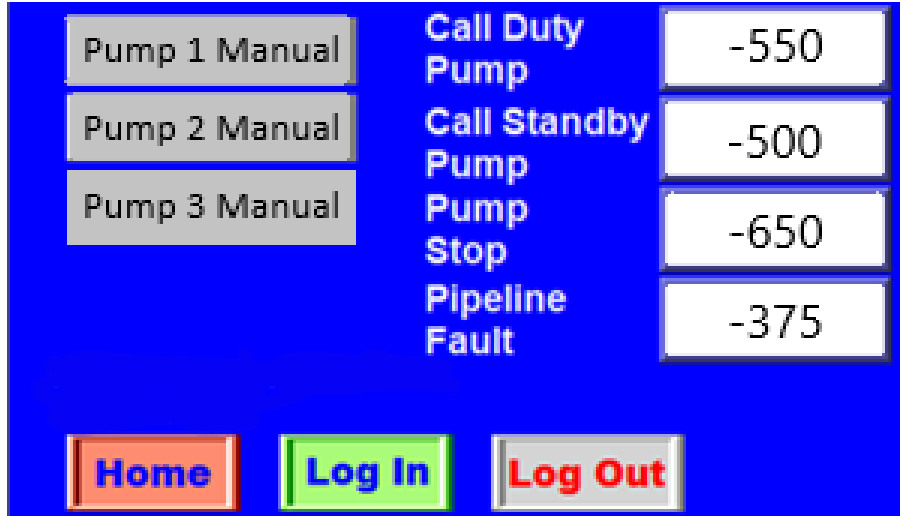


- Yellow Plant Fault :- illuminate's in the event of any single fault

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- b. Yellow Plant Emergency :- illuminates in the event of a dryer fault or the emergency pressure switch detecting receiver pressure below 450mm/Hg
- c. Red Pipeline Pressure Fault :- Illuminates if the Vacuum is lower than 360 mmHg

Setup Screen



- a. Pump 1 Manual :- Push and hold for 1 second to run pump 1 continuously (only visible if logged in)
- b. Pump 2 Manual :- Push and hold for 1 second to run pump 2 continuously (only visible if logged in)
- c. Pump 3 Manual :- Push and hold for 1 second to run pump 3 continuously (only visible if logged in)
- d. Call Duty Pump :- Set Pressure at which duty pumps start (can only be changed if logged in) Press to edit
- e. Call Standby Pump :- Set Pressure at which Standby pumps start (can only be changed if logged in) Press to edit
- f. Pump Stop :- Set Pressure at which all pumps stop (can only be changed if logged in) Press to edit
- g. Pipeline Fault :- Low Set Vacuum at which pipeline pressure alarm activates (can only be changed if logged in) Press to edit
- h. Red Prev Button :- press to return to Main Screen
- i. Green Login Button :- Press to enter login page (See Below)
- j. Grey Logout Button :- Press to Logout (prevents un-authorized editing of settings)

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Login Screen



- At the top we have “user” to login in if this is not already at 1 press the box and enter 1
- Below this we have “password” to login enter the password (555) and press enter
The box “labelled current status” should show a “1” when logged in and a “2” when logged out
- The grey “logout” button when pressed will logout the user so no alterations can be made
- The blue “setup” button will return you to the setup page.

Motor Starter Panel

Each pump shall be provided with a pump starter panel for the 400V 3 phase equipment to be wired into. This panel also includes an isolation switch, each pump motor has a manual motor breaker and contactor. They operate when the motor connected draws excessive current or if a phase is lost.

The trip current is set on the disc on the front of the breaker at the factory and should not need adjustment. There is a Manual Switch that allows testing of the unit.

GENERAL NOTE: it is recommended that all electrical work be carried out by a qualified electrician. The starter panel is controlled by a PLC and contains a number of LEDs to display various information.

The LEDs include the following:

Green LED – Mains On

Green LED – Pump Operating

Yellow LED – Control Circuit Failed – This fault should also bring up a Plant Fault on the main controller HMI.

Yellow LED – Motor Tripped - This fault should also bring up a Plant Fault on the main controller HMI.

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Yellow LED – Failed to Load – This fault should also bring up a Plant Fault on the main controller HMI.

Yellow LED – Over Temperature – This fault should also bring up a Plant Fault on the main controller HMI.

Normal operation

When a demand is put on the plant the primary pump(s) will start at 500mmHg and will run until a pressure of 650mmHg is achieved, if the pump(s) are unable to cope with the demand the second pump will start at 475mmHg, and both will run until a pressure of 650mmHg is achieved.

If the primary and secondary pumps combined are still unable to cope with the demand, then the third pump will start at 460mmHg and all 3 will run until a pressure of 650mmHg is achieved.

The Auto cycling of duty pump can be prevented by manually selecting either 1, 2 or 3 as duty using the touchscreen on the control panel.

The pumps can be made to run continuously, regardless of pressure by switching the Auto/Manual switch on the pump starter to manual. The reset button on the pump starter can be used to clear any of the fault indicators on the pump starter after the faults have been rectified.

In normal operation all volt free contacts shall be in the closed position. If the volt free contacts are in the open position and the troubleshooting guide does not address the situation, then EMC phenomena may need to be investigated.

Emergency operation

If for any reason none of the pumps start the plant will run on the emergency pressure switch set at 420mmHg, the yellow plant fault indicator will illuminate, and will call the primary pump(s) to run for a minimum time of 10 minutes.

If after 20 seconds, the pressure has not sufficiently risen above 420mmHg the third pump will start and run for a minimum of 10 minutes.

If after a further 20 seconds, the pressure still has not sufficiently risen above 420mmHg the fourth pump will start and run for a minimum of 10 minutes.

If the plant fault Lamp remains illuminated after the 10 minute pump run period, the pumps will continue to run until the lamp extinguishes.

If the pressure falls below 360mmHg the Red Pipeline pressure fault Indicator will illuminate.

Shutting Down the Plant

To shut the plant down - turn each isolator on the plant starter panels to the off position.

Note: This should not be attempted if the pump is on load.

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INSTALLATION

The installation must be carried out by a competent and suitably trained person to ensure the stability and safe operation of the equipment.

Mechanical

The plant is designed to be floor mounted by means of suitable floor fixings through the legs of the receiver. The mounting holes in the baseplate of the plant are 12mm diameter.

Siting

The plant should be easily accessible and should allow for all-round access for maintenance purposes.

The plant room temperature should be maintained in accordance with HTM 02-01. Oil flooded machines suffer from oil emulsification at low temperatures due to heated gases being drawn into the pumps via the intake, which condense and mix with the oil. Therefore, the plant room may need to be heated. The plantroom should be dedicated specifically to the medical vacuum plant.

Pipe work Connections

All soldered joints must be made by using inert gas soldering techniques, to prevent the pipeline from becoming contaminated.

A Stub located on the inlet side of the filters provides the Pipeline connection to the Plant. Exhaust Pipe Work from each pump should be installed out to atmosphere using the shortest possible route.

Where long or torturous pipe runs are unavoidable consideration should be given to increasing pipe diameters. Exhaust Outlets should be terminated with a mesh guard or similar to prevent small birds and insects entering the Pipe Work.

Any obstruction in the Exhaust Pipe Work will reduce Plant performance.

Always point Pipe Work downwards at termination to reduce rainwater penetration.

Electrical

Electrical power supply should be provided via three, three phase + neutral + earth supplies. The plant shall be connected to the essential power supply of the medical facility i.e. It shall be connected to the backup generator of the facility.

WARNING: The 230VAC power supply to the plant main controls is supplied by multiple sources.

WARNING: the Mains supply must have a protective Earth Connection

For MCB Sizes, please refer to the specific plant layout drawings.

Connections should be made to the wiring diagrams supplied with the plant.

MAINTENANCE

The two most important items to consider are oil and filters.

- Oil should be changed every 6 months or 1000 hours whichever comes first.
- Filters should be used individually and replaced at 12-month intervals.
- The plant should be in a controlled plant room with access limited to engineering staff only.
- Keep a daily logbook to record maintenance work carried out.

Routine Maintenance

DAILY.

- Oil levels should be visually checked and topped up as required with vacuum pump oil. Screw off the oil inlet cover and fill up to the maximum of the inspection glass located on the side of the pump. It is expected that a small amount of oil will need to be added every 1 or two weeks. Each oil check and top up should be recorded in the logbook.
- Visually check the medical vacuum filter differential pressure gauges, to ensure that the filter element is still working efficiently. Each inspection should be recorded in the logbook. If the differential pressure gauge indicates fail, the integrity of the system is not compromised, however the flow may be reduced, and the power consumption will be increased. In this case the element will need to be replaced.
- Visually inspect the plant for obvious signs of damage, or faults, or unusual noises.

WEEKLY.

- Observe all pumps whilst running and record the ammeter readings in the logbook. This will indicate the correct operation of the pumps.
- Check pump exhaust condensation drain traps, for accumulation of moisture, and empty if required. This condensation is due to the cooling of warm air in the exhaust pipework when the pump stops. This condensation is perfectly normal.
- Check Medical vacuum filter condensation drain traps, for accumulation of moisture, and empty if required. This condensation is due to the cooling of warm air in the filter bowl when there is no flow requirement through the filter. This condensation is perfectly normal. As this is connected to the medical vacuum supply, the contents should be treated as bio-hazardous. It is expected that this

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condensation will only need to be removed every two or three months as the moisture held in a vacuum is very little.

- Drain any moisture from the Receiver, using the manual drain valve.
- Change Duty Pump, (unless auto duty is selected on the main control panel).

MONTHLY (IN ADDITION TO THE ABOVE).

- Check Drain on Receiver using Valve.
- Check each Pump runs O.K. using Auto and Manual Switches (run for no less than 10 minutes each Pump).

EVERY SIX MONTHS.

- Check Pressure Sensor Cut In/ Cut Out Point of Duty.
- Change the duty filter, check the condition of the filter, replace if necessary.
- Change Oil in Pumps.
- Remove and replace medical vacuum filter elements, and 'O' ring seal on filter bowl. Record this in the logbook. The used parts should be treated as bio-hazardous.
- Check wiring connections are tight and secure.

EVERY 12 MONTHS.

- Drain and replace oil and oil filter in both pumps, check the condition of the oil, check for debris or suspended particles. The draining down of the pumps should be done one at a time to prevent the need for system shutdown. All maintenance carried out should be recorded in the logbook.
- Remove any build up of dust or other contamination from each pump.
- Check pressure switch settings and use a calibrated gauge, to gauge accuracy. Record the results in the logbook.
- Check that the pumps are securely mounted to the baseplate, tighten if necessary.
- Check overall plant operation and monitoring and warning alarm system.
- Re-commission plant to check each pumps performance and correct operation of plant.
- Check wiring connections are tight and secure.
- Change Bacterial Filter(s).

WARNING – Bacterial filters are classed as biohazardous, when changing filters full PPE should be worn including gloves, mask, disposable overalls and safety glasses, the filters and all components including PPE should be disposed of using correct biohazard protocols.

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The weekly and monthly checks should be completed by a suitably trained member of the hospital staff who has been trained by the installer or the relevant authorised person for the medical gas pipeline system.

Vessel Maintenance

Periodic insurance inspection will be required on the Pressure Vessel. The Vessel is provided with two inspection ports, one on each end.

Cleaning.

The device can be wiped with a lint free cloth using a mild disinfectant. The device shall be mounted in a dedicated locked plant room with restricted access.

EMC Warnings.

WARNING: Use of this equipment adjacent to or stacked with other equipment should be avoided because it could result in improper operation. If such use is necessary, this equipment and the other equipment should be observed to verify that they are operating normally.

WARNING: Use of accessories, transducers, and cables other than those specified or provided by the manufacturer of this equipment could result in increased electromagnetic emissions or decreased electromagnetic immunity of this equipment and result in improper operation.

WARNING: Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the Vacuum system, including cables specified by the manufacturer. Otherwise, degradation of the performance of this equipment could result.

NOTE: The EMISSIONS characteristics of this equipment make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If it is used in a residential environment (for which CISPR 11 class B is normally required) this equipment might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the equipment.

NOTE: Transducers and other ACCESSORIES that are replaceable and that are likely to affect compliance of the ME EQUIPMENT with the requirements of Clause 7 (EMISSIONS) and Clause 8 (IMMUNITY) of EN ISO 60601-1-2. These ACCESSORIES shall be specified by PRECISION UK. For replacement accessories please quote the SC or batch number on the labelling to the manufacturer.

The CPX MV-180-T Vacuum system has been tested to '*EN60601-1-2:2015 +A1:2021-Medical electrical equipment. Part 1-2: General requirements for basic safety and essential performance — Collateral Standard: Electromagnetic disturbances — Requirements and tests* for a professional healthcare environment and treated as a Group 1 Class A product.

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Fault Diagnosis

This document is aimed to aid with the diagnosis and remedy of faults which may occur with the PRECISION UK medical vacuum plant. It assumes that the unit has been correctly installed and commissioned.

Abbreviations used in this document:

MCB – Miniature Circuit Breaker

HMI – Human Machine Interface (Touchscreen)

PSU – Power Supply Unit

RTX1 – Alarm Contact Transmitter

PLC – Programmable Logic Controller

BMS – Building Management System

Ω - Ohms

LED – Light Emitting Diode

E-Stop – Emergency Stop Button

Component	Fault	Cause	Remedy
Whole plant	No vacuum production. No lights. No response	No power to any vacuum pump. Each pump should be on a separate MCB on the distribution board. <ol style="list-style-type: none"> No power to distribution board All MCBs are off. All pump isolators are off. PSU fuses have blown on all pump starters 	<ol style="list-style-type: none"> Apply power to the distribution board. Turn pump MCBs on Turn on the pump isolators. Fuses are within the pump starters. Replace with an identically rated fuse. These can be supplied if required. Note that consideration should be given as to why all of the fuses blew.
Controller	Pumps operating, but HMI blank	<ol style="list-style-type: none"> Failed HMI Failed fuse in control panel 	<p>If an RTX control board has been fitted on the plant, this will be LIVE, and MUST be isolated before continuing.</p> <p>Open top door of control panel (note that in the top panel, all circuits, except the RTX, are at 24V DC). If a light is flashing on the PLC, then the HMI or its cable has failed. Check that the power</p>

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			<p>cable to the HMI has not fallen out. If not, contact PRECISION UK for a replacement HMI.</p> <p>If the PLC light is not flashing, then the PLC is without power. Check the 1A fuse on the control board (see wiring diagram supplied in the control cabinet and in the certification pack supplied with the plant). Fuses are available locally or from PRECISION UK.</p>
Controller	'PLC no response' message on HMI	<ol style="list-style-type: none"> 1. Fault with the cable linking PLC and HMI 2. The PLC has failed 	<p>If an RTX control board has been fitted on the plant, this will be LIVE, and MUST be isolated before continuing.</p> <p>Open top door of control.</p> <ol style="list-style-type: none"> 1. Check the connectors are secure in the PLC and HMI. Check the cable between the PLC and HMI for wear or damage. Contact PRECISION UK for a replacement if required. 2. If the PLC light is off, ensure that 24VDC is supplied across the + and – terminals of the PLC. Check the tightness of power terminals. If power is being supplied, but the light is off, the PLC is likely to have failed. Contact PRECISION UK for a replacement.
Controller	Plant Fault light illuminated. No other errors on HMI	<ol style="list-style-type: none"> 1. A pump is in fault. 2. A pump has lost power. 3. Wiring fault – most likely a loose screw terminal 	<ol style="list-style-type: none"> 1. Identify the affected pump (yellow fault light will be illuminated on individual pump starter). See Pump Fault section to rectify. 2. Re-establish power to the pump. 3. Isolate power to the affected pump at the remote isolator or

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			MCB and isolate the RTX (if present). Tighten screw terminals in the affected pump starter panel, ensuring that the power is de-energised before tightening the terminals on the panel's rotary contactor.
Controller	Plant Emergency light illuminated. No other errors on HMI	<p>The emergency vacuum switch has triggered because the vacuum is insufficient. This could be caused by:</p> <ol style="list-style-type: none"> 1. One or more pumps not operating. 2. Out of calibration / faulty emergency pressure switch or wiring problem 3. A significant vacuum leak on the system 4. Too much demand for medical vacuum. The plant may have been specified incorrectly. 	<ol style="list-style-type: none"> 1. Check each of the pumps. If any are in fault (yellow lights on the front), move to Pump Fault section. 2. Remove the rubber cover on the pressure switch located on the incoming vacuum pipe. Check that both spade connectors are on the switch. Check the resistance across the switch, if the Plant Emergency warning is illuminated, the switch contact should be open. If it is closed, then there is a wiring fault between the switch and the control panel. Check the cables, crimps, and terminals. If the switch is open, Check reading on the vessel vacuum transducer and gauge. The emergency alarm level should be set to -420 mmHg. If the transducer pressure is significantly above this value, then the switch is faulty/out of calibration. Follow the guidance in Adjusting the Emergency Pressure Switch. If the transducer and gauge are also reading low vacuum, then move to 3 and 4. 3. Check the pipework for significant leaks and remedy any problems. 4. Contact PRECISION UK about how the plant can be upgraded.

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Controller	Pipeline Pressure Fault.	<p>Vacuum in the pipeline (as measured by the vacuum transducer) is insufficient. This is set to -375 mmHg. As the emergency pressure switch is set to -420mmHg, then the Pipeline Pressure Fault warning should only illuminate if the Plant Emergency light is also illuminated.</p> <p>If Plant Emergency is also illuminated, then:</p> <ol style="list-style-type: none"> 1. A filter may be blocked. 2. A significant leak in the system 3. Too much demand for vacuum. The plant may have been specified incorrectly. <p>If Plant Emergency is not illuminated, then:</p> <ol style="list-style-type: none"> 4. Pipeline vacuum transducer out of calibration / fault. 5. Loose connection 	<ol style="list-style-type: none"> 1. Two or more filters are provided, with a view that one should be in reserve. Check the differential pressure gauge on top – if in the red, swap to the second filter. Contact PRECISION UK about a replacement set of filters. 2. Check the dryer and downstream pipework for significant leaks. 3. Contact PRECISION UK about how the plant can be upgraded. 4. If the transducer is thought to be at fault, contact PRECISION UK for a replacement. 5. Isolate power to the plant and check all wiring and tighten relevant screw terminals.
Controller	Warning lights on RTX / BMS, but no warnings on HMI	<ol style="list-style-type: none"> 1. Loose wires 2. Relay failure 	<ol style="list-style-type: none"> 1. Isolate power to the plant and check the tightness of all screw terminals. 2. The relays that control the signals to the BMS can be unclipped and interchanged without changing the wiring. Swap relays and see if the problem moves to another circuit. If so, order a new relay from PRECISION UK.

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Pump Fault Finding

The following lights are present on the front of the pump starter:

Green: Mains On

Green: Pump running

Yellow: Control failed

Yellow: Motor Tripped

Yellow: Pump Failed

Note that the Pump Failed warning (and the alert that is sent back to the HMI) are latching and require a press of the reset button turn off.

Component	Fault	Cause	Remedy
Pump	Excessive vibration / noise	<ol style="list-style-type: none">1. Loss of one phase2. Bearing damage3. Motor-pump coupling damaged.4. Pump failure.	<p>Do not attempt any work in the pump controller or within the pump while it is still energised. Isolate the electrical supply before removing covers.</p> <ol style="list-style-type: none">1. Tighten all of the terminals. If this does not resolve, use a volt meter to identify if power goes as far as the motor, if not, it could be a contactor failure. If motor is powered to all phases, then it indicates a motor failure. Contact PRECISION UK for further advice.2. Remove fan cover at end of pump and rotate shaft by hand, feeling for any grinding. If found, contact PRECISION UK for further advice.3. Remove the fan over off the motor and the pump shaft. Attempt to rotate each in opposite directions. If they do, then the motor-pump coupling has failed. Contact PRECISION UK for a replacement.4. Take off the pump fan cover and rotate the shaft by hand. It should turn freely. If not, then

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			the pump is damaged. Contact PRECISION UK for a replacement.
Pump	Yellow Control Failed light illuminated	The pump control circuit has lost power, either because the whole pump has lost power, or the 24V control circuit has lost power.	<p>Confirm that the pump has power. Check the breaker on distribution board, the local isolator and rotary isolator on pump.</p> <p>If there is power coming out of all 3 phases on the rotary isolator:</p> <ul style="list-style-type: none"> • Check if the 24V PSU has power (green LED on PSU). If not, check the 3.15A 240V fuse for the PSU (wires 10 and 11 going into it). • Check there is a connection between the neutral PSU terminal and the incoming neutral wire. • If PSU light is on, check the 1.6A fuse on the DC side of PSU (wires 20 and 21 going into it). Check the 1.5A fuse (wires 21 and 26 going to it) • Check the relay R1 (wires 27, 66 and 68 going to it) is functioning correctly
Pump	Yellow Motor Tripped light illuminated	<p>Current monitoring of the pump has indicated a problem which has led to a trip. Possible causes are:</p> <ol style="list-style-type: none"> 1. Loose wiring. As a safety alarm, it is normally open, so any loose contact caused by vibration from the pump will cause an error. 	<p>Do not attempt any work in the pump starter or within the pump while it is still energised. Isolate the electrical supply to the pump before removing covers.</p> <ol style="list-style-type: none"> 1. Check the tightness of all screw terminals. 2. Measure resistance between phases. Should be >999MΩ. Measure the resistance between all the phases and earth¹. Should be >999MΩ. If

¹ If the pump has an inverter fitted, this will give a false reading on resistance measurement. Cables should be removed from the inverter before testing.

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		<ol style="list-style-type: none"> 2. Short in the wiring, either between phases or to earth. 3. Motor failure. Could be due to a bearing failure, or in the pump module. 4. Motor overheat. Excessively high temperatures will result in high currents, which will be detected. 5. Overload contactor failure 	<p>the pump fails the test, contact PRECISION UK for further advice.</p> <ol style="list-style-type: none"> 3. Remove the cover and manually try and rotate the shaft – it should rotate relatively easily. If the pump fails the test, contact PRECISION UK for further advice. 4. Measure the currents through each phase. Compare this to the motor rating plate and the values when factory tested (provided in the inspection certification) 5. If the pump passes all of the tests above, it is possible that that the overload contactor has failed. Contact PRECISION UK for a replacement.
Pump	Pump Failed Light	<p>This light is illuminated if the pump is being asked to operate by the control system, but after a set time the pipeline vacuum level (as measured by the vacuum transducer) has decreased.</p> <p>Possible causes are:</p> <ol style="list-style-type: none"> 1. A significant leak within the pump 2. A loose wire on the input signal from the control panel (into input 1E on the PLC). 3. A loose wire on the pressure input signal from the pump (wire 37) 4. Calibration drift on the pressure switch 5. Pump failed. This could include the motor, pump, etc. 	<p>Isolate power to the pump before proceeding.</p> <ol style="list-style-type: none"> 1. Check the internal fittings of the pump for a significant leak. 2. Check the tightness of all screw terminals. 3. Check the tightness of all screw terminals. 4. Adjust the set point using the screw terminal on the top of the switch. 5. Remove the fan cover and attempt to rotate the shaft. If seized, contact PRECISION UK for a replacement.

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Pump	Pump leaking oil from access metal access plug at rear of pump	<ol style="list-style-type: none"> 1. Plug not tight enough. 2. O-ring damaged 	<ol style="list-style-type: none"> 1. Tighten plug. PRECISION UK can supply a special tool to facilitate this if required. 2. Remove cap and inspect O-ring. PRECISION UK can supply a new O-ring if required.
Pump	Pump leaking oil from the plastic ballast valve cap at front of pump	<ol style="list-style-type: none"> 1. Ballast valve failed 	<ol style="list-style-type: none"> 1. Isolate ballast valve using the ¼ turn valve before the ballast valve (ballast valve is not required for normal medical vacuum requirements). If this does not prevent oil leaking, then the isolation valve may have failed. A replacement can be ordered from PRECISION UK.

RECALIBRATING THE EMERGENCY VACUUM SWITCH

*This can only be undertaken by taking the Medical Vacuum system offline and **stopping the availability of vacuum**. If this is not possible, do not attempt the following procedure and order a new pressure switch from PRECISION UK.*

- The target vacuum for the switch is -420 mmHg.
- Shut off the valves between the vacuum transducer and the vacuum users, to trap a set level of vacuum in the Medical Vacuum plant. **This will prevent the availability of vacuum to users.**
- Take the rubber cover off the emergency pressure switch.
- While wearing gloves to protect hands from any possible biological contaminants, close the quarter turn valve at the bottom of the filter and unscrew the capture bottle.
- Turn off as many pumps as is required to only leave one operational. This is because the pumps will turn on as the vacuum becomes worse – having more pumps on makes it more difficult to achieve the required vacuum level.
- While observing the vacuum level on the HMI, slowly open a valve on the bottom of the filter to allow air in. Note the vacuum level at which the Plant Emergency warning is illuminated.
- Close the valve at the bottom of the filter to allow the vacuum to reach normal levels.
- If the Plant Emergency warning was triggered at a better vacuum than -420mmHg, then use a screwdriver to turn the pressure switch setting screw *slightly* clockwise (note that the screw setting is **very** sensitive). Conversely, if the Plant Emergency warning was triggered at a worse vacuum than -420mmHg, then use a screwdriver to turn the pressure switch *slightly* counter clockwise (note that the screw setting is very sensitive).

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- Due to hysteresis in the switch, it may need several cycles of lowering the vacuum, noting the alarm pressure, adjusting and re-establishing the vacuum.
- When the switch is set, turn the pumps back on, replace the glass collection jar on the filter and open the valve at the bottom of the filter. Open the pipeline valve to allow vacuum to the end users.

REPLACING THE BACTERIAL FILTER

This can only be undertaken by taking by a trained professional full PPE should be provided as the filter is classed as a biological hazard and should be discarded using the biohazard protocols of the healthcare facility.

- Put on your personal protective equipment which should include, Biohazard gloves, a paper overall to cover the whole body including the head, safety goggles and shoe covers, you will also require 2 number biohazard bags 1 for the filter which should be placed inside the other bag which is for the PPE when the task is completed.
- Open the standby filter lockable line valves so the flow is now flowing through both filter assemblies.
- Close the duty filter lockable line valves so flow does not flow through the filter.
- Close the small valve for the glass jar at the bottom of the used filter.
- Carefully remove the glass jar by turning it counterclockwise slowly being careful to remove the pressure slowly within the jar.
- Slowly open the small valve of the filter housing to remove all the pressure.
- Using a strap clamp unscrew the filter housing removable portion and place it to one side revealing the filter to be replaced.
- Remove the filter by unscrewing anti clockwise and place in the biohazard bag seal the bag and place the biohazard bag inside the second biohazard bag. Remove the provided PPE and place it into the second bag and seal the bag.
- Replace the filter with the same type for filter types please contact Precision UK quoting the size of plant and the SC number on the label.
- Replace the removable filter cover using the strap clamp to tighten.
- Replace the jar by screwing it clockwise until it feels tight.
- Open the small valve on the bottom of the filter housing.
- This assembly is now the standby assembly and should be offline until the duty filter requires replacing in 6 months or after 1000 hours whichever comes first.

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SPARE PARTS

5 Liters of vacuum pump oil

VACOIL5

1 x Bacterial Filter

please specify batch number of Plant located inside control panel.

Any other spare parts required please refer to the batch number on the plant labelling inside the control panel.

WARRANTY

The CPX automatic manifolds comes with a 12-month warranty from day of shipment. Within this period Precision UK will repair, replace any part on site, or at the factory, which is proven defective at Precision UK's cost.

Furthermore, Precision UK will warrant its materials to be free from defects for an additional period of four (4) years (five (5) in total from date of shipment). Within this period Precision UK will replace any part, at no charge, which is proven to be defective. Shipping cost after the first twelve (12) months will be borne by the customer.

This warranty is valid when the product has been properly installed according to Precision UK's specifications, used in a normal manner and serviced according to the factory recommendations. It does not cover failure due to damage which occurs in shipments or failures which resulted from accidents, misuse, abuse, neglect, mishandling, alteration, misapplication or damage that may be attributable to acts of God.

Precision UK shall not be liable for incidental or consequential damages resulting from the use of this equipment.

DISPOSAL



The CPX Medical Vacuum plant is made up of many parts which can be recycled. Please recycle all parts of this device which are recyclable. These include all metal and plastic parts, copper wire and cable. Please ensure this device is disposed of in an environmentally friendly way.

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CONTACT US

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REGULATORY REQUIREMENTS

The following British, European and International Standards have been consulted during the design, manufacture and testing of the CPX Medical Vacuum Plant.

√ BS EN 14971:2019	Medical Devices. Risk Analysis
√ BS EN 13348:2016	Copper and copper alloys. Seamless round copper tubes for medical gases or vacuum.
√ ISO 7396-1:2016+A1:2021	Medical gas pipeline systems. Pipeline systems for compressed medical gases and vacuum.
√ BS EN 60601-1:2006+A2:2021	Medical electrical equipment. General requirements for basic safety.
√ BS EN 60601-1-2 :2015+A1:2021	Medical electrical equipment. General requirements for basic safety. Electromagnetic Compatibility – Requirements & Tests.
√ HTM 02-01	Medical gas pipeline systems. Design, installation, validation, and verification.
√ BS EN 286:1991	Simple unfired pressure vessels designed to contain air or nitrogen. Design, manufacture, and testing.
√ BS 5169:1992	Specification for fusion welded steel air receivers.
√ EN ISO 62366-1:2015+A1:2020	Medical devices — Part 1: Application of usability engineering to medical devices.
√ EN ISO 10993-1:2020	Biological evaluation of medical devices — Part 1: Evaluation and testing within a risk management process. Please see biocompatibility file
√ EN ISO 15001:2011	Anaesthetic and respiratory equipment — Compatibility with oxygen.
√ EN ISO 62304:2006+A1:2015	Medical Device Software — Software life-cycle processes

APPENDIX A: OPERATIONS & MAINTENANCE MANUAL APPROVAL

The undersigned acknowledge they have reviewed the Triplex Medical Vacuum Plant **Installation, O&M Manual Template** and agree with the approach it presents. Changes to this **O&M Manual Template** will be coordinated with and approved by the undersigned or their designated representatives.

Signature: *K. Pugh* Date: 30/01/2024

Print Name: Kevin Pugh

Title: Engineer

Role: Author

Signature: *I. Hughes* Date: 30/01/2024

Print Name: Ian Hughes

Title: Quality Manager

Role: Reviewer