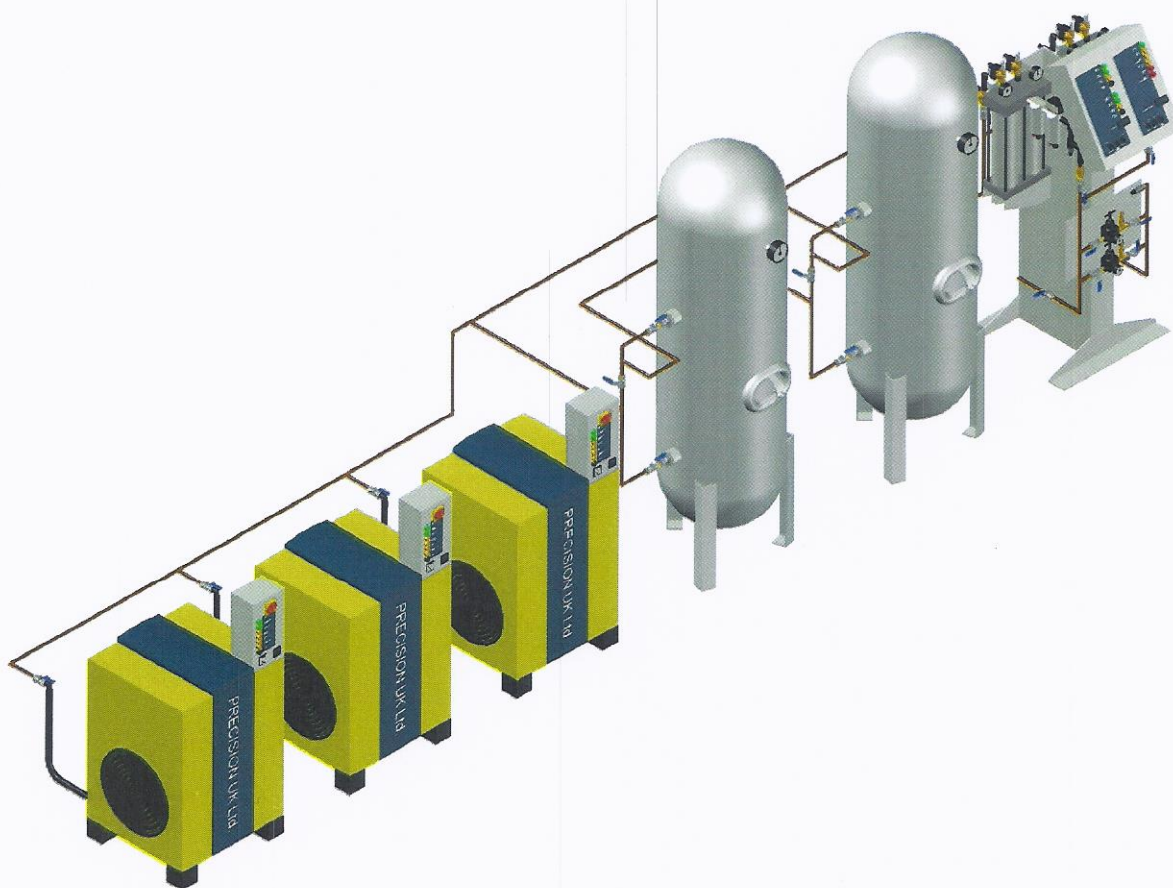


HTM02-01 TRIPLEX & QUADPLEX MEDICAL AIR PLANT

Kaeser Screw compressors **Installation, Operations & Maintenance Manual**



VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Matthew Dean	26/10/2015			1 st Issue

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1 INTRODUCTION

The CPX medical air plant shall fully comply with the United Kingdom Department of Health (D.o.H) HTM02-01, HTM2022 and NHS Model Engineering Specification C11. This plant is manufactured under ISO13485:2003 quality management system, a copy of the certificate shall be provided for review. CPX medical air plant shall ensure that medical quality air to European Pharmacopoeia monograph shall be delivered at pressures of 400kPa (4 bar), 700kPa (7 bar) or 1000kPa (10 bar) gauge for the supply of the hospital medical or surgical air systems. The entire system shall be as a minimum "duplexed" such that any single functional component failure will not affect the integrity of the medical gas compressed air system supply. The plant consists of a vertical air receiver or receivers (with automatic and manual drain valve), oil filled rotary screw type compressors, duplex filter dryer module, compressor starter panels, plant and dryer control units. Supplied factory tested and fully assembled unit ready to install as a plug and play item. Certificate of conformity shall accompany the Medical Air Plant.

2 SYSTEM DESCRIPTION

2.1 KEY FEATURES

The Precision UK Medical Air Plant has been designed to meet the requirements of the NHS Health Technical memorandums HTM2022 or HTM 02-01 dependent upon customer requirements. All medical air plants include the following:-

One or more vertical Air Receivers fitted with an Automatic and Manual Drain Valve, a Pressure Gauge and a Pressure Relief Valve.

Dryer assembly incorporating:-

Duplex 1 micron oil/water Separation Filters each fitted with Differential Pressure Gauge and Automatic Float Type Drain Valve.

Duplex Desiccant Regenerating Dryers with Pressure Gauges fitted to each column

Duplex activated Carbon filters for odour and dust removal each fitted with Manual Drain Valve.

Duplex 0.01 micron Medical Sterile filters each fitted with Differential Pressure Gauge and Manual Drain Valve.

Duplex Pressure Reducing Regulator set, and Line Pressure Relief Valve Assemblies.

A Dryer Control Unit incorporating Duplex PLC's for Cycle Timing, Economy/Continuous Switches for each dryer, a Duty dryer selector switch), a Dew Point Sensing Circuit to detect moisture after the Dryers and a Line Pressure Sensors and a pressure switch in each dryer sub-assembly.

A Plant Control Unit incorporating a Pressure Gauge, a Duty Selector Switch, Receiver pressure transducer and a Plant Emergency Run Pressure Switch. Status Indicators for Normal, Plant Fault, Plant Emergency, Reserve Low system fault, Pipeline Pressure Fault.

All Alarm Contacts are duplicate allowing complete dual Alarm System or BMS/Alarm Connection.

Oil flooded Rotary Screw Compressors each fitted with After Coolers, non-return valve, Flexible Hoses and Anti – Vibration Mountings.

Each Compressor has a Starter Panel incorporating Isolator, control PLC, Relays, Indicators for; Mains On, Compressor Running, Control Circuit Failed, Motor Tripped, Over Temperature and Compressor Failed. Each Compressor has a Reset Button.

2.2 MOTOR PROTECTION

Each Compressor 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.

2.3 SYSTEM OPERATIONS

The Duty Compressor(s) Maintain pressure in the receiver between 9 and 10 bar, if the Duty Compressor(s) fail or cannot cope with the System demand, the Standby Compressor(s) will start at 8.5 bar.

In the event of All Compressors failing to start the Plant Emergency Switch will Activate at 8 bar, the Dryer Fail Pressure Switch will operate at 6.5 bar followed by the Line Pressure transducer/switches.

2.4 INITIAL POWERING UP

Check Compressor oil levels are O.K. top up if necessary

Switch Compressor 1 Auto/Manual Switch to Manual, this will ensure the Compressor starts immediately.

Switch the isolator on Compressor number 1 starter to the on position

Quickly note the direction of rotation of Compressor 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 Compressor number 2.

Once it is established that all Compressors are rotating in the correct direction the plant can be brought on line after a few initial checks:-

1. Ensure that all isolation valves are all in the open position
2. That all filter drain valves are closed
3. That the drain valve at the base of the vessel(s) is closed
4. That all pipe work connected to the plant is appropriate.
5. On the 'control panel' ensure that the Duty selector switch is in the auto position. This is the default position and will cycle the duty compressor every time a compressor is called to run.

Switch all the Compressor isolators to the on position. One of the Compressors will start to run shortly followed by the standby(s).

Once powered up, the Duty Compressor(s) start immediately followed by the Standby Compressor(S), the Compressor Failed Lamps and the Dryer Failed Lamps may be on.

Once the Duty and Standby Compressors have stopped then press All Compressor and the Dryer Reset Buttons.

If the dryer will not reset to normal the dryers may be wet. Try running both dryers on "Continuous" for 30 minutes while also leaking a little air from the test point to allow a flow of dry air over the dew-point transmitter. The dryer should now reset to normal.

The plant can now be left to operate normally

2.5 NORMAL OPERATION

When a demand is put on the plant the duty Compressor will start at 9 Bar and will run until a pressure of 10 Bar is achieved, if the Compressor is unable to cope with the demand the standby Compressor will start at 8.5 Bar and all will run until a pressure of 10 Bar is achieved.

The duty dryer when set to economy will dump when any compressor runs it will then continue to purge and cycle until all the compressors are stopped.

2.6 EMERGENCY OPERATION

If for any reason none of the compressors start the plant will run on the emergency pressure switch set at 8.5 bar, the yellow plant fault indicator will illuminate, and will call compressor number 1 to run.

If after 20 seconds the Compressor has not produced sufficient air to increase receiver pressure Compressor number 2 will start. And so on for all compressors.

If the pressure falls below 3.8 Bar. For medical air or 6.5 Bar for surgical air Red Pipeline pressure fault Indicator will illuminate.

The dryer will run while the compressors are in emergency operation.

If there is a pressure fault in the duty dryer the dry control will automatically change over to the standby dryer and a dryer fault will be indicated.

If there is a Dewpoint fault in the duty dryer the dry control will automatically change over to the standby dryer and a dryer fault will be indicated.

2.7 DRYER OPERATION

The Dryer operates automatically in synchronization with the Compressors. Both Dryers are fitted with Economy/Continuous Switches, which allow manual operation for maintenance purposes.

In Auto Mode the Dryer can be seen to operate only when the Compressors run. This uses air to regenerate only when a demand exists (Economy Mode).

The operation time is a 12-minute cycle, each tower being on stream for 6 minutes. During the last minute of each towers cycle, the Dump Solenoid Valves close to allow pressure to equalise in both columns ready for changeover. This time stops and starts with the Compressors in Auto Mode but can best be time checked in hand.

2.8 DUTY COMPRESSOR SELECTION

The duty Selector Switch on the Control Panel indicates the Duty Compressor. This will prevent auto cycling of the compressors and should only be used to ensure even usage

The compressors can be made to run continuously, regardless of pressure by switching the auto/manual switch to manual for that compressor on the control panel.

Specialists in HTM02-01 Medical Gas Pipeline Equipment

The reset button on the compressor starter can be used to clear any of the fault indicators on the compressor starter after the faults have been rectified.

2.9 DUTY FILTER/DRYER SELECTION

The Dryer Control Panel has a Duty Selector Switch for Manual Selection of the Dryer/ Filter Set, however, in the event of a Dryer fault the selected (failed) Dryer is isolated and the Standby Dryer automatically put on stream.

Both Dryers have Manual Isolation Ball Valves on Inlet and Outlet sides all should be left open to allow auto changeover. These Valves are only for servicing and maintenance use.

2.10 SAFETY

Please ensure that this installation, operation and maintenance manual is read thoroughly by all parties concerned, and that all of its contents are understood, prior to commencement of work.

Qualified personnel are persons 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.

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.



This equipment should be kept clean and be free from oil and grease at all times. Oxygen will ignite spontaneously in the presence of oil and grease. If you suspect that any equipment is contaminated, do not use it.

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.

3 INSTALLATION

3.1 MECHANICAL

The Plant is designed to be floor mounted. The Compressor Unit should be mounted on the pads provided, the legs of the receiver and the Dryer Frame should be fastened direct to the floor through the frame Mounting Brackets. The mounting holes in the Receiver and Dryer are 10 mm diameter.

3.2 SITING

Plant room ambient temperature should be between 10°C and 40°C. Oil flooded machines suffer from oil emulsification at low temperatures due to heated gases being drawn into the compressors via the intake, which condense and mix with the oil. Therefore the plant room may need to be heated.

3.3 PIPEWORK CONNECTIONS

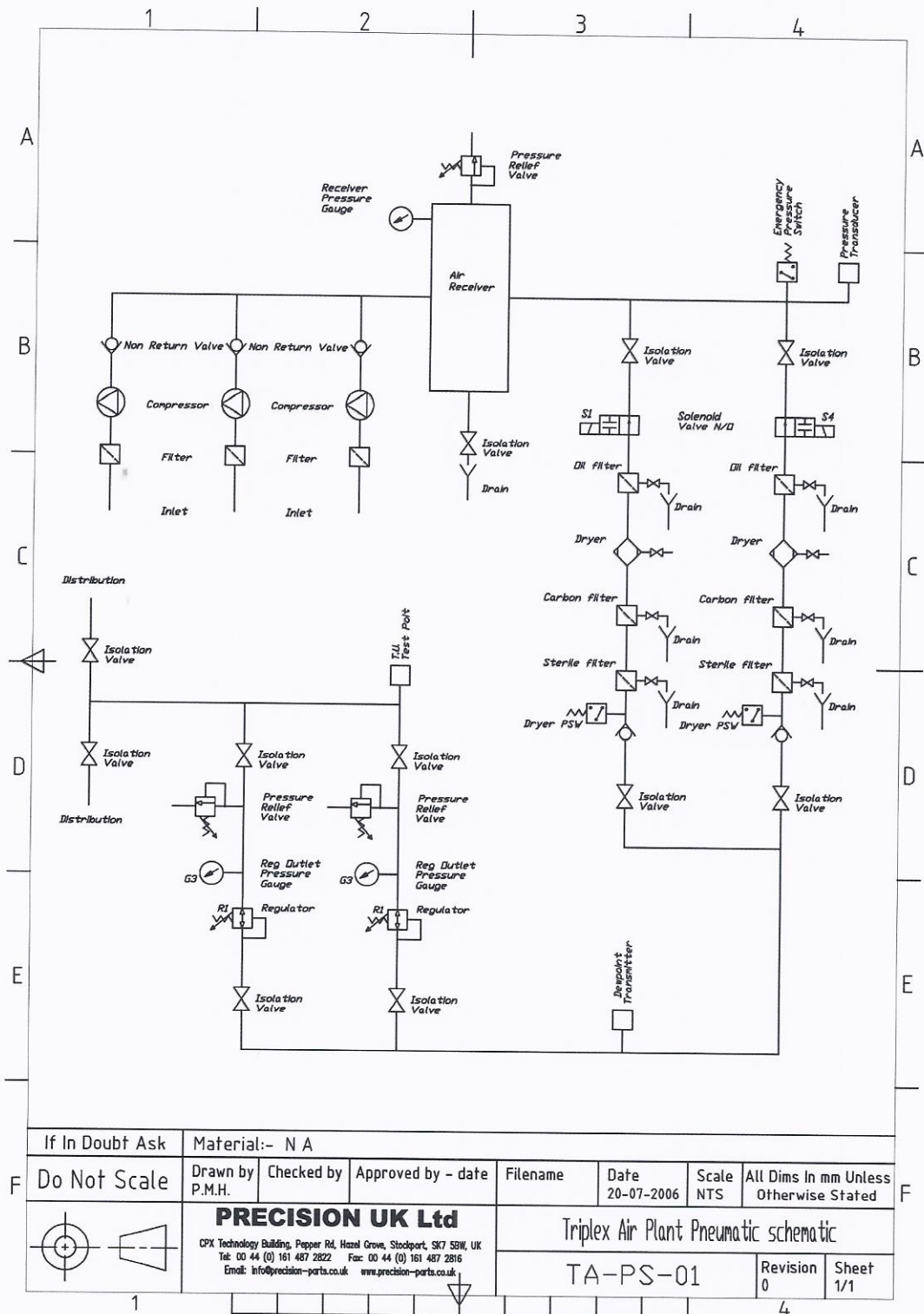
All soldered joints must be made by using inert gas soldering techniques, to prevent the pipeline from becoming contaminated.

Once sited connect the flexible pipe from the Compressors to the Vessel Pipe work and the Vessel to the Dryer Pipe work at the rear.

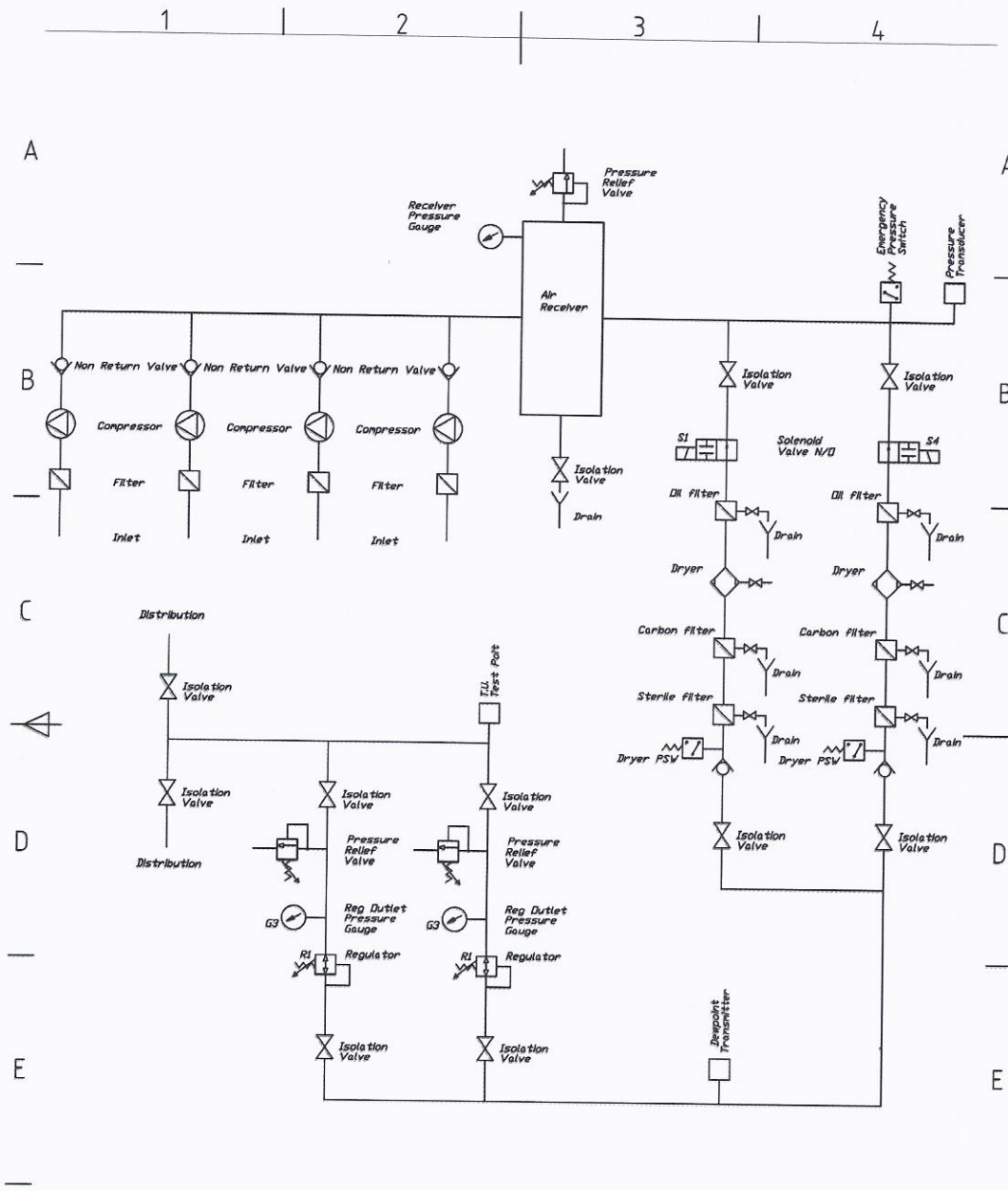
Where long or tortuous pipe runs are unavoidable consideration should be given to increasing pipe diameters. Exhaust Outlets should be terminated with a mesh guard or similar to prevent small birds and insects entering the Pipe Work.

<i>Plant model</i>	<i>Plant Flow</i>	<i>4 Bar Connection</i>	<i>7 Bar Connection</i>
MA-420-T	420 l/min	15mm	15mm
MA-580-T	580 l/min	15mm	15mm
MA-850-T	850 l/min	15mm	15mm
MA-1450-T	1300 l/min	15mm	15mm
MA-1800-T	1800 l/min	22mm	15mm
MA-2600-T	2600 l/min	28mm	22mm
MA-3000-T	3000 l/min	28mm	22mm
MA-840-Q	840 l/min	15mm	15mm
MA-1160-Q	1160 l/min	15mm	15mm
MA-1700-Q	1600 l/min	22mm	15mm
MA-2900-Q	2600 l/min	28mm	22mm
MA-3600-Q	3800 l/min	35mm	28mm
MA-5200-Q	5200 l/min	35mm	28mm
MA-6000-Q	6000 l/min	42mm	35mm

3.4 TRIPLEX AIR PLANT PNEUMATIC SCHEMATIC



3.5 QUADPLEX AIR PLANT PNEUMATIC SCHEMATIC



If In Doubt Ask		Material:- N A								
F	Do Not Scale	Drawn by P.M.H.	Checked by	Approved by - date	Filename	Date 20-07-2006	Scale NTS	All Dims In mm Unless Otherwise Stated		
		PRECISION UK Ltd					Quad Air Plant Pneumatic schematic			
		CPX Technology Building, Pepper Rd, Hazel Grove, Stockport, SK7 5BW, UK Tel: 00 44 (0) 161 487 2822 Fax: 00 44 (0) 161 487 2816 Email: info@precision-parts.co.uk www.precision-parts.co.uk					QA-PS-01		Revision 0	Sheet 1/1
										

3.6 ELECTRICAL

The entire electrical installation should be in accordance with the most up to date edition of the IEE Regulations for electrical installation.

Care should be taken when determining pipe work locations to avoid pipes coming into contact with electrical cables, therefore reducing the risk of electric shock.

Each compressor and the dryer should be on a separate circuit on a board which forms part of the "essential" Supply fed by the emergency generator system. This also applies for the alarms connected to the medical air Plant.

Each Compressor starter panel requires a three phase + neutral + earth Supply in accordance with the table below.

The dryer panel requires an un-switched single phase+ neutral + earth supply fused at 5 amps.

<i>Plant model</i>	<i>Power</i>	<i>Full load currents</i>	<i>Fuse Size</i>	<i>Connection Drg. No.</i>
MA-420-T	3 x 4.0kW	2 x 8,5A	2 x 10A	DA-CD-01
MA-580-T	3 x 5.5kW	2 x 11.3A	2 x 16A	DA-CD-01
MA-850-T	3 x 7.5kW	2 x 17A	2 x 20A	DA-CD-01
MA-1450-T	3 x 11.0kW	2 x 24A	2 x 35A	DA-CD-01
MA-1800-T	3 x 15.0kW	2 x 33A	2 x 35A	DA-CD-01
MA-2600-T	3 x 18.5kW	2 x 39A	2 x 50A	DA-CD-01
MA-3000-T	3 x 22.0kW	2 x 47A	2 x 50A	DA-CD-01
MA-840-Q	4 x 4.0kW	3 x 8,5A	3 x 10A	TA-CD-01
MA-1160-Q	4 x 5.0kW	3 x 11.3A	3 x 16A	TA-CD-01
MA-1700-Q	4 x 7.5kW	3 x 17A	3 x 20A	TA-CD-01
MA-2900-Q	4 x 11.0kW	3 x 24A	3 x 35A	TA-CD-01
MA-3600-Q	4 x 15.0kW	3 x 33A	3 x 35A	TA-CD-01
MA-5200-Q	4 x 18.5kW	3 x 39A	3 x 50A	TA-CD-01
MA-6000-Q	4 x 22.0kW	3 x 47A	3 x 50A	TA-CD-01

Plant/Central alarms should be connected to one set of the volt free normally energised closed contacts provided. The other set is for connection to the building management system if required. These will go open circuit in the event of a fault or power failure.

The contacts are rated at 5A, 240V AC/DC and transmit the following conditions:

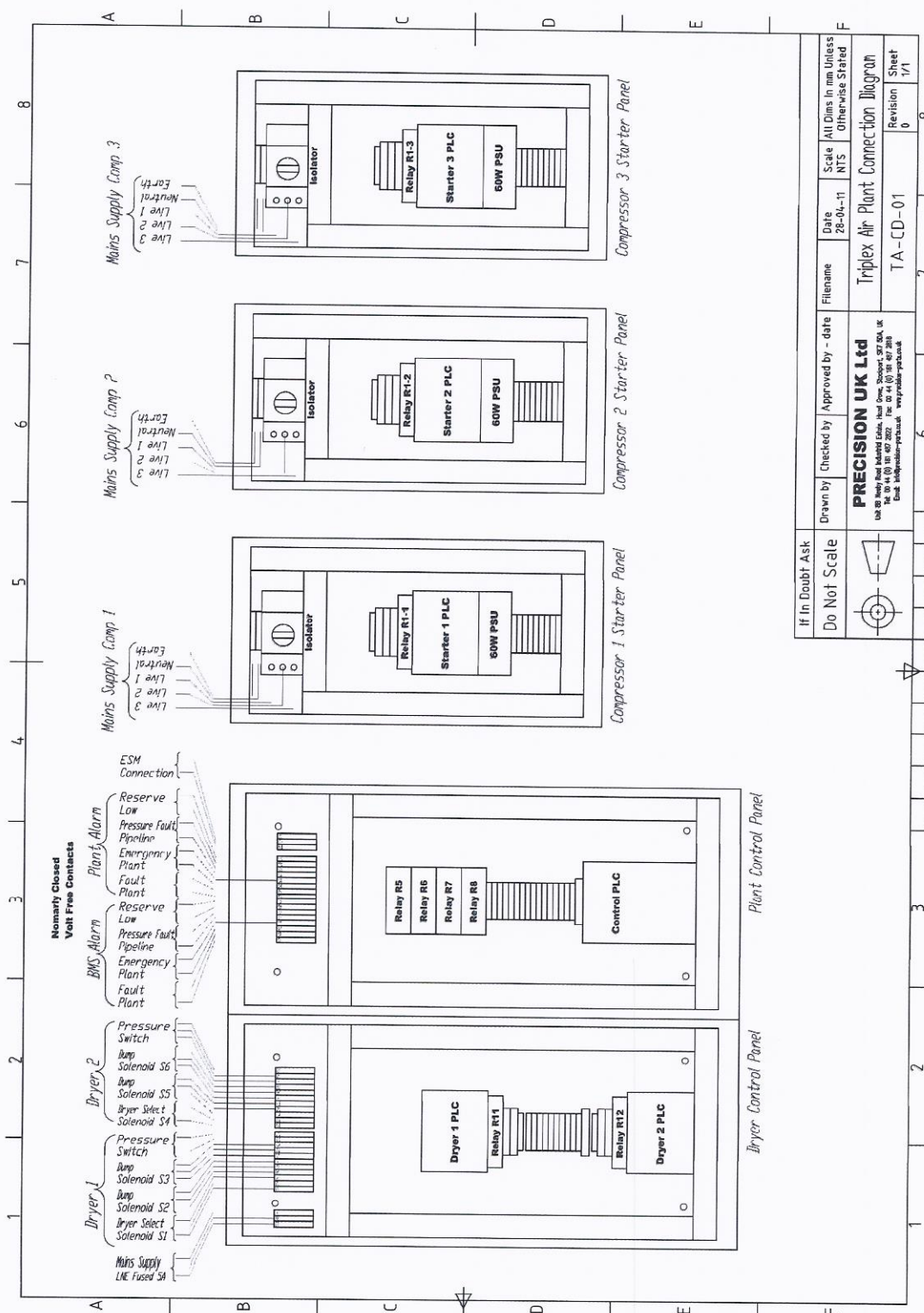
"Plant Fault"

"Plant Emergency"

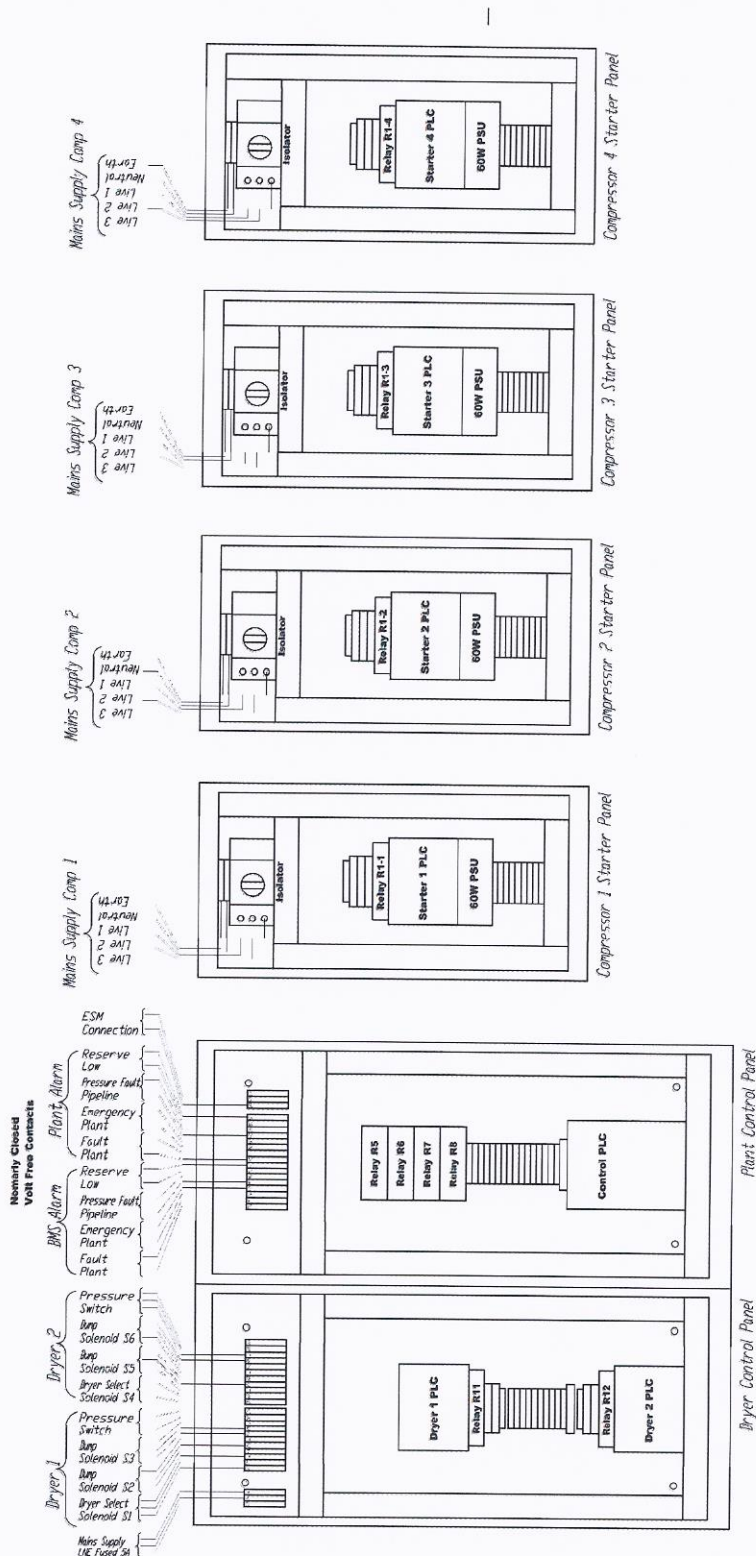
"Reserve Low"


"Pipeline Pressure Fault."

3.7 TRIPLEX AIR PLANT CONNECTION DIAGRAM



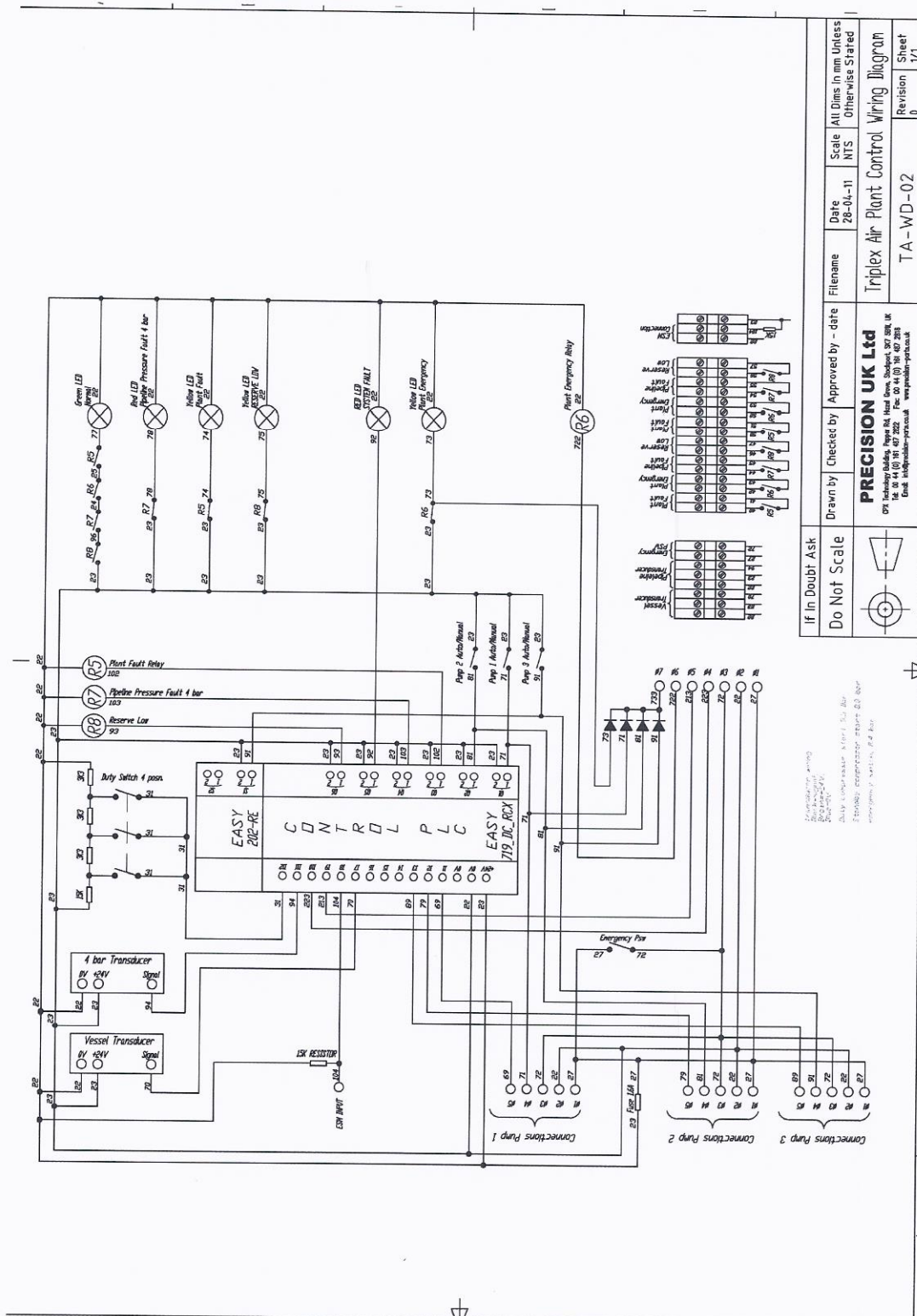
3.8 QUADPLEX AIR PLANT CONNECTION DIAGRAM



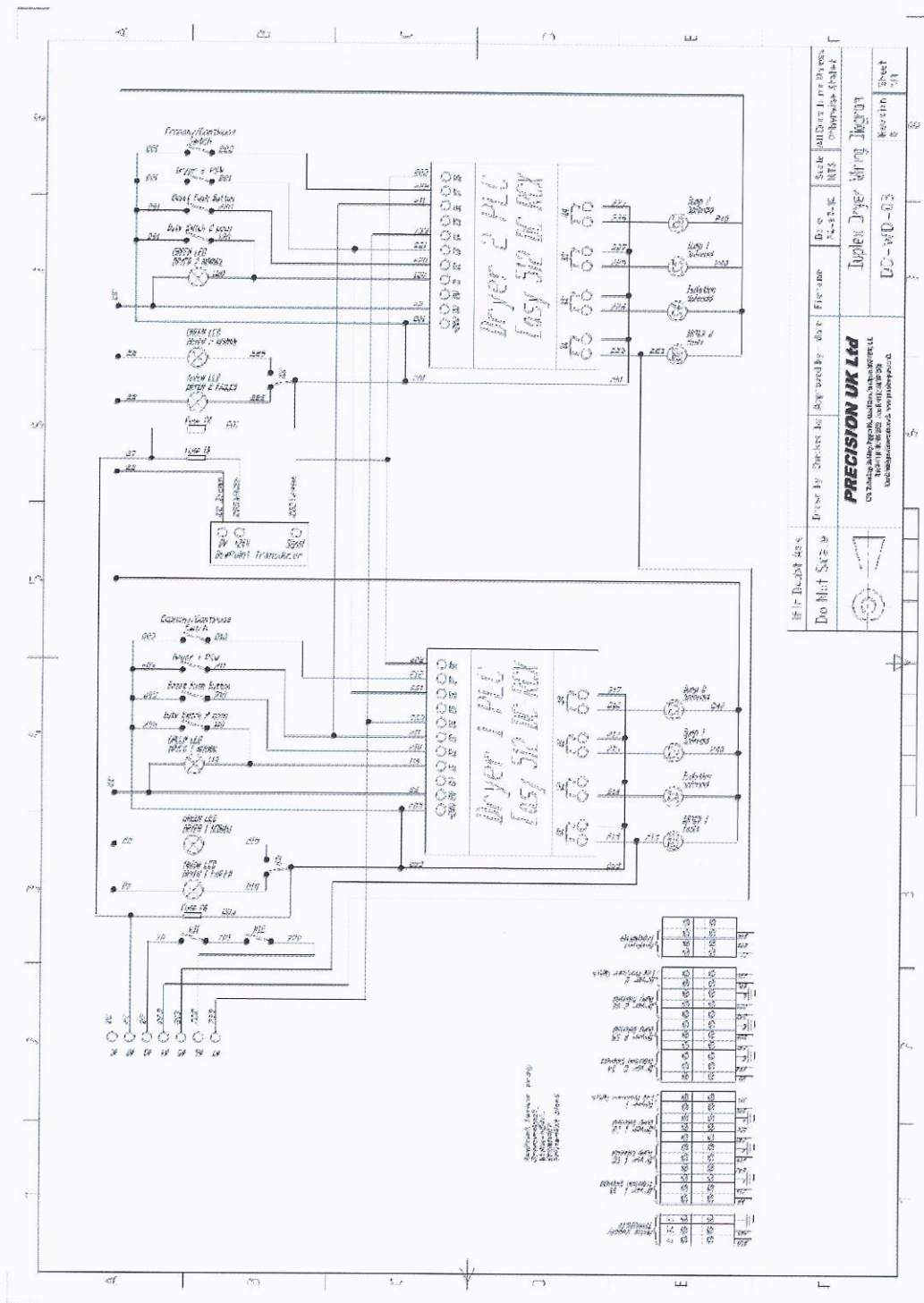
If in Doubt Ask Do Not Scale		Drawn by	Checked by	Approved by - date	Filename	Date	Scale	All Dims in mm Unless Otherwise Stated	Revision	Sheet
					Quad Air Plant Connection Diagram	28-04-11	NTS		0	1/1



3.9 TRIPLEX AIR PLANT CONTROL WIRING DIAGRAM



3.11 DUPLEX DRYER CONTROL PANEL



4 MAINTENANCE

4.1 GENERAL

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

Oil should be changed every 6 months or 1000 hours whichever comes first.

Pre and activated Carbon Filters should be replaced at 12-month intervals but Sterile filters every 6 months.

4.2 PREVENTATIVE MAINTENANCE

WEEKLY;

Check Vessel Drain operation.

Check oil levels, top up if necessary.

Check Compressor hours

Select Duty Compressors based on hours run. If even set to auto.

Change Duty Dryer.

MONTHLY;

Check Drain on Receiver using Manual Valve.

Check each Compressor runs O.K. using Manual/Auto Switches (run for no less than 10 minutes each Compressor).

EVERY 6 MONTHS;

Change Sterile Filter Elements.

EVERY 12 MONTHS;

Check all Pressure relief valves

Send Pressure transducers for calibration.

Send dew-point transducer for calibration.

Change oil in Compressors.

Any other maintenance to the compressors as recommended by the manufacturer

Tighten Electrical Connections.

Check all Switch settings.

Change Pre and Active Carbon Filter Elements.

4.3 VESSEL MAINTENANCE

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

4.4 FAULT DIAGNOSIS

SYMPTOM.	FAULT.	ACTION
Motor will not start.	Circuit breaker tripped/blown.	Check all Electrical Switchgear, Cables and Motor.
	Motor burnt out.	Return Compressor for repair.
	Overload tripped	Isolate Supply Power, reset Overload Trip.
	Motor or Air temp is high	Ensure Inlet to Motor Fan or After Cooler is not obstructed.
Standby Compressor Running.	Duty Compressor failed.	Check Motor is running.
	Plant overuse.	Check sizing.
Dryer Pressure fault.	Filter element blocked.	Replace filter.
	Pressure Switch faulty.	Reset set Point.
	Dryer hang up.	Check solenoids.
Dryer Dew point fault.	Desiccant Saturated	Change Desiccant, dry for 30mins by running on manual Then Reset.
	Dew-point Sensor needs calibrating	Calibrate Dew-point sensor
Reserve Lamp on.	E.S.M. empty.	Check ESM.
System Fault.	Fault in ESM Wiring.	Check ESM Wiring
Line Pressure fault.	Regulator set point low or high.	Check setting.
	Line Pressure Transducers Need Calibrating.	Calibrate Transducers.

5 SPARE PARTS

2-4 Compressor Air Intake Filter Elements. (Dependent upon compressor size and quantity) please refer to compressor manual

15-50L Compressor Oil. (Dependent upon compressor size and quantity) please refer to compressor manual

- 2 x 0-10bar n/o Pressure Switch.
- 1 x 0-10bar, 0-10V Pressure transducer.
- 2 x 1 micron Pre – Filter Elements.
- 2 x Activated Carbon Filter Elements.
- 2 x 0.01 micron Sterile Filter Elements.
- 1 x Filter Auto Drain Unit (float type).
- 1 x Regulator Repair Kit.
- 2 x Dryer Dump Solenoid Repair Kit.
- 1 x Dryer Isolation Solenoid Repair Kit.

6 WARRANTY

The CPX Medical Air Plant 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.

7 CONTACT US

CPX Technology Building, Pepper Road, Hazel Grove,
Stockport, Cheshire, SK7 5BW, UK

Tel: +44 (0) 161 487 2822

Fax: +44 (0) 161 487 2816

Email: info@precisionuk.co.uk



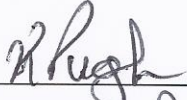
8 REGULATORY REQUIREMENTS


The following British, European and International Standards have been consulted during the design, manufacture and testing of the bed head unit.

- | | | |
|---|---------------|---|
| ✓ | BS EN 1441 | Medical Devices. Risk Analysis. |
| ✓ | BS EN 14971 | Copper and copper alloys. Seamless round copper tubes for medical gases or vacuum. |
| ✓ | BS EN 1044 | Brazing. Filler metals. |
| ✓ | BS EN 980 | Graphical symbols for use in the labelling of medical devices. |
| ✓ | BS EN 1089:3 | Transportable gas cylinders. Gas cylinder identification (excluding LPG). Colour coding. |
| ✓ | ISO 7396-1 | Medical gas pipeline systems. Pipeline systems for compressed medical gases and vacuum. |
| ✓ | BS EN 60601-1 | Medical electrical equipment general requirements for basic safety and essential performance. |
| ✓ | ISO 554 | Standard atmospheres for conditioning and/or testing. Specifications. |
| ✓ | SS 01 91 02 | Colour atlas. |
| ✓ | HTM 2022 | Medical gas pipeline systems. Design, installation, validation and verification. |
| ✓ | HTM 02-01 | Medical gas pipeline systems. Design, installation, validation and verification |
| ✓ | C11 | NHS model engineering specification – medical gases. |

Appendix A: Operations & Maintenance Manual Approval

The undersigned acknowledge they have reviewed the automatic manifold **Installation, Operations & Maintenance Manual** and agree with the approach it presents. Changes to this **Operations & Maintenance Manual** will be coordinated with and approved by the undersigned or their designated representatives.

Signature:  Date: 27/10/2015
Print Name: KEVIN PUGIN
Title: TECHNICAL MANAGER
Role: TECHNICAL ADVISOR

Signature:  Date: 27/10/2015
Print Name: MATTHEW DEAN
Title: ENGINEER
Role: AUTHOR

Signature: _____ Date: _____
Print Name: _____
Title: _____
Role: _____