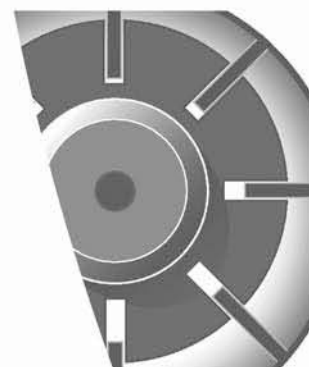
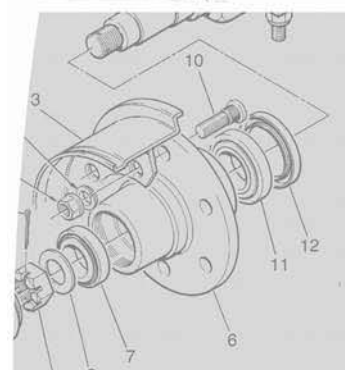
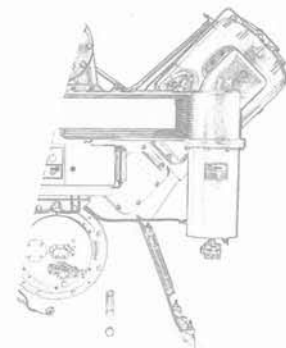




User Manual

Nitrogen Gas Generator CN20033 - CN20090

(EN) Original Language



Warranty

This warranty applies to the generator and associated parts (the equipment) supplied by CompAir.

Use of the generator without the recommended inlet air quality or genuine parts will expressly invalidate the warranty.

Should the equipment be defective as to materials or workmanship, the company warrants that it will remedy such defect. Where the Equipment is a generator, the warranty period will be 12 months from date of commissioning or 18 months from date of manufacture, whichever is the earlier. In the case of equipment other than a generator, the warranty period shall commence from the date of despatch. Should any defect occur during the warranty period and be notified in writing to the company or its authorised distributor within the said period, the company will, as its sole option, remedy such defect by repair or provision of a replacement part, provided that the equipment has been used strictly in accordance with the instructions provided with each item of equipment and has been stored, installed, commissioned, operated and maintained in accordance with such instruction and with good practice. the company shall not be under any liability whatsoever under the warranty, if, before giving notification in writing to the company as aforesaid, the Customer or any third party meddles, interferes, tampers with or carries out work whatsoever (apart from normal maintenance as specified in the said instructions) in relation to the Equipment or any part thereof.

Any accessories, parts and equipment supplied by the company but not manufactured by the company shall carry whatever warranty the manufacturer has given the company providing it is possible for the company to pass on such warranty to the customer.

To claim under the warranty, the equipment must have been installed and continually maintained in the manner specified in the User Guide. Our product support engineers are qualified and equipped to assist you in this respect. They are also available to make repairs that may become necessary in which event they will require an official order before carrying out the work. If such work is to be the subject of a warranty claim, the order should be endorsed for consideration under warranty.

Where equipment is sold outside the UK mainland direct to the end user the warranty will cover parts only. Any substitution of parts not manufactured or approved by the company will expressly invalidate the warranty.

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1 Safety Information

Do not operate this equipment until the safety information and instructions in this user guide have been read and understood by all personnel concerned.

The pressure envelope of the generator must not be breached under any circumstances. Failure to comply may result in an unplanned release of pressure, and may cause serious personal injury or death. All maintenance procedures that require the pressure envelope to be breached must only be performed by competent personnel trained, qualified, and approved by Compair.

Due to the nature of operation there is a possibility of oxygen enrichment surrounding the generator. Ensure that the area is adequately ventilated. Where the risk of oxygen enrichment is high, such as a confined space or poorly ventilated room, the use of oxygen monitoring equipment is advisable.

Nitrogen is not a poisonous gas but, in a concentrated form, there is a risk of asphyxiation. Depending upon the model and operating pressure, the generator is capable of delivering nitrogen at a flow rate of 33.3 m³/hr. If the generator is operated within a confined space ensure that adequate ventilation and oxygen monitoring equipment is fitted.

Use of the equipment in a manner not specified within this user guide may result in an unplanned release of pressure, which may cause serious personal injury or damage.

When handling, installing or operating this equipment, personnel must employ safe engineering practices and observe all related regulations, health & safety procedures, and legal requirements for safety.

Ensure that the equipment is depressurised and electrically isolated, prior to carrying out any of the scheduled maintenance instructions specified within this user guide.

Only competent personnel trained, qualified, and approved by Compair should perform installation, commissioning, service and repair procedures.

Note: Any interference with the calibration warning labels will invalidate the gas generator's warranty and may incur costs for the re-calibration of the gas generator.

Compair can not anticipate every possible circumstance which may represent a potential hazard. The warnings in this manual cover the most known potential hazards, but by definition can not be all-inclusive. If the user employs an operating procedure, item of equipment or a method of working which is not specifically recommended by Compair the user must ensure that the equipment will not be damaged or become hazardous to persons or property.






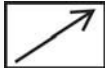






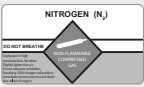

Most accidents that occur during the operation and maintenance of machinery are the result of failure to observe basic safety rules and procedures. Accidents can be avoided by recognising that any machinery is potentially hazardous.

Details of your nearest Compair sales office can be found at www.compair.com



Retain this user guide for future reference.

1.1 Markings and Symbols

The following markings and international symbols are used on the equipment or within this user guide:

	Caution, Read the User Guide.		Wear ear protection
	Risk of electric shock.		Pressurised components on the system
 Warning	Highlights actions or procedures which, if not performed correctly, may lead to personal injury or death.		Remote control. Generator may start automatically without warning.
 Caution	Highlights actions or procedures which, if not performed correctly, may lead to damage to this product.		Conformité Européenne
 Warning	Highlights actions or procedures which, if not performed correctly, could lead to electric shock.		When disposing of old parts always follow local waste disposal regulations.
	Read the User Guide		Waste electrical and electronic equipment should not be disposed of with municipal waste.
	NITROGEN (N₂) DO NOT BREATHE Asphyxiant in high concentrations. No odour. Slightly lighter than air. Ensure adequate ventilation. Breathing 100% nitrogen will produce immediate unconsciousness and death due to lack of oxygen. NON-FLAMMABLE COMPRESSED GAS		Use a fork lift truck to move the generator.

1.2 Approvals

SAFETY and ELECTROMAGNETIC COMPATIBILITY	
	This equipment has been tested and complies with the following European Standards:
	EN 61010-1: 2001 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory use - Part 1: General Requirements
	EN 61000-6-1:2007 Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments
	EN 61000-6-2:2005 Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
	EN 61000-6-3:2007 Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments
	EN 61000-3-2:2006 Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current <= 16 A per phase)
EN 61000-3-3:1995 Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current <= 16 A per phase and not subject to conditional connection.	
Including: Amendment A1:2001 Amendment A2:2006	
	This equipment has been tested to and complies with the following standard: UL 61010-1 2nd Edition 2005, Electrical Equipment for Measurement, Control and Laboratory Use; Part 1: General Requirements. CAN/CSA C22.2 No. 61010-1 2nd Edition 2004, Electrical Equipment for Measurement, Control and Laboratory Use; Part 1: General Requirements.

2 Description

The CN20033 - CN20090 range of nitrogen generators operate on the Pressure Swing Adsorption (PSA) principle to produce a continuous stream of nitrogen gas from clean dry compressed air.

Dual chamber columns, filled with extruded beads of adsorbent (Carbon Molecular Sieve [CMS]) material, are joined via an upper and lower manifold to produce a two bed system. Compressed air enters the bottom of the 'on-line' bed and flows up through the CMS. The oxygen, carbon dioxide, humidity and non-methane hydrocarbons are preferentially adsorbed by the CMS allowing clean dry nitrogen to pass through.

After a pre-set time the control system automatically switches the bed to regenerative mode. All of the contaminants are vented from the CMS and a small portion of the outlet nitrogen gas is expanded into the bed to accelerate the regeneration. At the same instant the second bed comes on-line and takes over the separation process.

The CMS beds alternate between separation and regeneration modes to ensure continuous and uninterrupted nitrogen production.

The oxygen concentration in the nitrogen stream is analysed continuously. If the concentration exceeds the required production level, the nitrogen outlet is closed and the gas is vented to atmosphere. Normal operation will resume when the purity recovers.

2.1 Technical Specification

	UNITS	10ppm	100ppm	250ppm	500ppm	0.1%	0.5%	1%	2%	3%	4%	5%
Flowrate												
CN20033	m ³ /hr	0.55	1.2	1.5	1.9	2.4	3.4	4.3	5.8	7.2	8.4	9.4
	cfm	0.3	0.7	0.9	1.1	1.4	2.0	2.5	3.5	4.2	4.9	5.5
CN20072	m ³ /hr	1.2	2.4	3.2	3.9	4.7	6.9	8.5	11.6	14.3	16.7	18.8
	cfm	0.7	1.4	1.9	2.3	2.8	4.1	5.0	6.8	8.4	9.8	11.1
CN20090	m ³ /hr	1.5	3.2	4.2	5.3	6.5	9.5	11.5	15.2	18.7	21.7	24.5
	cfm	0.9	1.9	2.5	3.1	3.8	5.6	6.8	8.9	11.0	12.8	14.4
Outlet Pressure												
	bar g	5.6	5.4	5.9	5.7	5.6	5.7	6.0	6.0	5.8	5.7	5.6
	psi g	81.2	78.3	85.6	82.7	81.2	82.7	87.0	87.0	84.1	82.7	81.2

Stated flows are for operation at 7 bar g (100 psi g / 0.7 MPa g) with reference to 25°C.

Inlet Parameters

Inlet Air Quality	ISO 8573-1: 2010 Class 2.2.2
Inlet Pressure	6 – 13 bar g 88 – 188.5 psi g
Inlet Temperature	5 – 50 °C (41 – 122 °F)

Port Connections

Air Inlet	G1/2
N ₂ Outlet to Buffer	G1/2
N ₂ Inlet from Buffer	G1/2
N ₂ Outlet	G1/2

Electrical Parameters

Generator Supply †	115 / 230 ± 10% Vac 50/60 Hz
Generator Power ‡	80 W
Fuse	3.15 A (Anti Surge (T), 250v, 5 x 20mm HBC, Breaking Capacity 1500A @ 250v, IEC 60127, UL R/C Fuse)
Max Dryer Power*	100W

Environmental Parameters

Ambient Temperature	5 – 50 °C (41 – 122 °F)
Humidity	29% @ 50°C (80% MAX ≤ 31°C)
IP Rating	IP20 / NEMA 1
Pollution Degree	2
Installation Category	II
Altitude	< 2000 m (6562 ft)
Noise	<80 dB (A)

Packed Weights and Dimensions

	Dimensions mm / (ins)			Weight Kg / (lbs)
	H	W	D	
CN20033	612 (24.48)	1490 (59.6)	950 (38)	174 (383.6)
CN20072	612 (24.48)	1490 (59.6)	950 (38)	221 (487.2)
CN20090	612 (24.48)	1490 (59.6)	950 (38)	272 (597.7)

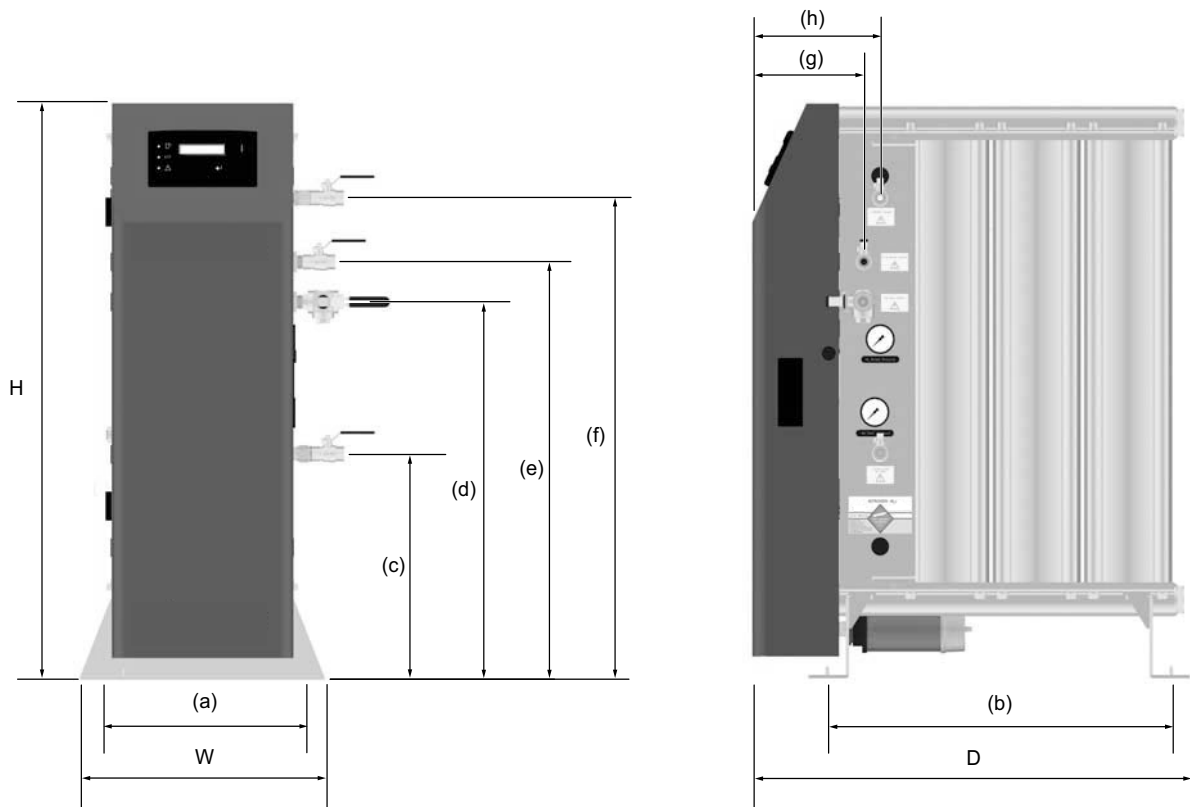
Notes:

† The generator does not require adjustment when connecting to 115v and 230v electrical supplies.

‡ The power rating specified is for the generator alone and does not take in to account any pre-treatment dryer connected to the dryer supply terminals of the generator.

* The dryer is fed directly from the generator supply.

2.1.1 Generator Weights and Dimensions

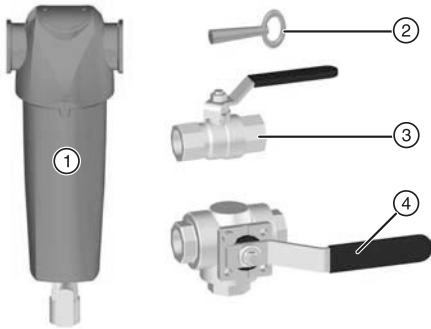


	Dimensions mm / (ins)											Weight Kg / (lbs)
	H	W	D	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
CN20033	1034 (41.36)	450 (18)	471 (18.84)	375 (15)	298 (11.92)	408 (16.32)	682 (27.28)	754 (30.16)	869 (34.76)	203 (8.12)	233 (9.32)	98 (216.1)
CN20072	1034 (41.36)	450 (18)	640 (25.6)	375 (15)	467 (18.68)	408 (16.32)	682 (27.28)	754 (30.16)	869 (34.76)	203 (8.12)	233 (9.32)	145 (319.7)
CN20090	1034 (41.36)	450 (18)	809 (32.36)	375 (15)	636 (25.44)	408 (16.32)	682 (27.28)	754 (30.16)	869 (34.76)	203 (8.12)	233 (9.32)	196 (432.1)

2.2 Receiving and Inspecting the Equipment

The equipment is supplied in a sturdy wooden crate designed to be moved using a forklift truck or pallet truck. Refer to the technical specification for packed weights and dimensions.

On delivery of the equipment check the crate and its contents for damage and verify that the following items have been included:



Ref	Description	Qty
1	Dust Filter	1
2	Access Key	1
3	1/2" Ball Valve	3
4	1/2" 3 – way Ball Valve	1

If there are any signs of damage to the crate, or there are any parts missing please inform the delivery company immediately and contact your local Compair office.

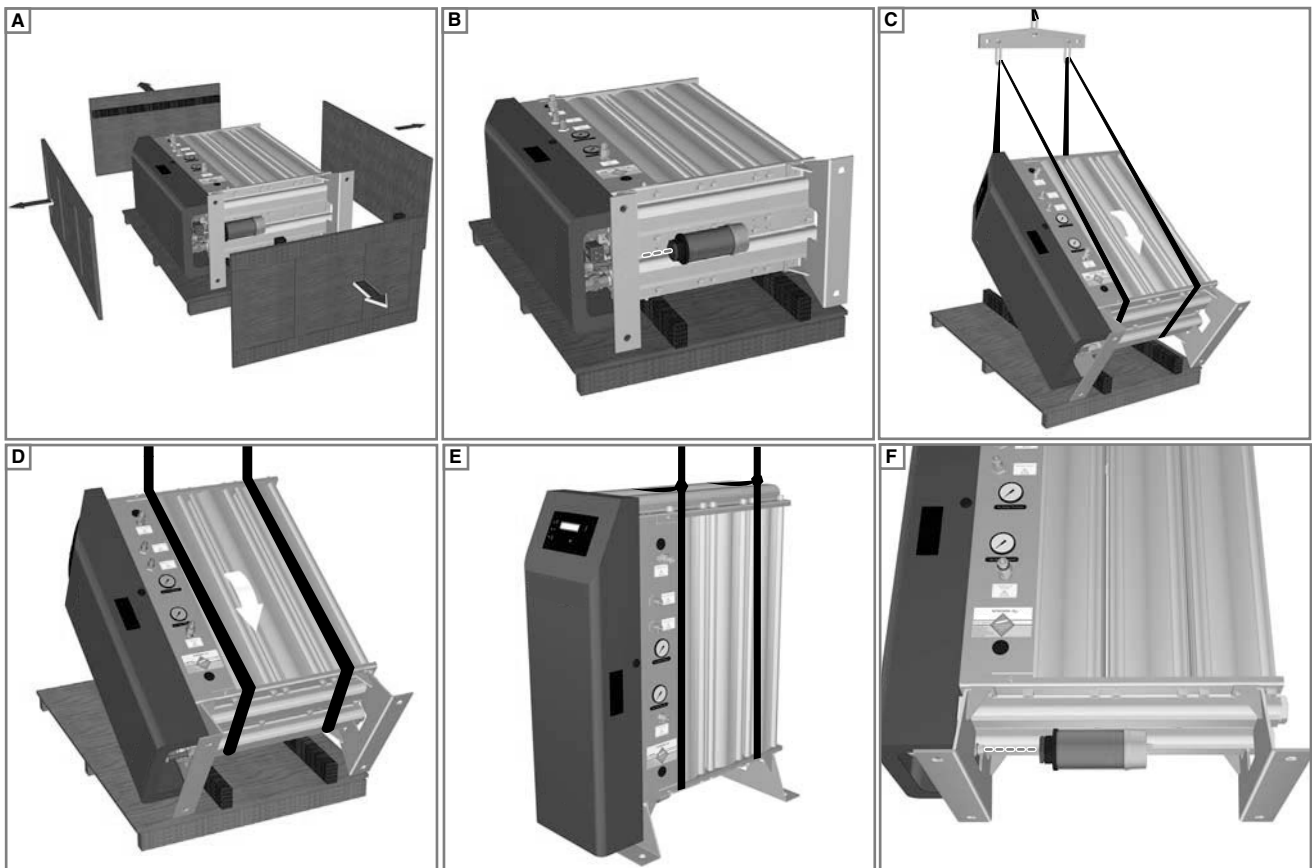
2.2.1 Storage

The equipment should be stored, within the packing crate, in a clean dry environment. If the crate is stored in an area where the environmental conditions fall outside of those specified in the technical specification, it should be moved to its final location (installation site) and left to stabilise prior to unpacking. Failure to do this could cause condensing humidity and potential failure of the equipment.

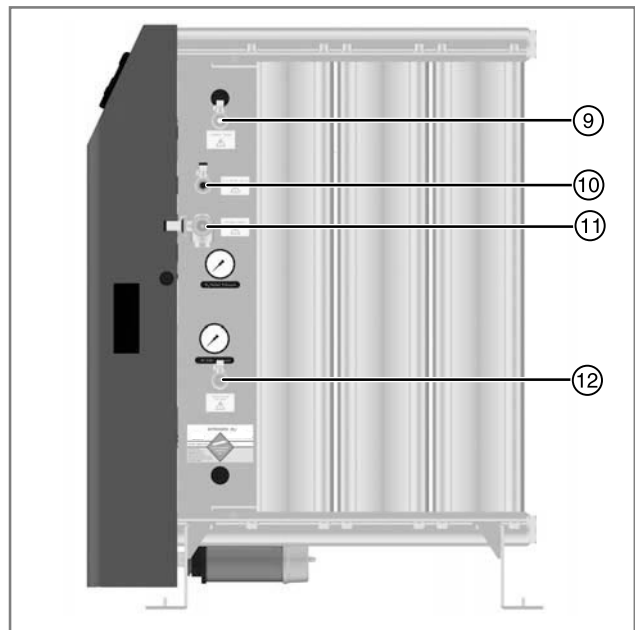
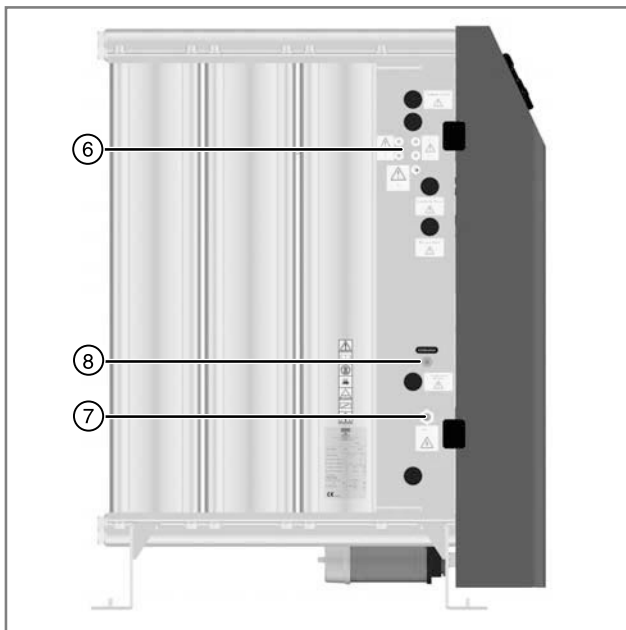
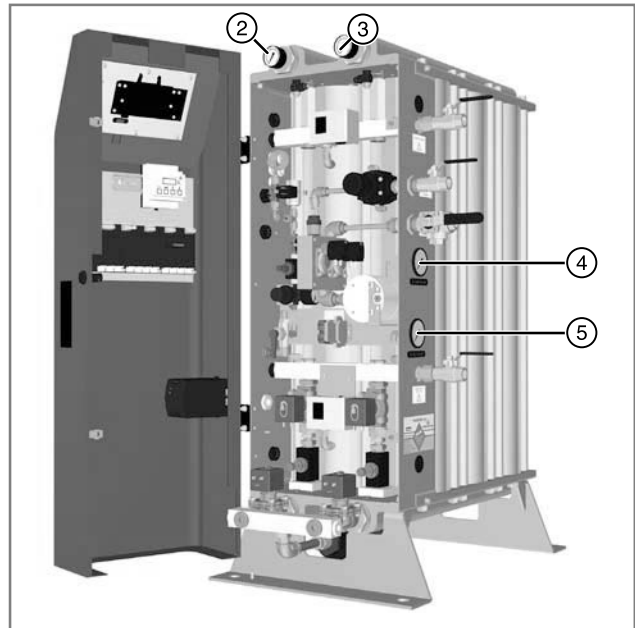
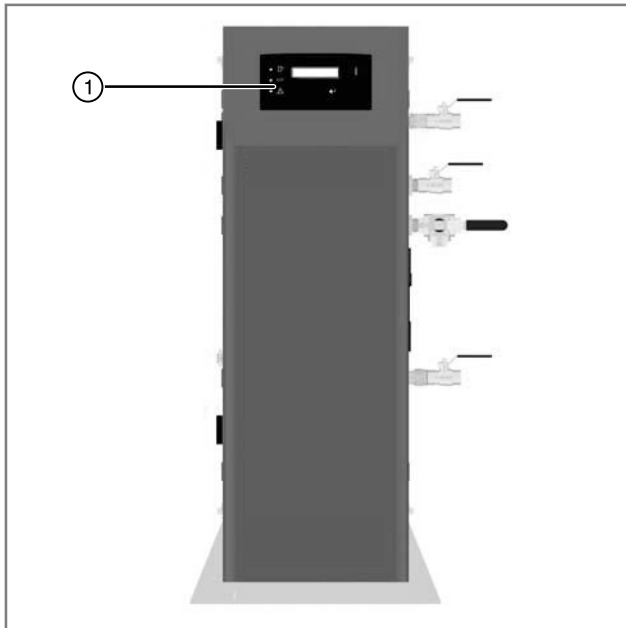
2.2.2 Unpacking

Remove the lid and all four sides of the packing crate (A) and unscrew the exhaust silencer from the generator (B). Lift the generator on to its feet using suitable slings and an overhead crane (C, D and E).

Carefully move the generator to its final location, using a forklift truck or pallet truck, and refit the silencer.



2.3 Overview of the equipment



Key:

Ref	Description	Ref	Description	
1	User control interface	7	Mains supply cable gland	
2	Column A pressure gauge	8	O ₂ Analyser calibration port	Calibration
3	Column B pressure gauge	9	N ₂ Outlet port to buffer (G1/2)	To Buffer Vessel ⚠
4	N ₂ Outlet pressure gauge	10	N ₂ inlet port from buffer vessel (G1/2)	From Buffer Vessel ⚠
5	Air inlet pressure gauge	11	N ₂ Outlet port (G1/2)	Nitrogen Outlet ⚠
6	Cable glands	12	Air Inlet port (G1/2)	Compressed Air Inlet ⚠

2.4 Locating the Equipment

2.4.1 Environment

The equipment should be located indoors in an environment that protects it from direct sunlight, moisture, and dust. Changes in temperature, humidity, and airborne pollution will affect the environment in which the equipment is operating and may impair the safety and operation. It is the customers' responsibility to ensure that the environmental conditions specified for the equipment are maintained.

2.4.2 Space Requirements

The equipment should be mounted on a flat surface capable of supporting its own weight plus the weight of all ancillary parts. There must be adequate space around the equipment to allow airflow and access for maintenance purposes and lifting equipment. A minimum spacing of approximately 500mm (20") is recommended around all sides. Refer to table 2.2 for overall dimensions of the equipment.

Do Not position the equipment so that it is difficult to operate or disconnect from the electrical supply.

Once positioned the equipment should be secured to the floor using M20 bolts.

2.4.3 Ventilation Requirements



Due to the nature of operation there is a possibility of oxygen enrichment surrounding the generator. Ensure that the area is adequately ventilated. Where the risk of oxygen enrichment is high, such as a confined space or poorly ventilated room, the use of oxygen monitoring equipment is advisable.

Nitrogen is not a poisonous gas but, in a concentrated form, there is a risk of asphyxiation. Depending upon the model and operating pressure, the generator is capable of delivering nitrogen at a flow rate of 33.3 m³/hr. If the generator is operated within a confined space ensure that adequate ventilation and oxygen monitoring equipment is fitted.

2.4.4 Air Inlet Quality

This generator is designed for use with clean dry compressed air in accordance with ISO 8573-1:2010 class 2.2.2.

ISO8573-1:2010 is an international standard that specifies the purity classes of compressed air with respect to solid particulates, water and oil. Understanding the requirements of the standard falls outside of the scope of this manual, however the following table summarises the classification for each contaminant.

ISO 8573-1:2010 class 2.2.2 equates to the following:

Class 2 (Solid Particulate)

In each cubic metre of compressed air, not more than 400,000 particles in the 0.1–0.5 micron size range are allowed.
In each cubic metre of compressed air, not more than 6,000 particles in the 0.5–1 micron size range are allowed.
In each cubic metre of compressed air, not more than 100 particles in the 1–5 micron size range are allowed.

Class 2 (Water)

A pressure dewpoint of -40°C or better is required.
No liquid is allowed.

Class 2 (Oil)

In each cubic metre of compressed air, not more than 0.1mg of oil is allowed.
Note. This is the combined level for aerosol, liquid and vapour.

2.4.5 Electrical Requirements

Connection to the electrical supply should be made through a switch or circuit breaker rated at 250VAC, 15A with a minimum short circuit rating of 10KA. This device should have a disconnection time not exceeding 40mS and all current carrying conductors should be disconnected.

The device chosen should be clearly and indelibly marked as the disconnecting device for the equipment and be located in close proximity to the equipment and within easy reach for the operator.

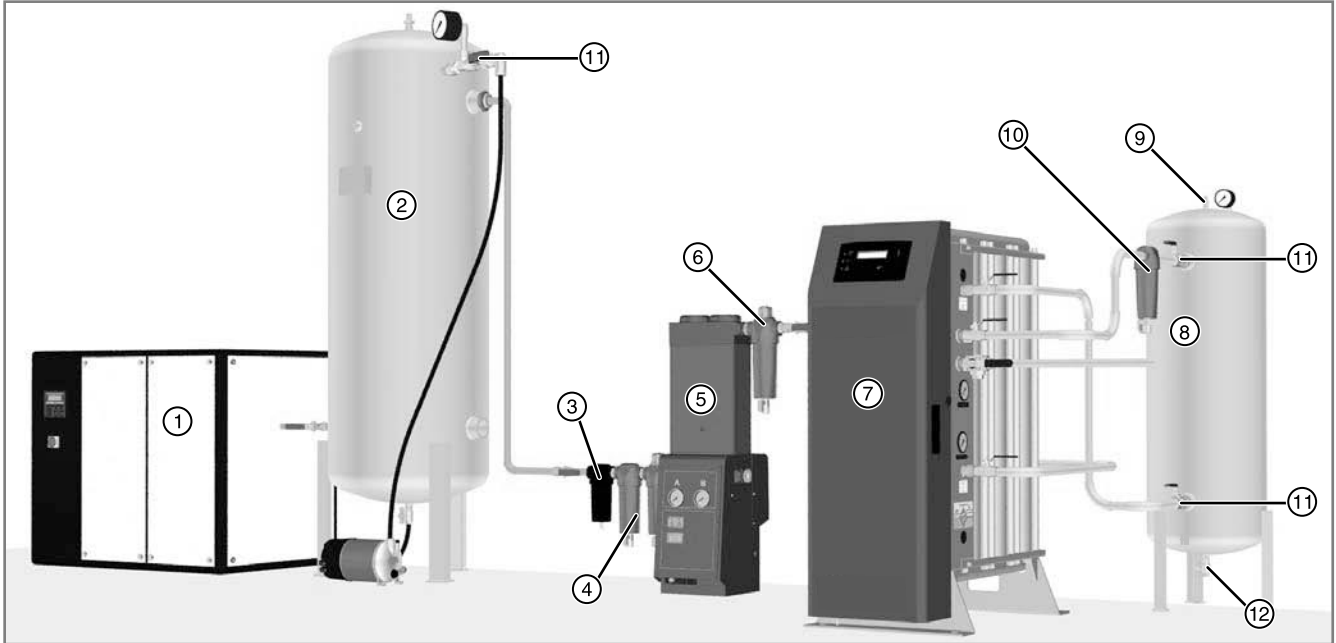
Overcurrent protection must be fitted as part of the building installation. This protection should be selected in accordance with local and national code regulations with a minimum short circuit rating of 10KA.

3 Installation and Commissioning



Only competent personnel trained, qualified, and approved by Compair should perform installation, commissioning, service and repair procedures.

3.1 Recommended System Layout



Ref	Description	Ref	Description	Ref	Description	Ref	Description
1	Compressor	4	Dryer pre-filtration	7	Generator	10	Dust filter
2	Wet air receiver	5	Pre-treatment dryer	8	Buffer vessel	11	Ball valve
3	Water separator	6	Dust filter	9	Pressure relief valve	12	Drain valve

3.1.1 Buffer vessel selection

The buffer selection should be sized according to the flowrate of the generator.

Flowrate		Vessel capacity
m ³ /hr	cfm	L
0 - 3	0 - 1.8	50
3.1 - 7.5	1.8 - 4.4	150
7.6 - 12.3	4.5 - 7.2	250
12.4 - 24	7.3 - 14.1	500
24.1 - 34	14.2 - 20	750

3.1.2 Pre-treatment dryer selection

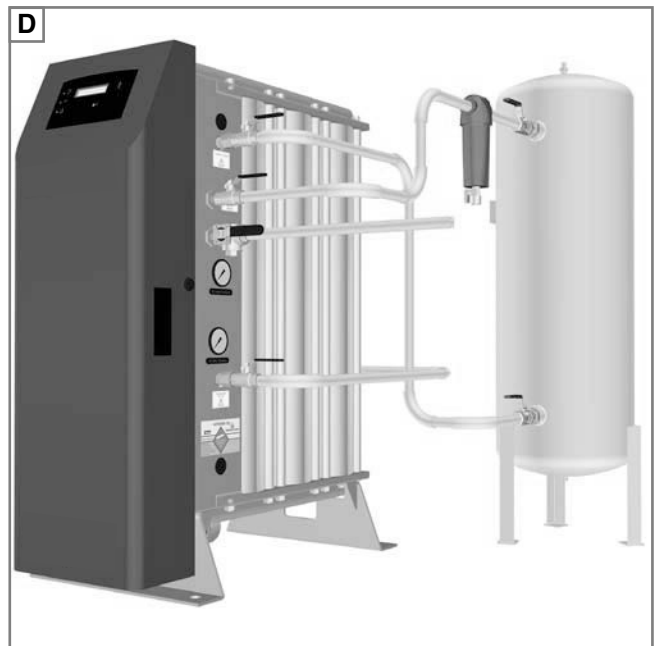
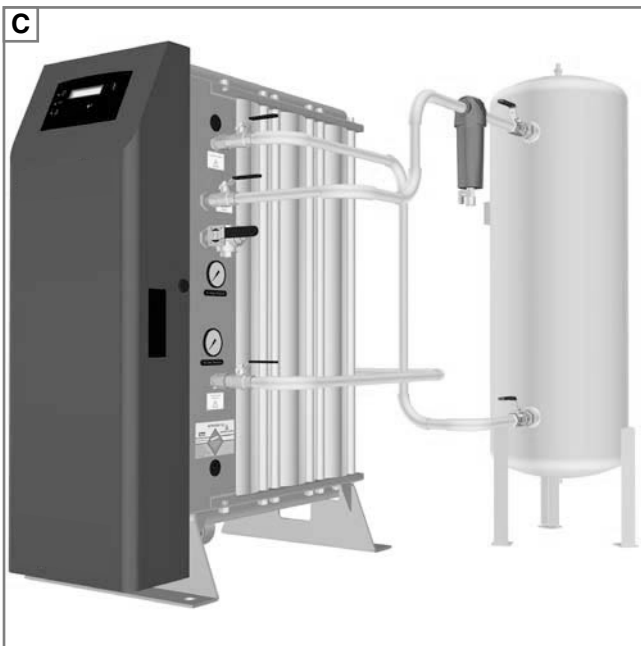
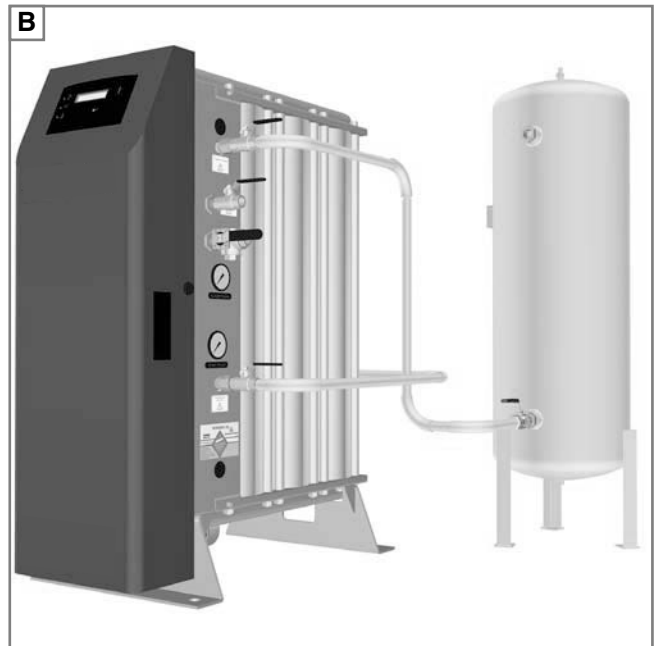
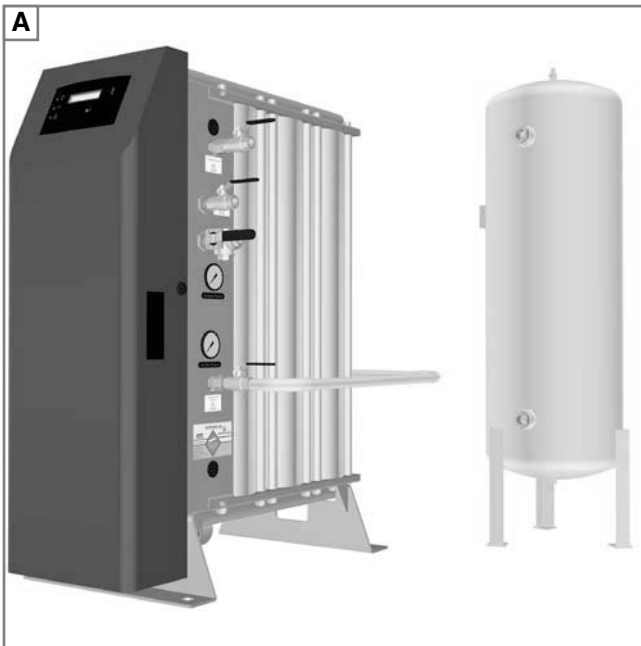
The following pre-treatment dryers are supplied with filtration.

Model	Part Number	Outlet Flow Rate m ³ /hr		Purge Loss (m ³ /hr)
		Up to 30°C	Up to 45°C	
A2LX	A51109474	6.3	5.3	1.7
A3LX	A51109574	10.3	8.3	2.7
A4LX	A51109674	12.6	10.6	3.4
A5LX	A51109774	16.5	13.6	4.4
A6LX	A51109874	18.9	15.9	5.1
A7LX	A51109974	25.2	22.2	6.8
A7XS	A51144874	38.6	33.1	7.31
A9XS	A51144974	51.3	44.0	9.85
A12XS	A51145074	67.4	57.7	12.91
A15XS	A51145174	85.2	73.0	16.14

3.2 Mechanical Installation

- A** Fit one of the 1/2" ball valves supplied to the compressed air inlet port on the generator and attach the compressed air supply to this ball valve. Ensure that the valve is in the closed position.
- B** Fit another of the 1/2" ball valves supplied to the port marked "To Buffer vessel". Install 1/2" NB / 16mm ID piping between the ball valve and the buffer vessel inlet port. It is recommended that a ball valve (not supplied) be installed at the inlet to the buffer vessel to allow it to be isolated during maintenance.
- C** Fit the remaining 1/2" ball valve to the port marked "From Buffer vessel". Install 1/2" NB / 16mm ID piping between the ball valve and the outlet port of the buffer vessel. The AR010 dust filter provided should be installed in this line. Follow the installation instructions provided with the filter taking note of the direction of flow. It is recommended that a ball valve (not supplied) be installed at the outlet of the buffer vessel to allow it to be isolated during maintenance.
- D** Fit the 3-way ball valve supplied to the port marked "Nitrogen Outlet". Connect this ball valve to the application using 1/2" NB / 16mm ID piping. This piping must be solid and non-porous to minimise the ingress of oxygen.

Note. The nitrogen buffer vessel must be rated to at least the maximum operating pressure of the generator and must be fitted with a suitable pressure gauge and pressure relief valve.



It is recommended that the system be protected with suitably rated pressure relief valves upstream of the generator.

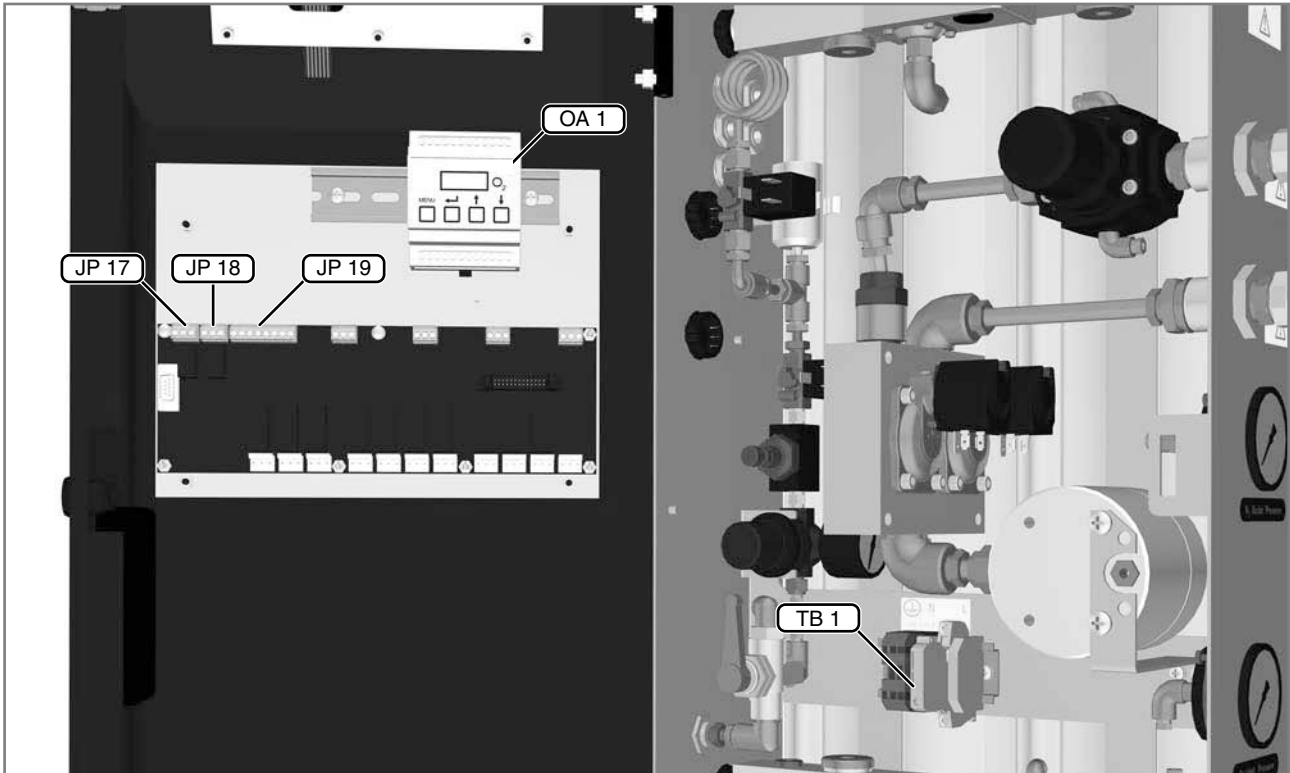
3.3 Electrical Installation



A fully qualified electrical engineer must undertake all field wiring and electrical work in accordance with local regulations.

In order to maintain the IP rating of the generator, all cables entering the electrical enclosure must do so through the dedicated cable glands located on the side of the generator.

Refer to the wiring schematics at the rear of the manual for details of the required terminations. All terminals are identified in the image below.



REF	Connection	Terminal	Notes	Cable Diameter
TB1	Generator Supply	N L <small>FUSE 3.15 A T 250V 5x20mm</small>	L - Fuse terminal for the phase conductor. N - Neutral conductor - Protective Earth conductor	6 - 12 mm
TB1	Dryer Supply	L (Grey) N (Blue) (Yellow / Green)	Dryer Live conductor Dryer Neutral conductor Dryer Earth conductor.	3 - 7 mm
JP 17	Purge Economy	JP17-1 (NC) JP17-2 (COM) JP17-3 (NO)	Not Used The relay is energised when the generator is in standby. Refer to installation instructions for the dryer.	3 - 7 mm
JP 19	Remote Switching	JP19-7 JP19-8 (INPUT 4)	Remote switching is activated in the customer Settings menu 3.11	3 - 7 mm
	MODBUS	A RS485 B MODBUS		
JP 18	Alarm Contacts	JP18-1 (NC) JP18-2 (COM) JP18-3 (NO)	The relay is energised when no faults are present	3 - 7 mm
OA 1	O ₂ 4-20mA	Analyser - 6 (+ve) Analyser - 7 (-ve)	The mesh screen of the cable should be bonded to the metal plate of the shroud.	3 - 7 mm



When wiring to the terminals of JP17, JP18 and JP19 ensure that the wires are secured so that, in the event of one coming loose, they cannot short out against the surrounding terminals.

3.3.1 Generator Supply



For safety reasons the generator must be connected to earth at the earth terminal provided on TB1.

The generator supply terminals are designed to accommodate a maximum conductor size of 2.5mm² (14 AWG). It is the users responsibility to size the supply cable in accordance with local wiring regulations, taking in to account cable temperatures, installation methods and voltage drop.

The protective earth conductor should be longer than the associated phase conductors so that in the event of the cable slipping in the cable gland, the earth will be the last to take the strain.

3.3.2 Dryer Supply

If a Compair pre-treatment air dryer is used, it should be connected to the generator at the dedicated DIN rail terminals. Refer to the documentation provided with your dryer for additional information on installation requirements.

3.3.3 Purge Economy

If the pre-treatment dryer is fitted with a purge economy feature, it may be controlled using the volt free relay contacts on JP17. The relay is energised only when the generator enters standby mode.

Refer to the documentation provided with your dryer for details on purge economy.

3.3.4 Remote Switching

The generator may be controlled remotely by connecting a remote start / stop circuit to JP19-7 and JP19-8 on the control board. When the circuit is open the generator should remain in standby mode, closing the circuit should initiate a start command.

To enable the remote switching function refer to "Customer Settings " on page 17 of this guide. Once the remote switching function has been enabled the local start control will no longer function.



When the remote switching function is enabled the generator can start without warning.

3.3.5 Alarm Contacts

The generator is fitted with a set of volt free relay contacts designed for connection to a remote alarm circuit. The contacts are rated 1A max @ 250Vac (1A @ 30Vdc). Under normal operation the relay is energised, when a fault occurs the relay will de-energise causing the relay contacts to change state.



If the generator is connected to a remote alarm circuit, the electrical enclosure will contain more than one live circuit. In the event of the generator electrical power supply being disconnected, the fault relay connections will remain live. It is the users responsibility to provide a disconnection device so that these connections can be safely isolated.

3.3.6 4–20mA Analogue Output

The oxygen content detected by the generators internal analyser may be re-transmitted to external peripherals using the 4-20mA linear analogue output. The output is a linear current source, with 10 bit resolution, which increases from 4mA (Zero Oxygen) to 20mA (Full Scale Deflection). The FSD of the internal analyser is factory set to a default value of twice the generators specified purity. For% purity generators the maximum FSD is set to 6%.

Note: The oxygen purity setting of the generator is marked on the rating plate.

The table below shows the correlation between the purity settings of the generator and the output current. The FSD can be altered in menu 3.8 of the control software (refer to "Customer Settings " on page 17 of this guide for details).

Generator Purity	Full Scale Deflection			Resolution		
	4mA	-	20mA		=	
10ppm	0	-	20ppm	1ppm	=	0.8mA
100ppm	0	-	200ppm	1ppm	=	0.08mA
250ppm	0	-	500ppm	1ppm	=	0.032mA
500ppm	0	-	1000ppm	0.01%	=	0.016mA
0.1%	0	-	0.2%	0.01%	=	0.8mA
0.5%	0	-	1%	0.01%	=	0.16mA
1%	0	-	2%	0.01%	=	0.08mA
2%	0	-	4%	0.01%	=	0.04mA
3%	0	-	6%	0.01%	=	0.026mA
4%	0	-	6%	0.01%	=	0.026mA
5%	0	-	6%	0.01%	=	0.026mA

4 Operating the Generator

4.1 Overview of controls

There are two control options available for this range of generators:

A–Control with O₂ Analyser.

When fitted with an O₂ analyser the controller provides a visual indication of the operating status of the generator. In addition to this the menu driven interface provides access to essential information such as oxygen purity, hour meters and fault logs. By entering a three digit password, trained personnel can view and adjust O₂ cell calibration settings, O₂ alarm settings and remote control functionality.

B–Control without O₂ Analyser.

The controller fitted to generators without an integrated O₂ analyser provides a visual indication of the operating status. The liquid crystal display gives a reading of the total number of hours that the generator has been running.



A–Control with O₂ Analyser





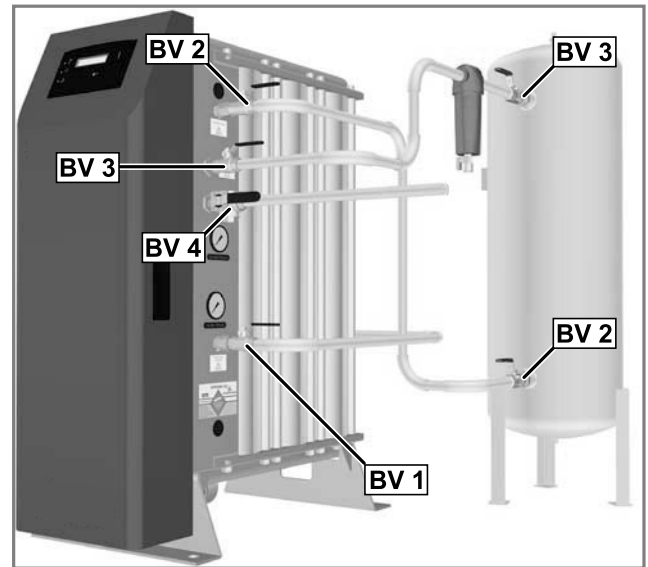
B–Control without O₂ Analyser

Key:

	Green - Cycling Amber - Start clean up, shutting down, N2 vent (No gas is delivered to the application), and entering economy Red - Standby		Moves upwards through the menus
	Green - Economy mode		Moves downwards through the menus
	Amber - Service due Red - Active Fault		Selects the current menu.
	Local Start control (This control is inactive when the generator is configured for remote control).		Toggles the generator between run and standby modes. THIS IS NOT AN ISOLATION SWITCH
	Local Stop control (This control is active for both local and remote control).		

4.2 Starting the generator



- 1 Make sure that all connection points are secure and all of the ball valves on the system are closed.
- 2 Open the ball valve (BV1) on the compressed air inlet port.
- 3 Switch 'ON' the electrical power to the generator and wait for the controller to complete the initialisation routine.
- 4 Press  or  to initiate the start up routine. If the start clean up option is enabled the generator will run through "Rapid Cycle / Pure Start" [Refer to section 4.4 for more details on Rapid Cycle and Pure Start].
Note. If the generator was running when the electrical power was removed (e.g. power failure), the start up routine will be initiated automatically.
On completion of the clean up cycle the N₂ outlet valve will open and the N₂ outlet indicator will illuminate green.
- 5 Open the buffer inlet ball valves (BV2) approximately 10 degrees and leave the buffer vessel to pressurise gradually. When the pressure gauge on the buffer vessel reads within 0.5 barg (7psig, 0.05MPa) of the inlet pressure, check for leaks in the connecting piping and then fully open the ball valves.
- 6 Open the ball valves on the outlet of the buffer vessel (BV3) and check for leaks in the piping between the vessel and the generator.
- 7 Open the ball valve (BV4) on the N₂ Outlet port.



Note: If the purity of the gas is not within specification (applies only to generators fitted with an O₂ analyser) it will be vented to atmosphere through a vent solenoid within the generator. Gas will only be delivered to the application when the specified purity is achieved.

The generator is designed for continuous use and, once running, requires no further operator intervention.

4.3 Stopping and depressurising the generator

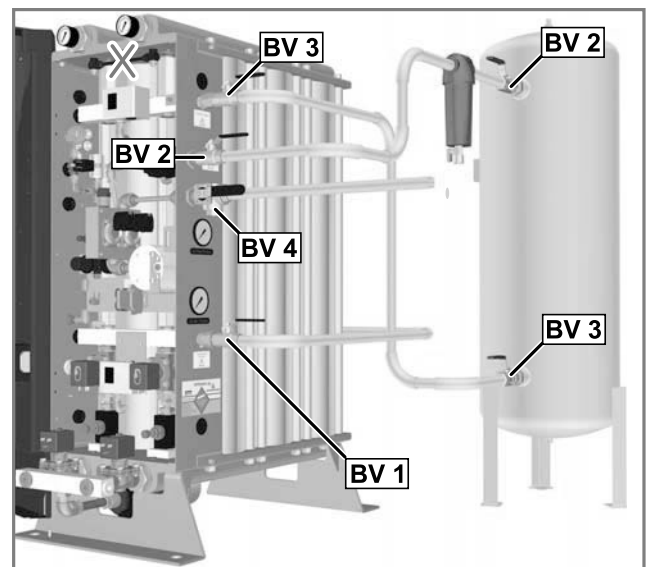
- 1 Close the ball valve on the N₂ Outlet port (BV4).
- 2 Press  or  to initiate the shutting down sequence.
- 3 The generator will complete the current cycle and then exhaust both beds. This may take several minutes particularly on ppm generators.
- 4 When the generator is depressurised it will revert to standby mode. Close the ball valve (BV1) on the compressed air inlet port and buffer vessel ball valves (BV2) and (BV3).



There may be a residual pressure of approximately 1.5 bar within the columns due to the release of oxygen from the CMS. This must be released if the generator is to be shipped or requires maintenance.

- 5 To release the residual pressure disconnect the purge pipe (X) from one of the flow regulators on the upper manifold.

Wait for the pressure gauges to drop to zero before continuing.



4.4 Start Clean Up

The clean up cycles are designed to clean the CMS bed of impurities, bring the generator up to production purity more rapidly, and prevent poor quality gas flowing into the buffer. The operation of the cycle is factory set and is dependant upon the purity as described below:

O ₂ = 5.00 % Rapid Cycle	Rapid Cycle – this cycle is used for lower purity generators (250ppm – 5.0%). The chambers are filled and exhausted alternately on a fixed cycle time. The Rapid Cycle takes 160 seconds to complete.
O ₂ = 100 ppm Pure Start A	Pure Start - The higher purity generators (10 - 100ppm) require a two stage cleaning process (A + B): A The chambers are filled and exhausted alternately. B The chambers are then filled and exhausted on a reduced cycle. The pure start cycle times are dependant upon the production purity of the generator. Refer to the table below for guidance.

PRODUCTION PURITY	PURE START CYCLE (Secs)	
	A	B
10 ppm	4 x 120	120/90
100 ppm	4 x 90	90/70

On completion of the start up cycles the N₂ outlet valve will open, allowing gas to be delivered to the application.



The Start clean up cycle can be disabled within the customer settings menu (applies only to generators fitted with an O₂ analyser), however Compair strongly recommend that the start up cycles remain enabled.

4.5 Economy Mode

Economy mode is designed to switch the generator into standby mode when there is no demand for gas.

The generator continually monitors the pressure at the outlet port. If the pressure exceeds a pre-determined level for a sustained period of time (Economy Period *), the N₂ outlet valve will close. The generator will continue to cycle as normal without delivering gas to the application. If the back pressure is maintained for an additional 5 minutes, the generator will stop cycling and enter Economy mode.

When the pressure falls below the regulated outlet pressure, the generator will resume normal operation. If the generator is in Economy mode when this occurs, it will run through the relevant clean up cycle.



The economy mode can be disabled within the customer settings menu (applies only to generators fitted with an O₂ analyser), however Compair strongly recommend that this option remains enabled.

The Economy over-ride facility (optional on generators fitted with an O₂ analyser) can be used to maintain the beds when the generator is in economy mode. If the over-ride is enabled, a clean up cycle will be performed once every 20 minutes. This allows the generator to go straight on-line when the outlet pressure falls below the regulated outlet pressure.

*The Economy Period is factory set to 5 minutes, however this can be adjusted during commissioning.

4.6 Menu Interface

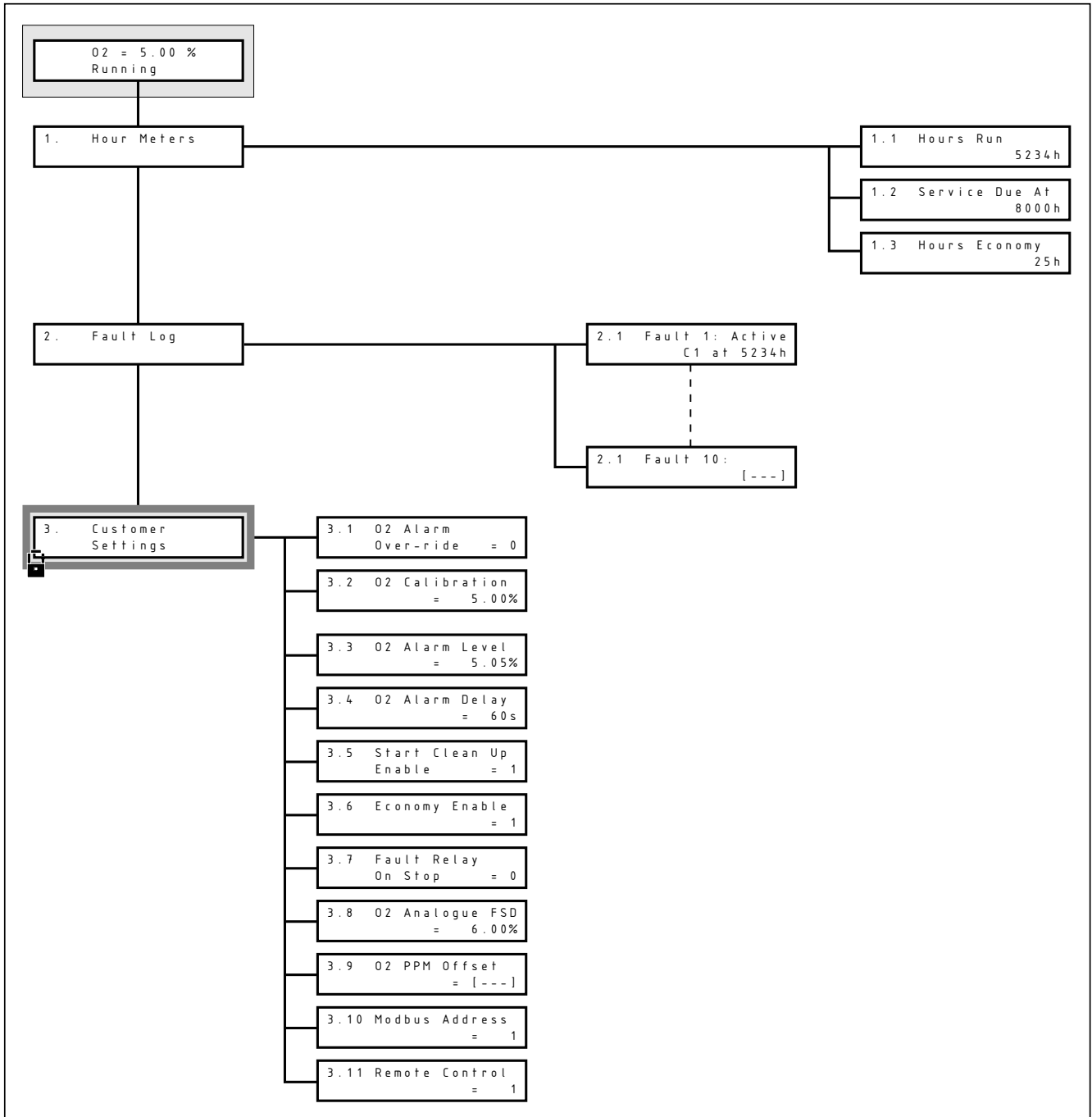
The default menu displays the current operating status of the generator and, when running, indicates the purity of the gas delivered at the "Nitrogen Outlet" port.

Note. The purity reading is for indication purposes only.

The menu driven interface provides access to the essential operational parameters of the generator. From the default menu use the **▲** and **▼** keys to scroll through to the desired menu and press **↵**.

The interface will automatically default back to the main operating menu if no key activity has been detected for one minute. After an additional two minutes of inactivity the display will shutdown. To bring the display back on-line press **↵**.

4.6.1 Menu Map



4.6.2 Password Protected Menus

The customer settings sub-menus contain the parameters that may be customised by the end user. To prevent unauthorised changes being made these menus are password protected and cannot be accessed until the password has been entered correctly.

	To enter the password from the main operating menu press and hold both the ▲ and ▼ keys for approximately 5 seconds until the menu changes to the password prompt as shown
	The flashing cursor will be positioned over the first digit. Using the ▲ key change the first digit of the code and press ▶ . The cursor will move to the next digit.
	Repeat the process and enter the following password 1 2 1 __. When the password has been entered correctly the Hour Meters menu will be displayed.
Use the ▲ key to navigate to page 3 "Customer Settings".	

4.6.3 Hour Meters

	The time in hours that the generator has been producing gas.
	The time in operating hours that the generator can produce gas before a service is required.
	The time in hours that the generator has been operating in Economy mode.

4.6.4 Fault Log

	The fault log contains details of the ten most recent faults that have occurred on the generator. Each fault is represented by a code which is displayed along with the time (hours run) at which the fault occurred and the status of the fault.
--	---

The following codes are used within the system:

Fault Codes		Notes
C1	Pressure Start Inhibit	Low inlet pressure. Inhibits start.
P1	Inlet Pressure Fault	Low inlet pressure during cycling.
P2	Pressure Sensor Fault	Pressure sensor communication error.
E1	Power Failure	
Y1	O ₂ Alarm	
Y2	O ₂ Communication failure	Communication fault between O ₂ analyser and control board
Y3	Incorrect cell selected	
Y4	O ₂ high (out of range)	Occurs when O ₂ > 25% (% generators) / O ₂ > 1.05% (ppm generators)
Y5	O ₂ zero drift error	Contact Compair
S1	Service due	

Note. Any faults that are active when the power is switched off, and remain active when the power is re-applied, will cause a new entry to be added into the fault log.

4.6.5 Customer Settings

The customer settings menu contains all of the generator parameters that may be altered by the end user. The following example demonstrates the method of altering a parameter, however it is recommended that none of the parameters are altered until their functionality is fully understood.

Note. All settings marked in bold text are the default settings.

<pre>3.7 Fault Relay On Stop = 0</pre>	Use the ▲ and ▼ keys to scroll through to the desired menu and press ↵ .																									
<pre>3.7 Fault Relay On Stop = 0</pre>	Referring to the menu map select the desired menu. The flashing cursor should be positioned over the "=" sign to indicate that the parameter may be changed.																									
<pre>3.7 Fault Relay On Stop = 1</pre>	Use the ▲ / ▼ keys to change the parameter. Press ↵ to accept the changes or press ▲ and ▼ simultaneously to cancel the changes.																									
Press ▲ and ▼ simultaneously to return to the customer settings menu and then again to return to the main operating menu.																										
<pre>3.1 O2 Alarm Over-ride = 0</pre>	When enabled the O ₂ alarm is over-riden. 0 = Over-ride disabled, 1 = Override Enabled [OVR]	<pre>O2 = 5.00 % OVR Running</pre>																								
<pre>3.2 O2 Calibration = 5.00%</pre>	O ₂ cell calibration menu. Refer to section 4.7 for details on calibration.																									
<pre>3.3 O2 Alarm Level = 5.05%</pre>	Sets the purity level at which an oxygen fault is initiated. Default Settings:																									
<table border="1"> <thead> <tr> <th>O2 values</th> <th>Alarm level</th> </tr> </thead> <tbody> <tr><td>10ppm</td><td>15ppm</td></tr> <tr><td>100ppm</td><td>105ppm</td></tr> <tr><td>250ppm</td><td>275ppm</td></tr> <tr><td>500ppm</td><td>500ppm</td></tr> <tr><td>0.10%</td><td>0.15%</td></tr> <tr><td>0.50%</td><td>0.55%</td></tr> <tr><td>1.00%</td><td>1.05%</td></tr> <tr><td>2.00%</td><td>2.05%</td></tr> <tr><td>3.00%</td><td>3.05%</td></tr> <tr><td>4.00%</td><td>4.05%</td></tr> <tr><td>5.00%</td><td>5.10%</td></tr> </tbody> </table>			O2 values	Alarm level	10ppm	15ppm	100ppm	105ppm	250ppm	275ppm	500ppm	500ppm	0.10%	0.15%	0.50%	0.55%	1.00%	1.05%	2.00%	2.05%	3.00%	3.05%	4.00%	4.05%	5.00%	5.10%
O2 values	Alarm level																									
10ppm	15ppm																									
100ppm	105ppm																									
250ppm	275ppm																									
500ppm	500ppm																									
0.10%	0.15%																									
0.50%	0.55%																									
1.00%	1.05%																									
2.00%	2.05%																									
3.00%	3.05%																									
4.00%	4.05%																									
5.00%	5.10%																									
<pre>3.4 O2 Alarm Delay = 60s</pre>	If the purity level exceeds the oxygen alarm level for a period longer than the alarm delay, the oxygen alarm will be activated and the gas will be vented to atmosphere. Delay Range = 0 – 600 Seconds, Default = 60 Seconds																									
<pre>3.5 Start Clean Up Enable = 1</pre>	When enabled the bed cleaning cycles will run whenever the generator is powered up, comes out of standby mode and economy mode. 0 = Disabled, 1 = Enabled																									
<pre>3.6 Economy Enable = 1</pre>	Enables the economy mode. 0 = Disabled, 1 = Enabled																									
<pre>3.7 Fault Relay On Stop = 0</pre>	When enabled the actuation of the Stop control will generate an alarm. 0 = Disabled, 1 = Enabled																									
<pre>3.8 O2 Analogue FSD = 6.00%</pre>	Sets the Full Scale Deflection value for the 4 – 20mA Analogue Output.																									
<pre>3.9 O2 PPM Offset = [---]</pre>	Sets the ppm O ₂ cell calibrated offset value marked on the cell. Note: This value must be entered only when the cell is changed.																									
<pre>3.10 Modbus Address = 1</pre>	Sets the address for the generator when communicating on a network via the RS485 MODBUS port. Address range is 1 – 32																									
<pre>3.11 Remote Control = 1</pre>	Sets the mode of control for the generator 1 = Local Start / Stop control, 2 = Remote Start / Stop control via the digital input																									

5 Servicing

5.1 Cleaning

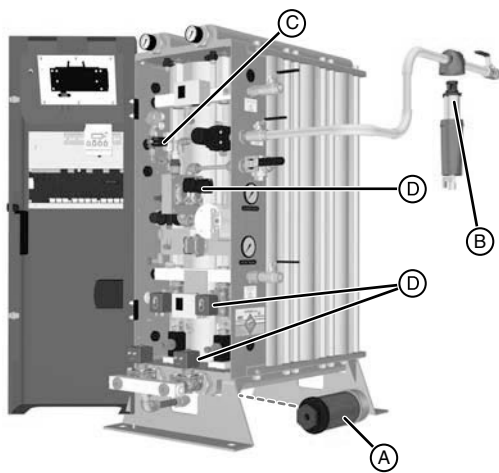
Clean the equipment with a damp cloth only and avoid excessive moisture around any electrical sockets. If required you may use a mild detergent, however do not use abrasives or solvents as they may damage the warning labels on the equipment.

5.2 Service Intervals

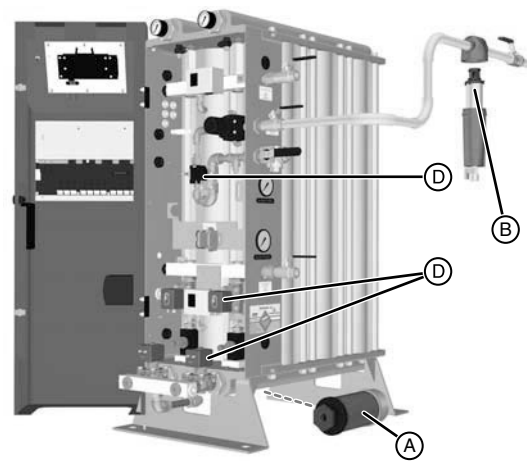
The service operations should be performed at the hours run or fixed time intervals specified below (whichever occurs first).

Description Of Service Required		Typical Recommended Service Interval					
Component	Operation	Daily	Weekly	2000 Hours (3-month)	4000 Hours (6-month)	8000 Hours (12-month)	16000 Hours (24-month)
Generator	Check status indicators located on the control panel.	☞					
Generator	Check regulated outlet pressure		☞				
Generator	Check O ₂ purity		☞				
System	Check filter drains		☞				
O ₂ Cell	Calibrate oxygen sensor			🔄			
System	Check inlet air quality			☞			
Generator	Check for air leaks			☞			
Generator	Check pressure gauges during purging for excessive back pressure			☞			
Generator	Check condition of electrical supply cables and conduits			☞			
Generator	Check cyclic operation				☞		
Generator	Replace mist-x silencer Recommended Service A					🔧	
Filtration	Replace buffer tank filter. Recommended Service B					🔧	
Generator	Replace/Calibrate oxygen sensor Recommended Service C						🔧
Generator	Replace/Service valves Recommended Service D						🔧

☞ - Check 🔧 - Replace 🔄 - Recommended Process



with O₂ Analyser



without O₂ Analyser

5.3 Service Kits

Recommended Service A - Required every 8000 Hours (12 months)



Description	Kit No
Kit: MIST-X Silencer	606280162

Recommended Service B - Required every 8000 Hours (12 months)



Description	Kit No
Kit: Filter Element (1x)	ZS1087938

Recommended Service C - Required every 16000 Hours (24 months)



Description	Kit No
Kit: PPM Oxygen Cell (1x)	606400002
Kit: % Oxygen Cell (1x)	606400001

Recommended Service D - Required every 16000 Hours (24 months)

Generator with analyser



Description	Kit No
Kit: Valve Overhaul	606510003
Air Inlet Valve Kit	608330002
Exhaust Valve Kit	608330002
Outlet Valve Kit	606500010

Generator without analyser



Description	Kit No
Kit: Valve Overhaul	606510005
Air Inlet Valve Kit	608330002
Exhaust Valve Kit	608330002
Outlet Valve Kit	606510010



Warning

The valve overhaul (Service D) and all other repair and calibration work should be undertaken by a Compair trained, qualified and approved engineer.

5.4 Service Procedures

5.4.1 Exhaust Silencer Replacement

- A** The exhaust silencer is located under the inlet manifold assembly.

Unscrew the element from the exhaust port and discard.

Fit the replacement element ensuring that it is fully engaged onto the pipe fitting and secure it hand tight.

5.4.2 Oxygen Cell Replacement

- B** Disconnect the oxygen cell lead from terminals 1, 2 and 3 (% vol. O₂ cells) or 3, 4 and 5 (ppm vol. O₂ cells) of the O₂ analyser (2).

Unscrew the tube nut (3) holding the O₂ cell (4) in place and remove the cell.

Fit the replacement sensor onto the t-piece and secure the tube nut. Perform a leak test and repair as required.

Refit the electrical connections to the O₂ analyser as detailed below.

Terminal	Colour	Function
1	Black	-ve % vol. sensor
2	Red	+ve % vol. sensor
3	Green	Ground
4	Black	-ve ppm vol. sensor
5	Red	+ve ppm vol. sensor

Calibrate the sensor as detailed.

Note: PPM cells require the offset value to be entered prior to calibrating).

5.4.3 Dust Filter Element Change

- C** Close the ball valves located on the inlet and outlet ports of the filter and de-pressurise it by opening the drain valve (5) on the filter bowl (6).

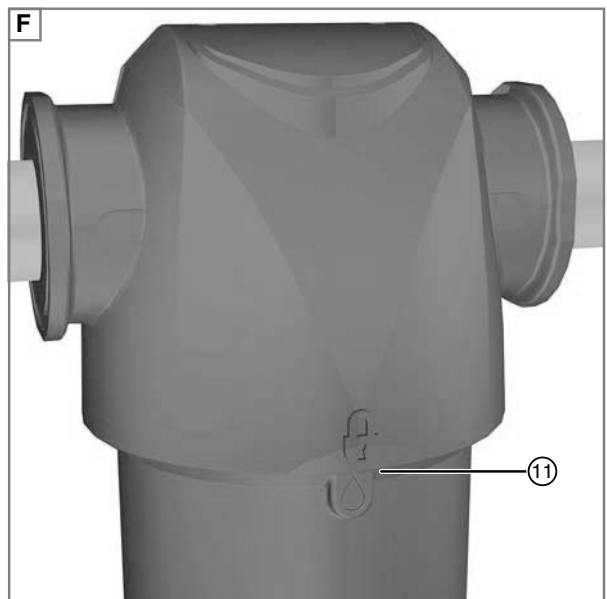
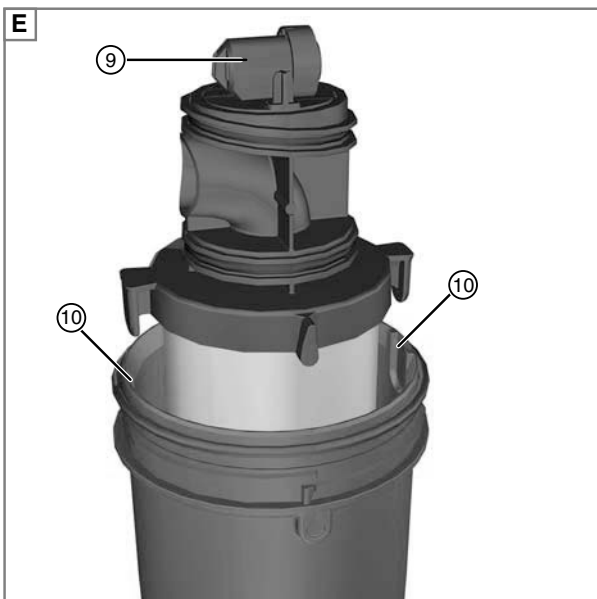
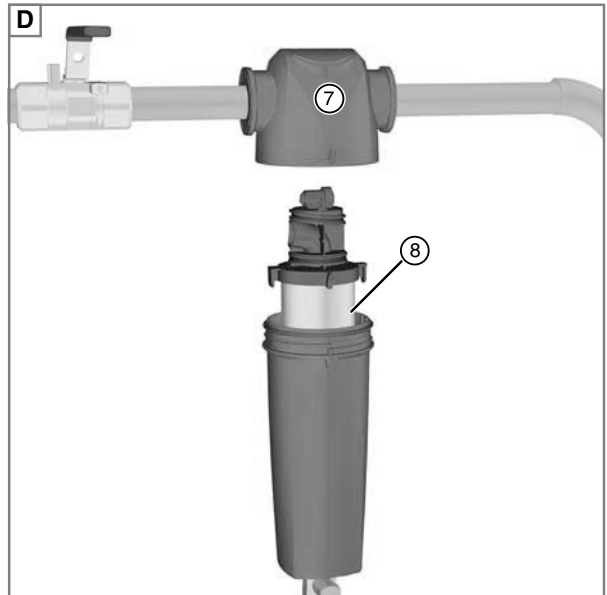
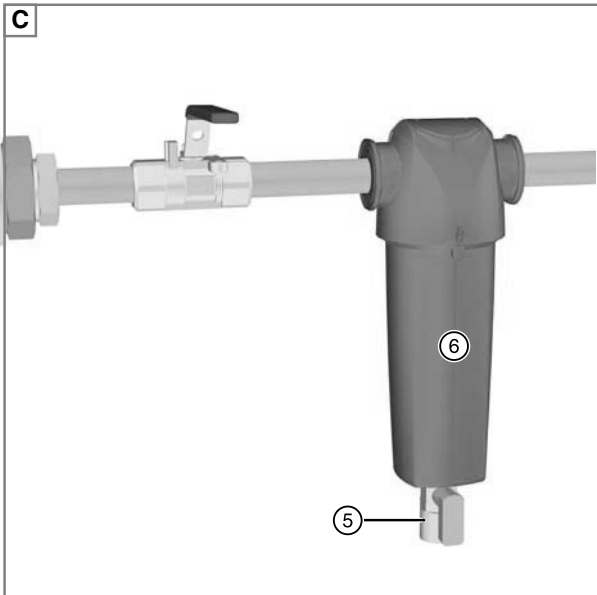
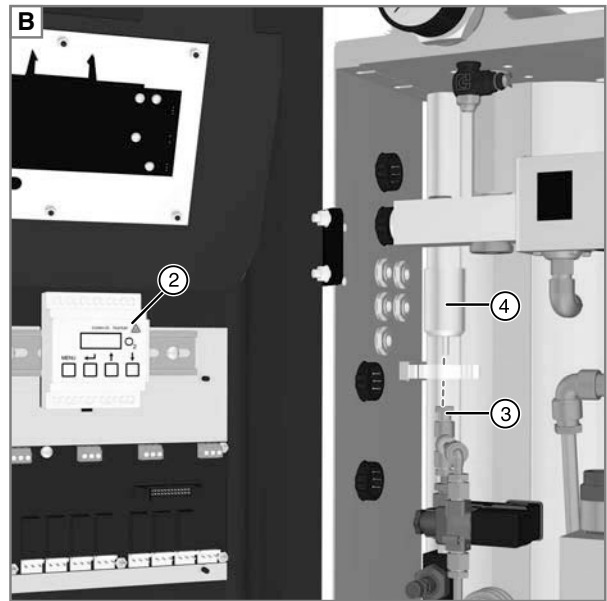
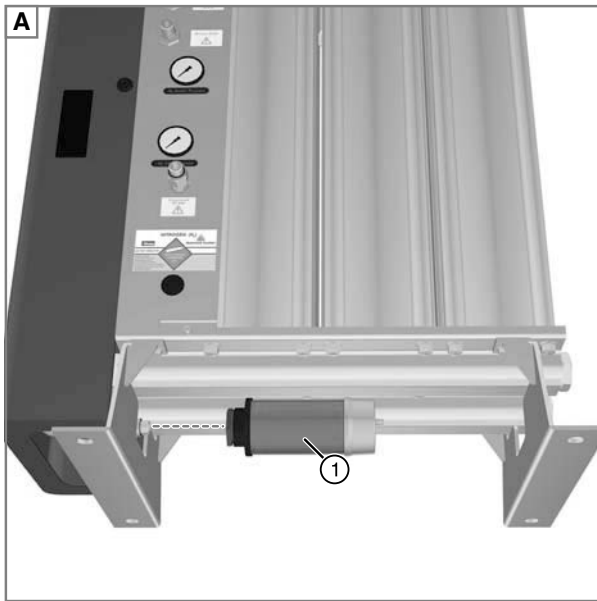
- D** Once de-pressurised unscrew the bowl from the filter head (7) and remove the old filter element (8).

- E** Holding the replacement element by the end caps (9) fit it into the bowl ensuring that the element is correctly seated in the grooves provided (10).

- F** Assemble the filter bowl back onto the filter head and tighten. The markers on the filter head and filter bowl must line up with each other when fully assembled (11).

Close the drain valve on the filter and slowly open the filter outlet valve and inlet valve.





5.5 Oxygen Analyser Calibration



Hot surfaces and hazardous live terminals. Take care when performing the following calibration procedure as there are hazardous live voltages and potentially hot surfaces within the enclosure.

The O₂ analyser should be calibrated at least once every three months against a **calibrated gas supply** or a **calibrated independent analyser**.

For low purity applications the calibration may be performed using compressed air, however this method is **not** recommended when the purity of the gas is critical.

The purity of the calibration gas should not exceed 50ppm for high purity generators (ppm oxygen cells) and 5% for lower purity generators (% oxygen cells). Do not exceed 7 barg pressure.



The pressure regulator and flow control valve are factory set to deliver 250cc/min. to the O₂ cell. Adjusting either component could cause damage to the O₂ cell or incorrect calibration.

Using a calibrated gas supply

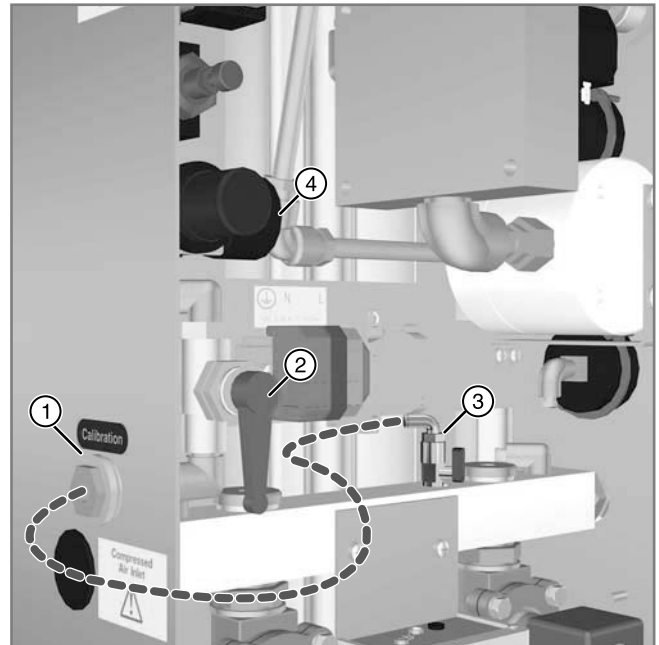
- Select menu 3.1 and enable the O₂ Alarm Over-ride.
- Connect the gas supply to the O₂ Analyser calibration port (1) on the side of the generator.
- Locate the calibration ball valve (2) inside of the shroud and rotate the handle clockwise so that it is pointing down as shown.
- Wait for the O₂ reading to stabilise before entering the calibrated level.

Using a calibrated independent analyser

- Select menu 3.1 and enable the O₂ Alarm Over-ride.
- Connect the analyser to the nitrogen outlet port of the generator.
- Wait approximately for the O₂ reading to stabilise before entering the calibrated level.

Using compressed air

- Select menu 3.1 and enable the O₂ Alarm Over-ride.
- Connect the O₂ sample line between the elbow push in fitting, located on the ball valve (3), and the O₂ Analyser calibration port (1).



If a sample line other than the one provided by Compair is used ensure that it is suitable rated for the working pressure of the generator.

- Open the ball valve (3) and rotate the handle of the calibration ball valve (2) so that it is pointing downwards as shown.
- Wait for the O₂ reading to stabilise before entering the calibrated level.



The sample line will need to be depressurised prior to disconnection. Close the ball valve (3) and wait until the pressure shown on the pressure gauge (4) reaches zero. When the line is fully depressurised, rotate the handle of the calibration ball valve (2) so that it is pointing upwards and disconnect the line from the generator.

5.5.1 Entering the calibrated level

- 1 Select menu 3.2 to view the existing reading from the O₂ analyser.
- 2 Using the **▲** and **▼** keys enter one of the following as applicable:
 - the purity of the calibration gas,
 - the purity reading from the independent analyser,
 - Oxygen content of the compressed air (20.9%).
- 3 Press **▶** to send the calibration level to the O₂ analyser.

3.2	O2 Calibration	4.95%
-----	----------------	-------

3.2	O2 Calibration	5.00%
-----	----------------	-------

3.2	O2 Calibration	Please Wait...
-----	----------------	----------------

3.2	O2 Calibration	5.00%
-----	----------------	-------

On successful completion of the calibration the new O₂ reading will be shown on the bottom line of the display as shown. Return the calibration ball valve back to its original position and remove the regulated calibration gas supply or independent analyser as applicable.

If the calibration is not successful the original reading from the analyser will be loaded. Should this occur repeat the above steps.

- 4 Select menu 3.1 and disable the O₂ Alarm Over-ride. When returning to the main operating menu, "CAL" will be shown on the top line of the display. This will remain for a period of twenty minutes after the calibration. Throughout this time period the O₂ alarm will be overridden to allow the sensor to return to the required level.

O2 = 5.00 %	CAL
Running	

5.6 Service Record

Generator Details	
Model Number:	
Serial Number	
Supply Voltage	
Commissioned By:	
Company Name	
Address:	
Telephone:	
Fax:	
Contact Name:	
Date of Commission:	

Service Interval Months (Hours)	Date	Serviced By		Comments
		Print	Sign	
6 (4,000)				
12 (8,000)				
18 (12,000)				
24 (16,000)				
30 (20,000)				
36 (24,000)				
42 (28,000)				
48 (32,000)				
54 (36,000)				
60 (40,000)				
66 (44,000)				
72 (48,000)				
78 (52,000)				
84 (56,000)				
90 (60,000)				
96 (64,000)				
102 (68,000)				
108 (72,000)				

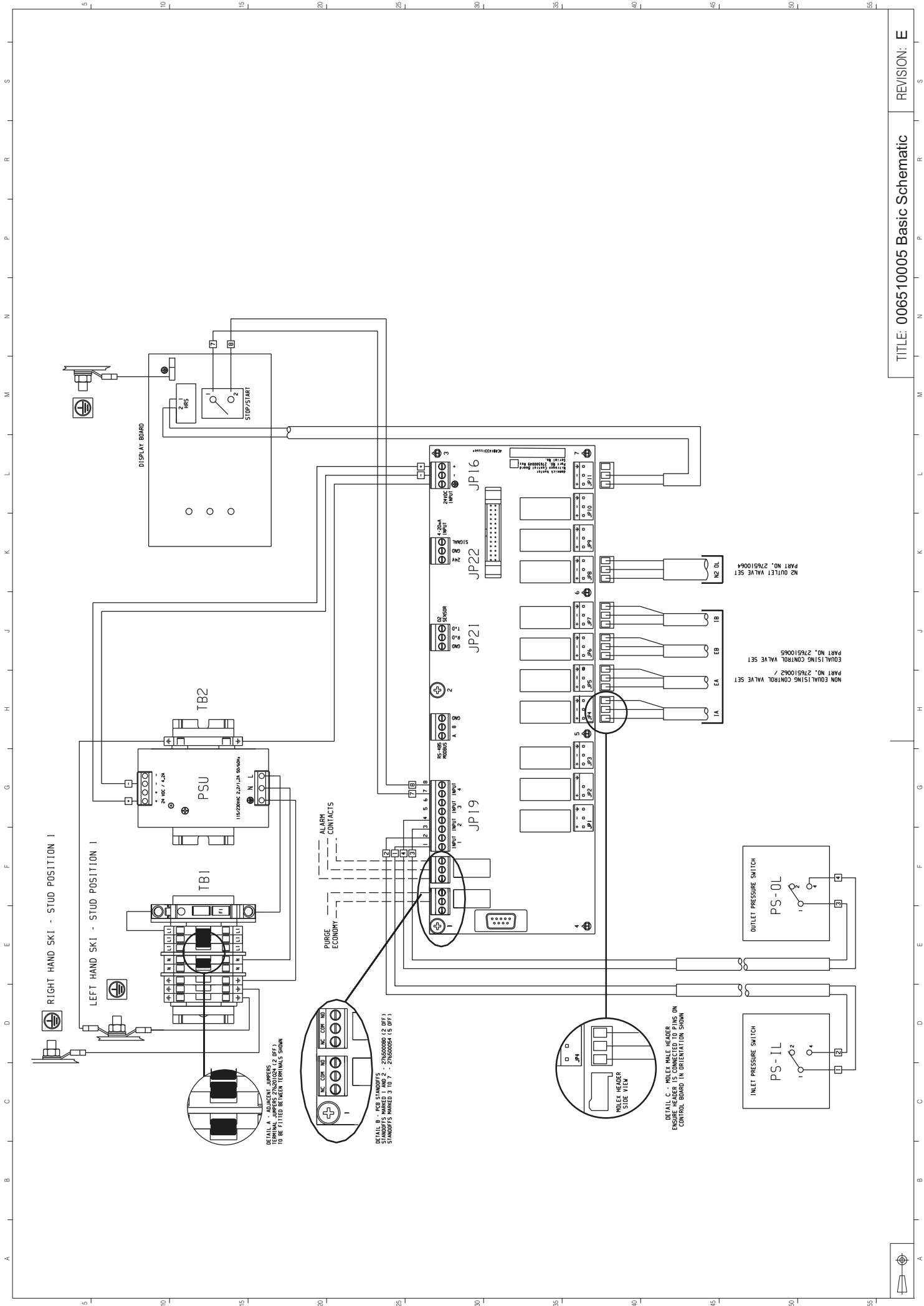
6 Troubleshooting

In the unlikely event that a problem occurs on the equipment, this troubleshooting guide can be used to identify the probable cause and remedy.



Troubleshooting should only be attempted by competent personnel. All major repair, and calibration work should be undertaken by a Compair trained, qualified and approved engineer.

Fault	Probable Cause	Remedy
Power connected but the status indicators and display (analyser only) is not illuminated.	The electrical power to the generator is not connected.	Check that there is power to the generator supply terminals on terminal block "TB1".
	The electrical supply fuse is blown.	Check fuse "F1" on terminal block "TB1". If the fuse has blown disconnect the electrical supply to the generator and replace the fuse.
	The controller ribbon cable is not connected.	Open the access door and check that the 26-way ribbon cable is connected between the controller and JP22 on the control board.
No / Low gas outlet pressure	External leak.	Check the piping and connection points for leaks. Repair as necessary.
	Internal leaks.	Open the access door and check all connection points for leaks. Repair as necessary.
	The pressure of the compressed air supply is low.	Refer to Low inlet pressure fault below.
	The generator requires a service.	Check the service schedule and perform the required service.
High Oxygen concentration.	Defective Oxygen cell.	Replace the oxygen cell.
	Leak in system piping.	Open the access door and check all connection points for leaks. Repair as necessary.
Low inlet pressure	The pre-filtration within the system is approaching the end of its operational life.	Check the service schedules for the filters and perform the required service.
	The pretreatment dryer is being overflowed or is operating at a reduced system pressure.	Check that compressed air delivered to the dryer meets the requirements specified within the documentation provided with the dryer.
	An isolation valve is partially closed upstream of the generator.	Check the position of all isolation valves.
	External leak.	Check the piping and connection points for leaks. Repair as necessary.
Excessive noise or vibration	Silencer loose or defective.	Check that the exhaust silencer is securely fitted in place.
	Solenoid valve wear or coil loose.	Check the exhaust valves and verify that the coils are secure. Contact Compair for advice.
High outlet pressure.	Outlet regulator is incorrectly set or is defective.	Contact Compair for advice.
Moisture in the gas at the outlet of the generator.	Blocked exhaust.	Contact Compair for advice.
	The CMS is beyond its operation life.	Contact Compair for advice.
Reduced flow at the outlet of the generator.	The flow controller is incorrectly set.	Contact Compair for advice.
	The dust filter on the receiver outlet is blocked.	Contact Compair for advice.
	Faulty or incorrectly set pressure regulators.	Contact Compair for advice.



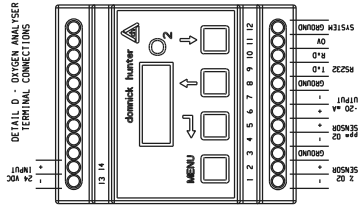
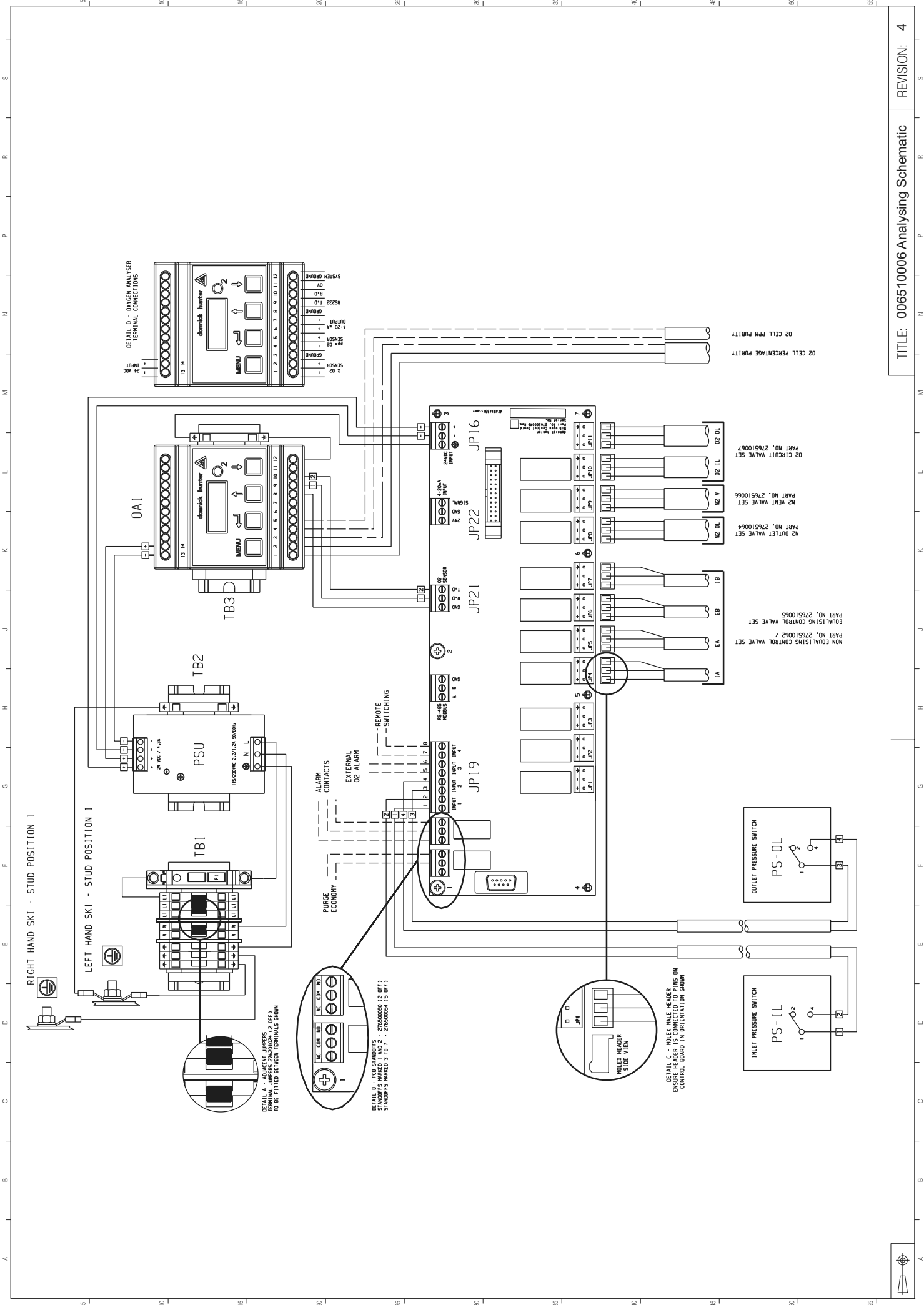
DETAIL A - ADJACENT JUMPS (2 OFF) TO BE FITTED BETWEEN TERMINALS SHOWN

DETAIL B - PCB STANDOFFS 726500090 (2 OFF) STANDOFFS MARKED 3 TO 7 - 276500064 (15 OFF)

DETAIL C - MOLEX MALE HEADER ENSURE HEADER IS CONNECTED TO PINS ON CONTROL BOARD IN ORIENTATION SHOWN

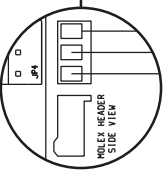
NON EQUALIZING CONTROL VALVE SET
PART NO. 276510062 /
EQUALIZING CONTROL VALVE SET
PART NO. 276510065
HP DL
PART NO. 276510064





DETAIL A - CONNECTOR JUMPER TERMINAL JUMPER 274201024 (2 OFF) TO BE FITTED BETWEEN TERMINALS SHOWN

DETAIL B - FOR SWITCHES STANDOFFS MARKED 1 AND 2 - 274500000 (2 OFF) STANDOFFS MARKED 3 TO 7 - 274500004 (5 OFF)



- O2 CELL PURITY
- O2 CELL PERCENTAGE PURITY
- O2 CIRCUIT VALVE SET PART NO. 276510067
- N2 INLET VALVE SET PART NO. 276510066
- N2 OUTLET VALVE SET PART NO. 276510064
- EQUALISING CONTROL VALVE SET PART NO. 276510065
- NON EQUALISING CONTROL VALVE SET PART NO. 276510062 /

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