



# PSD4 Pressure Swing Dryer User's Manual



97096 Issue 8.1  
September 2018

Please fill out the form(s) below for each instrument that has been purchased.

Use this information when contacting Michell Instruments for service purposes.

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Code	
Serial Number	
Invoice Date	
Location of Instrument	
Tag No	

Instrument	
Code	
Serial Number	
Invoice Date	
Location of Instrument	
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**PSD4**

For Michell Instruments' contact information please go to  
[www.michell.com](http://www.michell.com)

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## Safety

The manufacturer has designed this equipment to be safe when operated using the procedures detailed in this manual. The user must not use this equipment for any other purpose than that stated. Do not apply values greater than the maximum value stated.

This manual contains operating and safety instructions, which must be followed to ensure the safe operation and to maintain the equipment in a safe condition. The safety instructions are either warnings or cautions issued to protect the user and the equipment from injury or damage. Use competent personnel using good engineering practice for all procedures in this manual.

## Electrical Safety

The instrument is designed to be completely safe when used with options and accessories supplied by the manufacturer for use with the instrument.

## Pressure Safety

DO NOT permit pressures greater than the safe working pressure to be applied to the instrument. The specified safe working pressure is **10 barg** (145 psig).

## Toxic Materials

The use of hazardous materials in the construction of this instrument has been minimized. During normal operation it is not possible for the user to come into contact with any hazardous substance which might be employed in the construction of the instrument. Care should, however, be exercised during maintenance and the disposal of certain parts.

## Repair and Maintenance

The instrument must be maintained either by the manufacturer or an accredited service agent. Refer to [www.michell.com](http://www.michell.com) for details of Michell Instruments' worldwide offices contact information.

## Safety Conformity

This product meets the essential protection requirements of the relevant EU directives. Further details of applied standards may be found in the product specification.

## Abbreviations

The following abbreviations are used in this manual:

AC	alternating current
atm	pressure unit (atmosphere)
bar	pressure unit (=100 kP or 0.987 atm)
°C	degrees Celsius
°F	degrees Fahrenheit
dp	dew point
kg	kilogram
Hz	Hertz
lb	pound
NI/min	normal liters per minute
max	maximum
mm	millimeter
ppm <sub>v</sub>	parts per million (by volume)
ppb <sub>v</sub>	parts per billion (by volume)
V	Volts
"	inch(es)
%	percentage

## Warnings

The following general warning listed below is applicable to this instrument. It is repeated in the text in the appropriate locations.



**Where this hazard warning symbol appears in the following sections it is used to indicate areas where potentially hazardous operations need to be carried out.**

## 1 INTRODUCTION

### 1.1 Overview

The Michell PSD4 is a Pressure Swing Dryer in a compact wall mounting unit and is designed to remove moisture from compressed air down to trace levels of  $-100\text{ }^{\circ}\text{C}$  ( $-148\text{ }^{\circ}\text{F}$ ) dew point,  $13.8\text{ ppb}_v$ .

The dryer operates by pressure swing regeneration of a desiccant column. Design is such that, with 2 columns operating in rotation, a constant flow of very dry air (or other inert gas) can be produced for long periods without maintenance.

As no heating is used to regenerate the desiccant the unit is energy-efficient and extremely reliable, with the typical lifetime of the desiccant being 5 years.

### 1.2 Operating Principle

The supply of compressed air/gas is pressure regulated by use of the regulator (PR1) and indicated by the gauge (PG1 or PG2). The air/gas then passes through either switching solenoid valves (SV2 & SV1 or SV3 & SV4) and into the appropriate desiccant column (DC1 or DC2) before finally venting via particulate filters (F1 & F2). Refer to Appendix B.

The desiccant columns are filled with 4 Ångström molecular sieve. The column capacity is designed so that, as the molecular sieve absorbs water from the flowing gas, the moisture content is reduced to less than  $13.8\text{ ppb}_v$ . This very low moisture content level is achievable from an inlet source of either cylinder gas, or compressed air, which typically would be equal to or better than  $-40\text{ }^{\circ}\text{C}$  ( $-40\text{ }^{\circ}\text{F}$ ) dew point.

Assuming the solenoid valve (SV1) is allowing supply gas to pass through the desiccant column (DC1) then a dry gas passes through the non return valve (NRV1) and then through the filter (F1) before finally exiting through the **GAS OUTLET** connector located on the left hand side of the enclosure.

While the supply gas is being dried in DC1 the second desiccant column DC2 is being regenerated (stripped of accumulated moisture). At the beginning of its regeneration cycle the bulk of the moisture in DC2 is removed by rapidly reducing the pressure in the column, which effectively 'evaporates' moisture from the molecular sieve surface, this is caused by SV4 being opened to vent via the vent filter (F2). After depressurization, the remainder of the moisture is removed by back-flushing column DC2 with a small proportion of the dry gas being generated in DC1 which is controlled through the flow metering valve (FV1).

When the regeneration cycle is complete, DC2 is re-pressurized and then the supply gas is diverted to it via SV3. SV2 opens to vent DC1 and allows it to regenerate. Degradation of the desiccant is prevented by re-pressurizing 'off-line' with a low flow-rate of gas rather than with the main gas flow.

The procedure is now repeated with DC2 providing the main flow of dry gas and DC1 being regenerated by depressurization and back-flushing. This cyclic operation and regeneration process is operated and controlled by a programmable relay unit and is set to provide 6 minute cycles.

Refer to Appendix B, *Figure 2* for the System Flow Diagram.

## 2 INSTALLATION

The PSD4 is supplied with a full accessory package. Please check that you have received all the items listed on the Packing Check List.

The power supply voltage is indicated on the yellow label located adjacent to the power socket on the left of the enclosure.

### 2.1 Installing the Dryer

The PSD4 requires an operating environment of +10 to +40 °C (+50 to +104 °F). Refer to Appendix B for outline dimensions.

The PSD4 enclosure is designed for wall/panel mounting. Wall mounting brackets are supplied loose. Alternatively, it may free stand on or be placed under a bench. The enclosure should be mounted vertically and be located in a shaded position free from any appreciable vibration and not in direct sunlight.

**NOTE: A minimum distance of 200mm (8") to the left hand side of the unit is required for access to gas connections and wiring.**

### 2.2 Electrical Connections

Power is connected via an IEC socket located on the left hand side of the enclosure. A suitably fused power supply, conforming to local electrical safety regulations, must be provided by the user. The power supply voltage can be 100-240 V AC with power consumption a maximum of 160 W.

**IMPORTANT: Before connecting the unit to a mains power source, ensure the correct operating voltage. The voltage rating is marked on the yellow label located adjacent to the power socket.**

### 2.3 Gas Connections

Gas connections are made via tube fittings located on the left hand side of the enclosure marked **GAS INLET** and **GAS OUTLET**.

The gas inlet connection is a Swagelok® stainless steel ¼" bulkhead union tube fitting. The gas outlet connection is a Swagelok® stainless steel ¼" bulkhead union face seal (VCR) fitting.

Ensure the supply inlet gas is of a suitable pressure - between 5.5 to 7 barg (80 to 100 psig), free of oil and at a dew point of typically <-40 °C (<-40 °F). If the supply inlet gas does not meet this requirement it will reduce the dryer's efficiency and eventually lead to complete failure.

**NOTE: An oil free compressor or bulk inert gas source must be used.**



### 3 OPERATION

There are no external controls for the PSD4 Pressure Swing Dryer, operation is fully automatic and no internal adjustment is required.

After inlet and outlet gas connections are made tight the unit may be connected to a power supply. The unit is designed for on-line automatic use, therefore, as soon as power is applied the unit will operate.

#### 3.1 Operating the Dryer

The supply of compressed air/gas is pressure regulated to 4.8 barg (70 psig) by using the pressure regulator, as indicated on the pressure gauge.

Upon initial start-up the two desiccant columns will be at equilibrium with ambient air and therefore drying efficiency will be quite low. Initially, it is likely that the outlet dew point will be as high as -20°C (-4 °F) or -30 °C (-22 °F) dew point although the exact level depends on time since its previous use as well as local ambient conditions. The generator should be operated for a minimum of 24 hours with no flow of air being drawn from the outlet to allow correct regeneration of the desiccant columns. If the humidity level fails to reduce below 2 parts per million (-72 °C (-98 °F) dew point) after 12 hours of no-load operation the desiccant may have been damaged by oil or other contamination and it may need to be replaced. If this is the case, please consult Michell Instruments' Customer Service Department (see [www.michell.com](http://www.michell.com) for contact information) for further advice.

**NOTE:** For optimum performance it is necessary to operate the PSD4 continuously. It is recommended that, when not in use, the dryer is kept in stand-by condition by operating at a reduced outlet flow rate of 1 NI/min (2.1 scfh).

## 4 MAINTENANCE

### 4.1 Maintaining the Dryer

Other than replacement of the desiccant and the filters no other general maintenance is required.

The period between replacement of the desiccant will be determined by the period of operation and quality of the supply gas.

Replacement of the filters is recommended every 5 years.

#### 4.1.1 Desiccant Change

##### Desiccant Disposal Guidelines

Molecular sieve type 4 Å, 4 - 8 mesh hygroscopic used in this product may be sent to a licensed disposal facility.

Handling must be carried out by technically qualified persons familiar with potential chemical hazards. Personal protective equipment including safety goggles, respirator, gloves, face shield and/or safety shield must be used while handling desiccant.



After any change of desiccant the purge flow should always be checked.

Proceed as follows:

**NOTE: Both cylinders should be renewed with desiccant at the same time.**

1. Disconnect the power supply and gas supply source.
2. Disconnect the compression coupling at the base of the cylinder and the VCR coupling at the top of the cylinder.
3. Loosen the 2 cylinder restraining straps and remove the cylinder.
4. Remove the compression coupling from the inlet of the cylinder.
5. Carefully unscrew and remove the desiccant retaining gauze from the neck of the cylinder. The old desiccant may now be poured into a dry container for disposal.
6. Refill the cylinder with desiccant. When filling the cylinder continually lightly tap the outer cylinder wall to aid full filling at settlement of the desiccant. **There should be no air gap between the desiccant and the gauze.** Each cylinder contains approximately 1000cc of desiccant.
7. Immediately replace the retaining gauze, ensuring that the gauze does not fully pass the threaded part of the neck. Refit the compression coupling using PTFE tape to reseal the coupling into the cylinder neck.

8. Replace the cylinder into the retaining straps and secure.
9. Reconnect the VCR coupling ensuring a new metal gasket is fitted.
10. Reconnect the compression coupling. The system may now be powered up and gas applied.

To check the purge flow proceed as follows:

1. Connect a flowmeter to the exhaust filter (F2) and adjust the flow valve (FV1) to achieve a measured flow of 10 NI/min (21.2 scfh). This is measured after de-pressurization at the end of the purge cycle when the air flow is constant. This occurs just before the flow goes to zero and the changeover begins.
2. Check the measured flow is within 0.5 NI/min (1 scfh) of the exhaust flow previously measured, when the 2nd channel exhausts. Any significant difference from 0.5 NI/min (1 scfh) between the two exhaust ports would indicate a partial blockage in the pipe work.

#### 4.1.2 Outlet Filter Replacement

Replacement filter type – Michell part no. PSD-4-FO

Proceed as follows:

1. Disconnect power supply and gas supply source.
2. Disconnect both the VCR couplings at each end of the filter body.
3. Remove and discard the old filter body and replace with a new one.
4. Reconnect the VCR couplings ensuring new metal gaskets are fitted. The system may now be powered up and gas applied.

#### 4.1.3 Vent Filter Replacement

Replacement filter element type – Michell part no. PSD-4-FV

Proceed as follows:

1. Disconnect power supply and gas supply source.
2. Unscrew and remove the clear filter bowl.
3. Unscrew and discard the old filter element and replace with a new one.
4. Replace the clear filter bowl. The system may now be powered up and gas applied

4.2 Fault Diagnosis

The PSD4 Pressure Swing Dryer is a factory set unit which should not need any further adjustment.

If a fault occurs, it is recommended that the unit be returned to Michell Instruments (see [www.michell.com](http://www.michell.com) for contact details) or to your local Michell agent for repair or desiccant column refilling.

The table below details some likely faults and recommended actions.

SYMPTOM	POSSIBLE CAUSE	ACTION
No column changeover	Programmable relay fault	Replace programmable relay
	Solenoid valve failure	Replace solenoid valve
No, or intermittent, output flow	Input source gas interrupted	Check source supply
	Solenoid valve failure	Replace solenoid
	Regulator failure	Replace regulator
Dryer output wetter than expected	Incorrect purge flow	Check purge flow setting
	Desiccant saturated	Check supply gas quality and purge for 24 hours
	Desiccant contaminated	Replace desiccant
	Low inlet pressure	Increase pressure
	Excess load	Reduce outlet flow

# Appendix A

## Technical Specifications

## Appendix A Technical Specifications

Model	PSD4-STD (Standard)	PSD4-HFV (High flow volume)	PSD4-HPO (High pressure output)
<b>Performance</b>			
<b>Gas output</b>			
Flow	30 NI/min (63.6 scfh)	90 NI/min (109.7 scfh)	30 NI/min (63.6 scfh)
Pressure	0.5 barg (7 psig)		User-settable up 8 barg (116 psig)
Moisture content	<13.8 ppb <sub>v</sub>		
<b>Input Requirements</b>			
<b>Gas supply</b>			
Flow	30 NI/min (63.6 scfh)	90 NI/min (109.7 scfh)	30 NI/min (63.6 scfh)
Pressure	6 to 10 barg (87 to 145 psig)		
Moisture content	<16ppm <sub>v</sub>		
<b>Electrical Input</b>			
Power	100 to 240VAC 50/60Hz		
Power Connection	IEC socket		
<b>Environmental Conditions</b>			
Operating temperature	+10 to +40°C (+50 to +104°F)		
Storage temperature	-40 to +50°C (-40 to +122°F)		
<b>Mechanical Specifications</b>			
Type	Twin column desiccant, pressure swing		
Desiccant	4 Ångström Molecular sieve bead (4-8 mesh). 3.5 kg approx required		
Timer	Programmable relay		
<b>Gas connections</b>			
Inlet	¼" VCR Swagelok®		
Outlet	¼" VCR Swagelok®	½" VCR Swagelok®	¼" VCR Swagelok®
<b>Filters</b>			
Outlet	Millipore Wafergard IIF Micro Inline (sealed type) with PTFE membrane element rated at >99.999% retention of 0.003µm particles		
Vent	Bonded glass microfiber rated at >99.999% retention of 0.1µm particles		
Construction	304 stainless steel wall mounting enclosure: 800x600x300mm (31.5x24x12")		
Weight	30Kg (66lb)	35Kg (77lb)	32Kg (70lb)

# Appendix B

## System Drawings

Appendix C System Drawings

C.1 System Layout Drawing

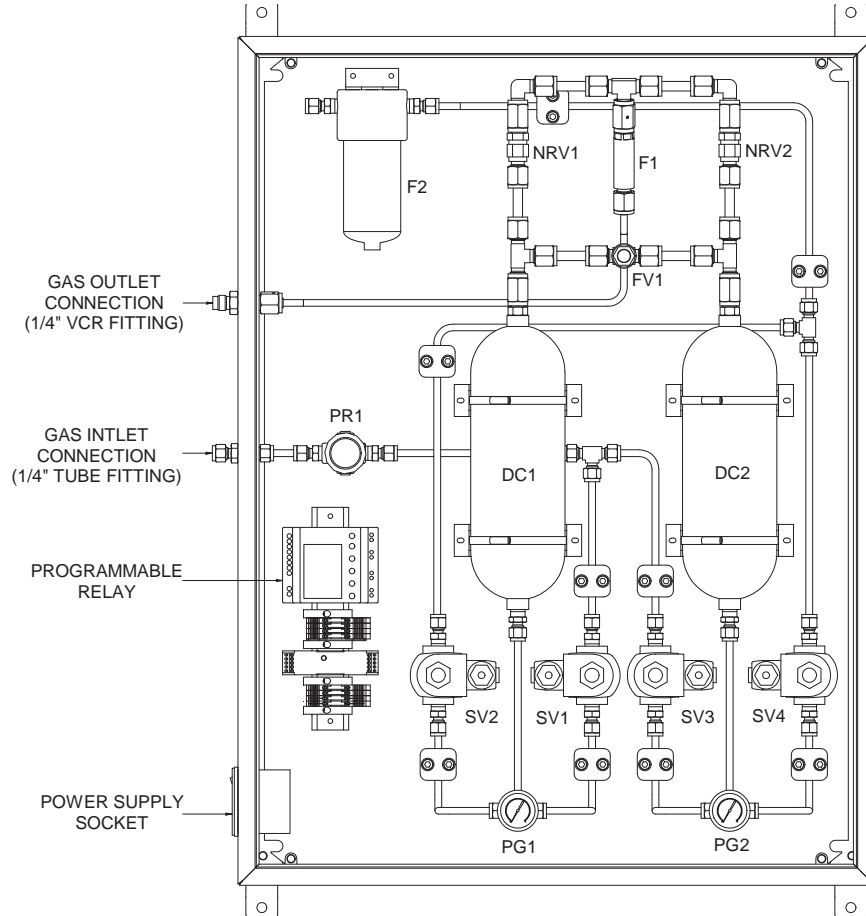
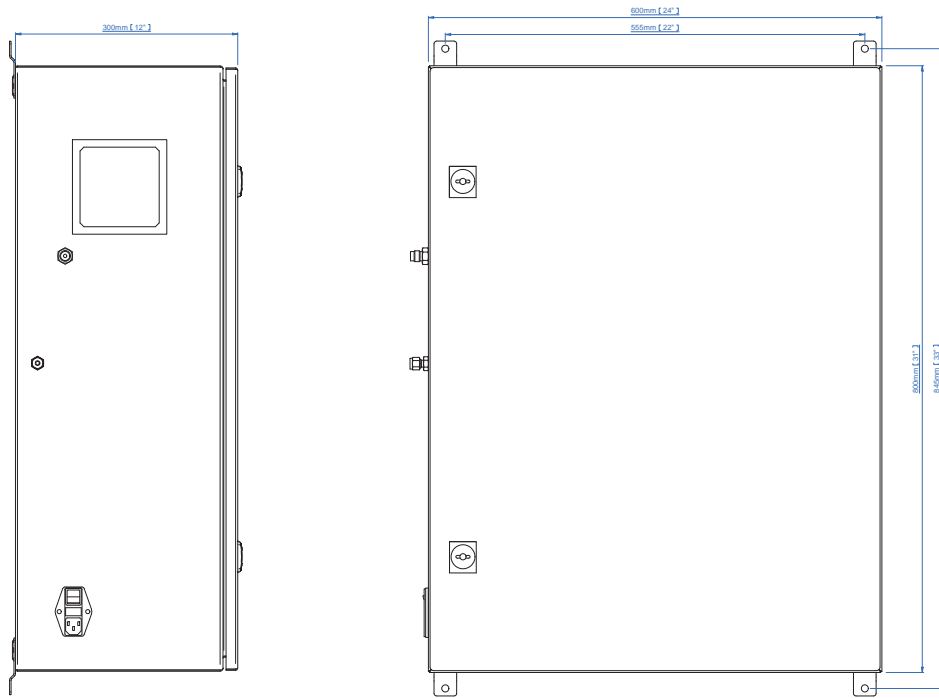


Figure 1 System Layout Drawing



C.2 Schematic Flow Drawing

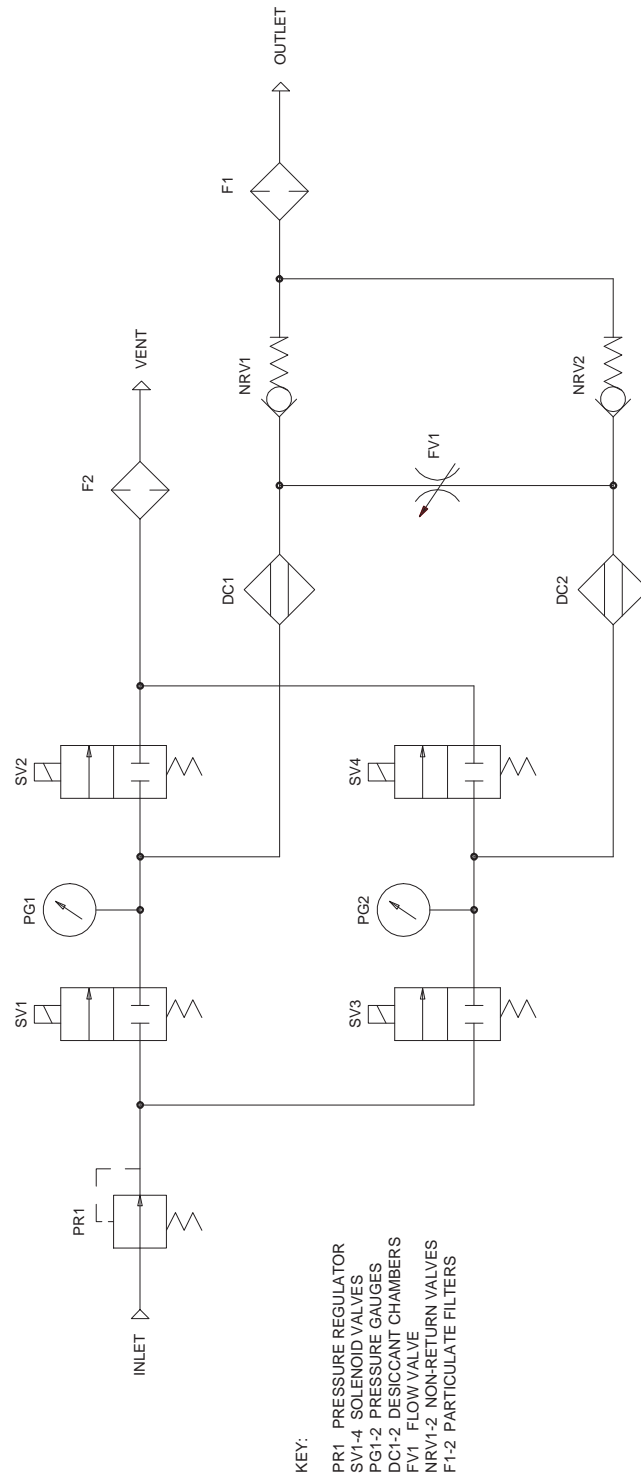


Figure 2 Schematic Flow Drawing

# Appendix C

## Quality, Recycling & Warranty Information

## Appendix D Quality, Recycling & Warranty Information

### D.1 Recycling Policy



Michell Instruments is concerned with the protection of the environment. It is our commitment to reduce and eliminate from our operations, wherever possible, the use of substances which may be harmful to the environment. Similarly, we are increasingly using recyclable and/or recycled material in our business and products wherever it is practical to do so.

To protect natural resources and to promote material reuse, please separate batteries from other types of waste and recycle responsibly. If batteries are not properly disposed of, these substances can cause harm to human health and the environment.

The product that you have purchased may contain recyclable and/or recycled parts and we will be happy to provide you with information on these components if required.

### D.2 WEEE And RoHS Compliance

The Waste Electronic and Electrical Equipment (WEEE) Directive, and the Restriction of Hazardous Substances (RoHS) Directive place rules upon European manufacturers of electrical and electronic equipment. The directives' aim is to reduce the impact that electronic devices have on the environment.

Michell products are currently exempt from the RoHS directive, however all future products will be developed entirely using compliant materials. Furthermore, Michell is taking active steps to remove non-compliant materials and components from existing products wherever possible.

Michell is in full compliance with the WEEE Directive (Registration No. WEE/JB0235YW). Customers may be required to return certain instruments for treatment at the end of their working life.

June 2010

### D.3 Manufacturing Quality

Michell Instruments is registered with the British Standards Institute for Quality Assurance to:

BS EN ISO 9001: 2008

Rigorous procedures are performed at every stage of production to ensure that the materials of construction, manufacturing, calibration and final test procedures meet the requirements laid down by our BSI approved Quality System.

Please contact Michell Instruments ([www.michell.com](http://www.michell.com)) if the product does not arrive in perfect working order.

#### D.4 Calibration Facilities

Michell Instruments' calibration facilities are among the most sophisticated in the world and have been recognized for their excellence.

Traceability to the National Physical Laboratory (NPL) UK is achieved through our UKAS Accreditation (Number 0179). This covers dew point over the range -90 to +90°C (-130 to +194°F) and also Relative Humidity.

Dew-point calibrations are also traceable to the National Institute for Standards & Technology (NIST) USA over the range -75 to +20°C (-103 to +68°F).

**NOTE: Standard traceable calibration certificates for instruments and sensors are not issued under our UKAS accreditation. UKAS certificates are usually to special order and are clearly identified.**

#### D.5 Return Policy

If a Michell Instruments' product malfunctions within the warranty period, the following procedure must be completed:

1. Notify a Michell Instruments' distributor, giving full details of the problem, the model variant and the serial number of the product.
2. If the nature of the problem indicates the need for factory service then the instrument should be returned to Michell Instruments, carriage prepaid, preferably in the original packaging, with a full description of the fault and the customer contact information.
3. Upon receipt, Michell Instruments will evaluate the product to determine the cause of the malfunction. Then, one of the following courses of action will be taken:
  - If the fault is covered under the terms of the warranty, the instrument will be repaired at no cost to the owner and returned.
  - If Michell Instruments determines that the fault is not covered under the terms of the warranty, or if the warranty has expired, an estimate for the cost of the repairs, at standard rates, will be provided. Upon receipt of the owner's approval to proceed, the product will be repaired and returned.

#### D.6 Warranty

Unless otherwise agreed, the Supplier warrants that as from the date of delivery for a period of 12 months the goods and all their component parts, where applicable, are free from any defects in design, workmanship, construction or materials.

The Supplier warrants that the services undertaken shall be performed using reasonable skill and care, and of a quality conforming to generally accepted industry standards and practices.

Except as expressly stated all warranties whether express or implied, by operation of law or otherwise, are hereby excluded in relation to the goods and services to be provided by the Supplier.

All warranty services are provided on a return to base basis. Any transportation costs for the return of a warranty claim shall reside with the Customer.

# Appendix D

## Return Document & Decontamination Declaration

## Appendix E Return Document &amp; Decontamination Declaration

## Decontamination Certificate

**IMPORTANT NOTE:** Please complete this form prior to this instrument, or any components, leaving your site and being returned to us, or, where applicable, prior to any work being carried out by a Michell engineer at your site.

Instrument			Serial Number	
Warranty Repair?	YES	NO	Original PO #	
Company Name			Contact Name	
Address				
Telephone #		E-mail address		
Reason for Return /Description of Fault:				
Has this equipment been exposed (internally or externally) to any of the following? Please circle (YES/NO) as applicable and provide details below				
Biohazards	YES		NO	
Biological agents	YES		NO	
Hazardous chemicals	YES		NO	
Radioactive substances	YES		NO	
Other hazards	YES		NO	
Please provide details of any hazardous materials used with this equipment as indicated above (use continuation sheet if necessary)				
Your method of cleaning/decontamination				
Has the equipment been cleaned and decontaminated?	YES		NOT NECESSARY	
Michell Instruments will not accept instruments that have been exposed to toxins, radio-activity or bio-hazardous materials. For most applications involving solvents, acidic, basic, flammable or toxic gases a simple purge with dry gas (dew point <-30°C) over 24 hours should be sufficient to decontaminate the unit prior to return. <b>Work will not be carried out on any unit that does not have a completed decontamination declaration.</b>				
<b>Decontamination Declaration</b>				
I declare that the information above is true and complete to the best of my knowledge, and it is safe for Michell personnel to service or repair the returned instrument.				
Name (Print)			Position	
Signature			Date	



F0121, Issue 2, December 2011

NOTES:

# EU Declaration of Conformity



Manufacturer: **Michell Instruments Limited**  
**48 Lancaster Way Business Park**  
**Ely, Cambridgeshire**  
**CB6 3NW. UK.**



On behalf of the above named company, I declare that, on the date that the equipment accompanied by this declaration is placed on the market, the equipment conforms with all technical and regulatory requirements of the directives. The product:

## PSD2 & 4 Pressure Swing Dryer

complies with all the essential requirements of the EU directives listed below.

**2014/30/EU EMC Directive**  
**2014/35/EU Low Voltage Directive (LVD)**  
**2011/65/EU Restriction of Hazardous Substances Directive (RoHS2)**

and has been designed to be in conformance with the relevant sections of the following standards or other normative documents.

EN61326-1:2013 Electrical equipment for measurement, control and laboratory use – EMC requirements –Class A (emissions) and Industrial Locations (immunity).

EN61010-1:2010 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements

### **2014/68/EU PE Directive**

This product and sample systems & accessories that may be supplied with it do not bear CE marking for the Pressure Equipment Directive, and are supplied in accordance with Article 4, paragraph 3 of 2014/68/EU by using SEP (sound engineering practice) in the design and manufacturer and are provided with adequate instructions for use.

Mr. Andrew Stokes, Technical Director  
Ely UK

August 2018







<http://www.michell.com>