



DG4

Automatic Dew-Point Generator

User's Manual



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

Use this information when contacting Michell Instruments for service purposes.

Instrument	
Code	
Serial Number	
Invoice Date	
Location of Instrument	
Tag No	

Instrument	
Code	
Serial Number	
Invoice Date	
Location of Instrument	
Tag No	

Instrument	
Code	
Serial Number	
Invoice Date	
Location of Instrument	
Tag No	



DG4

For Michell Instruments' contact information please go to
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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 qualified personnel and 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. The input power supply voltage limits are 220 to 240 V AC, 50Hz or 100 to 120 V AC, 60Hz depending on what was specified at time of order. **Refer to the yellow label located on the rear panel of the unit for the correct supply voltage required.**

Pressure Safety

DO NOT permit pressures greater than the safe working pressure to be applied to the instrument. The specified maximum gas inlet pressure is 2 barg (29 psig). Refer to the Technical Specifications in Appendix A.

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 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)
barg	pressure unit (=100 kP or 0.987 atm) gauge
°C	degrees Celsius
°F	degrees Fahrenheit
dp	dew point
EU	European Union
Hz	Hertz
NI/min	normal liters per minute
lb	pound
mm	millimeter
ppm _v	parts per million (by volume)
psig	pound(s) per square inch (gauge)
scfh	standard cubic feet per hour
V	Volts
"	inch(es)

Warnings

The following general warnings listed below are applicable to this instrument. They are 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

The Michell DG4 Automatic Dew-point Generator is designed for use as part of a hygrometry calibration system. It is capable of repeatable generation of factory set dew-point levels, typically over the range of -75 to $+20^{\circ}\text{Cdp}$ (-103 to $+68^{\circ}\text{Fdp}$) depending on dry air supply and set points chosen at time of order.

The DG4 is based on the volumetric mixing of dry and wet gases. It gives the fastest response when changing between set points, in comparison to other dew-point generation technologies (such as two-temperature, two-pressure or a combination of both). The mixing is automated using a bank of pre-set metering valves, selected by actuating combinations of solenoids to switch between the different wet-dry mixing ratios.

A suitable high quality dry gas source is fed to the generator and split into two streams. One stream is bubbled through liquid water via a sintered glass nozzle ensuring it is completely saturated with water vapor, while the other stream remains dry. The two gas streams are then mixed at atmospheric pressure, in a multi-stage process, to generate the target humidity level. The entire enclosure is insulated and temperature controlled ensuring that the saturation, and therefore the output, is always consistent.

Typically, the DG4 is supplied with factory pre-set dew-point values at intervals of 10°C across the entire range. However, the values are specified at the time of order and can be customized to suit the specific requirements of the application. The default values are full dry (unmixed), -70 , -60 , -50 , -40 , -30 , -20 , -10 , 0 , $+10$ & $+20^{\circ}\text{Cdp}$.

The dew-point pre-sets may be selected manually via the front panel keypad or remotely, via a computer, using RS232 Communications.

The DG4 is supplied with a manual override facility, which allows the operator to independently mix the wet and dry gas streams via front panel mounted vernier metering valves, over the range -40 to $+20^{\circ}\text{Cdp}$ (-40 to $+68^{\circ}\text{Fdp}$)

As with all humidity generators, the DG4 should be used in conjunction with a Michell chilled mirror reference instrument that is certified with a traceable calibration.

Note on Customization

Often calibration systems and components are customized to the particular requirements of the application at time of order. Throughout this manual we have attempted to highlight the common places where customization occurs, but good judgement and common sense should be exercised during interpretation. Customizations will be shown in the text of the original order or quotation.

2 INSTALLATION

Check that you have received all items listed on the packing check list. If anything is missing please contact Michell's Customer Service Department.

2.1 Environmental Conditions

The DG4 should be used in a conditioned laboratory environment and requires an ambient temperature of +18 to +24°C (+64 to +75°F) for best results.

2.2 Enclosure

The instrument enclosure is designed for 19" rack mounting (6U high) using M6 fixings. However, it can also be bench mounted without any special preparation.

2.3 Gas Connections

The generator requires a supply of high quality (oil free) dry gas with a moisture content of <1 ppm_v (<-75°C atmospheric dew point) or compressed air to the same specification as used during its setup/calibration. This enables the maximum range of dew points to be generated. A minimum flow of 7 NI/min (14.8 scfh) is required.

The generator was set-up/calibrated using either a Michell PSD2 Pressure Swing Dryer or a specific compressed air supply. A warning label stipulating what the air inlet specification needs to comply with, appears on the rear panel of the generator.

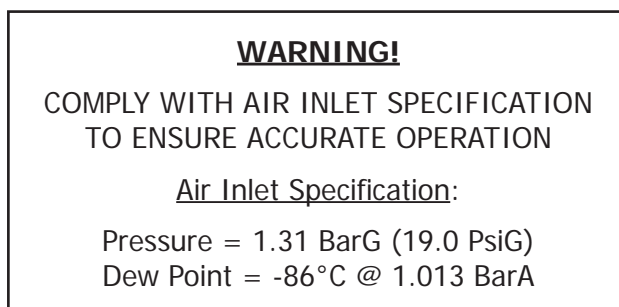


Figure 1 *Warning Label Example*

The gas inlet and outlet connections are Swagelok® 6mm stainless steel bulkhead union tube fittings located on the rear panel of the unit marked **GAS IN** and **GAS OUT** - unless otherwise specified at time of order.

2.4 Power Supply Connection

Either 220 to 240 V AC, 50Hz or 100 to 120 V AC, 60Hz power supply is required to operate this instrument. Refer to the yellow label located on the rear panel of the unit for the correct supply voltage required.

The power supply connection is via the 3-pin IEC plug located on the rear panel of the unit. A 3-core power cable is provided, the free end of which should be wired to a suitable earthed plug or directly via a fused power spur.

Power cable conductors are colored according to the convention:

Brown	L (Live)
Blue	N (Neutral)
Green/yellow	E (Earth)

2.5 Remote Control Connection

An RS232 communication interface is available from the 9-way D-type connector located on the rear panel of the unit marked **RS232 COMMS**.

Pin connections are as follows:

Pin 2	Transmit data (TXD)
Pin 3	Receive data (RXD)
Pin 5	Digital ground (GND)

The serial link has the following protocol:

2400 baud rate
8 data bits
1 stop bit
No parity

Refer to Section 3.4 for a list of RS232 commands.

3 OPERATION

Check that all connections are in accordance with the installation instructions.

3.1 First Time Operation

Before powering up the unit for the first time:

1. Fill the saturator with distilled water, according to the instructions below.
2. Switch on the generator via the front panel **POWER** On/Off switch.
3. Allow 1 hour for the generator temperature (factory set to 35°C) to stabilize. The generator temperature is controlled via a CAL3200 autotune PID temperature controller and displays the generator temperature.

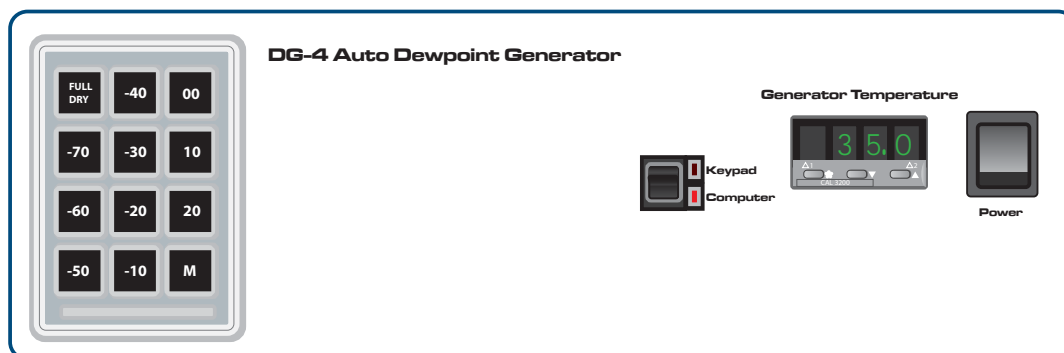


Figure 2 *Front Panel Controls*

4. When operating for the first time, or after a long period without use, the system pipework should be purged. Select **FULL DRY** dew point (on the keyboard) and allow the system to run for a minimum of 8 hours.

3.2 Filling the Saturator

**WARNING**

This unit operates under pressure. Safety goggles must be worn when filling the saturator.

Isolate the saturator system before attempting filling and subsequent top-ups while the unit is in operation. This is simply achieved by selecting FULL DRY.

NOTE: Ensure the level is checked with the unit in operation since water can be siphoned back into the water trap when depressurized, causing a false level to be shown.

1. Before operation, the saturator system must be filled with distilled water. Access to the saturator is through the hinged front panel of the unit (see *Figure 3*).



Figure 3 *Saturator and Filter Location*

2. Unscrew the red plastic filling port nut and fill with clean distilled water to the level indicated on the label. The water level must be kept above the minimum level and below the maximum level. Replace the filling port nut and close the hinged panel.

3. A visually identical water trap for the saturator is included to prevent the siphoning back of water into the pipework when the wet flow is shut off (depressurized). **NOTE:** The water level in the saturator and water trap should be added together when gauging if the generator is sufficiently filled with water.

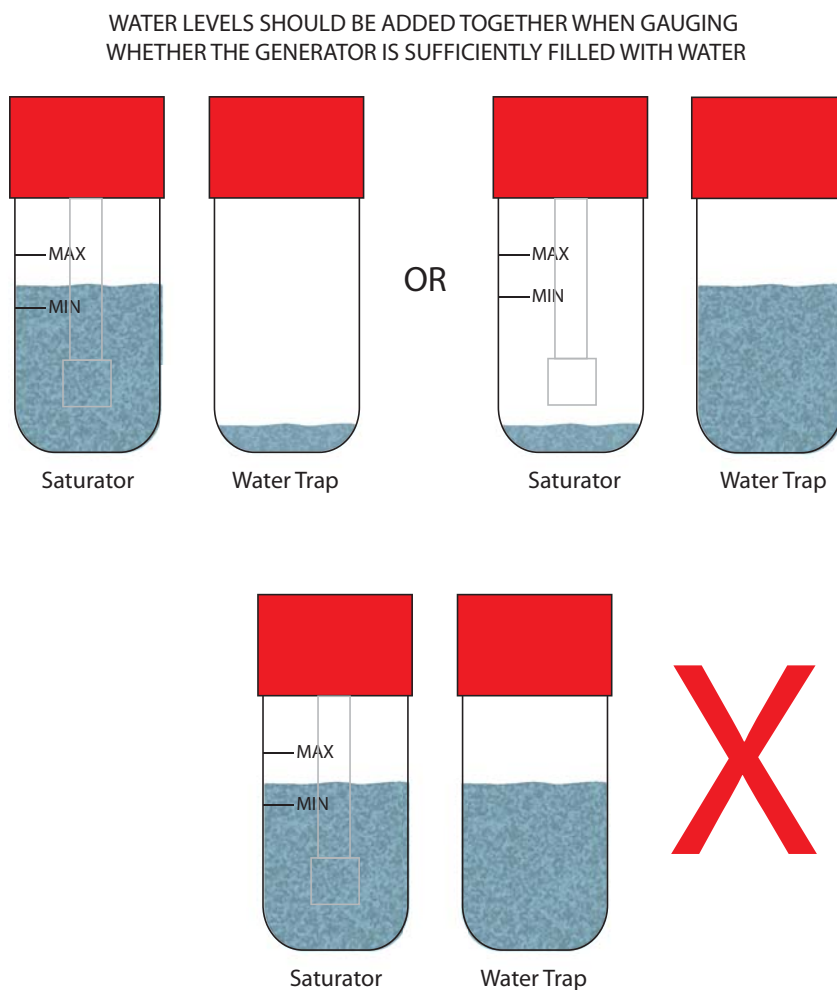


Figure 4 *Water Levels*

Frequency of top-ups is dependent on use and on the dew point being generated. If the generator is operating at dew points above -40°C (-40°F) for extended periods of time it may be necessary to fill the saturator more often, and it should be checked every other day.

3.3 Keypad Operation

Any one of the pre-set dew points can be selected via the front panel keypad.

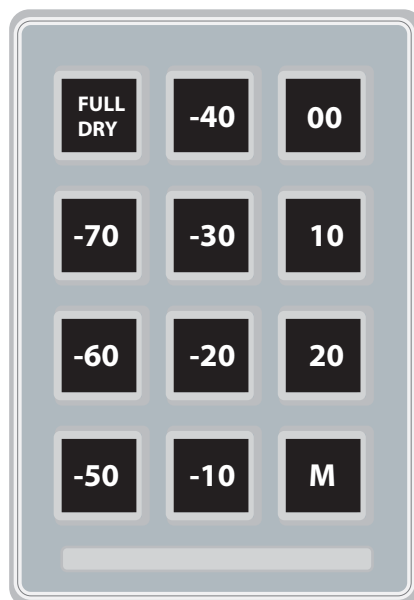


Figure 5 *Front Panel Keypad*



1. Press the **KEYPAD/COMPUTER** select switch into the **Keypad** position. The LED next to the **Keypad** will illuminate.
2. Press the appropriate button on the keypad for your desired dew point.

NOTE: If a sequence of dew points is required it is important to start at the driest dew point and select progressively through the range always moving from dry to wet.

When the sequence is complete always return the generator to the **FULL DRY** setting and allow the system to run for several minutes to purge out the moist gas before shut down.

3.4 Remote Control

Any one of the pre-set dew points can be selected remotely via a computer using RS232 Communications.



1. Press the **KEYPAD/COMPUTER** select switch into the **Computer** position. The LED next to **Computer** will illuminate.
2. Transmit the appropriate command (ascii characters) for your desired dew point.

The command is as follows:

DG:nn<CR> where: **DG:** is the entry code
nn is a number corresponding to the required dew point
<CR> is a carriage return

A list of the appropriate commands for selecting the desired dew point is as follows:

Command	Dew Point (°C)
DG:00	FULL DRY
DG:01	-70
DG:02	-60
DG:03	-50
DG:04	-40
DG:05	-30
DG:06	-20
DG:07	-10
DG:08	0
DG:09	10
DG:10	20
DG:11	MIX

NOTE: The dew-point values in the table above should be used as an example only. Typically the DG4 is supplied with factory pre-set dew-point values at intervals of 10°C across the entire range. However, the values are specified at time of order and can be customized to suit the specific requirements of the application.

3.5 Manual Override

The DG4 is fitted with the manual override facility, any dew point can be generated over the range -40 to +20°C (-40 to +68°F). This is achieved by manual mixing via front panel mounted vernier metering valves of dry gas and wet gas.

A reference dew-point hygrometer connected to the output of the generator is required to determine the actual dew-point value.



1. Press the **KEYPAD/COMPUTER** select switch into the **Keypad** position. The LED next to the **Keypad** will illuminate.
2. Rotate the **WET FLOW** valve fully clockwise to close. **NOTE: DO NOT OVER-TIGHTEN.**
3. Press **M** on the keypad for manual operation.
4. Adjust the **DRY FLOW** valve to give a total flow output from the generator of 4 NI/min (8.4 scfh). This value may need lowering when generating wet gases.

IMPORTANT NOTE: All further adjustments should be via the WET FLOW valve.

5. Carefully open the **WET FLOW** valve until the desired dew point is achieved.

NOTE: As there is a time delay between setting changes and dew-point measurement stabilization, it will be necessary to adjust the WET FLOW valve in small increments and wait for the dew point to stabilize before further adjustment, so that accurate dew points can be generated.

When the sequence is complete, always return the generator to the **FULL DRY** setting and allow the system to run for several minutes to purge out the moist gas before shut down.

4 MAINTENANCE

**WARNING**

This unit operates under pressure. It is recommended that safety goggles are worn.

Internal parts may be very HOT!

Routine maintenance of the DG4 Automatic Dew-point Generator is limited to three tasks.

4.1 Saturator Filling

Check the water level of the saturator (see Section 3.2) on a weekly basis and fill if necessary. If the generator is operating at dew points above -40°C (-40°F) for extended periods of time it may be necessary to fill the saturator more often, and it should be checked every other day.

The water level in the saturator, and the visually identical water trap, should be added together when gauging whether the generator is sufficiently filled with water (see *Figure 4*).

4.2 Checking Generator Temperature

The generator temperature control stability and level must be checked on a regular basis.

The temperature controller is factory set and locked at 35°C , and therefore does not require any further adjustment.

If the generator temperature is not 35°C ($\pm 2^{\circ}\text{C}$) then contact Michell Instruments' Customer Service Department for details.

4.3 Filter Element Replacement

A particulate filter is included within the generator on the gas inlet line. Access is through the hinged front panel of the unit (see *Figure 3*).

Frequency of the filter element replacement is dependent upon operating conditions. It is recommended that, initially, the filter element be examined on an six monthly basis. Then, depending on the conditions, increase or decrease the maintenance period accordingly.

Replacement filter element type – Michell order code: SSF-PF-10PK

Replace the filter element as follows:

1. Switch off the dew-point generator.
2. Isolate and disconnect the dry air supply to the **GAS IN** port on the rear panel of the unit.
3. Locate and unscrew the filter bowl and element.
4. Discard and replace the filter element.
5. Re-assemble the filter and close the hinged panel.

4.4 Fault Diagnosis

Below are detailed some possible faults, their causes and recommended actions.

Symptom	Cause	Action
Generated dew point higher than spec	High generator chamber temperature	Adjust setting
	High source gas dew point	Check source gas dew point
	Pipework leakage	Leak test pipework
	Dry gas solenoid valve failure	Repair/replace solenoid
Generated dew point lower than spec	Low generator chamber temperature	Adjust setting
	Low saturator water level	Fill saturator bottle
	Pipework leakage	Leak test pipework
	Wet gas solenoid valve failure	Repair/replace solenoid
No flow	Power failure	Check fuses
	Solenoid valve failure	Repair/replace solenoid
	Pipework leakage	Leak test pipework
	Gas Out port blocked/restricted	Remove blockage/restriction

Appendix A

Technical Specifications

Appendix A Technical Specifications

General	
Dew-Point Range	-75 to +20°C (-103 to +68°F) (depending on spec of dry air supply) -40 to +20°C (-40 to +68°F) (manual mixing) Default pre-set points are: Full dry, -70, -60, -50, -40, -30, -20, -10, 0, 10, & 20°C
Accuracy	± 0.5°C dew point - displayed
Remote Control	RS232 Communications
Gas Input	Compressed Air Set-up/calibrated using a Michell PSD2 Pressure Swing Dryer with an air supply of < -75°Cdp (< 1 ppm _v) @ 1.28 barg (18.6 psig) 7 NI/min (14.8 scfh)
Gas Input Pressure	2 barg (29 psig) maximum
Gas Output	2 to 5 NI/min (4.2 to 10.6 scfh) @ ATP over the dew-point range
Gas Fitting	Swagelok® 6mm stainless steel bulkhead union tube fittings, unless otherwise specified
Filter	Particulate, borosilicate glass bonded micro-fiber
Saturator	Polycarbonate and porous polyethene sinter
Heating	Finned heating element, 300 W (fan circulated)
Power Supply	220 to 240 V AC, 50Hz or 100 to 120 V AC, 60Hz
Power Consumption	500 V-A maximum
Power Supply Fuse	5 A (F) quick blow
Operating Temperature	+18 to +24°C (+64 to +75°F)
Storage Temperature	+5 to +40°C (with saturators empty)
Construction	Painted aluminum enclosure
Overall Dimensions	19" sub-rack x 6U high x 350mm (13.8") deep
Weight	25kg (55lbs) maximum

Appendix B

Quality, Recycling & Warranty Information

Appendix B Quality, Recycling & Warranty Information

B.1 Pressure Equipment Directive (PED) 97/23/EC

The above Directive has been implemented in United Kingdom Law by the Pressure Equipment Regulations 1999.

The Regulations require that all pressure equipment and assemblies within the scope of the Pressure Equipment Directive must be safe when placed on the market or put into service.

Michell Instruments' products have been assessed and, as referenced against the Classification Charts detailed in Annex II of the Directive, do not fall into the requirements for CE marking compliance with the Pressure Equipment Directive.

Article 3, paragraph 3 states that any product containing a pressurized fluid that does not qualify for compliance should, nevertheless, be constructed with Sound Engineering Practice (SEP).

Michell Instruments attests here that its products have been designed, manufactured & tested to assure safe operation, and in accordance with Sound Engineering Practices.

B.2 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. For further information please see the following sections.

B.3 WEEE Compliance

Directive 2012/19/EU 4 July 2012 on Waste Electronic and Electrical Equipment (WEEE)

The Waste Electronic and Electrical Equipment (WEEE) Directive places 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 Instruments is in full compliance with the WEEE Directive and is registered with an approved recycler (Registration No. WEE/JB0235YW) and treats the requirement of the directive and the protection of the environment with the utmost importance. All Michell Instruments' products are appropriately marked indicating their requirement for recycling.

It may be required to return certain instruments for treatment at the end of their working life.

Feb 2013

B.4 RoHS2 Compliance

Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011

The Restriction of Hazardous Substances (RoHS) Directive places rules upon European manufacturers of electrical and electronic equipment. The directives' aim is to reduce the impact that electronic devices have on the environment.

According to the EC Directive 2002/95/EC, Michell Instruments' products qualify as Category 9, Control and Monitoring Equipment. Under the 2002/95/EC Directive, Category 9 products are exempt from compliance with the Directive.

However, the careful design of all Michell Instruments' products takes into consideration the requirements of the Directive and, wherever possible, compliance is achieved. All future products will be developed entirely using compliant materials. Furthermore, Michell Instruments is taking active steps to remove non-compliant materials and components from existing products wherever these may occur. Presently, none of the non-compliant materials are known to occur in Michell Instruments' products.

The new Directive 2011/65/EU (RoHS2) entered into force on 21 July 2011 and required all Member States to transpose the provisions into their respective national laws by 2 January 2013.

Under the provisions of the RoHS2 EU Directive 2011/65/EU (Article 3, [24]) defines 'Control and Monitoring Equipment' specifically as 'monitoring and control instruments designed exclusively for industrial or professional use'.

RoHS2 EU Directive 2011/65/EU states the closing date for compliance of any Control and Monitoring Equipment product sold into the EU market place as 22nd July 2017.

However, the careful design policy of all Michell Instruments' products continues to attain compliance in the shortest practical timescales and strives to ensure that less than 0.1% of total mass per product, of all non-compliant materials, appear within them. Michell Instruments continues to monitor suppliers and material sources to ensure that compliance of goods provided is maintained.

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B.5 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 be 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.

B.6 REACH Compliance

Regulation (EC) No. 1907/2006

Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

Michell Instruments is a manufacturer of moisture measurement and gas analysis instrumentation and is a 'downstream' user of chemicals, as described by the EU Council Directive 76/769/EEC. The products we supply are not raw chemical products (goods).

Under normal and reasonably foreseeable circumstances of application, the goods supplied to you shall not contain or release any prohibited chemicals. No listed SVHC (Substances of Very High Concern) appear within products manufactured by Michell Instruments. Therefore the 0.1% mass per product, or total usage of 1 tonne/year, will never be exceeded. For these reasons we are neither required by obligation for registration nor for the creation of material safety data sheets (MSDS) for our products.

Our continued review of the SVHC Candidate List and latest additions is to ensure we remain compliant.

Michell Instruments maintains a hazardous material register in which MSDS data sheets are collated, and we will check that our suppliers will comply to REACH requirements for all materials and substances we use in the processes of our manufacturing.

In the unlikely event that any chemicals of concern appear in our products in quantities greater than 0.1% of total mass per product we will immediately inform you by correspondence according to the REACH Article 33 requirements. Our current appraisal is, however, that we do not expect or foresee such an incidence.

January 2013

B.7 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.

B.8 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.

B.9 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) if the product does not arrive in perfect working order.

Appendix C

Return Document & Decontamination Declaration

Appendix C Return Document & 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. Work will not be carried out on any unit that does not have a completed decontamination declaration.				
Decontamination Declaration				
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	

NOTES:



<http://www.michell.com>