



# DG2

## Dew-Point Generator

### User's Manual



97041 Issue 10.1  
September 2019

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	



## DG2

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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 220/240 V AC, 50Hz or 100/120 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](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)
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 <sub>v</sub>	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 DG2 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  $+68^{\circ}\text{F}$ ).

The Michell DG2 dew-point generator is based on the volumetric mixing of dry and wet gases. This gives the fastest response when changing between set points when compared to other dew-point generation technologies, such as two-temperature, two-pressure or the combination of both. The wet-dry mixing ratio is shown on integrated precision glass flow meters and set by front panel flow metering valves for a manual control of the target dew point.

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 two-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.

The first stage of mixing provides a coarse adjustment, limited to around  $-40^{\circ}\text{Cdp}$  ( $-40^{\circ}\text{Fdp}$ ). In order to generate drier dew points the output of this first stage, is mixed with the dry gas source a second time, providing finer adjustments for low moisture concentrations down to  $-75^{\circ}\text{Cdp}$  ( $-103^{\circ}\text{Fdp}$ ). The great strengths of the Michell DG2 dew-point generator are its ease of use, and flexibility in manually generating an accurate target dew point by fine tuning the gas mix via the flow metering valves. A table of nominal flows is supplied with the generator to guide the user in setting the metering valves appropriately for each desired set point.

As with all humidity generators, the DG2 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 our Customer Service Department.

### 2.1 Environmental Conditions

The DG2 should be used in an 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 (12U 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<sub>v</sub> (<-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 setup/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.

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 220/240 V AC, 50Hz or 100/120 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)

### 3 OPERATION



**Please take the time to familiarize yourself with this entire section before starting operation.**

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

#### 3.1 First Time Operation

Before using the unit for the first time:

1. Fill the saturator with distilled water, according to the instructions in Section 3.2.
2. Switch on the generator via the front panel **POWER** switch.
3. Allow 1 hour for the generator temperature (factory set to 30°C) to stabilize. The generator temperature is controlled via a CAL3200 autotune PID temperature controller and displays the generator temperature.

#### Generator Temperature



**Power**

4. Set **FULL DRY** dew point, according to Section 3.3.2, and allow the system to run for a minimum of 8 hours to purge the system pipework.

### 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 switching the valve marked Saturator On/Off to the Off position

**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 rear panel of the unit. Refer to the diagram below to identify the saturator.

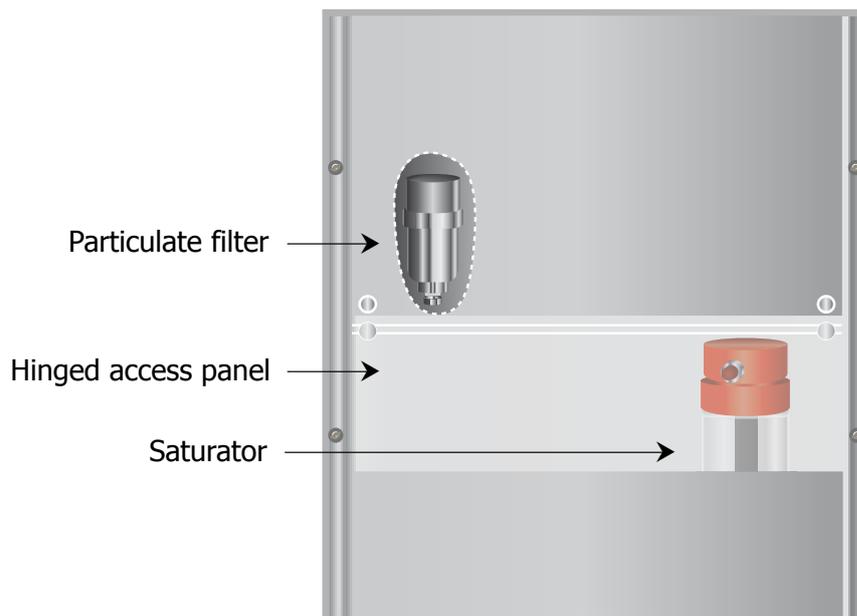
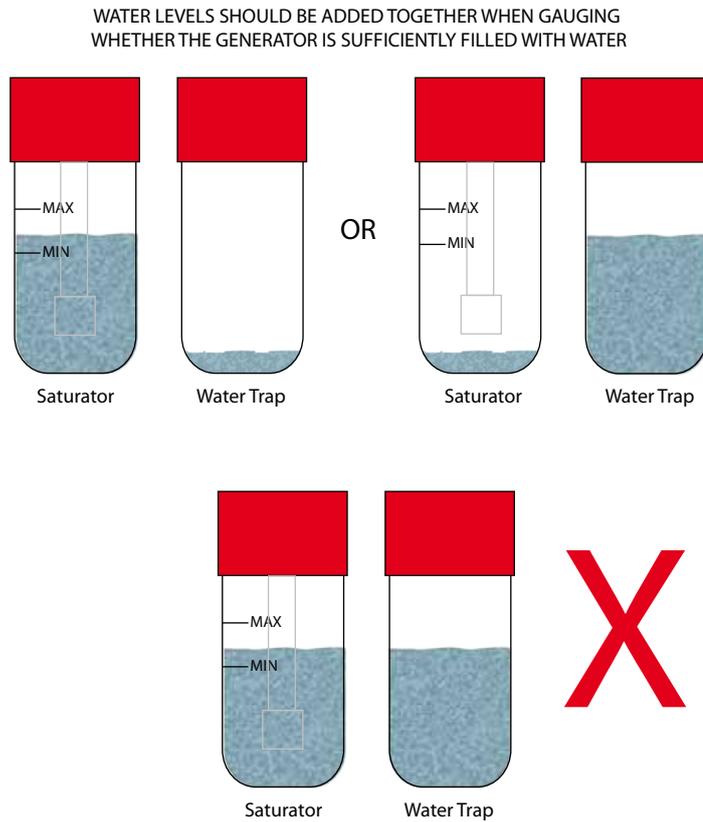


Figure 1 *Saturator and Filter Location*

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). The water level in the saturator and water trap should be added together when gauging if the generator is sufficiently filled with water. Replace the red filling port cap and close the hinged panel.



Frequency of top-ups is dependent on use and on the dew point being generated. If the generator is operating at dew points above  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ) 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 Mixing Stages

The combined flow meters and valves indicate and control the mixing of wet and dry gas flows to generate the desired dew point. The first mixing stage is indicated and controlled on the left hand side of the generator, and is labelled **First Stage 'A' Mixing**. The second mixing stage is indicated and controlled on the right hand side of the generator and is labelled **Second Stage 'B' Mixing**.

Generating dew points of  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ) and above requires only the **A** mixing stage to be used. A combination of the **A** and **B** mixing stages is required to generate dew points below  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ).

	No. 1 Valve	No. 2 Valve
<b>First Stage 'A' Mixing Only</b>	OPEN / ON	CLOSED / OFF
<b>First Stage 'A' &amp; Second Stage 'B' Mixing</b>	CLOSED / OFF	OPEN / ON

Before switching mixing configurations it is important that the wet flow valves for both **A** and **B** mixing stages are completely closed. This is to prevent slugs of wet air from contaminating the sample stream.

### 3.3.1 Saturator Control

A ball valve marked **Saturator On/Off** is provided to shut off the gas supply through the saturator when purging the system with dry gas prior to calibration, or when filling the saturator with distilled water.

### 3.3.2 Full Dry / Purging

When operating for the first time, or after a long period without use, the system tubing should be purged. The procedure for doing this is as follows:

1. Switch off the saturator using the ball valve marked **Saturator On/Off**.
2. Enable **A** and **B** mixing by closing No. 1 Valve, and opening No. 2 Valve.
3. Set a flowrate of 4 NI/min (8.5 scfh) (using the Second Stage **B** mixing flow valve marked **Dry**).
4. Fully close all the remaining flow valves.
5. Allow the system to run for a minimum of 8 hours.

### 3.3.3 Nominal Flow Rates / Set Points

The following table shows the flow rate settings required for generating various dew-point temperatures.

TARGET DEW POINT (°C)	FLOW RATES (L/MIN)				
	'A' MIXING			'B' MIXING	
	DRY	WET	WET	DRY	WET
FULL DRY	0	0	0	4	0
-70	3	0	0.040	4	0.035
-60	3	0.35	0.035	4	0.020
-50	3	0.35	0.035	2	0.030
-40	5	0	0.025	0	0
-30	5	0	0.080	0	0
-20	2	0	0.090	0	0
-10	3	0.35	0.035	0	0
0	2	0.725	0	0	0
10	1	1.1	0	0	0
20	0	1.2	0.125	0	0

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

**NOTE:** When switching to different dew points, always prioritize increasing dry flow, and decreasing wet flow. This avoids generating erroneously high dew points during the change of flows.

**NOTE:** These settings are only intended as a guide. The user will have to 'fine tune' each setting for accurate dew points. These settings require an inlet gas with the following specification: 7 NI/min (14.8 scfh), @ 1 to 2 barg (14.5 to 29 psig) and -75°C dew point in an operating environment of 21°C. Therefore, if the inlet gas specification is not identical, these settings will not be accurate.

On completion of dew-point generation, always return the generator to the FULL DRY setting (see Section 3.3.2) and allow the system to run for several minutes to purge out the moist gas before shut down.

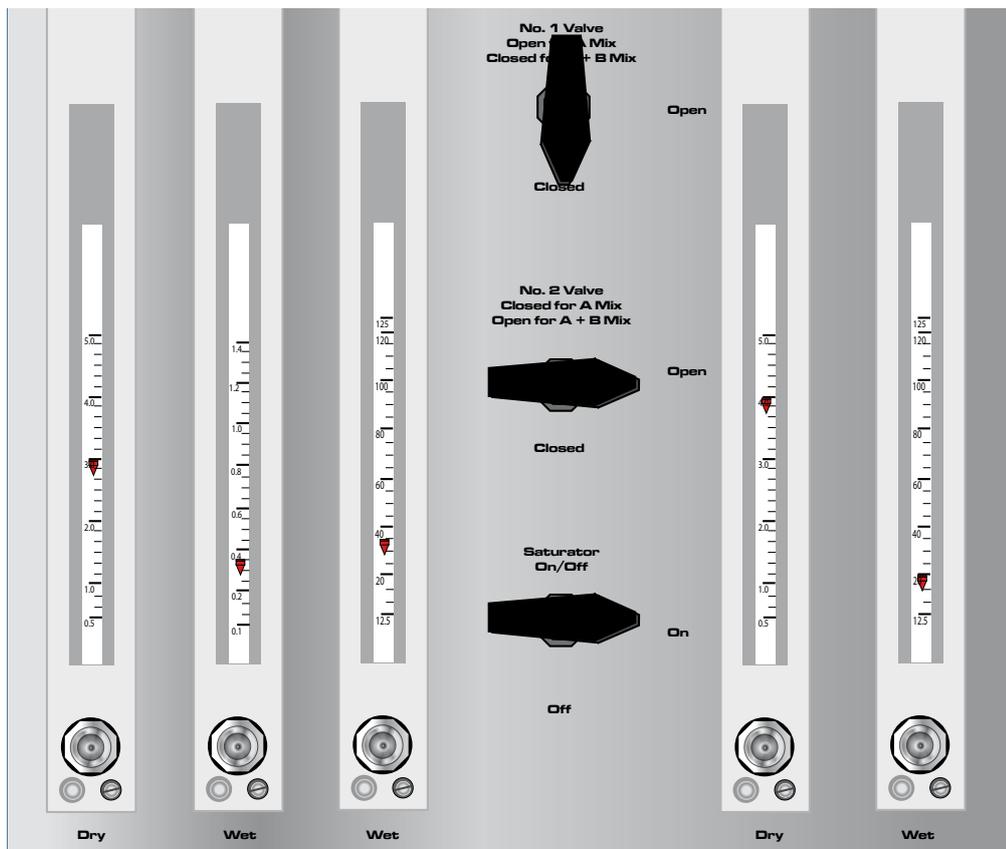


Figure 3 Example of -60°C Target Dew Point

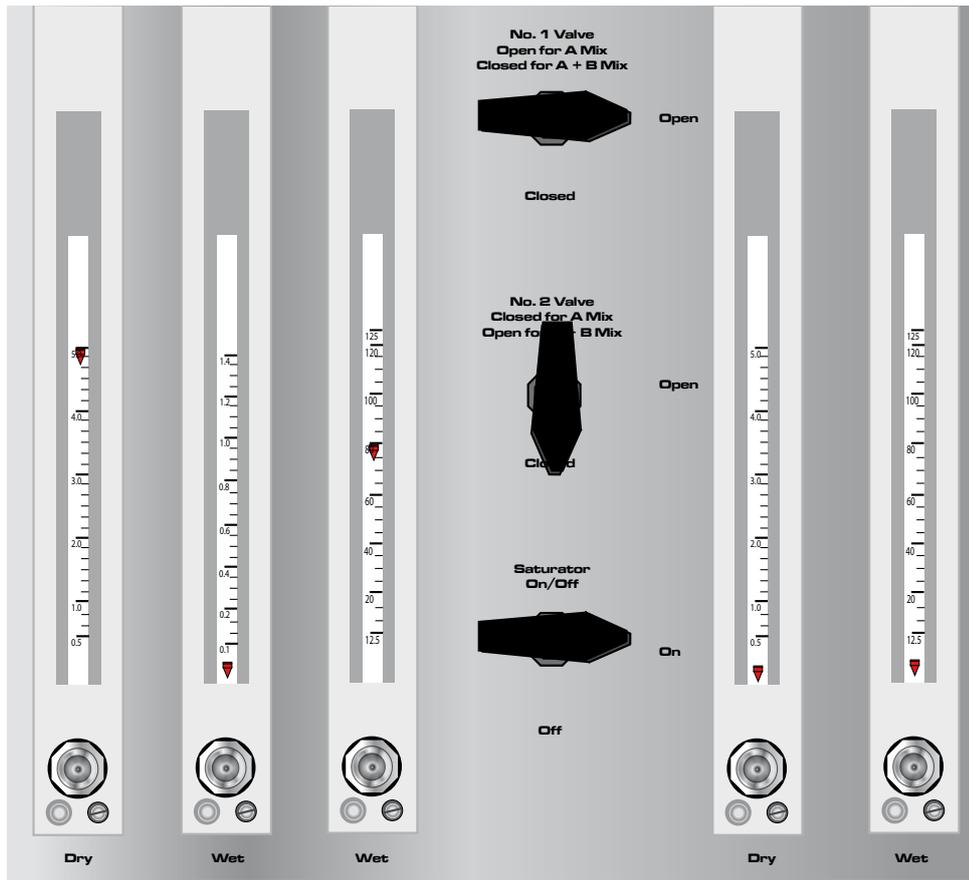


Figure 4 Example of -30°C Target Dew Point

## 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 Michell DG2 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  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ) 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 2*).

### 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  $30^{\circ}\text{C}$ , and therefore does not require any further adjustment.

If the generator temperature is not  $30^{\circ}\text{C}$  ( $\pm 2^{\circ}\text{C}$ ) 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 rear panel of the unit (see *Figure 1*).

Frequency of the filter element replacement is dependent upon operating conditions. It is recommended that, initially, the filter element be examined on a 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

The procedure to replace the filter element is 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, for the Michell DG2 Dew-point Generator.

<b>Symptom</b>	<b>Cause</b>	<b>Action</b>
Generated dew point higher than spec	High generator chamber temperature	Check setting is 30°C (±2°C)
	High source gas dew point	Check source gas dew point
	Pipework leakage	Leak test pipework
Generated dew point lower than spec	Low generator chamber temperature	Check setting is 30°C (±2°C)
	Low saturator water level	Fill saturator bottle
	Pipework leakage	Leak test pipework
No flow	Power failure	Check fuses
	Pipework leakage	Leak test pipework
	<b>Gas Out</b> port blocked/restricted	Remove blockage/restriction

# Appendix A

## Technical Specifications

## Appendix A Technical Specifications

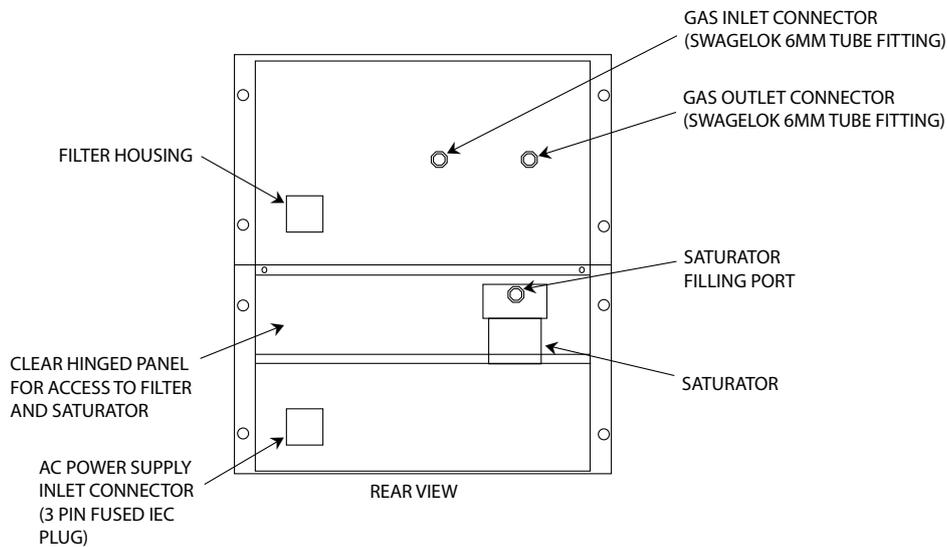
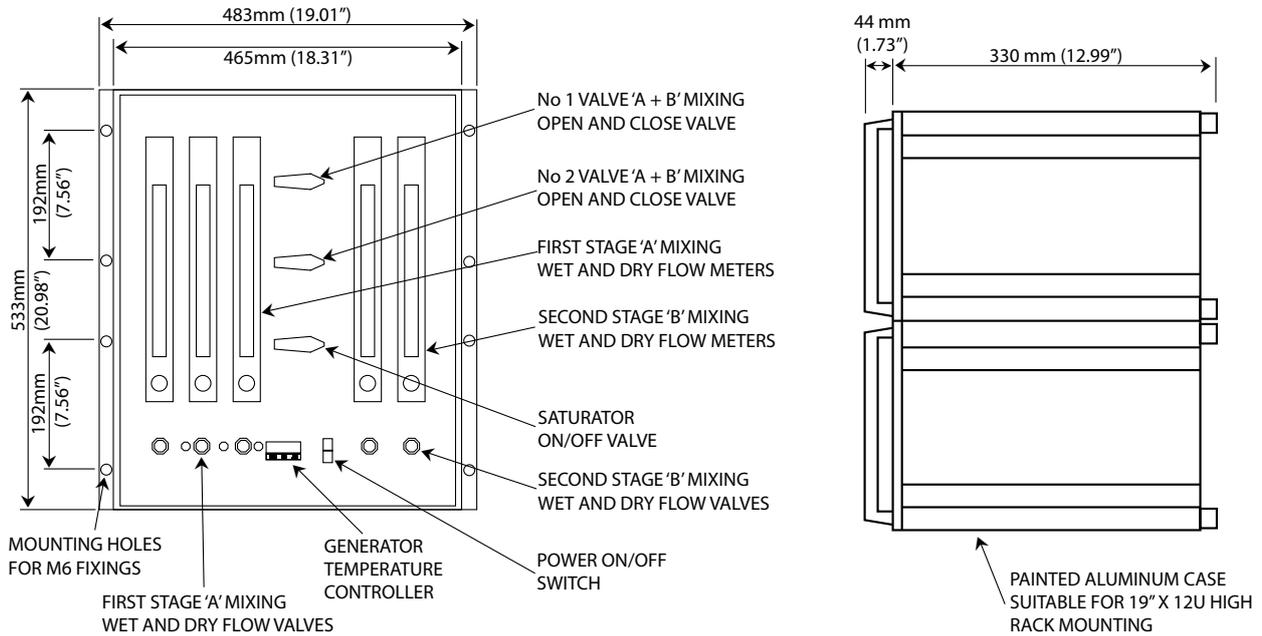
General	
Dew-Point Range	-75 to +20°C (-103 to +68°F) (depending on spec of dry air supply)
Accuracy	± 0.5°C dew point - displayed
Gas Input	Compressed Air (setup/calibrated using a Michell PSD2 Pressure Swing Dryer with an air supply of < -75°Cdp ( < 1 ppm <sub>v</sub> ) @ 1 to 2 barg (14.5 to 29 psig) 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	220/240 V AC, 50Hz or 100/120 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)
Construction	Painted aluminum enclosure
Overall Dimensions	535 x 483 x 390mm (21 x 19 x 15.4") (h x w x d)
Weight	20kg (44lbs) maximum

# Appendix B

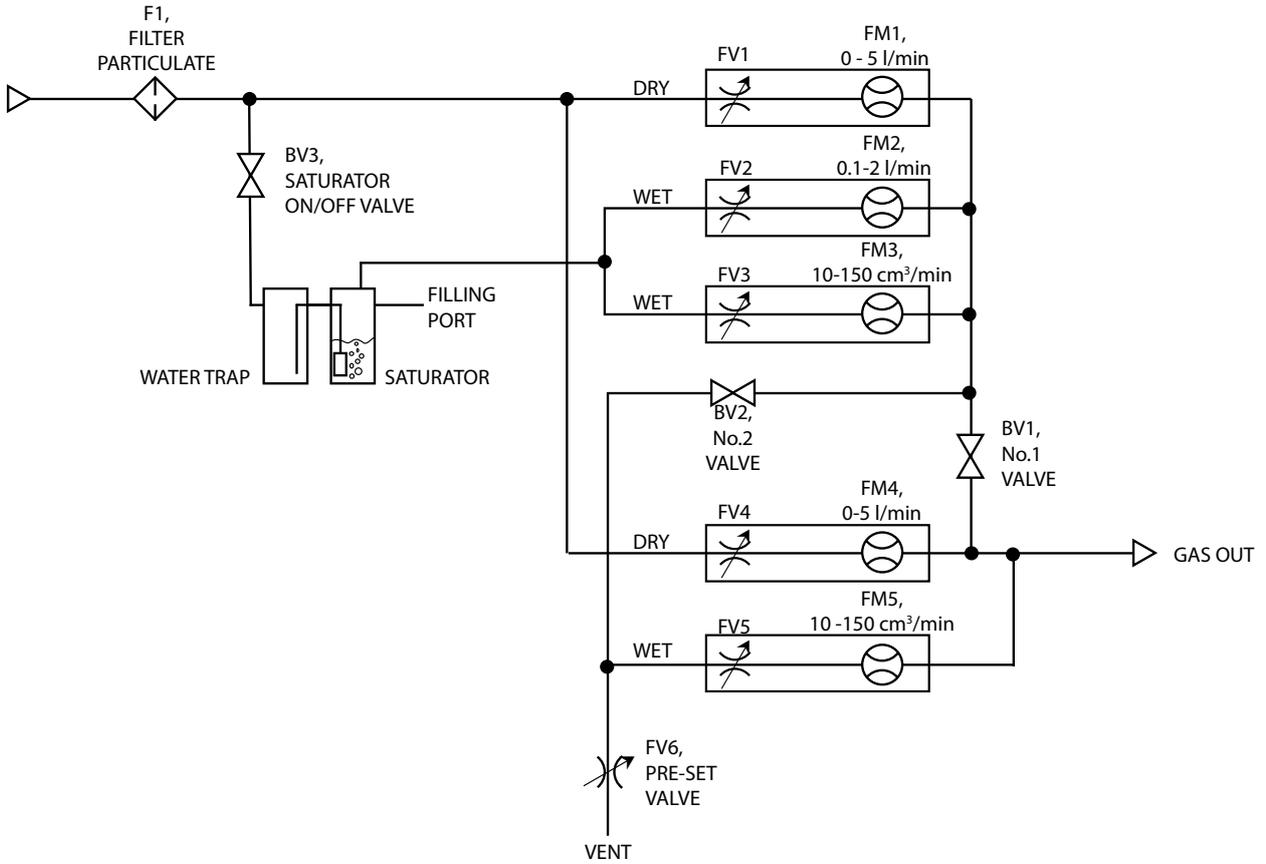
## Drawings and Flow Diagram

Appendix B Drawings and Flow Diagram

B.1 General Assembly



B.2 Flow Diagram



# Appendix C

## Quality, Recycling & Warranty Information

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**Appendix C      Quality, Recycling & Warranty Information****C.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.

**C.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

**C.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.

## C.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.

## C.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.

## C.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 D 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. <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



<http://www.michell.com>