



# Chilled Mirror Hygrometry

Precision instruments for critical measurement and control applications

# Chilled Mirror Hygrometry

Wherever precise, fundamental measurements are required in your laboratory or industrial application; Michell Instruments' chilled mirror hygrometers provide the solution.

Michell Instruments is an international leader in high-precision sensing with 40 years' humidity measurement and calibration experience. In 1980, we designed and provided the Transfer Standard Dew-Point Hygrometer, which formed the first traceability link between NIST (National Institute of Standards and Technology) and European calibration laboratories.

We've been building on this foundation ever since: continually developing and verifying our own chilled mirror reference instruments through continuous usage in our own laboratories and production environment. Our chilled mirror technology is used in-house to consistently and reliably calibrate over 2000 sensors at any moment in time at our calibration centres in UK, Netherlands, France, Italy, USA, Germany and Japan.

## Michell Chilled Mirror Technology

Chilled mirror is the measurement technology of choice for national standards laboratories worldwide. Here's why:

- Highest attainable accuracy of any dew-point measurement technology
- Excellent repeatability
- Wide measurement range
- Proven, well established and reliable technology
- Does not suffer from hysteresis
- Calibration does not drift over time

Furthermore, our technology is:

- Designed with Michell's 40 years expertise in chilled mirror technology built into every instrument
- Sensitive to minute changes (<5 ppb) in moisture content
- Designed to withstand harsh industrial applications

## Accuracy You Can Rely On

Moisture is a critical factor in many processes that needs to be monitored and controlled.

Chilled mirror hygrometers measure a primary characteristic of moisture — the temperature at which condensation forms on a surface.

This means that chilled mirror instruments:

- Have no drift: the temperature at which condensation forms is measured directly, so there are no calculated variables that could shift over time
- Are inherently repeatable, giving reliable results every time

From trace moisture in laboratory environments to hot, saturated gases in heavy industrial processes, Michell's chilled mirror technology provides the most precise, accurate and repeatable measurement of dew point and relative humidity available.



Environmental



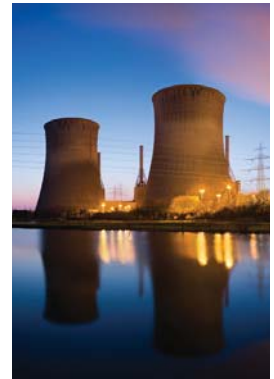
Calibration



Aero & Auto



Metallurgy



Power Gen

# Chilled Mirror Features

Michell's 40 years of expertise in the field of moisture measurement is built into each and every chilled mirror hygrometer design. All of our chilled mirror instruments come with the following features as standard:

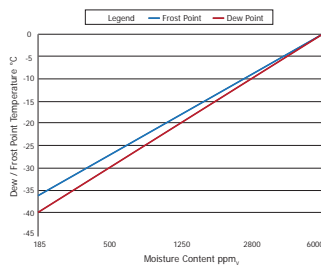
## Measurement Reliability (DCC)



Dynamic Contamination Control (DCC) ensures that measurement accuracy and stability are maintained even when contamination is present on the surface of the mirror.

During the DCC process the mirror is heated to approximately 20°C above the sensor temperature to remove the condensation which has formed during measurement. The surface finish of this mirror, with the contamination which remains, is used by the optics as a reference point for further measurements. This removes the effect of contamination on accuracy.

## Frost Assurance Technology (FAST)



In carefully controlled laboratory conditions, super-cooled water can exist in temperatures as low as -48°C. However, when using a chilled mirror instrument it only occurs on the mirror at temperatures down to around -30°C.

The difference in vapor pressure between condensed water and ice formed on a chilled mirror can introduce dew-point errors of up to 10% of reading. It is also possible for intermediate states to exist, where the formation is a mixture of ice and super-cooled water, making calculated conversions from one state to the other invalid.

All Michell Chilled Mirror Products feature FAST, the frost assurance technology which guarantees all dew-point measurements below 0°C are made over ice. The FAST system works by detecting whether the mirror is at a temperature where super cooled water could form, and if so; rapidly cooling the mirror until a film of ice of predetermined thickness forms. Once ice has formed, control returns to the instrument and measurement can begin.

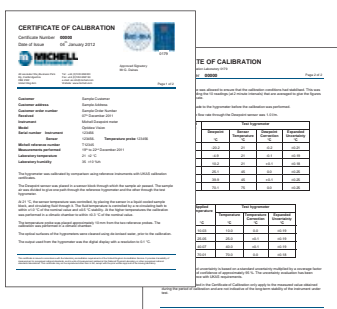
## Data Communication and Application Software



Our chilled mirror instruments feature a digital output (USB, RS232, RS485, ModBus or Ethernet options, depending on model) and multiple analog outputs, allowing configuration and monitoring by a suitable computer, data logger or other device. Adjustable isolated alarm contacts allow the Optidew and S8000 Series to be used for direct process control.

Comprehensive application software is supplied with our chilled mirror hygrometers free of charge, to provide an interface to configure and control instrument functions, and enable all measured and calculated parameters to be graphed or logged over time.

## Supplied with Traceable Calibration



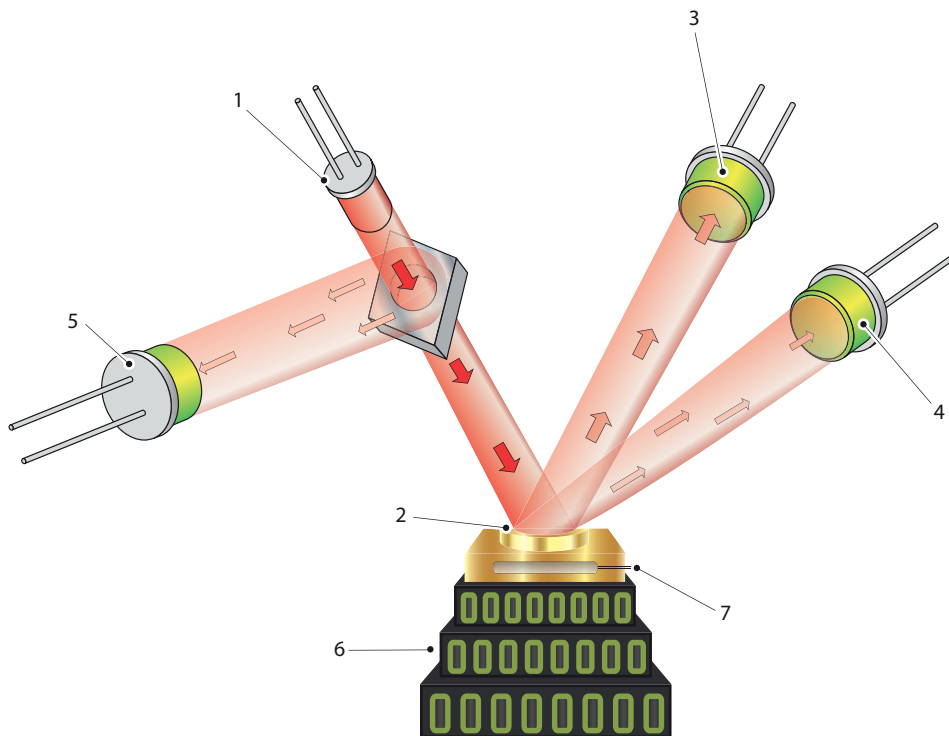
Chilled mirror is free from temperature dependence and remains accurate and drift-free across the entire measurement range. All of our chilled mirror instruments are delivered with calibrations performed against test equipment traceable to NPL and NIST national standards through Michell's ISO/IEC 17025 UKAS accreditation.

# How Does Chilled Mirror Technology Work?

The chilled mirror sensor consists of a temperature-controlled mirror and an advanced optical detection system.



Michell Instruments S8000 sensors utilize our **RRS Optical System** to guarantee 0.01°C sensitivity and the fastest dynamic response to dew points as low as -90°C. The system employs active monitoring and adjustment to automatically rebalance the optics to accommodate any changes in the signal level not associated with condensed moisture.



A beam of light from an LED (1) is focused on the mirror surface (2) with a fixed intensity. As the mirror is cooled, less light is reflected due to the scattering effect of the condensate formed on the mirror surface. The levels of reflected and scattered light are measured by two photo-detectors (3 & 4) and compared against a third reference detector (5) measuring the intensity of light from the LED.

The signals from this optics system are used to precisely control the drive to a solid state thermoelectric cooler (TEC) (6), which heats or cools the mirror surface. The mirror surface is then controlled in an equilibrium state whereby evaporation and condensation are occurring at the same rate. In this condition, the temperature of the mirror, measured by a platinum resistance thermometer (7), is equal to the dew-point temperature of the gas.

In the **S8000 RS**, and **S4000 TRS**, an auxiliary cooling system is used to remove heat from the “hot” side of the TEC. This supplements the depression capabilities of the heat pump, and enables measurement of very low dew points.



# Optidew Series

**The Optidew Series is Michell Instruments' entry-level range of chilled mirror hygrometers, offering a feature-complete instrument at an affordable price.**

The Optidew Series includes DCC, FAST, digital RS232 or RS485 communications, analog current loop outputs, alarm relays, optional display, and bundled PC application software as standard.

The Optidew Series' remote chilled mirror sensor offers a wide measurement range from the equivalent of <math><0.5</math> to 100% RH at ambient temperature. This equates to a dew-point range of \pm 0.2^{\circ}\text{C}</math> dew point and  $\pm 0.1^{\circ}\text{C}</math> temperature across the entire measurement range.$

A selection of corrosion resistant sensor materials are available, along with high pressure (up to 250 barg) and high temperature (up to  $+130^{\circ}\text{C}</math>) versions, making it possible to use the sensor in even the most demanding industrial applications. A special version of the sensor is also available that has been optimized for environmental monitoring applications, such as climatic chambers.$

## Optidew

The Optidew is supplied in a rugged IP66, NEMA 4X, 304 stainless steel wall-mount enclosure, making it ideal for industrial applications, or outdoor installation.

- Precision process dew point, %RH and temperature measurement
- Measurement Range:  $<0.5</math> to 100% RH,  $-40</math> to  $+90^{\circ}\text{Cdp}</math>$$$
- $\pm 0.2^{\circ}\text{Cdp}</math> accuracy ( $\pm 0.15^{\circ}\text{C}</math> optional)$$
- Fundamental drift-free dew-point measurement
- Rugged NEMA 4X industrial housing
- High temperature sensor option to  $+130^{\circ}\text{C}</math>$
- Optional local display



## Optidew Vision

The Optidew Vision has all the same great features as the Optidew, but is supplied in a bench-top package with a carry handle, making it perfect for laboratory use.

- Fundamental drift-free dew-point measurement
- Convenient, transportable package
- $\pm 0.2^{\circ}\text{Cdp}</math> accuracy; optional higher accuracy available$
- High temperature sensor option to  $+130^{\circ}\text{C}</math>$
- NEMA-12 bench-top housing
- Display and output of multiple engineering units
- High pressure sensor option to 25 MPa (250 barg)



# S8000 Series

**Michell's S8000 Series of chilled mirror reference hygrometers provide extremely accurate and precise measurement of dew point, relative humidity and temperature.**

These feature-rich modern laboratory instruments include an intuitive user-interface, built-in data logging, digital and analog outputs, and comprehensive application software.

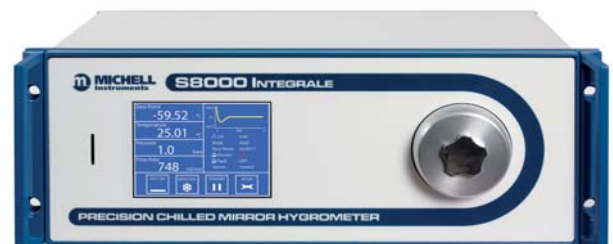
The S8000 Series' chilled mirror sensors'  $\pm 0.1^{\circ}\text{C}$  dew-point accuracy, coupled with the  $\pm 0.1^{\circ}\text{C}$  accuracy of the remote temperature probe provides highly precise relative humidity measurement. With an accuracy of 1% RH or better (up to 70% RH) and 1.5% RH or better (between 70 to 98% RH), the S8000 series gives the highest available relative humidity accuracy of any chilled mirror instrument on the market.

## S8000 Integrale

The S8000 Integrale features an integrated sensor head allowing measurement to  $-60^{\circ}\text{Cdp}$ , making it suitable for a range of calibration applications.

This dew-point reference instrument combines the measurement sensitivity and accuracy of the RRS system, with light weight construction and flexibility for dynamic measurements or for use as a calibration reference standard.

- Fundamental, accurate and drift-free measurement
- Rapid measurement response speed
- $-60$  to  $+40^{\circ}\text{Cdp}$  measurement range
- $\pm 0.1^{\circ}\text{Cdp}$  accuracy
- Operates at pressures up to 2.0 MPa (20 barg)
- Simple configuration and operation via touch screen interface
- $\pm 0.1^{\circ}\text{Cdp}$  accuracy



## S8000 Remote

The S8000 Remote has all the great features of the other S8000 Series chilled mirror hygrometers, but with a convenient and compact remote sensor design.

The relative humidity in climatic chambers will always deviate from the set point. Even in high precision chambers this deviation is typically between 1 to 3% RH, which can have a considerable effect on the results of many tests. The S8000 Remote can reduce this uncertainty to just 0.5% RH, depending on set point.

The compact remote sensor takes up minimal space in the chamber and features an open cell design, removing the need for any complex heated sampling arrangements or an external pump.

- Fundamental, accurate and drift-free measurement
- Remote sensor
- Open design allows the remote sensor to be mounted into a sample flow or simply placed in an environment to be monitored
- $-40$  to  $+90^{\circ}\text{C}$  dew-point range with  $\pm 0.1^{\circ}\text{C}$  accuracy
- Sensor operates in pressures up to 2 MPa (20 barg)



## S8000 RS

Michell's flagship chilled mirror hygrometer, capable of measuring as low as  $-90^{\circ}\text{C}$  dew point with no external cooling or bulky refrigeration unit. The sensor head construction has been optimized for fast response to low dew points, with the RRS system ensuring precision and accuracy across the measurement range.

The S8000 RS is our first chilled mirror instrument to feature a touch screen, providing a user-friendly and powerful interface for the control and configuration of all the instrument's features and parameters.



- Accuracy of  $\pm 0.1^{\circ}\text{C}$
- Precision measurement to  $-90^{\circ}\text{C}$  dew point (100 ppb) with no need for additional cooling
- Simple configuration and operation via touch-screen interface
- Sensor head optimized for fast response to low moisture levels
- High measurement sensitivity
- Microscope for visual inspection of condensate on mirror
- Compact 19" x 4U package for flexibility of installation
- Lightweight at 17kg – less than half the weight of its closest competitor

## S4000 Series

The Michell Instruments' S4000 Series of chilled mirror hygrometers is available in two distinct models: the S4000 TRS for very dry dew-point measurements to  $-100^{\circ}\text{C}$ , and the S4000 RC for a dynamic range of wet and dry measurements. Both models feature  $0.1^{\circ}\text{C}$  dew-point and temperature measurement accuracy.

The S4000 Series is supplied with all the standard features of our other chilled mirror hygrometers including dynamic contamination control, a microscope for visual identification of the condensate, RS232 digital communications, and both current and voltage analog outputs.

### S4000 TRS

The S4000 TRS was developed from the TSDH (Transfer Standard Dew-Point Hygrometer), which was selected to provide transfer of the trace humidity standard between the NPL (National Physical Laboratory, London, UK) and NIST (National Institute of Standards & Technology, Washington DC, USA), on account of its excellent stability and reproducibility. Its descendant — the S4000 TRS, is now widely used in calibration and standards laboratories worldwide, in recognition of these characteristics in addition to its long term reliability.



### S4000 RC

The S4000 RC features a monolithic sensor block for mounting in climatic chambers and other controlled environments. It is built with the same high quality sensing components as the S4000 TRS, but can operate over a wide range of environmental temperatures — resulting in a measurement range of  $-80$  to  $+85^{\circ}\text{C}$  dew point.



# Services Guide

We invite you to take advantage of our full range of support services to maintain your instrument and to keep its calibration up to date for absolute confidence in your moisture measurements.



## Calibration Services

Michell Instruments offers a calibration service for most moisture sensors and instrumentation, carried out in our ISO17025, ISO9001:2008 certified laboratories. Our four laboratories are accredited by UKAS (United Kingdom Accreditation Service), and maintain full traceability to NPL (National Physical Laboratory, London, UK) & NIST (National Institute of Standards and Technology, Washington DC, USA).



## Extended Maintenance Agreement

Michell's extended maintenance agreement includes application support, full annual service including traceable calibration or sensor exchange, free software upgrades and repairs (if required).

A regular calibration schedule is the best way to maintain traceability to national standards, so customers soon recoup the cost of the agreement, as well as benefiting from peace of mind and increased reliability that comes from the regular servicing and maintenance of the covered instruments.



## Customization Projects

Where a standard product doesn't quite meet the needs of an application, Michell's team of design engineers will work with you to develop a specific solution. From specialized sampling systems, to something as simple as a different connector, Michell's 40 years of experience in moisture measurement enables us to find the best fit for specific moisture measurement needs.



## Other Product Ranges

Portable Instruments | Dew-Point Transmitters & Instruments | Process Analyzers

Calibration Instruments | Relative Humidity Instruments | Oxygen & Binary Gas Analyzers

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Michell Instruments adopts a continuous development programme which sometimes necessitates specification changes without notice.

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