



Condumax II

Hydrocarbon Dew-Point Analyser

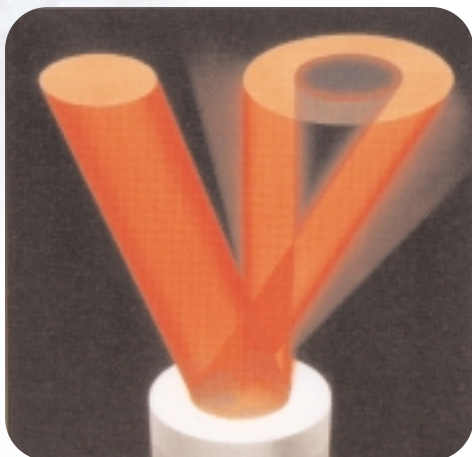
Automatic, on-line measurement of hydrocarbon dew point and moisture content in natural gas.





Condumax II Sampling System

- Fully automatic on-line analysis
- Objective, highly repeatable
- 0.5 °C hydrocarbon dew-point accuracy
- Fundamental chilled mirror principle
- Patented detection technique
- Self-cleaning
- ATEX approved to Ex II 2 G EExd IIB + H₂ T4 for hazardous area operation
*CSA certification pending
- No purge air or external cooling system required
- Optional combined water and hydrocarbon dew-point analysis
- Modbus RTU communications protocol



The Dark Spot™ Principle

Hydrocarbon dew point is becoming a critical natural gas quality parameter

In the age of interoperability, the -2 °C HCDP value now governing pan-European gas transfers and the 'no liquids' statements of some older contractual texts gives rise to the majority of disputes at custody transfer. It is often the most difficult parameter for a gas producer to fulfil - the most frequent reason for 'shut ins' is the failure to meet contractual limits for hydrocarbon dew point.

So great are the concerns over hydrocarbon dew-point control, that it has become the predominant subject of gas quality conferences held in recent years in Europe and North America (Advantica Conference, UK, 2002 and American Gas Association, USA, 2003). The need for harmonisation of analysis methods to ensure consistent best practice is being promoted by research groups within independent organisations such as API (USA), National Gas Council (USA) and GTE (European Union). These groups are evaluating relationships between direct hydrocarbon dew-point measurement, potential hydrocarbon liquid content (PHLC) and analytical techniques such as gas chromatography.

Nevertheless, for the vast majority of gas producers and pipeline operators the world over, the direct 'chilled mirror' approach provides the definitive hydrocarbon dew-point measurement. Since 1986, the original Michell Condumax, has enabled users to make direct fundamental measurements, automatically, on-line, with minimal maintenance demands in service and with a level of objectivity previously impossible. Condumax II continues this proud reputation, bringing together an established, proven and patented measurement technique with the latest features and specifications. Condumax II offers the user the opportunity to standardise on a hydrocarbon dew-point measurement technology that provides excellent correlation against PHLC and GC equation of state calculations, but that is simple to install and virtually maintenance free.

The Dark Spot Measurement Principle

Condumax II uses a patented optical measurement technique that is radically different to that of any other chilled mirror instrument. Sensitivity of the order of 5mg/m³ of condensate enables the analyser to detect the almost invisible films of condensate that are characteristic of hydrocarbon gases at dew point, due to their low surface tension and colourless appearance. This gives un-matched accuracy and repeatability.

The optical sensor comprises an acid etched, semi-matt stainless steel "mirror" surface with a central conical-shaped depression, which is cooled during a measurement cycle. Collimated visible red light is focused onto the central region of the optical surface. In the dry condition the incident light beam is dispersed by the matt surface providing a base signal to the optical detector. During a measurement cycle, hydrocarbon condensate is formed on the optical surface and it becomes reflective, due to the low surface tension of the condensate. An annulus ring of light forms around the detector and there is a dramatic reduction in the scattered light intensity within the central Dark Spot™ region. This secondary effect is monitored and interpreted. Hence, the Dark Spot™ Detection Technique utilises of the physical characteristic of hydrocarbon condensate that makes it so difficult to detect in a manual system. When a pre-determined layer of condensate has been detected the instrument electronics record the temperature of the optical surface as the hydrocarbon dew point and then initiate a recovery cycle whereby the optical surface is actively heated to evaporate the condensates back into the flowing gas sample. The whole process is fully automatic and takes less than ten minutes.



Sensor Cell

The design of the Condumax II sensor cell is critical to its dynamic performance. The optical detection system, Dark Spot™ sensor, thermocouple and three stage Peltier heat pump are all mounted in a stainless steel cell that can withstand operating pressures up to 100 barg and still achieve a depression capability (lowest measurable hydrocarbon dew point) of almost -35 °C at room temperature.

Flow Decoupling

In order to achieve maximum accuracy in this difficult measurement, a flow de-coupling method is used. Discrete measurement cycles, at user definable intervals, lock a fixed sample of the hydrocarbon gas mixture into the sensor cell. As the optical surface is cooled, sequential condensation of hydrocarbon components occurs until the pre-selected optical trip level is reached that signals the effective hydrocarbon dew-point temperature of the gas. The fixed sample ensures representative condensation of hydrocarbon components and prevents preferential drop-out of heavy ends that would occur with a flowing sample, leading to a falsely high indication of the hydrocarbon dew point.

Intelligent Control

Condumax II has a fully automatic, intuitive and intelligent control system that improves accuracy, sensitivity and reproducibility under any operating condition. A three-stage Peltier cooler under powerful digital command allows Condumax II to vary its cooling rate to enable detection of the smallest amount of condensate on the optical surface. During start-up, Condumax II will perform a measurement cycle at a standard cooling rate in order to "range-find" the hydrocarbon dew-point level. On subsequent cycles, the previous measured value is used to determine an optimised cooling rate that will cause the sensor surface to cool quickly in the initial phase, but reduce its cooling rate to 0.05 °C/sec as it approaches the hydrocarbon dew point. This gives the user previously unattainable levels of precision and reproducibility and allows easy correlation with other HCDP measurement techniques. Furthermore, Condumax II can be operated in Condensate Mode in order to give reliable PHLC measurement at a particular pre-set pressure and temperature condition.

Condumax II is designed for easy operation, with innovative touch-screen control of all functions through the simple user menu that can be viewed on the high-resolution vacuum fluorescent alphanumeric display, in complete safety within the hazardous area environment.

System Description

Main Unit

The Condumax II main unit contains all of the critical components in a single EEx d enclosure. The Dark Spot™ sensor cell and optional water dew-point sensor are mounted within the unit along with the pressure transducers, flow switches, measurement electronics and display. Flame arrestors on the gas inlet and outlet ports provide safety protection. Electrical connections are made through glanded ports at the base of the enclosure. The main unit is a fully functional hydrocarbon dew-point analyser and requires only a clean, pre-conditioned gas sample and mains power for its operation.

Sampling System

Two standard sampling systems are available, for indoor or outdoor use, and they provide comprehensive sample conditioning of natural gas at any pressure up to 200 barg. The sampling system comprises pressure regulation, flow control and most importantly micro-porous membrane filtration with by-pass arrangement and condensate drain to give fast response and protection from liquid hydrocarbon/glycol contamination. Dual channel sampling is available for the combined hydrocarbon/water dew-point analyser package. Thermostatically controlled heating is provided to ensure no condensate or water drop-out prior to measurement. For both sampling systems, the Condumax II Main Unit can be mounted remotely or integral to the Sampling System.

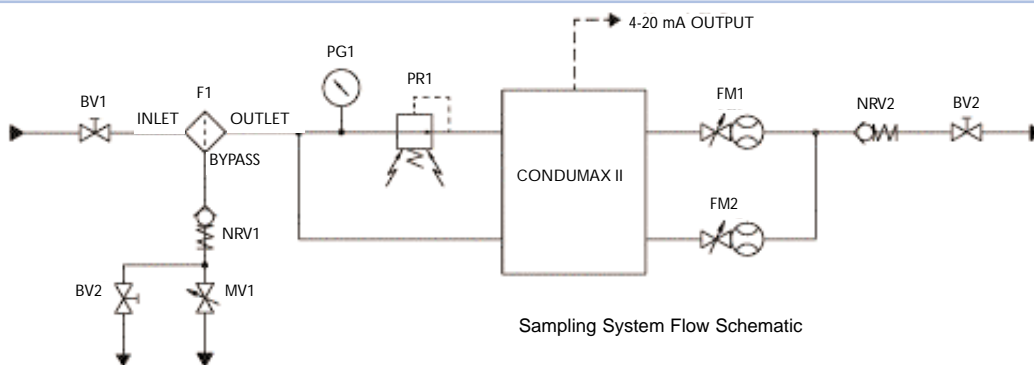
Human Interface

Condumax II is designed to offer great flexibility in terms of measurement display and connectivity to other equipment. As standard, Condumax II provides a multi-function vacuum fluorescent display on the Main Unit that shows all measurement parameters and allows the user to adjust certain control parameters, view log data, max/min statistics etc. In addition, Condumax II provides two milliamp outputs, configurable from the Main Unit user interface for any combination of measurement parameters. Also a digital output using Modbus RTU protocol is provided, for connection to an external computer, DCS or PLC system located in a safe area. Optional Active X controls are available for integration in DCS systems.

Optionally a remote twin-channel digital meter and a dedicated Remote Interface with Windows-based operating software are available with full remote control capability, including OPC (OLE for Process Control) technology.




Condumax II Remote Interface



Sampling System Flow Schematic

Technical Specifications

HAZARDOUS AREA CERTIFICATION

ATEX certified to  II 2 G EExd IIB + H₂T4, certificate number TRL04ATEX11060X
CSA certification to Class 1, Div 1, Groups A, B, C & D, T6 pending approval

HYDROCARBON DEW-POINT MEASUREMENT

Measuring Technique	DARK SPOT™ fixed sample analysis. Direct photo-detection of hydrocarbon condensate at hydrocarbon dew-point temperature
Sensor Cooling	Automatic via 3-stage Peltier effect electronic cooler
Maximum Range	-34 °C HCdp from 21 °C ambient @ 27 barg (range depends on sensor temperature)
Accuracy	±0.5°C hydrocarbon dew point
Sample Gas Flow Rate	0.03 m ³ /hr (0.5 l/min)

WATER DEW-POINT MEASUREMENT (OPTIONAL)

Measuring Technique	Michell Ceramic Moisture Sensor
Range	Calibrated from -100 to +20°C dew point
Accuracy	+/- 1°C from -59 to +20°C dew point; +/- 2°C from -100 to -60°C dew point
Sample Gas Flow Rate	1 to 5 l/min

PRESSURE MEASUREMENT

Type	HCdp - Type PDCR 1050-3465: 0 to 100 barg Wdp - Type PDCR 1050-3574: 0 to 210 barg
Accuracy	+/- 0.25% FS

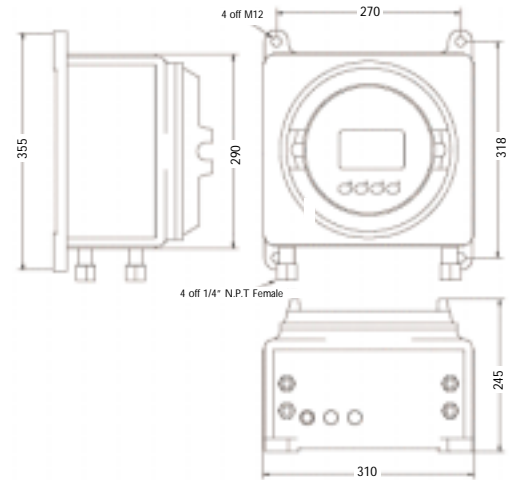
HYDROCARBON DEW-POINT ANALYSER

Sample Gas Supply	Natural gas up to 100 barg, pressure regulated in sampling system.
Enclosure	EEx d cast enclosure with removable glass window viewing port. Internally heated for condensation protection.
Sample Gas Connections	¼" NPT female ports for both hydrocarbon and water dew-point channels.
Operating Environment	Indoors/Outdoors -20 to 60 °C. Max 95 % rh.
Power Supply	90 - 264Vac 50/60Hz, 200W Main Unit; 300W c/w indoor sampling system; 400W c/w outdoor sampling system
Weight	Main Unit 22.5 Kg c/w Sampling System (indoor) 42kg (approx) c/w Sampling system (outdoor) 57kg (approx)
Integrated Display	Touch screen with vacuum fluorescent display.
Outputs and Alarms	Modbus RTU, RS485 @ 9600 baud rate. Two 4-20 mA linear (non-isolated) outputs, user configurable for any combination of dew point or pressure parameters. Hydrocarbon and water dew point alarms via software register. Integrated low flow alarms for each sample flow.

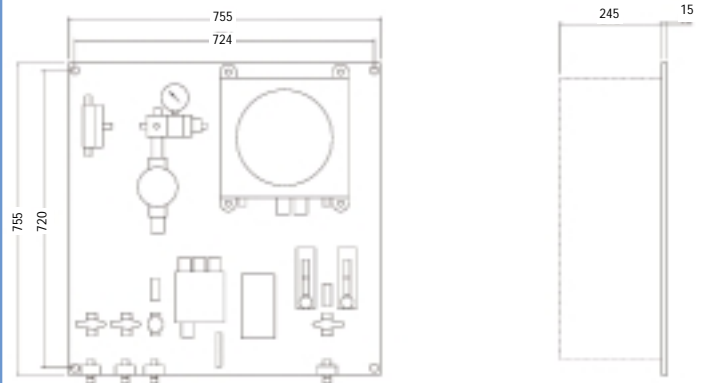
OPTIONS AND ACCESSORIES

Remote Interface	Integrated safe-area control unit for Condumax II, providing display of all variables, charting and logging functions, parameter control and remote diagnostic facilities. 19" Sub-Rack unit with 6.5" colour LCD display and mouse control.
Remote Digital Display	Two channel digital display for safe area use, providing indication of selected variables (any two from hydrocarbon dew point, water dew point or system pressures) on a bright, twin 3.5 digit LED display with analogue output re-transmission and dual alarms.
Plant control Integration	ActiveX components to be used by software programmers for integration of modbus protocol into a general plant software system.

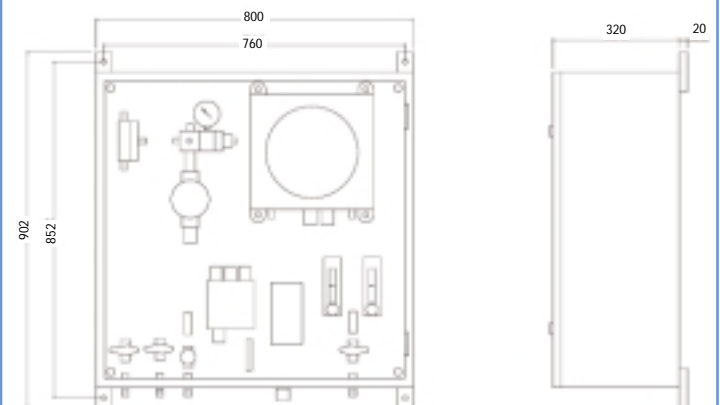
Dimensions



Main Unit



Condumax II - Complete with Indoor Sampling System



Condumax II - Complete with Outdoor Sampling System



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