



**Global - Procurement - Supplier Agreements**  
**TECHNICAL SPECIFICATION - ANALYZERS**  
**OXYGEN, CARBON DIOXIDE, MOISTURE**

Air Products became aware, during an informal meeting with Dr. Hoodless in December 1999, that a completely new range of Hygrometers (Si-grometers<sup>®</sup>) was available from MCM Ltd. The initial impressions and specifications seemed encouraging and MCM had extended invitations to Air Products both to visit their facilities to further assess the performance claims and to verify these observations at the Air Products facilities at Crewe.

Following internal discussions, it was felt that a visit to MCM would be merited, in view of the potential advantages that might be available to Air Products by adopting new technology in view of the known limitations of the equipment currently being used\*\*. It was considered prudent to satisfy ourselves that the performance advantages were equally evident under more controlled quantitative conditions at MCM's premises before committing any resources for prolonging testing at Air Products. (\*\*A list of performance features and benefits which were supplied by MCM are listed separately in Appendix A).

A visit was duly arranged, in February 2000, to inspect the performance and features of a portable, battery operated, unit from the MicroView range. Mains operated models were available but it was felt that a preliminary evaluation of a battery operated unit would more readily indicate any performance limitations. The particular MicroView unit tested covered a moisture range from 0.1 to 100 ppm [V] with a resolution to 0.1 ppm [V]. The instrument was tested repeatedly over its working range, throughout the day, on a number of primary moisture generators in different physical locations. The results appeared to confirm that reproducible and stable moisture readings could be achieved within minutes. This was evident even when the moisture equilibrium was being approached from very wet conditions. Arrangements were made, at that time, for more protracted tests to be conducted at Crewe, under site conditions and a more rigorous evaluation test programme was discussed.

MCM delivered a battery operated MicroView Instrument, Serial No. MV1212, by arrangement, on February 29th, 2000. All preparations had been made within the Air Products laboratory at Crewe to initially validate the performance of the Instrument to verify that it had not deteriorated from that witnessed at MCM's premises and that the indicated moisture readings were significant when evaluated by Air Products procedures. The acceptance test results listed in Appendix B, confirmed that the unit was in good working order and that the readings provided by the instrument were within fractions of a ppm [V] at moisture levels below 10 ppm [V]. It was encouraging to verify that the instrument could quickly and reproducibly verify moisture changes even at sub ppm [V] levels.

The instrument was then left with Air Products for 10 days during which time many tests were conducted on actual cylinder and process gases. This test period was agreed upon because, due to the speed of response of the instrument we would be able to carry out a significant number of tests. (This would not have been practicable with other technology within this time frame and is, in itself, indicative of the future potential of this equipment).

During the test period several tests per day were conducted on various gases without any problem being encountered.

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MCM staff called, by arrangement, on March 10th to collect the instrument and, prior to uplifting the unit the original validation checks were repeated in Air Products laboratory and the graphical records are available in Appendix C. MCM returned the instrument to their facility and also checked the calibration and performance.

**Conclusion**

The technology utilised in this analyser provides significant advantages to Air Products applications. The main benefits are:-

The use of a temperature controlled sensor reduces the tendency for contaminants to be adsorbed onto the sensor surface. This is particularly beneficial when an analyser is coming from a wet (ambient) condition (e.g. following a plant upset or post calibration) where the risk of soluble gas phase contaminants condensing onto a cold sensor surface are high. In such conditions the integrity of a sensors calibration can often be compromised leading to erroneous readings and analyser drift. This is eliminated with temperature control as evidenced during testing.

Substantial improvements in productivity were noted. Typical  $T_{90}$  times recorded can be seen on Graph A. The temperature control and Push Purge features were responsible for the rapid settling and drying down times of the Silicon sensor of the portable analyser.

The use of temperature controlled sensors offer a substantial reduction in both measurement and calibration times. The particular analyser tested was able to settle to equilibrium faster than the calibration hygrometers used in the calibration rig.

Improved confidence in readings through the use of the automated 'push purge' feature (sensor dry down) at the beginning of each measurement coupled with the graphical display intuitively showed trends towards equilibrium.

The instrument had a useful audit log and data download facility to assist in Quality Control. The graphical record appended to this report was generated by the instrument software.

Overall, an easy to use, fast and convenient trace moisture analyser offering productivity gains over existing moisture technologies.

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**APPENDIX A**

**Instrument Specification**

The manufacturer provided some preliminary data on the instrument (see attached).

The instrument issued for test was ranged 0.1-100 ppm. This addressed the majority of moisture applications within Air Products Crewe.

The L.D.L. was stated as 0.1 ppm.

Temperature stability is from -20 to +40 °C as the instrument sensor is temperature controlled.

Performance enhancing features include:-

Temperature control of the sensor.

Patented sensor heating feature 'Push Purge<sup>®</sup>' to aid dry down and validate data on line.

Graphical data display identifying trends and time to equilibrium.

Automated Push Purge<sup>®</sup> to improve repeatability of operation.

Audit log on data storage.

Simplicity of operation and convenience.

The speed of response was typically found to be less than 5 minutes to a stable reading across the instrument operating range.

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**APPENDIX B**

**Results of Air Products Crewe Evaluation - Acceptance Tests**

Instrument no. MV1212 was calibrated at MCM before despatch to Air Products Crewe.

Upon arrival the instrument was tested on the Crewe calibration system and found to be in close agreement with the calibration carried out by MCM.

Speed of response tests from 'wet' to dry' and 'dry to wet' achieved  $T_{90}$  times in less than 5 minutes over the calibrated range of the instrument.

The instrument was able to recover from ambient moisture levels in less than 2 minutes with aid of the 'Push Purge<sup>®</sup>' sensor drying feature.

Both Air Products and MCM were satisfied that the instrument was received in good order and had been appropriately calibrated across its operating range.

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**APPENDIX C**

**Revalidation Following Field Trial**

The instrument MV1212 was put back onto the Air Products calibration system to record any shift in measurement following its use on various bottled gases over a week.

The instrument agreed within  $\pm 2^{\circ}$  C dewpoint across the operating range.

Action options

Show all graphs

 Limit to serial number...
  Limit to site...

D

SERIAL NUMBER: MV1212

SITE NAME: Air products site va

 Minimum  
 Maximum  
 Average  
 St. Deviation

RANGE: (PPMV) 100

Purges: 1

Total readings: 189

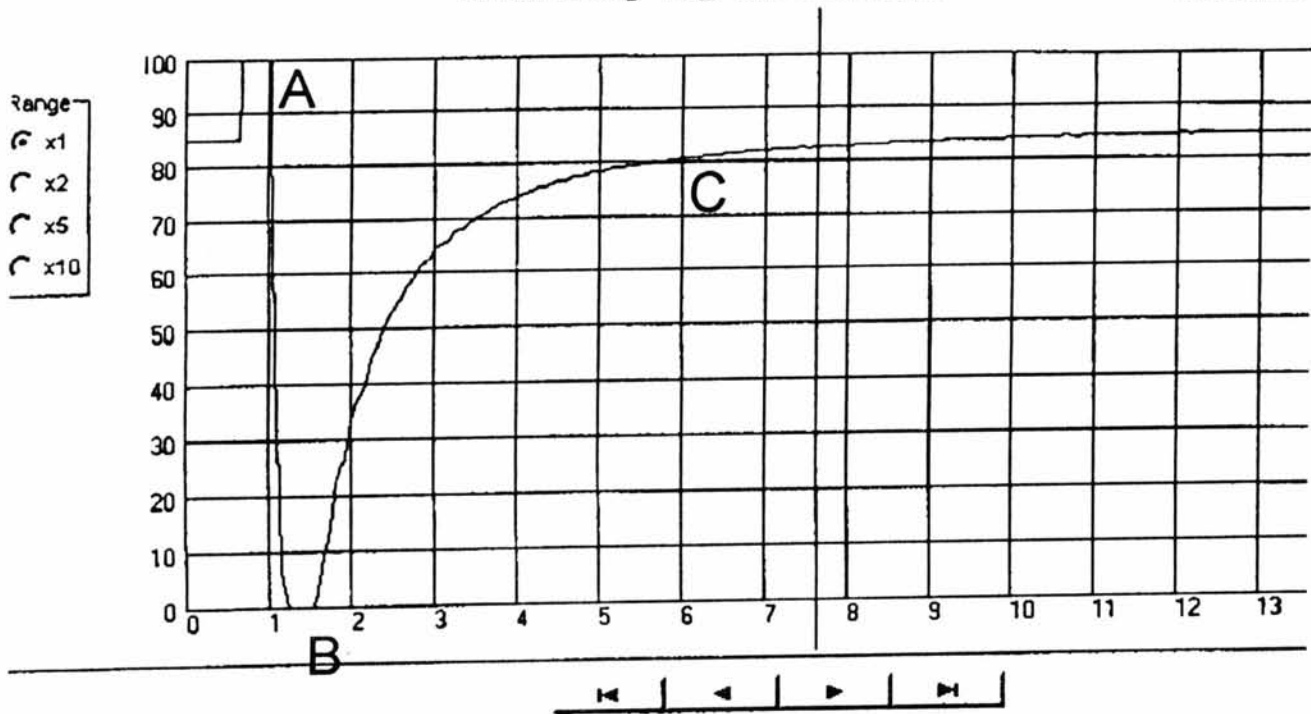
GRAPH INDEX: 198

Graph readings: 180

Readings began: 13:19:36, 29 Feb 2000

Cursor Reading 91 @ 0:08:15 = 82.45 PPM

Stats. span



### GRAPH A

Time base is in minutes!

- A. Typical gas changeover introduces wet gas.
- B. After one minute auto heating cycle (Push Purge™) dries the sensor down to a dry condition.
- C. After 30 seconds heater switches off and equilibrium is allowed to re-establish, eliminating hysteresis.  
  
95% of final value is achieved within 5 minutes.
- D. Log states site location, serial no., day/date, no. of readings, etc. for downloading to PC.

Ranges can be selected and graphical records selected from a particular instrument or location.

Further analysis options exist including standard deviation data on areas of interest.