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What Makes A Good Hygrometer?

A Guide to Assessing Key Performance Criteria

Section	
1	# Introduction

Negotiating the Minefield

When specifying a hygrometer for a particular application, there are a number of issues which must be considered. For example . . . ***What is the principle of operation? Is the sensor technology suitable for the process? How is the analyser calibrated? What level of traceability can be achieved? Is the unit simple to operate? Can it make your process more efficient? Can you use the instrument on more than one process?***

Hygrometry is one of the most challenging areas of gas analysis, and over the years the demands of industry have led to some manufacturers making claims which are hard to believe.

Instrument specifications are often misleading –
Sometimes, they are deliberately deceitful!

Careful consideration of the performance criteria in this guide should give the user sufficient knowledge to ask the right questions when addressing an application and comparing instrument specifications.

The following lists, although not exclusive, highlights some fundamental areas of performance that should be evaluated in any moisture analyzer. The table is divided into two columns; Characteristics (the area of performance of the instrument) and Benefits (the importance of the characteristic).

Remember, the onus is upon you, the user, to challenge the manufacturer until you are satisfied that their hygrometer will absolutely satisfy your requirements. Don't settle for second best!

Section	
2	*What Makes A Good Hygrometer?*

The content of this document specifically relates to the process of specifying a 'standard' portable or on-line hygrometer. Applications which are particularly demanding (i.e.: those that contain high concentrations of corrosive or contaminating gases) will often require a more considered system solution, although the key parameters of speed, stability, self-diagnosis etc are equally important in every process.

If your application falls in to the category of 'demanding', then you need to be even more diligent with the questions that you ask to any potential supplier.

Characteristic	***Benefit***
Speed of Response	A fast response, from 'dry' to 'wet' and *especially* from 'wet' to 'dry', minimizes the time spent on sample and allows the most productive use of time. The minimal use of sample gas is important in regard to ISO environmental issues and hazard reduction. In on-line applications, a fast speed of response provides 'real time' data which significantly aids process control and fault diagnosis.
Accuracy	The hygrometer ought to have a high level of traceable calibration, from an independent and accredited laboratory, to provide a full audit trail on data collected. A high accuracy of data can be important in several areas, for example: in the reduction of commercial interfaces at the point of supply / receipt, in the reduction of data uncertainties (and hence an *increased* level of operator confidence), in the increased flexibility and ease of correlation of data, and in the simplification of process control and management deliberation. In addition, a high level of accuracy in one area of data can help when diagnosing the criticality of other parameters.
Stability	On a gas stream of a known moisture concentration, the hygrometer should show a high resistance to the effects of drift and hysteresis. A high level of stability provides increased operator confidence and a higher significance of data. Cost penalties associated with inaccuracies of data, and the associated Plant disruption, can be minimized.

Repeatability	The analyzer should provide the ability to perform multiple tests on the same sample, given constant sampling conditions and methodology, and achieve consistent results within the stated operating tolerances of the instrument. Good repeatability of data leads to increased operator confidence, and will also be of benefit in terms of speeding the return to work of an analyzer on commissioning or following Plant disruption.
Self Diagnosis	The instrument ought to provide the capability to verify measurements while on-line. The user should be able to confirm the performance of both the Sensor and the electronics of the hygrometer. Such diagnostic features provide great levels of operator confidence that the analyzer is functioning correctly.
Flow Independence	The hygrometer ought not to require a set flow level for each measurement. Flow independence makes the instrument easier to use and aids productivity, through a less complex sampling methodology and reduced costs of ongoing service and maintenance. Flow independence provides an additional level of diagnostic capability on Plant equilibrium conditions.
Flow Requirement	A low flow level helps to minimize emissions of hazardous gases and / or wastage of expensive gases, important issues in terms of Health & Safety and ISO emissions requirements. A low flow will also require a less complex sampling methodology and installation, and will aid in ongoing service and maintenance issues.
Pressure Independence	The instrument ought to be calibrated, and operated, at atmospheric pressure. This practice helps reduce uncertainties associated with operational error and provides the only level of traceability to internationally accepted standards. The simple installation and sampling methodology required to work at atmospheric pressure means that the diagnosis of any System faults is also much simplified. This is even more important when sampling potentially contaminating gases (e.g.: Natural Gas), where elevated pressures will significantly increase the rate of contamination of the Sensor.
Thermal Stability	The analyzer should be able to operate in a wide range of ambient conditions, sampling gases of differing temperatures, without the displayed measurement being adversely affected by any such fluctuations. The resistance of the analyzer to fluctuations in temperatures greatly simplifies the installation and increases the reliability of, and confidence in, all data collected.
Heated Sensor	A heated Sensor offers a robust level of performance, as it cannot easily be saturated or damaged by exposure to ambient air / gases during connection and disconnection of the sample. The heated Sensor also provides a high level of calibration traceability which greatly increases the validity of sample data, and forms the basis of invaluable self-diagnostic procedures for validating readings or detecting the presence of contamination in the process gas.

Contamination Resistance	The instrument should display a high resistance to light volatile contaminants, and should show a fast recovery from exposure to any such contaminants. A high resistance to contamination significantly increases the confidence of the collected data.
Inertness of Sensor	The moisture Sensor should be chemically inert, and the operational performance of the Sensor should not degrade with time, given 'clean' operating conditions. The inert Sensor will not contaminate either the gas stream or the application process, and means the analyzer will be able to operate on a wide range of applications.
Warm-up Time	The analyzer should be quick to respond on initial start-up and in cases of power interruption. The fast warm-up of the instrument in these circumstances is critical to the productivity of the analyzer and the audit trail of collected data.
Specificity of Sample Gas	The instrument should be capable of achieving a high level of performance on a number of different sample gases. The versatility of the analyzer will have a direct bearing on the level of productivity that it offers the user.
Graphical Display	A graphical display not only offers a productivity benefit by allowing the operator to quickly identify an equilibrium condition, but it also provides the ability to scrutinize the long-term performance of the Sensor and in turn make a decision as to the required frequency of recalibration.
Datalogging	Internal datalogging facilities are an excellent means of aiding process and management control. A date-stamped identification of each measured sample will increase the integrity of the data audit trail.
Portability	The ease of transportation of any portable analyzer is critical to the simplicity of use and hence overall productivity for the operator.
Level of Analyzer Support	Any hygrometer purchased should be fully supported by a high level of after sales care. A fast turnaround should be available for recalibration work, and spare parts, where required, should be readily available. A fixed term maintenance contract can be an extremely reliable way of spreading costs and guaranteeing reliable performance.
Level of Supplier Knowledge	The level of technical knowledge of the supplier should be of paramount importance when buying a hygrometer. Purchasing direct from a supplier, or approved Sales representative, will provide a greater knowledge of hygrometry applications and solutions than will be available from a distributor .

When assessing the relative merits of any analyzer, the following should also be considerations. While not fundamental to the Sensor technology of a particular type of hygrometer, all will affect the level of performance to some degree, and the effect of each should be minimized to achieve accurate results.

These issues may include:

- Linearity of the analyzer
- Interference errors
- Electrical supply variations
- Output regulation
- Output ripple and noise
- Output terminal isolation
- Output insulation resistance
- Electrical supply interruptions
- Electrical supply transients
- Electrical supply insulation / isolation
- Radio frequency
- Vibration

Remember – you are the customer and it is you that will have to live with the legacy of a poorly specified analyser!

Ask the questions before it's too late!