



Measurement and Control of Compressed Air Systems

Background

Many manufacturers processes require a constant supply of compressed air. The air may be used for many different reasons—for example the actuation and control of pneumatic valves, cylinders and controllers; operation of process machinery or tooling; as a transport medium for bulk materials; or as a purge gas. The compressed air supply will contain some moisture which, if uncontrolled, could potentially cause damage to the process, pneumatic controls, tooling, finished product, or indeed the components of the air distribution system itself.

To reduce the likelihood of these problems occurring, compressed air supplies are often conditioned to remove or significantly reduce the moisture content, before the air is consumed by the process.

Refrigerant dryers commonly used to reduce the moisture content of compressed air. In principle the compressed air is cooled in a heat exchanger to a temperature just above the freezing point of water, causing much of the moisture in the air to condense out as a liquid, which can then be drained off. Efficient operation of the dryer is dependent on maintaining good temperature control at close to 32 °F in the heat exchanger and upon the design of the heat exchanger itself. If the temperature drops below 32 °F, ice will form on internal surfaces and dryer performance will be reduced. Refrigerant dryers are normally equipped with temperature sensing devices to monitor the outlet air temperature. This measurement will give a first indication of the operation of the dryer, but does not guarantee the quality of the air at the dryer output. The only way to be certain that the dryer is functioning correctly is to measure the moisture content of the outlet air directly using a suitable hygrometer.

Regenerative desiccant dryers can offer a very efficient method of air drying. These dryers are normally configured in twin columns, allowing one column of desiccant to be regenerated while the other is performing the air drying process. There are two common types; pressure swing and heat regenerative. A pressure swing air dryer uses a sudden drop in pressure of the column under generation to evaporate moisture from the desiccant, which is then flushed out of the column to atmosphere by a back purge of air from the column under load. In the case of heat-regenerative dryers, large electrical or steam heaters are used to regenerate columns of saturated desiccant material and in such cases energy efficiency is of prime importance. As the demand made on the dryer can be variable, it follows that it would be advantageous to control the dryer cycle period according to the output performance required rather than simply on a fixed time interval, as is often the case. By monitoring the moisture content of the common dryer outlet using a hygrometer, this information can be used, not only as a quantitative measurement, but also to initiate the dryer cycle change-over point at a pre-determined moisture level. This system is often referred to as “dewpoint demand system” or DDS and it provides the user with significant energy savings as well as providing a consistent quality of dry air output.



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It is common for a portable hygrometer to be used for spot-checking air quality where there are multiple usage points or long air line runs from the compressor to a working location. For on-line measurements either a transmitter or hygrometer (with display) may be installed depending on whether the user wishes to connect into a data acquisition system or simply provide a local display of the measured dewpoint. Increasingly transmitters are used for this application, since they are easy to install, relatively low cost and offering a standard milliamp output signal that is suitable for input into a control system.

Measurements may be made either at full line pressure or at atmospheric pressure, depending on preferred working practice. The diagram shows an example of an on-line hygrometer measuring the output of an air dryer after a particulate filter. Correct positioning of flow and pressure regulation will facilitate measurement at either line pressure or atmospheric pressure. A suitably ranged flowmeter after the sensor provides an on-going indication that an adequate flow rate is achieved across the sensor.

The sampling arrangement for a portable hygrometer would be similar, and Kahn Instruments can provide ready-made solutions for both the Easidew (see below) and Cermax portable hygrometers.



Cermax Portable Hygrometer



Easidew Portable Hygrometer

It is important that good sampling practice be observed in making these measurements. Sample tubing should be of high quality stainless steel, preferably 1/8" or 1/4" O.D. with high quality fittings. Tube lengths should be kept to a minimum to insure fast response and there should always be an outlet coil after the sensor to insure that back-diffusion of ambient air does not compromise the measurement. Filtration is also normally recommended for compressed air applications. Kahn offers a standard filter unit that provides particulate protection to 0.3 micron with an efficiency of 99.5%. A variety of sampling systems are also available on request.



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Which Instruments?

Kahn Instruments can offer a variety of hygrometers that are suitable for the measurement or control of compressed air quality.

The Easidew family of capacitive hygrometers provides simple on-line or portable measurement of compressed air dewpoint. The range comprises three products, all based around the core Easidew Transmitter, which is a fully self-contained sensor, powered by a 12 to 28V dc input and providing a linear mA output in °F dewpoint. This transmitter can be used alone, providing an output into a controller or external monitoring system. It can also be combined with a digital display unit that provides transmitter excitation, local indication, milliamp output and a dual alarm. Completing the range is the Easidew Portable, providing digital display and milliamp output and featuring an integral re-chargeable battery pack and a full sampling system with filtration, flow and pressure regulation. Easidew Transmitter gives continuous measurement and the Easidew Portable is a convenient instrument for regular spot-checks at point of use of the compressed air.

Kahn's Premium Range capacitive hygrometers use the same proven and reliable sensing technology, but provide the user with more features and functionality. The Cermet II Hygrometer is a sensor/monitor combination with intelligent digital display that offers multiple engineering units, mA, voltage and RS232 output options with up to four alarm contacts. The Cermax Portable Hygrometer also offers multiple engineering units and features built-in data-logger for storing up to 10,000 measurement points and a re-chargeable battery system. Both Cermet II and Cermax can take an auxiliary pressure input for active pressure compensation, if required. To round off the range Kahn offers the Transmet IS Dewpoint Transmitter. This is CSA/FM certified instrument providing linear 4-20mA output and is suitable for use in most hazardous area applications, such as hydrogen and natural gas dryers, when used with an approved safety barrier. It can be combined with a version of the Cermet II monitor, if a remote (safe area) digital display and alarms are required, to become a Cermet II IS Hygrometer.

Reference Users

- Atlas Copco
- Airtek
- Conair
- Daniel L. Bowers
- Beaconmedaes
- Ingersoll Rand
- SPX Air Treatment
- Scales Air Compressor
- Zeks