

## **The use of dry gas purging to prevent humidity and condensation damage.**

This article discusses the benefits of dry gas purging and the identification of in built moisture (hygroscopic loading) within instruments and systems. In order to prevent humidity and condensation damage, even equipment failures. In-built moisture has to be effectively removed during the build process. Historically, hygroscopic loading has been difficult to identify and quantify within instruments and equipments. However recent purging equipment developments have led to a much greater understanding and means of effectively removing the problem.

Instruments and equipments which can be adversely affected by moisture and high humidity are: electronics, optical systems, lasers, thermal imagers, waveguides and telecommunications.

Water in the form of condensation or high humidity can have a harmful deleterious effect on the reliable and efficient operation of instruments and systems. Water's ability to exist in more than one physical state i.e. solid, liquid or gas, contributes to its potential to cause these effects. Ice or frost formation can also contribute to mechanical failure by preventing the operation of moving parts. Therefore it is important to keep the dewpoint (water vapour content) within equipment to a suitably low level to prevent any of these effects occurring.

Dewpoint is defined as the saturation temperature of the air or gas. It is the temperature at which moisture just starts to condense out of the air or gas. (All dewpoint quoted in this article are atmospheric pressure values).

For example if the dewpoint dryness of an instrument or system is  $-40^{\circ}\text{C}$  this specifies the ambient temperature to which the instrument or system can be subjected to (operated) before internal ice or frost will occur. Even if the ambient temperature is lower than the dewpoint temperature ice or frost may not occur as the percentage dropout of water as ice or frost is so small.

The moisture contained within the air space of an instrument or equipment can be readily and effectively removed by purging with dry gas or dry air. A hygroscopic material is one which attracts moisture from the atmosphere.

A major source of moisture within instruments and equipments is held by the hygroscopic materials used in the constructional components. These components can be identified as non metallic, constructional components including circuit boards, potting compounds, wiring looms, rubbers and electronic components. Coatings including paint, impregnation and some forms of electroplating can also be considered as sources of hygroscopic moisture.

The amount of moisture held by materials and components is related to the humidity conditions during build and storage. Increasing humidity will result in an increase of the amount of hygroscopic moisture held by a material or

component. This is also true for reduced humidity as components and materials release moisture to maintain equilibrium with the prevailing relative humidity.

Failure to remove hygroscopic moisture by purging or desiccation during production can result in a significant amount of moisture being present in completed equipment.

Although the hygroscopic moisture loading of materials contributes to the performance of the instrument or system and its reliable operation in a global environment there is a positive benefit for its removal.

Purging instruments and systems to remove unwanted moisture is a standard practice. The method normally adopted is to allow dry gas to “flow through” an instrument or equipment for a defined period of time using an assumed dry gas. The dry gas can be nitrogen, dry air or SF6 to particular internal environments such as high current switchgear.

A further improvement to dry gas purging is to consider the use of single point purging. Single point purging combined with cyclic purging between selectable pressure levels. This provides the advantage of dry gas mixing and diffusing throughout the entire internal space volume of the instrument or system.

A typical instrument able to control and measure this process is the NEPS1000 dry gas purge system.

By using a NEPS1000 the process of hygroscopic removal, control and prediction of effective dewpoint (water vapour content) throughout the instrument can be predicted. In addition a systems desiccation operational life can be predicted.

NEPS1000 is capable of managing the complete drying process. This includes testing the dryness (dewpoint) of the dry gas prior to use along with automatic dewpoint control during purging.

An in-built leak testing facility enables an operator to validate the sealing integrity of their equipment prior to purging. Purging and desiccation is greatly improved by achieving a low leakage rate i.e. one of better than  $10 \times 10^{-3}$  cc per second.

Effective dry gas purging can prevent malfunctions caused by condensation and high humidity. The use of instruments and systems throughout the world is improved by dry gas purging enabling the use in low temperature extremes and high humidity tropical environments.