The Importance of Dew Point Measurement in Cryogenic Gases

Application Note

SHAW MOISTURE METERS

A cryogenic gas is any gas that becomes a liquid at extremely low temperatures, typically below –150 °C (–238°F). At normal room temperature, these substances are gases, but they are cooled so much that they become liquids for storage and transport. When released and warmed, they revert back into a gas. Common examples include nitrogen, oxygen, helium, argon, and hydrogen, stored in special tanks.

Trace moisture is the single most consequential contaminant in cryogenic gas processes. Even parts per million (ppm_v) or parts per billion (ppb_v) levels can freeze in brazed aluminium heat exchangers, trigger hydrate formation in LNG service, degrade product purity, and shorten equipment life.

Why Cryogenic Gases are Used

Cryogenic gases are used because cooling these gases to extremely low temperatures changes their properties in useful ways. They are commonly used for:

Storage and transport of large amounts of gas: Cooling a gas into a liquid makes it much denser. For example, 1 litre of liquid nitrogen expands to over 680 litres of gas. This makes storage and transportation far more efficient.

Industrial uses: Cryogenic gases help in metal cutting and welding (like LOX in oxy-fuel torches), shrinking metal parts for precision engineering and food freezing (flash-freezing with LN_2).

Medical and scientific applications: Cryogenic gases are essential in Cryopreservation (preserving cells, blood, embryos, and tissues), MRI machines (liquid helium cools superconducting magnets) and laboratory cooling for experiments that require extremely low temperatures.

Rocket fuel: Cryogenic liquids such as liquid hydrogen and liquid oxygen provide extremely high energy, making them ideal for space launch vehicles and upper-stage rocket engines.

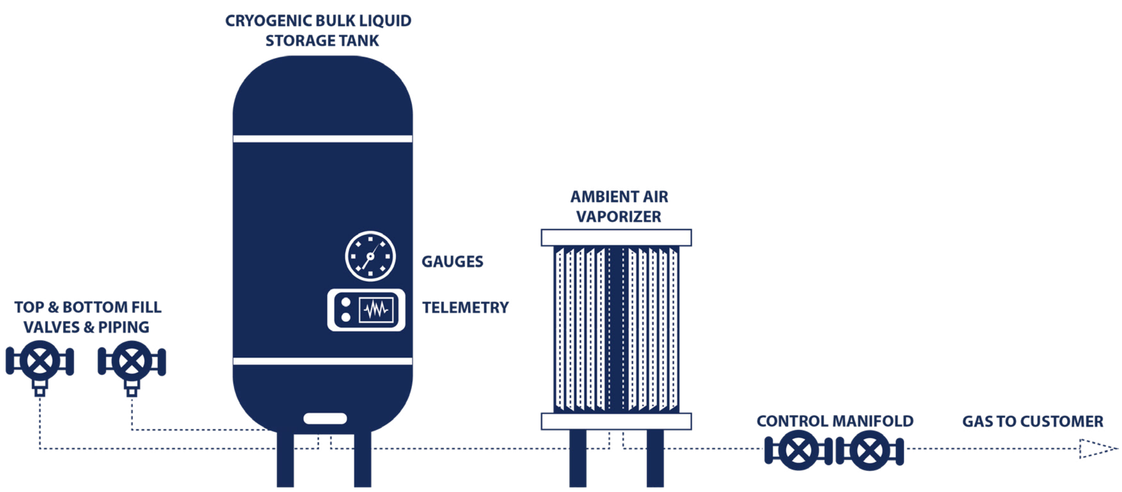
Energy and fuel systems: LNG (liquefied natural gas) is used because it stores more energy in smaller volume, burns cleaner than diesel or coal and is easier and safer to transport in liquid form.

Why Moisture is a Problem in Cryogenic Gases

Freeze out in cryogenic heat exchangers: Water and CO_2 solidify in the cold box, obstructing flow and causing thermal/ pressure upsets. Moisture ingress during maintenance or startup is a common root cause; a dry, warm purge to −40 °F (− 40 °C) dew point is recommended before cooldown.

Hydrate formation in natural gas/LNG systems: Under high pressure and low temperature, water and light hydrocarbons form clathrate hydrates—ice like solids that can plug lines and valves during transfers, cooldowns, or after shut ins.

Corrosion and product quality: Residual water vapour raises the risk of acid formation with CO_2/H_2S in hydrocarbon systems and compromises high purity products (e.g., Ar, N_2, O_2 and UHP specialty gases).



Measuring Moisture in Cryogenic Gas Systems

Always measure in the vapour phase and always after a stable vaporization stage, never directly from the cryogenic liquid.

Here are typical locations for trace moisture measurement:

After the cryogenic vaporizer: It is important that liquid must vaporize fully to avoid ice crystals that may corrupt readings. Continuous measurement using dewpoint transmitters at near-ambient gas temperature. Sampling may include ambient air vaporizers, electrical vaporizers and heated sample lines.

At the outlet of an air separation unit (ASU) column: Continuous dewpoint sensors monitor trace moisture to ensure product quality in N_2, O_2, Ar production. Dewpoint sensors are also used to detect failure and validate the performance of molecular sieve dryers.

At cylinder or tank filling stations: Cryogenic tankers and gas cylinders must meet moisture specifications before filling. Continuous dewpoint measurement should take place before liquefaction and in the final metering line.

On LNG systems: Trace moisture is typically measured in boil-off gas (BOG) lines to stop hydrate formation in cold suction lines and the fouling of downstream equipment.

Both portable dewpoint meters and fixed dewpoint transmitter measure trace moisture after LNG vaporizers for LNG storage and send-out. Continuous measurement on fuel supply lines to engines and turbines as small moisture amounts can form ice in fuel injectors.

In hydrogen systems (LH_2 or GH_2): Trace moisture sensors are installed after the warmup/vaporizer, in the purification train and before entering PEM fuel cells which are extremely moisture sensitive.

Accurate trace moisture measurement is fundamental in cryogenic gas production and storage, to prevent freeze out and hydrates, protect BAHX and storage integrity, and consistently meet product specifications.

References to Applicable Standards

- ASTM D1142-95(2021): Water vapour in gaseous fuels by dew point (chilled mirror).
- STM D5454-11(2020): Water vapour in gaseous fuels using electronic analysers.
- ISO 14687 (2025): Hydrogen fuel quality
- ISO 21087:2019: Analytical methods for hydrogen fuel
- ISO 10715:2022: Natural gas—Gas sampling.
- API 625: Tank systems for refrigerated liquefied gas storage

Suitable Products

Dewpoint Transmitters

Handheld Hygrometers

Portable Sample System

We design and manufacture dewpoint instruments for many different applications.

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