

SAFETY WARNING - COLD EMBRITTLEMENT FOR AIR GAS CUSTOMERS (THIS EXCLUDES CUSTOMERS WHICH ARE CUSTOMERS OF CO2 PRODUCTS ONLY)

The purpose of this warning is to ensure that Customers are aware of the risk of cold embrittlement in gas system installations.

Cold embrittlement occurs when non-resilient materials, such as carbon steel, PVC piping and glass, are exposed to cryogenic liquid or gas at temperatures that are too cold for the material. This can cause non-resilient materials to become brittle and rupture.

The consequences of cold embrittlement can include minor cracking of parts under pressure (causing release of gases used in production process) or even pressure blasts (projection of material pieces and/or release of cryogenic, toxic or flammable products, creating a risk of death or serious injury of persons and/or damage to equipment located in the vicinity of the incident).

Air Liquide plant and equipment

- As a supplier of plant and equipment in connection with supplies of industrial and medical gas, Air Liquide is required to ensure that, so far as is reasonably practicable, the gas plant and equipment it supplies are without risks to the health and safety of people who use it.
- Air Liquide's procedures to address cold embrittlement risk include use of fully resilient materials in new cryogenic vaporization systems installations, assessments of existing installations, and (dependent on the risk level and use of gas) recommendation of engineering solutions to protect downstream non-resilient piping and equipment against cold embrittlement risk.
- Air Liquide may request information from the Customer prior to and during the term of its Supply Agreement for the purpose of a review of cold embrittlement risk associated with piping and equipment, particularly where there is non-resilient material downstream of the cryogenic vaporization system, including the customer system up to (and including) the points of use. Such information may include (but not be limited to):
 - internal diameter of piping or the volume of equipment;
 - maximum operating pressure; and
 - material
- The Customer acknowledges that Air Liquide may be unable to properly assess cold embrittlement risk in the absence of receiving such information and that Air Liquide relies on the accuracy of the information it receives.
- Where Air Liquide assesses there is a cold embrittlement risk, Air Liquide reserves the right to suspend deliveries to the Customer until Air Liquide is satisfied that a protection solution has been identified and implemented (which Air Liquide can assist in) to mitigate that risk.

Customer equipment

- The Customer has responsibility and control over equipment on its site which is not supplied and maintained by Air Liquide, including that which connects to or forms part of the overall gas system or otherwise comes into contact with the gas. The Customer is responsible for maintenance of such Customer plant and equipment.
- To the extent the Customer equipment comes into contact with cryogenic liquid or gas at low temperatures, the Customer acknowledges that this equipment should also be resilient to low temperatures.

Usage of the system and modifications

- The Customer needs to be aware that increases in its production capacity and gas usage or changes made or commissioned by the Customer to its equipment and gas piping system downstream from the Air Liquide battery limit, including addition of buffer vessels, can create cold embrittlement risk. The Customer assumes full risk for any changes made or commissioned by the Customer to its downstream equipment and for gas consumption which exceeds the safe usage limits for Air Liquide equipment.
- The Customer should advise Air Liquide of planned significant changes to gas consumption and changes to its equipment and gas piping system downstream from the Air Liquide battery limit, recognising that such changes may lead to modifications or additions being required to the Air Liquide equipment to mitigate cold embrittlement risk.
- To mitigate cold embrittlement risk, Air Liquide recommends that the Customer continue to monitor:
 - Gas consumption - that this remains within any safe usage limits specified by Air Liquide for the Air Liquide equipment
 - Maximum allowable pressure of the Customer's pipework system and equipment;
 - Volume of any buffer vessel or reactors; and
 - Minimum allowable design temperature of components in the Customer's installation.

Abnormalities

If the Customer spots an abnormality (excessive frost, condensation, paint flaking), the Customer should do the following:

Do's

- ✓ Stop or reduce your gas consumption in accordance with plant safety requirements.
- ✓ Define a security perimeter and prevent access to the frozen parts.
- ✓ Leave the affected area.
- ✓ In case of requiring urgent (24/7) technical advice, call the Air Liquide hot line 1800 812 588 (Australia) or 0800 156 516 (New Zealand).

Don'ts

- ✗ Do not intervene on the frozen components.
- ✗ Do not adopt mitigating measures (incl. silencing alarm) which involve heating the temperature detection device by using steam, heater, open flame, etc.
- ✗ Do not operate the system by opening the bypass valve (if available)