LEAK TESTING OF ULTRA FREEZERS

Introduction

This application note describes the necessity, technical challenges and the INFICON solutions for reliable leak testing of **ultra freezers** in production. Ultra freezers is a critical infrastructure in transport and storage of vaccines and other medicine. Any failure of the ultra freezer will result in damage to the sample components which, if utilized, could negatively impact the health of the test persons and image of the manufacturers or result in significant financial losses due to loss of large sample quantities.

Application

Ultra freezers or ULT (**ultra low temperature**) freezers are often used in molecular biology and life science laboratories for the storage of biological samples such as DNA, RNA, proteins and vaccines. With the ongoing COVID-19 pandemic and the variety of e.g. RNA-based vaccines, the demand for ultra low temperature storage and transportation has increased significantly. Storage temperatures around -80 °C (-112 °F) must be maintained to avoid damage of any sample ingredients.

Reaching the required temperatures ultra freezers are typically using cascade cooling systems. Those systems are commonly compressor-based systems consisting of two separate circuits with thermal connection by a cascade condenser. Typical refrigerants used in this application are R-23 or R-508b, R-22, ammonia, R-507 and R-404a, among others.

Description of the Technical Challenge

Unidentified leaks in the refrigerant circuit can lead to costly downtime of the freezer or failure while storing important and expensive vaccines and medicine. Reliable and professional leak testing will allow detection and even locating of leaks, helping to reduce the risk of failures of the ultra freezer.

Admittedly, pressure decay, soap spray and use of cheap handheld service leak detectors approaches are straightforward methods frequently used in leak detection, but they do not meet the sensitivity requirements of down to 0,5 g/a refrigerant equivalent in this case. Due to small refrigerant cycles each gramm refrigerant loss counts. Here the INFICON solutions enter the picture.

Ultra freezers typically reach low temperatures around -80 °C (-112 °F) for storage of vaccines and medicine.

The INFICON Solutions

INFICON offers solutions for pre-testing before filling and final testing of the cooling circuit once it is filled with refrigerant. **Pre-testing** with tracer gases ensures that only leak-tight cooling circuits will be filled with refrigerant, saving filling time and gas. The INFICON portfolio includes the **Sentrac® Strix Edition Hydrogen Leak Detector** on an entry level, the **Protec® P3000 Helium Leak Detector** on a standard level and the **XL3000flex Helium and Hydrogen Leak Detector** on an advanced or flexible level.

The Sentrac Strix Edition enables leak detection with hydrogen as tracer gas down to the small, required leak rates. With the Protec P3000 Helium Leak Detector and the XL3000flex Helium and Hydrogen Leak Detector, leak detection down to 1E-7 mbar l/s is achievable (equal to 0.05 g/a for R134a). While the Protec P3000 detects helium, the XL3000flex is able to detect both helium and hydrogen. This offers the use of an inexpensive and conventional forming gas consisting of 5% hydrogen in nitrogen, which is also used for applications with the Sentrac Strix Edition. All three instruments are equipped with a hand probe for easy leak locating with immediate feedback of any found leaks.

The Sensistor ILS500 F HP

The Sensistor ILS500 F HP is a **tracer gas filler.** This unit can be combined with both helium and hydrogen INFICON leak detectors.

The ILS500 F HP has complete tooling and gas filling function eliminating the need for time-consuming manual tracer gas filling, improving test quality assurance. It comes along with a couple of features such as gross leak testing, blockage test and recipe handling. In the high-pressure version it allows tracer gas filling with pressures up to 30 bar.

INFICON Sensistor ILS500 F HP Tracer Gas Filler used for automated tracer gas filling with helium and hydrogen for subsequent leak detection with suited INFICON helium or hydrogen leak detectors.

Final Testing

Final testing of the refrigerant-filled cooling circuit can be carried out with the **INFICON HLD6000 Refrigerant Leak Detector** for halogen-based refrigerants with a minimum detectable leak rate down to 0.5 g/a or with the **INFICON Ecotec® E3000,** which is a multigas leak detector with a minimum detectable leak rate of 0.05 g/a for R134a. Both leak detectors are likewise equipped with a hand probe for locating leaks and direct feedback to the operator.

Forming Gas Facts

Forming gas is a mixture of 5 % hydrogen and 95 % nitrogen. It is a readily available, pre-mixed, inexpensive, non-flammable (see ISO 10156), non-toxic and environmentally friendly tracer gas.

INFICON Solutions at a Glance

Pre-testing with Sentrac Strix Edition, Protec P3000XL or XL3000flex

Sentrac Strix Edition Hydrogen Leak Detector	
Gases	Hydrogen
Minimum detectable leak rate	5E-7 mbar l/s (equal to 0.1 g/a R134a)

Protec P3000(XL) Helium Leak Detector	
Gases	Helium
Minimum detectable leak rate	1E-7 mbar l/s for P3000 and P3000XL (low flow) (equal to 0.05 g/a R134a) 1E-6 mbar l/s for P3000XL (high flow)

XL3000flex Helium and Hydrogen Sniffer Leak Detector	
Gases	Helium, hydrogen
Minimum detectable leak rate	2E-7 mbar l/s (equal to 0.05 g/a R134a)

Final testing with Ecotec E3000 or HLD6000

Ecotec E3000 Multigas Sniffer Leak Detector	
Gases	Multigas detector, refrigerants 4 gases detected simultaneously
Minimum detectable leak rate	R134a: 0.05 g/a (0.002 oz/yr) R600a: 0.05 g/a (0.002 oz/yr)

HLD6000 Refrigerant Leak Detector	
Gases	Single gas probe: R744 (CO_2), R600a/R290 Universal Smart probe: halogen-based refrigerants
Minimum detectable leak rate	Single gas probe: 1 g/a (0.03 oz/yr) Universal Smart probe: 0.5 g/a (0.014 oz/yr)

CONTACT

If you have any further questions about our products, please contact us at **reachus@inficon.com.**

INFICON Inspired by visions. Proven by success.