Stresses and strains

ITIS describes the testing processes involved in industrial products for low temperature and cryogenic fluids

Industrial Testing & Inspection Services (ITIS) is a Conformity Assessment Body (CAB) located in Goes in south-west Netherlands and has expert knowledge in providing leak and valve testing in accordance with ISO/IEC 17025.

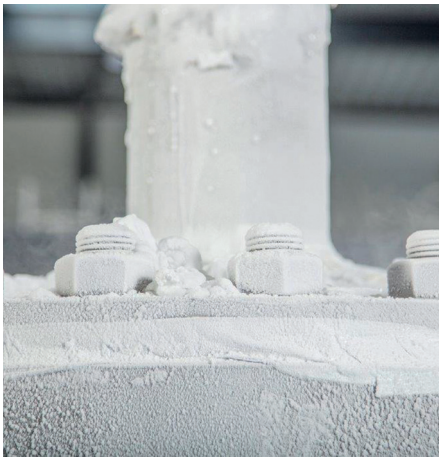
This ISO is a requirement for testing and calibration laboratories.

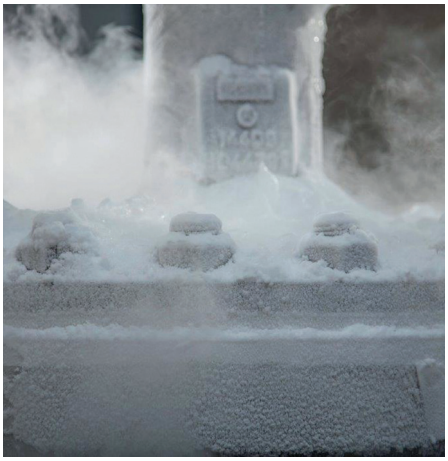
ITIS is a recognised provider of customised services to various industries, including power generation, chemical and petrochemical, oil & gas, cryogenic and other high risk industries.

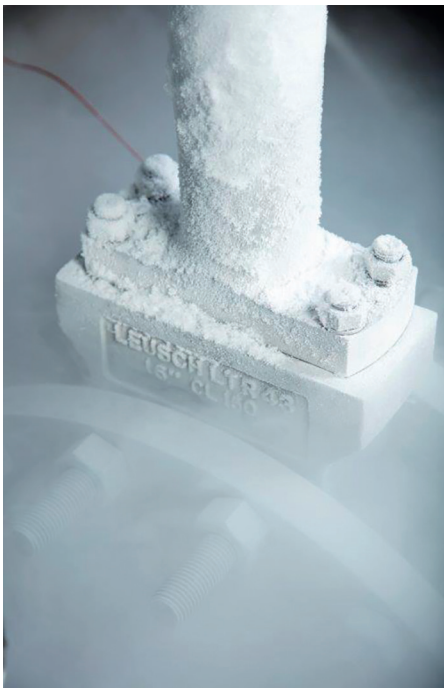
Cryogenic testing, low temperature testing, high temperature, burst tests and fire safe tests can be performed in its laboratory.

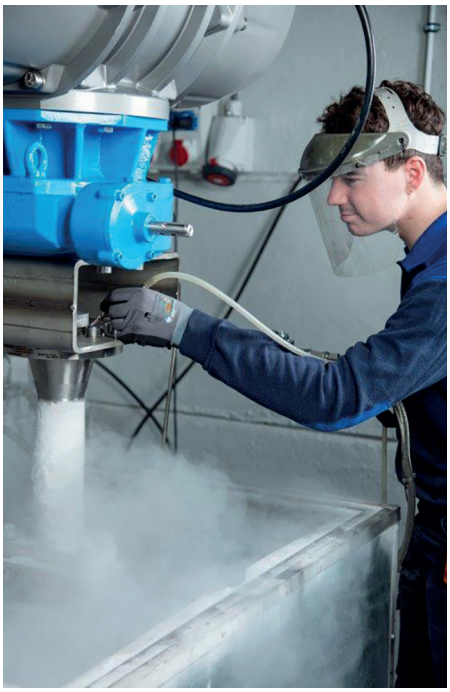
Valves, fittings, flanges and gaskets can be tested according to international standards and procedures of clients from -196C up to 800C.

The increased demand for liquefied natural gas (LNG) is driving an exponential growth of product testing at cryogenic temperatures for projects all around the world.









Croygenic flange testing being carried out

ITIS has tested for projects in the Netherlands, Belgium, Spain, Russia and Australia for onshore terminals, offshore and maritime projects.

Despite standards for design, engineering, manufacturing and testing of most products for cryogenic temperatures, these occasionally fail for variety of reasons.

Examples of cryogenic fluids include LNG temperature, liquid oxygen and liquid argon.

The company has also been asked to test products for liquid hydrogen which has a temperature -253C.

ITIS uses liquid nitrogen as fluid to cool down objects, but this cooling fluid cannot be used for temperatures of -253C. For this application, liquid helium is used as cooling fluid with an extremely low temperature of -269C.

Due to the hazardous nature of LNG, it is very important for asset owners to have reliable equipment for their installations.

Type approval testing

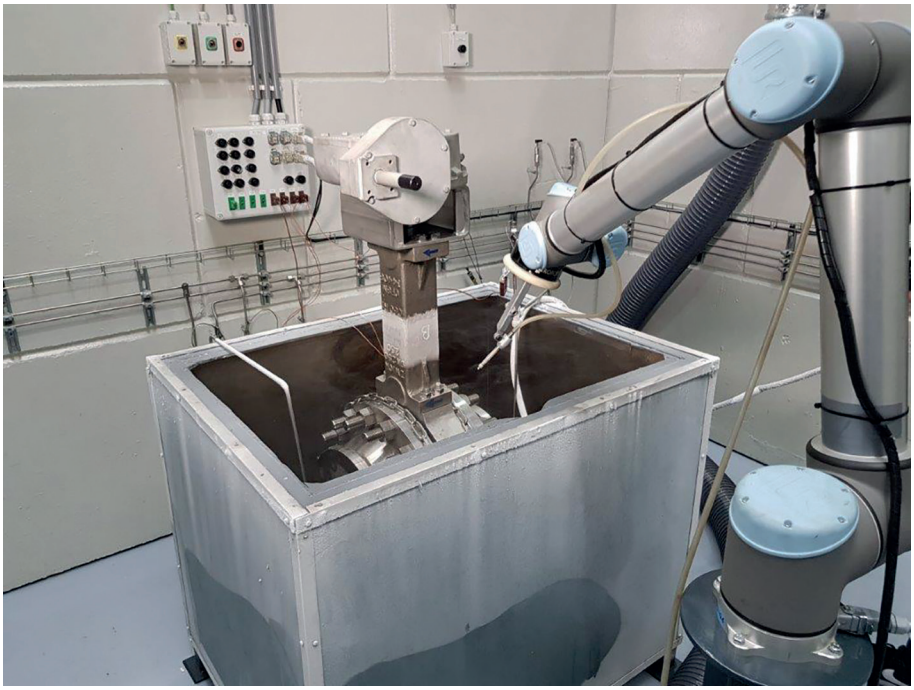
It is not uncommon in certain applications to have new type of products to be developed to meet the end user's needs. These 'prototypes' will undergo extensive testing to verify reliability and safety.

To ensure that these products are provided with asset owner requirements, we provide a design validation test (DVT).

For valves there is a testing method to confirm the seat sealing, fugitive emission and operational torque capabilities of the device when subjected to its rated design conditions. They must undergo a series of mechanical and thermal cycles, which requires testing at room temperature, upper design temperature, lower design temperature and again at room temperature. It is then stripped down after testing for potential damage and wear and tear.

During DVT of valves at ITIS, casting defects, gasket failures, broken parts and leakages are often found.

About 60 to 70% of tested valves do not pass despite the fact that the



A system ready to undergo testing

valve data sheets 'prove' all parts are in accordance with the pressure/ temperature requirements.

Leak Testing

Another solution to prevent leakages in practice is to perform a leak test on the complete installation before start up. Flange connections and welds can be tested for leakage.

Leak testing is a highly precise means of leak detection and is used to locate and quantify leaks in a wide variety of industries and applications, including valves, vessels, heat exchangers, seals, flange connections, tubes and condensers.

There are different methods used to measure the amount of released media, and various media can be used as tracer gas. The tracer gas testing determines the change in concentration or an actual leak rate of a tracer gas on the lower pressure side of a test part. Typical tracer gases are helium and hydrogen.

On site fugitive emission testing

ITIS is often asked to test complete industrial installations for leakages after overhaul or during shut down. Usually all components of the installation will be independently tested for possible leaks.

Any potential leaks, such as valve stem seals, flanges, gaskets and fittings will be taped to create accumulation chambers

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(hood method), as tracer gas – usually helium or hydrogen – will be used.

After pressurising the system with a tracer gas mixture and respecting a certain hold duration, all chambers of the parts to be tested will be checked for an increase of tracer gas concentration by a mass spectrometer.

The hold duration depends on the tracer gas concentration, volume of the accumulation chambers and maximum allowable leak rate.

The cause of leaks can be attributed to any number of things - wrong gasket, gasket installed incorrectly, loose bolts/ nuts, or the absence of a gasket or bolts.

Most of the time only the parts which have been disassembled and reinstalled during the overhaul or shut down have to be tested for leaks.

However, during some tests it is necessary to measure a high tracer gas background in the plant, for example with 'high leaker' stem seals of valves, where leak rates of more than 10 cm3/ second per stem seal are no exception.

Routine inspections of process equipment with gas detectors can be used to identify leaks and estimate the leak rate in order to decide on appropriate corrective action.

Proper routine maintenance of equipment reduces the likelihood of leaks.

Test results

During cryogenic testing, ITIS has noticed a relative high percentage of failures.

Therefore, the design of products and choice for materials very important in this process.

Engineers have seen problems during projects where valves were installed in a cryogenic installation.

The performance of the valves was perfect at room temperature. However, once installed at low temperature and pressure, all valves failed and this could have led to serious problems.

Due to decreased brittleness and change in tolerances, it was impossible to operate the valves with the original actuators.

After the valves were provided with larger actuators, the problems for operability were solved. Testing industrial products at practical conditions can prevent such problems.

Some failures are easy to solve

1. Make sure that your products are free from any dust, oil, and completely dried before installation or testing. Liquid (water) is often used as fluid during hydrostatic testing and this can lead to failures.
2. Use sealing and gaskets suitable for the fluids in combination with temperature. ITIS has sometimes found out that some of these products were not tested or exposed at the conditions (minimum/maximum temperature) mentioned in the product data sheet.
3. For some materials it is generally preferred to cool them down with a maximum temperature rate/ duration to prevent failures. However, a temperature shock can result in shrinking or cracking due to excessive temperature differences.

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