



Technical Guideline

Number

7.23e

B-MT

He Leak Testing of Cryogenic Tubing

Status

2011-04-04

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1. Scope

- 1) This document defines requirements and procedures to be executed for He - leak testing of tubing for conduction of liquid and gaseous cryogenic media in applications like
 - magnet cryostats,
 - cryogenic supply systems,
 - cryogenic transport systems,
 - cryogenic current lead boxes,
 - auxiliary cryogenic systems
 within FAIR accelerators.
- 2) The described testing procedure must NOT be applied to systems, not being suitable for vacuum operation within a surrounding at atmospheric pressure.
- 3) This document is NOT related to any other purpose as aforementioned.

2. Basic Requirements

2.1. Requirements on Systems being Tested

- 1) The systems being tested must be designed for vacuum operation within a surrounding at atmospheric pressure.
- 2) The described procedures must not be applied to thin walled objects due the possibility of collapsing.

2.2. Surrounding conditions

- 1) The tests must be performed in a clean, low dust and dry surrounding.
- 2) No contamination e.g. with dust, grease or oil must be accepted due to testing.

2.3. Required Documentation

- 1) All Documentation must be available on site at the date of testing.
- 2) A testing protocol showing at least the content as defined in 5.1 must be prepared prior to the test procedure being executed.
- 3) A valid calibration certificate for the He – leak tester in use for the tests must be added to the documentation. The calibration certificate must show a date of last calibration not older then one year at the date of testing.

2.4. Required Equipment and Media

- 1) The following equipment and media is required for the He leak test
 - calibrated He leak tester with a most sensible range of at least $1 \cdot 10^{-11}$ mbar*L/s,
 - quadrupole mass spectrometer with
 - faraday cup detector,
 - minimum detectable partial pressure of $5 \cdot 10^{-12}$ mbar,
 - atomic mass number range of 1 – 100,
 - turbo molecular pump,
 - rough pump,
 - oil-free vacuum equipment (pumps, tubing, valves etc.),
 - suitable oil free tubing, T – fittings and valves,
 - a set of blanking flanges and seals for all flanges not in use during testing,
 - plastic balloon for complete coverage of the tubing.

3. Test Preparation

- 1) Test objects showing obvious contamination with e.g. dust, grease, oil or any other solids or liquids must be rejected directly. The leak test must be declared as failed.
- 2) Test objects showing obvious damages e.g. at flanges must be rejected directly. The leak test must be declared as failed.
- 3) All flanges not in use for testing must be carefully closed by adequate seals and blanking flanges.
- 4) A testing scheme as described in Figure 1 must be set up. The testing scheme must be prepared for oil-free vacuum in the testing volume.
- 5) Before performing the testing procedure, it must be assured that the setup is leak tight already without test volume.

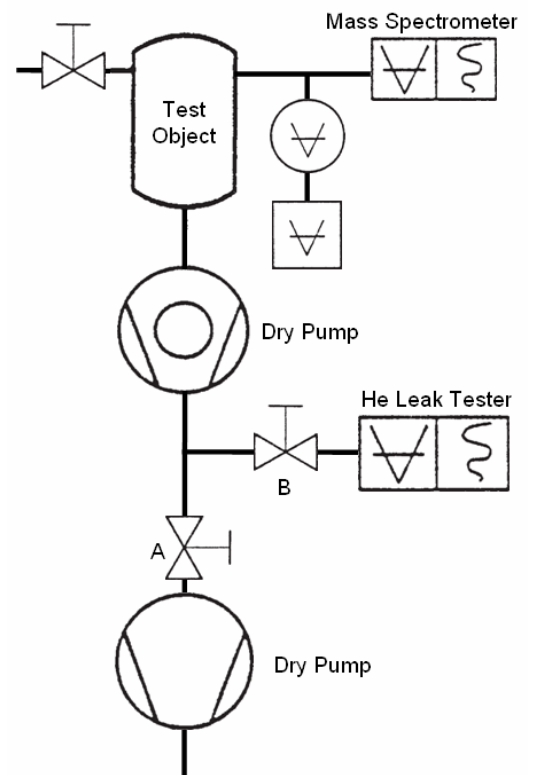


Figure 1: Vacuum testing scheme



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6) If possible the test volume must be tested without any interior.

4. Checks and Tests

1) For vacuum testing the tests and checks 4.1 to 4.4 must be performed following the listed sequence.

4.1. Document and Certification Check

1) All named documentation must be checked for completeness. In case of incomplete documentation, the leak test must be declared as failed.

4.2. Single He Leak Test

- 1) For single He leak testing valve B must be opened and valve A must be closed.
- 2) All welding seams and flanges must be tested for leaks separately by applying He gas to the full length of the welding seam respectively the vacuum gaskets.
- 3) One single detected He-leak must not exceed $1 \cdot 10^{-10}$ mbar*L/s.
- 4) In case a leak is detected it must be marked as such and must be documented in a photo.
- 5) In case of one single leak rate exceeds the defined maximum value, the test must be declared as failed.

4.3. Integral He Leak Test

- 1) For the integral He leak test, the tubing must be covered completely by a plastic balloon permanently filled with gaseous He.
- 2) For integral He leak testing valve B must be opened and valve A must be closed.
- 3) The He partial pressure of the residual gas must be recorded during a testing time of ≥ 20 min.
- 4) The integral He leak rate of the vacuum vessel must not exceed $2 \cdot 10^{-10}$ mbar*L/s.
- 5) In case of an integral He leak rate exceeds the defined value, the test must be declared as failed.

4.4. Residual Gas Test

- 1) The residual gas spectra of the test volume after 24 h of pumping must show a hydrocarbon percentage $< 2\%$ for all residual components with an atomic mass number ≥ 36 .
- 2) In case the residual gas spectra shows higher hydrocarbon percentages then defined, the test must be declared as failed.

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5. Documentation

- 1) All described checks and tests must be documented in a testing form agreed with the contracting entity.
- 2) The original testing protocol must be handed out to the contracting entity.
- 3) A digital version must be stored in EDMS following relevant guidelines for EDMS access and usage. The EDMS storage must be agreed with the contracting entity.
- 4) Any measured values must be documented in writing within a protocol as defined as follows.

5.1. Testing Protocol Requirements

- 1) The testing protocol must show comprehensible structure and content documenting each single test executed.
- 2) The following information must be at least documented within the cover sheet:
 - test identification,
 - address of Company or Institute,
 - identification of Department,
 - names of testing personnel,
 - name of quality testing leader,
 - date and time,
 - identification of tested object,
 - serial number of tested object,
 - test result,
 - number of pages (including photo prints).
- 3) The measurement equipment in use must be documented at least with
 - device identification,
 - serial number,
 - date of last calibration,
 - used measuring range.
- 4) All tests, described in the chapter 4 must be documented at least with
 - brief description of testing process,
 - test schemes if applicable (e.g. vacuum scheme),
 - relevant device settings,
 - registered non-conformities,
 - nominal values,
 - measured values,
 - ambient temperature, pressure and relative humidity,
 - photos of non-conformities,

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- single ratings,
 - full test rating
- in clearly separated chapters.

- 5) In case a component failed the test and was reworked, the documentation of the reworking procedure must be delivered within the documentation of the repeated and passed test.
- 6) All defined tests and procedures must be signed by the executing personnel.
- 7) A conclusion page must indicate the all over test result clearly. In case the full acceptance test failed a brief explanation must be stated.
- 8) The protocol must be crosschecked and signed by a person, responsible for the product quality of cryostat vacuum vessels.