GSI FAIR	Technical Guideline	Number	3.62e
B-MT	Overpressure Safety Systems for Cryostat Insulation Vacuum Vessels	Status	2011-04-04

Contents

1. Scope

1) This document defines procedures to be executed for the technical layout and requirements on the engineering design of over pressure safety systems for cryostat insulation vacuum vessels in applications like
   - magnet cryostats,
   - cryogenic supply systems,
   - cryogenic transport systems,
   - cryogenic current lead boxes,
   - auxiliary cryogenic systems

   within FAIR accelerators.
2) This document is NOT related to any other purpose as aforementioned.
3) This document does NOT represent a replacement for any relevant technical standards in terms of 97/23/EC [1] or the AD2000 Code [2].

2. Definitions

1) A *cryostat* in terms of this guideline is a technical system enclosing another technical system to be operated at temperatures far below room temperature (e.g. 4.5K).
2) *Pressure equipment* in terms of this document are devices being identified as such according to the European pressure equipment directive 97/23/EC.
3) C*ryogenic media* in terms of this guideline are liquefied pressurised and non pressurised Helium (LHe) and Nitrogen (LN_2) as well as gaseous Helium (GHe) and gaseous Nitrogen (GN_2).
4) The unit *bara* defines the absolute pressure in bar.

3. Codes and Standards

1) The European pressure equipment directive 97/23/EC defines the legal standards for components and assemblies being identified as pressure equipment.

2) The AD 2000 Code defines the engineering, production and documentation standards in terms of pressure equipment.

4. Necessity of Over Pressure Safety Systems

1) The necessity for the application of an over pressure safety system to a cryostat insulation vacuum vessel, is indicated as far as a device is identified as pressure equipment in terms of 97/23/EC.

4.1. Classification and Risk Analysis

1) The classification procedure in terms of pressure equipment as defined in [5] must be performed for all cryostats, including full interior as planned for operation, especially in case of cryogenic media is part of the interior at any time.
2) In case a cryostat is identified as pressure equipment, a risk analysis must be performed and completely documented as defined in [1], [2] and [4].

5. Design Issues

1) All relevant requirements as defined in [3] must be fulfilled.

5.1. Design Calculation Issues

1) A safety system must limit the maximum pressure inside the cryostat vacuum vessel during any possible operation mode to a maximum pressure of 1,3 bara.
2) The design calculations of the safety system must fulfil at least all definitions of [3].
3) For the maximum mass flow a safety factor of at least 2 must be considered.

5.2. Engineering Design Issues

1) The safety system must be of a self closing type. As soon as over pressure is sufficiently released from the cryostat, the system must close again, preventing atmospheric gas and humidity contaminating the inner cryostat surfaces.
2) The safety system must operate reliable in all possible operation modes.
3) The safety system must not show a juddering effect when activated.
4) When responding, a cool down of the safety system must be considered. Icing must be avoided. When iced, the functionality of the safety system must not be influenced. The vacuum tightness must be guaranteed under iced conditions.
5) When responding, a cold gas stream, released from the safety system must not harm any person close to the cryostat.
6) The valve must show a He - leak tightness of $\leq 5*10^{-9}$ mbar*L*s^{-1} also after closing again when being operated.
7) Any organic material components (e.g. sealing rings) must be replaceable without dismounting the valve from the cryostat.
8) The material choice for the housing of the safety system must be of a stainless steel type as defined as defined in [6] and has to fulfil the requirements of [3].

9) Any blocking (e.g. by objects placed on the valve) of the safety valve must be avoided by adequate constructive measures.

6. Documentation

1) All calculations as defined by [1] and [2] must be documented in detail.
2) All documentation and certificates (except mechanical engineering) shall be transferred into EDMS – documents following the relevant EDMS – guidelines.
3) In case of text, tables, diagrams and pictures the electronic version shall be delivered in the PDF-format without any access restrictions.
4) The mechanical engineering data (CAD-Model) must be delivered as defined in [7].
5) Any certificates shall be delivered as original versions compiled in files and shall be electronically scanned for electronic compilation.

7. Functional Testing

1) The functional Testing is defined in [3].

8. Certification

1) The applied safety system
   - must be classified as such in terms of 97/23/EC,
   - must necessarily fulfil the requirements of 97/23/EC,
   - must be certified with adequate documentation as defined in 97/23/EC and the AD 2000-Code.

9. References

[1] Directive 97/23/EC, European parliament and the council of the European Union, http://eur-lex.europa.eu, 1997
[2] AD 2000-Code; Verband der TÜV e. V.; Beuth Verlag GmbH; Berlin; Germany; 2009.
[3] AD 2000 Technical Bulletin A2: Safety devices against excess pressure - Safety valves, Beuth Verlag GmbH; Berlin; Germany; 2009
[4] Technical Guideline 52.0e: Safety Devices for FAIR Cryogenics
[5] Technical Guideline 8.7e: Classification Procedure for Pressure Loaded Equipment
[6] Technical Guideline 2.32e: Cryostat Vacuum Shell Materials
[7] Terms and Conditions for the Exchange of Mechanical Engineering Data, GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany, 2009