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Determination of the resistance to cryogenic spill of insulation materials —

Part 2: **Vapour exposure**

Détermination de la résistance des matériaux d'isolation thermique suite à un refroidissement cryogénique —

Partie 2: Phase vapeur

Reference number
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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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A list of all parts in the ISO 20088 series can be found on the ISO website.

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Introduction

The test is intended to be, as far as practicable, representative of a potential accidental pressurised release of cryogenic LNG material manufactured in industrial plants. The test includes

a) release from of cryogenic liquid under pressure, and

b) scenarios where the conditions in the jet characterized predominantly by gaseous exposure.

Liquid jet release may be formed upon release of Liquified Natural Gas (LNG) from process equipment operating at pressure, e.g., some liquefaction processes utilise 40 - 60 bar operating pressure. However, at specific distances from the release point, it is expected that the liquid fraction will diminish such that there is practically no effect from liquid cooling in the stream.

This test is designed to give an indication of how cryogenic spill protection materials will perform in a sudden exposure to cryogenic jet where it is expected that little or no liquid fraction is present.

The dimensions of the test specimen might be smaller than typical items of structure and plant. The liquid cryogenic jet mass flow rates can be substantially less than that which might occur in a credible event. However, individual thermal loads imparted to the cryogenic spill protection materials, from the cryogenic release defined in the procedure described in this document, have been shown to be representative of areas exposed to a cryogenic LNG accidental release where little or no liquid is present.

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Determination of the resistance to cryogenic spill of insulation materials —

Part 2:
Vapour exposure

CAUTION — The attention of all persons concerned with managing and carrying out cryogenic spill testing is drawn to the fact that liquid nitrogen testing can be hazardous and that there is a danger of oxygen condensation (risk of explosion), receiving a 'cold burn' and/or the possibility that harmful gases (risk of anoxia) can be evolved during the test. Mechanical and operational hazards can also arise during the construction of the test elements or structures, their testing and disposal of test residues.

An assessment of all potential hazards and risks to health shall be made, and safety precautions shall be identified and provided. Appropriate training and Personal Protection Equipment (PPE) shall be given to relevant personnel.

The test laboratory is responsible for conducting an appropriate risk assessment in order to consider the impact of liquid and gaseous nitrogen exposure to equipment, personnel and the environment.

1 Scope

This document describes a method for determining the resistance of Cryogenic Spill Protection (CSP) systems to vapour generated from a cryogenic liquid release where the liquid content is practically zero. It is applicable where CSP systems are installed on carbon steel.

The test provided in this document is not applicable to high pressure cryogenic liquid releases that can be found in refrigeration circuits and in LNG streams immediately post-liquefaction.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 22899-1, *Determination of the resistance to jet fires of passive fire protection materials — Part 1: General requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

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3.1
cryogenic spill protection
CSP
coating or cladding arrangement, or free-standing system which, in the event of a cryogenic jet release, provides insulation to restrict the heat transfer rate from the substrate

3.2
limiting temperature
minimum temperature that the equipment, assembly or structure that is protected can reach

3.3
nozzle
assembly from which the cryogenic liquid is released as a jet

3.4
sponsor
person or organization who/which requests a test

3.5
specimen owner
person or company that holds or produces a material to test

3.6
cooling power
amount of heat transferred per unit area per unit time from a surface (W/m^2)

4 Test configurations

The test is conducted with the plate specimen placed vertically. The material to be tested is exposed to a liquid nitrogen release under pressure where the liquid fraction is practically zero (i.e. gaseous exposure). Due to safety concerns, the test should only be performed outside unless there are sufficient safeguards implemented to mitigate the confined space and LN_2 (liquid nitrogen) safety risks.

5 Construction of the test apparatus and substrates

5.1 Apparatus

The key items required for the test are the following.

5.1.1 Nozzle and cryogenic liquid feed assembly, where the temperature and pressure of the liquid can be measured at the point the liquid enters the nozzle.

5.1.2 Environmental chamber, (3-sided plastic tunnel) up to a length of 6 m.

5.1.3 Liquid nitrogen, of sufficient volume for the test duration supplied from a tanker capable of offload via a pump to generate the required stable pressure at the nozzle.

5.1.4 Carbon steel specimen, protected with CSP.

5.1.5 Thermocouples, to determine the temperature as a function of time in the steel specimen and the atmosphere immediately in front of the test specimen.

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