INTERNATIONAL STANDARD

ISO 20088-1

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Determination of the resistance to cryogenic spillage of insulation materials —

Part 1: Liquid phase

Détermination de la résistance des matériaux d'isolation thermique suite à un refroidissement cryogénique —
Partie 1: Phase liquide

Reference number
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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 67, *Materials, equipment and offshore structure for petroleum, petrochemical and natural gas industries*, Subcommittee SC 9, *Liquefied natural gas installations and equipment*.

Introduction

The test described in the procedure in this document is one in which some of the properties of cryogenic spillage protection materials can be determined. This test is designed to give an indication of how cryogenic spillage protection materials will perform in a sudden exposure to cryogenic liquid.

The dimensions of the test specimen can be smaller than typical items of structure and plant and the release of liquid can be substantially less than that which might occur in a credible event. However, individual thermal and mechanical loads imparted to the cryogenic spillage protection materials, from the cryogenic spillage defined in the procedure described in this document, have been shown to be similar to those by large-scale cryogenic spillage.

Further parts of ISO 20088 are planned for future publication:

— Part 2 : Vapour phase;

— Part 3: High pressure jet release.

Determination of the resistance to cryogenic spillage of insulation materials —

Part 1: Liquid phase

CAUTION — The attention of all persons concerned with managing and carrying out cryogenic spillage testing is drawn to the fact that liquid nitrogen testing can be hazardous and that there is a danger of 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 shall be given to relevant personnel.

1 Scope

This document describes a method for determining the resistance to liquid cryogenic spillage on cryogenic spillage protection (CSP) systems. It is applicable where CSP systems are installed on carbon steel and will be in contact with cryogenic fluids.

Liquid nitrogen is used as the cryogenic medium since it has a lower boiling point than liquid natural gas or liquid oxygen and it is not flammable. Additionally, it can be safely used for experiment.

Future parts of the standard will cover vapour phase and jet exposure conditions.

The test laboratory is responsible to conduct an appropriate risk assessment according to local regulation in order to consider the impact of liquid and gaseous nitrogen exposure to equipment and personnel.

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 630-1, *Structural steels — Part 1: General technical delivery conditions for hot-rolled products*

ISO 845, *Cellular plastics and rubbers — Determination of apparent density*

ISO 8301, *Thermal insulation — Determination of steady-state thermal resistance and related properties — Heat flow meter apparatus*

ISO 16903, *Petroleum and natural gas industries — Characteristics of LNG, influencing the design, and material selection*

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

EN 10029, *Tolerances on dimensions, shape and mass for hot rolled steel plates 3mm thick or above*

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:

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

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

3.1
floating liquid natural gas
FLNG
floating liquid natural gas facilities such as floating production storage and offloading (LNG-FPSO), floating storage and re-gasification unit (LNG-FSRU)

3.2
cryogenic spill
unintended exposure to cryogenic liquid (CL) at –196°C

3.3
cryogenic spill protection
CSP
coating or cladding arrangement, or free-standing system which, in the event of a cryogenic spill, will provide thermal protection to restrict the heat transfer rate of the substrate

3.4
limiting temperature
minimum temperature that the equipment, assembly or structure to be protected may be allowed to reach

3.5
release point
assembly from which the cryogenic fluid flows out

3.6
sponsor
person or organization who/which requests a test

3.7
specimen owner
person or company that holds/produces a material to test

4 Test configurations

4.1 General

There is one basic configuration under which the test can be conducted. This is a liquid configuration where the material to be tested is rapidly exposed to liquid nitrogen in a pool at a temperature of –196 °C. For reasons of clarity, flexible hoses used for fume extraction are not shown in Figures 1 to 4 below.

4.2 Sample holder

Samples will be tested in a sample holder with exact dimension as specified in ISO 22899-1:2007, Figure 11.

5 Construction of the test items and substrates

5.1 General

The key items required for the test are:

— a liquid nitrogen injection point;

— a sample holder;

— the insulation part.

It is important to reduce vapour generation during the liquid nitrogen dumping. Flexible hoses are to be used without forced ventilation.

5.2 Material

The material normally used is a 10 mm thick steel plate complying with ISO 630-1, Grade Fe 430. An all welded construction shall be used and all welds shall be 5 mm fillet and continuous unless otherwise stated. All dimensions are in millimetres and, unless otherwise stated, the following tolerances shall be used:

— whole number ±1,0 mm;

— decimal to point, 0 mm ± 0,4 mm;

— decimal to point, 00 mm ± 0,2 mm;

— angles 0’ 30”;

— radius 0,4 mm.

5.3 Release tank

The liquid nitrogen is contained within a tank of a constant surface area either a square base of 750 mm or circular base of 846 mm diameter. The release orifice shall be 100 mm in diameter.

When there is 250 l of stable non-bubbling liquid nitrogen within the tank, the test is ready to start. The release tank shall be constructed of cryogenic resistant stainless steel and externally insulated for personnel protection.

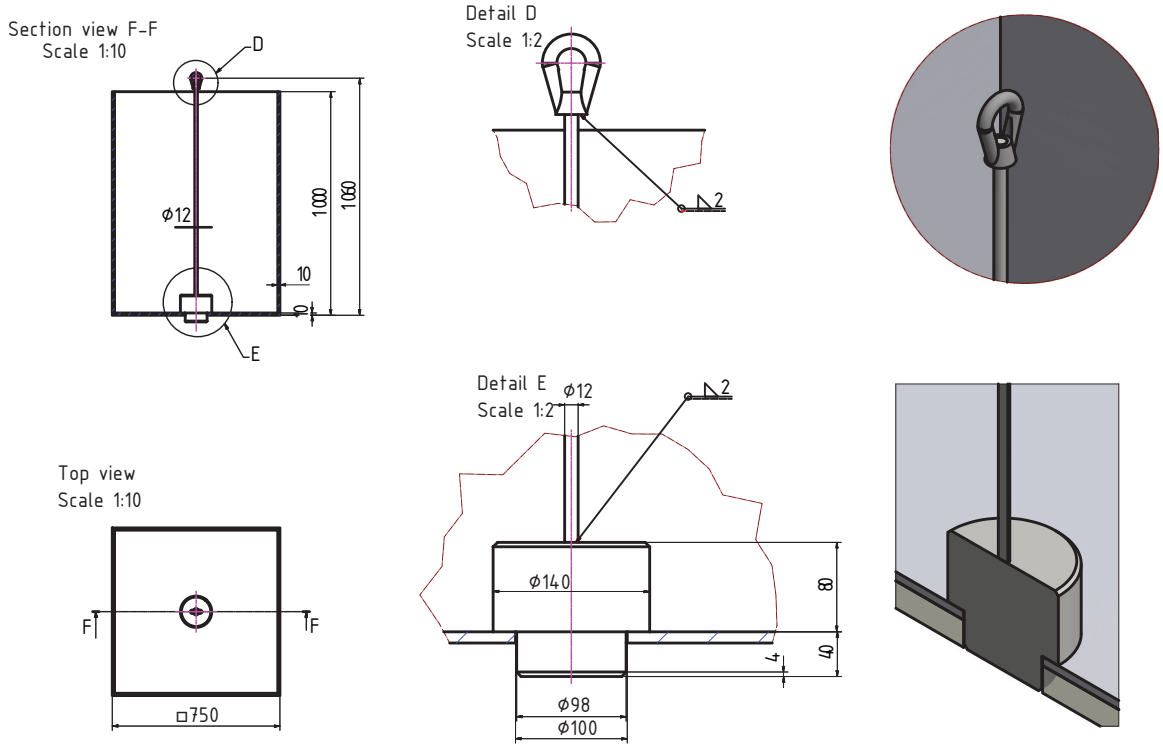

Figure 1 — Layout of a square release tank

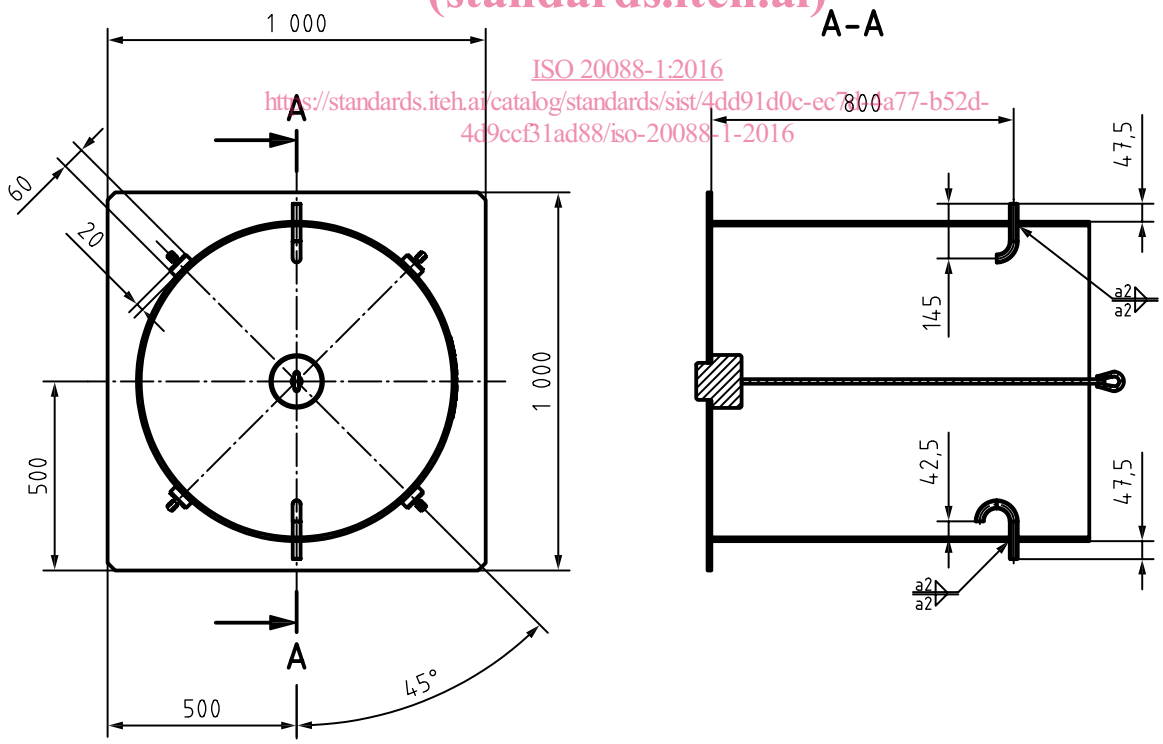

Figure 2 — Layout of a cylindrical release tank

5.4 Specimen support

A square generic support will be used to hold the test sample. It shall be constructed with 10 mm carbon steel. The centre of the table is hollow and will receive the sample holder as shown in Figure 3.

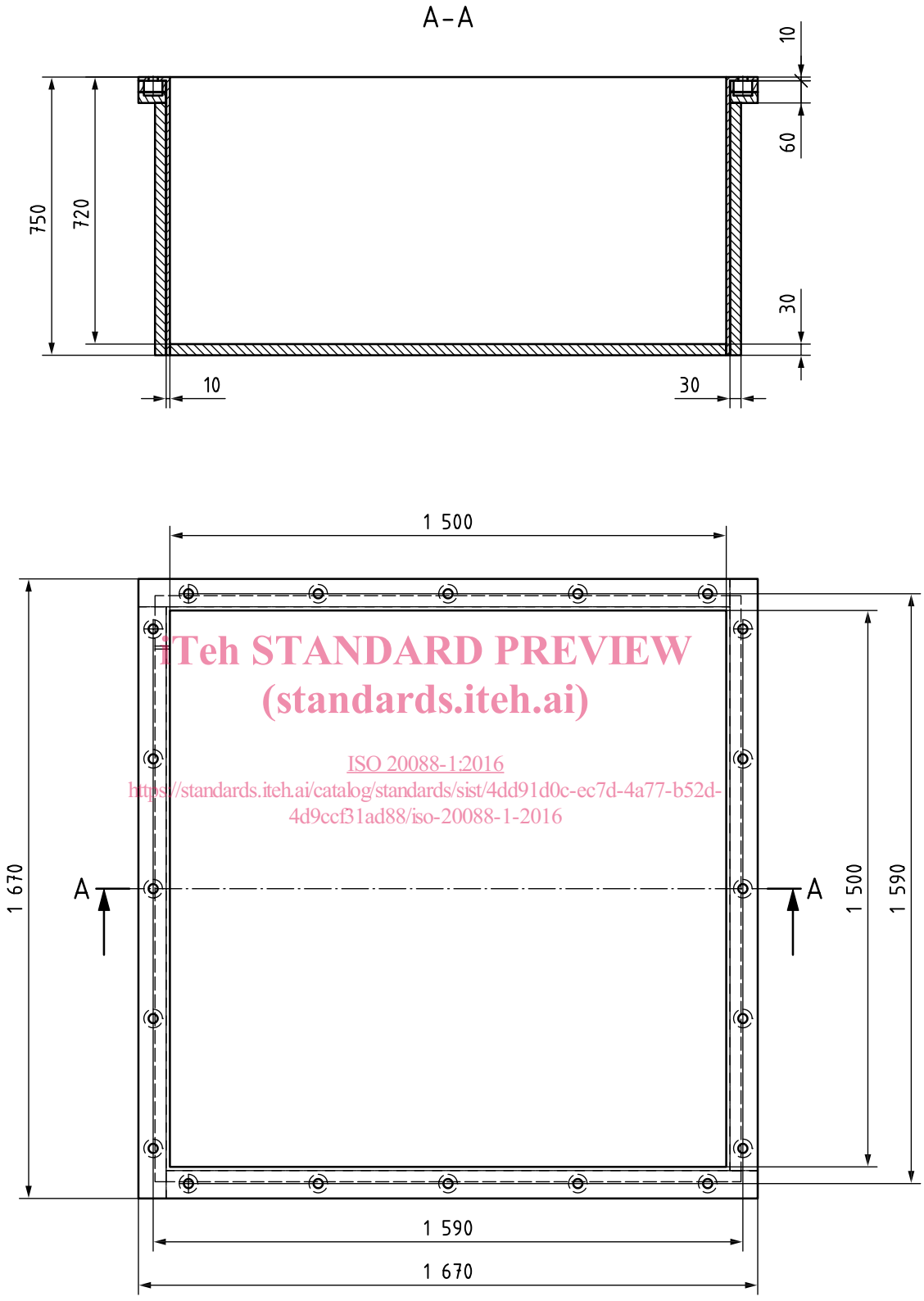

Figure 3 — Specimen support

The support walls and bottom panel are to be permanently insulated with rigid foam boards with a U value of a minimum of 1,25 W/m^2·K. An example material would be polyurethane (PU) foam boards with the following characteristics:

— density: 130 kg/m^3 ± 5 kg/m^3 determined as in accordance with ISO 845;