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BSI Standards Publication

Basic considerations for the safety of hydrogen systems

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National foreword

This Published Document is the UK implementation of ISO/TR 15916:2015.

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TECHNICAL REPORT

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Basic considerations for the safety of hydrogen systems

Considérations fondamentales pour la sécurité des systèmes à l'hydrogène

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 197, *Hydrogen technologies.*

This second edition cancels and replaces the first edition (ISO/TR 15916:2004), which has been technically revised.

Introduction

The focus of this Technical Report is on the relatively new hydrogen energy applications. The intent is to provide, those unfamiliar with the technology, a basis upon which to understand the safety issues. This Technical Report concerns itself with applications that derive their utility from the chemical reactions of hydrogen and does not apply to applications based on nuclear processes.

Traditionally, hydrogen has been used extensively in the petrochemical and chemical industries and in smaller quantities in the electronics, steel-producing, glass-making, and food hydrogenation industries. In energy applications, the first significant use of hydrogen has appeared in space programmes. This is changing, given the promise that hydrogen brings as an efficient energy carrier and a fuel with minimal environmental impact. Systems are being developed that produce hydrogen using variety of energy sources and feedstocks such as sunlight, wind, biomass, hydro power and fossil fuels, for use in energy applications for home and office heating, generation of electricity and transportation.

The safe use of hydrogen as a fuel is a primary ISO goal as it seeks to facilitate the rapid emergence of these hydrogen technologies. A key element in the safe use of hydrogen is to understand its unique safety-related properties and related phenomena, and that there are acceptable engineering approaches to controlling the hazards and risks associated with the use of hydrogen. This Technical Report describes the hazards associated with the use and presence of hydrogen, discusses the properties of hydrogen relevant to safety, and provides a general discussion of approaches taken to mitigate hydrogen hazards. The aim of this Technical Report is to promote the acceptance of hydrogen technologies by providing key information to regulators and by educating people involved with hydrogen safety issues.

The development of International Standards to eliminate barriers to international trade and to simplify the arduous regulatory process by providing hydrogen-specific standards to allow implementation for rapidly emerging technologies was among the needs identified by the ISO/TC 197. This Technical Report is one of many documents that have been developed, or are in the process of being developed, by ISO. Detailed safety requirements associated with specific hydrogen applications are treated in separate International Standards. This Technical Report provides an informative reference for those separate standards as a common, consistent source of safety-related hydrogen information. This should result in a reduction in duplication and possible inconsistencies in these separate standards.

The considerations presented in this Technical Report are broad, general, and attempt to address most aspects of hydrogen safety. The degree to which these guidelines are applied will vary according to the specifics of the application (such as the conditions and quantity of hydrogen involved, and the way in which the hydrogen is used). Industrial users may find large portions of the guidelines, presented herein, applicable for their operations. It is not expected that the general public will be required to apply this degree of knowledge to safely operate a hydrogen appliance. It is anticipated that good appliance design, coupled with appropriate care in installation, will reduce the degree of safety considerations to levels that are deemed acceptable by the public for common appliances. The manufacturers of hydrogen appliances will need to consider these guidelines to tailor sufficient specific information for the operation of their appliances, in the environment in which they are to be used, and for the audience that will use them. Readers are encouraged to keep these points in mind as they consider the information presented in this Technical Report. Hydrogen has been safely used in many different applications over many years. Adherence to the principles presented in this Technical Report can lead to a continuation of the safe and sustainable use of hydrogen.

Basic considerations for the safety of hydrogen systems

1 Scope

This Technical Report provides guidelines for the use of hydrogen in its gaseous and liquid forms as well as its storage in either of these or other forms (hydrides). It identifies the basic safety concerns, hazards and risks, and describes the properties of hydrogen that are relevant to safety. Detailed safety requirements associated with specific hydrogen applications are treated in separate International Standards.

“Hydrogen” in this paper means normal hydrogen ($^1H_2$), not deuterium ($^2H_2$) or tritium ($^3H_2$).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11114-4, *Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 4: Test methods for selecting metallic materials resistant to hydrogen embrittlement*

ISO 11119 (all parts), *Gas cylinders — Refillable composite gas cylinders and tubes — Design, construction and testing*

ISO 14687 (all parts), *Hydrogen fuel — Product specification*

ISO 16110 (all parts), *Hydrogen generators using fuel processing technologies*

ISO 16111, *Transportable gas storage devices — Hydrogen absorbed in reversible metal hydride*

ISO 17268, *Gaseous hydrogen land vehicle refuelling connection devices*

ISO 19880-1[1)], *Gaseous hydrogen — Fueling stations — Part 1: General requirements*

ISO 19881[2)], *Gaseous hydrogen — Land and vehicle fuel tanks*

ISO 19884[3)], *Gaseous hydrogen — Cylinders and tubes for stationary storage*

ISO 22734 (all parts), *Hydrogen generators using water electrolysis process*

ISO 26142, *Hydrogen detection apparatus — Stationary applications*

3 Terms and definitions

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

3.1
ambient conditions
AIT
local surrounding conditions characterized by the temperature and pressure at a particular location, such as a city or facility

Note 1 to entry: See *normal temperature and pressure* (3.71).

1) Under development.

2) Under development.

3) Under development.