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Gas cylinders — Guidance for design of composite cylinders

Part 2: Bonfire test issues

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National foreword

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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).

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

This document was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 3, *Cylinder design*.

Introduction

Composite reinforced cylinders have been used in commercial service for about 40 years. Common fibres used in composite cylinders include glass, aramid, and carbon. Resin matrix materials are commonly epoxy or vinyl ester.

Composite cylinders are known to be exposed to the action of fire, ranging from radiant heating to full engulfment in the fire. Cylinder performance during exposure to fire might depend on the cylinder materials of construction, size of the fire, dimensions of the cylinder, its orientation, its contents, and the use of temperature or pressure activated relief devices.

Fire exposure tests are often included in composite cylinder standards, sometimes as a mandatory test and sometimes as an optional test. This document addresses issues related to composite cylinders exposed to fire, summarizes test requirements, and offers a new approach to qualifying cylinders with relief devices.

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TECHNICAL REPORT **ISO/TR 13086-2:2017(E)**

Gas cylinders — Guidance for design of composite cylinders —

Part 2: Bonfire test issues

1 Scope

This document addresses the topic of safety and performance of composite cylinders in a fire situation. A statement of safety addresses the topics which should be understood in order to operate cylinders safely in service. The remainder of this document provides a basic level of understanding of these topics.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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 https://www.iso.org/obp

4 Background

Composite cylinders began service in the 1950s, initially as rocket motor cases with glass fibre reinforcement. This led shortly to glass fibre pressure vessels with rubber liners, and then to glass fibre pressure vessels with metal liners. Metal liners were typically either aluminium or steel. Eventually, new structural fibres, such as aramid and carbon, came into use for reinforcing pressure vessels. Today, typical reinforcements are glass and carbon, either individually or together as a hybrid. Typical liner materials are steel, aluminium, or polymers, often high density polyethylene (HDPE) or a polyamide (PA).

Composite cylinders offer certain advantages, particularly light weight and corrosion resistance. However, there are some performance requirements that tax the abilities of composite cylinders. One of these is the ability to withstand exposure to fire conditions without rupture. Fire conditions might include both direct exposure to fire, and to the elevated temperatures resulting from a fire. Direct exposure might include localized flames, or an engulfing fire.

Sources for a fire could include discharge of flammable gases from nearby cylinders, spilled liquid fuel from motor vehicles, car fires, house or building fires, and grass or forest fires, to name a few. There is significant variation in the fire conditions that arise from each of these causes, and there are issues on reproducibility of any of these types of fires.

Composite cylinders might be able to withstand a certain level of fire exposure on their own. However, it is more common in certain applications to use a system approach that could include isolation from fire, insulation, pressure activated relief valves or devices, and/or thermally activated relief devices. However, there might be conditions where the risk of rupture is less than the risk and consequence of leakage, and a pressure relief device (PRD) or similar device would not be used. Individual cylinders

