TECHNICAL REPORT

ISO/TR 13086-5

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Gas cylinders — Information for design of composite cylinders —

Part 5: Impact testing of composite cylinders

Bouteilles à gaz — Informations relatives à la conception des bouteilles en matière composite —

Partie 5: Essais d'impact sur bouteilles en matière composite

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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 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.

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

A list of all parts in the ISO/TR 13086 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document considers how impact testing is carried out, why it is done in particular ways and the relevance of various aspects (e.g. a cylinder drop, a flying element through the air, from what direction, size, shape, weight, impact velocity, etc.; does the cylinder "fail" safe or blow into fragments with associated pressure wave?).

This document only addresses cylinders, as a definition of all the associated equipment and its interaction with the cylinders is difficult to assess. The designer can conduct some system level impact tests, including drop, to assess valves, pressure release devices and other attached components.

It is recognized that there are differences between cylinders/tubes that are for general use (without any requirements related to packaging and protection in service) and cylinders/tubes permanently mounted in frames (which offer some differences in loading and protection). Impact testing of an assembly can be different from testing a single, freestanding cylinder/tube.

This document addresses transportable cylinders, vehicle fuel containers and cylinders permanently mounted in frames. It applies to all sizes of cylinders, and to carbon, aramid and glass fibre reinforcements.

Drop testing of smaller cylinders is a requirement in some regulations, codes and standards. For serial production of automotive cylinders, an adequate returnable packing material/method to protect the cylinder during production and until mounted in the vehicle can be used. However, the drop of a cylinder demonstrates a general resistance to impact, which improves safety.

In addition to providing an understanding of the background, an overview is provided of some standard approaches to conducting tests.

Gas cylinders — Information for design of composite cylinders —

Part 5: Impact testing of composite cylinders

1 Scope

This document provides information for the design of composite cylinders related to impact testing and service experience with impact, including:

— low energy impact, which can result from events that can occur during handling or working around cylinders;

— high energy impact, which can result from accidents during transportation, or impact by large objects with velocity;

— drop impact, which can result from handling, where cylinders are dropped or tipped over; and

— high velocity impact, which can result from high energy impact by a small object, such as gunfire, and demonstrates non-shatterability of the cylinder or tube.

Where appropriate, field experience relevant to testing requirements is provided.

NOTE Unless otherwise stated, the word "cylinder" refers to both cylinders and tubes.

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 10286, *Gas cylinders — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10286 apply.

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

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

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

4 Low energy impact

4.1 General

Low energy impacts can occur during normal service. Examples of this include dropping tools on the cylinder, being hit by road debris, some bouncing when initiating or ending a lift by a crane, hoist, or forklift, being hit by a forklift, or similar incidents. In some cases, low energy impact can leave visual evidence of the impact or can require a cylinder to be removed from service.