TECHNICAL REPORT

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Gas cylinders — Methods for establishing acceptance/rejection criteria for flaws in seamless steel and aluminium alloy cylinders at time of periodic inspection and testing

Bouteilles à gaz — Méthodes d'établissement des critères d'acceptation/de rejet des défauts dans les bouteilles en acier et en alliages d'aluminium, sans soudure, lors des contrôles et essais périodiques

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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.

ISO/TR 22694 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 4, *Operational requirements for gas cylinders*.

Introduction

Seamless steel cylinders and seamless aluminium-alloy cylinders used to transport high pressure gases are required to meet safety requirements based on ISO standards and the requirements of national authorities. These requirements cover the design, materials, manufacturing, initial inspection and testing, and periodic inspection and testing of the cylinders. As part of these requirements, the cylinders need to be periodically inspected and tested at regular intervals during their lifetime.

Periodic inspection and testing has traditionally been performed by a combination of visual inspection (internal and external) and hydrostatic pressure testing (sometimes including volumetric expansion measurements during pressurization). Using these traditional methods of retesting, the cylinders are rejected due to excessive volumetric expansion, excessively large surface flaws detected by visual examination, leaking or bursting. The maximum allowable size of surface flaws to cause rejection of the cylinders was essentially qualitative and was established from past service experience. None of the rejection criteria were based on quantitative assessment of the cylinder's performance or mechanical characteristics.

However, recently, methods of periodic inspection and testing the cylinders using ultrasonic inspection have been developed. These new retesting methods permit the quantitative determination of the cylinder wall thickness and the size of the flaws that are present in the cylinders. The ISO standards for periodic inspection and the requirements of certain national authorities permit the use of ultrasonic test methods for retesting seamless steel and aluminium-alloy cylinders. These ultrasonic test methods permit the quantitative determination of the size of any flaws that are detected in the cylinders. However, to use the ultrasonic test methods, it is required that quantitative "allowable flaw sizes" be established to set acceptance/rejection limits for the cylinders at the time of periodic inspection and testing.

NOTE The main conclusions and acceptance/rejection criteria are based on those provided by the United States Department of Transportation (DOT-designed cylinders) that have a working pressure to test-pressure ratio of 3:5. Application to ISO-designed cylinders, which use a working pressure to test-pressure ratio of 2:3, needs a further calculation.

Gas cylinders — Methods for establishing acceptance/rejection criteria for flaws in seamless steel and aluminium alloy cylinders at time of periodic inspection and testing

1 Scope

The aim of this Technical Report is to establish a technical basis for developing quantitative, allowable flaw sizes and for setting acceptance/rejection limits for cylinders at the time of periodic inspection and testing based on the performance and mechanical properties of the cylinders.

2 Normative references

The following referenced documents are indispensable for the application 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.

API RP 579, *Recommended Practice for Fitness-for-Service*

3 Terms and definitions

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

3.1
allowable flaw size
largest flaw that will not grow to the critical flaw size during the periodic inspection and testing interval of the cylinder

3.2
burst
opening of the cylinder due to the internal pressure with substantial extension of the flaw

3.3
cluster of pits
small, approximately round, flaws that are close together in a limited area

3.4
corrosion
general loss of wall thickness of either the interior or exterior surface of the cylinder, or localized corrosion which may form a narrow longitudinal or circumferential line or strip, or isolated craters or pits that are almost connected in a line

3.5
crack
split in the metal