PD ISO/TS 19016:2019

BSI Standards Publication

Gas cylinders — Cylinders and tubes of composite construction — Modal acoustic emission (MAE) testing for periodic inspection and testing

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National foreword

This Published Document is the UK implementation of ISO/TS 19016:2019.

The UK participation in its preparation was entrusted to Technical Committee PVE/3/7, Gas containers - Gas cylinder (receptacle) operations.

A list of organizations represented on this committee can be obtained on request to its secretary.

Attention is drawn to the fact that during the development of this Technical Specification, the UK committee voted against its approval as a Published Document.

There was disapproval from UK committee members on the Technical Specification in its present form. The reason for this is the inadequate description of the test protocols, which might prevent users from performing testing satisfactorily. It is recommended that users of this Published Document seek appropriate competent technical advice on such testing.

The UK committee supports the development of new technologies for the inspection of composite cylinders. The aim of this Technical Specification is to encourage users to implement this new technology and hence gain experience. If positive results are achieved, this Technical Specification may be converted into an international standard in the future. Hence, all users are requested to inform the secretary of PVE/3 of their experiences of using this Technical Specification.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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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 4, *Operational requirements for gas cylinders*.

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

In recent years, new non-destructive examination (NDE) techniques have been successfully introduced as an alternative to the conventional retesting procedures of gas cylinders, tubes and other cylinders.

One of the alternative NDE methods for certain applications is acoustic emission testing (AT), which in several countries has proved to be an acceptable testing method applied during periodic inspection. This AT method is described in ISO 16148, which authorizes pressurization pneumatically to a value equal to 110 % of the cylinder's working pressure and hydraulic pressurization to a value equal to the cylinder's test pressure. Since ISO 16148 was developed for periodic inspection and testing of monolithic materials (seamless steel and aluminium-alloy cylinders), the test method was not appropriate for composite cylinders. The modal acoustic emission (MAE) test method described in this document was developed to address this shortcoming.

The MAE test method described in this document applies during periodic inspection and testing, and it uses either hydraulic (liquid) pressurization or pneumatic (gas) pressurization to a level equal to the design test pressure of the cylinder. It detects structural damage that can result in a compromised burst pressure strength in a composite cylinder. The MAE waveforms can be used to identify damage such as fibre breakage and delamination. An MAE waveform is distinguished by the wave (mode) shapes, velocities, waveform energy and frequency spectrums. This MAE test method is not intended for newly manufactured composite cylinders.

The application of MAE testing on composite overwrapped gas cylinders with metallic and polymer liners was applied to a sample of composite cylinders [180 self-contained breathing apparatus (SCBA) cylinders selected from 50 000] that were near the end of their 15 year service life. The MAE testing was performed during physical testing, which was similar to design qualification testing for this type of composite cylinder. The physical testing included pressure cycling, burst testing, flaw tolerance testing and ISO 11119-2 drop testing. The MAE testing consistently detected and differentiated each cylinder that had a compromised burst pressure strength, which had been defined for this project to be a pressure less than the original design burst pressure of the cylinder, by the presence of background energy oscillation (BEO) at or near the test pressure.

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CAUTION — Some of the tests specified in this document involve the use of processes (e.g. pneumatic pressurization) which could lead to a hazardous situation.

1 Scope

This document describes the use of modal acoustic emission (MAE) testing during periodic inspection and testing of hoop wrapped and fully wrapped composite transportable gas cylinders and tubes, with aluminium-alloy, steel or non-metallic liners or of linerless construction, intended for compressed and liquefied gases under pressure.

This document addresses the periodic inspection and testing of composite cylinders constructed to ISO 11119-1, ISO 11119-2, ISO 11119-3, ISO 11515 and ISO/TS 17519 and can be applied to other composite cylinders designed to comparable standards when authorized by the competent authority.

Unless noted by exception, the use of "cylinder" in this document 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 9712, *Non-destructive testing — Qualification and certification of NDT personnel*

ISO 11623, *Gas cylinders — Composite construction — Periodic inspection and testing*

ASTM E1106-12, *Standard Test Method for Primary Calibration of Acoustic Emission Sensor*

3 Terms, definitions and symbols

3.1 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