



BSI Standards Publication

**Gas cylinders — Refillable permanently  
mounted composite tubes for transportation**

---

## National foreword

This Published Document is the UK implementation of ISO/TS 17519:2019.

The UK participation in its preparation was entrusted to Technical Committee PVE/3/3, Transportable Gas Containers - Cylinder Design, Construction and Testing at the Time of Manufacture.

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

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

© The British Standards Institution 2019  
Published by BSI Standards Limited 2019

ISBN 978 0 539 04211 5

ICS 23.020.35

**Compliance with a British Standard cannot confer immunity from legal obligations.**

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 June 2019.

### Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

---

TECHNICAL  
SPECIFICATION

**ISO/TS**  
**17519**

First edition  
2019-06

---

---

**Gas cylinders — Refillable  
permanently mounted composite  
tubes for transportation**

*Bouteilles à gaz — Tubes composites rechargeables montés de façon  
permanente pour le transport*



Reference number  
ISO/TS 17519:2019(E)



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2019

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Fax: +41 22 749 09 47  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

Page

<b>Foreword</b> .....	<b>v</b>
<b>Introduction</b> .....	<b>vi</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>2</b>
<b>4 Basis for the design requirements</b> .....	<b>4</b>
4.1 General.....	4
4.2 Design life.....	4
4.3 Design number of filling cycles.....	4
4.4 Temperature range.....	4
4.4.1 Gas temperature.....	4
4.4.2 Tube material temperature.....	4
4.5 Gas compatibility.....	5
4.6 Prohibited gases.....	5
4.7 External environment.....	5
<b>5 Conformity</b> .....	<b>5</b>
5.1 General.....	5
5.2 Design documentation.....	5
5.2.1 General.....	5
5.2.2 Tube design verification.....	5
5.2.3 Statement of design intent.....	6
5.2.4 Fire protection.....	8
5.2.5 Tube specification sheet.....	8
5.3 Type approval.....	8
5.4 Assembly documentation.....	8
<b>6 Tube requirements</b> .....	<b>8</b>
6.1 Failure modes.....	8
6.2 Materials.....	8
6.2.1 Liner materials.....	8
6.2.2 Composite materials.....	9
6.2.3 Metal end-fittings.....	9
6.3 Design requirements.....	9
6.3.1 Test pressure.....	9
6.3.2 Burst pressure and fibre stress ratios.....	9
6.3.3 Stress analysis.....	10
6.3.4 Openings.....	10
6.3.5 Fire protection.....	10
6.3.6 Flammable gas permeation.....	11
6.4 Construction and workmanship.....	11
6.4.1 General.....	11
6.4.2 Liner and boss requirements.....	11
6.4.3 Fibre winding.....	11
6.4.4 Curing of resins.....	11
6.4.5 Neck threads.....	11
6.4.6 Autofrettage.....	11
6.4.7 Exterior environmental protection.....	12
6.5 Type approval procedure.....	12
6.5.1 General.....	12
6.5.2 Prototype tests.....	12
6.5.3 Change of design.....	16
6.6 Batch tests.....	21
6.6.1 General requirements.....	21

6.6.2	Required inspection and tests.....	21
6.7	Production tests and examinations.....	22
6.8	Batch acceptance certificate.....	22
6.9	Failure to meet test requirements.....	22
<b>7</b>	<b>Marking.....</b>	<b>23</b>
7.1	General.....	23
7.2	Additional marking.....	23
7.2.1	General.....	23
7.2.2	Positioning of additional markings.....	24
7.2.3	Letter size.....	24
<b>8</b>	<b>Preparation for dispatch.....</b>	<b>24</b>
<b>9</b>	<b>Requirements for frames, mounting and fitting.....</b>	<b>24</b>
9.1	General.....	24
9.2	Frame materials.....	24
9.3	Interchangeable frames for intermodal service.....	24
9.4	Mounting frames for compressed gas service (non-intermodal).....	25
9.5	Mounting frame testing.....	25
9.6	Mounting frames static loads.....	25
9.7	Piping, valves, fittings and manifold components.....	26
9.8	Change of design.....	26
<b>Annex A (normative) Test methods and criteria.....</b>		<b>28</b>
<b>Annex B (informative) Report forms.....</b>		<b>39</b>
<b>Annex C (informative) Verification of stress ratios using strain gauges.....</b>		<b>43</b>
<b>Annex D (informative) Manufacturer's instructions for handling, use and inspection of tubes.....</b>		<b>44</b>
<b>Annex E (informative) Factor of safety (FS) for carbon fibre reinforced pressure tubes.....</b>		<b>46</b>
<b>Annex F (informative) Background regarding safety when transporting gas at high pressure in large tubes made of composite material.....</b>		<b>49</b>
<b>Bibliography.....</b>		<b>51</b>

## 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](http://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](http://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](http://www.iso.org/iso/foreword.html).

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

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](http://www.iso.org/members.html).

## Introduction

This document provides a specification for the design, manufacture and initial inspection and testing of composite tubes permanently mounted in a transport frame for worldwide usage. Current standards, such as ISO 11515 and ISO 11119, do not address the interaction between the tubes and the transport frame.

This document aims to eliminate existing concerns about duplicate inspection and restrictions because of the lack of International Standards and should not be construed as reflecting on the suitability of the practice of any nation or region.

This document has been written so that it is suitable to be referenced in the UN Model Regulations<sup>[6]</sup>.

This document addresses tubes of larger volume than previous documents.

This document is not applicable to on-board fuel cylinders in natural gas vehicles.

[Annexes B](#) to [F](#) are informative. [Annex A](#) is normative.

# Gas cylinders — Refillable permanently mounted composite tubes for transportation

## 1 Scope

This document specifies the minimum requirements for the material, design construction and workmanship, manufacturing processes, examination and testing at time of manufacture of an assembly of permanently mounted composite tube(s) in a frame with associated component.

Tubes covered by the requirements of this document are:

- a) of composite construction, permanently mounted in a transport frame and suitable for specified service conditions, designated as:
  - 1) Type 3 — a fully wrapped tube with a seamless metallic liner and composite reinforcement on both the cylindrical part and the dome ends; or
  - 2) Type 4 — a fully wrapped tube with a non-load sharing liner and composite reinforcement on both the cylindrical part and the dome ends.
- b) with water capacities from 450 l up to and including 10 000 l
- c) containing compressed gases but excluding:
  - 1) liquefied gases,
  - 2) dissolved gases, and
  - 3) gases and gas mixtures which are classified for transport as toxic or oxidizing;
- d) with working pressure up to 1 000 bar.

This document does not address tubes with working pressure times water capacity ( $p \times V$ ) more than 3 000 000 bar·l.

## 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 306, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST)*

ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

ISO 1496-3:1995, *Series 1 freight containers — Specification and testing — Part 3: Tank containers for liquids, gases and pressurized dry bulk*

ISO 2808, *Paints and varnishes — Determination of film thickness*

ISO 4624, *Paints and varnishes — Pull-off test for adhesion*

ISO 7866:2012, *Gas cylinders — Refillable seamless aluminium alloy gas cylinders — Design, construction and testing*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*