
**Gas cylinders — Design, construction
and testing of refillable composite gas
cylinders and tubes —**

Part 3:
**Fully wrapped fibre reinforced
composite gas cylinders and tubes
up to 450 l with non-load-sharing
metallic or non-metallic liners or
without liners**

*Bouteilles à gaz — Conception, construction et essais des tubes et
bouteilles à gaz rechargeables en matériau composite —*

*Partie 3: Tubes et bouteilles à gaz entièrement bobinés en matériau
composite renforcés de fibres d'une contenance allant jusqu'à 450 l avec
liners non métalliques ou métalliques non structuraux, ou sans liners*





COPYRIGHT PROTECTED DOCUMENT

© ISO 2020

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
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

	Page
Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Symbols	4
5 Inspection and testing	4
6 Materials	4
6.1 Liner materials.....	4
6.2 Composite materials.....	5
7 Design and manufacture	5
7.1 General.....	5
7.2 Design submission.....	6
7.3 Manufacturing.....	8
8 Type approval procedure	8
8.1 General requirements.....	8
8.2 Prototype tests.....	8
8.3 New design.....	9
8.4 Design variants.....	10
8.5 Type approval test procedures and criteria.....	14
8.5.1 Proof pressure test.....	14
8.5.2 Hydraulic elastic expansion test.....	14
8.5.3 Cylinder burst test.....	15
8.5.4 Ambient cycle test.....	15
8.5.5 Vacuum test.....	17
8.5.6 Environmental cycle test.....	18
8.5.7 Environmentally assisted stress rupture test.....	19
8.5.8 Flaw test.....	19
8.5.9 Drop/impact test.....	21
8.5.10 High velocity impact (gunfire) test.....	24
8.5.11 Fire resistance test.....	25
8.5.12 Permeability test.....	27
8.5.13 Torque test on cylinder neck boss.....	28
8.5.14 Salt water immersion test.....	28
8.5.15 Leak test.....	29
8.5.16 Pneumatic cycle test.....	29
8.5.17 Liner burst test.....	30
8.5.18 Resin shear strength.....	31
8.5.19 Glass transition temperature.....	31
8.6 Failure of type approval tests.....	31
9 Batch inspection and testing	31
9.1 Liner.....	31
9.2 Failure of liner batch tests.....	32
9.3 Overwrap materials.....	32
9.4 Composite cylinder.....	32
9.5 Cylinder failure during type approval or batch testing.....	34
10 Cylinder marking	34
10.1 General.....	34
10.2 Additional marking.....	34
Annex A (informative) Examples of design approval certificate	36

Annex B (informative) Specimen test reports	37
Annex C (informative) Test report for equivalency	40
Annex D (informative) Standardized test requirements for thermally activated pressure relief devices	42
Bibliography	47

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*.

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.

This third edition cancels and replaces the second edition (ISO 11119-3:2013), which has been technically revised. The main changes compared to the previous edition are as follows:

- References updated.
- [7.1.4](#) Minimum fibre stress ratios added.
- [8.5.9](#) Drop/impact test. Addition of new alternative test for cylinders up to and including 50 l water capacity with dedicated compressed gas service. Addition of alternative impact test for tubes 150 l and above.
- [8.5.11](#) Fire resistance test. Changes to the procedure to make the test more consistent. Adding a criteria for tubes above 150 l to be tested for 5 min.
- [8.5.12](#) Torque test is now only required for taper threads.
- References updated
- [8.5.16](#) Pneumatic cycle test. New procedure for the test to have a lower number of cycles but, with a significant hold time at pressure.

A list of all parts in the ISO 11119 series can be found on the ISO website.

Introduction

The purpose of this document is to provide a specification for the design, manufacture, inspection and testing of cylinders for world-wide usage. The objective is to balance design and economic efficiency against international acceptance and universal utility.

This document aims to eliminate the concern about climate, duplicate inspection and restrictions currently existing because of lack of definitive International Standards and is not to 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^[1].

This document addresses the general requirements on design, construction and initial inspection and testing of pressure receptacles of the *Recommendations on the transport of dangerous goods: Model regulations* developed by the United Nations^[2].

Gas cylinders — Design, construction and testing of refillable composite gas cylinders and tubes —

Part 3:

Fully wrapped fibre reinforced composite gas cylinders and tubes up to 450 l with non-load-sharing metallic or non-metallic liners or without liners

1 Scope

This document specifies minimum requirements for the material, design, construction and workmanship, manufacturing processes, examination and testing at time of manufacture for:

- type 4 composite fully wrapped cylinders or tubes with a non-load sharing liner and composite reinforcement on both the cylindrical portion and the dome ends;
- type 5 fully wrapped cylinders or tubes without liners and with a test pressure of less than 60 bar and composite reinforcement on both the cylindrical portion and the dome ends;
- water capacities up to 450 l;
- for the storage and conveyance of compressed or liquefied gases;
- cylinders and tubes with composite reinforcement of carbon fibre, aramid fibre or glass fibre (or a mixture thereof) within a matrix;
- a minimum design life of 15 years.

Cylinders and tubes manufactured and tested according to this document are not intended to contain toxic, oxidizing or corrosive gases.

This document does not address the design, fitting and performance of removable protective sleeves.

NOTE 1 References to cylinders in this document include composite tubes if appropriate.

NOTE 2 ISO 11439 applies to cylinders intended for use as fuel containers on natural gas vehicles and ISO 11623 covers periodic inspection and re-testing of composite cylinders.

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 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*

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

ISO 3341, *Textile glass — Yarns — Determination of breaking force and breaking elongation*

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method*