INTERNATIONAL STANDARD

**ISO 11114-1**

Third edition
2020-05

# Gas cylinders — Compatibility of cylinder and valve materials with gas contents —

## Part 1: **Metallic materials**

*Bouteilles à gaz — Compatibilité des matériaux des bouteilles et des robinets avec les contenus gazeux —*

*Partie 1: Matériaux métalliques*

Reference number
ISO 11114-1:2020(E)

© ISO 2020



## 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
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

# Contents

Page

**Foreword** ... **iv**
**Introduction** ... **v**
**1 Scope** ... **1**
**2 Normative references** ... **1**
**3 Terms and definitions** ... **1**
**4 Materials** ... **2**
4.1 General ... 2
4.2 Cylinder materials ... 2
4.3 Valve materials ... 3
4.3.1 General ... 3
4.3.2 Particular considerations ... 3
**5 Compatibility criteria** ... **3**
5.1 General ... 3
5.2 Corrosion ... 4
5.2.1 General ... 4
5.2.2 Corrosion in dry conditions ... 4
5.2.3 Corrosion in wet conditions ... 4
5.2.4 Corrosion by impurities ... 4
5.3 Hydrogen embrittlement phenomenon ... 5
5.4 Generation of dangerous products ... 5
5.5 Violent reactions (e.g. ignition) ... 5
5.6 Stress corrosion cracking ... 5
**6 Material compatibility** ... **5**
6.1 Table of compatibility for single gases ... 5
6.2 Compatibility for gas mixtures ... 5
6.3 Using Table 1 ... 6
6.3.1 Conventions and numbers ... 6
6.3.2 Abbreviations for materials ... 6
**Annex A** (informative) **Gas/materials NQSAB compatibility code** ... **37**
**Bibliography** ... **48**

© ISO 2020 – All rights reserved

# 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*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 23, *Transportable gas cylinders*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 11114-1:2012), which has been technically revised. It also incorporates the Amendment ISO 11114-1:2012/Amd.1:2017. The main changes compared to the previous edition are as follows:

— inclusion of all changes in ISO 11114-1:2012/Amd.1:2017;

— clarification of the definition of dry;

— addition of notes in Table 1.

A list of all parts in the ISO 11114 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.


© ISO 2020 – All rights reserved

# Introduction

Industrial, medical and special gases (e.g. high-purity gases, calibration gases) can be transported or stored in gas cylinders. An essential requirement of the material from which such gas cylinders and their valves are manufactured is compatibility with the gas content.

Compatibility of cylinder materials with gas content has been established over many years by practical application and experience. Existing national and international regulations and standards do not fully cover this aspect.

This document is based on current international experience and knowledge.

This document has been written so that it is suitable to be referenced in the UN Model Regulations[1].

© ISO 2020 – All rights reserved

# Gas cylinders — Compatibility of cylinder and valve materials with gas contents —

# Part 1: Metallic materials

## 1 Scope

This document provides requirements for the selection of safe combinations of metallic cylinder and valve materials and cylinder gas content.

The compatibility data given is related to single gases and to gas mixtures.

Seamless metallic, welded metallic and composite gas cylinders and their valves, used to contain compressed, liquefied and dissolved gases are considered.

NOTE In this document the term "cylinder" refers to transportable pressure receptacles, which also include tubes and pressure drums.

Aspects such as the quality of delivered gas product are not considered.

## 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 10156, *Gas cylinders — Gases and gas mixtures — Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets*

ISO 10286, *Gas cylinders — Terminology*

ISO 10297, *Gas cylinders — Cylinder valves — Specification and type testing*

ISO 11114-2, *Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 2: Non-metallic materials*

ISO 11114-3, *Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 3: Autogenous ignition test for non-metallic materials in oxygen atmosphere*

## 3 Terms and definitions

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

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

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

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

**3.1**
**competent person**
person who has the necessary technical knowledge, experience and authority to assess and approve materials for use with gases and to define any special conditions of use that are necessary

© ISO 2020 – All rights reserved

**3.2**
**acceptable**
**A**
material/gas combination that is safe under normal conditions of use, provided that any indicated non-compatibility risks are taken into account

Note 1 to entry: Low levels of impurities can affect the acceptability of some single gases or gas mixtures.

**3.3**
**not acceptable**
**N**
material/single gas combination that is not safe under all normal conditions of use

Note 1 to entry: For gas mixtures special conditions may apply (see 6.2 and Table 1).

**3.4**
**dry**
state in which there is no free water in a cylinder under any service conditions, including at the highest expected operating pressure and at the lowest expected operating temperature

Note 1 to entry: For compressed gases at, for example, 200 bar and –20 °C, the maximum moisture content is not to exceed 5 ppmV, to avoid condensation of free water. For other temperatures and pressures, the maximum moisture content needed to avoid condensation of water will be different. Another source of moisture to be considered is the cylinder itself which implies appropriate drying procedures such as purging and vacuuming.

**3.5**
**wet**
state in which the conditions as defined for *dry* (3.4) are not met

**3.6**
**gas mixture**
combination of different single gases deliberately mixed in specified proportions

**3.7**
**single gas**
gas which does not contain deliberately added content of another gas or gases

# 4 Materials

## 4.1 General

The compatibility of most materials used to manufacture gas cylinders and valves is identified in this document.

Other materials whose compatibility is not identified in this document may be used if all compatibility aspects have been considered and validated by a competent person.

## 4.2 Cylinder materials

The most commonly used metallic materials for cylinders are (among others) carbon manganese steel, chromium molybdenum steel, chromium molybdenum nickel steel, stainless steel and aluminium alloys, as specified in the following documents:

— aluminium and aluminium alloys: ISO 6361-2, ISO 7866 and ISO 11118;

— steel: ISO 4706, ISO 9328-5, ISO 9809-1, ISO 9809-2, ISO 9809-3, ISO 11118 and ISO 11120;

— stainless steel: ISO 9809-4 and ISO 15510.


© ISO 2020 – All rights reserved