
**Gas cylinders — Service life testing
for cylinders and tubes of composite
construction**

Bouteilles à gaz — Durée de vie des bouteilles et tubes composites

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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.

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

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Introduction

The concept of a service life test programme originated from the United Nation Recommendation on the Transport of dangerous Goods (The Orange Book 19th Revision). The Orange Book requirement for a service life test programme for composite cylinders of more than 15 years will be incorporated into the International Regulation for Transport of Dangerous Goods by sea, air and land.

In the 19th Revision of United Nation Recommendation on the Transport of dangerous Goods (The Orange Book) Note 2 of Section 6.2.2.1.1 is as follows:

***NOTE 2:** Composite cylinders with a design life longer than 15 years shall not be filled after 15 years from the date of manufacture, unless the design has successfully passed a service life test programme. The programme shall be part of the initial design type approval and shall specify inspections and tests to demonstrate that cylinders manufactured accordingly remain safe to the end of their design life. The service life test programme and the results shall be approved by the competent authority of the country of approval that is responsible for the initial approval of the cylinder design. The service life of a composite cylinder shall not be extended beyond its initial approved design life.*

To understand what testing programmes are in use by ISO P member countries, competent authorities were asked to provide information regarding the composite cylinder approvals that are accepted in their country and any service life test programmes currently practised.

The information received from the competent authorities has been used to determine the similarities and differences in the service life test programmes in use.

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Gas cylinders — Service life testing for cylinders and tubes of composite construction

1 Scope

This document covers composite cylinders and tubes to be used under the International Regulation for Transport of dangerous Goods by sea, air and land:

- with a water capacity up to 3000 l;
- with a design life greater than 15 years.

This document provides:

- information on existing service life test programmes from ISO/TC 58/SC 3 member countries;
- comments (initially for internal committee use only) on similarities and differences;
- recommendations on the feasibility of harmonization and whether it would be appropriate to develop an ISO deliverable.

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 10286, *Gas cylinders — Terminology*

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:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

design life

maximum life (in years) for which the composite cylinder is designed and approved in accordance with the applicable standard

3.2

service life

number of years the cylinder is permitted to be in service

Note 1 to entry: In this document for “cylinder/tube” only the term “cylinder” will be used.

4 Information on existing service life test programmes

4.1 General

The concept of a service life test programme is to ensure that an approved cylinder design, with a design life in excess of 15 years, is safe for use beyond 15 years of life. The service life cannot exceed the design life.

According to of United Nations Recommendations on the Transport of Dangerous Goods, the overall programme shall be part of the initial design type approval.

4.2 Information requested

To gather information, a request form and covering letter (see [Annex B](#)) were sent to the heads of governmental delegations to the sub-committee of experts on the transport of dangerous goods of the 25 countries who are P Members of ISO TC 58 /SC 3.

4.3 Information received

Information has been received from 11 countries. This information has been collated in [Tables 1, 2 and 3](#) (see [Clause 5](#)).

Service life testing on cylinders already in service has been practised in a limited number of countries with different checks, tests and requirements.

4.4 Service life test programmes (standards.iteh.ai)

Two countries have confirmed that they have service life test programmes (including one response for UN cylinders) in place. One other country has indicated additional requirements to permit the use of the cylinders beyond their 15 years service and up to the design life (not exceeding 30 years).

5 Commentary on similarities and differences

5.1 General

From the information obtained, the service life test programmes are based on two different approaches:

- Approach 1: Some of the destructive tests performed at the time of the type approvals, as required by the design standard, are carried out on a prescribed number of representative cylinders (see [5.2](#)).
- Approach 2: Some destructive tests are carried out on a number of representative cylinders and using a statistical assessment of the findings is done (see [5.3](#)).

Both approaches can also include non-destructive tests/inspections on each cylinder.

Additional information received from the authorities that is of interest has also been collated (see [5.4](#)).

5.2 Requirements: Approach 1

The requirements of the tests to be performed for the service test programmes may be different from those specified at the type approval stage in the design standard. [Table 1](#) attempts to summarize the sampling procedure and general concepts for the test work. However, full details can be found in the original approval documents.

Table 1 — Sampling and testing for Approach 1

| Country | Standard or specification | Cylinder sampling | | Tests to be performed | |
|----------------|--|--|---|---|---|
| | | Sampling size | Sampling period | Type of tests | Test requirements |
| United States | DOT special permits based on: DOT CFFC or ISO 11119 series | 60 off cylinders randomly selected for each design | At 10 years 30 off cylinders At 13 or 15 years 30 off cylinders, as specified | Hydraulic burst Ambient cycle Flaw Drop | Differ from the type approval requirements: aiming to reflect potential degradation of the cylinder over the 10–15 years of use |
| United Kingdom | HSE specs | This will depend upon the manufacturing or inspection standard, as well as the use to which the cylinder is put. | At 15 years | This will depend upon the manufacturing or inspection standard as well as the use to which the cylinder is put. | This will depend upon the manufacturing or inspection standard, as well as the use to which the cylinder is put. |

5.3 Requirements: Approach 2

Test procedure and requirements using the statistical assessment method are described below.

[Table 2](#) attempts to summarize the sampling procedure and general concepts for the test work.

Table 2 — Sampling and testing for Approach 2

| Country | Standard or specification | Cylinder sampling | | Tests to be performed | |
|---------|---|---|---|--|--|
| | | Sampling size | Sampling period | Type of tests | Test requirements |
| Germany | Official note of BAM "CAT" (concept additional tests) EN or ISO standard ATR national | ≥ 5 randomly selected cylinders per sample (at least 6 samples i.e. ≥ 30 cylinders during service life) | At design type testing; Further 2 dates for sampling during service life are determined by the competent authority dependent from design life (e.g. 10 and 20 years) | Two samples at each date of sampling. (1st: Slow burst testing, 2nd: Load cycle testing to failure) | Dependent from P-V-product; category of gas and LBB-property. Each sample shall demonstrate reliability higher than required (high mean value and low scatter including a safety margin). After 10 ... 15 years quantification of degradation and extrapolation of results to EoL. After 20 ... 30 years estimated EoL to be confirmed or modified. |

For details of the test procedure, criteria and definitions used in Approach 2, see [Annex A](#).

5.4 Other overviews

From the competent authority responses received, the following information has been collected from those countries who do not have service life test programmes and allow the use of non-UN composite cylinders beyond 15 years.