

# INTERNATIONAL STANDARD

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## **Containment enclosures —**

### **Part 2:**

Classification according to leak tightness and  
associated checking methods

*Enceintes de confinement —*

*Partie 2: Classification selon leur étanchéité et méthodes de contrôle  
associées*



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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 10648-2 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Subcommittee SC 2, *Radiation protection*.

ISO 10648 consists of the following parts, under the general title *Containment enclosures*:

- *Part 1: Design principles*
- *Part 2: Classification according to leak tightness and associated checking methods*

Annexes A to F of this part of ISO 10648 are for information only.

## Introduction

ISO 10648 applies to enclosures or enclosure lines intended to be used for work on

- radioactive and/or toxic products where containment is required for protection of personnel and the environment,
- sensitive products requiring a special atmosphere and/or a sterile medium.

It does not apply

- to pressurized vessels,
- to sealed sources,
- to transport packagings for radioactive materials,
- to enclosures, primary circuits and vessels of nuclear reactors.

# Containment enclosures —

## Part 2:

## Classification according to leak tightness and associated checking methods

### 1 Scope

This part of ISO 10648 gives a classification of containment enclosures according to leak tightness and specifies methods for checking this tightness for the following tests:

- manufacturing test at the factory,
- acceptance test at the laboratory,
- test before commissioning,
- periodical tests during operation.

These last two tests shall comply with relevant standards and local regulations.

The object of this part of ISO 10648 is to provide manufacturers, suppliers, users and the competent authorities with uniform principles in test procedures for testing the leak tightness of containment enclosures and for ascertaining the leak rate.

The tests cover the containment enclosures equipped with the basic components (see ISO 10648-1:—, annex B). All openings (for example glove ports and ventilation openings) are sealed with tight-fitting or sealable covers.

If additional equipments are to be used, a new control test taking into account these equipments should be performed.

### 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 10648. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 10648 are encouraged to investigate the possibility of applying the most recent editions of the

standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6144:1981, *Gas analysis preparation of calibration gas mixtures — Static volumetric methods*.

ISO 10648-1:—<sup>1)</sup>, *Containment enclosures — Part 1: Design principles*.

### 3 Definitions

For the purposes of this part of ISO 10648, the following definitions apply.

**3.1 containment enclosure:** Enclosure designed to prevent the leakage of the products contained in the environment concerned into the external environment, or the penetration of substances of the external environment into the internal environment, or both at the same time.

**3.2 hourly leak rate,  $T_f$ :** Ratio between the hourly leakage  $F$  of the containment enclosure under normal working conditions (pressure and temperature) and the volume  $V$  of the said containment enclosure.

$$T_f = \frac{F}{V}$$

It is expressed in reciprocal hours.

### 4 Classification of containment enclosures according to their leak tightness

The classification of containment enclosures according to their hourly leak rate,  $T_f$ , is given in table 1.

The leak rate is measured at the normal operating pressure (usually about 250 Pa) for checking during operational use, and 1 000 Pa for the acceptance test.

1) To be published.

**Table 1 — Classification of containment enclosures according to their hourly leak rate**

| Class                                                                                                                                                                                                                                                                | Hourly leak rate,<br>$T_f$<br>$h^{-1}$ | Example                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| 1 *)                                                                                                                                                                                                                                                                 | $\leq 5 \times 10^{-4}$                | Containment enclosure with controlled atmosphere under inert gas conditions                                          |
| 2 *)                                                                                                                                                                                                                                                                 | $< 2,5 \times 10^{-3}$                 | Containment enclosure with controlled atmosphere under inert gas conditions or with permanently hazardous atmosphere |
| 3                                                                                                                                                                                                                                                                    | $< 10^{-2}$                            | Containment enclosure with permanently hazardous atmosphere                                                          |
| 4                                                                                                                                                                                                                                                                    | $< 10^{-1}$                            | Containment enclosure with atmosphere which could be hazardous                                                       |
| *) The classification of leak tightness required for a particular application under classes 1 and 2 shall be decided by the designer and user and licensing authorities. Normally, class 1 will be applied for technical reasons when higher gas purity is required. |                                        |                                                                                                                      |

Containment enclosures with a leak rate exceeding that of class 4 are outside the scope of this part of ISO 10648.

## 5 Leak testing methods for containment enclosures

There are three methods of leak testing for containment enclosures:

- oxygen method (see 5.1);
- pressure change method (see 5.2);
- constant pressure method (see 5.3).

Except for special specifications (large dimensions, complex shape or installed equipment), the method of leak testing will be determined by the selected class of leak tightness as follows:

- for class 1, the oxygen method (5.1) shall be used;
- for classes 2 and 3, either the oxygen method (5.1) or the pressure change method (5.2) may be used, in accordance with relevant standards, local regulations and feasibility;
- for classes 3 and 4, the constant pressure method (5.3) may be used.

For acceptance, it is usual to carry out a more stringent leak test (with a pressure difference about 4 times greater than the working conditions).

If sealing systems are not readily available, the test shall be carried out with dummy closures (gaiters, bags, etc.).

If the containment enclosure is constructed of painted carbon steel, the leak test shall be carried out before and after painting.

If the containment enclosure is contaminated, special care shall be taken to avoid radiological difficulties. The use of HEPA filters may prevent the spread of contamination.

### 5.1 Oxygen method (see ref. [1])

#### 5.1.1 Principle

This method can be performed only if the containment enclosure is maintained at a negative pressure.

The method consists of measuring the increase in the oxygen concentration as a function of time inside a containment enclosure which has been previously purged by an inert gas. The purpose of this purging is to bring the residual oxygen concentration down to a level compatible with the leak rate to be measured.

The difference in the oxygen concentration in the containment enclosure between the end and the beginning of the test, calculated on an hourly basis, gives the hourly leak rate,  $T_f$ , of the containment enclosure:

$$T_f = 300 \frac{O_{2f} - O_{2i}}{t \times 10^6}$$

where

$O_{2f}$  is the final oxygen concentration by volume, in volume per million (vpm);

$O_{2i}$  is the initial oxygen concentration by volume, in volume per million (vpm);

$t$  is the duration of the test, in minutes;

300 = 60 × 100/20 where 60 represents the 60 minutes in an hour and 100/20 represents 20 % oxygen in normal air.