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AMENDMENT 1
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Cryogenic vessels — Large transportable vacuum-insulated vessels —

Part 1: Design, fabrication, inspection and testing

AMENDMENT 1

Récipients cryogéniques — Récipients transportables isolés sous vide de grande contenance —

Partie 1: Conception, fabrication, inspection et essais

AMENDEMENT 1

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This document was prepared by Technical Committee ISO/TC 220, *Cryogenic vessels*.

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Part 1: Design, fabrication, inspection and testing

AMENDMENT 1

10.3.2.1

Replace Table 3 with the following:

Table 3 — Inner-vessel minimum wall thickness

Dimensions in millimetres

Inner vessel diameter D_i	Minimum wall thickness for reference material[a] s_r
$D_i \leq 1\,800$	3
$D_i > 1\,800$	4

[a] Reference material is material having a product R_m [N/mm^2] × A_5 [%] of approximately 10 000, which yields $(R_m \times A_5)^{1/3} = 21{,}4$.

For other materials, the required minimum thickness of the metal used shall be calculated from Annex J.

Minimal wall thickness can be found in applicable national regulations.

10.3.2.4 b)

Replace with the following:

b) External pressure (pressure on the convex surface):

— cylindrical shells: $S_p = 1{,}4$;

$S_k = 2{,}6$ for out of roundness u ≤ 1,5 %;

$S_k = 2{,}0 + 0{,}4 \times u$ for out of roundness $u \leq 1{,}0$ % may be used if there is evidence of reduced safety factor for buckling analysis by better manufacturing quality (reduced out of roundness).

— spherical region: $S_p = 2{,}1$;

$S_k = 2{,}6 + 0{,}001\,8\ R/s_e$;

— knuckle region: $S_p = 1{,}6$.

10.3.3.4 a)

Replace with the following:

a) Internal pressure (pressure on the concave surface): $S \geq 1{,}33$, for steels having a clearly-defined yield point or guaranteed 0,2 % proof strength for steels with no clearly-defined yield point (1 % for austenitic steels).

   In the outer vessel as part of the fastening under each of the forces, the safety factor to be observed shall be as follows:

   $S \geq 1{,}33$ for fixed tanks;

   $S = 1{,}5$ for tank containers.

J.1

Add the following sentence to the end of the subclause:

The minimum thickness shall however not be less than the minimum wall thickness.

Minimum wall thickness can be found in applicable national regulations for the transport of dangerous goods.

J.2

Replace the text with the following:

The required minimum equivalent thickness shall be calculated according to Formula J.1:

$$s_r = \frac{464 \times s_0}{\sqrt[3]{(R_m \times A_5)^2}} \quad \text{J.1}$$

$(R_m \times A_5)^{2/3} = 464$ for reference material having a product R_m [N/mm^2] × A_5 [%] of approximately 10 000.

where

A_5 is the minimum elongation at 20 °C of the metal to be used;

s_r is the required thickness, in mm, of a seamless shell based on the circumferential stress, or of a formed end, for the designated pressure using $\eta = 1$;

s_0 is the minimum shell thickness for the metal chosen;

R_m is the minimum required tensile strength at 20 °C of the metal to be used.

For A_5 the following also applies:

In the case of sheet metal, the axis of the tensile test-piece shall be at right angles to the direction of rolling. The permanent elongation at fracture shall be measured on test-pieces of circular cross-section

in which the gauge length l is equal to five times the diameter d (l = 5d); if test-pieces of rectangular section are used, the gauge length shall be calculated by the following formula:

$$l = 5{,}65 \times F_0$$

where F_0 indicates the initial cross-section area of the test-piece.

J.2.1.

Delete the subclause.

J.2.2

Delete the subclause.

J.3

Replace all of J.3 with the following:

In all cases the wall thickness of the tank shell shall not undergo the value as defined in Table J.1.

Table J.1 — Minimum required wall thicknesses

	Inner vessel diameter D_i	≤ 1,80 m	> 1,80 m
Minimum thickness of shells	Austenitic stainless steels	2,5 mm	3 mm
	Austenitic-ferritic stainless steels	3 mm	3,5 mm
	Other steels	3 mm	4 mm
	Aluminium alloys	4 mm	5 mm
	Pure aluminium of at minimum 99,0 % (by mass)	6 mm	8 mm