INTERNATIONAL STANDARD

**ISO
90-1**

Light gauge metal containers — Definitions and determination of dimensions and capacities —

Part 1:
Open-top cans

Récipients métalliques légers — Définitions et détermination des dimensions et des capacités —

Partie 1: Boîtes serties

Contents

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 90-1 was prepared by Technical Committee ISO/TC 52, *Light gauge metal containers*, Subcommittee SC 4, *Open-top containers*.

This second edition cancels and replaces the first edition (ISO 90-1:1986), which has been technically revised.

ISO 90 consists of the following parts, under the general title *Light gauge metal containers — Definitions and determination of dimensions and capacities:*

— *Part 1: Open-top cans*

— *Part 2: General use containers*

— *Part 3: Aerosol cans*

Annexes A, B and C of this part of ISO 90 are for information only.

Introduction

ISO 90 consists of three parts which group definitions, methods for determination of dimensions and capacities, as well as tolerances and designations of rigid containers made of metal with a maximum nominal material thickness of 0,49 mm.

This part of ISO 90 covers open-top cans as defined in 2.1 and is applicable to both round and non-round cans.

Diameters for round open-top cans (beverage cans excluded) are specified in ISO 1361.

Light gauge metal containers — Definitions and determination of dimensions and capacities —

Part 1:
Open-top cans

1 Scope

This part of ISO 90 defines open-top cans and can types, cross-sections, constructions, shapes, special features and capacities of such cans. It specifies methods for determining cross-sections and gross-lidded capacities. It also specifies tolerances on capacity and recommends an international designation.

2 Definitions

For the purposes of this part of ISO 90, the following definitions apply.

2.1 Open-top cans

2.1.1 open-top can: Rigid container made of light gauge metal with a maximum nominal material thickness of 0,49 mm, one end of which is double-seamed after filling [see figure 6 a)].

2.1.2 open-top can for processed food products: Open-top can, tight to liquids and gases, preventing contamination of the contents by microorganisms after processing.

2.1.3 open-top can for beverages: Open-top can for liquid products to which gas is added during filling.

2.1.4 diaphragmed can: Can having a double-seamed diaphragm ring at the top end and a plug which fits into the ring [see figure 6 b)].

2.1.5 can with easy-open end for food and beverages: Can having one end comprised of a sheet metal wall with a line of scoring forming a tear strip or area and having a tab attached to the tear strip or area for easy manual severance thereof.

2.2 Cross-sections

2.2.1 round can: Can with a circular cross-section (see figure 1).

2.2.2 non-round cans

2.2.2.1 rectangular can: Can with a rectangular [see figure 2 a)] or square [see figure 2 b)] cross-section.

2.2.2.2 obround can: Can with a cross-section of parallel sides of equal length joined by two curved ends, which may be semicircular [see figure 3 a)] or include different radii [see figure 3 b)].

2.2.2.3 oval can: Can with an oval cross-section (see figure 4).
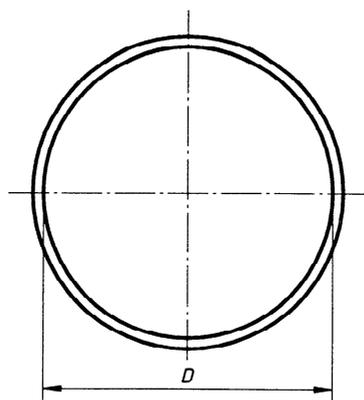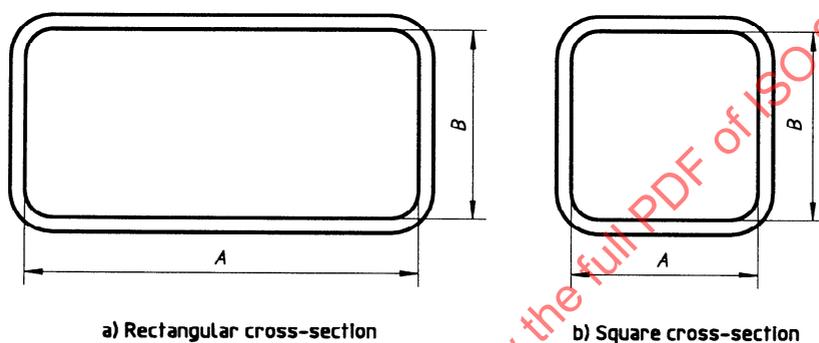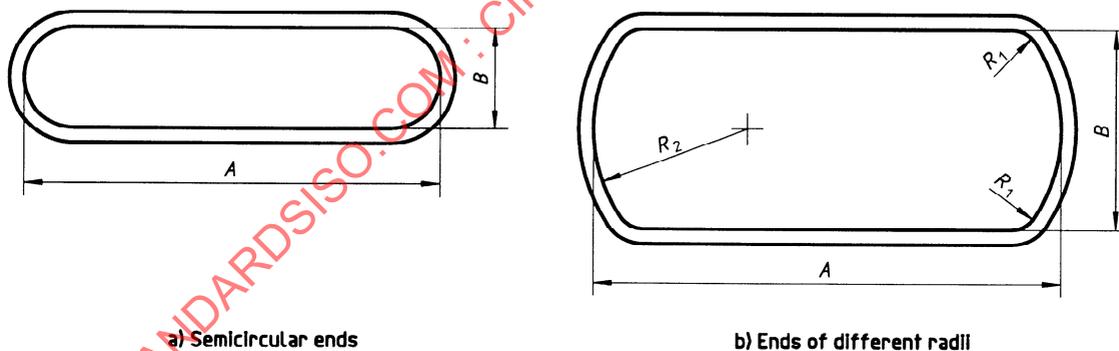
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Figure 1 — Round can

a) Rectangular cross-section b) Square cross-section

Figure 2 — Rectangular cans

a) Semicircular ends b) Ends of different radii

Figure 3 — Obround cans
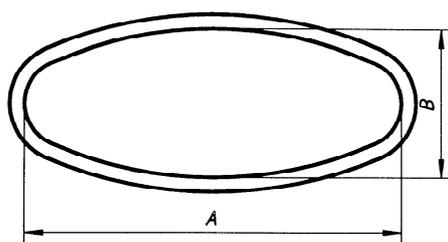
Figure 4 — Oval can

2.2.2.4 trapezoidal can: Can with an approximately trapezoidal cross-section with rounded corners (see figure 5).

NOTE — The shorter of the parallel sides [see figure 5 b)] may be curved.

a)

b)

Figure 5 — Trapezoidal cans

NOTE — Some variations of the trapezoidal can are also known as pear-shaped cans.

2.3 Constructions

NOTE — Figures 6 and 7 apply to both round and non-round cross-sections.

2.3.1 three-piece can: Can made from three main components: body, top end and bottom end (see figure 6).

a) Open-top can

b) Diaphragmed can
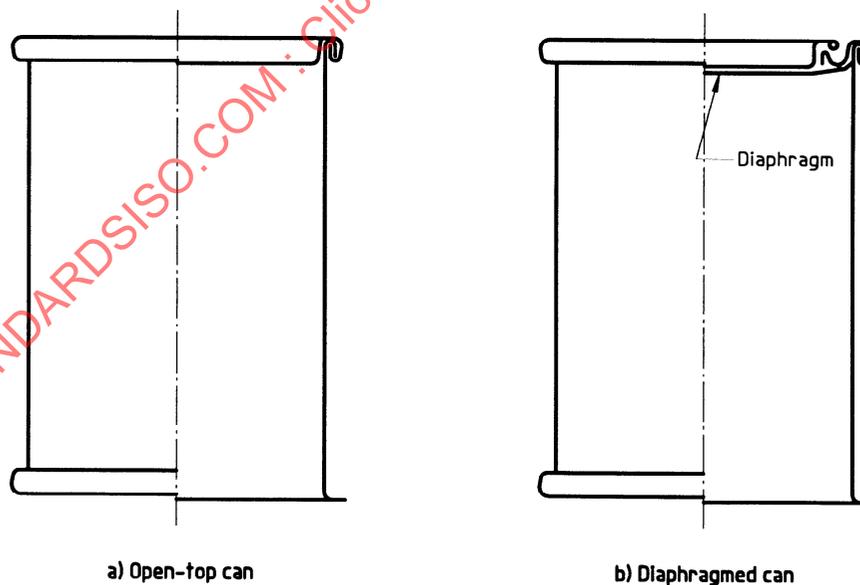
Figure 6 — Three-piece cans

2.3.2 two-piece can: Can made from two main components: body and bottom, which form one piece, and a top end (see figure 7).
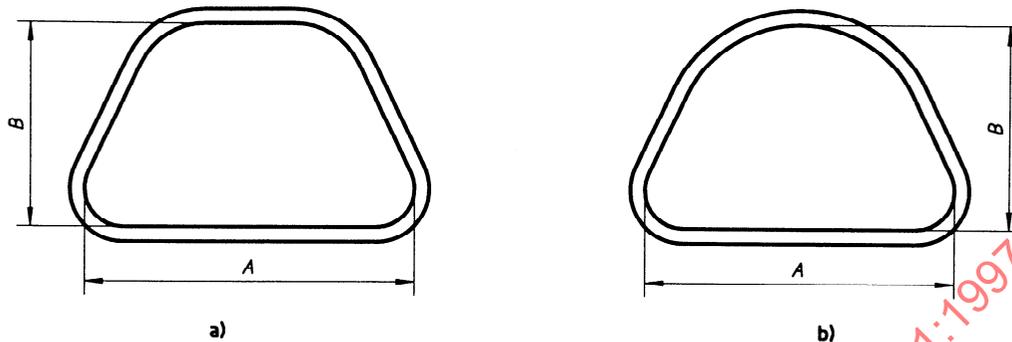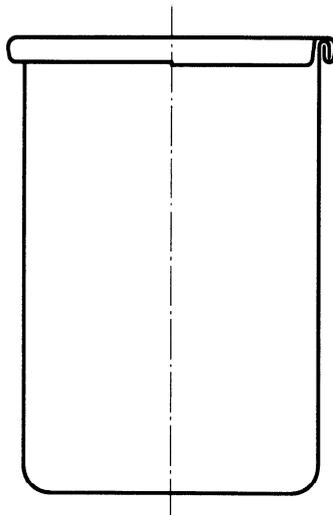
Figure 7 — Two-piece can

2.4 Shapes

NOTE — Figures 8 and 9 apply to both round and non-round cross-sections.

2.4.1 cylindrical can: Can which has cross-section of constant dimension from top to bottom, local variations caused by special features such as beading, etc. being disregarded (see figure 8).
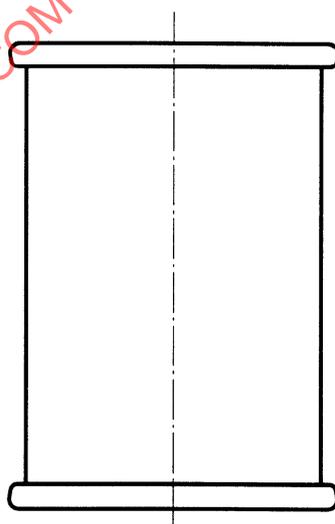
Figure 8 — Cylindrical can

2.4.2   tapered can: Can whose cross-section changes linearly from top to bottom, local variations caused by special features such as beading, necking-in, etc. being disregarded (see figure 9).
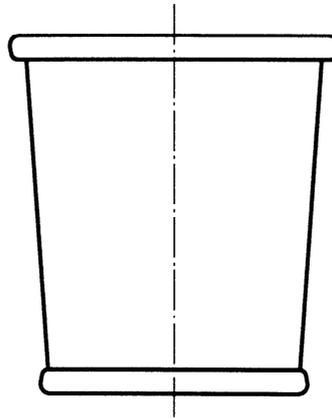
Figure 9 — Tapered can

2.5   Special features

NOTE — Figures 10 to 12 apply to both round and non-round cross-sections.

2.5.1   necked-in can: Can whose body is reduced in cross-section at one [see figure 10 b)] or both [see figure 10 a)] extremities.

a) Two neckings-in   b) One necking-in
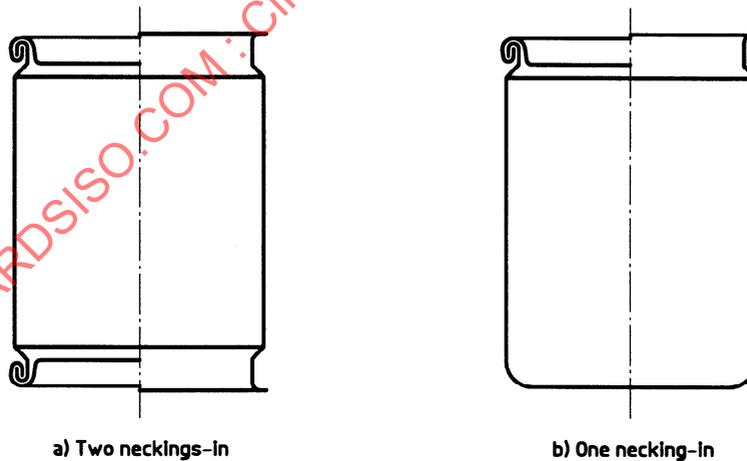
Figure 10 — Necked-in cans

2.5.2   step-sided can: Can whose body is increased in cross-section at one extremity (see figure 11).

a)   b)
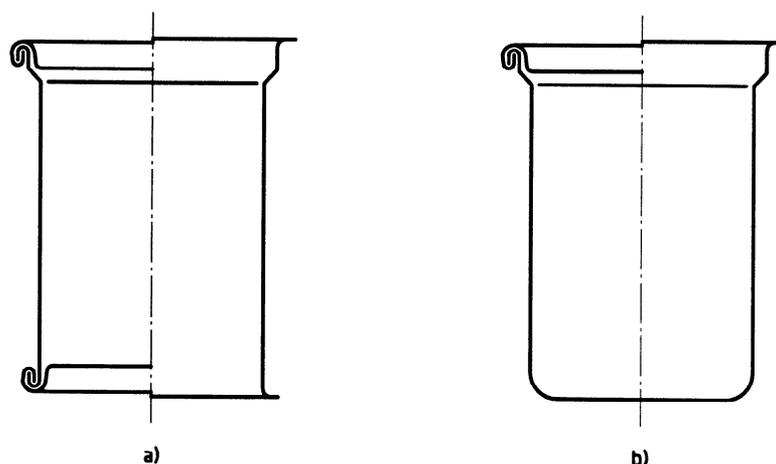
Figure 11 — Step-sided cans

2.5.3   beaded can: Can whose body has small internal and/or external peripheral changes in cross-section (see figure 12).

a) With external changes   b) With internal changes   c) With external and internal changes
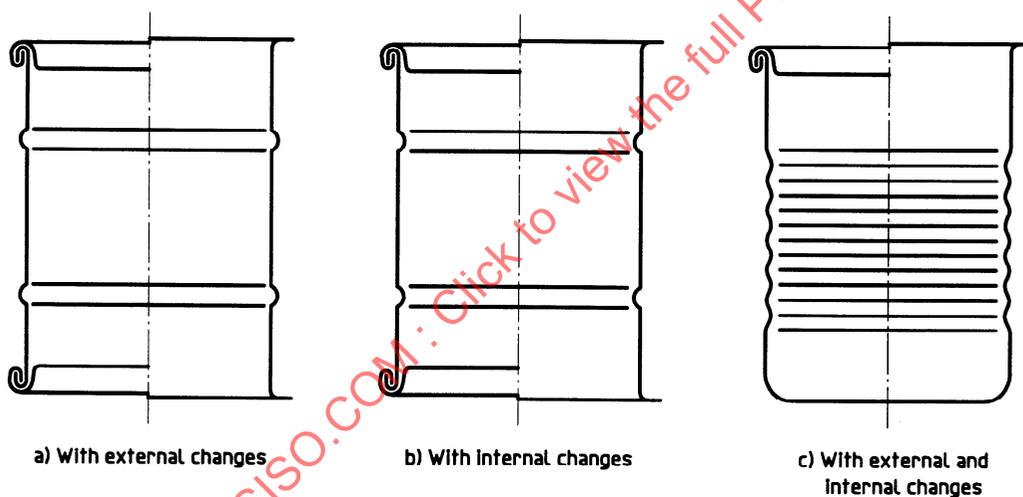
Figure 12 — Beaded cans

2.5.4   special-profile can: Can whose body varies in cross-section to give a particular profile.

2.6   Capacities

**2.6.1   nominal filling volume, V:** Volume, in millilitres, of product that the can is required to hold.

2.6.2   gross lidded capacity, C: Total capacity, in millilitres, of a closed can, determined in accordance with 4.2 (empty can) or annex B (full can).

2.6.3   head space for beverage cans, K: Difference between the gross lidded capacity and the nominal filling volume, expressed in millilitres or as a percentage of the gross lidded capacity.

2.6.4   freeboard for beverage cans: Height, in millimetres, from the flange of an open-top can to the surface level of a liquid product when filled to the nominal volume.

2.6.5   body height, H_1: Height, in millimetres, of the factory-finished empty can (see annex A).

3 Determination of dimensions

3.1 Measurement of cross-sections

3.1.1 Measure the internal body cross-section using a plug gauge, or derive it from the external cross-section measured with a vernier caliper.

3.1.2 Measure the necked-in or step-sided opening cross-sections using a plug gauge applied to the internal cross-section of the extremity to which the end is to be fixed.

3.1.3 Measure the opening cross-section of a cylindrical or tapered can using a plug gauge applied to the internal cross-section of the extremity to which the end is to be fixed.

3.2 Nominal cross-sections

The nominal cross-section is determined by rounding the internal body cross-section (see 3.1.1) or necked-in or step-sided cross-section (see 3.1.2) to the nearest whole millimetre (if the first decimal is 5 or above, round up; in all other cases, round down).

3.3 Measurement of height

See annex A.

3.4 Characteristic dimensions

Nominal cross-sections are characterized by the dimensions specified in 3.4.1 to 3.4.4.

3.4.1 Cylindrical round can

Dimension D (see figure 1).

3.4.2 Cylindrical non-round can

Dimensions A and B (see figures 2 to 5).

3.4.3 Tapered round can

Dimensions D_1 and D_2, of which D_1 is the larger and D_2 the smaller (see figure 13).

3.4.4 Tapered non-round can

Dimensions A_1, B_1, A_2 and B_2, of which A_1 and B_1 are the larger and A_2 and B_2 the smaller dimensions (see figure 13).

3.5 Special features

3.5.1 Necked-in cans

The cross-sections in the necked-in area shall be indicated as follows (see clause 6 and figure 13):

— for round cans:

   D_{N1} - top end;

   D_{N2} - bottom end;

— for non-round cans:

   $A_{N1} \times B_{N1}$ - top end;

   $A_{N2} \times B_{N2}$ - bottom end.

3.5.2 Step-sided cans

The cross-sections in the step-sided area shall be indicated as follows (see clause 6 and figure 13):

— round cans: D_S;
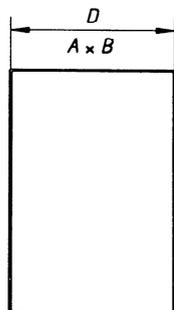
— non-round cans: $A_S \times B_S$.

	Code letter	Round cans	Non-round cans
	Cy	C - D	C - $A \times B$
	N	C - D/D_{N2}	C - $A \times B/A_{N2} \times B_{N2}$
	N	C - D/D_{N1}	C - $A \times B/A_{N1} \times B_{N1}$

Diagram labels:

a) Cylindrical cans — D, $A \times B$
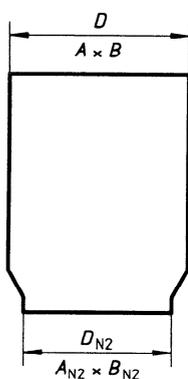
b) Necked–in cylindrical cans (bottom end) — D, $A \times B$, D_{N2}, $A_{N2} \times B_{N2}$
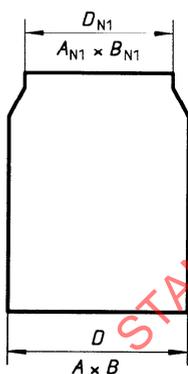
c) Necked–in cylindrical cans (top end) — D_{N1}, $A_{N1} \times B_{N1}$, D, $A \times B$

Figure 13 — Examples of designation of open-top cans

	D_1 $A_1 \times B_1$ (tapered can)	Code letter	Round cans	Non-round cans
		T	$C - D_1/D_2$	$C - A_1 \times B_1 / A_2 \times B_2$

d) Tapered can

	D_s $A_s \times B_s$ (step-sided)	S	$C - D_2/D_S$	$C - A_2 \times B_2 / A_S \times B_S$
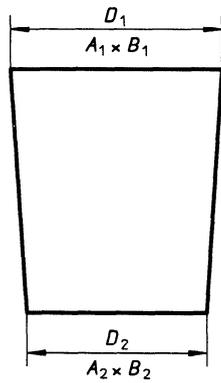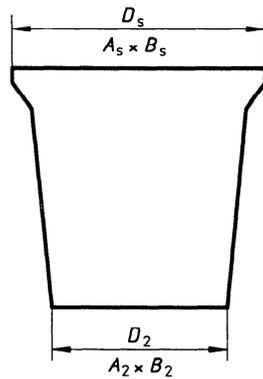
e) Step-sided tapered cans

Figure 13 — (end)

4 Determination of gross lidded capacity, C

4.1 General

The methods for determining capacity all rely on determining the mass of water in the can. For cans with a capacity equal to or greater than 400 ml, a correction factor (see 4.1.1) can be applied, but only if a very precise determination of capacity is necessary.

4.1.1 Correction factors

The correction factor to be applied to determine the gross lidded capacity depends on the water temperature (see table 1).

4.1.2 Accuracy of the balances

The balance used for determining the mass, m, of the cans shall have at least the accuracy specified in table 2.

Table 1 — Correction factors as a function of temperature

Water temperature °C	Correction factor F
12	1,000 5
14	1,000 8
16	1,001 1
18	1,001 4
20	1,001 8
22	1,002 2
24	1,002 7
26	1,003 3
28	1,003 8
30	1,004 4

Table 2 — Balance accuracy

Values in grams

Mass of can, m	Accuracy
$m \leqslant 500$	± 0,5
$500 < m \leqslant 2\ 500$	± 1,0
$2\ 500 < m \leqslant 5\ 000$	± 2,5
$5\ 000 < m$	± 5,0

4.1.3 Cans with flexible top and bottom ends

The development of containers in thin materials has in some cases led to the introduction of top/bottom ends with intentional flexibility. These ends are produced in convex shape; after sterilization and cooling, the bow changes to concave similar to other open-top can ends.

These ends are used for cans on which the body would collapse due to the vacuum produced as a result of hot filling, irrespective of whether they are beaded or not.

On account of the changing bow of the ends, the container has no absolute fixed capacity. Since there is no acceptable method for measuring the capacity of cans with such flexible ends, this capacity has to be considered as equal to the capacity of similar cans with non-flexible ends.

4.2 Determination of gross lidded capacity, C (empty cans)

NOTE — The gross lidded capacity is normally determined on empty cans. If the capacity of filled cans has to be determined, the method described in annex B can be applied.

4.2.1 For three-piece cans only, attach one end to the body by the usual method.

4.2.2 From the inside surface outwards, drill two holes, 3 mm to 6 mm in diameter and about 7 mm apart, in the unattached end of the can (the positioning of the holes depends on the end profile). In non-round ends, drill the holes as close as possible to a corner radius.

4.2.3 Attach this end to the body by the usual method.

4.2.4 Determine the mass of the empty can, m_1, in grams, accurately (refer to 4.1.2).

4.2.5 If necessary, measure the temperature of the water to be used (see 4.1.1).

4.2.6 Fill the can with water through one of the holes, with the can inclined at an angle to the vertical so that the holes are as high as possible. When water runs out of the second hole, close the holes with the fingers, shake the can gently, and complete filling.

4.2.7 If the above filling method results in deformation of the can, proceed as follows.

Place the can in a test container filled with water, with the can inclined at an angle to the vertical so that the holes are as high as possible. Fill the can completely with water through one of the holes. The water in the test container shall be not more than 10 mm below the highest point of the can. Close the holes with small strips of adhesive tape. Remove the can from the container.

4.2.8 Remove any surplus water from the outside of the can.

4.2.9 Determine the mass of the filled can, m_2, in grams, accurately (see 4.1.2).

4.2.10 The difference between the weighings ($m_2 - m_1$), if necessary multiplied by the relevant water temperature correction factor (see 4.1.1), represents the gross lidded capacity, C, in millilitres, of the can.

5 Tolerances on capacities

5.1 General

Tolerances for standardized nominal gross lidded capacities are given in tables 3 and 4.

At least 99,7 % of the individual cans shall lie within these limits[1].

5.2 Round cans

Tolerances on gross lidded capacities for round cans are given in table 3.

Table 3 — Tolerances on gross lidded capacities for round cans

Gross lidded capacity, C	Tolerances	
ml	%	ml
$C < 80$	± 5	
$80 \leqslant C \leqslant 100$		± 4
$101 \leqslant C \leqslant 150$	± 4	
$151 \leqslant C \leqslant 200$		± 6
$201 \leqslant C \leqslant 266$	± 3	
$267 \leqslant C \leqslant 320$		± 8
$321 \leqslant C \leqslant 520$	± 2,5	
$521 \leqslant C \leqslant 650$		± 13
$651 \leqslant C \leqslant 1\,000$	± 2	
$1\,001 \leqslant C \leqslant 1\,334$		± 20
$1\,335 \leqslant C \leqslant 2\,000$	± 1,5	
$2\,001 \leqslant C \leqslant 3\,000$		± 30
$3\,000 < C$	± 1	

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1) This percentage is derived from statistical theory: when a variable, x, is distributed according to the normal distribution of parameters μ and σ (where μ is the arithmetic mean and σ is the standard deviation), 99,7 % of its values are between ($\mu - 3\sigma$) and ($\mu + 3\sigma$).

5.3 Non-round cans

Tolerances on gross lidded capacities for non-round cans are given in table 4.

Table 4 — Tolerances on gross lidded capacities for non-round cans

| Gross lidded capacity, C | Tolerances | |
ml	%	ml
$C < 80$	± 5	
$80 \leq C \leq 100$		± 4
$101 \leq C \leq 150$	± 4	
$151 \leq C \leq 200$		± 6
$201 \leq C \leq 266$	± 3	
$267 \leq C \leq 320$		± 8
$321 \leq C \leq 520$	± 2,5	
$521 \leq C \leq 650$		± 13
$650 < C$	± 2	

6 Designation

It is recommended that open-top cans be designated internationally in the following manner:

a) a code letter:

Cy   for cylindrical cans;

T   for tapered cans;

S   for step-sided cans;

N   for necked-in cans;

D   for diaphragmed cans.

b)   their nominal gross lidded capacity, C, or their nominal filling volume, V, expressed in millilitres;

c)   their characteristic nominal cross-section, expressed in millimetres, in accordance with 3.1 and 3.2;

d)   the nominal cross-section of the end of the body for necked-in or step-sided cans in accordance with 3.5, placed immediately after the body dimensions.

Examples of designation are given in figure 13.

Annex A
(informative)

Measurement of height of open-top cans

In clause 6, it is recommended that open-top cans be designated internationally in the following manner:

a)   a code letter;

b)   their nominal gross lidded capacity or nominal filling volume;

c)   their nominal cross-section.

However, it may be necessary to refer to the can body height (see 2.6.5).

The height, H_1, (see figure A.1) shall be measured using a vernier caliper or a height gauge.
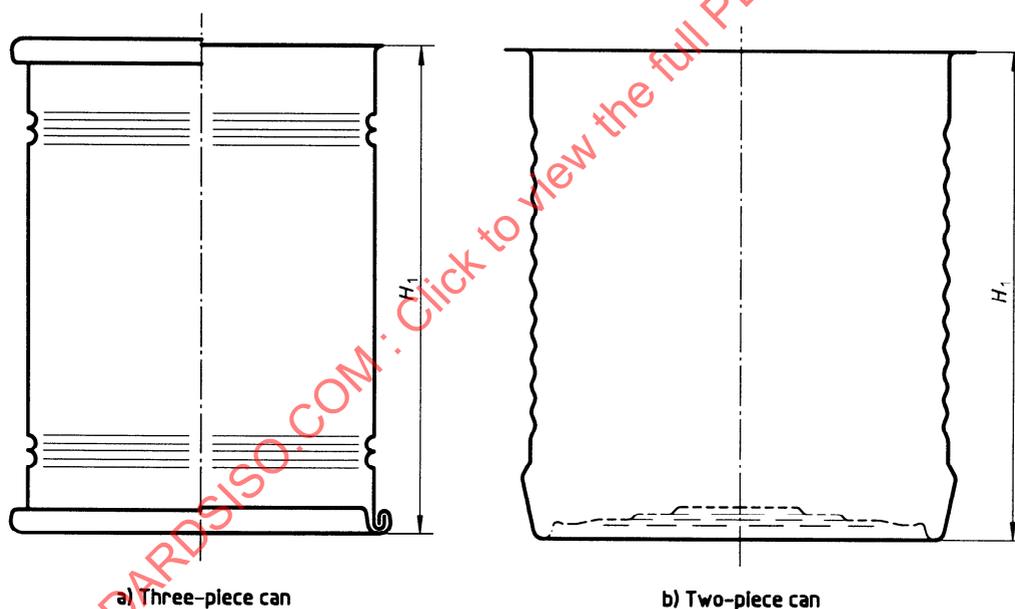

a) Three-piece can

b) Two-piece can

Figure A.1 — Measurement of body height of open-top cans

The body height, H_1, shall be expressed by rounding to the nearest whole millimetre (if the first decimal is 5 or above, round up; in all other cases, round down).

Annex B

(informative)

Determination of gross lidded capacity, C (cans filled with product)

B.1 Apparatus

B.1.1 Top-loading balance [see figure B.1 a)].

The double-pan torsion type of balance is not an acceptable substitute.

B.1.2 Water tank, whose level and contents are adjustable. The tank should be large enough to hold a submerged can without overflowing.

B.2 Preparation

B.2.1 The can to be tested shall be free from dents or buckles.

B.2.2 Fill the tank (B.1.2) to the desired level with water.

B.2.3 Measure the temperature of the water if a correction factor is to be applied (see 4.1.1).

B.2.4 Zero the balance with the water level adjusted to the mark on the can holder, by means of a small weight, S, set on the balance pan [see figure B.1 b)] and which will stay on it during subsequent operations.

B.2.5 Vent the can to the atmosphere. It may be necessary to make a small hole to do this. Seal any such hole with adhesive tape.

B.3 Determination of the mass of filled can in air, m_{fa}

B.3.1 Place the filled can on the balance pan.

B.3.2 Adjust the tank to bring the water level to the mark [see figure B.1 c)].

B.3.3 Read the mass of the filled can, m_{fa}, in grams, as accurately as the scale permits.

B.4 Determination of the mass of filled can in water, m_{fw}

B.4.1 Attach the filled can to the magnet under water [see figure B.1 d)]. Avoid trapping any air.

NOTE — If the magnet does not hold the can, it will be necessary to bind the can to the magnet. In this case, start again at B.2.4 with the binding on the magnet.

B.4.2 If the filled can floats in water, add weights B [see figure B.1 e)], to the balance pan until a positive reading is seen on the scale.

B.4.3 Adjust the tank to bring the water level to the mark [see figure B.1 d) or B.1 e)].

B.4.4 Read the mass, in grams, of the can on the scale. For cans which do not float in water, the reading is m_{fw}. For cans which do float in water, m_{fw} will have a value equal to the scale reading minus the mass of weights B. Note that in this latter case, m_{fw} will be negative.

B.5   Determination of the mass of empty can in air, m_{ea}

B.5.1 Open the can, remove the contents and wash and dry the can.

B.5.2 Place the complete, empty can (body, bottom and top) on the balance pan.

B.5.3 Adjust the tank to bring the water level to the mark [see figure B.1 c)].

B.5.4 Read the mass of the empty can, m_{ea}, in grams, as accurately as the scale permits (see 4.1.2 and table 2).

B.6   Determination of the mass of empty can in water, m_{ew}

B.6.1 Attach the complete, empty can to the magnet under water. Avoid trapping any air.

B.6.2 Adjust the tank to bring the water level to the mark [see figure B.1 d)].

B.6.3 Read the mass of the can, m_{ew}, in grams.

B.7   Calculation of the gross lidded capacity, C, of the can

The gross lidded capacity C, in millilitres, of the can filled with product, is calculated using the following equation:

$$C = F\left[(m_{fa} - m_{fw}) - (m_{ea} - m_{ew})\right]$$

where

 F is the correction factor, if necessary (see 4.1.1);

 m_{fa} is the mass, in grams, of the filled can in air (see clause B.3);

 m_{fw} is the mass, in grams, of the filled can in water (see clause B.4);

 m_{ea} is the mass, in grams, of the empty can in air (see clause B.5);

 m_{ew} is the mass, in grams, of the empty can in water (see clause B.6).