International Standard 7212

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Enclosures for protection against ionizing radiation — Lead shielding units for 50 mm and 100 mm thick walls

Enceintes pour la protection contre les rayonnements ionisants — Éléments de blindage en plomb pour murs de 50 mm *et* 100 mm *d'épaisseur*

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Descriptors : nuclear energy, radiation protection, lead, bricks, classification, specifications, dimensions, designation.

Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Contents

Section one: Lead shielding units — 50 mm thick

Enclosures for protection against ionizing radiation — Lead shielding units for 50 mm and 100 mm thick walls

1 Scope and field of application

This International Standard specifies the properties of the various lead units used in the construction of shielded enclosures for protection against ionizing radiation. The units dealt with are

— basic units: bricks, posts;

— functional units: aperture bricks, windows, sphere units, plugs and reducing units.

Only one and two chevron bricks are standardized in this International Standard. The 50 mm and 100 mm shielding units are dealt with separately in order to simplify general reference.

2 Classification

The units described in this International Standard are classified in the following three categories:

— **Category 1**: standardized units.

(The diagrams in figures 7, 18, 24 and 35 represent the standardized units in category 1.)

— **Category 2**: these are units which are either used very infrequently or for very specialized purposes, or used very frequently in one country and it is felt that this use will become more widespread.

(The diagrams in figures 8, 19, 25 and 36 represent the standardized units in category 2.)

— **Category 3**: units which are acceptable for a transition period.

These are units which are used in one or a few countries and which will be withdrawn from this International Standard after the transition period. This category may also include units which were in category 2, but which became less important and will be withdrawn after a transition period in category 3.

3 Designation

The designation of the lead shielding unit consists of its name written in full, the reference to this International Standard and the reference number as explained in 3.1.

Example of designation (see full explanation in 3.2):

Aperture brick ISO 7212 - 2V0 202

3.1 Explanation of the reference number

The reference number consists of a figure, a letter followed by another figure and a group of three figures, for example, 2V0 202:

a) 1st figure: lead thickness

1 = 50 mm 2 = 100 mm

b) letter: encasing profile

V = with chevrons R = rounded form

NOTE — In this International Standard, only the shielding units with chevrons are standardized.

c) 2nd figure: assembly direction

1 = assembly direction 1 (see clause 4)

2 = assembly direction 2 (see clause 4)

0 = two assembly directions

d) 3rd, 4th and 5th figures: number specific to each unit.

A unit which has two different positions inside the shielding wall has the same reference but according to its position in the wall, the name of its type is different. For example, the base plain brick and the left-hand ordinary end brick have the same reference number: 1V0 100.

Except for the cases outlined above, the last three figures are fixed in series according to table 1.

Table 1 — Series allocation

Units	Series
Plain bricks	100 to 119
Corner bricks	120 to 149
End bricks	150 to 169
Square bricks	170 to 179
X bricks	180 to 189
Posts	190 to 199
Circular aperture bricks	200 to 229
Square and rectangular aperture bricks	250 to 269
Circular windows	300 to 319
Square and rectangular windows	350 to 369
Sphere units	400 to 409
Plugs	500 to 519
Reducing units	600 to 619

3.2 Explanation of a designation example

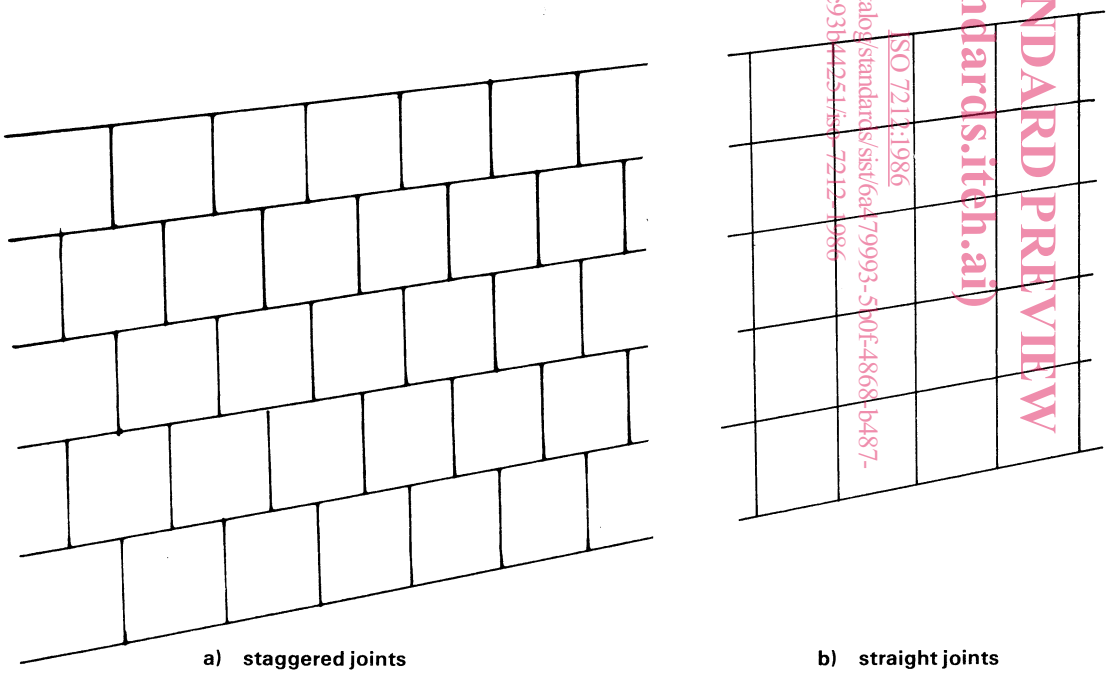
Lead circular aperture brick, 100 mm thickness, two chevrons, two assembly directions, No. 202 (300 mm × 300 mm) shall be designated as follows :

Aperture brick ISO 7212 - 2V0 202

4 Specifications of the bricks

4.1 General

The dimensions of the category 1 and 2 bricks have been standardized in order to ensure a 100 mm by 100 mm stepping of the dimensions on installation and if necessary to allow staggered joints [see figure 1a)].



a) staggered joints

b) straight joints

Figure 1 — Assembly of bricks

The bricks have two assembly directions (see figure 2) :

— assembly direction 1 : chevron pointing upwards to the right
— assembly direction 2 : chevron pointing upwards to the left

} Looking at the enclosure from the outside (cold side).

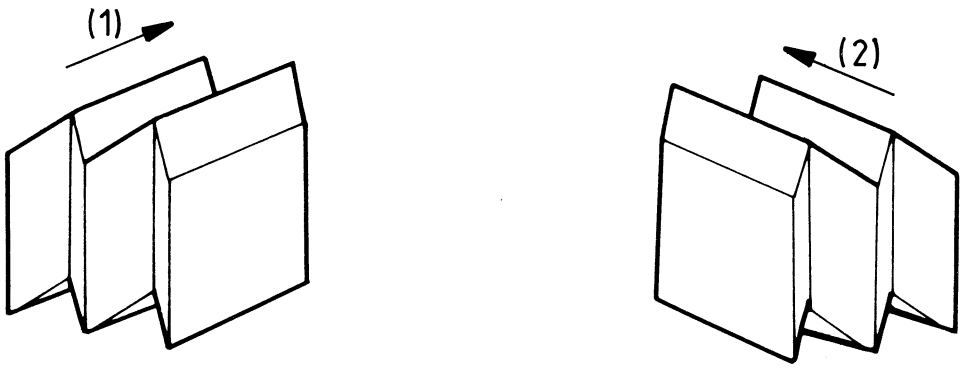


Figure 2 — Assembly directions of bricks

It is recommended that the same assembly direction be used for the entire shielding wall, but if it proves necessary to use the reverse direction, special bricks are used for the join (for example, see 5.4).

Diagrams of the basic units of category 1 and category 2 are given in figures 7 and 24, and figures 8 and 25, respectively.

4.2 Properties of the material

The properties of the lead used for the bricks are given in table 2.

Table 2 — Properties of the material

Minimum density of the lead	Percentage of antimony	Minimum hardness
10,9 g/cm^3	4 ± 0,5	9,5 HB*

* The value of 9,5 HB is the minimum which shall be obtained at any point on the brick immediately after casting. The Brinell hardness increases in the first few months after manufacture.

4.3 Profile of the chevron

The specifications relating to the chevron are given in table 3.

Examples of chevron bricks are illustrated in figures 3 and 4.

Table 3 — Specifications of a chevron

Angle of the chevron		Thickness e mm	Tolerance on height H and length L mm	Angle on face
Male	Female			
$90° \begin{smallmatrix}+15' \\ 0\end{smallmatrix}$	$90° \begin{smallmatrix}0 \\ -15'\end{smallmatrix}$	$50 \begin{smallmatrix}0 \\ -0,5\end{smallmatrix}$	± 0,2	90° ± 10′

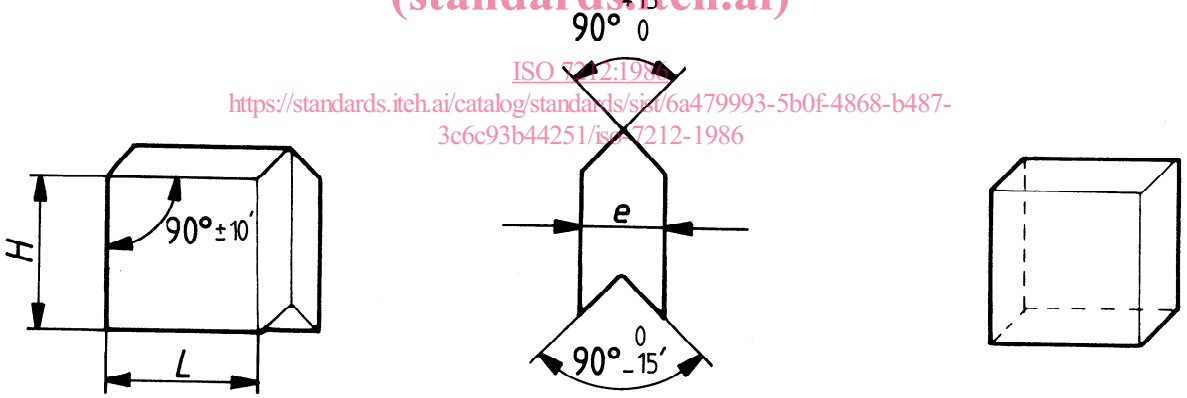


Figure 3 — Example of a one-chevron ordinary plain brick

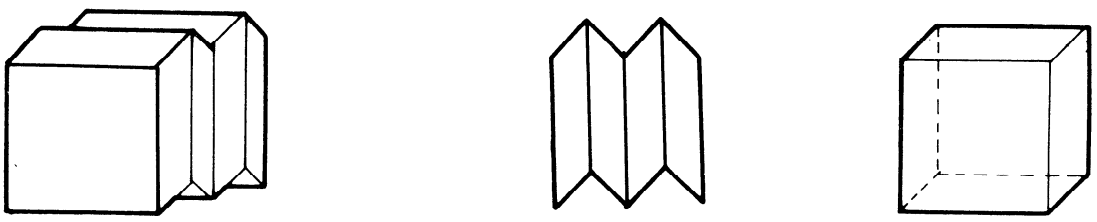


Figure 4 — Example of a two-chevron ordinary plain brick

Section one: Lead shielding units — 50 mm thick

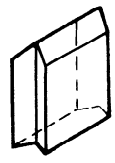
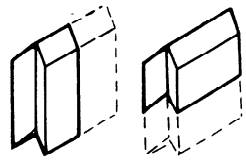
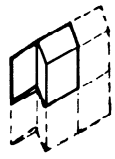
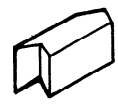
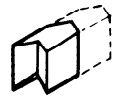
5 Categories 1 and 2

5.1 Plain bricks

Each type of plain brick may be assembled in each of the two assembly directions.

Table 4 shows the dimensions of category 1, one-chevron plain bricks. It should be stated that the unit module for the designation of the bricks is 100 mm × 100 mm.

Table 4 — Category 1 plain bricks

Type	Reference number	Dimensions mm		Diagram	Approximate mass kg
		H	*L*		
Base plain brick[1]	1V0 100	100	100		6,1
1/2 base plain brick[2]	1V0 101	100	50		3,1
Ordinary plain brick	1V0 102	100	100		5,5
1/2 ordinary plain brick[3]	1V0 103	100	50		2,7
		50	100		
1/4 ordinary plain brick	1V0 104	50	50		1,4
1/2 top plain brick[4]	1V0 105	50	100		2,0
1/4 top plain brick[5]	1V0 106	50	50		1,0

1) Identical to the 100 × 100 left-hand ordinary end brick (see table 7).

2) Identical to the 50 × 100 1/2 left-hand ordinary end brick (see table 7).

3) This brick may be turned round to constitute an ordinary plain brick 50 mm high and 100 mm long.

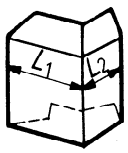
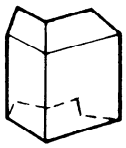
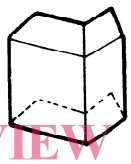
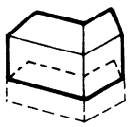
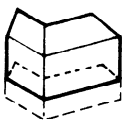
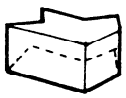
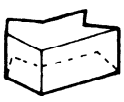
4) Identical to the 100 × 50 1/2 right-hand ordinary end brick (see table 7).

5) Identical to the 1/4 right-hand ordinary end brick (see table 7).

5.2 Corner bricks

The dimensions of category 1 and 2, one-chevron corner bricks are given in tables 5 and 6, respectively.

Table 5 — Category 1 corner bricks

Type	Reference number	Dimensions mm			Diagram	Assembly direction*	Approximate mass kg
		H	L_1 Re-entrant chevron	L_2 Projecting chevron			
Base corner brick	1V1 120	100	100	50		(1) →	6,1
Base corner brick	1V2 121	100	100	50		(2) ←	6,1
Ordinary corner brick	1V1 122	100	100	50		(1) →	5,5
Ordinary corner brick	1V2 123	100	100	50		(2) ←	5,5
1/2 ordinary corner brick	1V1 124	50	100	50		(1) →	2,7
1/2 ordinary corner brick	1V2 125	50	100	50		(2) ←	2,7
1/2 top corner brick	1V1 126	50	100	50		(1) →	2,0
1/2 top corner brick	1V2 127	50	100	50		(2) ←	2,0

* The assembly direction indicated is for convex angle enclosures.

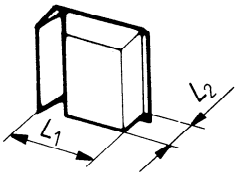
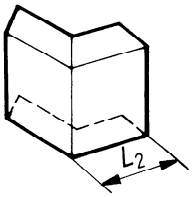
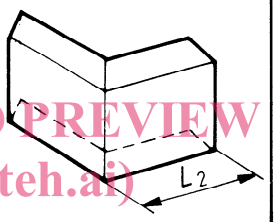
For a concave (or reflex) angle:

— either reverse the assembly direction using the same type of corner brick;

— or keep the same assembly direction using the opposite type of corner brick.

See detail on assembly directions in figure 2 and the general diagram in figure 7.

Table 6 — Category 2 corner bricks

Type	Reference number	Dimensions mm			Diagram	Assembly direction*	Approximate mass kg
		H	L_1 Re-entrant chevron	L_2 Projecting chevron			
Vee ordinary corner brick	1V2 130	100	150	50		(2) ←	8,2
Equal ordinary corner brick	1V2 131	100	100	100		(2) ←	8,2
Long equal ordinary corner brick	1V2 132	100	150	150		(2) ←	13,6

* See footnote under table 5.

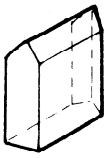
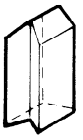
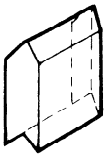
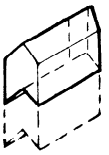
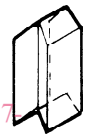
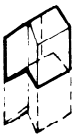
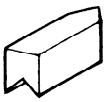
5.3 End bricks

End bricks are only provided for walls of 50 mm lead thickness (one-chevron brick). For walls 100 mm thick, in certain cases, two end bricks can be used side by side.

Left-hand end bricks for assembly direction 1, when reversed, also serve as right-hand end bricks for assembly direction 2.

The dimensions of the end bricks for assembly direction 1 are given in table 7.

Table 7 — Category 1 end bricks

Type	Reference number	Dimensions mm		Diagram	Approximate mass kg
		H	*L*		
Left-hand base end brick	1V0 154	100	100		6,9
1/2 right-hand base end brick[1]	1V0 155	100	50		2,3
Left-hand ordinary end brick[2]	1V0 100	100	100		6,1
1/2 left-hand ordinary end brick[3]	1V0 101	50	100		3,1
1/2 right-hand ordinary end brick[4]	1V0 105	100	50		2,0
1/4 right-hand ordinary end brick[5]	1V0 106	50	50		1,0
1/2 left-hand top end brick	1V0 155	50	100		2,3
1/4 right-hand top end brick	1V0 157	50	50		0,8

1) This brick may be turned round to constitute a 1/2 left hand top end brick 50 mm high and 100 mm long.

2) Identical to the 100 × 100 base plain brick (see table 4).

3) Identical to the 100 × 50 1/2 base plain brick (see table 4).

4) Identical to a 50 × 100 1/2 top plain brick (see table 4).

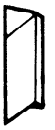
5) Identical to a 1/4 top plain brick (see table 4).

5.4 Special bricks

Special bricks are used to reverse the assembly direction and are made for walls of 50 mm lead thickness; for walls of 100 mm thickness, two special bricks are used side by side.

There are two types of special bricks: square bricks and X bricks for which the characteristics are given in tables 8 and 9 respectively, and for which the assembly directions are shown in figures 5 and 6, respectively.

Table 8 — Category 1 square bricks

Type	Reference number	Dimensions mm		Diagram	Approximate mass kg
		H	*L*		
Base square brick	1V0 170	100	0		1,5
Ordinary square brick	1V0 171	100	0		1,4
1/2 ordinary square brick	1V0 172	50	0		0,7
1/2 top square brick	1V0 173	50	0		0,5

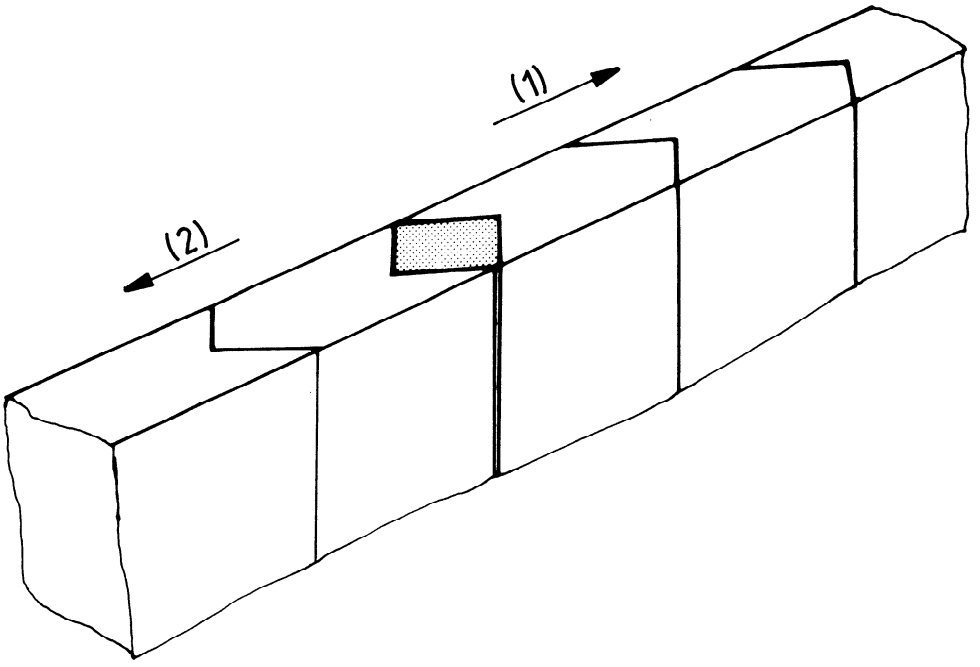
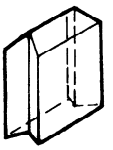
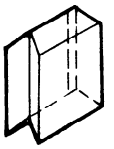
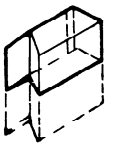
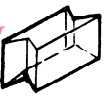


Figure 5 — Assembly of category 1 square bricks

Table 9 — Category 1 X bricks

Type	Reference number	Dimensions mm		Diagram	Approximate mass kg
		H	*L*		
Base X brick	1V0 180	100	100		4,6
Ordinary X brick	1V0 181	100	100		4,1
1/2 ordinary X brick	1V0 182	50	100		2,0
1/2 top X brick	1V0 183	50	100		1,5

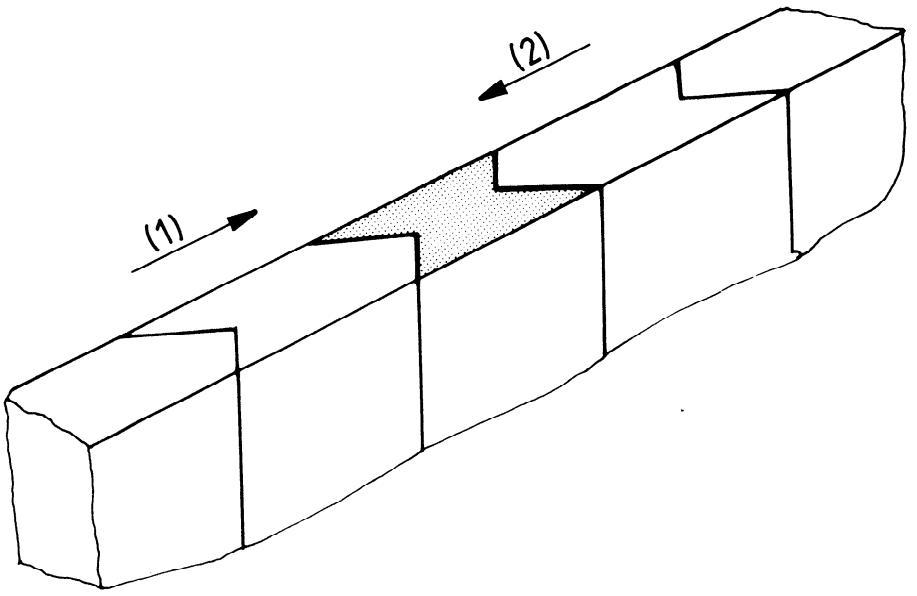


Figure 6 — Assembly of category 1 X bricks

5.5 Posts

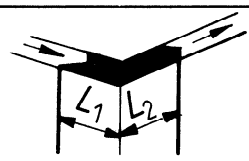
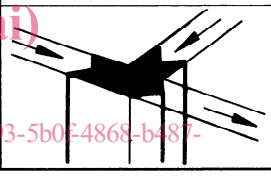
Posts are used to provide a framework for the brick enclosures.

When used, external tie rods and rigid angle bars can be attached.

These posts have a maximum height of 3 m; they are made of either antimoniated lead or soft lead cast on a steel frame.

The characteristics of the posts are given in table 10.

Table 10 — Category 2 posts (assembly direction 1)[1)]

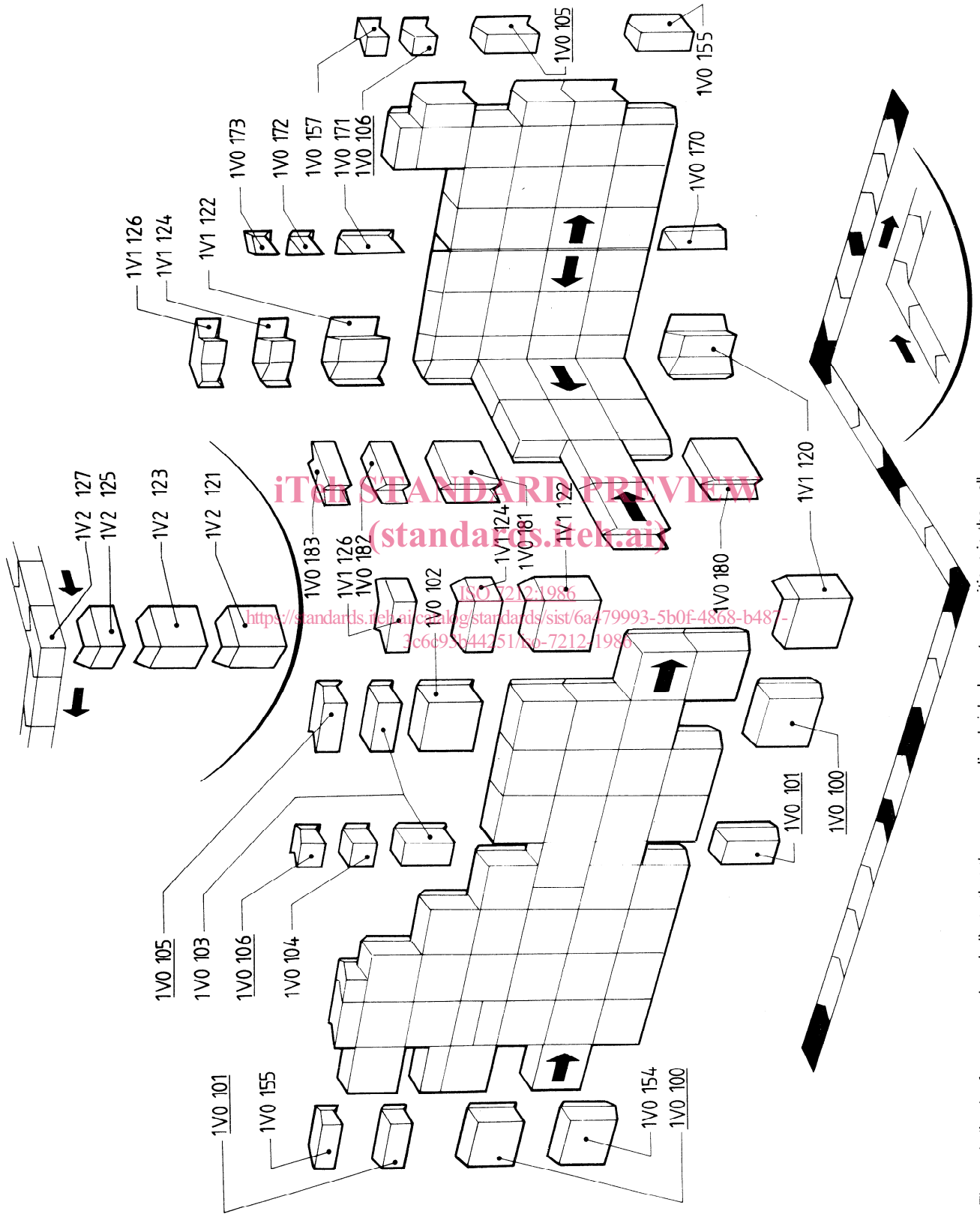
Type	Reference number	Section mm		Diagram	Approximate mass kg/m
		L_1 Re-entrant chevron	L_2 Projecting chevron		
Corner post	1V0 190	100	100		82,0
Tee post 2MF (2 male, 1 female)	1V0 191	100	100		89,0
Tee post 2FM (2 female, 1 male)	1V0 192	100	100		75,0

1) By turning these posts upside down, assembly direction 2 is obtained.

5.6 Assembly of basic units

A general diagram of the disposition of basic units for 50 mm lead thickness is given in figure 7 for the units of category 1, and in figure 8 for the units of category 2.

NOTE — All bricks, except corner bricks, are represented in their usual assembly direction, but they can be reversed.



The underlined reference numbers indicate that the corresponding bricks have two positions in the wall.

Figure 7 — General diagram of disposition of basic units for 50 mm lead thickness (category 1)