
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

First edition — 1986-06-15

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UDC 691.74-431 : 621.039.58

Ref. No. ISO 7212-1986 (E)

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

Price based on 55 pages

Foreword

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International Standard ISO 7212 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*.

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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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These are units which are used in one or a few countries and which will be withdrawn from this International Standard after the transition period.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)].

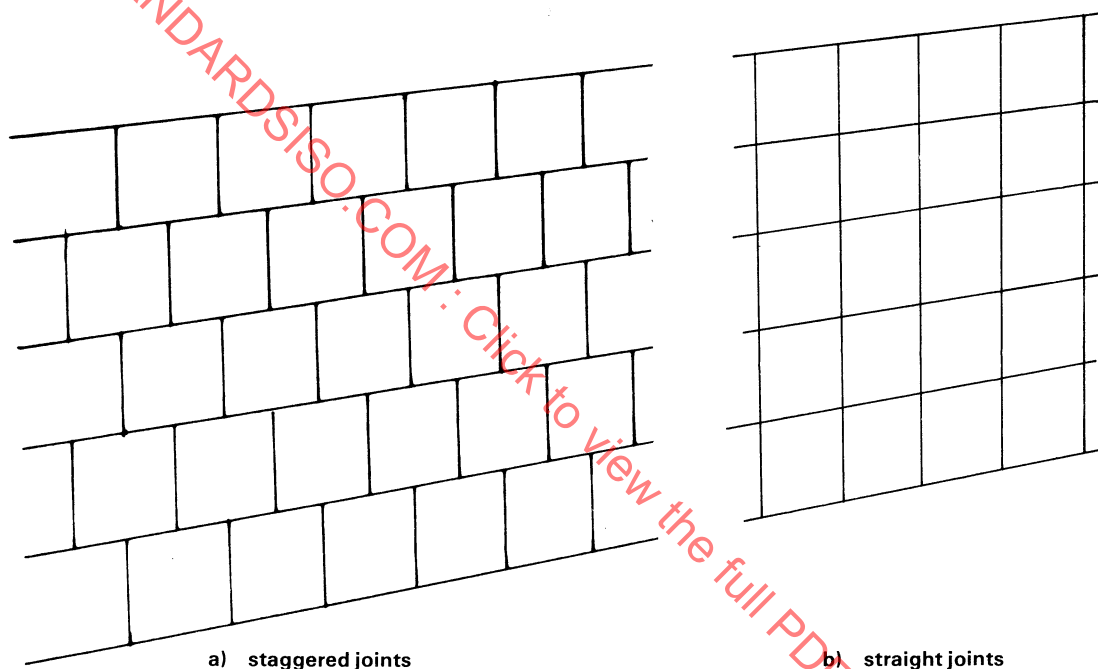


Figure 1 — Assembly of bricks

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).

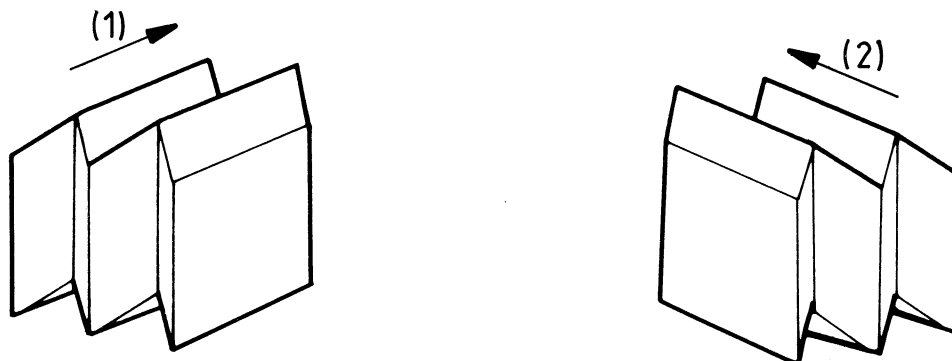


Figure 2 — Assembly directions of bricks

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			
$90^\circ + 15'$ 0	$90^\circ - 15'$ 0	$50 - 0,5$	$\pm 0,2$	$90^\circ \pm 10'$

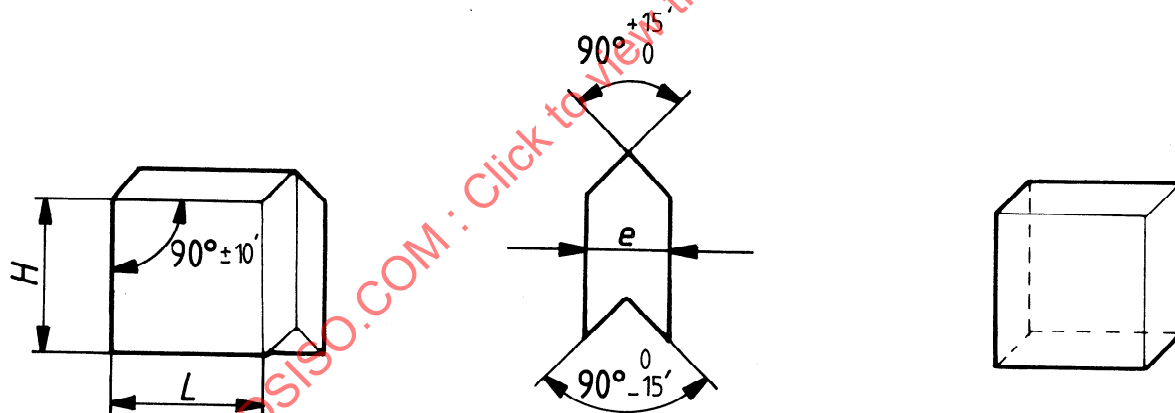


Figure 3 — Example of a one-chevron ordinary plain brick

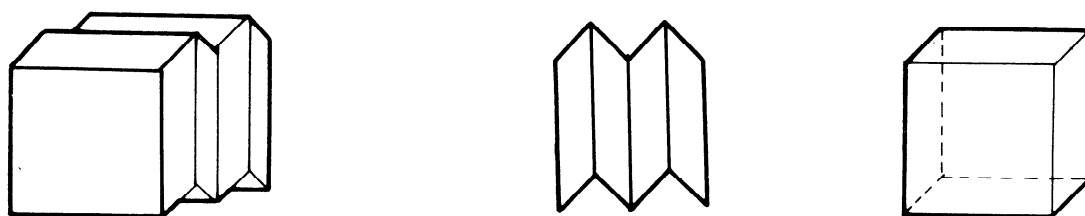


Figure 4 — Example of a two-chevron ordinary plain brick

Section one : Lead shielding units — 50 mm thick

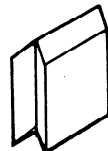
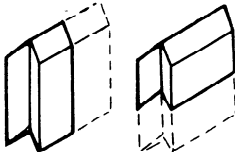
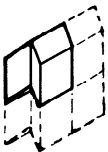
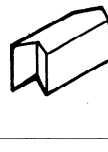
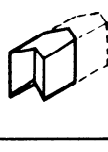
5 Categories 1 and 2

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
		<i>H</i>	<i>L</i>		
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.

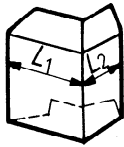
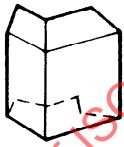
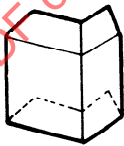
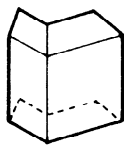
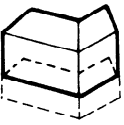
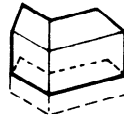
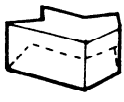
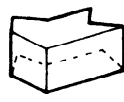
4) Identical to the 100 × 50 1/2 right-hand ordinary end brick (see table 7).

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

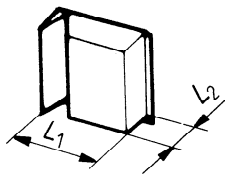
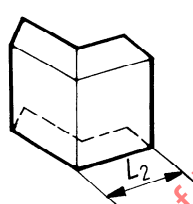
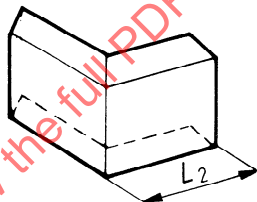
* The assembly direction indicated is for convex angle enclosures.

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.

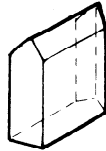
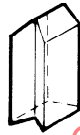
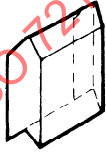
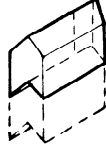
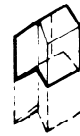
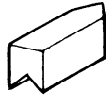
5.3 End bricks

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
		<i>H</i>	<i>L</i>		
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

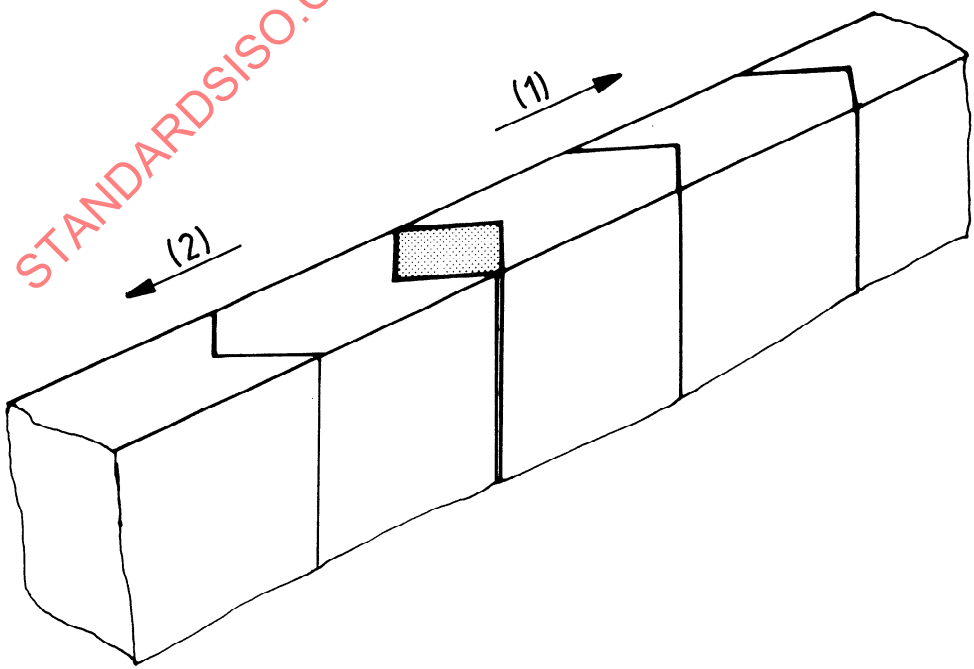
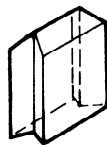
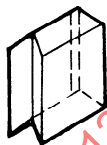
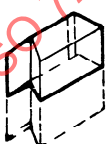
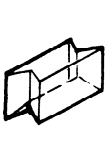


Figure 5 — Assembly of category 1 square bricks

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

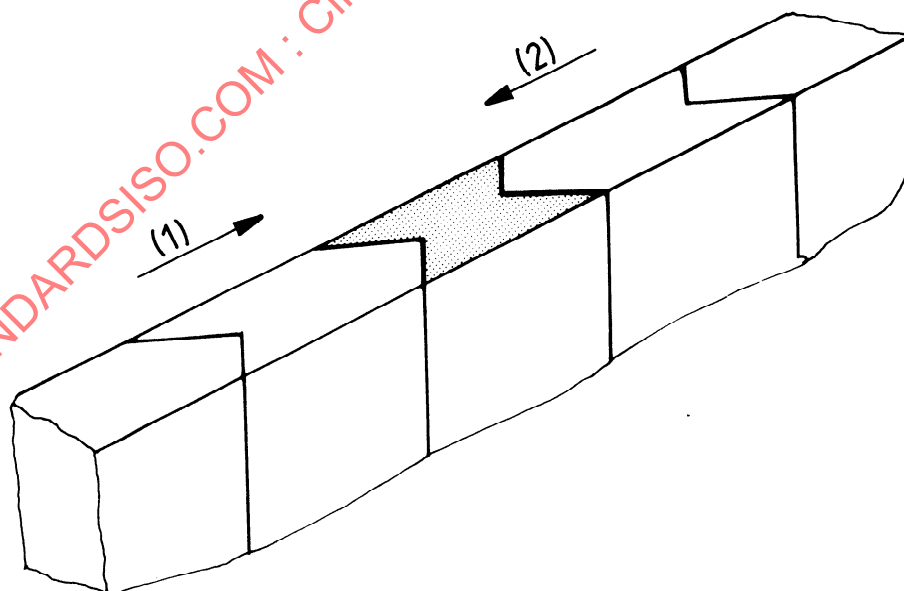


Figure 6 — Assembly of category 1 X bricks

5.5 Posts

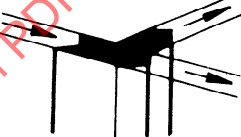
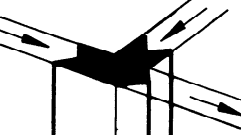
Posts are used to provide a framework for the brick enclosures.

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⁾

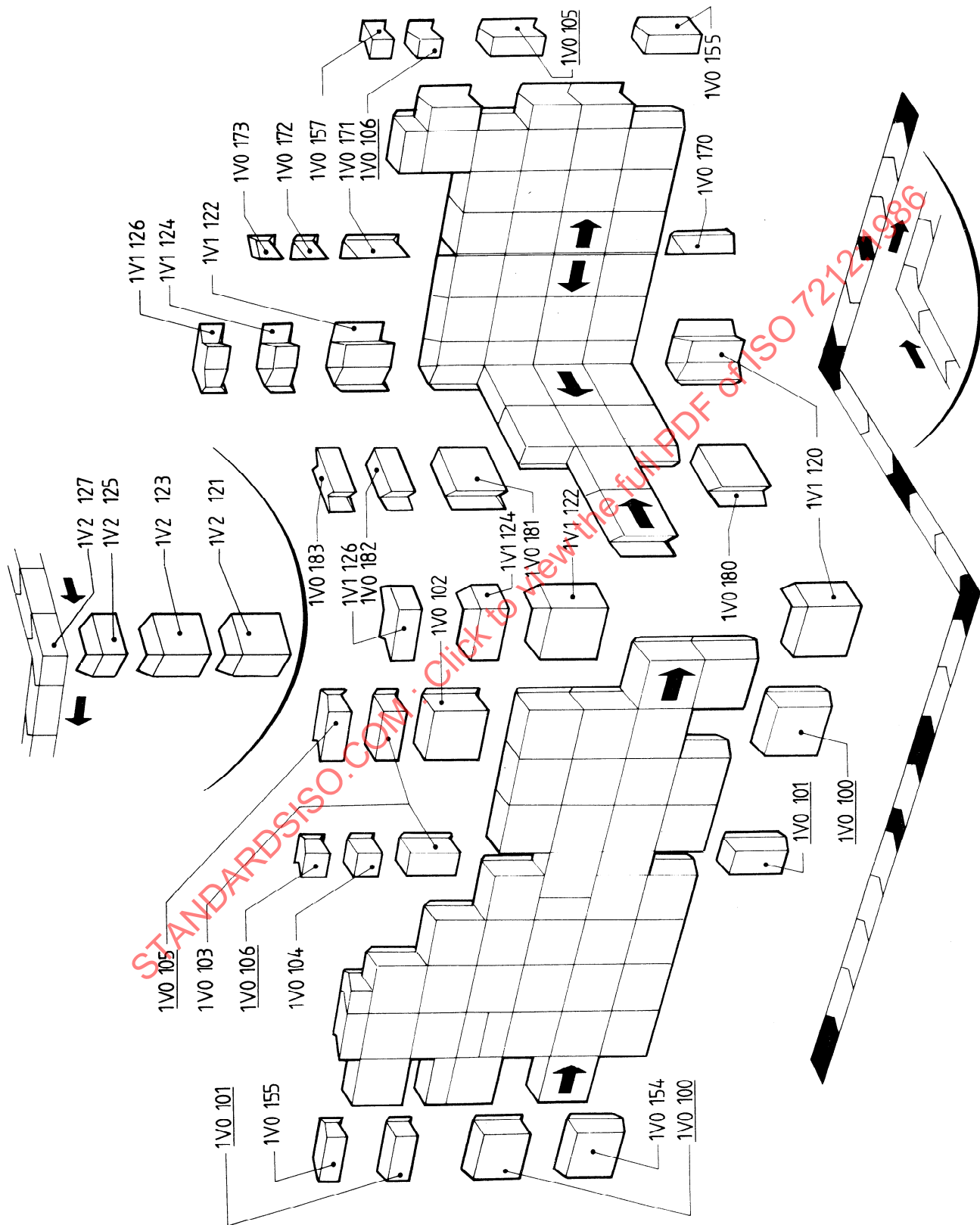
Type	Reference number	Section mm		Diagram	Approximate mass kg/m
		L_1 Re-entrant chevron	L_2 Projecting chevron		
Corner post	1V0 190	100	100		82,0
Tee post 2MF (2 male, 1 female)	1V0 191	100	100		89,0
Tee post 2FM (2 female, 1 male)	1V0 192	100	100		75,0

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)

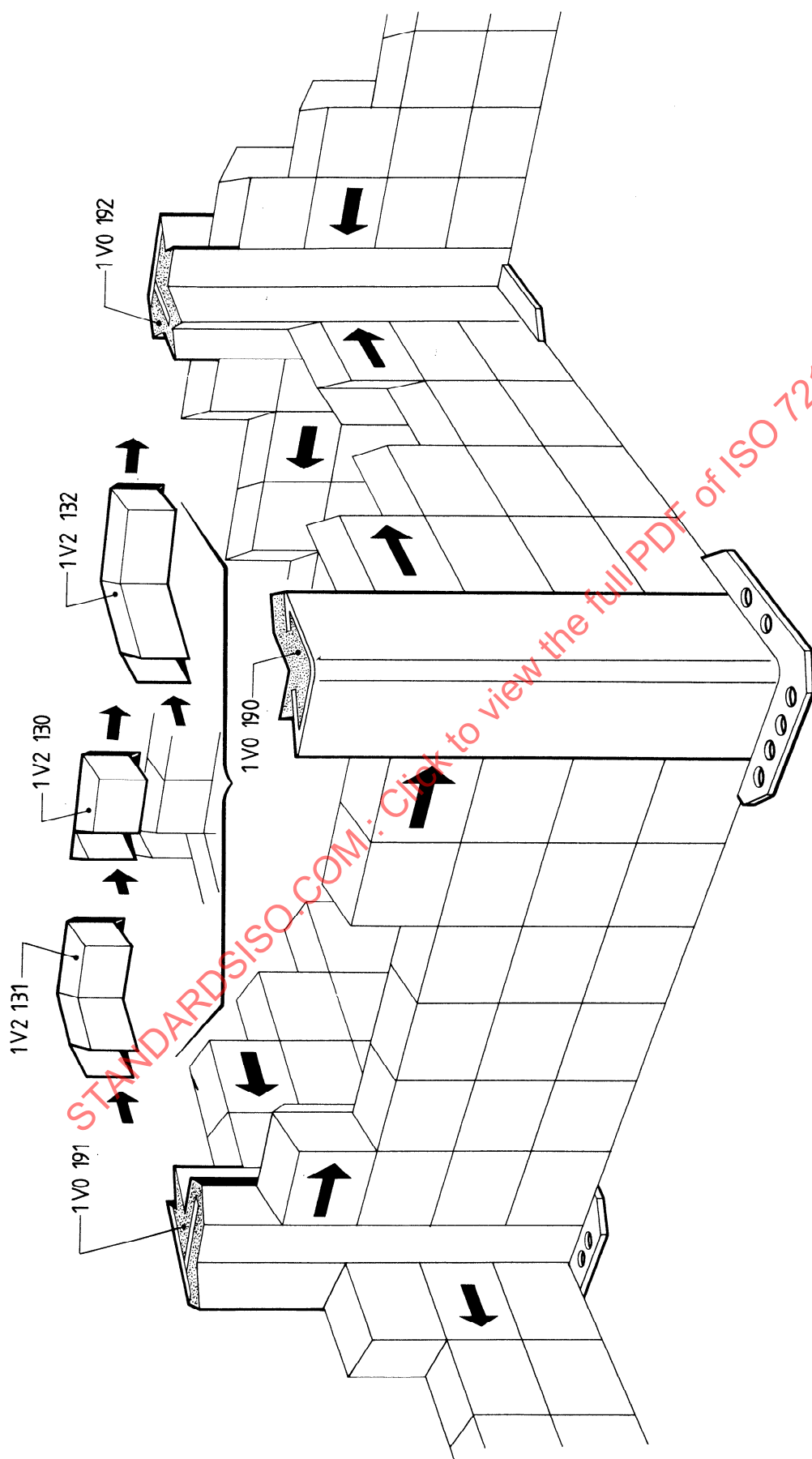


Figure 8 — General diagram of disposition of basic units for 50 mm lead thickness (category 2)

5.7 Aperture bricks

5.7.1 Non-demountable aperture bricks

See figures 9 and 10.

Externally aperture bricks are square or rectangular and their internal dimensions are standardized so that the units they hold may be interchanged.

The dimensions of the aperture bricks for 50 mm lead thickness are given in tables 11, 12 and 13.

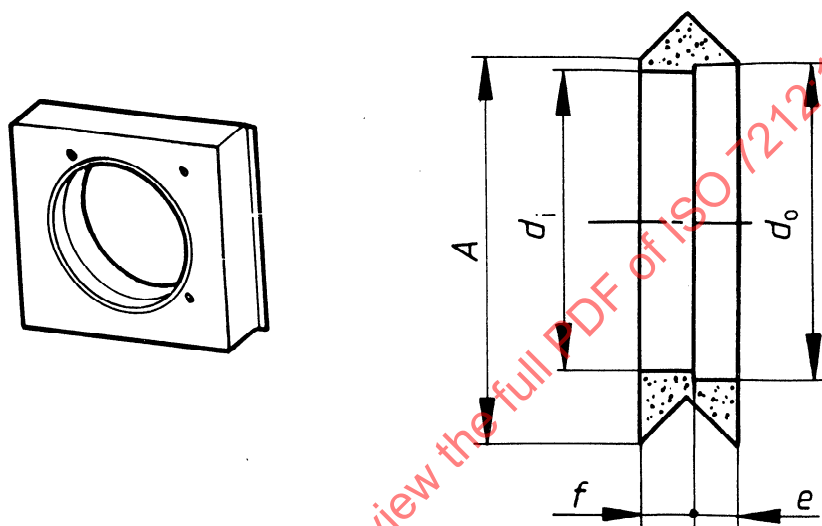


Figure 9 Aperture brick for circular units

Table 11 — Category 1 aperture bricks for circular units
(circular windows, plugs, spheres, reducing units)

Reference number	$A \times A$	d_i	d_o	e	f	Approximate mass kg
	mm					
1V0 200	200 × 200	170	172	22	26,5	9
1V0 201	250 × 250	210	214	10	40	15,3
1V0 202	300 × 300	266	270	20	26,5	18
1V0 204	400 × 400	366	370	20	26,5	24

NOTE — If, in special cases, an aperture brick is turned through 180° around the axis of the aperture to change the direction of assembly, it should be noted that, taking into account the chevron, the centreline of the aperture is offset 25 mm from the centreline of the face of the bricks.

Table 12 — Category 2 aperture bricks for circular units

Reference number	$A \times A$	d_i	d_o	e	f	Approximate mass kg
	mm					
1V0 205	150 × 150	104	108	—	50	7,9
1V0 207	200 × 200	150	160	25	25	11
1V0 209	250 × 250	195	205	25	25	17
1V0 211	300 × 300	240	250	25	25	23
1V0 213	350 × 350	285	295	25	25	32

NOTE — If, in special cases, an aperture brick is turned through 180° around the axis of the aperture to change the direction of assembly, it should be noted that, taking into account the chevron, the centreline of the aperture is offset 25 mm from the centreline of the face of the bricks.

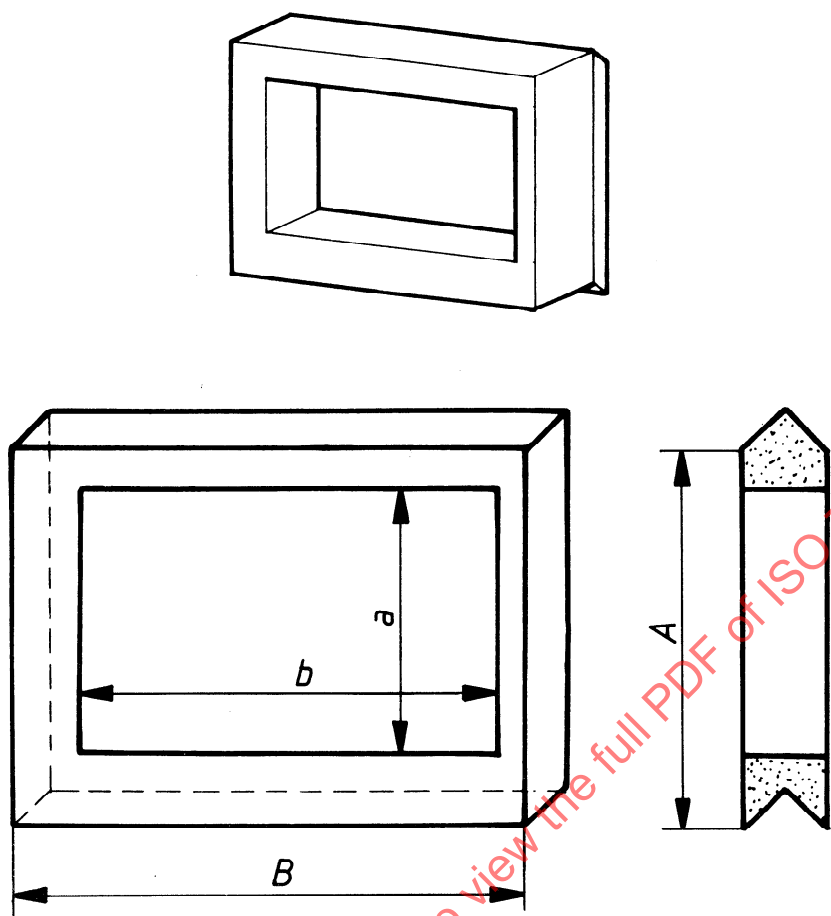


Figure 10 — Aperture bricks for square and rectangular windows

Table 13 — Category 1 aperture bricks for square and rectangular windows

Reference number	$A \times B$	Window mounting		Type and shape of window	Approximate mass kg
		a	b		
	mm				
1V0 250	250 × 250	171	176	Square 145 × 145	18,5
1V0 251	250 × 350	171	276	Rectangular 145 × 245	23
1V0 260	650 × 850	545	745	Rectangular 500 × 700	70

NOTE — If, in special cases, an aperture brick is turned through 180° around the vertical axis of the aperture to change the direction of assembly, it should be noted that, taking into account the chevron, the centreline of the aperture is offset 25 mm from the centreline of the face of the brick.

5.7.2 Special demountable circular aperture brick — Category 2 (1V0 220)

This aperture brick has the same properties as a non-demountable aperture brick (see 5.7.1). It is seldom used and allows an opening to be made in the wall. Its use is recommended whenever the wall cannot be partially dismantled from above (see figure 11).

This aperture brick should be placed either two or three rows below the top of the wall or under a rigid angle bar, as shown in figure 12.

The angle bar is used in lead brick walls at any level. It is used to increase stability and to distribute load.

In thicker walls the angle bars are placed side by side without joining.

These angle bars are supplied in 3 m lengths.

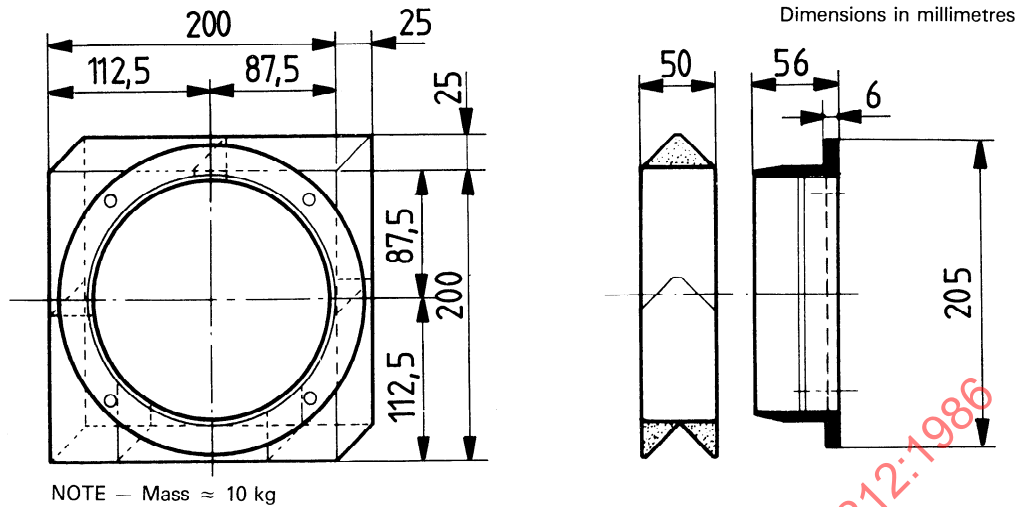
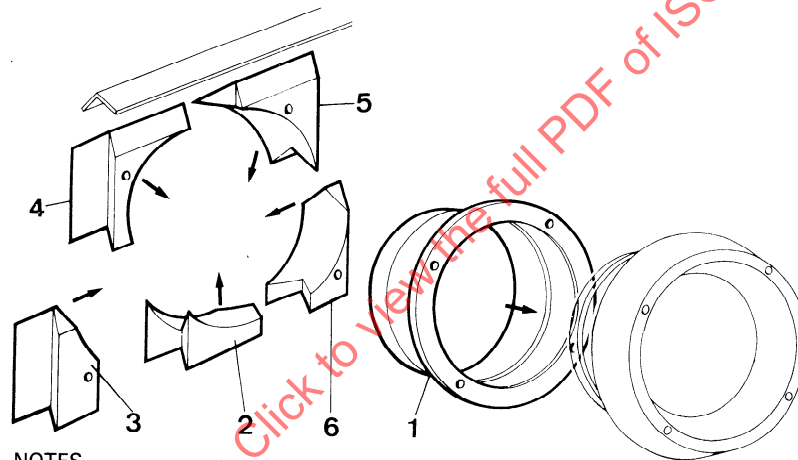


Figure 11a) — Special demountable circular aperture brick (1V0 220)



NOTES

- 1 If part 2 does not come out, support widthwise to release it.
- 2 When reassembling, support to introduce part 1.

Figure 11b) — Dismantling sequence

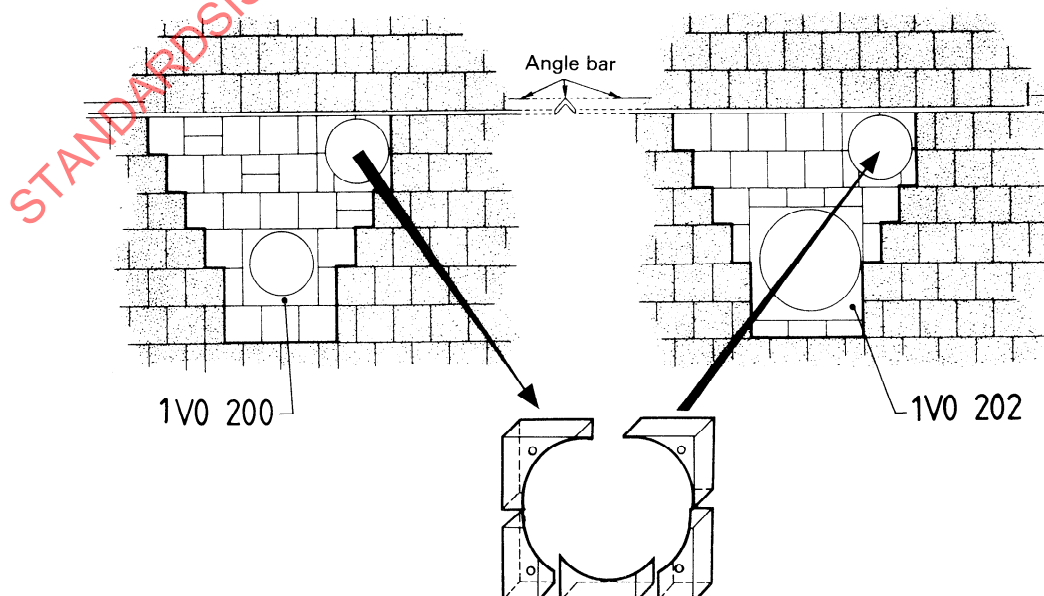


Figure 11c) — Example of use : replacement of a 1V0 200 aperture brick by a 1V0 202 aperture brick

Dimensions in millimetres

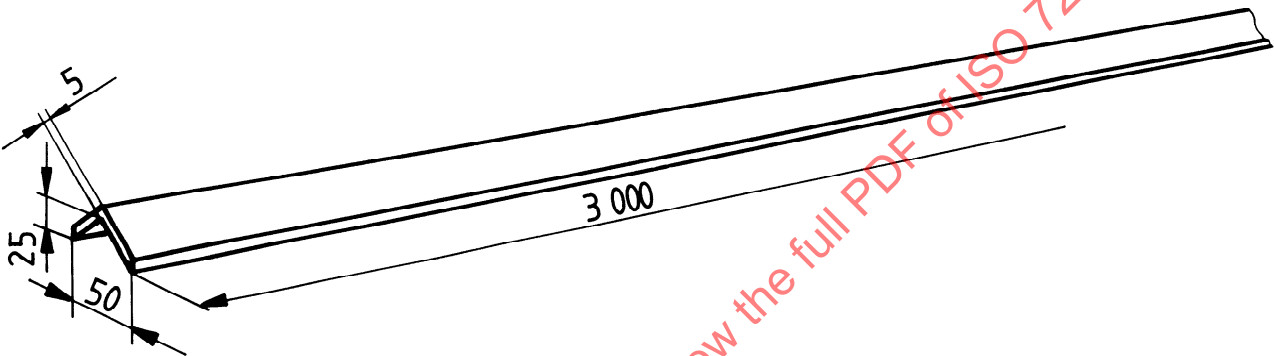


Figure 12 — Rigid angle bar

5.8 Windows

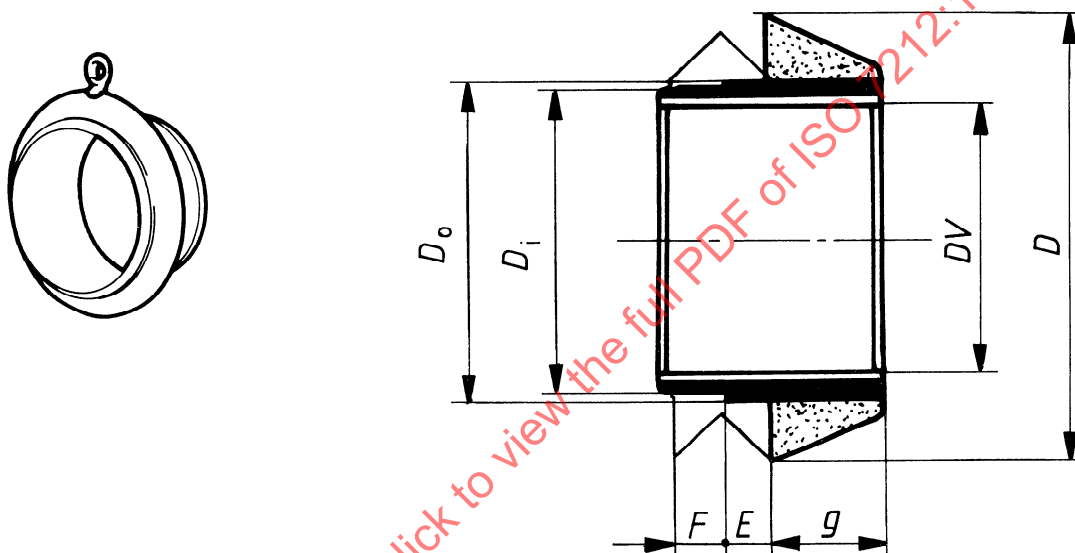
The minimum average density of the glass is $5,2 \pm 0,02 \text{ g/cm}^3$.

The minimum thickness of glass is 110 mm.

5.8.1 Circular windows

See figure 13.

The dimensions of the circular windows for 50 mm lead thickness are given in tables 14 and 15.



NOTE — Circular windows are demountable and interchangeable.

Figure 13 — Circular window

Table 14 — Category 1 circular windows

Aperture brick mm	Reference number	Window mounting ¹⁾				Flange		Glass		Approximate mass kg
		D_i	D_o	E	F	D	g	DV	Density	
		mm							g/cm ³	
200 × 200	1V0 300	170	172	22	26	232	80	140	5,2	24
300 × 300	1V0 302	266	270	20	26	334	80	230	5,2	50
400 × 400	1V0 304	366	370	20	26	434	80	330	5,2	91

1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.

Table 15 — Category 2 circular windows

Aperture brick mm	Reference number	Window mounting ¹⁾				Flange		Glass		Approximate mass kg
		D_i	D_o	E	F	D	g	DV	Density	
		mm							g/cm ³	
200 × 200	1V0 307	150	160	25	25	210	90	130	5,2	26
300 × 300	1V0 311	240	250	25	25	300	90	220	5,2	64

1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.

5.8.2 Square and rectangular windows

See figure 14.

The dimensions of the square and rectangular windows for 50 mm lead thickness are given in tables 16 and 17.

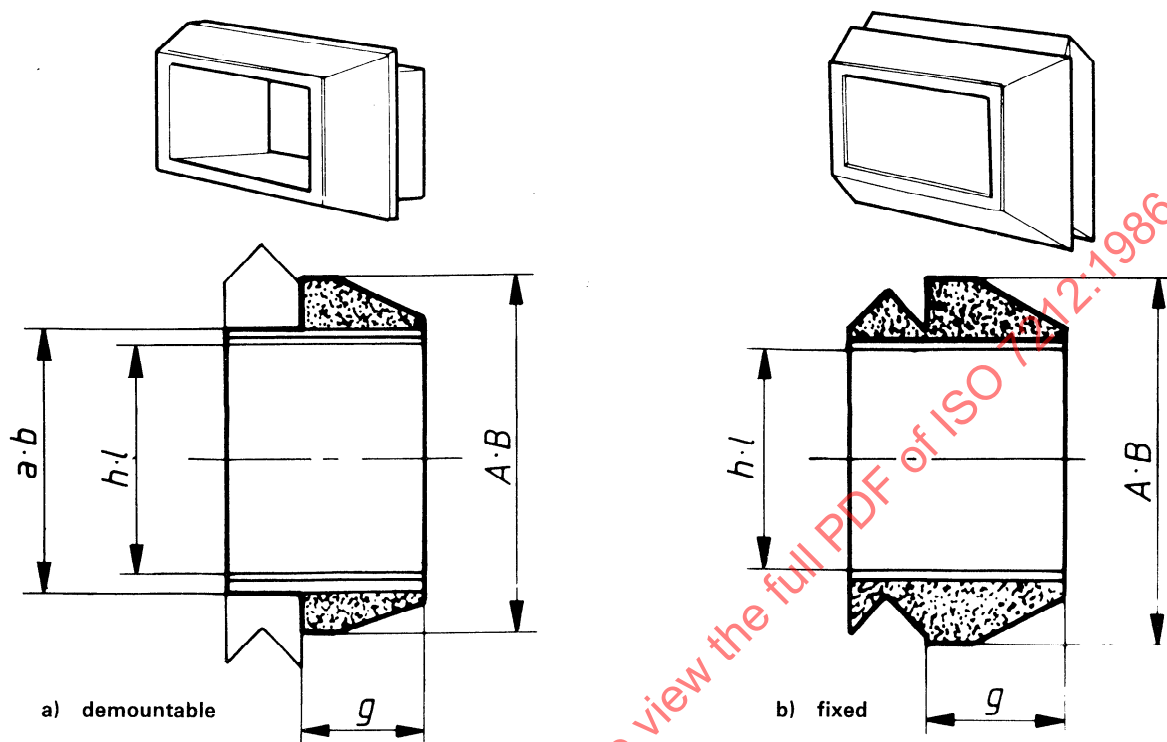


Figure 14 — Square and rectangular windows

Table 16 — Category 1 square and rectangular windows

Aperture brick mm	Reference number	Mounting ¹⁾		External frame			Glass			Approximate mass kg
		<i>a</i>	<i>b</i>	<i>A</i>	<i>B</i>	<i>g</i>	<i>h</i>	<i>l</i>	Density	
		mm							g/cm ³	
250 × 250	1V0 350	171 Demountable	176	230	235	80	145	145	5,2	26
250 × 350	1V0 351	171 Demountable	276	230	335	63	145	245	5,2	38
200 × 300	1V2 352	— Fixed	—	240	340	90	145	245	5,2	68
650 × 850	1V0 360	545 Demountable	745	770	970	112	500	700	5,2	550

1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.

Table 17 — Category 2 square and rectangular windows

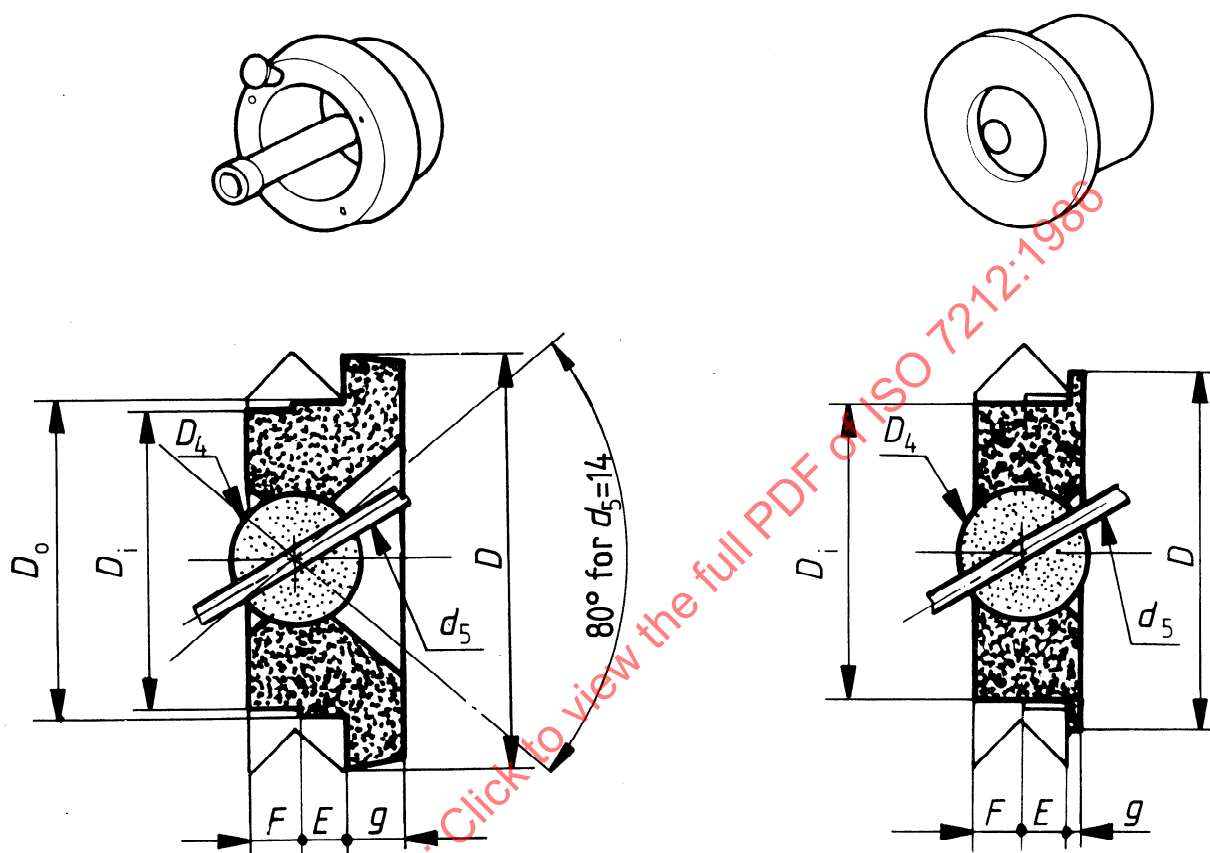
Aperture brick mm	Reference number	Mounting ¹⁾		External frame			Glass			Approximate mass kg
		<i>a</i>	<i>b</i>	<i>A</i>	<i>B</i>	<i>g</i>	<i>h</i>	<i>l</i>	Density	
		mm							g/cm ³	
200 × 200	1V2 355	— Fixed	—	240	240	90	145	145	5,2	52
300 × 300	1V2 356	— Fixed	—	340	340	90	245	245	5,2	92
400 × 500	1V2 358	— Fixed	—	420	510	90	330	420	5,2	180

1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.

5.9 Sphere units

See figure 15.

The dimensions of the sphere units for 50 mm lead thickness are given in tables 18 and 19.



NOTE — The flange is optional. It facilitates handling of the work piece, increases biological protection around the mounting and allows the sphere unit to be fixed in its aperture brick.

Figure 15 — Sphere units

Table 18 — Category 1 sphere units

Aperture brick mm	Reference number	Sphere unit mounting ¹⁾				Flange		Sphere unit		Approximate mass kg
		D_i	D_o	E	F	D	g	D_4	d_5 ϕ tong	
		mm								
200 × 200	1V0 400	170	172	22	26	220	34	70	14	20

1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.

Table 19 — Category 2 sphere units

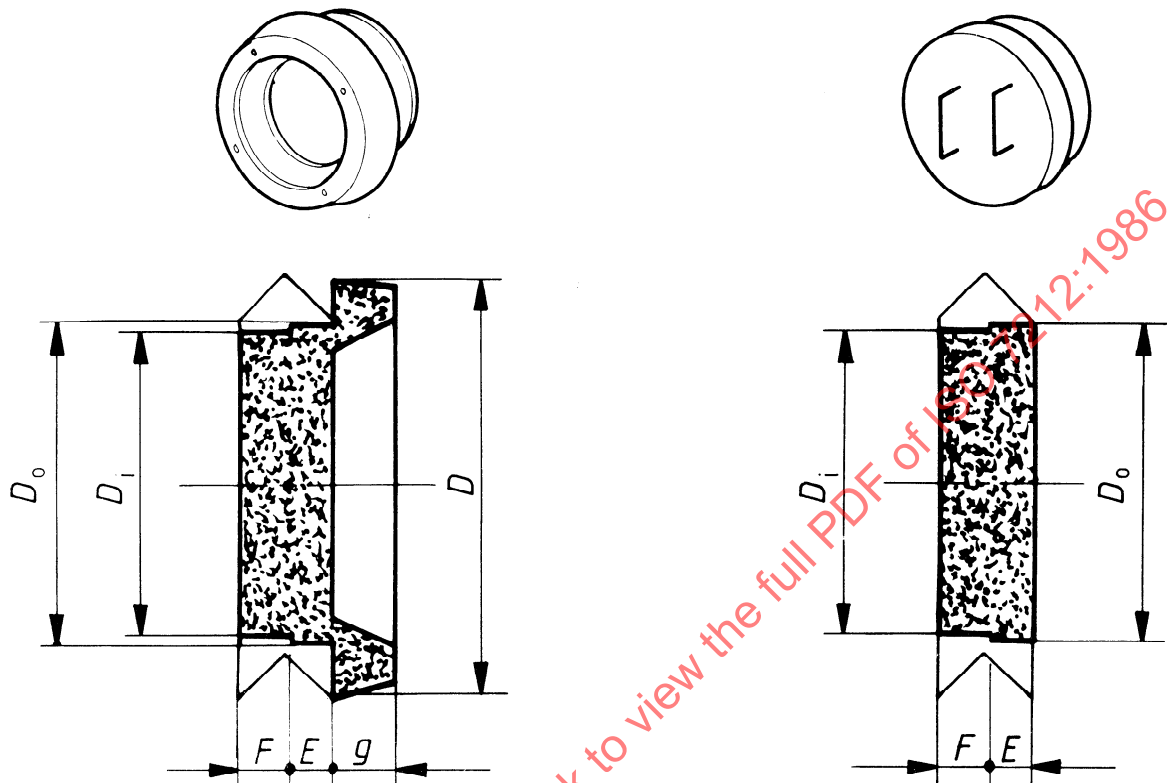
Aperture brick mm	Reference number	Sphere unit mounting ¹⁾				Flange		Sphere unit		Approximate mass kg
		D_i	D_o	E	F	D	g	D_4	d_5 ϕ tong	
		mm								
150 × 150	1V0 405	104	Not inset		50	125	6	70	12,7	6
200 × 200	1V0 407	150	160	25	25	160	10	80	14	13

1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.

5.10 Plugs

See figure 16.

The dimensions of the plugs for 50 mm lead thickness are given in tables 20 and 21.



NOTE — The flange is optional. It facilitates handling of the workpiece, increases biological protection around the mounting and allows the plug to be fixed in its aperture brick.

Figure 16 — Plugs

Table 20 — Category 1 plugs

Aperture brick mm	Reference number	Plug mounting ¹⁾				Flange		Approximate mass kg
		D_i	D_o	E	F	D	g	
		mm						
200 × 200	1V0 500	170	172	22	26	220	34	20
300 × 300	1V0 502	266	270	20	26	320	43	48
400 × 400	1V0 504	366	370	20	26	430	60	96

1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.

Table 21 — Category 2 plugs

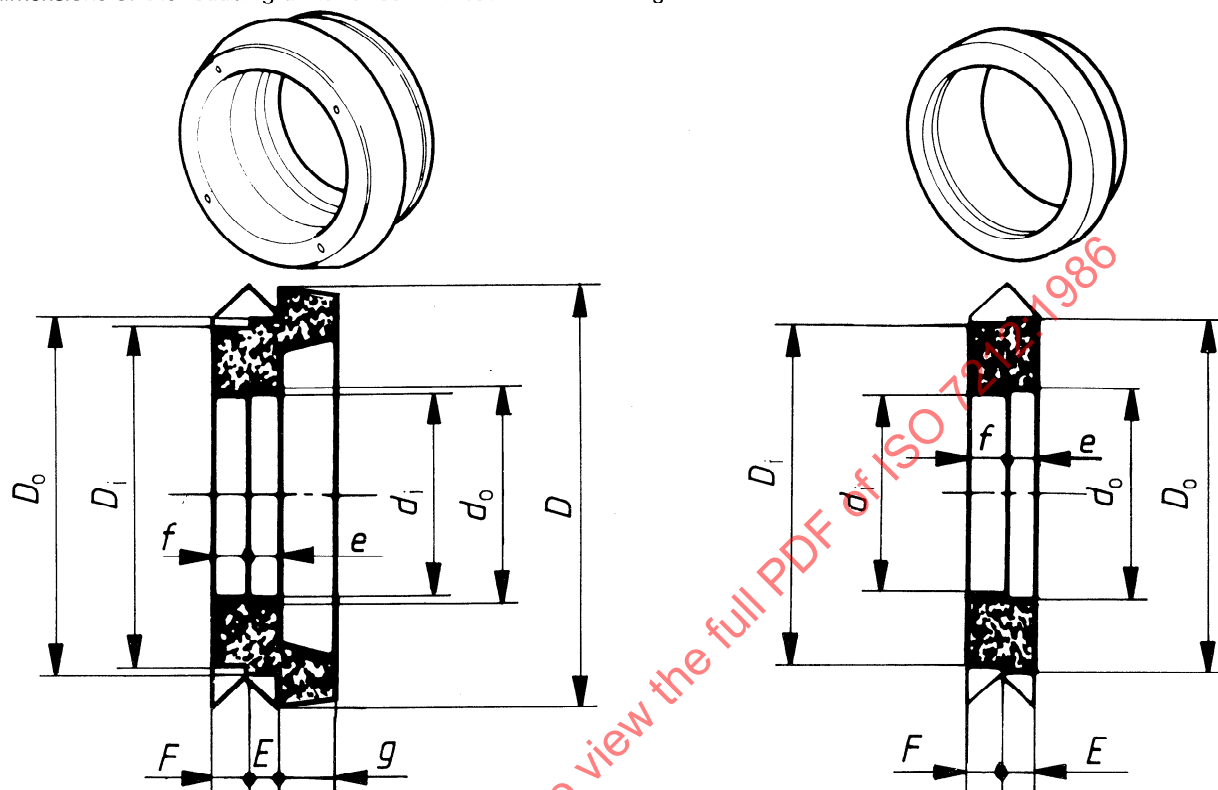
Aperture brick mm	Reference number	Plug mounting ¹⁾				Flange		Approximate mass kg
		D_i	D_o	E	F	D	g	
		mm						
150 × 150	1V0 505	104	Not inset		50	112	3	5
200 × 200	1V0 507	150	160	25	25	Without flange		10
250 × 250	1V0 509	195	205	25	25			17
300 × 300	1V0 511	240	250	25	25			25

1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.

5.11 Reducing units

See figure 17.

The dimensions of the reducing units for 50 mm lead thickness are given in tables 22 and 23.



NOTE — The flange is optional. It facilitates handling of the workpiece, increases biological protection around the mounting and allows the reducing unit to be fixed in its aperture brick.

Figure 17 — Reducing units

Table 22 — Category 1 reducing units

Aperture brick mm	Reference number	External mounting ^{1) 2)}				Internal mounting				Approximate mass kg
		D_i	D_o	E	F	d_i	d_o	e	f	
		mm								
250 × 250	1V0 601	210	214	10	40	104	Not inset		50	14,7
300 × 300	1V0 602	266	270	20 + flange	26	170	172	22	26	32
300 × 300	1V0 603	266	270	20	26	210	214	10	40	11,7
400 × 400	1V0 604	366	370	20 + flange	26	266	270	20	26	60

1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.

2) For dimensions D and g of flange, see plugs (5.10).

Table 23 — Category 2 reducing units

Aperture brick mm	Reference number	External mounting ^{1) 2)}				Internal mounting				Approximate mass kg
		D_i	D_o	E	F	d_i	d_o	e	f	
		mm								
250 × 250	1V0 609	195	205	25	25	150	160	25	25	7
300 × 300	1V0 610	240	250	25	25	150	160	25	25	15
300 × 300	1V0 611	240	250	25	25	195	205	25	25	8
350 × 350	1V0 613	285	295	25	25	240	250	25	25	10

1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.

2) For dimensions D and g of flange, see plugs (5.10).

5.12 Assembly of functional units

A general diagram of functional units for 50 mm lead thickness is given in figure 18 for the units of category 1, and in figure 19 for the units of category 2.

In each of the diagrams, units such as aperture bricks (circular, rectangular and square) windows, plugs, sphere units and reducing units have been illustrated.

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

- in category 1, 1V2 352;
- in category 2, 1V2 355;
1V2 356;
1V2 358;

which are fixed units.

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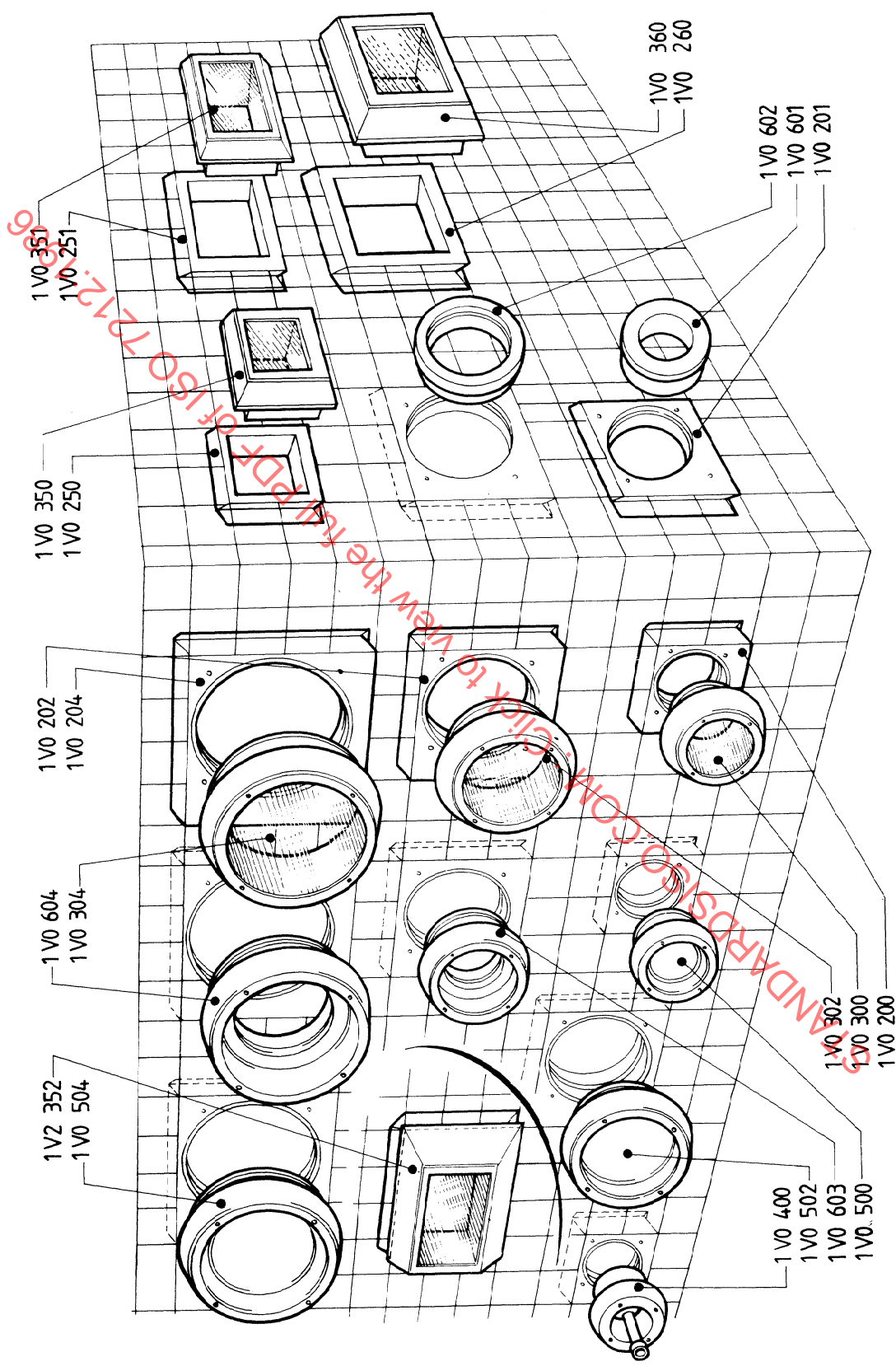


Figure 18 — General diagram of functional units for 50 mm lead thickness (category 1)

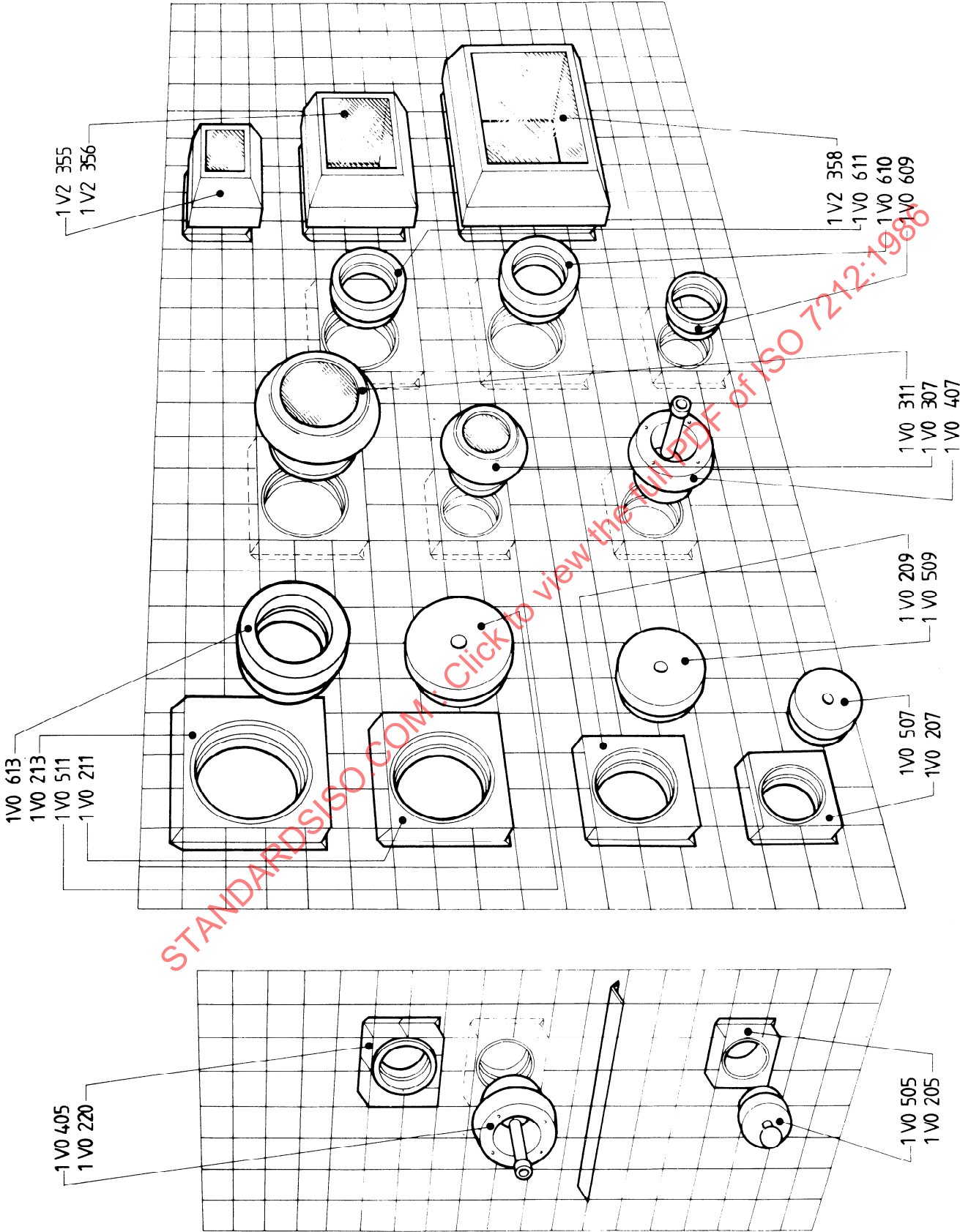


Figure 19 — General diagram of functional units for 50 mm lead thickness (category 2)

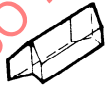
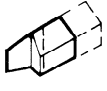
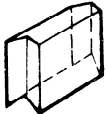
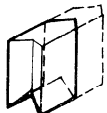
6 Category 3

6.1 Plain bricks

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

Table 24 shows the dimensions of category 3, one-chevron plain bricks.

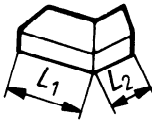
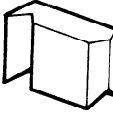
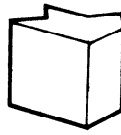
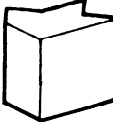
Table 24 — Category 3 plain bricks

Type	Reference number	Dimensions mm		Diagram	Approximate mass kg
		<i>H</i>	<i>L</i>		
Base plain brick (old type)	1V0 110	15	100		1,5
1/2 base plain brick (old type)	1V0 111	15	50		0,8
Top plain brick (old type)	1V0 112	85	100		3,9
1/2 top plain brick (old type)	1V0 113	85	50		2,0

6.2 Corner bricks

The dimensions of category 3, one-chevron corner bricks are given in table 25.

Table 25 — Category 3 corner bricks

Type	Reference number	Dimensions mm			Diagram	Assembly directions*	Approximate mass kg
		H	L ₁ Re-entrant chevron	L ₂ Projecting chevron			
Base corner brick (old type)	1V1 140	15	100	50		(1) →	1,5
Vee base corner brick (old type)	1V2 141	15	150	50		(2) ←	2,3
Top corner brick (old type)	1V1 142	85	100	50		(1) →	4,0
Vee top corner brick (old type)	1V2 143	85	150	50		(2) ←	5,9
Left-hand top corner brick (old type)	1V1 144	100	100	50		(1) →	4,8
Right-hand top corner brick (old type)	1V2 145	100	100	50		(2) ←	4,8

* See footnote under table 5.

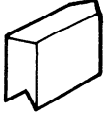
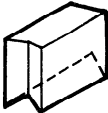
6.3 End bricks

End bricks are only provided for walls of 50 mm lead thickness (one-chevron bricks). 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 26.

Table 26 — Category 3 end bricks

Type	Reference number	Dimensions mm		Diagram	Approximate mass kg
		<i>H</i>	<i>L</i>		
Left-hand base end brick (old type)	1V0 160	15	100		1,7
Right-hand base end brick (old type)	1V0 161	15	100		1,7
Left-hand top end brick (old type)	1V0 162	85	100		4,5
Right-hand top end brick (old type)	1V0 163	85	100		4,5

6.4 Special bricks

Special bricks are used to reverse the assembly direction and are made for walls of 50 mm 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 dimensions are given in tables 27 and 28, respectively, and for which the assembly directions are shown in figures 20 and 21, respectively.

Table 27 — Category 3 square bricks

Type	Reference number	Dimensions mm		Diagram	Approximate mass kg
		H	L		
Base square brick (old type)	1V0 175	15	0		0,4
Top square brick (old type)	1V0 176	85	0		1,0
1/2 top square brick (old type)	1V0 177	35	0		0,3

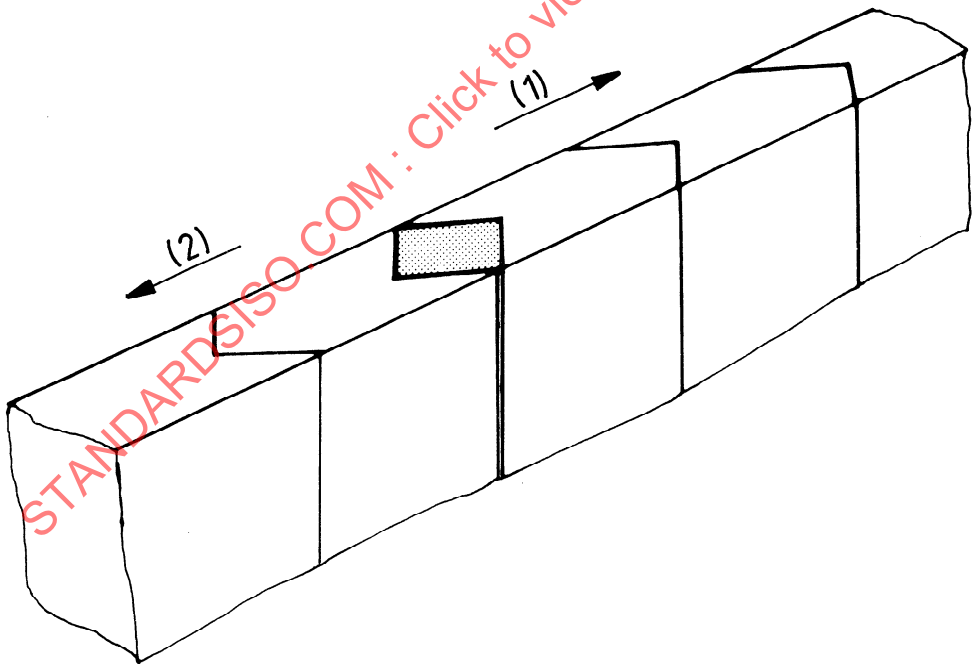
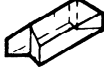
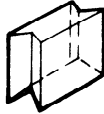


Figure 20 — Assembly of category 3 square bricks

Table 28 — Category 3 X bricks

Type	Reference number	Dimensions mm		Diagram	Approximate mass kg
		<i>H</i>	<i>L</i>		
Base X brick (old type)	1V0 185	15	100		1,1
Top X brick (old type)	1V0 186	85	100		3,0

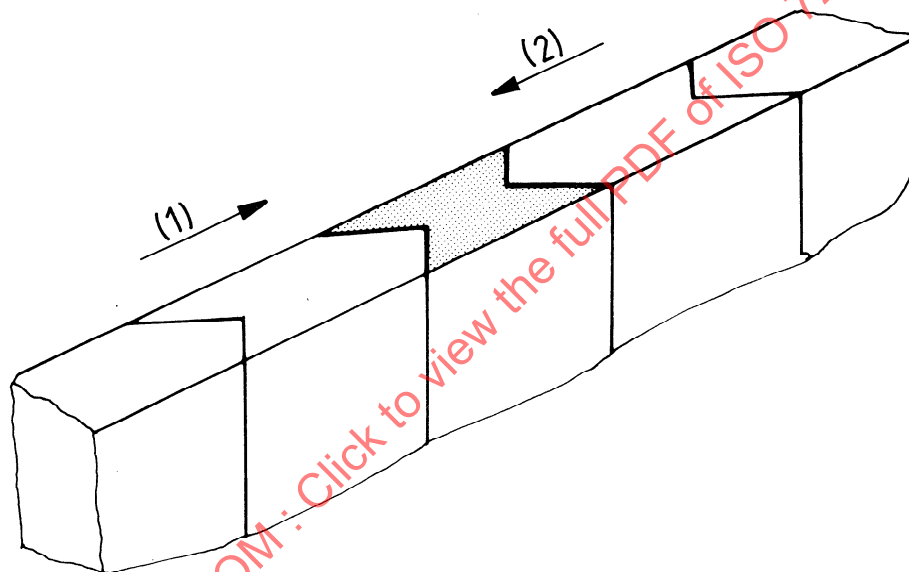


Figure 21 — Assembly of category 3 X bricks

Section two : Lead shielding units — 100 mm thick

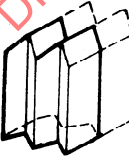
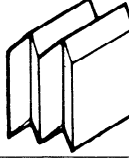
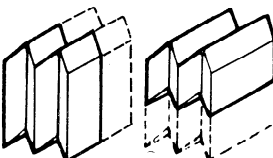
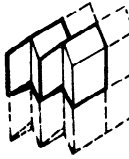
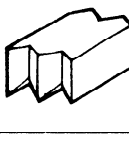
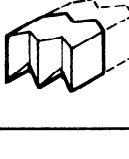
7 Categories 1 and 2

7.1 Plain bricks

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

Table 29 shows the dimensions of category 1, two-chevron plain bricks. It should be stated that the unit module for the designation of the bricks is 100 mm × 100 mm.

Table 29 — Category 1 plain bricks

Type	Reference number	Dimensions mm		Diagram	Approximate mass kg
		H	L		
Base plain brick ¹⁾	2V0 100	100	100		12,3
1/2 base plain brick ²⁾	2V0 101	100	50		6,1
Ordinary plain brick	2V0 102	100	100		10,9
1/2 ordinary plain brick ³⁾	2V0 103	100	50		5,5
		50	100		
1/4 ordinary plain brick	2V0 104	50	50		2,7
1/2 top plain brick ⁴⁾	2V0 105	50	100		4,1
1/4 top plain brick ⁵⁾	2V0 106	50	50		2,0

1) Identical to the 100 × 100 left-hand ordinary end brick (see table 32).

2) Identical to the 50 × 100 1/2 left-hand ordinary end brick (see table 32).

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

4) Identical to the 100 × 50 1/2 right-hand ordinary end brick (see table 32).

5) Identical to the 1/4 right-hand ordinary end brick (see table 32).

7.2 Corner bricks

The dimensions of category 1 and 2, two-chevron corner bricks are given in tables 30 and 31, respectively.

Table 30 — 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	2V1 120	100	150	100		(1) →	18,4
Base corner brick	2V2 121	100	150	100		(2) ←	18,4
Ordinary corner brick	2V1 122	100	150	100		(1) →	16,4
Ordinary corner brick	2V2 123	100	150	100		(2) ←	16,4
1/2 ordinary corner brick	2V1 124	50	150	100		(1) →	8,2
1/2 ordinary corner brick	2V2 125	50	150	100		(2) ←	8,2
1/2 top corner brick	2V1 126	50	150	100		(1) →	6,1
1/2 top corner brick	2V2 127	50	150	100		(2) ←	6,1

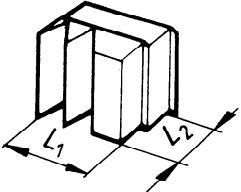
* The assembly direction indicated is for convex angle enclosures.

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 24.

Table 31 — 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	2V2 130	100	150	100		(2) ←	16,4

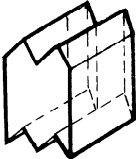
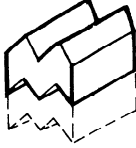
* See footnote under table 30.

7.3 End bricks

Left-hand end bricks for assembly direction 1, when reversed, serve as right-hand end bricks for assembly direction 2. The dimensions of the end bricks for assembly direction 1 are given in table 32.

Some one-chevron end bricks may in certain cases be used for walls of 100 mm thickness as shown in the general diagram in figure 24.

Table 32 — Category 1 end bricks

Type	Reference number	Dimensions mm		Diagram	Approximate mass kg
		H	L		
Left-hand ordinary end brick ¹⁾	2V0 100	100	100		12,3
1/2 left-hand ordinary end brick ²⁾	2V0 101	50	100		6,1
1/2 right-hand ordinary end brick ³⁾	2V0 105	100	50		4,1
1/4 right-hand ordinary end brick ⁴⁾	2V0 106	50	50		2,0

1) Identical to the 100 × 100 base plain brick (see table 29).

2) Identical to the 100 × 50 1/2 base plain brick (see table 29).

3) Identical to the 50 × 100 1/2 top plain brick (see table 29).

4) Identical to 1/4 top plain brick (see table 29).

7.4 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 (see 5.4).

There are two types of special bricks: square bricks (see figure 22) and X bricks (see figure 23).

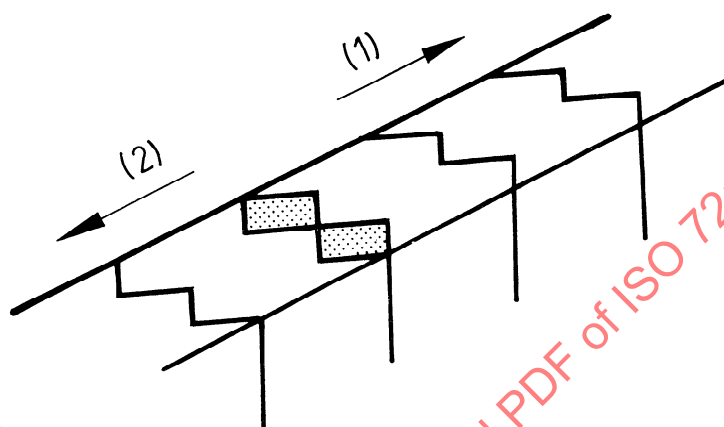


Figure 22 — Assembly of category 1 square bricks

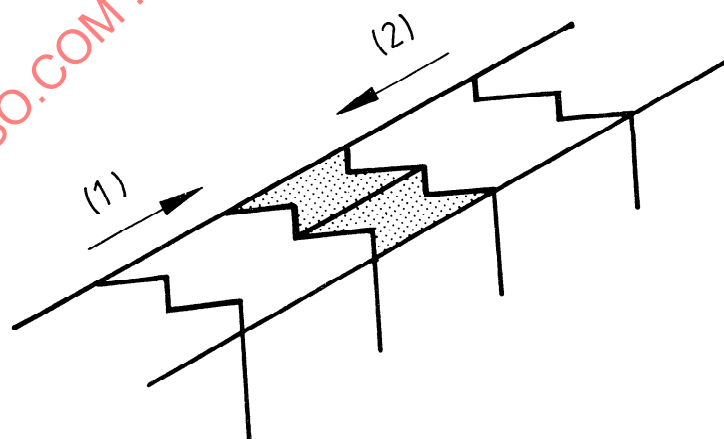


Figure 23 — Assembly of category 1 X bricks

7.5 Posts

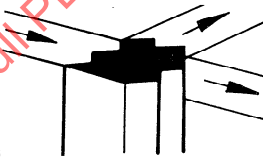
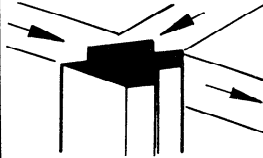
Posts are used to provide a framework for the brick enclosures.

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 33.

Table 33 — Category 2 posts (assembly direction 1)¹⁾

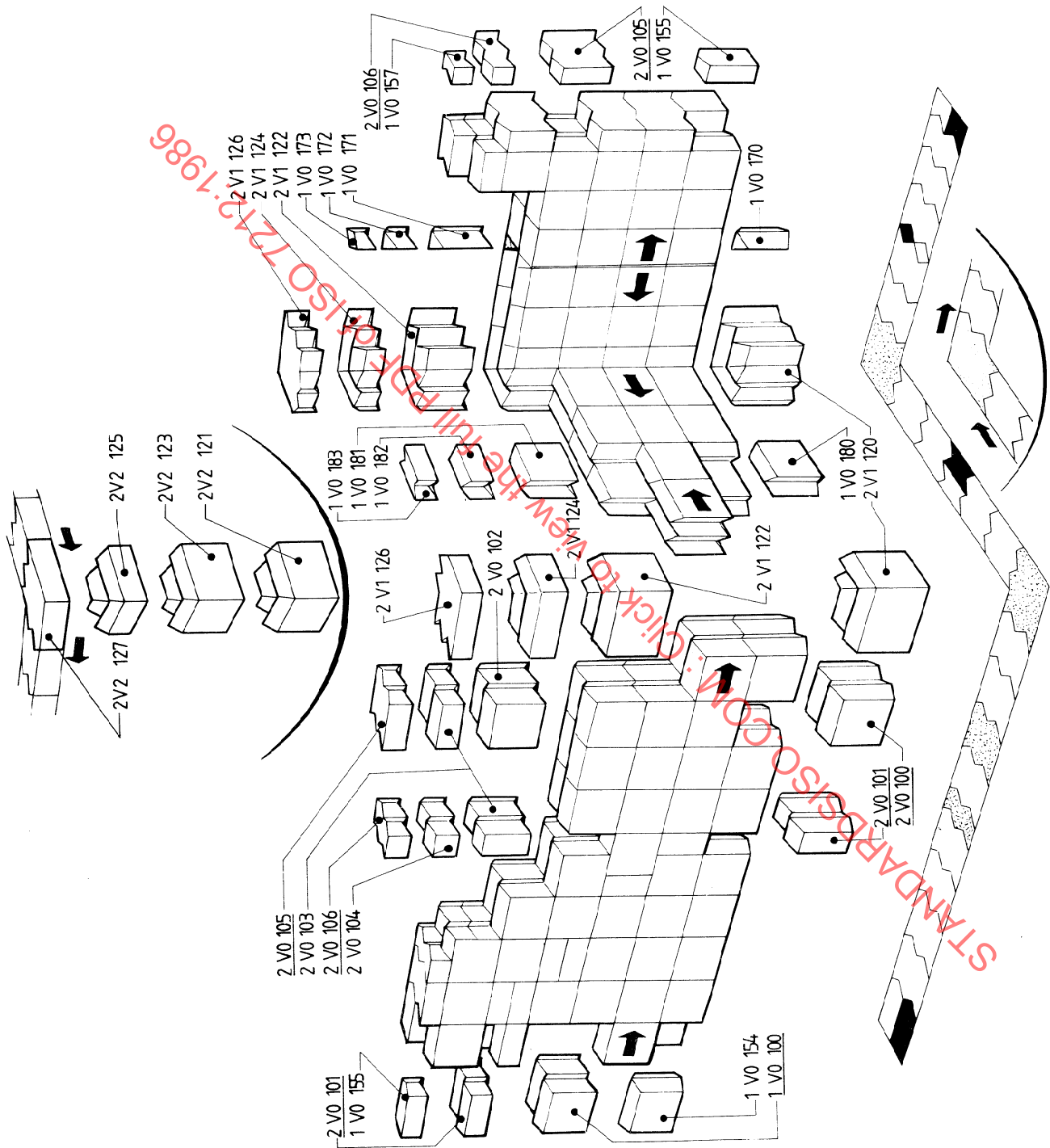
Type	Reference number	Section mm		Diagram	Approximate mass kg/m
		L_1 Re-entrant chevron	L_2 Projecting chevron		
Corner post	2V0 190	100	100		109
Tee post 2MF (2 male, 1 female)	2V0 191	100	100		123
Tee post 2FM (2 female, 1 male)	2V0 192	100	100		96

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

7.6 Assembly of basic units

A general diagram of the disposition of basic units for 100 mm lead thickness is given in figure 24 for the units of category 1, and in figure 25 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 24 — General diagram of disposition of basic units for 100 mm thickness (category 1)

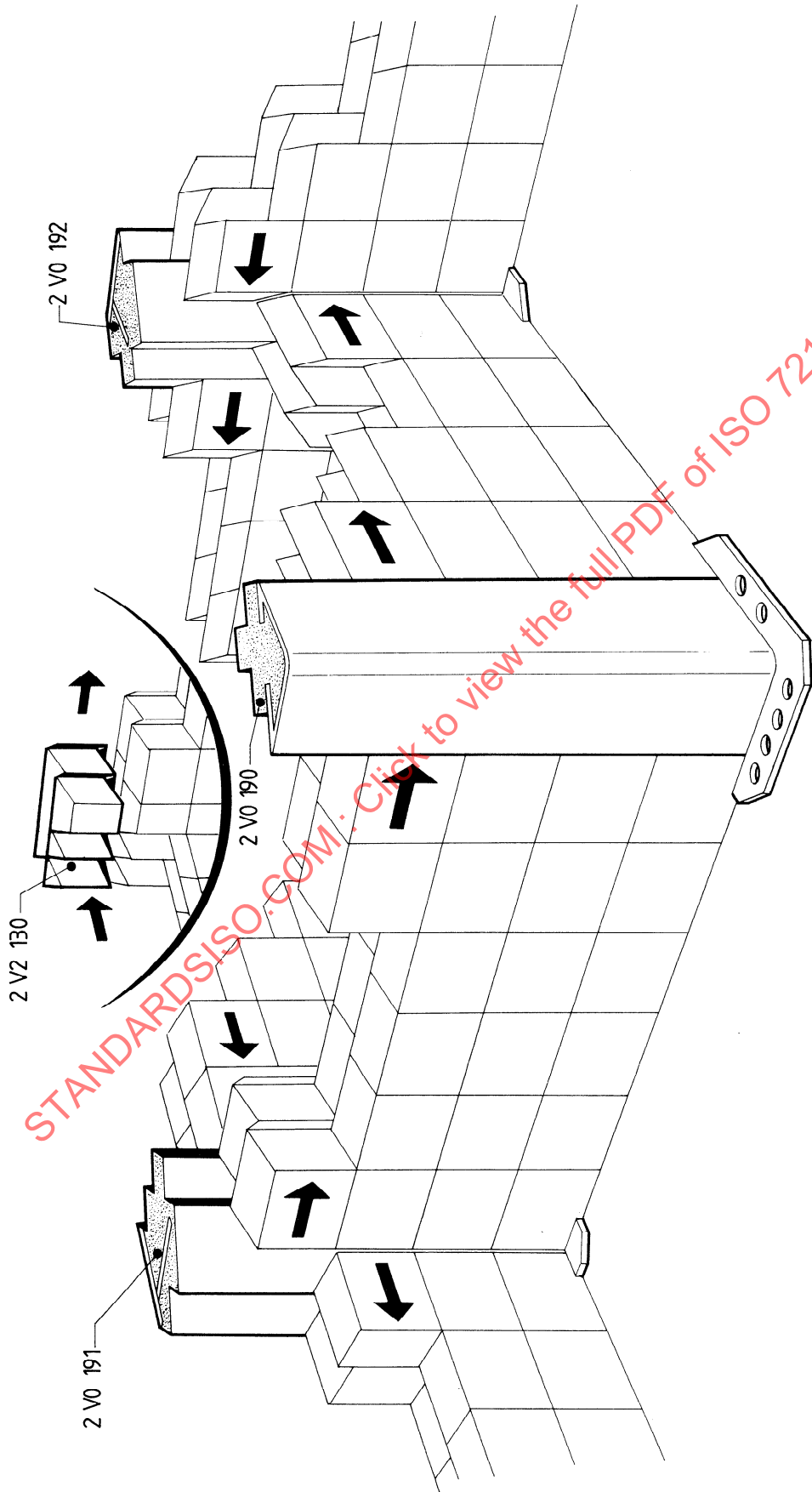


Figure 25 — General diagram of disposition of basic units for 100 mm lead thickness (category 2)

7.7 Aperture bricks

7.7.1 Non-demountable aperture bricks

See figures 26 and 27.

Externally aperture bricks are square or rectangular and their internal dimensions are standardized so that the units they hold may be interchanged.

The dimensions of the aperture bricks for 100 mm lead thickness are given in tables 34, 35 and 36.

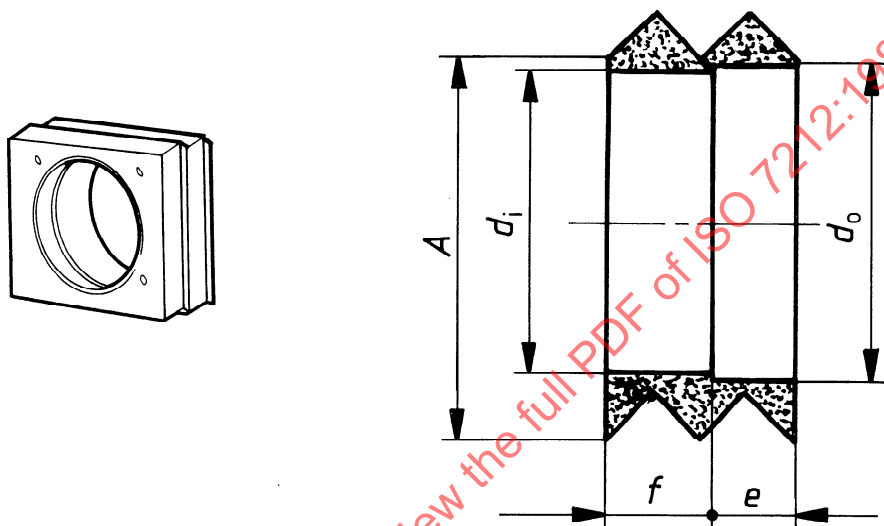


Figure 26 — Aperture brick for circular units

Table 34 — Category 1 circular aperture bricks for circular units
(circular windows, plugs, spheres, reducing units)

Reference number	$A \times A$	d_i	d_o	e	f	Approximate mass kg
	mm					
2V0 200	200 × 200	170	172	47	51,25	18
2V0 201	250 × 250	210	214	60	40	31,3
2V0 202	300 × 300	266	270	45	51,5	32
2V0 204	400 × 400	366	370	45	51,5	58

NOTE — If, in special cases, an aperture brick is turned through 90° around the axis of the aperture to change the direction of assembly, it should be noted that, taking into account the chevron, the centreline of the aperture is offset 25 mm from the centreline of the face of the brick.

Table 35 — Category 2 circular aperture bricks for circular units

Reference number	$A \times A$	d_i	d_o	e	f	Approximate mass kg
	mm					
2V0 205	150 × 150	104	108	50	50	15,3
2V0 207	200 × 200	150	160	50	50	23
2V0 209	250 × 250	195	205	50	50	34
2V0 211	300 × 300	240	250	50	50	46
2V0 213	350 × 350	285	295	50	50	63

NOTE — If, in special cases, an aperture brick is turned through 90° around the axis of the aperture to change the direction of assembly, it should be noted that, taking into account the chevron, the centreline of the aperture is offset 25 mm from the centreline of the face of the brick.

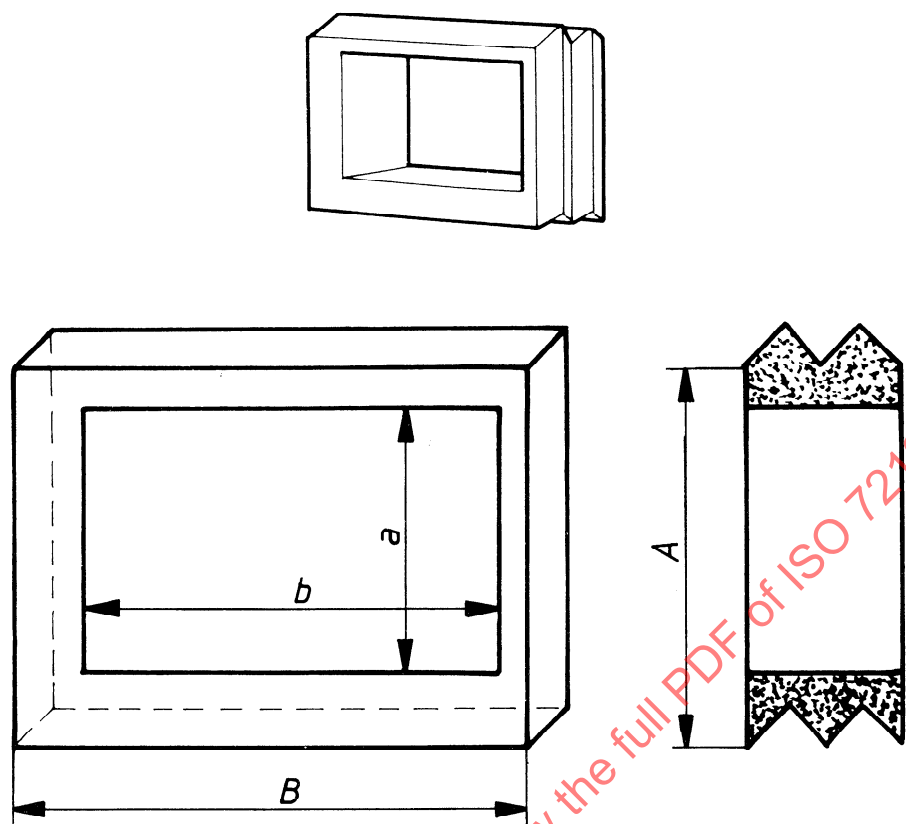


Figure 27 — Aperture brick for square and rectangular windows

Table 36 — Category 1 aperture bricks for square and rectangular windows

Reference number	$A \times B$	Window mounting		Type and shape of window	Approximate mass kg
		a	b		
		mm			
2V0 250	250 × 250	171	176	Square 145 × 145	56
2V0 251	250 × 350	171	276	Rectangular 145 × 245	94
2V0 261	550 × 750	445	645	Rectangular 400 × 600	130
2V0 262	750 × 950	645	845	Rectangular 600 × 800	170

NOTE — If, in special cases, an aperture brick is turned through 180° around the vertical axis of the aperture to change the direction of assembly, it should be noted that, taking into account the chevron, the centreline of the aperture is offset 25 mm from the centreline of the face of the brick.

7.7.2 Special demountable circular aperture brick — Category 2 (2V0 220)

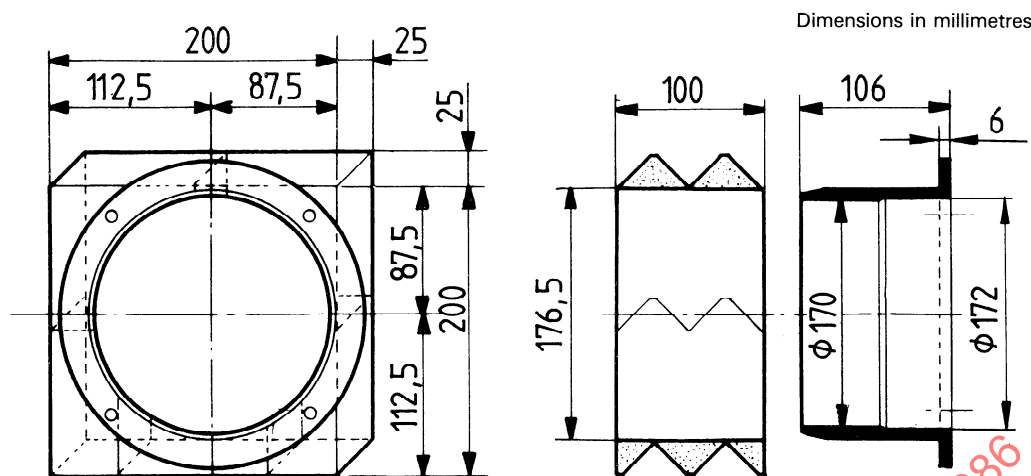
This aperture brick has the same properties as a non-demountable aperture brick (see 7.7.1). It is seldom used and allows an opening to be made in the wall. Its use is recommended whenever the wall cannot be partially dismantled from above (see figure 28).

This aperture brick should be placed either two or three rows below the top of the wall or under a rigid angle bar, as shown in figure 29.

The angle bar is used in lead brick walls at any level. It is used to increase stability and to distribute load.

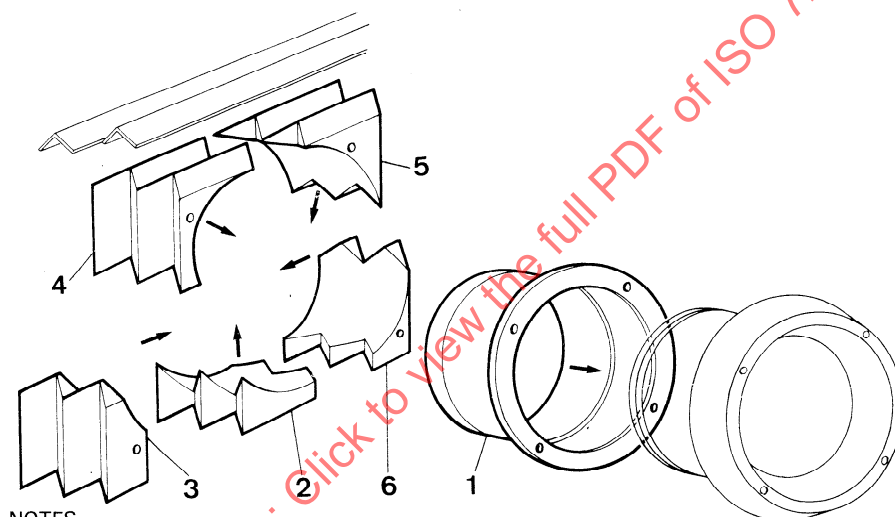
In thicker walls the angle bars are placed side by side without joining.

These angle bars are supplied in 3 m lengths.



NOTE — Mass $\approx$ 19 kg

Figure 28a) — Special demountable circular aperture brick (2V0 220)



NOTES

- 1 If part 2 does not come out, support widthwise to release it.
- 2 When reassembling, support to introduce part 1.

Figure 28b) — Dismantling sequence

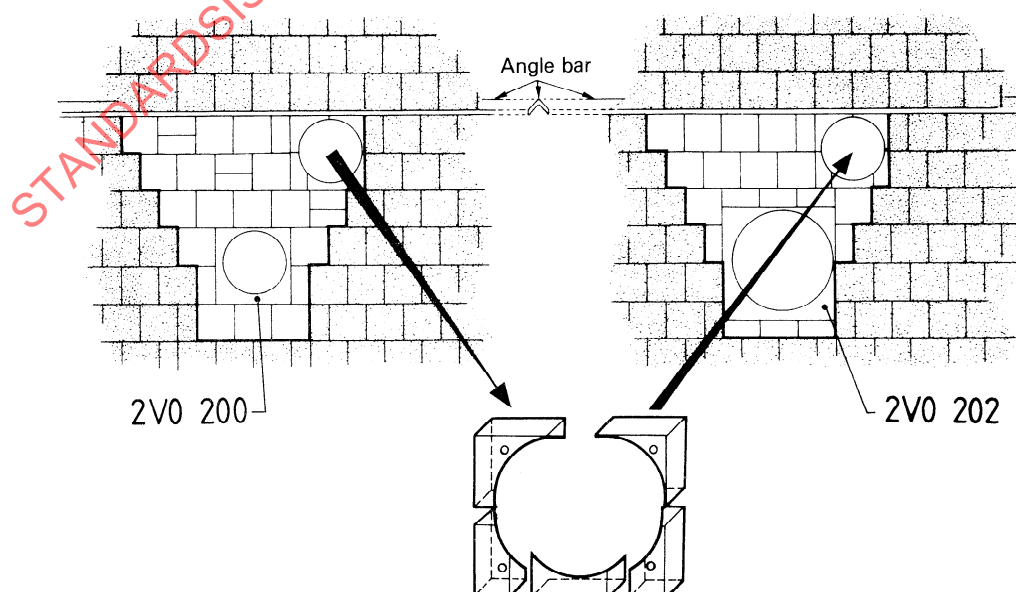


Figure 28c) — Example for use : replacement of a 2V0 200 aperture brick by a 2V0 202 aperture brick

Dimensions in millimetres

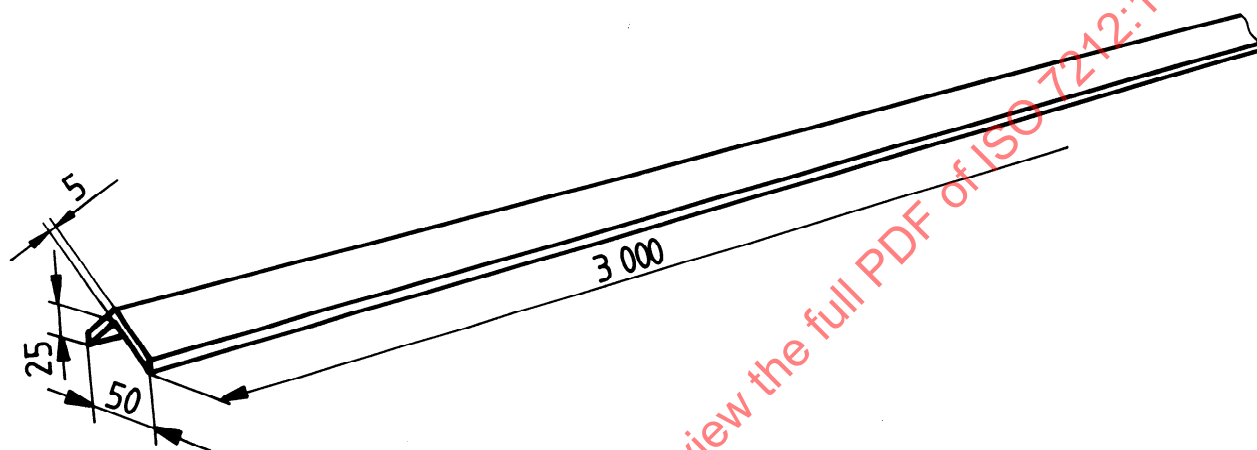


Figure 29 — Rigid angle bar

7.8 Windows

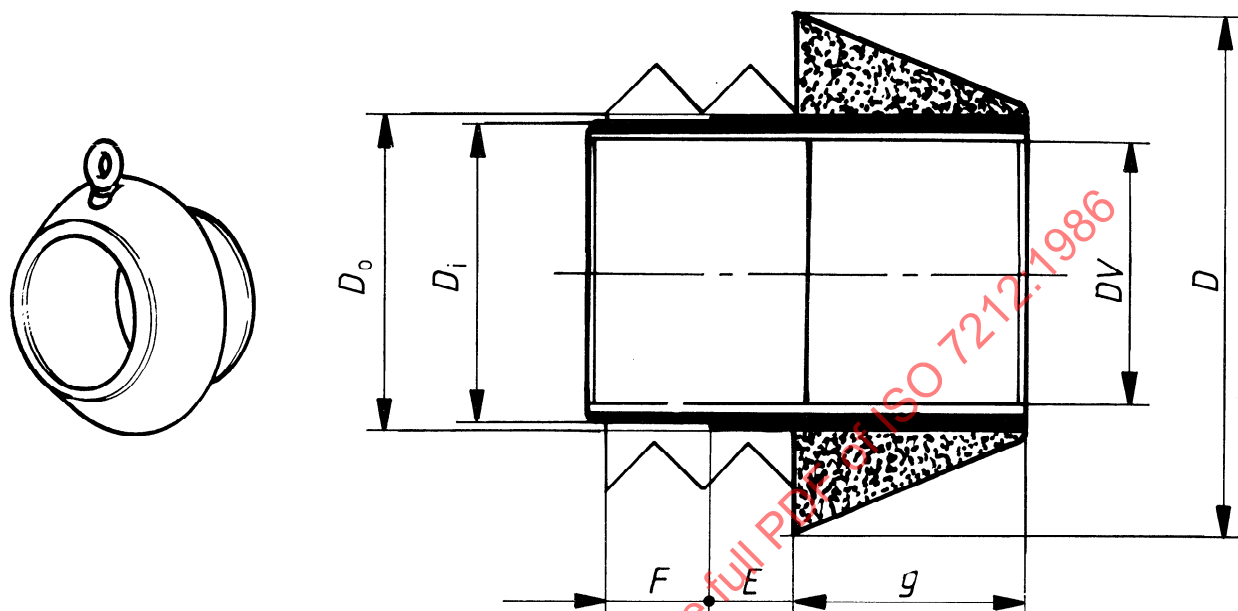
The minimum average density of the glass is $5,2 \pm 0,02$ g/cm³.

The minimum thickness of glass is 220 mm.

7.8.1 Circular windows

See figure 30.

The dimensions of the circular windows for 100 mm lead thickness are given in tables 37 and 38.



NOTE — The circular windows are demountable and interchangeable.

Figure 30 — Circular window

Table 37 — Category 1 circular windows

Aperture brick mm	Reference number	Window mounting ¹⁾				Flange		Glass		Approximate mass kg
		D_i	D_o	E	F	D	g	DV	Density	
		mm							g/cm ³	
200 × 200	2V0 300	170	172	47	51	275	120	140	5,2	59
300 × 300	2V0 303	266	270	45	51	377	120	230	5,2	115
400 × 400	2V0 304	366	370	45	51	477	120	330	5,2	190

1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.

Table 38 — Category 2 circular windows

Aperture brick mm	Reference number	Window mounting ¹⁾				Flange		Glass		Approximate mass kg
		D_i	D_o	E	F	D	g	DV	Density	
		mm							g/cm ³	
200 × 200	2V0 307	150	160	50	50	260	150	130	5,2	65
300 × 300	2V0 311	240	250	50	50	350	150	220	5,2	110

1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.

7.8.2 Square and rectangular windows

See figure 31.

The dimensions of the square and rectangular windows for 100 mm lead thickness are given in tables 39 and 40.

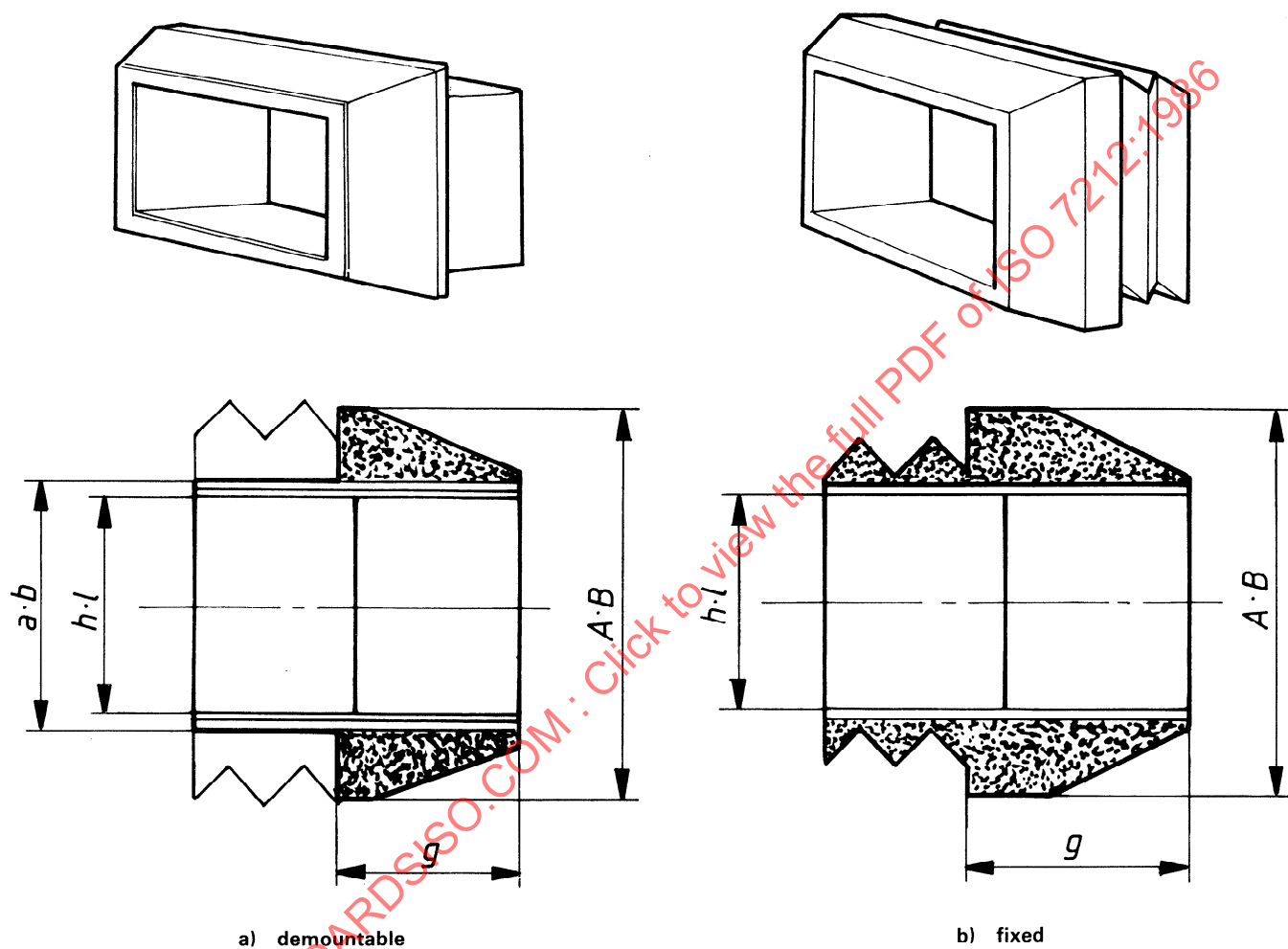


Figure 31 — Square and rectangular windows

Table 39 — Category 1 square and rectangular windows

Aperture brick mm	Reference number	Mounting ¹⁾		External frame			Glass			Approximate mass kg
		<i>a</i>	<i>b</i>	<i>A</i>	<i>B</i>	<i>g</i>	<i>h</i>	<i>l</i>	Density	
		mm							g/cm ³	
250 × 250	2V0 350	171 Demountable	176	300	300	125	145	145	5,2	66
250 × 350	2V0 351	171 Demountable	276	300	400	125	145	245	5,2	94
200 × 300	2V2 352	— Fixed	—	265	365	150	145	245	5,2	135
550 × 750	2V0 361	445 Demountable	645	805	870	142	400	600	5,2	760
750 × 350	2V0 362	645 Demountable	845	865	1065	200	600	800	5,2	1200

1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.

Table 40 — Category 2 square and rectangular windows

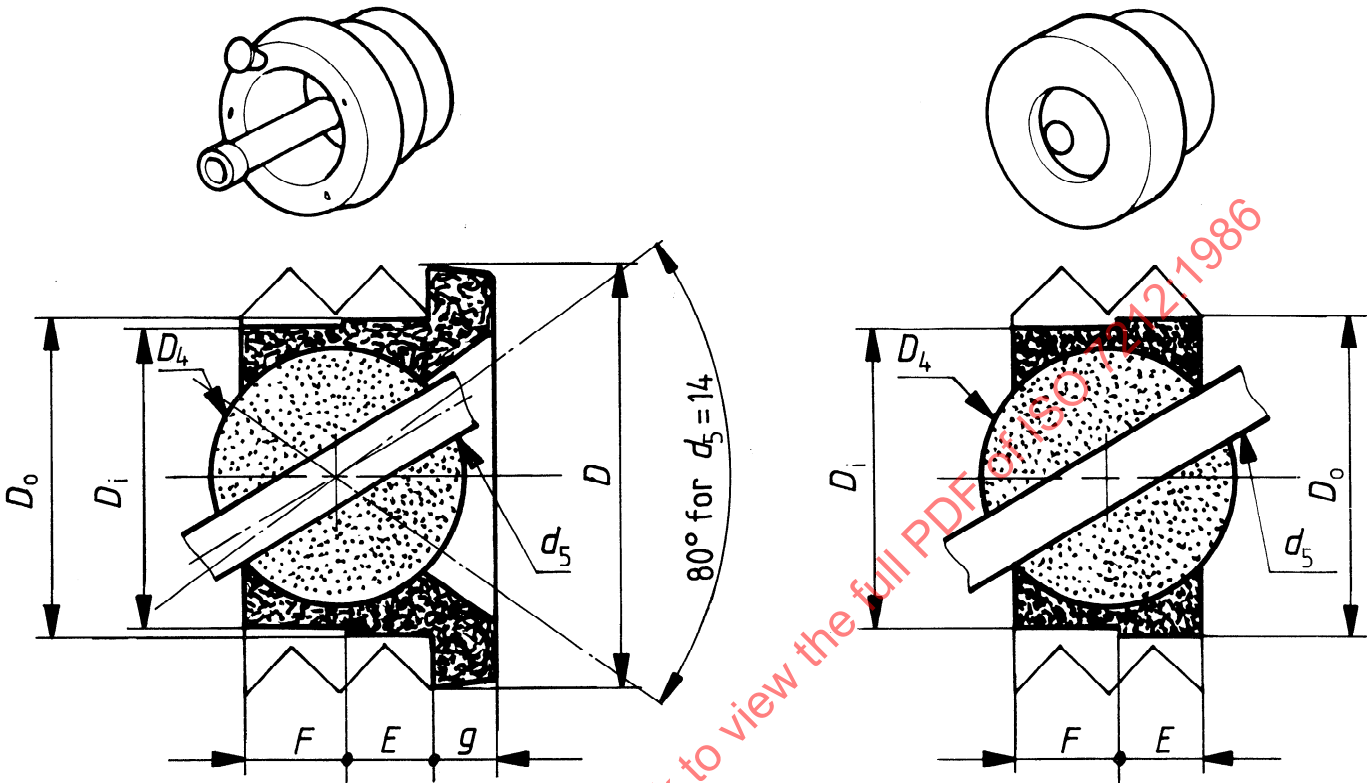
Aperture brick mm	Reference number	Mounting ¹⁾		External frame			Glass			Approximate mass kg
		<i>a</i>	<i>b</i>	<i>A</i>	<i>B</i>	<i>g</i>	<i>h</i>	<i>l</i>	Density	
		mm							g/cm ³	
200 × 200	2V2 355	— Fixed	—	265	265	150	145	145	5,2	100
300 × 300	2V2 356	— Fixed	—	365	365	150	245	245	5,2	185
400 × 500	2V2 358	— Fixed	—	450	540	150	330	420	5,2	350

1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.

7.9 Sphere units

See figure 32.

The dimensions of sphere units for 100 mm lead thickness are given in tables 41 and 42.



NOTE — The flange is optional. It facilitates handling of the workpiece, increases biological protection around the mounting and allows the sphere unit to be fixed in its aperture brick.

Figure 32 — Sphere units

Table 41 — Category 1 sphere units

Aperture brick mm	Reference number	Sphere unit mounting ¹⁾				Flange		Sphere unit ²⁾		Approximate mass kg
		D_i	D_o	E	F	D	g	D_4	d_5 ϕ tong	
		mm								
200 × 200	2V0 400	170	172	47	51	220	34	130	14	32 30
	b								20	
	c								33	
250 × 250	2V0 401	210	214	40	60	Without flange		140	14	43
	b								20	
	c								33	

- 1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.
2) A sphere unit of 33 mm diameter grip can accommodate reducing units for 20 or 14 mm diameter grips.

Table 42 — Category 2 sphere units

Aperture brick mm	Reference number	Sphere unit mounting ¹⁾				Flange		Sphere unit ²⁾		Approximate mass kg
		D_i	D_o	E	F	D	g	D_4	d_5 ϕ tong	
		mm								
250 × 250	2V0 409	195	205	50	50	245	12	160	14	43
	$\frac{a}{b}$								20	

- 1) The dimensions given here are the dimensions of the aperture brick, in practice these shall be reduced by the necessary clearance for installation.
2) A sphere unit of 33 mm diameter grip can accommodate reducing units for 20 or 14 mm diameter grips.