INTERNATIONAL STANDARD



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Enclosures for protection against ionizing radiation — Lead shielding units for 150 mm, 200 mm and 250 mm thick walls —

Part 1 : iTeh Schevron units of 150 mm and 200 mm thickness (standards.iteh.ai)

Enceintes pour la protection contre les rayonnements ionisants — Éléments de blindage en plomb-pour murs de 150 mm, 200 mm et 250 mm d'épaisseur os://standards.ion.ai/cataler/standards/stat/55452651150754526 les boo0mm d'épaisseur

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

iTeh STĂNDARD PREVIEW International Standard ISO 9404-1 was prepared by Technical Committee ISO/TC 85, Nuclear energy, Sub-Committee SC 2, Radiation protection Clarces. Iten.a1

ISO 9404 will consist of the following parts, under the general <u>gitle Enclosures</u> for protection against ionizing radiation – Lead shielding units for 150 mm 200 mm and -1ce7-481c-bee0-250 mm thick walls: c2d3ec9093cd/iso-9404-1-1991

- Part 1: Chevron units of 150 mm and 200 mm thickness
- Part 2: Rounded units of 150 mm, 200 mm and 250 mm thickness

Annex A of this part of ISO 9404 is for information only.

INTERNATIONAL STANDARD

Enclosures for protection against ionizing radiation – Lead shielding units for 150 mm, 200 mm and 250 mm thick walls –

Part 1: Chevron units of 150 mm and 200 mm thickness

iTeh STANDARD General IEW (standards.iteh.ai)

1.1 Scope

This part of ISO 9404 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 bricks for walls of 150 mm thickness are standardized in this part of ISO 9404. Since four- and five-chevron bricks are not manufactured, 200 mm and 250 mm thick walls are constructed with bricks of 50 mm, 100 mm and 150 mm thickness.

The 150 mm and 200 mm shielding units are dealt with separately in two sections for clarity. The 50 mm and 100 mm shielding units are standardized in ISO 7212.

1.2 Classification

The units described in this part of ISO 9404 are classified in three categories:

- Category 1: standardized units.

(The diagrams in figures 7, 15, 28 represent the standardized units in category 1.) (The diagrams in figures 16 and 29 represent the standardized units in category 2.)

- Category 2: these are units which are either used very

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 part of ISO 9404 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.

1.3 Designation

The designation of the lead shielding unit consists of its name written in full, the reference to this part of ISO 9404 and the reference number as explained in 1.3.1.

EXAMPLE

Aperture brick ISO 9404-1 3V0 202

1.3.1 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 3V0 202:

a) 1st figure: lead thickness

3 = 150 mm4 = 200 mm

b) letter: encasing profile

V = with chevrons R = rounded form

NOTE - In this part of ISO 9404, only the chevron shielding units are standardized.

- c) 2nd figure: assembly direction
 - 1 =assembly direction 1 (see 1.4)
 - 2 =assembly direction 2 (see 1.4)
 - 0 = two assembly directions

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

NOTES

Plain bricks

End bricks

X bricks

Posts

Pluas

Corner bricks

Square bricks

Circular aperture bricks

Circular windows

Sphere units

Reducing units

Square or rectangular aperture bricks

(for example, 3V0 101, 3V0 102, etc.).

Square and rectangular windows

1 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 end ordinary brick have the same reference number: 3V0 100.

2 Throughout the text, it is understood that

a plain brick is any module of brick having 100 mm imes 100 mm dimensions inserted in a wall, which is neither end, corner, nor special;

nor top.

Series

100 to 119

120 to 149

150 to 159

170 to 179

180 to 189

190 to 199

200 to 219

250 to 269

300 to 319

350 to 369

400 to 419

500 to 519

600 to 619

Except for the cases mentioned in note 2, the last three figures are fixed in series according to table 1.

Table 1 - Series allocation

Units

1.3.2 Explanation of a designation example

Lead circular aperture brick, 150 mm thickness, three chevrons. two assembly directions, No. 202 (300 mm \times 300 mm) shall be designated as follows:

Aperture brick ISO 9404-1 3V0 202

1.4 Specifications of the bricks

1.4.1 General

The dimensions of the category 1 and 2 bricks have been standardized in order to ensure a 100 mm by 100 mm module¹⁾ on installation and, if necessary, to allow staggered joints [see figure 1 a)].



Staggered joints a)



b) Straight joints

Figure 1 – Assembly of bricks

In each of these series, a serial number is given to all the units

¹⁾ The dimensions of bricks may vary by a half module.

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

- assembly direction 1: chevron pointing	Looking
upwards to the right	at the
encembly direction 2, shower pointing	enclosure

assembly direction 2: chevron pointing upwards to the left



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 (see 2.1). The surface roughness of the faces is R_a quality 2,8 or better (see ISO 468 and ISO 1302), to give the surface finish required for facilitating decontamination. There shall be no cavities.

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

Table 2 - Properties of the material

Minimum density	Percentage of	Minimum		
of the lead	antimony	hardness		
10,9 g/cm ^{3 1)}	4 ± 0,5	9,5 HB ²⁾		

1) This value is not the theoretical value, but that obtained by direct measurement at 20 °C on commercially available units.

2) 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.

1.4.3 Profile of the chevron

The specifications relating to the chevron are given in table 3. Figure 3 shows an example of a three-chevron brick.

Table 3 – Specifications of a chevron

A diagram of the basic units of category 1 is given in figure 7.RD	Angle of the chevron	EThickness	Tolerance on beight <i>H</i>	Angle
1.4.2 Properties of the material (standards.it	Male Female	mm	and length L mm	on face
The units are made out of a antimonial lead alloy, but they are	$90^{\circ} + \frac{15'}{2} 90^{\circ} 0_{15'}$	50 ⁰ 5	±0,2	90° ± 10′

0 90° – 15' 50 - 0.5



from the

outside



Figure 3 – Example of a three-chevron ordinary plain brick

ISO 9404-1 : 1991 (E)

Bricks with four chevrons are not manufactured except for functional units.

All other parts of a 200 mm thick wall comprise combinations of one-, two- or three-chevron bricks (see figure 4).



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Section 2 : Lead shielding units - Thickness 150 mm

2.1 Categories 1 and 2

A 150 mm thick wall may be built with three-chevron plain units (see table 4) or, alternatively, by using a combination of onechevron and two-chevron plain units. For reasons of stability, it is recommended that three-chevron base bricks only be used at the base of a 150 mm thick wall.

Because of their limited use, neither 1/4 plain ordinary bricks nor 1/4 plain top bricks are manufactured with a three-chevron

profile. To compensate for this, a combination of one-chevron and two-chevron 1/4 plain ordinary bricks may be used.

2.1.1 Plain bricks

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

Table 4 shows the standardized dimensions of category 1, three-chevron plain bricks. The unit module for the designation of bricks is 100 mm \times 100 mm.

		Dime	nsions		Approximate				
Туре	Reference number	m	im I ,	Diagram	mass				
		H	L		ĸy				
Base plain brick ¹⁾	3V0 100		100		19				
1/2 base plain brick ²⁾	3V0 101 (Sta	ISO 9404-1:19 (catalog/standards/s	iteh.ai)	81c-bee0-	9				
Ordinary plain brick	c20 3V0 102	13ec9093cd/iso-94 100	04-1-1991 100	TTT .	16				
1/2 ordinary plain brick ³⁾	3\/0 103	100	50		8				
		50	100		U				
1/2 top plain brick ⁴⁾	3V0 105	50	100		6				
1) Identical to the 100 \times 1	00 left-hand ordinary end	brick (see table 6).							
2) Identical to the 50 \times 10	0 1/2 left-hand ordinary e	nd brick (see table 6	5).						
3) This brick may be turne	d round to constitute an c	ordinary plain brick 5	0 mm high and 100	mm long.					
4) Identical to the 100 \times 50 1/2 right-hand ordinary end brick (see table 6).									

Table 4 — Category 1 plain bricks

2.1.2 Corner bricks

The dimensions of category 1, three-chevron corner bricks are given in table 5.

Because of their limited use, 1/2 ordinary corner bricks with a three-chevron profile are not manufactured. To compensate for this, a combination of a 1/2 one-chevron corner brick and a 1/2 two-chevron corner brick may be used.

Dimensions mm Approximate Assembly Type **Reference number** Diagram L_1 mass Η L_2 direction*) Re-entrant Projecting kg chevron chevron I Base corner brick 3V1 120 100 200 150 (1) 37 3V2 121 iTehooST 200ND 150 R Base corner brick (2) 37 standards SO 9404-:1991 https://standards.iteh.ai/catalog/standard e7-481c-bee0s/sist/f5e4c c2d3ec9093cd/iso-940 Ordinary corner brick 3V1 122 100 200 150 (1) 33 33 Ordinary corner brick 3V2 123 100 200 150 (2) 150 12 1/2 top corner brick 3V1 126 50 200 (1)1/2 top corner brick 3V2 127 50 200 150 (2)12

Table 5 - Category 1 corner bricks

*) 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.

2.1.3 End bricks

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

Because of their limited use, base end and top end bricks with a three-chevron profile are not manufactured. To compensate for this, a combination of one-chevron and two-chevron base end and top end bricks may be used.

The dimensions of the end bricks for assembly direction 1 are given in table 6.

Туре	Reference number	Dimer m	nsions m	Diagram	Approximate mass				
Left-hand ordinary end brick ¹⁾	3V0 100	100	100	THE REPORT OF	19				
1/2 left-hand ordinary end brick ²⁾	^{3V0 101} iTeh STA	50	100 PREVI	EW	9				
1/2 right-hand ordinary end brick ³⁾	(sta 3vo 105 https://standards.iteh.ai c20	ISC 99404-1:19 ISC 99404-1:19 /catalog/standards/s I3ec9093cd/iso-94	teh.ai) 191 50 1st/f5e4c26f-1ce7-4 104-1-1991	81c-beed-	6				
1) Identical to the 100 \times 100 base plain brick (see table 4).									
 Identical to the 100 × 50 1/2 base plain brick (see table 4). Identical to the 50 × 100 1/2 top plain brick (see table 4). 									

Table 6 — Category 1 end bricks

2.1.4 Special bricks

Special bricks are used to reverse the assembly direction and are made for walls of 50 mm lead thickness; for walls of 150 mm thickness, three special bricks are used side by side.

There are two types of special bricks: square bricks and X bricks, the assembly directions of which are shown in figures 5 and 6, respectively.



Figure 5 – Assembly of square bricks



Figure 6 – Assembly of X bricks

2.1.5 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 either of antimoniated lead or soft lead cast on a steel frame.

Table 7 — Category 2 posts (assembly direction $1)^{1)}$

Туре	Reference number	Sec m L ₁ Re-entrant	tion m L ₂ Projecting	Diagram	Approximate mass kg
Corner post	3V0 190	150	150		250
T-post 2MF (2 male, 1 female)	3v0 191 iTe	h ST5AN (stand	DAR5D P ards.iteh	REVEW .ai)	270
T-post 2FM (2 female, 1 male)	https://star 3V0 192	IS dards.iteh.ai/catalog c2d3ec90 150	<u>0 9404-1:1991</u> g/standards/sist/f5e/ 93cd/iso-9404-1-1 150	c26F1ce7-481c bee0- 99T	230
1) By turning these po	sts upside down, assembl	y direction 2 is obta	ined.		

2.1.6 Assembly of basic units

A general diagram of the disposition of the basic units, 150 mm thick, is shown in figure 7 for the units of category 1.





Figure 7 – General diagram of disposition of category 1 basic units for walls 150 mm thick

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2.1.7 Aperture bricks

Externally, three-chevron aperture bricks are square or rectangular and their internal dimensions are standardized so that the units they hold may be interchanged (see figures 8 and 9).

The dimensions of aperture bricks for a lead thickness of 150 mm are given in tables 8, 9, 10 and 11.



tş	500
1	tş

Reference number	$A \times A$	x	d _i mm	do	е	f	Approximate mass kg		
3V0 200	200 × 200	112,5	170	172	72	76,25	30		
3V0 202	300 × 300	162,5	266	270	70	76,5	50		
3V0 204	400 × 400	212,5	366	370	70	76,5	90		
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 brick.

Tal	ble	9 —	Category	2	aperture	bricks	for	circular	units
-----	-----	-----	----------	---	----------	--------	-----	----------	-------

Reference number	$A \times A$	x	d _i	do	е	f	Approximate mass
		kg					
3∨0 207	200 × 200	112,5	150	160	75	75	30
3∨0 209	250 × 250	137,5	195	205	75	75	50
3V0 211	300 × 300	162,5	240	250	75	75	70
3V0 213	350 × 350	187,5	285	295	75	75	110
NOTE — If, in special cas be noted that, taking int	ses, an aperture brick to account the chevro	is turned throug on, the centrelin	gh 180° around ne of the aper	the axis of the ture is offset 25	aperture to cha 5 mm from the	ange the directi centreline of t	on of assembly, it should he face of the brick.



a) Cut



d) Category 2, with step and inner redan ($e \neq f$)

Figure 9 – Aperture bricks for square and rectangular windows