BS EN 912:2011

BSI Standards Publication

Timber fasteners — Specifications for connectors for timbers

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee B/518, Structural timber.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Holzverbindungsmittel - Spezifikationen für Dübel besonderer Bauart für Holz

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Foreword

This document (EN 912:2011) has been prepared by Technical Committee CEN/TC 124 “Timber structures”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2012, and conflicting national standards shall be withdrawn at the latest by January 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 912:1999.

The following significant technical changes have been introduced in the new edition of this European Standard:

a) the EN 912:1999/AC:2000 corrigendum is included,

b) modifications regarding newer EN reference standards, steel material and tolerances.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the dimensions and the materials of certain well-established connectors for use in joints between members in load-bearing timber structures.

For data on strength and deformation properties of joints made with the connectors, reference is given to EN 13271.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1561, *Founding — Grey cast irons*

EN 1562, *Founding — Malleable cast irons*

EN 1706, *Aluminium and aluminium alloys — Castings — Chemical composition and mechanical properties*

EN 10025, *Hot rolled products of structural steels (all parts)*

EN 10131, *Cold rolled uncoated and zinc or zinc-nickel electrolytically coated low carbon and high yield strength steel flat products for cold forming —Tolerances on dimensions and shape*

EN 10139, *Cold rolled uncoated mild steel narrow strip for cold forming — Technical delivery conditions*

EN 10140, *Cold rolled narrow steel strip — Tolerances on dimensions and shape*

EN 10143, *Continuously hot-dip coated steel sheet and strip — Tolerances on dimensions and shape*

EN 10268, *Cold rolled steel flat products with high yield strength for cold forming — Technical delivery conditions*

EN 10346, *Continuously hot-dip coated steel flat products — Technical delivery conditions*

EN 13271, *Timber fasteners — Characteristic load-carrying capacities and slip-moduli for connector joints*

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

3.1
connector
device generally consisting of a plate, toothed-plate or ring which, when partly embedded in each or in one of the contact faces of two members and held together by a connecting bolt, is capable of transmitting a load from one member to another

3.2
double-sided connector
connector symmetrical in cross-section and embedded into each contact face of two adjacent timber members

3.3
single-sided connector
connector embedded into a timber contact face only on one side

3.4
ring connector
double-sided connector formed as a closed ring or a ring cut at one place on its circumference

3.5
plate connector
single-sided connector made of a circular plate with a flange along the circumference of one side of the plate

3.6
toothed-plate connector
connector made of a plate with triangular teeth along the edges of the plate or with spikes on the plate; a toothed-plate connector may be double-sided or single-sided

4 Symbols

In this European Standard, the following symbols are used with suitable subscripts where necessary:

a width of cut; distance; offset distance, in millimetre;

a_1 length of tongue; distance between screw holes, in millimetre;

a_2 depth of tongue; depth of countersink, in millimetre;

a_3 depth of slot, in millimetre;

d_1 diameter of centre hole (bolt-hole), in millimetre;

d_2 diameter of screw holes; diameter of nail holes; diameter of inner teeth circle, in millimetre;

d_3 outside diameter of hub; diameter of outer teeth circle, in millimetre;

d_4 diameter of perforations, in millimetre;

d_c diameter, diameter of plate;

h_1 height of straight portion; height of straight portion outside of flange; height of hub above plate, in millimetre;

h_c height; total height, in millimetre;

r radius, in millimetre;

t thickness, thickness of plate; maximum thickness of plate and flange, in millimetre;

t_1 minimum thickness of plate; thickness of plate, in millimetre;

t_2 thickness of notch, in millimetre.

5 Requirements

5.1 General

Connectors shall be marked in accordance with Clause 6.

Depending on the environmental conditions the connectors shall be given an anti-corrosion treatment of a type to be agreed between the purchaser and the manufacturer.

5.2 Classification and requirements of connectors

The connectors are classified into the following four groups:

— Group A Ring connectors; see Annex A;

— Group B Plate connectors; see Annex B;

— Group C Toothed-plate connectors; see Annex C;

— Group D Other connectors; see Annex D.

The annexes A to D specify the dimensions and specifications for materials for these 4 groups.

6 Marking

Every delivery unit shall be marked by the manufacturer. The marking shall contain the number of this European Standard, i.e. EN 912 and the number of the connector according to the annex to this European Standard. Furthermore, the nominal dimension (e.g. the nominal diameter) shall be marked.

Annex A
(normative)

Specifications for ring connectors

A.1 Type A1

A.1.1 Description and dimensions

A ring connector of type A1 (see Figure A.1) is a closed ring connector with a cross-sectional area like a lens. The dimensions shall comply with Table A.1.

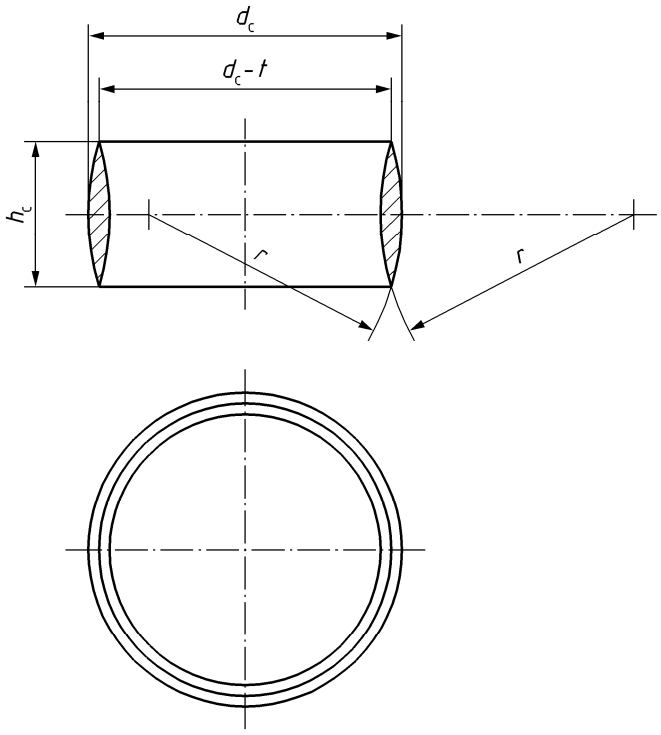


Figure A.1 — Connector of type A1

Table A.1 — Dimensions of connectors of type A1

Dimensions in millimetres

Diameter d_c	Height h_c	Thickness t	Radius r
65	30	5	50
80	30	6	50
95	30	6	60
126	30	6	60
128	45	8	60
160	45	10	60
190	45	10	60
Tolerances on all dimensions: ± 0,5.			

A.1.2 Material

Ring connectors of type A1 are made of aluminium casting alloy EN AC-AlSi9Cu3(Fe) according to EN 1706.

A.2 Type A2

A.2.1 Description and dimensions

A ring connector of type A2 (see Figure A.2) is a connector with parallel sides cut at one place on its circumference to form a tongue and a slot. The dimensions shall comply with Table A.2.

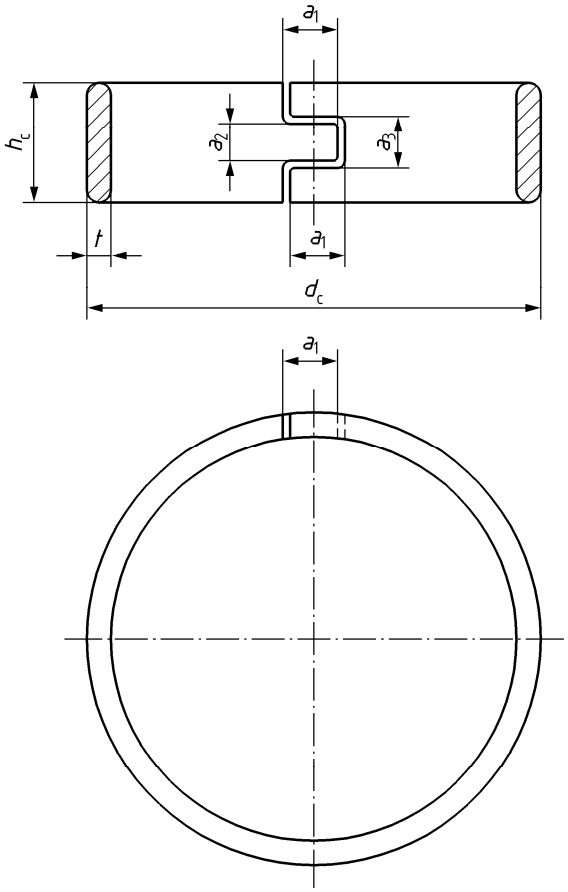


Figure A.2 — Connector of type A2

Table A.2 — Dimensions of connectors of type A2

Dimensions in millimetres

Nominal diameter	Diameter d_c	Height h_c	Thickness t	Length of tongue a_1	Depth of tongue a_2	Depth of slot a_3
64	72,0	19,0	4,1	9,0	6,5	7,0
Tolerances:	Diameter d_c ± 0,75 Thickness t ± 0,10 Other dimensions ± 0,25					

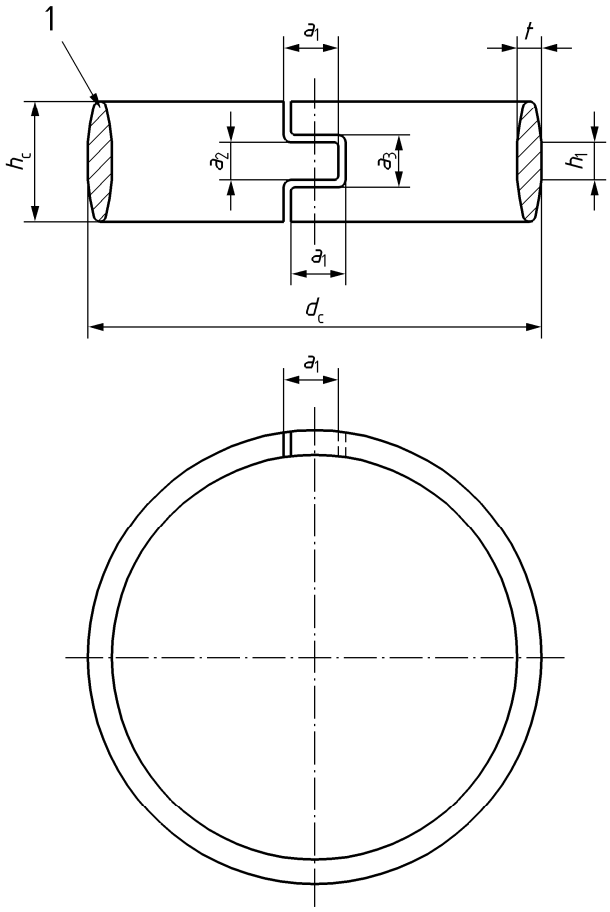
A.2.2 Material

Ring connectors of type A2 are made of hot or temper rolled steel strip of steel alloy HRMS Grade Fe430 according to EN 10025-1 to -6.

A.3 Type A3

A.3.1 Description and dimensions

A ring connector of type A3 (see Figure A.3) is a connector with double bevelled sides cut at one place on its circumference to form a tongue and a slot. The dimensions shall comply with Table A.3.



Key

1 round milled edge, radius *r*

Figure A.3 — Connector of type A3

Table A.3 — Dimensions of connectors of type A3

Dimensions in millimetres

Nominal diameter	Diameter d_c	Height h_c	Thickness t	Height of straight portion h_1	Radius r	Length of tongue a_1	Depth of tongue a_2	Depth of slot a_3
64	72,0	19,0	4,1	6,5	1,5	9,0	6,5	7,0
102	112,0	25,4	4,9	8,3	1,7	9,0	8,3	9,0
Tolerances:	Diameter d_c ± 0,75 Thickness t ± 0,10 Other dimensions ± 0,25							

A.3.2 Material

Ring connectors of type A3 are made of hot or temper rolled steel strip of steel alloy HRMS Grade Fe430A according to EN 10025-1 to -6.

A.4 Type A4

A.4.1 Description and dimensions

A ring connector of type A4 (see Figure A.4) is a connector with double bevelled sides. In every connector except the smallest, a V-shaped cut is made at one place on its circumference. The angle between the direction of cut and the direction of circumference is 45°. The dimensions shall comply with Table A.4.

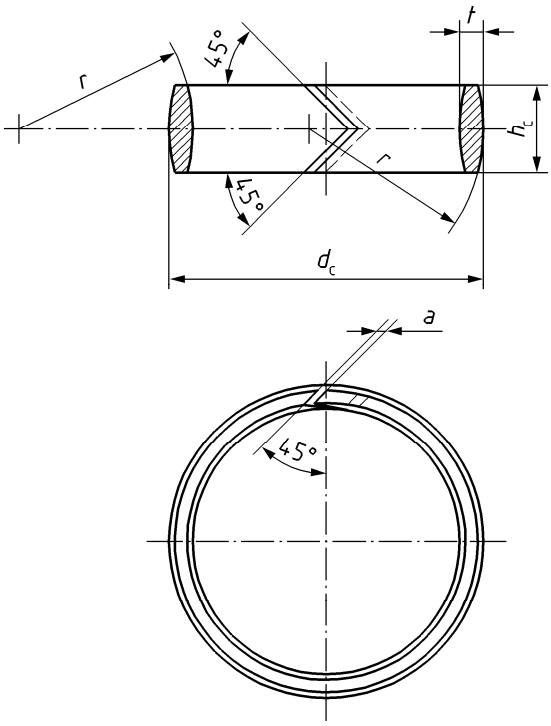


Figure A.4 — Connector of type A4

Table A.4 — Dimensions of connectors of type A4

Dimensions in millimetres

Diameter d_c	**Height** h_c	**Thickness** t	**Radius** r	**Width of cut** a
60	18	5	36	– [a]
80	22	6	48	2
100	26	7	60	2
120	30	8	72	2
140	36	9	84	4
160	40	10	96	4
180	46	10	108	4
200	50	11	120	4
Limit deviations:	Diameter d_c [b] $^{+1,0}_{-0,5}$			
Tolerances:	Height h_c	± 0,5 for $h_c \leq 36$		
		± 0,7 for $h_c \geq 40$		
	Thickness t	± 0,5 for $t \leq 9$		
		± 0,7 for $t \geq 10$		
	Angle 45°	± 1°		

[a] Without cut.

[b] Tolerances on cast ring before splitting.

A.4.2 Material

Ring connectors of type A4 are made of grey cast iron EN-GJL-150 or EN-GJL-200 (Material number: EN-JL 1020 or EN-JL 1030) according to EN 1561.

A.5 Type A5

A.5.1 Description and dimensions

A ring connector of type A5 (see Figure A.5) is a connector with a rectangular cross-section. It is cut at one place on its circumference so that the ends are in a V-shape. The dimensions shall comply with Table A.5.

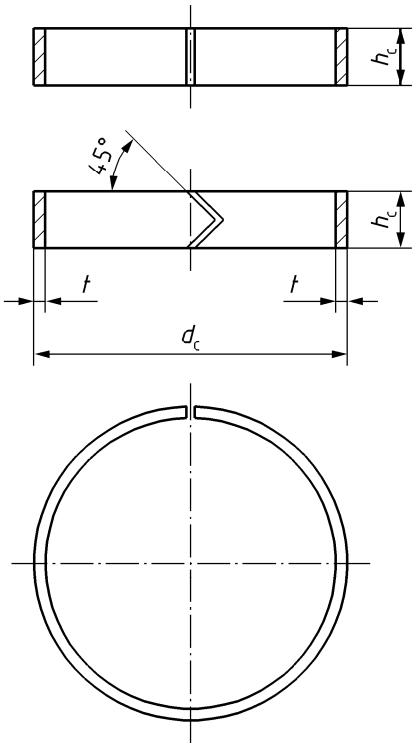


Figure A.5 — Connector type of A5

Table A.5 — Dimensions of connectors of type A5

Dimensions in millimetres

Diameter d_c	**Height** h_c	**Thickness** t
88	20	4
108	24	4
130	27	5
152	30	6
174	33	7
196	36	8
216	40	8
236	45	8
260	50	10
Tolerances:	Diameter d_c [a]	+ 1,0
	Height h_c	± 0,75 for $h_c \leq 33$
		± 1,0 for $h_c \geq 36$
	Thickness t	± 0,5

[a] Tolerances on cast ring before splitting.

A.5.2 Material

Ring connectors of type A5 are made of hot rolled steel strip of steel alloy S 235 JR G1 (Material number: 1.0036) according to EN 10025-1 to -6.

A.6 Type A6

A.6.1 Description and dimensions

A ring connector of type A6 (see Figures A.6 a and A.6 b) is a connector with simple or double trapezoïdal size.

In every connector, a V-shaped cut is made at one place on its circumference. The angle between the direction of cut and the direction of circumference is 60°. The dimensions shall comply with Table A.6.

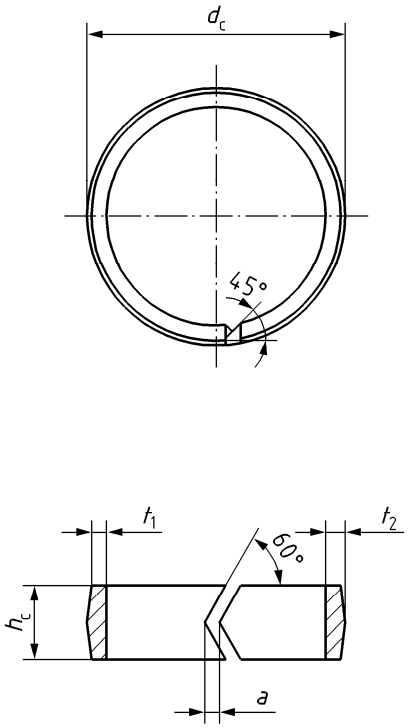


Figure A.6a — Connector of type A6

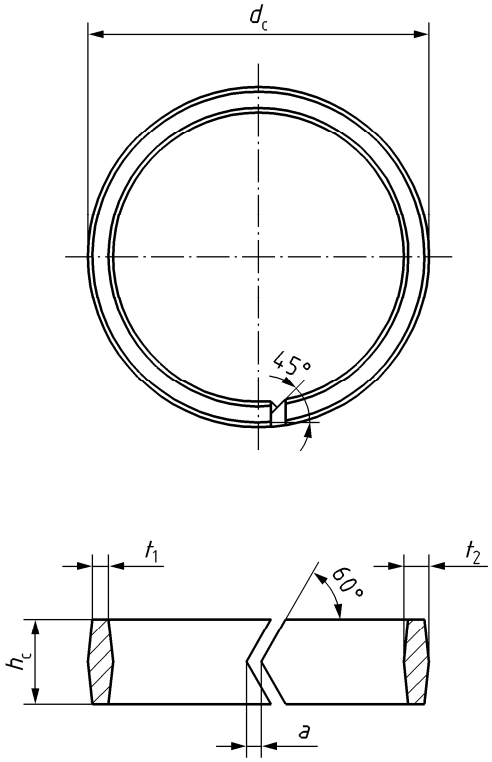


Figure A.6b — Connector of type A6

Table A.6 — Dimensions of connectors of type A6

Dimensions in millimetres

Type	Diameter	Height	Thickness	Maximum thickness	Width of cut
	d_c	h_c	t_1	t_2	a
a	75	22	4	5,5	3
b	100	26	4	7	4
a	125	30	5,5	7	4
a	150	38	6,5	8	4
Tolerances:	Diameter d_c [a]	± 1,5 mm			
	Height h_c	± 1,0 mm			
	Thickness t_1	± 1,0 mm			
	Maximum thickness of a cross section t_2 ± 1,0 mm				
	Angle 60°	± 1°			

[a] Tolerance on ring before splitting.

Type a: Trapezoïdal shape

Type b: Diamont shape

A.6.2 Material

Ring connectors of type A6 are made of cast metal FGL 250 according to EN 1561.

Annex B
(normative)

Specifications for plate connectors

B.1 Type B1

B.1.1 Description and dimensions

A plate connector of type B1 (see Figure B.1) is a connector made of a circular flanged plate with an integral cylindrical hub concentric with a bolt-hole through the centre of the plate. The flange and the hub are on opposite faces of the plate. Each connector has two screw holes through the plate on opposite sides of the bolt-hole. The dimensions shall comply with Table B.1.

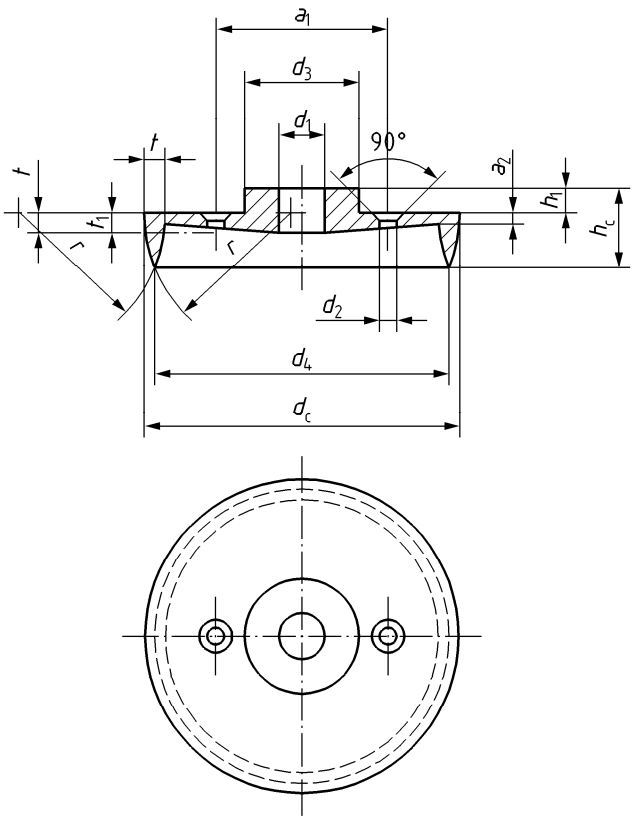


Figure B.1 — Connector of type B1

B.1.2 Material

Plate connectors of type B1 are made of aluminium casting alloy EN AC-AlSi9Cu3(Fe) according to EN 1706.

Table B.1 — Dimensions of connectors of type B1

Dimensions in millimetres

Diameter of plate	Total height	Max. thick-ness of plate and flange	Min. thickness of plate	Diameter of centre hole	Diameter of screw holes	Outside diameter of hub	Diameter of flange	Radius	Height of hub above plate	Distance between screw holes	Depth of countersin k
d_c	h_c	T	t_1	d_1	d_2	d_3	d_4	~ r	h_1	a_1	a_2
65	23	5	3,5	13	6,5	22,5	60	50	8	42	3
80	23	6	3,5	13	6,5	25,5	74	50	8	46	3
95	23	6	4,5	13	6,5	33,5	89	60	8	55	3
128	32,5	7,5	4,5	13	6,5	45	120	60	10	74	4
160	34,5	9	5,5	16,5	6,5	50	150	60	12	108	4
190	34,5	9	6	16,5	6,5	60	180	60	12	129,5	4
Tolerances on all dimensions ± 0,5.											

B.2 Type B2

B.2.1 Description and dimensions

A plate connector of type B2 (see Figure B.2) is made of a circular flanged plate with a bolt-hole through the centre. Two nail holes may be drilled midway between the centre of the plate and the circumference and on opposite sides of the bolt-hole. The dimensions shall comply with Table B.2.

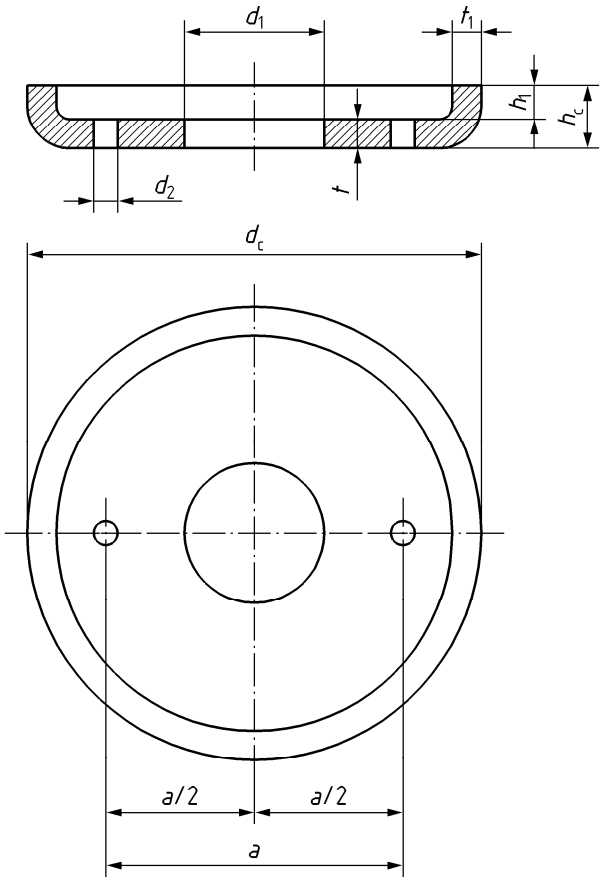


Figure B.2 — Connector of type B2

B.2.2 Material

Plate connectors of type B2 are made of hot rolled steel according to EN 10025-1 to -6.

Table B.2 — Dimensions of connectors of type B2

Dimensions in millimetres

Nominal diameter	Diameter of plate	Height	Height of straight portion on outside of flange	Thickness of plate	Thickness of flange	Diameter of centre hole	Diameter of nail holes	Distance
	d_c	h_c	h_1	t	t_1	d_1	d_2	a
67	66,7	10,7	6,4	4,4	4,4	20,5	4,0	41,0
Tolerances:	Diameter d_c	± 0,25						
	Height h_c	± 0,75						
	Height h_1	± 0,75						
	Thickness t	± 0,25						
	Thickness t_1	± 0,10						
	Diameter d_2	± 0,25						
	Distance a	± 0,75						
Limit deviations:	Diameter d_1	$^{+0,30}_{0}$						

B.3 Type B3

B.3.1 Description and dimensions

A plate connector of type B3 (see Figure B.3) is made of a perforated circular flanged plate with an integral cylindrical hub concentric with a drilled bolt-hole through the centre of the plate. The flange and the hub are on the same face of the plate and project at right angles to the plate. The plate may have two nail holes midway between the circumference of the bolt-hole and the circumference of the plate and on opposite sides of the bolt-hole. The dimensions shall comply with Table B.3.

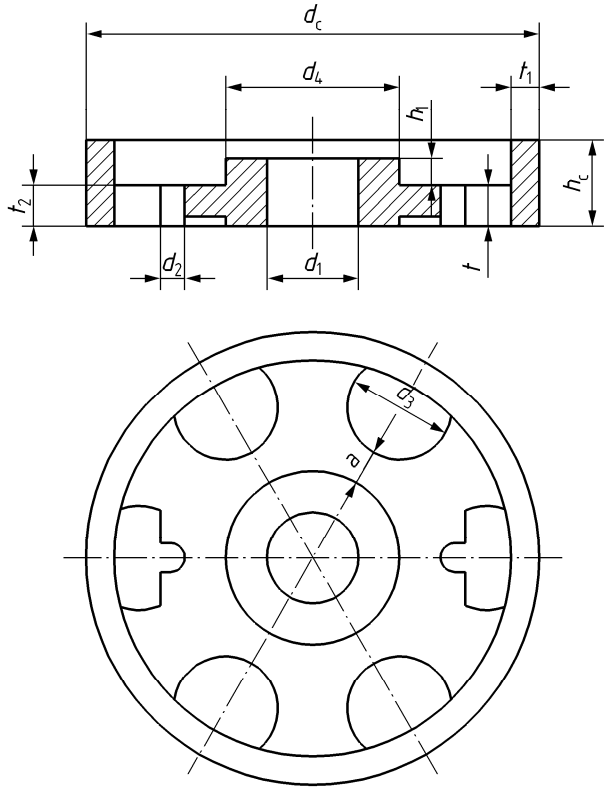


Figure B.3 — Connector of type B3

B.3.2 Material

Plate connectors of type B3 are made of malleable cast iron according to EN 1562.

Table B.3 — Dimensions of connectors of type B3

Dimensions in millimetres

Diameter of plate	**Height**	**Thickness of plate**	**Thickness of flange**	**Thickness of notch**	**Diameter of centre hole**	**Diameter of nail holes**	**Outside diameter of hub**	**Diameter of perforations**	**Height of hub above plate**	**Offset distance**
d_c	h_c	T	t_1	t_2	d_1	d_2	d_3	d_4	h_1	a
102,0	15,7	5,0	6,0	4,3	20,5	4,0	38,0	22,9	7,0	9,0
Tolerances:	Diameter d_c	± 0,75								
	Diameter d_3	± 0,50								
	Diameter d_4	± 0,75								
	Other dimensions	± 0,25								
Limit deviations:	Thickness t	$^{+0,25}_{-0,1}$								
	Diameter d_1	$^{+0,30}_{0}$								

B.4 Type B4

B.4.1 Description and dimensions

A plate connector of type B4 (see Figure B.4) is made of a circular flanged plate with a hole through the centre of the plate. The dimensions shall comply with Table B.4.

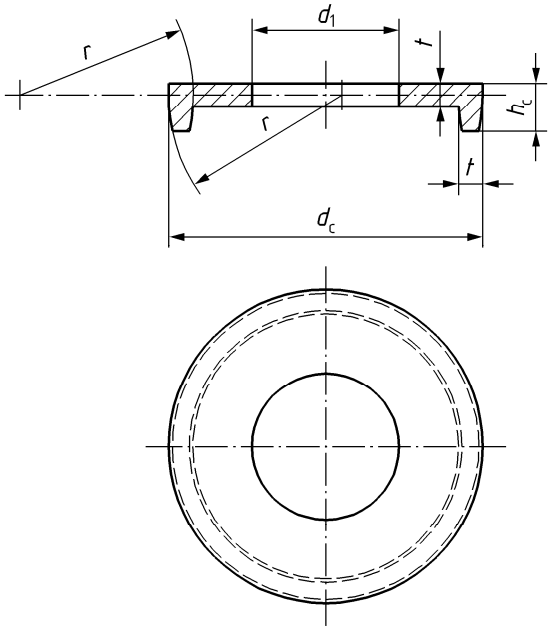


Figure B.4 — Connector of type B4

Table B.4 — Dimensions of connectors of type B4

Dimensions in millimetres

Diameter	Height	Thickness	Diameter of centre hole	Radius
d_c	h_c	t	d_1	r
80	14	6	41	48
100	16,5	7	56	60
120	19	8	56	72
140	22,5	9	71 [a]	84
160	25	10	71 [a]	96
180	28	10	91	108

Tolerances:	Height h_c	± 0,5	for h_c	$\leq$ 22,5
		± 0,7	for h_c	$\geq$ 25
	Thickness t	± 0,5	for t	$\leq$ 9
		± 0,7	for t	$\geq$ 10
	Diameter d_1	± 0,5		
Limit deviations:	Diameter d_c	$^{+1,0}_{-0,5}$		

[a] These connectors are also produced with d_1 = 21.

B.4.2 Material

Plate connectors of type B4 are made of grey cast iron EN-GJL-150 or EN-GJL-200 (Material number: EN-JL 1020 or EN-JL 1030) according to EN 1561.

Annex C
(normative)

Specifications for toothed-plate connectors

C.1 Type C1

C.1.1 Description and dimensions

A toothed-plate connector of type C1 (see Figure C.1) is a double-sided connector made of a circular plate, the edges of which shall be cut and bent over to form triangular teeth projecting alternately from opposite faces at 90° to the faces. The teeth shall be evenly spaced around the perimeter of the plate and, for connectors with diameter $d_c \geq 95$ mm, around the perimeter of the bolt-hole in the centre of the plate. Each plate has two nail holes between the centre of the plate and the circumference and on opposite sides of the bolt-hole. The dimensions shall comply with Table C.1.

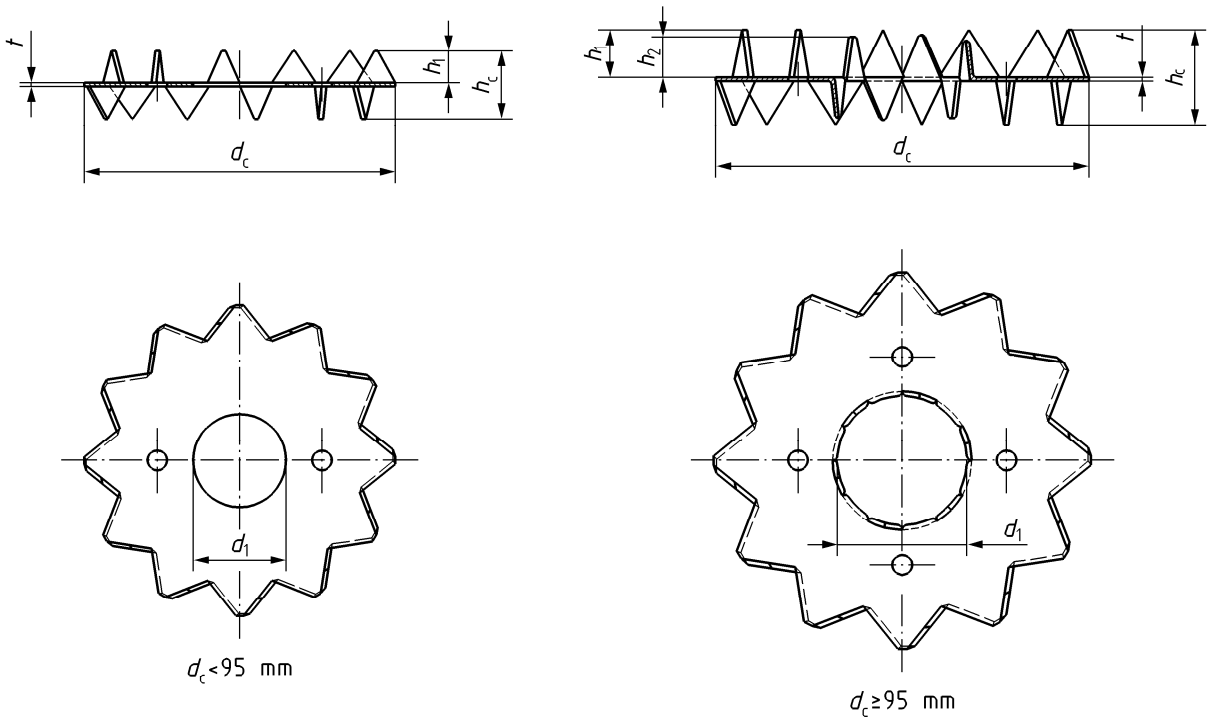


Figure C.1 — Connectors of type C1

Table C.1 — Dimensions of connectors of type C1

Dimensions in millimetres

Diameter d_c	Height h_c	Thickness [a] t	Diameter of centre hole d_1	Number of outer teeth	Number of inner teeth	Height of inner teeth [b] h_2
50	13,0	1,0	17,0	24	–	–
62	16,0	1,2	21,0	24	–	–
75	19,5	1,25	26,0	24	–	–
95	24,0	1,35	33,0	24	12	9,5
117	30,0	1,5	48,0	24	12	12,5
140	31,0	2,0	58,0	28	14	10,5
165	33,0	2,0	68,0	32	16	11,0
Tolerances:	Thickness t	EN 10131, EN 10140 or EN 10143				
	Other dimensions	± 1,5				

[a] Thickness without zinc-coating.

[b] Height of outer teeth $h_1 = (h_c - t)/2$.

C.1.2 Material

Toothed-plate connectors of type C1 are made of either

— cold rolled uncoated low carbon narrow strips for cold forming. The material shall comply with steel type DC01+C390 (Material number: 1.0330) according to EN 10139 with tolerance of the thickness according to EN 10140. In addition, the minimum elongation of the material shall be 10 %

or

— cold rolled high yield strength steel for cold forming HC340LA according to EN 10268, with tolerance of the thickness according to EN 10131

or

— continuously hot-dip coated low carbon steel for cold forming DX51D+Z275 or AZ150 according to EN 10346 with tolerance of the thickness according to EN 10143.

C.2 Type C2

C.2.1 Description and dimensions

A toothed-plate connector of type C2 (see Figure C.2) is a single-sided connector made of a circular plate, the edges of which shall be cut and bent over to form triangular teeth projecting from one face at 90° to the face. The teeth shall be evenly spaced around the perimeter of the plate and, for connectors with diameter $d_c \geq 95$ mm, additionally between the perimeter of the plate and the bolt-hole in the centre of the plate. Around the bolt-hole there is a flange projecting from the same face as the teeth. Each plate has two nail holes through the plate, between the centre of the plate and the circumference and on opposite sides of the bolt-hole. The dimensions shall comply with Table C.2.

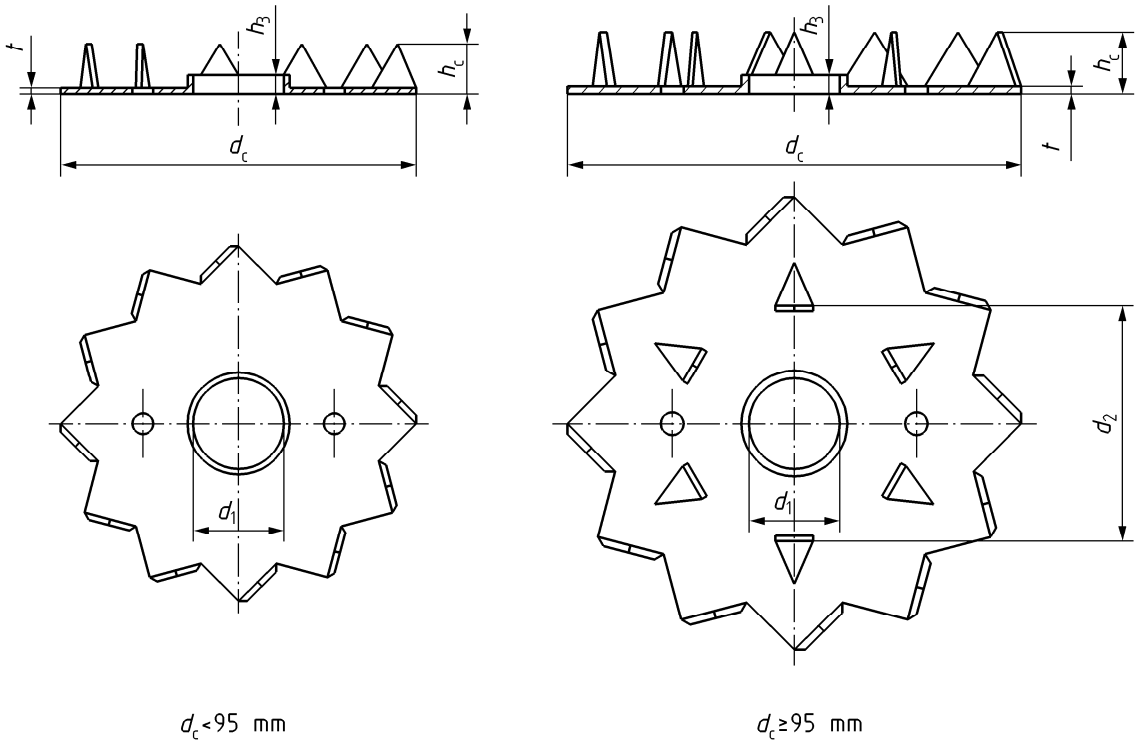


Figure C.2 — Connectors of type C2

Table C.2 — Dimensions of connectors of type C2

Dimensions in millimetres

Diameter d_c	**Height** h_c	**Thickness** [a] t	**Diameter of centre hole** d_1	**Height of flange** h_3	**Number of outer teeth**	**Number of inner teeth**	**Diameter of circle with inner teeth** d_2
50	6,6	1,0	10,4; 12,4; 16,4; 20,4	4,0	12	–	–
62	8,7	1,2	12,4; 16,4; 20,4	4,0	12	–	–
75	10,4	1,25	12,4; 16,4; 20,4; 22,4; 24,4	4,0	12	–	–
95	12,7	1,35	16,4; 20,4; 22,4; 24,4	4,0	12	6	49,0
117	16,0	1,5	16,4; 20,4; 22,4; 24,4	4,0	12	6	58,0
Tolerances:		Thickness t	EN 10131 or EN 10140				
		Other dimensions	± 1,5				
Limit deviations:		Diameter d_1	$^{+0,3}_{0}$				

[a] Thickness without zinc-coating.

C.2.2 Material

Toothed-plate connectors of type C2 are made of either

cold rolled uncoated low carbon narrow strips for cold forming. The material shall comply with steel type DC01+C390 (Material number: 1.0330) according to EN 10139 with tolerance of the thickness according to EN 10140. In addition, the minimum elongation of the material shall be 10 %,

or

cold rolled high yield strength steel for cold forming HC340LA according to EN 10268 with tolerance of the thickness according to EN 10131.

C.3 Type C3

C.3.1 Description and dimensions

A toothed-plate connector of type C3 (see Figure C.3) is a double-sided connector made of an oval plate, the edges of which shall be cut and bent over to form triangular teeth projecting alternately from opposite faces at 90° to the faces. The teeth shall be 28 in number. The height of six teeth disposed in the middle of each longer side of the plate is smaller than the height of the other teeth. Each plate has three holes through the plate, a bigger one in the centre of the plate and two smaller ones between the centre of the plate and the circumference and on opposite sides of the centre hole in the longer direction. The dimensions shall comply with Table C.3.

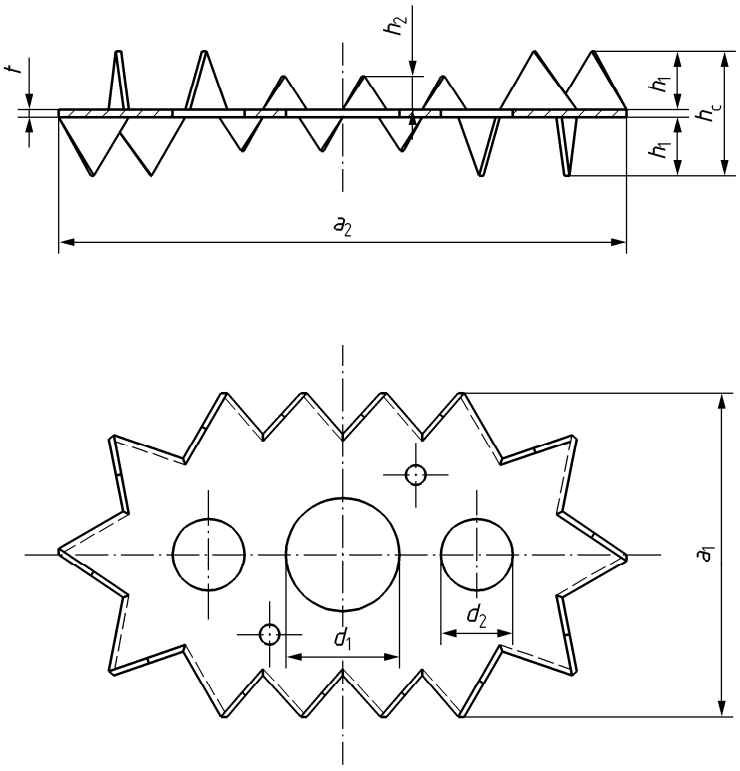


Figure C.3 — Connector of type C3

Table C.3 — Dimensions of connectors of type C3

Dimensions in millimetres

Dimensions	**Height**	**Thickness**	**Diameter of centre hole**	**Diameter of side holes**	**Height of teeth**	**Height of teeth**
$a_1 \times a_2$	h_c	t	d_1	d_2	h_1	h_2
73×130	28	1,5	26	16	13,25	8
Tolerances: Thickness *t* EN 10131 or EN 10140 Other dimensions ± 1,5						

C.3.2 Material

Toothed-plate connectors of type C3 are made of either

cold rolled uncoated low carbon narrow strips for cold forming. The material shall comply with steel type DC01+C390 (Material number: 1.0330) according to EN 10139 with tolerance of the thickness according to EN 10140. In addition, the minimum elongation of the material shall be 10 %,

or

cold rolled high yield strength steel for cold forming HC340LA according to EN 10268 with tolerance of the thickness according to EN 10131.

C.4 Type C4

C.4.1 Description and dimensions

A toothed-plate connector of type C4 (see Figure C.4) is a single-sided connector made of an oval plate, the edges of which shall be cut and bent over to form triangular teeth projecting from one face at 90° to the face. The teeth shall be 14 in number. The height of three teeth disposed in the middle of each longer side of the plate is smaller than the height of the other teeth. Each plate has three holes through the plate, a bigger one in the centre of the plate and two smaller ones between the centre of the plate and the circumference and on opposite sides of the centre hole in the longer direction. Around the centre hole there is a flange projecting from the same face as the teeth. The dimensions shall comply with Table C.4.

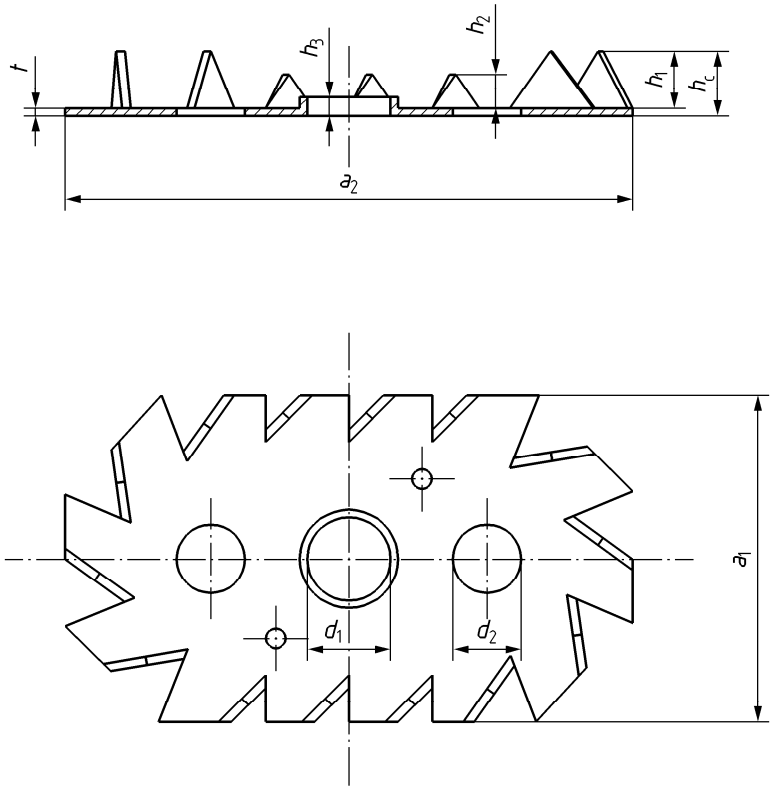


Figure C.4 — Connector of type C4

Table C.4 — Dimensions of connectors of type C4

Dimensions in millimetres

Dimensions	**Height**	**Thickness**	**Diameter of centre hole**	**Diameter of side holes**	**Height of teeth**	**Height of teeth**	**Height of flange**
$a_1 \times a_2$	h_c	t	d_1	d_2	h_1	h_2	h_3
73×130	14,75	1,5	16,4; 20,4; 22,4; 24,4	16	13,25	8	4
Tolerances:	Thickness t	EN 10131 or EN 10140					
	Other dimensions	± 1,5					
Limit deviations:	Diameter d_1	$^{+0,3}_{0}$					

C.4.2 Material

Toothed-plate connectors of type C4 are made of either

cold rolled uncoated low carbon narrow strips for cold forming. The material shall comply with steel type DC01+C390 (Material number: 1.0330) according to EN 10139 with tolerance of the thickness according to EN 10140. In addition, the minimum elongation of the material shall be 10 %,

or

cold rolled high yield strength steel for cold forming HC340LA according to EN 10268 with tolerance of the thickness according to EN 10131.

C.5 Type C5

C.5.1 Description and dimensions

A toothed-plate connector of type C5 (see Figure C.5) is a double-sided connector made of a square plate, the edges of which shall be cut and bent over to form triangular teeth projecting alternately from opposite faces at 90° to the faces. The teeth shall be evenly spaced along the perimeter and along the square hole in the middle of the plate. Each plate shall have a nail hole in each corner of the plate. The dimensions shall comply with Table C.5.

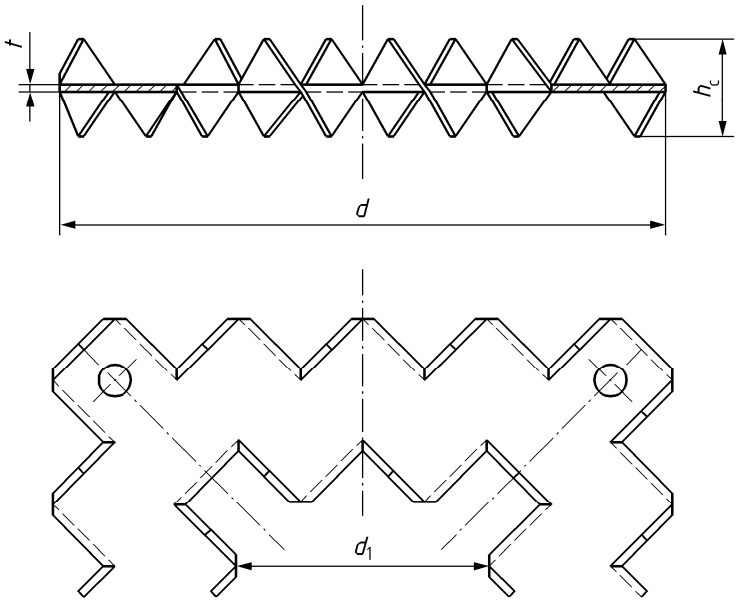


Figure C.5 — Connector of type C5

Table C.5 — Dimensions of connectors of type C5

Dimensions in millimetres

Side length d	Height h_c	Thickness t	Inner side length d_1	Number of outer teeth	Number of inner teeth
100	16	1,35	40	36	20
130	20	1,5	52	36	20
Tolerances:	Thickness t	EN 10131 or EN 10140			
	Other dimensions	± 1,5			

C.5.2 Material

Toothed-plate connectors of type C5 are made of either

cold rolled uncoated low carbon narrow strips for cold forming. The material shall comply with steel type DC01+C390 (Material number: 1.0330) according to EN 10139 with tolerance of the thickness according to EN 10140. In addition, the minimum elongation of the material shall be 10 %,

or

cold rolled high yield strength steel for cold forming HC340LA according to EN 10268 with tolerance of the thickness according to EN 10131.

C.6 Type C6

C.6.1 Description and dimensions

A toothed-plate connector of type C6 (see Figure C.6) is a double-sided connector made of a circular plate with a bolt-hole through the centre. Two nail holes may be drilled midway between the centre and the circumference and on opposite sides of the bolt-hole. The edges of the plate are cut and bent over to form 24 triangular teeth spaced evenly around the perimeter and projecting alternately from opposite faces at 90° to the faces. The dimensions shall comply with Table C.6.

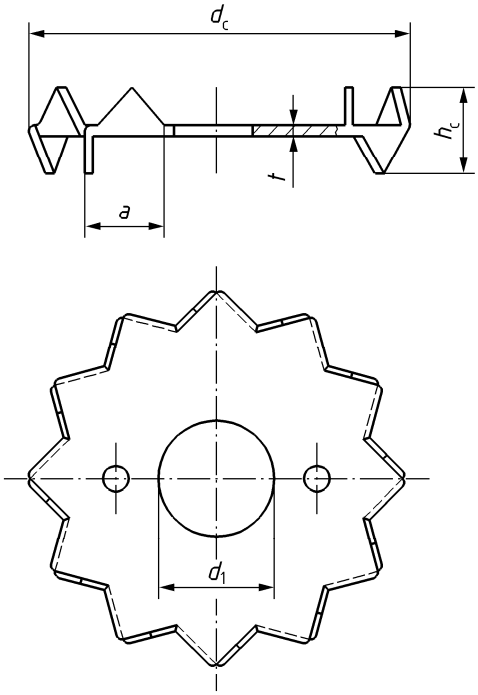


Figure C.6 — Connector of type C6

Table C.6 — Dimensions of connectors of type C6

Dimensions in millimetres

Diameter d_c	**Height** h_c	**Thickness** t	**Diameter of centre hole** d_1	**Width of teeth at base** a
38	12,0	0,9	10,5; 14,5	5,5
50	15,0	0,9	12,5; 14,5	8,0
63	18,5	1,2	12,5; 14,5	9,5
75	20,5	1,2	12,5; 14,5	11,0
Tolerances: Thickness t EN 10143 Other dimensions ± 1,5				

C.6.2 Material

Toothed-plate connectors of type C6 are made of continuously hot-dip coated low carbon steel for cold forming of DX51D+Z275 or AZ150 according to EN 10346 with tolerance of the thickness according to EN 10143.

C.7 Type C7

C.7.1 Description and dimensions

A toothed-plate connector of type C7 (see Figure C.7) is a single-sided connector made of a circular plate with a bolt-hole through the centre. Two nail holes may be drilled midway between the centre and the circumference and on opposite sides of the bolt-hole. The edges of the plate are cut and bent over to form 12 triangular teeth spaced evenly around the perimeter and projecting from one face at 90° to the face. Around the bolt-hole there is a flange projecting from the same face as the teeth. The dimensions shall comply with Table C.7.

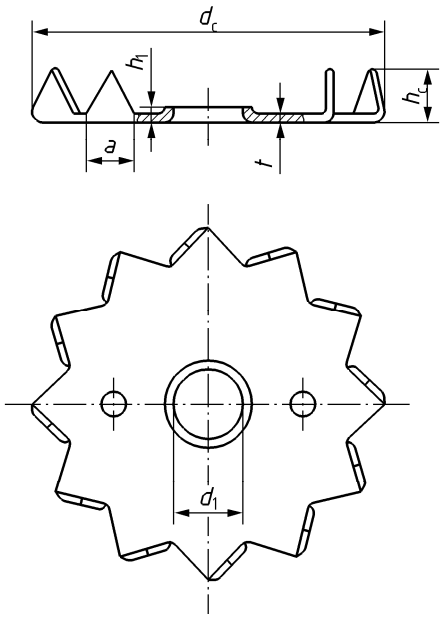


Figure C.7 — Connector of type C7

Table C.7 — Dimensions of connectors of type C7

Dimensions in millimetres

Diameter d_c	Height h_c	Thickness t	Diameter of centre hole d_1	Height of flange from face h_1	Width of teeth at base a
38	6,5	0,9	10,5; 14,5	1,6	5,5
50	8,0	0,9	12,5; 14,5	2,4	8,0
63	10,0	1,2	12,5; 14,5	2,4	9,5
75	10,5	1,2	12,5; 14,5	2,4	11,0
Tolerances:	Thickness t	EN 10143			
	Other dimensions	±1,5			
Limit deviations:	Diameter d_1	$^{+0,3}_{0}$			

C.7.2 Material

Toothed-plate connectors of type C7 are made of continuously hot-dip coated low carbon steel for cold forming of DX51D+Z275 or AZ150 according to EN 10346 with tolerance of the thickness according to EN 10143.

C.8 Type C8

C.8.1 Description and dimensions

A toothed-plate connector of type C8 (see Figure C.8) is a double-sided connector made of a square plate with a bolt-hole through the centre. Two nail holes may be drilled on opposite sides of the bolt-hole. The edges of the plate are cut and bent over to form 32 triangular teeth, with 8 evenly spaced teeth on each edge, projecting alternately from opposite faces at 90° to the faces. The base of each tooth shall be inclined at an angle of 60° to the edge of the plate or parallel to it. The dimensions shall comply with Table C.8.

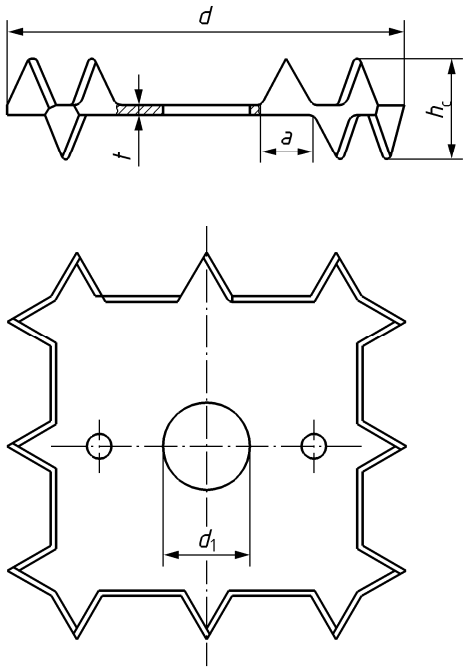


Figure C.8 — Connector of type C8

Table C.8 — Dimensions of connectors of type C8

Dimensions in millimetres

Side length *d*	Height h_c	Thickness *t*	Diameter of centre hole d_1	Width of teeth at base *a*
38	12,0	1,2	10,5; 14,5	5,5
50	14,0	1,2	12,5; 14,5	6,5
63	17,0	1,2	12,5; 14,5	8,5
75	20,0	1,6	12,5; 14,5	10,5
Tolerances: Thickness *t* EN 10143 Other dimensions ± 1,5				

C.8.2 Material

Toothed-plate connectors of type C8 are made of continuously hot-dip coated low carbon steel for cold forming of DX51D+Z275 or AZ150 according to EN 10346 with tolerance of the thickness according to EN 10143.

C.9 Type C9

C.9.1 Description and dimensions

A toothed-plate connector of type C9 (see Figure C.9) is a single-sided connector made of a square plate with a bolt-hole through the centre. Two nail holes may be drilled on opposite sides of the bolt-hole. The edges of the plate are cut and bent over to form 16 triangular teeth, with 4 evenly spaced teeth on each edge, projecting from one face at 90° to the face. The base of each tooth shall be inclined at an angle of 60° to the edge of the plate. Around the bore-hole there is a flange projecting from the same face as the teeth. The dimensions shall comply with Table C.9.

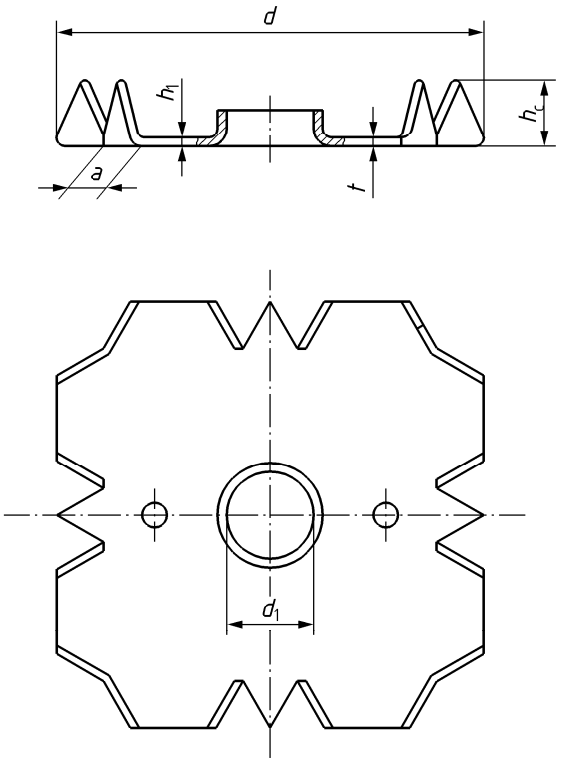


Figure C.9 — Connector of type C9

Table C.9 — Dimensions of connectors of type C9

Dimensions in millimetres

Side length	Height	Thickness	Diameter of centre hole	Height of flange from face	Width of teeth at base
d	h_c	*t*	d_1	h_1	*a*
38	7,0	1,2	10,5; 14,5	1,6	5,5
50	8,0	1,2	12,5; 14,5	3,2	6,5
63	9,0	1,2	12,5; 14,5	4,0	8,5
75	10,0	1,6	12,5; 14,5	4,8	10,5
Tolerances:	Thickness *t*	EN 10143			
	Other dimensions	± 1,5			
Limit deviations:	Diameter d_1	$^{+0,3}_{0}$			

C.9.2 Material

Toothed-plate connectors of type C9 are made of continuously hot-dip coated low carbon steel for cold forming of DX51D+Z275 or AZ150 according to EN 10346 with tolerance of the thickness according to EN 10143.

C.10 Type C10

C.10.1 Description and dimensions

A toothed-plate connector of type C10 (see Figure C.10) is a double-sided connector made of a ring plate with spikes on both sides. The spikes are equidistant and are arranged either in one or two circles on each side of the ring plate. In the case of two circles, half of the spikes are arranged in the inner circle, the other half in the outer circle, whereby the inner spikes are in a staggered position to the outer spikes. The spikes on the two sides of the ring plate are either staggered against each other or not. The shape of the spikes is like a cone with a blunted point. The inner side of the cone may be slightly flattened below the blunted point, but not more than 1,0 mm at the bottom of the cone. The dimensions shall comply with Table C.10.

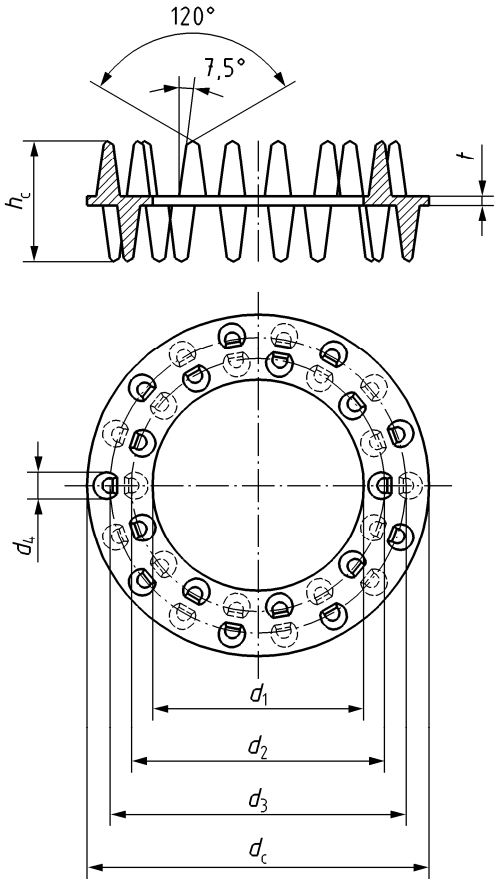


Figure C.10 — Connector of type C10

Table C.10 — Dimensions of connectors of type C10

Dimensions in millimetres

Diameter d_c	Height h_c	Thickness t	Inside diameter of ring plate d_1	Diameter of inner circle d_2	Diameter of outer circle d_3	Diameter of spikes at base d_4	Number of spikes at each side
50	27	3	30,5	41	–	6	8 [a]
65	27	3	35,5	48	58	6	14 [b c]
80	27	3	49,5	60	70	6	18 [b]
95	27	3	65,5	76	88	6	24 [b]
115	27	3	85,5	95	108	6	32 [b]
Tolerances on h_c, t ± 0,5; other dimensions ± 0,8.							
[a] Arranged in one circle. [b] Arranged in two circles. [c] The spikes of one side are not staggered against the spikes of the other side.							

C.10.2 Material

Toothed-plate connectors of type C10 are made of malleable cast iron EN-GJMB-350-10 (Material number: EN-JM 1130) according to EN 1562.

C.11 Type C11

C.11.1 Description and dimensions

A toothed-plate connector of type C11 (see Figure C.11) is a single-sided connector made of a round plate with spikes on one side of the plate. The spikes are equidistant and are arranged either in one or two circles. In the case of two circles, half of the spikes are arranged in the inner circle, the other half in the outer circle, whereby the inner spikes are in a staggered position to the outer spikes. The shape of the spikes is like a cone with a blunted point. The inner side of the cone may be slightly flattened below the blunted point, but not more than 1,0 mm at the bottom of the cone. Each connector has a bolt-hole through its centre with a flange around the bolt-hole projecting from the same face as the spikes. The dimensions shall comply with Table C.11.

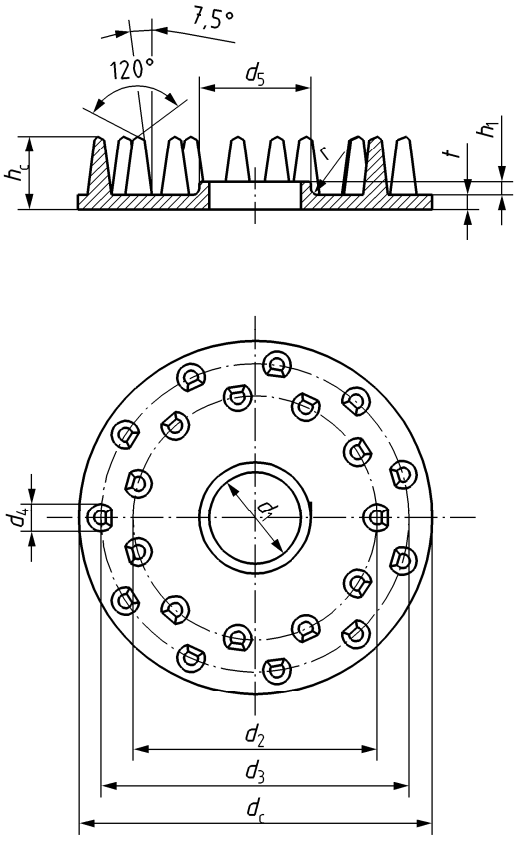


Figure C.11 — Connector of type C11

C.11.2 Material

Toothed-plate connectors of type C11 are made of malleable cast iron EN-GJMB-350-10 (Material number: EN-JM 1130) according to EN 1562.

Table C.11 — Dimensions of connectors of type C11

Dimensions in millimetres

Diameter d_c	Height h_c	Thickness t	Diameter of centre hole d_1	Diameter of inner circle d_2	Diameter of outer circle d_3	Diameter of spikes at base d_4	Diameter of flange d_5	Radius r	Height of flange from face h_1	Number of spikes
50	15	3	12,5	40	–	6	17	4	3	8 [a]
65	15	3	16,5	46	56	6	21	4	3	14 [b]
80	15	3	20,5	57	69	6	20,5 [c]	–	3	22 [b]
95	15	3	24,5	64	84	6	30,5	4	3	24 [b]
115	15	3	24,5	84	106	6	30,5	4	3	32 [b]

Tolerances on h_c, t, r, h_1 ± 0,5; other dimensions ± 0,8.

[a] Arranged in one circle.

[b] Arranged in two circles.

[c] The transition between the plate and the flange is not curved but sloped with an angle of 26,5°.

Annex D
(normative)

Specifications for other connectors

D.1 Type D1

D.1.1 Description

A connector of type D1 (see Figure D.1) is a double-sided connector made of a round wooden plate with a bevelled rim such that its diameter increases towards the middle. The plate has a bolt-hole through its centre. The dimensions shall comply with Table D.1.

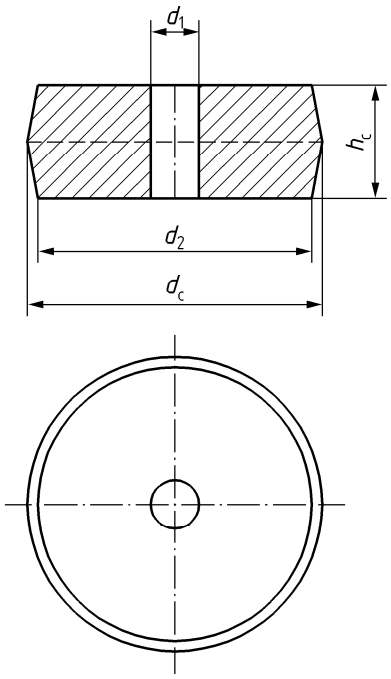


Figure D.1 — Connector of type D1

Table D.1 — Dimensions of connectors of type D1

Dimensions in millimetres

Diameter of plate d_c	Diameter of centre hole d_1	Min. diameter of plate d_2	Height h_c
66	14	60	32
100	14	95	40

D.1.2 Material

Connectors of type D1 are made of clear oak (quercus spp.) with a minimum characteristic density of 600 kg/m^3 and a moisture content of not more than 18 % during manufacturing. The grain direction shall be perpendicular to the axis of the bolt.

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