BRITISH STANDARD

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1977:2006

Conveyor chains, attachments and sprockets

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British Standards

National foreword

This British Standard was published by BSI. It is the UK implementation of ISO 1977:2006. It supersedes BS ISO 1977:2000 which is withdrawn.

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INTERNATIONAL STANDARD

ISO 1977

Second edition
2006-08-15

Conveyor chains, attachments and sprockets

Chaînes de manutention, plaques-attaches et roues dentées

Reference number
ISO 1977:2006(E)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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

ISO 1977 was prepared by Technical Committee ISO/TC 100, *Chains and chain sprockets for power transmission and conveyors*.

This second edition cancels and replaces the first edition (ISO 1977:2000), Figures 2 and 5, as well as 5.4 and 5.5, of which have been technically revised.

Introduction

ISO 1977 combines into a single document ISO 1977-1, ISO 1977-2 and ISO 1977-3, which covered metric-series chains and attachments, and chain wheels, while at the same time revising their technical content.

The principle technical changes are: a reduction in the flanged roller dimensions and the width between outer plates in the MC series of chains, an increase in the width between inner plates in M-series, MC56, MC112 and MC224 chains, and the addition of the small roller diameter to the MC series. New information on the calculation of sprocket tip diameters and tooth heights above root diameters is also given.

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Conveyor chains, attachments and sprockets

1 Scope

This International Standard specifies the characteristics of bush, plain and flanged roller chains of both solid and hollow bearing pin types designed for general conveying and mechanical handling duties, together with associated chain sprockets and attachments. The chain dimensions specified in this International Standard will ensure interchangeability of complete chains and individual links for repair purposes.

This International Standard is applicable to sprockets with from 6 to 40 teeth. Control criteria for sprockets are defined to ensure correct meshing, operation and transmission of load in use under normal operating conditions.

NOTE Controls do not necessarily determine sprocket design parameters.

Specifications are also given for K attachments and deep plates for use with the conveyor chains conforming to this International Standard.

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.

ISO 286-2, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts*.

3 Chains

3.1 Nomenclature

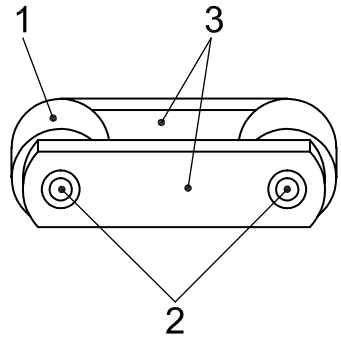
The nomenclature of the chains and their component parts is presented in Figure 1.

3.2 Dimensions

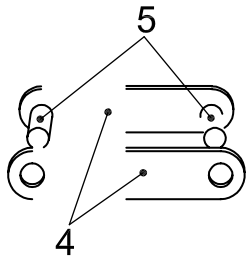
Conveyor chain dimensions shall conform to those given in Table 1 or Table 2 (see Figure 2). Both maximum and minimum dimensions are specified to ensure the interchangeability of links made by different chain manufacturers. Although these represent limits for interchangeability, they are not necessarily to be regarded as limits of tolerance for manufacture.

a) **Solid bearing pin chain**

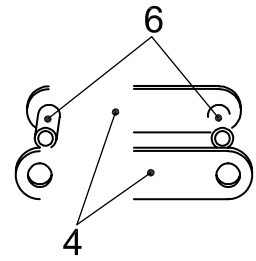
b) **Hollow bearing pin chain**



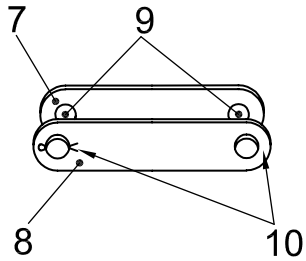
c) **Inner link**



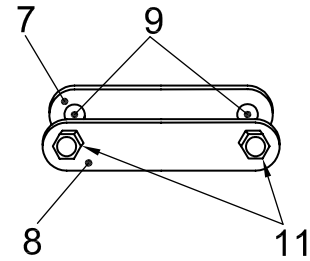
d) **Outer link** (solid bearing pins)



e) **Outer link** (hollow bearing pins)

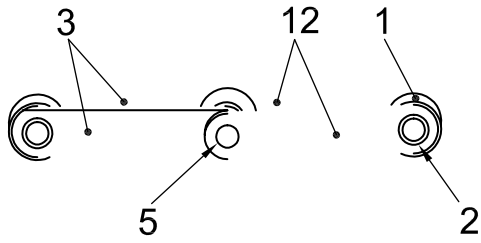


f) **Connecting link** (cotter pin fasteners)

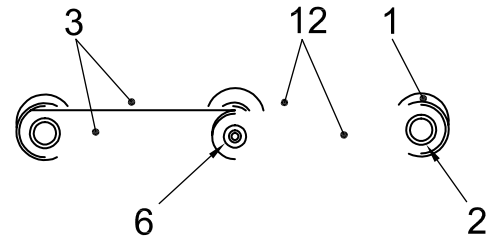


g) **Connecting link** (nut fasteners)

Figure 1 — Chain parts



h) Cranked link double (solid bearing pin)



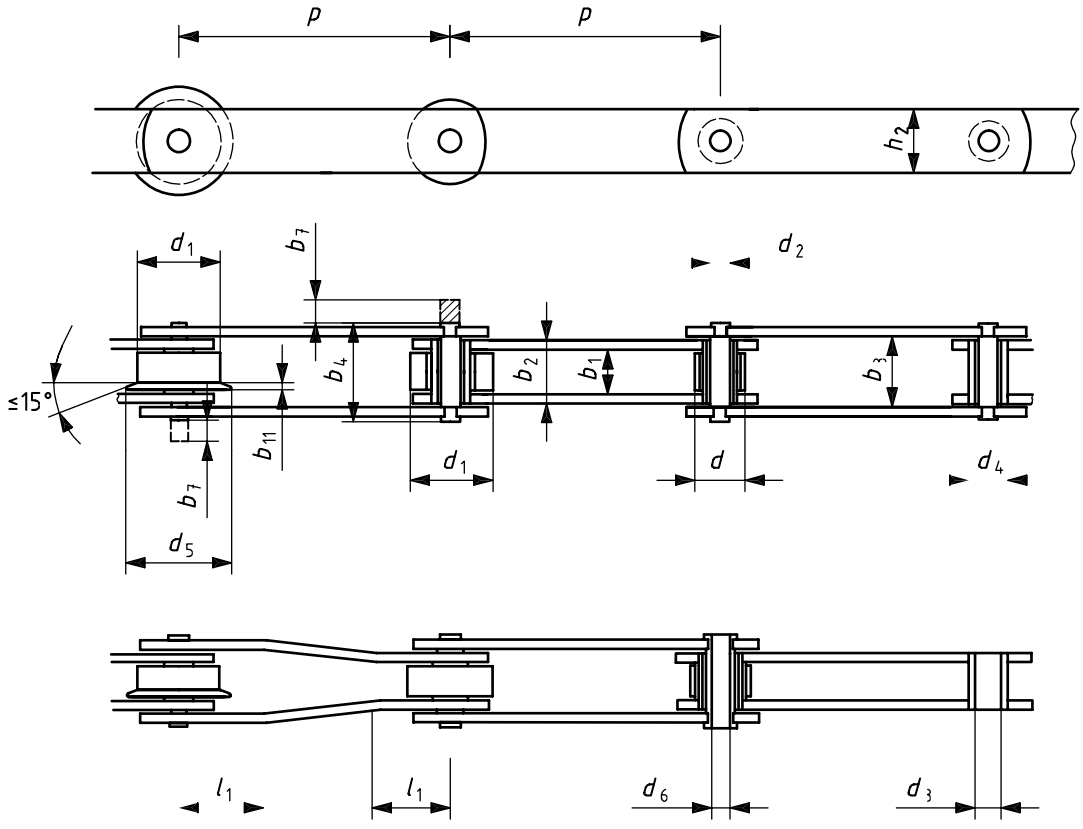
i) Cranked link double (hollow bearing pin)

Key

1	roller	5	bearing pins (solid)	9	connecting pins
2	bush	6	bearing pins (hollow)	10	cotter pin fasteners [a]
3	inner plate	7	fixed outer plate	11	nut fasteners [a]
4	outer plate	8	detachable plate	12	cranked plate

[a] The type of fastener (cotter pin, nut, etc.) is optional.

Figure 1 (*continued*)



d_1	plain roller diameter	b_2	width over inner links	d_5	flange roller diameter
d_2	bearing pin body diameter	b_3	width between outer plates	b_{11}	flange roller width
d_3	bush bore	b_4	width over bearing pins	d_6	hollow pin bore
d_4	bush diameter	b_7	additional width for joint faster	d_7	small roller diameter
h_2	plate depth	l_1	cranked link dimension		
b_1	width between inner plates	p	pitch		

NOTE 1 Bearing pins can be of necked design, as shown here, or plain as in Figure 1.

NOTE 2 These illustrations do not define the true form of the chain plates, pins, bushes or rollers.

Figure 2 — Chain dimensions and symbols (see Tables 1 and 2)

Table 1 — Solid pin conveyor chain dimensions and characteristics

ISO chain no. (basic)	Tensile strength	d_1	Pitch [a b c] p														d_2	d_3	d_4	h_2	b_1	b_2	b_3	b_4	b_7	Measuring force	l_1 [d]	d_5	b_{11}	d_7
	kN	mm	mm														mm									kN	mm			
	min.	max.	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1 000	max.	min.	max.	max.	min.	max.	min.	max.	max.		min.	max.	max.	max.
M20	20	25	X															6	6,1	9	19	16	22	22,2	35	7	0,4	12,5	32	3,5	12,5
M28	28	30		X														7	7,1	10	21	18	25	25,2	40	8	0,56	14	36	4	15
M40	40	36																8,5	8,6	12,5	26	20	28	28,3	45	9	0,8	17	42	4,5	18
M56	56	42			X													10	10,1	15	31	24	33	33,3	52	10	1,12	20,5	50	5	21
M80	80	50																12	12,1	18	36	28	39	39,4	62	12	1,6	23,5	60	6	25
M112	112	60				X												15	15,1	21	41	32	45	45,5	73	14	2,24	27,5	70	7	30
M160	160	70					X											18	18,1	25	51	37	52	52,5	85	16	3,2	34	85	8,5	36
M224	224	85						X										21	21,2	30	62	43	60	60,6	98	18	4,5	40	100	10	42
M315	315	100							X									25	25,2	36	72	48	70	70,7	112	21	6,3	47	120	12	50
M450	450	120																30	30,2	42	82	56	82	82,8	135	25	9	55	140	14	60
M630	630	140																36	36,2	50	103	66	96	97	154	30	12,5	66,5	170	16	70
M900	900	170									X							44	44,2	60	123	78	112	113	180	37	18	81	210	18	85

[a] Pitch, p, is a theoretical reference dimension used in the calculation of chain lengths and sprocket dimensions, and is not intended for use in the inspection of individual links.

[b] Those pitches indicated by an X are for bush and small roller chains only.

[c] Those pitches within the shaded area are the preferred pitches.

[d] The cranked link dimension l_1 also determines the maximum plate length and the limit of the path of articulation taking minimum play into account.

Table 2 — Hollow pin conveyer chain dimensions and characteristics

ISO chain no. (basic)	Tensile strength	d_1	Pitch [a b] p										d_2	d_3	d_4	h_2	b_1	b_2	b_3	b_4	b_7	Measuring force	l_1 [c]	d_5	b_{11}	d_6	d_7
	kN	mm	mm														mm									kN	mm			
	min.	max.	63	80	100	125	160	200	250	315	400	500	max.	min.	max.	max.	min.	max.	min.	max.	max.		min.	max.	max.	min.	max.
MC28	28	36											13	13,1	17,5	26	20	28	28,3	42	10	0,56	17	42	4,5	8,2	25
MC56	56	50											15,5	15,6	21	36	24	33	33,3	48	13	1,12	23,5	60	5	10,2	30
MC112	112	70											22	22,2	29	51	32	45	45,5	67	19	2,24	34	85	7	14,3	42
MC224	224	100											31	31,2	41	72	43	60	60,6	90	24	4,5	47	120	10	20,3	60

[a] Pitch, p, is a theoretical reference dimension used in the calculation of chain lengths and sprocket dimensions, and is not intended for use in the inspection of individual links.

[b] Those pitches within the shaded area are the preferred pitches.

[c] The cranked link dimension l_1 also determines the maximum plate length and the limit of the path of articulation taking minimum play into account.

3.3 Tensile testing

The test length shall have a minimum of three free pitches. The ends shall be attached to the testing-machine shackles by a pin through the plate holes or the bushes. The shackles shall be designed so as to allow universal movement. The actual test method shall be left to the manufacturer's discretion. Tests in which failures occur adjacent to the shackles shall be disregarded.

3.4 Length accuracy

3.4.1 General

When measured in accordance with the requirements given in 3.4.2, 3.4.3 and 3.4.4, the finished chain shall be accurate to within $^{0,25}_{0}$ % of the nominal chain length.

NOTE Chains that work in parallel can be matched by agreement between the purchaser and manufacturer.

3.4.2 Standard test-measurement length

The length of chain for measurement shall be that nearest to 3 000 mm with an odd number of pitches, terminating with inner links at each end.

3.4.3 Support

The chain, in unlubricated condition, shall be supported throughout its entire length.

3.4.4 Measuring force

A force equal to 1/50 of the appropriate tensile strength given in Table 1 or Table 2 shall be applied.

3.5 Cranked links

In order to obtain an odd number of pitches in an endless chain, a cranked link is used [see Figure 1 h) and 1 i)]. The cranked link dimension of a chain shall correspond to its respective l_1 as given in Table 1 or Table 2 and as appropriate.

3.6 Designation

The designation numbers for conveyor chains are based on the ISO numbers given in Table 1 and Table 2. These numbers are derived from the minimum tensile strength (in kilonewtons) and have been given the prefixes M, to indicate a solid bearing pin chain, and MC, to indicate a hollow bearing pin chain.

EXAMPLE M80 signifies a solid bearing pin chain of 80 kN tensile strength.

MC224 signifies a hollow bearing pin chain of 224 kN tensile strength.

The addition of the letter B, F, P or S indicates type: bush, flanged roller, plain or small roller, respectively. The addition of further digits indicates the pitch in millimetres.

EXAMPLE MC224 chain with flanged roller and pitch of 200 mm:

MC224-F-200

3.7 Marking

The chains shall be marked with the manufacturer’s name or trademark, and should be marked with the respective ISO chain number given in Table 1 or Table 2.

4 Attachments

4.1 K attachments

4.1.1 Dimensions

K attachments are shown in Figure 3, and their respective dimensions are given in Table 3.

4.1.2 Designation

This International Standard specifies three types of K attachment:

— K1, which has one attachment hole centrally disposed in each plate;

— K2, which has two attachment holes disposed in each plate (see Figure 3);

— K3, which has two attachment holes disposed in each plate and a third hole centrally positioned between the two.

Attachments may be fitted on one or both sides of the chain.

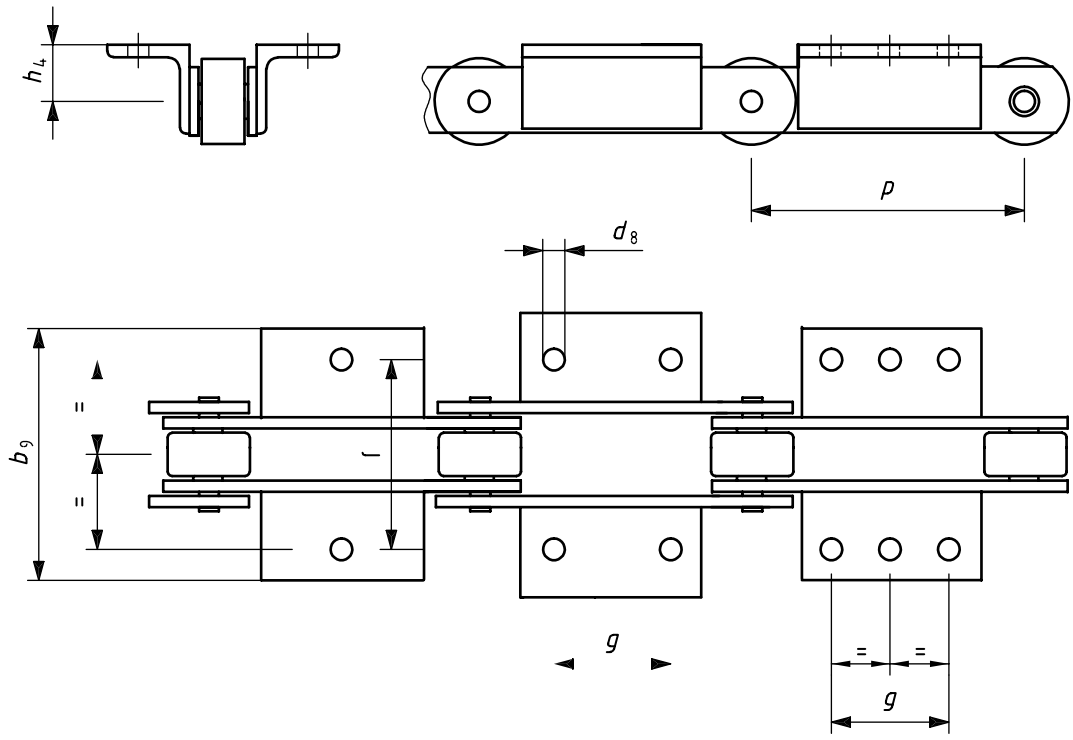
4.1.3 Manufacture

For convenience, the K attachments are shown in Figure 3 as being made of rolled steel angle section. However, their construction shall be at the discretion of the manufacturer and may be of integral form, whereby the actual chain plates will be bent over to form the platform.

The attachment length shall be at the discretion of the manufacturer.

4.2 Deep plates

The deep plate height, h_6, is shown in Figure 4, with respective heights given in Table 4. All other data, including chain tensile strengths, are specified in Tables 1 and 2.



d_8 hole diameter
h_4 platform height
f transverse distance between hole centres
b_9 width over attachments
g longitudinal distance between hole centres
p pitch

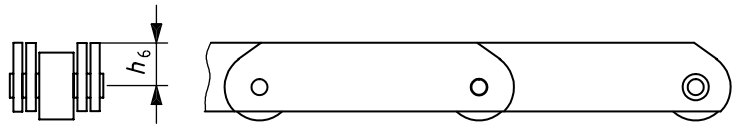
Figure 3 — K attachment dimensions and symbols (see Table 3)

Table 3 — K attachment dimensions

Dimensions in millimetres

ISO chain number	d_8	h_4	f	b_9	Longitudinal distance between hole centres					
					short		medium		long	
				max.	p [a] min.	g	p [a] min.	g	p [a] min.	g
M20	6,6	16	54	84	63	20	80	35	100	50
M28	9	20	64	100	80	25	100	40	125	65
M40	9	25	70	112	80	20	100	40	125	65
M56	11	30	88	140	100	25	125	50	160	85
M80	11	35	96	160	125	50	160	85	200	125
M112	14	40	110	184	125	35	160	65	200	100
M160	14	45	124	200	160	50	200	85	250	145
M224	18	55	140	228	200	65	250	125	315	190
M315	18	65	160	250	200	50	250	100	315	155
M450	18	75	180	280	250	85	315	155	400	240
M630	24	90	230	380	315	100	400	190	500	300
M900	30	110	280	480	315	65	400	155	500	240
MC28	9	25	70	112	80	20	100	40	125	65
MC56	11	35	88	152	125	50	160	85	200	125
MC112	14	45	110	192	160	50	200	85	250	145
MC224	18	65	140	220	200	50	250	100	315	155

[a] Minimum chain pitch for longitudinal distance between hole centres g.



h_6 plate height

Figure 4 — Deep plate height (see Table 4)

Table 4 — Deep plate heights

Dimensions in millimetres

ISO chain number	h_6
M20	16
M28	20
M40	22,5
M56	30
M80	32,5
M112	40
M160	45
M224	60
M315	65
M450	80
M630	90
M900	120
MC28	22,5
MC56	32,5
MC112	45
MC224	65
NOTE All other data, including those relating to tensile strength, are as those given for the basic chain plates in Clause 3.	

5 Sprockets

5.1 Diametral dimensions

5.1.1 General

The sprocket diametral dimensions are shown in Figure 5, and specified in 5.1.2 to 5.1.6.

5.1.2 Pitch circle diameter (d)

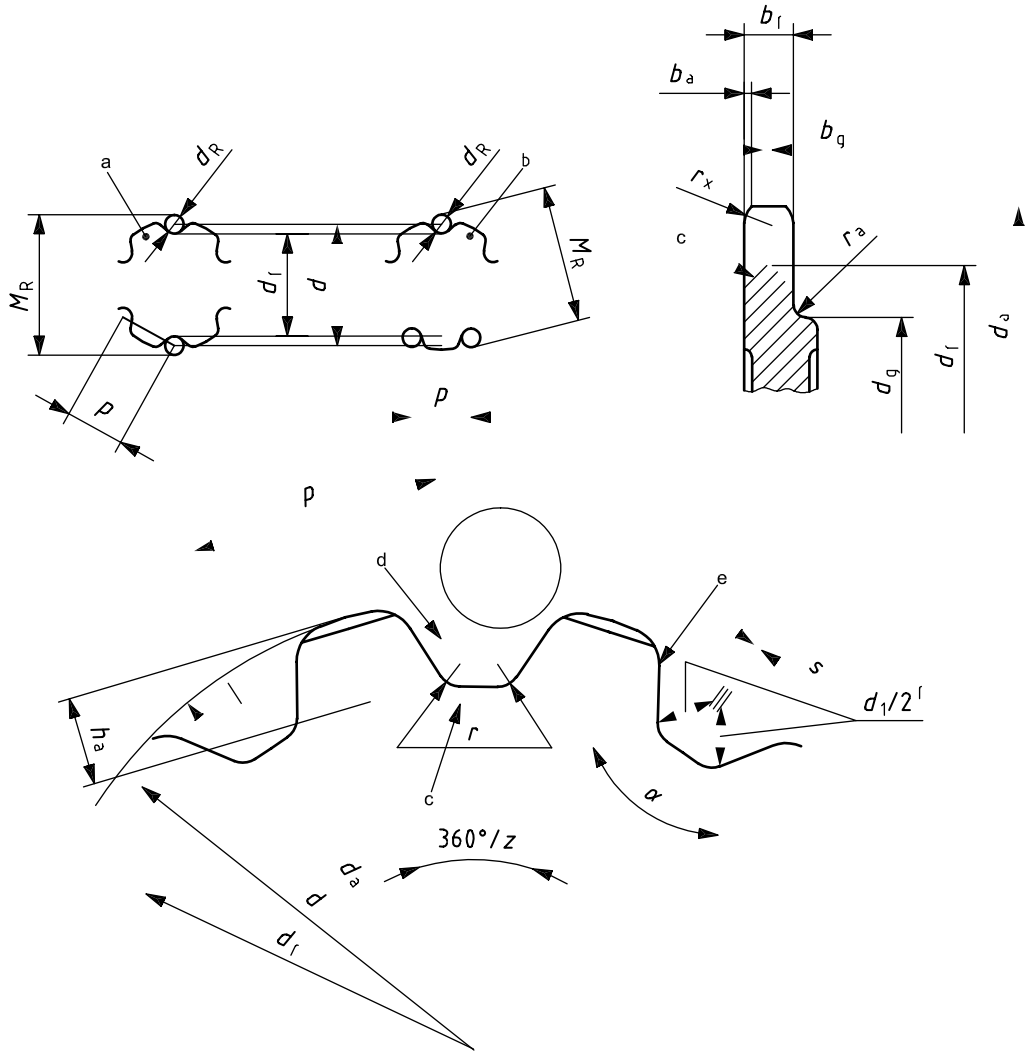
$$d = \frac{p}{\sin\frac{180°}{z}}$$

The unitary dimensions of the normal range of teeth are given in Annex A.

5.1.3 Tip diameter (d_a)

$$d_a \text{ max} = d + d_1$$

The minimum tip diameter shall ensure a tooth working face according to 5.2.2.



b_a	tooth side relief	d_R	measuring-pin diameter	r_i	roller seating radius
b_f	tooth width	d_1	plain roller diameter	r_x	minimum tooth side radius
b_g	relieved tooth width minimum	d_2	bearing pin body diameter	s	pitch line clearance
d	pitch circle diameter	h_a	tooth height above root diameter	z	number of teeth
d_a	tip diameter	M_R	measurement over measuring pins	α	roller seating angle
d_f	root diameter	p	chordal pitch (= chain pitch)		
d_g	absolute maximum shroud diameter	r_a	shroud radius		

For other than roller chains, replace the term “roller” by the term “bush”.

a Even numbers of teeth.
b Odd numbers of teeth.
c Roller seating relief.
d Pitch polygon.
e Tooth flank.
f Depending on the type of roller, d_1 may be replaced with d_4 or d_7.

Figure 5 — Sprocket parts and dimensions

5.1.4 Measuring pin diameter (d_R)

As appropriate, $d_R = d_1$, d_4 or d_7, subject to tolerance h_{11}, as specified in ISO 286-2.

5.1.5 Root diameter (d_f)

As appropriate, d_f max. $= d - d_1$ or $d - d_4$ or $d - d_7$.

The minimum root diameter shall be selected by the manufacturer to provide good chain operation.

5.1.6 Measurement over measuring pins (M_R)

For even numbers of teeth, measurement over measuring pins, $M_R = d + d_R$ min., and measurement shall be made over the appropriate pins inserted in diametrically opposed tooth spaces.

For odd numbers of teeth, $M_R = d \cos(90°/z) + d_R$ min., and measurement shall be made over pins inserted in the tooth spaces most nearly diametrically opposite.

During measurement, the pins shall always be in contact with the root diameter of the corresponding teeth.

5.2 Sprocket tooth gap form

5.2.1 General

The tooth gap shall be defined according to the criteria of 5.2.2 to 5.2.7 (see Figure 5).

5.2.2 Working face

The working face, the functional part of the tooth form, is the area between the lines of contact of two rollers, with the centreline of the one roller lying on the pitch circle, and that of the other on a circle of diameter equal to:

$$\frac{p + 0{,}25 d_2}{\sin\frac{180°}{z}}$$

That is, except when this is reduced owing to the limitation imposed on the tooth height, as given in 5.2.4.

The working face may be straight or convex.

5.2.3 Pressure angle

The pressure angle is the angle between the pitch line of the chain link and the line perpendicular to the working face at the point of roller contact. The pressure angle at any point on the working face shall be in accordance with Table 5.

5.2.4 Tooth height above root diameter (h_a)

$$h_a = \frac{d_a - d_f}{2}$$

When slats are attached to the K attachment platforms and the starts bridge the chain link, the tip of the tooth shall not project above the chord of the pitch circle by any more than $0{,}8 h_a$, where h_a is the platform height of the attachment according to Table 3.

5.2.5 Pitch line clearance (s):

For sprockets of unmachined tooth form:

s min. $= 0{,}04p$

For sprockets of machined tooth form:

s min. $= 0{,}08d_1$

5.2.6 Maximum roller seating radius (r_i)

As appropriate for the roller type, r_i max. $= d_1/2$ or $d_4/2$ or $d_7/2$.

5.2.7 Tooth flank

Regardless of the seating-radius size or whether a straight or curved tooth form is employed, a clearance equal to $d_1/2$ or $d_4/2$ or $d_7/2$ (as appropriate for the type of roller) shall be achieved between the pitch line clearance dimension lines and the tooth flank, measured along the seating angle dimension lines (see Figure 5).

Table 5 — Pressure angles

Number of teeth z	Pressure angle	
	min.	max.
6 or 7	7°	10°
8 or 9	9°	12°
10 or 11	12°	15°
12 or 13	14°	17°
14 or 15	16°	20°
16 to 19	18°	22°
20 to 27	20°	25°
28 and over	23°	28°

5.3 Rim profile

5.3.1 Tooth width (b_f)

a) For non-flanged rollers:

— b_f max. $= 0{,}9b_1 - 1$ mm

— b_f min. $= 0{,}87b_1 - 1{,}7$ mm

b) For flanged rollers:

— b_f max. $= 0{,}9(b_1 - b_{11}) - 1$ mm

— b_f min. $= 0{,}87(b_1 - b_{11}) - 1{,}7$ mm

5.3.2 Minimum tooth side radius (r_x)

$$r_x = 1{,}6 b_1$$

5.3.3 Nominal tooth side relief (b_a)

$$b_a = 0{,}16 b_1$$

5.3.4 Minimum relieved tooth width (b_g)

$$b_g = 0{,}25 b_f$$

NOTE Under certain operational conditions, the material being conveyed could build up in the space between the roller and the tooth. To prevent malfunctioning, the roller seating (see Figure 5) can be relieved.

5.3.5 Shroud radius (r_a)

The actual shroud radius provided is expressed as: r_a act.

5.3.6 Absolute maximum shroud diameter (d_g)

$$d_g = p \cot\frac{180^\circ}{z} - h_2 - 2r_a \text{ act.}$$

5.4 Radial run-out

The radial run-out between the bore and the root diameter shall not exceed 2 mm in any case. The values for the total indicator reading are derived from the following:

— for unmachined teeth: $0{,}005 d_f$ or 1,5 mm, whichever is the greater;

— for machined teeth: $0{,}001 d_f + 0{,}1$ mm or 0,2 mm, whichever is the greater.

5.5 Axial run-out

The axial run-out, measured with reference to the bore and the flat part of the side face of the teeth, shall not exceed 2 mm in any case. The values for the total indicator reading are derived from the following:

— for unmachined teeth: $0{,}005 d_f$ or 1,5 mm, whichever is the greater;

— for machined teeth: $0{,}001 d_f + 0{,}1$ mm or 0,2 mm, whichever is the greater.

5.6 Bore tolerances

Unless otherwise determined by agreement between the manufacturer and the purchaser, bores shall be to the H9 limits specified in ISO 286-2.

5.7 Marking

It is recommended that sprockets be marked with the following information:

— manufacturer’s name or trademark;

— number of teeth;

— ISO chain number (see Tables 1 and 2).

Annex A
(normative)

Pitch-circle diameters

Table A.1 specifies sprocket pitch-circle diameters suitable for a chain of unit pitch. Pitch-circle diameters suitable for a chain of any other pitch are directly proportional to that particular pitch.

Table A.1 — Pitch-circle diameters

Dimensions in millimetres

Number of teeth z	Pitch-circle diameter, d, for unit pitch [a]	Number of teeth z	Pitch-circle diameter, d, for unit pitch [a]	Number of teeth z	Pitch-circle diameter, d, for unit pitch [a]
6	2,000 0	18	5,758 8	30	9,566 8
6½	2,151 9	18½	5,917 1	30½	9,725 6
7	2,304 8	19	6,075 5	31	9,884 5
7½	2,458 6	19½	6,234 0	31½	10,043 4
8	2,613 1	20	6,392 5	32	10,202 3
8½	2,768 2	20½	6,550 9	32½	10,361 2
9	2,923 8	21	6,709 5	33	10,520 1
9½	3,079 8	21½	6,868 1	33½	10,679 0
10	3,236 1	22	7,026 6	34	10,838 0
10½	3,392 7	22½	7,185 3	34½	10,996 9
11	3,549 4	23	7,343 9	35	11,155 8
11½	3,706 5	23½	7,502 6	35½	11,314 8
12	3,863 7	24	7,661 3	36	11,473 7
12½	4,021 1	24½	7,820 0	36½	11,632 7
13	4,178 6	25	7,978 7	37	11,791 6
13½	4,336 2	25½	8,137 5	37½	11,950 6
14	4,494 0	26	8,296 2	38	12,109 5
14½	4,651 8	26½	8,455 0	38½	12,268 5
15	4,809 7	27	8,613 8	39	12,427 5
15½	4,967 7	27½	8,772 6	39½	12,586 5
16	5,125 8	28	8,931 4	40	12,745 5
16½	5,284 0	28½	9,090 2		
17	5,442 2	29	9,249 1		
17½	5,600 5	29½	9,408 0		

[a] The actual pitch-circle diameter can be obtained by multiplying this number by the pitch of the chain.

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