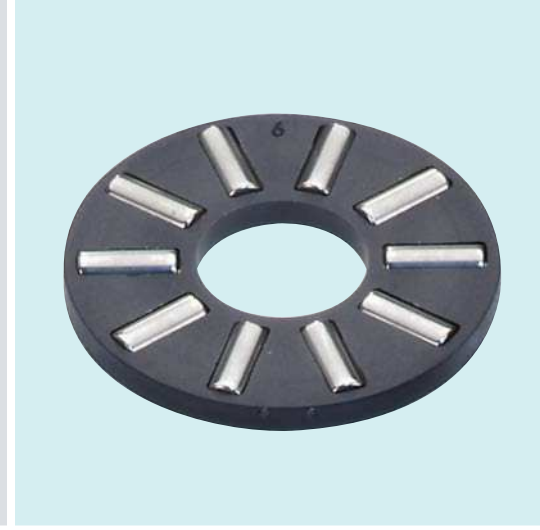




12

Needle roller thrust bearings



12 Needle roller thrust bearings

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SKF needle roller thrust bearings are fitted with a form-stable cage to reliably retain and guide a large number of needle rollers.

Needle roller thrust bearings provide a high degree of stiffness within a minimum axial space. In applications where the faces of adjacent machine components can serve as raceways, needle roller thrust bearings take up no more space than a conventional thrust washer.

Bearing features

- **Accommodate heavy axial loads and peak loads**

The very small diameter deviation of the rollers within one assembly enables these bearings to accommodate heavy axial loads and peak loads.

- **Extended bearing service life**

To prevent stress peaks, the roller ends are relieved slightly to modify the line contact between the raceway and rollers.

Designs and variants

SKF supplies needle roller thrust bearings in two designs:

- needle roller and cage thrust assemblies, AXK series ([fig. 1](#))
- needle roller thrust bearings with a centring flange, AXW series ([fig. 2](#))

In applications where adjacent components cannot serve as raceways, the assemblies can be combined with bearing washers in different series (*Bearing washers*, [page 898](#)).

Fig. 1

AXK needle roller and cage thrust assembly

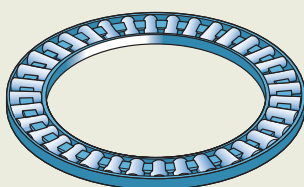
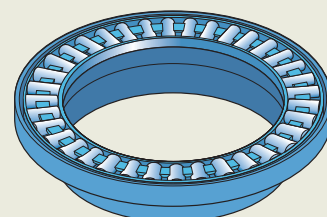


Fig. 2

AXW needle roller thrust bearing with a centring flange



Needle roller and cage thrust assemblies

AXK series needle roller and cage thrust assemblies (fig. 1):

- are available for $4 \leq d \leq 160$ mm
- can accommodate axial loads in one direction only
- can be combined with washers in the LS, AS, GS 811 or WS 811 series (*Bearing washers*, page 898) in applications where adjacent components cannot serve as raceways

Double direction bearings

Double direction bearings:

- can accommodate axial loads in both directions
 - can be created by combining two needle roller and cage thrust assemblies and two bearing washers with an intermediate washer
- Depending on the design, an intermediate washer can be shaft or housing centred (fig. 3 and fig. 4).

Intermediate washers must have the same hardness and surface finish as bearing washers. SKF does not supply intermediate washers, but provides material specifications and dimensional data on request.

For additional information, refer to *Design considerations*, page 903.

Needle roller thrust bearings with a centring flange

AXW series needle roller thrust bearings with a centring flange (fig. 2 and fig. 5):

- are available for $10 \leq d \leq 50$ mm
- accommodate axial loads in one direction only
- consist of a needle roller and cage thrust assembly and a thrust washer with a centring flange

The flange facilitates mounting and accurately centres the housing washer radially (fig. 6 and fig. 7).

Combined needle roller bearing arrangements

To accommodate combined radial and axial loads, needle roller thrust bearings in the AXW series can be combined with the following radial needle roller bearings:

- drawn cup needle roller bearings with a closed end or with open ends (fig. 6)
- needle roller bearings with machined rings (fig. 7)

These arrangements provide a cost-effective and compact solution for combined loads.

Fig. 3

Double direction bearing, shaft centred

Intermediate washer

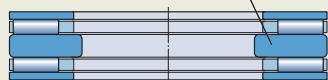


Fig. 5

AXW needle roller thrust bearing with a centring flange

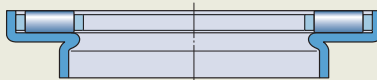


Fig. 4

Double direction bearing, housing centred

Intermediate washer

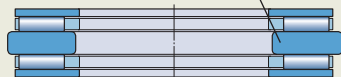


Fig. 6

AXW series bearing combined with a drawn cup needle roller bearing

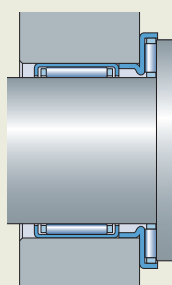
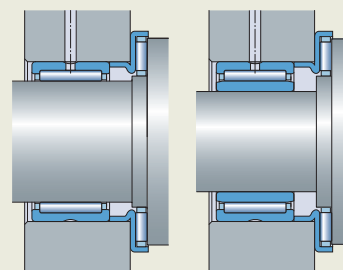


Fig. 7

AXW series bearing combined with a needle roller bearing with machined rings



Without an inner ring

With an inner ring

Bearing washers

Bearing washers are required in applications where adjacent machine components cannot serve as raceways.

Appropriate washers are listed in the [product tables](#), [page 906](#) and must be ordered separately, because of the number of possible combinations.

The following series can be combined with needle roller thrust bearings:

LS series universal washers

([fig. 8](#))

- are made of hardened carbon chromium bearing steel
- can be used as shaft or housing washers for needle roller thrust bearings in the AXK series
- can be used as shaft washers for bearings in the AXW series
- are available for $6 \leq d \leq 160$ mm
- raceway surface is ground, while all other surfaces are turned
- are used for applications where accurate centring of the washers is not necessary or where low speeds are involved
- washer face opposite the side with the chamfers is the raceway surface and should face the rollers

AS series thin universal washers

([fig. 9](#))

- are 1 mm thick
- are made of spring steel and hardened
- can be used as shaft or housing washers for needle roller thrust bearings in the AXK series
- can be used as shaft washers for bearings in the AXW series
- are available for $4 \leq d \leq 160$ mm
- can be used to provide a cost-effective bearing solution, if adjacent machine components are not hardened, but have adequate stiffness and the requirements to geometrical tolerances are moderate

Both faces of the washers are polished and can be used as raceways.

811 series shaft (prefix WS) and housing washers (prefix GS)

- are used primarily with cylindrical roller and cage thrust assemblies
- can also be combined with needle roller and cage thrust assemblies
- can be used in high-speed applications where accurate centring of the bearing washers is required

For additional information about 811 series washers, refer to *Cylindrical roller thrust bearings*, [page 877](#).

Cages

SKF needle roller thrust bearings are fitted with one of the cages shown in [table 1](#). Bearings in the AXW series are fitted exclusively with steel cages.

When used at high temperatures, some lubricants can have a detrimental effect on polyamide cages. For additional information about the suitability of cages, refer to *Cages*, [page 187](#).

Fig. 8

LS series universal washer

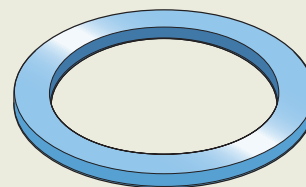
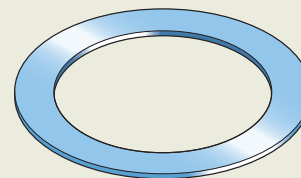


Fig. 9

AS series thin universal washer



Bearing data

Dimension standards	Boundary dimensions: ISO 3031 (where standardized) Bearings in the AXW series are not standardized.
Tolerances	Tolerances, tolerance classes, standards (table 2, page 900)
For additional information → page 35	Values for tolerance classes (table 3, page 901) Variation of gauge lot diameter of the rollers: ISO 3096, Grade 2
Permissible misalignment	Cannot tolerate any misalignment.

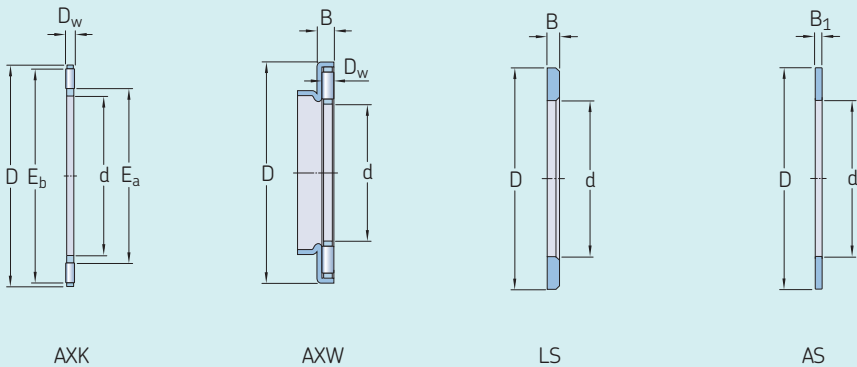
Table 1

Cages for needle roller thrust bearings

			
Materials	Machined steel	Sheet steel	Glass fibre reinforced PA66
Suffix	–	–	TN

Table 2

Tolerances for needle roller thrust bearings



Bearing, component Dimensions		Tolerance, tolerance class ¹⁾ , standard
Needle roller and cage thrust assemblies, AXK		
Bore diameter	d	E12
Outside diameter	D	c13
Roller diameter	D _w	Grade 2, ISO 3096
Needle roller thrust bearings with a centring flange, AXW		
Bore diameter	d	E12
Outside diameter	D	—
Thickness	B	0/−0,2 mm
Roller diameter	D _w	Grade 2, ISO 3096
Universal washers, LS		
Bore diameter	d	E12
Outside diameter	D	a12
Thickness	B	h11
Axial run-out	s _i	Normal, ISO 199
Thin universal washers, AS		
Bore diameter	d	E13
Outside diameter	D	e13
Thickness (1 mm)	B ₁	±0,05 mm

¹⁾ The envelope requirement (symbol E from ISO 14405-1) is not shown but applies to all tolerance classes.

Table 3

ISO tolerance classes

Nominal diameter		a12(E) Deviations		c13(E) Deviations		e13(E) Deviations		h11(E) Deviations		E12(E) Deviations		E13(E) Deviations	
>	≤	U	L	U	L	U	L	U	L	U	L	U	L
mm	μm	μm		μm		μm		μm		μm		μm	
–	3	–	–	–	–	–	–	0	–60	–	–	–	–
3	6	–	–	–	–	–	–	0	–75	+140	+20	+200	+20
6	10	–	–	–	–	–	–	0	–90	+175	+25	+245	+25
10	18	–	–	–95	–365	–32	–302	–	–	+212	+32	+302	+32
18	30	–300	–510	–110	–440	–40	–370	–	–	+250	+40	+370	+40
30	40	–310	–560	–120	–510	–50	–440	–	–	+300	+50	+440	+50
40	50	–320	–570	–130	–520	–50	–440	–	–	+300	+50	+440	+50
50	65	–340	–640	–140	–600	–60	–520	–	–	+360	+60	+520	+60
65	80	–360	–660	–150	–610	–60	–520	–	–	+360	+60	+520	+60
80	100	–380	–730	–170	–710	–72	–612	–	–	+422	+72	+612	+72
100	120	–410	–760	–180	–720	–72	–612	–	–	+422	+72	+612	+72
120	140	–460	–860	–200	–830	–85	–715	–	–	+485	+85	+715	+85
140	160	–520	–920	–210	–840	–85	–715	–	–	+485	+85	+715	+85
160	180	–580	–980	–230	–860	–85	–715	–	–	–	–	–	–
180	200	–660	–1 120	–240	–960	–100	–820	–	–	–	–	–	–

Loads

Minimum load For additional information → page 106	$F_{am} = 0,0005 C_0$	Symbols C_0 basic static load rating [kN] (product tables, page 906) F_a axial load [kN] F_{am} minimum axial load [kN] P equivalent dynamic bearing load [kN] P_0 equivalent static bearing load [kN]
Equivalent dynamic bearing load For additional information → page 91	$P = F_a$	
Equivalent static bearing load For additional information → page 105	$P_0 = F_a$	

Temperature limits

The permissible operating temperature for needle roller thrust bearings can be limited by:

- the dimensional stability of the bearing washers and rollers
- the cage
- the lubricant

Where temperatures outside the permissible range are expected, contact SKF.

Bearing washers and rollers

The bearings are heat stabilized up to at least 120 °C (250 °F).

Cages

Steel cages can be used at the same operating temperatures as the bearing washers and rollers. For temperature limits of polymer cages, refer to *Polymer cages*, [page 188](#).

Lubricants

For temperature limits of SKF greases, refer to *Selecting a suitable SKF grease*, [page 116](#).

When using lubricants not supplied by SKF, temperature limits should be evaluated according to the SKF traffic light concept ([page 117](#)).

Permissible speed

The speed ratings in the [product tables, page 906](#) indicate:

- the **reference speed**, which enables a quick assessment of the speed capabilities from a thermal frame of reference
- the **limiting speed**, which is a mechanical limit that should not be exceeded unless the bearing design and the application are adapted for higher speeds

For additional information, refer to *Operating temperature and speed*, [page 130](#).

Design considerations

Abutment dimensions

Abutment dimensions should fulfil the following:

- Support surfaces on shafts and in housings should be at right angles to the shaft or housing axis and should provide uninterrupted support over the entire washer face.
- The abutment diameter on the shaft should be $\leq E_a$ and in the housing $\geq E_b$.
Values for E_a and E_b (product tables, page 906) take the movement and position of the roller set into consideration.
- Shafts and housings should be manufactured to suitable tolerance classes (table 4) to provide satisfactory radial guidance for the individual thrust bearing components:
 - Housing centred washers → radial space between the shaft and washer bore required
 - Shaft centred washers → radial space between the washer and the housing bore required

Needle roller and cage thrust assemblies in the AXW series are generally combined with drawn cup needle roller bearings (fig. 6, page 897) or needle roller bearings with machined rings (fig. 7, page 897). The same housing tolerance must be selected for the centring flange as for the radial bearing.

Needle roller and cage thrust assemblies are generally shaft centred, to reduce the circumferential speed at which the cage slides against the guiding surface. This is particularly important for higher-speed applications. The guiding surface should be ground.

Raceways on shafts and in housings

- should have the same hardness, surface finish and axial run-out as a bearing washer, if the load carrying capacity of a needle roller and cage thrust assembly is to be fully exploited
- should be designed using the dimensions E_a and E_b (product tables, page 906), which take radial displacement of the roller set into consideration

For additional information, refer to *Raceways on shafts and in housings*, page 179.

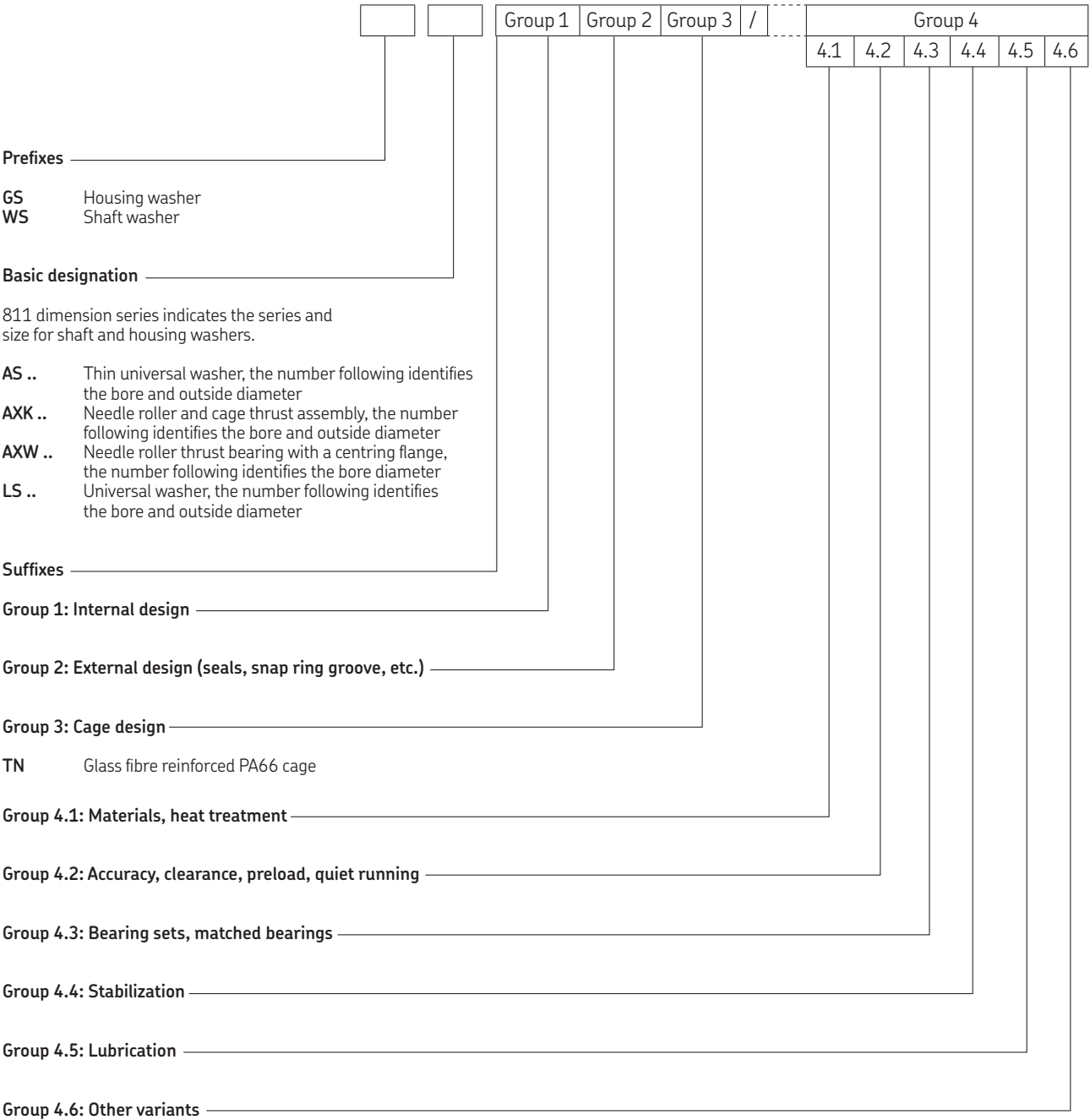
Table 4

Shaft and housing tolerance classes

Bearing component	Series	Tolerance class ¹⁾	
		Shaft centred	Housing centred
Needle roller and cage thrust assemblies	AXK	h8	–
Universal washers	LS	h8 radial space	radial space H9
Thin universal washers	AS	h8 radial space	radial space H9
Shaft washers	WS 811	h8	–
Housing washers	GS 811	–	H9

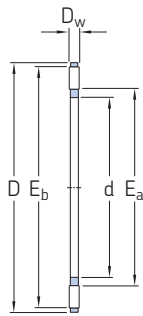
¹⁾ The envelope requirement (symbol $\oplus$ from ISO 14405-1) is not shown but applies to all tolerance classes.

Designation system



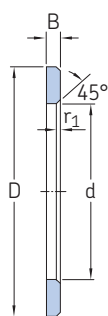
12.1 Needle roller and cage thrust assemblies

d 4 – 85 mm

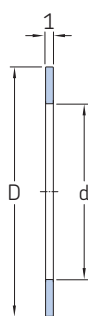


Principal dimensions					Basic load ratings		Fatigue load limit	Speed ratings		Mass	Designation
d	D	D _w	E _a min.	E _b max.	C	C ₀	P _u	Reference speed	Limiting speed		
mm					kN		kN	r/min		g	–
4	14	2	5	13	4,15	8,3	0,95	7 500	15 000	0,7	AXK 0414 TN
5	15	2	6	14	4,5	9,5	1,08	6 700	14 000	0,8	▶ AXK 0515 TN
6	19	2	7	18	6,3	16	1,86	6 000	12 000	1	AXK 0619 TN
8	21	2	9	20	7,2	20	2,32	5 600	11 000	2	▶ AXK 0821 TN
10	24	2	12	23	8,5	26	3	5 300	10 000	3	▶ AXK 1024
12	26	2	14	25	9,15	30	3,45	5 000	10 000	3	▶ AXK 1226
15	28	2	17	27	10,4	37,5	4,3	4 800	9 500	4	▶ AXK 1528
17	30	2	19	29	11	40,5	4,75	4 500	9 500	3,65	▶ AXK 1730
20	35	2	22	34	12	47,5	5,6	4 300	8 500	5	▶ AXK 2035
25	42	2	29	41	13,4	60	6,95	3 800	7 500	7	▶ AXK 2542
30	47	2	34	46	15	72	8,3	3 600	7 000	8	▶ AXK 3047
35	52	2	39	51	16,6	83	9,8	3 200	6 300	10	▶ AXK 3552
40	60	3	45	58	25	114	13,7	2 800	5 600	16	▶ AXK 4060
45	65	3	50	63	27	127	15,3	2 600	5 300	18	▶ AXK 4565
50	70	3	55	68	28,5	143	17	2 400	5 000	20	▶ AXK 5070
55	78	3	60	76	34,5	186	22,4	2 200	4 300	28	▶ AXK 5578
60	85	3	65	83	37,5	232	28,5	2 200	4 300	33	▶ AXK 6085
65	90	3	70	88	39	255	31	2 000	4 000	35	▶ AXK 6590
70	95	4	74	93	49	255	31	1 800	3 600	60	▶ AXK 7095
75	100	4	79	98	50	265	32,5	1 700	3 400	61	▶ AXK 75100
80	105	4	84	103	51	280	34	1 700	3 400	63	▶ AXK 80105
85	110	4	89	108	52	290	35,5	1 700	3 400	67	▶ AXK 85110

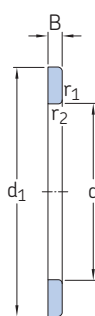
▶ Popular item



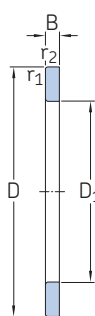
LS



AS



WS 811

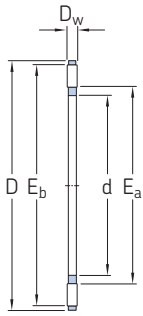


GS 811

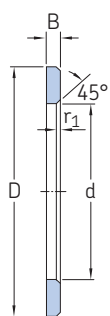
Dimensions						Masses Washers LS, WS, GS		Designations Universal washer		Thin universal washer	Shaft washer	Housing washer
d	d ₁	D	D ₁	B	r _{1,2} min.							
mm						g		—				
4	—	14	—	—	—	—	1	—	AS 0414	—	—	—
5	—	15	—	—	—	—	1	—	AS 0515	—	—	—
6	—	19	—	2,75	0,3	6	2	LS 0619	AS 0619	—	—	—
8	—	21	—	2,75	0,3	6	2	LS 0821	AS 0821	—	—	—
10	—	24	—	2,75	0,3	8	3	LS 1024	AS 1024	—	—	—
12	—	26	—	2,75	0,3	9	3	LS 1226	AS 1226	—	—	—
15	28	28	16	2,75	0,3	9	3	LS 1528	AS 1528	WS 81102	GS 81102	—
17	30	30	18	2,75	0,3	9	4	LS 1730	AS 1730	WS 81103	GS 81103	—
20	35	35	21	2,75	0,3	13	5	LS 2035	AS 2035	WS 81104	GS 81104	—
25	42	42	26	3	0,6	19	7	LS 2542	AS 2542	WS 81105	GS 81105	—
30	47	47	32	3	0,6	22	8	LS 3047	AS 3047	WS 81106	GS 81106	—
35	52	52	37	3,5	0,6	29	9	LS 3552	AS 3552	WS 81107	GS 81107	—
40	60	60	42	3,5	0,6	40	12	LS 4060	AS 4060	WS 81108	GS 81108	—
45	65	65	47	4	0,6	50	13	LS 4565	AS 4565	WS 81109	GS 81109	—
50	70	70	52	4	0,6	55	14	LS 5070	AS 5070	WS 81110	GS 81110	—
55	78	78	57	5	0,6	88	18	LS 5578	AS 5578	WS 81111	GS 81111	—
60	85	85	62	4,75	1	97	22	LS 6085	AS 6085	WS 81112	GS 81112	—
65	90	90	67	5,25	1	115	24	LS 6590	AS 6590	WS 81113	GS 81113	—
70	95	95	72	5,25	1	123	25	LS 7095	AS 7095	WS 81114	GS 81114	—
75	100	100	77	5,75	1	142	27	LS 75100	AS 75100	WS 81115	GS 81115	—
80	105	105	82	5,75	1	151	28	LS 80105	AS 80105	WS 81116	GS 81116	—
85	110	110	87	5,75	1	159	29	LS 85110	AS 85110	WS 81117	GS 81117	—

12.1 Needle roller and cage thrust assemblies

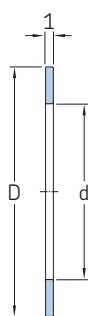
d 90 – 160 mm



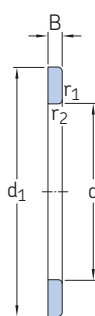
Principal dimensions					Basic load ratings		Fatigue load limit	Speed ratings		Mass	Designation
d	D	D _w	E _a min.	E _b max.	C	C ₀	P _u	Reference speed	Limiting speed		
mm					kN		kN	r/min		g	–
90	120	4	94	118	65,5	405	49	1 500	3 000	86	► AXK 90120
100	135	4	105	133	76,5	560	65,5	1 400	2 800	104	► AXK 100135
110	145	4	115	143	81,5	620	72	1 300	2 600	122	► AXK 110145
120	155	4	125	153	86,5	680	76,5	1 300	2 600	131	► AXK 120155
130	170	5	136	167	112	830	93	1 100	2 200	205	AXK 130170
140	180	5	146	177	116	900	96,5	1 000	2 000	219	► AXK 140180
150	190	5	156	187	120	950	102	1 000	2 000	232	AXK 150190
160	200	5	166	197	125	1 000	106	950	1 900	246	► AXK 160200



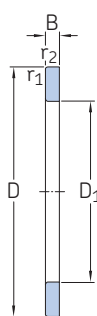
LS



AS



WS 811

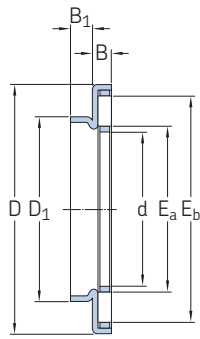


GS 811

Dimensions						Masses		Designations			
d	d ₁	D	D ₁	B	r _{1,2} min.	Washers LS, AS WS, GS		Universal washer	Thin universal washer	Shaft washer	Housing washer
mm						g		—			
90	120	120	92	6,5	1	234	39	LS 90120	AS 90120	WS 81118	GS 81118
100	135	135	102	7	1	350	50	LS 100135	AS 100135	WS 81120	GS 81120
110	145	145	112	7	1	385	55	LS 110145	AS 110145	WS 81122	GS 81122
120	155	155	122	7	1	415	59	LS 120155	AS 120155	WS 81124	GS 81124
130	170	170	132	9	1	663	65	LS 130170	AS 130170	WS 81126	GS 81126
140	178	180	142	9,5	1	749	79	LS 140180	AS 140180	WS 81128	GS 81128
150	188	190	152	9,5	1	796	84	LS 150190	AS 150190	WS 81130	GS 81130
160	198	200	162	9,5	1	842	89	LS 160200	AS 160200	WS 81132	GS 81132

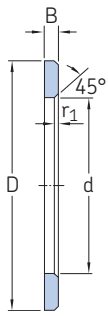
12.2 Needle roller thrust bearings with a centring flange

d 10 – 45 mm

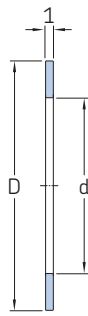


Principal dimensions							Basic load ratings		Fatigue load limit	Speed ratings		Mass	Designation
d	D	D ₁	B	B ₁	E _a min.	E _b max.	C	C ₀	P _u	Reference speed	Limiting speed		
mm							kN		kN	r/min		g	–
10	27	14	3,2	3	12	23	8,5	26	3	5 300	10 000	8,3	AXW 10
12	29	16	3,2	3	14	25	9,15	30	3,45	5 000	10 000	9,1	AXW 12
15	31	21	3,2	3,5	17	27	10,4	37,5	4,3	4 800	9 500	10	AXW 15
20	38	26	3,2	3,5	22	34	12	47,5	5,6	4 300	8 500	14	AXW 20
25	45	32	3,2	4	29	41	13,4	60	6,95	3 800	7 500	20	AXW 25
30	50	37	3,2	4	34	46	15	72	8,3	3 600	7 000	22	AXW 30
35	55	42	3,2	4	39	51	16,6	83	9,8	3 200	6 300	27	AXW 35
40	63	47	4,2	4	45	58	25	114	13,7	2 800	5 600	39	AXW 40
45	68	52	4,2	4	50	63	27	127	15,3	2 600	5 300	43	AXW 45





LS



AS



WS 811

Dimensions				Masses Washers LS, WS		Designations		
d	d ₁ , D	B	r _{1,2} min.	LS, WS	AS	Universal washer	Thin universal washer	Shaft washer
mm				g		—		
10	24	2,75	0,3	8	3	LS 1024	AS 1024	—
12	26	2,75	0,3	9	3	LS 1226	AS 1226	—
15	28	2,75	0,3	9	3	LS 1528	AS 1528	WS 81102
20	35	2,75	0,3	13	5	LS 2035	AS 2035	WS 81104
25	42	3	0,6	19	7	LS 2542	AS 2542	WS 81105
30	47	3	0,6	22	8	LS 3047	AS 3047	WS 81106
35	52	3,5	0,6	29	9	LS 3552	AS 3552	WS 81107
40	60	3,5	0,6	40	12	LS 4060	AS 4060	WS 81108
45	65	4	0,6	50	13	LS 4565	AS 4565	WS 81109