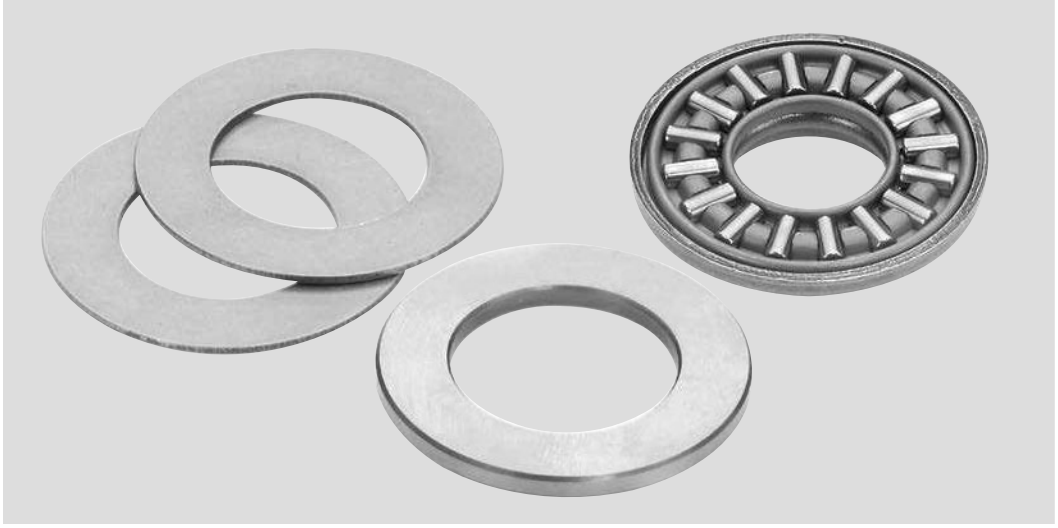
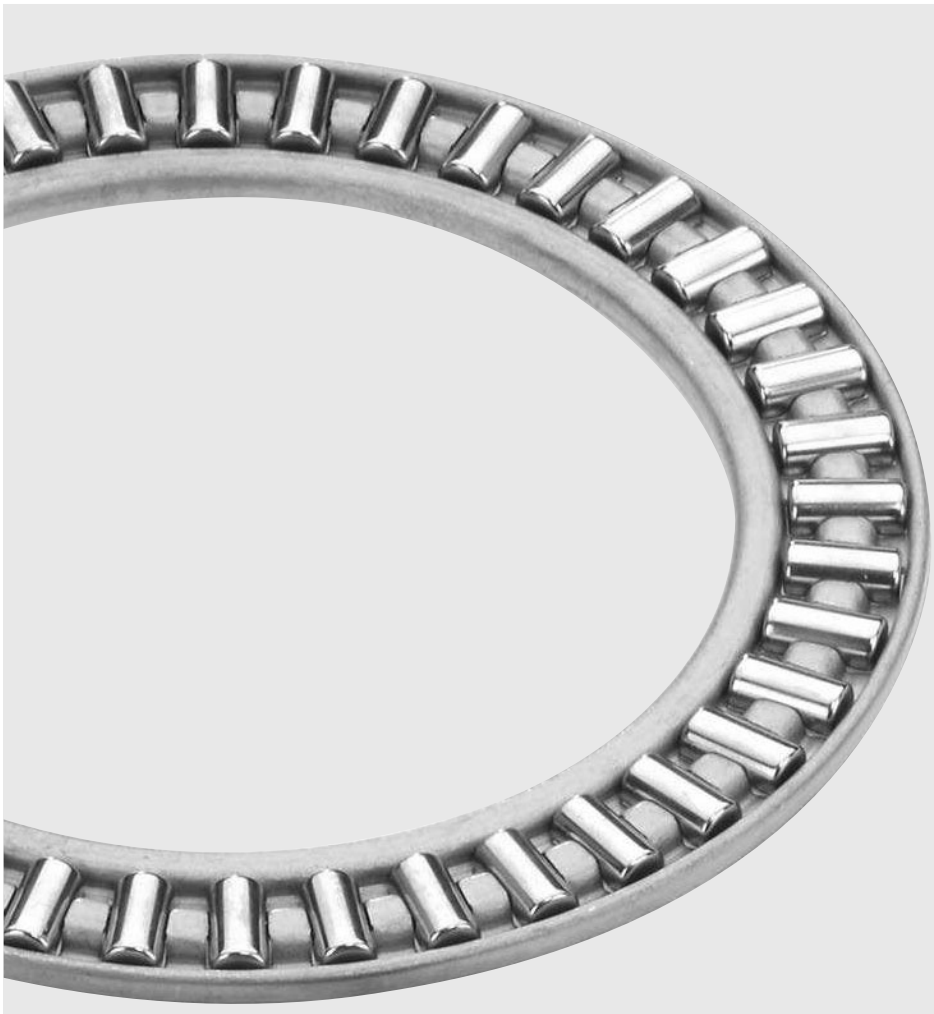


12 Needle roller thrust bearings



12 Needle roller thrust bearings

12 Needle roller thrust bearings

More information

SKF bearing maintenance handbook ISBN 978-91-978966-4-1

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

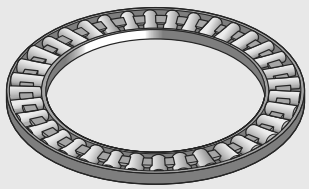
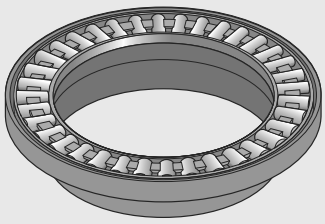


Fig. 2

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 ≤ d ≤ 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 ≤ d ≤ 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

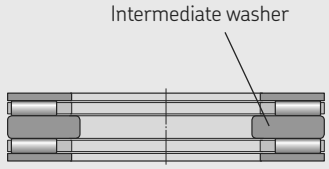


Fig. 4

Double direction bearing, housing centred

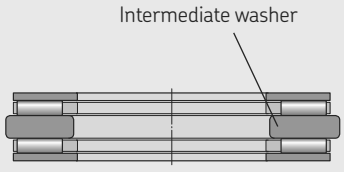


Fig. 5

AXW needle roller thrust bearing with a centring flange

Fig. 6

AXW series bearing combined with a drawn cup needle roller bearing

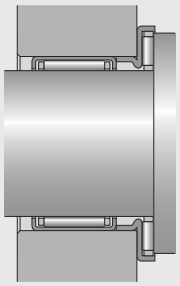
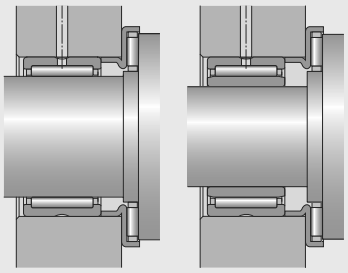


Fig. 7

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



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 ≤ d ≤ 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 ≤ d ≤ 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

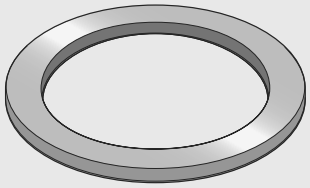
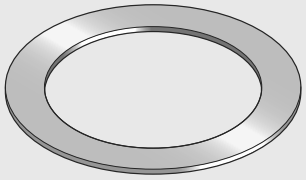


Fig. 9

AS series thin universal washer



Bearing data

Dimension standards	Boundary dimensions: ISO 3031 (where standardized) Bearings in the AXW series are not standardized.
Tolerances For additional information → page 35	Tolerances, tolerance classes, standards (table 2, page 900) 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.

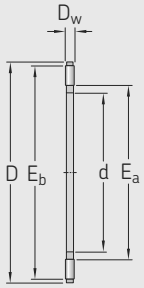
Table 1

Cages for needle roller thrust bearings

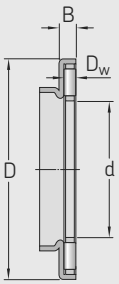
			
Materials	Machined steel	Sheet steel	Glass fibre reinforced PA66
Suffix	–	–	TN

Table 2

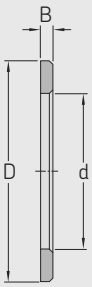
Tolerances for needle roller thrust bearings



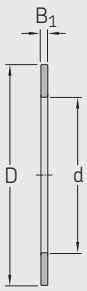
AXK



AXW



LS



AS

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 Ⓔ from ISO 14405-1) is not shown but applies to all tolerance classes.

Table 3

ISO tolerance classes

Nominal diameter		**a12**Ⓔ Deviations		**c13**Ⓔ Deviations		**e13**Ⓔ Deviations		**h11**Ⓔ Deviations		**E12**Ⓔ Deviations		**E13**Ⓔ 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	$F_{am} = 0{,}0005\ C_0$
Equivalent dynamic bearing load For additional information → page 91	$P = F_a$
Equivalent static bearing load For additional information → page 105	$P_0 = F_a$

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]

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 ≤ E_a and in the housing ≥ 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**.

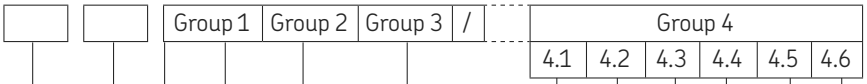
Table 4

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 Ⓔ from ISO 14405-1) is not shown but applies to all tolerance classes.

Designation system



Prefixes

GS Housing washer
WS Shaft washer

Basic designation

811 dimension series indicates the series and size for shaft and housing washers.

AS .. Thin universal washer, the number following identifies the bore and outside diameter
AXK .. Needle roller and cage thrust assembly, the number following identifies the bore and outside diameter
AXW .. Needle roller thrust bearing with a centring flange, the number following identifies the bore diameter
LS .. Universal washer, the number following identifies the bore and outside diameter

Suffixes

Group 1: Internal design

Group 2: External design (seals, snap ring groove, etc.)

Group 3: Cage design

TN Glass fibre reinforced PA66 cage

Group 4.1: Materials, heat treatment

Group 4.2: Accuracy, clearance, preload, quiet running

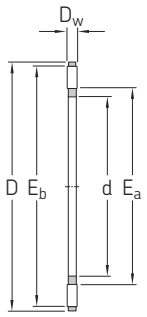
Group 4.3: Bearing sets, matched bearings

Group 4.4: Stabilization

Group 4.5: Lubrication

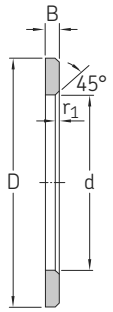
Group 4.6: Other variants

12.1 Needle roller and cage thrust assemblies
d **4 – 85** mm

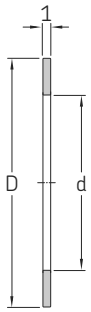


Principal dimensions					Basic load ratings dynamic	static	Fatigue load limit	Speed ratings Reference speed	Limiting speed	Mass	Designation
d	D	D_w	E_a min.	E_b max.	C	C_0	P_u				
mm					kN		kN	r/min		g	–
4	14	2	5	13	4,15	8,3	0,95	7 500	15 000	0,7	**AXK 0414 TN**
5	15	2	6	14	4,5	9,5	1,08	6 700	14 000	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**

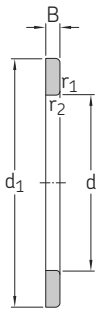
▸ Popular item



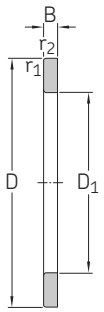
LS



AS

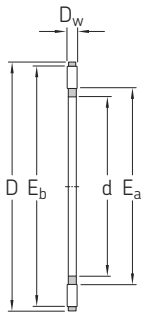


WS 811



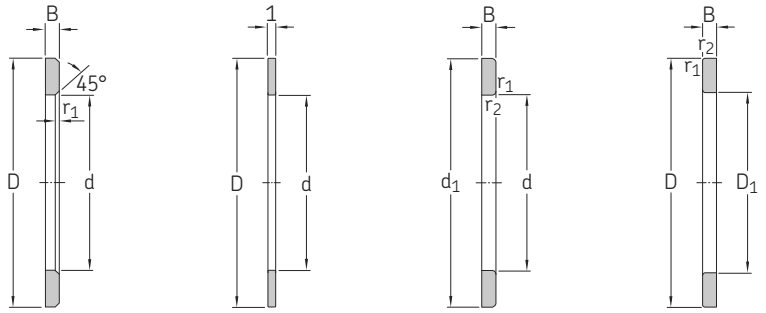
GS 811

Dimensions						Masses Washers		Designations			
						LS, WS, GS	AS	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**



Principal dimensions					Basic load ratings dynamic	static	Fatigue load limit	Speed ratings Reference speed	Limiting speed	Mass	Designation
d	D	D_w	E_a min.	E_b max.	C	C_0	P_u				
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**

▸ Popular item

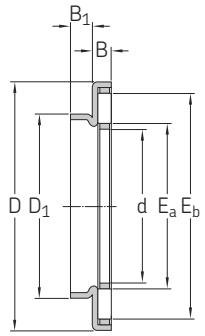


LS AS WS 811 GS 811

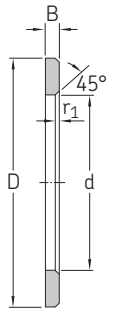
Dimensions						Masses Washers		Designations			
								Universal washer	Thin universal washer	Shaft washer	Housing washer
d	d_1	D	D_1	B	$r_{1,2}$ min.	LS, WS, GS	AS				
mm						g		–			
90	120	120	92	6,5	1	234	39	**LS 90120**	**AS 90120**	**WS 81118**	**GS 81118**
100	135	135	102	7	1	350	50	**LS 100135**	**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

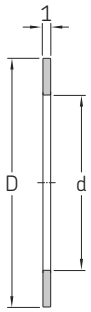
d **10 – 45** mm



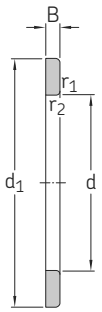
Principal dimensions							Basic load ratings dynamic	static	Fatigue load limit	Speed ratings Reference speed	Limiting speed	Mass	Designation
d	D	D_1	B	B_1	E_a min.	E_b max.	C	C_0	P_u				
mm							kN		kN	r/min		g	–
10	27	14	3,2	3	12	23	8,5	26	3	5 300	10 000	8,3	**AXW 10**
12	29	16	3,2	3	14	25	9,15	30	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		Designations		
				Washers		Universal	Thin universal	Shaft washer
				LS, WS	AS	washer	washer	
d	d_1, D	B	$r_{1,2}$ min.					
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**