Ball Screw Support Bearings

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13. Ball Screw Support Bearings

NTN ballscrew bearings are optimized to support a ballscrew.
These bearings are categorized as shown in **Table 13.1**.

Table 13.1 Bearing types

Type code	Notes	Bore diameter
BST 2A-BST	Open type thrust angular contact ball bearing with 60˚ contact angle, generally used with grease lubrication	ϕ17～ϕ60
BST LXL/L588 2A-BST LXL/L588	Grease-lubricated sealed angular contact ball bearing with 60˚ contact angle	ϕ17～ϕ60
BSTU LLX/L588	Grease-lubricated sealed double row thrust angular contact ball bearing unit with 60˚ contact angle	ϕ20～ϕ100
HT	Duplex angular contact ball bearing with 30˚ contact angle, generally used with grease lubrication	ϕ6～ϕ40
AXN	Needle roller bearing with double-direction thrust needle roller bearing, generally used with oil lubrication	ϕ20～ϕ50
ARN	Needle roller bearing with double-direction thrust cylindrical roller bearing, generally used with oil lubrication	ϕ20～ϕ70

① ULTAGE Angular contact thrust ball bearings BST-1B (LXL/L588), 2A-BST-1B (LXL/L588) series

The 2A-BST type incorporates the maximum possible number of small balls (compared with those of a standard bearing), has thicker inner and outer rings, and a larger contact angle of 60˚. Thus, this type of bearing boasts greater axial rigidity. Additionally, since balls are used as the rolling elements, the starting torque of a angular contact thrust ball bearing is less than that of a roller bearing.

Open (BST and 2A-BST type) and light-contact seals (BST LXL and 2A-BST LXL type) are available and molded resin cages are standard.

Side faces of BST type bearings are flush-ground to provide the same face height difference for both the front and back faces. As a result, bearings of the same part number can be freely combined into DB, DBT, DTBT configurations as illustrated in **Fig. 13.2**, and the adjustment for a relevant preload is no longer necessary.

Every single bearing is machined to the same face height so that when any arrangement is installed on a ballscrew the unit has optimal preload. For this reason, no time-consuming preload adjustment (adjustment with shims or tightening and loosening while measuring the starting torque) is necessary.

■Features 2A-BST-1B (LXL/L588)

1. Unique heat treatment greatly improves resistance against rolling contact fatigue, leading to longer service life (approximately two times that of the conventional type).
2. Both sides are sealed to enhance contamination resistance and to preserve the grease. (Light-contact seal type)
3. Special long-life grease is used. (Light-contact seal type)
4. The combination of a unique heat treatment and special grease reduces fretting (by 80% or more for sliding mode, 90% or more for rolling mode, compared to the conventional type). (Light-contact seal type)
5. Pre-grease bearings eliminate the need for further grease packing and allow easier handling. (Light-contact seal type)

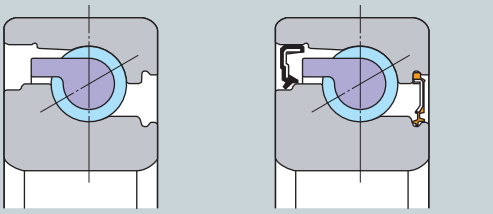


Fig. 13.1

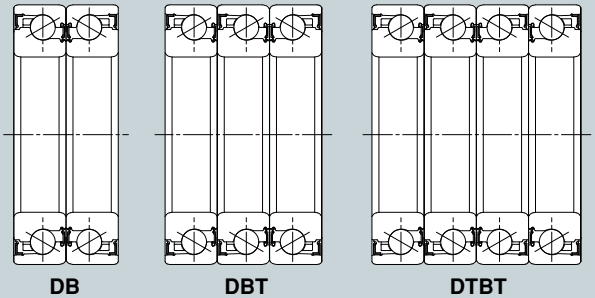
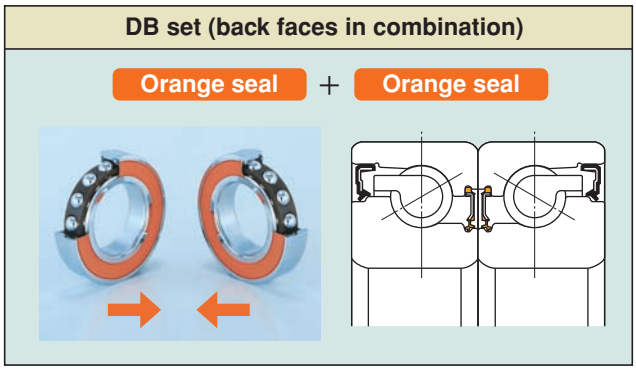


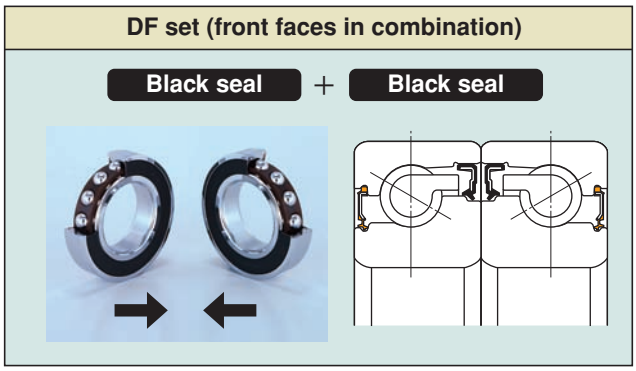
Fig. 13.2 Bearing arrangement

■Easy handling

2A-BST LXL type and BST LXL grease-lubricated sealed angular contact ball bearings eliminate the need for grease filling because they have been packed with grease in advance. You need to only wipe away rust preventive oil before use. Seals in different colors are used for the front and back sides.

The front side (black) and back side (orange) can be identified by the color of a seal, and you can easily check configuration during assembly.





■Performance tests 2A-BST-1B (LXL/L588)

Ball screw support thrust angular contact ball bearings have a unique internal design in order to lengthen service life and enhance resistance to fretting.

(1) Fretting resistance test (sliding)

Resistance to fretting while sliding is tested by the fretting resistance test. A conceptual drawing of the test is shown in **Fig. 13.3**, and the test conditions are shown in **Table 13.3**. In this test, a fixed ball is pushed against a plate, and reciprocated for a fixed period. The volume of ball and plate wear depth are checked after testing as shown in **Fig. 13.4**.

Due to a unique heat treatment and special grease (light-contact seal type), amount of wear is reduced to 1/5 or less compared to the conventional type consisting of standard SUJ2 plate material and lithium-based general purpose grease. (**Fig. 13.4**)

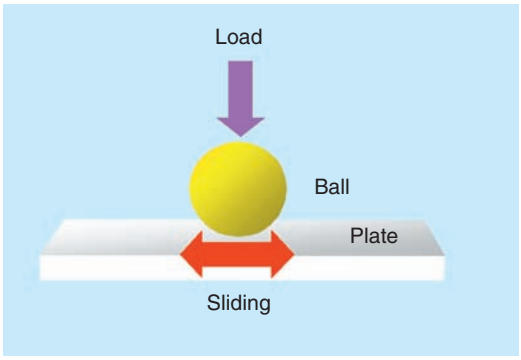


Fig. 13.3 Fretting resistance test (sliding)

Table 13.3 Test conditions

Material	Plate	Conventional type (SUJ2 without special heat treatment) **ULTAGE series (SUJ2 with special heat treatment)**
	Ball	SUJ2
Load (N)		98
Max. contact surface pressure (MPa)		2560
Loading frequency ($\times 10^5$cycle)		Test time: 8 h
Sliding cycle (Hz)		30
Amplitude (mm)		0.47
Lubrication		Grease
Temperature		Room temperature

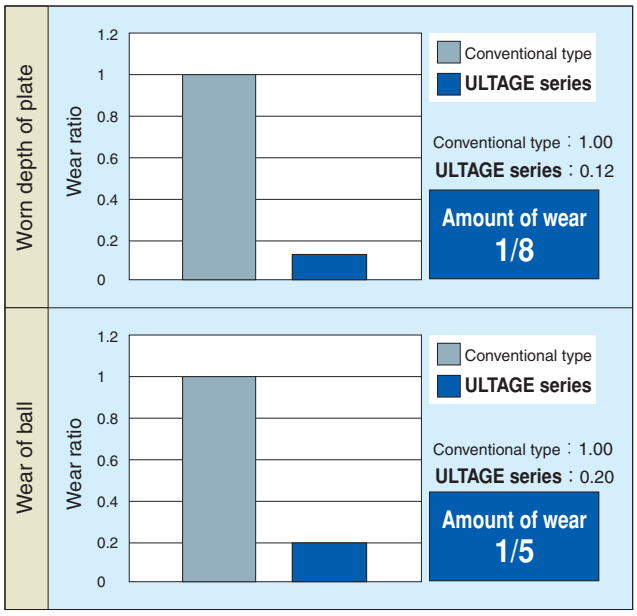


Fig. 13.4 Ratio of fretting corrosion in sliding mode

(2) Fretting resistance test (rolling)

Resistance against fretting while rolling is tested in the rotating and oscillating type fretting corrosion test. A conceptual drawing of the test is shown in **Fig. 13.5**, and the test conditions are shown in **Table 13-4**. In this test, a housing plate is fixed, and the shaft plate oscillates. The decrease in the weight of the bearing plate after the test is shown in **Fig. 13.6**.

Due to the combination of a unique heat treatment and a special grease (light-contact seal type), the amount of wear is reduced to 1/10 or less compared to the conventional type consisting of standard SUJ2 steel rings and lithium based general purpose grease. (**Fig. 13.6**).

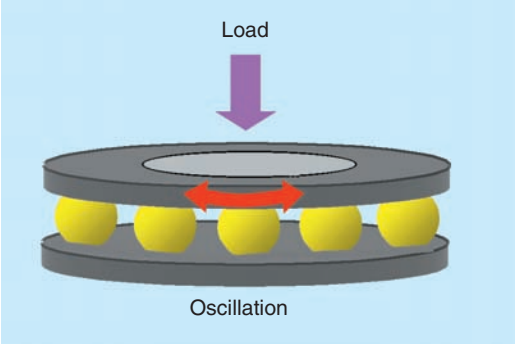


Fig. 13.5 Fretting resistance test (rolling)

Table 13.4 Test conditions

Bearing (mm)	Evaluated with thrust ball bearing 51204 (φ20×φ40×14)
Load (kN)	2.5
Max. contact surface pressure (MPa)	1700
Test time (h)	8
Oscillating cycle (Hz)	30
Oscillating angle (deg)	12
Lubrication	Grease
Temperature	Room temperature

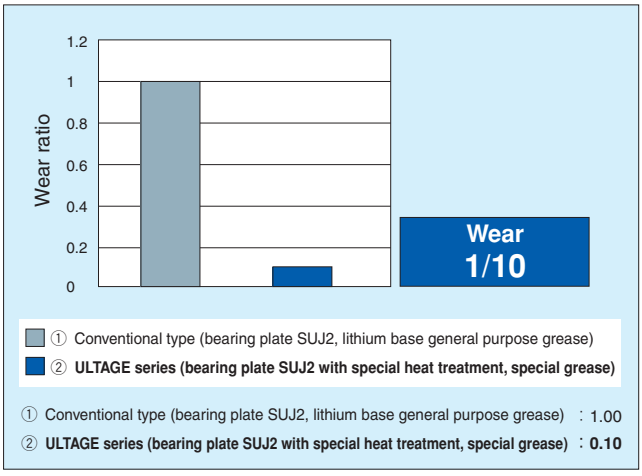


Fig. 13.6 Ratio of fretting corrosion while rolling

(3) Rolling contact fatigue life test

Resistance to rolling contact fatigue is improved as a result of a special heat treatment, leading to a longer service life compared to the standard heat-treated type model in both clean and contaminated oil. (**Fig. 13.7**)

Table 13.5 Test conditions

Bearing (mm)	Evaluated with deep groove ball bearing 6206 (φ30×φ62×16)
Radial load (kN)	6.86
Shaft speed (min^{-1})	2000
Lubrication	VG56 turbine oil
Atmosphere temperature (°C)	60

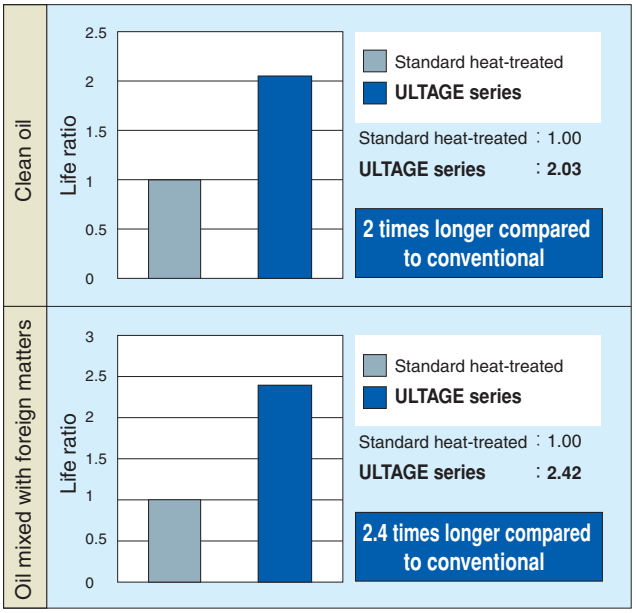


Fig. 13.7 Effect of special heat treatment on rolling contact fatigue life

(4) Grease life test

Service life of the grease has been dramatically extended compared to lithium-base general purpose grease (**Fig. 13.8**).

(Special grease is available for only the light-contact seal type.)

Table 13.6 Test conditions

Bearing (mm)	Evaluated with deep groove ball bearing 6204 (φ20×φ47×14)
Radial load (N)	67
Axial load (N)	67
Shaft speed (min^{-1})	10000
Atmosphere temperature (°C)	150

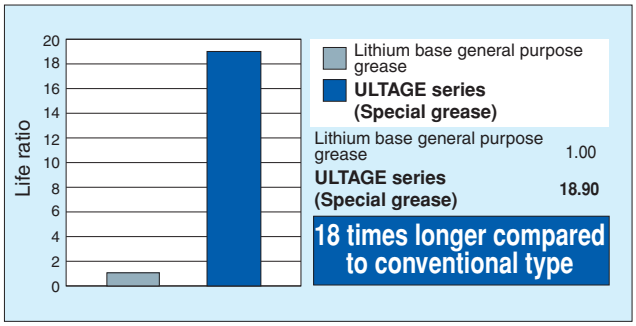


Fig. 13.8 Grease life ratio

(5) Grease leakage test

Light-contact type seals eliminate grease leakage from the bearing. (**Fig. 13.9**)

Table 13.7 Test conditions

Bearing (mm)	2A-BST40×72-1BDFP4 (φ40×φ72×15×2 rows)
Axial load (kN)	3.9
Shaft speed (min^{-1})	1000, 2000, 3000 running for two hours for each step
Atmosphere	Room temperature

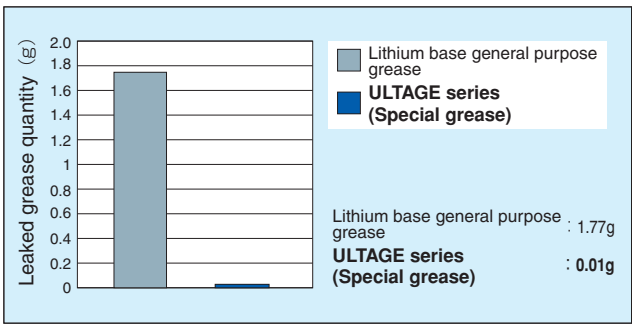


Fig. 13.9 Grease leakage

② ULTAGE Double row thrust angular contact ball bearing unit BSTU

The BSTU type is ball screw support bearing unit with thrust angular contact ball

bearing outer rings in a back-to-back duplex arrangement. It provides the worldin a back-to-back duplex arrangement.st angular contact ball ring, and the use of newly developed seal ensures low torque and high dust resistance. The outer ring has mounting holes for the housing for easier handling.

■Features

1. Greater high-load capacity with optimizations made to the internal bearing design.
2. Use of newly developed light-contact seal to achieve both low torque and high dust resistance.
3. The long operating life of the BST type, and use of special grease with excellent fretting resistance.
4. Outer ring mounting hole, and sealed grease lubrication groove for easier handling.
5. Specifications combining two of these units (D2) are also available for high-load capacity applications.

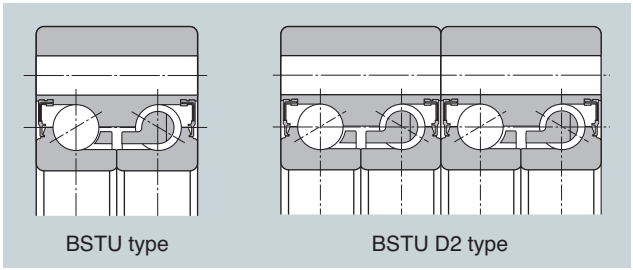


Fig. 13.10 BSTU

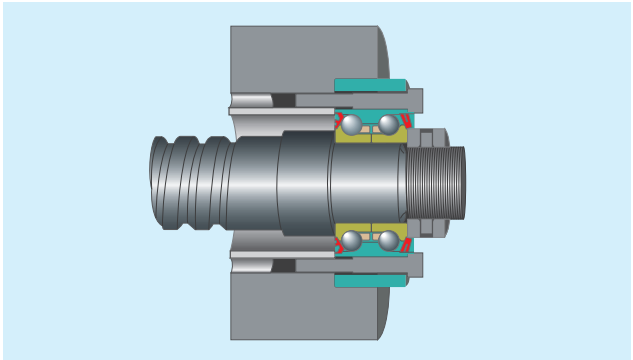


Fig. 13.11 Example of mounted BSTU type installation

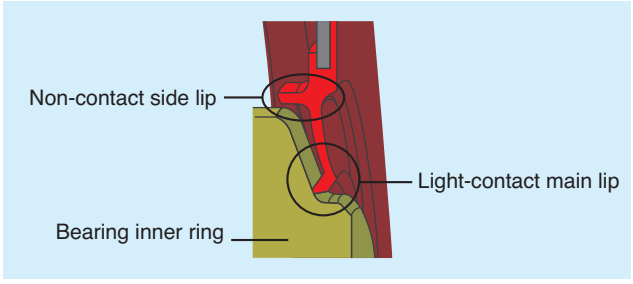


Fig. 13.12 Light-contact seal (code: LX)

■Performance tests

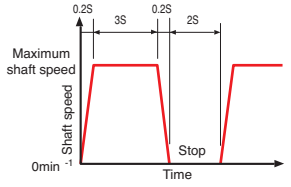
(1) Bearing operating test

The BSTU type exhibit stable temperature rises up to 5000 min^{-1} (d_{mn} value 225000) due to optimizations made to the internal bearing design and the use of a newly developed light-contact seal.(**Fig. 13.13**)

[Test conditions]

Bearing (mm)	BSTU3080LLX/GNP4U/L588 (φ30Xφ80X28)
Shaft speed (min^{-1})	Max. 5000

The operating pattern at each shaft speed is shown to the right.



Temperature increase test operating pattern

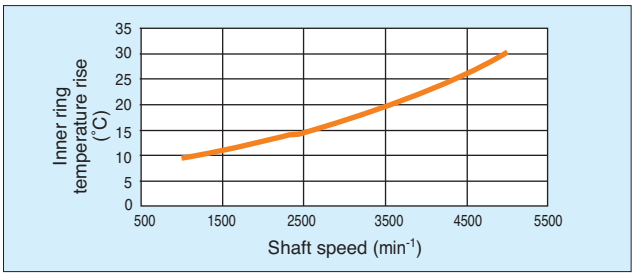


Fig. 13.13 Relation between shaft speed and temperature rise

(2) Torque test, dust test

The BSTU type limits starting torque and has better dust resistance with the use of a newly developed light-contact seal. (**Fig. 13.14**, **Fig. 13.15**)

[Test conditions]

Bearing (mm)	BSTU3080LLX/GNP4U/L588 (φ30Xφ80X28)

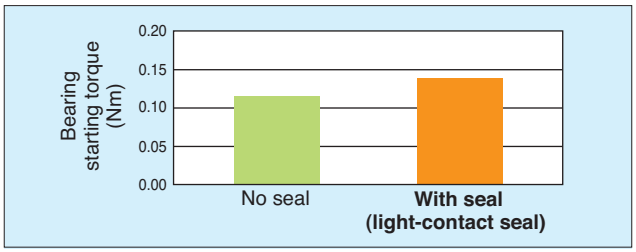
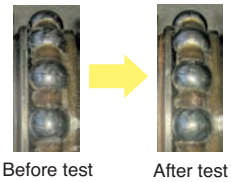


Fig. 13.14 Bearing starting torque

[Test conditions]

Bearing (mm)	BSTU3080LLX/GNP4U/L588 (φ30Xφ80X28)
Shaft speed (min^{-1})	2200
Dust particle diameter	5 to 75 µm (8 types of test powder 1 JIS Z8901)
Dust color phase	Brown
Test time	1 hour



Before test　　After test

Bearing internal conditions before and after test
(with bearing outer ring removed)
No internal bearing penetration of foreign matter observed after test

Fig. 13.15 Dust test results

③ Duplex angular contact ball bearings HT series

HT type duplex angular contact ball bearings feature larger axial load capacity while maintaining the same dimensions as a standard angular contact ball bearing (contact angle: 30˚). Bearings smaller than the BST type are available for use in small products.

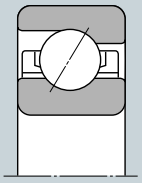


Fig. 13.10 HT

④ Needle roller bearings with double-row thrust needle roller bearings AXN series
Needle roller bearings with double-row thrust cylindrical roller bearings ARN series

AXN and ARN type bearings have thrust needle roller or thrust cylindrical roller bearings on both sides of a radial needle roller bearing. The outer ring side face of the radial needle roller bearing is used as the raceway of both thrust bearings. These bearings can withstand axial loads in both directions while maintaining compact designs. The radial needle roller bearings are suitable for heavy radial loads.

The axial rigidity of the AXN type is extremely enhanced since the thrust needle roller bearings are used for axial loads.

Likewise, the axial rigidity of the ARN type is improved. Since the axial load capacity of this type is larger than the AXN type, this type is suitable for heavy axial loads. Oil lubrication is recommended for the ARN type.

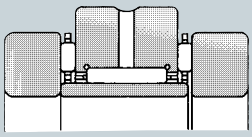


Fig. 13.11 AXN

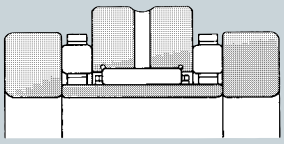
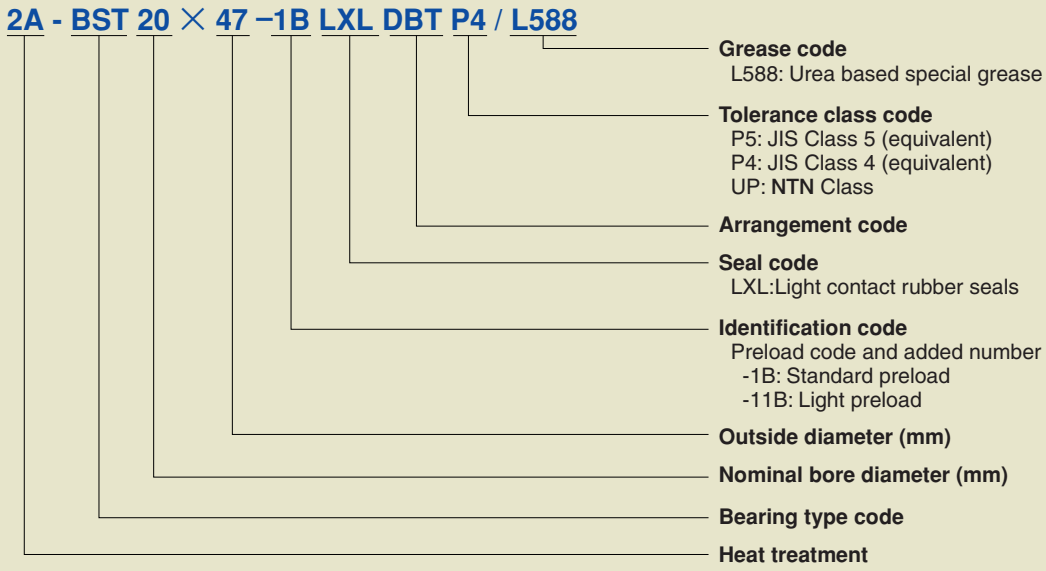


Fig. 13.12 ARN

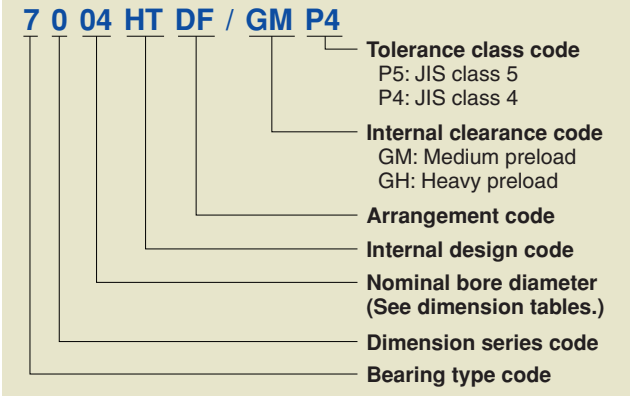
⑤ Bearing designations

The part number for a ballscrew bearing consists of a type code, dimension code, and various suffixes.

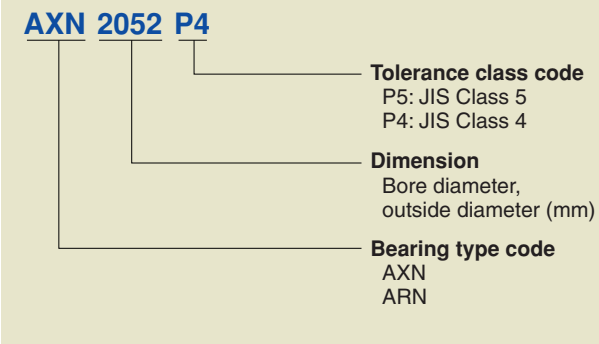
■2A-BST type



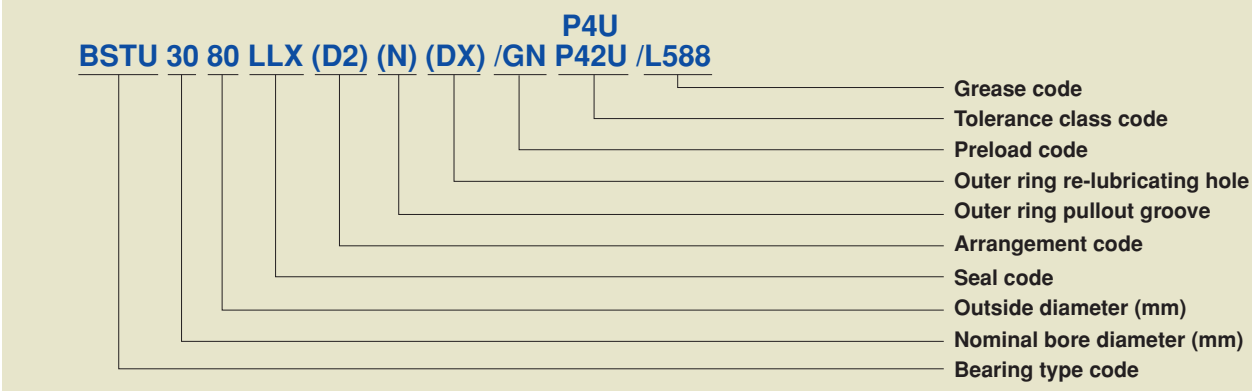
■HT type



■AXN and ARN type



■BSTU type



⑤ Bearing precision

The precision of ballscrew bearings varies depending on the bearing type.

- **2A-BST type**
  Available in **NTN** class 5 (tolerance class code P5), class 4 (tolerance class code P4) each complying with JIS standards, and grade UP (tolerance class code UP). The classes are listed in ascending order.
- **70HT type**
  Same precision as the main spindle angular contact ball bearing. Classes 5 and 4 are available.
- **AXN, ARN types**
  NTN standard classes 4 and 5 complying with the JIS standards.

■Accuracy of 2A-BST type

Table 13.8 Inner rings

Unit: μm

Nominal bore diameter d mm over	incl.	Single plane mean bore diameter deviation Δ_{dmp} Class 5 high	Class 5 low	Class 4❶ high	Class 4❶ low	Class UP❶ high	Class UP❶ low	Width variation V_{Bs} Class 5 max	Class 4 max	Class UP max	Radial runout K_{ia} Class 5 max	Class 4 max	Class UP max	Face runout with bore S_d Class 5 max	Class 4 max	Class UP max	Axial runout S_{ia} Class 5 max	Class 4 max	Class UP max	Width deviation Δ_{Bs} Class 5 high	Class 5 low	Class 4 high	Class 4 low	Class UP high	Class UP low
10	18	0	−5	0	−4	0	−3.5	5	2.5	2	3.5	3	2	7	3	2	5	3	2	0	−120	0	−120	0	−100
18	30	0	−6	0	−5	0	−3.5	5	2.5	2	4	3	2	8	4	3	5	3	2	0	−120	0	−120	0	−100
30	50	0	−8	0	−6	0	−5	5	3	2	5	4	3	8	4	3	6	3	2	0	−120	0	−120	0	−100
50	80	0	−9	0	−7	0	−5	6	4	3	5	4	4	8	5	4	7	4	3	0	−150	0	−150	0	−150

❶ The tolerance of outside diameter deviation Δ_{ds} applicable to classes 4 and UP is the same as the tolerance of single plane mean outside diameter deviation Δ_{dmp}.

Table 13.9 Outer rings

Unit: μm

Nominal bore diameter d mm over	incl.	Single plane mean outside diameter deviation Δ_{Dmp} Class 5 high	Class 5 low	Class 4❶ high	Class 4❶ low	Class UP❶ high	Class UP❶ low	Width variation V_{Cs} Class 5 max	Class 4 max	Class UP max	Radial runout K_{ea} Class 5 max	Class 4 max	Class UP max	Outside surface inclination S_D Class 5 max	Class 4 max	Class UP max	Axial runout S_{ea} All classes	Width deviation Δ_{Cs} All classes
30	50	0	−7	0	−6	0	−5	5	2.5	2	7	5	4	8	4	3	Identical to S_i relative to d on the same bearing.	Identical to Δ_{Bs} relative to d on the same bearing.
50	80	0	−9	0	−7	0	−5	6	3	2	8	5	4	8	4	3		
80	120	0	−10	0	−8	0	−7	8	4	3	10	6	4	9	5	4		

❷ The tolerance of outside diameter deviation Δ_{Ds} applicable to classes 4 and UP is the same as the tolerance of single plane mean outside diameter deviation Δ_{Dmp}.

■Accuracy of BSTU type (Class P42U)

Table 13.10 Inner rings

Unit: μm

Nominal bore diameter d mm	Single plane mean bore diameter deviation Δ_{dmp}		Single radial plane bore diameter variation V_{dp}	Mean bore diameter deviation V_{dmp}	Radial runout K_{ia}	Face runout with bore S_d	Axial runout S_{ia}	Width deviation Δ_{Bs}		Width variation V_{Bs}
	high	low	max	max	max	max	max	high	low	max
20	0	−5	2.5	2.5	3	4	2	0	−125	2
25	0	−5	2.5	2.5	3	4	2	0	−125	2
30	0	−5	2.5	2.5	3	4	2.5	0	−125	2.5
35	0	−5	2.5	2.5	4	4	2.5	0	−125	2.5
40	0	−5	2.5	2.5	4	4	2.5	0	−125	2.5
90	0	−8	4	4	5	5	3	0	−125	3
100	0	−8	4	4	5	5	3	0	−125	3

Table 13.11 Outer rings

Unit: μm

Nominal outside diameter D mm	Single plane mean outside diameter deviation Δ_{Dmp}		Single radial plane outside diameter deviation V_{Dp}	Mean single plane outside diameter deviation V_{Dmp}	Radia runout K_{ea}	Outside surface inclination S_D	Axial runout S_{ea}	Width variation Δ_{Cs}		Width deviation V_{Cs}
	high	low	max	max	max	max	max	high	low	max
68	0	−10	3.5	3.5	5	4	5	0	−250	3
75	0	−10	3.5	3.5	5	4	5	0	−250	3
80	0	−10	3.5	3.5	5	4	5	0	−250	3
90	0	−10	4	4	6	5	6	0	−250	4
100	0	−10	4	4	6	5	6	0	−250	4
190	0	−15	8	6	10	7	10	0	−250	7
200	0	−15	8	6	10	7	10	0	−250	7

■Accuracy of BSTU type (Class P4U)

Table 13.12 Inner rings

Unit: μm

Nominal bore diameter d mm	Single plane mean bore diameter deviation Δ_{dmp}		Single radial plane bore diameter variation V_{dp}	Mean bore diameter deviation V_{dmp}	Radial runout K_{ia}	Face runout with bore S_d	Axial runout S_{ia}	Width deviation Δ_{Bs}		Width variation V_{Bs}
	high	low	max	max	max	max	max	high	low	max
20	0	−5	2.5	2.5	3	4	4	0	−125	2.5
25	0	−5	2.5	2.5	3	4	4	0	−125	2.5
30	0	−5	2.5	2.5	3	4	4	0	−125	2.5
35	0	−5	2.5	2.5	4	4	4	0	−125	3
40	0	−5	2.5	2.5	4	4	4	0	−125	3
90	0	−8	4	4	5	5	5	0	−125	4
100	0	−8	4	4	5	5	5	0	−125	4

Table 13.13 Outer rings

Unit: μm

Nominal outside diameter D mm	Single plane mean outside diameter deviation Δ_{Dmp}		Single radial plane outside diameter deviation V_{Dp}	Mean single plane outside diameter deviation V_{Dmp}	Radia runout K_{ea}	Outside surface inclination S_D	Axial runout S_{ea}	Width variation Δ_{Cs}		Width deviation V_{Cs}
	high	low	max	max	max	max	max	high	low	max
68	0	−10	3.5	3.5	5	4	5	0	−250	3
75	0	−10	3.5	3.5	5	4	5	0	−250	3
80	0	−10	3.5	3.5	5	4	5	0	−250	3
90	0	−10	4	4	6	5	6	0	−250	4
100	0	−10	4	4	6	5	6	0	−250	4
190	0	−15	8	6	10	7	10	0	−250	7
200	0	−15	8	6	10	7	10	0	−250	7

■Accuracy of HT type

Table 13.14 Inner rings

Nominal bore diameter d mm		Single plane mean bore diameter deviation Δ_{dmp}						Single radial plane bore diameter variation V_{dp}						Mean bore diameter deviation V_{dmp}			Inner ring radial runout K_{ia}		
								Diameter series 9			Diameter series 0,2								
		Class 5		Class 4 ❶		Class 2 ❶		Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2
over	incl.	high	low	high	low	high	low	max			max			max			max		
2.5	10	0	−5	0	−4	0	−2.5	5	4	2.5	4	3	2.5	3	2	1.5	4	2.5	1.5
10	18	0	−5	0	−4	0	−2.5	5	4	2.5	4	3	2.5	3	2	1.5	4	2.5	1.5
18	30	0	−6	0	−5	0	−2.5	6	5	2.5	5	4	2.5	3	2.5	1.5	4	3	2.5
30	50	0	−8	0	−6	0	−2.5	8	6	2.5	6	5	2.5	4	3	1.5	5	4	2.5

❶ The tolerance of bore diameter deviation Δ_{ds}, applicable to classes 4 and 2, is the same as the tolerance of mean bore diameter deviation Δ_{dmp}. This applies to the diameter series 0 or 2 for class 4, and all the diameter series for class 2.
❷ Applicable to individual bearing rings manufactured for duplex bearings.

Table 13.15 Outer rings

Nominal outside diameter D mm		Single plane mean outside diameter deviation Δ_{Dmp}						Single radial plane outside diameter deviation V_{Dp}						Mean single plane outside diameter deviation V_{Dmp}			Outer ring radial runout K_{ea}		
								Diameter series 9			Diameter series 0,2								
		Class 5		Class 4 ❸		Class 2 ❸		Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2
over	incl.	high	low	high	low	high	low	max			max			max			max		
18	30	0	−6	0	−5	0	−4	6	5	4	5	4	4	3	2.5	2	6	4	2.5
30	50	0	−7	0	−6	0	−4	7	6	4	5	5	4	4	3	2	7	5	2.5
50	80	0	−9	0	−7	0	−4	9	7	4	7	5	4	5	3.5	2	8	5	4
80	120	0	−10	0	−8	0	−5	10	8	5	8	6	5	5	4	2.5	10	6	5

❸ The tolerance of outside diameter deviation Δ_{Ds}, applicable to classes 4 and 2, is the same as the tolerance of mean outside diameter deviation Δ_{Dmp}. This applies to the diameter series 0 or 2 for class 4, and all the diameter series for class 2.

■Accuracy of AXN and ARN type

Table 13.16 Inner ring and outer ring

Nominal bearing bore dia. d or nominal bearing outside dia. D mm		Deviation of mean bore ❶ diameter in a single plane d_{mp}				Thrust inner ring bore ❶ dia. deviation d_{is}		Deviation of mean outside ❷ diameter in a single plane D_{mp}				Bearing height deviation T_s		Outer ring width deviation C_s		Radial inner ring ❶ radial runout K_{ia}	
		Class 5		Class 4				Class 5		Class 4						Class 5	
Over	Incl.	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	Max.	
18	30	0	−6	0	−5	+61	+40	—	—	—	—					4	3
30	50	0	−8	0	−6	+75	+50	—	—	—	—					5	4
50	80	0	−9	0	−7	+90	+60	0	−9	0	−7	0	−370	0	−130	5	4
80	120	—	—	—	—	—	—	0	−10	0	−8					—	—
120	150	—	—	—	—	—	—	0	−11	0	−9					—	—

❶ Applicable only to dimension d. ❷ Applicable only to dimension D.

Unit: μm

Face runout with bore S_d			Axial runout S_{ia}			Width variation ΔB_s Single bearing				Width variation ΔB_s Duplex bearing ❷		Width variation VB_s		
Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5 high	Class 5 low	Class 4 high	Class 4 low	Class 5 high	Class 5 low	Class 5 max	Class 4 max	Class 2 max
7	3	1.5	7	3	1.5	0	−40	0	−40	0	−250	5	2.5	1.5
7	3	1.5	7	3	1.5	0	−80	0	−80	0	−250	5	2.5	1.5
8	4	1.5	8	4	2.5	0	−120	0	−120	0	−250	5	2.5	1.5
8	4	1.5	8	4	2.5	0	−120	0	−120	0	−250	5	3	1.5

Unit: μm

Outside surface inclination S_D			Axial runout S_{ea}			Width variation ΔC_s	Width variation VC_s		
Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	All classes	Class 5	Class 4	Class 2
max			max				max		
8	4	1.5	8	5	2.5	Identical to ΔB_s relative to d of the same bearing	5	2.5	1.5
8	4	1.5	8	5	2.5		5	2.5	1.5
8	4	1.5	10	5	4		6	3	1.5
9	5	2.5	11	6	5		8	4	2.5

Unit: μm

Outer ring ❷ radial runout K_{ea}		Perpendicularity of outer ring ❷ outside surface with respect to the face S_D		Thrust inner ring and ❶ outer ring thickness variation ❷ S_{ia}, S_{ea}	
Class 5	Class 4	Class 5	Class 4	Class 5	Class 4
Max.		Max.		Max.	
—	—	—	—	3	2
—	—	—	—	3	2
8	5	8	4	4	3
10	6	9	5	4	3
11	7	10	5	5	4

⑦ Basic preload and axial rigidity

Basic preloads for each type of ball screw support bearings are shown in the dimension tables. The preloads can be altered depending on the required rigidity. Contact **NTN** in such a case. In the AXN and ARN types, rigidity is normally enhanced by tightening the thrust bearing rings to supply preload. Preloads and torques are shown in the dimensions tables to help control basic preload. A bearing that allows preset preload by tightening the bearing raceways to adjust the clearance A between the both thrust bearing rings and radial bearing rings (**Fig. 13.19**) is also available. Ask **NTN** for details.

Axial rigidity of the 2A-BST type DB duplex arrangement and the AXN type at the basic preload are shown in **Figs. 13.20** and **13.21**.

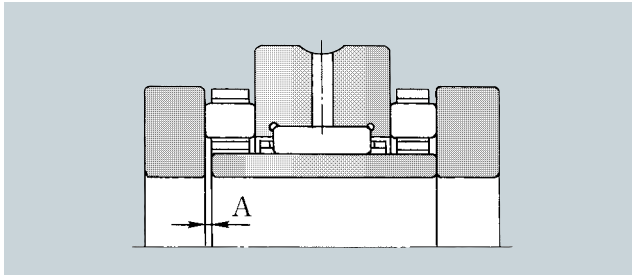


Fig. 13.19

(Notes) Axial displacement is measured under standard preloaded.

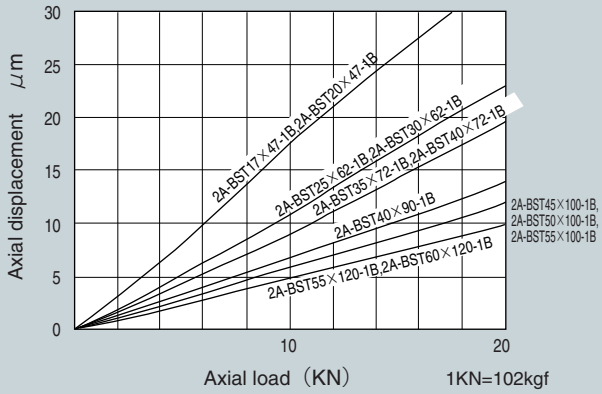


Fig. 13.20 BST type rigidity chart

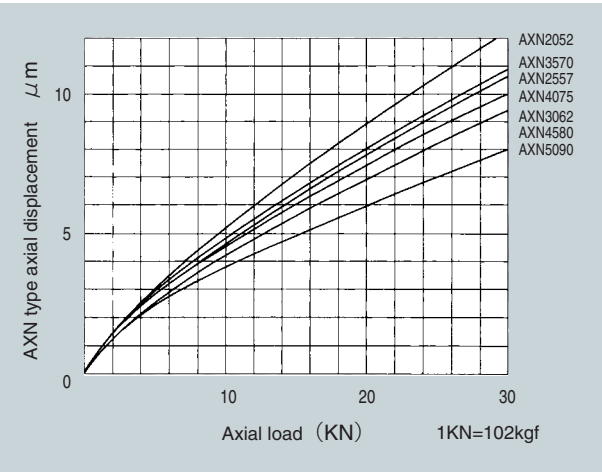


Fig. 13.21 AXN type rigidity chart

⑧ Shaft and housing fits

Recommended fit and tolerances of shaft and housing shoulder squareness are shown in **Tables. 13.17** and **13.18**.

Table 13.17 Shaft and housing fits

Type code	Fit	
	Shaft outside diameter	Housing
BST HT	h5	H6
BSTU	h5	H6
AXN ARN	j5	J6

Table 13.18 Tolerance of shoulder squareness Unit: μm

Diameter classification mm		Type code			
over	incl.	BST	BSTU	HT	AXN, ARN
—	30	4	4	4	4
30	80	4	4	4	5
80	120	5	5	—	6
120	180	—	—	—	7

⑨ Applications

The BST type is mainly installed on ball screws of machine tool feed systems, and two to four row arrangements are used in many cases. This type is popular because greased sealed angular contact ball bearings are easy to handle. The back-to-back duplex arrangement is commonly used because it allows acquisition of the specified preload by tightening the inner ring. The face-to-face duplex arrangement may be used if more precise alignment is required. It is not commonly used for machine tools. Examples of bearing arrangement are shown in **Figs. 13.22** and **13.24**.

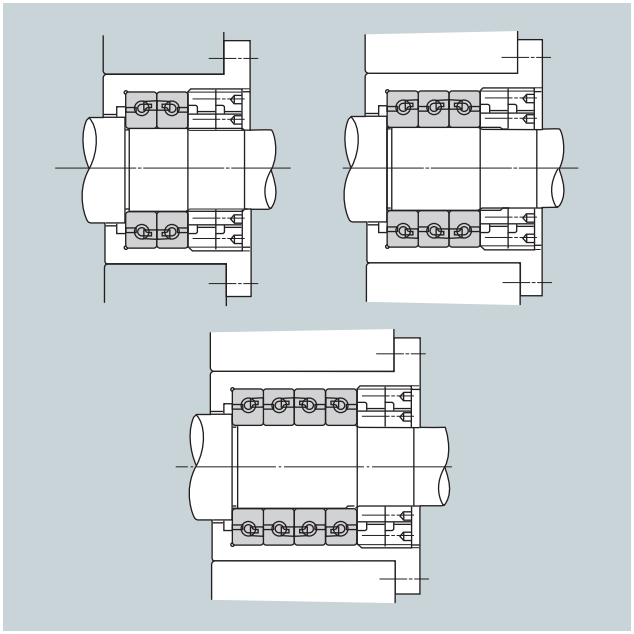


Fig. 13.22

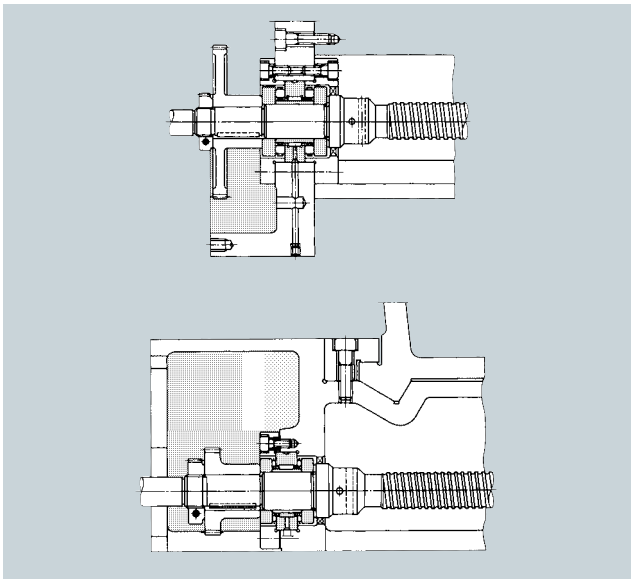


Fig. 13.23

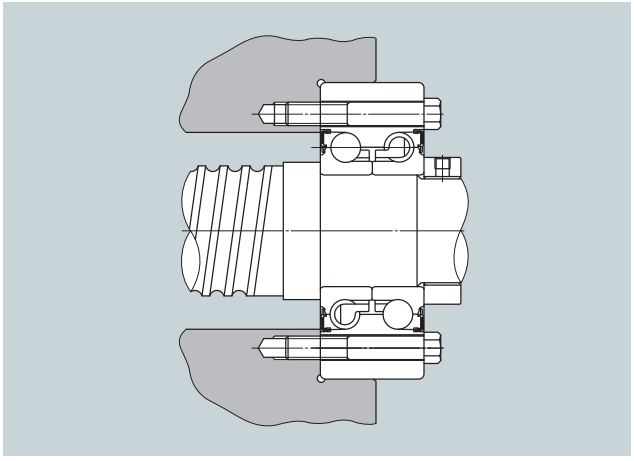


Fig. 13.24

⑩ Starting torque of 2A-BST type

Reference starting torque values for 2A-BST bearings are shown in **Tables 13.19** and **13.20**.

Table 13.19 Open type BST and 2A-BST

	Starting torque (reference) N · mm {kgf · cm}			
	DF type DB type	DFT type DBT type	DTFT type DTBT type	DFTT type DBTT type
BST17X47-1B 2A-BST17X47-1B	175 {1.8}	245 {2.5}	355 {3.6}	275 {2.8}
BST20X47-1B 2A-BST20X47-1B	175 {1.8}	245 {2.5}	355 {3.6}	275 {2.8}
BST25X62-1B 2A-BST25X62-1B	305 {3.1}	420 {4.3}	615 {6.3}	470 {4.8}
BST30X62-1B 2A-BST30X62-1B	305 {3.1}	420 {4.3}	615 {6.3}	470 {4.8}
BST35X72-1B 2A-BST35X72-1B	380 {3.9}	510 {5.2}	755 {7.7}	590 {6.0}
BST40X72-1B 2A-BST40X72-1B	380 {3.9}	510 {5.2}	755 {7.7}	590 {6.0}
BST40X90-1B 2A-BST40X90-1B	960 {9.8}	1305 {13.3}	1930 {19.7}	1500 {15.3}
BST45X75-1B 2A-BST45X75-1B	430 {4.4}	580 {5.9}	860 {8.8}	665 {6.8}
BST45X100-1B 2A-BST45X100-1B	1165 {11.9}	1580 {16.1}	2340 {23.9}	1815 {18.5}
BST50X100-1B 2A-BST50X100-1B	1165 {11.9}	1580 {16.1}	2340 {23.9}	1815 {18.5}
BST55X100-1B 2A-BST55X100-1B	1165 {11.9}	1580 {16.1}	2340 {23.9}	1815 {18.5}

Table 13.20 Light-contact sealed type BST LXL/L588 and 2A-BST LXL/L588

	Starting torque (reference) N · mm {kgf · cm}			
	DF type DB type	DFT type DBT type	DTFT type DTBT type	DFTT type DBTT type
BST17X47-1BLXL 2A-BST17X47-1BLXL	215 {2.2}	295 {3.0}	420 {4.3}	355 {3.4}
BST20X47-1BLXL 2A-BST20X47-1BLXL	215 {2.2}	295 {3.0}	420 {4.3}	355 {3.4}
BST25X62-1BLXL 2A-BST25X62-1BLXL	365 {3.7}	510 {5.2}	745 {7.6}	570 {5.8}
BST30X62-1BLXL 2A-BST30X62-1BLXL	365 {3.7}	510 {5.2}	745 {7.6}	570 {5.8}
BST35X72-1BLXL 2A-BST35X72-1BLXL	460 {4.7}	610 {6.2}	900 {9.2}	705 {7.28}
BST40X72-1BLXL 2A-BST40X72-1BLXL	460 {4.7}	610 {6.2}	900 {9.2}	705 {7.2}
BST40X90-1BLXL 2A-BST40X90-1BLXL	1155 {11.8}	1570 {16.0}	2315 {23.6}	1805 {18.4}
BST45X75-1BLXL 2A-BST45X75-1BLXL	520 {5.3}	695 {7.1}	1040 {10.6}	805 {8.2}
BST45X100-1BLXL 2A-BST45X100-1BLXL	1400 {14.3}	1890 {19.3}	2815 {28.7}	2175 {22.2}
BST50X100-1BLXL 2A-BST50X100-1BLXL	1400 {14.3}	1890 {19.3}	2815 {28.7}	2175 {22.2}
BST55X100-1BLXL 2A-BST55X100-1BLXL	1400 {14.3}	1890 {19.3}	2815 {28.7}	2175 {22.2}

⑪ Recommended lubrication specifications

BST and HT ball screw support angular contact ball bearings are generally lubricated with grease. (BST LXL bearings with light-contact seals are packed with grease.) AXN and ARN bearings are generally lubricated with circulated oil.

■Grease lubrication

- **Recommended type of grease**
  Lithium-mineral oil base general purpose grease of which base oil viscosity is high (for example, Alvania Grease S2, Shell).

- **Recommended grease fill**
  25% of the capacity shown in the dimensions tables

- **Recommended grease filling method**
  Refer to "6. Handling of Bearings, ① Rinsing of bearings and grease filling" in the Technical Data section.

■Oil lubrication

- **Recommended type of oil**
  Hydraulic oils or other industrial oils used for lubrication of sliding surfaces with viscosity grade ISO VG 68 or higher are recommended.
- **Oil quantity**
  Recommended oil quantity depends on the lubricating method. As a general guideline, the oil flow rate should be 5 to 10 cm^3/min.

⑫ Dimension tables

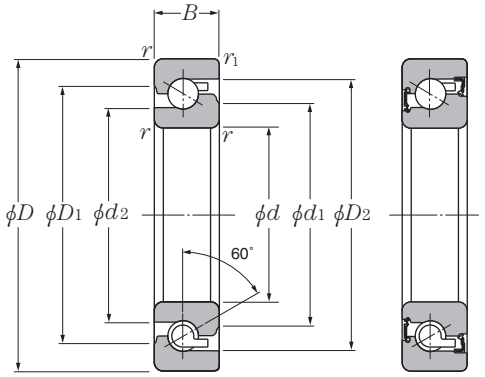
ULTAGE Angular contact thrust ball bearings for ball screws BST series

Contact angle 60° d 17～60mm

Dynamic equivalent axial load $P_a = XF_r + YF_a$

Number of rows in bearing arrangement		2		3			4			
Number of rows subjected to axial load		1	2	1	2	3	1	2	3	4
$F_a / F_r \leqq 2.17$	X	1.90	—	1.43	2.32	—	1.17	1.90	2.52	—
	Y	0.55	—	0.76	0.35	—	0.88	0.55	0.26	—
$F_a / F_r > 2.17$	X	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
	Y	1	1	1	1	1	1	1	1	1

Static equivalent axial load
$P_{oa} = F_a + 3.98F_r$

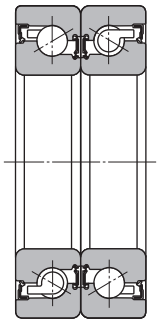


Open type

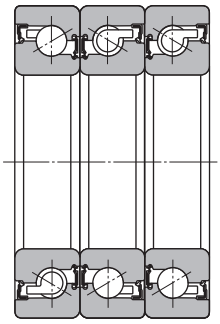
Contact sealed type

Part number	Boundary dimensions mm					Basic dynamic rated load C_a kN kgf			Basic static rated load C_{oa} kN kgf		
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	1	2	3	1	2	3
BST17X47-1B **BST17X47-1BLXL**	17	47	15	1	0.6	24.3 2 470	39.5 4 000	52.5 5 350	37.5 3 850	75.0 7 650	113 11 500
BST20X47-1B **BST20X47-1BLXL**	20	47	15	1	0.6	24.3 2 470	39.5 4 000	52.5 5 350	37.5 3 850	75.0 7 650	113 11 500
BST25X62-1B **BST25X62-1BLXL**	25	62	15	1	0.6	29.2 2 980	47.5 4 850	63.0 6 450	59.0 6 050	118 12 100	177 18 100
BST30X62-1B **BST30X62-1BLXL**	30	62	15	1	0.6	29.2 2 980	47.5 4 850	63.0 6 450	59.0 6 050	118 12 100	177 18 100
BST35X72-1B **BST35X72-1BLXL**	35	72	15	1	0.6	31.0 3 150	50.5 5 150	67.0 6 850	70.0 7 150	140 14 300	210 21 400
BST40X72-1B **BST40X72-1BLXL**	40	72	15	1	0.6	31.0 3 150	50.5 5 150	67.0 6 850	70.0 7 150	140 14 300	210 21 400
BST40X90-1B **BST40X90-1BLXL**	40	90	20	1	0.6	58.5 6 000	95.0 9 700	126 12 900	130 13 300	261 26 600	390 40 000
BST45X75-1B **BST45X75-1BLXL**	45	75	15	1	0.6	32.0 3 300	52.0 5 350	69.5 7 100	77.5 7 900	155 15 800	232 23 700
BST45X100-1B **BST45X100-1BLXL**	45	100	20	1	0.6	62.0 6 350	101 10 300	134 13 700	153 15 600	305 31 000	459 47 000
BST50X100-1B **BST50X100-1BLXL**	50	100	20	1	0.6	62.0 6 350	101 10 300	134 13 700	153 15 600	305 31 000	459 47 000
BST55X100-1B **BST55X100-1BLXL**	55	100	20	1	0.6	62.0 6 350	101 10 300	134 13 700	153 15 600	305 31 000	459 47 000
BST55X120-1B **BST55X120-1BLXL**	55	120	20	1	0.6	66.5 6 750	108 11 000	143 14 600	183 18 700	365 37 500	550 56 000
BST60X120-1B **BST60X120-1BLXL**	60	120	20	1	0.6	66.5 6 750	108 11 000	143 14 600	183 18 700	365 37 500	550 56 000

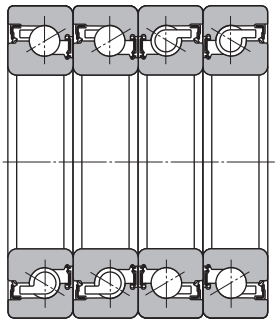
❶ Minimum allowable value for chamfer dimension r or r_1.



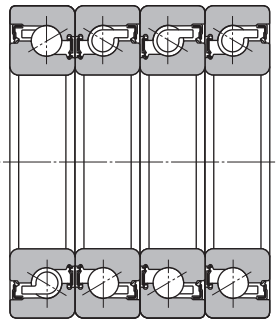
When one row bears axial load (DB)



When two rows bear axial load (DBT)



When two rows bear axial load (DTBT)



When three rows bear axial load (DBTT)

Dimensions mm				Space capacity cm³	Static axial load capacity kN kgf		
d_1	d_2	D_1	D_2	Single-row (approx.)	1	2	3
29.9	27.1 25.7	37.1	40.8 41.2	3.3	25.7 2 620	51.5 5 250	77.0 7 850
29.9	27.1 25.7	37.1	40.8 41.2	3.3	25.7 2 620	51.5 5 250	77.0 7 850
44.4	41.6 40.2	51.6	55.3 55.7	4.6	40.0 4 100	80.5 8 200	121 12 300
44.4	41.6 40.2	51.6	55.3 55.7	4.6	40.0 4 100	80.5 8 200	121 12 300
52.4	49.6 48.2	59.6	63.2 63.7	5.4	47.5 4 850	95.0 9 700	143 14 600
52.4	49.6 48.2	59.6	63.2 63.7	5.4	47.5 4 850	95.0 9 700	143 14 600
64.8	60.7 59.1	75.2	80.4 81.6	12	88.5 9 000	177 18 000	265 27 000
58.4	55.6 54.2	65.6	69.2 69.7	6.0	52.5 5 350	177 10 700	158 16 100
75.8	71.7 70.1	86.2	91.4 92.6	13	104 10 600	208 21 200	315 32 000
75.8	71.7 70.1	86.2	91.4 92.6	13	104 10 600	208 21 200	315 32 000
75.8	71.7 70.1	86.2	91.4 92.6	13	104 10 600	208 21 200	315 32 000
90.8	86.7 85.1	101.2	106.4 107.6	16	124 12 700	249 25 400	375 38 000
90.8	86.7 85.1	101.2	106.4 107.6	16	124 12 700	249 25 400	375 38 000

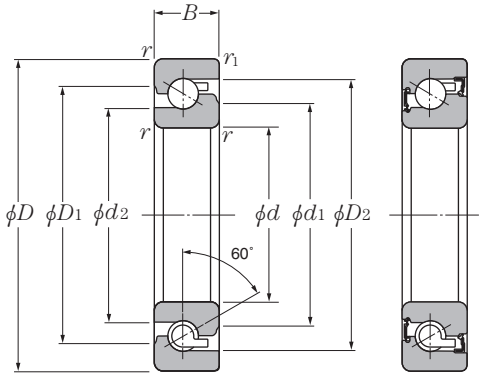
ULTAGE Angular contact thrust ball bearings for ball screws 2A-BST series

Contact angle 60° d 17～60mm

Dynamic equivalent axial load $P_a = XF_r + YF_a$

Number of rows in bearing arrangement		2		3			4			
Number of rows subjected to axial load		1	2	1	2	3	1	2	3	4
$F_a / F_r \leqq 2.17$	X	1.90	—	1.43	2.32	—	1.17	1.90	2.52	—
	Y	0.55	—	0.76	0.35	—	0.88	0.55	0.26	—
$F_a / F_r > 2.17$	X	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
	Y	1	1	1	1	1	1	1	1	1

Static equivalent axial load
$P_{oa} = F_a + 3.98F_r$

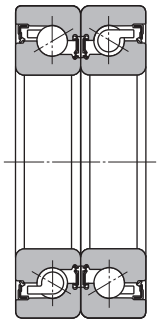


Open type

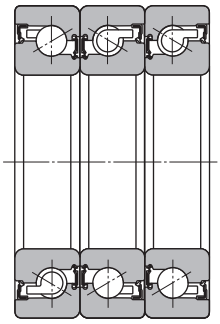
Contact sealed type

Part number	Boundary dimensions mm					Basic dynamic rated load C_a kN kgf			Basic static rated load C_{oa} kN kgf		
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	1	2	3	1	2	3
2A-BST17X47-1B 2A-BST17X47-1BLXL	17	47	15	1	0.6	24.3 2 470	39.5 4 000	52.5 5 350	37.5 3 850	75.0 7 650	113 11 500
2A-BST20X47-1B 2A-BST20X47-1BLXL	20	47	15	1	0.6	24.3 2 470	39.5 4 000	52.5 5 350	37.5 3 850	75.0 7 650	113 11 500
2A-BST25X62-1B 2A-BST25X62-1BLXL	25	62	15	1	0.6	29.2 2 980	47.5 4 850	63.0 6 450	59.0 6 050	118 12 100	177 18 100
2A-BST30X62-1B 2A-BST30X62-1BLXL	30	62	15	1	0.6	29.2 2 980	47.5 4 850	63.0 6 450	59.0 6 050	118 12 100	177 18 100
2A-BST35X72-1B 2A-BST35X72-1BLXL	35	72	15	1	0.6	31.0 3 150	50.5 5 150	67.0 6 850	70.0 7 150	140 14 300	210 21 400
2A-BST40X72-1B 2A-BST40X72-1BLXL	40	72	15	1	0.6	31.0 3 150	50.5 5 150	67.0 6 850	70.0 7 150	140 14 300	210 21 400
2A-BST40X90-1B 2A-BST40X90-1BLXL	40	90	20	1	0.6	58.5 6 000	95.0 9 700	126 12 900	130 13 300	261 26 600	390 40 000
2A-BST45X75-1B 2A-BST45X75-1BLXL	45	75	15	1	0.6	32.0 3 300	52.0 5 350	69.5 7 100	77.5 7 900	155 15 800	232 23 700
2A-BST45X100-1B 2A-BST45X100-1BLXL	45	100	20	1	0.6	62.0 6 350	101 10 300	134 13 700	153 15 600	305 31 000	459 47 000
2A-BST50X100-1B 2A-BST50X100-1BLXL	50	100	20	1	0.6	62.0 6 350	101 10 300	134 13 700	153 15 600	305 31 000	459 47 000
2A-BST55X100-1B 2A-BST55X100-1BLXL	55	100	20	1	0.6	62.0 6 350	101 10 300	134 13 700	153 15 600	305 31 000	459 47 000
2A-BST55X120-1B 2A-BST55X120-1BLXL	55	120	20	1	0.6	66.5 6 750	108 11 000	143 14 600	183 18 700	365 37 500	550 56 000
2A-BST60X120-1B 2A-BST60X120-1BLXL	60	120	20	1	0.6	66.5 6 750	108 11 000	143 14 600	183 18 700	365 37 500	550 56 000

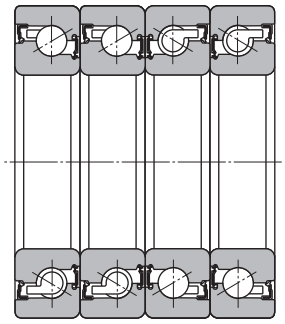
❶ Minimum allowable value for chamfer dimension r or r_1.



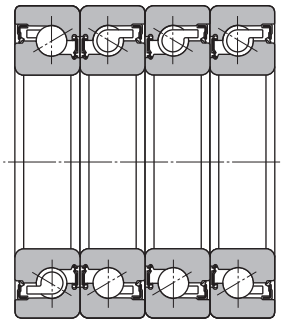
When one row
bears axial load
(DB)



When two rows
bear axial load
(DBT)



When two rows
bear axial load
(DTBT)



When three rows
bear axial load
(DBTT)

Dimensions mm				Space capacity cm³	Static axial load capacity kN kgf		
d_1	d_2	D_1	D_2	Single-row (approx.)	1	2	3
29.9	27.1 25.7	37.1	40.8 41.2	3.3	25.7 2 620	51.5 5 250	77.0 7 850
29.9	27.1 25.7	37.1	40.8 41.2	3.3	25.7 2 620	51.5 5 250	77.0 7 850
44.4	41.6 40.2	51.6	55.3 55.7	4.6	40.0 4 100	80.5 8 200	121 12 300
44.4	41.6 40.2	51.6	55.3 55.7	4.6	40.0 4 100	80.5 8 200	121 12 300
52.4	49.6 48.2	59.6	63.2 63.7	5.4	47.5 4 850	95.0 9 700	143 14 600
52.4	49.6 48.2	59.6	63.2 63.7	5.4	47.5 4 850	95.0 9 700	143 14 600
64.8	60.7 59.1	75.2	80.4 81.6	12	88.5 9 000	177 18 000	265 27 000
58.4	55.6 54.2	65.6	69.2 69.7	6.0	52.5 5 350	177 10 700	158 16 100
75.8	71.7 70.1	86.2	91.4 92.6	13	104 10 600	208 21 200	315 32 000
75.8	71.7 70.1	86.2	91.4 92.6	13	104 10 600	208 21 200	315 32 000
75.8	71.7 70.1	86.2	91.4 92.6	13	104 10 600	208 21 200	315 32 000
90.8	86.7 85.1	101.2	106.4 107.6	16	124 12 700	249 25 400	375 38 000
90.8	86.7 85.1	101.2	106.4 107.6	16	124 12 700	249 25 400	375 38 000

ULTAGE Angular contact thrust ball bearings for ball screws BST Type, 2A-BST Type

Contact angle 60° d 17～60mm

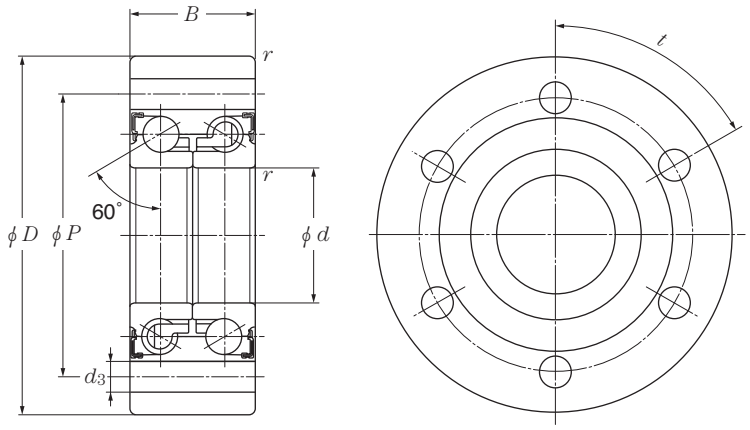
Part number	Basic preload：-1B											
	Double-row (DF/DB types)				Triple-row (DFT/DBT types)				Four-row (DTFT/DTBT types)			
	Preload		Axial spring constant		Preload		Axial spring constant		Preload		Axial spring constant	
	N	kgf	N/μm	kgf/μm	N	kgf	N/μm	kgf/μm	N	kgf	N/μm	kgf/μm
BST17X47 2A-BST17X47	2 060	210	635	65	2 840	290	930	95	4 100	420	1 270	130
BST20X47 2A-BST20X47	2 060	210	635	65	2 840	290	930	95	4 100	420	1 270	130
BST25X62 2A-BST25X62	3 250	330	980	100	4 400	450	1 370	140	6 450	660	1 960	200
BST30X62 2A-BST30X62	3 250	330	980	100	4 400	450	1 370	140	6 450	660	1 960	200
BST35X72 2A-BST35X72	3 800	390	1130	115	5 200	530	1 620	165	7 650	780	2 260	230
BST40X72 2A-BST40X72	3 800	390	1130	115	5 200	530	1 620	165	7 650	780	2 260	230
BST40X90 2A-BST40X90	7 050	720	1470	150	9 600	980	2 110	215	14 100	1 440	2 940	300
BST45X75 2A-BST45X75	4 200	430	1230	125	5 700	580	1 770	180	8 450	860	2 500	255
BST45X100 2A-BST45X100	8 250	840	1720	175	11 200	1 140	2 450	250	16 500	1 680	3 450	350
BST50X100 2A-BST50X100	8 250	840	1720	175	11 200	1 140	2 450	250	16 500	1 680	3 450	350
BST55X100 2A-BST55X100	8 250	840	1720	175	11 200	1 140	2 450	250	16 500	1 680	3 450	350
BST55X120 2A-BST55X120	9 900	1 010	2010	205	13 400	1 370	2 890	295	19 800	2 020	4 050	415
BST60X120 2A-BST60X120	9 900	1 010	2010	205	13 400	1 370	2 890	295	19 800	2 020	4 050	415

NOTE) Preload values are those obtained from matched bearings.
Spring constants mean axial spring constants on bearings subjected to the preloads listed in the table.

Part number	Light preload：-11B											
	Double-row (DF/DB types)				Triple-row (DFT/DBT types)				Four-row (DTFT/DTBT types)			
	Preload		Axial spring constant		Preload		Axial spring constant		Preload		Axial spring constant	
	N	kgf	N/μm	kgf/μm	N	kgf	N/μm	kgf/μm	N	kgf	N/μm	kgf/μm
BST17X47 2A-BST17X47	1 000	102	490	50	1 370	140	735	75	1 960	200	980	100
BST20X47 2A-BST20X47	1 000	102	490	50	1 370	140	735	75	1 960	200	980	100
BST25X62 2A-BST25X62	1 470	150	735	75	1 960	200	1 080	110	2 940	300	1 470	150
BST30X62 2A-BST30X62	1 560	159	735	75	2 160	220	1 080	110	3 150	320	1 470	150
BST35X72 2A-BST35X72	1 760	180	885	90	2 350	240	1 270	130	3 550	360	1 770	180
BST40X72 2A-BST40X72	1 860	190	885	90	2 550	260	1 270	130	3 700	380	1 770	180
BST40X90 2A-BST40X90	2 370	240	980	100	3 230	330	1 470	150	4 700	480	2 060	210
BST45X75 2A-BST45X75	2 000	200	980	100	2 650	270	1 370	140	3 900	400	1 960	200
BST45X100 2A-BST45X100	2 880	290	1 180	120	3 800	390	1 770	180	5 700	580	2 450	250
BST50X100 2A-BST50X100	3 010	310	1 180	120	4 100	420	1 770	180	6 100	620	2 450	250
BST55X100 2A-BST55X100	3 010	310	1 180	120	4 100	420	1 770	180	6 100	620	2 450	250
BST55X120 2A-BST55X120	3 520	360	1 370	140	4 800	490	2 060	210	7 050	720	2 840	290
BST60X120 2A-BST60X120	3 520	360	1 370	140	4 800	490	2 060	210	7 050	720	2 840	290

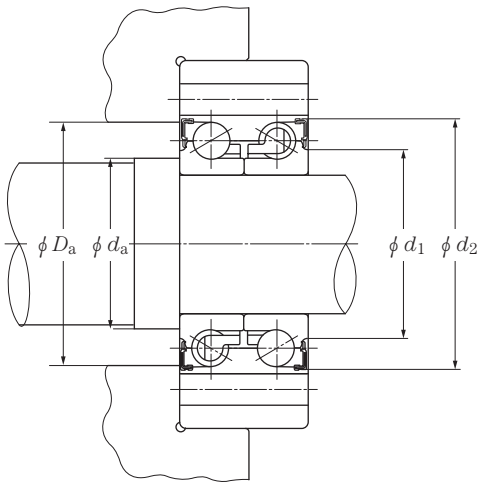
ULTAGE Ball screw support double row thrust angular contact ball bearing unit BSTU LLX type

d 20～100mm



Part number	Boundary dimensions mm						Basic load ratings dynamic kN	Basic load ratings static kgf	Basic load ratings dynamic kN	Basic load ratings static kgf	Limiting speed min^{-1} grease lubrication	Reference dimensions mm	
	d	D	B	r_{min} ❶	P	d_3	C_a	C_{oa}	C_a	C_{oa}		d_1	d_2
BSTU2068LLX	20	68	28	0.6	53	6.8	31.0	3 200	48.0	4 900	6 000	30.1	43
BSTU2575LLX	25	75	28	0.6	58	6.8	34.0	3 450	58.0	5 950	5 000	36.1	49
BSTU3080LLX	30	80	28	0.6	63	6.8	36.5	3 700	68.5	6 950	4 500	41.1	54
BSTU30100LLX	30	100	38	0.6	80	8.8	73.5	7 500	121	12 400	4 000	47.1	65
BSTU40100LLX	40	100	34	0.6	80	8.8	52.0	5 300	106	10 800	3 500	54.1	68.9
BSTU40115LLX	40	115	46	0.6	94	8.8	89.0	9 050	167	17 000	3 200	61.1	80.2
BSTU90190LLX	90	190	55	0.6	165	11	158	16 100	415	42 000	1 700	116.1	138.7
BSTU100200LLX	100	200	55	0.6	175	11	160	16 300	435	44 500	1 500	128.1	150.7

❶ Minimum allowable value for chamfer dimension r.



Dynamic equivalent radial load

$P_a = XF_r + YF_a$

e	$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y
2.17	1.90	0.55	0.92	1

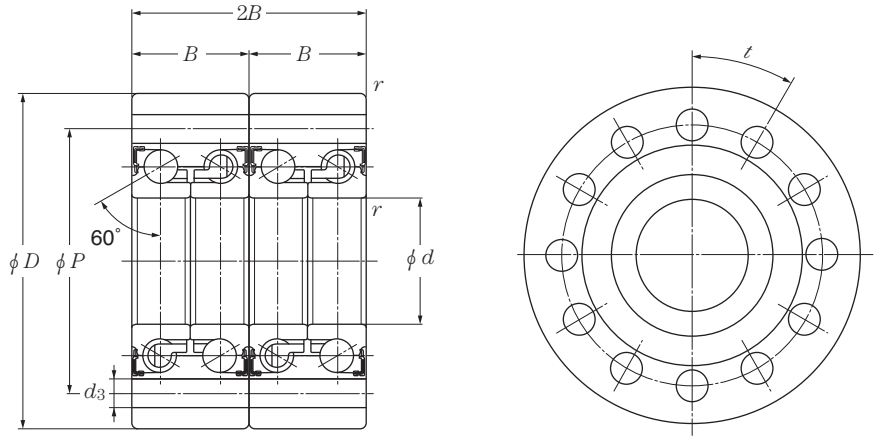
Static equivalent radial load

$P_{oa} = F_a + 3.98F_r$

Abutment and fillet dimensions mm		Outer ring mounting bolt		Preload		Mass	Bearing friction torque	Axial bearing rigidity	Rigidity against moment	Mass moment of inertia	Part number
D_a max	d_a min	Screws	Quantity×t	N	kgf	kg (approx.)	Nm (approx.)	N/μm	Nm/mrad	kg · cm^2	
42	26	M6	4×90°	2 100	215	0.60	0.2	675	150	0.25	**BSTU2068LLX**
48	32	M6	4×90°	2 400	245	0.72	0.3	790	230	0.45	**BSTU2575LLX**
53	37	M6	6×60°	2 700	275	0.78	0.3	900	315	0.68	**BSTU3080LLX**
64	39	M8	8×45°	4 800	490	1.71	0.8	1 040	500	1.99	**BSTU30100LLX**
68	49	M8	4×90°	3 200	325	1.46	0.4	1 050	610	2.16	**BSTU40100LLX**
80	52	M8	12×30°	5 800	590	2.57	1.0	1 260	960	5.52	**BSTU40115LLX**
137	104	M10	8×45°	8 200	835	7.95	1.5	2 010	4 700	60.0	**BSTU90910LLX**
150	116	M10	8×45°	8 800	900	8.47	1.7	2 130	5 800	83.8	**BSTU100200LLX**

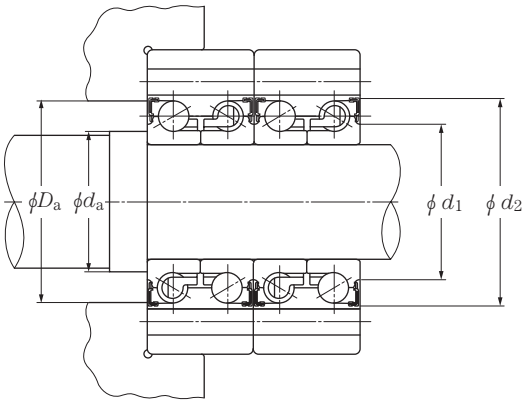
ULTAGE Ball screw support double row thrust angular contact ball bearing unit BSTU LLX D2 type

d 20～40mm



Part number	Boundary dimensions mm						Basic load ratings dynamic kN	static kgf	dynamic kN	static kgf	Limiting speed min^{-1} grease lubrication	Reference dimensions mm	
	d	D	B	r_{min} ❶	P	d_3	C_a	C_{oa}	C_a	C_{oa}		d_1	d_2
BSTU2068LLXD2	20	68	56	0.6	53	6.8	50.5	5 150	96.0	9 800	6 000	30.1	43
BSTU2575LLXD2	25	75	56	0.6	58	6.8	55.0	5 600	116	11 900	5 000	36.1	49
BSTU3080LLXD2	30	80	56	0.6	63	6.8	59.0	6 000	137	13 900	4 500	41.1	54
BSTU40100LLXD2	40	100	68	0.6	80	8.8	84.0	8 600	212	21 600	3 500	54.1	68.9
BSTU40115LLXD2	40	115	92	0.6	94	8.8	144	14 700	335	34 000	3 200	61.1	80.2

❶ Minimum allowable value for chamfer dimension r.



Dynamic equivalent radial load

$P_a = XF_r + YF_a$

e	$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y
2.17	—	—	0.92	1

Static equivalent radial load

$P_{oa} = F_a + 3.98F_r$

Abutment and fillet dimensions mm		Outer ring mounting bolt		Preload		Mass	Bearing friction torque	Axial bearing rigidity	Rigidity against moment	Mass moment of inertia	Part number
D_a max	d_a min	Screws	Quantity×t	N	kgf	kg (approx.)	Nm (approx.)	N/μm	Nm/mrad	kg · cm^2	
42	26	M6	8×45°	4 200	430	1.20	0.5	1 350	340	0.50	**BSTU2068LLXD2**
48	32	M6	8×45°	4 800	490	1.44	0.5	1 580	510	0.90	**BSTU2575LLXD2**
53	37	M6	12×30°	5 400	550	1.56	0.6	1 800	690	1.36	**BSTU3080LLXD2**
68	49	M8	8×45°	6 350	650	2.92	0.8	2 100	1 310	4.32	**BSTU40100LLXD2**
80	52	M8	12×30°	11 600	1 180	5.14	2.0	2 520	2 150	11.0	**BSTU40115LLXD2**

Duplex angular contact ball bearings (HT series)

Contact angle 30° d 6～40mm

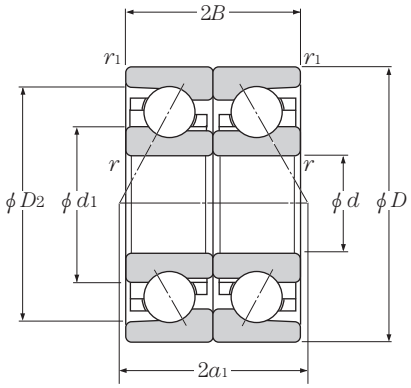
Dynamic equivalent axial load

$P_a = XF_r + YF_a$

Number of rows in bearing arrangement		2		3			4			
Number of rows subjected to axial load		1	2	1	2	3	1	2	3	4
$F_a / F_r \leqq 0.80$	X	0.81	—	0.61	0.99	—	0.50	0.81	1.07	—
	Y	0.63	—	0.88	0.40	—	1.02	0.63	0.30	—
$F_a / F_r > 0.80$	X	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
	Y	1	1	1	1	1	1	1	1	1

Static equivalent axial load

$P_{oa} = 1.52F_r + F_a$

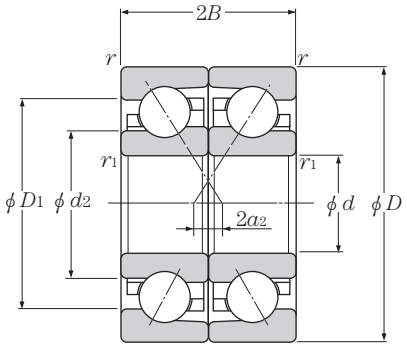


Back-to-back (DB)

Example diagram 1

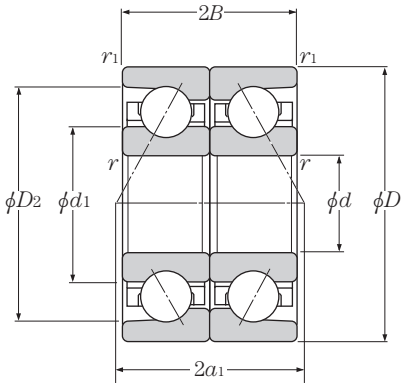
Part number		Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Dimensions mm				Load center cm³		Diagram
Back-to-back (DB)	Face-to-face (DF)	d	D	$2B$	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_a	C_{oa}	C_a	C_{oa}	d_1	d_2	D_1	D_2	DB a_1	DF a_2	
79M6ADB	**79M6ADF**	6	15	10	0.2	0.1	2.05	2.09	209	213	9.9	8.4	11.1	12.9	11.1	1.1	1
70M6DB	**70M6DF**	6	17	12	0.3	0.15	2.67	2.41	273	246	9.8	—	13.2	14.8	12.7	0.7	2
79M8ADB	**79M8ADF**	8	19	12	0.3	0.15	2.93	3.25	298	335	12.6	10.9	14.4	16.4	13.9	1.9	1
70M8DB	**70M8DF**	8	22	14	0.3	0.15	4.40	4.40	450	445	12.8	—	17.2	19.1	15.8	1.8	2
7000HTDB	**7000HTDF**	10	26	16	0.3	0.15	6.10	6.30	620	640	15.5	—	20.3	22.7	18.4	2.4	2
7001HTDB	**7001HTDF**	12	28	16	0.3	0.15	6.65	7.45	680	760	18.1	—	22.9	25.4	20.0	4.0	2
7002HTDB	**7002HTDF**	15	32	18	0.3	0.15	7.60	9.50	775	970	21.1	—	25.9	28.4	22.7	4.7	2
7203HTDB	**7203HTDF**	17	40	24	0.6	0.3	13.8	16.4	1 400	1 670	25.0	—	32.0	36.2	28.8	4.8	2
7004HTDB	**7004HTDF**	20	42	24	0.6	0.3	12.8	17.0	1 300	1 730	28.4	—	34.7	38.1	30.3	6.3	2
7204HTDB	**7204HTDF**	20	47	28	1.0	0.6	17.9	23.1	1 830	2 360	30.5	—	38.6	42.7	34.1	6.1	2
7205HTDB	**7205HTDF**	25	52	30	1.0	0.6	20.2	28.8	2 060	2 940	35.0	—	43.0	47.2	37.7	7.7	2
7206HTDB	**7206HTDF**	30	62	32	1.0	0.6	28.1	41.5	2 860	4 200	41.7	—	51.4	56.3	43.1	11.1	2
7207HTDB	**7207HTDF**	35	72	34	1.1	0.6	37.0	56.0	3 800	5 750	47.9	—	59.2	64.9	48.2	14.2	2
7208HTDB	**7208HTDF**	40	80	36	1.1	0.6	44.0	71.0	4 500	7 200	54.0	—	66.0	72.2	52.9	16.9	2

❶ Minimum allowable value for chamfer dimension r or r_1.
❷ The number of rows means the number of bearings that bear the axial load.
❸ Preload values are those obtained from matched bearings.
❹ Spring constants mean axial spring constants on bearings subjected to the preloads listed in the table.

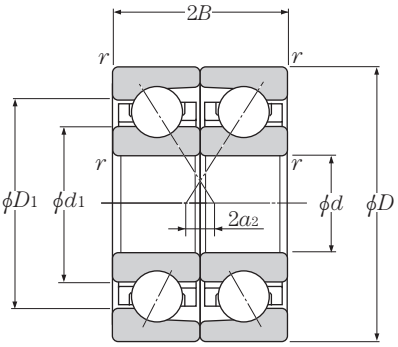


Face-to-face (DF)

Example diagram 1



Back-to-back (DB)
Example diagram 2

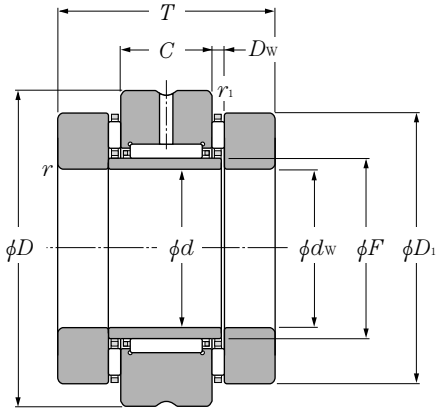


Face-to-face (DF)
Example diagram 2

Static axial load❷ capacity				Medium preload (GM)										Heavy preload (GH)									
				Preload❸				Axial spring constant❹				Starting torque		Preload❸				Axial spring constant❹				Starting torque	
kN	kgf	kN	kgf	N	kgf			N/μm	kgf/μm			N·mm (approx.)		N	kgf			N/μm	kgf/μm			N·mm (approx.)	
Single row		Double row		DB DF		DBT DFT		DB DF		DBT DFT		DB DF	DBT DFT	DB DF		DBT DFT		DB DF		DBT DFT		DB DF	DBT DFT
1.83	187	3.66	374	20	2	27	3	37	3.8	55	5.6	0.4	0.6	39	4	53	5.5	48	4.9	67	6.8	1.0	1.1
1.01	103	2.02	206	29	3	39	4	37	3.8	53	5.4	0.8	1.0	49	5	67	7	45	4.6	65	6.6	1.5	2.2
2.14	219	4.28	438	29	3	39	4	48	4.9	68	6.9	0.7	0.9	59	6	80	8	62	6.3	88	9.0	1.7	2.3
1.53	156	3.06	312	49	5	67	7	52	5.3	75	7.6	1.6	2.2	98	10	133	14	67	6.9	97	9.9	4.0	5.7
3.10	314	6.20	628	147	15	200	20	82	8.4	116	11.8	7.4	9.7	196	20	266	27	92	9.4	131	13.3	11.0	14.7
3.25	331	6.50	662	147	15	200	20	88	9.0	125	12.7	7.2	9.5	196	20	266	27	99	10.1	140	14.3	10.8	14.4
4.00	407	8.00	814	147	15	200	20	100	10.2	141	14.4	6.9	9.1	294	30	400	41	131	13.4	187	19.1	18.1	24.7
5.85	595	11.7	1 190	294	30	400	41	126	12.9	180	18.4	20.5	27.9	390	40	530	54	141	14.4	201	20.5	30.5	40.8
7.55	770	15.1	1 540	294	30	400	41	139	14.2	199	20.3	19.3	26.2	490	50	665	68	170	17.3	242	24.7	39.3	53.1
9.50	970	19.0	1 940	490	50	665	68	168	17.2	240	24.5	41.5	56.1	785	80	1070	109	203	20.7	289	29.5	79.7	108
11.5	1 170	23.0	2 340	490	50	665	68	188	19.2	269	27.4	39.7	53.7	785	80	1070	109	226	23.1	323	32.9	76.4	104
16.3	1 660	32.6	3 320	490	50	665	68	197	20.0	281	28.6	41.3	55.8	785	80	1070	109	235	24.0	336	34.2	79.4	108
21.9	2 230	43.8	4 470	885	90	1200	122	255	26.0	363	37.1	96.4	130	1470	150	2000	204	311	31.7	443	45.2	196	265
27.1	2 770	54.2	5 540	885	90	1200	122	272	27.8	389	39.6	95.8	129	1470	150	2000	204	331	33.8	473	48.2	195	264

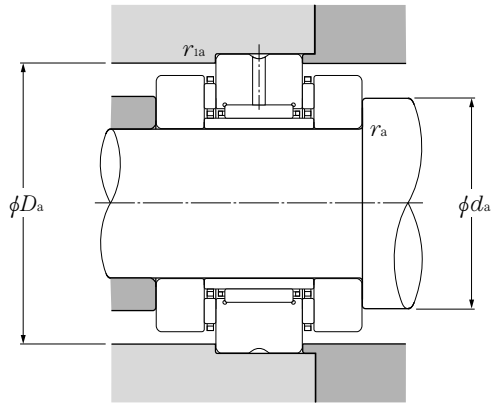
Needle roller bearings with double-direction thrust needle roller bearings (AXN series)

d 20～50mm



Part number	Boundary dimensions mm										Basic load ratings dynamic radial kN	static radial kN	dynamic radial kgf	static radial kgf	dynamic axial kN	static axial kN
	d	d_w	D	D_1 $^{-0.20}_{-0.50}$	T $^{0}_{-0.370}$	C $^{0}_{-0.130}$	F	D_w	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	C_a	C_{oa}
AXN2052	20	20 $^{+0.061}_{+0.040}$	52	42	40	16	25	2	0.6	0.6	15.1	22.4	1 540	2 280	14.6	58.0
AXN2557	25	25 $^{+0.061}_{+0.040}$	57	47	44	20	30	2	0.6	0.6	22.1	34.0	2 260	3 500	16.3	69.5
AXN3062	30	30 $^{+0.061}_{+0.040}$	62	52	44	20	35	2	0.6	0.6	24.8	41.5	2 520	4 250	17.8	81.5
AXN3570	35	35 $^{+0.075}_{+0.050}$	70	60	48	20	40	3	1	0.6	26.4	47.0	2 700	4 800	27.4	110
AXN4075	40	40 $^{+0.075}_{+0.050}$	75	65	48	20	45	3	1	0.6	28.0	52.5	2 860	5 400	29.8	128
AXN4580	45	45 $^{+0.075}_{+0.050}$	80	70	54	25	50	3	1	0.6	38.5	74.5	3 950	7 550	31.5	143
AXN5090	50	50 $^{+0.075}_{+0.050}$	90	78	54	25	55	3	1	0.6	41.0	82.0	4 150	8 400	38.0	186

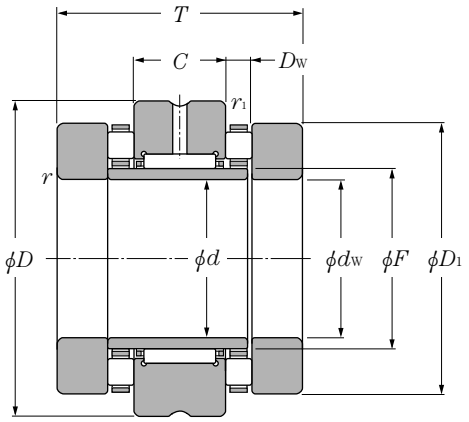
❶ Minimum allowable value for corner radius dimension r or r_1.
❷ Starting torque value relative to the standard preload.



Basic load ratings dynamic C_a kgf	Basic load ratings static C_{oa} kgf	Limiting speeds grease lubrication min^{-1}	Limiting speeds oil lubrication min^{-1}	Radial clearance μm min	Radial clearance μm max	Abutment and fillet dimensions mm d_a min	D_a max	r_{as} max	r_{1as} max	Preload N	Starting torque[2] N·mm (approx.)	Mass kg (approx.)	Part number
1 490	5 900	1 800	7 000	10	30	39	46	0.6	0.6	1 300	330	0.400	**AXN2052**
1 660	7 100	1 500	6 000	10	30	44	51	0.6	0.6	1 450	400	0.520	**AXN2557**
1 820	8 300	1 400	5 500	10	40	50	56	0.6	0.6	1 600	550	0.590	**AXN3062**
2 790	11 300	1 200	4 700	10	40	56	64	1	0.6	2 450	900	0.800	**AXN3570**
3 050	13 100	1 100	4 300	10	40	62	69	1	0.6	2 650	1 050	0.890	**AXN4075**
3 250	14 500	1 000	3 900	10	40	67	74	1	0.6	2 800	1 200	1.00	**AXN4580**
3 850	19 000	900	3 500	15	50	75	83	1	0.6	3 400	1 600	1.42	**AXN5090**

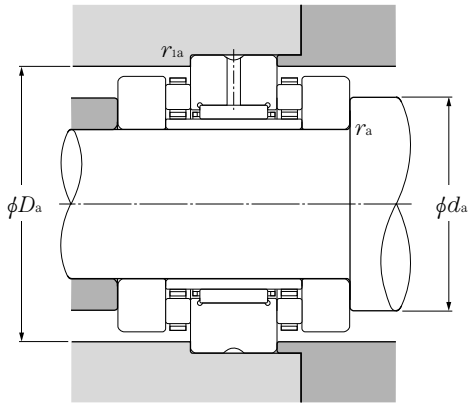
Needle roller bearings with double-direction thrust cylindrical roller bearings (ARN series)

d 20～70mm



Part number	Boundary dimensions mm										Basic load ratings dynamic radial kN	static radial kN	dynamic radial kgf	static radial kgf	dynamic axial kN	static axial kN
	d	d_w	D	D_1 $^{-0.20}_{-0.50}$	T $^{0}_{-0.370}$	C $^{0}_{-0.130}$	F	D_w	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	C_a	C_{oa}
ARN2052T2	20	20 $^{+0.061}_{+0.040}$	52	42	46	16	25	5	0.6	0.6	15.1	22.4	1 540	2 280	27.3	68.0
ARN2062	20	20 $^{+0.061}_{+0.040}$	62	52	60	20	30	7.5	1	0.6	22.1	34.0	2 260	3 500	53.5	129
ARN2557T2	25	25 $^{+0.061}_{+0.040}$	57	47	50	20	30	5	0.6	0.6	22.1	34.0	2 260	3 500	27.8	72.5
ARN2572	25	25 $^{+0.061}_{+0.040}$	72	62	60	20	35	7.5	1	0.6	24.8	41.5	2 520	4 250	54.5	139
ARN3062T2	30	30 $^{+0.061}_{+0.040}$	62	52	50	20	35	5	0.6	0.6	24.8	41.5	2 520	4 250	31.0	87.0
ARN3080	30	30 $^{+0.061}_{+0.040}$	80	68	66	20	40	9	1	0.6	26.4	47.0	2 700	4 800	74.5	190
ARN3570T2	35	35 $^{+0.075}_{+0.050}$	70	60	54	20	40	6	1	0.6	26.4	47.0	2 700	4 800	43.0	121
ARN3585	35	35 $^{+0.075}_{+0.050}$	85	73	66	20	45	9	1	0.6	28.0	52.5	2 860	5 400	82.0	222
ARN4075T2	40	40 $^{+0.075}_{+0.050}$	75	65	54	20	45	6	1	0.6	28.0	52.5	2 860	5 400	45.5	135
ARN4090	40	40 $^{+0.075}_{+0.050}$	90	78	75	25	50	9	1	0.6	38.5	74.5	3 950	7 550	85.0	238
ARN4580T2	45	45 $^{+0.075}_{+0.050}$	80	70	60	25	50	6	1	0.6	38.5	74.5	3 950	7 550	48.0	150
ARN45105	45	45 $^{+0.075}_{+0.050}$	105	90	82	25	55	11	1	0.6	41.0	82.0	4 150	8 400	121	340
ARN5090	50	50 $^{+0.075}_{+0.050}$	90	78	60	25	55	6	1	0.6	41.0	82.0	4 150	8 400	62.5	215
ARN50110	50	50 $^{+0.075}_{+0.050}$	110	95	82	25	60	11	1.1	0.6	41.0	85.0	4 200	8 700	125	365
ARN55115	55	55 $^{+0.090}_{+0.060}$	115	100	82	25	65	11	1.1	0.6	44.5	98.0	4 550	10 000	130	385
ARN60120	60	60 $^{+0.090}_{+0.060}$	120	105	82	25	70	11	1.1	0.6	45.0	91.5	4 600	9 350	134	410
ARN65125	65	65 $^{+0.090}_{+0.060}$	125	110	82	25	75	11	1.1	0.6	55.0	104	5 600	10 600	138	435
ARN70130	70	70 $^{+0.090}_{+0.060}$	130	115	82	25	80	11	1.1	0.6	57.0	119	5 800	12 200	142	460

❶ Minimum allowable value for corner radius dimension r or r_1.
❷ Starting torque value relative to the standard preload.



Basic load ratings dynamic C_a	Basic load ratings static C_{oa}	Limiting speeds grease lubrication	Limiting speeds oil lubrication	Radial clearance μm min	Radial clearance μm max	Abutment and fillet dimensions mm d_a min	D_a max	r_{as} max	r_{1as} max	Preload N	Starting torque[2] N·mm (approx.)	Mass kg (approx.)	Part number
2 780	6 900	1 800	7 000	10	30	39	46	0.6	0.6	2 500	430	0.440	**ARN2052T2**
5 450	13 100	1 500	6 000	10	30	48	56	1	0.6	4 950	1 150	0.910	**ARN2062**
2 840	7 400	1 500	6 000	10	30	44	51	0.6	0.6	2 600	500	0.560	**ARN2557T2**
5 550	14 200	1 200	4 900	10	40	56	66	1	0.6	5 050	1 400	1.22	**ARN2572**
3 150	8 900	1 400	5 500	10	40	49	56	0.6	0.6	2 900	650	0.630	**ARN3062T2**
7 600	19 400	1 100	4 400	10	40	63	73	1	0.6	6 900	2 100	1.54	**ARN3080**
4 350	12 400	1 200	4 800	10	40	56	64	1	0.6	3 950	1 050	0.850	**ARN3570T2**
8 350	22 600	1 000	4 100	10	40	68	77	1	0.6	7 600	2 500	1.67	**ARN3585**
4 650	13 800	1 100	4 400	10	40	61	69	1	0.6	4 200	1 250	0.930	**ARN4075T2**
8 650	24 200	950	3 800	10	40	73	87	1	0.6	7 850	2 850	2.15	**ARN4090**
4 900	15 300	1 000	4 000	10	40	66	74	1	0.6	4 450	1 550	1.16	**ARN4580T2**
12 300	34 500	850	3 300	15	50	83	96	1	0.6	11 200	4 350	3.16	**ARN45105**
6 350	21 900	900	3 600	15	50	75	83	1	0.6	5 800	2 050	1.48	**ARN5090**
12 800	37 000	800	3 100	15	50	88	101	1	0.6	11 600	4 900	3.38	**ARN50110**
13 200	39 500	750	2 900	15	50	93	106	1	0.6	12 000	5 500	3.61	**ARN55115**
13 700	42 000	700	2 700	15	50	98	111	1	0.6	12 400	6 000	3.81	**ARN60120**
14 100	44 500	650	2 600	15	50	103	116	1	0.6	12 800	6 500	4.00	**ARN65125**
14 500	47 000	650	2 500	15	50	106	121	1	0.6	13 200	7 000	4.25	**ARN70130**