



STAR – Linear Bushings and Shafts

Miniature Version

STAR – Linear Motion Technology

Ball Rail Systems	Standard Ball Rail Systems Ball Rail Systems with Aluminum Super Ball Rail Systems Wide Ball Rail Systems Accessories Miniature Ball Rail Systems	Runner Blocks
	Cam Roller Guides	
Roller Rail Systems		
Linear Bushings and Shafts	Linear BushingsLinear-SetsShaftsShaft Support RailsShaft Support BlocksBall Transfer UnitsOther Engineering Components	
Screw Drives		
Linear Motion Systems	Linear Motion Slides Linear Modules Compact Modules Precision Modules Ball Rail Tables	 Precision Ball Screw Assemblies Toothed Belt Drive Precision Ball Screw Assemblies Toothed Belt Drive Rack and Pinion Drive Linear Actuator Pneumatic Drive Precision Ball Screw Assemblies Precision Ball Screw Assemblies Precision Ball Screw Assemblies Linear Motor
	ALU-STAR Profile System Controllers, Motors, Electrical Acc Linear Actuators	cessories

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Additional Informations see catalog RE 83 100 "STAR – Linear Bushings and Shafts"



STAR – Linear Bushings and Shafts, Miniature Version Product Overview

			Page	Special feature	
Linear Bushings		Standard 0600 bis 0602	14		
		Tandem 0650-	18		
		Flansch 0740 bis 0742	20		
		Super-⊠ 0670- Super-⊡ 0672-	26	30 ' (Version 💁 only)	
		Compact 0658	36		
Taurus Davistant					
Linear Bushings	JEF	Torque-Resistant Compact 0720	40	Mt	
	5.	Linear Sets incor- porating Torque- Resistant Compact Linear Bushings 0721 bis 0723	46	Mt	
	SI	Torque-Resistant Linear Bushings with Shaft 0724 bis 0726	54	Mt	

		Shaft diameter [mm]									
		3	4	5	6	8	10	12	13	14 ²⁾	16
Types				D	ynami	ic load	l capa	ity C	[N] ¹⁾		
 without/with internal wiper seals normal/corrosion-resistant 		55 55	70 70	180 160		320 210	300 300	420 400			580 460
 with internal wiper seals/separate seals normal/corrosion- resistant 						340		650			750
 with internal wiper seals/separate seals 						210		400			460
- normal/corrosion- resistant	J D					340		650			750
- with internal wiper seals/separate seals	\bigcirc						550	770			940
 with internal wiper seals/separate seals 	\bigcirc							730		760	950
- normal/corrosion- resistant								510		530	660
- one ball track	\bigcirc							640			780
- one ball track	00							640			780
	\bigcirc							1040			1260
- four ball tracks			680		970	1150	2170		2120		4860

¹⁾ Specified values are valid for "min. position".

²⁾ In preparation

STAR – Linear Bushings and Shafts, Miniature Version Product Overview

	Designs	Page	Types	
Precision Steel Shafts		60	Solid shaft - heat-treatable steel	
	0 1000		- corrosion-resistant X46Cr13	
			X90CrMoV18	

	Shaft diameter [mm]								
Linear bushing diameters	3	4	5	6	8	10	12	14	16
		•	•	•	•	•	•	•	•
				•		•			
	2)	•	Ū	•	•	·	·		•
	3)						•		•

For further sizes and types, see main catalog RE 83 100.

³⁾ X105CrMo17

STAR – Linear Bushings and Shafts, Miniature Version Technical Data

Load capacity and direction of load If the direction of load and the position of the linear bushings cannot be precisely defined, calculations must be based on the minimum load capacity rating.



The load capacity ratings have been calculated on the basis of DIN 636 Part 1, in which the following definitions and calculation principles may be found.

The static load C_0 is that radial static load applied to the assembly that causes permanent deformation of 0.0001 x the ball diameter at the most highly loaded point of contact between the balls and the ball track. Care must be taken to ensure that this maximum load intensity is not exceeded even during load peaks (severe shock loads).

The relationship between the dynamic load capacity C, the resultant load and the travel life are defined in DIN 636 Part 1. Data on the dynamic load ratings are therefore based on the nominal life.

Nominal Life

Calculation

The travel life expectancy is largely determined by the quality and hardness of the shaft used.

Precision Steel Shafts are induction-hardened and ground, thus ensuring that Linear Bushings will give a long travel life.

Definition to DIN 636, Part 1

"The theoretical life which is reached to 90% or over by one single bearing or a group of obviously identical bearings running under identical conditions, made of materials and in the quality generally specified today and under normal operating conditions."

The figures for dynamic load capacities have been calculated assuming a nominal travel life of 100,000 meters.

For a travel life of 50,000 meters, the ,C' figures in the table must be multiplied by a factor of 1.26.

No DIN calculations have been performed for corrosion-resistant models.

The formula for the calculation of travel life for a known shaft hardness and operating temperatures in excess of 100 $^\circ C$ is as follows:

$L = \left(\frac{C}{F} \cdot f_{H} \cdot f_{t}\right)^{3} \cdot 10^{5}$	L = nominal life C = dynamic load capacity F = resultant of external forces acting on the linear bushings f _H = shaft hardness factor	[m] [N] [N]
$L_{h} = \frac{L}{2 \cdot s \cdot n \cdot 60}$		[h] [m] [min ⁻¹]

STAR – Linear Bushings and Shafts, Miniature Version Technical Data

Shaft hardness factor



Bushing temperature factor	Bushing temperature °C	100	125	150	175	200
	Temperature factor f _t	1	0.92	0.85	0.77	0.70

Short stroke

In short-stroke applications, the service life of the shafts is shorter than that of the Compact and Super Linear Bushings (refer also to the "Technical Data" section for the individual Linear Bushings).

Variable loads

If the bushings are subjected to variable loads but constant direction of load, the equivalent dynamic load F may be calculated as follows:

$F = \sqrt[3]{F_1^3}$	$\frac{q_1}{100}$ + F $_2^3 \cdot \frac{q_2}{100}$ + + F $_n^3 \cdot \frac{q_n}{100}$				
•	100 100 100				
F	= dynamic load [N]				
F ₁ , F ₂ F _n	, $F_2 \dots F_n = discrete dynamic load steps [N]$				
q ₁ , q ₂ q _n	= percentage of stroke covered under $F_1, F_2 \dots F_n$ (%)				

If the load acts from several directions, the overall load resultant must be calculated.

Major preloads also tend to shorten the travel life, and allowance should be made accordingly.

Initial greasing Initial greasing and in-service lubrication Whether grease is being applied for the first time or in-service, the shaft must always be inserted in the bushing. Add grease until the lubricant emerges.



The chart gives guide values for in-service lubrication. Practical experience has shown that longer lubrication intervals can readily be achieved. These values presuppose careful initial greasing and regular checks on the lubrication condition.

There are many factors affecting in-service lubrication or a change of grease in linear bushings.

Some of these factors are listed below:

- load
- velocity
- motion sequence
- temperature

Short lubricating intervals are required in the following cases:

- high loads
- high velocity (up to v_{max})
- short stroke (stroke s is shorter than the length of the linear bushing)
- low resistance to aging in the lubricant



STAR – Linear Bushings and Shafts, Miniature Version Technical Data

Lubrication	Standard lubrication practices as applied for anti-friction bearings can be used for all li- near bushings, too.
	Linear Bushings are delivered already filled with an anti-corrosion agent that is compatible with all petroleum-base lubricants.
	Either oil or grease can be used as a lubricant. In most cases, the use of grease as a lubricant is preferable. The advantage of using grease rather than oil is that, being more viscous, grease helps to seal off the linear bushing and adheres better to the surfaces inside the bushing. In-service lubrication is therefore only required at long intervals.
	Please observe the lubricant manufacturer's instructions for use.
	If oil is used instead, it is essential to check that all bushing surfaces and rolling elements are properly coated with lubricant.
Lubricating greases	We recommend the use of a grease to DIN 51825 as lubricant • K2K,

• KP2K (for higher loads).

The table below gives examples of types of base grease for different applications.

Designation to DIN 51825	Thickner	Base oil	Service temperature range [°C]	Consistency class to DIN 51818	Drop point [°C]	High pressure charac- teristics	Suitability for anti- friction bearings	Field of application
K2K-30	Lithium soap (Li-12-oxy)	Petroleum base	-30 120	2	appr. 200	good	very good	Multi-purpose grease
K2K-60		Ester base*	-60 120	2	appr. 200	good	very good	Low temperatures high velocities
KP2K-40	Lithium complex soap	Petroleum and/or syn- thetic base*	-40 120	2	appr. 240	good	very good	Higher loads

* Check the compatibility of the base oil with petroleum-base lubricants and anticorrosion agents.

Oil lubricants

If exceptionally smooth running is demanded, oil may be used as a lubricant for the linear bushings.

Different types of oil and their viscosity ratings are listed below:

ISO viscosity class to DIN 51519	Kinematic viscosity at 40 °C [mm²/s]	Field of application
ISO VG 32 ISO VG 68 ISO VG 100	32 68 100	For low friction and low loads
ISO VG 320 ISO VG 460	320 460	For low velocities and/or higher loads

Mounting Instructions

Installation of Linear Bushings Two linear bushings are required for linear motion assemblies using one shaft only.

Assemblies with two shafts must have at least one of the shafts mounted in two linear bushings.

To prevent distortion, which would increase running friction and shorten the service life of the assembly, special care must be taken to ensure precise spacing and parallelism between the two shafts with their associated linear bushings.

Recommended values for maximum spacing inaccuracy P, including deviation from parallelism, for assemblies incorporating linear bushings are as follows:

Shaft	Ρ [μm]								
Ød	Zero cle	earance	h7/H7						
[mm]	Standard, Super Linear Bushings	Compact Linear Bushings	Standard, Super Linear Bushings	Compact ¹⁾ Linear Bushings					
3	3	-	9	-					
4	3	-	9	-					
5	4	-	12	-					
8	4	-	12	-					
10	4	-	12	-					
12	5	8	13	17					
14	-	8	-	17					
16	5	8	13	17					

¹⁾ For the "Compact RT" type, the values in the "Zero clearance" columne apply.

Retention

See "Technical Data" of the various linear bushing types.

STAR – Standard Linear Bushings, Miniature Version **Product Overview**

Standard Linear Bushings have proven successful for decades.

Made entirely of solid metal, Standard Linear Bushings are especially suited for applications requiring a rugged construction and a high degree of insensitivity to dirt.

Long service life, precision and high efficiency are the classical features charac-terizing these guide elements.

The Linear Bushing for extra-sturdy linear motion assemblies

Standard Linear Bushings¹⁾ are available in the following versions

- Closed
- Steel version or corrosion-resistant version •
- With or without seals

Advantages

- Long service life
- Low friction

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- High running speed
- Robust all-metal version



Technical Data

Low friction

Very low friction due to the rolling friction principle. Even if the lubricant supply were to run short, there would be no appreciable increase in friction. Extremely low breakaway forces.

The friction µ of unsealed Standard Linear Bushings using oil as a lubricant lies between 0.001 and 0.004.

The friction is lowest under high load. It may, however, be greater than the stated value when only a slight load is applied.

The frictional drag in linear bushings sealed at both ends and not subject to radial loading depends on the speed and the type of lubrication and is shown in the below table.

Shaft Ø d	Closed Breakaway force	type Frictional drag
[mm]	[N] ca.	[N] ca.
3	-	-
4	-	-
5	0.8	0.4
8	1	0.5
10	1.5	0.8
12	6	2
16	9	3

Operating temperatures

Linear bushings without seals: up to 100 °C. Higher temperatures are permissible for sizes 12 and 16 as well as for corrosion-resistant versions though at the cost of reduced load capacity (see temperature factor f, in "General Technical Data and Mounting Instructions").

v_{max} [m/s]

2.5

Linear bushings with seals: up to 80 °C (brief peaks up to 100 °C).

Customer-built Housings

Retention

Standard Linear Bushings closed type adjustable

- Retaining rings
- Metal case
- Special arrangement



Standard-Linear Bushing d 16 mm

Retention by means of retaining rings to DIN 471

		<u>}</u> .
Retentio to DIN 4	n by means of retaining 72	g rings

a_{max} [m/s²]

100

Shaft Ød [mm]	Retaining rings Part number	DIN 471 Dimensions	Retaining rings Part number	DIN 472 Dimensions
5	8410-712-00	12 x 1	8410-207-00	12 x 1
8	8410-713-00	16 x 1	8410-208-00	16 x 1
10	8410-763-00	19 x 1.2	8410-221-00	19 x 1
12	8410-714-00	22 x 1.2	8410-209-00	22 x 1
16	8410-715-00	27 x 1.2 ¹⁾	8410-210-00	26 x 1.2

¹⁾ not to DIN 471.

Туре



STAR – Standard Linear Bushings, Miniature Version

Standard Linear Bushings, 0600closed type, without seals

Standard Linear Bushings, 0602closed type, with seals

Structural design

- Hardened and ground outer sleeve
- Steel ball retainer (plastic ball retainer in sizes 5 and 8)
- Balls made of anti-friction bearing steel
- Steel holding rings or seals
- Closed version, for use on unsupported shafts



Ordering data

Steel version

Shaft	Part nu	mass	
Ød [mm]	without seals	with two seals	[g]
3	0600-303-00	-	1.35
4	0600-304-00	-	1.9
5	0600-305-00	0602-305-10 1)	10
8	0600-308-00	0602-308-10 1)	20
10	0600-310-00	0602-310-10	29.5
12	0600-012-00	0602-012-10 1)	40
16	0600-016-00	0602-016-10 1)	50

Corrosion-resistant version

Shaft	Part n	mass	
Ø d [mm]	without seals	with two seals	[g]
3	0600-003-30	-	1.4
4	0600-004-30	-	2
5	0600-005-30	0602-005-30	11
8	0600-008-30	0602-008-30	22
10	0600-010-30	0602-010-30	36
12	0600-012-30	0602-012-30	45
16	0600-016-30	0602-016-30	60

¹⁾ With one seal: 060**1**-...-10.

The figures for dynamic load-carrying capacity have been calculated assuming a nominal travel of 100,000 m.

For a nominal travel of 50,000 m, the ,C' figures in the table must be multiplied by a factor of 1.26.







Steel version

Dimensions [mm]				No. of ball circuits	Working bore diameter	radial clearance ²⁾	loa dyr	d capa 1. C	cities ³⁾ stat	[N] t. C _o		
Ød	D h5	C h12	С ₁ н13	C ₂	D ₁		[µm]	[µm] h6	min	max	min	max
3	7 ³⁾	10	-	-	-	4	+8 0	+12 +2	55	65	45	65
4	83)	12	-	-	-	4	+8 0	+14 +2	70	80	60	85
5	12	22	14,2	1,1	11,1	4	+11 +1	+16 +4	180	210	140	200
8	16	25	16,2	1,1	14,7	4	+12 +2	+18 +5	320	370	240	330
10	19 ³⁾	29	21,6	1,3	18	4	+8 0	+18 +5	300	350	260	370
12	22	32	22,6	1,3	20,5	4	+12 +2	+20 +5	420	480	280	400
16	26	36	24,6	1,3	24,9	4	+14 +2	+22 +5	580	670	440	620

Corrosion-resistant version

Dimensions [mm]				No. of ball circuits	Working bore diameter	radial clearance ²⁾	load dyn	d capao . C	ities ³⁾ stat	[N] C _o		
Ød	D h6	C h12	С ₁ н13	C ₂	D ₁		[µm]	[µm] h6	min	max	min	max
3	7	10	-	-	-	4	+8 0	+12 +2	55	65	45	65
4	8	12	-	-	-	4	+8 0	+14 +2	70	80	60	85
5	12	22	14,2	1,1	11,5	4	+11 +1	+16 +4	160	185	180	250
8	16	25	16,2	1,1	15,2	4	+12 +2	+18 +5	210	240	235	330
10	19	29	21,6	1,3	18	4	+8 0	+18 +5	300	350	260	370
12	22	32	22,6	1,3	21	4	+12 +2	+20 +5	400	460	420	600
16	26	36	24,6	1,3	24,9	4	+14 +2	+22 +5	460	530	440	630

Standard version sizes 12 and 16 are fitted with a steel ball retainer.
 Statistically determined from the working bore diameter and shaft tolerance. Recommended housing bore tolerance: H6 or H7.

³⁾ h6

STAR – Tandem Linear Bushings, Miniature Version

Tandem Linear Bushing, 0650with seals

Design

- hardened and ground outer sleeve
- ball retainer of plastic
- balls of bearing steel
- integrated seals

Tandem Linear Bushings, 0650with seals corrosion resistant type

Design

- hardened and ground outer sleeve of corrosion resistant steel
- ball retainer of corrosion resistant steel
- balls of corrosion resistant bearing steel
- integrated seals

Shaft	Part nu	umbers	
Ø d [mm]	regular	corrosion resistant	mass [kg]
8	0650-508-00	0650-208-30	0,04
12	0650-512-00	0650-212-30	0,08
16	0650-516-00	0650-216-30	0,12
20	0650-520-00	0650-220-30	0,18
25	0650-525-00	0650-225-30	0,43
30	0650-530-00	0650-230-30	0,62
40	0650-540-00	0650-240-30	1,40

The values for dynamic-load capacity are based on a nominal travel of 100,000 m. For a nominal travel of 50,000 m the values must be multiplied by the factor 1.26.

Corrosion resistant steels to ISO 683-17 resp. EN 10088.



Ordering data



Dimensions [mm]						ball	bore toloranco	radial	dyr	load ca	apacity	
Ød	D h6	С	C ₁	C ₂	D ₁	circuits	[µm]	[µm] h6	[N min	I. C I] max	min	C ₀ 1] max
8	16	46 _{-0,3}	33_0,3	1,10	15,2	4	+9 -1	+15 +2	340	390	470	660
12	22	61 _{-0,3}	45,8 _{-0,3}	1,30	21,0	4	+9 -1	+17 +2	650	750	840	1200
16	26	68 _{-0,3}	49,80,3	1,30	24,9	4	+11 -1	+19 +2	750	860	880	1260
20	32	80 _{-0,3}	61 _{-0,3}	1,60	30,5	5	+11 -1	+20 +3	1100	1300	1720	2500
25	40	112 _{-0,4}	82 _{-0,4}	1,85	38,0	6	+13 -2	+22 +2	1250	1350	3240	4200
30	47	123 _{-0,4}	104,2 _{-0,4}	1,85	44,5	6	+13 -2	+22 +2	2000	2150	4000	5000
40	62	151 _{-0,4}	121,2 _{-0,4}	2,15	59,0	6	+16 -4	+27 +1	2800	3000	6600	8400

¹⁾ Statistically determined. Recommended housing bore tolerance: H6 or H7.

STAR – Flange Linear Bushings, Miniature Version

Flange Linear Bushing, 0740-

Design

- hardened and ground sleeve
- ball retainer of plastic
- balls of bearing steel
- integrated seals

Flange Linear Bushing, 0740corrosion resistant type

Design

- hardened and ground outer sleeve of corrosion resistant steel
- ball retainer of corrosion resistant steel (size 5 with plastic retainer)
- balls of corrosion resistant steel
- integrated seals

Ordering data

shaft	Part numbers								
Ø d [mm]	regular	corrosion resistant	mass [kg]						
5	0740-505-00	0740-505-30	0,020						
8	0740-508-00	0740-208-30	0,033						
12	0740-512-00	0740-212-30	0,064						
16	0740-516-00	0740-216-30	0,090						
20	0740-520-00	0740-220-30	0,150						
25	0740-525-00	0740-225-30	0,300						
30	0740-530-00	0740-230-30	0,470						
40	0740-540-00	0740-240-30	0,980						

The values for dynamic-load capacity are based on a nominal travel of 100,000 m. For a nominal travel of 50,000 m the values must be multiplied by the factor 1.26.

Corrosion resistant steels to ISO 683-17 resp. EN 10088.





	Dimensions [mm]									bore	radial	load capacity				
Ød	D	D ₁	D ₂	В	L ±0.3	L ₁	v	S	circuits	tolerance [µm]	clearance [µm] h6	dyr [l min	n. C N] max	stat [N min	C ₀ I] max	
5	12	28	20	22	22	5	3,1	3,5	4	+8 +0	+14 +2	160	185	180	250	
8	16 _{-0,013}	32	24	25	25	5	3,1	3,5	4	+8 +0	+15 +2	210	240	235	330	
12	226	42	32	32	32	6	4,1	4,5	4	+8 +0	+16 +3	400	460	420	600	
16	26 _{-0,016}	46	36	35	36	6	4,1	4,5	4	+9 -1	+17 +2	460	530	440	630	
20	32 _{-0,019}	54	43	42	45	8	5,1	5,5	5	+9 -1	+19 +2	680	800	860	1250	
25	400,019	62	51	50	58	8	5,1	5,5	6	+11 -1	+20 +3	780	830	1620	2100	
30	47 _{_0,019}	76	62	60	68	10	6,1	6,6	6	+11 -1	+20 +3	1250	1320	2000	2500	
40	62 _{-0,022}	98	80	75	80	13	8,1	9	6	+13 -2	+24 +3	1720	1820	3300	4200	

¹⁾ Statistically determined. Recommended housing bore tolerance: H6 or H7.

STAR – Flange Linear Bushings, Miniature Version

Flange Tandem Linear Bushing, 0741-

Design

- hardened and ground sleeve
- ball retainer of plastic
- balls of bearing steel
- integrated seals

Flange Tandem Linear Bushing, 0741corrosion resistant type

Design

- hardened and ground outer sleeve of corrosion resistant steel
- ball retainer of corrosion resistant steel
- balls of corrosion resistant steel
- integrated seals

Ord	orina	data
oru	ering	นสเส



Shaft	Part nu		
Ø d [mm]	regular	corrosion resistant	mass [kg]
8	0741-508-00	0741-208-30	0,05
12	0741-512-00	0741-212-30	0,09
16	0741-516-00	0741-216-30	0,14
20	0741-520-00	0741-220-30	0,23
25	0741-525-00	0741-225-30	0,50
30	0741-530-00	0741-230-30	0,72
40	0741-540-00	0741-240-30	1,60

The values for dynamic-load capacity are based on a nominal travel of 100,000 m. For a nominal travel of 50,000 m the values must be multiplied by the factor 1.26.

Corrosion resistant steels to ISO 683-17 resp. EN 10088.



Dimensions [mm]									ball	bore	radial	load capacity			
Ød	D	D ₁	D ₂	В	L ±0,3	L ₁	v	S	circuits	[µm]	liearance [µm] h6	dyn [M min	N] max	stat [N min	. C ₀ [] max
8	16 _{_0,013}	32	24	25	46	5	3,1	3,5	4	+9 -1	+15 +2	340	390	470	660
12	220,016	42	32	32	61	6	4,1	4,5	4	+9 -1	+17 +2	650	750	840	1200
16	26 _{-0,016}	46	36	35	68	6	4,1	4,5	4	+11 -1	+19 +2	750	860	880	1260
20	32 _{-0,019}	54	43	42	80	8	5,1	5,5	5	+11 -1	+20 +3	1100	1300	1720	2500
25	400,019	62	51	50	112	8	5,1	5,5	6	+13 -2	+22 +2	1250	1350	3240	4200
30	47 _{_0,019}	76	62	60	123	10	6,1	6,6	6	+13 -2	+22 +2	2000	2150	4000	5000
40	62 _{-0,022}	98	80	75	151	13	8,1	9	6	+16 -4	+27 +1	2800	3000	6600	8400

 $^{1)}\,$ Statistically determined. Recommended housing bore tolerance: H6 or H7.

STAR – Flange Linear Bushings, Miniature Version

Centre Flange Linear Bushing, 0742-

Design

- hardened and ground sleeve
- ball retainer of plastic
- balls of bearing steel
- integrated seals

Centre Flange Bushing, 0742corrosion resistant type

Design

- hardened and ground outer sleeve of corrosion resistant steel
- ball retainer of corrosion resistant steel
- balls of corrosion resistant steel
- integrated seals

Ordering data



Shaft	Part nu	umbers	
Ø d [mm]	regular	corrosion resistant	mass [kg]
8	0742-508-00	0742-208-30	0,05
12	0742-512-00	0742-212-30	0,09
16	0742-516-00	0742-216-30	0,14
20	0742-520-00	0742-220-30	0,23
25	0742-525-00	0742-225-30	0,50
30	0742-530-00	0742-230-30	0,72
40	0742-540-00	0742-240-30	1,60

The values for dynamic-load capacity are based on a nominal travel of 100,000 m. For a nominal travel of 50,000 m the values must be multiplied by the factor 1.26.

Corrosion resistant steels to ISO 683-17 resp. EN 10088.





Dimensions [mm]										ball	bore	radial	load capacity			
Ød	D	D ₁	D ₂	В	L ±0,3	L ₁	L ₂	v	S	circuits	tolerance [µm]	clearance [µm] h6	dyn [N min	I. C I] max	stat [N min	. C ₀] max
8	16- _{0,013}	32	24	25	46	5	20,5	3,1	3,5	4	+9 -1	+15 +2	340	390	470	660
12	220016	42	32	32	61	6	27,5	4,1	4,5	4	+9 -1	+17 +2	650	750	840	1200
16	26 _{-0,016}	46	36	35	68	6	31,0	4,1	4,5	4	+11 -1	+19 +2	750	860	880	1260
20	32 _{-0,019}	54	43	42	80	8	36,0	5,1	5,5	5	+11 -1	+20 +3	1100	1300	1720	2500
25	400,019	62	51	50	112	8	52,0	5,1	5,5	6	+13 -2	+22 +2	1250	1350	3240	4200
30	470019	76	62	60	123	10	56,5	6,1	6,6	6	+13 -2	+22 +2	2000	2150	4000	5000
40	62 _{-0,022}	98	80	75	151	13	69,0	8,1	9	6	+16 -4	+27 +1	2800	3000	6600	8400

¹⁾ Statistically determined. Recommended housing bore tolerance: H6 or H7.

STAR – Super Linear Bushings 🕢 and 🖪 , Miniature Version Product Overview

Design variants

- Closed type
- Super Linear Bushings a automatically compensate for alignment errors of up to 30 '. No reduction in load-carrying capacity due to pressure between bushing edge and shaft.
- version
 without self-alignment
- With internal or separate seals

The advantages

- High running speed and dynamic load capacity
- High rigidity
- extremely smooth operation
- extremely long service life

Alignment errors can be caused by:

- inaccurate machining
- mounting errors
- shaft deflection

The self-alignment feature is not able to compensate for poor parallelism between the two shafts of a carriage assembly.





STAR – Super Linear Bushings 🕢 and 🖪 , Miniature Version Technical Data

Please observe the general technical principles and mounting instructions at the beginning of this catalog as well as the additional technical data given below.

Friction

Very low friction due to the rolling friction principle.Extremely low breakaway forces.

The friction μ of unsealed Super Linear Bushings using oil as a lubricant lies between 0.001 and 0.0025.

The friction is lowest under high load. It may, however, be greater than the stated value when only a slight load is applied.

For Super Linear Bushings fitted at both ends with internal wiper seals and not subject to radial loading, the frictional drag (see table below) depends on the speed and the type of lubrication.

Shaft Ø d	Closed aı Super Linea with inter Breakaway force ¹⁾	nd open r Bushings nal seals Frictional drag ¹⁾
[mm]	[N] approx.	[N] approx.
10	1.5	0.8
12	2	1
16	2.5	1.3

¹⁾ For separate wiper seals, the values must be multiplied by a factor of 1.5.

Velocity

 $v_{max}^{1)} = 3 \text{ m/s}$

¹⁾ Velocities up to 5 m/s are possible, though the service life will be restricted due to the increased wear on the plastic parts. Units have been known to travel 5 to 10 x 10⁶ m without failure under test conditions.

Acceleration

 $a_{max} = 150 \text{ m/s}^2$

Operating temperature

up to 100 °C

Reduced load capacity in short-stroke applications

In short-stroke applications, the service life of the shafts is shorter than that of the Super Linear Bushings.

For this reason, the load capacities C listed in the tables must be multiplied by the factor f_w.





When this type is used, the self-alignment feature requires two Super Linear Bushings to be mounted on at least one of the two shafts of the assembly.

For applications involving water-base coolants/lubricants, we recommend the use of the following linear bushing models:

- Standard Linear Bushings

In permanently humid or wet environments (water vapor, condensation), we recommend the use of the following corrosion-resistant linear bushing models:

- Standard Linear Bushings or
- Compact Linear Bushings

with steel parts made of corrosion-resistant steel to ISO 683-17 resp. EN 10088.



Operation under difficult conditions

STAR – Super Linear Bushings 🕢 and 🖪 , Miniature Version Customer-Built Housings

Retention

Super Linear Bushings

- closed type
- Retaining rings
- Metal case
- Seal with metal case
- Special arrangement



Retention by means of retaining rings to DIN 471



Retention by means of retaining rings to DIN 472

Shaft	Retaining ring	5 DIN 471	Retaining rings DIN 472				
Ø d [mm]	Part numbers	Dimensions [mm]	Part numbers	Dimensions [mm]			
10	8410-763-00	19 x 1.2	8410-221-00	19 x 1			
12	8410-714-00	22 x 1.2	8410-209-00	22 x 1			
16	8410-715-00	27 x 1.2 ¹⁾	8410-210-00	26 x 1.2			

¹⁾ not to DIN 471.



Retention by means of metal case



Retention by means of seal with metal case

Separate seals

Seal with metal case (closed type)



Materials: elastomer seals, steel case

Shaft	Dimensi	ons [mm]	Part numbers					
Ø d [mm]	D ²⁾	b +0.3	seal with metal case	metal case				
10	19	3	1331-610-00	0901-184-00				
12	22	3	1331-612-00	0901-074-00				
16	26	3	1331-616-00	0901-075-00				

²⁾ The outside diameter D has been manufactured with an oversize of approx.0.1 mm. No additional retention required.

Advantages of separate seals:

- Increased sealing effect
- Can be fixed in the linear bushing without retaining rings

STAR – Super Linear Bushings 🐼 with self-alignment feature

Miniature Version

Super Linear Bushings, 0670closed type

Structural design

- Ball retainer with outer sleeve made of polyamide
- Hardened steel segmental load bearing plates with ground ball tracks
- Balls of anti-friction bearing steel
- Automatic compensation of alignment errors up to 30 '
- Without seals
- With internal seals
- Separat seals (see page 31)



Ordering data

Shaft	Part nu	mass				
Ø d [mm]	without seals	with two internal seals	[g]			
10	0670-010-00	0670-210-40	17			
12	0670-012-00	0670-212-40	23			
16	0670-016-00	0670-216-40	28			

With one internal seal: 0670-1..-40.

The figures for dynamic load-carrying capacity have been calculated assuming a nominal travel of 100,000 m.

For a nominal travel of 50,000 m, the ,C' figures in the table must be multiplied by a factor of 1.26.



Dimensions [mm]					No. of ball circuits	radial cl	earanc	e [µm]	load capacities [N]				
Ød	ØD	C h13	С ₁ н13	C ₂	D ₁		sha h5/H5	aft/bor h6/JS6	е h6/K6	dyr min	n. C max	stat min	. C _o max
10	19	29	21.6	1.3	18	5	+24 +6	+23 +1	+18 -3	600	820	330	480
12	22	32	22.6	1.3	21	5	+27 +6	+25 +2	+21 -3	830	1140	420	620
16	26	36	24.6	1.3	24.9	5	+27 +6	+25 +2	+21 -3	1020	1400	530	780

STAR – Super Linear Bushings B without self-alignment feature

Miniature Version

Super Linear Bushings, 0672closed type

Structural design

- Ball retainer with outer sleeve made of polyamide
- Hardened steel segmental load bearing plates with ground ball tracks
- Balls of anti-friction bearing steel
- Automatic compensation of alignment errors up to 30 '
- Without seals
- With internal seals
- Separat seals (see page 31)

Ordering data



Shaft	Part nu	mass			
Ø d [mm]	without seals	with two internal seals	[g]		
10	0672-010-00	0670-210-40	17		
12	0672-012-00	0670-212-40	23		
16	0672-016-00	0670-216-40	28		

With one internal seal: 0672-1..-40.

The figures for dynamic load-carrying capacity have been calculated assuming a nominal travel of 100,000 m.

For a nominal travel of 50,000 m, the ,C' figures in the table must be multiplied by a factor of 1.26.



Dimensions [mm]					No. of ball circuits	radial cl	load capacities [N]						
Ød	ØD	С	C C_1 C_2 D_1			sha	ft/bore	9	dyr	n. C	stat	. C _o	
		h13	H13				h5/H5	h6/JS6	h6/K6	min	max	min	max
10	19	29	21.6	1.3	18	5	+24 +6	+23 +1	+18 -3	600	820	330	480
12	22	32	22.6	1.3	21	5	+27 +6	+25 +2	+21 -3	830	1140	420	620
16	26	36	24.6	1.3	24.9	5	+27 +6	+25 +2	+21 -3	1020	1400	530	780

STAR – Compact Linear Bushings, Miniature Version Product Overview

Due to their small overall dimensions, Compact Linear Bushings help to build especially neat stuctures.

Compact Linear Bushings are available in the following types:

- Standard type
- Compact RT type With reduced radial clearance for applications requiring low-clearance operation with H7 bores.
- Corrosion-resistant type (anti-friction bearing steel to ISO 683-17 resp. EN 10088)

Corrosion-resistant Compact Linear Bushings feature the same installation dimensions as the standard variant and are thus fully interchangeable with them

- Balls made of stainless anti-friction bearing steel
- Corrosion-resistant steel segments
- Corrosion-resistant metal retaining rings

Advantages

- High travel speed
- Internal wiper seals
- No additional retaining elements required
- Cost-efficient



Technical Data

Please observe the general technical principles and mounting instructions at the beginning of this catalog as well as the additional technical data given below.

Sealing

Friction

The sealed standard types are fitted with integral wiper-type seals.

Separate end seals can also be ordered (no special retaining elements necessary).

The friction μ of unsealed Compact Linear Bushings using oil as a lubricant lies between 0.001 - 0.004.

The friction is lowest under high load. It may, however, be greater than the stated value when only a slight load is applied.

For Compact Linear Bushings fitted at both ends with internal wiper seals and not subject to radial loading, the frictional drag (see table below) depends on the speed and the type of lubrication.

Shaft Ø d [mm]	Breakaway force ¹⁾ [N approx]	Frictional drag ¹⁾ [N approx]
12	2	1
14	2.3	1.2
16	2.5	1.3

¹⁾ For separate wiper seals, the values must be multiplied by a factor of 1.5.

Velocity

Acceleration

Operating temperature

Reduced load capacity in shortstroke applications $a_{max} = 150 \text{ m/s}^2$

 $v_{max} = 5 \text{ m/s}$

up to 100 °C

In short-stroke applications, the service life of the shafts is shorter than that of the Compact Linear Bushings.

For this reason, the load capacities C listed in the tables must be multiplied by the factor f_w .



STAR – Compact Linear Bushings, Miniature Version

Compact Linear Bushing, 0658also in corrosion-resistant type

Structural design

- Ball retainer made of POM
- Without seals
- Internal/separate seals
- Balls made of anti-friction bearing steel
- Hardened steel segmental load bearing plates
- Metal holding rings



Ordering data

Shaft	Part numbers without seals								
Ø d [mm]	Compact	Compact RT	Compact corrosion-resistant	[g]					
12	0658-012-00	0658-051-00	0658-012-30	16					
14*	0658-014-00	0658-058-00	0658-014-30	17					
16	0658-016-00	0658-052-00	0658-016-30	25					

Shaft	Part numbers with two seals							
Ø d [mm]	Compact	Compact RT	Compact corrosion-resistant	[g]				
12	0658-212-40	0658-251-40	0658-212-30	16				
14*	0658-214-40	0658-258-40	0658-214-30	17				
16	0658-216-40	0658-252-40	0658-216-30	25				

With one seal: 0658-1..-40 oder 0658-1..-30. * In preparation

Shaft	Part numbers
Ø d [mm]	seal with metal casing
12	1331-812-10
16	1331-816-10

The figures for dynamic load-carrying capacity have been calculated assuming a nominal travel of 100,000 m.

For a nominal travel of 50,000 m, the ,C' figures in the table must be multiplied by a factor of 1.26.

separate seals





Dimension [mm]		No. of ball	ra	load capacities [N] standard corrosion-resistant						tant								
			circuits	Compact	Compact corrosion resistant	Compact RT (reduced radia clearance)	dyn. C l		dyn. C l		dyn. C l		stat	. C _o	dyı	n. C	sta	t. C _o
Ød	D ¹⁾	C ±0.2		h6/H6	h6/JS6	h6/H6	min	max	min	max	min	max	min	max				
12	19	28	5	+25 -1	+19 -8	+1 -25	730	870	420	620	510	610	340	500				
14	21	28	5	+25 -1	+19 -8	+1 -25	760	900	435	635	530	630	350	510				
16	24	30	5	+25 -1	+19 -8	+1 -25	950	1120	500	730	660	780	400	580				

 The outer diameter of the metal holding ring is slightly oversize. No special retention elements are necessary (housing bore length C).

Seal with metal casing



	Dimensio	Dimensions [mm]					
Ød	D ²⁾	b					
12	19	3					
16	24	3					

²⁾ The outer diameter D has been manufactured with an oversize of approx. 0.1 mm. No additional retention required.

STAR – Torque-Resistant Compact Linear Bushings, Miniature Version Product Overview

Torque-Resistant Compact Linear Bushings are similar in their structural design to the already familiar Super Linear Bushings
. The torque is transmitted between extra-deep ball races with special hardened steel load bearing plates in the linear bushings and ball guide grooves in the precision steel shaft.

Advantages

The Torque-Resistant Linear Bushing makes it possible to obtain axially and radially true linear motion with just one shaft.

Linear-Sets with Torque-Resistant Compact Linear Bushings

Linear Sets with Torque-Resistant Compact Linear Bushings are selfcontained units comprising a Torque-Resistant Compact Linear Bushing and a sleeve.

When mounted in tandem they provide stability in applications with cocking loads, thus allowing higher permissible torque levels.

A version with a flanged housing is also available.





STAR – Torque-Resistant Compact Linear Bushings, Miniature Version **Technical Data**

Please observe the general technical principles and mounting instructions at the beginning of this catalog as well as the additional technical data given below.

$v_{max} = 3 m/s$	
$a_{max} = 150 \text{ m/s}^2$	
up to 100 °C	

In short-stroke applications, the service life of the shafts is shorter than that of the Compact Linear Bushings.

For this reason, the load capacities C listed in the tables must be multiplied by the factor f_w .



Load capacity and travel life

Velocity

Acceleration

Operating temperature

stroke applications

Reduced load capacity in short-

In applications subject to superimposed radial loads and torque, the equivalent total load must first be calculated for use in the travel life calculation.

$$L = F_{R} + \frac{C \cdot M}{M_{t}}$$

$$F = equivalent total load [N]$$

$$F_{R} = radial load [N]$$

$$C = dynamic load capacity$$

$$M = torque [Nm]$$

$$M_{t} = torque (catalog rating) [Nm]$$

$$L = (\frac{C}{F})^{3} \cdot 10^{5} \text{ m}$$

$$L = travel life$$

In applications subject to torque only, travel life is calculated as follows:

$$L = \left(\frac{M_{t}}{M}\right)^{3} \cdot 10^{5} \text{ m}$$

$$M = \text{ torque} \qquad [Nm]$$

$$M_{t} = \text{ torque (catalog rating)} \qquad [Nm]$$

$$M_{1}, M_{2} \dots M_{n} = \text{ discrete torque steps}$$

$$q_{1}, q_{2} \dots q_{n} = \text{ percentage stroke}$$

$$\text{ covered under } M_{1}, M_{2}, \dots M_{n} \qquad (\%)$$

$$M = \sqrt[3]{M_{1}^{3}} \cdot \frac{q_{1}}{100} + M_{2}^{3} \cdot \frac{q_{2}}{100} + \dots + M_{n}^{3} \cdot \frac{q_{n}}{100}$$

- up to 1200 mm length : 0.1 mm

Stability against cocking loads

To ensure stability against cocking loads it is expedient to install two Torque-Resistant Linear Bushings.

Straightness of shaft

Mounting procedure



▲ Linear Sets are ready-mounted and adjusted to zero clearance. If the shaft has been removed, it is necessary to loosen the adjusting screws and re-adjust the Torque-Resistant Compact Linear Bushing.

- Chamfer and clean the bore (1) in the housing (2).
- Oil the adjusting screw (3) and lock screw (4).
- Check the lock screw (4) in the adjusting screw (3) for ease of movement.
- Check the adjusting screw (3) in the tapped hole (5) for ease of movement. Deburr thread runout, if necessary.
- Remove transport packing from the linear bushing.

Do not drive in linear bushings with a hammer!

- Insert linear bushing (9) in the housing (2) by hand.
- Align countersunk steel bearing plate (8) with the tapped hole (5) in the housing.
- Align one ball guide groove (6) with the marking (7) on the identification block of the linear bushing.
- Insert shaft, taking care not to tilt it!

Adjustment of adjusting screws



- Screw in adjusting screw until it meets with initial resistance.
- Move shaft to and fro, while simultaneously attempting to turn it in both directions. Tighten adjusting screw with screwdriver (1).
- Using a face wrench (2), insert lock screw into the adjusting screw and tighten to tightening torque MGK.
- After mounting, the frictional drag FR should be as shown in the table below. If the frictional drag varies significantly, loosen and re-adjust adjusting screws!
- Do not remove shaft!

Shaft diame	ter		[mm]	12	16	
Screw	а	а			0.8	
driver(1)	b	[mm]			5	
Face	S		[mm]	1.5	1.5	
wrench(2)	А		[mm]	5.5	5.5	
Tightening	adjusting screw	M_{GA}	[Ncm]	8	11	
torque	lock screw M _{GK}		[Ncm]	110	110	
Frictional drag (one linear bu	g F _R approx. shing)	[N]	1.5	2		

Installation of seal

• Push seal onto the shaft, aligning the lip with the groove.

- Press seal into the mounting bore.

With each installed seal the frictional drag rises higher than the value F_{R} . If two seals are installed, it increases to roughly three times the value stated in the table.

STAR – Torque-Resistant Compact Linear Bushings, Miniature Version

Torque-Resistant Compact Linear Bushing, 0720-

Structural design

- Plastic ball retainer and outer sleeve
- Hardened steel load bearing plates
- Balls made of anti-friction bearing steel
- Precision Steel Shaft with ball guide groove
- Hardened steel adjusting screw
- Steel lock screw



Ordering data

Shaft	Part numbers Torque-Resistant Compact Linear Bushing with shaft									
Ød [mm]	standard length as per table	shaft length 900 mm	shaft length shaft length shaft length 900 mm 1200 mm 2000 mm		shaft to specified length ¹⁾	customized shaft				
12	0720-012-80	0720-012-85	0720-012-87	0720-012-88	0720-012-89	0720-012-86				
16	0720-016-80	0720-016-85	0720-016-87	0720-016-88	0720-016-89	0720-016-86				
			.			0720 0 00				

Part numbers for Torque-Resistant Compact Linear Bushing without shaft: 0720-0..-00

¹⁾ Also available with corrosion-resistant steel shaft to ISO 683-17 resp. EN 10088: 0721-...-79.



Shaft Ø d [mm]	Part numbers
12	1331-112-00
16	1331-116-00

The seal must be ordered separately.



Dimensions [mm]							Standard shaft	Torque M,	load cap	acities ²⁾	ma	ss
									dyn.	stat.		
Ød	D ¹⁾	В	М	M_1	N ₁	N ₂	I.		с	C ₀	linear	shaft
					+0.1		[mm]	[Nm]	[N]	[N]	bushing [g]	[g/m]
12	22	32	M6x0.5	8	14.4	1.3	400	2	640	420	26	890
16	26	36	M6x0.5	8	16.4	1.3	400	3.3	780	530	32	1570

¹⁾ Recommended mounting bore: D^{K6}.

²⁾ The load capacities stated are minimum values as the position and direction of load cannot always be precisely defined.

Seal with metal case



	Dimensio	ons [mm]
Ød	D ³⁾	b
12	22	3
16	26	3

³⁾ The outer diameter D is about 0.1 mm oversize. No retaining elements required.

The figures for dynamic load-carrying capacity have been calculated assuming a nominal travel of 100,000 m.

For a nominal travel of 50,000 m, the ,C' figures in the table must be multiplied by a factor of 1.26.

STAR – Linear Sets incorporating Torque-Resistant Compact Linear Bushings, Miniature Version

Installation notes

- Linear Sets with Torque-Resistant Compact Linear Bushing, miniature version, are available including sleeve design
- Arrangement of lubrication channels and bores as well as for securing (fixing)
- Recommended mounting bore: D^{H6} (D^{J6})



Flanged version



Shaft	Screw
Ød [mm]	ISO 4762-8.8
12	M4x16
16	M4x16

Lubrication

- Lubrication for version with one Torque-Resistant Compact Linear Bushing
 - Lubricate only when shaft inserted. Add lubricant through lube port diam. 3.9 until excess emerges.
- Lubrication for Tandem version
 - Lubricate only when shaft inserted. Add lubricant through the centrally located lube groove on the outer diameter until excess emerges.
- Lubrication for Flanged version
 - Lubricate only when shaft inserted. Add lubricant through the recessed funnel-shaped lube port on the end face until excess emerges.

STAR – Linear Sets incorporating Torque-Resistant Compact Linear Bushings, Miniature Version

Linear Sets with shaft, 0721-

Structural design

- Space-saving steel sleeve
- Torque-Resistant Compact Linear Bushing
- Precision Steel Shaft with one ball guide groove
- Lubricatable
- Torque-transmitting steel load bearing plates adjusted to zero clearance before leaving factory
- External seals
- Stability against cocking loads: see Linear Sets (sleeve design),



Ordering data

Shaft			Part nu	mbers											
	Linear Set with Torque-Resistant Compact Linear Bushing and shaft														
Ød [mm]	standard length as per table	shaft length 900 mm	shaft length 1200 mm	shaft length 2000 mm	shaft to specified length ¹⁾	customized shaft									
12	0721-212-80	0721-212-85	0721-212-87	0721-212-88	0721-212-89	0721-212-86									
16	0721-216-80	0721-216-85	0721-216-87	0721-216-88	0721-216-89	0721-216-86									

¹⁾ Also available with corrosion-resistant steel shaft to ISO 683-17 / EN 10088: 0721-...-79.

The figures for dynamic load-carrying capacity have been calculated assuming a nominal travel of 100,000 m.

For a nominal travel of 50,000 m, the ,C' figures in the table must be multiplied by a factor of 1.26.



¹⁾ For Key A... DIN 6885.

			C	Dimensio	ons [mm]		Standard shaft	Torque M _t	load cap dyn.	oacities ²⁾ stat.	ma	ss	
Ød	D h6	L h11	D ₁	L1	b P9	t	L ₂	I		с	C ₀	without shaft	shaft
	110				15			[mm]	[Nm]	[N]	[N]	[g]	[g/m]
12	32	40	22	14	5	3	11	400	2	640	420	160	890
16	36	44	26	16	5	3	12	400	3.3	780	530	200	1570

²⁾ The load capacities stated are minimum values as the position and direction of load cannot always be precisely defined.

STAR – Linear Sets incorporating Torque-Resistant Compact Linear Bushings, Miniature Version

Linear Sets with shaft, Tandem version, 0722-

Structural design

- Space-saving steel sleeve
- Two Torque-Resistant Compact Linear Bushings
- Precision Steel Shaft with one ball guide groove
- Torque-transmitting steel load bearing plates adjusted to zero clearance before leaving factory
- External seals
- Stability against cocking loads
- Keyway for torque transmission
- Lubricatable



Shaft			Part nu	mbers		
	Linear S	Set with Torqu	ue-Resistant C	ompact Linea	r Bushing and	l shaft
Ød [mm]	standard length as per table	shaft length 900 mm	shaft length 1200 mm	shaft length 2000 mm	shaft to specified length ¹⁾	customized shaft
12	0722-212-80	0722-212-85	0722-212-87	0722-212-88	0722-212-89	0722-212-86
16	0722-216-80	0722-216-85	0722-216-87	0722-216-88	0722-216-89	0722-216-86

¹⁾ Also available with corrosion-resistant steel shaft to ISO 683-17 / EN 10088: 0721-...-79.

The figures for dynamic load-carrying capacity have been calculated assuming a nominal travel of 100,000 m.

For a nominal travel of 50,000 m, the ,C' figures in the table must be multiplied by a factor of 1.26.

Ordering data



¹⁾ For Key A... DIN 6885

			Dim	ensions [ı	mm]	Standard shaft	Torque M _t	load ca dyn.	pacities ²⁾ stat.	ma	ss	
Ød	D h6	L h11	D ₁	L ₁	b P9	t	I		с	C ₀	without shaft	shaft
							[mm]	[Nm]	[N]	[N]	[g]	[g/m]
12	32	76	22	20	5	3	400	3.2	1040	840	320	890
16	36	84	26	22	5	3	400	5.5	1260	1060	400	1570

²⁾ Load capacity, when both linear bushings are subject to equal loading. The load capacities stated are minimum values as the position and direction of load cannot always be precisely defined.

STAR – Linear Sets incorporating Torque-Resistant Compact Linear Bushings, Miniature Version

Linear Sets with shaft, flanged version, 0723-

Structural design

- Flanged steel sleeve
- Torque-Resistant Compact Linear Bushing
- Precision Steel Shaft with one ball guide groove
- Torque-transmitting steel load bearing plates adjusted to zero clearance before leaving factory
- External seals
- Stability against cocking loads: installation of two Linear Sets (see also "Retention options - Linear Sets (sleeve design)")
- Lubricatable



Ordering data

Shaft	Linear S	Set with Torq	Part nu ue-Resistant C	mbers compact Linea	r Bushing and	l shaft
Ød [mm]	standard length as per table	shaft length 900 mm	shaft length 1200 mm	shaft length 2000 mm	shaft to specified length ¹⁾	customized shaft
12	0723-212-80	0723-212-85	0723-212-87	0723-212-88	0723-212-89	0723-212-86
16	0723-216-80	0723-216-85	0723-216-87	0723-216-88	0723-216-89	0723-216-86

¹⁾ Also available with corrosion-resistant steel shaft to ISO 683-17 / EN 10088: 0721-...-79.

The figures for dynamic load-carrying capacity have been calculated assuming a nominal travel of 100,000 m.

For a nominal travel of 50,000 m, the ,C' figures in the table must be multiplied by a factor of 1.26.



Dimensions [mm]												Standard shaft	Torque M _t	load cap dyn.	acities ²⁾ stat.	ma	ss
Ød	D h6	D ₄ -0.1 -0.3	D ₁	D ₂	L h11	L ₁ -0.2	L ₂	D3	S ¹⁾	v	В	l [mm]	[Nm]	C [N]	C ₀ [N]	without shaft [g]	shaft [g/m]
12	32	32	22	50	40	10	10	40	4.5	4.5	17.4	400	2	640	420	250	890
16	36	36	26	54	44	10	10	44	4.5	4.5	20	400	3.3	780	530	300	1570

¹⁾ Mounting screws to ISO 4762-8.8.

²⁾ The load capacities stated are minimum values as the position and direction of load cannot always be precisely defined.

STAR – Torque-Resistant Linear Bushings with Shaft

for higher torque loads, Miniature Version

Sleeve design, 0724-

Design

- hardened and ground sleeve
- ball retainer of plastic
- balls of bearing steel
- integrated seals
- precision steel shaft with 4 ball grooves
- key for torque transmission
- with lubrication hole



Ordering data

Part numbers Linear-Set with												
ift machined to drawing	tubular cut to length	⁻ shaft ¹⁾ machined to drawing										
0724-204-86	0724-204-69	0724-204-66										
0724-206-86	0724-206-69	0724-206-66										
0724-208-86	0724-208-69	0724-208-66										
0724-210-86	0724-210-69	0724-210-66										
0724-213-86	0724-213-69	0724-213-66										
0724-216-86	0724-216-69	0724-216-66										
0724-220-86	-	-										
0724-225-86	-	_										
0724-230-86	-	-										
0724-240-86	_	_										
0724-250-86	_	_										
	Part numbers L ft machined to drawing 0724-204-86 0724-208-86 0724-210-86 0724-213-86 0724-216-86 0724-220-86 0724-220-86 0724-230-86 0724-230-86 0724-230-86 0724-230-86 0724-230-86 0724-230-86 0724-230-86 0724-230-86 0724-230-86 0724-230-86	Part numbers Liear-Set with ft machined to drawing tubular cut to length 0724-204-86 0724-204-69 0724-206-86 0724-208-69 0724-208-86 0724-208-69 0724-210-86 0724-210-69 0724-213-86 0724-213-69 0724-213-86 0724-213-69 0724-220-86 - 0724-220-86 - 0724-225-86 - 0724-230-86 - 0724-230-86 - 0724-230-86 - 0724-230-86 - 0724-230-86 - 0724-230-86 - 0724-230-86 - 0724-230-86 -										

¹⁾ Sizes 20 to 50 on request

The values for dynamic-load capacity are based on a nominal travel of 100,000 m. For a nominal travel of 50,000 m the values must be multiplied by the factor 1.26.



Size				Dimer	sions	[mn	n]			Shaft lenght	Tore	que	load ca	apacity ¹⁾	mass			
	Ø d h7	d ₁	D h6	L	L ₁	0	t	t ₁	b	max. l [mm]	dyn. M _t [Nm]	stat. M _t [Nm]	dyn.C [N]	stat. C ₀ [N]	without shaft [kg]	solid shaft [kg/m]	tubular shaft [kg/m]	
4	4	1,5	10	16	6	-	1,2	2	2	300	0,59	1,05	680	1220	0,0065	0,10	0,082	
6	6	2	14	25 _{-0,2}	10,5	1	1,2	2,5	2,5	600	1,20	2,40	970	2280	0,019	0,21	0,195	
8	8	3	16	25 _{-0,2}	10,5	1,5	1,2	2,5	2,5	600	1,70	3,70	1150	2870	0,023	0,38	0,34	
10	10	4	21	33 _{-0,2}	13	1,5	1,5	3	3	600	3,50	8,20	2170	5070	0,054	0,60	0,51	
13	13	6	24	36	15	1,5	1,5	3	3	600	16,70	39,20	2120	4890	0,07	1,00	0,80	
16	16	8	31	50 _{-0,2}	17,5	2	2	3,5	3,5	600	48	110	4860	11200	0,15	1,50	1,20	
20	18,2	-	32	60 _{-0,2}	26	2	2,5	4	4	1500	66	133	6200	11300	0,20	2,00	-	
25	23	-	37	70 _{-0,3}	33	3	3	5	5	1500	129	239	9800	16100	0,22	3,10	-	
30	28	-	45	80,3	41	3	4	7	7	1500	229	412	14800	23200	0,35	4,80	-	
40	37,4	-	60	100,3	55	4	4,5	8	10	1800	500	882	24400	37500	0,81	8,60	-	
50	47	-	75	112 _{-0,3}	60	4	5	10	15	1800	1100	3180	36600	74200	1,50	13,10	-	

¹⁾ The given values are minimum values because the direction of load is not always precisely defined.

Mounting instructions:

Linear-Set, shaft and key are delivered as separate parts. Recommended housing bore tolerance: H6 oder H7. Radial clearance: ca \pm 5 μm ; preload on request Align the shaft grooves to the ball circuits before inserting the shaft into the linear set.

STAR – Torque-Resistant Linear Bushings with Shaft

for higher torque loads, Miniature Version

Flanged Type, 0725-

Design

- hardened and ground sleeve
- ball retainer of plastic
- balls of bearing steel
- integrated seals
- precision steel shaft with 4 ball grooves
- with lubrication hole



Ordering data

	Part numbers Linear-Set with													
Size	solid cut to length	shaft machined	tubular cut to length	shaft ¹⁾ machined										
		to drawing		to drawing										
6	0725-206-89	0725-206-86	0725-206-69	0725-206-66										
8	0725-208-89	0725-208-86	0725-208-69	0725-208-66										
10	0725-210-89	0725-210-86	0725-210-69	0725-210-66										
13	0725-213-89	0725-213-86	0725-213-69	0725-213-66										
16	0725-216-89	0725-216-86	0725-216-69	0725-216-66										
20	0725-220-89	0725-220-86	-	-										
25	0725-225-89	0725-225-86	-	-										
30	0725-230-89	0725-230-86	-	-										
40	0725-240-89	0725-240-86	-	-										
50	0725-250-89	0725-250-86	_	_										

¹⁾ Sizes 20 to 50 on request

The values for dynamic-load capacity are based on a nominal travel of 100,000 m. For a nominal travel of 50,000 m the values must be multiplied by the factor 1.26.



Size				D	ime	nsions	[mr	n]				Shaft length	Tor	que	load ca	pacity ¹⁾) mass		
	Ød h7	d,	D h6	D ₁	D ₂	L	L ₁	L ₂	v	S ²⁾	0	max. I [mm]	dyn. M _t [Nm]	stat. M _t [Nm]	dyn.C [N]	stat. C _o [N]	without shaft [kg]	solid shaft [kg/m]	tubular shaft [kg/m]
6	6	2	14	30	22	25 _{-0,2}	5	7,5	3,3	3,4	1	600	1,2	2,4	970	2280	0,037	0,21	0,195
8	8	3	16	32	24	25 _{-0,2}	5	7,5	3,3	3,4	1,5	600	1,7	3,7	1150	2870	0,042	0,38	0,34
10	10	4	21	42	32	330,2	6	10,5	4,4	4,5	1,5	600	3,5	8,2	2170	5070	0,094	0,60	0,51
13	13	6	24	43	33	36	7	11	4,4	4,5	1,5	600	16,7	39,2	2120	4890	0,10	1,00	0,80
16	16	8	31	50	40	502	7	18	4,4	4,5	2	600	48	110	4860	11200	0,20	1,50	1,20
20	18,2	-	32	51	40	60 _{-0,2}	7	23	4,4	4,5	2	1500	66	133	6200	11300	0,22	2,00	-
25	23	-	37	60	47	70,3	9	26	5,4	5,5	3	1500	129	239	9800	16100	0,32	3,10	-
30	28	-	45	70	54	803	10	30	6,5	6,6	3	1500	229	412	14800	23200	0,51	4,80	-
40	37,4	_	60	90	72	1000,3	14	36	8,6	9	4	1800	500	882	24400	37500	1,15	8,60	-
50	47	_	75	113	91	1123	16	40	11	11	4	1800	1100	3180	36600	74200	2,10	13,10	-

¹⁾ The given values are minimum values because the direction of load is not always precisely defined.

²⁾ mounting bolts ISO 4762-8.8

Mounting instructions:

Linear-Set and shaft are delivered as separate parts. Recommended housing bore tolerance: H6 oder H7. Radial clearance: ca \pm 5 µm; preload on request Align the shaft grooves to the ball circuits before inserting the shaft into the linear set.

STAR – Torque-Resistant Linear Bushings with Shaft

for higher torque loads, Miniature Version

Miniature-Flanged type, 0726-

Design

- hardened and ground sleeve
- ball retainer of plastic
- balls of bearing steel
- integrated seals
- precision steel shaft with 4 ball grooves
- with lubrication hole



Ordering data

	Part numbers Linear-Set with										
Size	solid cut to length	shaft machined to drawing	tubula cut to length	r shaft machined to drawing							
6	0726-206-89	0726-206-86	0726-206-69	0726-206-66							
8	0726-208-89	0726-208-86	0726-208-69	0726-208-66							
10	0726-210-89	0726-210-86	0726-210-69	0726-210-66							

The values for dynamic-load capacity are based on a nominal travel of 100,000 m. For a nominal travel of 50,000 m the values must be multiplied by the factor 1.26.



Size	Dimensions [mm]							Dimensions [mm] Shaft Torque load ca length							ipacity ¹⁾ mass					
													max.	dyn.	stat.	dyn.C	stat. C ₀	without	solid	tubular
	Ød	d_1	D	D ₁	\mathbf{D}_2	В	L	L ₁	L ₂	V	S ²⁾	0	I	Mt	Mt			shaft	shaft	shaft
	h7		h6				-0,2						[mm]	[Nm]	[Nm]	[N]	[N]	[kg]	[kg/m]	[kg/m]
6	6	2	14	30	22	18	25	5	7,5	3,3	3,4	1	600	1,2	2,4	970	2280	0,029	0,21	0,195
8	8	3	16	32	24	21	25	5	7,5	3,3	3,4	1,5	600	1,7	3,7	1150	2870	0,035	0,38	0,34
10	10	4	21	42	32	25	33	6	10,5	4,4	4,5	1,5	600	3,5	8,2	2170	5070	0,075	0,60	0,51

¹⁾ The given values are minimum values because the direction of load is not always precisely defined.

²⁾ mounting bolts ISO 4762-8.8

Mounting instructions:

Linear-Set and shaft are delivered as separate parts. Recommended housing bore tolerance: H6 oder H7. Radial clearance: ca \pm 5 µm; preload on request Align the shaft grooves to the ball circuits before inserting the shaft into the linear set.

STAR – Precision Steel Shafts, Miniaturausführung Product Overview

STAR Precision Steel Shafts come in various tolerance grades, as solid or tubular shafts, in heat-treatable or corrosion-resistant steel, with hard chrome plating, in metric sizes.

They are induction hardened and centerless ground.

Besides their use as guide shafts for linear bushings, STAR Precision steel Shafts have proven successful in numerous other applications, for example as rollers, pistons or axles.

We supply STAR Precision Steel Shafts to your requirements: cut to length and chamfered at both ends, machined to your drawing or description, or in unmachined mill-cut lengths.





STAR – Precision Steel Shafts, Miniaturausführung Technical Data

Metric sizes

Shaft	Part numbers Solid shafts										
Ød [mm]	Heat-treatable steel h6	X46Cr13	X90CrMoV18 h6	hard chrome plated h6	[mm]						
3	1007-603-001)		1007-603-202)		400						
4	1007-404-00	1007-404-30			600						
5	1007-005-00	1007-005-30			1000						
6	1000-006-00	1000-006-30									
8	1000-008-00	1000-008-30									
10	1000-010-00	1000-010-30									
12	1000-012-00	1000-012-30	1000-012-20	1000-012-60							
14	1000-014-00										
15	1000-015-00										
16	1000-016-00	1000-016-30	1000-016-20	1000-016-60							

¹⁾ 100Cr6

²⁾ X105CrMo17

Dimensional accuracy and tolerance zones

The diameters of Precision Steel Shafts are accurate to within the tolerance zones h6. Details on the dimensional accuracy of the shafts are compiled in the tables on the right. The tolerance for the diameter of soft-annealed shaft sections may go slightly beyond the tolerance zones quoted.

For special diameter tolerances, please consult us.

Tolerances for metric-size steel shafts

Nominal diameter	[mm]	over		3	6	10	
		up to	3	6	10	16	
Tolerance for diameter	h6	[µm]	0 -6 0	0 8 0	0 -9 0	0 -11 0	
Roundness	h6	[µm]	3	4	4	5	
Taper, Convexity, Concavity	h6	[µm]	4	5	6	8	
Straightness		[µm/m]	75	75	60	50	
Measured value t_1^3)	150	150	120	100		
Surface roughness	C.L.A.(R _a) ⁴⁾ [µm]	0.32	0.32	0.32	0.32	

³⁾ Dial gauge reading during straightness measurement. For lengths of less than 1 m the lowest possible value is 40 µm. This corresponds to a straightness tolerance of 20 µm.

⁴⁾ Applies to shafts made of heat-treatable or anti-friction bearing steel only. Please contact us for surface finish and surface roughness (R_a) tolerances for hard chrome plated and corrosionresistant steel shafts.

Straightness

Because of the length of the shafts, it would be uneconomical to use the straightness measurement method specified in DIN ISO 1101 section 14.1. Instead of direct measurement for straightness, the shafts are tested for runout tolerance as described in DIN ISO 1101 section 14.13.1.

See "Measurement of straightness".

Measurement of straightness

Measurements are performed at points equidistant between the support points and the overhanging ends of the shaft. The measured values are then halved and the resulting value t_1 gives the straightness.



Measurement of roundness

The figure shows the roundness of a raw shaft compared with that of a finished Precision Steel Shaft.





Precision Steel Shaft

Shaft hardness

58o4a The surface of the shaft is induction-hardened to a depth of at least 0.4 up to 3.2 mm, depending on the shaft diameter. Surface hardness and depth of hardness are extremely uniform, both in the axial and in the circumferential direction. This is the reason for the excellent dimensional consistency and the long service life of Precision Steel Shafts.

The photographs opposite show a longitudinal and a transverse section through a hardened and ground Precision Steel Shaft.

The hardened surface zone has been made visible by caustic etching.





Shaft Ø d	[mm]	over	3	10	
		up to	10	16	
Depth of hardr	ness ¹⁾ [mm]	min.	0.4	0.6	

¹⁾ Pleas contact us to obtain the depth of hardness for corrosion-resistant steel shafts.

Rexroth Bosch Group

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