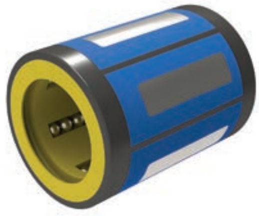
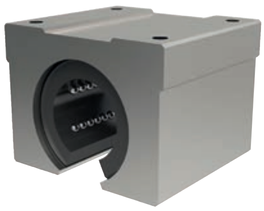
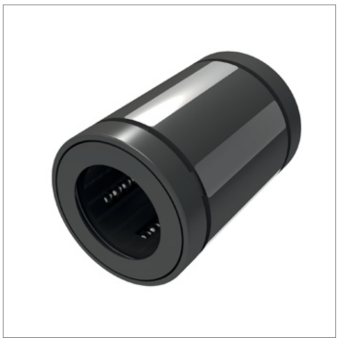
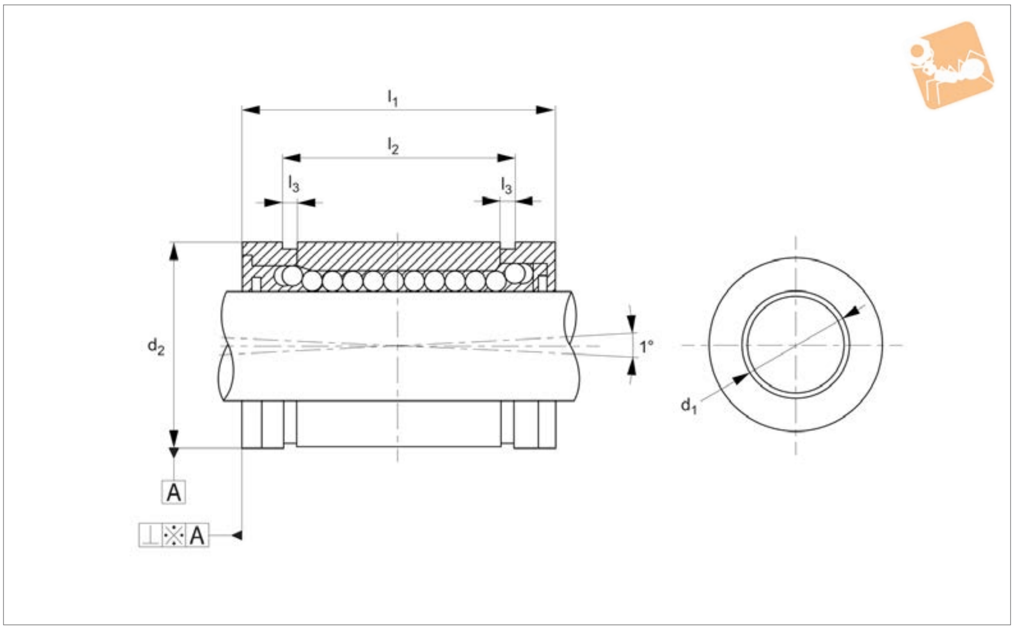
L1706	L1712	L1715
		
Closed, open + adjustable	Double compliment versions	Compact versions
L1718	**L1723**	**L1731**
		
Front flanged standard	Front flanged double compliment	Centre flanged double compliment
L1740	**L1750**	**L1753**
		
Superball bushings	Closed linear carriage	Open linear carriage

For full technical information, see end of product section.

Linear Ball Bushings from Automotion Components



L1740



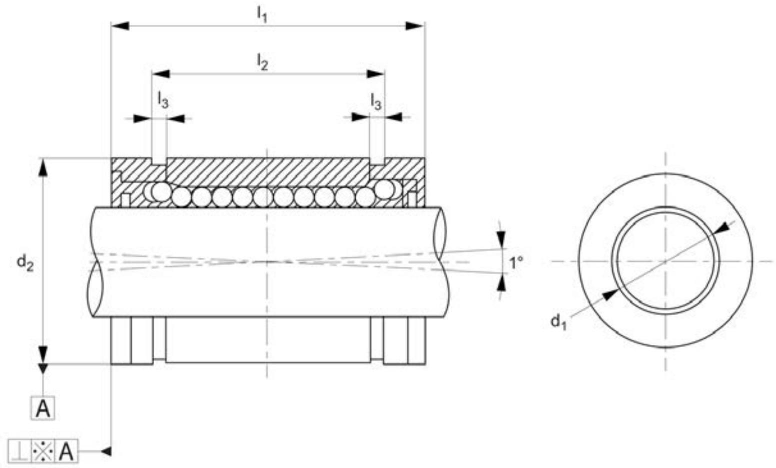
Material

Hardened and ground steel ball plate from bearing steel.
Floating plate feature offers self-alignment and clearance adjustment.
Single body resin retainer (POM).
Supplied with nitrile rubber (NBR) end seals -UU as standard.

Technical Notes

The superball series has 3 x the load rating and 27 x the travel life of conventional linear bushings.
They offer self-alignment - prolonging travel life by reducing the friction between shaft and balls.
For use with hardened shafts only (see part nos. L1770 - L1772) - tolerance h6.
Perpendicularity A is better than 15μ.
Temperature range: -20°C to +80°C.

Order No.	d_1 tol. h6	d_2 tol. h6	l_1 ±0.2	l_2 ±0.2	l_3 min.	No. of ball circuits	Dyn. load C N max.	Static load C_0 N max.	Weight g
L1740.010	10	19	29	21.7	1.35	5	550	750	17
L1740.012	12	22	32	22.7	1.35	5	1100	1230	23
L1740.016	16	26	36	24.7	1.35	5	1250	1550	28
L1740.020	20	32	45	31.3	1.65	6	1670	2580	61
L1740.025	25	40	58	43.8	1.90	6	2750	3800	122
L1740.030	30	47	68	51.8	1.90	6	2800	4710	185
L1740.040	40	62	80	60.4	2.20	6	5720	6500	360
L1740.050	50	75	100	77.4	2.70	6	7940	11460	580



L1741

Material
Hardened and ground body from bearing steel - nickel plated.
Stainless steel balls 440C.
Floating plate feature offers self-alignment and clearance adjustment.
Single body resin retainer (POM).
Supplied with nitrile rubber (NBR) end seals -UU as standard.

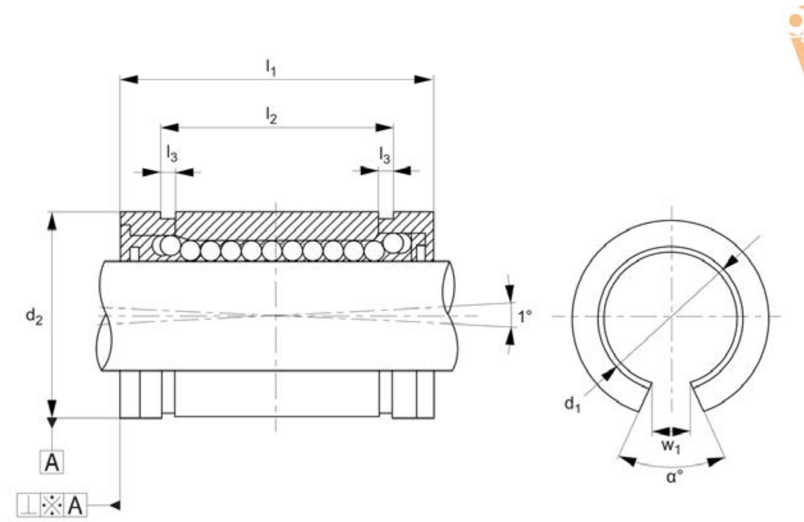
Technical Notes
The superball series has 3 x the load rating and 27 x the travel life of conventional linear bushings.
They offer self-alignment - prolonging travel life by reducing the friction between shaft and balls.
For use with hardened shafts only (see part nos. L1770 - L1772) - tolerance h6.

Perpendicularity A is better than 15µ.
Temperature range: -20°C to +80°C.

Tips
The nickel plated bearing plates and the stainless steel bearing balls provide a good degree of corrosion protection.

Order No.	d_1 tol. h6	d_2 tol. h6	l_1 ±0.2	l_2 ±0.2	l_3 min.	No. of ball circuits	Dyn. load C N max.	Static load C_0 N max.	Weight g
L1741.010	10	19	29	21.7	1.35	5	550	750	17
L1741.012	12	22	32	22.7	1.35	5	1100	1230	23
L1741.016	16	26	36	24.7	1.35	5	1250	1550	28
L1741.020	20	32	45	31.3	1.65	6	1670	2580	61
L1741.025	25	40	58	43.8	1.90	6	2750	3800	122
L1741.030	30	47	68	51.8	1.90	6	2800	4710	185
L1741.040	40	62	80	60.4	2.20	6	5720	6500	360
L1741.050	50	75	100	77.4	2.70	6	7940	11460	580

L1742



Material

Hardened and ground steel ball plate from bearing steel.
Floating plate feature offers self-alignment and clearance adjustment.
Single body resin retainer (POM).
Supplied with nitrile rubber (NBR) end seals -UU as standard.

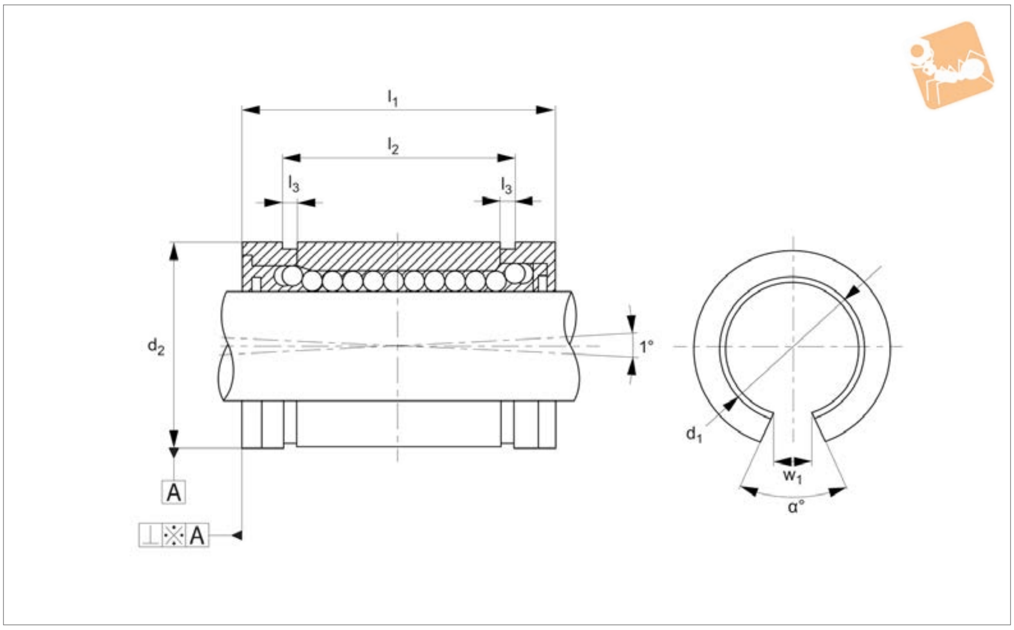
Technical Notes

The superball series has 3 x the load rating and 27 x the travel life of conventional linear bushings.
For use with hardened shafts only (see part nos. L1770 - L1772) - tolerance h6.
Perpendicularity A is better than 15µ.
Temperature range: -20°C to +80°C.

Tips

d_2 is the dimension before the bush has been slotted.

Order No.	d_1 tol. h6	d_2 tol. h6	l_1 ±0.2	l_2 ±0.2	l_3 min.	Dyn. load C N max.	w_1	α °	Static load C_0 N max.	Weight g
L1742.012	12	22	32	22.7	1.35	1260	6.5	66	1290	18
L1742.016	16	26	36	24.7	1.35	1320	9.0	68	1640	22
L1742.020	20	32	45	31.3	1.65	1720	9.0	55	2630	51
L1742.025	25	40	58	43.8	1.90	2850	11.5	57	3910	102
L1742.030	30	47	68	81.8	1.90	2900	14.0	57	4850	155
L1742.040	40	62	80	60.4	2.20	5900	19.5	56	6700	300
L1742.050	50	75	100	77.4	2.70	8100	22.5	54	11700	480



L1743

Material

Hardened and ground body from bearing steel - nickel plated.
Stainless steel balls 440C.
Floating plate feature offers self-alignment and clearance adjustment.
Single body resin retainer (POM).
Supplied with nitrile rubber (NBR) end seals -UU as standard.

Technical Notes

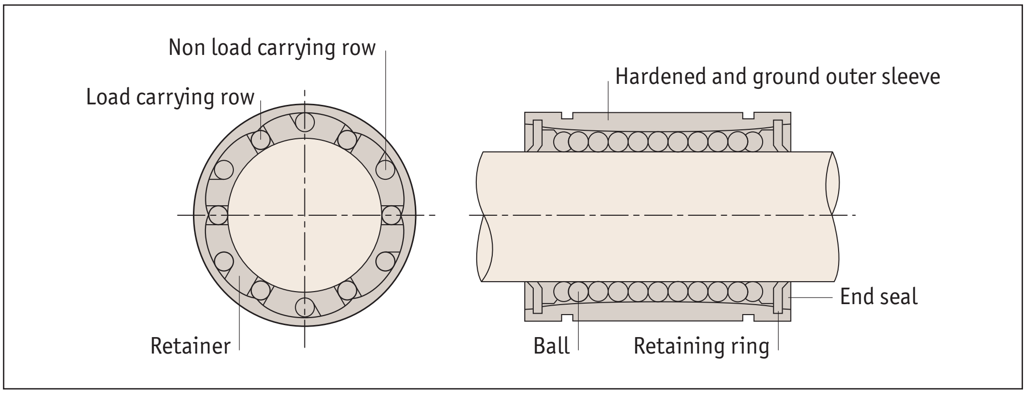
The superball series has 3 x the load rating and 27 x the travel life of conventional linear bushings.
They offer self-alignment - prolonging travel life by reducing the friction between shaft and balls.
For use with hardened shafts only (see part nos. L1770 - L1772) - tolerance h6.
Perpendicularity A is better than 15µ.
Temperature range: -20°C to +80°C.

Tips

The nickel plated bearing plates and the stainless steel bearing balls provide a good degree of corrosion protection. d_2 is the dimension before the bush has been slotted.

Order No.	d_1 tol. h6	d_2 tol. h6	l_1 ±0.2	l_2 ±0.2	l_3 min.	Dyn. load C N max.	w_1	α °	Static load C_0 N max.	Weight g
L1743.012	12	22	32	22.7	1.35	1260	6.5	66	1290	18
L1743.016	16	26	36	24.7	1.35	1320	9.0	68	1640	22
L1743.020	20	32	45	31.3	1.65	1720	9.0	55	2630	51
L1743.025	25	40	58	43.8	1.90	2850	11.5	57	3910	102
L1743.030	30	47	68	81.8	1.90	2900	14.0	57	4850	155
L1743.040	40	62	80	60.4	2.20	5900	19.5	56	6700	300
L1743.050	50	75	100	77.4	2.70	8100	22.5	54	11700	480

Linear ball bushings



Applications

- Computers and peripheral equipment.
- Recording equipment.
- Linear motion systems.
- Multi-axis drilling machine.
- Printing machines.
- Food packaging machines.
- Punching presses.
- Tool grinders.
- Assembly systems.
- Card selectors.

Interchangeability

Our linear bushing systems are designed to have full interchangeability, with other manufacturers' parts. **For shafting see part numbers L1770 to L1785.**

High precision retainer

The single body retainer guides 4-6 ball circuits. It precisely guides the balls with a smooth motion.

Tolerance of housing bore

Normal fit is standard, pressed fit is for without clearance.

Type	Case	
Part no.	Normal fit	Pressed fit
L1706 to L1733	H7	K6, J6
L1706...$^{-1}$ to L1733...$^{-1}$	H7	J7

Rigid outer sleeve

The hardened and precisely ground outer sleeve is made of bearing steel.

L1750 bushing carriages

Consists of light aluminium case and L1706 type linear bushing, so the installation can be finished simply by bolting. Longer life can be obtained by adjusting the orientation of the ball circuits in the linear carriage element against the direction of load.

Tolerance of shaft

Type	Shaft	
Part no.	Normal fit	Tight fit
L1706 to L1733	h6	k6
L1706...$^{-1}$ to L1733...$^{-1}$	f6, g6	h6

Basic dynamic load rating C

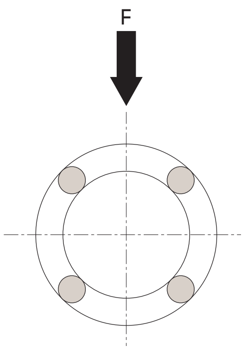
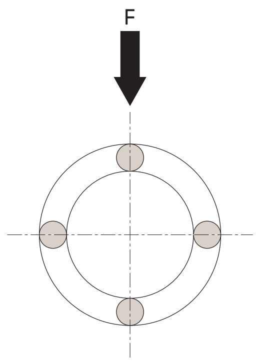
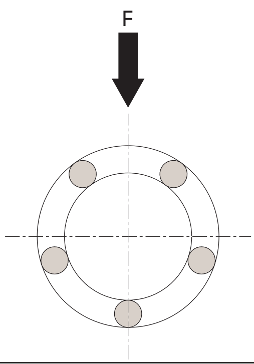
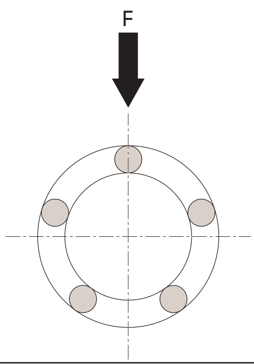
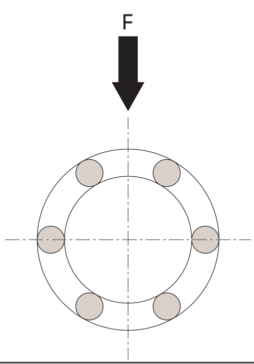
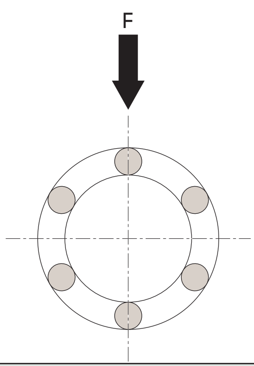
The basic dynamic load rating is defined as the constant load both in direction and magnitude under which a group of identical linear bushings are individually operated. 90% of the units can travel 50Km without failing due to rolling contact fatigue.

Basic static load rating C_0

If a linear bushing is subject to an excessive load or impact, a permanent deformation occurs between the raceway and the rolling element. The basic static load rating is defined as the static load that gives a prescribed constant contact stress at the centre of the contact area between the rolling element and raceway receiving the maximum load.

Relationships between load ratings and the position of ball circuits

Load ratings of linear bushing are affected by the position of the ball circuits as shown below.

No of ball rows	Orientation of balls	
	Maximum load rating	Minimum load rating
4		
	F = 1.41 x C	F = C
5		
	F = 1.46 x C	F = C
6		
	F = 1.26 x C	F = C

Load ratings and orientation of balls.

When designing a linear motion system it is necessary to consider how the application will affect performance. The following examples demonstrate how the position of the load and the centre of gravity can influence product selection. When evaluating your application, review each of the forces acting on your system and determine the product that best suits your needs.

Horizontal application

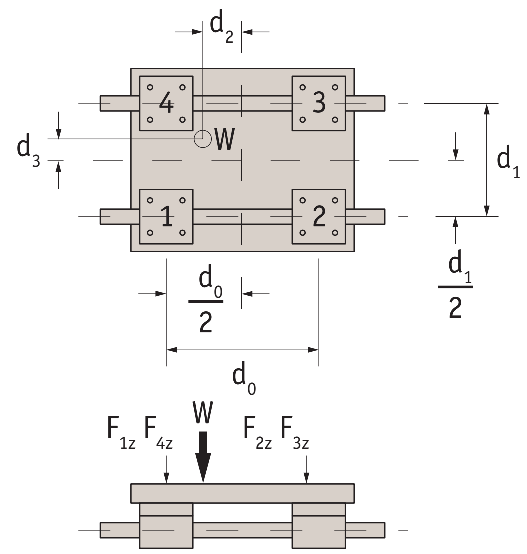
For uniform speed or when stopped.

$$F_{1z} = \frac{W}{4} + \left(\frac{W}{2} \cdot \frac{d_2}{d_0}\right) - \left(\frac{W}{2} \cdot \frac{d_3}{d_1}\right)$$

$$F_{2z} = \frac{W}{4} - \left(\frac{W}{2} \cdot \frac{d_2}{d_0}\right) - \left(\frac{W}{2} \cdot \frac{d_3}{d_1}\right)$$

$$F_{3z} = \frac{W}{4} - \left(\frac{W}{2} \cdot \frac{d_2}{d_0}\right) + \left(\frac{W}{2} \cdot \frac{d_3}{d_1}\right)$$

$$F_{4z} = \frac{W}{4} + \left(\frac{W}{2} \cdot \frac{d_2}{d_0}\right) + \left(\frac{W}{2} \cdot \frac{d_3}{d_1}\right)$$



Horizontal application

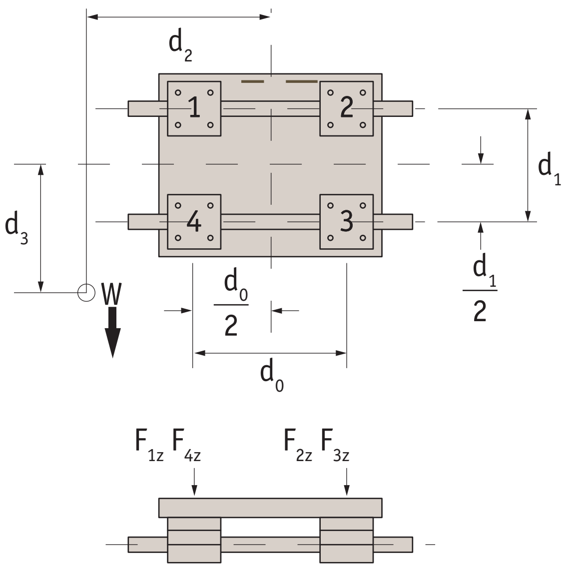
For uniform speed or when stopped.

$$F_{1z} = \frac{W}{4} + \left(\frac{W}{2} \cdot \frac{d_2}{d_0}\right) - \left(\frac{W}{2} \cdot \frac{d_3}{d_1}\right)$$

$$F_{2z} = \frac{W}{4} - \left(\frac{W}{2} \cdot \frac{d_2}{d_0}\right) - \left(\frac{W}{2} \cdot \frac{d_3}{d_1}\right)$$

$$F_{3z} = \frac{W}{4} - \left(\frac{W}{2} \cdot \frac{d_2}{d_0}\right) + \left(\frac{W}{2} \cdot \frac{d_3}{d_1}\right)$$

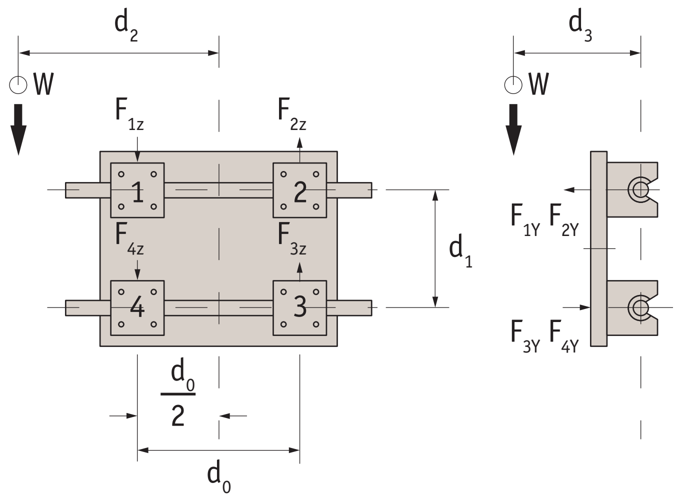
$$F_{4z} = \frac{W}{4} + \left(\frac{W}{2} \cdot \frac{d_2}{d_0}\right) + \left(\frac{W}{2} \cdot \frac{d_3}{d_1}\right)$$



$$F_{1Y} \sim F_{4Y} = \left(\frac{W}{2} \cdot \frac{d_3}{d_0}\right)$$

$$F_{1Z} = F_{4Z} = \frac{W}{4} + \left(\frac{W}{2} \cdot \frac{d_2}{d_0}\right)$$

$$F_{2Z} = F_{3Z} = \frac{W}{4} + \left(\frac{W}{2} \cdot \frac{d_2}{d_0}\right)$$



Side mounted application

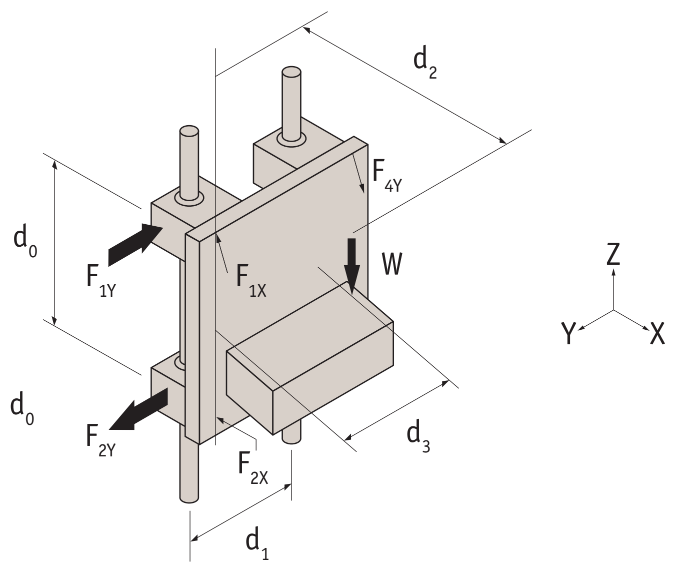
For uniform speed or when stopped.

$$F_{1X} \sim F_{4X} = \left(\frac{W}{2} \cdot \frac{d_2}{d_0}\right)$$

$$F_{1Y} \sim F_{4Y} = \left(\frac{W}{2} \cdot \frac{d_3}{d_0}\right)$$

$$F_{1X} + F_{4X} \sim F_{2X} + F_{3X}$$

$$F_{1Y} + F_{4Y} \sim F_{2Y} + F_{3Y}$$



Vertical application

For uniform speed or when stopped. On start up/stop the load varies due to inertia in the system.

Friction

The coefficient of friction (μ) of Automotion Components ball bushings without seals is very low at approximately 0.001 to 0.003. When seals are used to retain lubricant or to prevent entry of foreign particles, friction resistance must be taken into account for determining total frictional drag. This protection measure adds to the frictional drag of the bearing system. There is a fine line between minimizing frictional drag and maximizing containment protection which is controlled by the addition or removal of seals, wipers or scrapers.

Linear bushings are used with grease or oil lubrication but in some cases can be used without any lubrication.

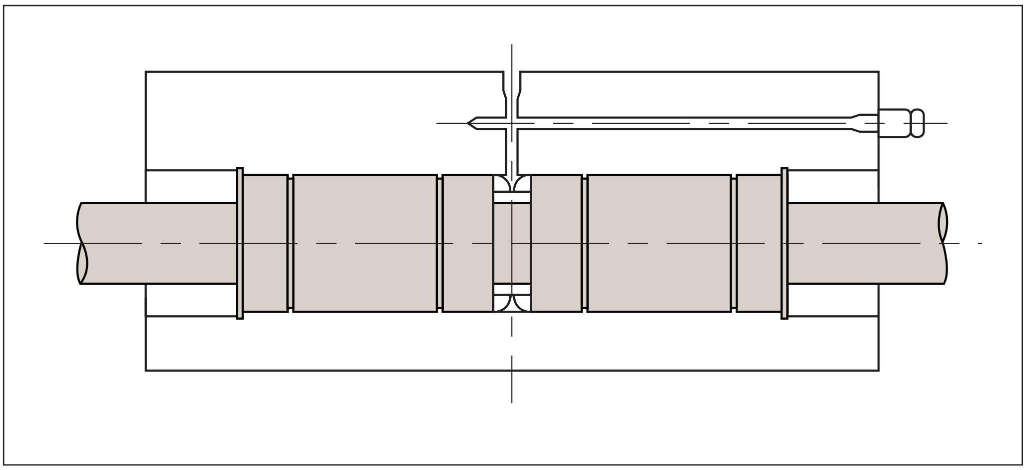
Grease lubrication

Before applying the grease, the anti-corrosive oil must be removed with kerosene or an organic solvent. The grease must be applied when the bushing is dry. Grease must be applied directly on the balls for linear bushing with seals. Lithium soap of viscosity mark (JIS No.2) is recommended for use.

Oil lubrication

There is no need to to remove the anti-corrosive oil when oil is used for lubrication. ISO viscosity grade VG15~100 oil is usually used according to the temperature ranges below. Drop the oil onto the shaft for lubrication, or supply it through an oil hole provided on the housing (see illustration below). However, dropping lubrication cannot be used on linear bushings with seals as the seals remove the oil.

Operating temperature	Viscosity
-30°C to +50°C	VG 15 to 46
+50°C to +80°C	VG 46 to 100



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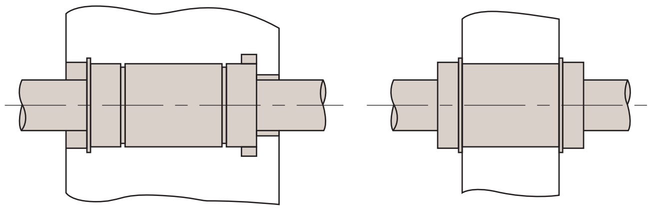
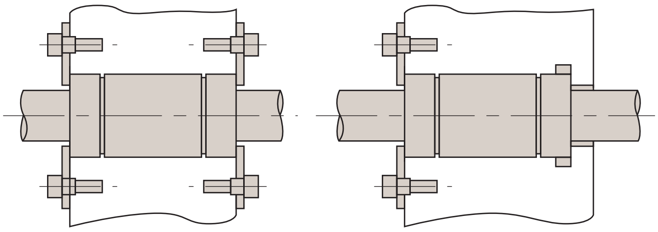
Standard type



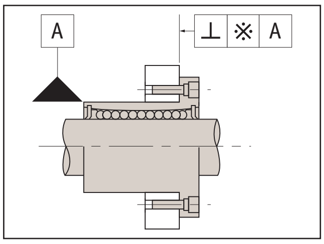
Mounted with circlips

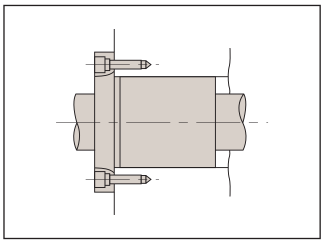


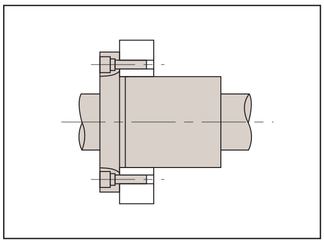
Mounted with adapter plates

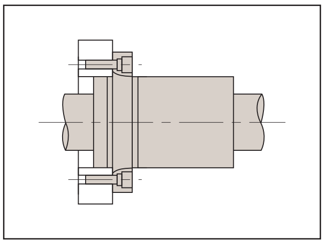
For shaft Ø	Circlip	
	External (for Shaft)	Internal (for Bore)
5	P0380.012-A2	P0381.012-A2
6	P0380.012-A2	P0381.012-A2
8	P0380.016-A2	P0381.016-A2
10	P0380.019-A2	P0381.019-A2
12	P0380.022-A2	P0381.022-A2
16	P0380.026-A2	P0381.026-A2
20	P0380.032-A2	P0381.032-A2
25	P0380.040-A2	P0381.040-A2
30	P0380.048-A2	P0381.047-A2
40	P0380.065-A2	P0381.062-A2
50	P0380.075-A2	P0381.075-A2
60	P0380.090-A2	P0381.090-A2

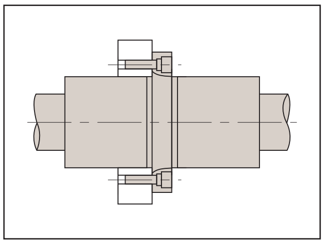
Flanged type











See part tolerances for perpendicularity accuracy ⊥ when outer sleeve is used as datum for installation.

Technical Information

Installation data

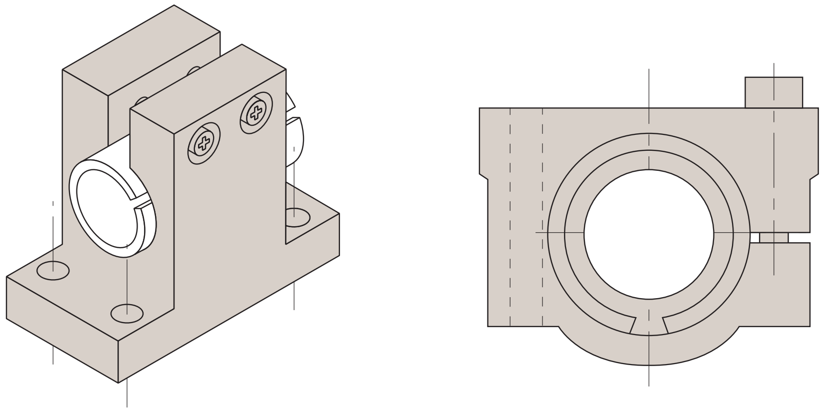
Adjustable type bearings

Adjustment of clearance (for adjustable type bearings and shafts), is achieved with an adjustable housing assembly (as shown below). In this case, the slotted side of linear bushing should be located at 90° to the open side of housing for equal radial deformation.

When moment load applies

External loads should be distributed uniformly on a linear bushing. When moment loads are applied, two or more linear bushings should be used on one shaft, and the distance between the two linear bushings should have adequate spacing. Calculate the equivalent load when the moment loads are applied and choose the correct linear bushing.

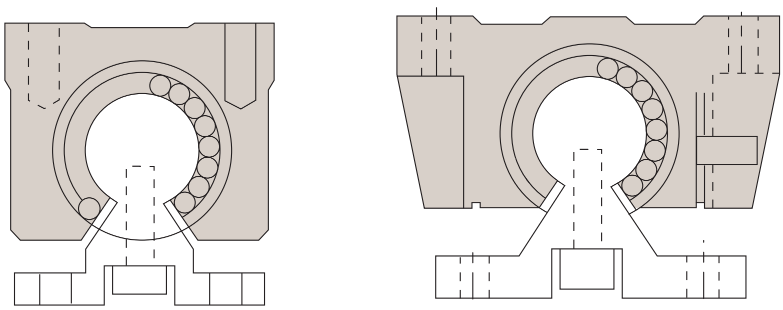
Mounting of adjustable type bearing



Open type bearings

Open type bearings can be used with a clearance adjustable housing as shown below. Light preload is applied for normal use, heavy preload should be avoided.

Mounting of open type bearing



Unflanged Flanged

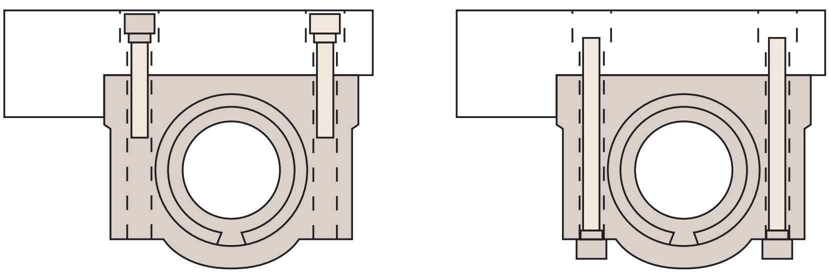
L1750 Bushing carriages

L1750 carriages can be mounted from both the top or the bottom, minimising assembly time.

Fixing holes

Carriage fixing holes are threaded from the top a certain distance down. Fixing holes from the bottom are through holes so the screw size when mounting from below needs to be smaller than the thread size if you weremounting from the top.

Mounting of case unit

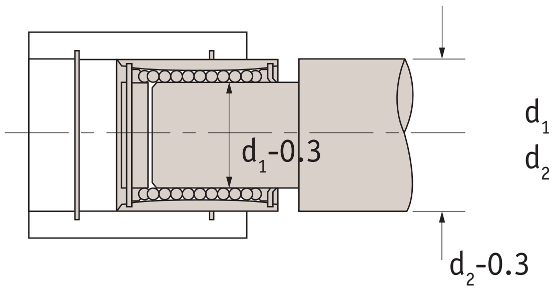


ov-linear-ball-bushings-installation-data-b-lnh - Updated - 22-02-2023

Application tips

For mounting a standard type linear bushing into a housing, a jig should be used to avoid directly striking the outer sleeve or seal during installation.

Mounting into housing

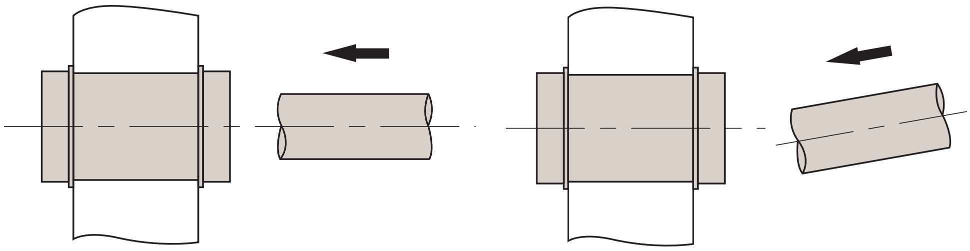


d_1: Shaft diameter
d_2: Housing bore diameter

Insertion of shaft

Care must be taken when inserting a shaft into a linear bushing. If the shaft is inserted incorrectly, the ball retaining cage may be damaged and the balls loosened from position.

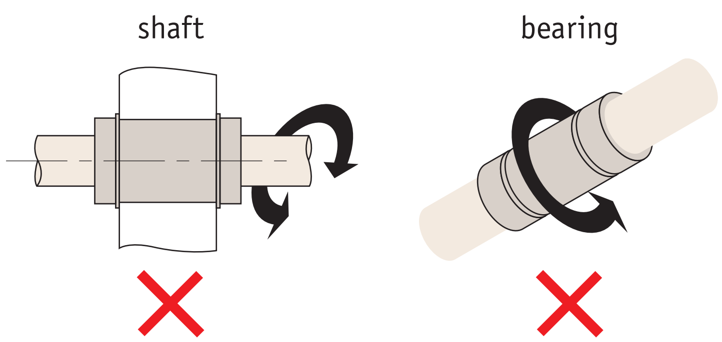
Insertion of shaft into linear bushing



Correct Incorrect

Rotational motion prohibited

Linear bushing are not suitable for rotational motion. If the linear bushing is exposed to rotational motion it may lead to unexpected accidents.



Static safety factor f_s

A linear motion system may receive an unpredictable external force due to vibration or impact while it is at rest or in motion, or inertia as a result of starting and stopping. It is, therefore, necessary to consider the static safety factor against operating loads. The static safety factor (f_s) indicates the ratio of a linear motion system load carrying capacity (basic static load rating, C_o) to the load exerted thereon.

$$f_s = \frac{C_0}{P} \quad \text{or} \quad f_s = \frac{M_0}{M}$$

f_s = Static safety factor
C_0 = Basic static load rating (N)
M_0 = Static permissible moment (Nmm)
P = Calculated load (N)
M = Calculated moment (Nmm)

To calculate a load exerted on the linear motion system, the mean load for calculating the service life and the maximum load for calculating the static safety factor must be obtained in advance. A system can receive unexpected excessive load when it is subject to frequent starts and stops, placed under machining loads, or when a severe moment is applied by overhanging loads. When selecting the correct type of a linear motion system for your application, be sure that the type you are considering can bear the maximum possible load when stopped and in operation. Both tables below specify the standard values for the static safety factors.

Machine used	Loading conditions	f_s Lower limit
Ordinary industrial machine	No vibration or impact	1,0 ~ 1,3
	Vibration and/or impact	2,0 ~ 3,0
Machine tool	No vibration or impact	1,0 ~ 1,5
	Vibration and/or impact	2,5 ~ 7,0

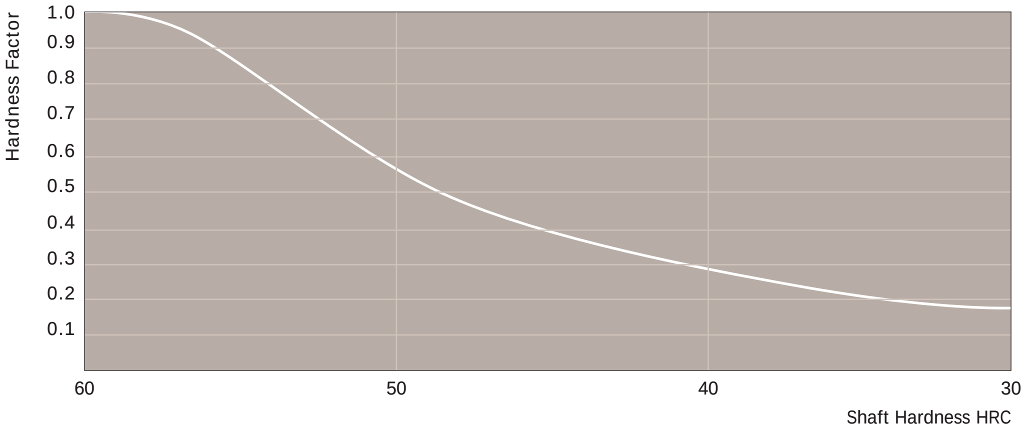
For large radial loads

$$\frac{f_h \cdot f_t \cdot f_c \cdot C_0}{P} \geqslant f_s$$

C_0 = Basic static load rating (N)
f_h = Hardness factor
f_c = Contact factor
P = Calculated load (N)
f_t = Temperature factor

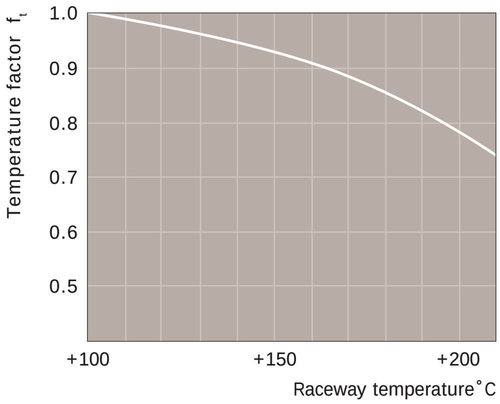
Hardness factor f_h

To achieve the optimum load rating of the linear ball bushings, the shaft hardness must be 58 to 64 HRC. At a hardness below this range, the basic dynamic and static load ratings decrease. The ratings must therefore be multiplied by the respective hardness factors (f_h).



Temperature factor f_t

For linear bushings used at ambient temperatures of over 100˚C, a temperature factor must be taken into consideration.
For higher than 80˚C applications, the seals, end plates, and retainer must be changed for high temperature specifications. (Temperature range: -20˚C - +80˚C). Please note that the selected linear bushing in this case must be a model with high temperature specifications.



Contact factor f_c

When multiple linear bushings are used moments and mounting surface precision will affect operation, making it difficult to achieve uniform load distribution. In this case, multiply the basic load rating (C or C_0) by a contact factor selected from the table.

Number of linear bushing on a shaft	Contact factor f_c
2	0.81
3	0.72
4	0.66
5	0.61
Over 6	0.60
In normal use	1.00

Operating conditions f_w

Some machines may cause vibration. It is particularly difficult to determine the magnitude of vibration that develops during high-speed operation, as well as that of impact during repeated starting and stopping and stopping in normal use. Therefore, where the effects of speed and vibration are estimated to be significant, divide the basic dynamic load rating (C) by a load factor selected from the table.

Operating conditions		Load factor f_w
Load conditions	Speed	
No impact and vibration	Under 15m/min	1.0~1.5
Slight impact and vibration	Under 60m/min	1.5~2.0
Considerable impact and vibration	Over 60m/min	2.0~4.0

Linear bushings load ratings and travel life are influenced by load direction, ball circuit orientation, and hardness of the shaft.

Basic dynamic load rating (C) and travel life

The travel life of a linear bushing is determined largely by the quality of the shaft. The basic dynamic load rating is the maximum continuous load that can be applied to the linear bushing with 90% of reliability and achieving over 50km of operation under normal conditions. When calculating the nominal life for 100km, please divide the dynamic load rating C in the data tables by 1.26.

The nominal travel life can be calculated by the following equation.

$$L = \left(\frac{C}{P}\right)^3 \times 50 \qquad L_{100} = \left(\frac{C_{100}}{P}\right)^3 \times 100$$

L = Nominal life in km (standard 50)
L_{100} = Nominal life in km (100)
C = Basic dynamic load rating (at 50km) in Newtons
C_{100} = Dynamic load rating (at 100km) in Newtons $\left(= \frac{C}{1.26}\right)$
P = Applied load (Newtons)

Other factors will affect the life as follows.

$$L = \left(\frac{f_h \times f_t \times f_c}{f_w} \times \frac{C}{P}\right)^3 \times 50 \qquad L_{100} = \left(\frac{f_h \times f_t \times f_c}{f_w} \times \frac{C_{100}}{P}\right)^3 \times 100$$

f_h = Hardness factor
f_w = Load factor
f_t = Temperature factor
f_c = Contact factor

From the above equations, when the stroke and frequency are constant, the travel life can be calculated by the following equation.

Travel life

$$L_n = \frac{L \times 10^6}{2 \times L_S \times n_o \times 60}$$

L_S = Stroke (km)
n_o = Number of strokes per minute
L_n = Travel life
L = Nominal life (km)

Calculation example

The maximum applied load and the travel life are the most important factors for choosing the correct size of linear ball bushings. Below are sample calculations for expected travel life and selection of the correctly sized linear ball bushing.

Working conditions

Applied load (P):	250N
Stroke (L_s):	0,25 m
Number of strokes per minute (n_o):	60
Shaft hardness:	HRC 60 (f_h = 1,0)
Operating speed (V):	2 x L_s x n_o 2 x 0,25 x 60 30,000 mm/min (f_w = 1,6)

other factors (f_c, f_t) are considered as 1,0

Calculation of expected travel life

Assuming the basic dynamic load rating is based on travel life of 50km and all other factors are 1,0, you choose the linear bushing size for the life required.

Let's try Superball bushing L1740.020 with the above working conditions.

$$L = \left(\frac{1,0 \times 1,0 \times 1,0}{1,6} \times \frac{2,580}{250}\right)^3 \times 50$$

$$= 13,417 \text{ km}$$

$$L_n = \frac{13,417 \times 10^6}{2 \times 0,25 \times 60 \times 60}$$

$$= 7,454 \text{ hours}$$

Choosing the correct linear ball bushing

Let's assume our design travel life is 15,000 hours.

$$L = 15,000 \times 2 \times 0,250 \times 10^{-6} \times 60 \times 60$$

$$= 27,000 \text{ km; and therefore}$$

$$C = \frac{250 \times 1,6}{1,0 \times 1,0 \times 1,0} \times \sqrt[3]{\frac{27,000}{50}}$$

$$= 3,257\text{N}$$

Choosing type L1740 and referring to the table, the correct Superball bushing for the above condition is L1740.025 which has 3,800N as the basic dynamic load rating.

Technical Information

Superball bushings bore tolerances

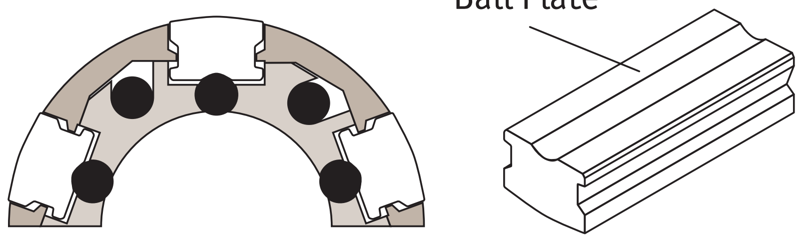
Superball linear ball bushings

- 3 x the load rating and 27 x the travel life of conventional linear bushings
- Self-aligning feature

Features

Higher load ratings

The uniquely designed ball plate (in the outside diameter of the bushing), is made of hardened steel. The precision ground groove is slightly larger than the ball size, which provides greater contact area between the balls and the ball plate, and as a result, provides 3 x higher load ratings of conventional linear bushings.



Self-alignment

The ball plate has a convex shape to provide a pivot point at the centre which allows self-alignment up to ±0.5°. This self-alignment capability eliminates any possibility of edge pressure caused by inaccurate machining, errors on mounting, or shaft deflection.

Tolerance of shaft and housing bore

<table>
<tr><th rowspan="2">Part no.</th><th colspan="2">Shaft</th><th colspan="2">Housing</th></tr>
<tr><th>Shaft Ø d_1</th><th>Tol. h6 µ</th><th>Housing bore Ø d_2</th><th>Tol. H7 µ</th></tr>
<tr><td>L1740.010</td><td>10</td><td>+0 to - 9</td><td>19</td><td rowspan="3">+21 to -0</td></tr>
<tr><td>L1740.012</td><td>12</td><td rowspan="2">+0 to - 11</td><td>22</td></tr>
<tr><td>L1740.016</td><td>16</td><td>26</td></tr>
<tr><td>L1740.020</td><td>20</td><td rowspan="3">+0 to - 13</td><td>32</td><td rowspan="3">+25 to -0</td></tr>
<tr><td>L1740.025</td><td>25</td><td>40</td></tr>
<tr><td>L1740.030</td><td>30</td><td>47</td></tr>
<tr><td>L1740.040</td><td>40</td><td rowspan="2">+0 to - 16</td><td>62</td><td rowspan="2">+30 to -0</td></tr>
<tr><td>L1740.050</td><td>50</td><td>75</td></tr>
</table>

ov-linear-ball-bushings-bore-tolerances-lnh - Updated - 23-02-2023