

直线轴承

Linear Motion Ball Bearing

结构和优点 Structure and Features

- **SNB** 直线轴承由外圈、钢球、保持架和挡圈组成。保持架能将钢球约束在循环轨道中，挡圈将保持架固定在外圈中。
- 这些零件组装在一起便使轴承具有最佳的功能。
- 外圈经热处理后，具有足够的硬度，从而保证其足够的行走寿命和满意的承载能力。
- 保持架用钢或尼龙制作。用户可根据使用条件从中选择。
- The **SNB** linear motion bearing consists of an outer cylinder, ball retainer, balls and two end rings. The ball retainer which holds the balls in the recirculating tracks is held inside the outer cylinder by end rings.

1. 高精度和刚性 High Precision and Rigidity

SNB 直线轴承外圈是钢制的坚固的外圈柱型，保持架为轧制钢板或具有工业强度的尼龙制成。

The **SNB** linear motion bearing is produced from a solid steel outer cylinder. Also the linear motion bearing incorporates either a patented all steel hardened seamless ball retainer or an industrial strength resin retainer.

2. 易于安装 Ease of Assembly

普通型的直线轴承可以作任何方向安装，仅使用轴为支撑便可精确地工作。安装表面也易于加工。**SNB** 提供能安装各种类型直线轴承的各种各样的轴承座，给设计和安装提供了方便。

The standard type of **SNB** linear motion bearing can be loaded from any direction. Precision control is possible using only the shaft supporter, and the mounting surface can be machined easily. **SNB** also provides a variety of housings for all types of slide bushings, offering convenience of design and assembly.

3. 易于更换 Ease of Replacement

由于直线轴承尺寸标准化和高加工精度，故每一套轴承都具有互换性。由于磨损和损坏而需要换轴承是很方便的。

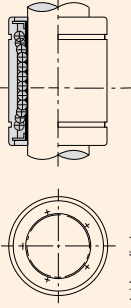
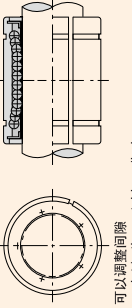
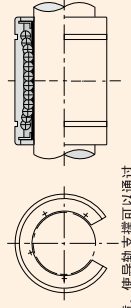
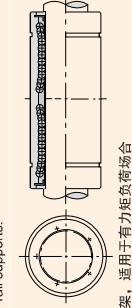
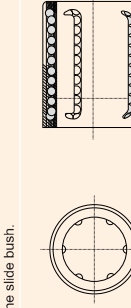
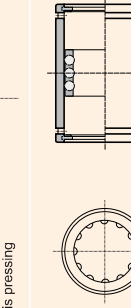
SNB linear motion bearing of each type are completely interchangeable because of their standardized dimensions and strict precision control. Replacement because of wear or damage is therefore easy and accurate.

4. 品种齐全 Variety of Types

SNB 直线轴承型号齐全，有普通型、间隙调整型、开口型、加长型和带法兰型，用户可以根据需要从中选择。

SNB offers a full line of linear motion bearing: the standard, integral single-retainer closed type, the clearance adjustable type and the open, double-retainer, and flanged types. The user can choose from among these according to the application requirements to be met.

直线轴承的类型 Type of Linear Motion Ball Bearings

类型 Type	结构 Description	材料 Material	
		外圈 Outer cylinder	保持架 Retainer
标准型 Standard Type	 封闭外圈型 Closed type outside cylinder	钢 Steel	钢 Steel
			尼龙 Resin
间隙调整型 Adjustable Type	 外径带开缝，可以调整间隙 This type has a slot in the outside cylinder. This design allows for clearance adjustment.	钢 Steel	钢 Steel
			尼龙 Resin
开口型 Open Type	 切掉一细环，使导轨支撑可以通过 One ball circuit is removed to allow an opening slot to fit over rail supports.	钢 Steel	钢 Steel
			尼龙 Resin
加长型 Double-Wide Type	 有两个保持架，适用于有力矩负荷场合 This type has two retainers in the outside cylinder. This structure is useful when moment loads are applied to the slide bush.	钢 Steel	钢 Steel
			尼龙 Resin
冲压外圈型 Pressing Outer Race Type	 外圈是冲压的 Outer race is pressing	钢 Steel	尼龙 Resin
			钢 Steel
行程轴承 Stroke Bearing	 封闭外圈型 Closed type outside cylinder	钢 Steel	铝 Aluminum
			钢 Steel

直线轴承的代号
Type Number Format

LM		25		L		M		UU		AJ	
类型 Type											
LM		公制，亚洲应用广泛 Metric dimension series most widely used in Asia									
LME		公制，主要是欧洲使用 Metric dimension series generally used in Europe									
LMB		英制，主要是美洲使用 Inch dimension series used mainly in America									
公称轴径 Nominal Shaft Diameter											
加长 Double type											
符号 Symbol		代表意义 Specification									
不标 No entry		标准型 Standard type									
L		加长型 Double type									
M 镀镍 Nickel plated											
符号 Symbol		代表意义 Specification									
不标 No entry		不带密封 No seal									
U		单密封 Seals on one side									
UU		双密封 Seals on both sides									
符号 Symbol		代表意义 Specification									
不标 No entry		标准型 Standard type									
AJ		间隙调整型 Adjustable type									
OP		开口型 Open type									
密封 Seal											

公差
Tolerance

- **SNB** 直线轴承有普通型和精密型两种，在样本中有标明。需要说明的是对于同调型 (.....AJ) 和开口型 (.....OP) 的钢球总体直径和外径的公差是在切口之前测量的。

额定负荷和寿命估算
Load Rating and Life Expectancy

- 直线轴承的额定寿命可以根据轴承的额定负荷和工作负荷利用下式计算出：
- The rated life (L) of a slide bush can be obtained from the following equation with the basic dynamic load rating and the load applied to the slide bush:

$$L = \left(\frac{f_w \cdot f_r \cdot f_c}{f_w} \cdot \frac{C}{P} \right)^3 \cdot 50 \quad (1)$$

L: 额定寿命 Rated life (km)
C: 基本额定负荷 Basic dynamic load rating (N)
P: 工作负荷 Working load (N)
f_w: 负荷系数 Load coefficient
f_r: 速度系数 Temperature coefficient
f_c: 接触系数 Contact coefficient

- The **SNB** linear motion ball bearing are divided into high class and precision class, indicated in the dimension tables. Note that precision of inscribed circle diameters and outside diameters for the clearance adjustable type (.....AJ) and the open type (.....OP) indicates the value obtained before the corresponding type is subjected to cutting process.

- 直线轴承的时间寿命可以根据每分钟行走距离进行计算。
- 如果行程长度、往复次数恒定，则时间寿命可用下式计算出。
- The lifespan (L_r) of a slide bush in hours can be obtained by calculating the traveling distance per unit time.
- The lifespan can be obtained from the following equation if the stroke length and the number of strokes are constant:

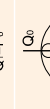
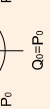
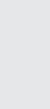
$$L_r = \left(\frac{L \cdot 10^3}{2 \cdot f_s \cdot n \cdot 60} \right) \quad (2)$$

L_r: 时间寿命 Lifespan(hr) f_s: 行程长度 Stroke length(m)
L: 额定寿命 Rated life(m) n: 每分钟往复次数 Number of strokes per minute(CPM)

钢球列数与额定负荷的关系
Relation between ball circuits and load rating

- **SNB** 直线轴承的几组钢球在圆周上是均匀分布的，负荷在圆周上作用点的位置不同则轴承的额定负荷也不通。产品样本上的额定负荷是负荷正对着一组钢球时的数值。如果负荷是作用在二组球道正中间，则额定负荷会大一些，下表列出了不同球列数的额定负荷的各种情况：

表1 Table 1

作用位置 额定负荷 Row position Load rating	3	4	5	6	8
作用位置 Row position	 Q ₁ =P ₀	 Q ₁ =P ₀	 Q ₁ =1.108P ₀	 Q ₁ =1.354P ₀	 Q ₁ =1.841P ₀
作用位置 Row position	 Q ₀ =P ₀	 Q ₀ =1.414P ₀	 Q ₀ =1.618P ₀	 Q ₀ =1.732P ₀	 Q ₀ =2.052P ₀
额定负荷 Load ratio	Q ₀ /Q ₁ =1	Q ₀ /Q ₁ =1.414	Q ₀ /Q ₁ =1.463	Q ₀ /Q ₁ =1.280	Q ₀ /Q ₁ =1.115

计算实例
Sample Calculations

- ① 根据下列条件计算轴承额定寿命：
Obtaining the rated life and lifespan L_h of the KENT slide bush used in the following conditions:
轴承型号 Slide bush: LM20
行程长度 Stroke length: 50mm
每分钟往复次数 Number of strokes per minute: 50次/分(cpm)
每套轴承承受负荷 Load per bush: 490N
从产品样本中查得LM-20额定动负荷为882N，额定寿命用下式算出：
The basic dynamic load rating of the slide bush is 882N from the dimension table. From equation (1), therefore, the rated life L is obtained as follows:
$$L = \left(\frac{f_w \cdot f_r \cdot f_c}{f_w} \cdot \frac{C}{P} \right)^3 \cdot 50$$

f_w = f_r = f_c = 1.0
$$= \left(\frac{882}{490} \right)^3 \cdot 50 = 292\text{km}$$
- ② 根据下列条件计算轴承额定寿命：
Obtaining the rated life and lifespan L_h of the KENT slide bush used in the following conditions:
轴承型号 Slide bush: LM20
行程长度 Stroke length: 1米 (m)
行走速度 Traveling speed: 10米/分钟 (m/min)
往复次数 Number of strokes per minute: 5次/分钟 (cpm)
时间寿命 Lifespan: 10.00小时 (hr)
总负荷 Total load: 980N
根据式 (2)，行走寿命可以从时间寿命中计算出：
From equation (2), the traveling distance within the lifespan is obtained as follows:
$$L_r = \frac{L \cdot 10^3}{2 \cdot f_s \cdot n \cdot 60} = \frac{292 \times 10^3}{2 \times 0.05 \times 50 \times 60} = 973\text{m}$$

根据式(2)，时间寿命计算如下：
From equation (2), the lifespan L_h is obtained as follows

$$L_r = \frac{L \cdot 10^3}{2 \cdot f_s \cdot n \cdot 60} = \frac{292 \times 10^3}{2 \times 0.05 \times 50 \times 60} = 973\text{m}$$

- The **SNB** linear motion ball bearing includes ball circuits that are spaced equally and circumferentially. The load rating varies according to the loaded position on the circumference. The value in the dimension table indicates the load rating when the load is placed on top of one ball circuit. If the MYT Slide bush is used with two ball circuits loaded uniformly, the load rating will be greater. The following table shows the values by the number of ball circuits in such cases:

- ② 根据下列条件选择轴承：
Selecting the slide bush type satisfying the following conditions:
设备承受的直线轴承数量 Number of slide bushes used: 4套
行程长度 Stroke length: 1米 (m)
行走速度 Traveling speed: 10米/分钟 (m/min)
往复次数 Number of strokes per minute: 5次/分钟 (cpm)
时间寿命 Lifespan: 10.00小时 (hr)
总负荷 Total load: 980N
根据式 (2)，行走寿命可以从时间寿命中计算出：
From equation (2), the traveling distance within the lifespan is obtained as follows:
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- ② 根据下列条件选择轴承：
Selecting the slide bush type satisfying the following conditions:
设备承受的直线轴承数量 Number of slide bushes used: 4套
行程长度 Stroke length: 1米 (m)
行走速度 Traveling speed: 10米/分钟 (m/min)
往复次数 Number of strokes per minute: 5次/分钟 (cpm)
时间寿命 Lifespan: 10.00小时 (hr)
总负荷 Total load: 980N
根据式 (2)，行走寿命可以从时间寿命中计算出：
From equation (2), the traveling distance within the lifespan is obtained as follows:
$$L_r = \frac{L \cdot 10^3}{2 \cdot f_s \cdot n \cdot 60} = \frac{292 \times 10^3}{2 \times 0.05 \times 50 \times 60} = 973\text{m}$$

假设使用二根轴，每根轴装二套直线轴承：
Assume the following with a pair of shafts each with two slide bushes:
f_c = 0.81, f_w = f_r = f_h = 1

结果从样本中查得LM30便可满足额定动负荷的要求。
As a result, LM30 is selected from the dimension table as the KENT slide bush type satisfying the value of C.

间隙和配合 Clearance and Fit

- 当一套标准型的直线轴承安装到轴上时，间隙不合适会使轴承过早地破坏，失效或运行不平衡。调整型和开口型直线轴承安装到可以控制外径尺寸的轴承座中，可以调整其间隙。然而过大的间隙调整会增加外圈的变形，影响精度和寿命。因此轴承与轴之间的间隙，外径与轴承座孔之间的间隙应根据使用条件来决定。表2为推荐的配合。
- When a standard-type **SNB** slide bush is used with a shaft, inadequate clearance adjustment may cause early bush failure and/or poor, rough traveling. The clearance adjustable slide bush and open

表2 Table 2

模型 Model	类别 Division	轴 Shaft			轴承座 Housing	
		一般配合 Normal fit	紧配合 Transitional fit	较松配合 Loose fit	较紧配合 Tight fit	
LM	High class	g6	h6	H7		J7
LMB	Precision class	g5	h5	H6		J6
LME	High class	h6	j6	H7		J7

注：间隙可以为零，也可以为负值，请注意运行情况 Note: The clearance may be zero or negative, Please attention the movement

轴和轴承座 Shaft and Housing

- 为了使直线轴承发挥最佳性能，必须使用高精度的轴和轴承座。
- To optimize performance of the **SNB** slide bush, high precision of the shaft and housing is required.

1. 轴 Shaft

SNB 直线轴承的钢球与轴的表面是点接触，因此轴的尺寸、公差、表面粗糙度和硬度极大的影响轴承运行性能，轴的生产应注意以下几点：
The rolling balls in the **SNB** slide bush are in point contact with the shaft surface. Therefore, the shaft dimensions, tolerance, surface finish, and hardness greatly affect the traveling performance of the bush. The shaft should be manufactured with due attention to the following points:

- 1) 因为表面粗糙度极大的影响运作的平稳性，因此轴表面粗糙度应达到 Ra0.4 或更好。
Since the surface finish critically affects smooth rolling of balls, grind the shaft at 0.4 S or better.
- 2) 最佳硬度是 HRC 60-64，硬度低于 HRC 60 会明显地降低寿命，故而降低了承载能力。另一方面，硬度超过 HRC 64，会增加轴承钢球的磨损。
The best hardness of the shaft is HRC 60 to 64. Hardness less than HRC 60 decreases the life considerably, and hence reduces the permissible load. On the other hand, hardness over HRC 64 accelerates ball wear.
- 3) 对同轴调整型和开口型直线轴承，其轴直径应尽可能低于产品样

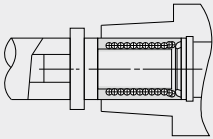
slide bush can be clearance adjusted when assembled in the housing which can control the outside cylinder diameter. However, too much clearance adjustment increases the deformation of the outside cylinder, to affect its precision and life. Therefore, the appropriate clearance between the bush and shaft, and clearance between the bush and housing are required according to the application. Table 2 shows recommended fit of the bush:

安装 Mounting

- 将直线轴承安装到轴承座孔中，不要敲打两端的挡圈(密封圈)，而是用手将其推入或轻轻地敲打(见图1)。轴承安装到轴承座之后需仔细地将其轴插入，注意不要碰击钢球。如果同时使用二根平行的轴，则轴承的平行度对保证轴承的平稳运行是非常重要的，一定要仔细地安装。

● When inserting the slide bush into the housing, do not hit the slide bush on the side ring holding the retainer but apply the cylinder circumference with a proper jig and push the slide bush into the housing by hand or lightly knock it in. (See Fig. 1) In inserting the shaft after mounting the bush, be careful not to shock the balls. Note that if two shafts are used in parallel, the parallelism is the most important factor to assure the smooth linear movement. Take care in setting the shafts.

Fig.1



安装实例 Examples of Mounting

- 通常的安装方法是将轴承推入座孔时阻力要适宜，然而我们建议尽量采用较松的配合，否则轴承的精度会下降。
- 图2-图6介绍了几种安装结构和固定方法供参考。
- The popular way to mount a slide bush is to operate it with an

appropriate interference. It is recommended, however, to make a loose fit in principle because otherwise precision is apt to be minimized. The following examples (Fig. 2 to 6) show assembling of the inserted bush in terms of designing and mounting, for reference.

Fig.2

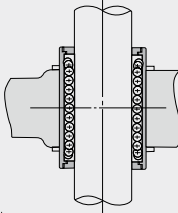


Fig.4

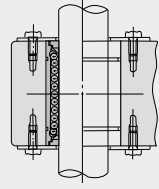


Fig.5

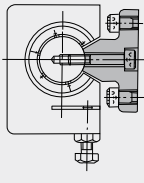


Fig.6

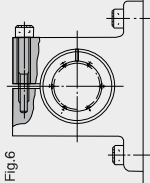


Fig.3

