

## 7. Lubrication

As bearings in NTN bearing units have sufficient high-grade grease sealed in at the time of manufacture, there is no need for replenishment while in use. The amount of grease necessary for lubrication is, in general, very small. With the NTN bearing units, the amount of grease occupies about a half to a third of the space inside the bearing.

### 7.1 Maximum permissible speed of rotation

The maximum speed possible while ensuring the safety and long life of ball bearings used in the unit is limited by their size, the circumferential speed at the point where the seal comes into contact, and the load acting on them.

To indicate the maximum speed permissible, it is customary to use the value of  $dn$  or  $d \cdot n$  ( $d$  is the bore of the bearing;  $d$  is the diameter of the pitch circle  $= (I.D. + O.D.)/2$ ;  $n$  is the number of revolutions).

Problems connected with the lubrication of bearings are the generation of heat and seizures occurring at the sliding parts inside the bearing, in particular at the points where the ball is in contact with the retainer, inner and outer ring. The contact pressure at the points where friction occurs on the retainer is only slightly affected by the load acting on the bearing; the amount of heat generated there is approximately in proportion

to the sliding velocity. Therefore, this sliding velocity serves as a yardstick to measure the limit of the rotating speed of the bearing. In the case of a bearing unit, however, there is another large factor that has to be taken into account—the circumferential speed at the part where the seal is in contact.

The graph in Fig. 7.1 indicates the maximum speed of rotation permissible, taking into account the aforementioned factors.

There are two common methods of locking the bearing unit onto the shaft—the set screw system and the eccentric collar system. However, in both of these systems high-speed operation will cause deformation of the inner ring, which may result in vibration of the bearing. For high-speed operation, therefore, it is recommended that an interference fit or a clearance fit with a near-zero clearance be used, with a shaft of the larger size as shown later in this manual in Fig. 8.1, Fig. 8.6.

For standard bearing units with the contact type seal, the maximum speed permissible is  $120,000/d$ . Where a higher speed is required, bearing units with the non-contact type seal, are advised. Please contact NTN regarding the use of the latter type. Additionally, it is necessary that the surface on which the housing is mounted be finished to as high a degree of accuracy as possible. A regularity of within  $\pm 0.05\text{mm}$ ,  $\pm 0.002$  inch is required.

### 7.2 Replenishment of grease

#### 7.2.1 Sealed-in grease

With NTN bearing units, no relubrication is the general rule. The standard self-lubricating type of bearing units contain high-grade lithium-based grease which, being suitable for long-term use, is ideal for sealed-type bearings. They also feature NTN's unique sealing device. Relubrication, therefore, is unnecessary under most operating conditions.

At high temperatures, or where there is exposure to water or excessive dust, the highest quality grease is essential. Therefore, NTN uses its own specially selected brands which are shown in Table 7.1. It is necessary to use the same brand when replenishing grease.

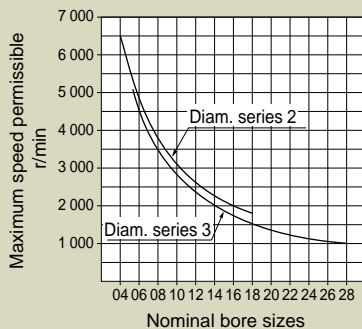


Fig. 7.1

Table 7.1 Brand of grease used in NTN bearing units

Bearing units	Grease			Symbols	Operating temperature range
	Name of grease	Thickening agent	Base oil		
Standard	Alvania grease 3	Li soap	Mineral oil	D1	$-15^{\circ}\text{C}$ to $+100^{\circ}\text{C}$ , ( $+5^{\circ}$ to $+212^{\circ}\text{F}$ ).
Heat-resistant	Darina grease 2	Non-soap	Mineral oil	HT1D1	Normal temp. to $+140^{\circ}\text{C}$ ( $284^{\circ}\text{F}$ ).
Heat-resistant	SH44M	Li soap	Silicone oil	HT2D1	Normal temp. to $+200^{\circ}\text{C}$ ( $392^{\circ}\text{F}$ ).
Cold-resistant	SH33L	Li soap	Silicone oil	CT1D1	$-60^{\circ}\text{C}$ ( $-76^{\circ}\text{F}$ ) to normal temp.

### 7.2.2 Mixing of different kinds of grease

Whether or not different kinds of grease may be mixed usually depends on their thickeners. The commonly used criteria are shown in Table 7.2. Properties which are most susceptible to influences from mixing are viscosity, dropping point and penetration. Water and heat resisting properties as well as mechanical stability are also lowered. Therefore, when mixing in a grease which is different to that which is already in use, it is essential that the thickener (soap base) and the base oil be of the same group.

When relubricating NTN bearing units, it is advisable to use the brands of grease shown in Table 7.1.

**Table 7.2** Mixing properties of grease

Soap base	Ca	Na	Al	Ba	Li
Ca	○	△	△	×	△
Na	△	○	△	×	×
Al	△	△	○	×	×
Ba	×	×	×	○	×
Li	△	×	×	×	○

○ Mixing will not produce any appreciable change of properties.

△ Mixing may produce considerable variations of properties.

× Mixing will cause a drastic change of properties.

### 7.2.3 Relubrication frequency

Relubrication frequency varies with the kind and quality of grease used as well as the operating conditions. Therefore, it is difficult to establish a general rule, but under ordinary operating conditions, it is desirable that grease be replenished before one third (1/3) of its calculated life elapses. It is necessary, however, to take into consideration such factors as hardening of grease in the oil hole, making replenishment impossible; deterioration of grease while operation of the machine is suspended, and so forth.

In Table 7.3 below are shown standard relubrication frequencies. Irrespective of the calculated life of the grease, this list takes into consideration such factors as the rotational speed of the bearings, operating temperatures and environmental conditions, with a view to safety.

### 7.2.4 Re-greasing

The performance of a bearing is greatly influenced by the quantity of grease. In order to avoid over-filling, it is advisable to replenish the grease while the machine is in operation.

Continue to insert grease until a little oozes out from between the outer ring raceway and the periphery of the slinger, for optimum performance.

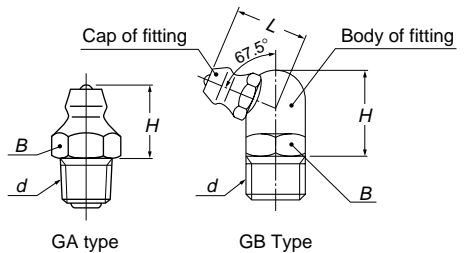
**Table 7.3** Standard relubrication frequencies

Type of unit	Symbol	dn Value	Environmental conditions	Operating temp. °C, °F	Relubrication frequency	
					Hours	Period
Standard	D1	40,000 and below	Ordinary	-15 to +80, +5 to +176	1,550 to 3,000	6 to 12 mo.
Standard	D1	70,000 and below	Ordinary	-15 to +80, +5 to +176	1,000 to 2,000	3 to 6 mo.
Standard	D1	70,000 and below	Ordinary	+80 to +100, +176 to +212	500 to 700	1 mo.
Heat-resistant	HT1D1	70,000 and below	Ordinary	+100 to +140, +212 to +284	300 to 700	1 mo.
Heat-resistant	HT2D1	70,000 and below	Ordinary	+140 to +170, +284 to +338	300 to 700	1 mo.
Heat-resistant	HT2D1	70,000 and below	Ordinary	+170 to +200, +338 to +392	100	1 wk.
Cold-resistant	CT1D1	70,000 and below	Ordinary	-60 to +80, -76 to +176	1,000 to 2,000	3 to 6 mo.
Standard	D1	70,000 and below	Very dusty	-15 to +100, +5 to +212	100 to 500	1 wk. to 1 mo.
Standard	D1	70,000 and below	Exposed to water splashes	-15 to +100, +5 to +212	30 to 100	1 day to 1 wk.

## 7.3 Grease fitting

NTN bearing units are, as a general rule, provided with a grease fitting made of brass, as shown in Table 7.4, and a grease gun is used for regreasing. However, button-head and pin types may also be furnished on demand.

Grease fitting dimensions and the designation of applicable bearing units are given in Table 7.5.



**Table 7.4 Grease fitting types available for bearing units**

Types of housing	NTN standard grease fitting types
Pillow type	GA type
Flange type	GA type
Take-up type	GB type
Hanger type	GA type
Cartridge type	GA type

**Table 7.5 Grease fitting dimensions and designations of applicable bearing units**

### GA type (Vertical type)

NTN Designation	<i>d</i>	<i>H</i>		<i>B</i>	
		mm	inch	mm	inch
GA-1/4-28 UNF	1/4-28 UNF	8.5	0.335	7	0.276
GA-PF1/8	G1/8	12	0.472	10	0.394
GA-PF1/4	G1/4	14	0.551	14	0.551

### GB type (67.5°)

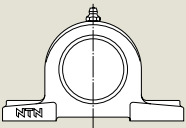

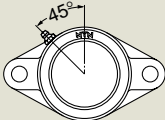
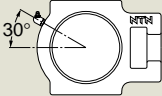
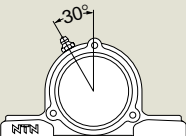
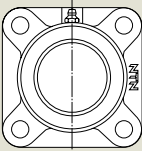
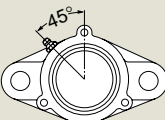
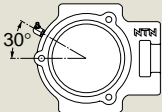
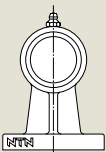
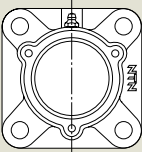
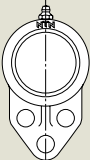
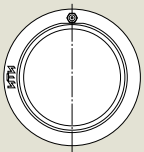
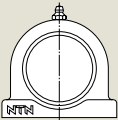

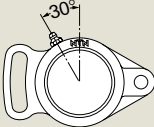
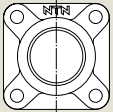
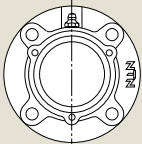
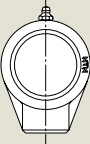
NTN Designation	<i>d</i>	<i>H</i>		<i>L</i>		<i>B</i>	
		mm	inch	mm	inch	mm	inch
GB-1/4-28 UNF	1/4-28 UNF	10.5	0.413	9.3	0.366	8	0.315
GB-PF1/8	G1/8	14.2	0.559	13.5	0.531	10	0.394
GB-PF1/4	G1/4	15	0.591	13.5	0.531	14	0.551

Nominal screw size <i>d</i>	Series 2	Series X	Series 3
1/4-28 UNF	203-209	X05-X08	305-309
G1/8	210-215	X09-X14	310-315
G1/4	216-218	X15-X20	316-328

Note: Screw size for the cartridge type is 1/4-28 UNF.  
That for C310D1 to C328D1 is G1/8 (PF1/8).

## 7.4 Standard location of the grease fitting

Standard location of grease fitting on the housing for the relubricatable bearing units of each type is illustrated below.

			
P, PL, PX, S-P, type	C-F type	FL, FLU, FLX, S-FL type	T, TX, S-T type
			
C-P type	F, FU, S-F (#204#205), FS type	C-FL type	C-T type
			
HP type	C-FS type	FH type	C,Cx type
			
UP type	FC, FCX, S-FC type	FA type	
			
Except #204#205 F, FU, FX, S-F type	C-FS type	HB type	