

INTRODUCTION

The bearings described in this section of the catalog have been designed to meet the specific needs of the airframe industry. Most of these bearings conform to military and national standards current at the time of publication of the catalog.

Before selecting specific airframe needle roller bearings, the Engineering Section should be reviewed for detailed information concerning:

- Bearing type
- Material section
- Load ratings/life calculations
- Application criteria

IDENTIFICATION

The code letters **ATF** denote a sealed airframe track roller bearing with a single row of needle rollers, internal thrust washers and a crowned o.d.

The code letters **ATL** denote a sealed airframe track roller bearing with two rows of needle rollers and internal thrust washers.

The code letters **NBF** denote an airframe track roller bearing with a single row of needle rollers.

The code letters **NBL** denote an airframe track roller bearing with two rows of needle rollers.

The code letters **NBC** denote an airframe bearing with a single row of needle rollers. Type **NBC** bearings must be mounted in supporting housings.

The code letters **NCC** denote an airframe bearing with a single row of needles and a drawn shell that must be mounted in supporting housings.

The code letters **NBE** denote a self-aligning airframe needle roller bearing with a single row of needle rollers. The code letters **NBK** denote an airframe bearing similar to type **NBE** but with two rows of needle rollers. Both types **NBE** and **NBK** bearings must be mounted in supporting housings.

The code letters **HRS** denote a stud type airframe track roller bearing with a single row of needle rollers. This bearing can be sealed.

The code letters **HRSC** denote a sealed, stud type airframe track roller bearing with a single row of needle rollers and a crowned o.d.

All of these various types of airframe needle roller bearings meet the requirements of U.S. Military Specification AS39901 and the following Military Standards:

bearing type	military standard	bearing type	military standard
ATF	SAE AS21438	NBC	SAE AS24461
ATL	SAE AS21439	NBE	SAE AS24463
NBF	SAE AS24465	NBK	SAE AS24464
NBL	SAE AS24466	HRS	SAE AS21432
NCC	SAE AS24462	HRSC	SAE AS21447

RBC airframe needle roller bearings are permanently marked with the bearing designation (which includes the bearing type code) and the military standard number as listed in the tabular pages.

Since these bearings are quite often supplied prelubricated to meet special requirements, the airframe manufacturer's parts list or another reliable source should always be consulted when ordering bearings to ensure the correct lubricant is used.



ATF



ATL



NBF



NBL



NBC



NBE



NBK



HRS/HRSC

BEARING TYPE SELECTION

Types **ATF** and **NBF** bearings are designed for use as track rollers to withstand heavy rolling loads. If their full radial capacity is to be realized, they should be mounted on high strength bolts. Also, the initial alignment between the bearing centerline and the surface of the track should be very good. To prevent deflections under load that would cause poor load distribution along the length of the rolling elements, the bearing should be straddle mounted in a rigid housing, and the track should be rigidly supported.

Types **ATF** and **NBF** bearings are sometimes cantilever mounted on high strength bolts. In this case, the deflection of the supporting member, the mounting bolt and the track should be balanced as carefully as possible to improve the load distribution. If this cannot be accomplished, the track should be crowned, or preference should be given to the type **ATF** which has a crowned outer ring.

Types **ATL** and **NBL** bearings are intended to carry rolling loads which are greater than those for which types **ATF** and **NBF** are designed. Since types **ATL** and **NBL** bearings are quite long, it is important to mount them on high strength shafts or bolts. The alignment between the bearing axis and the track is even more critical than with types **ATF** and **NBF**. Types **ATL** and **NBL** bearings must be straddle mounted.

Types **ATF** and **ATL** bearings are sealed and have internal thrust washers, both of which increase the life in case the bearings are infrequently relubricated.

Type **NBC** bearings are designed primarily to carry heavy static loads, or moderate loads under oscillation or slow rotation. This type of bearing can tolerate incidental thrust loads only through the outer ring when the retaining washers are properly backed up.

Type **NBC** bearings must be supported by housings and mounted on high strength shafts if their inherent load ratings are to be realized. Initial alignment must be good and operating deflections must be minimized to insure uniform load distribution along the length of the rolling elements.

Type **NCC** bearings are designed primarily to carry moderate loads under oscillation or slow rotation. This type of bearing should not be used in applications that require thrust capability. The **NCC** bearings are the minimal cross-section available in standard airframe needle bearings.

Type **NCC** bearings must be supported by housings and mounted on high strength shafts if their inherent load ratings are to be realized. Initial alignment must be good and operating deflections must be minimal to insure uniform load distribution along the length of the rolling elements.

Types **NBE** and **NBK** bearings are also used primarily for heavy static loads, and will also handle oscillation or slow rotation. They are designed to accommodate only minor locational thrust loads. Types **NBE** and **NBK** bearings, like type **NBC**, must be supported by housings and mounted on high strength shafts if their inherent load ratings are to be realized.

Types **NBE** and **NBK** bearings are of larger cross section than the type **NBC**, and, if properly mounted, will tolerate misalignment up to $\pm 5^\circ$. They are **not** designed to self-align under heavy loads. If alignment must be accommodated while the bearings are highly loaded, the torque required to overcome the friction at the spherical surfaces may overload the rolling elements.

Types **HRSC** and **HRS** bearings are designed for use as track rollers to carry moderate rolling loads. The bearings have an integral stud, which eliminates the need for a separate mounting bolt.

Types **HRSC** and **HRS** are to be cantilever mounted. Under load, the supporting member, the bearing stud, and the track may deflect to produce misalignment between the bearing and the track. These deflections should be carefully balanced to minimize the effective misalignment, and improve the load distribution. Where misalignment is a factor, preference should be given to type **HRSC**, which has a crowned outer ring.

CONSTRUCTION

All airframe needle roller bearings incorporate materials, protective finishes and relubrication facilities required for airframe service.

MATERIALS

The outer rings, inner rings and self-aligning rings are made of high carbon chrome steel, hardened and precision ground.

Studs are made of bearing quality steel, heat treated to 60 HRC minimum in the raceway area and 36-44 HRC in the shank and thread areas.

The rollers are made of high carbon chrome steel, through hardened, precision ground and lapped.

The retaining washers are made of high carbon steel, and hardened. The bearing components may also be available in a variety of stainless steels. These specialty steels have been developed for use in extremely corrosive environments and may be available upon request.

The **NCC** series thin shell is made from low carbon steel that is case hardened. The retaining washers are soft low carbon steel.

RELUBRICATION FEATURES

The inner rings of types **ATF, ATL, NBF, NCC** and **NBL** bearings are provided with relubrication grooves and holes. Relubrication features are omitted from the outer rings since they would be undesirable in track roller bearings or thin shells.

Types **HRSC** and **HRS** can be provided with lubrication fittings in the flanged end or threaded end of the stud, or with no relubrication provision.

Grooves are provided in the bore and outside diameters of the larger types **NBC, NBE** and **NBK** bearings with drilled holes leading to the needle roller complement to allow relubrication through the housing or the shaft. The smaller sizes, as noted in the tabular pages, do not have relubrication grooves and holes in their inner rings since the mounting shafts would be considerably weakened by the required drilled lubrication holes.

The right is reserved to change material specifications or to revise designs without notice.

PROTECTIVE FINISHES

Outer rings of types **ATF, ATL, NBF, NBL, HRSC** and **HRS** bearings, which are subjected to heavy rolling loads, may be chrome plated on the exposed surfaces for corrosion protection. The other external surfaces of the bearings, except the inner ring bore, (where applicable) are cadmium or zinc-nickel plated.

Types **NBC, NCC, NBE** and **NBK** bearings are cadmium or zinc-nickel plated on all external surfaces except the bore of the inner ring.

LOAD RATINGS

The **limit** load ratings listed in this catalog are the maximum radial loads which can be applied without impairing the subsequent function of the bearing in airframe applications.

The **ultimate (static fracture)** load ratings are not less than 1.5 times the limit load rating.

For types **ATF, ATL, NBF** and **NBL** bearings, the ultimate load rating assumes an unsupported outer ring. Therefore the **limit** load ratings listed on the tabular pages correspond to 2/3 of the **limit** load ratings of the fully supported bearing, or 4/9 ASC. The **ultimate (static fracture)** load ratings are not less than 1.5 times the **limit** load rating (2/3 ASC).

In addition to heavy static radial loads, types **ATF, ATL, NBF** and **NBL** bearings must withstand heavy rolling loads under slow rotation. The **capacity as a track roller** is the load the bearing will carry as a track roller for an L10 life of 20,000 revolutions. The **capacity as a track roller** is based on 1/3 Aircraft Static Capacity.

To calculate the L_{10} life, in revolutions, of a type **ATF, ATL, NBF** and **NBL** bearing, the following formula should be used:

$$TL = \frac{20000}{\sum T_i \left(\frac{P_i}{CTR} \right)^6 + \sum t_i \left(\frac{p_i}{CTR} \right)^{10/3}}$$

Where TL = total life (L_{10})

CTR = capacity as a track roller

P_i = loads greater than CTR

p_i = loads less than CTR

T_i = fraction of total revolutions at load P_i

t_i = fraction of total revolutions at load p_i

Under no circumstances should the applied load exceed the limit load rating.

In the case of types **NBC, NCC, NBE** and **NBK** bearings, the ultimate load ratings correspond to the Aircraft Static Capacity (ASC). The limit load rating listed is 2/3 of the ultimate load rating.

Types **NBC, NCC, NBE** and **NBK** bearings are generally applied where they carry only moderate loads while oscillating or rotating slowly, but they are expected to carry heavy static radial loads or shock loads. For this reason the basic (dynamic) load ratings are not listed. If the basic load ratings are required for specific bearings, please consult the Aircraft Engineering Department.

If types **NBE** and **NBK** bearings are required to carry more than light loads while self-aligning, the torque required to overcome the friction between the spherical surfaces may add substantially to the radial loads on the rolling elements. Under such circumstances, please consult the Engineering Aircraft Group.

Type **HRS** and **HRSC** track roller bearings have heat treated studs as such working loads are not limited by stud strength. The limit load ratings listed on the tabular pages correspond to 2/3 of ASC. The **ultimate (static fracture)** load ratings are not less than 1.5 times the limit load rating (ASC). The capacity as a track roller for 20,000 revolutions L10 life is $1/3 \cdot ASC$.

TRACK CAPACITY

When applying types **ATF, ATL, NBF, NBL, HRS** and **HRSC** track roller bearings, the compressive strength of the track material is often the critical design factor for the application. Where listed, the **track capacities** are based on a track harness equivalent to 40 HRC. For other hardness values multiply the **track capacity** listed on the tabular pages by the appropriate factor selected from Table 1.

When using track materials with high hardness, it must be remembered that the load applied to a bearing should not exceed the limit load for that bearing.

TABLE 1

Track Hardness	Track Capacity Factor
HRC	
20	0.4
25	0.5
30	0.6
35	0.8
40	1.0
45	1.4
50	1.9
55	2.6
58	3.2

TEMPERATURE

The unsealed airframe needle bearings listed herein can be operated at temperatures up to 400°F (200°C) if a suitable lubricant is used. Subjecting these bearings to higher temperatures will result in a loss of capacity which depends upon the length of time that the bearings are exposed to the higher temperature. Temperature differential between bearing parts should be watched to prevent take-up of internal clearance due to differential expansion.

The operating temperature of the sealed bearings is limited by the seal material and should not exceed 250°F (120°C).

The data herein permit tentative bearing selection but before the application is finalized, consult the Engineering Aircraft Group.

SPECIAL BEARINGS

RBC supplies airframe bearings, in addition to types **ATF** and **ATL**, which are sealed to help retain lubricants and exclude foreign matter. For superior performance, the sealing arrangement has been designed to be cable of withstanding a pressure of 400 bar. We also supply bearings with special configurations, materials, protective finishes, tolerances and lubricants. Please consult the Engineering Department for details.

SPEED

Airframe Needle Roller Bearings are intended for use in low speed, high load applications. The bearing speed should not exceed 100 RPM. Speeds in excess of 100 RPM will greatly reduce the bearing life.

LUBRICATION

The most common greases used in aircraft track roller and cam follower applications are MIL-PRF-23827 TYPE 1 and MIL-PRF-81322 grease. Either grease is available for catalog items, if a specific grease is preferred then specify it upon placing the order.

Military Spec. No.	MIL-PRF-23827 TYPE 1	MIL-PRF-81322
Grease Name	Aeroshell 33	Mobil 28
Operating Temp.	-65°F to 250°F	-60°F to 350°F

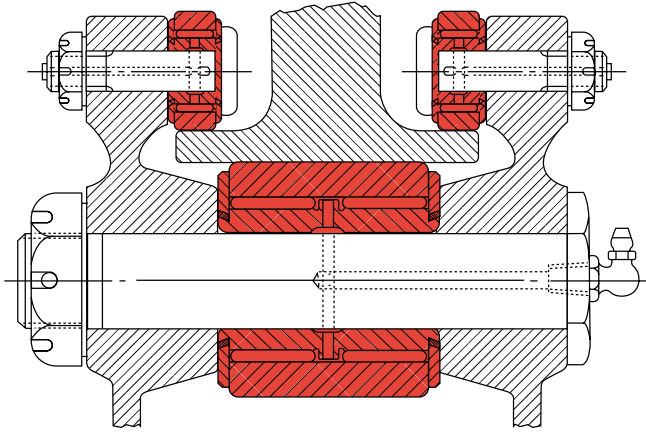
OPERATING TEMPERATURES FOR BEARING COMPONENT MATERIALS

CHART I - RINGS, BALLS AND ROLLERS

Material	Approximate Chemical Analysis-%	Temp. °F	Hardness R _c	Operating Temperature										
				-100°F -73°C	-65°F	0°F -17°C	100°F 38°C	200°F 93°C	250°F	300°F 149°C	400°F 204°C	500°F 260°C	600°F 316°C	700°F 371°C
Low alloy carbon-chromium bearing steels. 52100 and others per ASTM A295	1C 0.5-1.5Cr 0.35Mn	70	60	STANDARD DIMENSIONAL STABILIZATION <0.0001 in/in dimensional change in 2500 hours at 212°F. Good oxidation resistance.							Note: ASTM A295 bearing steels are suitable for many applications up to 250°F but are not as dimensionally stable as they are at temperatures below 212°F.			
Low alloy carbon-chromium bearing steels. 52100 and others per ASTM A295	1C 0.5-1.5Cr 0.35Mn	70 350 450		Heat stabilized per FS136 <.0001 in./in dimensional change in 2500 hours at 300°F. When given a stabilizing heat treatment, A295 steel is suitable for many applications in the 350-450°F range; however, it is not as stable dimensionally as it is at temperatures below 350°F. If utmost stability is required, use materials in the 600°F group below.										
Deep hardening steels for heavy sections per ASTM A485	1C 1-1.8Cr 1-1.5 Mn .06Si	70 450 600	58 55 52	As heat treated and tempered, it is stabilized, <.0001 in/in dimensional change in 2500 HR at 300°F (149°C).										
Carburizing steels per ASTM A534		70	58	4118, 8620 steel frequently used to achieve extra ductility in inner rings for locking device bearings. 3310 and others used for extra thick section rings.										
(a) low alloy 4118 (b) 8620 (c) high nickel 3310	.2C, .5Cr, .80Mn, .12Mo .2C, .5Cr, .80Mn, .20Mo, .55Ni .10C, 1.60Cr, .50Mn, 3.50Ni													
Corrosion Resistant 440C stainless steel per ASTM A756	1C 18Cr	70	58	Excellent corrosion resistance.										
Corrosion Resistant 440C stainless steel per ASTM A756	1C 18Cr	70 450 600	58 55 52	As heat stabilized for maximum hardness at high temperatures (FS238). Good oxidation resistance at higher temperatures. Note load capacity drops off more rapidly at higher temperatures than M50 shown below, which should be considered if loads are high. <.0001 in/in dimensional change in 1200 hours.										
M-50 Medium High Speed	4Cr. 4 Mo 1V 0.8C	70 450 600	58 55 52	Recommended where stable high hardness at elevated temperature is required. <.0001 in/in dimensional change in 1200 hours at 600°F.										

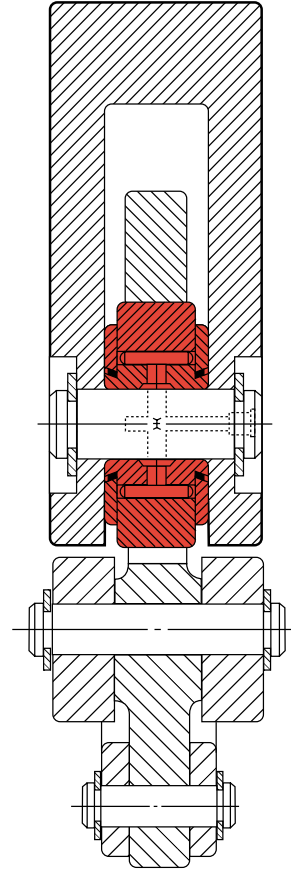
Dimensional stability data shown above is the permanent metallurgical growth and/or shrinkage only. Thermal expansion effects are not included.

Bearings have been made of special material for operation at temperatures above 800°F consult Torrington engineers regarding the application.



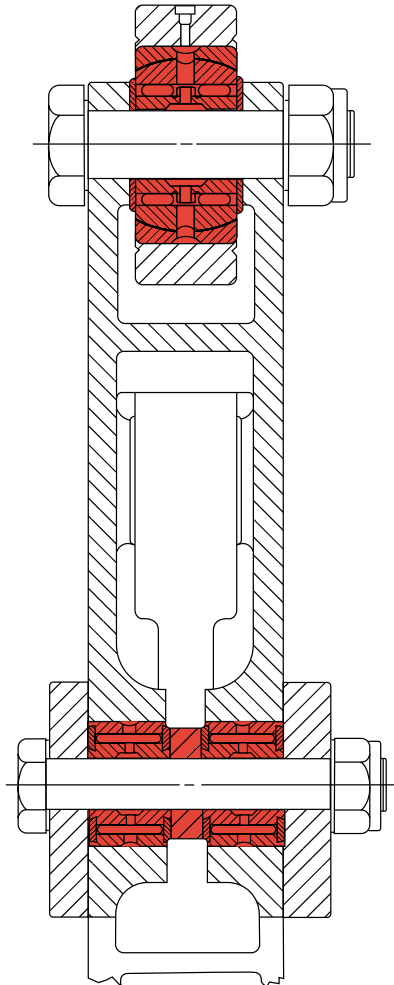
FLAP TRACK

Airframe needle roller bearings serve where weight and space are vital factors. They give high capacity anti-friction performance on flap tracks of large high-speed, high-altitude planes.



CANOPY

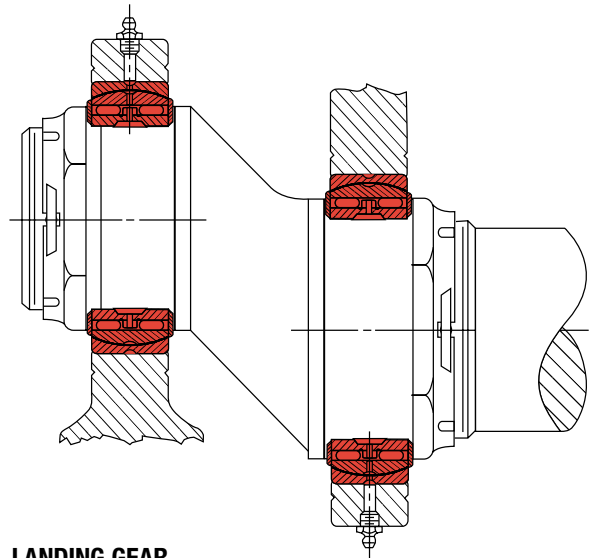
The high capacity and anti-friction characteristics of airframe needle roller bearings are ideal for canopy lock rolls where failure to operate may be fatal.



BELL CRANK

The small size and light weight of the airframe needle roller bearing permits reduction in material required in surrounding parts.

The high capacity offers superior anti-friction operation under severe service conditions.



LANDING GEAR

The high static capacity of the airframe needle roller bearing is an important factor in meeting the rugged impact loads found in aircraft landing gears.

Small size and simple lubrication contribute to lighter assemblies and long service life.