

An Introduction to Mounted Unit Bearings

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NTN Ultra-Class pillow block mounted unit cutaway to expose insert bearing

Introduction

Bearings come in a seemingly endless array of sizes and configurations, each tailored to meet the specific demands of a particular application. The objective of this guide is to provide a basic introduction to a specific group of bearings—*mounted unit bearings*—commonly referred to as *pillow block* and *flange* bearings.

This family of bearings is distinctive because the *bearing unit* is considered as a product item, when in fact it actually consists of a ball or roller bearing installed within a separate fixture called the *housing*. These housings are most commonly made of cast iron but may also be made of other metals or nonmetallic materials.

The housing provides rigidity and secure positioning for the bearing within the application. It also simplifies the task of replacing the bearing, as the housing and bearing can be replaced as a complete unit. Bearing units also offer the additional advantage of being an “off the shelf” housed bearing product.

Also covered in this guide, in addition to housings and their features, are a number of the other product design features, attachments and special options that make these versatile bearings a basic item in many applications and industries.

While it’s not possible to cover every aspect of bearing unit design technology, we will attempt to provide you with a basic understanding of the principles of how they have been designed and how they function. Whatever your level of familiarity, we hope to further your understanding of mounted units, or that the information provided will serve as a refresher course for you or assist you in training others.

Rolling Element Bearings and Tolerances

No discussion of mounted units can begin before examining the heart of every bearing unit—the bearing inside—and the significance of precision manufacturing to specific guidelines and tolerances.

The precise operation of a rolling element bearing increases incrementally as each of the individual components approaches “perfection” in its manufacture. Bearings manufactured within tighter tolerance ranges provide greater accuracy of shaft rotation, quiet operation, longer bearing life and contribute to higher speed capability.

Electric motor bearings are generally acknowledged as being manufactured to extremely tight tolerances. NTN applies the same precision manufacturing processes for electric motor bearings to insert bearings for mounted units—that means that they too go beyond average expectations, an important consideration when selecting any bearing component.

Major Types of Mounted Units

Housed bearings are categorized by the type of bearing that is inserted into the housing. The two types are *ball bearing units* and *roller bearing units*. This guide will focus primarily on those mounted unit bearings using radial ball bearing inserts. These units are available in a wide variety of configurations and serve an even wider array of applications. The illustrations on this page show some of the major types of mounted units featuring radial ball bearing inserts available from NTN:

- Pillow block units
- Two-bolt flange units
- Three-bolt flange units
- Four-bolt flange units
- Four-bolt square piloted flange units
- Four-bolt round piloted flange units
- Take-up units
- Cylindrical cartridge units
- Hanger units
- Other specialized flange units

Note: The standard line of NTN mounted units are manufactured to ISO specifications (the catalog lists both inch and metric dimensions), while the premium grade Ultra-Class line of NTN mounted units is uniquely manufactured to American industry standards.

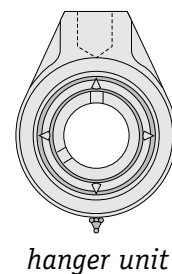
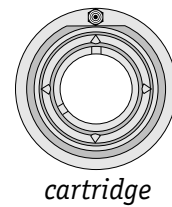
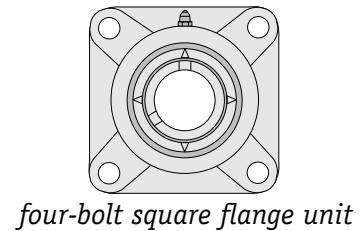
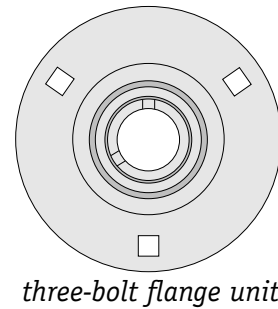
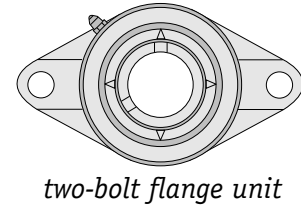
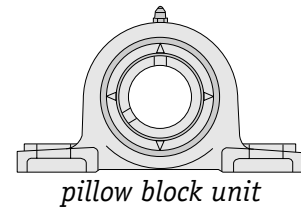
As mentioned, the wide range of mounted bearing units includes others that feature roller bearing inserts and heavier duty housings. Below are some of the units also available from NTN:

- *Plummer block units* — Also known as split pillow blocks, these units are designated as SAF or SN units.
- *SPW and SPWA Pillow block units* — These units feature sealed spherical bearing inserts and one-piece housing for simplified installation and superior bearing protection.
- *SFCW flange block units* — Like the SPW units, these flanged units are sealed, one-piece constructed units.

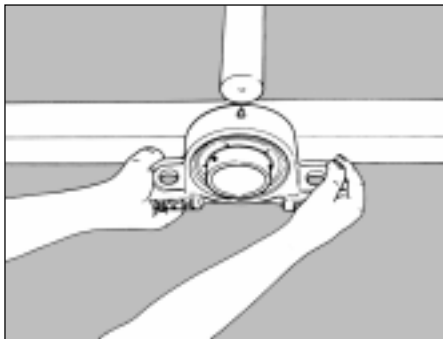
Due to the complexity and variety of these roller bearing units, they are not covered in this guide. Contact NTN for more detailed material on these bearing units.

General Application of Bearing Units

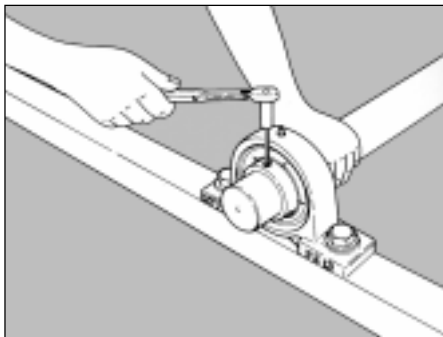
Bearing units have found widespread acceptance in the many industrial applications that carry radial or combination radial and thrust loads. Both types (ball and roller) are used to support shafts, pulleys, augers, and conveyors, as well as other components involved in the transmission of power. They are used in applications involving chain and belt drives, fans and blowers, conveyors, in material handling and food processing machinery, textile and mining equipment, and as



well as in baggage handling systems. Generally, bearing units containing radial ball bearings are used in light-to-heavy duty applications. In contrast, units featuring roller bearing inserts are used only in heavy duty applications.



slip fit



tightening the set screw

Why Choose Mounted Unit Bearings?

Off-the-shelf bearing units offer a number of advantages over unmounted (naked) bearings. The housed unit simplifies the installation process: with unmounted bearings, a customer supplied housing must be manufactured to precise, predetermined tolerances to ensure proper positioning and operation of the bearing; with housed units, the difficult housing manufacturing process has been completed by the bearing manufacturer, providing the end user with a unitized “bolt-on” assembly. Working with a complete assembly greatly simplifies the design of adjacent machinery components.

The most common ball bearing units contain insert bearings almost identical to the 6200 and 6300 series electric motor bearings. Upon comparison, the most obvious differences would be: 1) the modification of the bearing’s *outside diameter (O.D.)* — the insert bearing in NTN housed units features a curved or spherical O.D. — and, 2) an extended *inner ring (I.R.)*.

The insert’s spherical O.D. fits into a corresponding spherical *inner diameter (I.D.)* of the housing and allows the insert bearing to slip within the housing and to compensate for any *misalignment*. The misalignment may occur for a number of reason; either the bearing unit has been mounted improperly; or, the span of the shaft between the bearings is long and/or, heavy loads are present. The latter two could cause shaft deflection (flexing), resulting in misalignment. Without this aligning feature, the bearing raceways and balls would be subjected to higher stress levels which in turn would lead to shorter bearing life, or premature bearing failure.

The inner ring has been extended to provide the means to secure the insert bearing to the shaft. Various locking devices will be covered in greater detail later in the guide.

Limitations of Bearing Units

While ball bearing units are useful in applications requiring a simply designed, misalignment tolerant, easily mounted, versatile bearing, they do have limitations. One is that these bearings are generally sealed with heavy contact seals, therefore their speed capability is limited. In addition, they are not typically used in high precision applications because of their loose shaft fits.

Ball Bearing Mounted Unit Components

There are six basic topics to explore when describing mounted unit bearings which will be covered in this guide.

- The properties and characteristics of the various **housings** that hold the insert bearing,
- The properties and characteristics of the **insert bearing** ,
- The **seals** that protect the bearing,
- **Maintenance-free** and **relubrication type units** , and their **lubrication** ,
- **Locking devices** for fixing the unit to the application, and,
- Proper methods for **mounting** the units.

The Bearing Housing

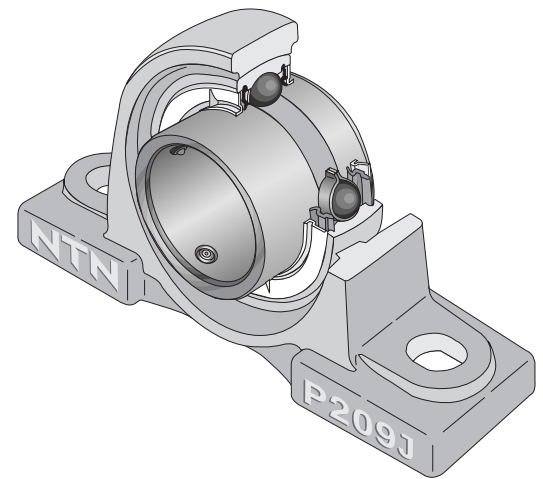
Whether the housing is a pillow block or flange type, the purpose it serves is the same—to position the insert bearing, as well as to support loads transferred from the shaft through the bearing.

The housings are manufactured with flat mounting surfaces that simplify the installation of the unit. In pillow blocks, the flat surface is a straight footed support at the base of the housing — the mounting surface of a pillow block is parallel to the axis of the shaft. Conversely, in flange units, the shaft runs at a 90° angle to the mounting surface to which the unit is attached.

In addition to the different types of housings available, another major option exists. The housing may be manufactured to allow for the relubrication of the bearing. A housing without this option is described as being *maintenance-free* . A housing with this option is described as a relubricatable, or *relube* , type unit.

While the maintenance-free housing is made with no provision for regreasing the bearing insert, the relubricative-type housing is drilled and tapped (threaded) to accept a grease fitting. In the U.S. the fitting typically is available in inch sizes; outside the U.S. the fitting would come in metric sizes. In packaging, the fitting may be included within the carton but not assembled in order to prevent shearing during shipment. In this case, the drilled hole is plugged to prevent bearing contamination. Most units are packaged fully assembled.

The drilled hole leads through the housing to a circumferential grease groove which has been machined along the housing's bore. This groove is slightly offset to either side of the outer ring's width, a variation dependent on the manufacturer's specifications. When ordering a replacement insert bearing and when installing it within the housing, it is important to identify the small offset holes in the outer ring of the insert bearing and to ensure that they are positioned



maintenance-free housing cut to show insert components

on the same side as the groove machined in the housing. Failure to position the bearing properly means that the lubricant will not be able to flow into the bearing.

Housing Materials

Most general purpose bearing housings are designed and constructed as a single piece. They are cast of high grade gray iron, commonly called *cast iron*. After the housing is cast, the base is machined to provide a perfectly flat mounting surface. The inside diameter of the housing is also machined to provide the proper fit with the insert bearing. Cast iron bearings provide good rigidity and strength for most applications, but for heavy load applications a variety of other housing materials are also available that address the special requirements of those applications.



cast iron housings

Malleable cast iron housings are another one-piece designed housing, but they are less rigid and therefore less susceptible to fracture than gray iron housings. They are more suitable for applications where shock loads are present.



pressed steel housing

Pressed steel housings are, as their name implies, pressed, or stamped, of plain carbon steel and are much less rigid than either of the cast iron versions previously described. They are generally used for light duty applications.

These units are designed as two-piece housings; the insert bearing is cradled between the two housing sections and the assembled unit is held in place with the bolts that attach it to the application. Although these units do not have the machined bases of the other units, they do provide a relatively stable foundation for the insert bearing while providing the lightest, most economical housing possible.

Some applications using pressed steel housings additionally require a rubber grommet (tire) around the insert bearing's O.D. This tire serves to dampen noise and is designated by an **R**. Examples include the **RPF** and **RPP** pressed housings.

Cast stainless steel housings are another option and are intended as an additional measure of protection—specifically anticorrosion—against exposure to liquids and other contaminants. They're most often used in applications in the food and beverage industries where equipment must be kept hygienically clean and is washed down frequently. Ordinary housings when subjected to repeated washing would corrode, but the stainless steel housings resist corrosion from moisture and are often referred to as "*wash down units*."

Molded plastic housings, a more competitively priced alternative to the stainless steel housings, are another option for moist environments. Manufactured of a glass-filled polyester engineering plastic, these housings not only resist corrosion but offer better water resistance.

Both stainless steel and plastic housed units typically feature insert bearings also made of stainless steel for optimum corrosion resistance. Additional information on these units and on the other housing types offered by NTN is available. Contact your NTN representative for the appropriate catalog.

Pillow Block Units

Pillow blocks are designed to support a shaft: the mounting surface is on a parallel line with the axis of the shaft. Elongated bolt holes in the base, or feet, of the unit allow for some adjustment and easy mounting. NTN catalogs list the proper bolt sizes to secure the pillow block to the application.

Certain dimensions and measurements are critical to selecting the right pillow block—whether original to the equipment or as a replacement—for the application.

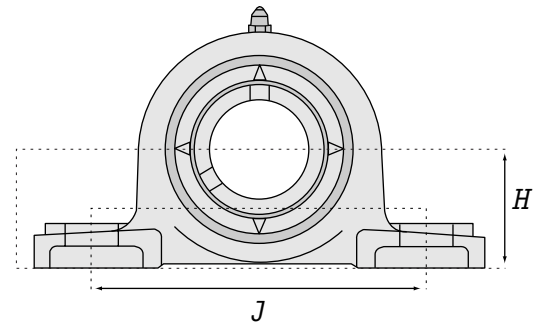
- *Shaft diameter* — The shaft diameter is matched with the appropriate corresponding bore dimensions of the bearing unit. If a properly sized unit matching the shaft is selected, the bearing will easily slide onto the shaft and into position, ready to be secured by the locking device.
- *Shaft height (or backing height)* — This dimension is determined by measuring the distance from the base (or bottom) of the pillow block to the center of the inner ring or shaft.
- *The distance between the bolt hole centers* — This measurement is taken from the center of one elongated bolt hole to the center of the housing's other bolt hole.

The shaft size, shaft height and the distance between the bolt hole centers dimensions are listed in the appropriate NTN catalog.

Table 1 on the following page provides a brief example of the dimensional details available. In this short catalog excerpt, the details are provided for a pillow block fitting a one-inch diameter shaft. From this you may select the proper combination of shaft height and the distance or spacing between bolt hole centers.

Examining the base

Different types of pillow block units have been cast with variations to the base of the housing. In some cases the base is a solid, flat surface; others have recessed, cut out areas along the underside of the flat base of the housing. While each design has its purpose, solid base pillow blocks such as those standard in NTN's Ultra-Class line provide greater rigidity, dampen vibration and resist cracking when mounting bolts are overtightened.



*the dimension "H" is shaft height:
the dimension "J" is the distance
between bolt hole centers*

Table 1: Pillow block housing variations — 1" diameter shaft

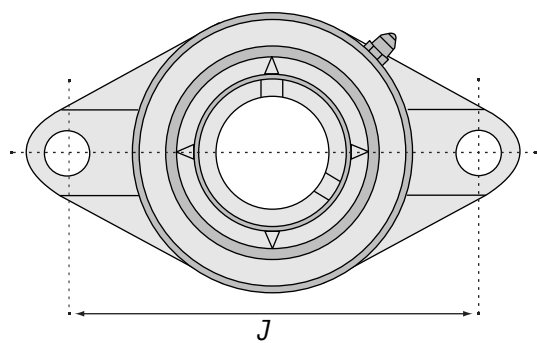
Pillow block housing type	Insert bearing series	Shaft height (inch)	Bolt center distance (inch)	Housing material	Shaft height	Application duty
PL*	2	1 5/16	4 1/8	Cast iron	Low base	Normal
P*	2	1 7/16	4 1/8	Cast iron	High base	
HP	2	3 5/32	4 1/8	Cast iron	Tall base	
UP	2	1 7/16	2 7/32	Cast iron	Tapped base	
PP	2	1 1/8	3 3/8	Pressed steel		Light
RPP	2	1 5/16	3 3/4	Pressed steel		
P*	2 (adapter)	1 11/16	4 3/4	Cast iron	High base	Normal
P*	X	1 3/4	4 11/16	Cast iron	High base	Medium
P*	3	1 49/64	5 3/16	Cast iron	High base	Heavy

* The most commonly used cast housings are P (standard or high base) and PL (low base).

Flange Units

Flange units also support shafts, however they have been designed to support shafts that are positioned at a 90° angle to the mounting surface.

As with pillow blocks, certain critical dimensions are important when selecting the proper flange unit for the application.



distance between bolt hole centers

- *Shaft diameter* — As with the pillow block, the shaft diameter is matched with the appropriate corresponding bore dimensions of the bearing unit. If a properly sized unit is selected, the bearing will easily slide onto the shaft and into position, ready to be secured by the locking device.
- *The distance between bolt hole centers* — The exact method used to measure this distance varies according to the configuration of the housing. The methods for measuring the distance between bolt hole centers will be discussed in greater detail for each housing.

The shape of the housing is determined by the number of bolts used for mounting the flange unit, the application requirements and the space available on the machine for mounting. The most commonly used configurations are listed below:

- Two-bolt flange
- Three-bolt round flange
- Four-bolt square flange
- Four-bolt square piloted flange
- Four-bolt round piloted flange



Ultra-Class 2-bolt flange with cast iron (FL) housing

Table 2: Two-bolt flanged housing variations — 1" diameter

2-Bolt flange housing type	Insert bearing series	Bolt center distance (inch)	Housing material	Application duty
FD	2	2 63/64	Cast iron	Normal
PFL	2	2 63/64	Pressed steel	Light
FL	2	3 57/64	Cast iron	Normal
FLU	2	3 57/64	Cast iron	Normal
FL2	2 (Adapter)	4 39/64	Cast iron	Normal
FL	X	3 39/64	Cast iron	Medium
FL	X (Adapter)	5 1/8	Cast iron	Medium
FL	3	4 29/64	Cast iron	Heavy

Two-bolt flange

This elliptically shaped housing uses, as the name implies, two-bolts to fasten the unit to the machinery. They are made of cast iron or stamped steel material and carry the NTN nomenclature designation of **FL** (iron) and **PFL** (pressed steel). The two bolt holes are normally positioned on opposite sides of the housing. The center line of each hole aligns with the center line of the shaft. As stated earlier, the dimensions important for mounting and replacing the units are:

- *The shaft diameter*
- *The distance between bolt hole centers* — This measurement is taken from the center of one bolt hole to the center of the other.

The shaft size and the distance between bolt hole centers for two-bolt flanges are listed in the appropriate NTN catalog. *Table 2* above provides a brief example of the dimensional details available. In the section listed, the details are provided for a two-bolt flange fitting a one-inch diameter shaft. From this you may select the proper distance or spacing between bolt hole centers for the various units.

Note: The housing thickness may vary according to the housing series; this factor should be considered when selecting the proper flange bearing unit for the application.

Three-bolt flange

Round in shape, these flanges are constructed as two-piece, pressed steel housings, and are used in applications that require less critical mounting accuracy and rigidity. The NTN nomenclature designation for this unit is **PF**.

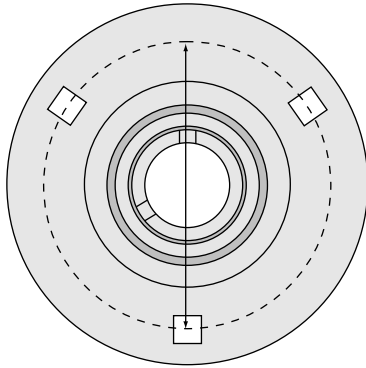
The bolt holes are spaced 120° apart, when using the center of the shaft as the center reference point. This positioning of the bolt holes requires a modification to the measurement of the distance between bolt hole centers described previously.



PFL: 2-bolt pressed steel housing

Table 3: Three-bolt flanged housing — 1" diameter

Round flange housing type	Number of bolts	Insert bearing series	Bolt pitch circle diameter (inch)	Housing material	Application duty
PF	3	2	2 63/64	pressed steel	light duty
RPF	3	2	3 35/64	pressed steel	light duty



bolt pitch circle

Using the center of the shaft as the reference point, a circle is drawn through the center point of all three holes. This dimension is referred to as the *diameter of the bolt hole center*, or the *bolt pitch circle diameter*.

The shaft size and the bolt pitch circle diameter for three-bolt flanges are listed in the appropriate NTN catalog. *Table 3* above provides a brief example of the dimensional details available. In the section listed, the details are provided for a three-bolt flange fitting a one-inch diameter shaft.

Four-bolt square flange

Typically made of cast iron, four-bolt square flanges provide greater rigidity when mounted than two-bolt flanges. The NTN nomenclature designations for this unit are **F** and **FU**.

The bolt holes are spaced equidistant from the shaft or bearing bore. The distance between bolt hole centers is measured from the center of one bolt hole to the center of an adjacent bolt hole.

The shaft size and the distance between bolt hole centers for four-bolt flanges are listed in the appropriate NTN catalog. *Table 4* below provides a brief example of the dimensional details available. In the section listed, the details are provided for a four-bolt flange fitting a one-inch diameter shaft. From this you may select the proper distance or spacing between bolt hole centers.

Table 4: Four-bolt square flanged housing variations — 1" diameter

4-bolt flange housing type	Insert bearing series	Bolt center distance (inch)	Application duty
F	2	2 3/4	Normal
FU	2	2 3/4	
F	2 (Adapter)	3 17/64	Medium
F	X	3 17/64	
F	X (Adapter)	3 5/8	Heavy
F	3	3 5/32	

Four-bolt square piloted flange

Although these flanges have the same face dimensions as the four-bolt flanges described above, they have little else in common.

Table 5: Four-bolt square piloted flange housing variations — 1" diameter

Square piloted flange housing	Number of bolts	Insert bearing series	Bolt center distance (inch)	Pilot diameter (inch)	Housing material	Application duty
FS	4	3	3 5/32	3.1496	cast iron	heavy
FS	4	3 w/adapter	3 47/64	3.5433	cast iron	heavy

The four-bolt square piloted flange is offered only in a heavy-duty series and uses *series 3* insert bearings. (Additional information on insert bearings and series sizing will follow later in the guide.) The NTN nomenclature designation for this housing is **FS**.

The back of the square four-bolt piloted flange is machined to set flush against the mounting surface. In addition, a cylindrical *pilot* section extends from the back face of the housing. This pilot, when inserted through a corresponding hole in the mounting surface, helps to locate the unit during installation. The pilot extension is machined to tight tolerances to ensure a close fit, resulting in greater placement accuracy and additional rigidity of the flange unit.

When specifying four-bolt piloted flanges an additional dimension is required—the outside diameter of the pilot extension, which can only be measured from the back of the flange.

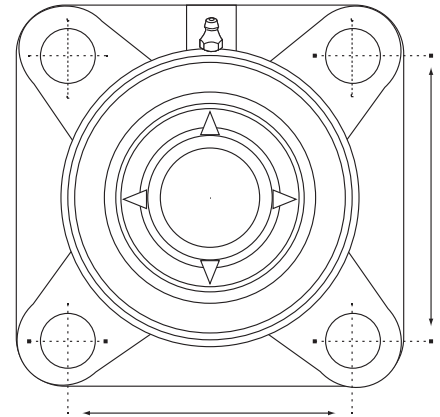
The shaft size and the distance between bolt hole centers for four-bolt piloted flanges are measured exactly like the four-bolt square flanges, and are listed in the appropriate NTN catalog. *Table 5* above provides a brief example of the dimensional details available. In the section listed, the details are provided for a four-bolt square piloted flange fitting a one-inch diameter shaft. From this you may select the proper distance or spacing between bolt hole centers.

Four-bolt round piloted flange

As with the square four-bolt, this flange is typically made of cast iron and provides the same increased rigidity when mounted over two-bolt flanges. They carry the NTN nomenclature designation **FC**.

As with the square flanges, the bolt holes are spaced equidistant from the shaft or bearing bore. The distance between bolt hole centers is measured from the center of one bolt hole to the center of an adjacent bolt hole. This flange also features a pilot extension on the back of the housing similar to the one described above.

When specifying this round flange another dimension must be considered—the diameter of the bolt hole center, or the bolt pitch circle diameter. This measurement is similar to that described for three-bolt round flanges.



both dimensions represent the distance between bolt hole centers



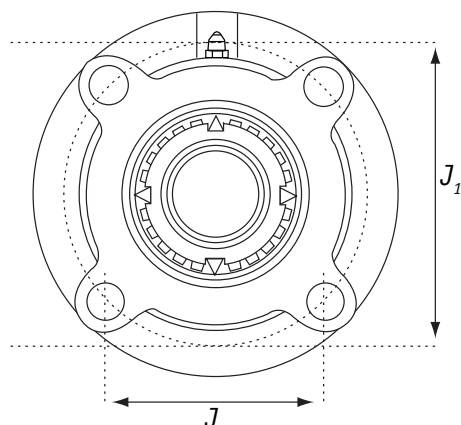
the dashed lines highlight the raised pilot extension of this four-bolt square flange



detail of 4-bolt round pilot extension

Table 6: Four-bolt round piloted flanged housing variations — 1" diameter

Round flange housing type	Number of bolts	Insert bearing series	Bolt center distance (inch)	Pitch circle diameter (inch)	Pilot diameter (inch)	Housing material	Application duty
FC	4	2	2 1/2	3 35/64	2.7559	Cast iron	Normal
FC	4	2 (Adapter)	2 25/32	3 15/16	3.1496	Cast iron	
FC	4	X	2 9/16	3 5/8	2.9921	Cast iron	Medium
FC	4	X (Adapter)	2 59/64	4 9/64	3.3465	Cast iron	



the dimension " J_1 " is the bolt pitch circle diameter: the dimension " J " is the distance between bolt hole centers



hanger unit



take-up unit

The shaft size, the distance between bolt hole centers and the diameter at bolt hole center for four-bolt round piloted flanges are listed in the appropriate NTN catalog. *Table 6* above provides a brief example of the dimensional details available. In the section listed, the details are provided for a four-bolt round piloted flange fitting a one-inch diameter shaft. From this you may select the proper distance or spacing between bolt hole centers.

Specialized Bearing Units

The mounted units discussed in this section are used for specialized applications and/or applications in which space is limited. They include *hanger units*, *take-up units*, and *cylindrical cartridge units*.

Hanger Units

Hanger bearing units are designed to support a shaft which is positioned at the end of and perpendicular to a supporting pipe on a conveyor. Typically, the end of the pipe is threaded and mates with the portion of the hanger bearing housing that extends beyond the circumference of the bearing. This extended section has been manufactured with a corresponding threaded female fitting. When mounting, the hanger bearing unit simply screws onto the threaded pipe and is secured by a lock nut.

NTN hanger units are manufactured of cast iron and the nomenclature designation is **HB**. The NTN mounted unit catalog lists hanger units for a variety of shaft diameters.

Take-Up Units

These units are designed to support a shaft which is positioned at either end of an adjusting screw. The unit is held in position by a take-up frame. The unit has a channel machined on either side of the housing that fits the guide rails of the take-up frame. The adjusting screw is attached to the unit by a collar which is pinned to the end of the adjusting screw.

These units are typically mounted where it is important to position a shaft or tighten a belt. As the adjusting screw is turned, the shaft shifts position. Generally, the take-up frame and unit are placed on

opposite ends of the shaft, and both must be adjusted in like increments to maintain the proper shaft position.

The primary application for these units is conveyors and the NTN nomenclature designation is **T**. More information on these units can be found in the NTN mounted unit catalog.

Cylindrical Cartridge Units

The outside diameter of the cartridge unit is cylindrical or straight, and is press fit inside the customer's housing. The inside diameter of the cartridge has a spherical shape that matches that of the insert bearing to allow for movement and to accommodate shaft misalignment. The beneficial result of this design is a self-aligning bearing that doesn't require the customer to machine a corresponding spherical housing bore.

The nomenclature designation for NTN cartridge units is **C** and detailed information can be found in the NTN mounted unit catalog.

Other Specialized Units

In addition to the units previously described, NTN also manufactures **FH** and **FA** type units. **FA** type flanged units are used where space is restricted and a standard pillow block or flange unit cannot be used due to space limitations. It also allows for shaft positioning, and can accommodate variable bolt positioning.

Likewise, the **FH** type flange units, also called *flange brackets*, are used where space is restricted. Manufactured of cast iron, they are mounted with three bolts fastened through the portion of the housing that extends beyond the circumference of the bearing. Detailed information on these units can be found in the appropriate NTN mounted unit catalog.

The Insert Bearing

A separate and distinct component of the ball bearing mounted unit is the insert bearing. This component is a standard 6200 or 6300 series radial ball bearing which has been adapted to fit into the housing. Although it is generally sold assembled within the housing, it may also be purchased as a stand-alone item as a replacement bearing for an NTN bearing unit. It may also be inserted into a customer-supplied housing or into a housing that is an integral component of the application equipment.

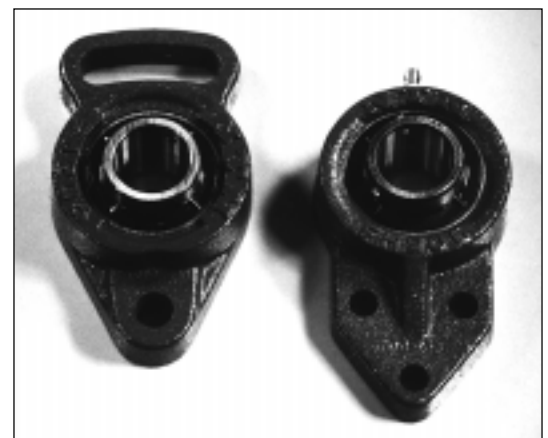
Ball Bearing Insert Series

As stated previously, ball bearing inserts are simply modified single row, deep groove (SRDG) radial ball bearings, however they warrant a closer look.

Insert bearings manufactured by NTN are available as a standard *200* or *300 dimension series*, and are available as well as a special *X dimension*



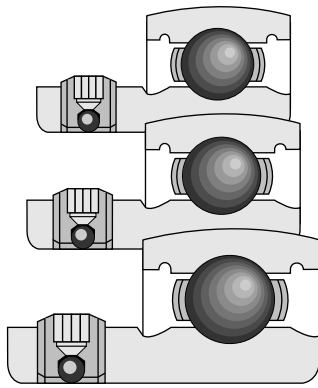
cartridge unit



FA (left) and FH (right) type units



wide inner ring insert bearing



200, X and 300 series insert bearings (top to bottom) for the same size insert series and shaft—the illustration shows the proportional difference in O.D.

series. The 200 and 300 series inserts have the same number and diameter of balls as their counterpart standard bearings in the 6200 and 6300 SRDG bearing series.

Just as with SRDG ball bearings, the 200 series has a smaller outside diameter and balls, and carries lighter loads than the 300 series.

The X series, however, is a special dimension series that falls between the 200 and 300 series inserts. They are classified as medium-duty.

The 2, 3 and X in the NTN part number will indicate the series. For example, a *UC206-104* bearing indicates a 200 series bearing with the same internal specifications as a *6206* radial ball bearing, while a *UEL306-103* indicates a 300 series with the same internal specs as a *6306* radial ball bearing.

Note: NTN's UEL series insert is slightly wider than other inserts due to the use of heavy-duty seals and flingers (more information on seals and flingers follows later in this guide). This variation is present in all 6200/200 and 6300/300 series bearings and inserts.

Insert Bearing Components

As with standard radial ball bearings, the six basic components of the insert ball bearing are the:

- Outer ring,
- Inner ring,
- Balls,
- Cage or retainer,
- Seals, and
- Grease.

The Outer Ring

Manufactured of through-hardened bearing steel, the outer ring is the larger of the two rings and, as the name implies, is the outermost of the two. A highly finished groove on its inside diameter forms a pathway for the balls.

The external surface of the bearing's outer ring is made in a variety of configurations that mate with the inside bore of the housing. In most instances, the bore of the housing and the outside diameter of the bearing are spherical in shape. This allows the insert bearing to automatically align itself in the housing when the bearing is subjected to misaligned loads.

The outside diameter of the outer ring and the housing bore are manufactured to tight tolerances. This results in a precise fit

between the two surfaces, providing proper insert bearing alignment inside the housing and making the unit more forgiving of misalignment. NTN's tight corresponding tolerances of the outer ring/housing fit eliminate the need for the anti-rotation devices used by other manufacturers. Without the impediment of the anti-rotation device, the replacement of the insert in the housing is much easier.

Insert ball bearings can also be supplied with a straight (cylindrical) outer diameter, which does not allow for misalignment. This type does not fit typical bearing unit housings, but is more commonly sold to be used within housings that are integral components of the application.

The outside edges of the bearing's outer ring, inner diameter are grooved to hold the seals.

Bearings designed to allow for relubrication have an oil hole in the outer ring, which aligns with a circumferential grease groove in the housing, providing a channel for grease to flow freely from the grease fitting into the bearing.

Typically, NTN product is manufactured so that the holes in the insert and the circumferential grease groove are located on the side of the bearing where the locking device is located. If the application requires that the oil hole and grease groove be on the side opposite the locking device (as is common with the NTN Ultra-Class bearing units), the prefix **A** is used in addition to the standard insert part number, for example, *A-UC206-104D1*. More on the NTN numbering system will follow.

Insert Bearing Outer Ring Configurations Options and Corresponding Designations

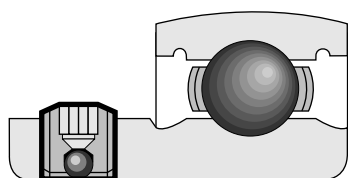
- A spherical shaped outer diameter without a relubrication hole is considered to be a standard part and carries no suffix designation (ex. *UC206-104*)
- A spherical shaped outside diameter with a relubrication hole carries the suffix designation "D1." (ex. *UC206-104D1*)
- A cylindrically (straight) shaped outside diameter is designated by the letter "S." (ex. *UCS206-104*)
- A cylindrically shaped outside diameter (S) with a snap ring groove is designated with the letter "N." (ex. *UCS206-104N*)
- A cylindrically shaped outside diameter (S) with a snap ring groove (N) and snap ring assembled in the snap ring groove carries the designation "R." (ex. *UCS206-104NR*)
- Another possible configuration would be a cylindrically shaped outside diameter (S) with a snap ring groove (N), a snap ring (R) and with relubrication holes (D1). (ex. *UCS206-104D1NR*)

The Inner Ring

The smaller of the two rings, the inner ring is also manufactured of through-hardened bearing steel. It has a highly finished groove on its outside diameter to form a pathway for the balls. The inner ring is usually the rotating element. The bore diameter of the inner ring is generally finished to fit the shaft.

In the U.S., the bore is usually measured in inches. At NTN, the bore size designation, in an inch series insert bearing, is coded numerically: the first of the three numbers is the full inch size, the second two numbers indicate the fractional inch in sixteenths. For example, a bore measuring 1" would be designated as *100*; a 15/16" bore would be *015*; and, a 1 15/16" bore would be *115*. In the previous example used to classify outer ring configurations, the part number *UCS206-104D1NR* indicates that the bore size is 1 4/16", or 1 1/4".

The inner ring of the insert bearing is wider than the inner ring of a standard radial ball bearing. This width difference plays a role in how the two are mounted on the shaft. The standard radial ball bearing is *press fit* onto a machined shaft, requiring special tools for installation. The standard insert bearing, however, is mounted to a shaft that is typically slightly smaller than the bearing's bore diameter. The insert bearing may be *slip fit* onto the shaft. The looser fit of the standard insert bearing, however, necessitates a locking device to hold it securely to the shaft. The inner ring of the bearing is extended to one side to accommodate the locking device. In addition, the width of the insert bearing's inner ring may vary according to the type of the bearing.



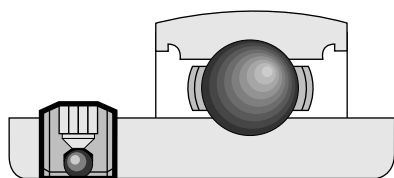
narrow inner ring, AS-type with set screw

Narrow inner ring inserts

The narrow inner ring, or single extended inner ring, of some inserts features an inner ring that extends beyond the outer ring on one side in order to accommodate the locking device. The NTN designations for these types of insert bearings are **AS**, **AEL**, **AR** and **JEL**. This type of insert (and/or a bearing unit featuring this insert) is generally a lower cost product.

Wide inner ring inserts

The wide inner ring, or double extended inner ring insert features an inner ring that extends beyond the width of the outer ring on both sides of the insert. The extension on one side accommodates a heavy duty seal. The other side is extended even further to accommodate both a heavy duty seal and the locking device.



wide inner ring, UC-type with set screw

The wide inner ring insert bearing also distributes the load over the larger surface area created by the wider inner ring. These bearings are generally used for heavier duty applications and are designated by NTN as **UC**, **UEL**, **UK**, **UR** or **REL**.

Some manufacturers create inserts that fall between narrow and wide inner ring inserts. By combining features of both they create a more economical “will-fit” that is neither a true narrow or wide inner ring.

The Rolling Elements (Balls)

The function of the balls is to transmit the load through the bearing while allowing the shaft to rotate with minimal friction. The ball radius is slightly smaller than the raceway radius of the inner and outer rings. This allows the balls to contact the rings at a single point, appropriately called *point contact*. Ball dimensions are controlled to very tight tolerances. Ball roundness, size variations, and surface finish are very important attributes and are controlled to *micro-inch* levels (1 micro-inch = one-millionth of an inch).

Cage (Retainer)

The main purpose of the cage or retainer is to separate the balls, maintaining an even and consistent spacing, and to accurately guide the balls in the raceways during rotation. NTN uses two types of cages for bearing inserts: *pressed steel* cages and *nylon* cages.

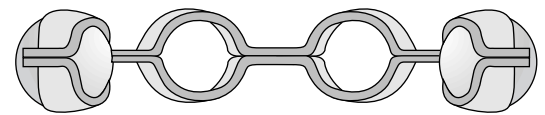
Pressed steel cages

Pressed steel cages are the most common type of cage produced by NTN. In this process, steel is formed (pressed) into the proper shape and size to fit the rolling elements, their spacing, etc. NTN insert bearing steel cages are pressed as two separate halves and riveted or welded together to form a one-piece retainer. These cages have a very high temperature capacity and are generally used in heavier duty applications.

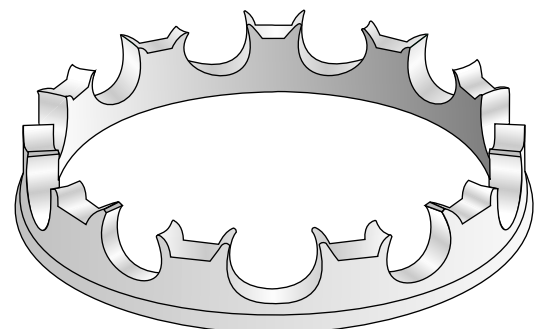
UC, UEL, UK, AS and AEL inserts use pressed steel cages. Although NTN’s suffix for a pressed steel cage is **J**, it is seldom used with these inserts because it is considered to be “standard,” unless otherwise specified. The Ultra-Class wide inner ring mounted units specifically use UC and UEL inserts with steel cages.

Nylon cages

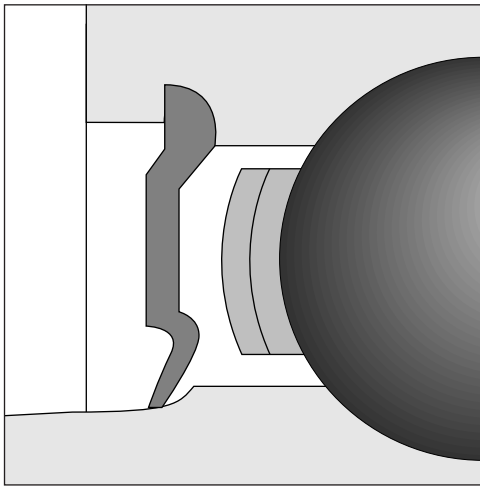
Nylon cages are designed as one-piece retainers and are created by an injection molding process. NTN typically uses glass-reinforced Nylon 66 for these cages: these cages more readily tolerate misalignment and are generally quieter in operation, but are limited to applications where the continuous operating temperature does not exceed 250°F (120°C). Nylon cages are considered “standard” for UR, REL, AR and JEL inserts unless otherwise specified: the suffix designation is **T2**, though it is rarely used in reference. The Ultra-Class narrow inner ring mounted units use only AR and JEL inserts with nylon cages.



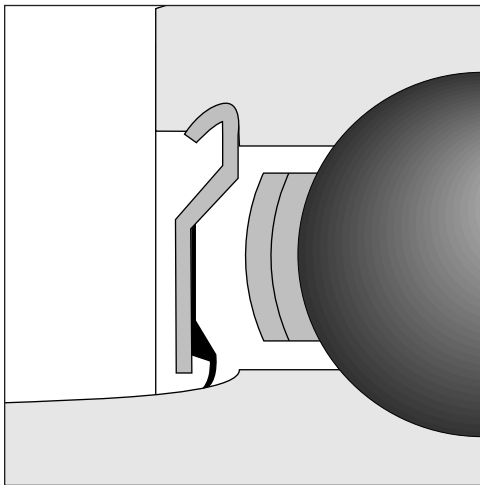
pressed steel cage



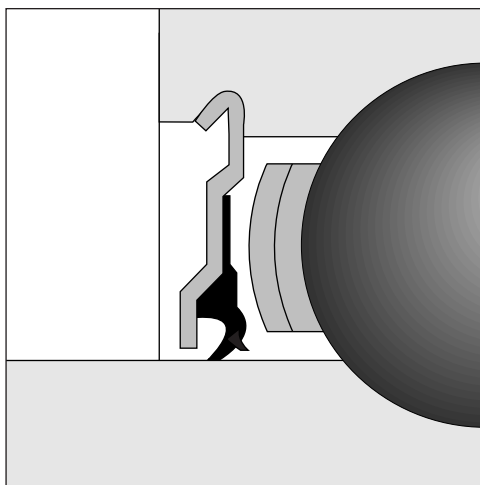
nylon cage



AS: single lip contour riding seal



AELS: single lip contour riding seal with trash guard



AR: single lip land riding seal with trash guard

Seals

The primary purpose of a seal is to protect the critical internal working elements from contaminants, keeping the lubricant clean and inside the bearing. Seals are available in a variety of types and compositions, the most common being synthetic (Nitrile® or Buna®) rubber molded to a steel plate.

The seal snaps into a small groove on the under side of the outer ring's inside diameter. The rubber portion of the seal that contacts the inner ring is molded into a specially designed lip configuration.

NTN bearing inserts are offered with a variety of seal options, each designed to protect the bearing from contaminants in an equally wide variety of applications. The following seals are normally used in NTN standard units:

- Single lip contour riding seal
- Single lip contour riding seal with trash guard
- Single lip land riding seal with trash guard with secondary lip
- Single lip land riding seal with flinger
- Triple lip land riding seal with trash guard

Single Lip Contour Riding Seal

This example (see illustration *AS*) shows a single lip *contour riding* seal without trash guard protection. Contour refers to the step machined into the inner ring O.D. to provide a surface for the seal lip to contact and ride against. This seal offers less contact pressure than other seals and therefore is preferable for higher speed applications, but it has less sealing capacity than other NTN insert bearing seals. This seal is primarily used on the AS series insert bearing.

Single Lip Contour Riding Seal with Trash Guard

This example (see illustration *AELS*) shows a single lip contour riding seal with a metal trash guard. The seal is bonded to a metal trash guard to provide additional protection. The seal lip rides on a contoured surface. The trash guard protects the rubber lip from abrasion. This seal is primarily used on the AEL series insert bearing.

Single Lip Land* Riding Seal with Trash Guard

This seal (see illustration *AR*) features a combination of a synthetic rubber seal and metal trash guard. Although this seal is referred to as a single lip, in fact it has two lips. The larger primary lip maintains contact with the inner ring and seals the bearing. The smaller flared secondary lip serves several purposes. It provides additional rigidity to the primary lip, it retains some grease for the

lubrication of the primary lip and it helps to channel grease back into the bearing raceway.

A key consideration in selecting this type of seal is that even under moment loads the primary lip continues to seal the bearing. If the misalignment is severe enough, the secondary lip may also contact the inner ring. In addition, the trash guard protects the seal lips from abrasion. This type of seal is used in bearing applications subjected to heavy dirt contamination, such as balers, disk openers and combines.

This seal type is used on JEL, AR, REL and UR series insert bearings and on several SBX (special dimension) insert bearings.

* *Land (as in "landing")* refers to the flat surface on the inner ring's outer diameter.

Single Lip with Flinger (Flinger Seal)

As shown in the example (see illustration **UK**), a single lip molded rubber seal is bonded to a steel backing plate. The rubber seals snap into grooves in the bearing's outer ring. The seal lip rides on the inner ring outside diameter which has been ground to provide a smooth contacting surface. The additional metal flinger protects the seal lip and is pressed onto the inner ring's outside diameter.

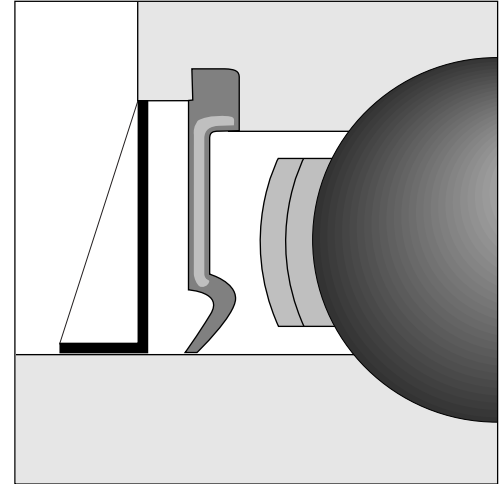
NTN's flinger has triangular protrusions on its outside face and, as the bearing rotates, these protrusions create a flow of air outward from the bearing. In this way, the flinger acts as a fan which keeps dust and water away from the bearing. This design, in combination with the seal, is very effective in highly contaminated applications. The protrusions on the flinger repel contaminants such as dirt, straw, sand and water. The flinger also provides excellent protection against crop wrap damage. The seal is used on UC, UEL, and SBX (special dimension) series insert bearings.

Triple Lip Land Riding Seal (LLS)

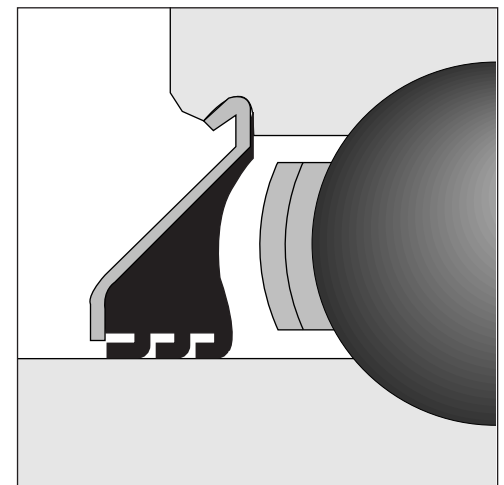
As shown in the example (NTN designation **UEL, LLS**), the three rubber seal lips which are molded to a steel trash guard. The trash guard, when crimped into the outer ring's seal groove, protects the seal lips from abrasive contaminants. All three lips contact the precision ground inner ring's outside diameter surface. This configuration provides the best seal protection against contamination. These seals are designated by the suffix **LLS** and are used for special applications on a variety of wide inner ring inserts, including hex and square bore bearing series (1AH, 1AS), UR and REL inserts, UC, UELS and SBX insert bearings.

The Vanguard® Seal

A selection of bearings (primarily used in agricultural applications) from the NTN-BCA product line are sealed with the Vanguard® seal, a one-piece, molded single, double or triple lip seal made of a high



UK: single lip with flinger



T: Vanguard® triple lip seal

quality elastomeric material. This seal also features a heavy gage steel trash guard which offers better protection of the rubber seal lips. The designations **R** and **G** are used for single lip designs, **V** for double lip and **T** for triple lip designs.



pressed steel dust cover

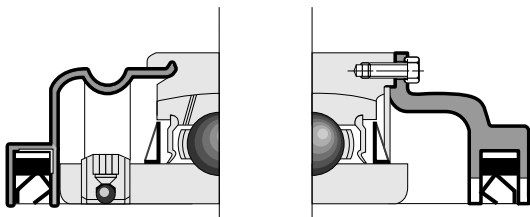
Bearing Units with Dust Covers

For protection beyond that provided by the insert bearing's seals and housing, mounted unit bearings may be fitted with special dust covers. This configuration consists of a bearing unit with external covers which provide extra protection in heavily contaminated operating environments, such as in flour mills, steel mills, foundries, galvanizing plants, chemical plants, and as well in construction and transportation applications. What these applications have in common is that they involve excessive dust, and/or splashes of liquids.

NTN supplies both cast iron and pressed steel dust covers. Pressed steel dust covers are attached to specially designed housings; the outside surface of these housings are machined with a circular groove. The covers snap into the groove and are then ready to provide additional protection in heavily contaminated areas.

Generally, cast iron covers are more rigid and are less likely to be damaged by larger objects, such as rocks, coal and other aggregate materials. Three bolts secure these covers to a specially designed housing; the housings feature three threaded holes.

Each dust cover is fitted with a seal which has two lips that ride on the shaft. The space between the lips is filled with grease. This grease pocket forms an effective seal and provides good lubrication (cooling) to the contacting lips. Generally, cast iron covers provide better seal lip alignment and the most effective seal.



pressed steel and cast iron dust covers

Cast iron covers are designated by attaching prefix **C** (open end) or **CM** (closed end) and pressed steel covers by attaching prefix **S** (open end) and **SM** (closed end) to the standard mounted unit part number. Examples of complete part numbers are:

Complete units with dust covers

- **C-UCP205-100D1** — a 1" pillow block unit with an open end, cast iron cover
- **CM-UCP204-100D1** — a 1" pillow block unit with a closed end, cast iron cover
- **S-UCP204-100D1** — a 1" pillow block unit with an open end, pressed steel cover
- **SM-UCP204-100D1** — a 1" pillow block unit with a closed end, pressed steel cover

Replacement dust covers

- *CM-205-100* — a closed end, cast iron cover for a 205 size bearing with 1" shaft
- *S-206-104* — an open end pressed steel cover for a 206 size bearing with 1 1/4" shaft

Note: you must specify the bore size (-100) to ensure the seals properly contact the shaft.

Replacement housings

- *C-P205* pillow block housing with three drilled holes to accept a cast iron housing (205 insert series)
- *S-P205* pillow block housing with a circular groove to accept a pressed steel cover (205 insert series)

Grease for Mounted Unit Bearings

NTN insert bearings are sealed and factory pre-lubricated for the life of the bearing. Generally, the bearing will not need regreasing, however, when subjected to severe operating conditions, insert bearings may require the occasional replenishment of grease, necessitating the addition of a grease fitting in the housing which allows the relubrication of the unit.

The standard grease chosen by NTN for ball bearing mounted units is Shell Alvania® #3. This is a lithium-based product that maintains proper lubrication over a wide range of operating temperatures -4°F to 275°F (-20°C to 135°C).

The standard factory grease fill is 35% for most NTN inserts. This fill will accommodate most applications. However, the JL, RL, UR and AR series of inserts have a standard grease fill range of 60–70%. For bearings known to rotate at high speeds, the grease fill should be reduced to prevent excessive heat generation.

A word of caution: some NTN customers may specify different greases and/or grease fills.

Maintenance-free Units

These units make no provision for relubrication or regreasing the insert bearing. They contain sufficient grease to last the bearing's lifetime when used in general applications. The unit's seal is also of a high quality and has been chosen to prevent any leakage of grease.

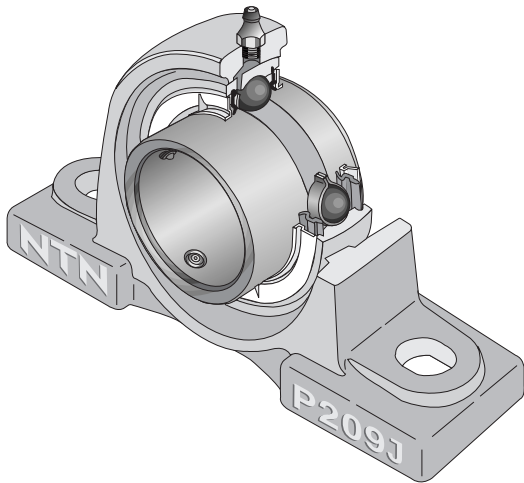
In addition to the labor saved by eliminating the relubrication process, the maintenance-free units also prevent premature bearing failure due to over-lubrication, or the mixing of incompatible greases, contaminants introduced during relubrication, or blown seals.

Maintenance free units may be used under normal operating conditions and in temperatures up to 212°F (100°C).

Relubrication Type Units

Some medium- to heavy-duty applications require the insert bearing to be relubricated at regular intervals. The relubrication type unit has a grease hole in the bearing's outer ring, a circumferential groove in the bore of the housing and a grease fitting at the housing outside diameter to allow for regreasing. The following conditions are those that typically warrant the use of a relubrication type unit:

- The bearing operates in temperatures in excess of 212°F (100°C)
- In operating conditions with excessive dust, high humidity
- When the bearing may be splashed with water or other liquid
- Under heavy load
- Applications having very small oscillatory motion
- Higher speed applications
- Where noise has to be minimized.



relubrication type unit with grease fitting

Relubrication Guidelines:

It cannot be stated strongly enough that when relubricating a bearing unit it is essential to choose a clean lubricant compatible with the grease already in the bearing.

Whether or not different kinds of grease may be mixed depends on the thickening agents used in making the grease. Mixing different types of grease can affect key properties and alter the grease's performance. If these key properties are diminished, the grease can become ineffective, leading to premature bearing failure. (Refer to *Table 7* for further information.)

Pump the grease gun once prior to connecting it to the fitting to purge the nozzle of any contaminants that may have accumulated and wipe it with a clean towel. The grease fitting also merits inspection for contaminants and should also be wiped clean.

Taking these precautionary measures to prevent the introduction of contaminants into the bearing will help ensure the proper operation of the bearing and performance to and beyond the rated life of the bearing.

Table 7: Grease thickener compatibility

	Aluminum Complex	Barium	Calcium	Calcium 12-Hydroxy	Calcium Complex	Clay	Lithium	Lithium 12-Hydroxy	Lithium Complex	Polyurea
Aluminum Complex	●	■	■	●	■	■	■	■	●	■
Barium	■	●	■	●	■	■	■	■	■	■
Calcium	■	■	●	●	■	●	●	▲	●	■
Calcium 12-Hydroxy	●	●	●	●	▲	●	●	●	●	■
Calcium Complex	■	■	■	▲	●	■	■	■	●	●
Clay	■	■	●	●	■	●	■	■	■	■
Lithium	■	■	●	●	■	■	●	●	●	■
Lithium 12-Hydroxy	■	■	▲	●	■	■	●	●	●	■
Lithium Complex	●	■	●	●	●	■	●	●	●	■
Polyurea	■	■	■	■	●	■	■	■	■	●

Table key

- *Mixing greases will not produce any appreciable change in properties*
- *Mixing greases may produce considerable variation in properties*
- ▲ *Mixing greases will cause drastic changes in properties*

As for the quantity of lubricant used, most applications require only two pumps of grease. This is an instance where more is not better. Overpacking the bearings during relubrication should be avoided. Too much grease may create a “churning” action within the bearing, which in turn results in the bearing running hotter. This leads to premature deterioration of the grease and ultimately bearing failure.

Table 8 below lists some general relubrication guidelines to follow when scheduling the relubrication of a standard bearing unit operating in typical operating conditions.

Table 8: Suggested relubrication frequencies

Type of bearing unit	NTN lubrication designation	dn Value [bore (mm) x speed (rpm)]	Environmental conditions	Operating temperature		Relubrication frequency	
				°C	°F	Hours	Period
Standard	D1	40,000 and below	Ordinary	-15 to +80	+5 to +176	1,550 to 3,000	6 to 12 months
		70,000 and below	Ordinary	-15 to +80	+5 to +176	1,000 to 2,000	3 to 6 months
		70,000 and below	Ordinary	+80 to +100	+176 to +212	500 to 700	1 month
		70,000 and below	Very dusty	-15 to +100	+5 to +212	100 to 500	1 wk. to 1 mo.
		70,000 and below	Exposed to water splashes	-15 to +100	+5 to +212	30 to 100	1 day to 1 week

Note: These relubrication frequencies are general recommendations. Specific application conditions may require deviation from this table. Additional information on relubrication may be found in the appropriate NTN catalog.



left to right: ball point, cup and knurled cup set screws

Bearing Insert Locking Devices

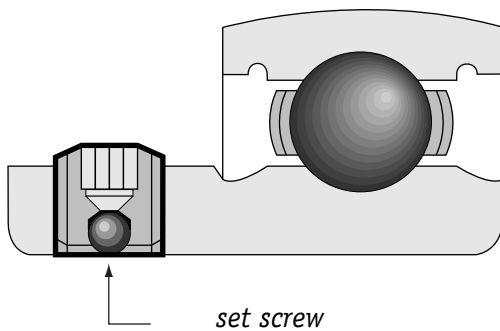
As described previously, the looser fit of the standard insert bearing on the shaft means that a locking device is needed to hold it securely to the shaft. The extended inner ring accommodates the locking device which is an integral part of the bearing and fastens the bearing to the shaft. This is accomplished using one of the following methods:

- Set screw mounting
- Eccentric (cam) locking collar mounting
- Tapered SNW* adapter mounting

* SNW = Sleeve, Nut, Washer

Set Screw Method

The set screw method for mounting the bearing on the shaft can be used in applications where the shaft rotates in either direction. The extended side of the insert bearing's inner ring is drilled and tapped (threaded) in two spots, 120° apart in order to accept the set screw. A set screw is inserted into each hole, and, when both are tightened, serve to secure the bearing to the shaft. NTN uses the designations C, R and S to indicate set screw type mounting. The UC, UR, AS and AR series inserts all use the set screw mounting method.



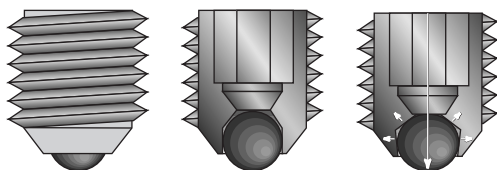
After slipping the mounted unit on the shaft, the set screws are tightened against the shaft to the torque value specified in the NTN catalog. The force exerted between the tip of the set screw and the shaft firmly clamps the unit into place.

There are a variety of set screw types on the market, several of which are listed below:

- Ball-point set screw (the NTN standard for set screw mounted bearings, carries no suffix)
- Cup point (suffix **W3**, ex. UC205-100 D1 **W3**)
- Knurled cup point (suffix **W2**, ex. UC205-100 D1 **W2**)

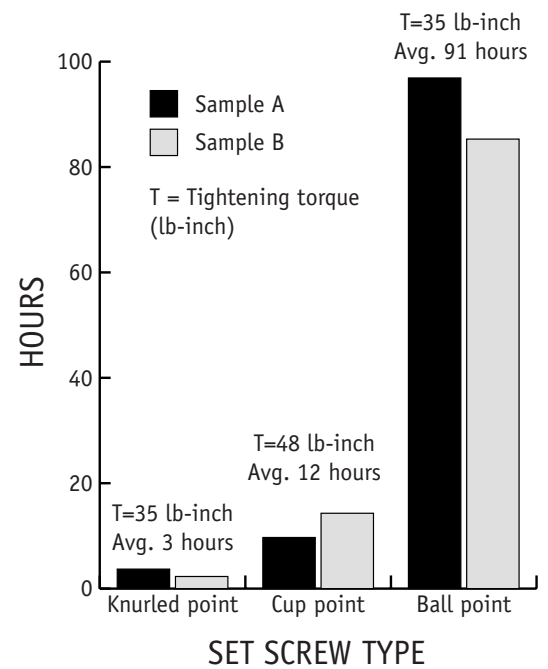
Ball-point set screw

The ball-point set screw—an exclusive NTN design—has a hardened ball at the end of the set screw. In fact, because of the superior and reliable lock provided by the unique design of the ball-point set screw, it was chosen as the standard locking mechanism for the Ultra-Class bearing unit line. It has the following advantages over other types of set screws:



ball point set screw, cutaway view and set screw under pressure

- *Difficult to work loose* — Upon tightening, the steel ball is squeezed back into the tapered portion of the set screw, causing the threads to spread. This expansion of the threads makes it extremely difficult for the set screw to loosen when exposed to vibration and/or shock loads.
- *Develops greater holding force* — The ball point set screw makes a point contact with the shaft, allowing easy tightening and complete transmission of force to the shaft. The cup point and knurled cup point, on the other hand, make a circular contact with the shaft. In those designs, a portion of the tightening torque is used in cutting a circular groove on the shaft, effectively reducing the holding force.
- *Can be reused repeatedly* — The hardened steel ball does not deform when tightened. Additionally, it leaves only a small contact print on the shaft. The cup point set screw not only marks the shaft, but the screw itself becomes damaged, making it difficult to retighten if removed.
- *Needs no flat on the shaft* — The ball point set screw makes a point contact with the shaft and therefore does not need a flat on the shaft. The cup point set screw cannot make full contact with the shaft unless there is a flat machined onto the shaft.
- *Reduced fretting corrosion at the tip of the set screw* — The hardened steel ball of the ball point set screw significantly reduces fretting corrosion. Cup point and knurled cup point set screws cause more fretting as they are softer.

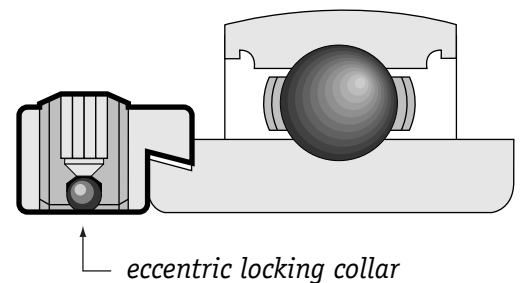


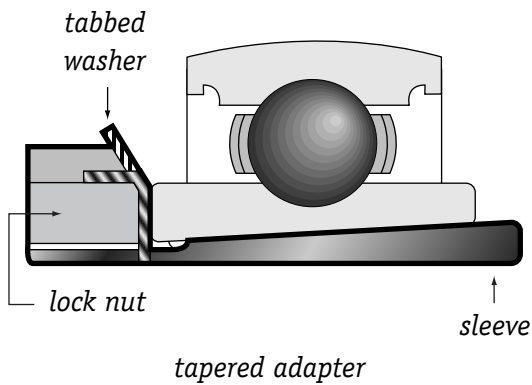
Each of the set screws tested above were set to the recommended tightening torque (in lb-inches) and tested for their ability to resist vibration. The ball point set screw clearly does very well, but, it should be noted, is not recommended for large axial loads.

Eccentric (Cam) Locking Collar

An eccentric locking collar should only be used in applications where the shaft rotates in one direction. An eccentric track is machined on the outside diameter at the end of the extended side of the insert's inner ring. What makes this track "eccentric" is that it has a different center point than does the inner ring. When examining the groove, it appears to be offset from the center of the bearing bore. A separate locking collar is manufactured to match the eccentric track on the insert's inner ring. When the collar is placed on the track and rotated, the elliptical rotation causes the locking collar to jam against the shaft, locking the bearing to the shaft.

The set screw, which is supplied with the collar, is then tightened through the collar's threaded hole. The force exerted between the tip of the set screw and the shaft keeps the collar from rotating, relative to the inner ring and shaft. The designation for the eccentric locking collar is **EL** and is used on the following series: **UEL**, **REL**, **AEL**, and **JEL**.





Tapered SNW Adapters

The tapered adapter creates a force and holding ability similar to that of a press fit standard ball bearing while offering the ease of a slip fit mounting. Typically it is used where impact loads and vibration are present or when the shaft oscillates or quickly reverses rotation.

The insert bearing using a tapered adapter is manufactured with a slight taper to the bore diameter. The bore diameter at the back of the insert is slightly larger than the bore diameter on the locking device side of the insert. The adapter consists of the following, all of which are supplied with the bearing at time of purchase.:

- A split sleeve having a cylindrical bore (that corresponds with the shaft) and tapered outside diameter (that matches the tapered bore of the insert bearing); the thinner end of the sleeve's external surface is straight and threaded.
- A tabbed washer, and
- A lock nut.

To mount the insert, the split sleeve is placed onto the shaft, the insert bearing is placed over the split sleeve, the tabbed washer and lock nut are placed on the threaded side of the sleeve and tightened to pull the tapered adapter into the tapered insert. By tightening the nut against the face of the bearing's inner ring, the bearing is secured to the shaft in a manner which can be compared to the way a door stop secures a door against the floor. The tab on the washer is then bent to prevent the lock nut from backing off.

The adapter method for locking a mounted bearing to the shaft provides a holding force similar to that of a press fit inner ring. The result is that there is no danger of the fit between the shaft and the inner ring working loose.

The designation for a tapered adapter on a bearing unit or insert is **K**. It is present in **UK** series inserts.

Note: NTN offers a variety of locking devices, inner ring configurations, cages, seals and bearing series for insert bearings. Table 9 on the following page provides a brief summary of possible configurations offered by NTN and the designations by which they are identified.

Mounting Guidelines

On the following page are some general guidelines to follow when mounting a bearing unit using the various (and appropriate) mounting methods.

Table 9: Insert bearing components

Insert bearing series	Locking device	Steel cage	Nylon cage	Steel cage	Nylon cage
200	<ul style="list-style-type: none"> • Set screw • Eccentric locking collar • Adapter 	<ul style="list-style-type: none"> • UC2 insert • UEL2 • UK2 	<ul style="list-style-type: none"> • UR2 insert • REL2 	<ul style="list-style-type: none"> • AS2 insert • AEL2 	<ul style="list-style-type: none"> • AR2 insert • JEL2
X	<ul style="list-style-type: none"> • Set screw • Adapter 	<ul style="list-style-type: none"> • UCX insert • UKX 			
300	<ul style="list-style-type: none"> • Set screw • Eccentric locking collar • Adapter 	<ul style="list-style-type: none"> • UC3 insert • UEL3 • UK3 			
Seal type		<ul style="list-style-type: none"> • Land riding with flinger 	<ul style="list-style-type: none"> • Land riding w/trash guard 	<ul style="list-style-type: none"> • Contour riding (AS) • Contour riding with trash guard (AEL) 	<ul style="list-style-type: none"> • Land riding w/trash guard
Inner ring type		Wide inner ring		Narrow inner ring	

Set Screw Mounting

- 1 Make sure the support for the bearing unit is rigid and the surface where the unit is going to be mounted is clean and flat
- 2 Make sure that the end of the set screw is not protruding into the bore of the bearing insert.
- 3 Make sure that the end of the shaft is free of any burrs.
- 4 Insert the shaft into the bore of the bearing. (Fig. 1)
- 5 Do not strike the seal or subject the unit to any shock loads.
- 6 Mount the housing using bolts recommended in the appropriate NTN catalog.
- 7 Insert a wrench securely into the hole of the set screw, and tighten the two screws uniformly. Use the tightening torque specified in the appropriate NTN catalog. (Fig. 2)

Figure 1

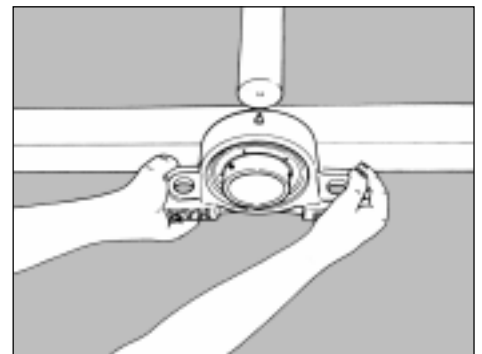
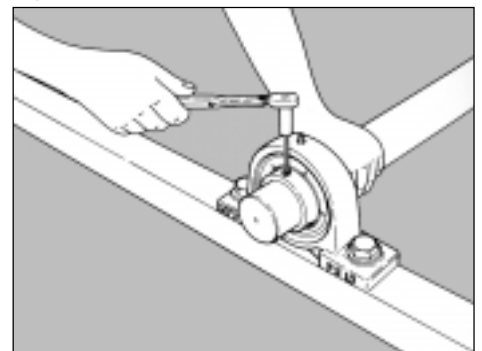


Figure 2



Eccentric Locking Collar Mounting

On the following page are some general guidelines to follow when mounting a bearing unit using an eccentric locking collar.

- 1 Make sure the frame on which the unit is going to be mounted is rigid. The mounting surface should also be clean and flat.
- 2 Make sure that the end of the shaft is free of any burrs. (Fig. 3)
- 3 The end of the set screw in the eccentric collar should not protrude into the bore of the collar.
- 4 Insert the shaft into the bore of the bearing.

Figure 3

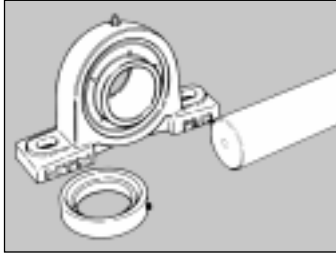


Figure 4

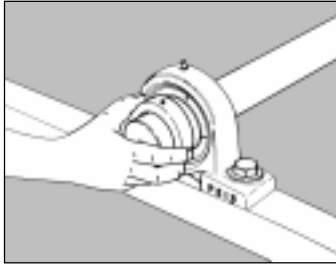


Figure 5

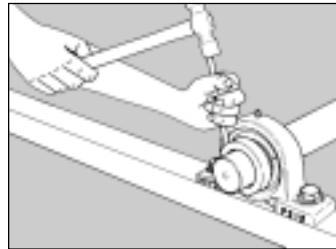


Figure 6

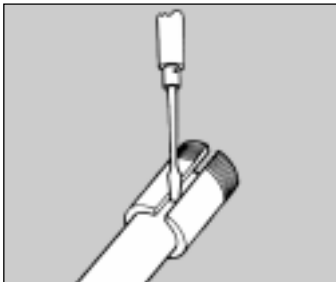
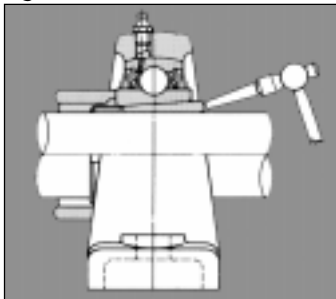


Figure 7



- 5 Mount the housing of the unit using bolts recommended in the appropriate NTN catalog.
- 6 Match the eccentric groove on the collar with the eccentric groove on the bearing inner ring.
- 7 Turn the collar by hand in the direction of shaft rotation. (Fig. 4)
- 8 To set the collar, insert a punch into the hole in the O.D. of the collar. Tap the punch so that the collar turns in the direction of shaft rotation. (Fig. 5)

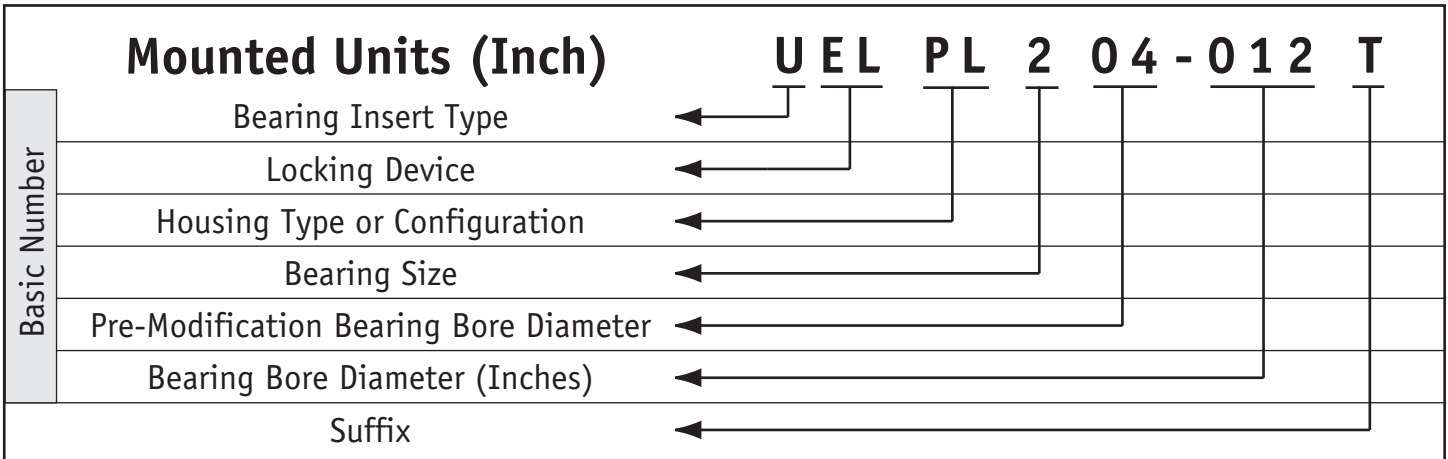
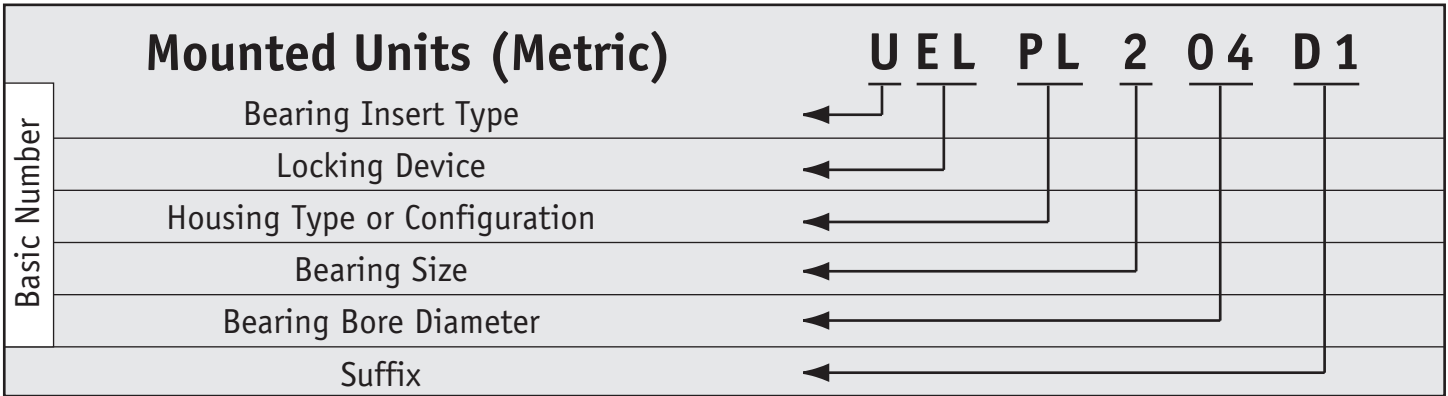
Adapter Mounting

Below are some general guidelines to follow when mounting a bearing unit using an adapter.

- 1 The sleeve should be positioned so that the nut is located on the side opposite any adjacent components that might interfere with the installation.
- 2 Adjust the position of the sleeve on the shaft so that the tapered part is approximately centered on the bearing. To facilitate the mounting of the sleeve onto the shaft, the opening in the sleeve can be widened using a screwdriver or similar tool. (Fig. 6)
- 3 Place the bearing unit with the tapered bore oriented to match the taper on the sleeve. Tap the back side of the adapter sleeve lightly over its entire periphery until a positive contact is made between the bearing and the sleeve. (Fig. 7)
- 4 Install the washer and lock nut; tighten the nut fully by hand.
- 5 Apply a punch or screw driver into the notch of the nut and tap it with a hammer. Stop tapping after the nut has turned 60° to 90°. Do not strike the seal. Care should be taken not to overtighten the nut as this will deform the inner ring, causing heat generation and seizure.
- 6 Bend up the tab on the rim of the washer, which is in line with the notch of the nut. This will prevent the nut from turning. Do not turn the nut backwards in order to bring the notch into line with the tab in the washer.
- 7 Mount the housing securely in position on the machine, using the bolts, recommended in the appropriate NTN mounted unit catalog.

Note: Information follows on the numbering system used by NTN to identify mounted unit bearings. For more information on mounted unit bearings or about other titles in this general information series, contact your NTN representative.

NTN Numbering System: Complete Units



Bearing Inserts/Locking Device

- AEL ... Narrow (extended) inner ring bearing, contour riding seal with trash guard, steel cage/eccentric locking collar
- AR..... Narrow (extended) inner ring bearing, land riding seal with trash guard, nylon cage, induction tempered threads/set screw type
- AS..... Narrow (extended) inner ring bearing, contour riding seal, steel cage/set screw type
- JEL.... Narrow (extended) inner ring bearing, land riding seal with trash guard, nylon cage, induction tempered eccentric lip/eccentric locking collar
- REL ... Wide inner ring bearing, land riding seal with trash guard, nylon cage, induction tempered eccentric lip/eccentric locking collar
- UC..... Wide inner ring bearing, land riding seal with flinger, steel cage/set screw type
- UEL ... Wide inner ring bearing, land riding seal with flinger, steel cage/eccentric locking collar
- UK Wide inner ring bearing, land riding seal with flinger, steel cage/tapered bore
- UR Wide inner ring bearing, land riding seal with trash guard, nylon cage, induction tempered threads/set screw type

Housings

- C..... Cylindrical cartridge unit
- F..... 4-bolt square flanged unit, cast housing
- FA Special flanged unit, cast housing
- FC 4-bolt round flanged piloted unit, cast housing

Housings, cont.

- FD 2-bolt flanged unit, cast housing
- FH.... 3-bolt flanged bracket, cast housing
- FL 2-bolt flanged unit, cast housing
- FS 4-bolt square flanged piloted unit, cast housing
- FU 4-bolt square flanged unit, cast housing
- PF 3-bolt flanged unit, pressed steel housing
- PFL .. 2-bolt flanged unit, pressed steel housing
- RPF .. 3-bolt flanged unit, pressed steel housing with rubber ring
- HP ... Pillow block, cast housing, tall base
- P Pillow block, cast housing, high base
- PL Pillow block, cast housing, low base
- PP Pillow block, pressed steel housing
- RPP .. Pillow block, pressed steel housing with rubber ring
- UP ... Pillow block, cast housing, tapped base
- HB ... Hanger unit, cast housing
- PT Mini-stretcher
- T..... Take-up unit, cast housing

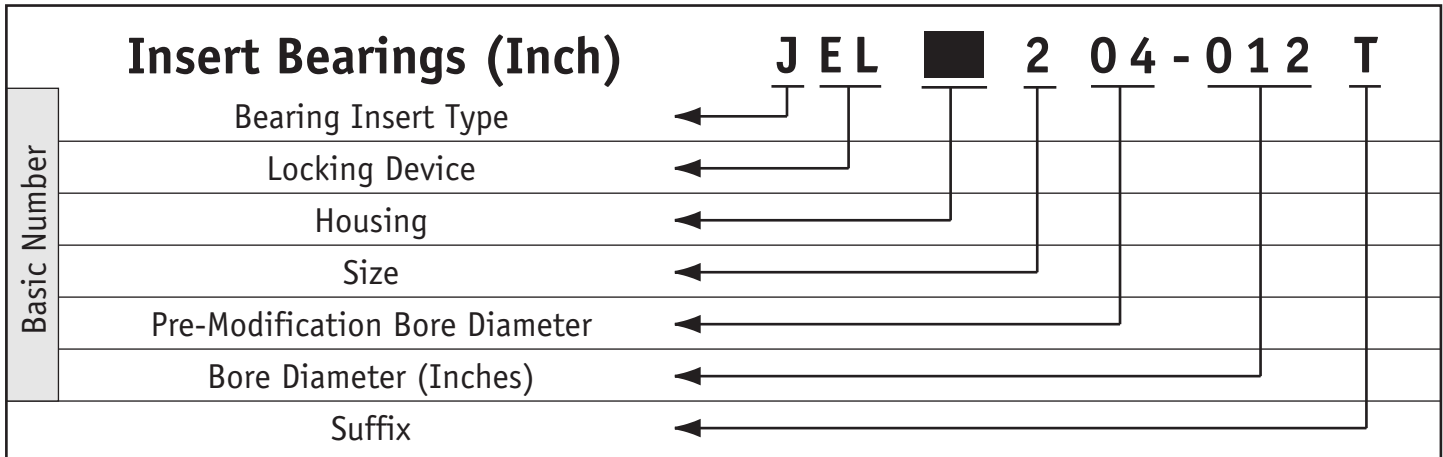
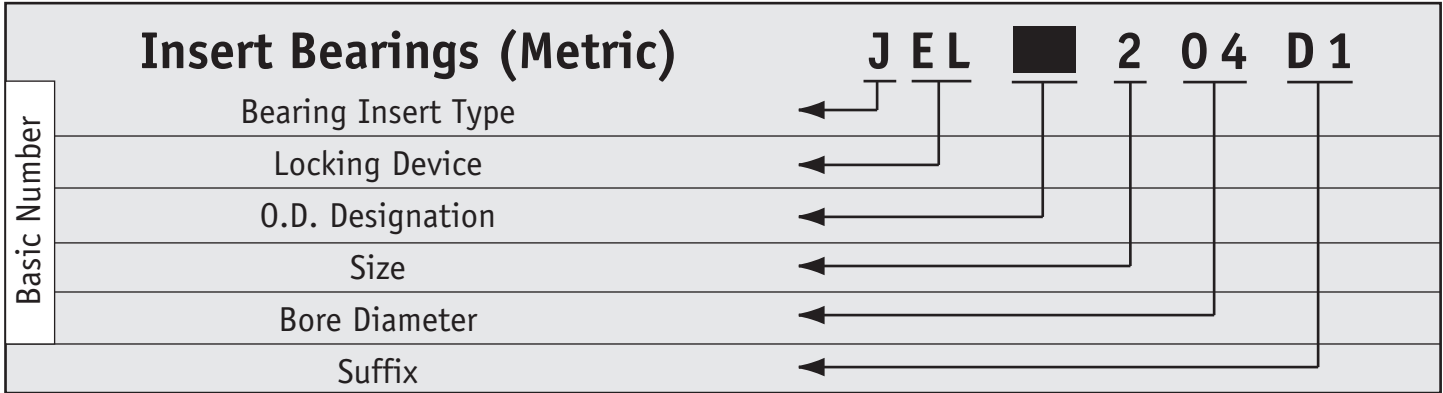
Size

- 2 Light
- X..... Medium
- 3 Heavy

Suffix

- D1.... Relube type
- T..... Relube type (obsolete designation)

NTN Numbering System: Insert Bearings



Bearing Inserts/Locking Device

- AEL .. Narrow (extended) inner ring, contour riding seal with trash guard, steel cage/eccentric locking collar
- AR.... Narrow (extended) inner ring, land riding seal with trash guard, nylon cage, induction tempered threads/set screw
- AS.... Narrow (extended) inner ring bearing, contour riding seal, steel cage/set screw type
- JEL... Narrow (extended) inner ring, land riding seal with trash guard, nylon cage, induction tempered eccentric lip/eccentric locking collar
- REL .. Wide inner ring, land riding seal with trash guard, nylon cage, induction tempered eccentric lip/eccentric locking collar
- UC.... Wide inner ring bearing, land riding seal with flinger, steel cage/set screw type
- UEL .. Wide inner ring bearing, land riding seal with flinger, steel cage/eccentric locking collar
- UK ... Wide inner ring bearing, land riding seal with flinger, steel cage/tapered bore
- UR ... Wide inner ring, land riding seal with trash guard, nylon cage, induction tempered threads/set screw

O.D. Designation

- No symbol .. Spherical outer diameter
- S..... Cylindrical outside diameter
- N O.D. snap ring groove
- NR ... O.D. snap ring groove, assembled with snap ring

Size

- 2 Light (ref. 6200 series ball bearing)
- X..... Medium
- 3 Heavy (ref. 6300 series ball bearing)

Pre-Modification Bore Diameter

Metric bore size of insert before modifying to inch dimensions

Bore Diameter (Inches)

- 1st Number Indicates full inches
- 2nd, 3rd No.s..... Indicates fractional inch measurement (in 16th of inch)

Suffix

- D1.... Relube type
- T..... Relube type (obsolete designation)

NTN Numbering System: Ultra-Class Units

Mounted Units (Inch)	UCP - 2.15/16
Bearing Insert Type	← U C
Locking Device	← P
Housing Type or Configuration	← 2 . 15 / 16
Bearing Bore Diameter (Inches)	← 2 . 15 / 16

Insert Bearings (Inch)	A - UC 215 - 215 D1
Oil Hole Location	← A
Bearing Insert Type	← U C
Locking Device	← 2 1 5
Nominal Insert Bearing Size	← 2 1 5
Bore Diameter–Inches ($2^{15/16}$)	← 2 1 5
Suffix	← D 1

Pillow Block Units Standard Features

- 200 series bearing (normal duty)
- Relube type
- Oil hole located opposite to the mounting
- Cast iron housing
- Grease fitting at 45°
- Ball point set screw

Prefix

- A- Oil hole located opposite to the mounting. Use this prefix only for insert part numbers. Do not use for complete unit part numbers.

Bearing Inserts/Locking Devices

- AR.... Narrow inner ring, set screw locking, nylon cage
- JEL... Narrow inner ring, eccentric locking collar, nylon cage
- UC.... Wide inner ring, set screw locking, steel cage
- UEL .. Wide inner ring, eccentric locking collar, steel cage

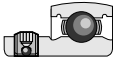
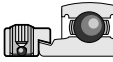
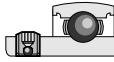
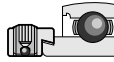
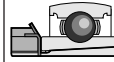

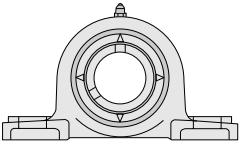
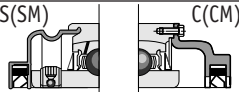

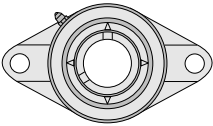
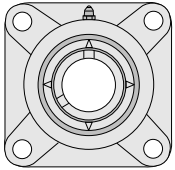

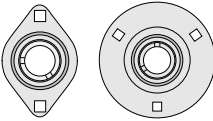
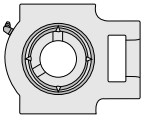
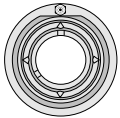
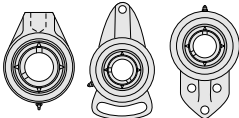
Housings

- P High base, also called normal or standard base, pillow block
- PL Low base pillow block
- FU Four bolt square flange
- FLU .. Two bolt flange

Suffix

- D1 Relube type*
- S..... Used for $1\frac{1}{4}$ " and 2" shaft size units as follows: S denotes smaller bearing size. Example: The part number for a $1\frac{1}{4}$ " shaft size with 206 bearing is UCP- $1\frac{1}{4}$ S, and with 207 bearing is UCP- $1\frac{1}{4}$.

**Note: All NTN Ultra-Class units contain a 200 series insert, are relube type (D1) and offer the NTN exclusive ball point set screw as the locking device. These are standard features which do not appear in the part number.*

NTN Mounted Unit Reference Chart	NARROW INNER RING			WIDE INNER RING		
						
PRODUCT FEATURES	SPHERICAL INSERTS	SET SCREW	ECCENTRIC COLLAR	SET SCREW	ECCENTRIC COLLAR	ADAPTER
Electric motor quality inserts	200 Series	AS2, AR2	AEL2, JEL2	UC2, UR2	UEL2, REL2	UK2
Ball point set screws	X Series			UCX		UKX
Superior seal designs	300 Series			UC3	UEL3	UK3
TECHNICAL DRAWINGS	HOUSING TYPES	PART NO.	PART NO.	PART NO.	PART NO.	PART NO.
	Pillow Block-Cast					
	• 200 Series High Base	ARP, ASP2, ARP2	JELP, AELP2, JELP2	UCP, UCP2, URP2	UEL2, UELP2, RELP2	UKP2
	• 200 Series Low Base	ARPL, ASPL2, ARPL2	JELPL, AELPL2, JELPL2	UCPL, UCPL2, URPL2	UELPL, UELPL2, RELPL2	
	• X Series			UCPX		UKPX
	• 300 Series			UCP3	UEL3	UKP3
• 200 Series Tall Base	ASHP2, ARPH2	AELHP2, JELHP2	UCHP2, URHP2	UELHP2, RELHP2	UKHP2	
• 200 Series Tapped Base	ASUP2, ARUP2	AELUP2, JELUP2	UCUP2, URUP2	UEL2, RELUP2	UKUP2	
	Pillow Block with Covers*					
	• Pressed Steel			S(SM)-UCP2		
• Cast Iron			C(CM)-UCP2			
	Pillow Block-Pressed Steel					
	• 200 Series	ASPP2	AELPP2			
• Rubber Mounted Insert	ASRPP2	AELRPP2				
	2-Bolt Flange-Cast					
	• 200 Series	ASFD2, ARFD2	AELFD2, JELFD2	UCFLU, UCFL2, URFL2	UELFLU, UELFLU2, UELFL2	UKFL2
		ARFLU, ASFL2, ARFL2	JELFLU, AELFLU2, JELFLU2			
			AELFL2, JELFL2			
	• X Series			UCFLX		UKFLX
• 300 Series			UCFL3	UELFL3	UKFL3	
• 300 Series Piloted Flange			UCFL3	UELFL3	UKFL3	
	4-Bolt Square Flange-Cast					
	• 200 Series	ARFU, ASF2, ARF2	JELFU, AELFU2, JELFU2	UCFU, UCF2, URF2	UELFU, UELFU2, UELF2	UKF2
			AELF2, JELF2			
	• X Series			UCFX		UKFX
	• 300 Series			UCF3	UELF3	UKF3
• 300 Series Piloted Flange			UCFS3	UELFS3	UKFS3	
	4-Bolt Round Flange-Cast					
	• 200 Series	ASFC2, ARFC2	AELFC2, JELFC2	UCFC2, URFC2	UELFC2	UKFC2
• X Series			UCFCX		UKFCX	
	Flangette-Pressed Steel					
	• 2-Bolt	ASPFL2, ARPFL2	AELPFL2, JELPFL2			
	• 3-Bolt	ASPF2, ARPF2	AELPF2, JELPF2			
	• 3-Bolt Rubber Mounted Insert	ASRPF2	AELRPF2			
	Take-Up Unit					
	• 200 Series	AST2, ART2	AELT2, JELT2	UCT2, URT2	UEL2	UKT2
	• X Series			UCTX		UKTX
	• 300 Series			UCT3	UEL3	UKT3
	Cylindrical Cartridge					
	• 200 Series	ASC2, ARC2	AELC2, JELC2	UCC2, URC2	UELC2	UKC2
	• X Series			UCCX		UKCX
	• 300 Series			UCC3	UELC3	UKC3
	Stretcher Unit	ASPT2, ARPT2	AELPT2, JELPT2			
	Hanger Unit	ASHB2, ARHB2	AELHB2, JELHB2	UCHB2, URHB2	UELHB2, RELHB2	UKHB2
	Adjustable Flange Unit	ASFA2, ARFA2	AELFA2, JELFA2	UCFA2, URFA2	UELFA2, RELFA2	UKFA2
	Special 3-Bolt Flange Unit	ASFH2, ARFH2	AELFH2, JELFH2	UCFH2, URFH2	UELFH2, RELFH2	UKFH2
STRAIGHT O.D. INSERTS	SET SCREW	ECCENTRIC COLLAR	SET SCREW	ECCENTRIC COLLAR	ADAPTER	
200 Series	ASS2	AELS2, JELS2	UCS2 (ER type)	UELS2	UKS2	
300 Series			UCS3	UELS3	UKS3	