DRAWN CUP NEEDLE ROLLER BEARINGS

INCH SERIES

When a rolling bearing is needed for a compact and economical design, where it is not practical to harden and grind the housing bore, or where the housing materials are of low rigidity such as cast iron, aluminum or even plastics – drawn cup needle roller bearings should be considered.

REFERENCE STANDARDS

- **ANSI/ABMA 18.2** – needle roller bearings - radial, inch design.
- **ASTM F2162** – standard specification for bearing, roller, needle: drawn outer ring, full complement, without inner ring, open and closed end, standard type.

B **M** **J** **JTT**

Full complement bearings **Caged bearings**

Fig. B-7. Types of inch series drawn cup needle roller bearings

IDENTIFICATION

The prefix letter, or letters in inch series drawn cup bearing designation, denote whether the bearings are made with a full complement of needle rollers or caged needle rollers. The use of a full complement of needle rollers is indicated by the prefix code letter **B**, and for use of caged needle rollers by the prefix code letter **J**.

Inch bearings are available in either of two radial cross sections. The larger cross section is indicated by the prefix code letter **H**. Absence of the letter **H** indicates the smaller radial cross section.

These major features of dimension and construction are summarized in Table B-9.

In addition, there can be other identifying letters which cover special modification. Please consult your representative when special modifications are required.

Because the entire identification code in the bearing designation may not appear on the bearing itself, the manufacturer's parts list (or another reliable source) should always be consulted when ordering bearings for service or field replacement.

Table B-9. Prefix letter in bearing designations

	Prefix letters in bearing designation	
	Smaller roller	Larger roller
Full complement (mechanically retained)	B	BH
Caged	J	JH

Other prefix letters denoting major construction features are:

M – closed end style
P – open end (finger) cage
T – single seal
TT – double seal
G – extra-precision

CONSTRUCTION

FULL COMPLEMENT BEARINGS

The original drawn cup needle roller bearing employs a full complement of needle rollers. The full complement drawn cup bearing combines maximum load-carrying capability with the advantages of the drawn outer ring.

The inward turned lips of the cup are used to mechanically retain the full complement of needle rollers, providing their positive radial retention – even though it may be necessary to remove the shaft repeatedly during servicing of the mechanism employing the bearing.

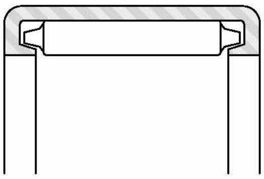


Fig. B-8. Full complement bearing

CAGED BEARINGS

The one-piece steel cage, used in most caged drawn cup bearings, is designed to provide rigidity and minimize wear. This cage design separates the roller guiding and roller retainment functions. The portions of the cage that retain the rollers cannot contact the rollers while the bearing is operating. Thus, there is no wear which might affect roller retention.

The cage contacts the rollers only near their ends at the roller pitch line, so accurate guidance is achieved with least effort. Pitch line guidance at the ends of the rollers prevents skewing and assures roller stability, with little stress on the cage itself. The design minimizes the contact area and force required for roller guidance, and thus minimizes drag between cage and rollers.

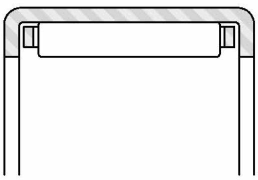


Fig. B-9. Caged bearing

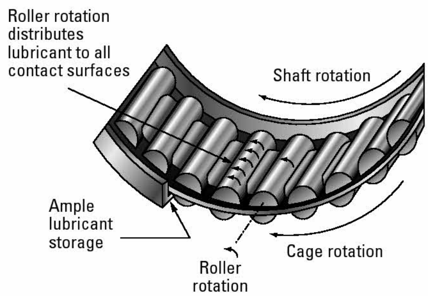


Fig. B-10. Cage design

The same design feature that assures no contact between roller retention bars and rollers while the bearing is operating, also provides ample clearance along the length of the roller to enhance the circulation of lubricant.

There are bearings with other cage designs. Bearings with engineered polymer cages are for use where operating conditions permit. Before applying bearings with engineered polymer cages, please consult your representative.

SEALED BEARINGS

Drawn cup caged needle roller bearings are offered with integral seals. The tables of dimensions on pages B-120 and B-121 indicate those sizes available with lip contact seals which limit the bearing operating temperature between -30° C and 110° C (-25° F and 225° F). The seal lip design achieves a light and constant contact with the shaft throughout the range of mounting bearing clearances thereby ensuring positive sealing and low frictional drag.

Sealed drawn cup bearings are intended to retain grease or non-pressurized oil within a bearing while also preventing contaminants from entering the raceway area.

Details of shaft design for sealed bearings are given in the engineering section.

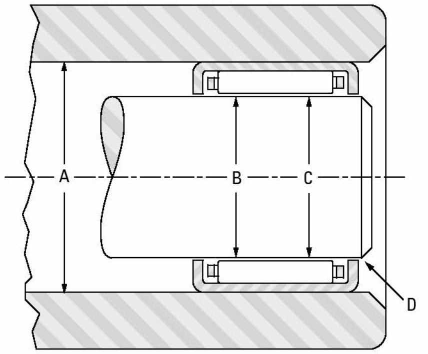
The standard lip contact seals are compatible with common lubricating oils and petroleum based fuels. But they are adversely affected by certain fire-resistant hydraulic fluids and most common solvents.

If the operating temperature must be outside of the specified range, or if the seals are exposed to unusual fluids, please consult your representative.

DIMENSIONAL ACCURACY AND MOUNTING DIMENSIONS

MANUFACTURING TOLERANCES AND RESULTING CLEARANCES

Reference: J-1616 bearing



A. Housing bore tolerance 0.025 mm (0.0010in.)
B. Manufacturing tolerance for bearing 0.023 mm (0.0009 in.)
C. Shaft diameter tolerance 0.013 mm (0.0005 in.)
D. Min. Initial radial clearance 0.013 mm (0.0005 in.)

Fig. 11. Manufacturing tolerances and resulting clearances

BEARING MOUNTING FITS AND RADIAL INTERNAL CLEARANCE

Drawn cup bearings are manufactured to a degree of precision that will satisfy the radial clearance requirements of most applications. The total radial clearance of an installed drawn cup bearing results from the buildup of manufacturing tolerances of the housing bore, inner raceway O.D., and the bearing – as well as the minimum radial clearance required for the application.

For bearings of nominal inch dimensions, the suggested mounting dimensions will provide correct running clearance for most applications. Closer control of radial clearance would be governed by the user's capability of holding housing and shaft raceway dimensional tolerances tighter than the limits shown in the bearing tables.

The drawing illustrates the manufacturing tolerances and resulting clearances applying to medium size drawn cup bearings, in rotating applications, when using the suggested tabulated mounting dimensions.

Radial clearance in a mounted bearing may be more closely controlled by reducing the manufacturing tolerances of the housing bore and inner raceway diameter. Where extremely close control of radial clearance is required for bearings of nominal inch dimensions, extra-precision full complement bearings are available (see page B-108).

TOLERANCES FOR HOUSING MATERIALS OF LOW RIGIDITY

For housing materials of low rigidity, or steel housings of small section, it is suggested that for initial trial the housing bore diameters given in the bearing tables be reduced by the amounts shown in Table B-10. To maintain normal radial internal clearance, the inner raceway diameter tolerance given in the bearing tables should be used.

Table B-10. Inner raceway diameter tolerance

Nom. housing bore				Subtract	
Over	Incl.	Over	Incl.		
mm		in.		mm	in.
0.0	**9.5**	0.00	0.38	**0.010**	0.0004
9.5	**25.4**	0.38	1.00	**0.015**	0.0006
25.4	**50.8**	1.00	2.00	**0.025**	0.0010
50.8	**76.2**	2.00	3.00	**0.030**	0.0012
76.2	**152.4**	3.00	6.00	**0.036**	0.0014

OUTER RING ROTATION

For applications where the outer ring rotates with respect to the load, it is suggested that both the housing bore and inner raceway diameter be reduced. Bearings of nominal inch dimensions should have the housing bore and inner raceway diameters reduced by 0.013 mm (0.0005 in.)

OSCILLATING MOTION

Applications involving oscillating motion often require reduced radial clearances. This reduction is accomplished by increasing the shaft raceway diameters as shown in Table B-11.

Table B-11. Nominal inch bearing oscillating shaft size

Shaft size		Add	
mm	in.	mm	in.
2.38 to 4.76	0.094 to 0.188	**0.008**	0.0003
6.35 to 47.62	0.250 to 1.875	**0.013**	0.0005
50.8 to 139.70	2.000 to 5.500	**0.015**	0.0006

B

INNER RINGS

Where it becomes impractical to meet the shaft raceway design requirements (hardness, case depth, surface finish, etc.) outlined in the engineering section, standard inner rings for drawn cup bearings are available. These are tabulated on pages B-122 to B-124 of the drawn cup section.

Inner rings for drawn cup bearings are designed to be a loose transition fit on the shaft and should be clamped against a shoulder. If a tight transition fit must be used to keep the inner ring from rotating relative to the shaft, the inner ring O.D., as mounted, must not exceed the raceway diameters required by the drawn cup bearing for the particular application.

LUBRICATION

Inch series drawn cup bearings can be furnished with an oil hole (centered in the drawn cup) to facilitate re-lubrication. If desired, specify on order by adding an **-OH** suffix to the bearing designation.

LOAD RATING FACTORS

Dynamic Loads

Drawn cup needle roller bearings can accommodate only radial loads.

$P = F_r$

P = The maximum dynamic radial load that may be applied to a drawn cup bearing based on the dynamic load rating, C given in the bearing tables. This load should be $\leq$ C/3.

Static Loads

$$f_0 = \frac{C_0}{P_0}$$

f_0 = static load safety factor

C_0 = basic static load rating

P_0 = maximum applied static load

To ensure satisfactory operation of drawn cup needle roller bearings under all types of conditions the static load safety factor f_0 should be $\geq$ 3.

ADJUSTED RATING LIFE

When application data includes details of operating temperature, oil viscosity, operating speed and the applied load meets the $\leq$ C/3 condition, adjusted rating life may be evaluated using the information given in the engineering section of this catalog.

INSPECTION PROCEDURES

Although the bearing cup (outer ring) is accurately drawn from strip steel it may go out of round during heat treatment. When the bearing is pressed into a true, round housing or ring gage of correct size and wall thickness, it becomes round and is sized properly. For this reason, it is incorrect to inspect an unmounted drawn cup bearing by measuring the O.D. The correct method for inspecting the bearing size is to:

1. Press the bearing into a ring gage of proper size.
2. Plug the bearing bore with the appropriate "go" and "no go" gages.

Table B-12 on page B-91 provides the correct ring and plug gage diameters for inspecting Torrington drawn cup needle roller bearings. When the letter **H** appears in the columns headed "Bearing Bore Designation" and "Nominal Shaft Diameter," the gage sizes listed are for the larger cross section bearings which include **H** in their bearing designation prefix.

Example

Find the ring gage and plug gage dimensions for a BH-68 bearing.

The nominal bore diameter (F_W) for this bearing, as shown in the table of dimensions on page B-91, is 9.525 mm (0.3750 in.). Since the letter H appears in the bearing designation, the following information will be found opposite H6 9.525 mm (0.3750 in.) in Table B-12 on page B-91.

	in.
ring gage	0.6255
diameter under needle rollers, min.	0.3765
diameter under needle rollers, max.	0.3774

The "go" plug gage is the same size as the minimum needle roller complement bore diameter and the "no go" plug gage size is 0.002 mm (0.0001 in.) larger than the maximum bore diameter. Therefore the correct ring and plug gage dimensions are:

	in.
ring gage	0.6255
plug gage, "go"	0.3765
plug gage, "no go"	0.3775

These same gage dimensions also apply to JH-68.

B

Table B-12. Ring and plug gage dimensions

Bearing bore designation	Nominal shaft diameter	Nominal. bore diameter	Ring gage	Needle roller complement bore diameter	
				Max.	Min
	mm in.	mm in.	mm in.	mm in.	mm in.
2	**3.175** 1/8	**3.175** 0.1250	**6.363** 0.2505	**3.218** 0.1267	**3.195** 0.1258
2 1/2	**3.970** 5/32	**3.967** 0.1562	**7.155** 0.2817	**4.013** 0.1580	**3.99** 0.1571
3	**4.763** 3/16	**4.763** 0.1875	**8.730** 0.3437	**4.806** 0.1892	**4.783** 0.1883
4	**6.350** 1/4	**6.350** 0.2500	**11.125** 0.4380	**6.411** 0.2524	**6.388** 0.2515
5	**7.938** 5/16	**7.938** 0.3125	**12.713** 0.5005	**7.998** 0.3149	**7.976** 0.3140
H 5	**H 7.938** H 5/16	**7.938** 0.3125	**14.300** 0.5630	**7.998** 0.3149	**7.976** 0.3140
6	**9.525** 3/8	**9.525** 0.3750	**14.300** 0.5630	**9.586** 0.3774	**9.563** 0.3765
H 6	**H 9.525** H 3/8	**9.525** 0.3750	**15.888** 0.6255	**9.586** 0.3774	**9.563** 0.3765
7	**11.113** 7/16	**11.113** 0.4375	**15.888** 0.6255	**11.174** 0.4399	**11.151** 0.4390
H 7	**H 11.113** H 7/16	**11.113** 0.4375	**17.475** 0.6880	**11.174** 0.4399	**11.151** 0.4390
8	**12.700** 1/2	**12.700** 0.5000	**17.475** 0.6880	**12.761** 0.5024	**12.738** 0.5015
H 8	**H12.700** H 1/2	**12.700** 0.5000	**19.063** 0.7505	**12.761** 0.5024	**12.738** 0.5015
9	**14.288** 9/16	**14.288** 0.5625	**19.063** 0.7505	**14.349** 0.5649	**14.326** 0.5640
H 9	**H 14.288** H 9/16	**14.288** 0.5625	**20.650** 0.8130	**14.349** 0.5649	**14.326** 0.5640
10	**15.875** 5/8	**15.875** 0.6250	**20.650** 0.8130	**14.349** 0.6274	**15.913** 0.6265
H 10	**H 15.875** H 5/8	**15.875** 0.6250	**22.238** 0.8755	**14.349** 0.6274	**15.913** 0.6265
11	**17.463** 11/16	**17.463** 0.6875	**22.238** 0.8755	**17.524** 0.6899	**17.501** 0.6890
H 11	**H 17.463** H 11/16	**17.463** 0.6875	**23.825** 0.9380	**17.524** 0.6899	**17.501** 0.6890
12	**19.050** 3/4	**19.050** 0.7500	**25.387** 0.9995	**19.086** 0.7514	**19.063** 0.7505
H 12	**H 19.050** H 3/4	**19.050** 0.7500	**26.975** 1.0620	**19.086** 0.7514	**19.063** 0.7505
13	**20.638** 13/16	**20.638** 0.8125	**26.975** 1.0620	**20.673** 0.8139	**20.650** 0.8130
H 13	**H 20.638** H 13/16	**20.638** 0.8125	**28.562** 1.1245	**20.673** 0.8139	**20.650** 0.8130
14	**22.225** 7/8	**22.225** 0.8750	**28.562** 1.1245	**22.261** 0.8764	**22.238** 0.8755
H 14	**H 22.225** H 7/8	**22.225** 0.8750	**30.150** 1.1870	**22.261** 0.8764	**22.238** 0.8755
15	**23.813** 15/16	**23.813** 0.9375	**30.150** 1.1870	**23.848** 0.9389	**23.825** 0.9380
16	**25.400** 1	**25.400** 1.0000	**31.737** 1.2495	**25.436** 1.0014	**25.413** 1.0005
H 16	**H 25.400** H 1	**25.400** 1.0000	**33.325** 1.3120	**25.436** 1.0014	**25.413** 1.0005
17	**26.988** 1 1/16	**26.988** 1.0625	**33.325** 1.3120	**27.023** 1.0639	**27.000** 1.0630
18	**28.575** 1 1/8	**28.575** 1.1250	**34.912** 1.3745	**28.611** 1.1264	**28.588** 1.1255
H 18	**H 28.575** H 1 1/8	**28.575** 1.1250	**38.087** 1.4995	**28.611** 1.1264	**28.588** 1.1255
19	**30.163** 1 3/16	**30.163** 1.1875	**38.087** 1.4995	**30.198** 1.1889	**30.175** 1.1880
20	**31.750** 1 1/4	**31.750** 1.2500	**38.087** 1.4995	**31.786** 1.2514	**31.763** 1.2505
H 20	**H 31.750** H 1 1/4	**31.750** 1.2500	**41.262** 1.6245	**31.786** 1.2514	**31.763** 1.2505
21	**33.338** 1 5/16	**33.338** 1.3125	**41.262** 1.6245	**33.376** 1.3140	**33.350** 1.3130
22	**34.925** 1 3/8	**34.925** 1.3750	**41.262** 1.6245	**34.963** 1.3765	**34.938** 1.3755
H 22	**H 34.925** H1 3/8	**34.925** 1.3750	**44.437** 1.7495	**34.963** 1.3765	**34.938** 1.3755
24	**38.100** 1 1/2	**38.100** 1.5000	**47.612** 1.8745	**38.141** 1.5016	**38.113** 1.5005
26	**41.275** 1 5/8	**41.275** 1.6250	**50.787** 1.9995	**41.316** 1.6266	**41.288** 1.6255
28	**44.450** 1 3/4	**44.450** 1.7500	**53.962** 2.1245	**44.493** 1.7517	**44.463** 1.7505
30	**47.625** 1 7/8	**47.625** 1.8750	**57.137** 2.2495	**47.668** 1.8767	**47.638** 1.8755
32	**50.800** 2	**50.800** 2.0000	**60.312** 2.3745	**50.846** 2.0018	**50.815** 2.0006
H 33	**H 52.388** H 2 1/16	**52.388** 2.0625	**64.280** 2.5307	**52.436** 2.0644	**52.400** 2.0630
34	**53.975** 2 1/8	**53.975** 2.1250	**63.487** 2.4995	**54.026** 2.1270	**53.990** 2.1256
36	**57.150** 2 1/4	**57.150** 2.2500	**66.662** 2.6245	**57.201** 2.2520	**57.165** 2.2506
42	**66.675** 2 5/8	**66.675** 2.6250	**76.187** 2.9995	**66.736** 2.6274	**66.700** 2.6260
44	**69.850** 2 3/4	**69.850** 2.7500	**79.362** 3.1245	**69.911** 2.7524	**69.875** 2.7510
56	**88.900** 3 1/2	**88.900** 3.5000	**101.587** 3.9995	**88.961** 3.5024	**88.925** 3.5010
88	**139.700** 5 1/2	**139.700** 5.5000	**152.375** 5.9990	**139.774** 5.5029	**139.725** 5.5010

Bearing bore should be checked with "go" and "no go" plug gages. The "go" gage size is the minimum needle roller complement bore diameter. The "no go" gage size is larger than the maximum needle roller complement bore diameter by 0.0001 in.

INSTALLATION OF DRAWN CUP BEARINGS

GENERAL INSTALLATION REQUIREMENTS

- A drawn cup bearing must be pressed into its housing.
- An installation tool, similar to the ones shown, must be used in conjunction with a standard press.
- The bearing must not be hammered into its housing – even in conjunction with the proper assembly mandrel.
- The bearing must not be pressed tightly against a shoulder in the housing.
- If it is necessary to use a shouldered housing, the depth of the housing bore must be sufficient to ensure the housing shoulder fillet, and the shoulder face, clear the bearing.
- The installation tool must be coaxial with the housing bore.

INSTALLATION OF OPEN END BEARINGS

It is advisable to utilize a positive stop on the press tool to locate the bearing properly in the housing. The assembly tool should have a leader or a pilot, as shown, to aid in starting the bearing true in the housing. The ball detent shown on the drawing is used to assist in aligning the rollers of a full complement bearing during installation and to hold the bearing on the installation tool. A caged-type drawn cup bearing does not require a ball detent to align its rollers. The ball detent may still be used to hold the bearing on the installation tool or an "O" ring may be used as shown in the drawing on this page. The bearing should be installed with the marked end (the end with identification markings) against the angled shoulder of the pressing tool.

A – 0.40 mm (0.016 in.) less than housing bore
B – 0.08 mm (0.003 in.) less than shaft diameter
C – distance bearing will be inset into housing, minimum of 0.20 mm (0.008 in.)
D – pilot length should be length of bearing less 0.80 mm (0.030 in.)
E – approximately 1/2 D

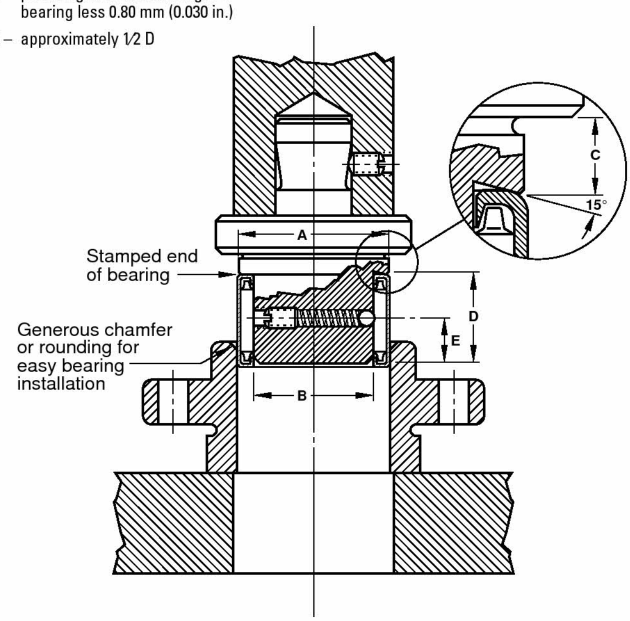


Fig. B-12. Installation of open ends caged bearings

A – 0.40 mm (0.016 in.) less than housing bore
B – 0.08 mm (0.003 in.) less than shaft diameter
C – distance bearing will be inset into housing, minimum of 0.20 mm (0.008 in.)
D – pilot length should be length of bearing less 0.80 mm (0.030 in.)
E – approximately 1/2 D

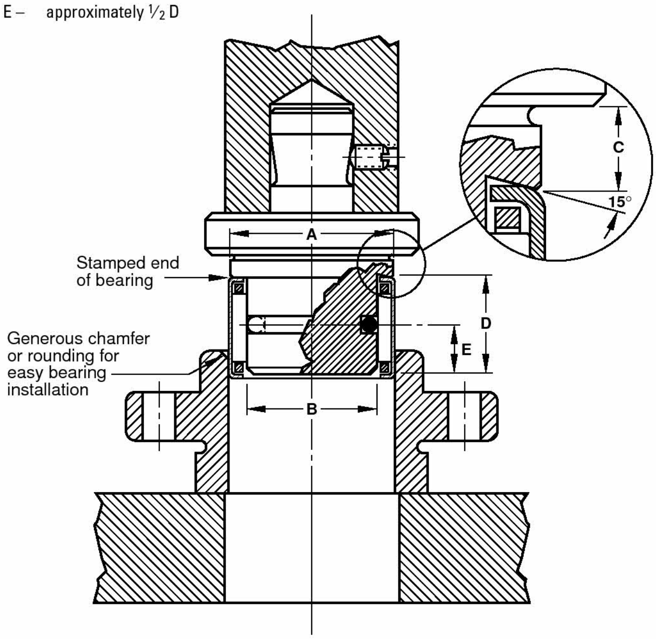


Fig. B-13. Installation of open ends full complement bearings

INSTALLATION OF CLOSED END BEARINGS

The installation tool combines all the features of the tool used to install open end bearings. But the pilot is spring loaded and is part of the press bed.

The angled shoulder of the pressing tool should bear against the closed end, with the bearing held on the pilot, to aid in starting the bearing true in the housing.

A – 0.40 mm (0.016 in.) less than housing bore
B – 0.08 mm (0.003 in.) less than shaft diameter
C – distance bearing will be inset into housing, minimum of 0.20 mm (0.008 in.)

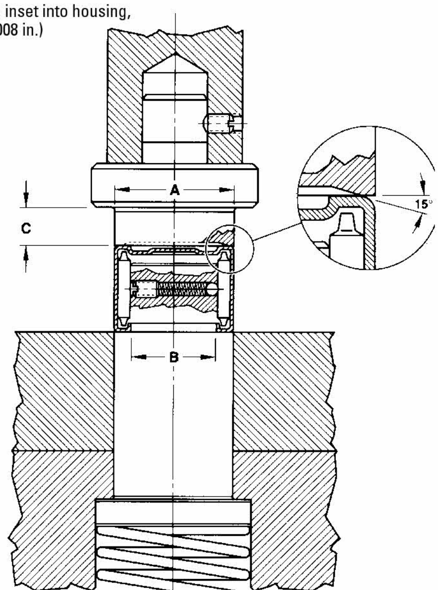


Fig. B-14. Installation of closed end bearings

B

EXTRACTION OF DRAWN CUP BEARINGS

The need to extract a drawn cup bearing does not arise often. Standard extractor tools may be purchased from a reputable manufacturer. Customers may produce the special extraction tools at their own facilities. After extraction, the drawn cup bearing should not be reused.

EXTRACTION FROM A STRAIGHT HOUSING

When it is necessary to extract a drawn cup bearing from a straight housing, a similar tool to the installation tool – but without the stop – may be used. To avoid damage to the bearing, pressure should be applied against the marked end of the bearing, just as it is done at installation.

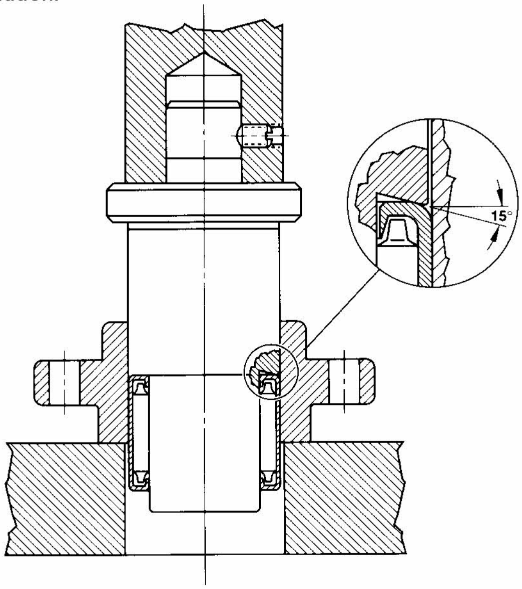


Fig. B-15. Extraction from a straight housing

EXTRACTION FROM A SHOULDERED HOUSING

(with bearing pressed up close to the shoulder)

The tool to be used, as shown, is of a similar type described for a shouldered or dead end housing. But the rollers must first be removed from the bearing.

The four segment puller jaws are collapsed and slipped into the empty cup. The jaws are then forced outward into the cup bore, by means of the tapered expansion rod. The jaws should bear on the lip as near as possible to the cup bore. The cup is then pressed out from the top.

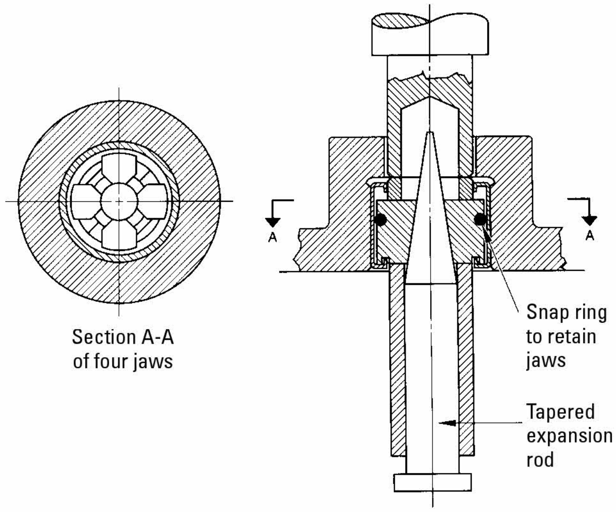


Fig. B-16. Extraction from a shouldered housing

EXTRACTION FROM A SHOULDERED OR DEAD END HOUSING

(with space between the bearing and the housing shoulder)

Bearings may be extracted from shouldered or dead end housings with a common bearing puller tool as shown. This type of tool is slotted in two places, at right angles, to form four prongs. The four puller prongs are pressed together and inserted into the space between the end of the bearing and the shoulder. The prongs are forced outward by inserting the expansion rod, and then the bearing is extracted. Do not reuse the bearing after extraction.

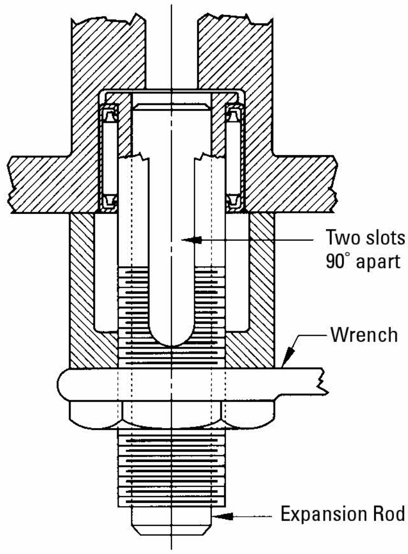


Fig. B-17. Extraction from a shouldered or dead end housing