USA TOLERANCE RINGS

Your Solution for Mounting Cylindrical Components

- Tough enough for off-road equipment
- Delicate enough for miniature ball bearings

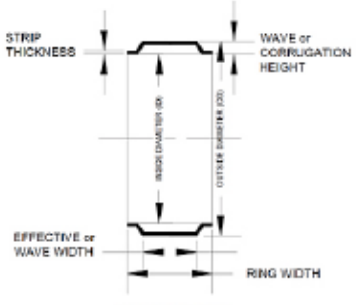
Tolerance Rings 101

What are Tolerance Rings?

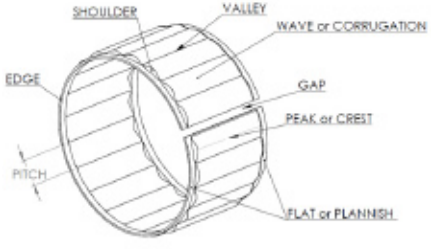
Tolerance Rings are highly engineered frictional fasteners used to effectively join mating cylindrical parts. Manufactured from high quality spring steel or stainless steel strip, Tolerance Rings are widely accepted as fastening devices capable of handling torque transfer, axial retention and radial loading between mating and/or parts.

Technical and economical advantages ensured by use of Tolerance Rings include:

- *Rapid, low cost of assembly*
- *Wider dimensional tolerance of mating diameters for interference fits Compensation for Δ thermal expansion between mating materials*
- *Elimination of keys, pins, adhesives, D-shafts, threads and splines*
- *Compensation for small amounts of misalignment of up to 1/2° draft angle*
- *Infinite rotational indexing of parts prior to assembly*
- *Modification to spring rates/critical frequencies of assemblies*



(BN STYLE SHOWN)



(BN STYLE SHOWN)

NOMENCLATURE MAY VARY AMONG MANUFACTURERS

Basic Principle of the Tolerance Ring

The Tolerance Ring is made from a thin spring steel strip of material into which waves, corrugations, or bumps are formed. The strips are cut to length and curled into the ring shape. The waves are either facing inward or outward to accommodate different applications. The AN style, waves facing inward, is designed so that the ends can be closed and fitted into a bore or tube and is self-retaining when released. The BN style, waves facing outward, is designed so that when the ends are opened it will slip over a shaft and also be self-retaining when released.

The waveforms of a tolerance ring are designed to exert a holding force yet allow for ease of assembly between mating components. When the Tolerance Ring is assembled between mating components, each wave is elastically deflected, resulting in holding force. The holding ability of the ring is the resultant force of all the waves and the coefficient of friction with the mating components.

E= Modulus of Elasticity or Young's Modulus, typically 28×10^6 psi for 301 stainless steel

t = strip or raw material thickness

p = pitch, distance between waves

w = effective or wave width

$k \approx 4.8Ew(t/p)^3$ = simplified theoretical spring constant of a single wave or corrugation, "little k"

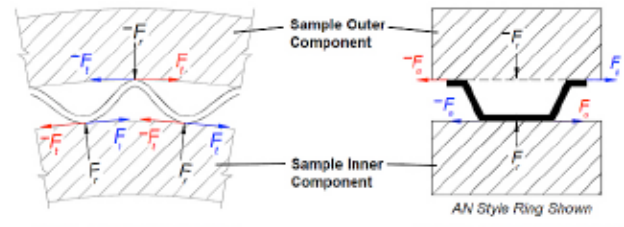
Δh= amount of wave compression

N = number of waves or corrugations on entire perimeter

$F_r = \Delta hk$ = radial spring force exerted by a single wave or corrugation

$F_R = \sum F_r = \Delta hNk$ = total radial circumferential load

$\varrho_r = \sum F_a = \varrho_s F_R = \varrho_s \sum F_r$ = peak axial retention force or maximum pull-out force



AXIAL CROSS-SECTION
(EXAGGERATED)
$-F_r, F_r$ = radial compressive forces
$-F_t, F_t$ or $-F_t, F_t$ = induced rotational frictional forces when torque is applied

RADIAL CROSS-SECTION
(EXAGGERATED)
$-F_r, F_r$ = radial compressive forces
$-F_a, F_a$ or $-F_a, F_a$ = induced frictional forces when axial force is applied

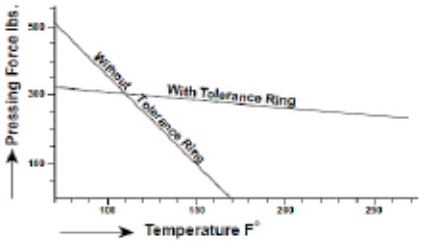
Ball Bearings

DIFFERENTIAL THERMAL EXPANSION

Tolerance Rings are used with great success in compensating for differential thermal expansion of mating parts. Examples include aluminum housings with steel bearings, silicon carbide bushings and sleeves mated to steel housing and shafts, and glass-filled plastic impellers to shafts. Tolerance Rings maintain retention and minimum torque values, and may accommodate wide variations in diameter without over-stressing brittle components.

The graph to the right illustrates ring performance in retaining a 2.00" OD bearing in an aluminum housing. With .0012" traditional interference fit, an installation force of 500 pounds is required. Due to thermal growth between the steel bearing and aluminum housing, the bearing becomes loose at a temperature of 170 °F. With the Tolerance Ring, an initial installation force of only 320 pounds is required, and retention remains high at 230 pounds at 270 °F.

ZINC-DIECAST BEARING BRACKETS



Since draft angle on these brackets is minimal, they normally require no secondary machining operation. Oftentimes ANL or light duty AN-style rings are used to keep assembly forces low to avoid brinelling the bearing during assembly. Whereas glue and rubber boots trap heat, air-flow around the rings may allow the bearing to run cooler. Elastomer boots can vary in their durometer readings (stiffness) and allow unwanted side movement of the bearing, while tolerance rings have a predictable spring rate to better center the bearing.

GLASS-FILLED MOLDED PLASTIC HOUSINGS

The ring's waves expand and contract to accommodate thermal expansion of the housing. Glass is needed as a hardener to prevent the ring from wallowing its way (creeping) into the housing. Typically, there is no need for an insert ring or any secondary machining operations.

STAMPINGS

Tolerance Rings allow mounting precision bearings in stamped housings. As the tooling wears and the housing bore decreases with later production runs, the waves deflect without taking up all the internal clearance of the bearing. Tolerance rings compensate for tool wear with stampings.

MOLDED BEARINGS

Power tools, which operate near energized wiring, often use molded bearings (outer race insulated with plastic) for electric shock prevention. Tolerance rings are ideal for dealing with both mechanical and thermal tolerance stack-up occurring with these molded bearings.

MOUNTING BEARINGS INSIDE TUBES

Straight tubular sections, with a centered hole already bored, are natural housings for ball bearings. The tubes can be cut to the desired length, then welded to one another; forming a structural framework.

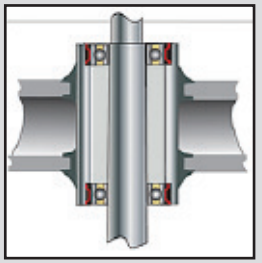
Problems arise, however, due to tube bore tolerances not being acceptable for a bearing press fit. Other dimensional distortions occur from the heat produced during welding operations and the application of paint layers. What was previously a circular tube ID may now be out of round due to manufacturing processes.

Tolerance rings can compensate for these incurred dimensional variations. An example is part number AN35X11S with a 6202 bearing inside a tube. Despite a 0.007" tolerance stack up in the final tube bore ID, the tolerance ring keeps the bearing fully functional.

Mounting Ball Bearings

- Compensates for distortion due to paint, glues, welding induced deformation
- Adjust for out of roundness
- Allows for larger dimensional tolerances of mating diameters

Bearing in Tubes



Applications

ELIMINATING FRETTING & CORROSION

Fretting and corrosion constitute a detrimental wear process occurring at the contact area between materials under load and subject to minute relative motion by vibration or other forces. Tolerance Rings may reduce or eliminate this damaging wear process by shifting the vibrational frequency of the bearing away from the natural frequency of the system or by preventing rotation of the bearing outer race while allowing it to float axially. In one such application, 100mm OD preloaded bearings in the generators of electronically controlled wind turbines were encountering strong vibration. The bearings were prematurely failing due to fretting & corrosion. Upon mounting the bearings in the housing with Tolerance Rings, they no longer encountered fretting & corrosion and endured for their full design life-cycle.

REPAIR WORN OR OVERSIZED HOUSING BORES

Tolerance rings can be used to reclaim worn housing bores or bearing pockets which have been accidentally machined oversized. By adjusting the inside diameter with additional machining to accommodate the Tolerance Ring, the original intended (or alternate) ball bearing size can be installed. AN-style rings for popular ball bearing sizes are packaged individually and sold as TR packs in the aftermarket.

Save time and money by repairing worn or oversized housings. By using our tolerance rings, specifically designed to hold and center the outer race of ball bearings, housings can be salvaged.

1. *Easy machining and quick assembly with generous tolerances (thousandths, not ten-thousandths)*
2. *Bearing may run cooler, and waves allow for thermal growth of the housing*
3. *No expensive sleeves or messy glues*
4. *Perfect fit that allows for 1/2° misalignment for rings with a width <7mm*
5. *Rings for 37 common bearing sizes*

Miniature Bearing Series of Tolerance Rings

These are made specifically for miniature and small-sized ball bearings, up to 30mm in outer diameter. Ideal for high-precision and high-speed rotating components to ensure rotational accuracy.

ANL RINGS

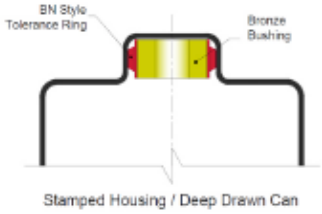
BEARING NUMBER	dia nominal	BRG O.D. d (in)	BRG W W (in)	USA TOLERANCE RINGS PART NUMBER	RADIAL CAPACITY (lbs)	TYPICAL BORE FOR BEARING MOUNT D min (in)	D max (in)
R3	1/2	0.5000	0.1960	ANL12.7X5S	6	0.525	0.527
R4	5/8	0.6250	0.1960	ANL16X5S	8	0.650	0.652
34	16mm	0.6299	0.1969	ANL16X5S	8	0.655	0.657
21104	11/16	0.6875	0.3125	ANL17.5X8S	11	0.714	0.716
35	19mm	0.7480	0.2362	ANL19X6S	10	0.773	0.775
608/38	22mm	0.8661	0.2756	ANL22X7S	13	0.890	0.892
608/38	22mm	0.8661	0.2756	ANL22X10S	21	0.890	0.892

AN RINGS

BEARING NUMBER	dia nominal	BRG O.D. d (in)	BRG W W (in)	USA TOLERANCE RINGS PART NUMBER	RADIAL CAPACITY (lbs)	TYPICAL BORE FOR BEARING MOUNT (in)	(in)
R3	1/2	0.5000	0.1960	AN12.7X5S	180	0.555	0.558
R4	5/8	0.6250	0.1960	AN16X5S	250	0.680	0.683
34	16mm	0.6299	0.1969	AN16X5S	250	0.685	0.688
35	19mm	0.7480	0.2362	AN19X6S	420	0.823	0.826
38/608	22mm	0.8661	0.2756	AN22X7S	550	0.941	0.944
R6	7/8	0.8750	0.2500	AN087025S	580	0.950	0.953
6000	6mm	1.0236	0.3150	AN26X8S	770	1.098	1.101
6001	28mm	1.1024	0.3150	AN28X8S	840	1.177	1.181
R8	1-7/8	1.1250	0.2500	AN112025S	720	1.199	1.203
6200	30mm	1.1811	0.3543	AN30X9S	890	1.256	1.259

Bushings and Sleeves

A tolerance ring's unique wave properties provide a secure grip for holding bushings (i.e., bronze, plastic) and sleeves both firmly and gently in place. Torque and axial retention requirements are met while cushioning them from thermally induced stresses from adjacent components.

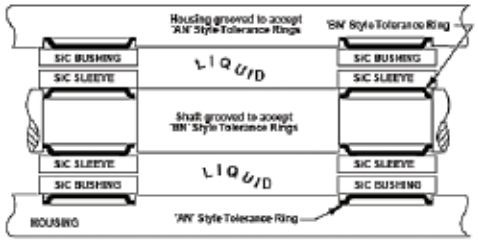


Typically tolerance rings are made of 301 stainless steel (SST) for basic corrosion resistance. SST tolerance rings can handle a large range of operating temperatures from -100°F/-73°C to 450°F/232°C. With higher temperatures (>450 °F/232°C) or more corrosive applications, the rings are made from Hastelloy C276 or Monel K-500.

Chemical pumps such as magnetic drive seal-less pumps often employ silicon carbide (or tungsten) bushings and journals. The carbide components have a very low coefficient of thermal expansion compared to the typical steel or alloy based mating housings or shafts. Carbide materials are also brittle and can fracture if exposed to the high forces of press fits or excessive stresses due to differential thermal expansion/contraction.

Mounting these fragile ceramic sliding bearings can be a challenge. Using O-rings often results in premature pump failure due to the softening or brittlizing of the O-ring materials from the extreme operational temperatures.

A variety of tolerance ring configurations can be made for accommodating design constraints. Providing a spring rate strong enough to hold over the extremes of tolerance and temperature, yet soft enough to prevent damage to relatively brittle or delicate materials is done by balancing a ring's parameters.



Silicon Carbide Bushing and Sleeve in a Seal-less Chemical Pump

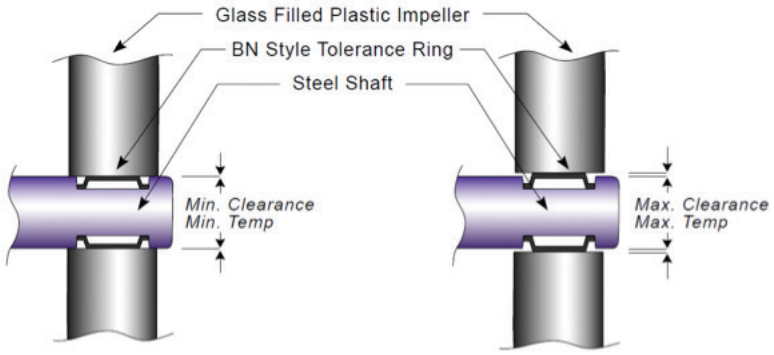
Torque Transfer

Tolerance Rings can be used to transmit torque from one cylindrical component to another, without the need for costly splines or expensive keyways. Gears, pulleys, disks, sprockets, flywheels, rollers, impellers are a sample of the many torque transmitting components that can be mounted with tolerance rings. Unlike a keyway's tolerances which result in backlash with a change in rotational direction, the tolerance ring provides zero backlash.

Depending on the diameter of the mounting components and the configuration of the tolerance ring, torques from .015 ft.-lbs. to 250 ft.-lbs. and much higher can be handled prior to slippage. The amount of torque transmitted will vary with tolerance ring configurations, diameters, material hardness, surface finish, and the amount of thermal expansion/contraction occurring between components. The slippage point can provide natural torque overload protection, acting as a "fuse" and preventing damage to less sturdy components such as plastic gear teeth.

TORQUE TRANSFER IN THERMAL GROWTH APPLICATIONS

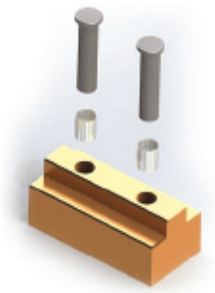
Tolerance rings often mount ball bearing outer races to retain the bearing in thermal growth applications. Similarly, the rings can be used in high temperature applications involving dissimilar materials such as steel shafts to plastic glass filled fan hubs or impellers.



FLEXIBLE POSITIONAL INDEXING / ALIGNMENT

Tolerance rings allow for easy rotational alignment of indicator knobs and dials during initial calibration, especially with instrumentation. For electronic equipment that needs "tuning" prior to the placement of control knobs or dials, tolerance rings allow for proper polar orientation with markers.

Fastening/Joining



Tolerance rings are well suited for fastening and joining different or dissimilar materials. To allow for future repair or removal, they provide an alternative when a permanent bond is not desired. Faster assembly can be achieved without the use or curing time of messy adhesives.

HANDLES & KNOBS

Quickly assembling a handle or knob onto a shaft reduces production time and labor costs. Using epoxy or adhesives can be messy and doesn't allow for future replacement. A tolerance ring rapidly attaches handles or knobs onto shafts and still allows for future repair or replacement.

PHENOLIC BRUSH HOLDERS

In motors, maintaining relative position between the brushes and commutator under high impact conditions is critical for motor performance. Using epoxy to secure the brush holder is both messy and time-consuming. Set screws run the risk of being too tight and cracking the brush holder, or being too loose and resulting in undesirable movement. Regardless of whether the brush holder is molded or ground, a tolerance ring from USA Tolerance Rings can secure it without mess or guesswork.

MOUNTING STATORS IN ELECTRIC MOTORS

Mounting a motor stator assembly in an aluminum housing can be difficult, especially when there is thermal expansion and contraction expected during the electric motor's life cycle. The stator core laminates can be fragile or brittle and any excessive force concentrations during assembly or thermal cycling can result in fragmentation and particle generation. Tolerance rings can reduce these concerns by compensating for thermal movements with their spring like characteristics, creating a uniform force distribution around the core's circumference and allowing for proper axially positioning.

MOUNTING MAGNETS

Magnets are commonly used in probes and sensing devices. Securing magnets can be challenging due to their brittleness and different thermal expansion rates, especially in automotive applications where under hood temperatures can range from -40 °F to 350 °F [-40 °C to 177 °C] and higher. Press fitting the magnet in place introduces large dimensional stresses during assembly and large thermal stresses during operation. These large stresses may crack the magnet or holder and introduce unwanted particle chips into the device. Glues or adhesives can soften or become brittle over time from temperature fluctuations and fail prematurely. Tolerance rings can properly retain magnets while allowing for differences in thermal growth. By adjusting the ring's design, a suitable spring rate can be achieved which is strong enough to hold the magnet firmly in place throughout the thermal range and tolerances, yet gentle enough to prevent material damage. The unique cushioning effect of the waves also resists the long term effects of creep and cold flow with softer plastic housing materials.

MANUFACTURING ASSEMBLY AID

Tolerance rings temporarily position, hold or center components prior to final assembly or holding components together as they move through an assembly line.

MOUNTING LARGE OR OVERSIZED COMPONENTS

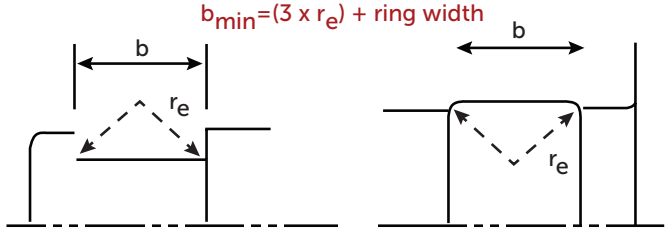
Tolerance Rings provide a secure means for retaining large components, such as mounting larger OD (>12") thin section bearings in housings. In addition to saving on machining costs by relaxing housing ID tolerances, they allow for minor out of roundness and thermal expansion. Tolerance Rings can be provided in spooled strip form for customizing to large diametric sizes. They are excellent for centering large components prior to final bolting during assembly and can present a significant cost savings by increasing tolerances and reducing scrap. In off-highway equipment, where large, rugged components are commonplace, tolerance rings can ease assembly.

Design of Mating Parts

The "tops" of the corrugations (The I.D. on AN style rings, or the O.D. on BN rings) are formed with a rounded contour, which assists as a lead-in edge during assembly. It is very important that the lead-in edge of the mating part is contoured with a generous radius or a shallow (15^0) chamfer. Sharp corners on the lead-in edge could dig in and mar the Tolerance Ring, sacrificing performance.

Best results of assembling mating parts are achieved by using an arbor or hydraulic press and fixturing the parts to hold them squarely in place during assembly. Except for very light duty rings, aligning the parts by hand and/or hammering the assembly together jeopardizes alignment and performance. If misalignment occurs during assembly, there is a tendency for the lead-in edge of the mating part to flatten corrugations in one area of the Tolerance Ring, resulting in reduction of ring integrity.

r_e=.010 max for dia <2"
=.020 max for dia > 2"
b_{min}=(3 x r_e) + ring width



Groove in shaft O.D. Groove in housing bore

When using the centered arrangement, a small radius and adequate groove width should be used to ensure that the Tolerance Ring may be properly seated on the cylindrical surface.

Mounting Choices

CENTERED ARRANGEMENT

This arrangement provides a groove in the housing for AN rings or a groove on the shaft for BN rings. These grooves capture the ring axially on both sides and simplify assembly. When the shoulder (stepped) diameter is held close to the nominal diameter, the following advantages occur:

- *Improved alignment of parts during installation*
- *Improved concentricity due to low radial clearance at the shoulder*

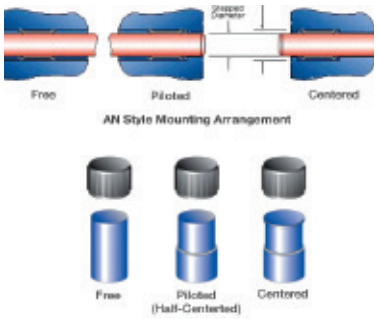
Excessive radial loads and shock loads can be accommodated since the Tolerance Ring is protected in its own cavity. The corrugations will deflect until the shoulder or stepped diameter contacts the mating member. Additional loading will be transmitted through the step, and will not act to further deflect or crush the corrugations.

PILOTED (HALF-CENTERED) ARRANGEMENT

This arrangement is similar to the centered configuration, at a lower cost. With the exception of piloting for alignment, this method may provide the advantages of the centered arrangement when the stepped diameter is held close to the nominal diameter of the mating component.

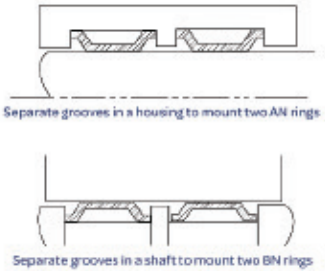
FREE ARRANGEMENT

This arrangement will not provide axial support to the ring in either direction, so the assembly machine must be fixtured to "back up" or axially locate the ring temporarily while the mating components are assembled. The Tolerance Ring will be subjected to all radial loading and should be selected with appropriate capacity.



Assembly with Multiple Rings

When an application requires a greater radial load capacity, torque capacity, or width than may be provided by a single Tolerance Ring, more than one ring may be used. It is necessary to separate the rings by a flange or shoulder to prevent the rings from overlapping.



Part Identification Chart

BN	5	X	6	C	
AN	125		075	S	2

SERIES: AN, ANL, BN

DIAMETER: mm or x.xx"

INCH SERIES = blank
METRIC SERIES = X

WIDTH: mm or xx"

MATERIAL:
S = 301 Stainless Steel
C = Carbon Steel
H = Hastelloy
M = Monel

DESIGNATES SPECIAL DESIGN

SAMPLE PART NUMBER IDENTIFICATION:

BN 5 X 6 C	BN series, 5 mm DIA, 6 mm width, carbon steel
AN 125075 S2	AN series, 1-1/4" DIA, 3/4" width, stainless, special

APPROXIMATE SIZE RANGE OF STANDARD RINGS

Diameter Rings	.18"/.29" 4.5mm/7.5mm	.31"/.73" 8mm/18mm	.5+" 12.7mm	.70"/1.23" 19mm/30mm	.1.25"+ 32mm+	2"+ 51mm+	3"+ 82mm+	5"+ 125mm
Ring Widths Available	1/4", 5/16", 3/8", 7/16", 1/2", 5/8", 5mm, 6mm	1/4", 5/16", 3/8", 1/2", 5/8", 3/4", 4mm, 5mm, 6mm, 8mm	4mm, 5mm, 6, 7, 8, 10mm, 14mm, 15mm	1/4", 3/8", 1/2", 5/8", 3/4", 1", 1-1/8", 6mm, 7mm, 8mm, 9mm, 10mm, 13mm, 16mm, 22mm	1/4", 3/8", 1/2", 5/8", 3/4", 7/8", 1", 1-1/4", 1-1/2" 7mm, 10mm, 11mm, 12mm, 13mm, 14mm, 15mm,16mm, 17mm, 18mm, 19mm, 20mm, 21mm, 30mm	10mm, 15mm, 16mm	19mm, 21mm	1/2", 5/8", 12mm
Pitch	.059", 1.25mm	.984", 3.5mm	.1236", 3.14mm This Pitch is ANL Version Only	.1378", 3.5mm	.1968", 5mm	.248", 6.3mm	.2953", 7.5mm	.370", 9.4mm
Material Thickness	.006", 0.15mm	.008", .2mm	.004", 0.10mm	.012", .3mm	.016", 0.40mm	0.020", 0.50mm	0.024", 0.60mm	0.028", 0.70mm

Types of Tolerance Rings

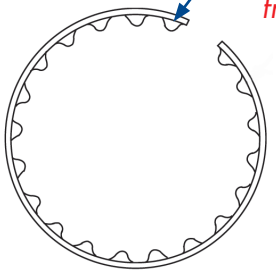
Tolerance Rings are typically made in three varieties: AN, ANL, and BN. The appropriate ring for your application will depend on such factors as assembly procedure, which part is a "nominal" diameter, and which part may be more readily modified to accept the Tolerance Ring in the design.

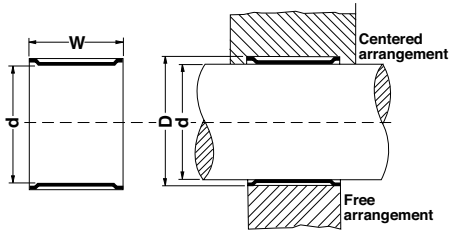
AN Series Rings

The AN style ring is "open" in the free state so that when installed inside a bore the ring will conform to that bore and be self retaining. If used with the centered or half-centered arrangement no further handling of the ring is necessary during assembly of the mating machine parts. When used with the free arrangement, the ring must be supported axially during assembly of the mating machine parts.

The AN style is cut to length so as to fit outside a "nominal" circumference. Examples for use of the AN style include mounting a bearing outer race, or mounting a fan or pulley to a shaft of common inch or metric diameter.

Corrugations face inward on AN and ANL rings. Corrugation heights range from .014" to .049"for most rings.



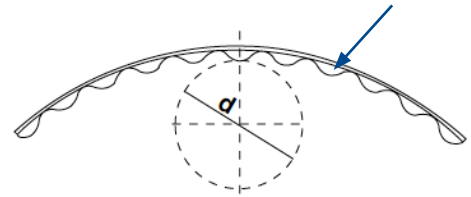


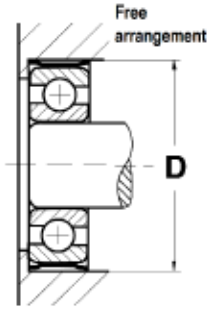
AN RINGS														
d nominal	d (in)	w2 (in)	PART NUMBER	d min (in)	D max (in)	DIAMETRAL [2] CLEARANCE		RADIAL CAPACITY (lbs)	TORQUE CAPACITY @ G1 [3] (in-lbs)	TYPICAL BORE FOR TORQUE			TYPICAL BORE FOR BEARING MOUNT	
						G1 (in)	G2 (in)			TC (in-lbs)	D min (in)	D max (in)	D min (in)	D max (in)
4 mm	0.157	0.236	AN4X8C	0.156	0.195	0.032	0.039	20	3	2	0.190	0.192	0.193	0.195
3/16	0.188	0.250	AN018025C	0.187	0.226	0.032	0.039	23	4	3	0.219	0.221	0.224	0.226
6 mm	0.236	0.236	AN6X6C	0.235	0.274	0.032	0.039	30	6	4	0.269	0.270	0.273	0.274
1/4	0.250	0.250	AN025025C	0.249	0.289	0.032	0.039	45	9	4	0.283	0.285	0.287	0.289
5/16	0.313	0.250	AN031025C	0.312	0.370	0.048	0.058	65	11	7	0.362	0.364	0.368	0.370
3/8	0.375	0.250	AN037025S	0.374	0.433	0.048	0.058	190	21	15	0.424	0.426	0.430	0.433
7/16	0.438	0.250	AN043025S	0.437	0.495	0.048	0.058	230	25	18	0.487	0.489	0.492	0.495
1/2	0.500	0.250	AN050025S	0.498	0.558	0.048	0.058	270	50	25	0.549	0.552	0.555	0.558
5/8	0.625	0.250	AN062025S	0.623	0.683	0.048	0.058	320	75	37	0.674	0.677	0.680	0.683
16 mm	0.630	0.197	AN16X5S	0.628	0.688	0.048	0.058	250	58	30	0.678	0.682	0.685	0.688
11/16	0.688	0.250	AN068025S	0.686	0.746	0.048	0.058	370	100	50	0.737	0.740	0.743	0.746
19 mm	0.748	0.236	AN19X6S	0.746	0.826	0.066	0.078	420	98	60	0.814	0.817	0.823	0.826
3/4	0.750	0.250	AN075025S	0.748	0.828	0.066	0.078	440	115	70	0.816	0.819	0.825	0.828
22 mm	0.866	0.276	AN22X7S	0.864	0.944	0.066	0.078	550	220	135	0.932	0.935	0.941	0.944
7/8	0.875	0.500	AN087050S	0.873	0.953	0.066	0.078	1200	325	200	0.941	0.944	0.950	0.953
1	1.000	0.500	AN100050S	0.998	1.078	0.066	0.078	1300	425	260	1.066	1.069	1.075	1.078
28 mm	1.102	0.472	AN28X12S	1.100	1.181	0.066	0.078	1330	525	325	1.168	1.171	1.177	1.181
1 1/8	1.125	0.500	AN112050S	1.123	1.203	0.066	0.078	1440	530	330	1.188	1.192	1.199	1.203
30 mm	1.181	0.512	AN30X13S	1.179	1.259	0.066	0.078	1400	640	390	1.247	1.250	1.256	1.259
1 1/4	1.250	0.500	AN125050S	1.248	1.328	0.066	0.078	890	530	410	1.316	1.320	1.324	1.328
1 3/8	1.375	0.500	AN137050S	1.373	1.453	0.066	0.078	1040	650	500	1.441	1.445	1.449	1.453
35 mm	1.378	0.433	AN35X11S	1.376	1.456	0.066	0.078	820	550	290	1.444	1.448	1.452	1.456
1 1/2	1.500	0.500	AN150050S	1.498	1.578	0.066	0.078	1100	795	420	1.566	1.570	1.574	1.578
1 9/16	1.563	0.500	AN156050S	1.561	1.641	0.066	0.078	1100	860	460	1.629	1.633	1.637	1.641
40 mm	1.575	0.472	AN40X12S	1.573	1.653	0.066	0.078	1000	835	445	1.641	1.645	1.649	1.653
1 5/8	1.625	0.500	AN162050S	1.623	1.703	0.066	0.078	1200	940	500	1.691	1.695	1.699	1.703
42 mm	1.654	0.512	AN42X13S	1.652	1.731	0.066	0.078	1200	890	475	1.720	1.724	1.727	1.731
1 3/4	1.750	0.500	AN175050S	1.748	1.828	0.066	0.078	1200	1110	590	1.816	1.820	1.824	1.828
47 mm	1.850	0.551	AN47X14S	1.848	1.928	0.066	0.078	1400	1360	720	1.916	1.920	1.924	1.928
1 7/8	1.875	0.500	AN187050S	1.873	1.953	0.066	0.078	1300	1240	660	1.941	1.945	1.949	1.953
2	2.000	0.500	AN200050S	1.998	2.097	0.080	0.098	1100	1175	675	2.082	2.087	2.092	2.097

AN & ANL Series Rings

The ANL style may be described as a very light duty AN style ring. It is often characteristic of this ring to not have a circular shape in the free state.

Designed for light duty, ANL rings have .014" corrugation height standard and use .004" to .006" thick material.





AN RINGS (cont'd)

BEARING NUMBER	d Nominal	BRG O.D. d (in)	BRG W W (in)	PART NUMBER	RADIAL CAPACITY (lbs)	TYPICAL BORE FOR BEARING MOUNT	
						D min (in)	D max (in)
R3	1/2	0.5000	0.1960	AN12.7X5S	180	0.555	0.558
R4	5/8	0.6250	0.1960	AN16X5S	250	0.680	0.683
34	16 mm	0.6299	0.1969	AN16X5S	250	0.685	0.688
35	19 mm	0.7480	0.2362	AN19X6S	420	0.823	0.826
38/608	22 mm	0.8661	0.2756	AN22X7S	550	0.941	0.944
R6	7/8	0.8750	0.2500	AN087025S	580	0.950	0.953
6000	26 mm	1.0236	0.3150	AN26X8S	770	1.098	1.101
6001	28 mm	1.1024	0.3150	AN28X8S	840	1.177	1.181
R8	1-1/8	1.1250	0.2500	AN112025S	720	1.199	1.203
6200	30 mm	1.1811	0.3543	AN30X9S	980	1.256	1.259
6201	32 mm	1.2598	0.3937	AN32X10S	670	1.334	1.338
6202/6300	35 mm	1.3780	0.4331	AN35X11S	820	1.452	1.456
6301	37 mm	1.4567	0.4724	AN37X12S	900	1.531	1.535
6203	40 mm	1.5748	0.4724	AN40X12S	1000	1.649	1.653
6302	42 mm	1.6535	0.5118	AN42X13S	1200	1.727	1.731
6204/6303	47 mm	1.8504	0.5512	AN47X14S	1400	1.924	1.928
6205/6304	52 mm	2.0472	0.5906	AN52X15S	1600	2.140	2.145
6206/6305	62 mm	2.4409	0.6299	AN62X16S	2000	2.533	2.538
6305W	62 mm	2.4409	0.9055	AN62X23S9	3600	2.533	2.538
6207	72 mm	2.8346	0.6693	AN72X17S9	2900	2.910	2.913
6306	72 mm	2.8346	0.7480	AN72X19S9	3600	2.910	2.913
6208	80 mm	3.1496	0.7087	AN80X17S9	3250	3.224	3.227
6307	80 mm	3.1496	0.8268	AN80X20S9	4000	3.224	3.227
6209	85 mm	3.3465	0.7480	AN85X19S9	4300	3.422	3.425
6210	90 mm	3.5433	0.7874	AN90X20S9	4550	3.618	3.621
6308	90 mm	3.5433	0.9055	AN90X22S9	5350	3.618	3.621
6211	100 mm	3.9370	0.8268	AN100X21S9	5100	4.051	4.054
6309	100 mm	3.9370	0.9843	AN100X25S9	6550	4.012	4.015
6212	110 mm	4.3307	0.8661	AN110X22S9	6525	4.406	4.409
6310	110 mm	4.3307	1.0630	AN110X25S9	7190	4.406	4.409
6213	120 mm	4.7244	0.9055	AN120X22S9	7190	4.799	4.802
6311	120 mm	4.7244	1.1417	AN120X25S9	7950	4.799	4.802
6214	125 mm	4.9213	0.9449	AN125X22S9	7480	4.996	4.999
6215	130 mm	5.1181	0.9843	AN130X25S9	8550	5.193	5.196
6312	130 mm	5.1181	1.2205	AN130X31S9	10500	5.193	5.196
6216	140 mm	5.5118	1.0236	AN140X25S9	9200	5.587	5.590
6313	140 mm	5.5118	1.2992	AN140X33S9	12200	5.587	5.590
6217	150 mm	5.9055	1.1024	AN150X25S9	9950	5.980	5.983
6314	150 mm	5.9055	1.3780	AN150X33S9	13000	5.980	5.983
6218	160 mm	6.2992	1.1811	AN160X25S9	10550	6.374	6.377
6315	160 mm	6.2992	1.4567	AN160X33S9	13950	6.374	6.377
6316	170 mm	6.6929	1.5354	AN170X39S9	17250	6.767	6.770
6317	180 mm	7.0866	1.6142	AN180X39S9	19000	5.161	7.164
6318	190 mm	7.4803	1.6929	AN190X39S9	20500	7.555	7.558

ANL RINGS

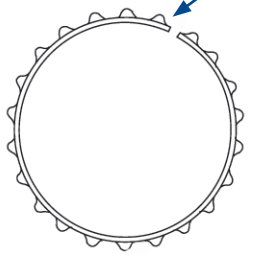
BEARING NUMBER	d nominal	BRG O.D. d (in)	BRG W W (in)	PART NUMBER	RADIAL CAPACITY (lbs)	TYPICAL BORE FOR BEARING MOUNT	
						D min (in)	D max (in)
R3	1/2	0.5000	0.1960	ANL12.7X5S	6	0.525	0.527
R4	5/8	0.6250	0.1960	ANL16X5S	8	0.650	0.652
34	16 mm	0.6299	0.1969	ANL16X5S	8	0.655	0.657
21104	11/16	0.6875	0.3125	ANL17.5X8S	11	0.714	0.716
35	19 mm	0.7480	0.2362	ANL19X6S	10	0.773	0.775
608/38	22 mm	0.8661	0.2756	ANL22X7S	13	0.890	0.892
608/38	22 mm	0.8661	0.2756	ANL22X10S	21	0.890	0.892
6203	40 mm	1.5748	0.4724	ANL40X12S	45	1.600	1.602

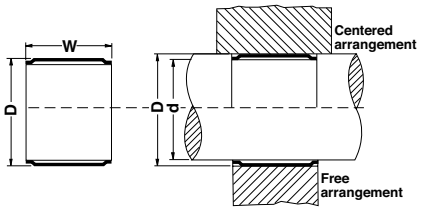
BN Series Rings

BN style rings have a free-state diameter smaller than the shaft diameter over which they are to be installed, so that when mounted to the shaft the rings conform to and become self-retaining on the shaft. If used with the centered or halfcentered arrangement, the ring will snap into the groove and no further handling of the ring is necessary. If used with the free arrangement, the ring must be axially supported during assembly of the mating parts.

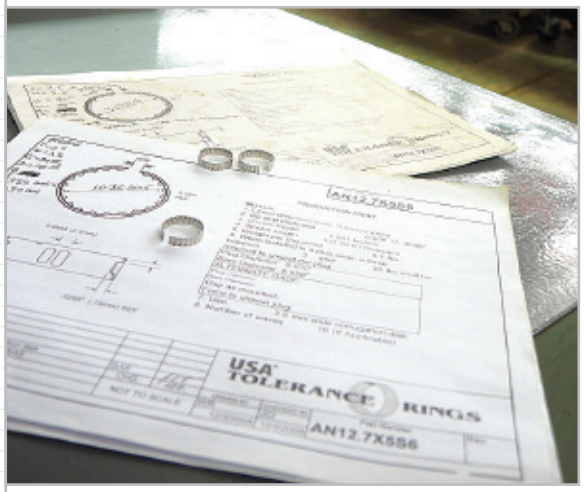
The BN ring is cut to fit inside a nominal circumference. Examples for use of the BN ring include mounting a bearing inner race to a shaft, or assemblies in which modification of the shaft is more practical than modifying the bore of the outer member.

The free-state shape of the BN ring may be overlapped or may have a slight gap, but the ring should always be self-retaining to the specified shaft diameter.





BN RINGS														
D nominal	D (in)	W[1] (in)	PART NUMBER	d min (in)	D max (in)	DIAMETRAL[2] CLEARANCE (in)	(in)	RADIAL CAPACITY (lbs)	TORQUE CAPACITY (in-lbs)	TYPICAL O.D. FOR TORQUE TC (in-lbs)	d min (in)	d max (in)	TYPICAL O.D. FOR BEARING MOUNT d min (in)	d max (in)
3/16	0.188	0.250	BN018025C	0.149	0.189	0.032	0.039	50	3	1.8	0.153	0.155	0.149	0.150
5 mm	0.197	0.236	BN5X6C	0.159	0.198	0.032	0.039	50	3	2	0.162	0.164	0.159	0.160
6 mm	0.236	0.236	BN6X6C	0.198	0.237	0.032	0.039	85	4	2	0.201	0.203	0.198	0.200
1/4	0.250	0.250	BN025025C	0.211	0.251	0.032	0.039	105	7	4	0.215	0.217	0.211	0.213
5/16	0.313	0.250	BN031025C	0.254	0.314	0.048	0.058	55	11	8	0.262	0.264	0.254	0.256
8 mm	0.315	0.197	BN8X5S	0.257	0.316	0.048	0.058	125	9	5	0.264	0.266	0.257	0.259
3/8	0.375	0.250	BN037025S	0.317	0.376	0.048	0.058	190	21	12	0.323	0.326	0.317	0.320
10 mm	0.394	0.276	BN10X7S	0.336	0.395	0.048	0.058	200	24	17	0.342	0.345	0.336	0.339
12 mm	0.472	0.197	BN12X5S	0.414	0.473	0.048	0.058	200	31	18	0.420	0.423	0.414	0.417
1/2	0.500	0.250	BN050025S	0.442	0.501	0.048	0.058	240	37	21	0.448	0.451	0.442	0.445
9/16	0.563	0.250	BN056025S	0.505	0.564	0.048	0.058	240	47	28	0.511	0.514	0.505	0.508
15 mm	0.591	0.236	BN15X6S	0.532	0.592	0.048	0.058	270	49	30	0.539	0.542	0.532	0.535
5/8	0.625	0.250	BN062025S	0.567	0.627	0.048	0.058	300	75	38	0.573	0.576	0.567	0.570
17 mm	0.669	0.472	BN17X12S	0.611	0.671	0.048	0.058	640	185	92	0.617	0.620	0.611	0.614
11/16	0.688	0.375	BN068037S	0.629	0.690	0.048	0.058	510	160	80	0.636	0.639	0.629	0.632
3/4	0.750	0.500	BN075050S	0.672	0.752	0.066	0.078	880	200	120	0.681	0.684	0.672	0.675
20 mm	0.787	0.472	BN20X12S	0.710	0.789	0.066	0.078	840	175	110	0.718	0.721	0.710	0.713
7/8	0.875	0.500	BN087050S	0.797	0.877	0.066	0.078	1000	300	185	0.806	0.809	0.797	0.800
15/16	0.938	0.500	BN093050S	0.859	0.940	0.066	0.078	1125	405	245	0.869	0.872	0.859	0.862
25 mm	0.984	0.472	BN25X12S	0.907	0.986	0.066	0.078	1100	275	170	0.915	0.918	0.907	0.910
1	1.000	0.500	BN100050S	0.922	1.002	0.066	0.078	1200	400	245	0.931	0.934	0.922	0.925
1 1/8	1.125	0.500	BN112050S	1.047	1.127	0.066	0.078	1300	515	315	1.056	1.059	1.047	1.050
30 mm	1.181	0.512	BN30X13S	1.104	1.183	0.066	0.078	1400	550	340	1.112	1.115	1.104	1.107
1 3/16	1.188	0.875	BN118087S	1.109	1.190	0.066	0.078	2500	1150	700	1.119	1.122	1.109	1.112
1 1/4	1.250	0.750	BN125075S	1.172	1.252	0.066	0.078	1200	740	450	1.181	1.184	1.172	1.175
1 3/8	1.375	0.688	BN137068S	1.297	1.377	0.066	0.078	1170	770	410	1.305	1.309	1.297	1.301
35 mm	1.378	0.669	BN35X17S	1.300	1.380	0.066	0.078	1220	785	415	1.308	1.312	1.300	1.304
1 1/2	1.500	0.750	BN150075S	1.422	1.502	0.066	0.078	1500	1120	595	1.430	1.434	1.422	1.426
40 mm	1.575	0.551	BN40X14S	1.497	1.577	0.066	0.078	1200	850	450	1.505	1.509	1.497	1.501
1 5/8	1.625	1.000	BN162100S	1.547	1.627	0.066	0.078	2200	1800	955	1.555	1.559	1.547	1.551
1 3/4	1.750	1.000	BN175100S	1.672	1.752	0.066	0.078	2400	2100	1115	1.680	1.684	1.672	1.676
2	2.000	1.000	BN200100S	1.922	2.002	0.066	0.078	2700	2900	1775	1.931	1.934	1.922	1.926



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Since 1961, USA Tolerance Rings has been producing tolerance rings for numerous industries. We've remained a flexible company that specializes in custom solutions for our clients' specific engineering needs. In addition to custom design rings, we carry a number of stock ring sizes for various applications.

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