STUD & GREASE FITTING CONFIGURATIONS

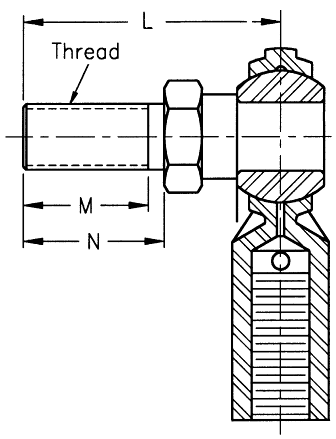
TECHNICAL

ROD END STUD Specifications

ROD END STUD - INCH / METRIC

- Low Carbon Steel
- Protective Coated for Corrosion Resistance
- Right Hand Threads Standard
- Available with All Cataloged Rod Ends, Male and Female*

ROD END STUD CONFIGURATION



DIMENSIONS IN INCHES

Rod End Bore Size	L Ref.	N ±.010	M Ref.	Thread UNF-2A
3/16	1.000	0.500	0.437	10-32
1/4	1.031	0.562	0.500	1/4-28
5/16	1.219	0.687	0.593	5/16-24
3/8	1.562	0.906	0.812	3/8-24
7/16	1.750	1.062	0.937	7/16-20
1/2	2.000	1.125	1.000	1/2-20
5/8	2.500	1.500	1.375	5/8-18
3/4	3.000	1.182	1.625	3/4-16

When ordering a standard stud, add the letter **"S"** to the completed rod end number. ***Example: CMR8S***

If studded rod end is ordered with a grease fitting, the standard placement is in the right hand location with stud pointed toward the viewer. *Please specify if alternate placement is required.*

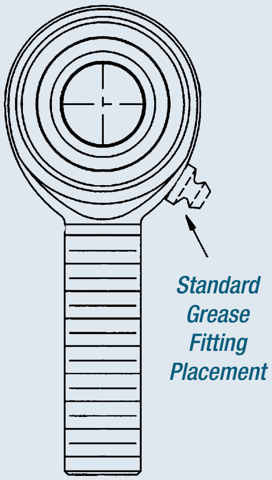
When ordering a stud and grease fitting, add the letter **"S"** and **"Z"** to the completed number. ***Example: CMR8SZ***

** Please consult QA1 for availability of stainless steel studs and metric studs.*

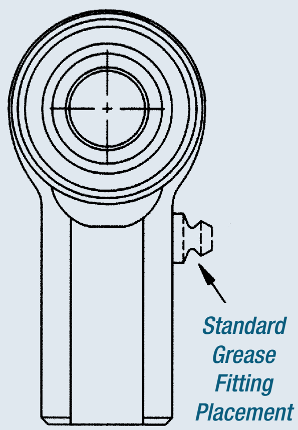
GREASE FITTING CONFIGURATION

Location
Standard grease fitting locations are illustrated at the right. Note that for a female configuration, once the male threaded component is fully engaged, the grease is forced through the hole at the top of the female shank to facilitate ball lubrication.

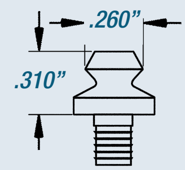
Standard Grease Fitting
Order by adding the letter **"Z"** to the completed number.
Example: CMR8Z



Male



Female



Standard Grease Fitting

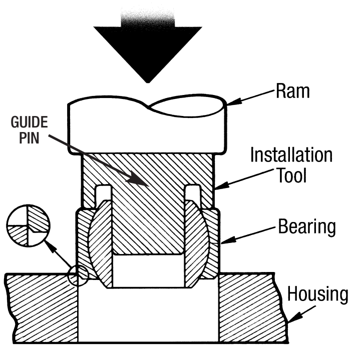
Catalog load ratings are based on rod ends without grease fittings.
For adjusted load ratings with grease fittings, consult QA1 Engineering.

INSTALLATION & STAKING OF SPHERICAL BEARINGS

ENGINEERING DATA

TECHNICAL

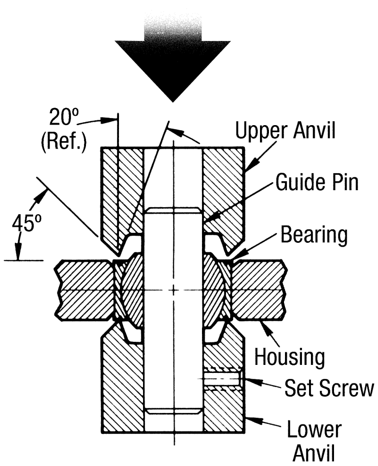
INSTALLATION OF SPHERICAL BEARINGS



Proper press-fitting of spherical bearings into a housing fixture will result not only in smooth bearing performance, but also in better wear characteristics leading to longer life. QA1 Engineering recommends strict adherence to the following installation procedures in order to assure optimal spherical bearing performance and wear.

The use of a hydraulic press to apply constant pressure is recommended. Any other shock-inducing device such as a hammer will result in damage and/or ultimate misfit. An installation tool such as that shown on the left is ideal. Here the guide pin aligns the ball's bore parallel to the race O.D., while all force is applied to the outer race surface only. A lead chamfer (inset) on the bearing and/or housing fixture is essential.

STAKING METHOD FOR V-GROOVED SPHERICAL BEARINGS



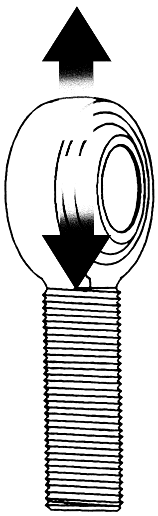
Customers often require a bearing with a specially formed "V"-shaped groove on the face of the outer race, allowing for staking of the bearing into a fixed outer housing. This is accomplished by forcing the metal on the outside of the groove onto the fixture's face or into its chamfer. The use of a hydraulic press for this operation is recommended, as is following the instructions for the initial installation of the bearing into the housing as described above.

QA1 Engineering recommends an upper and lower anvil method for installation. Anvils should be aligned as shown, with guide pin in position. This pin should ideally be secured in the lower anvil by means of a set screw. A test assembly should be undertaken to assure that required axial (thrust) load requirements of the final product are maintained. Avoid excessive pressure which can result in distortion leading to premature failure or malfunction. When the test requirements are met, the assembly should be rotated at 90º maximum intervals, with pressure re-applied, to assure uniformity of the metal swaging process.

NOTE: QA1 Spherical Bearings with staking groove are denoted with the letter "G" at the end of the part number as cataloged. ***Example: WPB4TG***

RADIAL & AXIAL STATIC LOAD RATINGS

RADIAL STATIC LOAD RATINGS



The ultimate radial static load rating is measured as the failure point when a load is increasingly applied to a pin inserted through the rod end's bore and pulled straight up while the rod end is fixtured. Note that QA1's cataloged radial load ratings include a safety factor, and that insertion of a grease fitting into the radius of the rod end may reduce the load rating due to lesser cross-sectional material in the stressed point. The actual rating is determined by calculating the lowest of the following three values:

1. Race material compressive strength (R value): $R = E \times T \times X$

2. Rod end head strength (H Value, cartridge type construction): $H = [(\frac{T}{2}\sqrt{D^2 - T^2}) + (\frac{D^2}{2} \times \sin^{-1}\frac{T}{2}) - (\text{O.D. of Bearing} \times T)] \times X$

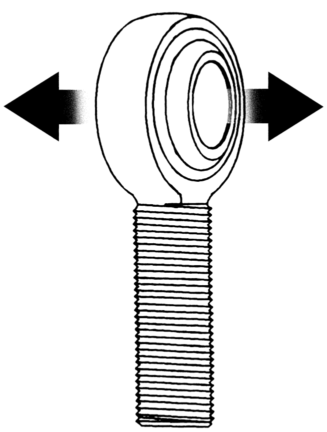
   Angle of $\frac{T}{D}$ expressed in radians

3. Shank strength (S Value) Male threaded rod end: $S = [(\text{root diameter of thread}^2 \times .78) - (N^2 \times .78)] \times X$

   Female threaded rod end: $S_1 = [(J^2 \times .78) - (\text{major diameter of thread}^2 \times .78)] \times X$

Where: E = Ball Diameter
T = Housing Width
X = Allowable Stress (See Table Below)
D = Head Diameter
N = Diameter of Drilled Hole in Shank of Male Rod End
J = Shank Diameter of Female Rod End

AXIAL STATIC LOAD RATINGS



The axial static load capacity is measured as the force required to cause failure via a load parallel to the axis of the bore. Depending on material types and construction methods, the ultimate axial load is generally 10-20% of the ultimate radial static load. The formula does not account for the bending of the shank due to a moment of force, nor the strength of the stake in cartridge-type construction.

AXIAL STRENGTH (A Value): $A = .78 [(E + .176 T)^2 - E2] \times X$

Where: X = Allowable Stress (See Table)
E = Ball Diameter
T = Housing Width

MATERIAL	ALLOWABLE STRESS (PSI)
Brass	30,000
Aluminum Bronze	35,000
300 Series Stainless Steel	35,000
Low Carbon Steel	52,000
Alloy Steel	140,000

ANGLE OF MISALIGNMENT

ANGLE OF MISALIGNMENT

The maximum angle of the ball in a rod end or spherical bearing that can be maintained without interference is calculated as the angle of misalignment. It is defined as the angle between the ball centerline and the outer member centerline when the ball is aligned in its extreme position as allowed. The worst case limiting angle is determined by clevis-mounted assembly as seen in Figure 1. Total misalignment under this condition, as cataloged by QA1 for rod end applications, is twice the angle from one side of center to the opposite extreme position. Misalignment in a spherical bearing is limited by ball and race width, as functions of ball diameter, and is illustrated in Figure 3 on the right. This calculation is the basis for QA1 cataloged angles of misalignment. Other mounting arrangements as shown in Figures 2-4 can also be used as guidelines in calculating the precise angle of misalignment depending on the mounting configuration, and are frequently referenced for metric usage.

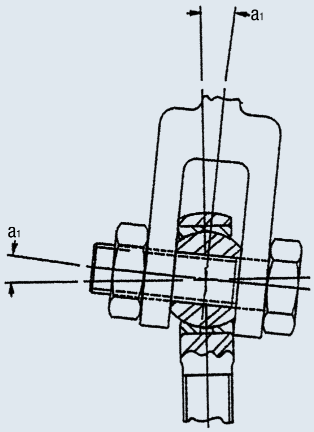


FIGURE 1

$$a^1 = Sin^{-1}\frac{W}{D} - Sin^{-1}\frac{T}{D}$$

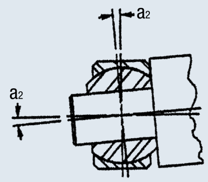


FIGURE 2

$$a^2 = Sin^{-1}\frac{W}{A} - Sin^{-1}\frac{T}{A}$$

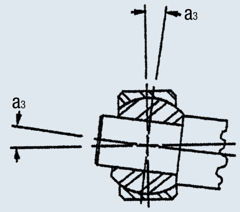


FIGURE 3

$$a^3 = Sin^{-1}\frac{W}{E} - Sin^{-1}\frac{T}{E}$$

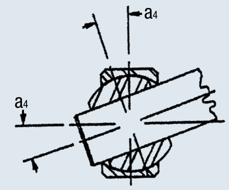


FIGURE 4

$$a^4 = Cos^{-1}\frac{B}{E} - Cos^{-1}\frac{T}{E}$$

Reference Letters

B = Ball Bore

M = Outer Race Chamfer

D = Head Diameter of the Outer Race Diameter

E = Ball Diameter

T = Housing Width

A = $\sqrt{(D\text{-}2M)^2 + T^2}$

W = Ball Width

WARRANTY

QA1 warrants that the products will be free from defects in material and workmanship for one year from date of sale. QA1 makes no other warranty of any kind, express or implied. QA1 shall have no obligation under the foregoing warranty where the defect is the result of improper or abnormal use, negligence, vehicle accident, improper or incorrect installation or maintenance, nor when the product has been repaired or altered in any way so as (in our judgment) to affect its performance. QA1's liability in the case of defective products subject to the foregoing warranty shall be limited to the repair or replacement, at QA1's option, of the defective products. Except expressly provided herein, QA1 shall have no liability (on account of negligence or otherwise) for, or in connection with, defects or deficiencies in the products and in no event shall QA1 be liable for any incidental, special or consequential damages or commercial loss (including loss of revenue or profits) of buyer or any other person, arising out of the use, or inability to use, the goods, or the failure or ineffectiveness of the goods.

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INCH/METRIC CONVERSION TABLE

ENGINEERING DATA

TECHNICAL

INCH / METRIC CONVERSION TABLE

INCH Fraction	INCH Decimal	MM	INCH Fraction	INCH Decimal	MM	INCH Fraction	INCH Decimal	MM	INCH Fraction	INCH Decimal	MM
	0.00004	0.001	17/64	0.2656	6.746		0.6693	17.0		1.3780	35.0
	0.00039	0.010		0.2756	7.0	43/64	0.6719	17.066		1.4173	36.0
	0.0010	0.025	9/32	0.2812	7.1437	11/16	0.6875	17.4625	1-1/2	1.5000	38.1
	0.0020	0.051	19/64	0.2969	7.5406	45/64	0.7031	17.859		1.5354	39.0
	0.0030	0.0762	5/16	0.3125	7.9375		0.7086	18		1.5748	40.0
	0.00394	0.1		0.3150	8.0	23/32	0.7187	18.256		1.6535	42.0
	0.0050	0.1270	21/64	0.3281	8.334	47/64	0.7344	18.653	1-3/4	1.7500	44.45
	0.00984	0.25	11/32	0.3437	8.731		0.7480	19.0		1.7717	45.0
	0.0100	0.254		0.3543	9.0	3/4	0.7500	19.05		1.8898	48.0
1/64	0.0156	0.396	23/64	0.3594	9.1281	49/64	0.7656	19.446		1.9685	50.0
1/32	0.0312	0.793	3/8	0.3750	9.525	25/32	0.7812	19.843	2	2.0000	50.8
	0.03937	1.0	25/64	0.3906	9.9219		0.7874	20.0		2.0472	52.0
3/64	0.0469	1.191		0.3937	10.0	51/64	0.7969	20.240		2.1654	55.0
	0.0591	1.5	13/32	0.4062	10.318	13/16	0.8125	20.6375		2.2047	56.0
1/16	0.0625	1.5875	27/64	0.4219	10.716		0.8268	21.0	2-1/4	2.2500	57.15
5/64	0.0781	1.984		0.4331	11.0	53/64	0.8281	21.034		2.3622	60.0
	0.0787	2.0	7/16	0.4375	11.1125	27/32	0.8437	21.431	2-1/2	2.5000	63.5
3/32	0.0937	2.381	29/64	0.4531	11.509	55/64	0.8594	21.828		2.5197	64.0
	0.0984	2.5	15/32	0.4687	11.906		0.8661	22.0	2-3/4	2.7500	69.85
	0.1000	2.54		0.4724	12.0	7/8	0.8750	22.225		2.8346	72.0
7/64	0.1094	2.778	31/64	0.4844	12.303	57/64	0.8906	22.621		2.9528	75.0
	0.1181	3.0	1/2	0.5000	12.7		0.9055	23.0	3.0	3.0000	76.2
1/8	0.125	3.175		0.5118	13.0	29/32	0.9062	23.018		3.1496	80.0
	0.1378	3.5	33/64	0.5156	13.096	59/64	0.9219	23.416	3-1/4	3.2500	82.55
9/64	0.1406	3.571	17/32	0.5312	13.493	15/16	0.9375	23.8125	3-1/2	3.5000	88.9
5/32	0.1562	3.968	35/64	0.5469	13.891		0.9449	24.0		3.5433	90.0
	0.1575	4.0		0.5512	14.0	61/64	0.9531	24.209	3-3/4	3.7500	95.25
11/64	0.1719	4.366	9/16	0.5625	14.2875	31/32	0.9687	24.606		3.9370	100.0
	0.1772	4.5	37/64	0.5781	14.684		0.9843	25.0	4	4.0000	101.6
3/16	0.1875	4.7625		0.5906	15.0	63/64	0.9844	25.003	4-1/4	4.2500	107.95
	0.1969	5.0	19.32	0.5937	15.081	1	1.0000	25.4		4.3307	110.0
13/64	0.2031	5.159	39/64	0.6094	15.478		1.0630	27.0	4-1/2	4.5000	114.3
7/32	0.2187	5.556	5/8	0.6250	15.875		1.1024	28.0		4.7244	120.0
15/64	0.2344	5.953		0.6299	16.0		1.1811	30.0	4-3/4	4.7500	120.65
	0.2362	6.0	41/64	0.6406	16.271	1-1/4	1.2500	31.75	5	5.0000	127..0
1/4	0.2500	6.35	21/32	0.6562	16.668		1.2992	33.0	5-1/2	5.5000	139.7

CONVERSION FACTORS

Inches	x 25.4	= Millimeters
Millimeters	x .03937	= Inches
Sq. Inches	x 6.4515	= Sq. Centimeters
Sq. Centimeters	x .155	= Sq. Inches
Pounds	x .4536	= Kilograms
Kilograms	x 2.2046	= Pounds

Lbs. per in.^{2}	x .0703	= Kg per cm^2
Kg per cm^2	x 14.2231	= Lbs. per in.^{2}
Pounds (Force)	x 4.448	= Newtons
Newtons	x .2248	= Pounds (Force)

Degrees C = (Degrees F - 32) x .5556

Degrees F = (Degrees C x 1.8) + 32