



Housing, Bearing fit, Staking Procedure and Proof Loading information and considerations for design.

*** PLEASE NOTE THE INFORMATION WITHIN RELATES TO STEEL COMPONENT HOUSINGS ONLY***

Introduction and scope;

This is designed to be a guide and is a combination of translation of manufacturer catalogue specifications, recommendations and our own findings during testing and assembly procedures. It is by no means comprehensive, though should covers the key points needed by both design engineers and assembly operatives alike.

For any help with the recommendations for housing design or any questions relating to either this guide or the staking of spherical bearings, please do not hesitate to contact us.

Considerations;

A bearing in the free state is not a functioning bearing. Its performance begins only after it has been installed into its end assembly, and the methods, fits and forces applied in installation will often determine its success or failure in service.

A surprising percentage of early bearing failures can be traced directly to improper mounting conditions. Some examples of frequently occurring installation errors are:

- Excessive interference fit between housing bore and bearing O.D.
- Improperly designed/used staking tools.
- Excessive staking forces applied.
- Incorrect housing design

If you require any more information, please contact Autosport Bearings and Components on

01932 225777 or abc@autosport-bearings.co.uk



1. V-Groove Retention

V-groove retention widely used and recommended. The bearing outer race has a small groove machined into each face, which leaves a lip on the race O.D. corners.

With the use of staking tools, these lips are swaged (flared) over the chamfered edges of the housing.

Good V-groove staking requirements:

- Correct housing including chamfer profile
- Correct staking tools (per bearing size/type)
- Hydraulic or pneumatic press capable of applying the correct staking force/pressures.

2. Housing Design

The housing into which the bearing is mounted must be designed to ensure the structural integrity of the bearing.

2.1 Housing Recommendation

T=H

When designing new housings, we suggest creating the housing to be equal width to the outer raceway of the bearing.

I.E. Thickness or width, H, of the Housing is equal to the Width, T, of the Bearing.

Chamfer OD

The catalogue states a chamfer OD of $(T-H + 2 * E)$, with a 45 deg. Chamfer angle.

The catalogue spec is in place for modifying housings to suit the acceptance of the bearing.

When designing a housing that is T=H, this allows for correct installation of the bearing into the housing so that it is easier to centre the bearing in the housing.

It also makes it easier during the staking procedure to swage v-groove to conform the (created flange- of the bearing v-groove) to the chamfer of the housing- meaning a stronger stake and reduced possibility misalign the bearing in the housing.

If you require any more information, please contact Autosport Bearings and Components on

01932 225777 or abc@autosport-bearings.co.uk

Housing tolerances should be adhered to- to catalogue recommendation.

2.2 NMB Minebea Catalogue Specifications;

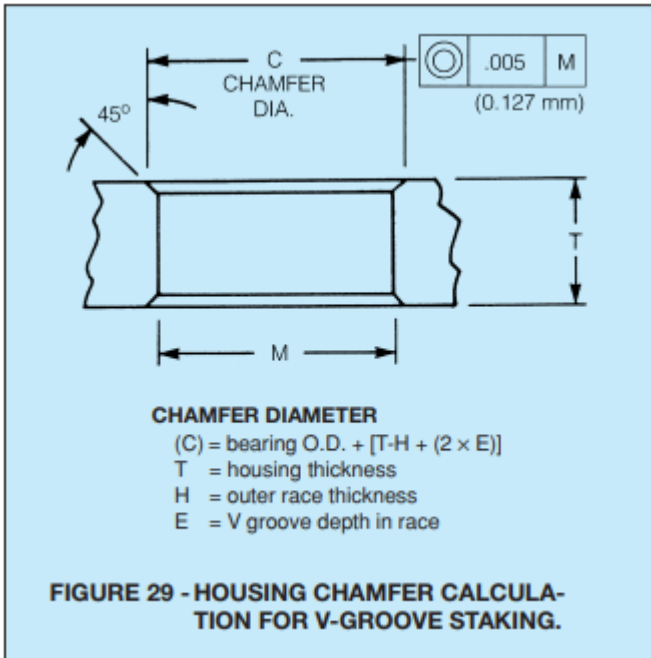


Fig. 1

Chamfer Dia.
 $(C) = M + [T - H + (2 \times E)]$
 (Tolerance + .008/- .007)
 T = average housing thickness
 H = average outer race thickness
 E = average V-groove depth in race, depending on groove.

Chamfered Size Calculation for V-Groove Retention

V-Groove Size	Avg. Groove Depth (E)
A	.023
B	.033
C	.053
D	.073

TABLE 7 - HOUSING BORE TOLERANCES FOR METAL TO METAL AND PTFE LINED BEARINGS

BEARING		HOUSING BORE					
TYPE	STYLE	O.D.		Tolerances		Fit-up	
		inch	mm	inch	mm	inch	mm
METAL TO METAL	Sphericals	Up to 1.750	Up to 44.45	+0.0000 -0.0005	+0.000 -0.013	Line to Line to .0010 tight	Line to Line to 0.025 tight
		1.750 and over	44.45 and over	+0.0000 -0.0008	+0.000 -0.020	Line to Line to .0013 tight	Line to Line to 0.033 tight
PTFE LINED	Sphericals	All	All	+0.0005 -0.0000	+0.013 -0.000	Line to Line to .0010 loose	Line to Line to 0.025 loose
	Plain and Flanged Journal (Sleeve) Bearings	Up to 1.000	Up to 25.40	-0.0007 -0.0012	-0.018 -0.030	.0002 to .0012 tight	0.005 to 0.030 tight
		1.000 and over	25.40 and over	-0.0010 -0.0015	-0.025 -0.038	.0005 to .0015 tight	0.013 to 0.038 tight

Fig. 2

If you require any more information, please contact Autosport Bearings and Components on



3. Staking Procedure

3.1 Installation

Please ensure use of correct ABC specified installation tool

First seat the bearing into the housing using the correct tool.

The installation of a bearing into the housing bore is a simple operation when done properly.

Alignment of the bearing or sleeve to the housing bore is critical to prevent skewing or misalignment during insertion which may damage the bearing and/or housing.

Correct housing tolerances- including diameter, width, roundness and parallelism- should be adhered to.

Hydraulic or pneumatic press capable of applying the correct staking force/pressures.

Correct installation tools and staking tools are required. A guide pin in the tool aligns the ball in a 90° position.

Force should be applied to the outer race face/v-groove only.

A lead chamfer on either the bearing or housing is required.

3.2 Staking;

Please ensure use of correct ABC specified staking tool

1. Install bearing into housing and position it symmetrical about housing centre-line within .005.
2. Mount bearing and top anvil over bottom anvil guide pin. (V-groove Staking Method)
3. A trial assembly should be made for each new bearing lot to determine the staking force necessary to meet the axial retention load required. Excessive force should be avoided since this may result in bearing distortion and seriously impair bearing function and life. (See table for recommended Staking Force).
4. Apply the staking force established by trial assembly, rotate assembly 90° and re-apply force.
5. After staking, a slight gap may exist between race lip and housing chamfer as shown in the detail. This gap should not be a cause for rejection providing the bearing meets the thrust load specified.

3.3 Staking force

The force required to stake V-groove bearing is approximately equal to the product of the O.D. and a constant for each groove size.

For example, a 1.500" (38.10 mm) O.D. bearing having a "B" size groove should require a staking force of approximately 18,000 lbs (80064 N). Constants shown (below) are based on outer race material having an ultimate tensile strength of 140,000 psi (984.6 N/mm²).

If you require any more information, please contact Autosport Bearings and Components on

01932 225777 or abc@autosport-bearings.co.uk

Staking force constants for other materials are proportional to the ultimate tensile of those materials as compared to 140,000 psi (984.6 N/mm²).

Staking forces derived by this formula should be used as a reference guide only to establish a starting point.

3.4 Step Guide

Press Insert/proof load tool.

This has 2 orientations- one for press Insert and one of proof load.

Press Insert/Proof Tool and staking tool



Fig.3

Staking tool in 2 halves.

one half has a guiding pin, the other a receiving bore.

Please note the tool comes in 3 parts- this constitutes the tool as a whole, with the Press Insert/ Proof load tool having 2 operations



Fig.4

Step 1.

Load the bearing to be staked onto the pin of the staking tool. This uses only the 1/2 of the staking tool with the pin at this stage. Orientation of the ball should be perpendicular to the outer race.



Fig.5

Step 2.

Resting the housing on the Press Insert tool, locate the bearing into the housing with the half of the staking tool.



Fig.6

Step 3.

Next, either using the press, or by hand if the housing fit allows.

If you require any more information, please contact Autosport Bearings

01932 225777 or abc@autosport-bearings.co.uk



Fig.7

Step 4.

Ensure that the bearing is inserted fully into the housing.

If the recommendations for housing manufacture have been adhered to (See section 2.1, T=H), this should mean that the end face of the bearing is flush with the housing end face- when using the press Insert tool, this will be when the bearing and face meets the tool and the bearing can no longer move axially in the direction it is being pressed.

If the housing is wider than the bearing, it must be located centrally either by measurement or by eye.



Fig.8

Step 5.

We next recommend to apply a force of around 1/2-3/4 the staking force. This should deform the v-groove slightly, though only enough to locate the bearing whilst the tool part is changed from the press insert tool to the mating half of the staking tool. See table 3.4.1, Fig 12.

This is not intended as the primary stake.



Fig.9

Step 6.

Remove the staking tool from Press Insert tool and check to ensure the bearing is centred in the housing.



Fig.10

Step 7.

Assemble mating half of the staking tool, ensuring both halves are correctly seated into the v-grooves ready for the staking force to be applied.



Fig. 11

Step 8.

Apply the staking force with the press onto the staking tool, ensuring the staking tool is in proper and full contact with the staking grooves.

The staking force can be calculated using the catalogue, or common sizes are listed in table 3.3.1, Fig.12.

We recommend applying the staking at least twice- stake once, change orientation through 180 deg. axially and stake again.

It is best practice to rotate through 120 Deg radial and stake 3 times per side.



3.4.1 Some common sizes and loads:

Part No.	OD (in)	Groove Type	Conversion Constant (N)	Staking Force (N)	Conversion load (KG)	Staking Gauge Pressure (Bar)	Proof Load (KG)	Proof Gauge Pressure (Bar)
ABT3V	0.5625	A	34,250	19,266	1,964	50	434	20
ABT4V	0.6562	A	34,250	22,475	2,291	50	506	20
ABT5V	0.75	B	53,376	40,032	4,080	100	711	20
ABT6V	0.8125	B	53,376	43,368	4,421	100	770	20
ABT7V	0.9062	B	53,376	48,369	4,931	125	859	20
ABT8V	1	C	78,730	78,730	8,026	200	1,061	40
ABT9V	1.0937	C	78,730	86,107	8,778	225	1,161	40
ABT10V	1.1875	C	78,730	93,491	9,530	250	1,260	40
ABT12V	1.4375	C	78,730	113,174	11,537	275	1,526	40
ABT14V	1.5625	C	78,730	123,015	12,540	300	1,658	50
ABWT3V	0.625	A	34,250	21,406	2,182	50	482	20
ABWT4V	0.625	A	34,250	21,406	2,182	50	482	20
ABWT5V	0.6875	A	34,250	23,547	2,400	50	530	20
ABWT6V	0.8125	B	53,376	43,368	4,421	100	770	20
ABWT7V	0.9375	B	53,376	50,040	5,101	125	889	20
ABWT8V	1	B	53,376	53,376	5,441	150	948	20
ABWT9V	1.125	B	53,376	60,048	6,121	150	1,067	40
ABWT10V	1.1875	B	53,376	63,384	6,461	175	1,126	40
ABWT12V	1.375	C	78,730	108,254	11,035	275	1,459	40
ABWT14V	1.625	C	78,730	127,936	13,041	325	1,725	50
ABYT3V	0.5625	A	34,250	19,266	1,964	50	434	20
ABYT4V	0.74	A	34,250	25,345	2,584	50	571	20
ABYT5V	0.6875	A	34,250	23,547	2,400	50	530	20
ABYT6V	0.906	A	34,250	31,031	3,163	75	699	20
ABYT7V	1	A	34,250	34,250	3,491	75	771	20
ABYT8V	1.125	A	34,250	38,531	3,928	100	867	20
ABYT10V	1.375	B	53,376	73,392	7,481	200	1,304	40
ABYT12V	1.5625	C	78,730	123,016	12,540	325	1,658	50
ABYT14V	1.75	C	78,730	137,778	14,045	375	1,857	50

Fig.12

If you require any more information, please contact Autosport Bearings and Components on

3.5 V-Groove type and corresponding staking force- NMB Catalogue

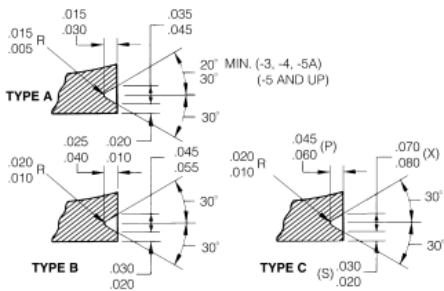


FIGURE 35 - STANDARD V-GROOVE TYPES & SIZES

TABLE 8 - V-GROOVE STAKING FORCE

GROOVE TYPE*	A	B	C
CONSTANT (lbs)	7,700	12,000	17,700
CONSTANT [N]	34,250	53,376	78,730
*SEE FIGURE 35 FOR GROOVE SIZES			

Fig.13

4. Proof Loading

Please ensure use of correct ABC specified proof load tool

4.1 Staked Bearing Proof Testing Method

Some common sizes and loads - see table- Fig.12



Fig.14

Proof Load.

Using the correct proof load side of the Press Insert/proof load tool (as marked), place the bearing and housing (complete) onto the proof load tool.

Either half of the staking tool or another press tool equal to the OD of the bearing can be used.



Ensure the correct proof load is used- this can be calculated with use of the catalogue - or please see section **3.4.1, fig.12.**

If you require any more information, please contact Autosport Bearings and Components on



5. V-Groove Staking Tool, Installation Tool and Proof load Tool

Staking tools to include press in guide tool, v-groove staking tool and proof load capability are available from ABC for each type and size range of NMB Minebea bearings- including both imperial (inch) and Metric sizes.

If you require any more information, please contact Autosport Bearings and Components on

01932 225777 or abc@autosport-bearings.co.uk