



WHITE PAPER:

Plastic plain bearings: tolerances, assembly, measurement

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1 Tolerance design for defining the bearing clearance

When determining the tolerance or fit of plastic plain bearings, the specifications of the respective materials must be taken into account. Often the tolerances are defined in advance on the basis of metallic materials and transferred to plastic-based variants. In most cases, this leads to problems during manufacturing or in the subsequent use of the plain bearings. Here we present the most important influencing factors to consider.



Bearing position with pressed-in plastic plain bearing

1.1 Press fit and bearing clearance

Plain bearings are typically designed to be pressed into a housing. Due to the slightly "oversized" outer diameters, the bearings are fixed into the housing. This ensures that the relative movement takes place between the shaft and bearing and not between the bearing, shaft and bore. If the press fit is lost, the bearing may slip out of position or rotate irregularly in the bore. Both can lead to severe wear or damage to the bearing and shaft.

At the same time, the tolerance of the inner diameter must be selected so that a correct bearing clearance remains between the shaft and bearing. This space is necessary to prevent the shaft from jamming. If the shaft jams in the bearing, the required drive force increases, which in turn leads to erratic operation, overload and noise.

1.2 Moisture absorption

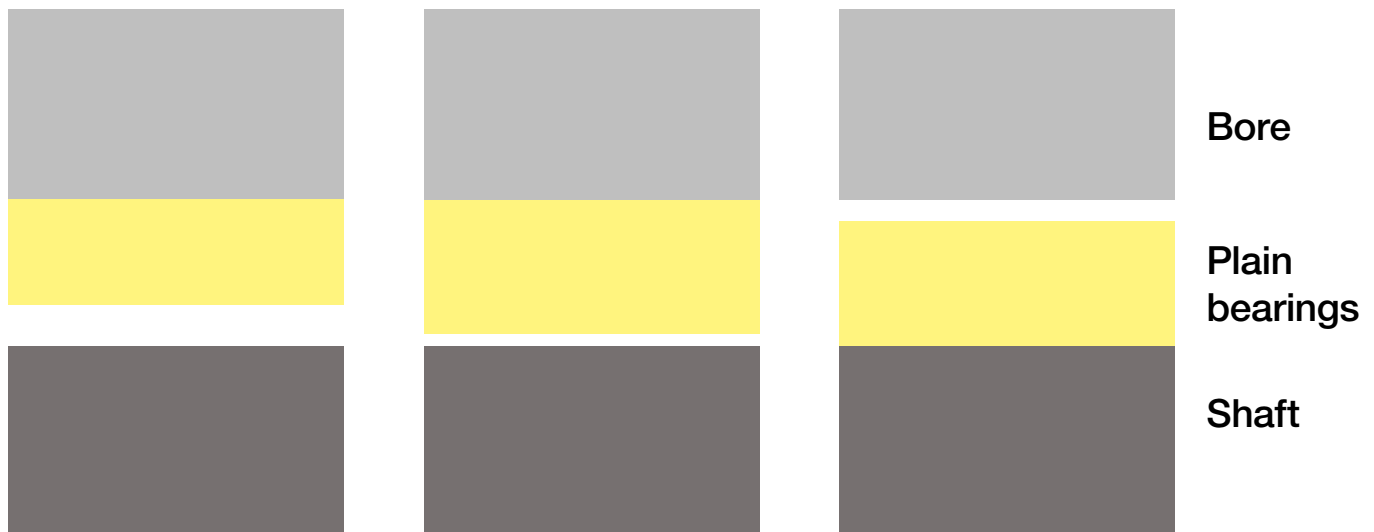
Plastics absorb different amounts of moisture. The humidity present in the ambient air is already sufficient for this. At 50% relative humidity and room temperature, the range extends from <0.1% by weight for composite plastics with very low moisture absorption to values of 1.8-2% by weight for composite plastics with high moisture absorption. Underwater, this moisture absorption can increase to over 8% by weight, or remain below 0.5% by weight for plastics with lower absorption specifications.

This moisture absorption can lead to dimensional changes and, if the bearing clearance is insufficient, to seizure within the bearing system.

1.3 Thermal expansion of plastics

Compared to metallic materials, plastics have a comparatively high coefficient of thermal expansion. This means that plastics can undergo greater dimensional changes with temperature changes. This can have an effect especially at cold temperatures, which can cause the diameter of the bearings to constrict. Both the press fit and the bearing clearance are affected. Seizing can also occur in the event of incorrect design.

Expansion of plastic plain bearings at different temperatures



Room temperature

The plain bearing sits firmly in the bore. The desired clearance remains between the shaft and the plain bearing.

Heating

The plain bearing expands in the direction of the shaft. The clearance is reduced. At this point problems could arise

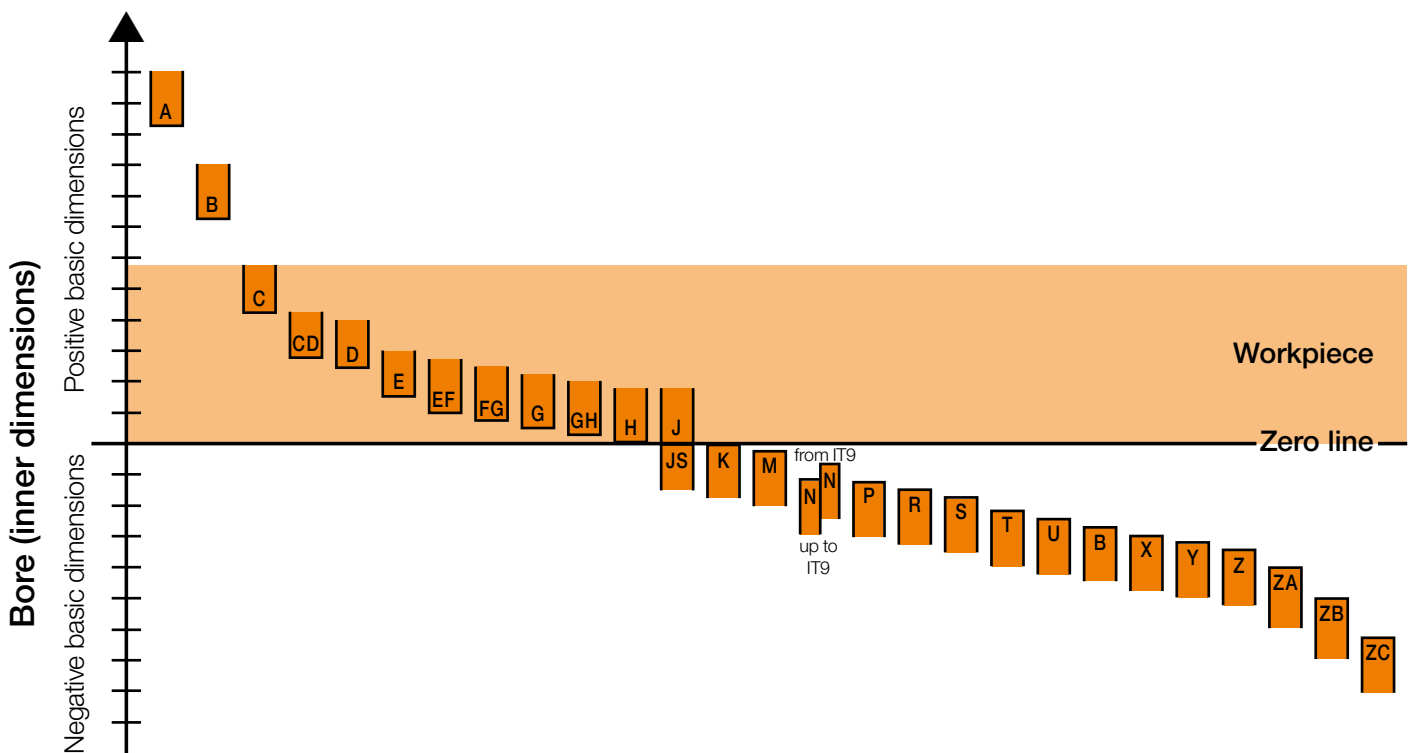
Cooling down

The plain bearing contracts and shrinks onto the shaft and then loses the press fit.

1.4 Recommended tolerances for plastic plain bearings

The respective bearing tolerances must be determined individually for each plastic in order to take into account the specifications of moisture absorption and thermal expansion. These are often empirical values, so the relevant manufacturers define them and develop recommendations for the tolerances of housing bores and shafts.

For the housing bore, igus® recommends the selection of an H7 fit. This can be reliably achieved with conventional machining methods. igus® plain bearings, which are pressed into these housings, then have various predefined fits at the inner diameter.



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2 How to measure plastic plain bearings correctly

Due to the specifications of plastics described in the previous section, certain special features must be taken into account when correctly measuring plastic plain bearings.

Both the potential deformity of plastic bearings and the manufacturing-related influences on the component geometry mean that certain measuring methods, such as 3D measuring machines, do not provide accurate results. Especially not when the components are measured in a non-assembled state.

The diameter and also the shape of the inner diameter change depending on the nature of the bore of the housing. If this has inaccuracies or irregularities in its composition, these are transferred to the plain bearing. This is crucial in the context of creating a press fit. It is often impractical to measure the plain bearings before they reach this final state.

With mechanical measuring methods, such as measuring with calipers or micrometers, inaccuracies can occur due to the elasticity of the plastics. Depending on the exact composition, the measuring tool can be pressed into the material, which can also lead to inaccurate measurements.

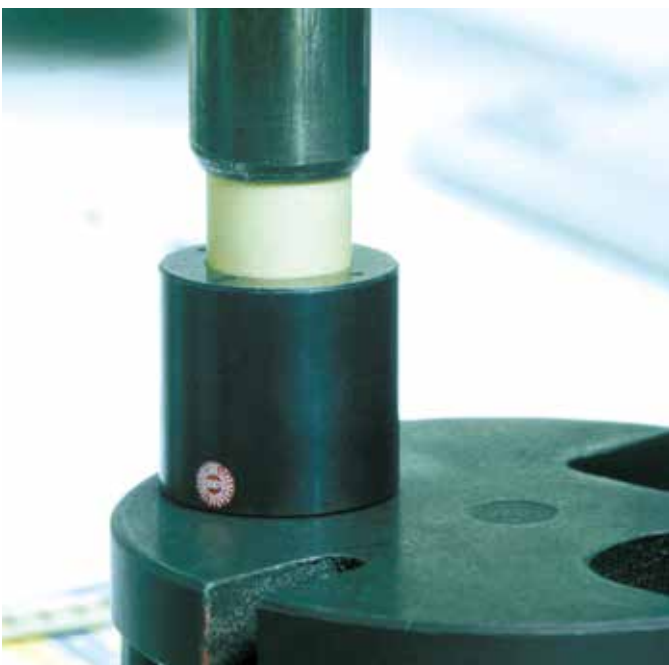
For this reason, the following methods have proven helpful:

2.1 Measurement only in pressed-in condition in test fixture

To measure plastic plain bearings, use a test fixture manufactured in accordance with the assembly specifications. This ensures that the inner dimensions of the plain bearing are not distorted by inaccurate or misshapen bores.

In the case of custom plain bearings—which are manufactured according to your instructions or specifications and tolerances for the specifications of the housing bore in your component—the test fixture should either have the same specifications or the plain bearing should be mounted directly in the mounting bore of the component and only then measured or tested.

2.2 Checking the inner diameter by means of a plug gauge or test pin



Test pins are the most common tool for checking the dimensional accuracy of the inner diameter. For correct testing of plain bearings, use two different test pins. One pin should be made in such a way that its diameter corresponds to the tolerance of the maximum dimension of the shaft. The second test pin must correspond to the tolerance of the minimum dimension.

In addition, the bearings in the press-fit state can be measured in several levels on the inside diameter to check the uniformity of the wall thickness. For this purpose the measurement using a plug gauge is suitable.

Pressing a plain bearing into a test fixture

3 How to install plastic plain bearings correctly

The choice of installation method for plain bearings depends largely on how many bearings, size and where they will be installed. In the case of a multi-joint bearing in an automobile, an automated assembly solution is the obvious choice. In the case of the bearing in the arm of a backhoe, a rubber mallet is often used. The following is therefore a list of what needs to be considered and how the assembly process can be made safe and simple.

3.1 Observe the recommended installation tolerances

The following applies to all installation types: if the housing bore is undersized or deliberately made small—for example, to achieve a better press fit or a smaller bearing clearance—the force required for installation can increase. Care must be taken not to damage the bearing by applying too much force.

3.2 Avoid sharp or rough edges

Sharp edges along the housing bore should be chamfered and any burrs removed. Ideally, the edges are slightly chamfered and can therefore additionally facilitate positioning and the press fit. Generally a housing bore with a 25 degree chamfer is advised. A longer degree may cause the material to become damaged.



Housing bore with burr (top left)



Housing bore with chamfer

4 Press-in methods

Ideally, bearings are installed on a table by means of a hand press. These allow for a repeatable, straight-guided press-fit process, reducing the risk of the bearings becoming jammed and damaged during the press fit. Use a flat press-in punch, especially for injection-molded plastic bearings. Centering pins can lead



Press-fit in an inserted plastic bushing

to cracks along the joint line of the bearings under certain circumstances.

Use a rubber mallet to install the bearings. A piece of wood held in front of the bearing can also help protect the bearing from damage caused by unevenly applied force.

When implementing automated or semi-automated assembly, the reliable and correct feeding and positioning of the components is crucial. Here it can be useful to optimize the component geometry to suit the process. There are virtually no limits to the shape of plastic plain bearings, and geometries with tapered diameters, slots or anti-rotation devices can be implemented cost-effectively.

5 Contact



If you require any further information, please do not hesitate to contact the igus® plain bearings department.

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