

GETTING THE RIGHT FIT

When two parts are designed to be pieced together, there may be play or looseness between them or they may be tight to the point they are nearly bonded. This degree of tightness or looseness is referred to as "fit." The fit between a shaft, machine key, and the mating component can be critical to the operation and safety of the assembly.

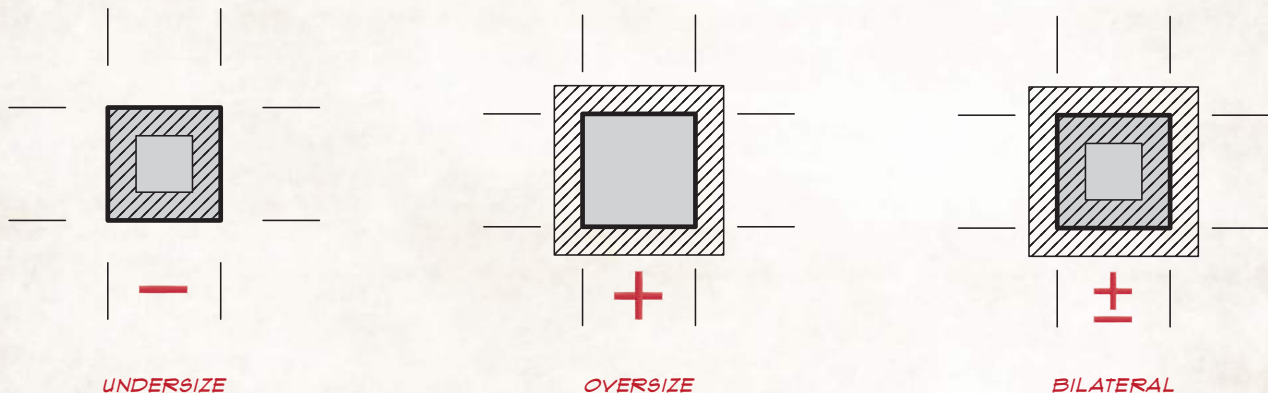
FIT & TOLERANCE

Before the age of the assembly line and interchangeable parts, skilled craftsmen known as "fitters" were required to piece together mating parts. Since the parts were usually hand-crafted, production was limited to one assembly at a time. The craftsman employed a system of cut, try, cut again, try again to eventually achieve proper fit between components.

With the advent of the assembly line, it became necessary to supply parts that could be used interchangeably, so that any one like part could be used to complete the component. It is extremely difficult to produce exactly identical parts, a system of tolerances and specifications was developed to determine when parts were close enough to be interchangeable.

NOMINAL SIZING TOLERANCES

Tolerance is the limit of how much a part can deviate from its nominal or named size. Tolerances can deviate less than the nominal size (referred to as undersize), greater than the nominal size (referred to as oversize), or both.

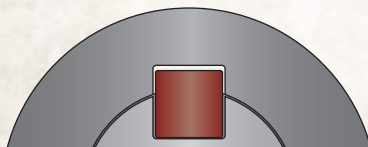


These tolerances cannot be larger than the nominal size but may be smaller.

These tolerances cannot be smaller than the nominal size but may be larger.

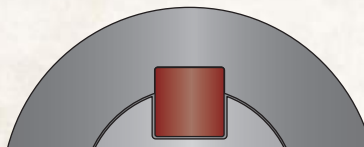
These tolerances may be either smaller or larger than the nominal size.

ANSI B17.1 KEYS & KEY WAY FIT CLASSES



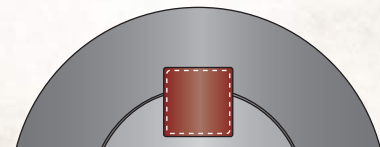
CLASS 1

Sometimes called a clearance fit, the key width will be slightly smaller than the key way allowing the shaft and component piece to slide over each other.



CLASS 2

Also known as a transition fit, the key width and the key way can have a slight clearance fit or a slight interference fit. Generally this fit is sufficient to hold mating parts together while still allowing for disassembly.



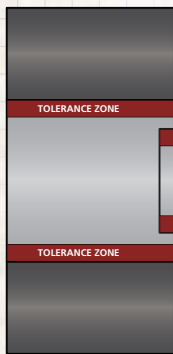
CLASS 3

This is an interference fit, meaning the key will be larger than the key way and will encounter interference during installation. Some means of force or the use of temperature differential is required for installation. ANSI B17.1 does not have specific standards for this class of fit.

GETTING THE RIGHT FIT

Each application will determine the type of fit required. Should it be a loose fit for easy disassembly? Does it need to precisely hold a component in place? Is it a bearing joint that requires movement? Will it be a semi-permanent bond? The dimensional tolerances of a given part must be taken into account when determining the correct fit for an application.

TYPES OF FIT



CLEARANCE FIT

In a clearance fit, a space will exist between the two mating parts. The difference in sizes is referred to as a positive difference. The minimum clearance will be the difference between the maximum tolerance of the inserted part and the minimum tolerance of the receiving part.

LOOSE FIT

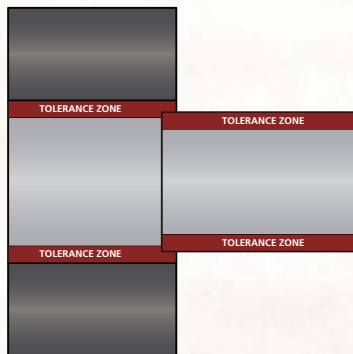
Used in applications that do not require precision, such as pulleys, agricultural equipment, or other applications requiring frequent disassembly.

RUNNING FIT

This type of clearance fit has just enough space to maintain a film of lubrication between the mating parts. Most bearings will require this type of fit.

SLIDE FIT

Also known as a medium fit, this fit is used when precision is required. It is used on slides, slide valves, and some automobile part assemblies.



TRANSITION FIT

In a transition fit, a space may exist or the parts may collide. If the inserted part is at maximum tolerance and the receiving part is at minimum tolerance an interference will occur. However, a clearance fit will result if the inserted part is at minimum tolerance and the receiving part is at maximum tolerance.

PUSH FIT

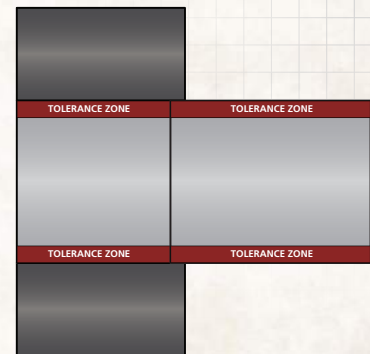
Also known as a snug fit, this fit has zero allowance between the mating parts and will require a slight pressure to install. This is a good fit where vibration may be encountered.

SHRINK/FORCE FIT

This fit is required when the two mating parts are to be rigidly fixed so that they move together. It will require high pressure or expansion by heating to install.

WRINGING FIT

A small negative allowance is allowed between the two mating parts requiring pressure to assemble. It is used on flushed bolts, driven bushings, and electric motors.



INTERFERENCE FIT

In an interference fit, the tolerance zones of both parts will collide with each other regardless if they are at minimum or maximum. The degree to which they collide will determine the strength of the fit. An interference fit will require either force or temperature change to facilitate installation.

SHRINK FIT

Also known as a heavy force fit, the receiving part is heated to cause expansion allowing the inserted part to fit. This is commonly used in rims and heavy duty assemblies such as railway wheels.

MEDIUM FORCE FIT

With this fit, a substantial amount of pressure is required to force the parts together. This is used for car wheels, dynamo armatures, and other semi-permanent joints.

TIGHT FIT

Also known as press fit, the parts can be mated by hand with a hammer or light pressure. It is used in keyed pulleys, rocker arms, and applications not requiring a large force.