

# Hole Preparation for Press Fit Pins

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Press fit pins are retained in an assembly by the frictional forces between the pin and its mating host component. These forces are a product of the coefficient of friction between the mating materials/coatings, and the interference fit between the pin and its host component.

There are two general categories of press fit pins; solid pins and spring pins. Solid pins, such as ground dowels and knurled pins, are retained by deforming the host material. Springs pins retain themselves by compressing to conform to the hole.

Successful installation and retention of press fit pins is greatly effected by the quality of the hole in the host component. Recommended hole sizes vary with the type of pin chosen for an assembly, which indirectly determines the hole preparation process. Generally, tighter hole tolerances require more expensive hole preparation.

This paper addresses the hole preparation processes required to successfully install and retain commonly used press fit pins. The pins evaluated in this document are listed below, in order of increasing recommended hole tolerance.

1. Ground Dowels & Straight Pins
2. Knurled & Grooved Pins
3. Slotted Spring Pins
4. Coiled Spring Pins



## 1. Ground Dowels & Straight Pins

Ground dowels and straight pins are solid cylindrical pins that normally have chamfered ends. The pins are retained in the assembly by being pressed into holes that are smaller than the pin diameter. In most applications, the amount of interference has to be limited to keep insertion forces within a practical limit. The acceptable press fit for most metals (steel, brass, and aluminum) is between .0005" and .002". In production assembly, the acceptable press fit is the sum of the tolerances for the pin and the hole. It is for this reason that a very precise and straight hole is required to install these pins, with total tolerances between .0002" and .0005".

To achieve such a precise hole, common machining practice is to drill and ream, but it is not as simple as just that. In order to ream a precise hole, you need to begin with a good quality drilled hole. A reamer will not correct a bell-mouthed, out-of-round, crooked, oversized or badly chattered hole. The quality of drilled hole required prior to reaming is of the same quality required for the use of a solid knurled or grooved pin.



## 2. Knurled & Grooved Pins

Knurled pins and grooved pins are solid cylindrical pins that have raised longitudinal “ridges” along the length of the pin, which are larger than the cylindrical pin body. The hole is sized to be larger than the body of the pin, yet smaller than the raised knurls or grooves. Keeping the body of the pin smaller than the hole decreases insertion forces. The knurls or grooves serve as the interference portion of the pin in the hole, for press fit applications. The difference in diameter between the pin body and raised “ridges” allows for greater hole tolerances in the assembly than with ground dowels or straight pins.

The common machining practice to achieve the recommended hole tolerances required of knurled and grooved pins, is a quality drilled hole. A prerequisite to producing any quality hole is having rigid control of the work piece. This requirement becomes more critical in difficult to machine materials, as well as with small diameter tools. Even slight movements of the work piece while machining will hinder creation of a quality hole.

Drilling a quality hole will almost always include the use of a spot or center drill prior to drilling, unless a core hole exists, as may be the case with a casting. Spot drilling prior to hole drilling prevents the drill from “walking” on its point, prior to the outer edges of the drill cutting the host material. This practice will help produce a hole that is straight and closer to the diameter of the drill.

When producing holes in surfaces that are not flat, or not perpendicular to the drilled hole to be produced, it is often necessary to use a drill bushing to produce a straight and true hole. A drill bushing may also be necessary when drilling deep holes to keep the drill from flexing while machining. It is recommended that the shortest drill available to produce the hole be used, as the increased rigidity will improve hole accuracy and tool life.

The use of a proper cutting fluid, as well as the proper speeds and feeds per the drill manufacturer’s recommendation or a machinist’s handbook, will help produce a quality hole and extend the life of the drill. Carbide tooling and coatings should be utilized whenever practical and keeping the drill sharp is a must. For sharpened drills, it is important that the cutting lips are of equal length and angle, or the drill will walk.



## 3. Slotted Spring Pins

Slotted spring pins are hollow tubular parts, chamfered on the ends with a single longitudinal slot along the length of the pin. The pin is retained in the assembly by compressing as it is installed into a hole, which is smaller than the body of the pin. The slot provides room for the pin to compress, and the spring characteristic of the pin’s material provides the resistance that keeps the pin in the hole. If the pin were to “butt” during installation, the insertion forces would increase significantly, as the pin no longer functions as a spring but as a solid object. This spring characteristic of the pin, in conjunction with the slot, allows for greater hole tolerances in the assembly than with solid pins.

Slotted spring pins are designed to be installed in common drilled holes. In addition to their greater allowable hole diameter tolerance, it is not critical that the holes be straight or round, due to the pin’s ability to conform to the hole. The relaxed hole requirements allow these pins to be successfully utilized in as-cast, as-molded or stamped holes. Although it is usually not necessary to use the hole preparation methods previously described, a more consistent hole will improve the repeatability of insertion and retention values in the assembly.

In stamped holes it is recommended that the pins are installed in the same direction as the punch, and excessive burrs should be avoided. Cast or sintered holes should be created with a slight lead-in radius, and the edges of holes in hardened materials should be deburred. These provisions will aid in the successful installation of any spring pin. A countersink does not eliminate the sharp edge of a hardened hole; it merely places a sharp edge deeper into the hole.



#### 4. Coiled Spring Pins

Coiled spring pins are hollow tubular parts produced from 2-1/4 coils of spring steel with swaged chamfered ends. The pin is retained in the assembly by compressing as it is installed into a hole, which is smaller than the body of the pin. The pin coils within itself under compression, and the spring characteristic of the pin's material provides the resistance that keeps the pin in the hole. Due to the 2-1/4 coil design of the pin it cannot "butt" when installed into a minus tolerance hole. The pin maintains its spring characteristic; thus having the lowest installation force of all press fit fasteners. The ability to be installed into a minus tolerance hole, allows for greater hole tolerances in the assembly than other spring pins.

As with other spring pins, coiled spring pins are designed to be installed in common drilled holes. It is not critical that the holes are straight or round, and this pin is the most successful in as-cast, as-molded or stamped holes. The pin's ability to install into a minus tolerance hole allows the use of standard drills in materials which tend to cut undersized. The use of methods previously described for a quality drilled hole will improve the repeatability of insertion and retention values in the assembly, although not required.

In stamped holes it is recommended that the pins are installed in the same direction as the punch, and excessive burrs should be avoided. Cast or sintered holes should be created with a slight lead-in radius, and the edges of holes in hardened materials should be deburred. These provisions will aid in the successful installation of any spring pin. A countersink does not eliminate the sharp edge of a hardened hole; it merely places a sharp edge deeper into the hole.

Coiled spring pins have the largest recommended hole tolerance of all press fit pins. This allows the pin user more freedom in the selection of the hole preparation method, resulting in the lowest prepared hole cost.

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