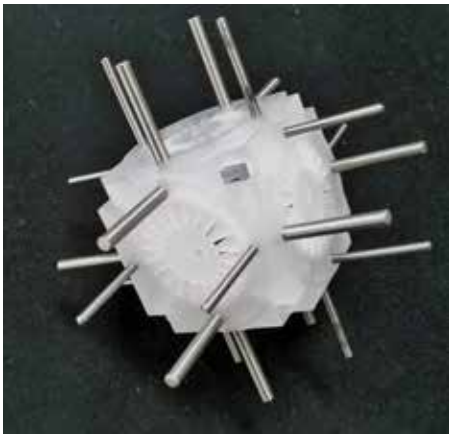
APPLICATION BRIEF

Press Fitting

3D Systems MultiJet Printing Technology



Precision metal press fit dowel pins on all orthogonal sides of a cube

Square and round features on the sides of the diagnostic show isotropic properties

It is often advantageous in a design to employ hardware using press fits. The high accuracy and geometrically isotropic nature of 3D Systems' MultiJet Printing (MJP) technology makes it ideal for press fit applications. Press fitting can be used to assemble two MJP 3D printed parts together to create sliding surfaces for movable assemblies or introduce removable dowel pins for jig and fixture designs.

Press fittings commonly use a precision hole with a metal dowel pin for assembly or alignment purposes. Any deviation in hole size can interrupt the planned part interference and change the resulting forces and frictions, meaning accuracy is critical.

3D Systems' MJP software uses scale factors to automatically adjust the size of all materials to achieve extremely high precision. Whether printed in a single build or in a different batch, all 3D Systems MJP parts will have a seemingly exact fit for most practical purposes. This capability holds true across print orientations and materials and is demonstrated in the above diagnostic, which shows precision metal dowel pins inserted on all orthogonal sides of a cube structure. This diagnostic additionally shows finely cut triangular features that are true-to-CAD. All faces have consistent geometric accuracy.

The below guidelines highlight key considerations when incorporating MJP 3D printing into a workflow that requires metal inserts or press fittings.

MJP is an ideal technology for your prototyping application if:

1. You need high fidelity, true-to-CAD parts
2. You require robust material properties and functional versatility
3. Good surface quality is important for your use case
4. You need repeatable accuracy with fine details and complex geometries

MJP materials

All the VisiJet® Rigid and Engineering materials for MJP printers can be press fitted, machined, drilled and tapped, and can be treated like traditional thermoplastics, such as acrylic, polypropylene, polycarbonate and ABS. VisiJet MJP materials are a rigid or semi-rigid thermoset, meaning they will not melt or easily gum-up with heat.

Key considerations for metal inserts into MJP printed parts

Press fit inserts are typically installed with an arbor press or hammer, following the manufacturer's recommended hole size for the specific insert to be used. They are held in place by their knurled body, do not require a tapped hole and are self-aligning due to their tapered shape.

It is recommended to first test insert techniques on spare material before attempting to install into the actual part.

Distinguishing among metal insert types

SCREW-TO-EXPAND INSERTS

Installing screw-to-expand inserts of most varieties can be done in two simple steps:

1. Press or hammer the insert into a printed or drilled hole.
2. Install a screw to expand the insert and drive the knurls into the surrounding plastic.

Varieties of screw-to-expand inserts include:

- *Pull-out resistant* have fins that cut into the surrounding material for a more secure hold than knurled inserts.
- *Through hole versions* are installed in the underside of the material. The flange keeps the insert from being pulled through the hole. For through hole inserts with brittle material, it can be advantageous to compress the material to achieve the highest holding forces. A threading tap can be run into the insert to clean out the threads of any debris, allowing for a simpler and smoother insertion.
- *Flanged screw-to-expand inserts* have a flange that provides a load bearing surface for use in weaker plastics or for higher temperature applications.

PUSH-TO-EXPAND INSERTS

Also known as Dodge inserts, an installation tool is used to push down on the inside of the insert so it expands the knurled material into the surrounding part before the screw is inserted. The brass inserts shown on the fourth column from the left on the diagnostic part are push-to-expand inserts. The hole size for the inserts was determined using the manufacturer's recommendations which were transcribed directly into the CAD model. Most manufacturers provide their recommendations on product packaging.

Fourth column from left shows brass screw-to-expand inserts. These can be inserted with either an arbor press or a hammer

It is also possible to thread the correct size bolt into the insert first and then hammer the end of the bolt. This method helps to protect the surface quality of the part and can reach into tight areas. If an insert is used with a thin-walled injection molded screw boss or if the insert seems too tight or likely to break the part, it may be advantageous to heat the part prior to installation or carefully push the insert into the boss with the tip of a soldering iron.

USING HEAT TO INSTALL INSERTS

1. Use pliers to hold the insert or a screw that is threaded into the insert.
2. Use the tip of a soldering iron and apply downward pressure. The heat transfers to the insert, and should soon begin to sink into the softening plastic.
3. Continue with downward pressure until the insert is at the desired depth, then remove the heat and hold the insert in place long enough for the plastic to stiffen.

The goal with this methodology is to heat the plastic just enough to soften it. MJP materials will not melt, but can burn or become brittle if exposed to too much heat. When using heat for installation, it is best to carefully position the insert in the final position. The plastic will form around the insert as it cools and will be difficult to move. Repeated heating is not recommended.

TAPPING INSERTS

Also known as Tap-Lok inserts, these cut their own threads and have excellent pull-out resistance. These can be installed into a drilled hole with an installation tool and a ratchet wrench and do not require you to tap the hole. Built-in flutes channel loose chips up and out to keep threads clean during installation. Installation tools can also be placed in the chuck on a drill press and turned by hand.

HELICAL INSERTS

While normally used in metal parts, helical inserts can be used with 3D printed threads or traditionally drilled and tapped holes. To install:

1. Use the suggested drill and thread size for the desired insert and drill a tap hole or 3D print a threaded hole.
2. Screw the insert onto the installation tool. The prong must be properly engaged in the tool's driving contour.
3. Install the insert a quarter to half turn below the surface of the hole.
4. Remove the prong to allow full passage of your screw into the insert.

STANDARD NUT

One of the simplest and least expensive inserts to use is a standard nut. One can add a hexagonal pocket to the part and press the nut into the feature using force and/or temperature. The screw can be used on either the front or back side of the nut. Adding a clearance hole in the part/boss and using the nut in compression is recommended if possible.

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