FDM BEST PRACTICE:

EMBEDDING HARDWARE

Stratasys®
3D Printers and Production Systems

SOFTWARE/PRODUCT/FINISHING

OVERVIEW

Hardware may be added to an FDM® part to mimic insert molding. A pocket or hole is added to accommodate sensors, wiring, RFID tags, fabric, bushings, threaded inserts or other items. During the FDM build process, the job is paused, the item is placed in the part and the build is resumed (Figures 1 and 2).

Reference materials:
- Processes
  - Best Practice: CAD to STL

1. CONSIDERATIONS

- When placed in the part, the insert must not protrude any higher in the Z-axis than the layer it is installed in. This is so the tip does not hit the insert, damaging the tip, head or part.
- Supports for the insert and part must be generated as if the insert is already in the build. This ensures that there is material below the insert to hold it in position.
- If the insert is not flat, a capture part may be built and used to fill any voids (Figure 3). The capture part will be placed over the insert prior to resuming the build.

NOTE: Descriptions of all the commands are available through the Insight™ software help menu. Many of these settings can have detrimental effects on your parts if not used properly. It is recommended that only experienced users make changes to these values. To ensure the best possible part quality, Stratasys® recommends that you always review the toolpaths on your parts and make modifications if necessary, before downloading them to your system.

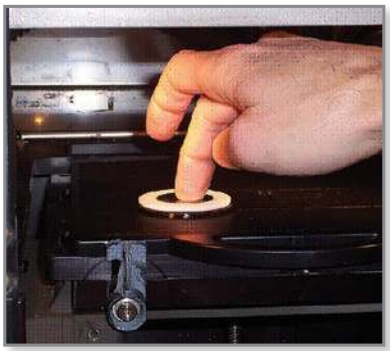

Figure 1: Place insert into the part.

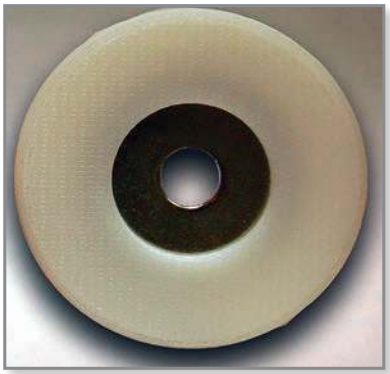

Figure 2: Embedded metal washer inserted into a 3D printed ABS part.

Figure 3: A non-flat insert and the capture part.

2. PROCESS

2.1 Prepare the CAD file.

STEP 1: Create the CAD model of the part and item to be inserted as an assembly.

TIP: Incorporating the insert's CAD model is optional. However, it will make the Insight software work easier since its STL can be used for support generation.

STEP 2: Create the cavity in the part that will hold the insert and add a 0.13 to 0.25 mm (0.005 to 0.010 in) clearance in the X/Y axis.

NOTE: The required clearance will vary depending on the system, tip and build material, and insert material. Build a test part to validate the required clearance.

STEP 3: Create a CAD model of a capture part.

NOTE: If the insert gets smaller with successive slices, as would be the case with a sphere, a void is required to place the insert into once the part has been built to the maximum height of the insert. This void will be filled with a custom made capture part (Figure 4).

STEP 4: Export the files as an STL using the CAD software's export-as-assembly function to ensure proper alignment of the assembly components.

TIP: Export a high resolution STL to avoid issues with overlapping curves between parts. For details, see the *Best Practice: CAD to STL.*

2.2 Prepare the build job using Insight software.

STEP 1: Configure the modeler.

STEP 2: Open and orient the STL so that the insert can be placed into the part during the FDM build without protruding above the working layer.

STEP 3: Click to create part curves using the current parameters.

STEP 4: Use the ***Custom groups*** operation located in the ***Toolpaths*** menu drop-down to create a custom group for the insert and add the insert's boundary curves to this group (Figure 5).

TIP: Use a unique color for the insert's custom group so that it can be easily selected later.

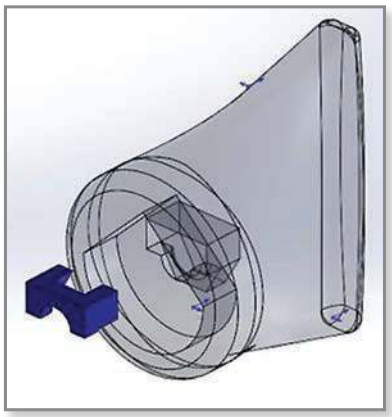

Figure 4: Transparent part with pocket and corresponding capture part.

Figure 5: Creating a custom group for the insert.

STEP 5: Click to create supports. This will create supports around the part and insert.

STEP 6: Use the ***Delete*** operation located in the ***Edit*** menu drop-down to delete the insert's boundary curves (Figure 6).

STEP 7: If fully encasing an insert, and supports are generated in the cavity due to the insert's geometry, convert these supports to model material using ***Custom groups***.

STEP 8: Click to create toolpaths.

STEP 9: In the ***Toolpaths*** menu drop-down select ***Insert Pause***.

STEP 10: Select the layer above the top of the insert and click **OK** (Figure 7).

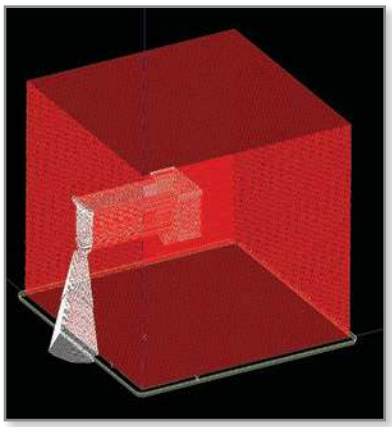

Figure 6: Insert boundary curves and support material to be deleted (white).

TIP: Adding the build pause must be the last action before saving the job.

STEP 11: Save the job.

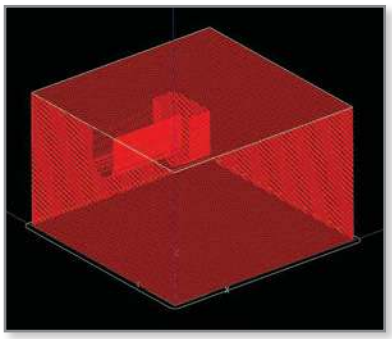

Figure 7: Selected layer (white) indicating a system pause.

2.3 Build the part.

STEP 1: Prepare the insert to promote adhesion of FDM thermoplastic.

- Clean the top surface of the insert — the surface that will be exposed when a paused build is resumed — with a degreaser.
- Spray the top surface with a thin coating of clear acrylic paint. Allow to dry for a minimum of 30 minutes (Figure 8).

TIP: Not all insert materials will require degreaser or an acrylic coating.

Figure 8: Clear acrylic paint used for adhesion of FDM thermoplastic.

STEP 2: Place the inserts into the build chamber to pre-heat and start the job.

TIP: Ensure the insert is located in an area that will not interfere with the motion of the head or the build table.

STEP 3: When the build pauses, open the system's door and immediately place the insert in the part. Then apply pressure to ensure the insert is seated properly.

TIP: (1) Placing a few drops of cyanoacrylate in the insert's cavity will hold the insert rigidly in place, preventing shifting during the extrusion process.

(2) To prevent heat loss, access the build using the opening on the top of the system where the head is mounted. This eliminates the risk of thermal-related issues.

(3) Utilize Control Center™ software's ***Remote Notification*** to get an alert when the system pauses.

(4) Move the platen down to provide access to hard-to-reach cavities requiring an insert.

Figure 9: FDM part with embedded bolt inserts (ABS-M30™ black).

STEP 4: Close the door and resume the build.

STEP 5: Embedding Hardware Into FDM Parts procedure complete.

3. SAFETY

Observe manufacturer's recommendations for safety, material handling and storage. This information can be found in the Safety Data Sheet (SDS).

4. TOOLS & SUPPLIES

4.1 Software:

- Insight software (documented with Insight 9.0)
- Control Center software

4.2 Optional items:

- Cyanoacrylate: Loctite® 495™
- Degreaser: PPG Acryli-Clean® DX330
- Acrylic paint

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