

OVERVIEW

Manufacturing relies upon tools including jigs, fixtures, templates and gauges to maintain high levels of quality and production efficiency. These manufacturing tools are used to align, assemble, clamp, hold, test and calibrate components and sub-assemblies at all stages of the manufacturing process. And although these tools are virtually invisible when production is running smoothly, their importance becomes evident when problems arise. To avoid production halts or product defects, new manufacturing tools must be quickly designed, manufactured and deployed.

APPLICATION OUTLINE

Manufacturing tools such as jigs as fixtures are most commonly machined or fabricated from metal, wood or plastic. Like the items they are used to produce, these tools go through the design, documentation, production and inspection processes. The geometries of the tools are limited by the nature of the machining and fabrication processes and by the specific capabilities of the equipment used to produce them. Elaborate or intricate tools may require several cycles of design, prototyping and evaluation before the required level of performance is achieved. On average, each iteration of manufacturing tooling takes between one and four weeks to design and build.

Fused Deposition Modeling (FDM) provides a fast and accurate method of producing manufacturing tooling. FDM technology is an additive manufacturing process that builds plastic parts layer-by-layer, using data from computer-aided design (CAD) files. A key advantage of FDM manufacturing tools is that they can be produced in less time with fewer production steps. The FDM tool is designed in 3D CAD software. The only required output is an STL file; detailed drawings are not required. The tool is produced by processing the STL file using Stratasys Insight software and downloading it to the FDM system for building. After support material is removed, the FDM tool can be immediately tested. If the first iteration is not acceptable, the design is modified, and a new tool is produced, typically in a matter of hours. The result is that FDM tools are often substantially less expensive to make and can be made in much less time than conventional machined or fabricated tools.

FDM manufacturing tools free designers from the constraints imposed by conventional manufacturing methods. So they can often be designed to deliver substantial improvements in functional and ergonomic performance for manufacturing, assembly and inspection processes.

APPLICATION CHECKLIST

FDM IS A BEST FIT FOR JIGS AND FIXTURES WHEN:

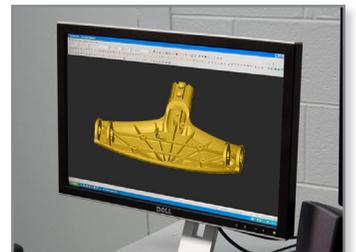
- ✓ Complex and organic designs
- ✓ Quantity: less than 25 (but up to 100 possible)
- ✓ Tolerance of +/- 0.005inch or greater
 - Less than 390 °F (200 °C)
 - Exposure to some chemicals and solvents
 - Strength (thermoplastic) is acceptable

BENEFITS OF FDM JIGS & FIXTURES INCLUDE:

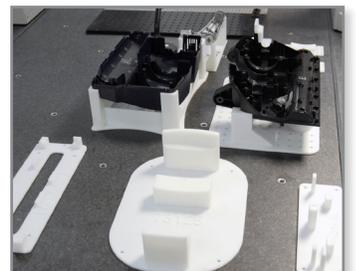
- ✓ Lead time reductions of 40% to 90%
- ✓ Cost reductions of 70% to 95%
- ✓ Integrated design (consolidation)
 - Eliminate assembly
 - Improve performance and accuracy
- ✓ Design freedom
 - Improved function
 - Improved ergonomics
- ✓ Streamlined process:
 - Eliminate detailed drawings
 - Minimize paperwork.
- ✓ Protect intellectual property (IP)—keep designs in-house.



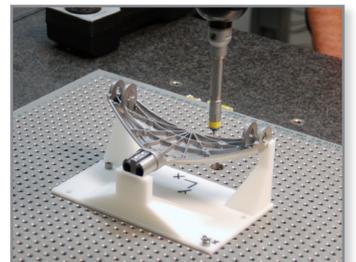
Modular clamps were used in the past to hold first articles during inspection.



CAD model of vacuum cleaner yoke to be inspected on a CMM.



First articles mounted in FDM fixtures on CMM base.



First article inspections of the yoke were completed within one day of receipt when an FDM fixture was used.

Additional design iterations of FDM manufacturing tools can typically be produced in a few hours, making it practical to optimize the tool design to a much higher level than is practical with tools produced by conventional methods. The initial version of a manufacturing tool can serve as a functional prototype or bridge-to-production solution. Since there is little delay and minimal labor required to make subsequent tools, engineers can gather performance data from the first iteration and make a series of design revisions to optimize the manufacturing process.

FDM tools are made from tough and durable thermoplastics, so they will withstand the rugged manufacturing environment. And when a new manufacturing tool is needed, it can be produced on the FDM machine in only a few hours.

CUSTOMER STORY

The Oreck Corporation produces lightweight, durable and easy-to-use cleaning products for every room in the house. Before production begins for a new product, Oreck's quality assurance department must complete a first article inspection of its components. Typically there are between 20 and 30 injection molded parts in the bill of materials. The department uses coordinate measuring machines (CMMs) to be sure the parts meet Oreck's demanding requirements.

Previously, the process to complete the first article inspection would span 30 days—a few days for inspection and many weeks of preparation, set-up, programming and waiting. Using FDM to make CMM fixtures and inspection samples, Oreck finishes first article inspections within days of receiving parts from production tooling.

To complete the inspections, Oreck first has to program the CMM, which takes two to four hours per part. For the average assembly, this is two weeks of work. However, programming can't be done without fixtures and sample parts. For simple parts, modular clamps provided the fixturing. For the more complex parts, machined fixtures were required, and they had 7 to 10 day lead times. But parts were still needed. So, Oreck could not begin the programming work until the injection mold began spitting out molded parts.

Oreck now uses FDM to make fixtures and sample parts while the injection mold is being constructed. This allows it to complete all programming and setup work before molded parts arrive. By removing programming from the critical path, Oreck condenses its inspection lead time to just a few days. According to Craig Ulmer, senior quality assurance labs technician, the average FDM fixture take just three to four hours to make and cost just \$55.00.

"I found it was very easy to design the fixtures in CAD software based on the CAD model of the part to be inspected," said Ulmer. He noted that they now build fixtures as soon as the design is frozen "I can now easily inspect all of the first articles for a new product in one day as opposed to one month," Ulmer said. "This means we can give the go-ahead to start production one month earlier than in the past."

For more information about Stratasys systems, materials and applications, contact Stratasys Application Engineering at 1-855-693-0073 (toll free), +1 952-294-3888 (local/international) or ApplicationSupport@Stratasys.com.

How Did FDM Compare to Traditional Methods for Oreck?

Method	Time	Cost
Machined Fixtures (15)	14 days	\$3,750
FDM Fixtures	2 to 3 days	\$825
SAVINGS	11 to 12 days (78% to 86%)	\$2,925 (78%)



Assembly line-yoke installed on vacuum cleaner base.



Oreck has built many FDM fixtures for CMM inspection.

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