



CASE STUDY

Siemens Gas & Power

INDUSTRY	Energy
APPLICATION	Tooling & Fixtures
LOCATION	Finspång, Sweden
CUSTOMER SINCE	2018

CASE STUDY

Siemens

A New Kind of "Power" Tool: How Siemens Gas & Power Supports Production with Additively Manufactured Tooling

36

HOURS FROM
CONCEPT TO PRINT

90%

REDUCED TIME
COMPARED TO
CONVENTIONAL
MANUFACTURING

The Challenge

Siemens Gas & Power manufactures world-class gas turbines for industrial power generation and mechanical drive applications. Used for a variety of applications, including turn-key power station projects, Siemens power systems are frequently tailored for each customer project. One such area of customization is the fuel type used to power the gas turbine.

Siemens is also a pioneer in the field of additive manufacturing and has been driving its industrialization for over a decade. In 2012, they opened their first designated 3D printing workshop for serial manufacturing, repairs, and prototyping of metal components. The workshop is located Finspång, Sweden, as an integral part of the gas turbine manufacturing business.

Recently the Siemens engineers in Finspång began 3D printing a specially designed fuel injector nozzle to react quickly to customers' customization requirements. They found that conventional methods of manufacturing were hindering the team from achieving higher customer benefits.

By additively manufacturing the fuel injector nozzles, the engineers were able to fabricate high-performing, complex parts faster than before. However, they also realized that the more intricate the 3D printed custom nozzles became, so too did the post-production machining. The necessary support structure required to 3D print the nozzle had to be milled away afterwards, and a special fixture had to be designed to do this. Conventional tooling could not reliably hold the nozzles without causing damage due to the thin, geometrically obscure nature of the nozzle walls. To outsource the geometrically complex, custom tooling would drive up lead time significantly.

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We become more flexible. We become faster. It [the Markforged X7] is absolutely a lean tool.

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ANDREAS GRAICHEN, GROUP MANAGER ADDITIVE



Siemens Gas & Power utilized its industrial X7 printer for strong, stiff fixtures.

SIEMENS

 **Markforged**

 **goengineer**

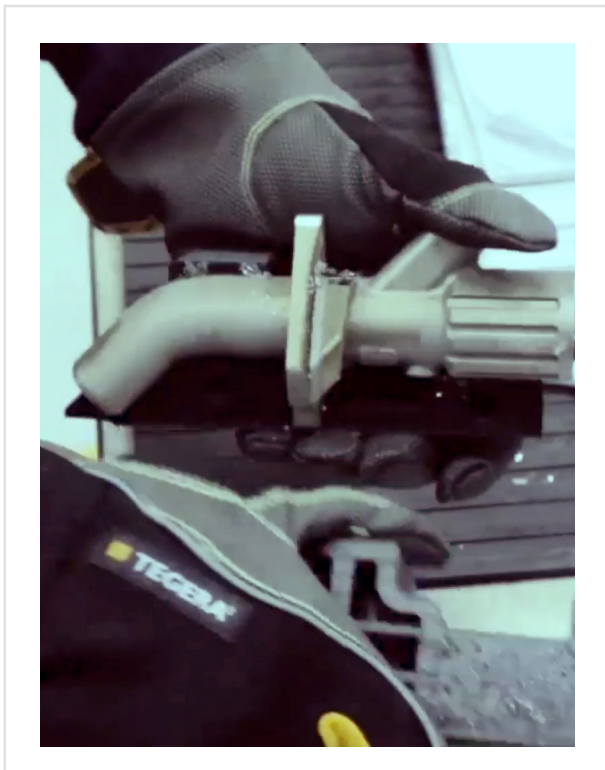
The Solution

The Siemens team started to look to other options that could withstand use in industrial settings. Markforged technology — specifically the X7 — was found to be the most promising. With the unique capability to reinforce each layer with continuous strands of fiber, the X7 enabled the team to produce a smooth, quality surface finish unlike other plastic-based 3D printers. They utilized their industrial Markforged X7 printer to additively manufacture the fixtures that could hold the fuel nozzle in place for machining. “From concept to print, it saved us 10% of time compared to fabricating a conventional machined fixture,” says Jonas Fagertoft, Additive Manufacturing Technician at Siemens in Finspång. Andreas Graichen, Group Manager at the Additive Manufacturing Centre of Competence at Siemens; “With Markforged technology, the design and the production of the holding devices was significantly faster and still strong.”

The fixture allowed the Siemens technicians to clamp the geometrically complex fuel nozzle for machining on their 5-axis mill. As the metal part’s walls were quite thin, they were concerned that the fuel nozzle might flex under machining loads. However, since the Markforged-printed fixture was printed in Onyx — a nylon-based thermoplastic filled with chopped carbon fiber — the fuel nozzle could be clamped without it vibrating within the conformal fixture. The composite workholding has transformed the fuel injector nozzle from a machining challenge to an asset. The team is impressed with the quality and stiffness of the fixtures. “It’s absolutely a lean tool,” says Graichen of the X7. Fagertoft agrees, “The material itself is thoroughly impressive in terms of strength.”



The holding devices are clamped on while the fuel nozzle is machined on a 5-axis mill.



The fixtures allow Siemens engineers to machine the fuel injector nozzles.

“ You can basically make the impossible possible. ”

JONAS FAGERTOFT, ADDITIVE
MANUFACTURING TECHNICIAN SIEMENS

Looking Ahead

Engineers at Siemens Gas & Power in Finspång can continue to quickly iterate on designs for different customer needs. There are already plans in place to use Markforged technology for other significant tooling projects. Siemens employees are now empowered to take on new and existing projects with this newly gained knowledge. “We’re looking forward to working with Markforged in our upcoming projects”, says Graichen.