



A Division of Renaissance Services Inc.

Successful Application of 3D-Printed Ceramics

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US Air Force Legacy Aircraft



The Need: Castings for Legacy Aircraft

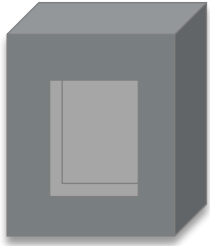
Small quantities of castings needed for replacement parts to keep planes flying

- B-52 Gearbox Housing
- B-52 Fuel Pump Housing
- E-3 Gimbal Housing
- F-15 Gun Drive Housing
- A-10 Pressure Regulator
- F-16 Fuel Oil Cooler Housing
- F-16 Torque Convertor
- KC-135 APU Air Inlet Guide

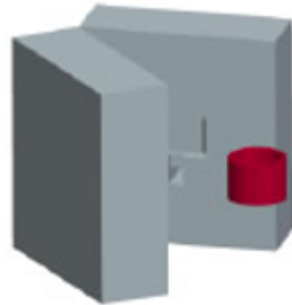


Traditional Investment Casting Flow

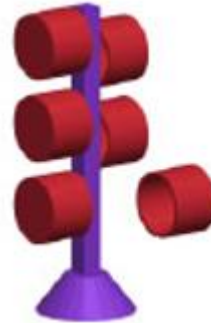
**Machining
Pattern Die**



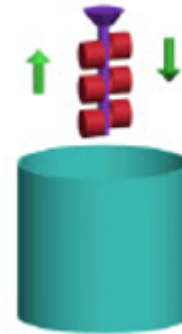
**Injecting Wax
Patterns**



**Assembling
Wax Mold Tree**



**Coating with
Slurry**



**Coating with
Ceramic**



**Melting Out
Wax**



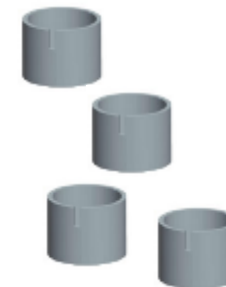
**Firing Ceramic
Mold Tree**



**Pouring Metal
Into Mold Tree**



**Removing
Ceramic Mold**



**Cleaning the
Castings**

Casting with 3D-Printed Ceramic Molds

**3D Print
Ceramic Mold**



Ceramic 3D Printing:

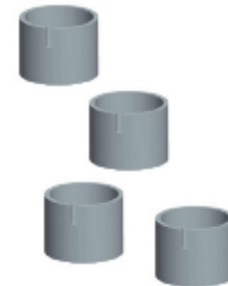
- Eliminates need for expensive hard tooling for casting process
- Reduces overall processing steps and lead time to produce castings



**Pouring Metal
Into Mold Tree**



**Removing
Ceramic Mold**

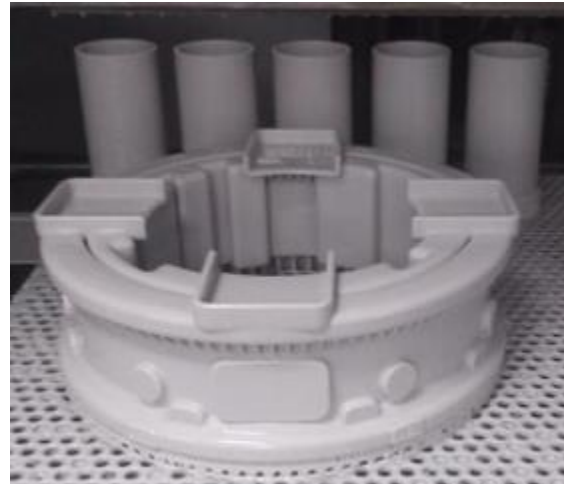


**Cleaning the
Castings**

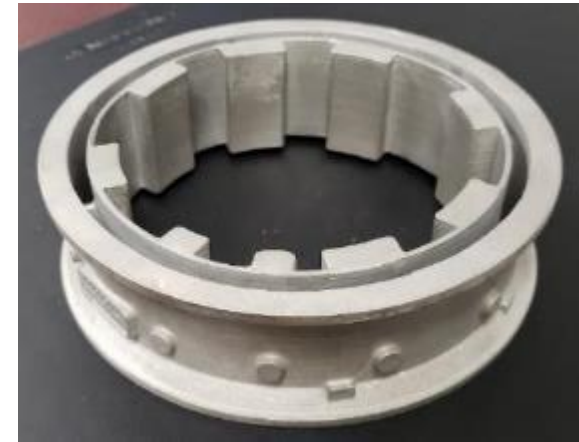
Example Casting from 3D-Printed Ceramic Mold



3D Casting Model



3D-Printed Ceramic Mold



Nickel Casting