

“Vacuum Investment Casting Process for Manufacturing of Equiaxed Ni-base Superalloy Components of Small Turbo-Fan Engine (STFE)”

i. Description of Technology

Nickel-base superalloy parts such as blades, vanes and rotors are used in hot sections of aero gas turbine engines. Currently, one of the DRDO laboratories (GTRE, Bengaluru) is developing a small turbo-fan aero-engine (STFE), which will be used for a variety of strategic applications such as unmanned aerial vehicles and certain missiles. The hot sections of this engine requires seven types of critical equiaxed Ni-base superalloy components, namely (i) high pressure turbine (HPT) blades, (ii) HPT nozzle guide vane (HPTNGV)- outer casing, (iii) HPTNGV- inner casing, (iv) HPTNGV- vane, (v) pyro-duct starting nozzle, (vi) low pressure turbine rotor (LPTR) blisk and (vii) low pressure nozzle guide vane (LPNGV), as shown in Fig. 1 below. These components are of aeronautical grade and are fabricated through vacuum investment casting method. Three of the above components (HPTNGV-vane, pyro-duct starting nozzle and LPNGV) are hollow and ceramic cores are used to achieve them by casting method. DMRL has established the vacuum investment casting technology to realize the above parts and have supplied them in limited numbers to the user. The supplied castings have already been utilized by the user agency successfully. The above casting technology is being offered for transfer to a production agency for bulk production of the components.

The casting technology developed at DMRL has the following constituents:

- a) Design of wax pattern dies from component drawings using indigenous sources
- b) Process for producing the required ceramic cores for the hollow components
- c) Ceramic shell making process
- d) Casting process using vacuum induction melting
- e) Post-casting processes including ceramic core removal by chemical leaching and non-destructive and destructive examinations
- f) Dimensional measurements by coordinate measuring machine (CMM)

Therefore, the transfer of casting technology will include all the above aspects pertaining to the seven components except core making. The silica-based ceramic core manufacturing technology is planned to be transferred to an agency independently prior to the transfer of the above casting technology. Therefore, the cores required for the fabrication of the hollow components can be directly sourced from the core manufacturer.

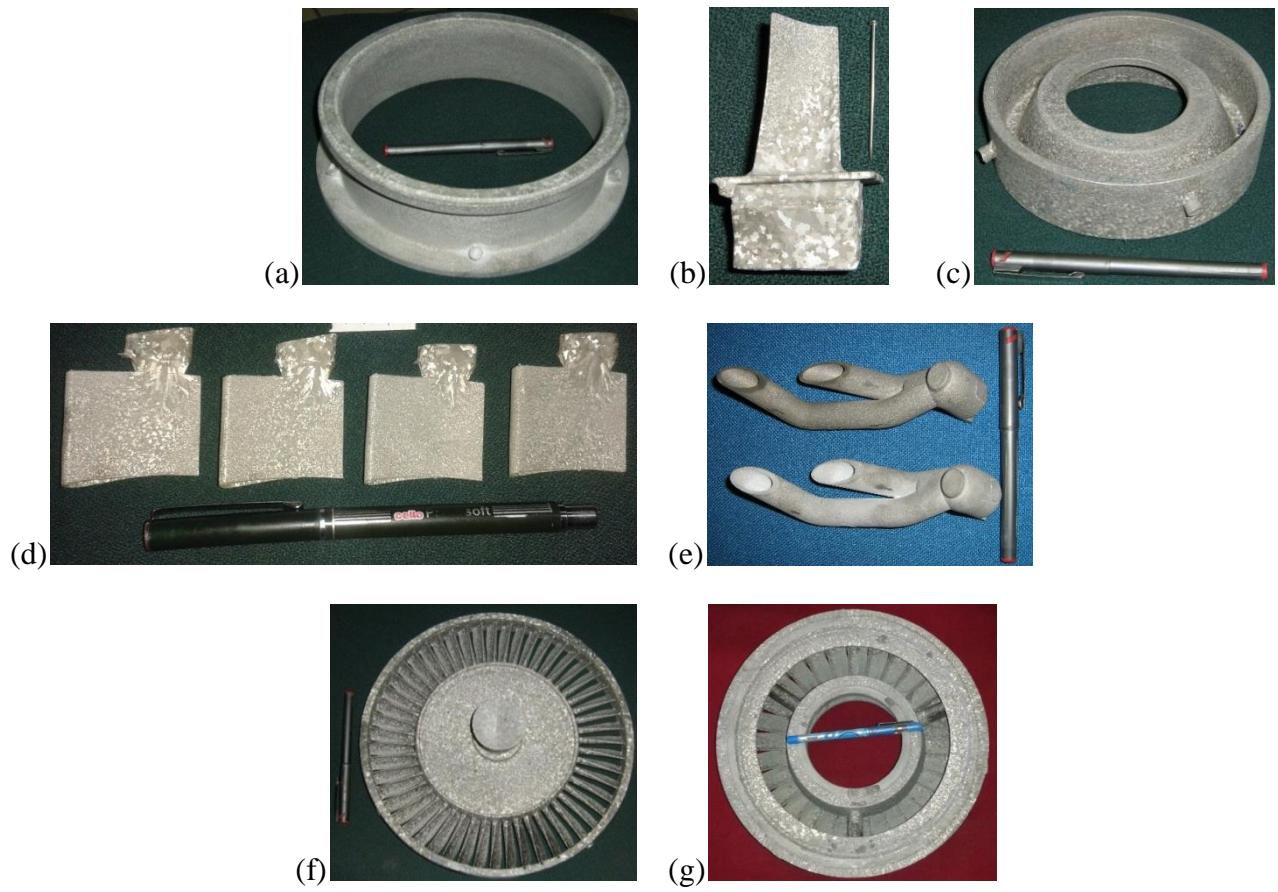
ii. Application Areas

This technology can be used for producing cast superalloy components of gas turbines used in aerospace and power generation sectors.

iii. USP of the Technology

Superalloy components fabricated through this technology have been accepted for use in a small turbine engine developed by DRDO and huge demand for these engines from armed forces is foreseen in near future.

- iv. Photographs at appropriate places on the technology developed (if available)



Pictures of the seven cast components: (a) HPTNGV-outer casing, (b) HPT blade, (c) HPTNGV-inner casing, (d) HPTNGV vane, (e) pyro-duct starting nozzle, (f) LPTR blisk and (g) LPNGV.