

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

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. 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 Aerofoil, (v) Pyro-duct Starting Nozzle, (vi) Low Pressure Turbine Rotor (LPTR) Blisk and (vii) Low Pressure Nozzle Guided Vane (LPNGV). These components are shown in Fig.1 below. These components are of aeronautical grade and are fabricated through vacuum investment casting method. Four components (HPT blade, HPTNGV - Outer Casing, HPTNGV - Inner Casing and LPTR Blisk) do not require ceramic cores. The other three components (HPTNGV-Vane Aerofoil, Pyro-duct Starting Nozzle and LPNGV) are hollow and require the use of ceramic cores.

DMRL has established the vacuum investment casting technology including the manufacturing of ceramic cores to realize the above mentioned seven components of STFE and has 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 for realization of all seven components:

- 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)
- g) Acceptance and inspection procedure of the components

Therefore, the transfer of the casting technology will include all the above aspects pertaining to the seven components.

Application Areas

This technology can be used for producing cast superalloy components for STFE.

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.

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



(a)



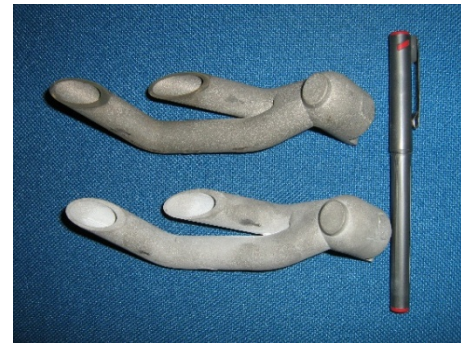
(b)



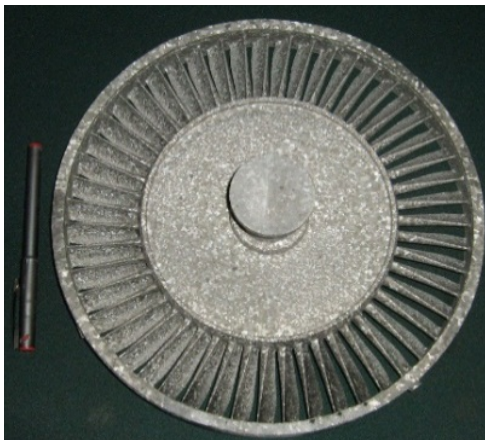
(c)



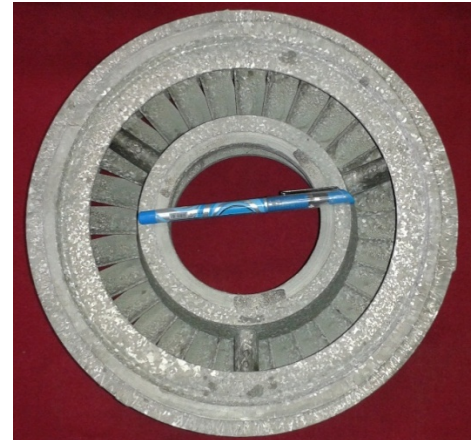
(d)



(e)



(f)



(g)

Fig. 1: Pictures of the seven cast components: (a) HPTNGV – Outer Casing, (b) HPT blade, (c) HPTNGV- Inner Casing, (d) HPTNGV Vane Aerofoil, (e) Pyro-duct Starting Nozzle, (f) LPTR Blisk and (g) LPNGV

Interested companies/ industries are requested to apply against this EoI to following address:-

Director

Defence Metallurgical Research Laboratory

Kanchanbagh P.O.,

Hyderabad-500058

Phone : 040-2434 0681

Fax : 040-24340683

Email : director[dot]dmrl[at]gov[dot]in

A copy of interest may be sent to the following address (without any attachment):-

Director

Directorate Industry Interface and Technology Management (DIITM)

Room No 447, DRDO Bhawan, DRDO HQrs, Rajaji Marg, New Delhi – 110011

Phone No: 01123013209/23015291

Fax No: 011-23793008

Email ID: diitm[dot]hqr[at]gov[dot]in

All industries interested in seeking ToT are requested to fill in the Application cum Industry Assessment form given below and provide reference of page no. of supporting document (wherever applicable) in the relevant field. The list of documents to be attached is provided in Annexure - I.

Application cum Industry Assessment Form

PART-1

General Information

a)	Name of the Technology requested for Technology Transfer (Technology name and concerned Lab, Category)	
b)	Name of the industry/ organization	
c)	Complete Address and other details	
	Registered Office State Phone No Fax Email Website	

	<p>Factory</p> <p>State Phone No Fax Email Website</p>	
4.	<p>Point of Contact</p> <p>Name Designation Address Mobile No Ph No Email ID</p>	
5.	<p>NAME OF CMD/ MD /PARTNERS/ PROPRIETOR/ etc</p> <p>Name Designation Address Mobile No Ph No Email ID</p>	
d)	Date of Incorporation of company	
e)	Foreign Direct Investment in company (if any in %)	
f)	Shareholding pattern	
g)	<p>Turn over as per Audited Balance Sheet for the preceding three years.</p> <p>Year ____ Year ____ Year ____</p>	
h)	<p>Annual budget for R&D during last three years (if any)</p> <p>Year ____ Year ____ Year ____</p>	
i)	<p>Income Tax returns for the preceding three years period</p> <p>Year ____ Year ____ Year ____</p>	

j)	Nature of company DPSU, Private Limited, Public Limited, Partnership, Proprietary, Ex-Serviceman Unit	
k)	Category of industry Large Scale, Medium Scale, Small Scale, Micro, Startup	
l)	MSME Registration No	
m)	Certificates of registration as a manufacturing unit, if any.	
n)	If Startup, DPIIT Registration No	
o)	UDYOG AADHAR No	
p)	PAN Number	
q)	Details of Industrial license for defence manufacturing issued by DPIIT (if any)	
r)	Details of PESO license (if any)	
s)	GST Number	
t)	Nature of business Manufacturing/ Sole Selling or Authorized Agent/ Assembler/ Traders/ Dealer/ Processor/ Repacker/ Others	
u)	Details of current products and services Products and services Supplied (please specify Govt/ Domestic market/ Export)	
v)	Record of past performance (e.g., Supply orders executed against of Ministry of Defence orders, Public Sectors and Paramilitary Forces, if any).	
w)	Details of registration with NSIC / SSI, DGS&D, other Defence Department, other Govt. Dept, membership of FICCI/ASSOCHAM/CII or other Industrial Association (Attach relevant copies of registration letters)	
x)	Have you already taken any technology from DRDO (If yes, give details attaching separate sheet) Name of the Technology, Lab, Year, License number & Status	
y)	ISO/ ISI certification or any other certification (If yes, give details)	
z)	Relevant clearances form the authorities/ ministries (if any)	
aa)	Capacity and capability to undertake developmental work and to accept attendant financial and commercial risks.	
bb)	Capacity/capability to market the product through the marketing network, sales and service network, reliability to maintain confidentiality.	

PART-2

Infrastructure and other Information

a.	Total area of factory Covered (m ²), Uncovered (m ²), Bonded space available (m ²)	
b.	Ownership of factory Self-owned, partnership, rental	
c.	Electric power Sanctioned Installed Standby (if any)	
d.	Availability of adequate infrastructure (List of machines and their production capacities) and technical expertise	
e.	Name of bank & A/c No Name of bank A/c type A/c no Address of the bank Phone: Email:	

(a) Details of current products:

Sl.no.	Type	Description	Licensed/installed capacity	Annual production for preceding 3 years

(b) Details of foreign collaboration, if any

Sl.no.	Product	Name & address of collaborator	Year	Remarks

(c) Details of products developed for services

Sl.no.	Nomenclature of stores	Order no and date	Remarks

(d) Please give details of important facilities & infrastructure as per following format for:

- a. Production
- b. Unconventional, special m/c
- c. Testing & quality control facilities

Sl.no.	Description of m/c	Make & model	Qty	date of purchase	Remarks

(e) Furnish the following details with relevant certificates and documents

- a. R&D facilities available :
- b. Inspection quality control of raw material components :
- c. Assistance from central agency for testing / calibration etc. :
- d. laboratory and drawing office facility :

(f) Principal customers:

Sl.no.	Name & address	S.O No. & date	Date of last supply	Products supplied	Value

(g) Future plan (if any) in respect of expansion programme installation of additional machines/ test facilities etc.

(h) Name of the technology requested for transfer (give self-assessment of your capability to absorb the technology)

(i) Details of employee as on date on firm's pay roll

PERMANENT				
Category	Post Held	Number	Qualification	Total Service
Technical	Prod. Manager Q.C. Manager Supervisor Testing Staff (Qc) Skilled workers Unskilled workers, etc.			
Administrative	Purchase Manager Accounts Officer Office Superintendent Clerical Others etc			

TEMPORARY				
Category	Post Held	Number	Qualification	Total Service
Technical	Prod. Manager Q.C. Manager Supervisor Testing Staff (Qc) Skilled workers Unskilled workers, etc			

Administrative	Purchase Manager Accounts Officer Office Superintendent Clerical Others, etc			
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DECLARATION :

I / we confirm that the information furnished in Part 1 & 2 above is correct. In the event of any information given by me / us is found incorrect / false at any time, I / we understand our EoI for ToT will be cancelled/ rejected without notice, beside any other appropriate action against me / us.

Industry seal

Authorized signatory

Name(s) in capital
designation and seal of authorized signatory

dated:

Place:

Annexure - I

List of Supporting documents to be attached with EoI

- (a) Memorandum and Articles of Association (Should be incorporated as per Indian Companies Act, as amended time to time)
- (b) Certificates of registration as a manufacturing unit, if any.
- (c) Audited Balance Sheet for the preceding three years.
- (d) Income Tax returns for the preceding three year period
- (e) Details of shareholding/ownership pattern especially foreign partners/ shareholders, foreign employees, directors, etc. The company must adhere to the prevailing Govt of India policies and regulations on Foreign Direct Investment (FDI)/DIPP norms as applicable.
- (f) Annual budget for R&D during last three years.
- (g) Numbers and details of IPR or patents, etc., held by the company.
- (h) Number of technically or professionally qualified personnel.
- (i) Record of past performance (e.g., Supply orders executed against of Ministry of Defence orders, Public Sectors and Paramilitary Forces, if any).

- (j) Availability of adequate infrastructure (List of machines and their production capacities) and technical expertise.
- (k) List of Testing and Support equipment's
- (l) ISO/ ISI certification or any other certification
- (m) Relevant clearances form the authorities/ ministries (if any)
- (n) Capacity and capability to undertake developmental work and to accept attendant financial and commercial risks.
- (o) Capacity/capability to market the product through the marketing network, sales and service network, reliability to maintain confidentiality.
- (p) PESO and DPIIT license for explosive handling if ToT is for high energy Material, explosives, propellants, and component/ system dealing with it etc.
- (q) Under taking form company seeking ToT that none of its Directors, Independent Directors, non-executive Directors, Key management personnel are involved in any corrupt practices, unfair means and illegal activities.
- (r) Details of the industrials license for defence manufacturing be provided by the industry seeking ToTs.