Annexure I

Technical specification for Induction brazing furnace

Sl.No.	Description	Specification
1.0	Scope of work	Design, fabrication, supply, installation, testing, commissioning and demonstration of Induction Brazing Furnace (IBF).
2.0	End use	Induction heating and brazing of Graphite, stainless steel, Titanium and copper materials.
3.0	Major parts of the supply	1. Induction power source 2. Portable Tank circuit and cables 3. Induction coil – 1 No 4. Brazing furnace chamber 5. Control systems for brazing furnace operation
4.0 Detailed specification of power source		
4.1	Power	16 kW (minimum)
4.2	Range of frequency for operation	Operating range: 40(±5) kHz to 320 (±20) kHz
4.3	Induction coil	Multi turn OD type induction coil suitable for a hot zone dimension of 100 mm diameter and 100 mm height.
4.4	Power control	The input to the induction coil shall be controlled by a PID controller and temperature measured using thermocouple/pyrometer from the furnace chamber.
4.5	Parameters to be monitored.	Equipment shall be able to record the key process parameters such as output power, frequency and temperature over the time. This data should be easily transferable to external storage devices.
4.6	HMI	The power source should include an independent HMI unit displaying current process parameters.
4.6	Programing	The temperature and heating rate of the brazing process can be programmable in the PID controller. Equipment shall perform induction heating according to the heating cycle that programmed in PID controller.
4.7	Power and frequency adjustment	The power and frequency adjustments should be responsive to inputs from the PID controller. The power source should incorporate multiple transformer ratios and configurable capacitor banks to accommodate a wide range of load impedance matching (0 to 100%).
4.8	Auto Tune	The equipment should have the features to auto-tune to optimize power and frequency whenever a new coil is used.
4.9	Equipment model & conformity standards	The equipment must adhere to CE standards. Party shall provide make and model number and a detailed specification of the induction power source that you are proposing, in your offer. Offer will not considered without relevant information.
4.10	Electrical power	The input power supply should be 415V, 3-phase, 50 Hz. The supplier must clearly specify the estimated connected power, as well as the estimated peak power consumption of the

		system, considering the various operation modes described above.
4.11	Water manifold	The cooling water for various equipment systems will be distributed through an inlet manifold and collected back through an outlet manifold. The party shall provide a water manifold that meets the specified requirements. The manifold should include the following provisions in both the inlet and outlet sections: 1. Cooling water from the chiller. 2. Emergency cooling water supply. 3. Water distribution lines for different systems with independent ball valves 4. Gauges for monitoring cooling water pressure and temperature.
4.12	Cooling water	VSSC will provide the necessary cooling water, including chiller and emergency water, up to the manifold. The party is responsible for making the connections to their manifold. Additionally, the party may clearly specify the cooling water requirements in their offer
4.13	Cooling system in induction power sources	Tank circuit shall be water proof to prevent the damages that may occur due to water leakages. The water lines are preferable to use polyamide pipe with high temperature capability.
5.0 Detailed specification for brazing furnace		
5.1	Maximum temperature	1200°C
5.2	Working zone	Ø100 x 100 mm
5.3	Schematic of the furnace	Detailed schematic of the induction brazing furnace provided in Appendix I.
5.4 Furnace chamber		
5.4.1	Chamber design	The furnace, designed with vertical bottom loading and constructed with a single wall using 6 mm thick SS 304L material, with an internal dimensions of 500 mm in diameter and 500 mm in length.
5.4.2	Bottom door	The bottom door made as a flange with Viton O-rings and clamped to the chamber using mechanical self-locking clamps. The bottom door flange shall move vertically up and down (500 mm approx.) using a piston-cylinder arrangement. The preferred dimension of the flange is 300 mm.
5.4.3	Top door	The top door shall be generally in a closed condition using nut and bolt arrangements and necessary Viton O-rings to maintain a vacuum-tight environment. However the top door to be removed occasionally for ease of maintenance.
5.4.4	View ports	Two view ports (about 100 mm in size) are required to observe the brazing operations. Locations of view ports are shown in the schematic. Corning 7980 industrial grade quartz glass should be used for the viewports. The viewport glass should be mounted as a floating assembly with Viton O-rings
5.4.5	Operating environments	The chamber will operate in vacuum and inert atmospheres. The design should withstand the vacuum in the order of 10^{-2}

		mbar and inert pressure of 0.2 bar (gauge). Normal operating pressure will be 0.1 bar (gauge) max.
5.4.6	Ports in furnace chamber	The furnace chamber should have specific ports for: 1. Gas inlet 2. Vent valve 3. Spring loaded safety valve 4. Compound gauge (pressure and vacuum) 5. Flange for induction coils with feedthroughs 6. Evacuation port 7. Two 100 mm view ports 8. Flange for thermocouple and feedthrough 9. Dummy port with KF 25 flange – 1 no
5.4.7	Job support plate	A height adjustable job support plate must be provided to hold the job within the induction coil. The size of the job plate must be higher than hot zone dimensions. Job support plate will be directly mounted on the movable bottom door over a 25 mm thick thermal insulation board. Suitable centering guides shall be provided in bottom door to ensure the concentricity of the job with coil. The material for job support plate shall be SS 304L
5.4.8	Leak rates	The total leak rate (system level) should be $\leq 1 \times 10^{-3}$ mbar.lt/s, and individual leak rates for joints, vacuum lines, feedthroughs, feedthrough flanges, valves, and all ports and fittings should be $\leq 1 \times 10^{-8}$ mbar.lt/s.
5.4.9	Standards flanges	Use only standard ISO flanges where required.
5.4.10	Feedthroughs	Feedthroughs should be easy to remove and assemble.
5.4.11	Structural Support	The chamber should be supported on a designed structure fabricated from thick SS plates/angles.
5.5 Vacuum and inert gas control systems		
5.5.1	Vacuum line	A port for the vacuum line shall be provided at the side of the chamber with a KF 25 flange. Also, a vacuum isolation valve (size: 25 mm) shall be provided between the KF 25 flange and chamber to connect and disconnect vacuum system whenever required. A vacuum pump will connect to this KF 25 flange for evacuation of chamber. VSSC will provide nnecessary vacuum pumping systems.
5.5.2	Gas control system	The gas control system should maintain the pressure inside the chamber between 0 to 0.1 bar (gauge). The gas control system shall equip with a gas inlet valve and vent valve.
5.5.3	Gas manifold	Party shall provide a gas manifold to connect the gas cylinder to the chamber. This manifold should have flexible hoses to connect the gas cylinder regulator, fine control gas pressure control valve, and gas inlet valve.
5.5.4	Gas control valves	The size of the inlet and vent valves shall be 15 mm and it is operated pneumatically using solenoid valves.
5.5.5	Compound gauge	A compound mechanical gauge showing vacuum up to -1.0 bar and pressure up to 2 bar (gauge) should be mounted to the chamber.

5.5.6	Pressure indicator	A digital pressure indicator displaying actual pressure in the chamber shall be provided in the control console.
5.5.7	Gas pressure lines	Stainless steel tubing with a thickness of 1 mm or higher should be used for all insert gas lines.
5.5.8	Pneumatic operation	The vacuum isolation valve, gas inlet valve, and vent valve should be operated pneumatically using solenoid valves. The pneumatic air (8 bar) will be provided by VSSC, and the party should provide a separate FLR & manifold with sufficient outlet ports to supply air to different valves.
5.5.9	Interlock	Necessary interlocks should be provided to avoid the simultaneous opening of multiple valves.
5.5.10	Pressure Protection	Two-stage protection should be provided to prevent excess pressure rise above 0.1 bar (gauge): a. Pressure measured electronically and maintain pressure in the chamber between 0 to 0.1 bar (gauge) by operating gas inlet valve and vent valve suitably. b. Release of excess pressure using a mechanical pressure relief valve when the pressure reaches a pressure of 0.2 bar (gauge).
5.6 Temperature control		
5.6.1	Temperature programing	Temperature of brazing process controlled by a PID controller and thermocouple. The PID controller shall be of reputed make (Eurotherm/Yokogawa/ Honeywell or equivalent) and coupled to induction power supply for temperature control.
5.6.2	Programing features of controller	The PID controller should be a programmable controller capable of storing 5 programs, with each program having 5 segments.
5.6.3	Heating rate	The heating rate of the induction heating unit should be between 5 to 300°C/min.
5.6.4	Over Temperature Controller (OTC):	An over-temperature controller (OTC) should be provided to limit the furnace temperature below the safe level. The OTC should be interconnected to the induction power system to cut off power in emergencies.
5.6.5	Accuracy	The accuracy of the controller and OTC should be ±1°C.
5.7 Instrumentation		
5.7.1	Control panel	A control panel housing all control switches, and instruments for smooth furnace operation should be provided. The control console houses the temperature controller, OTC, voltmeters, ammeters, operation status indicators, alarm indicators, etc.
5.7.2	Valve control Switches	Control switches for the operation of the gas inlet valve, vent valve, and vacuum isolation valve should be provided in control panel
5.7.3	Emergency Stop Button	A large red mushroom-style emergency stop button should be provided in the console. It will turn off the induction power and bring the unit to a safe operating condition.
5.7.4	Power Supply Status	The control panel should indicate the status of the power supply.
5.7.5	Mounting of Electrical Components	All electrical switch gears, contactors, relays, fuses, etc., should be mounted on a plate fitted vertically for the convenience of maintenance.

5.7.6	Electrical Wiring	The electrical wiring of the panel should conform to accepted international standards.
5.8 Safety devices and interlocks		
5.8.1	Over Temperature Protection	In the event of over-temperature, the induction power to the furnace should be cut off by OTC.
5.8.2	Cooling Water Failure	In the case of water supply failure or low water supply, electrical power to the induction coil should be switched off.
5.8.3	Emergency Cooling Water during Power Failure	During a power failure, the overhead tank will supply necessary cooling water to the equipment to bring the temperature to a safe point. VSSC will provide overhead water supply. Party should provide suitable connections and automatic control systems.
5.8.4	Gas Pressure Protection	Two-stage protection should be provided to prevent excess pressure rise above 0.1 bar (gauge): a. Pressure measured electronically, shutting off the gas inlet valve below the safe pressure. b. Release of excess pressure using a mechanical spring-loaded pressure relief valve when the pressure reaches the 0.2 bar (gauge).
5.8.5	Alarm Indications	All alarm indications like low pneumatic air, low gas pressure, vacuum readiness, phase failure, should be properly displayed on the control console with LED indications.
5.8.6	Interlocks for Valve Operation	Necessary interlocks should be provided to avoid the simultaneous opening of gas inlet, vent, or vacuum isolation valves.
5.8.7	Calibration of Instruments	All measuring instruments, including pressure gauges and controller, temperature controllers, OTC, thermocouples should have valid calibration. The party has to produce calibration certificates during PDI.
6.0 General terms and conditions		
6.1	Party shall specify the make and model number of all sub-systems that intended to use in the equipment, in the technical bid.	
6.2	The quote shall be from OEM or authorized representative of OEM or similar furnace manufacturer. Valid authorization certificate must be submitted in case of representative.	
6.3	Offers from those OEM/Representative/Furnace manufacturers that have supplied at least one similar equipment in past 5 years shall only be considered for evaluation. The bidder must provide the details of similar systems supplied in past five years with customer's name, place and year of installation. Bidder my also provide a copy of PO and contact address and phone numbers of previous supplies. VSSC reserves the right to contact the reference provided and may reject the offer in case of unfavourable opinion.	
6.4	VSSC will conduct factory visit during technical bid evaluation to ensure credential of the supplier, if required. VSSC reserves the right to reject the offer in case of unfavourable opinion.	
6.5	The total furnace system shall be designed in compact manner to save the space requirements. Schematic of the furnace chamber and its connections shall be provided along with the technical bid. The complete equipment shall fit in an area of 1 m x 2 m	

6.6	After receiving the purchase order, the party shall submit the design drawings before starting the fabrication work. This is to ensure that the product conforms to VSSC requirements. Fabrication may proceed with VSSC consent. However, the party bears full responsibility for meeting VSSC requirements in terms of furnace actuality and performance
6.7	Pre Dispatch Inspection (PDI): The supplier shall propose the acceptance procedure step by step based on below base guidelines to VSSC at least 2 weeks before offering for PDI. The same shall be reviewed by VSSC and the mutually acceptable procedure shall be followed. VSSC will conduct PDI and following points will be verified during PDI. 1. All protection features, indicators, interlocks, if any shall be demonstrated. 2. All applicable calibration certificates shall be provided at the time of PDI 3. One heating trial at 1200°C using non-magnetic steel to be successfully demonstrated. Vendor shall prepare the complete test results documents for PDI and shall offer to VSSC for review and clearance before shipment.
6.8	All utility and accessories requirements shall be arranged by the vendor for installation, commissioning and training at VSSC site.
6.9	Packing and transportation: Supplier shall package the complete system after PDI clearance suitably to avoid any damage or contamination for safe transportation to VSSC located at Thiruvanthapuram, Kerala. Any damage occurred during transit shall be repaired by the party without any additional cost.
6.10	Installation, commissioning and demonstration: It shall be the responsibility of the supplier to carry out the installation commissioning and successful demonstration of equipment at VSSC. The system shall be considered commissioned only after written certificate from VSSC.
6.11	Training: Party shall provide thorough training after installation and commission at free of cost.
7.0 Warranty period and requirements	
7.1	Supplier shall provide standard 01-year warranty.
7.2	Additional two years extended comprehensive warranty shall be quoted separately as optional.
7.3	The warranty period shall be considered only after installation, commissioning and acceptance at VSSC.
7.4	Extended warranty, if available shall start after completion of 01-year standard warranty.
7.5	It shall be confirmed that the warranty and extended warranty services will be provided by OEM or OEM trained personnel with valid certificates in India. Supporting documents must be submitted during the technical bid.
7.6	The supplier shall attend to breakdown repairs within normally 24 hours from the date of written intimation (email/FAX etc.) and shall be completed within nominally 7 days during warranty period
7.7	It shall be noted that VSSC will not make payment for any visit/labour/parts shall be paid by VSSC during the warranty period (including extended warranty, if applicable)
8.0 Post warranty AMC	
8.1	The supplier shall provide non-comprehensive AMC services for 05 years for post-warranty period.

8.2	Party shall quote AMC charges as per year basis. AMC charges will be considered for price bid evaluation.
8.3	The supplier shall clearly mention the scope of services (all inclusions and exclusions) offered during AMC period in the technical bid.
8.4	Preventive maintenance shall be carried out twice a year as part of AMC.
8.5	The supplier shall attend to breakdown repairs within normally 24 hours from the date of intimation and shall be completed within nominally 7 days during AMC. Minimum one breakdown visit shall be provided per year at free of cost.
8.6	It shall be noted that payment shall be done after completion of each preventive maintenance visit.
8.7	Separate PO will be issued for AMC with terms and conditions.