

DETAIL TECHNICAL SPECIFICATION OF HIGH TEMPERATURE VACCUM SINTERING FURNACE:

Sl. No.	Key Features	Our requirement:
1.	Furnace type:	Horizontal and front loading Box type all metal (molybdenum) Vacuum Sintering Furnace.
2.	Maximum Temperature:	1600 ⁰ C (+/- 5 ⁰ C),(max.4 hrs in) in maximum vacuum and inert atmosphere.
3.	Continuous working temperature:	1550 ⁰ C (+/- 5 ⁰ C) For continuous running in maximum vacuum and inert atmosphere.
4.	Heating element	Lanthanum doped Molybdenum element (Grooved) for uniform heating of full length hot zone (size mentioned in column 7). Insulation and hearth material shall be of reputed make molybdenum.
5.	Vacuum	<ul style="list-style-type: none"> Furnace should be designed for controlled vacuum pumping speeds as per application. Fully automatic controlled by software/PLC for use with powders and sample also. The furnace must have appropriate sealing with water cooling jacket to ensure vacuum level of 0.01milli bar (10⁻⁵ bar) at room temperature as well as highest operating temperature. The vacuum pumping system may consists a combination of Direct drive rotary vane pump and turbo molecular pump/diffusion pump (with suitable water condenser ,baffle etc. . <u>Liquid nitrogen cannot be used as running coolant</u>) to create the above mentioned vacuum and all the relevant fittings is to be supplied. Vacuum valves should be electro pneumatically operated with transmitter type pirani sensor gauge. All the weldments/joints/valves of the furnace should be checked using MSLD (Helium Mass Spectrometer Leak Detector) in the range of 10⁻⁹mbar lts/sec . The furnace chamber leak rate is < 5 microns/hr complied to AMS2769 A) to ensure the desired vacuum level as per specification. Necessary safety provision of nitrogen gas purging should be provided to safe the hot zone during power failure.

Note: In order to judge the technical compliance of the offer with respect to Sl. No. 2-5, Vendor must submit documentary evidence of supplying 03 nos. of such furnaces with Molybdenum heating element, having metal hot zone and operating Temperature of 1400⁰ C or above and operating vacuum of 10⁻⁵ bar or less in Public sectors/Govt. Research institute/Govt. Academic organization in India within last 5 years. PO copies with all annexure will only be accepted as documentary evidence. In absence, it will be considered that the Vendor is not complying the technical criteria in Sl. No. 2-5.

6.	Application	<ul style="list-style-type: none"> Vacuum and controlled atmosphere sintering of various Metal Injection Molded parts for engineering application.
7.	Hot Zone	<ul style="list-style-type: none"> Size :150(H)X 150(W)X250 (L) m.m.(minimum) Temperature variation +/- 5 °C (max.)over the whole working range. Heating rate ; 10 °C /min.(max.) ,cooling rate : 7 °C /min. (max.) up to 800 °C there after vacuum/atmospheric cooling. Hot zone should consists of at least 4 layer molybdenum, 2 layer SS shield with striped molybdenum heating element. Circular casing of the hot zone is preferable. Over-temperature cutout Controller for thermal protection (class 2) to protect the furnace and sample. Provision must be provided to supply/purge gases (Argon, Nitrogen, Argon- 5%Hydrogen gas mixtures) in case of power failure. Two sliding trays (Molybdenum) must be provided (equi distance) to place the specimen. <ul style="list-style-type: none"> Weight of material to be sintered: 50 gm.-10 kg .
8.	Controlled Atmosphere	<ul style="list-style-type: none"> Air tight chamber with proper high temperature sealing is to be fitted within the chamber to withstand both positive and negative pressure (vacuum level as discussed above).. The chamber must have the purging facility of Argon, Nitrogen, 95%argon-5% hydrogen mixture gases with positive pressure (max 1.3 bar) throughout the sintering cycle whenever it is required. It must have switching (purging/flushing) capability from vacuum to requisite atmosphere at any

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		<p>temperature with all necessary pressure safety valves..</p> <ul style="list-style-type: none"> • Must consist of software controlled process gas management/controlled atmosphere system.
9.	Basic construction of chamber	<ul style="list-style-type: none"> • All the basic construction of the furnace may be of mildsteel / stainless steel .Reference standard :ASME Sec VIII, Div. – 1 standard. • Direct heat exposed parts to be made of heat resistant material with double walled water cooled shell to make the furnace robust ,long life and easy to maintain. • Water-Cooled Flange type Door and furnace wall is required • All the pipelines fitting must be leak proof and reliable for at least 5 years. • Exhaust valve should be there to wave out the exhaust gases. • Safety system for overshoots of gas pressure inside the chamber with hooter. • The volatiles must not react with heating elements (specifically volatiles,hydro-carbons, impurities). • Provision should be there to displace unburn/explosive gases manually in case of emergency .(power failures,sensor problem etc.)
10.	Cooling system	<ul style="list-style-type: none"> • The total cooling system of the furnace to be taken from the central manifold distribution with control valves for independent operation with proper sensing signal for PLC. • A closed loop chiller with required specification / Tonnage is to be mentioned along with bid to overcome the cooling load in various atmospheric/temperature condition of the furnace.CSIR-CMERI will purchase the chiller separately.
11.	Gas Purging arrangement	<ul style="list-style-type: none"> • Must be fitted with proper flow meters ,safety valves to purge Nitrogen, Argon 95%argon-5% hydrogen the process . • necessary flow valve with gas line connections with the chamber to create positive pressure even at temperature as and when required , • non-return solenoid valve to interface with PLC. • Gas flow rate = 1-50 ml/min • All gas line fittings must be easy operational.
12.	Power	415V, 3- phase ,Thyristor base power control , stepdown transformer etc. as required.
13.	Mandatory Mounting in control Panel	<p>The furnace should be fitted with safety thermocouple (B/C -type) with display.</p> <p>Necessary Ammeters and Voltmeters are required.</p> <p>Pressure indicator & vacuum Indicator, load and phase lamps/ indicators etc. to be fitted.</p> <p>The furnace should be fitted with over temperature cut off for safety purpose; It may be protected using Current Limit Feed Back arrangement.</p>
14.	Thermocouples	One thermocouple (B/C-Type) must be placed in the hot Zone for direct measurement of the temperature another in a suitable position near heating element with tantalum /high alumina sheathed. Both the thermocouples should be calibrated.
15.	Furnace control unit	<p>The furnace should be fitted with PLC controlling unit with suitable software (SCADA/HMI etc.) containing PID controller (make: Eurotherm or Similar standard) to synchronize the furnace operation but having the minimum features.</p> <p>No. Of Programme: Minimum 4</p> <ul style="list-style-type: none"> • Pattern status: Must have at least 16 segments (Ramp + Soak) • Control Configuration: 0.5°C/ Min or lesser to 5 °C/Min or greater (Heating & cooling) <ul style="list-style-type: none"> ▪ Process value <ol style="list-style-type: none"> i. Set Value ii. Status indication iii. Mode indication iv. Pressure Indication in the tube (if possible) • Accuracy: +/- 5°C at 600°C -1550°C • Temperature protector: Solid state with audio signal/manual state. • All the display and control should be in the CONTROL PANEL mandatorily having auto and manual control features. <p>Necessary software must be provided for operating the furnace through computer.</p> <ul style="list-style-type: none"> • Scan time/Logging time: Programmable <ol style="list-style-type: none"> i. Facility to view the real time line graph of the process values (12-24 hrs duration) ii. Data base must be created in the back ground which can be seen in tabular form with real time and date for process cycle reporting. iii. The records can be searched by date and time or by the user selectable field.

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		<p>iv. The program of ramp & soak, tuning and start & stop must be done by software through branded computer (computer to be provided with the system).</p> <p>v. In process programme/cycle editing facility.</p> <p>There must be an additional provision for controlling the furnace manually in case of emergency.</p>
16.	Safety devices & interlocks	All the required safety devices and interlocks to be provided for trouble free and smooth operation and to prevent accidental failures to furnace and operator.
17.	Warranty :	Comprehensive onsite warranty for 1 year (at least) including heating element.
18.	Documentation & Training :	Operation & maintenance manual of the furnace in English Language must be provided in CD or hard copy, 3-days training must be provided on operation & maintenance of the furnace at CSIR-CMERI after commissioning.
19.	Thyristor	Full automatic (make : Eurotherm/ AEG/Yudian etc.)
20.	Control Cables	Standard copper conductor, PVC insulated, extruded PVC inner sheathed, steel wire armored, FRLS PVC outer sheathed as per IS: 1554 (part-I) Make :Finolex, Mescab etc..
21.	Fuses ,contactors etc.	Power contactor, MCB, Fuse etc. should be make of L&T , Siemens or equivalent reputed brand.
22.	General Terms	<ol style="list-style-type: none"> 1. For authorized vendor an authorization letter from OEM to be submitted. 2. General Layout Drawings with hot zone, Vacuum pumping ,electrical & electronics control scheme to be approved before manufacturing. 3. Vendors submit list of spares required items for 3 years running. This may be not applicable for L1 Criteria. 4. A product manual is to be supplied with working principle and schematic drawing is to be supplied along with the Technical Bid.
23.	Inspection & acceptance Test	<ul style="list-style-type: none"> • Pre-dispatch inspection will be carried out at Vendor's site by CSIR- CMERI personnel as per below mentioned sintering cycle. <p>Sintering cycle :</p> <p>Heating @ 1.5°C /min. 300 °C soaking for 30 min. at .01mbar & Ar-5% Hydrogen mixture.(to inspect the temperature profile, vaccum level, pressure level))</p> <p>Heating @ 1.5°C /min. 550 °C soaking for 120 min. .(to inspect the temperature profile, vaccum level, pressure level)</p> <p>Heating @ 1.5°C /min. 800°C soaking for 90 min. (to inspect the temperature profile, vaccum level, pressure level)</p> <p>Cooling @ 5°C /min. 350°C soaking for 30 min. (to inspect the temperature profile, vaccum level, pressure level.)</p> <p>Cooling @ 3°C /min. 100°C soaking for 30 min. (to inspect the temperature profile, vaccum level, pressure level)</p> <p>Material of sintering MIM green & brown compact specimen of steel/nickel/WC-Co etc. will be . At least 3 such cycles must be demonstrated to ensure repeatability in terms of set temperature, pressure, and vaccum. The cost of running the furnace during pre-dispatch trial/inspection must be included in the offer.</p> <p>Final Acceptance Test to be carried out with trial run of sample, in different programmes for 3 cycles with highest operating temperature, highest vaccum and highest pressure to inspect and test the machine performance before releasing the Test certificate. at CSIR CMERI, Durgapur</p>