



**INDIAN INSTITUTE OF TECHNOLOGY BOMBAY**  
**MATERIALS MANAGEMENT DIVISION**  
**Powai, Mumbai - 400076**

**Purchase Requisition No. 1000013327 (SRM / RFX No. 6100000260)**

**Specifications for Vacuum Induction Melting Furnace**

Furnace type : Vacuum Induction Melting along with Arc Melting Furnace

For Induction Melting Furnace –

The furnace should be designed for melting of high grade steel alloys or super alloys or alloys with elements Fe, Ti, Co, Ni, Mn, V, La, Mm, Cr etc. The furnace should be for melting of alloys of melting point upto 2100<sup>0</sup>C, i.e. maximum temperature should be able to attain 2500<sup>0</sup>C. The melting capacity of the furnace should be melting of maximum of 10 kg and minimum of 5 kg of the above mentioned materials.

1. Furnace Chamber -Double walled water cooled vacuum furnace chamber with a SS 304L steel interior and carbon steel water jacket and flanges. Baffles are fabricated inside the water jacket to ensure optimum water flow. The vertical furnace with with an opening hinged door and of same construction as that of the melt chamber and clamped to melt chamber with a clamp. There should be two sight glass ports/assemblies to view all functions carried out during melting and casting. Design of furnace chamber should be done such that it should allow addition of reactive additives at later point of time after some of the elements have melted and also support the keeping of mould inside the chamber for pouring. The melting chamber should have the following 9 ports :

2nos of 100 mm diameter sight glass ports

1 No Inert gas connection port

1No Admittance valve (Air) connecting port

1No Coax power feed through port

1No 250 vacuum pumping port

1No Bridge breaker Port

1No Optical Pyrometer Port

1No Over melting charge Port

Detail drawing should be submitted along with the offer

2. Mould Platform- For mounting the mould a stainless steel mould platform and a suitable copper Mould should be provided inside the furnace chamber. Copper mould should be water cooled and so designed to be able to hold 15 kg melt. The casted material can be taken out through the front door. Motorized to-and-fro movement for mould plate along with copper mould should be provided. Copper mould should be

water cooled, so appropriate provision for the water cooling should be there in the mould and corresponding inlet and outlet should be provided in the vacuum chamber with suitable flexible piping. Include a mould heater to maintain the melt at a certain temperature after pouring.

3. Power Supply – Power to the induction coil should be supplied with a solid state power supply rated at 30kW, 9600Hz with a power factor better than 0.95.
4. Induction melting coil- Interchangeable induction melting coils should be fitted to a common co-axial feed through and manual tilting lever. A set of flexible power leads to connect up to the 30kW power supply. The melting coil units should be supported from their base by a bracket attached to the vacuum tube surrounding the coaxial feed through. The furnace should be supplied with the following coils :
  - a) one 10kg capacity melting coil

The melting coil and tilting assembly should be designed for manual rotational pour of the molten metal. Motor and gear based tilting mechanism

5. Vacuum Pumping system - Evacuation of the furnace chamber and auxiliary equipment chamber should be achieved by the following pumping equipment:
  - a) Roughening pumps of appropriate capacity, justify so that the pumping capacity to be in synchronization with the pumping volume.
  - b) Diffusion Pump 4650 ltr/sec
  - c) LN2 Trap with chevron baffle
  - d) Vacuum Gauges  $1 \times 10^{-7}$
  - e) Electro air operated vacuum valves
  - f) Flexible bellows
  - g) Set of interconnecting pipework with KF fittings and vacuum seals

Ultimate vacuum :  $10^{-6}$  m bar under clean, dry and empty conditions.

Partial pressure : inert gas back fill controllable to 1000mbar max.

6. Instrument Controls - The control panel should be rated to IP54 standard and should house the following controls and instrumentation:

- One - Siemens S7 PLC control system
- One - Set of relays, motor starters and circuit breakers
- One - Set of push button controls and indicator lamps
- One - Mains isolating switch.

A Siemens touch screen HMI should be provided with the following screens:

- Status Screen - Displays the logical status of the furnace.
- Melt Screen - Displays the manual melt control / time based melting profile.
- Leak Check and Vacuum Screen - Displays the vacuum values and leak rate test values.
- Alarm Screen - Displays the current alarms.

7. Material addition chute –

Material addition chute which could facilitate addition of material in specific quantity and sequence in the melt at any time. It is particularly advantageous to add a particular material to correct the composition of the melt or add reactive elements. This could be through a feed through mechanism with load lock valve and should be coupled with the main pump mentioned in point number 5 above.

8. Temperature Measurement –

The temperature of the furnace should be measured by non contact measurement method.

The temperature measurement should be through an infrared pyrometer which should be used through PID and coupled to the induction power supply and thereby measurement and control of temperature is carried out. The temperature is displayed on the control panel. Specifications of optical pyrometer :

Temperature range	: 1200 <sup>0</sup> C to 2500 <sup>0</sup> C .
Detector	: Si/Si layered detector , nominal 1 um
Accuracy	: +/- (0.5% T <sub>meas</sub> + 2 <sup>0</sup> C), T <sub>meas</sub> in degree C
Repeatability	: +/- 0.3% full scale.
Temperature resolution	: 1 <sup>0</sup> C
Response time	: 10 m Sec
Emissivity one – colour	: 0.10 to 1.0 in 0.01 increments.
Slope two- color	: 0.85 to 1.150 in 0.001 increments
Signal processing	: Peak hold and averaging.

9. Safety Devices:

A number of safety devices should be incorporated in the design of the plant to ensure conformity with statutory regulations and to afford protection of both the plant and the operators. These devices include:

- a) Water flow switches to protect the furnace against water failures or water starvation.
- b) Relays and interlocks to ensure the correct sequencing of the vacuum valves and protect the system against malfunction of the plant.
- c) Over load protection
- d) The furnace controls, switches and push buttons operate from a 24 Volt DC supply from a step down transformer inside the vacuum control cubicle.

10. All the lines should be supplied. These includes:

- a) Air Lines - Inter connecting air lines between the vacuum valves and electro-air control valves

- b) Water lines – Interconnecting water lines with valves, shut-off valves and water flow switches for connection to the customer’s supply and return manifolds.
11. Air compressor should be included in the cost while submitting commercial bid. Any other requirement for the installation or running of the complete system, should be quoted in the commercial bid.
  12. In technical bid, all the details regarding dimensions need to be mentioned. The chamber dimensions, volume, other accessories, power supply all dimensions should be included and justified for why that much size required and whether could be further reduced, all that need to be included in the technical bid.
  13. The bidder should mention in technical details, whether there will be any noise from the system, if yes, how many decibels and will there be any shielding required to reduce the noise levels during operation of pumps etc.
  14. Mention in the technical specifications how much will be the stray field, electro magnetic field leakage. This is essential as there could be sophisticated instruments in the vicinity of the furnace.
  15. The bidder shall have a well-trained service network available in India to cater the service requirements of the Induction furnace. The details of the same shall be submitted along with the technical bid. The bidder should have supplied at least 5 or more such melting systems in India and are required to produce certificate of reference along with contact details to whom they have supplied along with the technical bid. The bidder should be able to extend technical service support for quoted furnace. They should be able to supply spare parts, consumables, software and hardware upgrades.