

## Tube furnace specifications

**Equipment justification:** The proposed furnace will be used for annealing different metallic and ceramic materials. Since annealing is to be carried out under different atmospheric conditions, a tube furnace with vacuum flanges is required. The temperature requirement is material dependent and hence a maximum temperature of 1600 °C is proposed, taking into account the different systems to be studied.

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### Compliance requirements:

S. No	Specification	Complies (please tick)	
		Yes	No
1	Maximum temperature of 1600 °C and continuous operating temperature of 1500 °C		
2	Heating element is made of MoSi <sub>2</sub>		
3	Hot zone length of 250 mm or longer.		
4	Temperature uniformity within hot zone is less than 5 °C		
5	Tube ID is equal to or greater than 50 mm		
6	PID based temperature control with at least 15 programmable steps included		
7	Temperature overprotection is included		

### Full technical requirements:

Along with the basic compliance requirements, the full specifications are given below:

1. Maximum temperature of 1600 °C, with a continuous operating temperature of at least 1500 °C.
2. A heating element made of MoSi<sub>2</sub> and a tube made of alumina with at least 99.7 % pure alumina. In case of any other materials, they should be clearly specified and their applicability for high temperatures should be justified.
3. A hot zone length of 250 mm or larger. The hot zone length should be specified clearly and cannot be equal to the tube length. The temperature uniformity within the hot zone should be specified and cannot exceed 5 °C.
4. The minimum tube length should be 1000 mm. The tube OD should be at least 60 mm and ID should be at least 50 mm. For any other dimensions, these values should be specified clearly and should meet the minimum requirements specified here.

5. Variable heating rate, from 0-10 °C/min. The maximum heating rate should be specified.
6. A PID and thyristor based power supply with a programmable temperature controller. There should be at least 15 ramp/soak steps programmable. The number of steps and number of programs/recipes, which can be stored need to be specified.
7. The thermocouple make should be included in the quote. Its accuracy should be specified and at the time of delivery, a calibration sheet for the thermocouple should be provided.
8. The working voltage, frequency, and maximum power should be specified.
9. Safety features should be specified. Presence of over temperature protector is desirable.
10. SS high vacuum flanges and vitono-rings should be provided with the furnace unit, for using with inert and reducing environments. Any flange cooling unit required should be specified and adequate provisions should be made for inlet/outlet.
11. A list of institutions (government labs, universities, private R&D units) where this or similar unit has been supplied should be included in the quotation. This is for our information only.