

Specifications for Carburization Furnace

1. The furnace must be able to attain a temperature of 1,000 degrees Celsius and maintain that temperature for at least 7 days of continuous operation.
2. The furnace tube material and all components exposed to process gases must withstand chemical degradation from direct exposure to the gases listed in 7. below.
3. The furnace must be a three zone furnace with temperature control in each portion of the working zone within 1 degree Celsius of the process setpoints.
4. A gas control system must be provided to balance the flow of six (6) control gases, with mass flow controllers calibrated in the appropriate gases (listed below). Flow controllers must be interfaced with a programmable control system for ramping and control of the gas flows. The mass flow controllers should be provided with an electrical interface for control directly from the microprocessor. High and low flow limit alarms should be programmable to abort the process if proper flows are not present.
5. Gas flow controllers (and programmable flow rates) should include:
 - Argon 0- 10 SLPM
 - Nitrogen 0- 10 SLPM
 - Hydrogen 0-1 SLPM
 - Methane 0-1 SLPM
 - Hydrogen Chloride 0-1 SLPM
 - Carbon Monoxide 0-1 SLPM
6. The furnace must be engineered to avoid inhomogeneity of mixed gases in the process zone, and to avoid streaming of cold gases into the process zone.
7. The furnace must be configured such that quenching into a liquid bath (oil or water) can be done quickly from the treatment chamber, and the furnace must have a quenching bath into samples may be placed for room-temperature quenching. Based on this quenching requirement, it is anticipated that a vertical-tube furnace may be required.
8. The furnace must have microprocessor control of processing parameters interfaced to a personal computer (PC), able to monitor all control parameters (including individual gas flow rates) and graphically display process history during the operating cycle. The furnace control system must be capable of

independent, graduated control of all process parameters containing at least 20 process steps, and store in excess of 100 process recipes.

9. The furnace must have safety systems that ensure gas flow and other systems are shut down in case of a power failure

10. On site installation and training are required.

11. A residual gas analyzer is required, sensitive to 200 atomic mass units (AMU) level of detection of either exhaust or inlet gases.

12. OPTION 1 - An exhaust condition system that ensures effluent gases are safe to exhaust, including a scrubber for acid removal and a pyrolyzing furnace for oxidizing and thermally decomposing reactive effluent gases. The exhaust gas conditioning system must operate in such a way that it can signal "Ready to Operate" to the furnace control system.

13. OPTION 2 – Sample Receptacle(s)/Basket(s) capable of holding batch samples with collective diameter of 5 inches and a length of at least 7 inches. The receptacle(s)/basket(s) must have a mesh size that would allow samples as small as 1 cm in diameter and 1 mm in thickness to be treated.