

## Pack Carburizing

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### Furnaces for Pack Carburizing

The suitability of a furnace for pack carburizing depends on its ability, at reasonable cost, to provide adequate thermal capacity and temperature uniformity (furnaces must be controllable to within  $\pm 5$  °C, or  $\pm 9$  °F, and must be capable of uniform through heating to within  $\pm 8$  to  $\pm 14$  °C, or  $\pm 14$  to  $\pm 25$  °F) and provide adequate support for containers and workpieces at the required temperatures.

Modern heating systems and furnace construction provide ample heating capacity and temperature uniformity over a wide range of temperatures. A variation of  $\pm 8$  °C ( $\pm 14$  °F) throughout the entire working section of a large furnace can be easily maintained. Many furnaces incorporate automatic compensation for heat losses at doors or other connection points. Combustion systems that maintain constant pressure or constant flow permit close temperature control on variable loads. Zoning is also a major contributor to control. To maintain good uniformity, it is necessary to load the furnace as uniformly as possible and to allow adequate space between containers—50 to 100 mm (2 to 4 in.) or more—to permit circulation of the heating gases.

The three types of furnaces most commonly used for pack carburizing are the box, car-bottom, and pit types. Box furnaces are loaded by mechanical devices or by in-plant transportation equipment. Car-bottom furnaces provide for convenient loading of heavy units. A car-bottom furnace with a car at each end allows a second car to be loaded while the furnace is in use, which minimizes the heat loss and downtime between batches. Pit furnaces are general-purpose furnaces that may be used for carburizing and other heat treating operations that require minimum floor space.

Adequate support of containers and workpieces does much to minimize distortion. It also helps maintain the shape and extend the life of carburizing containers. Three or more points of support should be used in car-bottom furnaces. The container should be blocked above the hearth to allow circulation around, and proper shimming of, the container. In box-type furnaces, silicon carbide and certain other hearth materials provide excellent wear resistance to maintain the shape of the hearth. Their high thermal conductivity helps promote temperature uniformity.

Furnaces for pack carburizing have a minimum number of parts that are subject to high wear or that require frequent maintenance. Very few alloy parts inside the furnace are subjected to thermal fatigue, and a minimum of auxiliary equipment is needed. ~~The personnel who operate these furnaces do not need extensive technical training.~~

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