Fast Guide to Furnaces

Carbolite offer you more than 150 standard furnaces to choose from, plus a custom design capability. We could make you a furnace as small as a cigarette packet, or as big as a bus, and with operating temperatures as high as 2000°C.

How should you select the right furnace from such a wide range?

Take 10 minutes to read this guide, then ask yourself these five questions:-

1 How hot?
2 Tube furnace or chamber furnace?
3 What heating elements?
4 How big?
5 What controls and options?

When you have the answers, choosing a furnace will be a logical process.

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1. How Hot?

What maximum temperature do you need now? And what will you need in the future?

An Oven? or a Furnace?

We say that an oven has a maximum temperature of 600°C or less, and transfers heat into the work mostly by convection.

Simple ovens have heaters mounted near the bottom of the chamber to warm the cold air that naturally sinks to the bottom due to convection.

A fan is fitted in more sophisticated ovens. This thoroughly mixes the air and evens out the temperature. It also speeds up heat transfer to the work placed in the oven. (Fans are now fitted to domestic ovens for the same reasons).

Furnaces have higher maximum temperatures (above 600°C) and are designed to transfer heat into the work mostly by radiant heating.

Furnaces <u>can</u> work at temperatures below 600°C, but air convection currents can make the temperature uniformity worse.

Also, at low temperatures heat from the elements is slow to reach the temperature sensor and this can cause the furnace to overshoot a low "set temperature". Certain controllers allow you to limit the furnace power to prevent overshoot on initial warm-up.

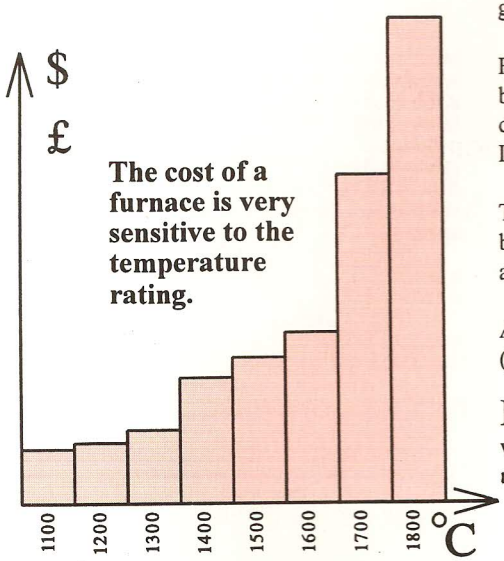
This guide is about <u>furnaces</u>.
See separate literature for details of ovens.

Not too cold!

The life of a heating element is shortened considerably when it is used close to its maximum temperature. So you should choose a furnace with a maximum temperature about 100 degrees higher than you will regularly use.

Not too hot!

If you specify a maximum temperature that is much higher than you need, the furnace will be unnecessarily expensive. The cost of manufacturing a furnace increases in steps at certain temperatures because of the need to use higher quality materials as shown below:-



Thermocouples

Low cost thermocouple materials can be used up to 1100°C (type K, NiCr/NiAl) or 1200°C (type N, nicrosil/nisil).
Above this temperature these materials have only a short life so more expensive platinum/rhodium (Pt/Rh) thermocouples must be used eg types R, B, 20/40.

Heating Elements

FeCrAl resistance wire can be used up to 1300°C. Above this temperature more expensive silicon carbide (SiC) elements are used. And from 1500°C to 1600°C a higher grade of silicon carbide is required.

From 1600°C to 1800°C we move to a choice between Kanthal Super (molybdenum disilicide $MoSi_2$), Pyrox (lanthanum chromite $LaCrO_3$), or platinum wire Pt.

The cost of using $MoSi_2$ elements is increased by their need for low voltage transformers and a current limiting control system.

Above 1800°C graphite (C), molybdenum (Mo) or zirconia (ZrO_2) elements are used.

Insulation costs also increase steeply with temperature. 1700°C insulation costs nearly 20 times more than 900°C insulation.