How to Buy the Right Muffle Furnace

Muffle furnaces, or muffle ovens, are crucial for high-temperature heating such as ashing, soldering and brazing, glass fusing, heat treating, and environmental testing.

Using energy-efficient and front-loading box-type models that do not consume too much laboratory space, the modern muffle furnace varieties can let you perform heat treatment at temperatures over 1000°C.

While muffle furnaces have been around since the 20th century, modern varieties can now achieve control standards in temperature uniformity and isolate heated samples from combustion material or contaminants. This, in turn, ensures accuracy and efficacy in research operations.

Additionally, muffle furnaces now include automation features such as programmable digital controllers or microprocessor-controlled thermoregulators. These features are perfect for intricate metallurgical and chemical applications, as well as for soaking, ramping, sintering, debinding, and end-to-end processes that involve metal injection molding.

Electrical furnaces, on the other hand, use heating elements such as iron-chrome alloys with insulated material to serve as a muffle, which prevents heat from exiting the chamber. With energy produced through either blackbody radiation, convection, or conduction processes, these eliminate combustion byproducts commonly seen in non-electric muffle furnaces, making these highly valuable for laboratory use and research.

Factors to consider when buying a muffle furnace

When choosing a muffle furnace, it is crucial to consider the design specifications and requirements for your preferred production or application including the crucible size, chamber size, and input voltage. On the other hand, you also have the option of a custom-built lab furnace for unique productions and applications.

Below are the noteworthy variables that you need to know in choosing the right muffle furnace.

1. Your application

When choosing a muffle lab furnace, you have to consider your intended application first. While numerous furnace models can serve multiple lab operations, some processes and industries will require specific retort-based designs to successfully execute operations, especially for research that requires a wide temperature range. With an extremely heat-resistant internal ceramic and alumina fiber design, high-temperature furnaces are versatile and highly suitable for use in applications including:

- material research
- ceramics
- alloying
- fusion
- heat treatment
- metallurgy

- mining
- brazing
- reducing
- environmental testing
- glass formation
- nuclear fuel disposal

- ashing samples
- pharmaceutical development

Considering your intended application will be a good head start in selecting the right muffle furnace.

2. Working temperature

Aside from the application, it is also crucial to consider the operating temperature range of the muffle furnace, as well as the rise time, which is the time it takes for the furnace to reach maximum operating temperature.

The maximum operating temperature will depend on the installed heating element. For example, lab furnaces that use iron-chrome wires such as [Yamato FO Series 11.3 to 30L Programmable Muffle Furnaces](#) have a maximum operating temperature of 1150 °C with an R-thermocouple sensor —a better choice over S-type thermocouple sensors.   R-thermocouples are used in very high temperature applications and sometimes in lower temperature applications because of its high accuracy and stability.

Take note that the ideal furnaces should maintain maximum temperatures for about an hour with continuous working temperatures at safe levels. Moreover, it's also highly recommended that you choose a muffle furnace with a maximum temperature a little above your usual operating temperature. This ensures flexible operation and prolonged equipment life.

3. Samples

As mentioned previously, certain applications require specific design requirements. Lab muffle furnaces are widely used in various industries such as agricultural labs, steel and paint manufacturers, biotech companies, physics laboratories, pharmaceutics, and small industries, to name a few. Therefore, a variety of samples are employed in research and experiments.

For instance, tests on giant molecule compounds such as rubber and plastics (polymers) require the combustion of samples at a temperature range of around 900 °C to 1400 °C to determine the percentage of ash from combustible material. When you go above or below this specific requirement, the furnace will either disintegrate the sample fully or risk contamination, which, in both ways, can gravely affect the reliability of research.

With this in mind, it is only right that you also think about the subject material or samples you are about to work with when selecting a muffle furnace.

4. Crucible size

You should be specific about the sample dimensions to determine the appropriate crucible size. The type of crucible material will also depend on the furnace's max temperature. For example, a Zirconia crucible goes best with a max temperature of equal to or more than 2100 °C.

5. Input voltage

The input voltage is another important variable in choosing the right muffle furnace. The available options for power sources range from 110 VAC to 220 VAC, depending on the furnace type. However, in the US, the standard input voltage is different from the rest of the world with 120V and 60Hz AC electricity. That is why some lab furnaces with power supplies beyond the standard have round terminals instead of plugs.

So, make sure to look for the power source requirements on the label before settling on a product to know whether your lab can accommodate the energy demands. Yamato's FO Series Standard Muffle Furnace and FP Series High Performance Muffle Furnace offer options for 115V and 220V. Either voltage will provide the same results.

6. Chamber size

Take note that to determine your required chamber size, it is important to remember that the constant temperature zones are smaller compared with the chamber size. Hence, select a muffle furnace that has a constant temperature zone larger than your subject material to achieve uniform heating. Yamato offers chamber size ranging from 1.5L to 30L. It is also noteworthy to mention that the FP Series Muffle Furnace is designed with a heater not exposed to the inner chamber, preventing contamination of samples.

7. Material

Since the heating zone is a crucial aspect in selecting a muffle furnace, you should also opt for designs with heating chambers insulated with high-density ceramic or alumina fiber material such as those used in FO Series and FP Series, respectively.

Ceramic is an upgraded version of the traditional brick muffle furnace. That means a ceramic muffle furnace is fire-resistant but more time-saving, lightweight, and energy-saving. The Ceramic's fiber blanket is also essential, as it maintains the outer surface of the oven at safe temperature levels. The external material is as important as the internal blanket as well. Alumina fiber, on the other hand, shows good electrical insulation at high temperatures, low thermal conductivity, good wear resistance and super light weight. Alumina fiber can be used up to 1700 °C. So, you have to make sure that your muffle furnace unit is made of durable materials.

8. Safety features

Choose lab furnaces with safety features to reduce risks for accidents and injuries at work, as well as prevent moisture-reuptake during thermal treatment processes. Look for models with self-diagnostic functions, auto-recovery features especially after a power failure, calibration off-set, key lock function, automatic and independent overheat prevention device; and earth leakage breaker.

Likewise, self-diagnostic functions will ensure mechanical stability and include sensor error, memory error, SSR short circuit, triac short circuit, heater disconnection, automatic overheat prevention, and main relay failure disconnection. However, both safety and self-diagnostic functions may vary per model.

9. Customization

Lastly, you may consider customizing to meet your required specifications. Depending on the make and the model, you may choose to add items such as:

- exhaust system — highly needed for thermal processes
- N2 gas loading device with built-in flow meter
- Time-up or alarm output terminal
- external communication adapter
- external communication terminal (RS232C)

- temperature output terminal
- operation signal output terminal
- event output terminal
- furnace floor plate
- sample tray

Custom muffle furnaces have a high success rate in product development or testing process output. So, you may want to add accessories to ensure the best quality in your chosen lab muffle furnace.

Buy the right muffle furnace today.

With many muffle furnaces available on the market, buying a new one may be daunting. However, with careful planning, research, and information from this guide, you can choose the best muffle furnace.

With 130 years of quality service to its name, Yamato Scientific America has proven to be at the forefront of providing state-of-the-art products to the research and scientific innovation community. We guarantee that all equipment is manufactured under strict compliance with industry quality standards, as well as international regulatory requirements.

Interested in getting a muffle furnace from us? Visit our website at https://yamato-usa.com. You may also call us at 1-800-292-6286 or let's talk at customerservice@yamato-usa.com. We will be more than happy to assist you.