



Manufacturers of High Temperature & High Vacuum Equipment

370-G Industrial Road | San Carlos, CA 94070  
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## **Equipment Description**

### **CAMCo (150mm) 6" Diameter by (250mm) 10" Deep**

### **High Vacuum Furnace with dual vacuum chamber**

### **HIGH VACUUM TURBO-PUMPED FURNACE**

For Automatic Programmed Operation to 1250° C

### **Model G-VAC 12 Auto Loading Vacuum Furnace**



## **Overview**

The CAMCo Furnace "G-VAC 12" auto-loading vacuum furnace is designed to reproducibly vacuum braze, degas and otherwise process loads of up to (150mm) 6 inches in diameter by (250mm) 10 inches deep. The auto-loading mechanism and furnace controls are performed by our latest state of the art computer controls, using Entivity Think-N-Do software. Temperature is controlled to 1250° C at pressures to the 10<sup>-6</sup> Torr range via a 250 L/s turbo molecular pump. The furnace and vacuum controls, pump system and interlocks, are integrated in a fully automated unit to assure simple reliable operation.

## **Operation**

Product is loaded into 5 separate high temperature loading baskets and onto a carousel in the loading chamber. The (300mm) 12 inch x (180mm) 7 inch door is closed and latched, and the operator selects a recipe through the computer software.

The loading chamber is brought to a roughing vacuum pressure equal to that of the process heating chamber and the cover /top shield stack assembly is raised to expose a loading hook. A second arm is used to pick one of the loading baskets from the carousel and place it onto the loading hook.

The basket and chamber cover are lowered into the furnace chamber. The high vacuum gate valve is opened exposing the furnace chamber to the Turbo Pump and high vacuum capable of low E10-6 torr, and the heating cycle is started. The heat is controlled automatically through the pre programmed settings set in the recipe.

When the heating cycle is finished the gate valve will close and the furnace chamber is brought to the same roughing pressure as the loading chamber. The furnace chamber can be opened to the loading chamber at 400 deg C. The cover is then raised to allow the loading arm to remove the processed basket onto the carousel. The carousel indexes one position and another basket is loaded onto the loading hook to be lowered into the chamber. This process is repeated until all baskets have been heat treated.

The furnace chamber is lowered and sealed off, and the loading chamber is vented with Nitrogen up to atmosphere, allowing the operator access. This process is then repeated.

## **Base Unit**

The base unit measures approximately (160cm) 63 inches wide by (75cm) 29 inches deep (to fit through a standard door opening) by (180cm) 70 inches high. It's substantial frame is constructed of heavy wall square steel tubing. Service access is readily gained through a hinged steel front door and removeable front, side and rear panels.

The plate steel floor within the left third of the base unit supports the heavy transformer and closes the bottom. This left section, containing the power components and electronics is, for safety purposes, isolated from the right two thirds by an internal airflow-directing baffle. A fan at the rear of the base unit draws cooling air through a replaceable filter element to cool the power control unit and transformer.

The floor within the right third of the base unit supports the mechanical pump. In addition, the base frame supports and houses the instrument console, chamber, high vacuum plumbing and cover hinge and latch assemblies.

A convenient feature is the inclusion of recessed heavy-duty casters. The unit is easily rolled into place, and the leveling feet lowered to immobilize and level the equipment. The stainless steel top provides an area for convenient load preparation, and completes closure of the base unit. The finish used on this, and all CAMCo equipment is baked, environmentally friendly powder coating, chosen for its' durability. A cable hoist is included to lift the heavy loading chamber off the frame to allow access to the heat shield and elements.

## **Furnace Vacuum Chamber Assembly**

The double wall, water-cooled stainless steel furnace vacuum chamber, a water-cooled copper pumping port baffle within the chamber, the gate valve, and the turbo-pump are assembled as a module. This is bolted at the chamber flange that supports the chamber assembly within the center of the frame. The chamber cylindrical wall is penetrated by the element power feed-thru ports, furnace thermocouple fittings, and the vacuum system neck. This neck includes fittings for the ion and convectron gauges, and gas letdown port and roughing valve.

## **Heat Shield and Element Assembly**

The furnace shields and elements are located within the water-cooled furnace chamber. It is very conservatively rated for continuous 1300<sup>o</sup> C operation. The low voltage, serpentine Molybdenum rod heating element is of two semi-cylindrical sections supported by high alumina insulators. It surrounds the top, sides and bottom of the work area. Work is placed in a refractory metal basket that in turn is hung from a hook just below the top shield stack. This basket is in turn surrounded by the elements and a series of cylindrical heat shields and bottom shield stack.

## **Heating Power Supply**

Power is proportionally delivered to a conservatively rated 10 KVA transformer. This is driven by a phase angled fired SCR controller which is in turn controlled via the computer software. A current limiting feature is included, which provides long element life. This is the same furnace we have manufactured for the last 20 years. Shields and elements are standard parts.

## System and Temperature Control

Temperature control and monitoring functions are achieved using standard computer and I/O module, incorporating Entivity Think-and-Do control software. The computer operates solenoid valves for control of vacuum and venting valves. All inputs, digital and analog, are monitored thru the I/O module and transferred to the computer and updated 20 times per second. A large screen is supplied along with a standard keyboard and mouse pad, for operator interface. All thermocouple and vacuum readings, along with valve status, is incorporated on an easy to read screen.

We will customize this software for customer individual language. For this project we will substitute English language for Russian language for all human interface with the machine. The software will have both Russian and English languages available.

Multi-stage programmed control is achieved through use of this computer controlled automated system which receives its' input signal from the thermocouples and remote vacuum gauges. Automatic time/temperature ramp and soak programmed control of up to 100 different, 15 segment programs may be stored. The operator is required only to insert the load, specify a program by number and press the start button to operate the furnace.

Load temperature is monitored by the computer and a separate process controller, which provides digital readout of the load area temperature and provides an over-temperature shutdown. The computer and overtemp monitor receive their signal via a second thermocouple located within close proximity to the load.

Control and overtemp thermocouple are Type "C" for long lasting and high accuracy temperature measurement. This noble thermocouple is rated for high temperature and maintains its calibration for several years.

## Safety Features

- Thermocouple break protection (Thermocouple burn-up) assures that heating power is removed from the furnace in the event of sensor failure.
- Over-temperature indication is read on a separate control module from the monitor thermocouple. This overtemp alarm causes the heating elements to shut down as a further back-up.

Other numerous interlock functions protecting the operator and equipment include:

- Panel Interlock
- High Cabinet Temperature
- Low Coolant Flow
- Low Gas Pressure Switches
- Vacuum Ramp Delay
- Heaters are interlocked with the vacuum gauge control so that heating will not occur if there is insufficient vacuum.
- Thermal overload protection for the Turbo Molecular Pump
- High Vacuum isolation valve to protect the Turbo Pump during vent and accessing the loading chamber.

# Specification Sheet



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Equipment Model: G-VAC-1200-Custom Vacuum Furnace  
Double chamber with auto loading feature

<b>Type</b>	Coldwall, Vertical, Top Loading/High Vacuum
<b>Maximum Temperature</b>	1250 Degrees C.
<b>Hot Zone</b>	6.5" (165mm) Dia. x 10" (250mm) Deep. Nominal
<b>Frame Dimensions</b>	72" (183 cm) W. x 28" (72 cm) D. x 60" (150 cm) H.
<b>Power Requirements</b>	240V 1 Ph. 60A 50 Hz. 12KW
<b>Controls</b>	Computer controls, Entivity think and Do software with English and Russian text.
<b>Gas Requirements</b>	25 – 50 psig, Nitrogen (1/4" swagelok) 2-3- bar
<b>Compressed Air</b>	80 – 100 psi (1/4" swagelok) 6 bar
<b>Thermocouple</b>	Type "K" Chromel / Alumel
<b>Weight of equipment</b>	2200 lbs 1000KGs (not to exceed 1500kg)
<b>Upper chamber door size</b>	12" (300mm) diameter
<b>Data acquisition</b>	Computer think and do software
<b>Number of containers per run</b>	5 each
<b>Process container size</b>	5.7" (145mm) DIA x 6.2" (160mm) tall
<b>Max weight allowed in container</b>	2.5 kgs

Process Vacuum at temperature  $10^{-6}$  Torr range

Vacuum in  $10^{-7}$  Torr range at ambient

Upper chamber vacuum  $5.0^{-4}$  Torr range

Additional flange for customer pressure measurement (NW-25)

Multiple windows in upper chamber for viewing of product transfer and lighting

Multiple thermocouples in chamber for product temperature monitoring

**Cooling Requirements** - 25 psig at 3 gallons per min. Note maximum back pressure is 15 psig.

Heat up ramp rate 50 degrees C per minute - empty chamber.

Heating elements and heat shields are constructed of Molybdenum.

## Standard Features:

- 300 LPS Turbo Pump
- High Vacuum isolation valve
- Triscroll 300 dry pump X2 (rough and foreline pump)
- Equipment on casters to roll into place
- Computer controls
- Tower Indicating Lights - 3 color
- Watlow SD Overtemp Control
- 50 Programs - 15 segments per program
- Fully automatic - One button push starts the run. Automatically it will load a container, rough pump and cross over to high vac - ramp to temperature and soak - cool down - unload, reload and process up to 5 containers, vent to nitrogen.

This custom furnace is designed to meet the specifications attached to contract No 100511 dated May 11, 2010.

See attached proposed frame dimensions and chamber sizes. This equipment dimensions are subject to change as per engineering requirements.