



Manufacturers of High Temperature & High Vacuum Equipment

1017 Bransten Road | Phone (650) 593-1064  
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## Specification Sheet

Equipment Model: K-VAC-14

<b>Type</b>	Vertical Bell, High Vacuum (Turbo Pumped)
<b>Chamber</b>	Stainless Steel Coldwall
<b>Maximum Temperature</b>	1450° C.
<b>Hot Zone</b>	20" (500mm) Dia. x 30" (760 mm) H. Nominal
<b>Frame Dimensions</b>	76" (193 cm) W. x 36" (91 cm) D. x 110" (279 cm) H.
<b>Power Requirements</b>	480V 3 Ph. 120A 60 Hz, 240V 3 Ph. 220A 60 Hz
<b>Gas Requirements</b>	25 – 50 psig, regulated, clean dry Nitrogen
<b>Turbo</b>	ISO 250, 1000L/PS, (38,000 rpm) Ceramic Bearings
<b>Thermocouple</b>	Type "C" Tungsten-Rhenium
<b>Compressed Air</b>	80 PSI regulated Clean/Dry

Process vacuum at temperature 10<sup>-6</sup> torr.  
 Vacuum at ambient, 10<sup>-7</sup> torr.

**Cooling Requirements** - 40 psig, at 10 gallons per minute.  
 Note: Maximum backpressure is 15 psig.  
 70,000 BTU load for chiller calculation

Heat up ramp rate 75° C per minute - empty chamber.

All Molybdenum Hot Zone & Elements. All Insulators are made of High Alumina.  
 Element style - 1/8" Molybdenum Wire.

**Standard Features:**

- 1000 LP/S Turbomolecular Pump
- 600 L/min Mechanical "Roughing" Pump
- Easy to Operate Microprocessor Controllers
- 19 Programs - 20 Segments per Program
- Digital Chart Recorder
- Ethernet Connectivity and Webserver
- Independent Dual Heating Zones
- Active Braze Control
- **Fully Automatic** - One button push starts the run.

Automatically it will rough pump → cross over to high vac → ramp to temperature and soak → cooldown → let up to ATM → and show amber indicator light when run is finished.

**Options:**

- Dry Scroll Pump
- Survey Thermocouples (up to 6)
- Computer Controls
- Partial Pressure Operation
- Helium Quick Cool
- Combination Hydrogen/Inert Operation
- Residual Gas Analyzer (RGA)
- Tower Indicator Lights - 3 Color



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### **Equipment Description**

**CAMCO 20”(500mm) Dia. x 30”(760mm) H., 1400° C**

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

*For Automatic, Programmed Operation to 1400° C*

**Model KVAC-1400 [20x30]**



### **Overview**

The model K Furnace currently has the largest diameter hot zone at 1400° C available to our customers in the coldwall style chamber. Its hot zone is 20” diameter by 30” high. It has a bell type chamber assembly that is raised off the bottom chamber assembly to expose a 20” diameter hearth plate that is located at a convenient height to load and unload parts of up to 30” in height. It is dual zone controlled, using a modern Honeywell DCP302 microprocessor for programmed ramp and soak control of up to 19 programs of 19 segments each. It is designed to operate at temperatures up to 1400° C at 10<sup>-6</sup> Torr vacuum. The furnace is fully automatic requiring the operator only to load the parts, select the desired program for processes, lower the chamber and press start. The furnace will automatically rough the chamber - cross over to high vacuum - ramp & soak to the pre-programmed temperature - cool down at a controlled rate and vent to atmosphere with nitrogen.

### **Base Unit**

The base unit measures 76" (193cm) wide by 36" (91cm) deep by 110" (279cm) high. Its' substantial frame is constructed of heavy wall square steel tubing. With the chamber fully raised the hoist and chamber assembly is 120 (305cm) inches high. Service access is readily gained through a hinged steel door and the removable front, side and rear panels. The plate steel floor within the base unit supports the heating transformer and closes the bottom. Also contained within the base unit are the SCR units, power components, and other electronics. At the lower right are the atmosphere control module, gas plumbing and cooling water plumbing. The high vacuum turbo pump, roughing pump and manifold are also located within the right side of the cabinet. In addition, the base frame supports the instrument console and the water-cooled chamber bottom end at a convenient operator height for loading of product. 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. A handy 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 finish used on this, and all CAMCO equipment is baked powder coating, chosen for its' durability. The stainless steel top skin reduces the possibility of load contamination.

### **Hoist Assembly**

The chamber/furnace assembly is mounted to the arm of the motor driven hoist assembly by which it may be raised to provide access to the work area. The mounting allows the chamber to lift with respect to the hoist. The hoist itself is screw driven, and cannot inadvertently lower on the removal of power. Its speed is approximately eighteen inches per minute, a rate that is slow enough to minimize jarring, while not being inconvenient. Limit switches control the extremes of travel. Large bearing areas assure hoist rigidity and long life, and further assist in providing close registration of the chamber to the chamber bottom assembly upon closing.

## Temperature Control

2 heating zones are used to create temperature uniformity throughout the hot zone. Two cylindrical heating elements are individually controlled to provide excellent temperature control. Temperature monitoring functions to 1600° C. are achieved using type “C” Tungsten 5% vs. 26% Rhenium thermocouples. These thermocouples are in close proximity to the element to ensure long furnace life by controlling the element temperatures to safe values regardless of load thermal mass. Multi-stage programmed control is achieved through use of a Honeywell process controller which compares the setpoints with the inputs from thermocouples located in close proximity to the heating elements, sending appropriate drive signals to the SCR power controllers. Totally automatic time/temperature programmed control of up to nineteen different, 19 segment programs may be stored. Load temperature monitoring is provided by a second thermocouple located within close proximity to the load. It drives a Honeywell UDC2500 process monitor, which provides digital readout of the load area temperature and provides an over-temperature shutdown signal. This process monitor also provides a safe chamber access interlock and access signal for the operator. A thermocouple feed through at the bottom chamber and related holes in the shields allow survey thermocouples to be inserted to monitor actual temperature of load. These thermocouples can be used in conjunction with the “Active Closed Loop Braze Control”.

## Active Closed Loop Braze Control

The Furnace comes standard with one type “K” Inconel sheathed survey thermocouple that can be attached to the workload. This thermocouple drives a second channel on the program controller that can be integrated with the process control. These thermocouples are rated for use up to 1250° C (2250° F).

## Operation

The work is loaded onto the 20” diameter hearth plate and the chamber is lowered via the hoist switch. One of nineteen selectable, user programmed thermal profiles is chosen, and the “Start” key pressed. A one-button push will start the run and automatically it will rough the chamber, cross over to the high vacuum pump, ramp to temperature and soak, cool-down and vent with nitrogen. Upon completion of the cooldown portion of the program, the chamber is opened and unloaded.

## Chamber/Furnace assembly

The stainless steel water-jacketed chamber bottom end is mounted on the base unit. It is sealed in operation to the chamber by a flange containing a silicone “O” ring. The location of the seal is such that it is well cooled and optically baffled assuring long life. The chamber bottom includes work and survey thermocouple feedthroughs, gas admission and exhaust plumbing. It supports the Molybdenum hearth and bottom end stack of eight shields and bottom trim heater via the lower support structure. The furnace hot zone is located within the jacketed stainless steel chamber. It incorporates two Molybdenum heating element zones of five sections each supported by high alumina insulators. These surround the twenty inch diameter by thirty inch high work area. A series of six Molybdenum cylindrical heat shields supported by 12 Molybdenum shield supports provide the major heating for the furnace. The top and bottom shield stack of eight shields finish off the hot zone for superior temperature uniformity.

In addition, the chamber includes the insulated water-cooled power feedthroughs, control thermocouple, two sight ports, and required cylindrical heat shield support structure. Perforated stainless steel guards surround the heater power feedthroughs and provide electrical protection to the operator. The chamber assembly is supported by the hoist arm, and is located by pilot guides to assure accurate registration to the chamber bottom assembly when the furnace is lowered. Pneumatic clamping assures a positive seal to the bottom chamber assembly.

## Power Control

Power is proportionally controlled through use of a digitally controlled SCR three phase power modules. These unit are phase angle fired control, and includes three phase current limiting made necessary by the strongly positive resistivity coefficient of the heating element. In the event of a power outage at higher temperature, the load temperature would drop to a level where a hard application of heat might thermally shock damage the parts. In this event, an abort relay will trip, and the program will resume and time out under process atmosphere without the application of heat. Impedance match of the heating elements to the incoming power is accomplished through two conservatively rated 40 KVA transformers driven by this power module.

## Vacuum System

This automatically controlled, turbo pumped version of the type K Furnace is designed for clean, oil-free elevated temperature in a high vacuum atmosphere. From a cold start, the clean furnace will evacuate to the  $10^{-6}$  Torr range in approximately 30 minutes, and is capable of maintaining six-scale vacuum at temperature. When pumped for a longer period, lower pressures are easily attained. The vacuum plumbing is designed to provide convenient component access, and to provide maximum practical conductance to the chamber. Mass spectrometer leak checks are performed on all high vacuum assemblies. A water-cooled elbow is used to baffle the turbo-pump and vacuum gauging during heating to ensure long pump life. The high vacuum system is specifically designed to handle the large gas loads presented by vacuum furnaces. An ISO250 flanged, 1000 L/Sec. ceramic bearing turbo molecular pump, capable of  $10^{-9}$  scale ultimate vacuum, is used for the application. The turbo-pump is capable of very rapid 3 thru 7 scale pumping of air and water vapor typically encountered during the earlier out-gassing part of the firing cycle. For maximum pumping speed, it is close coupled to the chamber pumping neck through the high conductance high vacuum gate valve, as are the chamber vacuum gauges and inert gas let-up valve. Chamber roughing is accomplished through the turbo pump by a quiet, direct drive mechanical pump. At acceptable foreline pressure, the turbo-pump is automatically powered up. For ultra clean operations, a dry scroll or diaphragm pump can be substituted for the mechanical pump. The foreline includes a baked molecular sieve back-streaming trap and electro-pneumatic foreline valve.

## Vacuum Instrumentation and Control

A digital gauge control unit with process control module, supporting two Convectron (Pirani) gauges and one Bayard-Alpert Ion gauge is included to monitor system pressure. A self-cleaning degas feature helps keep the Ion gauge calibrated and the process consistent. The Bayard-Alpert Ion gauge tube, and the Convectron that measures chamber pressure are located on the ISO250 flanged chamber neck. The second Convectron is located to measure pressure at the roughing/backing line.

## Vacuum Ramp Delay

A circuit receiving a signal from an ion gauge related set-point can be used to toggle the program controller between run and hold. This circuit is designed to keep vacuum levels below a programmed vacuum setpoint during periods of high gas load (vacuum/heat ramp delay). This circuit can be programmed ON or OFF depending on user preference. Linearized, analog output provided by the gauge control is coupled to a recorder to record vacuum in logarithmic scaling.

## Optional Atmosphere Control

Our vacuum furnaces can be ordered with Combination Vacuum and Inert Reducing Atmosphere control. Through programming, either vacuum or atmosphere can be chosen to make this an ideal R & D or laboratory furnace. When this option is ordered, the furnace can run either Nitrogen or Argon as the purge gas. The process gas can be Hydrogen, Hydrogen/ Argon or Hydrogen/ Nitrogen. A Bubbler to humidify the process gas comes standard with this option. A burn-off column to ignite excess process gas is also standard. As with our standard atmosphere furnaces, this combination furnace has all the safety interlocks required with Hydrogen operation.

## 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 over-temp alarm causes the heating elements to shut down and latch.

Other numerous interlock functions protecting the operator and equipment include:

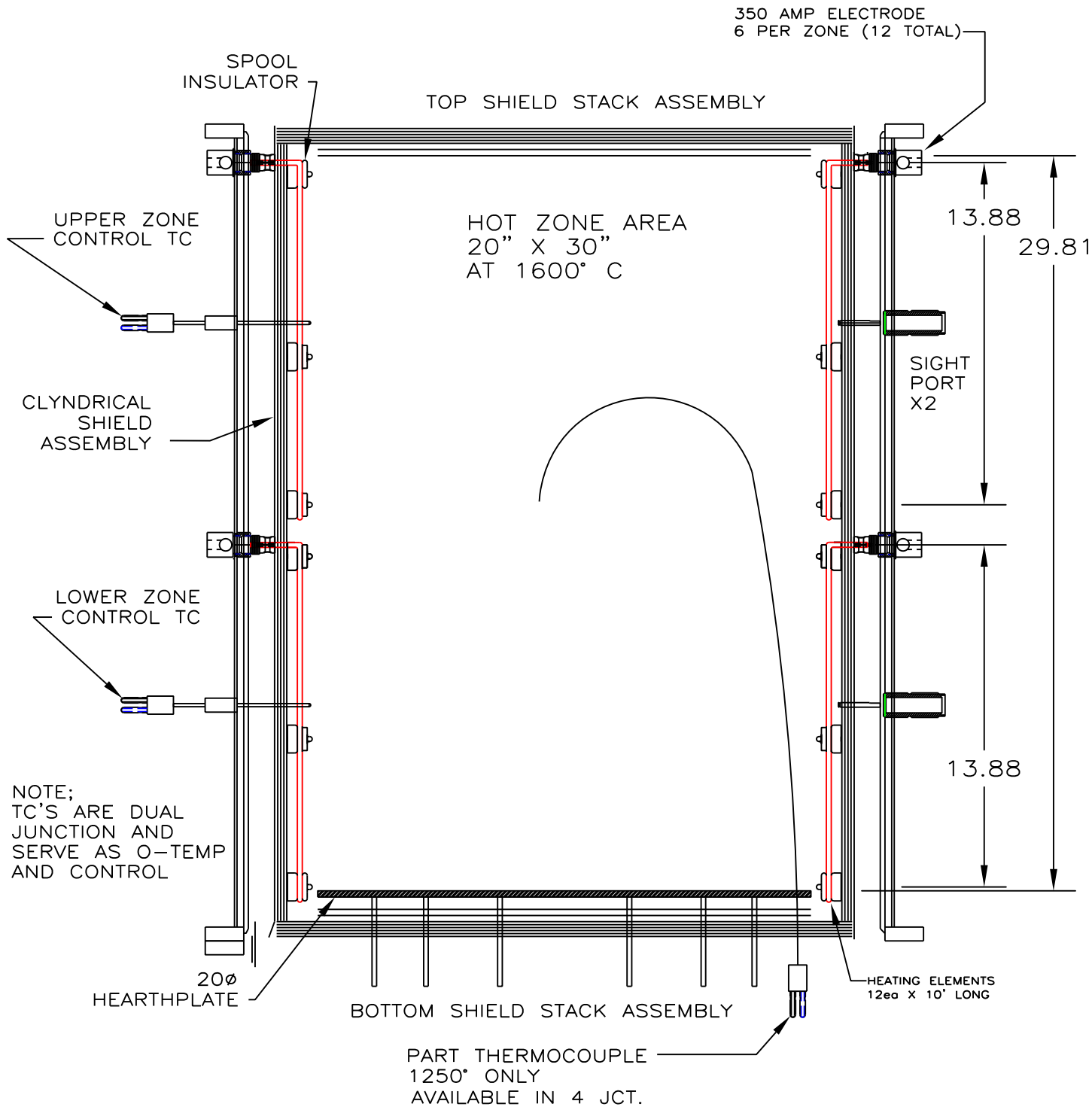
- Panel Interlock
- Emergency OFF panic button at front panel
- High Cabinet Temperature indication
- Low Coolant Flow
- Low Gas Pressure Switches
- Vacuum Ramp Delay
- Heaters are interlocked with the vacuum gauge control so that heating will not occur if there is insufficient vacuum.
- Thermal overload protection for the Turbo Molecular Pump

- High Vacuum isolation valve to protect the Turbo Pump during vent and quick cooling of the hot zone.
- Separation of high voltage and vacuum components for maintenance and electrical safety


### **Documentation**

Facilities information is supplied to assist in site preparation for installation. An operating manual is supplied with the equipment. Worksheets included in the manual provide a convenient form to depict the desired process for entry into the microprocessor controller. The worksheets also serve as a hard copy of the program. The unit is shipped with an example program stored in memory, depicted by the example worksheet. Wiring and plumbing schematics along with a published spare parts list are also included in the manual. Vendor supplied manuals for the program controller, overtemp, SCR, recorder, dewpointer, and other small items are supplied in our documentation. A program and operation section has a complete button-by-button push instruction for installation of a generic program. Relatively simple operation of the furnace is well described and documented in the manual.

REV.	DATE	DESCRIPTION
A	7-10-08	CHANGE FROM J TO K



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		TOL'S EXCPT AS NOTED	DRN.BY: T BARULICH	 <b>Concepts &amp; Methods Company, Inc.</b>
		fract. ±1/32	APP.BY:	
		.XX ±.010	DATE: 2-23-08	
		.XXX ±.005	MAT: NOTED	
K-VAC-14	389	.XXXX ±.0005	FINISH:	TITLE: K-14 20X30 HOT ZONE LAYOUT
USED ON TASK	FWO	ANGLES ±1/2°		DWG.NO: 89206
				SHEET 1 OF 4
				REV: A

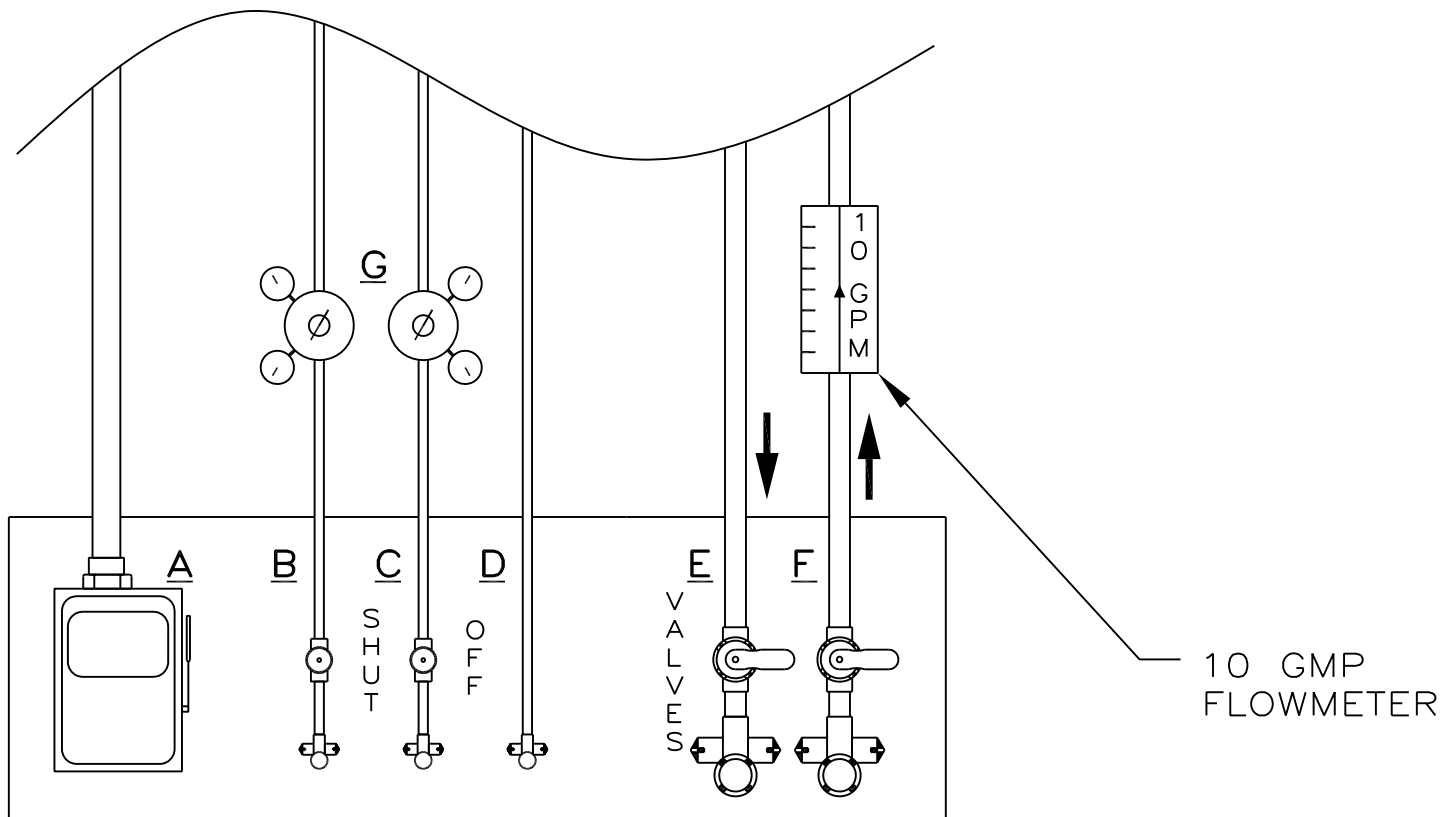
UTILITIES: PREPARED AS SHOWN BY CUSTOMER.

REV.	DATE	DESCRIPTION

- A: 120A./LEG @ 240V, 60A/LEG @480V, 60Hz 3 PH DISCONNECT.  
75A/LEG @400V, 50Hz 3 PH DISCONNECT.
- B: NITROGEN, 25 TO 50 PSIG AT A MAXIMUM FLOW OF 50 SCFH
- C: CLEAN DRY AIR, 90-110-PSI
- D: PROCESS ATMOSPHERE EXHAUST
- E: COOLING WATER SUPPLY; 30 PSIG MIN. AT 10 GPM.
- F: COOLING WATER RETURN OR PRESS. DRAIN IF USED.
- G: LINE PRESSURE REGULATORS SET AT 40 PSI.

- 1/4" SWAGELOCK
- 1/4" SWAGELOCK
- 3/8" TUBE
- 3/4" FPT
- 3/4" FPT

**NOTE:** (MAX. BACK PRESSURE 15 PSIG AT 8 G.P.M.)  
MAX HEAT LOAD 72,000 BTU (6 TON) FOR CHILLER CALCULATION.



SUGGESTED UTILITY PANEL LAYOUT

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		TOL'S EXCPT AS NOTED	DRN.BY: ZEVEDA 08/01/00
		fract. ±1/32	APP.BY:
		.XX ±.010	DATE:
		.XXX ±.005	MAT:
		.XXXX ±.0005	FINISH:
USED ON TASK	FWO	ANGLES ±1/2"	

**CMG**  
Concepts & Methods Company, Inc.

TITLE: J FURNACE FACILITIES PREP.

DWG.NO: 88189      SHEET 1 OF 3      REV:



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## Model K-VAC-14

20" DIA. X 30" Work Area  
TURBO-PUMPED HIGH  
VACUUM FURNACE

For programmed continuous  
operation to 1400° C.



*Size: 76" (193 cm) W. x 36" (91 cm) D. x 110" (279 cm)H.*

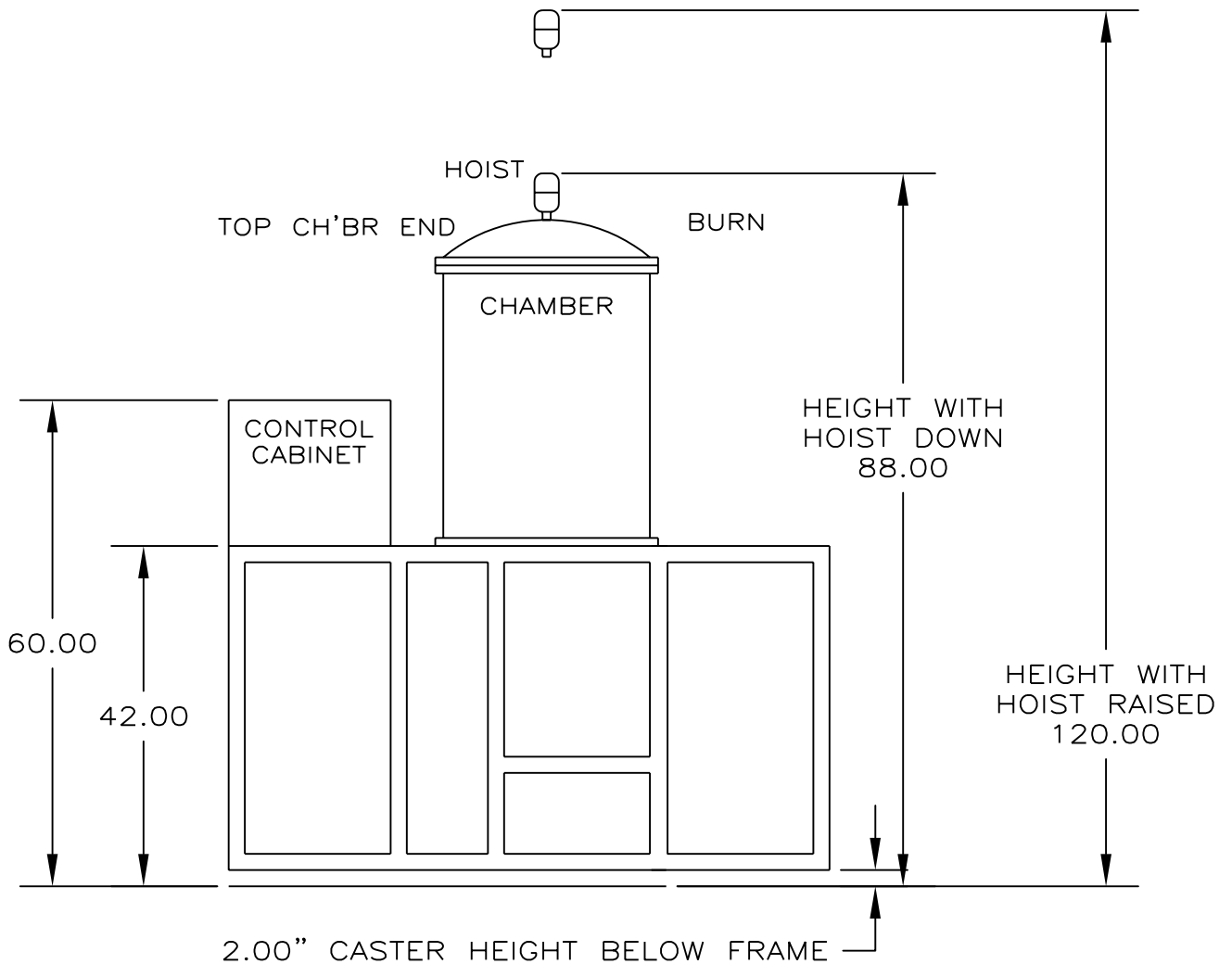
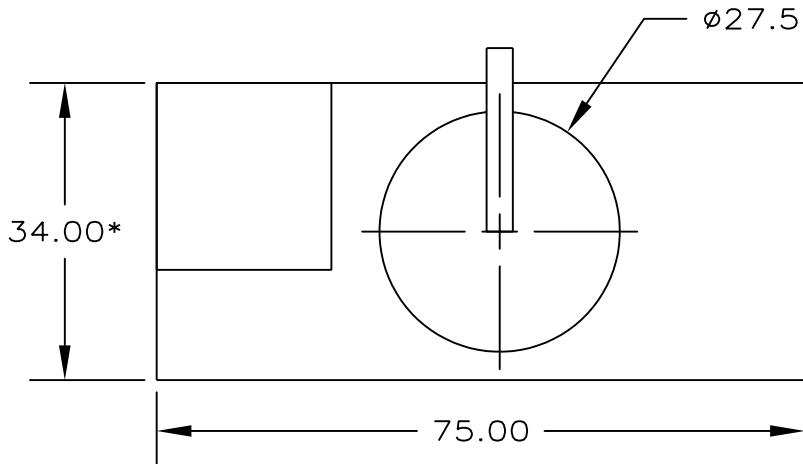
### Standard Features:

- 1000 LPM Turbo Pump
- 600 L/min Mechanical "Roughing" Pump
- High Vacuum Isolation Valve
- 19 Programs – 20 Segments per Program
- Fully Automatic
- Vacuum Delay Setpoint
- All Stainless Steel Construction
- Instrutech Gauges and Controller
- Digital Chart Recorder

### Options:

- Dry Scroll Pump
- Partial Pressure Operation
- Residual Gas Analyzer
- Tower Indicating Lights – 3 Color
- Additional Survey Thermocouples (1-5)
- Computer Controls
- Quick Cool Option
- Combination Hydrogen Atmosphere





\*WITH HOIST REMOVED.

NOTE: WITH THE TOP END OF THE CHAMBER AND THE HOIST REMOVED, THE FURNACE WILL FIT THRU A 3-0 DOOR.

		TITLE: J FURNACE FACILITIES PREP.			
		DRN.BY: ZEVADA	08/01/00	APP.BY: TONY BARULICH	
USED ON TASK	FWO	DATE:	DWG.NO: 88189	SHEET 3 OF 3	