



Manufacturers of High Temperature & High Vacuum Equipment

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Specification Sheet

Equipment Model: J-ATM-1600 [18x30] Hydrogen Furnace



Type	Vertical Bell with lifting hoist
Chamber	Stainless Steel Coldwall
Maximum Temperature	1600° C.
Hot Zone	18" (45 cm) Dia. x 30" (75 cm) H. Nominal
Frame Dimensions	54" (137 cm) W. x 34" (86 cm) D. x 127" (322 cm) H.
Power Requirements	480V 3 Ph. 120A 60 Hz - 240V 3 Ph. 240A 60 Hz. 380/400/415V 3 Ph. 140A 50 Hz.
Gas Requirements	25 - 55 psig, Nitrogen or Argon 25 - 55 psig, Hydrogen 60 - 100 psig, CDA
Thermocouple	Type "C" Tungsten-Rhenium // Control & Monitor Type "K" Inconel-sheathed, work survey
Cooling Requirements	10 Ton (120,000 BTU), 8-10 GPM @ 40 PSI max

Standard dual heating zones for temperature uniformity

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

Inert purge gas is Nitrogen or Argon.

Process gas is Hydrogen or inert, or a mixture of both.

Process gas can be humidified via a heated bubbler to over 20° C. Dewpoint.

All Molybdenum Hot Zone & Elements. All Insulators are made of High Alumina.

Element style - 1/8" Molybdenum Wire.

Standard Features:

- Mass Flow Controllers for process gas
- Rough Vacuum Pump
- Oxygen Sensor
- 1x Survey Thermocouple - Type "K"
- Easy to use Touchscreen HMI
- Dual Sight glass for calibration melts
- Burn-off Column
- Ethernet connectivity - FTP and webserver
- **Fully Automatic** - One button push starts the run.

Options:

- Gas humidifier "Bubbler", heated
- High Vacuum Capability (1e-6 torr)
- Dewpoint Monitor -60 to +40° C
- Additional Survey Thermocouples - Type "K"
- Auxiliary ports though chamber - hot zone
- Agency certification - NRTL, CE, etc.



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Equipment Description

VERTICAL, DUAL ZONE, COLDWALL REDUCING/INERT ATMOSPHERE FURNACE

For Programmed Continuous Operation to 1600° C.

Model J-1600 [18x30]



Overview

The model J Furnace currently has the largest 1600° hot zone available to our customers in the coldwall style chamber. Its useable hot zone is 18" in diameter by 30" high. It has a bell type chamber assembly that is raised off the bottom chamber assembly to expose an 18" diameter hearth plate that is located at a convenient height to load and unload parts of up to 28" in height.

It is dual zone controlled for temperature uniformity, using a modern IDEC touchscreen PLC for programmed ramp and soak control. It is designed to operate in a Hydrogen/Nitrogen mixed atmosphere and can divert a portion or all the process gas through a water filled bubbler to humidify the gas for processes requiring a reducing atmosphere. The furnace is fully automatic requiring the operator only to load the parts, select the desired program for processes, lower the chamber and press RUN. The furnace will automatically purge - process gas fill - ramp & soak to the pre-programmed temperature - cool down at a controlled rate and post purge.

Base Unit

The base unit measures 54" wide by 34" deep by 60" high. Its' substantial frame is constructed of heavy wall square steel tubing. With the chamber fully raised the hoist and chamber assembly is 127" 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 transformers 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 (mass flow controllers), gas plumbing and cooling water plumbing. The vacuum purge pump and manifolding 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 an ergonomic 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 units and transformers. 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. With the removal of the hoist assembly and the top cover this unit can fit through a standard door. 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 ball-screw driven with a self-braking garmotor, 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

Temperature control and monitoring functions to 1600° C. are achieved using type “C” Tungsten-Rhenium thermocouples. Pairs of these, in close proximity to the two element zones, 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 PLC which compares the setpoints with the inputs from thermocouples located in close proximity to the heating elements, sending appropriate output signals to the SCR power controllers. Totally automatic time, temperature, and process gas control, with many different available recipes saved and stored.

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 for guaranteed soak, cascade controls, and individual work limits. These thermocouples are rated for use up to 1200° C (2200° F). Up to four type K “survey” thermocouples are supported. The process variable can be calculated using any combination of installed thermocouples, and calculated either by using the average, or the highest/lowest temperature of the selected inputs. This can be used in many different ways to verify the total workload reaches various process requirements.

Operation

The work is loaded onto the 18” 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 purge, process gas fill, ramp to temperature and soak, activate the bubbler for humidification of process gas, cooldown and post purge. Upon completion of the cooldown portion of the program, the chamber is opened and unloaded.

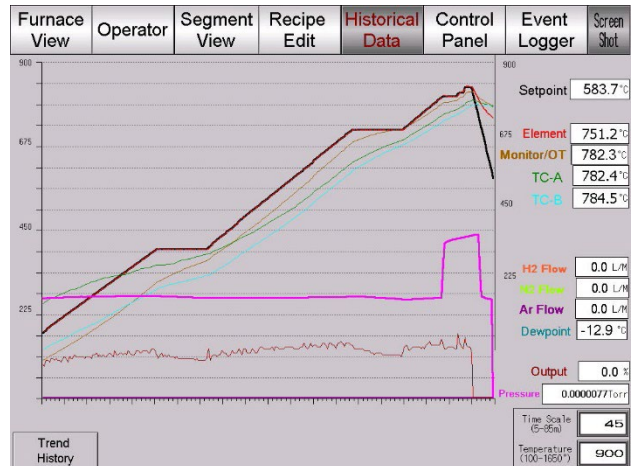
Chamber/Furnace assembly

The 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 including gas admission and exhaust plumbing. It supports the Molybdenum hearth and bottom end stack of eight shields via the lower support structure. The furnace chamber is located within the jacketed stainless steel chamber. It incorporates two Molybdenum heating element zones of six sections each supported by high alumina insulators. These surround the eighteen-inch diameter by thirty-inch high work area. A series of six Molybdenum cylindrical heat shields and the top and bottom stack of eight shields surround the elements. This assembly is supported from the inner wall of the chamber.

In addition, the chamber includes the insulated water-cooled power feedthroughs, control thermocouples, two sightports, 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 two digitally controlled SCR three phase power modules. These units are phase angle fired control, and include 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.



Atmosphere Control

Customer-supplied Hydrogen and Nitrogen gasses are admitted to the chamber through programmed valves and preset flowmeters. An interlock is included, which provides for automatic Nitrogen purge in the event of loss of Hydrogen or chamber pressure. Operator-set flowmeters control the flow of gasses to achieve the appropriate operating atmosphere. Included is a system which, when called to do so by the installed program, humidifies a portion of the selected process gas via a bubbler column. This gas is then recombined with the remaining process gas in a pre-selected ratio to obtain the desired process dewpoint. The included bubbler column will humidify the process gas to a dewpoint of up to 20° C. Higher dewpoint equipment, and controlled temperature bubblers are available.

Exhaust gas is routed through a check valve and out a fitting at the rear of the cabinet. This valve establishes a slight positive pressure when the chamber is closed and sealed. As a safety feature, the absence of this pressure prevents the admission of hydrogen and inhibits the application of heater power. An exhaust gas burn-off column electronically ignites the waste gas. Ignition is called for automatically at all times that Hydrogen is called for, and the unit attempts re-ignition should the flame be inadvertently extinguished. The igniter is automatically tested to assure proper operation each time a run is started. All gas plumbing and components are stainless steel. All gas connections are high-quality, high-pressure Swagelok fittings.

Standard Safety Features

Thermocouple break protection assures that heating power is removed from the furnace in the event of sensor failure. Overtemperature 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 backup.

Other numerous interlock functions protecting the operator and equipment include:

- Panel Interlock
- High Cabinet Temperature
- Low Coolant Flow
- Low Gas Pressure Switches
- Hydrogen is prohibited from entering the system and heating cannot begin until the chamber cover is closed, sealed and purged. At the end of a programmed run the chamber is inhibited from being opened until the work has cooled to a predefined safe temperature.
- A mandatory vacuum pumpdown with leak check precedes every furnace run.
- An oxygen sensor analyzes the exhaust to make sure the makeup of chamber gas is suitable for introducing hydrogen.
- "Purge assure" logic provides an internally set minimum timed Nitrogen purge regardless of the program status whenever power or the program is interrupted.

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 HMI. 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 instructions for the installation of a generic program. The relatively simple operation of the furnace is well described and documented in the manual.

Facilities Requirements

The J-ATM-16 is typically run at 480VAC 3-phase, 60hz, requiring a 120A service. This furnace can be built to lower voltage and/or international specs. Please inquire with Camco for a complete list of available configurations. Additional equipment requirements and options are listed on the attached specification sheet.

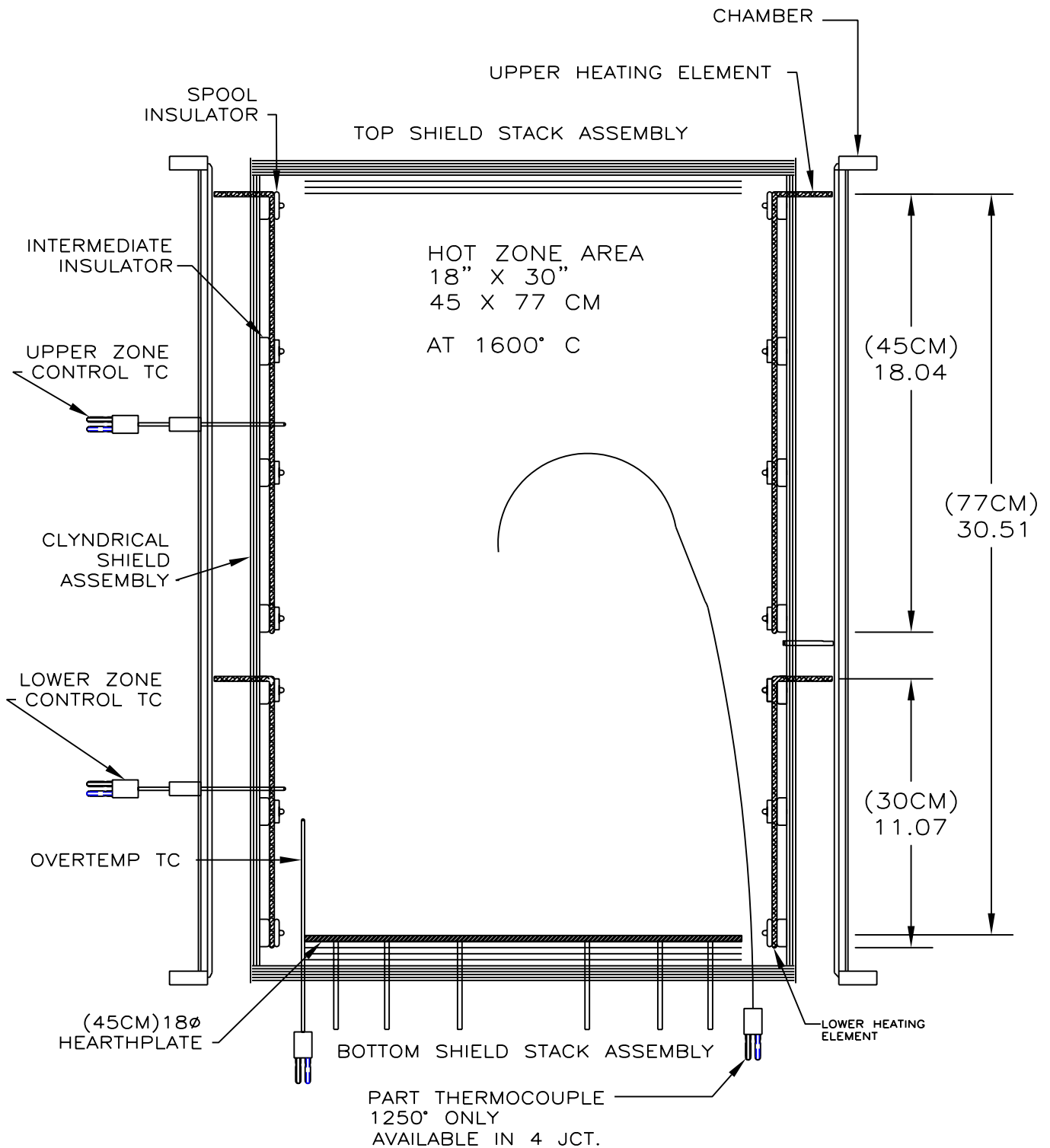


Camco's Model J-16 Hydrogen Furnace with chamber fully open and closed, shown here with computer controlled option.



A row of Camco Model 'J' Furnaces at their test facility in San Carlos, California.

REV.	DATE	DESCRIPTION



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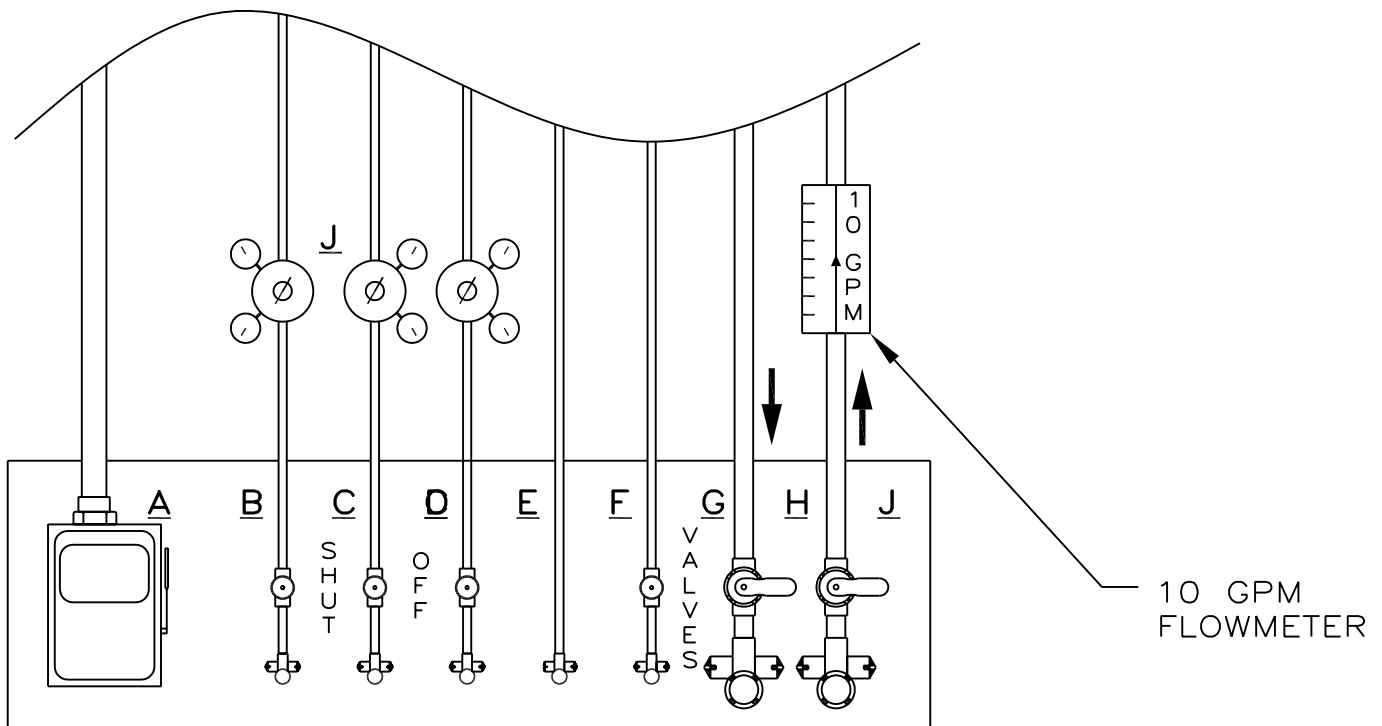
		TOL'S EXCPT AS NOTED	DRN.BY: T BARULICH	
		fract. ±1/32	APP.BY:	
		.XX ±.010	DATE: 4-20-05	
		.XXX ±.005	MAT: NOTED	
J-16 FURNACE		.XXXX ±.0005	FINISH:	TITLE: J-16 HOTZONE DIM
USED ON TASK	FWO	ANGLES ±1/2'		DWG.NO: 88912
				SHEET OF
				REV:

REV.	DATE	DESCRIPTION

UTILITIES: PREPARED AS SHOWN BY CUSTOMER.

- | | |
|--|---------------|
| A: 120A./LEG @ 480V. 60Hz 3 PH DISCONNECT. | |
| B: NITROGEN, 25 TO 50 PSIG AT A MAXIMUM FLOW OF 50 SCFH | 1/4" SWAGELOK |
| C: HYDROGEN 25 TO 50 PSIG AT A MAXIMUM FLOW OF 30 SCFH | 1/4" SWAGELOK |
| D: CLEAN DRY AIR, REGULATED AT 90 PSI | 1/4" SWAGELOK |
| E: PROCESS ATMOSPHERE EXHAUST (NOT NEEDED WITH BURNOFF OPTION) | 3/8" TUBE |
| F: D.I. WATER FOR BUBBLER MAKEUP | 1/4" POLYFLOW |
| H: COOLING WATER SUPPLY; 30 PSIG MIN. AT 10 GPM. | 3/4" FPT |
| I: COOLING WATER RETURN OR PRESS. DRAIN IF USED. | 3/4" FPT |
| J: LINE PRESSURE REGULATORS SET AT 40 PSI. | |

NOTE: (MAX. BACK PRESSURE 15 PSIG AT 4 G.P.M.)

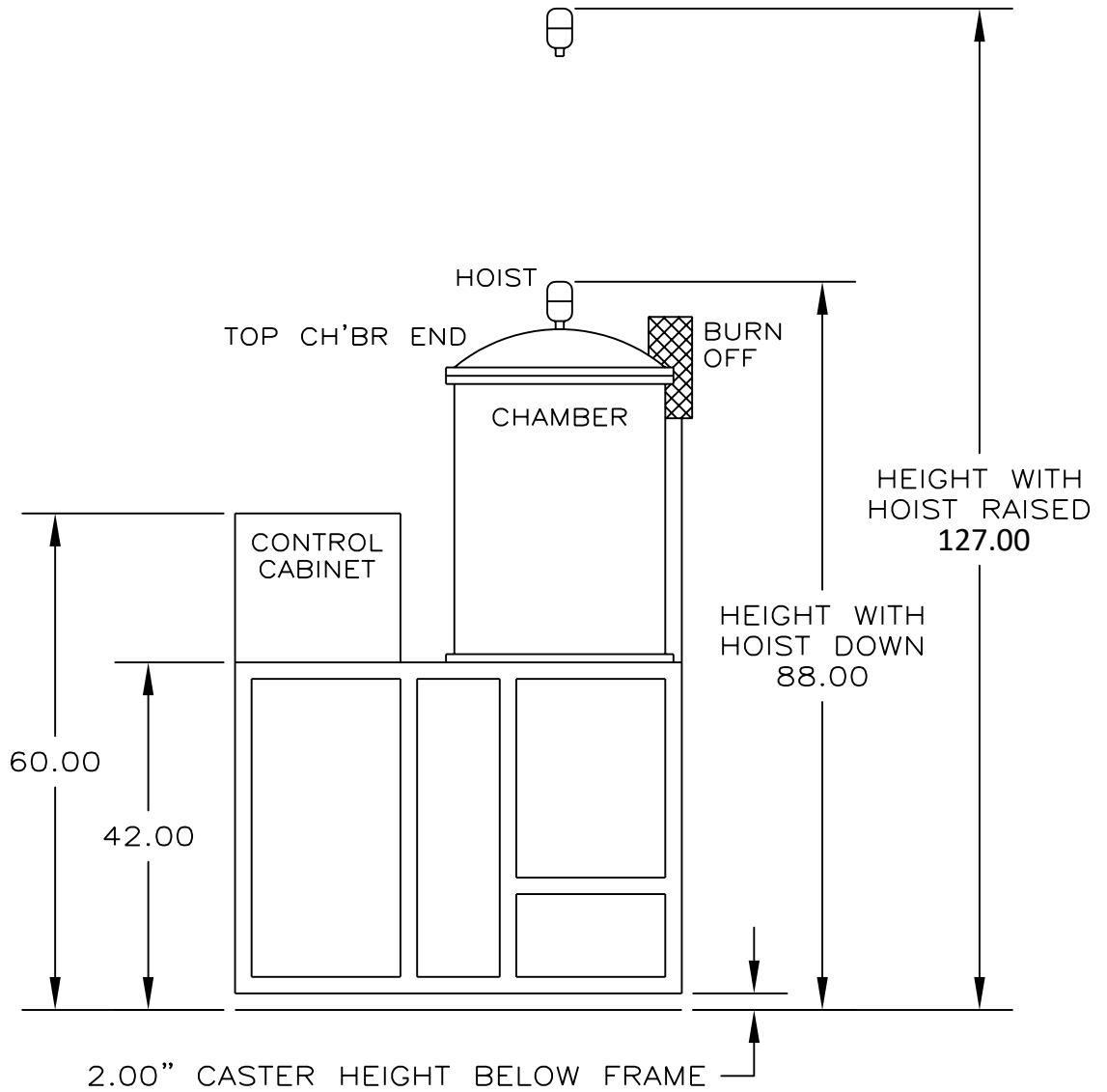
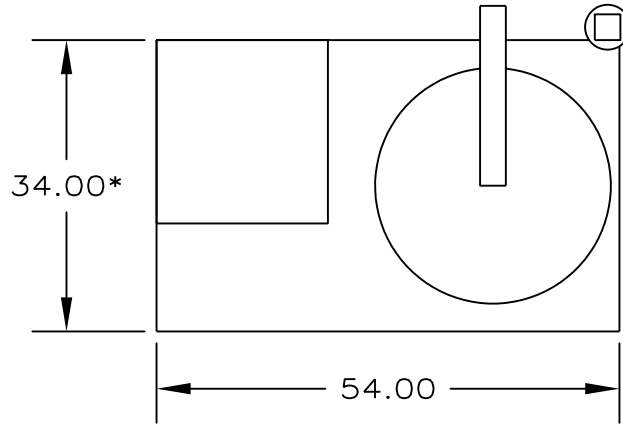


SUGGESTED UTILITY PANEL LAYOUT

NOTE; WATER SUPPLY SHOULD BE CONNECTED TO EMERGENCY CITY WATER BACK UP IN CASE OF POWER FAILURE AT HIGHR TEMPERATURE OPERATION

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		TOL'S EXCPT AS NOTED	DRN.BY: T BARULICH	CAMG Concepts & Methods Company, Inc.
		fract. ±1/32	APP.BY:	
		.XX ±.010	DATE: 7-20-05	TITLE: J FURNACE FACILITIES PREP.
J-VAC COMBO 18X48	318	.XXX ±.005	MAT: NOTED	DWG.NO:
USED ON TASK	FWO	.XXXX ±.0005	FINISH:	SHEET 1 OF 3
		ANGLES ±1/2"		REV:



*WITH HOIST REMOVED.

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

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