



Manufacturers of High Temperature & High Vacuum Equipment

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

Equipment Model: **G-ATM-16**  
 Hydrogen / Reducing Atmosphere Furnace

<b>Type</b>	Hydrogen Operation, Horizontal / Front Loading
<b>Chamber</b>	Stainless Steel Coldwall
<b>Maximum Temperature</b>	1600° C.
<b>Hot Zone</b>	5" (13 cm) W. x 5" (13 cm) H. x 10" (25 cm) Deep
<b>Frame Dimensions</b>	39" (100 cm) W. x 30" (76 cm) D. x 21" (53 cm) H.
<b>Power Requirements</b>	240V 1 Ph. 60A 60 Hz. or 230V 1 Ph. 60A 50HZ
<b>Gas Requirements</b>	25 – 50 psig, Nitrogen – ¼" Swagelok connection
	25 – 50 psig, Hydrogen – ⅜" Swagelok connection

Purge gas is Nitrogen.

Process gas is Hydrogen or Nitrogen or a mixture of both.

Process gas can be humidified via standard bubbler to ~18° C. Dewpoint.

Equipment fits on table top or bench

**Cooling Requirements** - 25 psig at zero back pressure, at 4 gallons per min.

Note: Maximum back pressure is 15 psig.

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

### Standard Features:

- Robust, All Molybdenum Hot Zone
- Easy to use Microprocessor Controls
- Digital Chart Recorder
- Ethernet Connectivity – FTP and Webserver
- Burn-off Exhaust Column
- Bubbler for humidification of process gas
- 19 Programs - 20 Segments per Program
- Sight port for calibration melts
- Turnkey Solution. Fully Automatically it will:
  - Pre-purge with inert gas (Nitrogen)
  - Process gas fill
  - Ramp to temperature and soak
  - Bubbler for humidification of process gas
  - Cooldown
  - Post purge with safe access check

### Options:

- Programming Software
- Vacuum Purge
- Additional Survey Thermocouples (Up to 4)
- Dewpoint Monitor -60 to +40° C
- Matching Table on Castors
- Tower Indicator Lights
- Computer Controls



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## Camco Model G-ATM-16 Equipment Description

### **1600° C Hydrogen / Reducing Atmosphere Furnace 5" Dia x 10" D. Work Zone**

#### **COLDWALL LABORATORY FURNACE**

For Automatic, Programmed Operation to 1600° C  
*Higher temperature and high vacuum versions available.*



#### **Overview**

This compact front-loading, bench top furnace is designed for automatic program controlled thermal processing of work in wet and dry, inert and reducing atmospheres. The heat shielded work area includes a Molybdenum hearth plate, 5" wide by 5" high by 10" deep for uniform ramp and soak processing to temperatures to 1600° C. The low thermal mass heat shields allow cooldown to be programmed at a rate such that three complete process runs can be done in a day shift. The furnace chamber is constructed of double walled stainless steel with water passages between the walls. The heat shields and elements are constructed of pure Molybdenum and high alumina insulators support the elements.

#### **Base Unit**

The cabinet measures approximately 39" wide by 30" deep by 21" high. Its substantial frame is constructed of heavy steel structural shapes. Steel panels are readily removed to gain access for efficient, on the spot service. The square tubular support feet provide a convenient location in which to insert bars for lifting. The left side of the cabinet contains the logic controller, gas valving, bubbler column, power components and electronics. A fan located at the rear of the unit draws cooling air through the cabinet to cool the power control module. The right side of the cabinet contains the chamber, gas-plumbing bulkhead, thermocouples and is baffled from the electronics. There are no high voltage components on the chamber side of the frame. The finish used on this, and all CAMCo equipment, is baked powder coating chosen for its durability and solvent resistance. The top of the unit is 18-gauge stainless steel to provide a clean area to load product from.

#### **Temperature Control**

Temperature control signals are received from a type "K" thermocouple located close to the element for tight thermal control of the process. Multi-stage programmed thermal control and atmosphere sequencing is achieved through use of a Honeywell Micro process controller. The controller receives its' input signal from a thermocouple located close to the heating element. Thermocouple break protection assures that heating power is removed from the furnace in the event of sensor failure. A second thermocouple is used to monitor the load. This is a flexible, inconel sheathed type "K" thermocouple that can be attached directly to the load. It is monitored on a second input channel located on the microprocessor controller. This signal can be used with an alarm for process load control and delicate brazing. Over-temperature monitoring is provided by a third 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 the over-temperature shutdown signal. The process monitor also provides a safe chamber access interlock and access signal for the operator.

## Operation

Work is loaded into the furnace, the front heat shield stack inserted, the cover closed and latched. 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, a lamp signals when the chamber may be opened and unloaded. The front of the double wall, water-cooled chamber is closed in operation by a jacketed, water-cooled door. The door handle includes a cam locking arrangement to easily compress the silicone door seal gasket. Hydrogen is prohibited from entering the system and heating cannot begin until the door is closed and sealed and the chamber is purged of air. Power to the heating elements is prohibited if there is not enough water flow through the chamber cooling system.

## Power Control

Power is proportionally controlled through use of a digitally controlled SCR single-phase power module. This unit is phase angle fired controlled, and includes current limiting made necessary by the strongly positive resistivity coefficient of the heating element. An adjustable, manual reset over current trip provides for automatic resumption of a run in the event of a brief power interruption. Impedance match of the heating elements to the incoming power is accomplished through the conservatively rated transformer 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 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 door is closed and sealed. As a safety feature, absence of this pressure prevents admission of Hydrogen and inhibits the application of heater power. An exhaust gas burnoff 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 ignitor 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 pre-defined safe temperature.
- Purge Assure Circuit provides an internally set minimum timed Nitrogen purge regardless of the program status whenever power or the program is interrupted.

## Digital Chart Recorder

Included in every Camco Furnace is a digital chart recorder for continuous monitoring of thermocouple inputs and other components. Standard inputs include control thermocouple, part thermocouple, over-temperature thermocouple, and program setpoint. Other inputs that can be monitored (based on options ordered) include additional survey thermocouples, dewpoint monitors, current sensors, vacuum transducers, coolant temperature and oxygen analyzers.

This chart recorder includes 512MB of memory which covers decades of recordings. It is packaged with convenient software for reading files and can be either read from an external memory card or connected to a network and read remotely via FTP.

The recorder also has webserver functionality that runs through the network to show you quickly the current state of the furnace in real time. This feature is especially useful if the furnace is to be installed, for example, in a clean room where access is limited (or a hinderance to physically get to).

## 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. The relatively simple operation of the furnace is well described and documented in the manual.

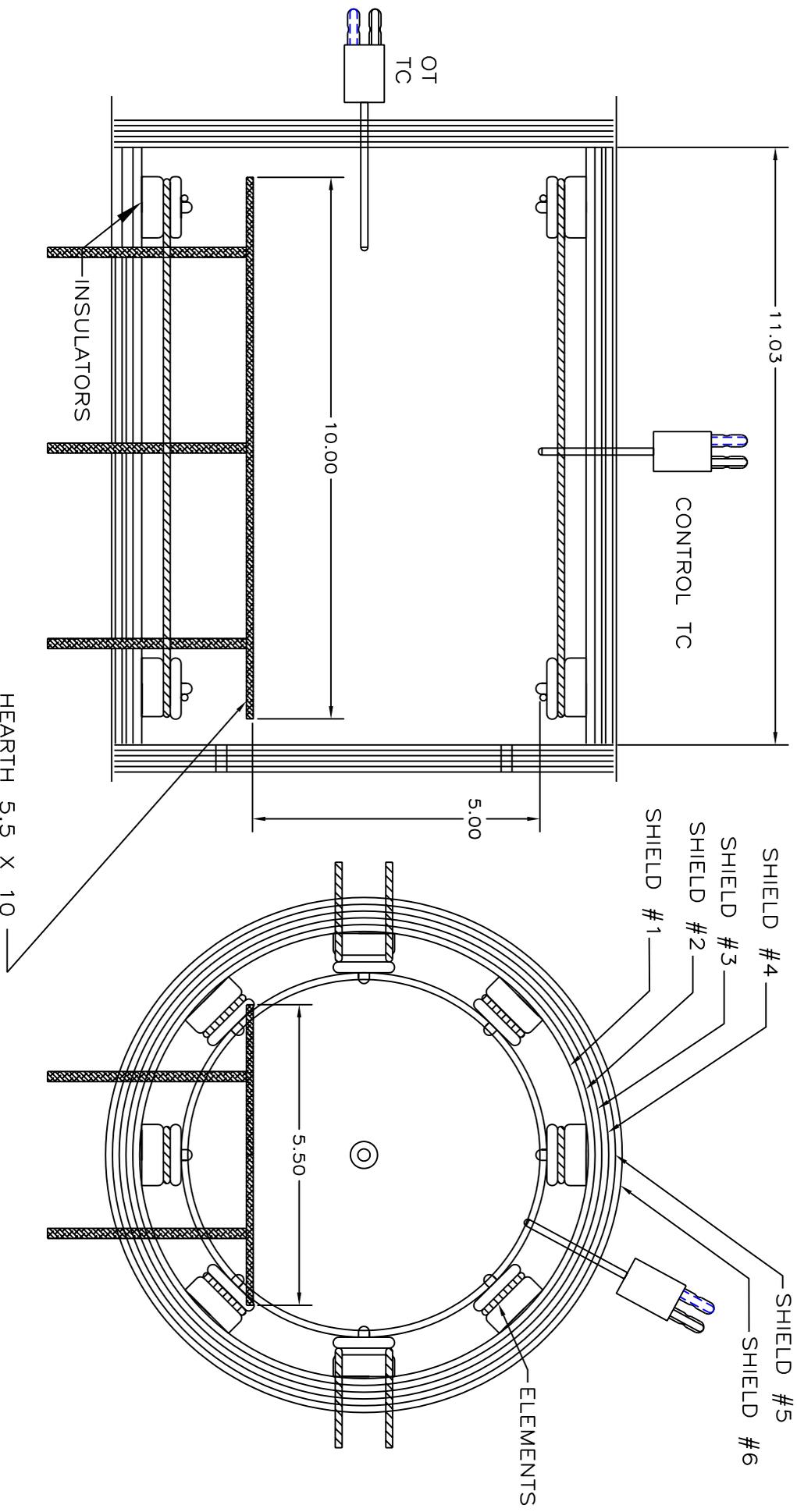
**While the furnace is a complete, stand-alone unit as described, many applications suggest the inclusion of one or more of the options described in the enclosed data or web site. Other, less commonly ordered options can also be provided. Please inquire.**

## Camco Model G-ATM-1600 Hydrogen Coldwall Furnace

5" Wide x 5" High x 10" D., 1600° C  
*Front Loading*



# G-15 HOT ZONE LAYOUT



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USED ON TASK	FWO
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TOL'S EXCEPT AS NOTED	DRN. BY: T BARULICH
fract. ± 1/32	APP. BY:
.XX ± 0.10	DATE: 5-1-07
.XXX ± .005	MAT: MOLY
.XXXX ± .0005	FINISH:
ANGLES ± 1/2°	

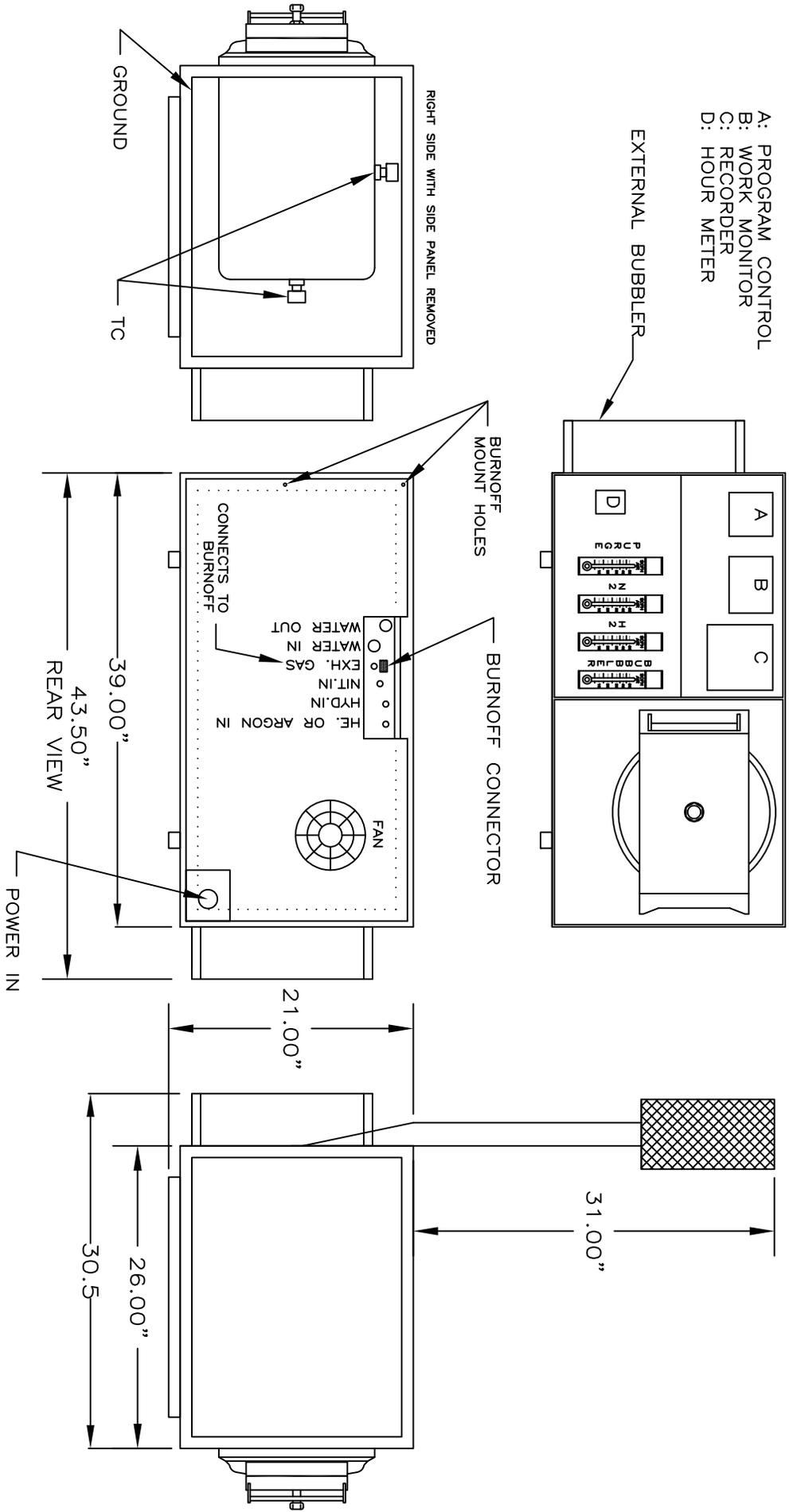
DRN. BY: T BARULICH	TITLE: G-15 HOT ZONE LAYOUT
APP. BY:	DWG. NO: 98023
DATE: 5-1-07	SHEET 4 OF 4
MAT: MOLY	REV:

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

REV.	DATE	DESCRIPTION

REV.	DATE	DESCRIPTION
A	12/10/12	ADD EXTERNAL BUBBLER

(FRONT VIEW)



- A: PROGRAM CONTROL
- B: WORK MONITOR
- C: RECORDER
- D: HOUR METER

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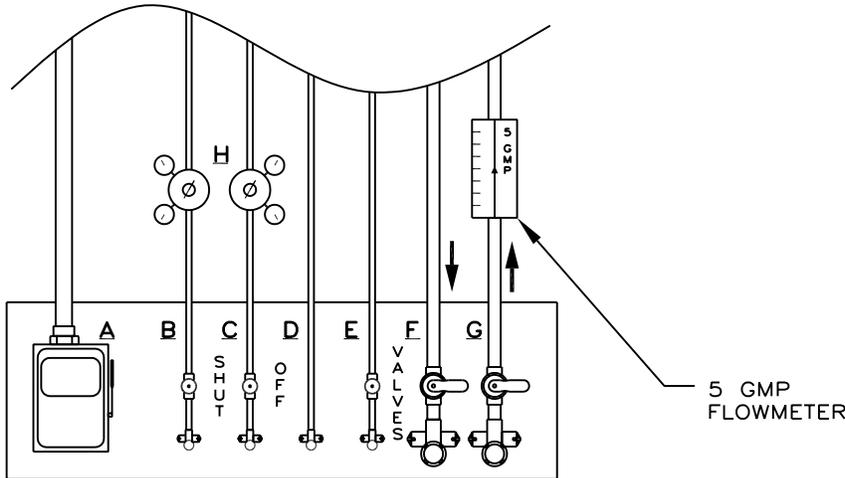
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.XX	±.010	DATE: 01/05/89	DWG. NO: 86531	SHEET 1 OF 2
.XXX	±.005	MAT:	REV: A	
.XXXX	±.0005	FINISH:		
ANGLES ±1/2°				
USED ON TASK	FWO			

UTILITIES: PREPARED AS SHOWN BY CUSTOMER.

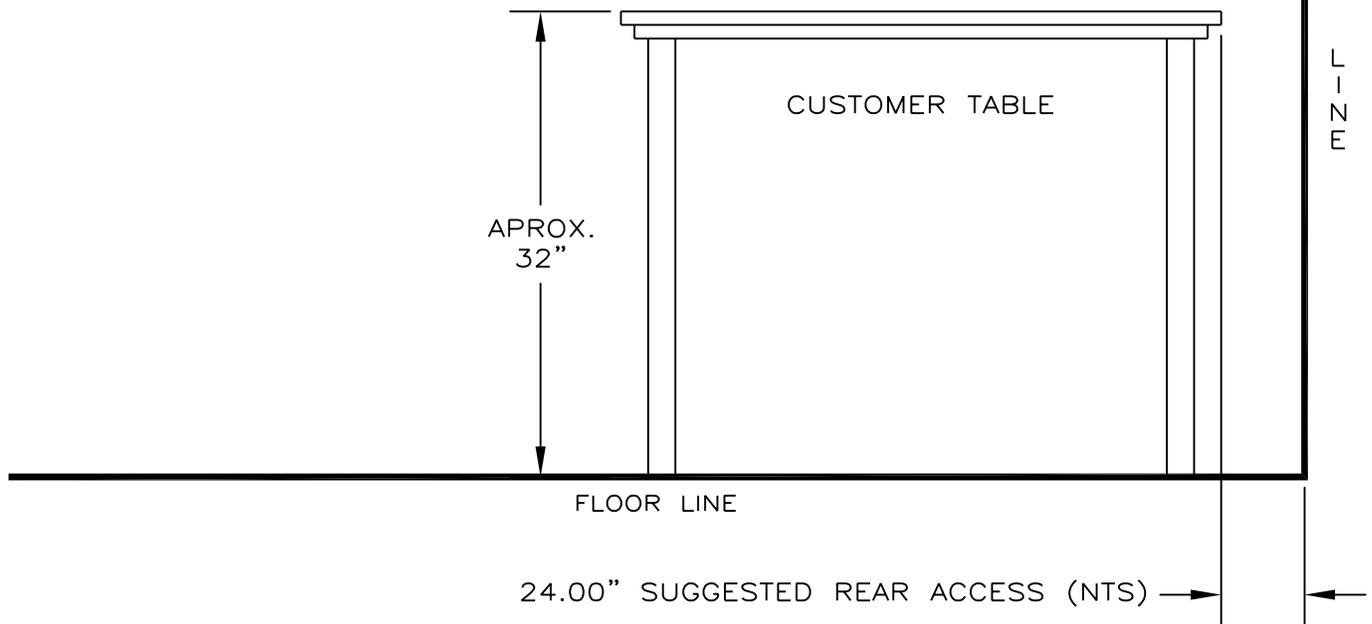
REV.	DATE	DESCRIPTION
A	3-1-06	DELETE 480V OPTION

- A: 60A. @ 208 OR 240V. 60 Hz SINGLE PHASE DISCONNECT.
- B: NITROGEN, 30 TO 50 PSIG AT A MAXIMUM FLOW OF 30 SCFH
- C: HYDROGEN 30 TO 50 PSIG AT A MAXIMUM FLOW OF 30 SCFH
- D: PROCESS ATMOSPHERE EXHAUST (NOT NEEDED WITH BURNOFF OPTION)
- E: D.I. WATER FOR BUBBLER MAKEUP
- F: COOLING WATER SUPPLY; 25 PSIG MIN. AT 2.5 GPM – SEE NOTE
- G: COOLING WATER RETURN OR PRESS. DRAIN IF USED--SEE NOTE
- H: LINE PRESSURE REGULATORS SET AT 40 PSI.

- 1/4" TUBE
- 1/4" TUBE
- 3/8" TUBE
- 1/4" POLYFLO
- 1/2" FPT
- 1/2" FPT



SUGGESTED UTILITY PANEL LAYOUT  
LOCATE ON WALL BEHIND TABLE



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

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		TOL'S EXCPT AS NOTED	DRN.BY: ZEVADA 08/22/00	<p><b>Concepts &amp; Methods Company, Inc.</b></p>
		fract. ±1/32	APP.BY:	
		.XX ±.010	DATE: 01/05/89	
		.XXX ±.005	MAT:	
		.XXXX ±.0005	FINISH:	
USED ON TASK	FWO	ANGLES ±1/2'		TITLE: G FURNACE FACILITIES PREP.
				DWG.NO: 86531
				SHEET 1 OF 2
				REV: A