



Manufacturers of High Temperature & High Vacuum Equipment

1017 Bransten Road | Phone (650) 593-1064  
 San Carlos, CA 94070 | Fax (650) 593-4458



## Specification Sheet

Equipment Model: B-ATM-2000  
 Hydrogen Furnace

<b>Type</b>	Hydrogen or Inert Gas. Vertical / Top Loading
<b>Chamber</b>	Stainless Steel Colwall (Water-cooled)
<b>Maximum Temperature</b>	2000° C.
<b>Hot Zone</b>	8" (20cm) Dia. X 12" (30cm) H. Nominal
<b>Frame Dimensions</b>	66" (167cm) W. x 29" (73cm) D. x 50" (127cm) H.
<b>Power Requirements</b>	480V 3 Ph. 60A 60 Hz or 240V 3 Ph. 120A 60 Hz.
	400V-415V 3 Ph. 60A 50Hz (International)
<b>Gas Requirements</b>	25 – 50 psig, Nitrogen ¼" Swagelok, 50 L/M Max
	25 – 50 psig, Hydrogen ⅜" Swagelok, 50 L/M Max

Purge gas is Nitrogen.

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

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

**Cooling Requirements** - 25 psig at zero back pressure, at 4 gallons per minute (3GPM minimum)

Note: Maximum back pressure is 15 psig. Room temperature inlet water (20 C / 68F)

BTU Load: 60,000 (5 tons) for chiller calculation

Heat up ramp rate 60° C per minute - empty chamber. (25 C recommended)

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

### Standard Features:

- Burn-off Column
- Equipment on casters to roll into place
- IDEC Touchscreen PLC controls
- Watlow EZ-Zone Overtemp Control
- 40 Programs - 15 Segments per Program
- MFCs for gas input (Mass Flow Controllers)
- Sight glass for calibration flag melts
- Vacuum purge with automatic leak check (Rate of Rise)
- O2 analyzer for Hydrogen safety
- Cascade Braze Control with Type "K" Survey TC
- Tower Indicating lights
- Fully Automatic - One button push starts the run.  
 Automatically it will purge → process gas fill → ramp to temperature and soak → bubbler for humidification of process gas → cool down → post purge.

### Common Options:

- Bubbler for humidification of process gas
- Cable Hoist for loading heavy loads
- Additional Survey Thermocouples
- Dewpoint Monitor -60 to +40° C
- Custom moly furniture, loading racks



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## Equipment Description

### CAMCo 8" Dia. X 12" H., 2000° C

#### REDUCING/INERT ATMOSPHERE, COLDWALL FURNACE

For Automatic, Programmed Operation to 2000° C  
Touchscreen PID controller with MFCs

### Model B-ATM-16



## **Overview**

The Concepts & Methods Co., Inc. "B-ATM-2000", reducing/inert atmosphere furnace is designed to reproducibly metallize, braze, clean fire and otherwise process loads of up to 7" diameter by 10" high. Materials may be lowered onto its hearth within the 10" dia. by 12" high work area. One of 40 selected ramp and soak programs is accurately controlled up to 2000° C. The MFC furnace gas controls, thermal controls and interlocks are integrated in a single Touchscreen PID controller to assure simple, reliable, programmed operation. The furnace chamber is located within the right half of the base unit and is of the "coldwall" variety. It incorporates a Molybdenum heating element of six sections supported by high alumina insulators. This surrounds the twelve-inch diameter by eighteen-inch high work area. Work is placed on a 8" molybdenum hearth, which in turn is held by the support structure within the chamber. A series of six cylindrical heat shields, the bottom end stack of nine shields, and the removable top shield stack of eight heat shields surround the element. A double wall, water jacketed stainless steel chamber contains these items as well as the six insulated power feedthroughs, control and work thermocouples and other required features. The water-jacketed cover assembly is reliably silicone gasket sealed to the chamber through use of an interlocked camming latch. A 5/8" diameter sightport is located at the center of the cover, and its centerline is vertical. In registration with this are holes of approximately 7/16" diameter, which penetrate the top heat shield stack. A "flag" in close thermal proximity to the work monitoring thermocouple may thus be watched, and a precise calibration thereby obtained. This viewpoint can also be used in conjunction with an optical pyrometer. The sight glass is sealed through use of an o-ring and is readily removable to facilitate cleaning or replacement. There is a feedthrough at the side of the chamber and related holes in the cylindrical shields that 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 Option."

## **Base Unit**

The base unit measures approximately 72" wide by 29" deep (to fit through a standard door) by 50" high. Its' substantial frame is constructed of heavy wall square steel tubing. Service access is readily gained through a hinged steel front mounted door and the removable side rear and left front panels. The plate steel floor within the left half of the base unit supports the heavy heater power transformer and closes the bottom. The left half, containing the power components and electronics is isolated from the right 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. In addition, the base frame supports the instrument console, chamber, 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, powder coating chosen for its' durability and solvent resistance.

## **Temperature Control**

Temperature control and monitoring signals are achieved from two type "C" thermocouples. Multi-stage programmed Ramp & Soak Temperature control along with process gas sequencing is achieved through use of a PLC Touchscreen controller. The controller receives its' input signal from a thermocouple located close to the heating element. This can be changed to operate with any TC in the chamber or a combination of all (cascade control). Thermocouple break protection assures that heating power is removed from the furnace in the event of sensor failure. Multiple thermocouples can be used to control and monitor the load. These are flexible, Inconel sheathed type "K" thermocouple that can be attached directly to the load (limited to 1250 C). This signal can be used for process load control.

## **Overtemp & Safe Access Control**

Over temperature monitoring is provided by a third thermocouple located within close proximity to the load. It drives a Watlow Limit Controller, which provides digital readout of the load area temperature and provides an over temperature shutdown signal. The process monitor also provides a safe access temperature interlock and run complete signal for the operator.

## **Operation**

The work is loaded into the furnace, the top heat shield stack inserted, the cover closed and latched. One of 40 selectable, user programmed thermal recipes is chosen, and the "start" key pressed. Gas flows and dewpoint are set. The furnace will automatically pre-purge, process gas fill, perform the pre-programmed ramp & soak temperature profile, cool down, and post purge. Upon completion of the cooldown portion of the program, the chamber is opened and unloaded.

## **Power Control**

Power to the elements is proportionally controlled through use of a digitally controlled SCR three phase power module. This unit is phase angle fired control and includes three-phase current limiting made necessary by the strongly positive resistivity coefficient of the heating elements. 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 the conservatively rated 40KVA transformer driven by this power module.

## **Atmosphere Control**

Customer supplied Hydrogen and Nitrogen gasses are admitted to the chamber through programmed Mass Flow Controllers (MFC). Gasses and flow rates can be changed from segment to segment. An interlock is included which provides for automatic Nitrogen purge in the event of loss of Hydrogen/Nitrogen or chamber pressure. An optional feature is a system which, when called to do so by the controller, humidifies a portion of the selected process gas via a water bubbler column. This gas is then recombined with the remaining dry process gas in a pre-selected ratio to obtain the desired process dewpoint (Wet Hydrogen Process). This bubbler column can humidify the process gas to a dewpoint level of up to 20° C. Higher dewpoints are achievable through a controlled temperature bubbler (optional).

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 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 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 (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 backup.

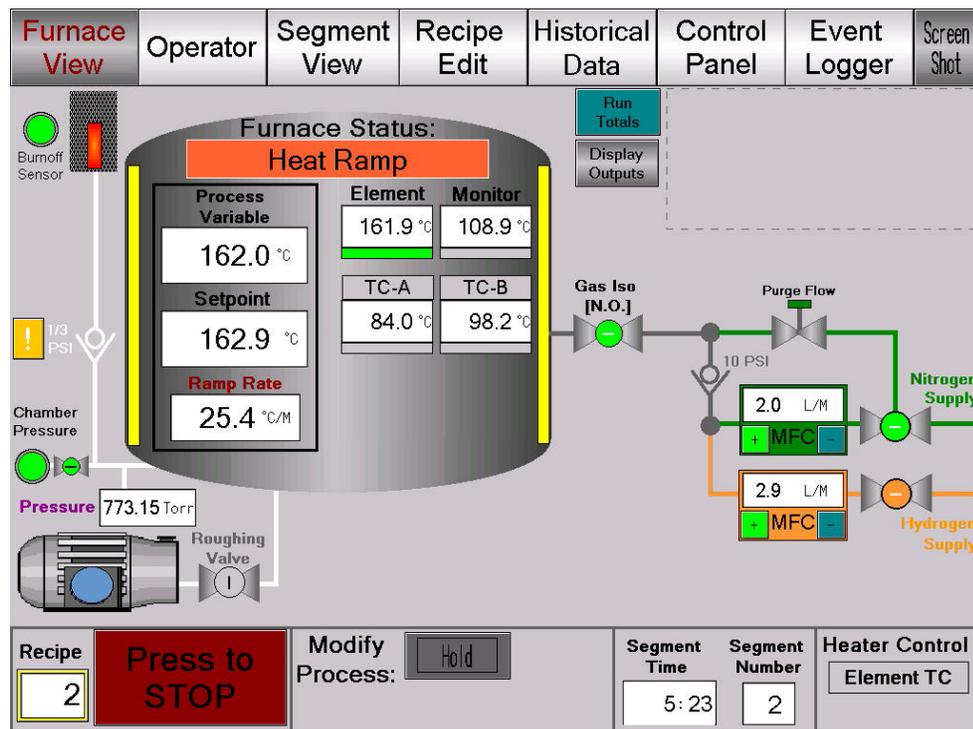
Other numerous interlock functions protecting the operator and equipment include:

- 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, vacuum purged with rate of rise and checked with an internal O<sub>2</sub> analyzer set to 1%. 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 Purge Assure Circuit provides an internally set minimum timed Nitrogen purge regardless of the program status whenever power or the program is interrupted.
- A normally open solenoid valve on the nitrogen purge circuit assures that the furnace is always under a constant flow of gas in the event of a power failure. This feature will purge the chamber of hydrogen so that the furnace chamber will have a safe atmosphere to be opened to.

## Documentation

Facilities information is supplied to assist with site preparation and installation. A hard and soft copy of the operating manual is supplied with the equipment. Pre-programmed recipes are included in the manual and controller to provide a convenient form to depict the desired process for entry into the PLC controller. The unit is shipped with several example program stored in memory, depicted in the recipe screen. 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 controller, SCR, recorder, dewpoint monitor, and other small items are supplied in our documentation. The touchscreen pages are full of information for easy to understand instructions and explanations for what is happening during the heat profile. The relatively simple operation of the furnace is well described and documented in the manual.

## HMI Screens



Main screen depicting temperatures, valve status and MFC gas flow

Furnace View	Operator	Segment View	Recipe Edit	Historical Data	Control Panel	Event Logger	Screen Shot								
Recipe List	Recipe		Recipe Name:				Segment Time Remain (Min)								
Recipe Chart	1	1000° EXAMPLE				Recipe Time Remain (Min)									
Segment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Setpoint °C	20	300	300	700	700	1000	1000	0	0	0	0	0	0	0	0
Time (Min)	15	15	10	22	10	16	15	33	15	0	0	0	0	0	0
Ramp °/M		18		18		18		-30							
H2 Flow LPM		8.0	6.0	7.0	8.0	7.0	8.0	9.0							
N2 Flow LPM	10.0	2.0	3.0	2.5	2.0	3.0	2.0	15.0							
Bubbler	Fixed Flow	OFF	OFF	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Auto-Cooldown			OFF	OFF	OFF	OFF	OFF	ON	OFF						
Heater Control	Element TC	Default	Default	Default	Default	Default	Default	Default	Default	Default	Default	Default	Default	Default	Default
Status:		Runtime:		IDLE		R & D									

Program worksheet depicting Temperature setpoint, Ramp rates and Gas flows.

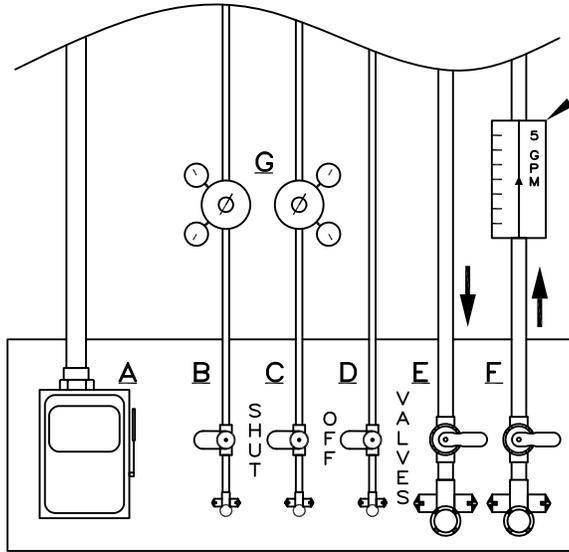


Recipe Chart depiction

**UTILITIES: PREPARED AS SHOWN BY CUSTOMER.**

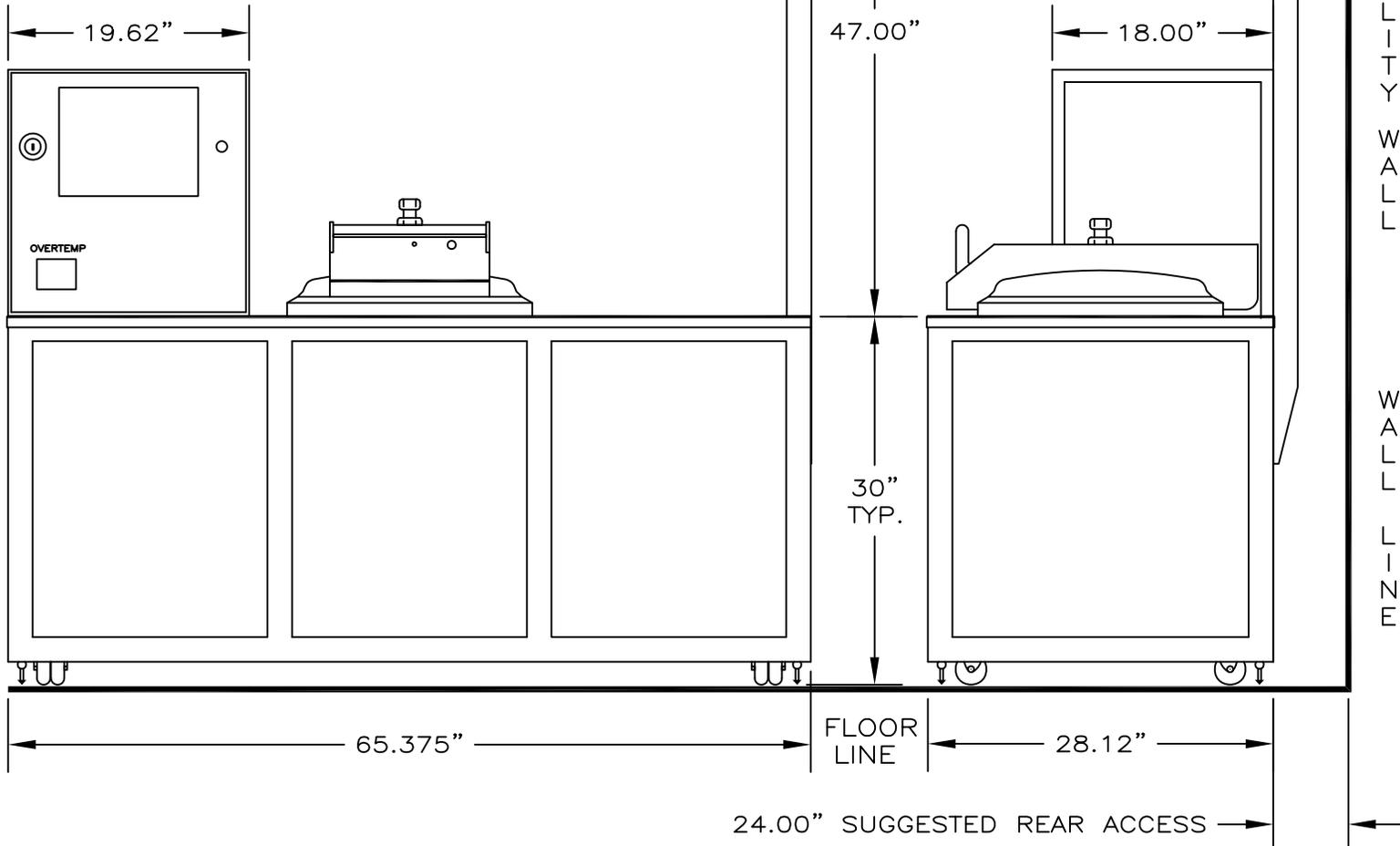
- A: 150 A/LEG 208V. OR 120@240V. OR 60@480V. 60Hz 3 PH DISCONNECT
- B: NITROGEN, 25 TO 50 PSIG AT A MAXIMUM FLOW OF 30 SCFH
- C: HYDROGEN 25 TO 50 PSIG AT A MAXIMUM FLOW OF 30 SCFH
- D: D.I. WATER FOR BUBBLER MAKEUP
- E: COOLING WATER SUPPLY; 25 PSIG MIN. AT 4 GPM MAX.—SEE NOTE
- F: COOLING WATER RETURN OR PRESS. DRAIN IF USED—SEE NOTE
- G: LINE PRESSURE REGULATORS SET AT 40 PSI.

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



**NOTE:** (MAX. BACK PRESSURE 15 PSIG AT 4 G.P.M.)  
 (MAX LOAD—60K BTU (5 TON) FOR CHILLER CALC)  
 INLET WATER TEMP 60—80F

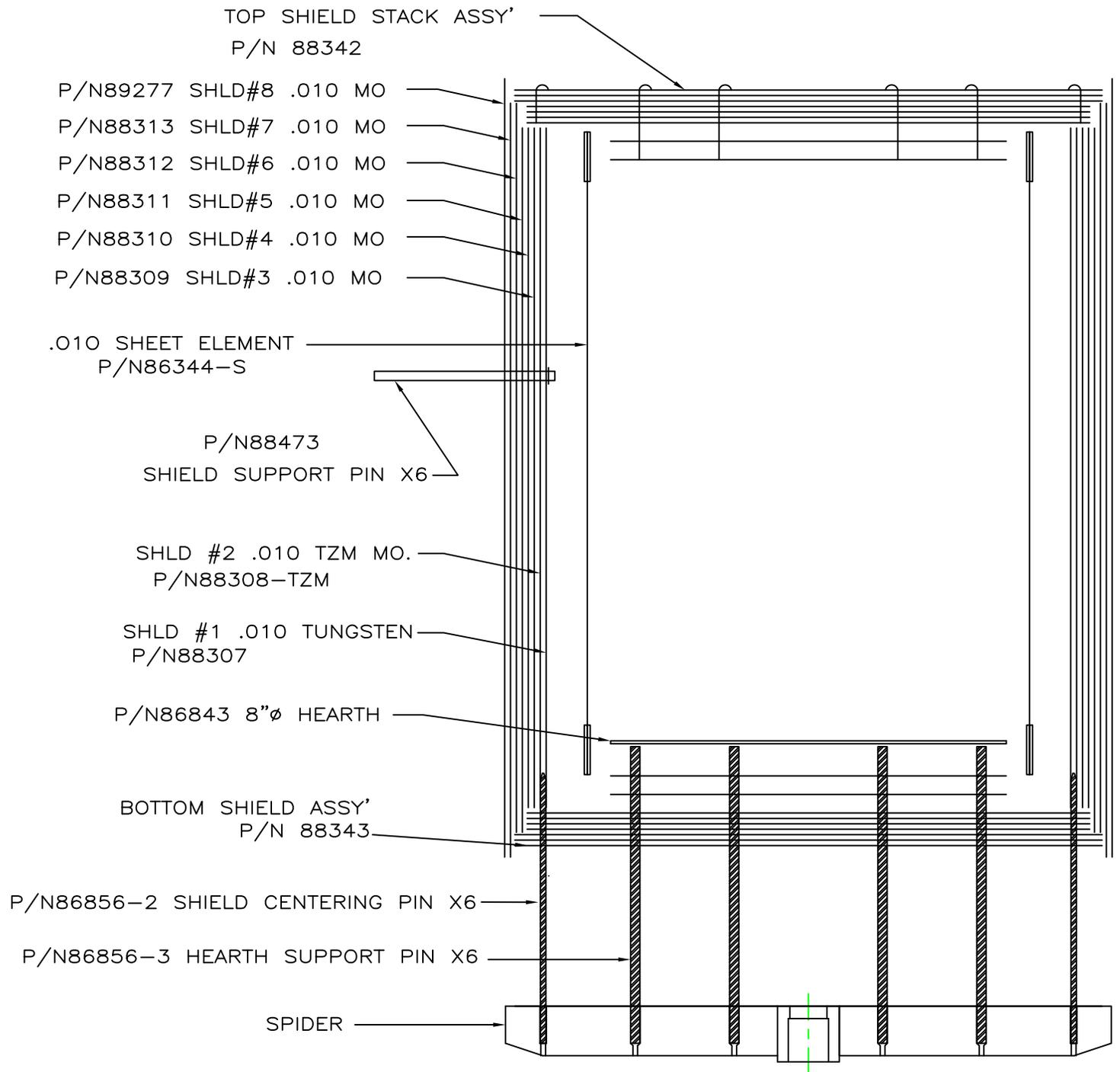
SUGGESTED UTILITY PANEL LAYOUT



(ALL CASTERS SWIVEL.)

		TITLE: B FURNACE FACILITIES PREP.		
		DRN.BY: T BARULICH	APP.BY: TONY BARULICH	
USED ON TASK	FWO	DATE: 8-26-21	DWG.NO: 86263-B	SHEET 1 OF 3

REV.	DATE	DESCRIPTION
A	7-7-04	ADD PART NUMBERS
B	6-10-09	ADD SHIELD #8, SHORTEN #5,#7 AT TOP
C	10-27-09	CHANGE PN FOR SHLD SUPPORT PIN



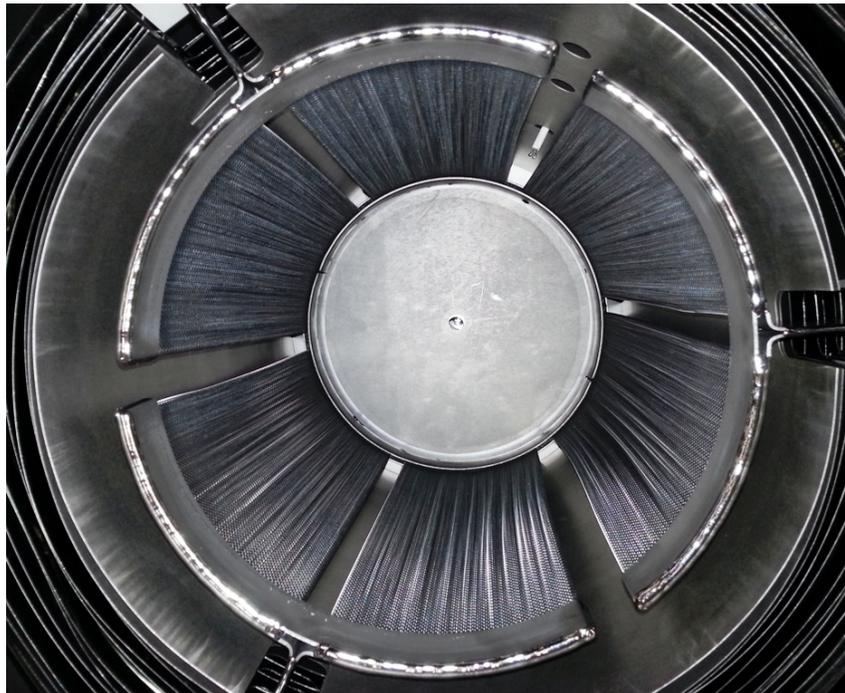
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		TOL'S EXCPT AS NOTED	DRN.BY: T. BARULICH	 <b>Concepts &amp; Methods Company, Inc.</b>
		fract. ±1/32	APP.BY:	
2000 DEG FURNACE		.XX ±.010	DATE: 03/02/01	
B-20		.XXX ±.005	MAT:	
USED ON TASK	FWO	.XXXX ±.0005	FINISH:	TITLE: B-20 HOTZONE LAYOUT WITH P/Ns
		ANGLES ±1/2°		DWG.NO: 88570
				SHEET 2 OF 3
				REV: B

B-2000 Hot Zone 8"Ø (200mm) X 12" (300mm) Depth  
Tungsten and Molybdenum Heat Shields. Tungsten Bottom (Hearth) Plate



Standard Tungsten Sheet Element



*Optional Tungsten Mesh Element, for 2100° C Operation (Identical Dimensions)*