

Controlled Atmosphere Conveyor Furnace

Model Number: 10C-87H

Serial Number: 4552

WATKINS-JOHNSON COMPANY

Commercial Equipment Division

440 Kings Village Road

Scotts Valley, California 95066

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

NOTE

This manual has been prepared to cover a general line of Watkins-Johnson equipment, and in some cases reference may be made to items which are not included in the unit with which this manual is packaged. Whenever differences occur which might cause operating difficulties, this manual will apply to your unit. Should the manual prove to be inaccurate or inadequate for your use, we would appreciate being notified so that we can provide you with the information you desire and simultaneously improve the quality of our instruction manual.

Failure to maintain recommended spare parts can create problems involving unnecessary downtime. Parts used, other than those specified, can cause improper operation of the furnace and use of such parts shall void the Warranty.

DAMAGE CLAIMS

Inspect the furnace on arrival for possible damage incurred during shipment. In the event that the equipment has been damaged, immediately enter a claim with the shipping carrier. Watkins-Johnson Company, or our representative, should also be contacted for assistance if necessary.

GENERAL

This Watkins-Johnson 10C-87H conveyor furnace utilizes a metallic muffle in order to properly maintain a clean, contamination free atmosphere. This muffle is heated by wire-wound heating elements embedded in a ceramic base. The heating elements are installed in segments above and below the muffle, and each segment is independently connected to the power supply so that a maximum amount of zone control may be attained. All materials exposed to the interior of the hot zone, muffle, and belt are of a suitable high temperature alloy chosen for its long life at the zone temperature involved. A water-cooled exit chamber is provided in order to speed the cooling of parts emerging from the furnace.

A conveyor belt of flexible, link construction is supported throughout the entry, hot zone, and cool zone on the bottom of the muffle. The drive system is located at the furnace exit end and the slack take-up occurs just beyond the drive pulley.

A processing environment of nitrogen or hydrogen is offered.

The temperature is accurately controlled by a multichannel microprocessor based temperature controller.

NOTE: This furnace has a maximum temperature rating of 600°C for zone 1 and 1000°C for all other zones.

DETAILS OF CONSTRUCTION

Power Control

Voltage is applied to the heating coils through solid state relays activated by the temperature controller.

Temperature Control

The temperature is controlled by a Watkins-Johnson 951 Microprocessor Based Temperature Controller. Chromel/Alumel thermocouples installed under the hearth provide the input signal to the corresponding controller channel.

Heating Elements

The heating elements consist of a helical winding of Kanthal A1 alloy wire supported in a ceramic plate. These plates are assembled above and below the muffle. The elements are installed in short segments, each individually wired so that maximum zone control can be achieved.

Muffle Section

The muffle is a gas tight Inconel 800 alloy tube constructed with gas curtains at each end. The muffle design allows for easy removal and replacement.

Water Cooling Section

The exit chamber walls are enclosed in water-cooled heat sinks to speed the cooling of parts emerging from the furnace. Water enters the cooling section via the 3/8 inch couplings on the back of the furnace, flows through the cooling plates, through a water temperature probe, and finally through a water flow switch before going to a drain. Failure of water flow will light the indicator status, sound an alarm, and disconnect the element.

Insulation

Suitably rated block-type insulation is provided around the heating chamber. This insulation is quite durable in service, but care must be exercised in its removal for routine maintenance to prevent its damage.

Furnace Environment

Connections for furnace inlet gases are provided at the exit end of the furnace. Nine atmosphere flowmeters are provided. Three burnoff stacks with venturi gas flowmeters are provided for operation in the hydrogen mode. See Drawing 901170 for additional information.

Conveyor Belt and Drive System

The wire mesh conveyor belt is supported throughout the furnace by hearth plates. The chain drive system incorporates a DC motor and SCR speed controller. Belt tracking is maintained with aligning bearings which are located throughout the conveyor track. A rotary switch on the front panel allows the belt to be run in the forward direction, reverse direction, or stopped.

Safety Circuits

1. Water Failure -- Failure of the water flow will light the indicator status, sound an alarm, and shut off power to the elements.
2. Thermocouple Break Protection -- Thermocouple break protection is provided in the WJ-951 controller to shut off zone power in the event of a thermocouple open circuit.
3. Overtemperature Protection -- Thermoguard overtemperature protection is provided. A thermocouple is located in the center of each zone. In the event of an overtemperature condition, the element circuit breaker will open, shutting down the heating element power.

4. Atmosphere Safety System -- The furnace is provided with a combustible atmosphere safety system to provide safe operation of a potentially hazardous gas.



WATKINS - JOHNSON COMPANY

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Microwave Device Products • Easylink 62602190
Production Equipment Products • Easylink 62887411

PROCUREMENT SPECIFICATION NO. 4005116
Watkins-Johnson Model 10C-87(H)
Controlled Atmosphere Conveyor Furnace

1.0 Scope This specification shall cover the manufacture of a controlled atmosphere conveyor furnace for operation to 1000 Degrees C in an atmosphere of hydrogen, forming gas or nitrogen. The specification shall include all items necessary to deliver a complete furnace ready for installation and connection to utilities.

2.0 Specifications

2.1 Temperature The furnace shall be capable of continuous operation to 1000 Degrees C, except zone 1 shall be limited to 600 Degrees C.

2.2 Muffle

2.2.1 Vertical Clearance A minimum vertical clearance of 2.5 inches shall be provided above the conveyor belt.

2.2.2 Heated Section An 11-1/2 inch wide by 4 inch high (inside dimensions) muffle of Type 330 Stainless Steel, or equal, shall be the firing section. A sectioned hearth shall be provided in the firing section.

2.2.3 Cooling Section An 11-1/2 inch wide by 3 inch high (inside dimensions) by 72 inch long stainless steel muffle shall be the cooling section. Heat exchange clamp-on water-cooled heat sinks. The cooling section shall be provided with a water temperature gauge and shall be capable of operating with either high or low pressure water systems. A panel-mounted flowmeter shall be provided.

2.3 Atmosphere The furnace shall be capable of utilizing nitrogen or hydrogen gas atmospheres within the muffle.

2.3.1 Atmosphere Inlet The furnace shall be supplied with atmosphere inlets located above the belt in the center of the heated section. Two flowmeters shall be provided; one flowmeter shall be calibrate for hydrogen and for nitrogen. A mixing hydrogen and the other chamber to blend nitrogen shall be provided.

2.3.2 Combustible Atmosphere Burnoff The furnace shall be provided with atmosphere exhaust burnoffs located at the entry and exit of the heated section and in the cooling section.

2.3.3 Cooling Shower A nitrogen or hydrogen cooling shower shall be provided in the cooling section. The cooling shower shall be provided with flowmeters calibrated for hydrogen and nitrogen.

2.3.4 Curtain Assemblies The furnace shall be provided with a 36-inch flapper door assembly at each end of the furnace. Each flapper door assembly shall be provided with two flowmeters calibrated for nitrogen. Nitrogen purge in the curtain assemblies shall be from both above and below the belt. Flow switches shall be provided in the curtain top plenums.

2.3.5 Safety Shields Bolt-on type blast gates shall be provided at each end of the muffle.

2.3.6 Sample Ports The furnace shall be provided with three sample ports near the bottom of the muffle and two for the incoming gasses for a total of five. Sample ports shall be connected to a Ondyne Model 2100 hygrometer.

2.4 Conveyor System

2.4.1 Conveyor Belt The furnace shall be provided with a 10 inch wide conveyor belt of Type Stainless Steel (mesh 60-35-16).

2.4.2 Conveyor Speed The furnace shall be provided with a variable speed conveyor drive system capable of control between 1 to 10 inches per minute. Tachometer feedback closed loop control shall be provided. Speed control accuracy shall be $\pm 1/4\%$ over the full range.

NOTE: Design belt speed shall be 6.0 inches-per-minute.

2.4.3 Drive System The conveyor drive system shall provide positive traction and belt alignment throughout the furnace and shall be controlled through a dc motor. A reverse direction switch shall be mounted on the control panel.

2.4.4 Conveyor Belt Return The conveyor belt return shall be a roller conveyor.

2.4.5 Battery Back-Up System A battery back-up system shall be provided to control the 115 volt circuit in the event of a main power failure.

2.5 Furnace Chamber The furnace chamber shall be divided into the following sections:

Entry 40 inches

Heated Section

Zone 1	19-1/4 inches
Zone 2	19-1/4 inches
Zone 3	19-1/4 inches
Zone 4	19-1/4 inches
Zone 5	9-5/8 inches

Total Heated Length 87 inches

Cooling Section

Insulated Pre-Cooling	12 inches
Water Cooling	72 inches

2.6 Temperature/Power Controls

2.6.1 Thermocouples Two Chromel/Alumel (Type K) thermocouples shall be provided in each independently controlled heated zone. Thermocouples shall be spring loaded

under the muffle
bottom of the

and shall be removable from the
furnace.

2.6.2 Process Control System (Model WJ-951) The furnace shall be provided with an integrated microprocessor based multi-channel temperature control system featuring a DOS based PC computer with color graphics and CRT touch screen user interface. The control system shall provide three mode (PID) temperature control of all furnace zones including side-to-center power trim. Belt speed control and monitoring, real time profiling, recipe storage, high-low temperature process alarms shall be accomplished through the WJ-951 Control System. All process variables are protected against main power fail by a ten year battery backed memory for fail-safe operation. Three thermocouple jacks shall be mounted at the load table and wired to the WJ-951 Process Control System.

2.6.3 Power Controls Power to the heating elements shall be controlled through zero firing optically isolated SCR power controllers.

2.6.4 Trim Controls Power levels to top and bottom elements relative to the side elements shall be provided through the WJ-951 (side-to-center trim).

2.6.5 Function Controls The furnace shall be provided with switches and indicator lights for the following functions:

Control Power	Element Power
Conveyor System	Alarm Silence
Water Fail	Atmosphere Safety System

2.7 Heating Elements The furnace shall be provided with heating elements of Kanthal A-1 alloy, or equal. Elements shall be supported in grooved ceramic backplates.

2.8 Safety Features The furnace shall be provided with the following safety features:

2.8.1 Thermocouple Break Protection Thermocouple break protection shall be provided on the temperature controller.

2.8.2 Water Failure A flow switch shall be provided to shut off conveyor and element power in event of water failure.

2.8.3 Atmosphere Safety The furnace shall comply with Motorola Safety Specification No. 118.

2.8.4 Overtemperature Protection The furnace shall be provided with a WJ-991 five zone overtemperature scanning system.

3.0 Construction

3.1 Frame The furnace shall be constructed on a welded steel frame. Leveling capability of $\pm 3/4$ inch shall be provided.

3.2 Panel The furnace shall be enclosed with removable painted metal panels. Panels shall be painted an equivalent or DuPont Imron 824 Beige.

3.3 Insulation A suitably rated combination of insulating firebrick and batt-type insulating material shall enclose the heated section of the muffle.

3.4 Load/Unload Tables 72 inch long load and 36 inch long unload sections shall be provided. Blast deflectors shall be mounted at both the entry and exit to the furnace. Both load and unload sections shall be of minimum width for belt, framing and panels. Side panels will extend down to the floor and the sections be supported with leveling legs. The belt will be supported by stainless steel wear pads.

NOTE: Blast Gates take up 12 inches clearance on load and unload tables making useable clearance 60 inches and 24 inches respectively.

3.5 Weight and Dimensions

Overall dimensions	26.8 feet long 42 inches wide (46 inches at the control console) 50 inches high
Conveyor belt height	33 inches above floor level
Shipping weight	4,500 pounds

NOTE: All weight and dimensions in this specification are approximate. End tables to be removed for shipment making furnace, with blast gates, approximately 19.5 feet long.

4.0 Utilities

4.1 Electrical Power Supply 50 KVA maximum connected load, 208/230 volts, three-phase, 60 Hz. The furnace shall be provided with a fused disconnect switch.

4.2 Atmosphere Hydrogen and nitrogen at 30 psig plumbed to 3/8 inch pipe couplings.

Nitrogen 1000 scfh

Hydrogen 400 scfh

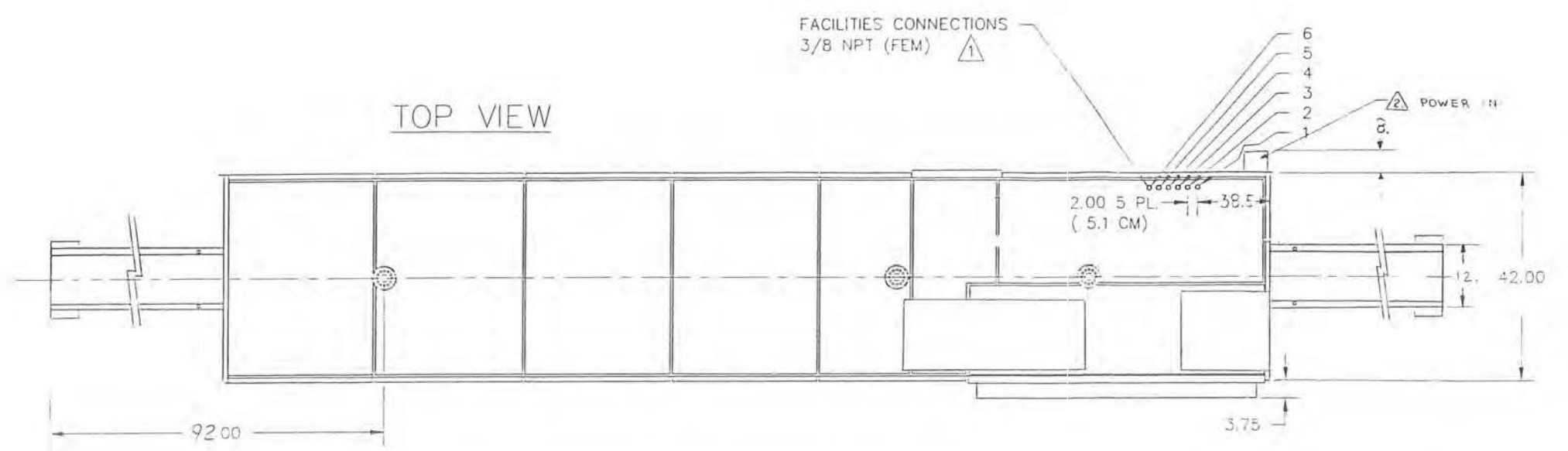
4.3 Water Supply 240 gph (minimum) at 60 psig.

4.4 Utility Connections Electrical power, atmosphere inlet, and water connections shall be located at the top back side of the control console.

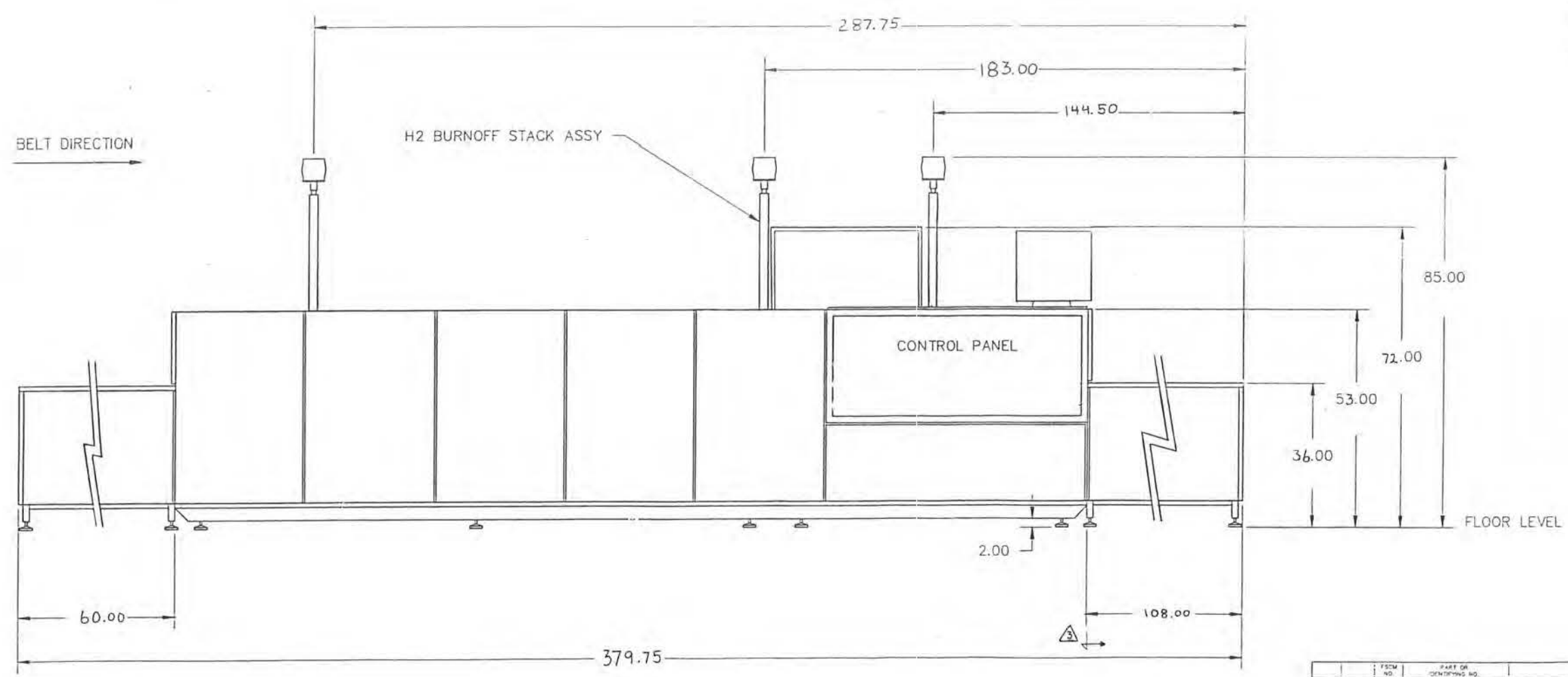
NOTE: Supply requirement in Paragraph 4.0 are recommended supplies and may exceed actual furnace requirements.

5.0 Documentation Three sets of Installation, Operation, and Maintenance manuals shall be provided.

REVISIONS			
ZONE / REV	DESCRIPTION	DATE	APPROVED



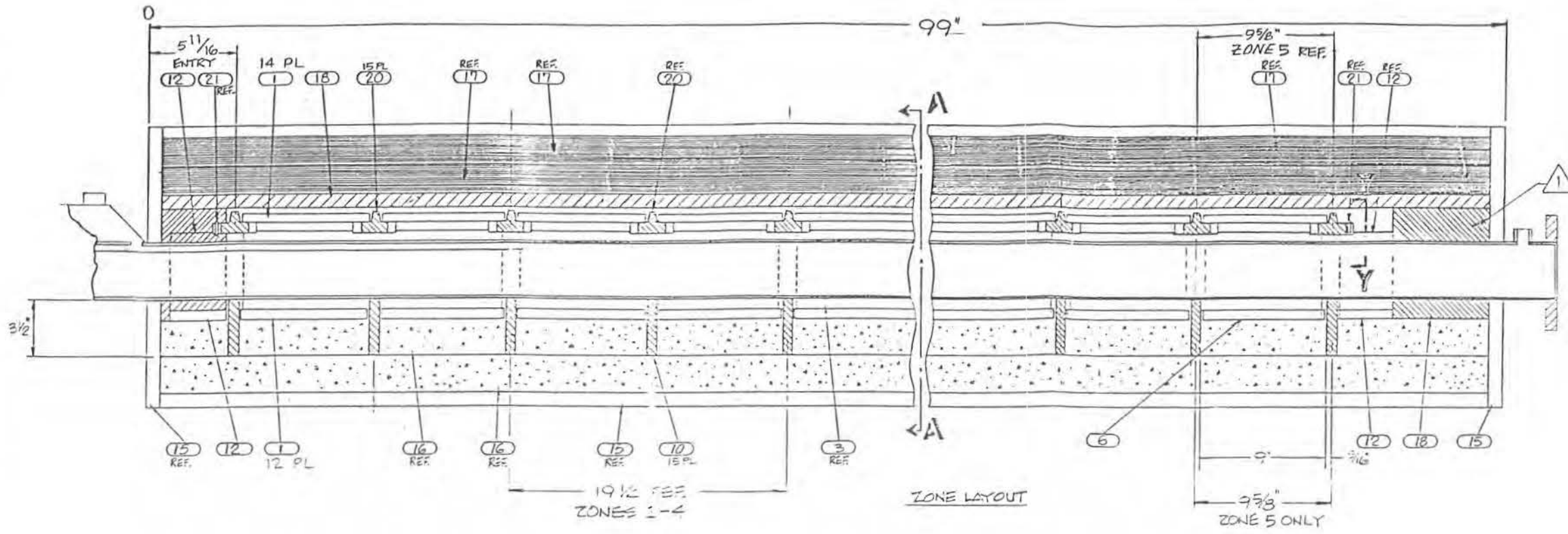
- NOTES:
- 1. FACILITIES REQUIREMENTS
 1. WATER OUT
 2. WATER IN - 240 GPH (MAX) @ 60 PSIG
 3. N2 - 1000 SCFH (MAX) @ 20 PSIG
 4. AUX. N2 - 200 CU. FT. (SEPERATE BOTTLE SUPPLY)
 5. H2 - 400 SCFH (MAX) @ 20 PSIG
 6. VENTURI N2 - 6 SCFM (MAX) @ 20 PSIG
 - 2. ELECTRICAL REQUIREMENTS
 - 480 VOLTS, 60 Hz, 3 PHASE WYE
 - 50 KVA MAX. 10 KVA TYP.
 - 3. UNLOAD TABLE BREAKDOWN
 - 1-12" BLAST HOOD
 - 12-50" DODGING FAN
 - 60-102" BELT



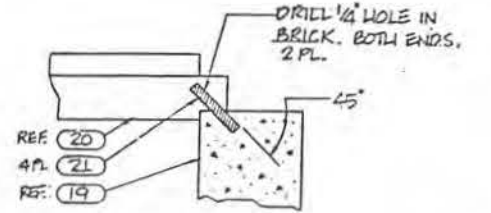
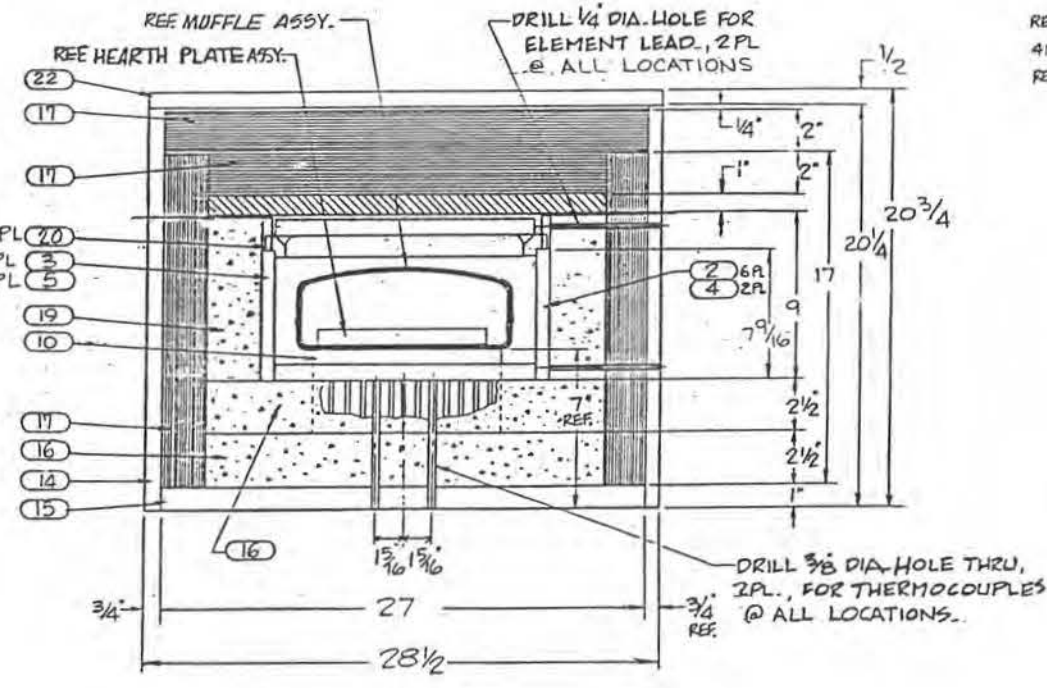
FRONT VIEW

ITEM		PART OR IDENTIFYING NO.		NOMENCLATURE OR DESCRIPTION		MATERIAL SPECIFICATION		ITEM NO.	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:									
FRACTIONS	DECIMALS	ANGLES		PARTS LIST					
1/32	.001	°		CONTRACT NO.		WATKINS-JOHNSON COMPANY			
APPROVALS				DATE		MICROWAVE DEVICES, PRODUCTION EQUIPMENT			
DRAWN				1/8/91		SCOTT'S VALLEY, CALIFORNIA			
CHECKED				11/8/91		FURNACE OUTLINE & UTILITY CONNECTIONS			
ENGR.									
MFG. ENGR.									
P.A.									
DASH NO.	NEXT ASSY	USED ON	SIZE	FSM NO.	QTY NO.	REV.			
001	B930127	10C-87	D	05783	930536	-			
APPLICATION				UNCTRL		DO NOT SCALE DRAWING			

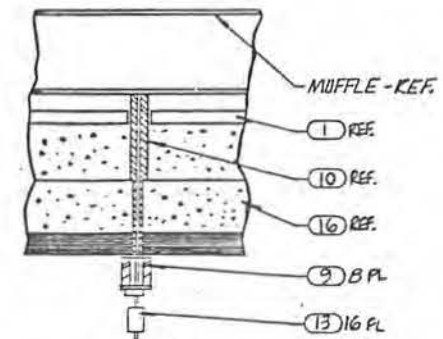
REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
-	-	P.R. PER W.O. # 0606	3-20-89	RI/RW



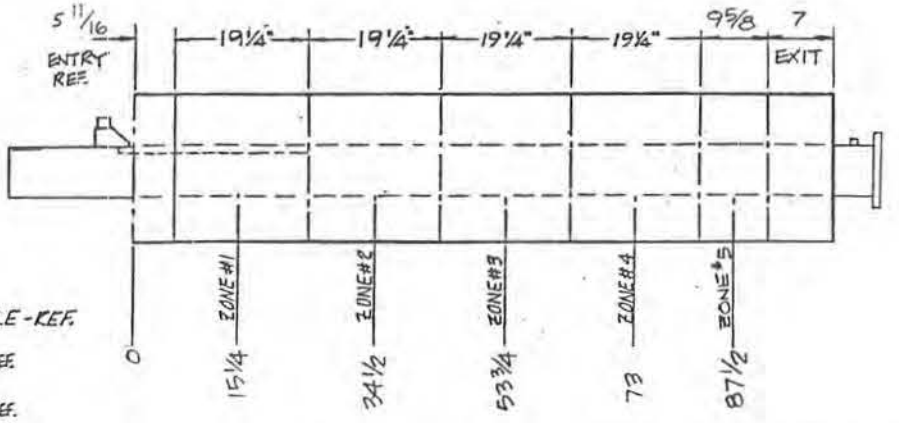
NOTES:
 ▲ PACK BOTH ENDS WITH CERAFELT SIDES, TOP & BOTTOM



SECTION YY



THERMOCOUPLE DETAIL

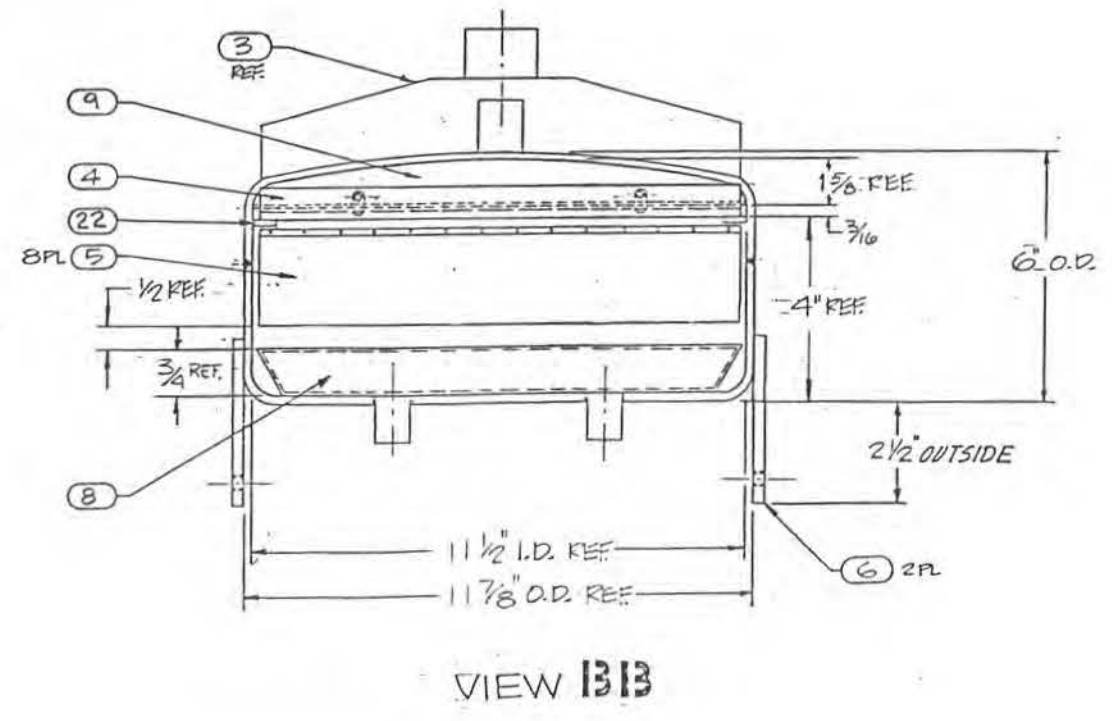
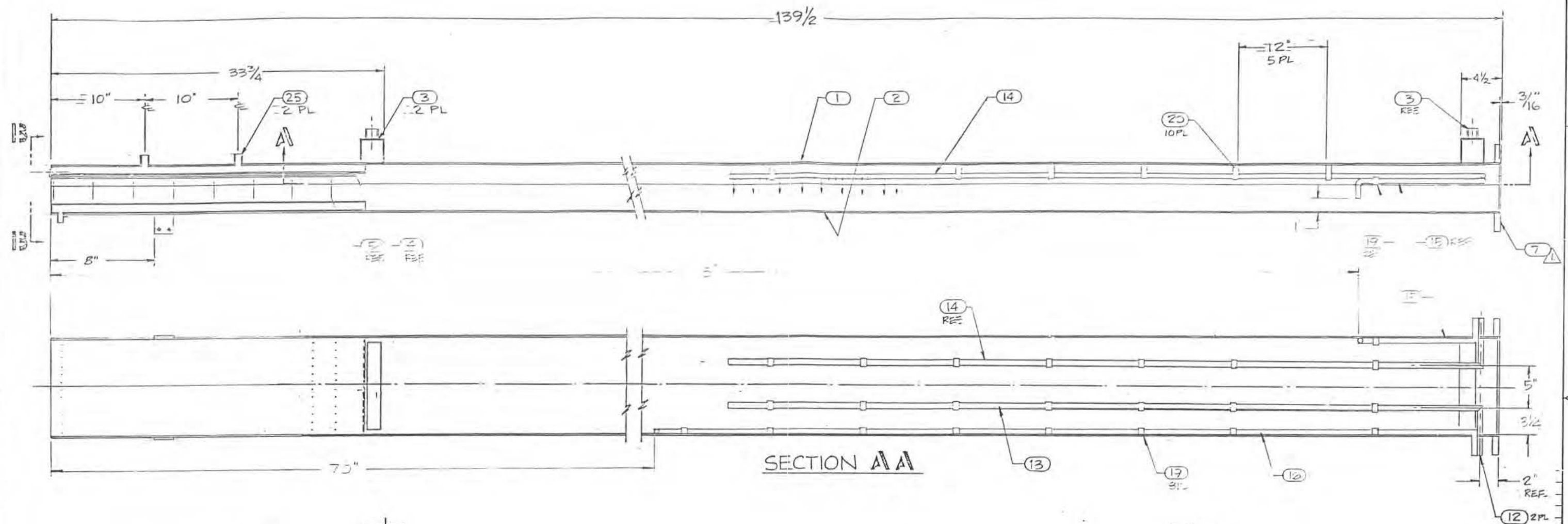


HEATED BOX OUTLINE W/ THERMOCOUPLE LOCATIONS.

SEE B901168-1, SH. 1 OF 2, FOR PARTS LIST.

DASH NO.		PART OR IDENTIFYING NO.		NOMENCLATURE OR DESCRIPTION		MATERIAL SPECIFICATION		ITEM NO.	
001	B901168-1	100C-87(H)(S)		HEATED BOX ASSEMBLY		WATKINS-JOHNSON COMPANY MICROWAVE DEVICES, PRODUCTION EQUIPMENT SCOTTS VALLEY, CALIFORNIA		901168	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± 1/32 ± .005 ± .005 ± .005		CONTRACT NO.		APPROVALS		DATE		REV	
MATERIAL		DRAWN R.Y.		CHECKED RAS		3-20-89		1	
FINISH		ENGR. RB		MFG. ENGR.		7/27/89		2	
APPLICATION		DO NOT SCALE DRAWING		SCALE: ---		DIV 23		SHEET 2 OF 2	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROV
		PRODUCTION RELEASE PER W.O. # 0606	3-28-57	RV / [Signature]



SEE B901249-1, SH. 1 OF 2 FOR PARTS LIST.

DASH NO.		NEXT ASSY		USED ON		APPLICATION		DO NOT SCALE DRAWING	
001	B901169-1	100	87(4)(6)						

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:		CONTRACT NO.		APPROVALS		DATE	
FRACTIONS	DECIMALS	ANGLES					
± .002	± .005	± .005					

PARTS LIST		MATERIAL SPECIFICATION		ITEM NO.	
WATKINS-JOHNSON COMPANY MICROWAVE DEVICES, PRODUCTION EQUIPMENT SCOTTS VALLEY, CALIFORNIA		MATERIAL SPECIFICATION		ITEM NO.	
MUFFLE WELD/ ASSY (HEATED SECTION)		MATERIAL SPECIFICATION		ITEM NO.	
SIZE / FSCM NO. / DWG. NO.		MATERIAL SPECIFICATION		ITEM NO.	
D / 05783 / 901240		MATERIAL SPECIFICATION		ITEM NO.	
SCALE / DIV. 23 / SHEET 2 OF 2		MATERIAL SPECIFICATION		ITEM NO.	