



WATKINS - JOHNSON COMPANY

440 Kings Village Road • Scotts Valley, California 95066 • (408) 438-2100
Microwave Device Products • Easylink 62602190
Production Equipment Products • Easylink 62887411

PROCUREMENT SPECIFICATION NO. 4010268
Watkins-Johnson Model 9C-38(H)
Controlled Atmosphere Conveyor Furnace

October 1990

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 or air. 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, under no load conditions and 600 Degrees C under normal operating conditions.

2.2 Muffle

2.2.1 Vertical Clearance A minimum vertical clearance of 1 inch shall be provided above the conveyor belt.

2.2.2 Heated Section A 10-1/2 inch wide by 3 inch high (inside dimensions) muffle of Incoloy 800 alloy, or equal, shall be provided in the firing section.

2.2.3 Cooling Section A 10-1/2 inch wide by 3 inch high (inside dimensions) by 52 inch long Incoloy 800 muffle shall be provided in the cooling section. Heat exchange shall be through 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 hydrogen, nitrogen or combustible forming gas atmospheres within the muffle.

- 2.3.1 Atmosphere Inlet The furnace shall be supplied with an atmosphere inlet located above the belt in the center of the heated section. Two flowmeters shall be provided; one calibrated for hydrogen and one for nitrogen. A mixing chamber shall be provided for making forming gas. A flowmeter shall be provided down stream of the mixing chamber for monitoring flowrate.
- 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.
- 2.3.3 Cooling Shower A nitrogen or hydrogen shower shall be provided in the cooling section. The cooling shower shall be provided with flowmeters calibrated for nitrogen and hydrogen. A mixing chamber shall be provided for making forming gas. A flowmeter shall be provided down stream of the mixing chamber for monitoring flowrate.
- 2.3.4 Curtain Assemblies The furnace shall be provided with a flapper door assembly at each end of the furnace. Each flapper door assembly shall be provided with flowmeters calibrated for nitrogen. Gas purge in the curtain assemblies shall be from above the belt.
- 2.3.5 Safety Shields Bolt-on type blast gates shall be provided at each end of the muffle.
- 2.4 Conveyor System
- 2.4.1 Conveyor Belt The furnace shall be provided with a 9 inch wide conveyor belt of Incoloy 800 alloy (mesh 60-50-20).
- 2.4.2 Conveyor Speed The furnace shall be provided with a variable speed conveyor drive system capable of control between 2 to 30 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 9 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.

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

Entry 24 inches

Heated Section

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

Total Heated Length 38-1/2 inches

Cooling Section

Insulated Pre-Cooling	7 inches
Water Cooling	52 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 and shall be removable from the bottom of the furnace.

2.6.2 Process Controller The furnace shall be provided with a WJ-988 multi-channel microprocessor-based temperature controller. The controller shall provide three mode temperature control with keyboard entry of setpoint, power level, proportional band, rate, reset, and high-low process alarm settings for each individual zone.

Belt speed control shall be accomplished through the Model WJ-988 Microprocessor Controller. Up to eight different profiles (recipes) can be stored and recalled through the keyboard. An alpha-numeric one line readout is provided for belt speed, temperature, setpoint, power level, proportional band, reset, rate and high-low process alarm settings for each zone.

- 2.6.3 Power Controls Power to the heating elements shall be controlled through zero-firing optically isolated SCR power controllers.
- 2.6.4 Function Controls The furnace shall be provided with switches and indicator lights for the following functions:

Control Power	Element Power
Conveyor Belt	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 controllers.
- 2.8.2 Water Failure A flow switch shall be provided to shut off conveyor and element power in the event of a 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 four zone over-temperature scanning system.
- 2.8.5 Motorola Hydrogen Sniffer System The furnace shall be provided with a General Monitor Model 580 with four hydrogen sensors. This allows compliance with Motorola Safety Policy #0021.

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 Panels The furnace shall be enclosed with removable painted metal panels. Panels shall be painted Sherwin Williams Aqua Blue #PH-63-141, or equivalent.
- 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 Loading/Unloading Tables A 12 inch long load and an 18 inch long unloading table shall be provided. The table tops shall be of type 304 stainless steel. The bolt on blast gates which are mounted to the tables reduce the useable exposed belt to approximately 8 inches.

3.5 Weight and Dimensions

Overall Dimensions	12.7 feet long 42 inches wide (46 inches at the control console) 68 inches high
Conveyor Belt Height	36 inches above the floor
Shipping Weight	3,000 pounds

NOTE: All weight and dimensions in this specification are approximate.

4.0 Utilities

- 4.1 Electrical Power Supply 15 KVA maximum connected load, 208 volts, three-phase, 60 Hz. Main fused disconnect shall be provided by the customer.

- 4.2 Atmosphere Nitrogen and hydrogen at 20 psig plumbed to 3/8 inch pipe couplings shall supply the following flowmeters:

Nitrogen

Entry Curtain	0.5-6 scfm
*Chamber Atmosphere	0.5-6 scfm
Cooling Shower	0.5-6 scfm
Exit Curtain	0.5-6 scfm

Hydrogen

*Chamber Atmosphere	200 scfh
Cooling Shower	200 scfh

- *NOTE: The output of the chamber atmosphere nitrogen and hydrogen flowmeters shall be plumbed to a stainless steel mixing chamber for the purpose of mixing various ratios of these gases prior to introduction to the muffle.

- 4.2 Water Supply 50 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 requirements in Paragraph 4.0 are recommended supplies and may exceed actual furnace requirements.

- 5.0 Documentation Two sets of Installation, Operation and Maintenance Manuals shall be provided.