TECHNICAL SPECIFICATION

A. Dry-Off Oven

Load Area = 2286mm L x 1397mm W x 3O5mm H
Maximum Pass Height = 305mm
Process Height from Floor = 1067mm
Automatic Doors
Oven Incorporated with Furnace Conveyor System
Water Loading = 15 gal/hr. max.
Thermal Input -Natural Gas 1,000,000 Btu/Hr maximum
Normal OperatIng Temp. = 232°C
Max. Operating Temp. = 316°C
Total Connected HP = 15 HP
Recirculating Air Capacity = 14,000 cfm

1. High velocity, natural gas-fired burners shall provide the heat input necessary to properly dry the products of moisture present prior to the brazing process.

2. Oven construction shall consist of sturdy mild steel exterior and a stainless steel alloy interior. All structural members shall be provided to support the oven shell.

3. Oven will utilize the braze furnace conveyor belt and drive system as the means to convey the products through the dry off and brazing stages.

B. Convection Braze Chamber

Load Area = 2286mm L x 1397mm W x 3O5mm H
Maximum Pass Height = 305mm
Process Height from Floor = I067mm
316L SST Balanced Weave Mesh Belt 1397mm wide
Maximum Temperature = 650°C
Thermal Input -Direct Fired High Velocity Natural Gas Burners
950,000 Btu/Hr Maximum
Motors and Controls = 25 kW max.
Mild Steel Furnace Exterior
316L SST Patented Convection Muffle 1/4" corrugated design
Entrance & Exit Chambers with Atmosphere Curtains

1. A patented 316L stainless steel convection muffle will be used throughout the main heating chamber to ensure atmosphere integrity, as well as a uniform heat-up rate and braze temperature.

2. The heat input into the brazing section of the furnace will be provided by direct-fired, high velocity natural gas burners which will be mounted horizontally above and below the muffle. Heat distribution to the furnace muffle will be such that the proper temperature profile will be achieved.

3. A water-jacketed cooling chamber will be located at the discharge end of the brazing furnace. This chamber will solidify the brazed joint and cool the parts after being discharged from the furnace.

4. An air blast cooling station will follow the water-jacketed cooling chamber to cool the parts to approximately 10°C above the ambient temperature for handling. Fixtures may be at a higher temperature depending on mass.

5. The furnace will be a semi-continuous type, that will allow for variable heating and cooling rates depending upon indexing times.

6. The atmosphere curtain entrance chamber and water jacketed cooling section, also with curtains, will be designed with minimum volume to further reduce atmosphere consumption.

C. Instrumentation & Controls

Allen Bradley SLC 5/03 PLC
Gateway 2000 PC computer
"Accubraze" Man-Machine Interface
Honeywell UDC 2000 Temperature Device
120 VAC Control Power

D. Power Control Instruments

415 V AC, 3 phase, 50 Hz
Control Circuit Transformers
Variable Speed Drive Controllers - Conveyors and Fan

E. Spare Parts

See Scope of Supply

The equipment supplied shall be capable of producing the conditions necessary for successful aluminum brazing which includes temperature uniformity, atmosphere integrity and proper cooling of the products.

EQUIPMENT LIST

A. Dry-off Oven

Supplier will provide a single zone dry-off oven with overall outside dimensions as shown on Sales Sketch. A 1397mm wide x 305mm high opening at each end of the oven will be provided for the passage of the products and conveyor. Automatic doors will be provided at the entrance and exit of the dry off oven.

Housing

The walls and roof of the oven will be constructed of aluminized steel exterior with a 304 stainless steel interior. The oven chamber will have 150mm of insulation. One access door will be supplied for access to the fan and heating equipment in the oven. Supplier will supply all necessary structural members to provide a rigid frame for the oven. All structural members on the interior of the oven will be 304 stainless steel and all members on the exterior will be mild steel. The dry off oven will utilize the braze furnace conveyor belt to convey the products through the oven.

Recirculating System

Recirculation for the oven will be provided by one fan plug assembly as shown on Sale Sketch. A 15 Hp blower will be used for the recirculation blower. The fan shaft will extend through the oven roof to the ball bearing unit located outside of the oven. The fan wheel and housing will be of 304 stainless steel construction and all external fan components will be of mild steel construction. Recirculating air flow will pass vertically up through the product workspace and return past the heat source to the fan for recirculation. The total recirculated air flow will be approximately 14,000 cfm.

Burner and Combustion System

One burner assembly will be provided for natural gas operation of the dry-off oven. The system will include a single burner assembly that will be fully piped and tested to have a complete and safe operating combustion system that will conform to NFPA standards. Flame supervision will be provided by a flame rod. The dry off oven combustion system will have a maximum capacity of 1,000,000 Btu/Hr.

Exhaust System

One 1500 cfm. 1/2 Hp exhaust blower will be provided for removing vapors from the dry-off oven during heating. Exhaust points for the equipment

approximately 915 mm above the roof of the oven will be provided by the Supplier.

Temperature Control
The dry off oven temperature control will be provided by the system PLC. An over temperature thermocouple and one Honeywell UDC-2000 over temperature control instrument will be included to shutdown the dry off oven in case of an over temperature condition. The over temperature controller and controller components will be mounted and wired in the CAB furnace control panel.

B. Convection Braze Chamber

The Supplier will provide a convection brazing chamber that will be approximately as shown on SALE SKETCH. This chamber will be provided to heat the products to brazing temperature in a recirculated atmosphere. Recirculation will be provided by two (2) variable speed axial flow fans. The fans will be belt driven with 7.5 Hp motors and water-cooled. The recirculating atmosphere flow will begin at the top of the internal baffle, flow evenly distributed down through the uniform load area and return up the sides of the muffle which will uniformly heat the product. The total recirculated flow will be approximately 18,000 scfm for each fan. The heat input into the convection braze chamber will be provided by direct-fired, high-velocity natural gas burners which will be mounted horizontally above and below the muffle. The braze chamber will contain one control zone. The Supplier will provide five (5) burners with a total combustion input of approximately 950,000 BTU/Hr. This heat input will bring the products in the load area to 610^{o}C in approximately 15 to 30 minutes. The system will be designed to process 2 to 4 loads per hour.

The muffle will be a D-shape, corrugated, one-section design as shown on Sales Sketch SK- 7367-R1. The muffle will be welded atmosphere tight to provide the integrity required for the brazing process. The braze muffle will be fabricated from 6 mm 316L stainless steel alloy. The muffle will be necked down at the entrance and exit ends of the convection brazing chamber to minimize atmosphere consumption and air infiltration. The mesh belt conveyor will ride on heavy herring bone supports. Proper heat distribution and uniform atmosphere circulation will be provided by the axial flow fan assembly in conjunction with the internal recirculation baffles mounted around and above the load area. All internal muffle components will be fabricated from 316L alloy.

Muffle

The fans will be removable through easily accessible fan towers and the remaining muffle internals will be accessible through the ends of the muffle after breaking the flange area at either end. All the internals will be removable for inspection, repair or replacement and may be accomplished with the muffle in place in the furnace. The Supplier will provide a bolted, gas-tight flange connection for the necked - down flange area of the entrance and exit ends of the muffle. Four (4) atmosphere inlets will be provided, two (2) in the braze chamber to assure a uniformly distributed and preheated atmosphere flow in the muffle and one (1) inlet each will be provided in the entrance chamber and the water jacketed cooling chamber. A nitrogen inlet will also be provided in the fan plug to ensure a proper seal. Approximately 98m^3/hr maximum of atmosphere will be required at 1 psi. Each chamber inlet will have an individual flow meter with a valve to balance nitrogen flow into the muffle. All atmosphere flow meters will be mounted on a separate stand and come pre-connected to the furnace atmosphere supply piping. Fan speed/temperature control thermocouples will be inserted directly into the muffle, allowing accurate and precise temperature control at the product, where it is needed most. Tension will be applied to the muffle by an air cylinder at the discharge end of the furnace prior to the water-cooled section to prevent muffle distortion

Control Thermocouples

Control thermocouples will be inserted directly into the muffle chamber in the braze zone. The muffle design will allow for inserting the thermocouples directly into the muffle, allowing accurate and precise temperature control at the product where it is needed most. Thermocouples will be placed directly above and below the load area and will be used to monitor the temperature of the load area. Convection heating will be utilized to bring the load area to a uniform braze temperature. A PID loop in the PLC control system will monitor and control the variable heating rate of the load area to achieve the uniformity required for the brazing process.

Shell

The shell will be constructed of 6 mm thick steel sheet. Steel skids will be provided throughout the length of the furnace including the entrance and exit chambers. The roof of the furnace will be removable and will be bolted and gasketed to the side wall shell.

Insulation

The walls and roof of the braze chamber will have insulation, which will restrict the surface temperature to ~10^{o}C above ambient.

Water-Jacketed Cooling Station

The water-jacketed cooling chamber will be of double-wall construction. The inner wall will be mild steel. Water will constantly circulate around all sides of the inner wall, removing heat from the newly brazed products. The water will

be contained by an outer wall of mild steel plate. Water temperature will be controlled by a thermostat with thermometer, pre-piped solenoid and ball valves. Also included will be a visible sight drain and easy-access removable cover. The cooling chamber will be designed such that the work will exit the water-jacketed chamber at approximately 400^{o}C maximum.

Atmosphere Curtains

The Supplier will provide multiple rows of atmosphere curtains inside the furnace doors in the entrance and exit chambers to minimize atmosphere consumption. The curtains will be arranged for easy removal to facilitate replacement or repair when required. The atmosphere curtain sections will include two types of curtain arrangements fabricated from lnconel 600 and woven fiberglass material.

Doors

Doors will be provided at both the charge and discharge ends of the furnace. These doors will be pneumatically operated and actuate automatically. The doors will work in conjunction with the atmosphere curtains to minimize atmosphere consumption.

Burners and Combustion System

The convection brazing furnace will be equipped with a one (1) zone, nozzle-mixing combustion system. The brazing zone will contain five (5) high velocity burners firing into the furnace chamber in the area above and below the muffle. This system will include a single combustion air blower, cross-connected zone regulator, control valve, control motor, manual and automatic valves as required to have a complete and safe- operating combustion system. The system will conform to NFPA standards. Flame supervision will be provided by UV flame sensors.

Conveyor Belt, Drive and Take-Up Mechanism

The conveyor belt will be a balanced-weave design which will weigh approximately 1.36 kg/ft^2. This belt will convey the products specified through the furnace and should provide years of trouble-free service. The conveyor drive will be located at the discharge end of the furnace and will consist of a variable speed drive unit operating a drive drum through a speed reducer and a pinch roll assembly. An automatic take-up drum will be located at the discharge end of the furnace. An AC drive motor with a variable speed drive unit will provide the power and flexibility required to effectively convey the product through the braze furnace. A PLC controlled indexing system will provide the semi-continuous capabilities of the system. The distance of each index will be maintained with an encoder which will be connected to the PLC.

Oxygen Analyzer

The Supplier will furnish a single-point oxygen analyzer for monitoring oxygen content at selected locations in the furnace. The analyzer will be a Teledyne or equivalent.

Atmosphere System

Nitrogen (-50°C dewpoint, 5 PPM) will enter the furnace through the nitrogen delivery system. The system will preheat the nitrogen before it enters the muffle, and distribute it evenly when it does enter the muffle, preventing "cold spots" on the product. The flow of the nitrogen is controlled and monitored with flow meters, one (I) for each nitrogen entry point. This will enable directing the nitrogen to the area of the system where it is most needed.

BeIt Return

The furnace design incorporates an external belt return. This design allows the conveyor belt to return under the bottom of the heat chamber to the drive station.

Atmosphere Scrubber

The Supplier will provide a dry scrubber unit fabricated for pollution control of the residue discharged from the brazing furnace. This scrubber will allow all nitrogen exhausted from the brazing furnace to pass through an activated alumina bed before exiting to the atmosphere. The system includes an exhauster and flanges to adapt to the Supplier's ductwork to carry nitrogen from the exhaust ports on the furnace to the scrubber. The scrubber will have quick disconnect latches and hinged doors to facilitate easy removal and replacement of the activated alumina when required. Ducting to the scrubber will be galvanized pipe provided by the Supplier.

The scrubber unit shall be capable of treating the exhaust gases to the standards specified below.

HF emissions in $\mu gm/M^3$ (max.)	30
NO_X in PPM (max.)	50
Particulate matter mg / NM^3(max.)	150
SO_2 PPM (max.)	100

Airblast Cooling Station

Downstream of the water-jacketed cooler, the parts will leave the exit chamber and pass through an airblast cooling station which will utilize outside air to cool the parts. Two (2) tube axial fans with 1/4 Hp motors each will be supplied to force air into the airblast cooling station to cool the product. The products exiting the airblast cooler will be approximately 10°C above the ambient temperature.

The unit will be approximately as shown on Sketch SALE SKETCH.

C. Instrumentation and Controls

The foundation of the electrical control system will be an Allen Bradley SLC 5/03 programmable logic controller (PLC), linked to a Gateway 2000 Pentium computer for the man/machine interface. The "Accubraze' control system will use Wonderware's Intouch software to enable the computer to communicate with the programmable controller via an RS-232 serial interface cable. The "Accubraze" software will be fully configured by the Supplier's engineers with various animated, color screens depicting the status of electrical components, temperatures in the control zone for the braze furnace, oxygen levels, belt speed, recipe selection, run or idle mode, PID loop tuning, alarms. etc. The operator should be able to make the required selections for operation using the attached keyboard and mouse. Report generation and data trending is available with the "Accubraze" software. Software will also be included to monitor the operation of the furnace and enable access to the "Accubraze" control screens via modem.
The computer and PLC will be housed inside a pre-wired, floor standing, NEMA 12 control panel. The keyboard and mouse will be accessible by a pullout tray, mounted below the Plexiglas window which protects the 15" color computer monitor. Also mounted on the control panel are the Honeywell UDC 2000 excess temperature shutdown instruments, the master control relay, emergency stop push button and indicating light, oxygen analyzer, sample pump on/off control switch, and flow meters and filters for the sampling system. Located on top of the panel will be the atmosphere sample point solenoid valves. Inside the control panel will be the electro-mechanical relays, circuit breakers, terminal strips and a re-circulating fan. Two (2) half- height doors will allow access inside the cabinet from the front and two (2) removable access covers are located on the back of the panel.

The instrumentation and controls will have interlocks, annunciations, and alarms, for the safe operation and monitoring of the system.

Approximate panel dimensions are 1830mm wide * 610mm deep * 1830mm high.

D. Power Control Instruments

The power panel will also be a pre-wired, floor standing, NEMA 12 enclosure which will house all electrical components of 220 VAC and higher .The main power disconnect breaker is located in the first door of the panel. Behind the other door will be the variable speed AC controller required for the convection fan and will be controlled by the PLC. The circuit breakers, starters for the full voltage AC motors for the air blast fans and the variable speed AC drive controllers for the conveyor of the braze furnace are located behind the second door. All motor starters and AC drives will be controlled by the programmable controller. Located on top of the power panel will be the control circuit transformers which convert the line voltage to control voltage

(120 VAC and less). Approximate panel dimensions will be 4267mm wide * 610mm deep * 1830mm high.

E. Combustion systems

The combustion systems will have standard features like automatic ignition, flame sensors, lockout relays, fail-safe solenoid valves for the fuel, etc.

SUMMARY OF ITEMS FURNISHED BY THE SUPPLIER

One Seco/Warwick Aluminum Brazing System consisting of:

- One (1) "Active Only" Convection CAB Furnace
- One (1) Dry Off Oven
- One (1) PLC Temperature Control Panel with O_2 Analyzer
- One (1) Power Panel
- One (1) Water-Jacketed Cooling Chamber
- One (1) Air Blast Cooling Station
- One (1) Atmosphere Scrubber
- One (1) Lot of Manuals and Drawings