



QUOTATION

Date: 22 December 2009
 To: LITEFLEX
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 Attention: Mr. Dennis Rediker drediker@b4cllc.com

Quotation No. 8-27-11328B
 Shipment 20-22 Weeks ARO
 Delivery Terms: FOB Nashua, NH
 Packaging: Common Carrier
 Payment Terms: See Body of Quotation

Item	Description	Price
<p>Centorr Vacuum Industries Sintervac® C 600 Horizontal Vacuum /Controlled Atmosphere Sintering Furnace Series 3710 Model 241848-2450-4S/2MT consisting of:</p>		
A.	<p><u>Series 3710 Vacuum & Controlled Atmosphere Chamber</u></p> <p>One horizontally oriented vacuum tight chamber with inner jacket, outer jacket, and flanges. Cold-wall type chamber with baffles positioned between the vessel's walls and recirculating water for uniform cooling. Front and rear closures are double-walled dished head design. Maximum operating range of the vessel from 10⁻³ torr to 2 psig. Chamber includes the following:</p> <p>Inner Jacket: Stainless Steel Outer Jacket: Mild Steel Flanges: Mild Steel Front Door: Full access manual, heavy duty swing-away type clamps. Rear Door: Full access manual, heavy duty swing-away type clamps. Ports: Power feedthrough ports, pumping ports, control and overtemperature thermocouple ports, water drain plugs on chamber/doors, and other ports as detailed below:</p> <ul style="list-style-type: none"> • One (1) automatic air-operated ball valved Centorr Rotatable, gas-purged sight ports for Optical Pyrometer (normally closed during debinding cycle). • One (1) manual operated ball valved Centorr Rotatable, gas-purged sight ports mounted in lower chamber sidewall for use with customer-supplied handheld Optical Pyrometer for checking trim zones. • One (1) Retractable thermocouple port. 	
<p>ANY ORDER RESULTING FROM THIS QUOTATION WILL BE FILLED BY CENTORR VACUUM INDUSTRIES SUBJECT TO THE TERMS AND CONDITIONS IN THIS QUOTATION AS WELL AS THOSE ON THE CVI STANDARD TERMS AND CONDITIONS SHEET (FORM TC2000).</p>		

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	<ul style="list-style-type: none"> • Universal vacuum manifold. • Debind manifold and pumpout tube. • Couplings on each door for air operated hot zone shutter cylinders. • Fan port. <p>Inert gas introductory system is manifolded to the chamber and includes a 5 psig pressure relief valve and 30" Hg-0-15 psig compound Bourdon gauge. The chamber is mounted on four (4) carbon steel legs at a convenient work height.</p>	
B.	<p><u>Chamber Pressure Relief Port</u></p> <p>Spring loaded approx 3" ID relief port mounted on chamber or roughing manifold.</p>	
C.	<p><u>Series 3710 Hot Zone</u></p> <p>The high temperature hot zone is designed for resistance heating and rated to maximum temperature in vacuum, and partial pressure or full atmosphere of inert gas. In order to provide optimal temperature uniformity, the heating element is designed to exacting resistance specifications. Graphite elements, graphite insulation and graphite supports. Mounted in a jail. Includes copper electrode feedthroughs, graphite power studs and interconnecting flexible or rigid copper busswork.</p> <p>Effective Uniform Hot Zone: 24"w x 17.25 h x 48"l (610mm x 438 mm x 1220mm) (uniform effective hot zone size inside of retort, not including load truck clearances).</p> <p>Elements: Graphite Tube & Block</p> <p>Insulation: Four (4) inch thick Rigid graphite board insulation (no coatings or foil) retained with CFC hardware and SS jail. Board to consist of two layers for managing thermal expansion and sacrificial layer for less expensive hot zone repair and replacement in a process environment. Board will be overlapped and staggered to minimize stepjoints which weaken the board.</p> <p>Hearth Supports: Graphite posts and rails.</p> <p>No. of Sides: Four (4) Sided Heating (top, bottom, left and right)</p> <p>No. of Zones: Two (2) manually trimmed upper and lower zones.</p> <p>Max. Temperature: 2450°C in vacuum, partial pressure, positive pressure (or one atmosphere) of Argon gas (with N₂ or He gas to spoil gas plasma as required). NOTE: max temperature in vacuum consistent with vapor pressure of graphite</p> <p>Ramp Rate: 5°C /min (average)</p> <p>Max. Load: 600 kgs (includes load and kiln furniture).</p>	
D.	<p><u>Series 3710 Graphite Retort</u></p> <p>The furnace includes a rectangular graphite retort/work box with the following features:</p>	

Item	Description	Price
Design / Access:	Rectangular work box with front and rear access through a removable doors.	
Retort Inside Dimensions:	Approx 27.5"w x 22.75 h x 50 53"l (699mm x 538mm x 1270mm 1346mm) (inside dimensions of retort)	
Load support:	Graphite Roller Hearth assembly for supporting customer graphite hearth plates. Includes two (2) roller hearth rails (max height of roller at 2.5" from top of retort floor). CVI to add "break-off" stop at end of rollers for load depth placement.	
Gas Plenum:	Gas preheating plenum located in corners of retort positioned down and across the width and length of the load with multiple outlets for improved gas flow dynamics and "showerhead" distribution of gas. Prevents cold gas from flushing the top of the retort causing cold /low density parts on the top rows.	
Pumpout Tubes:	Approx 2" inside dia (50mm) low mass CFC or solid graphite pumpout tube and optical baffle.	
Gas Flow:	CVI dual-flow gas system uses "Outside-in" technology bringing the carrier gas into the chamber, with an additional gas flow into retort for better process control and less chamber contamination. All gases exit the retort pumpout tube(s) through the hot zone to the debind manifold.	
E.	<p><u>Vacuum Pumping System</u> Kinney Model CB-4015 (150/400 CFM)</p> <p>Vacuum pumping system consists of Mechanical pump and blower. Manifold design is configured to consider conductance dynamics related to chamber design and pump sizing. Welded, vacuum tight manifold for integration with vacuum pumping system.</p> <p>Manifolding includes:</p> <ul style="list-style-type: none"> • Main Roughing Manifold - with electro-pneumatic valve • Bypass Manifold - located off roughing manifold with air operated ball valve and manual ball valve to control initial pumpdown and prevent implosion of hot zone and retort. <i>Bypass runs around blower to allow high partial pressure operation without going through the blower to minimize overheating blower bearings package.</i> • Debind Manifold- with isolation delube valve. Manifold is heat-traced and insulated from the chamber to the PEG pot. NOTE: CVI to include T off peg pot exit port for connection to roughing system for partial pressure operation. <i>Manifolding from pot to vacuum pump includes 2nd delube valve for regulation of flow during partial pressure operation. Vacuum clean out port on T (with blankoff) on debind manifold to allow ease of cleaning.</i> <p>Vacuum system includes roughing manifold with isolation valve, vibration isolation, manual air vent valve, and mass spectrometer connection valve. Pump package includes a water miser and an oil mist eliminator.</p>	
F.	<p><u>Power Supply</u> (Approx 460 KVA) SCR 460/3/60</p> <p>Packaged power supply in separate cabinet with circuit breaker and on/off contactor, low voltage power transformer, linear power controller, water flow safety switch with high current, and water-cooled power busswork. (Flexible or Rigid Copper).</p>	

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	<p>Two (2) approx 230 KVA upper and lower three-phase transformers with two three phase outputs to top and bottom elements with manual trim via a current limiter/trim pot located in power supply cabinet.</p> <p>Primary voltage power is transformed and distributed via the busswork and power clamps (studs) and converted to thermal energy by the resistance style heating elements.</p> <p>Centorr Vacuum Industries stepdown transformers are sized for proper holding power and customer-specific ramping power requirements, including a built-in power safety factor with additional secondary taps on the power supply to allow for changes in resistance to compensate for aging elements and insulation.</p> <p><u>Inert Gas Systems</u></p> <p>G. <u>G-10504B Partial Pressure Flowthrough System - (TH-2002 Pirani Combo) (Gas Dependent) Manual Control / Single Setpoint /with Data Log (10-500 torr)</u></p> <p>Flow through partial pressure control system uses a flow of inert gas to maintain chamber pressure between 10-500 torr. Provides for single set point inert gas backfill between two (2) preset values on a TH2002 Controller/Power Supply/Display. System includes solenoid valves, micrometer/needle valves (or flowmeter for higher flows) and two (2) Pirani vacuum sensors. Flow is through included debind manifold to provide for proper flow conductance at higher partial pressures. Functional run/hold interlock, leak checking, and partial pressure control included. Second sensor on pump manifold for ultimate vacuum measurement. <i>(Note: due to high partial pressure value, the run/hold setpoint will be relocated to a U/E or SMC sensor)</i></p> <p>Operation: With chamber in vacuum below the setpoints of the vacuum controller initiate the partial pressure flowthrough system. the debind, rough, and bypass vacuum valves will initially close and the solenoid valve introduces gas until the pressure reaches the upper setpoint, which will turn off the gas. The air-operated bypass valve will open causing the pressure level to drop tot he lower setpoint, which will cause the gas to turn back on. The bypass valve stays open and The inert gas valve will open and close to keep the pressure between the two setpoints. The stability of control is fine-tuned by manually adjusting the micrometer valve and flow of inert gas line resulting in a continuous stream of gas that is offset by the pumping capacity of the mechanical pump at that specified operating pressure.</p> <ul style="list-style-type: none"> • Gas Type (s): Argon • Gas Inlet: Into chamber through UVM. • Gas Flow Rates: Approx 8-80 slpm (Note: actual gas flow based on vacuum pump capacity and any product offgassing). • Gas Outlet: through debind manifold to PEG pot to vacuum system. • Operation: System can be initiated manually, or through and event on the programmable controller. <p>The linear output displays vacuum level in "torr" on the chart recorder or data logger if included.</p>	
H.	<p><u>G-10505B2 Positive Pressure Inert Gas Flowthrough Debinding System (0-2 psig) - Dual flow / Manual Control / Single Setpoint</u></p>	

Item	Description	Price
	<p>Constant Flow Through Inert Gas Positive Pressure Control System . The gas circuit is configured with dual flow to retort and chamber consisting of automatically actuated solenoid valves, integrated needle valve/flow meters, pressure sensor and manifolding to the chamber.</p> <p><i>Operation:</i> The solenoid valve introduces gas into the retort and chamber until the pressure reaches the lower setpoint of the pressure sensor opening the exhaust valve. If the chamber pressure reaches the upper setpoint, the inert gas flow is cycled off. The flowthrough gas, when operating above atmospheric pressure, then exits the chamber through the debind manifold, to the tower mounted off the PEG pot containing an automatically operated ball valve and orifice or <i>optional</i> PEG Pot and thermal incinerator.</p> <p>Gas flow into the retort (1/3 of total) entrains binder/process offgassing and directs it out the pumpout tube. Gas flow into the chamber (2/3 of total) is used to prevent process gas/binder leakage out of the retort where it can attack the graphite hot zone elements and insulation, and condense on the cool chamber walls.</p> <p>Retort Flow Circuit</p> <ul style="list-style-type: none"> • Gas type(s): Argon • Gas Inlet: Into top of retort in through plenum mounted on top of retort to preheat incoming Argon gas. • Gas Flow Dynamics Inside-Out • Gas Flow Rates: 20-100 slpm <p>Chamber Flow Circuit</p> <ul style="list-style-type: none"> • Gas type(s): Argon • Gas Inlet: Into chamber through UVM • Gas Flow Dynamics Outside-in • Gas Flow Rates: 20-100 slpm • Gas type(s): Helium • Gas Flow Rates: 2-12 slpm • He Gas Inlet: Manifolled into chamber gas inlet with flowmeter to meter in small amounts of He gas whenever positive pressure or partial pressure Chamber Argon gas circuit is active • Operation: System can be initiated manually, or through an event on the programmable controller. 	
I.	<p><u>Series 3710 Peg Pot - Binder Collection System</u></p> <p>One (1) binder collection pot with quick release swing clamps will be positioned under the vacuum chamber on the debind manifold. Electric rope heaters and insulation jacket will be used on Peg Pot manifolding and isolation delube valves to ensure minimum condensation of binder vapors. <i>Debind manifolding to include 'T' to allow for ease of cleaning debind pumpout tubing leading to PEG pot.</i></p> <p>For operation above atmospheric pressure, the valved gas outlet tower will be supplied with a automatically operated ball valve and orifice positioned on the top of the tower to open and close the outlet.</p>	
J.	<p><u>G-10505G Gas Backfill Line</u></p>	

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	<p>The gas circuit is configured with manual or automatically actuated solenoid valve, pressure switch, and manifold to the UVM/Chamber.</p> <p><i>Operation:</i> The solenoid valve introduces gas on an unregulated inert gas line for fast backfill of the chamber volume, until the pressure reaches the upper setpoint of the pressure switch.</p> <ul style="list-style-type: none"> • Gas type(s): Argon • Gas Inlet: Into chamber through Universal Vacuum Manifold (UVM) or separate chamber port. <p>System can be initiated manually using a switch on the control cabinet, or through an event on the PLC.</p>	
K.	<p><u>Instrumentation and Controls</u></p> <p>Control system consisting of a single door NEMA-1 cabinet with safety power disconnect switch on door and having the following instrumentation and controls face mounted.</p> <ol style="list-style-type: none"> 1. <u>Model Y550-2/1 Temperature Programmer/Controller</u> One (1) digital controller and variable set point vs. time programmer. Stores up to 30 programs each with 99 segments (total number of segment 300), and up to 8 events. Programmed logic control to allow "start" button on process programmer to control heating, debinding, partial pressure, controlled atmosphere, and cooling cycles. (Yokogawa UP550). Two (2) channels (control temperature and optical pyrometer). Systems with a single programmable controllers will use the Run, Hold, Reset functionality of the UP550. 2. <u>Furnace System Startup Routine - Control Cabinet with Separate P/S</u> Throw main disconnect switch to control cabinet. Press push-button for control power to the cabinet. Evacuate chamber. Throw undervoltage trip circuit breaker or press pushbutton/contact for heater power. Initiate cycle using programmable controller. 3. <u>Model UT350L High Limit Temperature Control</u> Overtemperature protector-analog set point with adjustable high limit relay to turn off furnace power at a pre-selected temperature. Second set point for fan operation. (Yokogawa UT-350L). 4. <u>(G-10504B) Model TH 2002 Partial Pressure Vacuum Gauge - Manual / Single Set Point /with Data Log/Gas Dependent</u> Combo Pirani/Piezoresistive sensor located on universal vacuum manifold for single setpoint partial pressure control, functional vacuum run/hold, and leak checking. Second sensor on pump manifold for ultimate vacuum. Integrated Vacuum Controller/ Power Supply /Display with 1×10^{-4} to 1000 torr scale. Uses same set point for run/hold interlock. Two linear outputs to the chart recorder or Specview. (Teledyne Hastings Model 2002 or equal mounted on control cabinet). 5. <u>Model SMC Positive Pressure Display/Gauge (G-10505A)</u> Digital display, compact pressure transmitter with analogic digital gas pressure meter. (Model SMC Sensor). Digital output provided for future customer tie-in. 6. <u>Universal Vacuum Manifold Pressure Control (Model UE/SMC)</u> Includes three (3) position setpoint UE pressure switch (or SMC equivalent) for vacuum-power supply interlock (27 in Hg), fan pressure interlock (5 in Hg), and backfill circuit pressure setpoint (3 in Hg). 	

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7.	<u>Programmable Logic Controller (PLC)</u> Microprocessor based logic controller, for versatility with regards to equipment sequence, event and relay activation and interlocking. Complete electrical integration with system controller (Mitsubishi FX-2N - customer approved).	
8.	<u>Graphic Display and Indication Panel with ON-OFF Switch & Indicating Lights</u> Manual control and system indication lamps are illustrated on a graphic mimic display panel located on the control cabinet. This includes ON-OFF switches for furnace power, instrument power, mechanical pump, blower, valve status, and fan with OPEN/CLOSE indication lights.	
9.	<u>EMERGENCY Stop (E-Stop) Button</u> Control panel will include large Red "mushroom" style Emergency stop button that will turn off heater power, close all valves (vacuum, inert gas, and exhaust) and bring the unit to safe operating condition (ie - system stays in current state, either vacuum or controlled atmosphere).	
10.	<u>Alarm Panel</u> Provides visual and audible alarm signals with pushbutton to silence alarm: <ul style="list-style-type: none"> • Chamber overtemperature condition - shuts down heater power, (indicator light and alarm sound). • Low water flow to critical circuits (ie - power supply, chamber, busswork, fan) - shuts down heater power, (indicator light and alarm sound). 	
	<u>Interlocks:</u> Three (3) position UE/SMC setpoint sensor on UVM: <ul style="list-style-type: none"> • Vacuum interlock @ 27 in Hg gauge (75 torr), for heater power • Fan interlock @ 5 in Hg (530 torr), for operation. • Backfill interlock @ 3 in Hg (680 torr), for operation • Fan Shutter Limit Switches: Open/Closed on front and rear cylinders. • Vacuum Valves: all valves interlocked for safe operation. • Door closure interlock: prevents heater power to furnace unless door is shut. 	
11.	<u>Two-Stage, Two-Point Temperature Measurement</u> <ol style="list-style-type: none"> a. Control thermocouple One (1) Type "C" thermocouple with sheath rated to 1600°C. Complete with ceramic insulation, matching connectors, lead wire and mounting hardware. The thermocouple is automatically withdrawn from the hot zone above 1000°C-1600°C and control switched to the optical pyrometer's signal. b. Overtemperature Thermocouple One (1) Type "C" thermocouple with sheath, rated to 1600°C. Complete with matching connectors, lead wire and mounting hardware. The thermocouple will be inserted into the insulation package to monitor overtemperature conditions. c. Optical Pyrometer - Model Modline 5 One (1) Ircon Head two-color optical pyrometer for temperature measurement 	

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	<p>between 1000 - 3000°C. Supplied with support hardware, and mounted on a gas purged, rotatable, valved sight port with graphite closed-end sight tube located in control zone or focused on the retort.</p> <p>d. Redundant Overtemperature Protection Provided by separate overtemp relay viewing Modline 5 optical pyrometer</p>	
L.	<p><u>Water System (Closed Drain)</u></p> <p>Closed-Drain Water System with a single point water entry with combination temperature/pressure gauge, leading to a multi-valved distribution manifolds. Water circuits exit through single manifold with combination temperature/pressure gauge, and individual Effector combination flow indicators/flow switches with single alarm setpoint and indicator light display on all critical circuits for alarm interlock to a single outlet manifold for single point connection to customer's existing in-house water system. Includes pressure reliefs on main inlet and drain manifolds, and color-coded water lines (blue=inlet; red=drain). Additional pressure reliefs are included on main chamber body and both doors.</p> <p>Customer is responsible for providing a furnace water cooling system and emergency water supply. Centorr Vacuum Industries recommends a system with safety valves which will automatically open in the event of loss of the primary water supply.</p>	
M.	<p><u>Utilities</u></p> <p>1. <u>Cooling Water:</u> The cooling water supply can be either Air-cooled, Fan-cooled unit, Evaporative-cooled designs, or city water systems. All systems should employ a filter and some form of emergency backup water. The cooling water should meet the following specifications for use in Centorr Vacuum Industries Furnace systems:</p> <p>Flow rate (peak): 80 gpm (303 liters/min) at a maximum 40°F (22°C) temperature rise.</p> <p>Supply Temperature: Water inlet temperature above ambient dewpoint temperature and below 90°F (32°C). *</p> <p>Supply Pressure: 35-40 psig (2.5 - 2.8 kg/cm²) (2.3 - 2.7 barg).</p> <p>Drain Pressure: Less than 10 psig (0.7 kg/cm²).</p> <p>Conductivity: Less than 350 micro mhos, or 2000 micro mhos for chemically treated in-house water.</p> <p>Undissolved Solids: Less than 10 ppm.</p> <p>Alkalinity / Acidity: 7.0 - 7.8 pH.</p> <p>* Tempered water of at least 50°F (10°C) should be used, as cooler water can effect vacuum pump performance.</p> <p>A cooling water supply is required by customer. Specifications to be supplied by Centorr/Vacuum Industries.</p> <p>2. <u>Electrical Power:</u> Customer provides Incoming Power of 460/3/60 from fused disconnect for operation of furnace power supply, pumping system, and controls. Estimated total connected load is 494 KVA.</p>	

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	<ol style="list-style-type: none"> 3. <u>Inert Gas</u>: Approximately 0-100 slpm of Argon or Nitrogen gas flow is required, at an inlet pressure of 10 psig for flowmeters. 4. <u>Compressed Air</u>: Filtered and lubricated compressed air is used intermittently to actuate air operated valves. Compressed air requirements are approx. 2 SCFH (0.06 SCMh) at 80 psig (5.6 kg/cm²). Nitrogen may be used for compressed air supply. 	
N.	<p><u>Series 3700 Fan Cooling System</u> (10 HP)</p> <p>A canned motor, vacuum tight and vacuum sealed assembly including: fan, pressure switch, gas purge line, and controls with electro-pneumatic push/pull, shutter on CFC post in the rear of the hot zone, and push/pull in the front. Fan is mounted to a flanged port on the rear door.</p> <p><i>Operation</i>: System is interlocked with an event on the PLC to initiate fan cooling after the chamber temperature drops below 1000°C. Gas will be drawn out from the rear of the hot zone, recirculated down the cold chamber walls and then drawn into the front of the hot zone through the hot zone shutters.</p>	
O.	<p><u>Special Customer Specification</u></p> <ul style="list-style-type: none"> • One (1) manual operated ball valved VI site port, gas-purged sight ports mounted in right-side, middle of chamber depth, on lower sidewall with closed end graphite site tube, for use with customer-supplied handheld Optical Pyrometer. • CVI to replace fixed graphite rails inside retort with Graphite Roller Hearth assembly. Includes two (2) roller hearth rails (max height of roller at 2.5" from top of retort floor). CVI to add "break-off" stop at end of rollers for load depth placement. • CVI to extend the current 50" (inside dimensions) retort length to 53". CVI makes no statement about temperature uniformity at ends of load but does not expect the difference to be significant at max sintering temperature. • CVI to machine approx. 0.5" off the edges of 2.5" tall corner gussets on <i>vertical walls</i> inside retort, to allow customer hearth plate to sit at lower level in bottom of hot zone, and allow for more parts to be loaded at the top of the reort. 	
P.	<p><u>Special Furnace Modifications for 2450°C B4C Processing</u></p> <ol style="list-style-type: none"> 1. Positive Pressure Exhaust Bypass Manifold - Because of possibility of customer binder buildup in exhaust manifold, CVI to add a bypass with check valve around the exhaust ball valve. 2. Increased diameter debind pumpout tube with felt wrap after exiting hot zone and FFX insulation around larger diameter water cooled port to reduce chance for clogging with condensate. <i>Also include cleanout T on debind line at chamber exit.</i> 3. PEG Pot Filtration Media_- Leave existing PEG pot but add Pall rings/SS wool inside of PEG pot (with screen covers on pot inlet/outlet to prevent them from being sucked into vacuum pump), for minor filtration. 	
Q.	<p><u>G-10504W Static Partial Pressure System - (TH-2002 Pirani/PiezoCombo) (Gas Dependent) Manual Control / Single Setpoint /with Data Log (100-500 torr)</u></p> <p><i>Static</i> partial pressure control system uses an initial flow of inert gas to bring chamber pressure up to desired pressure setpoint. Provides for single set point inert gas backfill between two (2)</p>	

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	<p>preset values on a TH2002 Controller/Power Supply/Display. System includes solenoid valves, micrometer/needle valves and two (2) combo Pirani/Piezoresistive vacuum sensors (on UVM and vacuum pump). Flow is through delube manifold. Second sensor on pump manifold for ultimate vacuum measurement.</p> <p><i>Operation:</i> With chamber in vacuum below the setpoints of the vacuum controller and the vacuum valve open, initiate the partial pressure static system. The roughing valve and bypass valve (and debind vacuum valve) all close. The solenoid valve introduces gas until the pressure reaches the lower setpoint. As temp increases and gas expands and pressure rises, gas will shut off at low setpoint. At the upper setpoint (there is typically a large range between low and high setpoints to prevent nuisance chattering of solenoids), vacuum valve opens (CVI to select bypass and debind open) and pumps unit back down to lower setpoint (or deadband around high setpoint) then closes. If the pressure drops down below the lower setpoint, the gas solenoid valve will open to increase the chamber pressure.</p> <ul style="list-style-type: none"> • Gas Type (s): Argon • Gas Inlet: Uses existing partial pressure circuit flowmeter. • Gas Flow Rates: 0-80 slpm • Operation: System can be initiated manually, or through and event on the programmable controller. <p>The linear output displays vacuum level in "torr" on the chart recorder.</p>	
R.	<p><u>Ammeters and Voltmeters (Digital Display)</u></p> <p>CVI to replace simple dial gauges for Amp and Volt meters with one (1) <i>digital</i> 3 channel ammeter and one (1) 3 channel voltmeters (one output for each leg of power supply secondary). The Digital Volt Meter displays the 3 voltage phases, displays A, B, & C and the Digital Amp Meter displays the 3 amp phases, displays A, B, & C. There are also analog outputs, 4-20 mA, associated with, each of the 3 amp phase displays and each of the 3 voltage phase displays, which are linear over the entire operating range of the Digital Volt & Amp Meters. The analog outputs can be connected to a future data logger. Modbus protocol available.</p> <p>Note: two (2) sets of digital amp/voltmeters required for two (2) three-phase heating elements.</p>	
	<p>TOTAL SYSTEM PRICE</p>	<p>\$ 575,000.00</p>
	<p>OPTIONS:</p>	
S.	<p><u>Field Service Assistance</u></p> <p>Five (5) working days on-site services of a Centorr/Vacuum Industries field service technician for post installation system checkout, supervision of initial startup, and training of operating personnel. Customer to arrange for furnace to be positioned into plant, install hot zone, and make electrical/gas/water service connections. Air travel, car rental, and living expenses are included. Reference C/VI Field Service Terms and Conditions (Form FSTC2000) for more details. Note: for international locations, customer to provide ground transportation.</p>	

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	Price (Additional)	\$ 13,000.00
T.	<p><u>Instrumentation & Control - PC System - Specview/Yokogawa UP-550/UP-750</u></p> <p>Includes PC with network card, monitor, keyboard, and mouse housed in a PC Cart located adjacent to control cabinet via umbilical cord connection. Specview computer software will be configured with the Yokogawa UP-550/750 Programmable Controller with Specview Modmux data collection modules for misc vacuum signals (Requires Yokogawa PC Link network protocol for controllers and Modbus RTU protocol for vacuum signals).</p> <p>Specview functionality includes programmable control, recipe uploading/downloading, and data recordering functions. Yokogawa Green software provided for recipe generation. Actual furnace controls and mimic panel are located on control cabinet. Display/data logging of:</p> <p>1 - Control temperature t/c 2 - Control temperature OP 3 - Overtemperature 4 - Control Temp Setpoint (aux. output from Programmable Controller) 5.6 - Low vacuum/partial pressure</p> <p>Price (Additional) \$ 8,500.00 \$ 4,250.00</p>	
U.	<p><u>One (1) Year Spare Parts - Sintervac C600 Series 3710-241848-2450-10HP</u></p> <ol style="list-style-type: none"> 1. Two (2) sets O-rings and gaskets 2. Two (2) TH2002 vacuum sensors 3. Two (2) site glasses 4. One (1) drum (55gal) Mechanical Pump Oil 5. One (1) tube vacuum grease 6. Two (2) sets fuses (2 of each amp/volt rating) 7. One (1) sets light bulbs 8. Two (2) motor starters (2 of each rating) 9. Two (2) control and two (2) overtemperature thermocouples (type C) 10. One (1) flow switch 11. Two (2) Graphite Elements rods for main body element 12. One (1) jar graphite cement 13. One (1) set relays for control cabinet (1 of each amp/volt rating) <p>Price (Additional) \$ 9,500.00</p>	
V.	<p><u>Forklift Load Truck</u></p> <p>Hydraulic lift, manual push, loading/unloading truck rated at 600 kgs. Includes chamber alignment guides, up/down movement via hydraulic cylinder, up/down hard stops on truck, loading "arm" extensions, and bumper stops on chamber to ensure proper alignment of the load into the hot zone.</p>	

Item	Description	Price
	Price (Additional)	\$17,750.00
W.	<u>Water System Upgrade with Temperature Interlock</u> Water temperature system includes type J thermocouples on <i>eight (8) critical</i> water circuits (ie-chamber, fan, and power bus/ PFT circuits). A Watlow programmable display with setpoint control will provide a warning alarm with visual indication of the alarming circuit on either a Watlow scanning t/c device or chart recorder if sold with the job. Water temp alarm will show solid water indicator lights and sound standard alarm, and will shut off power supply similar to low water flow alarm functionality. Price (Additional)	\$5,650.00
X.	<u>Stainless Steel Outer Jacket</u> Replace mild steel outer jacket with stainless steel Price (Additional)	\$6,000.00
Y.	<u>Graphite Hearth Plate</u> 1" thk x 24" w x 48"l to support customer parts Price (Additional)	\$1,400.00

PAYMENT TERMS - Domestic:

Payment Terms are Progress Payments using the following schedule, or as mutually agreed.

20% - with order. Shipment clock starts after receipt of downpayment.

Customer to open irrevocable letter of credit for 80% balance of order through buyer's bank in the name of the seller.

80% - due at CVI prior to shipment with payment through letter of credit.

Z. **NOTES:**

1. Two (2) copies of Operation and Maintenance Manuals, top-level assembly drawings, and Spare Parts List and one (1) copy of vendors manuals, are included at no additional charge with all systems. All markings including control cabinet silkscreens and vendor's manuals will be in English. Foreign language manuals available at extra cost. Vendor's manuals supplied in Customer's Language if available.
2. The entire system will be assembled and operated at Centorr Vacuum Industries plant prior to shipment. You are invited to send your representative(s) to witness these tests which will consist of the following demonstration under clean, empty, dry, outgassed conditions, at room temperature:
 - a. Ultimate vacuum maximum 10 microns (1×10^{-2} torr) or less.
 - b. Leak up rate (Rate of rise), all valves closed Less than 10 microns/hr.

Item	Description	Price
	<ul style="list-style-type: none"> c. Pumpdown of chamber, less than 25 minutes to 10⁻¹ torr range. d. Vent chamber and inspect interior of chamber. e. Close chamber and evacuate for heat up of hot zone to 2450°C temperature in positive pressure of Argon gas (with He bleed as required). f. Demonstrate partial pressure operation. g. Demonstration of instrumentation, and check various parameters as indicated in the specifications h. Inspect overall equipment. i. Demonstration of equipment safety, alarms, and interlocks. 	
3.	We are equipment manufacturers, therefore, process with end-users' products will not be run on our shop floor.	
4.	<i>Unless you are thoroughly familiar with this type of furnace, we strongly recommend that you purchase additional days of field service to assist you during installation and to help train your furnace operator.</i> Additional service of a field service engineer for post installation check-out, supervision of initial start-up and instruction of operating personnel is available at \$ 1,040.00 per day, plus travel and living expenses. <i>The price of this system does not include field service.</i>	
5.	Centorr Vacuum Industries' Warranty C/VI-107 (see attached) shall apply to any order received as a result of this quotation. in summary, any defect in workmanship or material which may become apparent under normal use in any product sold by Centorr/Vacuum Industries will be repaired or replaced, provided written notice of such defect is received by Centorr/Vacuum Industries within one (1) year from date of shipment. Responsibility will be limited to such repair and/or replacement. Expendable items such as heating elements, heat shields, thermocouples, vacuum gauge tubes, seals, fluids, and refractory tubes are not included in this warranty. Wherein components or accessories other than of Centorr/Vacuum Industries manufacture are incorporated in the proposed system, the applicable manufacturers' standard warranty will be extended in lieu of any other warranty.	
6.	Replacement parts and spare parts are readily available and may be ordered from replacement schedules supplied with the system operation manuals.	
7.	Centorr Vacuum Industries furnaces are designed to our own internal quality standards developed over our five decades of history, and are built to the following industry standards: NFPA 86, and NEC. Adherence to CE, UL, CSA, FM or other code certifications is not provided unless specifically requested by the customer, and/or as defined herein.	
8.	THIS DOCUMENT IS COPYRIGHT © 2009 BY CENTORR VACUUM INDUSTRIES INC. THIS DOCUMENT, INCLUDING ANY REFERENCED OR APPENDED DOCUMENTS PREPARED BY CENTORR VACUUM INDUSTRIES INC., ARE THE COPYRIGHTED PROPERTY OF CENTORR VACUUM INDUSTRIES INC. THESE DOCUMENTS ARE PREPARED AND DISTRIBUTED BY CENTORR VACUUM INDUSTRIES INC. SOLELY FOR THE USE OF THE INTENDED PARTIES. THE CONTENTS OF THESE DOCUMENTS INCLUDE PROPRIETARY TRADE SECRETS, PATENT RIGHTS AND/OR OTHER PROPERTY RIGHTS OF CENTORR VACUUM	

Item	Description	Price
	<p>INDUSTRIES INC. DISCLOSURE OF ANY CONTENT OF THESE DOCUMENTS TO ANY PARTY BEYOND THOSE FOR WHOM IT WAS INTENDED MUST BE APPROVED IN WRITING BY CENTORR VACUUM INDUSTRIES INC. PRIOR TO DISCLOSURE IN ANY FORM.</p> <p>9. The inclusion of information by Centorr Vacuum Industries to you does not involve any granting of a license or ownership to the furnace technology included with our design. CVI reserves all rights to manufacture furnaces for any new processes or designs with combinations of individual furnace components. Copying or reverse-engineering of our equipment technology is expressly forbidden.</p> <p>10. System to be painted standard "VI Blue". Please add \$325.00 for using a customer specified color.</p> <p>11. Unless otherwise listed, CVI reserves the right to substitute equipment, items, models of quoted components of equal value if necessary.</p> <p>12. Shipment subject to factory loading at the time of receipt of the Purchase Order.</p>	

Prices valid for 30 days

Prepared by: Scott K. Robinson
 Market Manager - Ceramics/PM