

**Competence Versatility Innovation**



**Custom Vacuum and Controlled Atmosphere  
High Temperature Furnaces for Processing Metals,  
Ceramics, Carbons and Other Advanced Materials**

**Laboratory & Production Sizes, Batch & Continuous  
Models Available**

## 1954 - Present

Centorr Vacuum Industries, Inc. was incorporated upon the combination of two of the premier furnace companies in North America. Centorr Furnaces and Vacuum Industries, Inc. both having long histories in the development and manufacture of thermal process solutions.

Centorr Furnaces was founded in 1962 and provided a wide range of controlled atmosphere, high vacuum/high temperature furnaces for the processing of metals and ceramics, with product expertise in fiber optics and gas purification.

Vacuum Industries was founded in 1954 and focused its efforts on the debinding, sintering and densification of ceramics and metals. Additionally, Vacuum Industries had developed expertise in Vacuum Induction melting and casting, heat treatment, annealing, and brazing equipment.

After a series of acquisitions, the two companies were merged together in the 1980's into a single location in Nashua, NH. In January 1997 CVI was acquired by its internal management team and this change of ownership represents the next step in Centorr Vacuum Industries strategy to better meet its customers' needs and grow the business.

Centorr Vacuum Industries' leading position has been achieved through high quality engineering and manufacturing of robust long-lasting equipment. Over 70% of the 6000 units built since 1954 are still in service which is a testament to their design and durability.

## Custom Projects are our Strength

When your furnace has to be built right the first time and to exacting specifications, try CVI. We build 40-50 custom units each year and have the corporate mind-set and infrastructure to design a custom furnace from the ground floor up. Most companies shy away from "all-new" designs requiring substantial engineering resources and hundreds of new drawings. We specialize in, and deliver prototype units that work! Buying #001 off our assembly line is not like getting new units from other companies. CVI has the financial health and size to take on large jobs without the need to consider cash flow issues experienced by smaller firms.

After a thorough interview of the customer's needs and process, we build a unit that is designed specifically for the application. Options such as load fixturing, gas flow systems, power supply sizing for specific ramps rates, mass flow gas control, emergency backup water system requirements, and a full complement of customized safeties and interlocks to ensure a safe operation that meets with your own in-house specifications. No more *settling* for a furnace size that does not optimize your productivity, or results in excessive



## Research & Development

Centorr Vacuum Industries works with materials testing labs, government research labs, and private industry to develop high-strength super alloys, ceramics, composite materials, and exotic metals. Our R&D and laboratory furnaces are easy to operate, flexible and provide accurate and repeatable control of all furnacing parameters.

## Metals

Our furnaces are recognized around the world for delivering high productivity consistent yields in batch and production metallurgical processing applications.

Applications include heat treating, brazing, hardening, and annealing of stainless steels and other alloys. Techniques for sintering of powdered metals, metal injection molded parts, and high-temperature processing of refractory metals have all been performed in Centorr Vacuum Industries furnaces. Our new line of metal and graphite MIM sintering furnaces are world-class.

## Ceramics

Since the 1950's Centorr Vacuum Industries has been involved in ceramics research and materials processing. Our furnaces are widely used in high-temperature sintering and hot-pressing of non-oxide Ceramics such as SiC, Si<sub>3</sub>N<sub>4</sub>, AlN, BN, B<sub>4</sub>C; and Co-firing and annealing of oxide ceramics, including single and polycrystalline Sapphire. Systems are also available for Chemical Vapor Deposition of materials like SiC, TiC, pyrolytic BN, and TiN.

Process steps requiring removal of excess oxygen, lubricant, or binder materials can be accomplished in one furnace for applications including ceramic matrix composites, titanium-based advanced materials and cermets, metal-matrix composites, and ceramic injection molding.

## Advanced Materials

With our extensive knowledge base in furnacing and the continued process techniques developed in our Applied Technology Center, Centorr Vacuum Industries is ideally positioned to take advantage of new emerging technologies in advanced materials with either laboratory sized furnaces for process proofing, or fully sized production units for large capacity operation.

Our experience in Carbons and Graphites includes heat-treating, purification, Chemical Vapor Infiltration and Chemical Vapor Deposition of carbon-fiber-composites, and Ceramics. We are actively working in new fields such as nanomaterials, nuclear products, photonics and other advanced composites to meet the furnacing challenges presented by these materials.

## Debinding & Sintering

Centorr Vacuum Industries pioneered the idea of combining the debinding and sintering operations of bicomponent materials like Tungsten Carbide Harmorals back in the 1970's and 80's. After continually improving on a variety of debinding techniques, today's Sintervac® and MIM-Vac™ furnaces offer a variety of debinding techniques including vacuum dewax, inert gas-assisted Sweepgas™, MIM Sweepgas™, positive pressure flowthrough, and atmospheric thermal incineration.

Sintervac® furnaces have been used throughout the world in the development and production of Tungsten Carbide and Silicon Carbide materials.

To date, Centorr Vacuum Industries has experience with the removal or trapping of over 100 different binder systems.

# WORLD CLASS LEADERSHIP IN THERMAL PROCESSING TECHNOLOGY

## AFTERMARKET SUPPORT

Centorr Vacuum Industries' Aftermarket Department offers our customers a variety of services including:

- Custom hot zone rebuilds
- Hydrogen gas systems
- Quick cooling fan designs
- Water and gas system upgrades
- All spare parts sales.

Field Service on-site support of a trained furnace technician is available for installation support, furnace checkout and witness testing, preventative maintenance, and equipment troubleshooting. Special pricing programs are available for annual support contracts.

In-house Field Service personnel are also on staff to assist with any technical questions that may arise during ownership of your vacuum furnace equipment.

## APPLIED TECHNOLOGY CENTER

The Applied Technology Center is equipped with state-of-the-art furnace equipment that you can use for high temperature processing of advanced materials. Our experienced staff can offer you a unique "try before you buy" opportunity to evaluate your advanced materials processing method and better define your equipment needs.

Use of one or more of our batch or continuous laboratory furnaces has been found helpful by several companies in the Metals, P/M, MIM, Hardmetals, Ceramics, Refractory Metals, Powders, and Advanced Materials Industries. We look forward to the opportunity to work with your company.

Analytical equipment in our lab includes:

- System VII Graphite-lined sintering furnace 2800°C
- System VII Tungsten-lined sintering furnace 2200°C
- Continuous Belt Furnace to 2000°C
- Transparent test furnace
- Refractory Air furnace
- LECO® Carbon Analyzer

## EQUIPMENT SELECTION GUIDE

Laboratory Furnaces are highlighted in red

Technology		Furnace Type	Hot Zone	Hardmetals	Refractory Metals	Heat Treat, Brazing, Annealing	Ferrous Metals	Oxide Ceramics	Non-Oxide Ceramics	MIM / PM	
Batch	Debind and Sinter Technologies	Sintervac® Series 3800 <b>Series 45, 46, 15, 16</b>	Graphite	WC		Ni-Steel	Cr/CrC, TS, HSS, SS	Al <sub>2</sub> O <sub>3</sub> -TiC Sapphire	Si <sub>3</sub> N <sub>4</sub> , SiC, SiAlON, AlN		
		MIM-Vac™	Alloy		Mo, Ta	W-Ni, Cu, Ti				316L, Ti, 17-4PH	
		Injectovac™	Graphite	WC							WC, 17-4PH, MS, Tool Steel
		Workhorse™ <b>Series 17 Series 50</b>	Alloy		W / Mo / Ta	W-Ni, Cu	Cr/CrC	Al <sub>2</sub> O <sub>3</sub> -TiC Sapphire	Si <sub>3</sub> N <sub>4</sub> , SiAlON, AlN		316L, Ti
	Pressure Consolidation	Hot-Press <b>Series HP</b>	Alloy				Ti				
			Graphite						Si <sub>3</sub> N <sub>4</sub> , AlN, B <sub>4</sub> C, BN, TiB <sub>2</sub>		
		Sinterbar™ <b>Series EP</b>	Graphite	WC			Ti		Si <sub>3</sub> N <sub>4</sub> , SiC		
	Powder Processing	Rotary Furnace Rotovac™	Alloy	Ta	Mo	W-Ni, Cu	Cr/CrC				
			Graphite	WC							
	CVD/CVI	Series 3800	Graphite						CFC, SiC, BN, Graphitization		
	Heat Treat	TR-50 / TQ II	Alloy					MS, HSS, SS, TS			
	Sinter	<b>M-60/ S-60</b>	Alloy / Graphite	WC	W / Mo / Ta	W-Ni, Cu, Ti			Al <sub>2</sub> O <sub>3</sub> -TiC Sapphire	CFC, SiC, BN, Graphitization	
Continuous	Debind and Sinter Technologies	Belt Furnace	Alloy	Ta	Mo	W-Ni, Cu		Al <sub>2</sub> O <sub>3</sub> -TiC	Si <sub>3</sub> N <sub>4</sub> , SiAlON, AlN,		
			Graphite	WC				HSS, SS	Si <sub>3</sub> N <sub>4</sub> , SiC, SiAlON		
		Pusher Furnace	Graphite	WC			Ni-Steel,	TS, HSS, SS	Si <sub>3</sub> N <sub>4</sub> , SiC, SiAlON		



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# High - Temperature Laboratory Furnaces

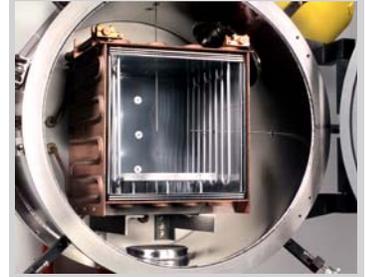
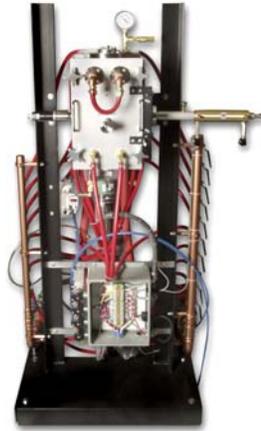
## Series 50 High Temperature Heat Treat Furnace

This metal hot zone design was developed for operation from 1000-2800°C in low or high vacuum, inert gas, or even 100% Hydrogen gas. The unique water-cooled jail design allows for ultra-high temperature operation with the cleanliness of an all-metal hot zone. Excellent for brazing work, heat-treating, or sintering this furnace is available in a variety of sizes from laboratory to small production, and comes with available options including: H<sub>2</sub> gas kits, forced cooling options, and a variety of control package offerings.



## Model 60 / Series 60 Furnaces for annealing, heat-treating, and brazing

The M60 is a versatile front-loading resistance heated design with temperature capability to 2000°C. Available with metal or graphite hot zones the M60 offers easy loading and access for routine maintenance on a console mounting. With hot zone sizes starting from 3" dia x 8"h (75 x 200mm), the Model 60 is a perfect fit for applications in Brazing, Degassing, Heat-treating, and functions as a complete R&D system with the optional add-on kits including: Crystal Growth, Physical Test, Dilatometer, Differential Thermal Analyzer, Quick Quench, and Hot Pressing. The Series 60 furnace offers similar functionality but in a slightly larger hot zone size.



## Series 11 Fiber Optical Fiber Drawing Furnaces

The Series 11 resistance heated optical fiber drawing furnace consists of a double wall water-cooled SS chamber, high-purity graphite heating element and shield assembly matched with a precision gas and temperature control system allowing accurate control of all critical furnace functions. The controlled gradient hot zone and programmable controller offer fast temperature response and extremely repeatable drawing processes while the automated Mass Flow Controllers provide precise gas flow dynamics and atmosphere control.



## Series 15 / 16 / 45 / 46 Vertical Top/Bottom Loading Furnaces

Available in top (15, 16, 45) or bottom loading (46) variations, these designs contain a refractory metal hot zone (15, 16) or graphite hot zone (45, 46) and are appropriate whenever a vertical furnace design is required. Hot zones start at 2" dia x 2" (50x50mm) and go up to 36" dia x 36"h (914x914mm). Process gas systems include Ar, N<sub>2</sub>, and H<sub>2</sub>. A variety of pumping system and controls are available, along with integrated Glove Box designs.



## Testorr® Materials Testing Furnace System

The Testorr furnace system provides for a variety of tightly controlled, elevated-temperature environments for materials testing within the confines of a standard testing frame. Available with a choice of five interchangeable hot zones, each with its own thermal and atmosphere capabilities ranging from 300°C to 2500°C. The Testorr system has been designed to interface with optical and contact extensometers, hydraulic grips, internal load cells, and fixtures for 3- and 4-point bend/compression tests, and comes with appropriately sized ports for water cooling, hydraulic and electrical connections.

## Model 5SA/5TA Single Arc and Tri-Arc Furnaces for Melt Studies

Designed as an inexpensive Arc melting appliance, the 5SA and 5TA can be used for Czochralski Crystal Growth, Melting point determination, Freeze Purification and Arc casting. This low cost, easy to operate design includes high-end features such as water-cooled power cables, copper stinger rods, and Tungsten electrodes. Each rod is mounted in a swivel ball to allow for angular as well as vertical movement. The bottom section can accept a variety of copper hearths. Provisions are included for connection to a vacuum pumping system and inert gas connection.



## Model 2A Oxygen Monitors and Inert Gas Purifiers

This Solid State ZrO<sub>2</sub> Sensor detects O<sub>2</sub> levels from 1x10<sup>-15</sup> to 2x10<sup>5</sup> ppm O<sub>2</sub> and comes with rapid sensor response, adjustable alarm output, and digital LED for display of O<sub>2</sub> levels. The purification process of inert gases such as Argon and Helium, takes place by reacting the gaseous impurities present in the gas stream with an active metal. Testing has shown that Argon gas with 2-10 ppm initial impurities can be purified to less than 1x10<sup>-10</sup> ppm O<sub>2</sub>. Systems are available for flow rates from 10-70 slpm. O<sub>2</sub> monitors are available as a standalone sensor or can be combined with an Inert Gas Purifier.



# High - Performance Production Furnaces

## System VII™ / Super VII™ Multipurpose Furnaces

Heat treat, braze, sinter, weld, induction melt or cast, all in one furnace with interchangeable accessories. Modular vacuum chambers, pumping systems and controls. 500°C to 2800°C in 6"x6"x15" (150x150x380mm) or 8"x8"x20" (200x200x510mm) horizontal metal and graphite hot zones. Options include Hydrogen kit, liquid quench and fast gas cooling. Diffusion, turbomolecular and cryogenic pumps available. Automatic controls, programming and data logging.

## Workhorse® Furnaces for annealing, heat-treating, and brazing

Dedicated brazing, heat treating and annealing furnaces for small to large production. Standard sizes start at 12" wide by 12" high (300x300mm) by 12", 24", or 36" (300,610,915mm) in length, and go up to 125 cu ft (3.5m<sup>3</sup>). Choice of metal or graphite heating hot zones with 2 or 4 sided heating. Temperatures to 1000, 1315, 1650, 1800, 2000, and 2300°C. Gas quenching capability, coupled with full cycle process control provides in-place hardening and tempering for a wide range of materials. The TQ-II "Tool Quenching" version is also available for fast cooling of tool steels.

## Sintervac® Furnaces for Hardmetals, Tool Steels, and Ceramics

CVI's best-selling batch furnaces designed for P/M, carbides, tool steels, stainless, nickel-iron, and ceramic production. Standard temperature ranges from 1200, 1450, 1600, 1800, 2000, 2300, 2450, 2600, and 2800°C. Work zone sizes from 4" dia x 5" h (100x125) Sintervac Jr., and 1, 2, 3, 4.5, 9, 25, and 50 cu ft (30, 60, 85, 125, 250, 700, 1415 cu liter). Complete cycle capability for degas, debinding, presintering, and sintering. Process capabilities in vacuum, inert gas atmospheres including Ar, and Nitrogen, and 100% Hydrogen. Available with integrated debinding capability.

## Series 3800 Vertical Top/Bottom Loading Furnaces for CVI, CVD, and Carbon/Graphite Heat Treating, Purification, and Graphitization

Available in top or bottom loading variations, this design contains an all graphite hot zone and is used when a vertical furnace design is desired. Hot zones start at 18" dia x 24" (458x610mm) and go up to 100" dia (2500mm). Process gas systems include H<sub>2</sub>, CH<sub>4</sub>, C<sub>3</sub>H<sub>8</sub> for Chemical Vapor Infiltration of Carbons and Graphite, as well as a host of Metal Organic Solvents for Chemical Deposition of most Carbides and Nitrides, including SiC, TiC, BN, and TiN.

## Hot Press Furnaces for Diffusion Bonding and Powder Compaction

Combine resistance or induction heating with hydraulic rams and a vacuum chamber to press powder mixes or diffusion bond bi-component parts. Temperatures to 2300°C in metal or graphite hot zones with operation in vacuum, inert gas, or Hydrogen process gas. Press ratings to 500 tons with hot ejection and forced cooling options. Laboratory and production sizes available. Compacts from 1-24" dia (25mm to 610mm). Automatic temperature, force, position control available.

## MIM-Vac™ and Injectavac™ Furnaces for Metal and Ceramic Injection Molding

Specially designed debind and sinter furnaces developed to handle large volumes of binder present in metal and ceramic injection molded parts. Available with Molybdenum or Graphite hot zones, the furnaces have excellent temperature uniformity, precise gas flow across the entire load and a unique gas plenum retort design. Designed for 1st and/or 2nd stage binder removal and final sintering. Available in sizes from 1 - 12 cu ft. (30-340 cu liters). Includes fully automated computer control, specialized binder traps, and dry pumping system.

## Belt and Pusher Furnaces for Continuous Processing of Metals and Ceramics

Our unique "cold-wall" design offers several advantages over conventional belt and pusher furnace designs. Sizes range from R&D to Production. Operating temperatures up to 2600°C utilizing Tungsten, Tantalum, or Graphite hot zones in process gases of Ar, N<sub>2</sub>, and H<sub>2</sub>. Patented belt systems are available in Molybdenum/Tungsten mesh or Silicon Carbide/Graphite link belt. Gas curtains, entrance/exit load locks, and fast cool sections available as options.

## Custom Specials - Vacuum Furnace Designs

Additional custom vacuum processing designs are available for specialized applications. System sizes range from 1 cu. cm to several cu. meters can be custom-designed around a customer's specific requirements.



# World Wide Reach

## Global Support

Centorr Vacuum Industries supports all of its products and services with an extensive sales and service network located strategically throughout the world.

## Global Technology Exchange

As one of the world's most extensive technical and engineering resources, Centorr Vacuum Industries is uniquely positioned to introduce emerging technologies from the R&D Laboratory to commercial production facilities.

Our experience servicing the needs of global manufacturing companies allows us to provide the latest technology from emerging, leading edge, and production thermal processing applications.



## Global Commitment to Customers

Centorr Vacuum Industries is committed to providing world class leadership in thermal processing by providing customers a means to increase productivity, maximize up-time and increase quality, while quickly capitalizing on leading edge technologies through product innovation.

## Global Engineering and Design

We have the largest engineering group in our market niche for custom advanced high-temperature vacuum furnaces. Our Senior engineers have a minimum of 15 years designing furnaces, and our in-house software group writes all our own custom software programming and PLC programs ensuring tight integration with the furnace operation. None of this work is sub-contracted out to third party firms not familiar with the furnace business.

It is inevitable in the design of custom equipment for new prototype processes to make mistakes. Having done this for over five decades means that we have a long track record of what works and what doesn't. This saves your company time and costly mistakes when specifying equipment for new or unique processes. Tap into our knowledge base, whether its for integrated debinding methods, reactions between products and furnace components, gas flow rates required for process reactions, or other cycle development issues.

### Please provide me with literature and information about:

- Laboratory or R&D furnaces
- Production Size furnaces
- Continuous furnaces
- Aftermarket Spare Parts
- Aftermarket Field Service or Maintenance request
- Other: \_\_\_\_\_

### Contact Information:

Name/Title: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

City, State: \_\_\_\_\_

Zip, Country: \_\_\_\_\_

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## World Wide Service

Centorr Vacuum Industries equipment is sold and serviced throughout the world with sales engineering representatives in most countries to provide local service. Arrangements can be made to have factory personnel visit your location and conduct seminars to familiarize your operating groups with vacuum furnace technology. In turn, your personnel are welcome to visit our facilities located in New Hampshire just 1 hour North of Boston Massachusetts' Logan International Airport.