

# INDUSTRIAL HEATING

The International Journal of Thermal Processing

industrialheating.com

APRIL 2018

## Blacksmithing is Hot

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Reed Miller – Editor

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Carnegie Mellon University

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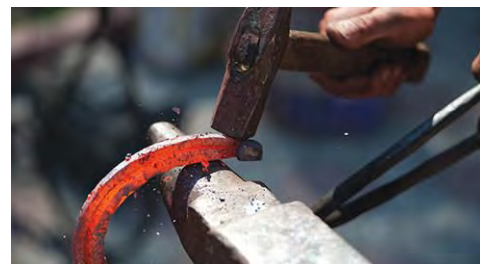
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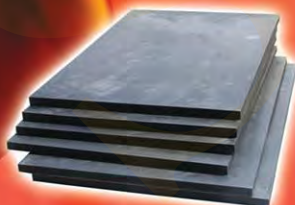




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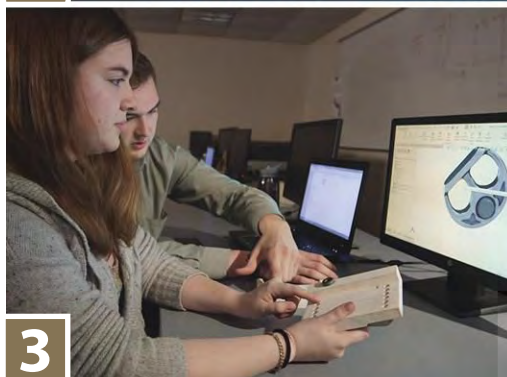
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### 2 Web Exclusive

#### Ice Hockey's Elite Steel Edge

Brynäs IF is one of Sweden's best ice hockey teams. This article discusses how the latest knife blade steel is keeping them ahead of the competition. Formulated by Sandvik, the hardened steel resists blows better and requires less-frequent sharpening.

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### 3 Web Exclusive

#### Designing a New Way to Train 3D-Printing Workers

An engineer is combining his expertise and passion into a national 3D-printing training program for industry and government. Called ACADEMI, the training program is part of a long-term strategic alliance between America Makes, the national accelerator for 3D printing, and The Lanterman Group.

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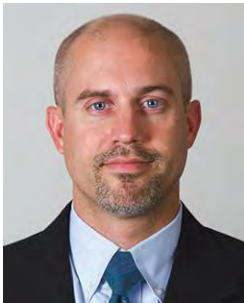
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# Important Industry Events in 2018



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It's April, which means trade-show season – like the weather – is about to start heating up. There are several noteworthy industry events that are on the horizon. Whether or not you plan on attending these events, it's important to know what the thermal-processing industry has to offer.

## Rapid + TCT 2018

North America's preeminent event for discovery, innovation and networking in 3D manufacturing, Rapid + TCT is held April 23-26 in Fort Worth, Texas. *Industrial Heating* was in attendance at last year's show in Pittsburgh, and it was quite a spectacle. You can read our review of the show at [www.industrialheating.com/rapid2017](http://www.industrialheating.com/rapid2017).

To give you an idea of how much this event has grown, it needed only 15,000 square feet of show floor at Pittsburgh's David L. Lawrence Convention Center in 2013. Just four years later at the same venue, Rapid spanned 70,000 square feet – a nearly fivefold increase in floor space. Last year's show also welcomed 329 exhibiting companies – an event record – and 6,000 attendees, with 45 countries represented. Needless to say, the 3D-printing industry is bigger than ever. If you want to learn more about the industry and stay on top of the latest technological developments, Rapid + TCT is a good place to start.

## AISTech 2018

The steel industry's premier event will be held May 7-10 in Philadelphia, Pa. It will feature technologies from all over the world that help steel producers compete more effectively in today's global market. Educational sessions will

include topics covering electric steelmaking, refractory systems, metallurgy, specialty alloys and much more.

## PowderMet 2018

Held June 17-20 in San Antonio, Texas, this annual event is the largest North American exhibit to showcase leading suppliers of powder metallurgy, particulate materials and metal additive-manufacturing process equipment.

## International Thermprocess Summit (ITPS)

Hosted by IHEA, ITPS is a two-and-a-half day executive-level summit designed to bring upper management from manufacturing facilities and industry suppliers together for information exchange and networking. Held July 30-Aug. 1 in Atlanta, the event will feature sessions that address: strategies for the future of thermal processing, economic updates, technological advancements and trends, and globalization issues. ITPS will also include a tabletop exhibition that complements the sessions and offers networking activities. Learn more at [www.ihea.org](http://www.ihea.org).

## FNA 2018

Furnaces North America is the heat-treating industry's marquee event every other year. Held Oct. 8-10 in Indianapolis, it will provide: a technical conference designed by heat treaters and suppliers; a trade show featuring suppliers from every facet of thermal processing; and a variety of social functions and networking opportunities that allow heat treaters to connect with each other.

FNA 2016 attracted over 1,600 attendees from 17 countries, as well as 160 exhibitors. Attendees represented just about every major industry, including automotive, aerospace, military, medical, heavy equipment, tooling and agriculture. Exhibitors, meanwhile, included suppliers of furnace equipment, furnace accessories, sensors, controls, combustion equipment, chemicals, cooling equipment and more.

If there's one event you decide to travel to this year, FNA 2018 should be at the top of your list. Visit [www.furnacesnorthamerica.com](http://www.furnacesnorthamerica.com) for more information. 🇺🇸



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# The Real Threat to U.S. Metals Industries



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**All American  
manufacturing  
must be  
protected  
equally from  
the real,  
current threat  
posed by China.**

In June 2017 this column addressed problems with trade barriers, especially tariffs that are “manipulated favoritism” and result in forms of protectionism, often with unintended consequences. Then, in December 2017, we discussed the rise of the People’s Republic of China and problems they have caused the industrial world through both intellectual-property theft and manufacturing dishonesty as well as the apparent permanence of the current regime in power. These two subjects are combined here and project an unstable outlook.

First, it is important to recognize the differences between types of trade barriers. An embargo is a prohibition of commerce or trade and is considered a strong diplomatic measure. It might mean limiting or banning exports or imports, creating quotas, or imposing tolls or taxes. The effectiveness of an embargo depends on international participation.

Sanctions are an economic tool of foreign policy, most often instituted to coerce regime change. Tariffs are instituted to protect a nation’s industrial sector from foreign producers of competitive goods. (The World Trade Organization ruled in 2004 that U.S. steel tariffs placed on China and Russia in 2002 were illegal, and they were removed.) Unique wrinkles in tariffs are addressed in Section 232(b) of the Trade Expansion Act of 1962, where the president has broad discretion powers to impose high tariffs when national security is at risk; and in Section 301 of the Trade Act of 1974, which provides the U.S. Trade Representative (USTR) legal authority to deny trade benefits or impose import duties in response to foreign trade barriers.

Understand that, this year, Congress has not discussed or proposed any legislation related to the subject of tariffs, trade sanctions or embargos in any way related to manufacturing industries of interest to IH readers. Nothing meaningful or pending from this do-nothing branch of federal government has happened or is on the horizon as of this writing in early March 2018.

Wilbur Ross, U.S. Secretary of Commerce, however, has suggested three options to President Trump that will aid the current and growing instability and market losses in the nation’s steel and aluminum production sectors: a tariff of 24% on all steel imports; a 53% tariff on all steel

products from 12 nations; or no tariff but impose a quota on all steel imports at a level of two-thirds the level of last year.

Regarding aluminum, a 7.7% tariff could be levied from all countries, or a 23.6% tariff imposed on all products from China, Hong Kong, Russia, Vietnam and Venezuela. Spokesmen from the steel sector and steel unions applaud these options, but their counterparts in the aluminum sector are more “reticent” and suggest greater focus on the real problem of China’s “overcapacity.” (Note that two years ago only 2% of U.S. steel imports came from China, which today produces over half of the world’s steel and aluminum.)

Nobody, except words in a study by Mercatus Center, pointed out that for every steel-industry employee helped by the tariff being considered, 38 workers in other sectors would be hurt. Meanwhile, it will probably not be until mid-April that the President decides on his preferred option between tariff, sanction(s), embargo(s) or nothing at this time. The best option, as I view it, is a global quota system based on 2017 exports to the U.S. at 63% for steel and 87% for aluminum from all exporting nations to American markets and has been suggested as a form of sanction.

Quite honestly, the real American problem here is not steel or aluminum foreign overcapacity in production. The problem is China’s overcapacity and bullying of the world marketplace, which is made more complicated by world resellers obscuring product origins. Honest sourcing of U.S. imports must be strictly monitored and understood. This function is the responsibility of the Office of Foreign Assets Control of the Department of the Treasury, which administers and enforces economic sanctions. American steel and aluminum production is important, but this sector cannot request and receive relief at the expense of other U.S. industry.

All American manufacturing must be protected equally from the real, current threat posed by China as it strives for global dominance. Imposing tariffs is not a simple balancing of internal national interests because it can cause “more harm than good” without addressing the ultimate problem that is growing on our horizon. President Trump and Congress in their turn must address the real issues for U.S. metals industries posed by China. 🇺🇸



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# Hardness Testing: Problems and Solutions



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**R**ockwell hardness testing is arguably the most common tool used by the heat-treating industry to measure the success or failure of a heat-treatment process. It is one of the seemingly easiest tests to perform on the shop floor, in the quality-control department or in the metallurgical laboratory but arguably one of the hardest tests to perform properly. Let's learn more.

## What is hardness?

A common definition of hardness is the measure of the resistance of a material to an applied force and involves the use of an indenter of fixed geometry under static load. However, hardness can also refer to stiffness (temper resistance) or to resistance to scratching, abrasion or cutting. It can be thought of as the ability of the material to resist permanent deformation (i.e., to be bent, broken or have its shape changed) in service. The greater the hardness, the greater its resistance. It is important to recognize that the hardness of a material is highly dependent on its microstructure, however, which in turn is influenced by the heat-treatment process.

Hardness is *not* a fundamental material property but rather a composite value. As such, it is an indication that all is well, not a guarantee that it is so. It is of great interest because hardness can be directly related to the expected strength of the material, which would otherwise require destructive testing to measure. The location of the hardness indentations, away from working surfaces, is often an important consideration if hardness testing is to be considered a nondestructive test.

Hardness measuring methods fall into three general categories, depending upon the manner in which the tests are conducted: scratch hardness, indentation hardness (Fig. 1) and dynamic rebound hardness (Fig. 2). Rockwell hardness testing machines can be either benchtop or portable devices.

## Rockwell Testing Tips

Many different factors can affect the results of a hardness test. In most instances, incorrect or misleading readings are the result of poor testing practices that violate simple yet basic testing rules. This leads to good parts being discarded or scrapped or, worse yet, bad parts being accepted and used. By following the rules, accurate hardness readings can be obtained. To aid in this endeavor, we have gathered some of the most common Rockwell hardness testing problems and solutions faced by the heat treater (in no particular order).

1. Follow the testing guidelines outlined in ASTM E18 (latest revision), "Standard Test Methods for Rockwell Hardness of Metallic Materials" or the appropriate ASTM standard for the material being tested.
2. Always use a hardness tester that has an up-to-date calibration sticker from an approved outside service provider.
3. Use a test block to verify hardness readings. Typically, three readings are performed on a test block and the average compared to the value stamped on the block. This should be done daily. Never use a test block on both sides. It is intended to be used on one side only because diamond marks on the bottom side facing the anvil will cause incorrect readings. Old test blocks can be ground down, marked as scrap and used to "set the indenter" when either the indenter or anvil is changed. Remember, the first reading on a part after an indenter or anvil change should be discarded.
4. Inspect the indenter for damage (chipped or cracked diamonds or flattened balls) that will produce erroneous readings. Perform the inspection on a weekly basis by removing the indenter from the machine and inspecting the tip using a low-power magnification (10-50X) such as a stereomicroscope or jeweler's eye loop to check for damage. Flattened balls are sometimes difficult to detect unless you inspect all surfaces – often at an angle.

**Fig. 1. Fixed-location indentation-style bench hardness tester**





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If you see consistently high or erratic readings, perform this inspection immediately. An old heat-treater's trick is to place one finger over the tip of the indenter when removing it to prevent accidental damage.

5. Cleanliness of the part and tester is paramount. Remove any scale, debris, dirt and oil on the part or the machine before testing. Even a small amount of debris can alter the reading by as much as several Rockwell points. Remove and clean the indenter and anvil prior to operation and at shift change. Lightly sand then clean both the bottom and top surfaces of the part before hardness testing.
6. Non-flat surfaces can alter readings. Extremely rough or textured surfaces (e.g., machining marks) may give inconsistent readings. Lightly sand both the bottom and top surfaces before hardness testing.
7. Take into account the curvature of the surface. Remember that a correction factor must be added to the hardness reading of small-diameter shapes for Rockwell A, C and D scales and varies with the apparent hardness and part diameter. The correction factor to be added is shown in the appropriate ASTM E18 tables. In addition, do not rotate a previous diamond mark downward toward the anvil because this indent will cause microscopic movement and a resultant low reading.
8. If the part moves, the reading is invalid (even if it is within the specified range). Discard these readings and do not include them in your average. In many instances the readings are recorded with an appropriate note as to why they are not being used.
9. Remember that a minimum case depth is needed to support a given Rockwell scale and produce a valid reading (see ASTM E18 for details). On the Rockwell-C scale, for example, a minimum case depth of 0.030 inch is needed to hold a 60 HRC reading. A shallower case depth may yield a soft reading, so changing to either the A scale or a superficial scale such as the N scale is appropriate.
10. Surfaces not perpendicular to the indenter will give false readings. Remember that surfaces should be flat within 2 degrees. Be careful when taking readings on mounted samples. They must be flat, thick and not flex under load. A microhardness test may be more appropriate.
11. Remember that the A scale spans both the Rockwell-C and Rockwell-B ranges and is often a good referee.
12. Readings taken too close to the sample edge may damage the indenter and will produce false readings. Per ASTM E18, indentations should be spaced no closer than 2.5 times the indenter diameter from the edge. If the metal buckles outward, the indenter is too close to the edge and the reading is invalid.
13. Readings taken too close together will give false (higher) hardness readings. This is also true on the test (calibration) blocks, where often one tries to place too many readings in one area to save the cost of buying a new



**Fig. 2. Portable dynamic rebound-style hardness tester**  
(courtesy of Columbia Machine Inc.)

block. Indentations should be spaced per ASTM E18 – three diameters apart.

14. Parts that are not properly supported will give false readings. Large and irregularly shaped parts need to be well supported. Parts that move, even slightly during the test, produce a false reading – even if that reading falls within the desired hardness range. Change the anvil to one that keeps the part stationary. Additional outside support devices (such as a Steady-Rest®) may also be required.
15. A sample that is too thin will yield false readings. The material being tested should have a thickness at least 10 times the depth of the indentation. The minimum acceptable thicknesses can be found in ASTM E18 tables. Special (prehardened) anvils can be used when hardness testing thin sheet or foil material.

Finally, put up wall charts and have laminated cards in convenient places that show the various hardness testing scales and their relationships to one another. Almost all companies that manufacture hardness testing equipment offer them for free.

### Summary

Most people need not be experts in all the intricate details of hardness testing. However, it is important that the user selects the appropriate hardness testing method and scale, considers part geometry and test location, and accounts for equipment and testing limitations. Failure to do so can lead to improper interpretations of the true material condition, properties and hardness.

Should you find yourself in a dispute regarding hardness and hardness testing methods, the first item to confirm is that the specified hardness is appropriate for that material. Then confirm how the hardness was measured and if the method was appropriate for that sample. While there can be varying levels of uncertainty between hardness testing machines or laboratories, expect some level of consensus if the methods are correct. ■

### References available online

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# Manufacturing First ... Heat Treating Second



**TOM MORRISON**

CEO MTI Management  
tom@heattreat.net  
904-249-0448

Robotics and  
automation are  
**NOT** about  
eliminating  
people.

In my last column, I shared how change is happening so fast that companies don't have the luxury of time any longer to wait to make change. In order to keep pace and compete in this economy, you must "live in the future" yet "act today." Those who live in today or the past risk becoming irrelevant to the marketplace and being left behind.

So, how fast are we moving? Well, since January's column, new technology advances have been released that are game changers for many industries. Each month, new advances in automation are taking shape that will create opportunity or eliminate your company's business model.

Before I discuss five elements that your plant needs to focus on, take a look at two new technology developments launched in the last couple of months.

## Amazon GO Stores

Located in Seattle, Wash., and tested over three years with their employees, Amazon went live with their first brick-and-mortar GO Store. With "waiting in long checkout lines" being the #1 pain point for consumers in retail stores, Amazon's GO Store has none. You may be asking, "So how do you pay for your goods?" Very simple. When you enter, you scan your Amazon GO Store app. Once inside, anything you pick up and put in your physical cart gets put in your online cart. When you walk out of the store, the app charges your credit card, and you are immediately sent a receipt – all with no human interaction or checkout lines. The employees you do see are there for assistance and stocking. This is HUGE for any industry in retail, or supporting retail, in that it minimizes the number of people it takes to deal with a consumer.

## LG

In 2018, LG (South Korea) is launching robots to automate three customer-service interactions. They are:

- Serving food and beverages at hotels and airports
- Hotel check-in and check-out services
- Assisting customers in supermarkets, telling them prices and product locations

## 5 Key Elements of IoT

I share these two examples of technology shifts to open your mind and show that almost anything can be automated in today's world of manufacturing. You just have to figure it out. Both of the aforementioned companies are using robotics and artificial intelligence to eliminate errors and maximize capacity. Heat-treat plants need to start looking into the same solutions for productivity and capacity issues, especially given the labor shortage over the next 10 years.

You see, robotics and automation are NOT about eliminating people. They are about expanding capacity with your current set of employees. Heat-treat divisions and plants that figure out how to take one person operating two furnaces and (with automation) empower them to operate six furnaces are going to be the real market leaders in the future.

This is where the "Internet of Things" (IoT) comes in. Many have heard of the IoT, but most think that it only deals with the Internet or technology. This is not true. The full scope of the IoT is the combination of five key elements.

- Technology
- Human capital
- Machines
- Processes
- Data

The question for your plant is: Are you maximizing the use of each of these five areas to excel at productivity, safety, quality and output? If not, you have some work to do.

It is critical that your captive heat-treat division or commercial heat-treating plant gets your team focused on each of the five elements that make up the IoT so you can maximize your ability to compete in the future.

Take time to sit down with your entire team and look at your operation from every angle. Brainstorm what you are missing to ensure that you are maximizing technology, human capital, machines, processes and data.

Those who leverage the IoT will win in the future. Remember, you are a manufacturing plant first and a heat-treating plant second. Get your team together and start winning at the Internet of Things. 🇺🇸

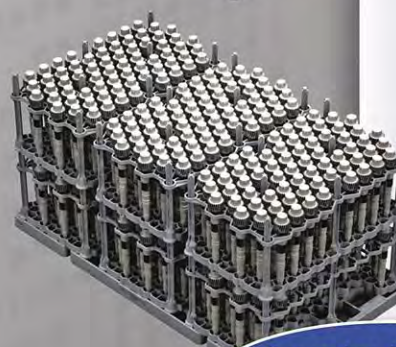
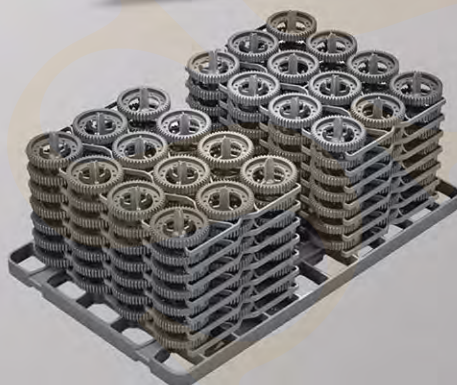
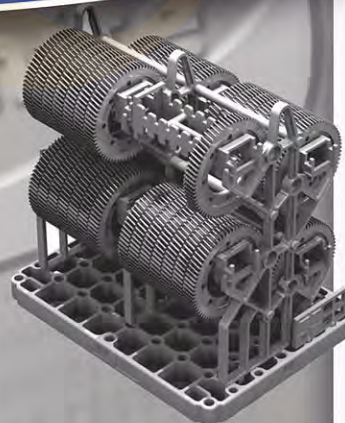
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# Hercules Heat Treating Corp.

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www.HeatTreat.net

**H**ercules Heat Treating Corp. is all about continuity. The company is operating out of the same location and is still owned by the same family since its founding in 1949.

Joseph J. Rizzo, along with first cousins Angelo and Joseph G. Rizzo, started the Brooklyn, N.Y., company almost 70 years ago. Hercules Heat Treating remains owned and operated by several new generations of the Rizzo family. Today, Anthony I. Rizzo and Joseph J. Rizzo, two of the founders' sons, run the company. A third-generation member, Anthony P. Rizzo, has also joined the business, which never moved from its original site.

Hercules Heat Treating got its start by heat treating tools and dies in the 1950s. Eventually, however, the company transitioned to processing aerospace parts in the 1960s. And when Hercules Heat Treating started aerospace processing, the company never quit. In fact, aerospace is the only industry the MTI member serves today.

The company began with neutral and case hardening salt baths for steels and salt baths for heat treating aluminum. Today, Hercules Heat Treating still heat treats with salt but with much larger baths to offer marquenching services. And even though it's an older technology that is rare today, salt-bath heat treating is vital to this heat-treater's success. The method aids in keeping all parts straight and true.

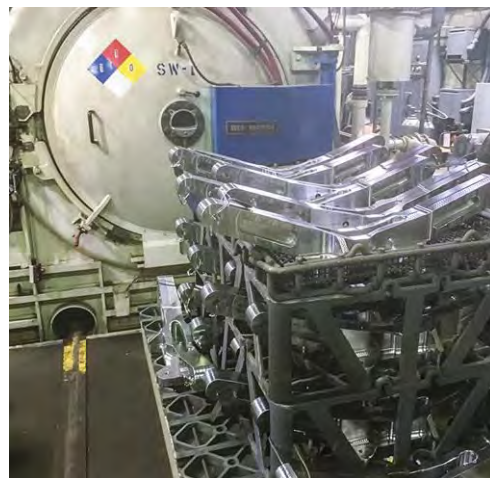
In addition to salt, the company also utilizes vacuum gas-pressure furnaces (2-bar and 10-bar) and vacuum oil-quench furnaces to process aerospace components. It performs aluminum heat treatment with a drop-quench furnace (water or glycol) and multiple aging ovens, which together deliver large-volume production.

Heat treatment is not all Hercules Heat Treating does. One of the company's specialties is fixture straightening of high-strength parts. This capability affords customers the ability to leave less material on high-strength (280-300 ksi) parts for the heat-treat operation. As a result, the customer has less material to machine off after heat treatment when the material is hard (HRC 52-55).

With the help of a full-time, on-site metallurgical engineer, Hercules Heat Treating also performs its own hardness, microhardness, metallography and tensile testing. This is beneficial because all testing is performed in-house, ultimately saving time for customers.

But if one thing is clear, it's the importance of the aerospace industry to Hercules Heat Treating's success. The company processes parts for the F-15, F-16, F-18 and F-35 (JSF) military programs, as well as 737 through 787 Boeing commercial programs.

Visit [www.herculesht.com](http://www.herculesht.com) for more information on Hercules Heat Treating.



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# IHEA Fall Seminars to be Held in Conjunction with FNA



**T**his fall IHEA will offer three concurrent technical seminars in conjunction with MTT's Furnaces North America (FNA) in Indianapolis, Ind. Held Oct. 8-10, this will present an opportunity for manufacturers to expand their technical knowledge and spend time on the exhibit floor.

IHEA will conduct its Combustion Seminar, Safety Standards and Codes Seminar and Induction Seminar on Monday, Oct. 8 and the mornings of Tuesday, Oct. 9 and Wednesday, Oct. 10 at the Indiana Convention Center. This schedule will provide the benefit of classroom education and ample time to visit with FNA exhibitors, which include IHEA members and companies represented by IHEA seminar speakers that provide instruction during the seminars.

For nearly half a century, the Combustion Division of IHEA has delivered quality education for those in the thermal-processing industry. The Combustion Seminar will provide attendees with updated and relevant information from experts in combustion technologies. It is designed for those responsible for the operation, design, selection and/or maintenance of fuel-fired industrial process furnaces and ovens. It offers over 12 hours of instruction from industry professionals.

IHEA's Safety Standards and Codes seminar will provide a comprehensive overview of NFPA 86, including newly released updates for many areas of safety. Sessions will cover the required uses of the American National Standards

governing the compliant design and operation of ovens and furnaces. Speakers are all very involved in NFPA and serve on the technical committees. They will discuss the most recent revisions incorporated into NFPA 86.

For the past few years IHEA's Induction Division has developed materials and worked with induction member companies to support the need for additional induction education. IHEA will offer the Induction Seminar during the fall seminar series to educate those who want to learn more about induction and its applications. The seminar will provide the basics of induction technology and how electrically powered induction technology can create heat in parts.

Attendees from all three seminars will have the advantage of a private networking reception on Monday afternoon with speakers, and they will also have an opportunity to visit with all FNA exhibitors on the trade-show floor.

IHEA members receive significant discounts on these seminars. Consider joining IHEA today to save on registration fees. End users receive four vouchers with their membership that can be used to register for seminars for free. Visit [www.ihea.org](http://www.ihea.org) for more information about membership and the Fall Seminars.

Established in 1929 to meet the need for effective group action in promoting the interests of industrial furnace manufacturers, IHEA has expanded and currently includes designers and manufacturers of all types of industrial heat-processing equipment.

**Learn from the best at IHEA's Fall Seminar Series. This fall IHEA will offer its Combustion Seminar, Safety Standards and Codes Seminar and Induction Seminar in conjunction with Furnaces North America.**




## ITPS 2018

JULY 30-AUG. 1 • ATLANTA, GA.

## ITPS Americas

After a successful launch in 2016, the Industrial Heating Equipment Association will once again hold the International Thermprocess Summit (ITPS) in the U.S. This two-and-a-half day, executive-level summit is designed to bring upper management from manufacturing plants and industry suppliers together for networking and information exchange.



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## INDUSTRIAL HEATING

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# Equipment & Business News

## EQUIPMENT NEWS

### Vacuum Furnaces

**Solar Manufacturing** shipped two vacuum furnaces to an aviation-engine repair facility located in the western U.S. Each furnace is designed with energy-efficient graphite insulation and engineered to accommodate various part and load sizes. Both are tailored specifically to fit the needs of aerospace-engine component repair processing to the aerospace specification AMS 2750E. One furnace has a work zone measuring 28 inches wide x 21 inches high x 36 inches deep with a weight capacity of 1,500 pounds, and the second furnace has a work zone measuring 42 inches wide x 42 inches high x 60 inches

deep with a weight capacity of 5,000 pounds. They are equipped with mass-flow controllers for accurate, repeatable and recordable gas-flow control of argon, nitrogen and hydrogen partial-pressure gases.

[www.solararmfg.com](http://www.solararmfg.com)



### Advanced Quench-and-Temper Facility

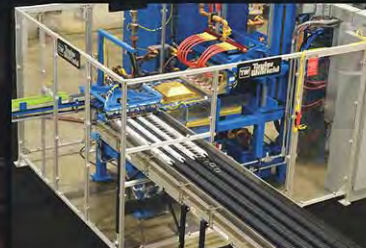
The new advanced quench-and-temper facility (AQTF) heat-treatment line supplied by **SMS group** to **TimkenSteel** at its Gambrinus Steel Plant in Canton, Ohio, commenced full commercial production. Extensive testing was successfully completed in November 2017. The line is able to treat 10 tons per hour of bars and heavy-walled tubes up to 13 inches in diameter. The compact line is characterized by a combination of induction preheaters and combustion furnaces for austenitizing and tempering processes. Subsequent cooling takes place in the newly developed quenching shell, an advanced OD/ID water sprayer, characterized by high-quench severity. [www.sms-group.com](http://www.sms-group.com)



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## Furnace Line

**Premier/BeaverMatic** received an order from a manufacturer and supplier of oilfield logistics services for an internal-quench furnace line capable of processing 30-inch-wide x 48-inch-long x 26-inch-high workloads weighing up to 1,500 pounds. The equipment will be installed in a new facility in Dubai. The order includes a Premier/BeaverMatic internal-quench furnace including high-efficiency SER heating system, quench-oil cooling and centrifugal separation systems; temper furnace; drying oven; spray and dunk washer; endothermic-gas generator; data-collection system; and a manual-load transfer cart.

[www.premierfurnace.com](http://www.premierfurnace.com)

## Horizontal Quench Systems

**Wisconsin Oven Corp.** shipped two electrically heated horizontal quench systems to an aluminum manufacturer. The systems are designed for the solution treatment of aluminum. Each system is designed to heat 1,000 pounds of aluminum to a 950°F operating



temperature. Once the loads are heated to the operating temperature, they will soak at temperature and then be rapidly lowered into the quench tank in less than 10 seconds from the time the door starts to open until the load is fully submerged. The aluminum solution-treating systems are

each designed for a load size of 4 feet wide x 4 feet high x 4 feet long and have qualified operating temperature ranges of 775°F and 1075°F. The systems utilize PLC process control with an HMI operator interface. [www.wisoven.com](http://www.wisoven.com)

## Vacuum Furnace, Retort Furnace

**SECO/WARWICK** received an order from voestalpine High Performance Metals (formerly Böhler-Uddeholm), a manufacturer of tool and special steels, for a 15-bar vacuum furnace with high-pressure gas quenching and a retort furnace. The company will use the equipment to increase its production capacity and expand its processing capabilities. The gas-quenching capabilities of the vacuum furnace were tested and proven on a 400/400/400-mm reference steel block, achieving rates in the range 40–80°C/min.

[www.secowarwick.com](http://www.secowarwick.com)

## Material Testing System

The Additive Manufacturing Center was established at the University of Connecticut (UConn) in April 2013 in partnership with Pratt & Whitney to advance additive-manufacturing (AM) research and development. The facility recently expanded their capabilities by adding a material testing and simulation system that combines high-temperature capabilities with high-speed deformation. The Gleeble 3500 will be used to characterize new materials and optimize manufacturing processes.

[www.gleeble.com](http://www.gleeble.com)

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# Equipment & Business News

## BUSINESS NEWS

### Applied Process to Open Heat-Treat Plant in Arkansas

**Applied Process Inc.**, a leader in austempering technology, will open a multi-million-dollar heat-treatment plant in Fort Smith, Ark. The 51,000-square-foot facility will house six furnaces and create at least 30 new jobs. The plant is expected to be fully operational in the third quarter and will serve customers in the Midwest and South. Applied Process plants in Livonia, Mich., and Oshkosh, Wis., will remain in operation, serving the automotive, agriculture, aerospace, heavy truck, railroad and mining industries. According to the company, the new facility will allow it to expand into new markets and serve a broader geographic customer base.

### Verder Scientific Adds Hardness Testing Line with Acquisition

**The Verder Group** acquired the majority of Austria's Qness GmbH, a manufacturer of hardness testing machines that comply with recognized standards like Brinell, Vickers, Knoop and

Rockwell. The acquisition extends the portfolio of Verder Scientific with a product line for hardness testing. Instruments manufactured by Qness are used both for industrial applications and material research. The Qness portfolio complements the offering of ATM GmbH, which is also part of Verder Scientific.

### Process Combines Stamping, Heat Treating in Single Operation

**Hot Form Quench (HFQ) Technology**, a manufacturing process that combines stamping and heat treating in a single operation to produce complex aluminum parts up to 20% lighter than corresponding cold-formed components, has arrived in the U.S. after five years of successful applications in European car models. HFQ Technology heat treats 6000- or 7000-series range aluminum blanks and transfers them to a stamping press, where they are formed at high speed and quenched in the tool. HFQ Technology was developed by Impression Technologies Ltd.




### Sandvik Investing in Metal-Powder Plant

**Sandvik** will invest approximately \$25 million in a new plant for manufacturing titanium and nickel fine metal powders within the business area Sandvik Materials Technology. The investment will complement the company's existing powder offering and strengthen its position in markets for metal powder and metal additive manufacturing. The facility, which is expected to be operational in 2020, will be located in Sandviken, Sweden, near in-house titanium raw-material supply and Sandvik's center for additive manufacturing.

### Bodycote, Safran Enter into Agreement


**Bodycote** entered into a long-term agreement with Safran, a Tier-1 supplier of systems and equipment in the aerospace market. Under the agreement, Bodycote will provide manufacturing services including heat treatment, hot isostatic pressing (HIP), electron-beam welding

## McLaughlin Services



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and thermal spray coatings to Safran companies and their strategic first-tier suppliers. Bodycote's global network will support the agreement, operating initially from facilities in France and Belgium.

## Carpenter Technology Acquires AM Service Provider

**Carpenter Technology Corp.** purchased MB CalRAM LLC (CalRAM), a leader in powder-bed fusion additive-manufacturing (AM) metal printing services. The acquisition provides Carpenter with direct entry into the part-production segment of the AM value chain. According to Carpenter, the addition of CalRAM is a strong complement to its technical experience in producing highly engineered metal powders and wire for AM applications, such as jet-engine fuel nozzles, rocket-thrust chambers and orthopedic implants.

## Solar Manufacturing Relocating

**Solar Manufacturing Inc.**, a manufacturer of industrial vacuum furnaces, is relocating its headquarters to Sellersville, Pa. The Sellersville Borough Council recently granted unanimous preliminary and final approval for a new building located on a combined 8.5 acres. The manufacturing area will occupy 40,000



*\*Artistic rendering, not to scale*

square feet of the facility, with an additional 17,500 square feet of office space. There is the option of a 22,500-square-foot addition to the manufacturing area in the future. Gorski Engineering is scheduled to break ground for the \$8 million dollar facility in spring 2018. Completion is scheduled for fall 2018.

## Braid Industries Acquires Powder-Metallurgy Provider

Braid Industries finalized its acquisition of 100% of the outstanding equity of MIT-incubated ultrahigh-strength alloy and powder-metallurgy provider Veloxint. The manufacturing base for Veloxint will be co-located with Braid Industries' aluminum rolling mill in Ashland, Ky. Veloxint's research and prototyping facilities will continue to be located in the Boston area and will be expanded in scope.

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# Equipment & Business News

## INDUSTRY EVENTS

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### April 23-25

**IHEA Annual Meeting/ MTI Spring Meeting;**  
Scottsdale, Ariz.  
[www.ihea.org](http://www.ihea.org) / [www.heat treat.net](http://www.heat treat.net)

### April 23-26

**Rapid 2018;** Fort Worth, Texas  
[www.rapid3devent.com](http://www.rapid3devent.com)

### April 25-26

**5th Central/Eastern European Heat Treatment Forum & Exhibition;** Wroclaw, Poland  
[www.heat-treatment-forum.pl](http://www.heat-treatment-forum.pl)

### May 1-3

**Ceramics Expo;** Cleveland, Ohio  
[www.ceramicsexpousa.com](http://www.ceramicsexpousa.com)

### May 7-10

**AISTech 2018 – The Iron & Steel Technology Conference and Exposition;** Philadelphia, Pa.  
[www.aist.org](http://www.aist.org)

### June 5-7

**Thermal Processing in Motion –** Including the 4th International Conference on Heat Treatment and Surface Engineering in Automotive Applications; Spartanburg, S.C.  
[www.asminternational.org](http://www.asminternational.org)

### June 6-8

**19th China International Heat Treatment & Industrial Furnace Exhibition;** Guangzhou, China  
[www.heat treatmentexpo.com](http://www.heat treatmentexpo.com)

### June 17-20

**AMPM 2018 – Additive Manufacturing with Powder Metallurgy;** San Antonio, Texas  
[www.ampm2018.org](http://www.ampm2018.org)

### June 17-20

**Powdermet 2018 –** International Conference on Powder Metallurgy & Particulate Materials; San Antonio, Texas  
[www.powdermet2018.org](http://www.powdermet2018.org)

### July 30-Aug. 1

**International Thermprocess Summit 2018;** Atlanta, Ga.  
[www.ihea.org](http://www.ihea.org)

### Sept. 11-12

**Forging Industry Technical Conference;** Long Beach, Calif.  
[www.forging.org](http://www.forging.org)

### Sept. 25-28

**Heat Treat Mexico 2018 –** Advanced Thermal Processing Technology Conference and Expo; Queretaro, Mexico  
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## FNA 2018

### Oct. 8-10

**Furnaces North America 2018;** Indianapolis, Ind.  
[www.furnacesnorthamerica.com](http://www.furnacesnorthamerica.com)

### Oct. 14-18

**Euro PM 2018 Congress & Exhibition;** Bilbao, Spain  
[www.europm2018.com](http://www.europm2018.com)

### Oct. 15-17

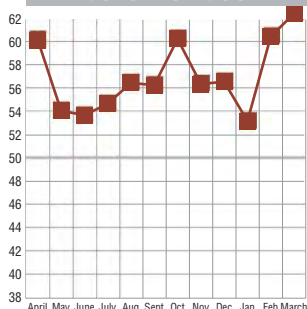
**2018 Die Casting Congress & Exposition;** Indianapolis, Ind.  
[www.diecasting.org](http://www.diecasting.org)

### Nov. 13-15

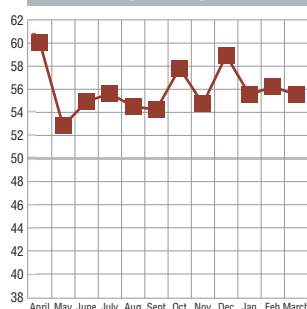
**EUROFORGE – 1st European Fair and Congress for the Forging Industry;** Berlin, Germany  
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## ECONOMIC INDICATORS

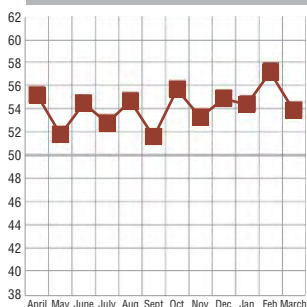
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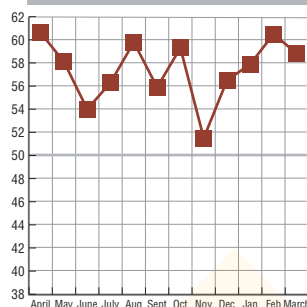
### ORDERS



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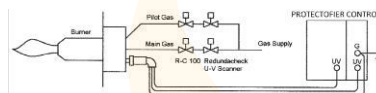
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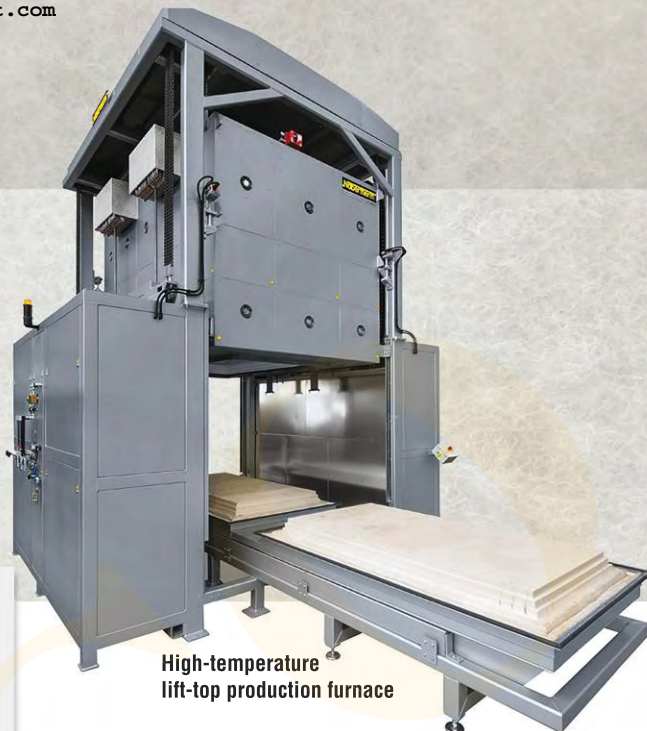
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# Reader-Favorite Ceramics, Refractories and Insulation Articles

## Reed Miller – Editor

In search of the most informative articles in this topic, readers communicate their interest by the amount of page views on our website. Based on this activity, we are sharing the eight ceramics and refractories/insulation articles most loved by readers.



High-temperature  
lift-top production furnace

Many of the articles published by *Industrial Heating* are what we call “evergreen.” This simply means that they are applicable and useful well past the magazine print date. The articles provided here have stood the test of time, and readers continue to show their interest through online viewing. We hope you agree that these articles continue to have something to offer.

## High-Temperature Insulating Wools: Classification/Application

This article was a two-part offering starting in October 2016. If we combine the numbers from both parts, this is clearly our readers’ favorite in this category. The first part ([www.industrialheating.com/htwools](http://www.industrialheating.com/htwools)) covered the classification of high-temperature insulating wools (HTIW) by discussing what it is and what advantage HTIW has in a variety of applications.

Speaking of applications, the second part ([www.industrialheating.com/HTIW2](http://www.industrialheating.com/HTIW2)) discusses this topic and why HTIW is so effective in certain applications. An applicable

quote from the author’s mentor was, “There are no bad refractories; you just put them in the wrong spot.”

We encourage you to check out these two articles to see what readers have found so interesting, helpful and/or useful.

## Seven Signs: Ensuring Furnace Refractory Reliability

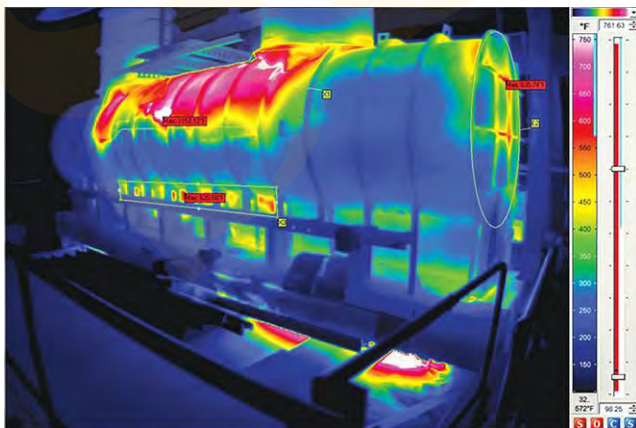
In spite of just being published in November 2017, this article takes second place in the view of our online readers. When refractory materials fail, furnaces and heaters begin to experience problems. This can be avoided through careful collaboration between end users and refractory material suppliers. By understanding the common signs of refractory failure, engineers can carry out maintenance to both fix a problem and avoid it in the future. As the headline says, the authors provide seven key things to watch out for. You can find it at [www.industrialheating.com/refmat](http://www.industrialheating.com/refmat).

## Substituting Aluminum-Silicate Wool Products in the Furnace Industry

It appears wools and fibers are of significant interest because there are several articles in the top-8 for this category. Something to be aware of, however, is that some of this material may present a health risk. It is a constant task of industrial furnace manufacturers to apply all their know-how to limit the health risk of their employees and users of their furnace technology. This article originally appeared in our April 2017 issue, and you can find it at [www.industrialheating.com/silwool](http://www.industrialheating.com/silwool).

## Achieving High Value in Kiln Insulation and Furnace Refractories

This article addresses the following: the importance of correct material selection; achieving the best insulation system; meeting the unique demands of kiln furniture; fired refractory shapes;



Hot spots are seen on a reheate furnace.



Ceramic-fiber module



Fully assembled PuzzleJoint module



Z-Flex™ panel

and the best options for inert and vacuum furnaces. Originally run in April 2016, you can learn more by reading the article at [www.industrialheating.com/morgancrri](http://www.industrialheating.com/morgancrri).

### Advantages of Mullite-Fiber Linings for High-Temperature Furnaces

Although this article goes back to October 2014, reader interest is still high. Industrial furnaces that fire to temperatures of 2300°F (1260°C) and higher continuously pose serious challenges to insulating fiber and dense-refractory furnace linings. Industrial manufacturers that use high-temperature furnaces are focused on temperature uniformity, energy efficiency and low maintenance cost. You can read it online at [www.industrialheating.com/mullite](http://www.industrialheating.com/mullite).

### Options for Complete, Partial Refractory Relining in Older Furnaces

As manufacturing “re-shores” from countries outside the U.S. back to the 50 states, older, previously mothballed furnaces – many built decades ago – are being brought back from the dead. When reconditioning older heat-treating furnaces, thermal oxidizers, boilers and the like, refractory lining redesigns should be considered along with changes in burners, electric heating elements and control systems. Published in October 2017, you can find this recent readers’ favorite here: [www.industrialheating.com/relined](http://www.industrialheating.com/relined).



Shop layout of new hot-face Z-Blok2 trapezoidal folded modules for retort ring

### Redesigning Traditional Refractory Linings

A general trend is evident in iron and steel works. As alloys, products and designs are constantly improving, processes have started running hotter to keep up with the production requirements while trying to maintain the same or better process efficiencies. Equipment and process design have become more crucial than ever before.

Continuous improvements are being sought in raw-material supply as well as refractory design. Two examples are examined in this article. One is a redesigned reheat furnace and the other is a redesigned rotary kiln – both traditionally lined with hard refractory insulation. You can read this October 2015 article at [www.industrialheating.com/linings](http://www.industrialheating.com/linings).

### Optimization of Folded Ceramic-Fiber Refractory Furnace Modules

Rounding out our top-8 articles is this one from April 2015. Modular refractory systems have been widely used for the last several decades. Throughout this time, module design advanced in an effort to combat issues such as shrinkage, water penetration and attachment-system failures.

In many instances, use of ceramic-fiber modules is more effective than hard refractory systems because they allow heat to shed more quickly and facilitate safe, rapid installation. The overall result is a more efficient, cost-effective alternative. Read it online at [www.industrialheating.com/CFmodules](http://www.industrialheating.com/CFmodules).

While these articles are not the only evergreen content available on our website, they are great examples of editorial information that interests readers long after their original publication date. And that’s one of the benefits of our website ([www.industrialheating.com](http://www.industrialheating.com)). Articles back to the turn of the century are preserved for your reference. That’s a treasure trove of great information, and it is just a search away. Happy hunting! 🇨🇦

Use the QR Code to the right to link to a wealth of Ceramic & Refractories and Insulation content on our website.



## HEAT TREATING

# Advanced Carburizing Technology: An Industrial Perspective

**Aaron Flesher & Tyler Logan – Oerlikon Fairfield Manufacturing; Lafayette, Ind.**  
**Daniel H. Herring – The HERRING GROUP, Inc.; Elmhurst, Ill.**

Oerlikon Fairfield has been a technology leader and product innovator in gear and drive design for almost 100 years. Its people, knowledge and resources help to provide unique solutions for a wide range of application needs.



**Fig. 2.**  
Carburized bull gear

**W**ith manufacturing operations in the U.S., India and China, Oerlikon Fairfield has the capability to produce up to AGMA class-14 custom gears with spur, helical or bevel forms from 20 mm to 2 meters in diameter. The company also designs and builds custom drives for mobile equipment and stationary industrial machinery with torque outputs from 800 Nm to well over 4,000,000 Nm. Other products designed to provide integrated solutions for mechanical, hydraulic or electrically driven systems require Torque Hub® planetary drives, drop boxes, right-angle drives, transfer cases, specialty transmissions, differentials and differential carrier assemblies, housings and custom drive assemblies.

## Need for Gas Carburizing

To meet both customer product performance requirements and service-life expectations, parts require a hard, wear-resistant surface; a soft, ductile core; and the ability to withstand not only the high Hertzian stresses present along the active flank of gear teeth but also significant bending moments in the root.

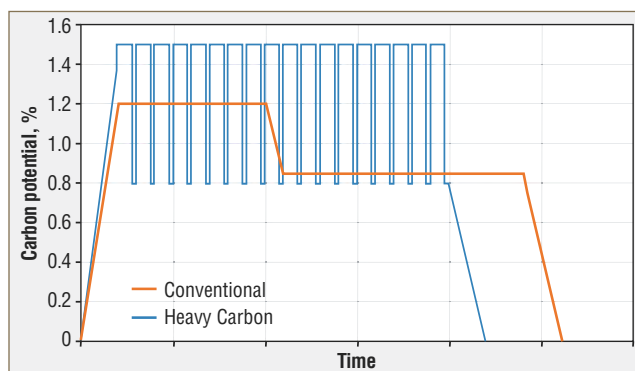
Gas carburizing is an ideal technology and a cost-effective solution to these challenges. As such, Oerlikon Fairfield operates a large heat-treat shop incorporating numerous batch and continuous furnaces running endothermic gas and operating 24/7.

## Increased Productivity Investigation

Oerlikon Fairfield decided to investigate a process technology being offered by Heavy Carbon Co., LLC (Pittsford, Mich.) that manufactures an Endocarb system “Endocarb,” which claims to dramatically reduce cycle time. This is accomplished by alternately increasing and then decreasing the carbon

potential in the furnace, thereby producing parts more quickly.<sup>[1]</sup> Endocarb differs from a conventional gas-carburizing system in several important ways:

1. Endocarb is the source of process gas and control. It is mounted directly on the furnace, simplifying gas piping and avoiding transmission issues. The close proximity also minimizes the risk of leaks and decreases the amount of upkeep necessary to maintain the system. The system can be easily set up so that the furnace runs at reduced gas flowrates.
2. At 925°C (1700°F), the process can be set to run at a carbon potential of 1.5%, which is significantly higher than conventional values often in the range of 1.05-1.10% but certainly no higher than 1.2%.
3. The increased carbon potential decreases the run time for the load. The carburizing time to achieve a 2.3-mm effective case was decreased by nearly 18%.



**Fig. 1.** Example of a comparison between conventional and Heavy Carbon methods

While conventional carburizing maintains a constant carbon potential during the boost phase, Endocarb uses “carbon cycling” (i.e., the process starts at a much higher potential and is then rapidly lowered well below the initial setpoint). This cycling continues throughout the run. In addition, at certain points, air is pumped into the furnace and a “controlled lean-out” performed. As a result, atmosphere is rejuvenated and the furnace itself remains clean and soot-free. A typical Heavy Carbon cycle can be seen versus a conventional gas carburizing cycle in Figure 1.

**Trial Plan**

With a lower cycle time at the same process temperature, Endocarb would have a relatively quick payback<sup>[2]</sup> when compared to conventional carburizing based on reduced cycle time and improved furnace cleanliness. In order to assess potential cost savings with equal or better quality, Oerlikon Fairfield decided to conduct an investigation to determine whether the time savings claimed could be achieved without sacrificing metallurgical quality or the performance characteristics of gears.

Two identical gear sets were chosen for the trials along with five different material test bars (8620, 4320, 8822, 4820 and 4817) and eight different segments of various part numbers with varying diametrical pitches. The gear used was a 230-kg bull gear (Fig. 2).

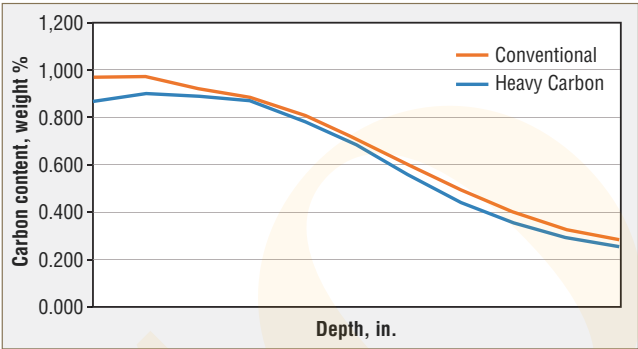
Metallurgical results were compared to both internal and customer specifications and included checks of surface and core hardness (flank and root), effective case depth (tip, flank, root), case and core microstructure, carbide morphology, surface carbon content, retained-austenite percentages, NMTP percentages, decarburization, and IGO/IGA.

For testing purposes, the austenitizing and carburizing temperatures were held constant for both trials. The parts were furnace-cooled after carburizing from both processes and then reheated and quenched in the same furnace to eliminate any difference related to the quenching process.

**Trial Results**

Carbon content was analyzed for each of the samples sent to the commercial heat treater whose furnace was equipped with an Endocarb unit installed on it, namely Euclid Heat Treating (Euclid, Ohio), as well as those run at Oerlikon Fairfield. For clarification, the cycle run at Oerlikon Fairfield will be referred to as “Conventional” and the cycle run at Euclid Heat Treating will be referred to as “Heavy Carbon.” The carbon percentage at various depths was taken, and charts of identical samples sent to each testing facility were compared. Two of the results are reported in Fig. 3.

Figure 3 illustrates that there is no significant difference in carbon weight percentage at varying depths on similar samples. These results suggest that there is no carbon composition difference in the products produced by both the conventional



**Fig. 3. A comparative example of carbon analyses from both Euclid Heat Treating (Endocarb) and Oerlikon Fairfield (conventional carburizing)**

and Endocarb carburization methods. This suggests that the surface carbon, case depth at 0.40% carbon and other carbon-potential characteristics used to determine the mechanical properties of the produced part are virtually identical between the two sample sets.

Effective case depth (50 HRC) results as well as surface-hardness measurements of the parts created by both carburization techniques were also compared (Tables 1 and 2 respectively). These show the measured effective case-depth (ECD) difference and percent difference between the two measurements. Samples from both techniques were tested by Oerlikon Fairfield, Euclid Heat Treating and independently by The HERRING GROUP, Inc. (Elmhurst, Ill.).

Table 1. Effective Case-Depth Comparison				
ECD (inches)	Bull gear A	Bull gear B	Bull gear C	Comparison
Conventional <sup>[a]</sup>	0.0865	0.0916	0.0789	✓
Conventional <sup>[b]</sup>	0.0844	0.0844	0.0769	
Heavy Carbon <sup>[a]</sup>	0.0858	0.0739	0.0783	✓
Heavy Carbon <sup>[b]</sup>	0.0843	0.0886	0.0859	
Notes: a. Oerlikon Fairfield testing, b. Third-party testing. Diametrical pitch = 2.7922 inch				

Table 2. Surface-Hardness Comparison				
Surface hardness (Midpoint, HRC)	Bull gear A	Bull gear B	Bull gear C	Comparison
Conventional <sup>[a]</sup>	61.5	63.8	63.8	✓
Conventional <sup>[b]</sup>	62.7	63.1	63.1	
Heavy Carbon <sup>[a]</sup>	63.7	62.6	61.6	✓
Heavy Carbon <sup>[b]</sup>	63.5	62.7	63.3	
Notes: a. Oerlikon Fairfield testing, b. Third-party testing. Diametrical pitch = 2.7922 inch				

The data indicates that, once again, there are few differences between all four measurements conducted for each tooth of the bull gear. The main experimental difference (over 10%, or 3 HRC) comes from the ECD measurement of bull-gear tooth #2 (or Sample B as referred to by Oerlikon Fairfield). The third-

## HEAT TREATING

party measurements, however, were very similar for the ECD measurements of this tooth in both instances. Overall, there is only a slight difference between measurements, indicating again that there is only a slight variance of the essential characteristics within the parts produced by the two carburization techniques.

Although the balance of all measurements (not reported here) supported this conclusion, microstructural analysis was conducted to characterize the microstructure (Figs. 4-6) before and after etching.<sup>[4]</sup>

The microstructure is consistent between samples (the color difference in Figure 6 is due to an etching effect and differences in lighting). These microstructures confirm that there is virtually no difference between the parts produced via both systems.

### Business Case

In order to justify a change in the carburizing process, a business case must be built using an SEQCDM (safety, environmental, quality, cost, deliverables and morale) model.

- **Safety** - The project is expected to meet safety goals by making the gas quality easier to monitor while adhering to the same quality standards as the previous method. More study is needed to ensure safety compliance, though Euclid Heat Treating has been utilizing this method for years.
- **Environmental** - The direct injection of endothermic gas would reduce the potential leakage coming from the piping that currently requires continual maintenance and monitoring. Endocarb also requires less gas use than the conventional carburizing method, hence the overall air quality throughout the facility would improve.
- **Quality** - The parts produced by Endocarb would maintain the same quality standards as those produced through traditional gas carburization.
- **Cost** - Endocarb would decrease the

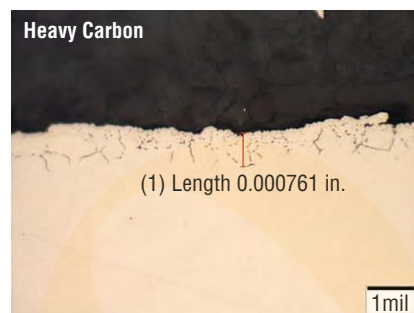
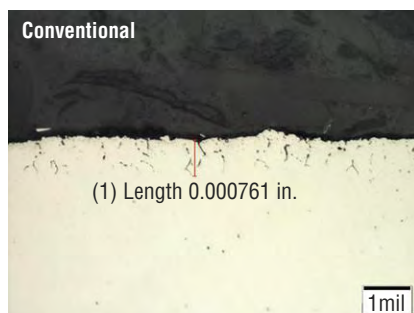


Fig. 4. Intergranular oxidation (IGO) comparisons on tooth #2 of the bull gear from both facilities<sup>[4]</sup>



Fig. 5. Flank (midpoint) comparisons performed on tooth #2 of the bull gear from both facilities<sup>[4]</sup>

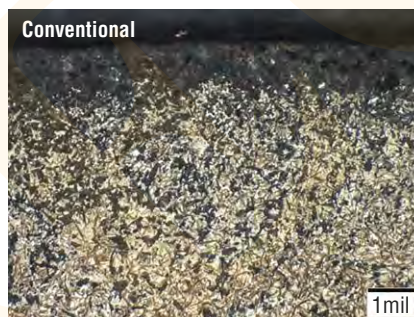


Fig. 6. Root-center comparisons performed on tooth #2 of the bull gear from both facilities<sup>[4]</sup>

typical run time for gas carburization of the specified part analyzed here by 18%.

As a result, payback will be relatively short given the ability to carburize more parts in less time. The maintenance savings are also significant.

- **Deliverables** - The product produced with Endocarb meets or exceeds customer expectations in less time than more-traditional gas carburizing. Case-hardness and effective case depth are virtually equivalent between the two methods.
- **Morale** - Endocarb is directly attached to the furnace, allowing for an easier path with less complications for the technicians to deal with. Morale would improve over time due to the simplification of the process.

Thus, from both an economic and quality standpoint, Endocarb satisfies the SEQCDM model by producing the same overall quality of parts more quickly and efficiently.


### Summary

The Endocarb system was determined to have achieved the same results with the part studies in these trials as those produced from conventional endothermic gas carburizing. The principal conclusions reached were:

- **Carbon potential** - The higher and lower carbon-potential setpoint throughout the process produced less soot accumulation within the furnace, resulting in less “housekeeping” for the pyro technicians. Sooting from conventional processing is known to cause significant equipment problems and process variation.
- **Temperature** - The temperature fluctuations necessary to control the varying carbon setpoints were not shown to adversely affect the quality of the heat-treated products.
- **Time** - The cycle time for gas carburizing was found to decrease by approximately 18%, allowing higher productivity and associated cost savings.
- **Microstructure, case depth, surface hardness, retained austenite** - The analyses of both the conventional and Heavy Carbon treated parts produced similar microstructures. No significant differences in mechanical properties are expected from identical parts produced by both processes.

Given that Endocarb appears to produce identical quality in less time at lower cost, the heat-treatment department will operate more efficiently, shorten product lead times and still meet or exceed customer expectation.

### Acknowledgements

The authors would like to thank the following individuals and companies for their contributions to this study: Mr. George Barbour (Heavy Carbon Co., LLC), Mr. Jon Vanas (Euclid Heat Treating), Mr. Marc Abney, (retired, Oerlikon Fairfield), Mr. Ryan Wilmes (American Axle and Manufacturing), and the Oerlikon Fairfield MetLab Technicians (Oerlikon Fairfield). 

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COVER FEATURE  
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# Playing with Fire: Blacksmithing a Hot Topic

*Industrial Heating in cooperation with Carnegie Mellon University*

We have noticed an uptick in the number of blacksmithing stories over the past few years. Because of their general interest, we try to highlight some of these in our magEzine newsletters. Here's an opportunity to dig a little deeper.

**A**lmost weekly, we run across another interesting blacksmithing story about someone who seems an unlikely blacksmith or who is making wonderful creations from lumps of metal or common items. The story of a Carnegie Mellon graduate student will be highlighted, but we will also talk more about the phenomenon.

## Blacksmithing History

Many of today's blacksmiths work with tools and techniques that have been utilized for many centuries. The first evidence of smithing by hammering iron into shape is a dagger found in Egypt dating to 1350 B.C. Although in Egypt, it was likely the product of a Hittite tradesman. The Hittites probably invented forging and tempering, and they kept their ironworking techniques secret. When the Hittites were scattered, their ironworking skills spread to Greece and the Balkans. This early Iron Age occurred about 800-500 B.C. The smith can also be found in the classical mythology of the Romans, Greeks, Phoenicians and Aztecs.

Early smiths likely heated iron in wood fires. They found that wood converted to charcoal produced a better fire – the intensity of which could be increased with an air blast. The smith began to specialize in the Middle Ages, especially with the onset of the Industrial Revolution. The whitesmith was someone who worked with lead, and the blacksmith was the ironworker. The farrier was a specialist in the making and fitting of horseshoes, while the chainsmiths and nailsmiths had their specialties. The number of folks with the last name of "Smith" demonstrates the prevalence of the vocation.

In the 16<sup>th</sup> century, cast iron came into greater use. A Frenchman named Jean Tijou introduced the art of decorative blacksmithing in the late 17<sup>th</sup> century. The flair seen in this art is, at least in part, due to the early work of this smith. Most of today's blacksmiths are drawn to the art of the trade versus its utility. The uniqueness of the goods produced by today's

blacksmiths is what attracts buyers.

Many contemporary blacksmiths have more sophisticated equipment, but some have chosen to do it the old-fashioned way. In either case, the forge is heated to temperatures of 2000-3000°F using coke and a blower or bellows to concentrate the air. The steel is usually heated to around 2000°F. The key tools of a smith are still the anvil, tongs and a hammer.

Should you think that smithing is a skill-less trade, the road to becoming a journeyman smith in the American Blade Association requires a rigorous knife-making test. The knife must be able to slice apart a 1-inch rope, cut through a 2x4 and retain enough sharpness to shave hair from the maker's arm. In the final test, the knife must withstand being bent in a vice more than 90 degrees without breaking.

## In the News

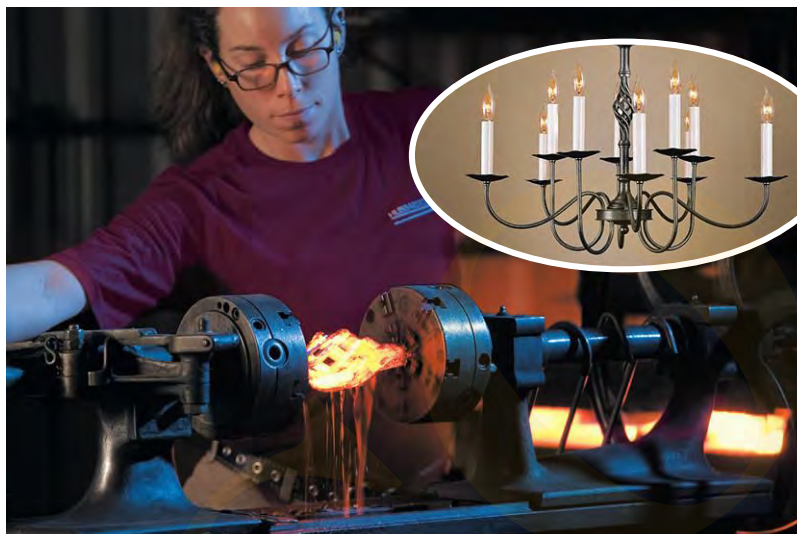
We wanted to present a sampling of blacksmithing stories showing up in our news. We believe blacksmithing appeals to our desire to create as well as to "strong-arm" something as immovable as steel. Lest we not forget, The History Channel is in the fourth season of a reality show titled "Forged in Fire."

A farrier at work





Forge used by David Sapiro



Jean Tijou's legacy of crafting beauty

### Forging Rings

Not unlike Lord of the Rings, a blacksmith in the Pittsburgh, Pa., area is forging rings and teaching people to forge their own wedding rings, which is a romantic concept. Check out Barefoot Forge if your creative juices are stirred or if you would like to purchase a forged ring.

### Schooling Blacksmiths

In addition to the classes offered by Barefoot Forge, many other educational opportunities abound. A new blacksmith and metal arts school will soon be opening in Johnstown, Pa., in the site of the defunct Cambria Iron Works blacksmith shop. The school is actually relocating from New York.

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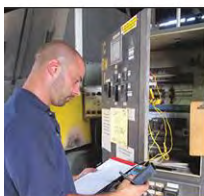


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### Specific Tales

In just a few months, numerous blacksmithing stories caught our eye. These include a metal sculptor in Texas, an Australian knifemaker who demonstrated how to turn a ubiquitous ball-peen hammer into a beautiful tomahawk axe, an innovative knifemaker in Montana, and a family that is forging homestead tools in the Ozarks.

Something of particular interest was a portable blacksmithing forge that is small enough to store in a 5-gallon bucket. This innovative little forge is currently available to back by the Kickstarter crowdfunding website for an early-bird pledge of \$225. Check out the video using this link ([www.industrialheating.com/miniforge](http://www.industrialheating.com/miniforge)) or the QR Code (below).

### PhD Blacksmith

In the lab, David Sapiro studies the properties of corrosion in austenitic stainless steels. But in his garage, you'll often find him leaning over a blacksmith's anvil, hammering hot steel bars into new shapes, and crafting tools and blades from red-hot metals.

When one thinks of science, one rarely thinks of fire or hammering, but Sapiro, who is pursuing his doctorate at Carnegie Mellon University in materials science and engineering, blacksmiths in his spare time. Blacksmithing, or the creation of objects made from heated wrought iron or steel, is a trade not often associated with academia, but when designing and crafting many of his own tools – tongs, power hammers, chisels and the like – Sapiro improves his creations by applying the science behind the metals to his hands-on hobby.

"In undergrad, I studied pure chemistry and also did blacksmithing on the side, so now I'm combining them with corrosion and metallurgy," Sapiro said. "Corrosion is very much electrochemistry and studying individual atoms and molecules – very upper-level science. But then the metal

breaks, and I have to look at the fracture surface and say, ‘Was this a ductile fracture or a brittle fracture, and why did it break like that?’ That’s stuff I can do in my garage.”

Austenitic stainless steels, the most corrosion-resistant types of steel, are used in silverware, tubing and other common household objects. Though they are resistant to corrosion, austenitic stainless steels still have an Achilles’ heel: saltwater.


“Austenitic stainless steels don’t just rust like normal steel. They corrode in saltwater, and they can actually crack. So I’m working on trying to figure out when they do that, why they do that and questions like that,” Sapiro said.

How a metal corrodes and breaks is all tied into blacksmithing, Sapiro explained. To see if a particular steel would be good to use when forging a knife, for example, you take it, heat it up, quench it, see if it’s hardenable and then hit it with a hammer. Then, depending on how it breaks, it’s either good or bad for that use.

“And that’s why I like the research I’m doing and metallurgy in general,” Sapiro said. “Because you can get really nitty-gritty on the science, but you can also just go to your garage and use that science, hands-on.”

Sapiro doesn’t only make tools. He makes swords using authentic blacksmithing techniques. Sapiro has forged several different types of swords in his garage: a pata (an Indian sword fashioned with a gauntlet around the fist, traditionally shaped like an animal’s head), a falchion (a broad, single-edged sword) and a khopesh (an Egyptian sickle-shaped sword that evolved from the battle-ax). Currently, he is working with a group of other Carnegie Mellon students to forge a traditional Viking battle-ax.

What do swords have to do with academia? It turns out that TMS, one of the largest materials-science conferences in the world, recently incorporated an alternating bladesmithing competition and symposium into its annual proceedings. Sapiro entered the inaugural competition in 2015 with his creations – individually and in teams – and presented his findings at the symposium in 2016. He even published an article on the casting of his khopesh, “Fabrication of a Bronze Age sword using ancient techniques,” in TMS’s scientific journal, JOM. And last year, he competed in TMS 2017’s bladesmithing competition again, this time with his brand-new flamberge (a wave-bladed sword).

So, whatever your interest may be, there is most certainly a science that can deepen your knowledge and augment your pastime. A perfect blend of technical and tangible, Sapiro is living the dream – working with his hands and pursuing a career studying the science behind his passion. 



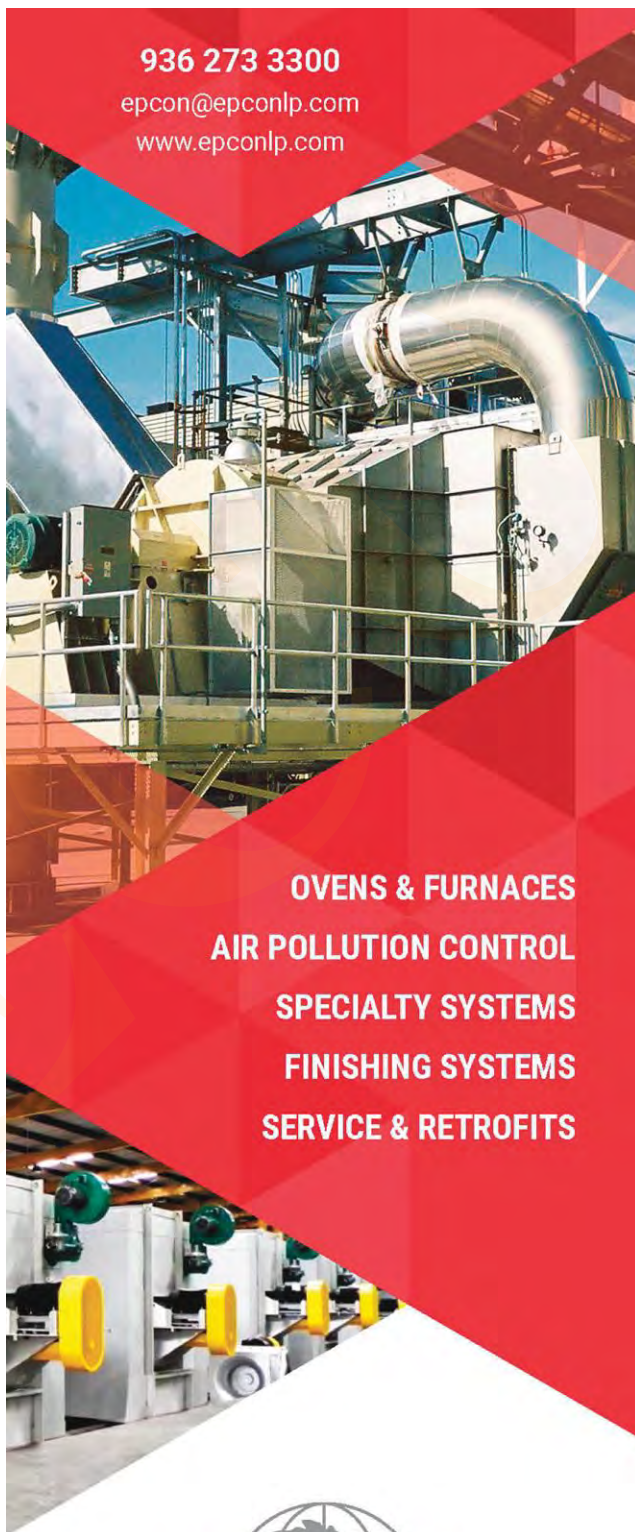
## INDUSTRIAL HEATING

Watch Sapiro talk more about swordsmithing, metal corrosion and the intersection between research and hobbies. Use this QR Code to watch the video.

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# Endothermic Generators for Management

**Jeff McLaughlin –  
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With a wide processing capability, endothermic gas is a common industrial process gas. With readily available ingredients, endo is a simple, economical gas to generate.

**E**ndothermic gas (endo) is synthetically created from reacting natural gas or propane and air at elevated temperatures with a nickel catalyst to speed up reaction and reduce the equipment footprint. For new operators, the equations are generally something like:

Natural gas	Propane
$2\text{CH}_4 + 4\text{N}_2 + \text{O}_2$ $2\text{CO} + 4\text{H}_2 + 4\text{N}_2$	$2\text{C}_3\text{H}_8 + 12\text{N}_2 + 3\text{O}_2$ $6\text{CO} + 8\text{H}_2 + 12\text{N}_2$
HEAT	HEAT
Air/gas ratio = 2.5 to 5.5	Air/gas ratio = 13.1 to 28.8
And for volume calculations:	
(Air + Gas) x 1.43 = Endo cfh	(Air + Gas) x 1.53 = Endo cfh

## Equipment Requirements

Generators for endo come in various sizes and configurations. All have construction standards per NFPA 86, specifically 13.5.3. As such, they all fall under the class C standard. This standard applies to the combustion system (fuel gas) and the process system (reaction gas). The fuel-gas requirements are similar to furnace and oven requirements. Interestingly, current NFPA guidelines regarding the safety requirements of 8.5 (purging and trial for ignition) and flame supervision are not applicable. Purging and supervision are always good – for no other reason than not wasting gas.

Reaction gas supply has requirements for safety shutoff valves and controls required for air-fuel gas mixing systems. Manual reset is required for low/high reaction gas pressures, generator low temperature and power failure. Since many systems utilize blowers and pumps, loss of air supply to the mixer also requires a manual reset.

PLC-based control systems on new generators will track these conditions and alert the operators to the shutdown. The ability to track the ladder logic and custom alarm codes allows for quick troubleshooting. Better still are descriptive alarm messages on graphic HMI interface displays (Fig. 1).



## Mixing Systems

As noted, a wide range of air/gas ratios for specific processes are used. Measuring the CO or H<sub>2</sub>O content of the endo will confirm the proper ratio is maintained. Automatic monitoring and control of the air-gas mixture minimizes the monitoring and adjustment of a manually controlled mixer. Automatic systems usually have an additional benefit of electronic records of gas production quality.

Whether or not record retention is required by the heat-treater's quality policy, these records are an important component in troubleshooting any heat-treat process issues. Manual records can be spotty and are typically infrequent, missing the peaks and valleys in the gas production trend. Endothermic gas synthesis is a production process in its own.

As endo demands rise and fall, automatic volumetric control is almost a necessity. Depending on mixing equipment, various methods have differing abilities to adjust the volume of endo-gas



Fig. 1. Control screen



Fig. 2. Burn-off flare

generation while maintaining an acceptable gas quality level. Fixed-volume systems burn off excess gas (Fig. 2). While stable in gas quality, this is a very inefficient means of gas generation. Both manual and automatic ratio controls lose the ability to accurately measure air and gas over high and low flows. Both quality and volume stability must be determined for generator sizing and operating specifications for new equipment.

The effects of volume control can be seen in the production costs in Fig. 3. The numbers are based on a 4,000-CFH generator capacity and represent production with automatic turndown.

The costs associated in Figure 3 are based on independently determined national averages. Actual costs depend on local utility costs – trending would remain similar to those shown. Also shown are comparisons of a high-efficiency natural-gas-fired design to an electrically heated design. Finally, the fixed-volume costs skyrocket as the generator burns off excess capacity. In all cases, the most economical operation is at maximum capacity.

### Heating System

Heat is required for the production of endo gas. Heating is normally done two different ways: fuel gas or electric. Since reaction gas is required for endo generation anyway, use of the same gas for the fuel gas requires few extra components that are not on the generator already.

Electricity is the zero-emissions alternative. Emissions are handled at the electric generation facility – and priced accordingly. The facility infrastructure can be expensive for an electric generator. A modest-capacity generator can easily require 50-100 kW electric service to the generator. However, electric

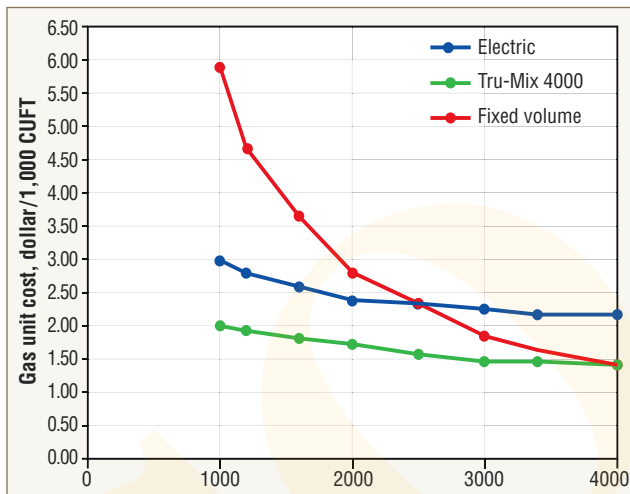


Fig. 3. Endo gas costs

### Typical Heating Efficiencies

Heating method	Efficiency	Excess air
Electric	99%	0%
Atmospheric	20%	50-70%
Forced draft	45%	10%
Recuperative gas	75%	10%



Batch  
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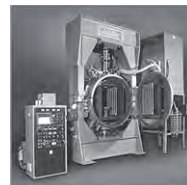
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allows for a virtually unlimited heating turn-down capability.

High-efficiency fuel-gas-fired burners are more cost-effective to operate. The high insulating capabilities of the generator and recuperative burners have actual costs below electric.

All generators use the same amount of reaction gas to produce endo. Typically, endo gas requires 156-402 CFH natural gas (reaction gas) for 1,000 CFH endo gas. Heating the air-gas mixture requires the same energy, regardless of heating method. Energy savings arise from excess gas generation and, to a lesser extent, efficiency of the heating system.

### Safety

Endo gas is explosive! Simple operation is a safety consideration. Manual control can easily create an unsafe condition with untrained operators. PLC-based control systems on new generators with automatic controls will shut down the generator before a dangerous condition can develop. Simple systems also offer simple training. Simple is good.

Endo gas generation is a hazardous mixture. As such, OSHA may require an SDS for endo (see online exclusive). This is an OSHA requirement for all suppliers of hazardous chemicals and is necessary for workplace HazCom programs. OSHA has several interpretations for use of "generic" SDS in the workplace. They can provide guidance in meeting any of the requirements.

### Energy Payback

Many local utility companies have rebate programs for energy savings from new, efficient equipment. This is on top of the utility savings from normal operation. Several customers have taken advantage of our energy-efficient designs for a significant rebate. The equipment supplier will be able to provide operational information. The user will have to determine the operation of the equipment (e.g., capacity, hours of operation, max/min flow requirements and fluctuations). If this is offered, do your homework. It is free money.

### Conclusion

Endothermic gas is an easily produced industrial gas with a wide range of process capabilities. The materials are readily available and are more economical than other bottled-gas options. Newer equipment offers easy-to-use operator-friendly controls and improved production costs. And, with the increasing availability of rebates from utility companies, replacement of older generators is an option worth careful consideration. 

#### For more information:

Contact Jeff McLaughlin,  
McLaughlin Services,  
333 Progress Way,  
Avilla, IN 46710;  
tel: 260-897-4329;  
e-mail: jmclaughlin@  
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Peter Swenson,  
Heat Resistant Sales Dir.

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**Consolidated Engineering Co.**  
Kennesaw, GA; (800) 486-6836  
www.cec-intl.com  
Scott Fagan, Aftermarket Sales Mgr.

**Cumberland Vacuum Products Inc.**  
Vineland, NJ; (856) 691-9155  
www.cumberlandvacuum.com  
Michael Selby, Sales Mgr.

**Custom Electric Manufacturing Co.**  
Wixom, MI  
www.custom-electric.com  
(248) 305-7700 Fax: (248) 305-7705  
Bob Edwards, Pres.  
**SEE OUR AD ON PAGE 15**

**Dalton Electric Heating Co. Inc.**  
Ipswich, MA; (978) 356-9844  
www.daltonelectric.com  
Jamie Baker, Cust. Serv.

**DANTE Solutions Inc.**  
Cleveland, OH; (440) 234-8477  
www.dante-solutions.com  
Charlie Li, V.P.

**DATAPAQ/Fluke Process Instruments,  
Fluke Corporation**  
Salem, NH; (425) 446-6780  
www.flukeprocessinstruments.com  
William Adaschik, Natl. Sales Mgr.

**Delta Cooling Towers**  
Roxbury Township, NJ  
www.deltacooling.com  
(973) 586-2201 Fax: (973) 586-2243  
Liza Wheatley, Sales Assoc.  
**SEE OUR AD ON PAGE 38**

**Dry Coolers Inc.**  
Oxford, MI; (800) 525-8173  
www.drycoolers.com  
Matt Reed, Chief Engr.

**Du-Co Ceramics Co.**  
Saxonburg, PA; (724) 352-1511  
www.du-co.com  
Michael Carson, Sales Mgr.

**Duraloy Technologies Inc.**  
Scottdale, PA; (724) 887-5100  
www.duraloy.com  
Henry Kemp, Eastern Regl. Sales

**Durex Industries**  
Cary, IL; (847) 639-5600  
www.durexindustries.com  
John Golko, Sales Mgr.

**Dynamic Systems Inc.**  
Kirkland, WA; (425) 216-1204  
dynamic-systemsinc.com/software/  
equipment-tool-tracking-software

**East Coast Induction Inc.**  
Brockton, MA; (508) 587-2800  
www.eastcoastind.com  
Ann Parsons, Mgr.

**Ebner Furnaces Inc.**  
Wadsworth, OH; (330) 335-1600  
www.ebner.cc; Peter Andexlinger,  
Mgr.-Engrg./Spare Parts Sales

**ECM-USA Inc.**  
Pleasant Prairie, WI; (262) 605-4810  
www.ecm-usa.com  
Dennis Beauchesne, Gen. Mgr.

**eldec LLC,  
a member of the EMAG Group**  
Auburn Hills, MI; (248) 364-4750  
www.eldec.net  
Greg Holland, Sales Engr.

**ELECTROHEAT LLC**  
Hartford, WI; (800) 925-8565  
www.eheatllc.com  
John Krebs, Sales/Engrg.

**Electronic Development  
Labs Inc. (EDL)**  
Danville, VA; (800) 342-5335  
www.edl-inc.com  
Danielle Smith, Sales Mgr.

**Epcon Industrial Systems LP**  
The Woodlands, TX  
www.epconlp.com  
(936) 273-3300 Fax: (936) 273-4600  
Nedzad Hadzajlic, Engr.  
**SEE OUR AD ON PAGE 39**

**E.R. Advanced Ceramics Inc.,  
US Refractories**  
East Palestine, OH; (330) 426-9433  
www.usrefractories.com  
David Early, V.P./COO

**ETS Schaefer LLC**  
Macedonia, OH; (330) 468-6600  
www.etsschaefer.com  
Dennis Guilmette, Gen. Mgr.

**Eurotherm by Schneider Electric**  
Ashburn, VA; (703) 724-7300  
www.eurotherm.com

**Fireye Inc.**  
Derry, NH; (603) 432-4100  
www.fireye.com  
John Devine, Gen. Mgr.

**Fives North American  
Combustion Inc.**  
Cleveland, OH  
(216) 271-6000  
www.fivesgroup.com  
Tim Warner, Dir.,  
Bus. Dev.-Global Serv.

**Fuel Applications Ltd.**  
Hamilton, ON CANADA  
(905) 525-9700  
www.fuelapplications.ca  
Frans Osterman, Pres.

**Furnacare Inc., Vacuum Furnaces &  
After Sales Services**  
Spartanburg, SC; (864) 599-9955  
www.furna.care  
Damon Bizuka, Sales

**Furnace Rebuilders Inc.**  
Denver, NC; (888) 532-8453  
www.furnacerebuilders.com  
John Murphy, Pres.

**G-M Enterprises**  
Corona, CA  
www.gmenterprises.com  
(951) 340-4646 Fax: (951) 340-9090  
Robert Huckins, Natl. Sales Mgr.  
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**GeoCorp Inc.**  
Huron, OH; (419) 433-1101  
www.geocorpinc.com  
James LaFollette, V.P./Sales

**Giltron Inc.**  
North Dighton, MA; (508) 359-4310  
www.giltron.com  
Fred Pittman, Pres.

**Glen Dimplex Thermal Solutions**  
Kalamazoo, MI; (800) 968-5665  
www.dimplexthermal.com

**Grieve Corp.**  
Round Lake, IL  
www.grievcorp.com  
(847) 546-8225  
Fax: (847) 546-9210  
Frank Calabrese, V.P. Sales  
**SEE OUR AD ON PAGE 28**

**HarbisonWalker International**  
Moon Township, PA  
www.thinkhwi.com  
(412) 375-6600  
(800) 492-8349  
Maegan Hatala, Mktg.  
Content/Comm. Mgr.  
**SEE OUR AD ON PAGE 13**

**Harper International**  
Buffalo, NY; (716) 276-9900  
www.harperintl.com  
Cassandra Harm, Inside Sales Engr.

**Harrop Industries Inc.**  
Columbus, OH; (614) 231-3621  
www.harropusa.com  
Doug Jeter, Dir. Sales/Mktg.

**H.C. Starck Inc., Fabricated Products**  
Euclid, OH; (216) 692-3990  
www.hcstarck.com  
Dawnette Fariello, Sales Mgr.

**Heat Treat Central**  
Wixom, MI; (734) 927-1692  
www.heatreatcentral.com  
Bernie Parry, Heat Treat Central Sales

**Heat Treat Equipment Co.**  
Canton, MI; (734) 331-3939  
www.heatreatequip.com  
Roger Emery, Management Cons.

**Heat Treating Services  
Unlimited Inc.**

**Simpsonville, SC; (888) 383-4878**  
www.htsu.com  
Kevin Ruff, V.P./Gen. Mgr.

**Hi-Tech Furnace Systems Inc.**  
Shelby Twp., MI; (586) 566-0600  
www.hi-techfurnace.com  
Rob Kornfeld, Pres.

**Honeywell Combustion Safety**  
Brook Park, OH; (216) 749-2992  
www.combustionsafety.com  
Dale Smith, Sales Mgr.

**Honeywell Thermal Solutions, Combustion Safety, Combustion Service, Eclipse, Exothermics, Hauck, Kromschroder, and Maxon**  
Muncie, IN; (765) 284-3304  
thermalsolutions.honeywell.com

**Hydro-Thermal Corp.**  
Waukesha, WI; (262) 548-8900  
www.hydro-thermal.com

**HydroThrift Corp.**  
Massillon, OH; (330) 837-5141  
www.hydrothrift.com  
Mike Wlodarski, RSM

**I Squared R Element Co. Inc.**  
Akron, NY  
www.isquaredrelement.com  
(716) 542-5511 Fax: (716) 542-2100  
Christina Clowes, V.P.-Sales & Mktg.  
**SEE OUR AD ON PAGE 47**

**Indelect**  
Lone Star, TX; (903) 656-2518  
www.indelectcorp.com  
John Hrelja, Supt.

**Induction Heating Consultations**  
Grosse Pointe Woods, MI  
(313) 432-1602  
Frank Wilson

**Induction Professionals**  
Youngstown, OH; (330) 779-3456  
www.inductionprofessionals.com  
Tom Kearney, Gen. Mgr.

**Induction Resources**  
Canton, MI; (734) 776-1026  
Scott Berry, Owner

**Induction Tooling Inc.**  
North Royalton, OH; (440) 237-0711  
www.inductiontooling.com  
David Lynch, Engrg. V.P.

**Inductoheat Inc., an Inductotherm Group Co.**  
Madison Heights, MI; (248) 585-9393  
www.inductoheat.com  
Steve Phillip, Aftermarket Sales Dir.

**Industrial Furnace Interiors Inc. (IFI Inc.)**  
Sterling Heights, MI; (586) 977-9600  
www.ifi-inc.com  
Steve Bennett, Sales Mgr.

**Industrial Gas Engineering**  
Westmont, IL; (630) 968-4440  
www.igefans.com  
Dean Keal, V.P./G.M.

**Industronics Service Co.**  
South Windsor, CT  
(860) 289-1551  
www.industronics.com  
George Shaw, Instrument Dept. Mgr.

**INEX Inc.**  
Holland, NY  
www.inexinc.net  
(716) 537-2270 Fax: (716) 537-3218  
Curt Colopy, Bus. Devel. V.P.  
**SEE OUR AD ON PAGE 42**

**INFICON**  
East Syracuse, NY  
(315) 434-1100  
www.inficon.com

**International Thermal Systems LLC, Aftermarket Parts & Services**

Milwaukee, WI  
www.internationalthermalsystems.com  
(414) 672-7700  
Fax: (414) 672-7760  
John Kubacki, Aftermarket Mgr.  
**SEE OUR AD ON PAGE 27**

**Ipsen, Ipsen Customer Service (ICS)**  
Cherry Valley, IL  
www.ipsenusa.com/ics  
(844) 464-7736  
(815) 332-2553  
Fax: (815) 332-2659  
Nathan Durham, Engineered Components Group Mgr.  
**SEE OUR AD ON PAGE 3**

**Ircon/Fluke Process Instruments, Fluke Corporation**  
Everett, WA; (831) 458-3900  
www.flukeprocessinstruments.com  
Bill Adaschik, Natl. Sales Mgr.

**ITW EAE - Despatch**  
Minneapolis, MN; (952) 469-5424  
www.despatch.com  
Paula McGranahan, Sales Assoc.

**J. L. Becker, A Gasbarre Furnace Group Co.**

Plymouth, MI; (734) 656-2000  
www.jlbecker.com  
Eric Buchanan, Regional Sales Mgr.

**Jackson Transformer Company**  
Tampa, FL; (813) 879-5811  
www.jacksontransformer.com

**JC Cole & Associates Inc., Vacuum Furnace Insulation Products**  
Plaistow, NH; (603) 679-2440  
www.jccole.net  
Gordon Flint, Pres.

**Jiangsu Fengdong Thermal Technology Co. Ltd.**  
Jiangsu Province, CHINA  
www.fengdong.com  
086-515-8351-3872  
086-515-8328-2819  
Fax: 086-515-8351-2665

**Keith Co.**  
Pico Rivera, CA; (562) 948-3636  
www.keithcompany.com

**Keylon Thermal Consulting**  
Pollock Pines, CA  
(530) 788-8566  
keylonthermal.com  
Marty Keylon, Owner/Pres.

**Kleenair Products Co.**  
Clackamas, OR  
(503) 653-6925  
www.kleenairusa.com

**L & L Special Furnace Co. Inc.**  
Aston, PA  
www.llfurnace.com  
(610) 459-9216  
(877) 846-7628  
Fax: (610) 459-3689  
Thomas Schultz, Sales Mgr.  
**SEE OUR AD ON PAGE 47**

**Lanly Co.**  
Cleveland, OH; (216) 731-1115  
www.lanly.com  
John Wachter, Appl. Engrg.

**Lindberg/MPH, Thermal Product Solutions**

Riverside, MI; (269) 849-2700  
www.lindbergmph.com  
Steve Kempowski, Pres.

**Linn High Therm GmbH**  
Eschenfelden, GERMANY  
(49) 9665 9140-0  
www.linn.de  
Horst Linn, Pres.

**Lone Star Induction Inc.**  
Corsicana, TX; (866) 403-5744  
www.lonestarinduction.com

**Lucifer Furnaces Inc.**  
Warrington, PA; (215) 343-0411  
www.luciferfurnaces.com  
Robert Hauser, Sales

**Madison Co.**  
Branford, CT; (203) 488-4477  
www.madisonco.com  
Robert Wawrzyniak, Bus. Dev. Mgr.

**Magnetic Specialties Inc.**  
Telford, PA; (267) 384-5231  
www.magspecinc.com  
Michael Afflerbach, Pres.

**Mangold Engineering Inc.**  
Pomona, CA; (909) 622-1091  
www.mangoldengineering.com  
Scott Frostrom, Pres.

**Marathon Monitors and Control Systems Corporation (Beijing), Limited, a member of United Process Controls**  
Shanghai, CHINA  
86-21-3463-0376  
www.group-upc.cn  
Johnny Xu, Gen. Mgr.

**Maztherm Cokeless Melting Inc., Furnaces**  
Sumas, WA; (360) 988-6058  
www.cokelessmelt.com  
Baha Abulnaga, Pres.

**Metallurgical High Vacuum Corporation**

Fennville, MI  
https://www.methivac.com  
(269) 543-4291  
(877) 787-9880  
Fax: (269) 543-4750  
Dave Milliman, Sales/Mfg. Engr.  
**SEE OUR AD ON PAGE 59**

**Metro Services Inc., Combustion & Controls Engineering**  
Chattanooga, TN; (423) 870-5558  
www.metro-services-inc.com  
Scott Norton, Pres.

**Micropyretics Heaters International Inc.**  
Cincinnati, OH; (513) 772-0404  
www.mhi-inc.com

**Minteq International Inc., Pyrogenics Group**  
Easton, PA; (484) 541-7090  
www.pyrographite.com  
Mark Breloff, Sales Mgr.

**Mitutoyo America Corp.**  
Aurora, IL; (630) 820-9666  
www.mitutoyo.com

**MoviTHERM**  
Irvine, CA; (949) 699-6600  
www.movitherm.com  
Markus Tarin, Pres. & CEO

**Nanmac Corp.**  
Holliston, MA; (800) 786-4669  
www.nanmac.com  
Dan Kusza, Sr. Bus. Dev./Acct. Mgr.

**The New York Blower Co.**  
Willowbrook, IL  
www.nyb.com  
(630) 794-5755  
(800) 208-7918  
Fax: (630) 794-5776  
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# COMPANY LISTINGS - AFTERMARKET DIRECTORY

**Nitrex Metal Inc.**  
Montreal, QC CANADA  
(877) 335-7191  
www.nitrex.com  
Jack Kalucki

**Nitrex Metal Sp. z o.o.**  
Sosnowiec, POLAND  
48-32-296-66-30  
www.nitrex.com  
Marcin Stoklosa

**Nutec Bickley**  
Santa Catarina, N.L. MEXICO  
(855) 299-9566  
www.nutecbickley.com  
Arturo Arechavaleta

**Nutec - The Power of Insulation**  
Monterrey N.L. MEXICO  
52-81-8151-4646  
www.nutec.com  
Juan Faudoa, V.P.-Sales

**Odyssey Technical Solutions**  
Round Rock, TX; (512) 989-7007  
www.odysseyrf.com

**Palmer Wahl Temperature Instruments**  
Asheville, NC; (828) 658-3131  
www.palmerwahl.com

**Phoenix Induction Corp.**  
South Lyon, MI; (248) 486-8760  
www.phoenixinduction.com  
Robert Van Aken, Electrical Engr.

**Pillar Induction**  
Brookfield, WI; (800) 558-7733  
www.pillar.com  
Rich Konecny, Aftermarket Mgr.

**Praxair Inc.**  
Danbury, CT  
www.praxair.com/heat treating  
(800) 772-9247 Fax: (800) 772-9985  
Steve Mueller, Assoc. Dir.-Bus. Dev.  
**SEE OUR AD ON PAGE 37**

**Preco Inc.**  
Somerset, WI; (715) 247-3285  
www.precoinc.com  
Dave Plourde, Exec. V.P.-Sales

**Premier Furnace Specialists/ BeaverMatic**  
Farmington Hills, MI  
(248) 596-9000  
www.premierfurnace.com  
Don Selmi, Pres.

**Process-Electronic France, a member of United Process Controls**  
Besancon, FRANCE  
33 (03) 8148-3737  
www.group-upc.com  
Emmanuel Jeanguyot

**Process-Electronic GmbH, a member of United Process Controls**  
Heiningen, GERMANY  
49-7161-94888-0  
www.group-upc.com  
Jens Baumann, Sales

**Process-Electronic Sp. z o.o., a member of United Process Controls**  
Sosnowiec, POLAND  
48 (32) 2966600  
www.group-upc.com

**Protection Controls Inc.**  
Skokie, IL  
www.protectioncontrolsinc.com  
(847) 674-7676  
Fax: (847) 674-7009  
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**PVT Inc.**  
Rancocas, NJ; (609) 267-3933  
www.pvt-vf.com  
Brett Wenger, Pres.

**Pyrotek**  
Spokane, WA; (509) 926-6212  
www.pyrotek.com

**Qual-Fab Inc.**  
Avon, OH; (440) 327-5000  
www.qual-fab.net  
Horst Botsch, Inside Sales/Mktg.

**Radyne Corp., an Inductotherm Group Co.**  
Milwaukee, WI; (800) 236-8360  
www.radyne.com

**Raytek/Fluke Process Instruments, Fluke Corporation**  
Everett, WA; (831) 458-3900  
www.flukeprocessinstruments.com  
Bill Adaschik, Natl. Sales Mgr.

**The Rembar Co. LLC**  
Dobbs Ferry, NY; (914) 693-2620  
www.rembar.com  
Hal Rostad, Sales Mgr.

**R&G Services Inc.**  
Joliet, IL; (815) 727-3300  
www.randgservices.com

**Rolled Alloys**  
Temperance, MI; (800) 521-0332  
www.rolledalloys.com  
Marc Glasser, Dir. of Metallurgical Serv.

**Safe Cronite**  
North Ridgeville, OH  
www.safe-cronite.com  
(440) 353-6594  
(800) 243-4123  
Fax: (440) 353-6599  
Jim Demarest, V.P. Sales/Mktg.  
**SEE OUR AD ON PAGE 19**

**Sandvik Heating Technology USA, Kanthal, Part of Sandvik Group**  
Amherst, NY; (716) 691-4010  
www.kanthal.com  
Jon Hartmayer, NAFTA Sales Mgr.

**Sauereisen**  
Pittsburgh, PA; (412) 963-0303  
www.sauereisen.com  
John E. Davis, Inside Sales/Mktg.

**SECO/VACUUM Technologies LLC**  
Meadville, PA  
www.secovacusa.com  
(814) 332-8400 Fax: (814) 724-1407  
Brandon Grey, Aftermarket Sales  
**SEE OUR AD ON PAGE 17**

**SECO/WARWICK Corp.**  
Meadville, PA; (814) 332-8400  
https://www.secowarwick.com/en/  
professional-technical-services  
Jamie Triola, Aftermarket Sales

**Selas Heat Technology Company**  
Streetsboro, OH  
(800) 523-6500  
www.selas.com  
Chris Forti, Business Dev. Mgr.

**Shimadzu**  
Columbia, MD; (410) 381-1227  
www.ssi.shimadzu.com

**Signature Vacuum Systems Inc.**  
Harmonsburg, PA; (814) 333-1110  
www.signaturevacuum.com  
Greg Kimble, Sales Mgr.

**☛ Sinterite, A Gasbarre Furnace Group Co.**

**St. Marys, PA; (814) 834-2200**  
www.sinterite.com  
Bill Gasbarre, Sales/Mktg. Dir.

**Skamol A/S**  
Nykobing, DENMARK  
45 9772 1533  
www.skamol.com

**SMS Elotherm North America LLC**  
Shelby Twp., MI; (586) 469-8324  
www.us.sms-elotherm.com  
Curt Sutherland, Sales Mgr.

**Solar Manufacturing**  
Souderton, PA  
www.solarmfg.com  
(267) 384-5040  
Fax: (267) 384-5060  
Bryant Strelecki, Sales Mgr.  
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**Spirec N.A. Inc.**  
Paterson, NJ  
(973) 569-9277  
www.spirec.com  
Ed Kitlas

**SteelTech Ltd.**  
Grand Rapids, MI; (616) 243-7920  
www.steeltechltd.com  
Bobb Otvos, COO

**Stelter & Brinck**  
Harrison, OH; (513) 367-9300  
www.stelterbrinck.com  
Gerry Koch, Purch.

**Sticker Corp.**  
Willoughby, OH; (440) 946-2100  
www.stickercorp.com  
Barry Pollock, V.P. Engrg./Sales

**Sun-Tec Corp.**  
Novi, MI; (248) 669-3100  
www.sunteccorp.com  
Mark Antonik

**Super Systems Inc.**  
Cincinnati, OH; (513) 772-0060  
www.supersystems.com  
Bob Fincken, N.A. Sales Mgr.

**Surface Combustion Inc.**  
Maumee, OH  
www.surfacecombustion.com  
(419) 891-7150; (800) 537-8980  
Fax: (419) 891-7151  
Ben Bernard, V.P.-Global Sales  
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**Swerea IVF AB**  
Mölnal, SWEDEN  
4631706 60 00  
www.ivfsmartquench.com  
Nils-Erik Strand

**Taylor-Winfield Technologies Inc.**  
Youngstown, OH  
www.inductionheating-tw.com  
(330) 259-8500; (800) 523-4899  
Fax: (330) 259-8538  
Ryan Neiss, Induction Heating Product Mgr.  
**SEE OUR AD ON PAGE 24**

**TE Wire & Cable**  
Saddle Brook, NJ; (201) 845-9400  
www.tewire.com  
Joe Ugalde, Business Mktg. Analyst

**Teledyne Hastings Instruments**  
Hampton, VA; (757) 723-6531  
www.teledyne-hi.com  
Vikki Jewell, Key Account Mgr.

**Tenova Inc.**  
Coraopolis, PA; (412) 262-2240  
www.tenovacore.com  
David Pekor, Mgr. Furnace Tech. Svcs.

**☛ Thermal Product Solutions, Blue M, Gruenberg**

**New Columbia, PA; (800) 586-2473**  
www.thermalproductsolutions.com  
Carl Calloway, Aftermarket Dir.

**Thermal Technology LLC**  
Santa Rosa, CA; (707) 571-1911  
www.thermaltechnology.com

**Thermcraft Inc.**  
Winston Salem, NC; (336) 784-4800  
www.thermcraftinc.com  
Jim Miller, Sales Mgr.

**Thermo Transfer Inc.**  
Shelbyville, IN; (317) 398-3503  
www.thermotransferinc.com  
Ren Jhala, Pres.

**T-M Vacuum Products**  
Cinnaminson, NJ; (856) 829-2000  
www.tmvacuum.com  
Rennie Wessner, V.P.

**Trent Inc.**  
Philadelphia, PA; (215) 482-5000  
www.trentheat.com

**Trillium US Inc.**  
Hamburg, NJ; (800) 453-1340  
www.trilliumus.com

**Tuthill Vacuum & Blower Systems**  
Springfield, MO; (800) 825-6937  
www.tuthillvacuumblower.com  
Adam Crampton, N.A. Sales Dir.

**Ulbrich Stainless Steels & Special Metals Inc.**  
North Haven, CT; (203) 239-4481  
www.ulbrich.com  
Chris Ulbrich, CEO

**Ultra Electronics, Furnace Parts**  
Cleveland, OH; (423) 302-9502  
www.ultra-furnaceparts.com  
Matt Watts, Bus. Dev. Mgr.

**Ultraflex Power Technologies Corp.**  
Ronkonkoma, NY; (631) 467-6814  
ultraflexpower.com  
Ultraflex Power Technologies

**United Process Controls Inc.**  
West Chester, OH; (513) 772-1000  
www.group-upc.com  
Pat Torok, V.P.-Sales

**United Process Controls Inc.**  
Milwaukee, WI; (414) 462-8200  
www.group-upc.com  
Danny Woodring, Oper. Mgr.  
Flow Prod.

**Unitherm Furnace LLC**  
Wentzville, MO; (636) 327-5777  
www.unithermfurnace.com  
Joe Slattery, Plant Mgr.

**VAC AERO International Inc.**  
Oakville, ON CANADA  
(905) 336-0673; www.vacaero.com  
Bill Potts, Sales/Cust. Serv. Mgr.

**Vacuum Processes Inc.**  
Everett, PA; (814) 652-6767  
www.vacpro.com  
John Swatkoski, Pres.

**Vitta Corporation**  
Bethel, CT; (203) 790-8155  
www.vitta.com  
K. Skandera, Sales

**Vulcan Electric Co., Thermal Div.**  
Porter, ME; (207) 625-3231  
www.vulcanelectric.com  
Paul Wieszeck, V.P.-Engrg./Tech. Servs.

**Watlow**  
St. Louis, MO; (800) 928-5692  
www.watlow.com

**Wellman Furnaces Inc.,  
Precious Technology Group LLC**  
Shelbyville, IN  
(317) 398-4411  
www.wellmanfurnaces.com  
Ms. Bobbie Kerr, Inside Sales

**Wisconsin Oven Corp.**

East Troy, WI  
www.wisoven.com  
(262) 642-3938 Fax: (262) 363-4018  
Steve Bertschinger, Serv. Sales Mgr.  
**SEE OUR AD ON PAGE 35**

**WS Thermal Process Technology Inc.**  
Lorain, OH; (440) 385-6829  
www.flox.com  
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V.P.-Tech. Sales

**Young Metallurgical Consulting**  
West Bloomfield, MI; (248) 909-0038  
www.youngmetallurgical  
consulting.com  
John Young, Metallurgist

**Zircar Ceramics Inc.**

Florida, NY; (845) 651-6600  
www.zircarceramics.com  
David Hamling, V.P.

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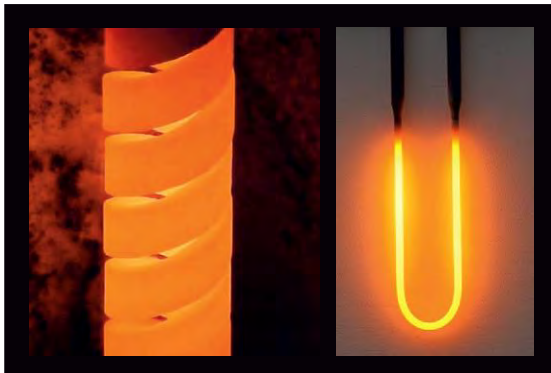
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#### AFC-Holcroft

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Alhern-Martin Industrial Furnace Co.  
Alloy Engineering Co.  
Baker Furnace  
CAN-ENG Furnaces International Ltd.  
Castalloy Inc.  
CerCo Inc., Diamonite  
CMI Industry Americas Inc.  
Consolidated Engineering Co.  
Duraloy Technologies Inc.

#### Ebner Furnaces Inc.

#### → Epcon Industrial Systems LP

#### → G-M Enterprises

H.C. Starck Inc., Fabricated Products  
Hi-Tech Furnace Systems Inc.

#### → J. L. Becker, A Gasbarre Furnace Group Co.

Keith Co.  
Keylon Thermal Consulting

#### → Lindberg/MPH, Thermal Product Solutions

Mangold Engineering Inc.

#### → Praxair Inc.

Premier Furnace Specialists/  
BeaverMatic  
Qual-Fab Inc.  
The Rembar Co. LLC  
Rolled Alloys

#### → Safe Cronite

SECO/WARWICK Corp.

#### → Sinterite, A Gasbarre Furnace Group Co.

SteelTech Ltd.  
Sticker Corp.

#### → Surface Combustion Inc.

Thermo Transfer Inc.  
Ulbrich Stainless Steels &  
Special Metals Inc.  
Ultra Electronics, Furnace Parts  
Ultraflex Power Technologies Corp.  
Vacuum Processes Inc.  
Vitta Corporation  
Wellman Furnaces Inc.,  
Precious Technology Group LLC

#### → Wisconsin Oven Corp.

### Consulting

Advanced Heat Treat Corp.  
(Waterloo, IA - Burton)

Advanced Heat Treat Corp.  
(Waterloo, IA - MidPort)

Advanced Heat Treat Corp. (MI)

#### → Aerospace Testing and Pyrometry

#### → Air & Energy Systems Inc.

Ajax-Tocco De Mexico S.A. DE C.V.  
Ajax TOCCO Magnethermic (Japan)  
Ajax TOCCO Magnethermic  
(Shanghai) Co. LTD  
Ajax TOCCO Magnethermic  
Canada Ltd.  
Ajax TOCCO Magnethermic Corp. (AL)  
Ajax TOCCO Magnethermic Corp. (MI)

Ajax TOCCO Magnethermic Corp.  
(North Canton, OH)

Ajax TOCCO Magnethermic Corp. (TX)  
Alhern-Martin Industrial Furnace Co.

ANDRITZ METALS Inc.

CAN-ENG Furnaces International Ltd.

Cashvac Inc., Vacuum Pumps

Casso-Solar Technologies LLC

CMI Industry Americas Inc.

Conrad Kacsik Instrument Systems Inc.

DANTE Solutions Inc.

Dry Coolers Inc.

Dynamic Systems Inc.

eldec LLC, member of EMAG Group

ELECTROHEAT LLC

#### → Epcon Industrial Systems LP

Fuel Applications Ltd.

Furnacare Inc.

Furnace Rebuilders Inc.

#### → G-M Enterprises

Giltron Inc.

Heat Treat Equipment Co.

#### → Heat Treating Services Unlimited Inc.

Honeywell Combustion Safety

Induction Heating Consultations

Induction Resources

#### → Ipsen, Ipsen Customer Service (ICS)

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Technology Co. Ltd.

Keylon Thermal Consulting

Kleenair Products Co.

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Systems Corporation (Beijing),

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Metro Services Inc., Combustion &

Controls Engineering

Micropyretics Heaters International Inc.

MoviTHERM

Nanmac Corp.

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Nitrex Metal Sp. z o.o.

Nutec Bickley

#### → Praxair Inc.

Premier Furnace Specialists/  
BeaverMatic

Process-Electronic France

Process-Electronic GmbH

Process-Electronic Sp. z o.o.

R&G Services Inc.

Sauereisen

Signature Vacuum Systems Inc.

Thermal Technology LLC

Ultraflex Power Technologies Corp.

United Process Controls Inc. (OH)

United Process Controls Inc. (WI)

Vacuum Processes Inc.

Wellman Furnaces Inc., Precious

Technology Group LLC

Young Metallurgical Consulting

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(Warren, OH)

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ANDRITZ METALS Inc.

Baker Furnace

Bloom Engineering Co. Inc.

CAN-ENG Furnaces International Ltd.

Casso-Solar Technologies LLC

#### → Centorr Vacuum Industries

CMI Industry Americas Inc.

Conrad Kacsik Instrument Systems Inc.

Consolidated Engineering Co.

#### → Epcon Industrial Systems LP

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Fireye Inc.

Fives North American Combustion Inc.

Fuel Applications Ltd.

Furnace Rebuilders Inc.

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Giltron Inc.

#### → Grieve Corp.

Harper International

#### → Heat Treating Services Unlimited Inc.

Hi-Tech Furnace Systems Inc.

Honeywell Combustion Safety

Honeywell Thermal Solutions,

Combustion Safety, Combustion

Service, Eclipse, Exothermics,

Hauck, Kromschroder, and Maxon

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#### → International Thermal Systems LLC,

Aftermarket Parts & Services

#### → Ipsen, Ipsen Customer Service (ICS)

ITW EAE - Despatch

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Keylon Thermal Consulting

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Lanly Co.

#### → Lindberg/MPH, Thermal Product Solutions

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Systems Corporation (Beijing),

Limited, a member of United

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Controls Engineering

Nanmac Corp.

Nitrex Metal Inc.

Nitrex Metal Sp. z o.o.

Nutec Bickley

Pillar Induction

Premier Furnace Specialists/  
BeaverMatic

Process-Electronic France

Process-Electronic GmbH

Process-Electronic Sp. z o.o.

#### → Protection Controls Inc.

R&G Services Inc.

SECO/WARWICK Corp.

Signature Vacuum Systems Inc.

Stelter & Brinck  
Super Systems Inc.

#### → Surface Combustion Inc.

TE Wire & Cable

Tenova Inc.

#### → Thermal Product Solutions,

Blue M, Gruenberg

Thermal Technology LLC

Thermcraft Inc.

United Process Controls Inc. (OH)

United Process Controls Inc. (WI)

Unitherm Furnace LLC

VAC AERO International Inc.

Vacuum Processes Inc.

Watlow

Wellman Furnaces Inc.,

Precious Technology Group LLC

### Equipment Rental & Leasing

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Conrad Kacsik Instrument Systems Inc.

eldec LLC, member of EMAG Group

#### → Epcon Industrial Systems LP

Giltron Inc.

#### → Heat Treating Services Unlimited Inc.

#### → Ipsen, Ipsen Customer Service (ICS)

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Premier Furnace Specialists/  
BeaverMatic

#### → Thermal Product Solutions,

Blue M, Gruenberg

Vacuum Processes Inc.

### Gas/Electric Furnace Conversions

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#### → Aerospace Testing and Pyrometry

AFC-Holcroft

#### → Air & Energy Systems Inc.

#### → Air Products and Chemicals Inc.

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(Warren, OH)

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ANDRITZ METALS Inc.

Baker Furnace

Bloom Engineering Co. Inc.

CAN-ENG Furnaces International Ltd.

Casso-Solar Technologies LLC

CMI Industry Americas Inc.

Conrad Kacsik Instrument Systems Inc.

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Ebner Furnaces Inc.

#### → Epcon Industrial Systems LP

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Fuel Applications Ltd.

Furnace Rebuilders Inc.

#### → Grieve Corp.

Harrop Industries Inc.

Heat Treat Equipment Co.

Honeywell Thermal Solutions,

Combustion Safety, Combustion

Service, Eclipse, Exothermics,

Hauck, Kromschroder, and Maxon

#### → I Squared R Element Co. Inc.

Industrial Furnace Interiors Inc.

Industronics Service Co.

- ➔ **INEX Inc.**
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
ITW EAE - Despatch
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Keylon Thermal Consulting  
Kleenair Products Co.  
Lanly Co.
- ➔ **Lindberg/MPH, Thermal Product Solutions**  
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Marathon Monitors and Control Systems Corporation (Beijing), Limited, a member of United Process Controls  
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Metro Services Inc., Combustion & Controls Engineering  
Micropyretics Heaters International Inc.  
Nitrex Metal Sp. z o.o.  
Premier Furnace Specialists/BeaverMatic  
Process-Electronic France  
Process-Electronic GmbH  
Process-Electronic Sp. z o.o.  
R&G Services Inc.  
Sandvik Heating Technology USA, Kanthal, Part of Sandvik Group  
SECO/WARWICK Corp.
- ➔ **Solar Manufacturing**  
Stelter & Brinck
- ➔ **Surface Combustion Inc.**
- ➔ **Thermal Product Solutions, Blue M, Gruenberg**  
Thermcraft Inc.  
Thermo Transfer Inc.  
United Process Controls Inc. (OH)  
United Process Controls Inc. (WI)  
Unitherm Furnace LLC  
Vacuum Processes Inc.  
Wellman Furnaces Inc., Precious Technology Group LLC
- ➔ **Wisconsin Oven Corp.**
- ➔ **Zircar Ceramics Inc.**

### Instrument Analysis, Replacement, Service

- Albertus Energy Inc.
- Alhern-Martin Industrial Furnace Co.
- ANDRITZ METALS Inc.
- CEA Instruments Inc.
- Conrad Kacsik Instrument Systems Inc.
- Consolidated Engineering Co.
- Electronic Development Labs Inc. (EDL)
- Eurotherm by Schneider Electric
- Fuel Applications Ltd.
- Furnace Rebuilders Inc.
- ➔ **Heat Treating Services Unlimited Inc.**  
Industronics Service Co.
- ➔ **Ipsen, Ipsen Customer Service (ICS)**
- ➔ **J. L. Becker, A Gasbarre Furnace Group Co.**  
Kleenair Products Co.  
Mangold Engineering Inc.  
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Metro Services Inc., Combustion & Controls Engineering  
Micropyretics Heaters International Inc.  
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Process-Electronic France  
Process-Electronic GmbH  
Process-Electronic Sp. z o.o.  
R&G Services Inc.

- Signature Vacuum Systems Inc.**  
Super Systems Inc.  
Teledyne Hastings Instruments  
Tenoa Inc.  
United Process Controls Inc. (OH)  
United Process Controls Inc. (WI)  
Vacuum Processes Inc.  
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### Instrument Calibration

- ➔ **Across International LLC**
- ➔ **Aerospace Testing and Pyrometry**  
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Vacuum Products  
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- ➔ **Applied Test Systems**  
Bloom Engineering Co. Inc.  
CEA Instruments Inc.
- ➔ **Centorr Vacuum Industries**  
Conrad Kacsik Instrument Systems Inc.  
DATAPAQ/Fluke Process Instruments  
Electronic Development Labs Inc. (EDL)  
Eurotherm by Schneider Electric
- ➔ **G-M Enterprises**  
GeoCorp Inc.
- ➔ **Heat Treating Services Unlimited Inc.**  
Industronics Service Co.
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
ITW EAE - Despatch  
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Mangold Engineering Inc.  
Marathon Monitors and Control Systems Corporation (Beijing), Limited, a member of United Process Controls  
Metro Services Inc., Combustion & Controls Engineering  
Mitutoyo America Corp.
- ➔ **Nanmac Corp.**  
Palmer Wahl Temperature Instruments
- ➔ **Praxair Inc.**  
Premier Furnace Specialists/BeaverMatic  
Process-Electronic France  
Process-Electronic GmbH  
Process-Electronic Sp. z o.o.  
Raytek/Fluke Process Instruments  
R&G Services Inc.
- ➔ **Sinterite, A Gasbarre Furnace Group Co.**  
Sun-Tec Corp.
- ➔ **Surface Combustion Inc.**  
TE Wire & Cable  
Teledyne Hastings Instruments  
Tenoa Inc.  
Thermcraft Inc.  
United Process Controls Inc. (OH)  
United Process Controls Inc. (WI)  
Unitherm Furnace LLC  
VAC AERO International Inc.  
Vacuum Processes Inc.

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Advanced Heat Treat Corp. (AL)  
Advanced Heat Treat Corp. (Waterloo, IA - Burton)  
Advanced Heat Treat Corp. (Waterloo, IA - MidPort)  
Advanced Heat Treat Corp. (MI)  
DANTE Solutions Inc.  
Duraloy Technologies Inc.  
Harrop Industries Inc.  
Induction Tooling Inc.

- Inductoheat Inc., an Inductotherm Group Co.
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Mangold Engineering Inc.  
Maztherm Cokeless Melting Inc.  
Micropyretics Heaters International Inc.  
Minteq International Inc.,  
Pyrogenics Group  
Mitutoyo America Corp.  
Nitrex Metal Inc.  
Nitrex Metal Sp. z o.o.  
Pillar Induction
- ➔ **Praxair Inc.**  
Preco Inc.  
Shimadzu  
Sun-Tec Corp.
- ➔ **Surface Combustion Inc.**
- ➔ **Taylor-Winfield Technologies Inc.**  
TE Wire & Cable  
Ultraflex Power Technologies Corp.

### Post-Quench Spray/Drink Washer-Process Upgrade

- AFC-Holcrott**  
CMI Industry Americas Inc.
- ➔ **Epcor Industrial Systems LP**
- ➔ **J. L. Becker, A Gasbarre Furnace Group Co.**  
Madison Co.  
Mangold Engineering Inc.

### Process Improvement & Cost Reduction Analysis

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3T True Temperature Technologies
- ➔ **Aerospace Testing and Pyrometry**
- ➔ **Air & Energy Systems Inc.**
- ➔ **Air Products and Chemicals Inc.**  
Albertus Energy Inc.  
Alhern-Martin Industrial Furnace Co.  
ANDRITZ METALS Inc.  
Bloom Engineering Co. Inc.  
CAN-ENG Furnaces International Ltd.  
Casso-Solar Technologies LLC  
CMI Industry Americas Inc.  
DANTE Solutions Inc.  
DATAPAQ/Fluke Process Instruments  
Ebner Furnaces Inc.  
ECM-USA Inc.
- ➔ **Epcor Industrial Systems LP**  
Fives North American Combustion Inc.  
Furnace Rebuilders Inc.
- ➔ **G-M Enterprises**  
Giltron Inc.  
Hi-Tech Furnace Systems Inc.  
Honeywell Combustion Safety  
Honeywell Thermal Solutions,  
Combustion Safety, Combustion Service, Eclipse, Exothermics, Hauck, Kromschroder, and Maxon  
Hydro-Thermal Corp.  
Induction Resources  
Industronics Service Co.
- ➔ **Ipsen, Ipsen Customer Service (ICS)**
- ➔ **J. L. Becker, A Gasbarre Furnace Group Co.**  
Keith Co.  
Kleenair Products Co.  
Lanly Co.  
Mangold Engineering Inc.  
Marathon Monitors and Control Systems Corporation (Beijing), Limited, a member of United Process Controls  
Micropyretics Heaters International Inc.  
**Nanmac Corp.**  
Nitrex Metal Inc.

- Nitrex Metal Sp. z o.o.
- Nutec Bickley  
Preco Inc.  
Premier Furnace Specialists/BeaverMatic  
Process-Electronic France  
Process-Electronic GmbH  
Process-Electronic Sp. z o.o.  
Sandvik Heating Technology USA, Kanthal, Part of Sandvik Group  
SMS Elotherm North America LLC  
Stelter & Brinck
- ➔ **Taylor-Winfield Technologies Inc.**  
Tenoa Inc.  
Ultra Electronics, Furnace Parts  
Ultraflex Power Technologies Corp.  
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United Process Controls Inc. (WI)  
Vacuum Processes Inc.  
WS Thermal Process Technology Inc.  
Young Metallurgical Consulting

### Pyrometry Services

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GeoCorp Inc.
- ➔ **Heat Treating Services Unlimited Inc.**  
**Nanmac Corp.**  
Nutec Bickley  
Ultra Electronics, Furnace Parts  
Ultraflex Power Technologies Corp.

### Surface Cleaning Equipment, Chemicals & Technical Support

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Hi-Tech Furnace Systems Inc.  
Madison Co.

### Temperature Control/Calibration

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3T True Temperature Technologies
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Alhern-Martin Industrial Furnace Co.  
American Isostatic Presses Inc.  
ANDRITZ METALS Inc.
- ➔ **Applied Test Systems**  
Bloom Engineering Co. Inc.  
CMI Industry Americas Inc.  
Conrad Kacsik Instrument Systems Inc.  
DATAPAQ/Fluke Process Instruments  
Durex Industries  
Electronic Development Labs Inc. (EDL)  
Eurotherm by Schneider Electric  
Fuel Applications Ltd.  
Furnace Rebuilders Inc.
- ➔ **G-M Enterprises**  
GeoCorp Inc.  
Harrop Industries Inc.
- ➔ **Heat Treating Services Unlimited Inc.**  
Industronics Service Co.
- ➔ **International Thermal Systems LLC, Aftermarket Parts & Services**
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
Ircor/Fluke Process Instruments  
ITW EAE - Despatch  
Kleenair Products Co.  
Lanly Co.  
Madison Co.  
Mangold Engineering Inc.  
Marathon Monitors and Control Systems Corporation (Beijing), Limited, a member of United Process Controls

# CAPABILITIES LISTINGS - AFTERMARKET DIRECTORY

Metro Services Inc., Combustion & Controls Engineering  
 MoviTHERM  
**Nanmac Corp.**  
 Nutec Bickley  
 Palmer Wahl Temperature Instruments  
**➔ Praxair Inc.**  
 Premier Furnace Specialists/  
 BeaverMatic  
 Process-Electronic France  
 Process-Electronic GmbH  
 Process-Electronic Sp. z o.o.  
 Raytek/Fluke Process Instruments  
 R&G Services Inc.  
 SECO/WARWICK Corp.  
 Stelter & Brinck  
 Super Systems Inc.  
**➔ Surface Combustion Inc.**  
 TE Wire & Cable  
 Tenova Inc.  
 Thermcraft Inc.  
 Ultra Electronics, Furnace Parts  
 Ultraflex Power Technologies Corp.  
 United Process Controls Inc. (OH)  
 United Process Controls Inc. (WI)  
 Unitherm Furnace LLC  
 VAC AERO International Inc.  
 Vacuum Processes Inc.  
 Vulcan Electric Co., Thermal Div.  
 Watlow  
 Wellman Furnaces Inc., Precious Technology Group LLC

## Temperature Uniformity Survey

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**➔ Air & Energy Systems Inc.**  
 Ajax TOCCO Magnethermic Corp.  
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 ALD Vacuum Systems Inc.  
 Alhern-Martin Industrial Furnace Co.  
 American Isostatic Presses Inc.  
 ANDRITZ METALS Inc.  
 Baker Furnace  
 CAN-ENG Furnaces International Ltd.  
**➔ Centorr Vacuum Industries**  
 CM Furnaces Inc.  
 CMI Industry Americas Inc.  
 Conrad Kacsik Instrument Systems Inc.  
 DATAPAO/Fluke Process Instruments  
 Electronic Development Labs Inc. (EDL)  
 Eurotherm by Schneider Electric  
 Fuel Applications Ltd.  
 Furnacare Inc.  
 GeoCorp Inc.  
**➔ Heat Treating Services Unlimited Inc.**  
 Hi-Tech Furnace Systems Inc.  
 Industronics Service Co.  
**➔ International Thermal Systems LLC, Aftermarket Parts & Services**  
**➔ Ipsen, Ipsen Customer Service (ICS)**  
 Ircon/Fluke Process Instruments  
 ITW EAE - Despatch  
**➔ J. L. Becker, A Gasbarre Furnace Group Co.**  
 Kleenair Products Co.  
 Lanly Co.  
**➔ Lindberg/MPH, Thermal Product Solutions**  
 Mangold Engineering Inc.  
 Marathon Monitors and Control Systems Corporation (Beijing), Limited, a member of United Process Controls  
 Metro Services Inc., Combustion & Controls Engineering  
 Micropyretics Heaters International Inc.  
 MoviTHERM  
**Nanmac Corp.**

Nutec Bickley  
 Premier Furnace Specialists/  
 BeaverMatic  
 Process-Electronic France  
 Process-Electronic GmbH  
 Process-Electronic Sp. z o.o.  
 PVT Inc.  
 Raytek/Fluke Process Instruments  
 R&G Services Inc.  
 SECO/WARWICK Corp.  
 Super Systems Inc.  
**➔ Surface Combustion Inc.**  
 TE Wire & Cable  
 Tenova Inc.  
**➔ Thermal Product Solutions, Blue M. Gruenberg**  
 Thermal Technology LLC  
 Thermcraft Inc.  
 Ultra Electronics, Furnace Parts  
 Ultraflex Power Technologies Corp.  
 United Process Controls Inc. (OH)  
 United Process Controls Inc. (WI)  
 Unitherm Furnace LLC  
 VAC AERO International Inc.  
 Vulcan Electric Co., Thermal Div.  
**➔ Wisconsin Oven Corp.**

## Training & Education

**➔ Aerospace Testing and Pyrometry AFC-Holcroft**  
 Agilent Technologies,  
 Vacuum Products  
**➔ Air & Energy Systems Inc.**  
 Ajax TOCCO Magnethermic Corp.  
 (Warren, OH)  
 Albertus Energy Inc.  
 ALD Vacuum Systems Inc.  
 Alhern-Martin Industrial Furnace Co.  
 ANDRITZ METALS Inc.  
**➔ Applied Test Systems**  
 Bloom Engineering Co. Inc.  
 CAN-ENG Furnaces International Ltd.  
 CM Furnaces Inc.  
 CMI Industry Americas Inc.  
 Conrad Kacsik Instrument Systems Inc.  
 ELECTROHEAT LLC  
 Eurotherm by Schneider Electric  
 Fives North American Combustion Inc.  
 Furnacare Inc.  
**➔ Heat Treating Services Unlimited Inc.**  
 Honeywell Combustion Safety  
 Honeywell Thermal Solutions,  
 Combustion Safety, Combustion Service, Eclipse, Exothermics,  
 Hauck, Kromschröder, and Maxon  
 Induction Resources  
 Industronics Service Co.  
**➔ International Thermal Systems LLC, Aftermarket Parts & Services**  
**➔ Ipsen, Ipsen Customer Service (ICS)**  
 ITW EAE - Despatch  
**➔ J. L. Becker, A Gasbarre Furnace Group Co.**  
 Keylon Thermal Consulting  
 Kleenair Products Co.  
 Lanly Co.  
 Mangold Engineering Inc.  
 Metro Services Inc., Combustion & Controls Engineering  
 Nutec Bickley  
 Pillar Induction  
 Premier Furnace Specialists/BeaverMatic  
 PVT Inc.  
**Signature Vacuum Systems Inc.**  
 Super Systems Inc.  
**➔ Surface Combustion Inc.**  
 Tenova Inc.  
 Thermal Technology LLC  
 Vacuum Processes Inc.

Wellman Furnaces Inc., Precious Technology Group LLC  
 Young Metallurgical Consulting

## Troubleshooting & Repair

**➔ Across International LLC AFC-Holcroft**  
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 Ajax-Tocco De Mexico S.A. DE C.V.  
 Ajax TOCCO Magnethermic (Japan)  
 Ajax TOCCO Magnethermic (Shanghai) Co. LTD  
 Ajax TOCCO Magnethermic Canada Ltd.  
 Ajax TOCCO Magnethermic Corp. (AL)  
 Ajax TOCCO Magnethermic Corp. (MI)  
 Ajax TOCCO Magnethermic Corp. (North Canton, OH)  
 Ajax TOCCO Magnethermic Corp. (Warren, OH)  
 Ajax TOCCO Magnethermic Corp. (TX)  
 Albertus Energy Inc.  
 ALD Vacuum Systems Inc.  
 Alhern-Martin Industrial Furnace Co.  
**➔ Applied Test Systems**  
 Baker Furnace  
 Blasdel Enterprises Inc.  
 Bloom Engineering Co. Inc.  
 CAN-ENG Furnaces International Ltd.  
**➔ Centorr Vacuum Industries**  
 CM Furnaces Inc.  
 CMI Industry Americas Inc.  
 Conrad Kacsik Instrument Systems Inc.  
 Consolidated Engineering Co.  
 ELECTROHEAT LLC  
 Electronic Development Labs Inc. (EDL)  
**➔ Epcor Industrial Systems LP**  
 Eurotherm by Schneider Electric  
 Fives North American Combustion Inc.  
 Fuel Applications Ltd.  
 Furnacare Inc.  
 Furnace Rebuilders Inc.  
**➔ G-M Enterprises**  
 Giltron Inc.  
 Harrop Industries Inc.  
 Heat Treat Equipment Co.  
**➔ Heat Treating Services Unlimited Inc.**  
 Honeywell Combustion Safety  
 Honeywell Thermal Solutions,  
 Combustion Safety, Combustion Service, Eclipse, Exothermics,  
 Hauck, Kromschröder, and Maxon  
 Indelect  
 Inductoheat Inc.,  
 an Inductotherm Group Co.  
 Industrial Gas Engineering  
 Industronics Service Co.  
**➔ International Thermal Systems LLC, Aftermarket Parts & Services**  
**➔ Ipsen, Ipsen Customer Service (ICS)**  
 ITW EAE - Despatch  
**➔ J. L. Becker, A Gasbarre Furnace Group Co.**  
 Keith Co.  
 Keylon Thermal Consulting  
 Kleenair Products Co.  
 Lanly Co.  
**➔ Lindberg/MPH, Thermal Product Solutions**  
 Mangold Engineering Inc.  
 Marathon Monitors and Control Systems Corporation (Beijing), Limited, a member of United Process Controls  
 Metro Services Inc., Combustion & Controls Engineering  
**Nanmac Corp.**  
 Nutec Bickley  
 Odyssey Technical Solutions  
 Pillar Induction

Premier Furnace Specialists/  
 BeaverMatic  
 Process-Electronic France  
 Process-Electronic GmbH  
 Process-Electronic Sp. z o.o.  
 Protection Controls Inc.  
 PVT Inc.  
 R&G Services Inc.  
 SECO/WARWICK Corp.  
 Selas Heat Technology Company  
**Signature Vacuum Systems Inc.**  
 SMS Elotherm North America LLC  
 SteelTech Ltd.  
 Stelter & Brinck  
 Sun-Tec Corp.  
 Super Systems Inc.  
**➔ Surface Combustion Inc.**  
**➔ Taylor-Winfield Technologies Inc.**  
 Tenova Inc.  
**➔ Thermal Product Solutions, Blue M. Gruenberg**  
 Thermal Technology LLC  
 Thermcraft Inc.  
 Thermo Transfer Inc.  
 Ultra Electronics, Furnace Parts  
 Ultraflex Power Technologies Corp.  
 United Process Controls Inc. (OH)  
 United Process Controls Inc. (WI)  
 VAC AERO International Inc.  
 Vacuum Processes Inc.  
 Wellman Furnaces Inc.,  
 Precious Technology Group LLC  
**➔ Wisconsin Oven Corp.**

## REFRACTORY & INSULATION

### Refractory Installation & Dry Out

**AFC-Holcroft**  
 Albertus Energy Inc.  
 Baker Furnace  
 CMI Industry Americas Inc.  
 ETS Schaefer LLC  
 Fives North American Combustion Inc.  
 Fuel Applications Ltd.  
 Furnace Rebuilders Inc.  
**➔ HarbisonWalker International**  
 Harrop Industries Inc.  
**➔ Heat Treating Services Unlimited Inc.**  
 Hi-Tech Furnace Systems Inc.  
 Indelect  
 Industronics Service Co.  
**➔ Ipsen, Ipsen Customer Service (ICS)**  
 Keith Co.  
 Keylon Thermal Consulting  
**➔ Lindberg/MPH, Thermal Product Solutions**  
 Linn High Therm GmbH  
 Mangold Engineering Inc.  
 Nutec Bickley  
 Nutec - The Power of Insulation  
 Premier Furnace Specialists/  
 BeaverMatic  
 R&G Services Inc.  
 SECO/WARWICK Corp.  
 Skamol A/S  
 SMS Elotherm North America LLC  
**➔ Surface Combustion Inc.**  
 Thermo Transfer Inc.  
 Unitherm Furnace LLC  
 Vacuum Processes Inc.  
 Wellman Furnaces Inc.,  
 Precious Technology Group LLC

### Refractory Repair, Replacement & Upgrade

Ace Industrial Mfg.  
**➔ Advanced Material Science LLC**

➔ Indicates an advertiser in this issue

- ➔ **Aerospace Testing and Pyrometry AFG-Holcroft**  
Albertus Energy Inc.  
Baker Furnace  
CerCo Inc., Diamonite  
CMI Industry Americas Inc.  
Electronic Development Labs Inc. (EDL)  
E.R. Advanced Ceramics Inc.,  
US Refractories  
ETS Schaefer LLC  
Fives North American Combustion Inc.  
Fuel Applications Ltd.  
Furnace Rebuilders Inc.
- ➔ **HarbisonWalker International**  
Harper International  
Harrop Industries Inc.
- ➔ **Heat Treating Services Unlimited Inc.**  
Hi-Tech Furnace Systems Inc.  
Indelect  
Industronics Service Co.
- ➔ **Ipsen, Ipsen Customer Service (ICS)**
- ➔ **J. L. Becker, A Gasbarre Furnace Group Co.**  
Keith Co.
- ➔ **Lindberg/MPH, Thermal Product Solutions**  
Linn High Therm GmbH  
Mangold Engineering Inc.  
Micropyretics Heaters International Inc.
- ➔ **The New York Blower Co.**  
Nuteck Bickley  
Nuteck - The Power of Insulation  
Premier Furnace Specialists/  
BeaverMatic  
Pyrotek  
R&G Services Inc.  
SECO/WARWICK Corp.  
Skamol A/S  
SMS Elotherm North America LLC
- ➔ **Surface Combustion Inc.**  
TenoVA Inc.  
Thermo Transfer Inc.  
Ultra Electronics, Furnace Parts  
Unitherm Furnace LLC  
VAC AERO International Inc.  
Vacuum Processes Inc.  
Wellman Furnaces Inc.,  
Precious Technology Group LLC
- ➔ **Zircar Ceramics Inc.**

## COMPLIANCE

### Environmental, Hazardous Waste & EPA

- Bloom Engineering Co. Inc.  
CEA Instruments Inc.
- ➔ **Epcon Industrial Systems LP**  
ITW EAE - Despatch  
Keylon Thermal Consulting  
Maztherm Cokeless Melting Inc.  
Minteq International Inc.,  
Pyrogenics Group  
Stelter & Brinck  
TenoVA Inc.

### Military, Aircraft & Industry Specification

- ➔ **Across International LLC**
- ➔ **Aerospace Testing and Pyrometry**  
Baker Furnace  
Conrad Kacsik Instrument Systems Inc.  
DATAPAQ/Fluke Process Instruments
- ➔ **Epcon Industrial Systems LP**
- ➔ **G-M Enterprises**  
GeoCorp Inc.
- ➔ **Heat Treating Services Unlimited Inc.**
- ➔ **Ipsen, Ipsen Customer Service (ICS)**

- ITW EAE - Despatch  
Keylon Thermal Consulting
- ➔ **Lindberg/MPH, Thermal Product Solutions**  
Minteq International Inc.,  
Pyrogenics Group  
**Nanmac Corp.**  
Premier Furnace Specialists/  
BeaverMatic  
**Sauereisen**  
Ultra Electronics, Furnace Parts  
Unitherm Furnace LLC  
VAC AERO International Inc.

## NFPA

- Abell Combustion Inc.  
Ajax TOCCO Magnethermic Corp.  
(Warren, OH)  
Alhern-Martin Industrial Furnace Co.  
Blasdel Enterprises Inc.  
Bloom Engineering Co. Inc.
- ➔ **Centorr Vacuum Industries**  
CMI Industry Americas Inc.  
Conrad Kacsik Instrument Systems Inc.
- ➔ **Epcon Industrial Systems LP**  
Fives North American Combustion Inc.
- ➔ **Grieve Corp.**
- ➔ **Heat Treating Services Unlimited Inc.**  
Honeywell Combustion Safety  
Honeywell Thermal Solutions,  
Combustion Safety, Combustion  
Service, Eclipse, Exothermics,  
Hauck, Kromschroder, and Maxon
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
ITW EAE - Despatch  
Kleenair Products Co.  
Lanly Co.  
Metro Services Inc., Combustion &  
Controls Engineering  
Nuteck Bickley  
Premier Furnace Specialists/  
BeaverMatic
- ➔ **Protection Controls Inc.**  
SECO/WARWICK Corp.  
Stelter & Brinck
- ➔ **Surface Combustion Inc.**  
Thermo Transfer Inc.  
United Process Controls Inc. (OH)  
United Process Controls Inc. (WI)  
Unitherm Furnace LLC  
Wellman Furnaces Inc.,  
Precious Technology Group LLC

## Worker Safety/OSHA

- CEA Instruments Inc.
- ➔ **Centorr Vacuum Industries**  
CMI Industry Americas Inc.
- ➔ **Epcon Industrial Systems LP**  
Furnace Rebuilders Inc.  
Honeywell Combustion Safety  
Honeywell Thermal Solutions,  
Combustion Safety, Combustion  
Service, Eclipse, Exothermics,  
Hauck, Kromschroder, and Maxon
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
ITW EAE - Despatch  
Keylon Thermal Consulting  
Minteq International Inc.,  
Pyrogenics Group  
Nuteck Bickley  
Vacuum Processes Inc.

## Technical Standards & Safety Authority (TSSA) Submissions & Approvals

- Fuel Applications Ltd.

- Honeywell Thermal Solutions,  
Combustion Safety, Combustion  
Service, Eclipse, Exothermics,  
Hauck, Kromschroder, and Maxon

## DIRECT-FIRED, ELECTRIC & ATMOSPHERE FURNACE SYSTEMS

### Atmosphere Composition Analysis

- Alhern-Martin Industrial Furnace Co.  
CEA Instruments Inc.  
CMI Industry Americas Inc.
- ➔ **Ebner Furnaces Inc.**
- ➔ **G-M Enterprises**  
Heat Treat Equipment Co.
- ➔ **Heat Treating Services Unlimited Inc.**  
Honeywell Combustion Safety
- ➔ **Ipsen, Ipsen Customer Service (ICS)**
- ➔ **J. L. Becker, A Gasbarre Furnace Group Co.**  
Keylon Thermal Consulting  
Lucifer Furnaces Inc.  
Mangold Engineering Inc.  
Marathon Monitors and Control  
Systems Corporation (Beijing),  
Limited, a member of United  
Process Controls  
Nitrex Metal Inc.  
Nitrex Metal Sp. z o.o.  
Premier Furnace Specialists/  
BeaverMatic  
Process-Electronic France  
Process-Electronic GmbH  
Process-Electronic Sp. z o.o.  
SECO/WARWICK Corp.
- ➔ **Surface Combustion Inc.**  
TenoVA Inc.  
United Process Controls Inc. (OH)  
United Process Controls Inc. (WI)  
Vacuum Processes Inc.

### Atmosphere Generator Services

- ➔ **Across International LLC**  
**AFG-Holcroft**  
Alhern-Martin Industrial Furnace Co.  
Baker Furnace  
CAN-ENG Furnaces International Ltd.
- ➔ **C.I. Hayes, A Gasbarre Furnace Group Co.**  
CMI Industry Americas Inc.  
Conrad Kacsik Instrument Systems Inc.  
Furnace Rebuilders Inc.  
Heat Treat Equipment Co.
- ➔ **Heat Treating Services Unlimited Inc.**  
Industronics Service Co.
- ➔ **Ipsen, Ipsen Customer Service (ICS)**
- ➔ **J. L. Becker, A Gasbarre Furnace Group Co.**  
Keylon Thermal Consulting  
Kleenair Products Co.
- ➔ **Lindberg/MPH, Thermal Product Solutions**  
Mangold Engineering Inc.  
Marathon Monitors and Control  
Systems Corporation (Beijing),  
Limited, a member of United  
Process Controls  
Premier Furnace Specialists/  
BeaverMatic  
Process-Electronic France  
Process-Electronic GmbH  
Process-Electronic Sp. z o.o.  
R&G Services Inc.  
SECO/WARWICK Corp.  
Super Systems Inc.
- ➔ **Surface Combustion Inc.**

- TenoVA Inc.  
Thermo Transfer Inc.  
United Process Controls Inc. (OH)  
United Process Controls Inc. (WI)  
Unitherm Furnace LLC

## Combustion Systems Services

- Abell Combustion Inc.
- ➔ **Across International LLC**
- ➔ **Aerospace Testing and Pyrometry AFG-Holcroft**
- ➔ **Air & Energy Systems Inc.**  
Ajax TOCCO Magnethermic Corp.  
(Warren, OH)  
Albertus Energy Inc.  
Alhern-Martin Industrial Furnace Co.  
ANDRITZ METALS Inc.  
Baker Furnace  
Bloom Engineering Co. Inc.  
CAN-ENG Furnaces International Ltd.  
CMI Industry Americas Inc.  
Conrad Kacsik Instrument Systems Inc.  
Consolidated Engineering Co.
- ➔ **Epcon Industrial Systems LP**  
Fireye Inc.  
Fives North American Combustion Inc.  
Fuel Applications Ltd.  
Furnace Rebuilders Inc.  
Harrop Industries Inc.  
Heat Treat Equipment Co.
- ➔ **Heat Treating Services Unlimited Inc.**  
Honeywell Combustion Safety  
Industronics Service Co.
- ➔ **INEX Inc.**
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
ITW EAE - Despatch
- ➔ **J. L. Becker, A Gasbarre Furnace Group Co.**  
Keith Co.  
Keylon Thermal Consulting  
Kleenair Products Co.  
Lanly Co.
- ➔ **Lindberg/MPH, Thermal Product Solutions**  
Lucifer Furnaces Inc.  
Mangold Engineering Inc.  
Marathon Monitors and Control  
Systems Corporation (Beijing),  
Limited, a member of United  
Process Controls  
Maztherm Cokeless Melting Inc.  
Metro Services Inc., Combustion &  
Controls Engineering  
Nuteck Bickley
- ➔ **Praxair Inc.**  
Premier Furnace Specialists/  
BeaverMatic  
Process-Electronic France  
Process-Electronic GmbH  
Process-Electronic Sp. z o.o.
- ➔ **Protection Controls Inc.**  
R&G Services Inc.  
SECO/WARWICK Corp.  
Selas Heat Technology Company  
Stelter & Brinck  
Super Systems Inc.
- ➔ **Surface Combustion Inc.**  
TenoVA Inc.  
Thermcraft Inc.  
Thermo Transfer Inc.  
United Process Controls Inc. (OH)  
United Process Controls Inc. (WI)  
Unitherm Furnace LLC  
WS Thermal Process Technology Inc.

## Emission Testing

- Albertus Energy Inc.  
Alhern-Martin Industrial Furnace Co.  
Bloom Engineering Co. Inc.

# CAPABILITIES LISTINGS - AFTERMARKET DIRECTORY

- ➔ **Epcon Industrial Systems LP**  
Fives North American Combustion Inc.  
Ircan/Fluke Process Instruments  
Kleenair Products Co.  
Mangold Engineering Inc.  
Metro Services Inc., Combustion & Controls Engineering  
Nutek Bickley  
Raytek/Fluke Process Instruments  
SECO/WARWICK Corp.  
Tenoa Inc.  
Vacuum Processes Inc.  
WS Thermal Process Technology Inc.

## Field Service

- ➔ **Across International LLC**
- ➔ **Aerospace Testing and Pyrometry AFC-Holcroft**
- ➔ **Air & Energy Systems Inc.**  
Ajax-Tocco De Mexico S.A. DE C.V.  
Ajax TOCCO Magnethermic (Japan)  
Ajax TOCCO Magnethermic (Shanghai) Co. LTD  
Ajax TOCCO Magnethermic Canada Ltd.  
Ajax TOCCO Magnethermic Corp. (AL)  
Ajax TOCCO Magnethermic Corp. (MI)  
Ajax TOCCO Magnethermic Corp. (North Canton, OH)  
Ajax TOCCO Magnethermic Corp. (Warren, OH)  
Ajax TOCCO Magnethermic Corp. (TX)  
Albertus Energy Inc.  
Alhern-Martin Industrial Furnace Co.  
ANDRITZ METALS Inc.  
Baker Furnace  
Bloom Engineering Co. Inc.  
CAN-ENG Furnaces International Ltd.
- ➔ **Centorr Vacuum Industries**
- ➔ **C.I. Hayes, A Gasbarre Furnace Group Co.**  
CM Furnaces Inc.  
CMI Industry Americas Inc.  
Conrad Kacsik Instrument Systems Inc.  
Consolidated Engineering Co.  
Ebner Furnaces Inc.
- ➔ **Epcon Industrial Systems LP**  
ETS Schaefer LLC  
Fives North American Combustion Inc.  
Fuel Applications Ltd.  
Furnace Rebuilders Inc.
- ➔ **Grieve Corp.**  
Harper International  
Harpor Industries Inc.  
Heat Treat Equipment Co.
- ➔ **Heat Treating Services Unlimited Inc.**  
Hi-Tech Furnace Systems Inc.  
Honeywell Combustion Safety  
Industronics Service Co.
- ➔ **International Thermal Systems LLC, Aftermarket Parts & Services**
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
ITW EAE - Despatch
- ➔ **J. L. Becker, A Gasbarre Furnace Group Co.**  
Keith Co.  
Keylon Thermal Consulting  
Kleenair Products Co.  
Lanly Co.
- ➔ **Lindberg/MPH, Thermal Product Solutions**  
Mangold Engineering Inc.  
Marathon Monitors and Control Systems Corporation (Beijing), Limited, a member of United Process Controls  
Metro Services Inc., Combustion & Controls Engineering  
Micropyretics Heaters International Inc.

- Nutek Bickley  
Premier Furnace Specialists/  
BeaverMatic  
Process-Electronic France  
Process-Electronic GmbH  
Process-Electronic Sp. z o.o.  
R&G Services Inc.  
SECO/WARWICK Corp.  
Selas Heat Technology Company
- ➔ **Sinterite, A Gasbarre Furnace Group Co.**  
Stelter & Brinck
- ➔ **Surface Combustion Inc.**  
Tenoa Inc.
- ➔ **Thermal Product Solutions, Blue M. Gruenberg**  
Thermal Technology LLC  
Thermcraft Inc.  
Thermo Transfer Inc.  
United Process Controls Inc. (OH)  
United Process Controls Inc. (WI)  
Unitherm Furnace LLC  
Vacuum Processes Inc.  
Wellman Furnaces Inc., Precious Technology Group LLC
- ➔ **Wisconsin Oven Corp.**  
WS Thermal Process Technology Inc.

## Heat Transfer Analysis

- ➔ **Across International LLC**  
Alhern-Martin Industrial Furnace Co.  
ANDRITZ METALS Inc.  
Bloom Engineering Co. Inc.
- ➔ **C.I. Hayes, A Gasbarre Furnace Group Co.**  
CMI Industry Americas Inc.  
DANTE Solutions Inc.
- ➔ **Epcon Industrial Systems LP**  
Fives North American Combustion Inc.  
Honeywell Combustion Safety  
Hydro-Thermal Corp.
- ➔ **INEX Inc.**
- ➔ **International Thermal Systems LLC, Aftermarket Parts & Services**
- ➔ **Ipsen, Ipsen Customer Service (ICS)**
- ➔ **J. L. Becker, A Gasbarre Furnace Group Co.**  
Kleenair Products Co.  
Mangold Engineering Inc.  
Maztherm Cokeless Melting Inc.  
Minteq International Inc., Pyrogenics Group  
Nanmac Corp.  
Nutek Bickley
- ➔ **Praxair Inc.**  
Premier Furnace Specialists/  
BeaverMatic  
SECO/WARWICK Corp.  
Tenoa Inc.  
Vacuum Processes Inc.  
Wellman Furnaces Inc., Precious Technology Group LLC  
WS Thermal Process Technology Inc.

## Heating Element Analysis

- ➔ **Across International LLC**  
Alhern-Martin Industrial Furnace Co.  
Blasdel Enterprises Inc.
- ➔ **Centorr Vacuum Industries**
- ➔ **C.I. Hayes, A Gasbarre Furnace Group Co.**  
CMI Industry Americas Inc.  
Conrad Kacsik Instrument Systems Inc.
- ➔ **Custom Electric Manufacturing Co.**  
Hi-Tech Furnace Systems Inc.
- ➔ **I Squared R Element Co. Inc.**  
Industrial Furnace Interiors Inc.  
Industronics Service Co.

- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
Ircan/Fluke Process Instruments  
ITW EAE - Despatch
- ➔ **J. L. Becker, A Gasbarre Furnace Group Co.**  
Keith Co.  
Kleenair Products Co.  
Mangold Engineering Inc.  
Micropyretics Heaters International Inc.  
MoviTHERM  
Nutek Bickley  
Premier Furnace Specialists/  
BeaverMatic  
Raytek/Fluke Process Instruments  
R&G Services Inc.  
Sandvik Heating Technology USA, Kanthal, Part of Sandvik Group  
SECO/WARWICK Corp.  
Tenoa Inc.  
Thermal Technology LLC  
Thermcraft Inc.  
Thermo Transfer Inc.  
Vacuum Processes Inc.  
Watlow  
Wellman Furnaces Inc., Precious Technology Group LLC
- ➔ **Zircar Ceramics Inc.**

## Installation & Start-Up

- Abell Combustion Inc.
- ➔ **Aerospace Testing and Pyrometry AFC-Holcroft**
- ➔ **Air & Energy Systems Inc.**  
Ajax-Tocco De Mexico S.A. DE C.V.  
Ajax TOCCO Magnethermic (Japan)  
Ajax TOCCO Magnethermic (Shanghai) Co. LTD  
Ajax TOCCO Magnethermic Canada Ltd.  
Ajax TOCCO Magnethermic Corp. (AL)  
Ajax TOCCO Magnethermic Corp. (MI)  
Ajax TOCCO Magnethermic Corp. (North Canton, OH)  
Ajax TOCCO Magnethermic Corp. (Warren, OH)  
Ajax TOCCO Magnethermic Corp. (TX)  
Albertus Energy Inc.  
Alhern-Martin Industrial Furnace Co.  
ANDRITZ METALS Inc.
- ➔ **Applied Test Systems**  
Baker Furnace  
CAN-ENG Furnaces International Ltd.
- ➔ **Centorr Vacuum Industries**
- ➔ **C.I. Hayes, A Gasbarre Furnace Group Co.**  
CM Furnaces Inc.  
CMI Industry Americas Inc.  
Conrad Kacsik Instrument Systems Inc.  
Ebner Furnaces Inc.
- ➔ **Epcon Industrial Systems LP**  
Fives North American Combustion Inc.  
Fuel Applications Ltd.  
Furnace Rebuilders Inc.
- ➔ **G-M Enterprises**
- ➔ **Grieve Corp.**  
Harper International  
Harpor Industries Inc.  
Heat Treat Equipment Co.  
Honeywell Combustion Safety  
Industronics Service Co.
- ➔ **International Thermal Systems LLC, Aftermarket Parts & Services**
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
ITW EAE - Despatch
- ➔ **J. L. Becker, A Gasbarre Furnace Group Co.**  
Keith Co.  
Keylon Thermal Consulting  
Kleenair Products Co.

- Lanly Co.
- ➔ **Lindberg/MPH, Thermal Product Solutions**  
Mangold Engineering Inc.  
Marathon Monitors and Control Systems Corporation (Beijing), Limited, a member of United Process Controls  
Maztherm Cokeless Melting Inc.  
Metro Services Inc., Combustion & Controls Engineering  
Micropyretics Heaters International Inc.  
Nitrex Metal Inc.  
Nitrex Metal Sp. z o.o.  
Nutek Bickley  
Premier Furnace Specialists/  
BeaverMatic  
Process-Electronic France  
Process-Electronic GmbH  
Process-Electronic Sp. z o.o.  
R&G Services Inc.  
SECO/WARWICK Corp.
- ➔ **Sinterite, A Gasbarre Furnace Group Co.**  
Stelter & Brinck
- ➔ **Surface Combustion Inc.**  
Tenoa Inc.
- ➔ **Thermal Product Solutions, Blue M. Gruenberg**  
Thermal Technology LLC  
Thermcraft Inc.  
Thermo Transfer Inc.  
United Process Controls Inc. (OH)  
United Process Controls Inc. (WI)  
Unitherm Furnace LLC  
Vacuum Processes Inc.  
Wellman Furnaces Inc., Precious Technology Group LLC
- ➔ **Wisconsin Oven Corp.**  
WS Thermal Process Technology Inc.

## Preventative Maintenance

- ➔ **Across International LLC**
- ➔ **Aerospace Testing and Pyrometry AFC-Holcroft**
- ➔ **Air & Energy Systems Inc.**  
Ajax-Tocco De Mexico S.A. DE C.V.  
Ajax TOCCO Magnethermic (Japan)  
Ajax TOCCO Magnethermic (Shanghai) Co. LTD  
Ajax TOCCO Magnethermic Canada Ltd.  
Ajax TOCCO Magnethermic Corp. (AL)  
Ajax TOCCO Magnethermic Corp. (MI)  
Ajax TOCCO Magnethermic Corp. (North Canton, OH)  
Ajax TOCCO Magnethermic Corp. (Warren, OH)  
Ajax TOCCO Magnethermic Corp. (TX)  
Albertus Energy Inc.  
Alhern-Martin Industrial Furnace Co.  
ANDRITZ METALS Inc.
- ➔ **Applied Test Systems**  
Baker Furnace  
Bloom Engineering Co. Inc.  
CAN-ENG Furnaces International Ltd.
- ➔ **Centorr Vacuum Industries**
- ➔ **C.I. Hayes, A Gasbarre Furnace Group Co.**  
CM Furnaces Inc.  
CMI Industry Americas Inc.  
Conrad Kacsik Instrument Systems Inc.
- ➔ **Custom Electric Manufacturing Co. Ebner Furnaces Inc.**
- ➔ **Epcon Industrial Systems LP**  
Fives North American Combustion Inc.  
Fuel Applications Ltd.  
Furnace Rebuilders Inc.
- ➔ **Grieve Corp.**  
Harper International

- Heat Treat Equipment Co.
- ➔ **Heat Treating Services Unlimited Inc.**  
Hi-Tech Furnace Systems Inc.  
Industrial Furnace Interiors Inc.  
Industronics Service Co.
- ➔ **International Thermal Systems LLC, Aftermarket Parts & Services**
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
Ircon/Fluke Process Instruments  
ITW EAE - Despatch
- ➔ **J. L. Becker, A Gasbarre Furnace Group Co.**  
Keith Co.  
Kleenair Products Co.  
Lanly Co.
- ➔ **Lindberg/MPH, Thermal Product Solutions**  
Mangold Engineering Inc.  
Marathon Monitors and Control Systems Corporation (Beijing), Limited, a member of United Process Controls
- Metro Services Inc., Combustion & Controls Engineering
- Nutec Bickley
- Premier Furnace Specialists/  
BeaverMatic
- Process-Electronic France  
Process-Electronic GmbH  
Process-Electronic Sp. z o.o.
- Raytek/Fluke Process Instruments  
Sauereisen
- SECO/WARWICK Corp.
- Selas Heat Technology Company
- ➔ **Sinterite, A Gasbarre Furnace Group Co.**  
Stelter & Brinck
- ➔ **Surface Combustion Inc.**  
Tenoa Inc.
- ➔ **Thermal Product Solutions, Blue M. Gruenberg**  
Thermal Technology LLC  
Thermcraft Inc.  
Thermo Transfer Inc.  
United Process Controls Inc. (OH)  
United Process Controls Inc. (WI)  
Unitherm Furnace LLC  
Vacuum Processes Inc.
- ➔ **Wisconsin Oven Corp.**  
WS Thermal Process Technology Inc.

### Rebuilds, Upgrades, Overhauls & Modifications

- Abell Combustion Inc.  
Ace Industrial Mfg.
- ➔ **Across International LLC**
- ➔ **Advanced Material Science LLC**
- ➔ **Aerospace Testing and Pyrometry AFC-Holcroft**
- ➔ **Air & Energy Systems Inc.**  
Ajax TOCCO Magnethermic (Shanghai) Co. LTD  
Ajax TOCCO Magnethermic Canada Ltd.  
Ajax TOCCO Magnethermic Corp. (AL)  
Ajax TOCCO Magnethermic Corp. (MI)  
Ajax TOCCO Magnethermic Corp. (North Canton, OH)  
Ajax TOCCO Magnethermic Corp. (Warren, OH)  
Ajax TOCCO Magnethermic Corp. (TX)  
Albertus Energy Inc.  
Alcon Industries Inc.  
Alhern-Martin Industrial Furnace Co.  
Alloy Engineering Co.  
ANDRITZ METALS Inc.
- ➔ **Applied Test Systems**  
Baker Furnace
- Blasdel Enterprises Inc.  
Bloom Engineering Co. Inc.  
CAN-ENG Furnaces International Ltd.  
Casso-Solar Technologies LLC
- ➔ **Centorr Vacuum Industries**
- ➔ **C.I. Hayes, A Gasbarre Furnace Group Co.**  
CM Furnaces Inc.  
CMI Industry Americas Inc.  
Conrad Kacsik Instrument Systems Inc.
- ➔ **Custom Electric Manufacturing Co. Ebner Furnaces Inc.**
- ➔ **Epcon Industrial Systems LP**  
ETS Schaefer LLC  
Fireye Inc.  
Fives North American Combustion Inc.  
Fuel Applications Ltd.  
Furnace Rebuilders Inc.
- ➔ **G-M Enterprises**
- ➔ **International Thermal Systems LLC, Aftermarket Parts & Services**
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
ITW EAE - Despatch
- ➔ **J. L. Becker, A Gasbarre Furnace Group Co.**  
Jiangsu Fengdong Thermal Technology Co. Ltd.  
Keith Co.  
Keylon Thermal Consulting  
Kleenair Products Co.
- ➔ **L & L Special Furnace Co. Inc.**  
Lanly Co.
- ➔ **Lindberg/MPH, Thermal Product Solutions**  
Linn High Therm GmbH  
Lucifer Furnaces Inc.  
Magnetic Specialties Inc.  
Mangold Engineering Inc.  
Marathon Monitors and Control Systems Corporation (Beijing), Limited, a member of United Process Controls
- Maztherm Cokeless Melting Inc.
- Metro Services Inc., Combustion & Controls Engineering
- ➔ **The New York Blower Co.**  
Nitrex Metal Inc.  
Nitrex Metal Sp. z o.o.
- Nutec Bickley
- Odyssey Technical Solutions
- Premier Furnace Specialists/  
BeaverMatic
- Process-Electronic France  
Process-Electronic GmbH  
Process-Electronic Sp. z o.o.
- Pyrotek
- Qual-Fab Inc.
- R&G Services Inc.
- SECO/WARWICK Corp.
- Selas Heat Technology Company
- ➔ **Sinterite, A Gasbarre Furnace Group Co.**  
Stelter & Brinck
- ➔ **Surface Combustion Inc.**  
Tenoa Inc.
- ➔ **Thermal Product Solutions, Blue M. Gruenberg**  
Thermal Technology LLC  
Thermcraft Inc.  
Thermo Transfer Inc.
- United Process Controls Inc. (OH)  
United Process Controls Inc. (WI)  
Unitherm Furnace LLC  
Vacuum Processes Inc.  
Wellman Furnaces Inc.,  
Precious Technology Group LLC
- ➔ **Wisconsin Oven Corp.**
- ➔ **Zircar Ceramics Inc.**

- United Process Controls Inc. (OH)
- United Process Controls Inc. (WI)
- Unitherm Furnace LLC
- Vacuum Processes Inc.
- Wellman Furnaces Inc.,  
Precious Technology Group LLC
- ➔ **Wisconsin Oven Corp.**
- ➔ **Zircar Ceramics Inc.**

### Replacement & Spare Parts

- Abell Combustion Inc.  
Ace Industrial Mfg.
- ➔ **Across International LLC**
- ➔ **Advanced Material Science LLC**
- ➔ **Aerospace Testing and Pyrometry AFC-Holcroft**
- ➔ **Air & Energy Systems Inc.**  
AirPro Fan & Blower Co.  
Ajax-Tocco De Mexico S.A. DE C.V.  
Ajax TOCCO Magnethermic (Japan)  
Ajax TOCCO Magnethermic (Shanghai) Co. LTD  
Ajax TOCCO Magnethermic Canada Ltd.  
Ajax TOCCO Magnethermic Corp. (AL)  
Ajax TOCCO Magnethermic Corp. (MI)  
Ajax TOCCO Magnethermic Corp. (North Canton, OH)  
Ajax TOCCO Magnethermic Corp. (Warren, OH)  
Ajax TOCCO Magnethermic Corp. (TX)  
Albertus Energy Inc.  
Alcon Industries Inc.  
Alhern-Martin Industrial Furnace Co.  
Alloy Engineering Co.  
ANDRITZ METALS Inc.
- ➔ **Applied Test Systems**  
Baker Furnace  
Blasdel Enterprises Inc.  
Bloom Engineering Co. Inc.  
CAN-ENG Furnaces International Ltd.  
Casso-Solar Technologies LLC
- ➔ **Centorr Vacuum Industries**  
CerCo Inc., Diamonite
- ➔ **C.I. Hayes, A Gasbarre Furnace Group Co.**  
CM Furnaces Inc.  
CMI Industry Americas Inc.  
Conrad Kacsik Instrument Systems Inc.  
Consolidated Engineering Co.
- ➔ **Custom Electric Manufacturing Co.**  
Dalton Electric Heating Co. Inc.  
Du-Co Ceramics Co.  
Duraloy Technologies Inc.
- Ebner Furnaces Inc.**
- ➔ **Epcon Industrial Systems LP**  
E.R. Advanced Ceramics Inc.,  
US Refractories
- Fireye Inc.
- Fives North American Combustion Inc.
- Fuel Applications Ltd.
- Furnace Rebuilders Inc.
- ➔ **G-M Enterprises**  
GeoCorp Inc.
- ➔ **Grieve Corp.**  
Harper International  
Harrop Industries Inc.  
H.C. Starck Inc., Fabricated Products
- Heat Treat Central**  
Heat Treat Equipment Co.
- ➔ **Heat Treating Services Unlimited Inc.**  
Hi-Tech Furnace Systems Inc.  
Hydro-Thermal Corp.
- ➔ **I Squared R Element Co. Inc.**  
Industrial Furnace Interiors Inc.  
Industrial Gas Engineering  
Industronics Service Co.
- ➔ **INEX Inc.**
- ➔ **International Thermal Systems LLC, Aftermarket Parts & Services**
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
ITW EAE - Despatch
- ➔ **J. L. Becker, A Gasbarre Furnace Group Co.**  
Jiangsu Fengdong Thermal Technology Co. Ltd.  
Keith Co.  
Keylon Thermal Consulting  
Kleenair Products Co.  
Lanly Co.
- ➔ **Lindberg/MPH, Thermal Product Solutions**  
Linn High Therm GmbH  
Lucifer Furnaces Inc.  
Magnetic Specialties Inc.  
Mangold Engineering Inc.  
Marathon Monitors and Control Systems Corporation (Beijing), Limited, a member of United Process Controls
- Metro Services Inc., Combustion & Controls Engineering
- Micropyretics Heaters International Inc.
- Nammac Corp.**
- Nutec Bickley
- Odyssey Technical Solutions
- Premier Furnace Specialists/  
BeaverMatic
- Process-Electronic France  
Process-Electronic GmbH  
Process-Electronic Sp. z o.o.
- The Rembar Co. LLC
- R&G Services Inc.
- ➔ **Safe Cronite**  
Sandvik Heating Technology USA,  
Kanthal, Part of Sandvik Group
- SECO/WARWICK Corp.
- Selas Heat Technology Company
- ➔ **Sinterite, A Gasbarre Furnace Group Co.**  
SteelTech Ltd.  
Stelter & Brinck  
Sticker Corp.  
Super Systems Inc.
- ➔ **Surface Combustion Inc.**  
TE Wire & Cable  
Tenoa Inc.
- ➔ **Thermal Product Solutions, Blue M. Gruenberg**  
Thermal Technology LLC  
Thermcraft Inc.  
Trent Inc.  
Ultra Electronics, Furnace Parts  
United Process Controls Inc. (OH)  
United Process Controls Inc. (WI)  
Unitherm Furnace LLC  
Vacuum Processes Inc.  
Wellman Furnaces Inc.,  
Precious Technology Group LLC
- ➔ **Wisconsin Oven Corp.**
- ➔ **Zircar Ceramics Inc.**

### High-Temperature Alloy Fans

- AFC-Holcroft**  
AirPro Fan & Blower Co.  
Alcon Industries Inc.  
Alloy Engineering Co.  
Baker Furnace  
CMI Industry Americas Inc.
- Ebner Furnaces Inc.**  
Industrial Gas Engineering
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
Keith Co.  
Keylon Thermal Consulting
- ➔ **Lindberg/MPH, Thermal Product Solutions**  
Mangold Engineering Inc.  
Premier Furnace Specialists/  
BeaverMatic

# CAPABILITIES LISTINGS - AFTERMARKET DIRECTORY

Qual-Fab Inc.  
SECO/WARWICK Corp.  
SteelTech Ltd.  
Vacuum Processes Inc.

## VACUUM FURNACE SYSTEMS

### Field Service

- ➔ **Across International LLC**
- ➔ **Aerospace Testing and Pyrometry**  
Ajax-Tocco De Mexico S.A. DE C.V.  
Ajax TOCCO Magnethermic (Shanghai) Co. LTD  
Ajax TOCCO Magnethermic Canada Ltd.  
Ajax TOCCO Magnethermic Corp. (AL)  
Ajax TOCCO Magnethermic Corp. (MI)  
Ajax TOCCO Magnethermic Corp. (North Canton, OH)  
Ajax TOCCO Magnethermic Corp. (Warren, OH)  
Ajax TOCCO Magnethermic Corp. (TX)  
ALD Vacuum Systems Inc.  
Baker Furnace  
Cashvac Inc., Vacuum Pumps
- ➔ **Centorr Vacuum Industries**
- ➔ **C.I. Hayes, A Gasbarre Furnace Group Co.**  
Conrad Kacsik Instrument Systems Inc.  
ECM-USA Inc.  
Furnacare Inc.  
Furnace Rebuilders Inc.
- ➔ **G-M Enterprises**
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
Keylon Thermal Consulting
- ➔ **Lindberg/MPH, Thermal Product Solutions**  
Mangold Engineering Inc.
- ➔ **Metallurgical High Vacuum Corp.**  
Nutech Bickley  
Premier Furnace Specialists/  
BeaverMatic  
PVT Inc.
- ➔ **SECO/VACUUM Technologies LLC**  
SECO/WARWICK Corp.
- ➔ **Signature Vacuum Systems Inc.**
- ➔ **Solar Manufacturing**
- ➔ **Surface Combustion Inc.**  
Thermal Technology LLC  
T-M Vacuum Products  
Tuthill Vacuum & Blower Systems  
Ultra Electronics, Furnace Parts  
VAC AERO International Inc.  
Vacuum Processes Inc.  
Wellman Furnaces Inc.,  
Precious Technology Group LLC

### Hot Zone Rebuild & Replacement

- ➔ **Across International LLC**
- ➔ **Advanced Material Science LLC**
- ➔ **Aerospace Testing and Pyrometry**  
Alcon Industries Inc.  
ALD Vacuum Systems Inc.  
Alloy Engineering Co.
- ➔ **Centorr Vacuum Industries**
- ➔ **C.I. Hayes, A Gasbarre Furnace Group Co.**  
Furnacare Inc.  
Furnace Rebuilders Inc.
- ➔ **G-M Enterprises**  
H.C. Starck Inc., Fabricated Products  
Heat Treat Equipment Co.
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
JC Cole & Associates Inc., Vacuum  
Furnace Insulation Products  
Keylon Thermal Consulting  
Mangold Engineering Inc.  
Nutech Bickley

- Premier Furnace Specialists/  
BeaverMatic  
PVT Inc.  
The Rembar Co. LLC
- ➔ **SECO/VACUUM Technologies LLC**  
SECO/WARWICK Corp.
- ➔ **Signature Vacuum Systems Inc.**
- ➔ **Solar Manufacturing**
- ➔ **Surface Combustion Inc.**  
Thermal Technology LLC  
T-M Vacuum Products  
Ultra Electronics, Furnace Parts  
VAC AERO International Inc.  
Vacuum Processes Inc.  
Wellman Furnaces Inc.,  
Precious Technology Group LLC

### Installation & Start-up

- ➔ **Across International LLC**
- ➔ **Aerospace Testing and Pyrometry**  
Ajax-Tocco De Mexico S.A. DE C.V.  
Ajax TOCCO Magnethermic (Shanghai) Co. LTD  
Ajax TOCCO Magnethermic Canada Ltd.  
Ajax TOCCO Magnethermic Corp. (AL)  
Ajax TOCCO Magnethermic Corp. (MI)  
Ajax TOCCO Magnethermic Corp. (North Canton, OH)  
Ajax TOCCO Magnethermic Corp. (Warren, OH)  
Ajax TOCCO Magnethermic Corp. (TX)  
ALD Vacuum Systems Inc.
- ➔ **Centorr Vacuum Industries**
- ➔ **C.I. Hayes, A Gasbarre Furnace Group Co.**  
Conrad Kacsik Instrument Systems Inc.  
ECM-USA Inc.  
Furnacare Inc.  
Furnace Rebuilders Inc.
- ➔ **G-M Enterprises**  
Heat Treat Equipment Co.
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
Keylon Thermal Consulting  
Mangold Engineering Inc.  
Marathon Monitors and Control  
Systems Corporation (Beijing),  
Limited, a member of United  
Process Controls  
Nutech Bickley  
Premier Furnace Specialists/  
BeaverMatic  
Process-Electronic France  
Process-Electronic GmbH  
Process-Electronic Sp. z o.o.  
PVT Inc.
- ➔ **SECO/VACUUM Technologies LLC**  
SECO/WARWICK Corp.
- ➔ **Signature Vacuum Systems Inc.**
- ➔ **Solar Manufacturing**
- ➔ **Surface Combustion Inc.**  
Thermal Technology LLC  
Ultra Electronics, Furnace Parts  
United Process Controls Inc. (OH)  
United Process Controls Inc. (WI)  
VAC AERO International Inc.  
Vacuum Processes Inc.  
Wellman Furnaces Inc.,  
Precious Technology Group LLC

### Leak Detection & Repair

- ➔ **Across International LLC**  
Advanced Vacuum Co. Inc. (ADVACO)
- ➔ **Aerospace Testing and Pyrometry**  
Agilent Technologies,  
Vacuum Products  
ALD Vacuum Systems Inc.  
Cashvac Inc., Vacuum Pumps
- ➔ **Centorr Vacuum Industries**

- ➔ **C.I. Hayes, A Gasbarre Furnace Group Co.**  
Cumberland Vacuum Products Inc.  
Furnacare Inc.  
Furnace Rebuilders Inc.
- ➔ **G-M Enterprises**  
Honeywell Combustion Safety  
INFICON
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
Keylon Thermal Consulting  
Madison Co.  
Mangold Engineering Inc.
- ➔ **Metallurgical High Vacuum Corp.**  
Nutech Bickley
- ➔ **Praxair Inc.**  
Premier Furnace Specialists/BeaverMatic  
PVT Inc.
- ➔ **SECO/VACUUM Technologies LLC**  
SECO/WARWICK Corp.
- ➔ **Signature Vacuum Systems Inc.**
- ➔ **Solar Manufacturing**  
Super Systems Inc.
- ➔ **Surface Combustion Inc.**  
Thermal Technology LLC  
VAC AERO International Inc.  
Vacuum Processes Inc.

### Preventative Maintenance

- ➔ **Across International LLC**  
Advanced Vacuum Co. Inc. (ADVACO)
- ➔ **Aerospace Testing and Pyrometry**  
Ajax-Tocco De Mexico S.A. DE C.V.  
Ajax TOCCO Magnethermic (Shanghai) Co. LTD  
Ajax TOCCO Magnethermic Canada Ltd.  
Ajax TOCCO Magnethermic Corp. (AL)  
Ajax TOCCO Magnethermic Corp. (MI)  
Ajax TOCCO Magnethermic Corp. (North Canton, OH)  
Ajax TOCCO Magnethermic Corp. (Warren, OH)  
Ajax TOCCO Magnethermic Corp. (TX)  
ALD Vacuum Systems Inc.  
Baker Furnace  
Cashvac Inc., Vacuum Pumps
- ➔ **Centorr Vacuum Industries**
- ➔ **C.I. Hayes, A Gasbarre Furnace Group Co.**  
Conrad Kacsik Instrument Systems Inc.  
Cumberland Vacuum Products Inc.  
ECM-USA Inc.  
Furnacare Inc.  
Furnace Rebuilders Inc.
- ➔ **G-M Enterprises**  
Heat Treat Equipment Co.
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
Ircan/Fluke Process Instruments  
Keylon Thermal Consulting
- ➔ **Lindberg/MPH, Thermal Product Solutions**  
Mangold Engineering Inc.
- ➔ **Metallurgical High Vacuum Corp.**  
Nutech Bickley  
Premier Furnace Specialists/  
BeaverMatic  
PVT Inc.  
Raytek/Fluke Process Instruments  
Sauereisen
- ➔ **SECO/VACUUM Technologies LLC**  
SECO/WARWICK Corp.
- ➔ **Signature Vacuum Systems Inc.**
- ➔ **Solar Manufacturing**
- ➔ **Surface Combustion Inc.**  
Thermal Technology LLC  
Tuthill Vacuum & Blower Systems  
Ultra Electronics, Furnace Parts  
VAC AERO International Inc.  
Vacuum Processes Inc.

### Pump Repair & Maintenance

- ➔ **Across International LLC**  
Advanced Vacuum Co. Inc. (ADVACO)
- ➔ **Aerospace Testing and Pyrometry**  
Agilent Technologies,  
Vacuum Products  
ALD Vacuum Systems Inc.  
Cashvac Inc., Vacuum Pumps  
Cumberland Vacuum Products Inc.  
Furnacare Inc.
- ➔ **G-M Enterprises**
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
Keylon Thermal Consulting  
Mangold Engineering Inc.
- ➔ **Metallurgical High Vacuum Corp.**  
Premier Furnace Specialists/  
BeaverMatic
- ➔ **SECO/VACUUM Technologies LLC**  
SECO/WARWICK Corp.
- ➔ **Signature Vacuum Systems Inc.**  
Thermal Technology LLC  
Trillium US Inc.  
Tuthill Vacuum & Blower Systems  
VAC AERO International Inc.  
Vacuum Processes Inc.

### Rebuilds, Upgrades, Overhauls & Modifications

- ➔ **Across International LLC**
- ➔ **Aerospace Testing and Pyrometry**  
Agilent Technologies, Vacuum Products  
Ajax-Tocco De Mexico S.A. DE C.V.  
Ajax TOCCO Magnethermic (Shanghai) Co. LTD  
Ajax TOCCO Magnethermic Canada Ltd.  
Ajax TOCCO Magnethermic Corp. (AL)  
Ajax TOCCO Magnethermic Corp. (MI)  
Ajax TOCCO Magnethermic Corp. (North Canton, OH)  
Ajax TOCCO Magnethermic Corp. (TX)  
Alcon Industries Inc.  
ALD Vacuum Systems Inc.  
Alloy Engineering Co.  
Baker Furnace  
Cashvac Inc., Vacuum Pumps
- ➔ **Centorr Vacuum Industries**
- ➔ **C.I. Hayes, A Gasbarre Furnace Group Co.**  
Conrad Kacsik Instrument Systems Inc.  
ECM-USA Inc.  
ETS Schaefer LLC  
Furnacare Inc.  
Furnace Rebuilders Inc.
- ➔ **G-M Enterprises**  
H.C. Starck Inc., Fabricated Products  
Heat Treat Equipment Co.
- ➔ **Ipsen, Ipsen Customer Service (ICS)**  
Jiangsu Fengdong Thermal  
Technology Co. Ltd.  
Keylon Thermal Consulting
- ➔ **Lindberg/MPH, Thermal Product Solutions**  
Magnetic Specialties Inc.  
Mangold Engineering Inc.  
Marathon Monitors and Control  
Systems Corporation (Beijing),  
Limited, a member of United  
Process Controls
- ➔ **Metallurgical High Vacuum Corp.**
- ➔ **The New York Blower Co.**  
Nutech Bickley  
Premier Furnace Specialists/  
BeaverMatic  
Process-Electronic France  
Process-Electronic GmbH  
Process-Electronic Sp. z o.o.  
PVT Inc.  
Qual-Fab Inc.

➔ Indicates an advertiser in this issue

The Rembar Co. LLC  
 ➔ **SECO/VACUUM Technologies LLC**  
 SECO/WARWICK Corp.  
**Signature Vacuum Systems Inc.**  
 ➔ **Solar Manufacturing**  
 ➔ **Surface Combustion Inc.**  
 Thermal Technology LLC  
 T-M Vacuum Products  
 Ultra Electronics, Furnace Parts  
 United Process Controls Inc. (OH)  
 United Process Controls Inc. (WI)  
 VAC AERO International Inc.  
 Vacuum Processes Inc.  
 Wellman Furnaces Inc.,  
 Precious Technology Group LLC

### Replacement & Spare Parts

➔ **Across International LLC**  
 ➔ **Advanced Material Science LLC**  
 ➔ **Aerospace Testing and Pyrometry**  
 Agilent Technologies,  
 Vacuum Products  
 AirPro Fan & Blower Co.  
 Ajax-Tocco De Mexico S.A. DE C.V.  
 Ajax TOCCO Magnethermic  
 (Shanghai) Co. LTD  
 Ajax TOCCO Magnethermic Canada Ltd.  
 Ajax TOCCO Magnethermic Corp. (AL)  
 Ajax TOCCO Magnethermic Corp. (MI)  
 Ajax TOCCO Magnethermic Corp.  
 (North Canton, OH)  
 Ajax TOCCO Magnethermic Corp.  
 (Warren, OH)  
 Ajax TOCCO Magnethermic Corp. (TX)  
 Alcon Industries Inc.  
 ALD Vacuum Systems Inc.  
 Alloy Engineering Co.  
 Baker Furnace  
 ➔ **Centorr Vacuum Industries**  
 CerCo Inc., Diamonite  
 ➔ **C.I. Hayes, A Gasbarre Furnace**  
**Group Co.**  
 Conrad Kacsik Instrument Systems Inc.  
 Consolidated Engineering Co.  
 Cumberland Vacuum Products Inc.  
 Dalton Electric Heating Co. Inc.  
 Du-Co Ceramics Co.  
 Durex Industries  
 ECM-USA Inc.  
 E.R. Advanced Ceramics Inc.,  
 US Refractories  
 Furnacare Inc.  
 Furnace Rebuilders Inc.  
 ➔ **G-M Enterprises**  
 H.C. Starck Inc., Fabricated Products  
 Heat Treat Equipment Co.  
 ➔ **Heat Treating Services Unlimited Inc.**  
 Industrial Furnace Interiors Inc.  
 Industrial Gas Engineering  
 ➔ **Ipsen, Ipsen Customer Service (ICS)**  
 JC Cole & Associates Inc.,  
 Vacuum Furnace Insulation Products  
 Jiangsu Fengdong Thermal  
 Technology Co. Ltd.  
 Keylon Thermal Consulting  
 ➔ **Lindberg/MPH,**  
**Thermal Product Solutions**  
 Magnetic Specialties Inc.  
 Mangold Engineering Inc.  
 ➔ **Metallurgical High Vacuum Corp.**  
**Nanmac Corp.**  
 Nutec Bickley  
 Premier Furnace Specialists/BeaverMatic  
 PVT Inc.  
 Qual-Fab Inc.  
 The Rembar Co. LLC  
 ➔ **Safe Cronite**  
 ➔ **SECO/VACUUM Technologies LLC**  
 SECO/WARWICK Corp.

**Signature Vacuum Systems Inc.**  
 ➔ **Solar Manufacturing**  
 SteelTech Ltd.  
 ➔ **Surface Combustion Inc.**  
 TE Wire & Cable  
 Teledyne Hastings Instruments  
 Thermal Technology LLC  
 T-M Vacuum Products  
 Tuthill Vacuum & Blower Systems  
 Ultra Electronics, Furnace Parts  
 VAC AERO International Inc.  
 Vacuum Processes Inc.  
 Wellman Furnaces Inc., Precious  
 Technology Group LLC

## INDUCTION SYSTEMS

### Coil Design & Efficiency Improvements

➔ **Across International LLC**  
 Ajax-Tocco De Mexico S.A. DE C.V.  
 Ajax TOCCO International  
 Ajax TOCCO Magnethermic (Japan)  
 Ajax TOCCO Magnethermic  
 (Shanghai) Co. LTD  
 Ajax TOCCO Magnethermic Canada Ltd.  
 Ajax TOCCO Magnethermic Corp. (AL)  
 Ajax TOCCO Magnethermic Corp. (MI)  
 Ajax TOCCO Magnethermic Corp.  
 (North Canton, OH)  
 Ajax TOCCO Magnethermic Corp.  
 (Warren, OH)  
 Ajax TOCCO Magnethermic Corp. (TX)  
 Alpha 1 Induction Service Center,  
 Inductotherm Group  
 Durex Industries  
 eldec LLC, member of EMAG Group  
 ELECTROHEAT LLC  
 Giltron Inc.  
 Indeect  
 Induction Professionals  
 Induction Resources  
 Induction Tooling Inc.  
 Inductoheat Inc.,  
 an Inductotherm Group Co.  
 Minteq International Inc.,  
 Pyrogenics Group  
 Pillar Induction  
 Radyne Corp., an Inductotherm  
 Group Co.  
 SMS Elotherm North America LLC  
 ➔ **Taylor-Winfield Technologies Inc.**  
 Ultraflex Power Technologies Corp.  
 Vacuum Processes Inc.

### Coil Repair & Replacement

➔ **Across International LLC**  
 ➔ **Advanced Material Science LLC**  
 Ajax-Tocco De Mexico S.A. DE C.V.  
 Ajax TOCCO International  
 Ajax TOCCO Magnethermic (Japan)  
 Ajax TOCCO Magnethermic  
 (Shanghai) Co. LTD  
 Ajax TOCCO Magnethermic Canada Ltd.  
 Ajax TOCCO Magnethermic Corp. (AL)  
 Ajax TOCCO Magnethermic Corp. (MI)  
 Ajax TOCCO Magnethermic Corp.  
 (North Canton, OH)  
 Ajax TOCCO Magnethermic Corp.  
 (Warren, OH)  
 Ajax TOCCO Magnethermic Corp. (TX)  
 Alpha 1 Induction Service Center,  
 Inductotherm Group  
 Durex Industries  
 East Coast Induction Inc.  
 eldec LLC, member of EMAG Group  
 ELECTROHEAT LLC

Giltron Inc.  
 Indeect  
 Induction Professionals  
 Induction Tooling Inc.  
 Inductoheat Inc.,  
 an Inductotherm Group Co.  
 Lone Star Induction Inc.  
 Magnetic Specialties Inc.  
 Phoenix Induction Corp.  
 Pillar Induction  
 Radyne Corp., an Inductotherm  
 Group Co.  
 SMS Elotherm North America LLC  
 ➔ **Taylor-Winfield Technologies Inc.**  
 Ultraflex Power Technologies Corp.  
 Vacuum Processes Inc.

### Field Service

➔ **Across International LLC**  
 Ajax-Tocco De Mexico S.A. DE C.V.  
 Ajax TOCCO International  
 Ajax TOCCO Magnethermic (Japan)  
 Ajax TOCCO Magnethermic  
 (Shanghai) Co. LTD  
 Ajax TOCCO Magnethermic Canada Ltd.  
 Ajax TOCCO Magnethermic Corp. (AL)  
 Ajax TOCCO Magnethermic Corp. (MI)  
 Ajax TOCCO Magnethermic Corp.  
 (North Canton, OH)  
 Ajax TOCCO Magnethermic Corp.  
 (Warren, OH)  
 Ajax TOCCO Magnethermic Corp. (TX)  
 Alpha 1 Induction Service Center,  
 Inductotherm Group  
 ➔ **Centorr Vacuum Industries**  
 eldec LLC, member of EMAG Group  
 ELECTROHEAT LLC  
 Furnace Rebuilders Inc.  
 Giltron Inc.  
 Induction Tooling Inc.  
 Inductoheat Inc., an Inductotherm  
 Group Co.  
 Phoenix Induction Corp.  
 Pillar Induction  
 Radyne Corp., an Inductotherm  
 Group Co.  
 SMS Elotherm North America LLC  
 Stelter & Brinck  
 ➔ **Taylor-Winfield Technologies Inc.**  
 Ultraflex Power Technologies Corp.  
 Vacuum Processes Inc.

### Installation & Start-up

➔ **Across International LLC**  
 Ajax-Tocco De Mexico S.A. DE C.V.  
 Ajax TOCCO International  
 Ajax TOCCO Magnethermic (Japan)  
 Ajax TOCCO Magnethermic  
 (Shanghai) Co. LTD  
 Ajax TOCCO Magnethermic Canada Ltd.  
 Ajax TOCCO Magnethermic Corp. (AL)  
 Ajax TOCCO Magnethermic Corp. (MI)  
 Ajax TOCCO Magnethermic Corp.  
 (North Canton, OH)  
 Ajax TOCCO Magnethermic Corp.  
 (Warren, OH)  
 Ajax TOCCO Magnethermic Corp. (TX)  
 Alpha 1 Induction Service Center,  
 Inductotherm Group  
 ➔ **Centorr Vacuum Industries**  
 eldec LLC, member of EMAG Group  
 Giltron Inc.  
 Induction Tooling Inc.  
 Inductoheat Inc., an Inductotherm  
 Group Co.  
 Phoenix Induction Corp.  
 Pillar Induction  
 Radyne Corp., an Inductotherm  
 Group Co.

SMS Elotherm North America LLC  
 Stelter & Brinck  
 ➔ **Taylor-Winfield Technologies Inc.**  
 Ultraflex Power Technologies Corp.  
 Vacuum Processes Inc.

### Load Matching Services

➔ **Across International LLC**  
 Ajax-Tocco De Mexico S.A. DE C.V.  
 Ajax TOCCO International  
 Ajax TOCCO Magnethermic (Japan)  
 Ajax TOCCO Magnethermic  
 (Shanghai) Co. LTD  
 Ajax TOCCO Magnethermic Canada Ltd.  
 Ajax TOCCO Magnethermic Corp. (AL)  
 Ajax TOCCO Magnethermic Corp. (MI)  
 Ajax TOCCO Magnethermic Corp.  
 (North Canton, OH)  
 Ajax TOCCO Magnethermic Corp.  
 (Warren, OH)  
 Ajax TOCCO Magnethermic Corp. (TX)  
 Alpha 1 Induction Service Center,  
 Inductotherm Group  
 eldec LLC, member of EMAG Group  
 ELECTROHEAT LLC  
 Giltron Inc.  
 Inductoheat Inc., an Inductotherm  
 Group Co.  
 Phoenix Induction Corp.  
 Pillar Induction  
 Radyne Corp., an Inductotherm  
 Group Co.  
 ➔ **Taylor-Winfield Technologies Inc.**  
 Ultraflex Power Technologies Corp.  
 Vacuum Processes Inc.

### Power Supply Service & Upgrades

➔ **Across International LLC**  
 Ajax-Tocco De Mexico S.A. DE C.V.  
 Ajax TOCCO International  
 Ajax TOCCO Magnethermic (Japan)  
 Ajax TOCCO Magnethermic  
 (Shanghai) Co. LTD  
 Ajax TOCCO Magnethermic Canada Ltd.  
 Ajax TOCCO Magnethermic Corp. (AL)  
 Ajax TOCCO Magnethermic Corp. (MI)  
 Ajax TOCCO Magnethermic Corp.  
 (North Canton, OH)  
 Ajax TOCCO Magnethermic Corp.  
 (Warren, OH)  
 Ajax TOCCO Magnethermic Corp. (TX)  
 Alpha 1 Induction Service Center,  
 Inductotherm Group  
 East Coast Induction Inc.  
 eldec LLC, member of EMAG Group  
 ELECTROHEAT LLC  
 Giltron Inc.  
 Induction Heating Consultations  
 Inductoheat Inc., an Inductotherm  
 Group Co.  
 Magnetic Specialties Inc.  
 Phoenix Induction Corp.  
 Pillar Induction  
 Radyne Corp., an Inductotherm  
 Group Co.  
 SMS Elotherm North America LLC  
 ➔ **Taylor-Winfield Technologies Inc.**  
 Ultraflex Power Technologies Corp.  
 Vacuum Processes Inc.

### Preventive Maintenance

➔ **Across International LLC**  
 Ajax-Tocco De Mexico S.A. DE C.V.  
 Ajax TOCCO International  
 Ajax TOCCO Magnethermic (Japan)  
 Ajax TOCCO Magnethermic  
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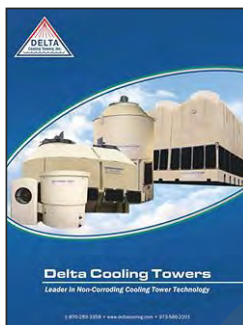
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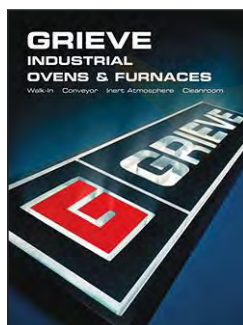
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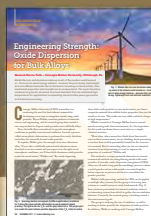
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High Temperature Electric Furnace, 24" W x 24"H x 36" L, Max. Temp. 1,800°F, Powered Rollers, Load/Unload Table & Controls.

#### SURFACE COMBUSTION

Surface Combustion Snap Hearth Atmosphere Heat Treat Line, 300 lbs/hr including automatic loading, snap tray Nitrogen/Natural Gas Hardness Furnace (1,700°F, 18" W x 2.5" H) with inline Salt or Polymer Quench Tanks (1,000 gallons each), Parts Washer/RI (200 gallons), Draw Dry Furnace (40 KW, 1,000°F), Unload Conveyor and controls with Allen Bradley PLC, controller, high limit etc.

#### SURFACE COMBUSTION

(2) INTEGRAL QUENCH FURNACES,

30"W x 30"H x 48"L, 1,750°F, 1,000,000 BTUH, Trident Tubes, Endo/Natural Gas/Ammonia, SSI Atmosphere Controllers, SSI Gold Probes, Oil Filters And SBS Coolers. System Comes Complete with a Gas Fired Temper, Washer and Charge Car.

#### SURFACE COMBUSTION

INTEGRAL QUENCH FURNACE, 5000 lb. Payload Each, 36"W x 36"H x 72"L, Recuperated Rear Handler And Controls.

#### SURFACE COMBUSTION

INTEGRAL QUENCH FURNACE, 10,000 lb. payload, 87" W x 87" L x 36" H, 1,850°F, 4,600,000 BTUH, 12,500 Gallons, 6 Agitators, Eclipse Burners, 3 Rear Handlers & Controls with PLC.

#### SURFACE COMBUSTION

Surface Combustion Gas Fired Mesh Belt Furnace, 42"W x 12"H x 36'-6"L (heated), 1,350°F, 2,000,000 BTUH, 2 zones, 3 fans and controls.

#### SURFACE COMBUSTION

Electric Batch/Oil Quench Furnace, 30" W x 30" H x 48"L, Max. Temp. 1,950°F, System 1 Rear Handler, 3500 Gal. Quench Tank, 2 Agitators & Controls.

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### ATMOSPHERE GENERATORS

750CFH	Endothermic Ipsen	Gas
800CFH	Endothermic Surface	Gas
1,000CFH	Exothermic Gas Atmos.	Gas
1,500CFH	Endothermic Lindberg (Air)	Gas
2,000CFH	Ammonia Dissoc. Drever (3)	Elec
3,000CFH	Endothermic Lindberg (3) - Air	Gas
3,600CFH	Endothermic Surface (2)	Gas
5,600CFH	Endothermic Surface (3)	Gas
6,000CFH	Gas Atmos. Nitrogen Generator	Gas

### BOX FURNACES

12" x 24" x 10"	Lindberg (Atmos.)	Elec 2000°F
12" x 24" x 10"	Lindberg (Atmos.)	Elec 2500°F
12" x 24" x 12"	Hevi Duty (2)	Elec 1950°F
12" x 32" x 12"	L&L (Retort)	Elec 2000°F
13" x 24" x 12"	Electra Up/Down	Elec 2000°F
17" x 14.5" x 12"	L&L (New)	Elec 2350°F
18" x 30" x 13"	Hevi-Duty	Elec 1850°F
18" x 36" x 18"	Lindberg (Fan)	Elec 1850°F
20" x 48" x 12"	Hoskins	Elec 2000°F
24" x 48" x 24"	Hevi-Duty	Elec 2350°F
36" x 48" x 36"	CEC (Atmos-N <sub>2</sub> )	Elec 2000°F
36" x 72" x 42"	Eisenmann (Car Bottom)	Gas 3100°F
60" x 216" x 48"	IFSI (Car Bottom)	Gas 2400°F
60" x 156" x 60"	Lindberg Car Bottom	Gas 1850°F
64" x 180" x 68"	Swindell-Dress. Car Bottom	Gas 2350°F
126" x 420" x 72"	Drever "Lift-Off" (2) (Atmos.)	Gas 1450°F

### PIT FURNACES

14" Dia x 60"D	Procedyne Fluid Bed	Elec 1850°F
28" Dia x 48"D	L&L Nitridor	Elec 1200°F
72" Dia x 72"D	Flynn + Dreffein (2) (Atmos.)	Elec 1400°F
48" Dia x 60"H	"Bell" Nitridor (Retort)	Elec 1200°F

### VACUUM FURNACES

15" x 24" x 10"	Ipsen - VFC 224	Elec 2400°F
24" x 36" x 18"	Hayes (Oil Quench)	Elec 2400°F
48" x 48" x 24"	Surface (2-Bar)	Elec 2400°F
60" Dia x 96"H	Ipsen "Bottom Load"	Elec 2400°F

### INTEGRAL QUENCH FURNACES

24" x 36" x 24"	AFC (Top-Cool-Line)	Elec 1850°F
30" x 48" x 20"	Surface (2)	Gas 1750°F

### BELT FURNACES/OVENS

12" x 120" x 15"	Grieve (Solvent)	Elec 450°F
24" x 18" L	Thermal Basic Belt Line	Gas 1750°F
32" x 24" x 12"	OSI Slat Belt	Gas 450°F
36" x 24" x 8"	Surface Cast Belt (Line)	Gas 1750°F
36" x 28" x 22"	Lewco (2)	Elec 350°F
60" x 40" x 14"	GE Roller Hearth (Atmos)	Elec 1650°F
60" x 40" x 14"	Wellman Roller Hearth (Atmos)	Elec 1650°F

### MISCELLANEOUS

Combustion Air Blowers (All sizes)		
24" x 36"	Lindberg Charge Car (Manual)	
30" x 48"	Surface Charge Car (SE-ER)	
SBS Air/Oil Coolers (4)		
24" x 36" x 24"	Salt Quench Tanks (2)	Elec 1000°F
30" x 48" x 30"	Surface Washer	Gas
Wilson Hardness Testers (Superficial)		
(2) Bell & Gossett "Shell & Tube" Heat Exchangers		
26" x 15" x 15"	Belt Washer/Dryoff	Gas
36" x 48"	AFC Charge Car (DE)	Elec
30" x 30" x 30"	Subzero	-105 to 375°F Elec.

### MISCELLANEOUS (continued)

AFC Pusher Line (Atmos.)	Gas 1750°F
36" Wide Table - Rotary Hearth (Atmos.)	Elec 1850°F
30" x 48"	Surface Roller Table
36" x 48"	Holcroft Charge Car (DE)
48" x 60" x 60"	Steel "Roll-in" Carts (3)
54" Dia x 108" H	Ebner Bell (Atmos.) Gas 1650°F

### OVENS/BOX TEMPERING

8" x 18" x 8"	Lucifer	Elec 1250°F
12" x 16" x 18"	Lindberg (3)	Elec 1250°F
14" x 14" x 14"	Blue-M	Elec 1050°F
14" x 14" x 14"	Gruenberg	Elec 1200°F
14" x 14" x 14"	Blue-M	Elec 650°F
14" x 14" x 14"	Gruenberg (solvent)	Elec 450°F
15" x 24" x 12"	Sunbeam (N <sub>2</sub> )	Elec 1200°F
20" x 18" x 20"	Blue-M	Elec 400°F
20" x 18" x 20"	Despatch	Elec 650°F
20" x 18" x 20"	Blue-M	Elec 650°F
20" x 18" x 20"	Blue-M (2)	Elec 800°F
22" x 18" x 15"	Precision Quincy	Elec 1000°F
24" x 20" x 20"	Blue-M	Elec 1000°F
24" x 26" x 24"	Grieve	Gas 500°F
24" x 24" x 24"	Grieve	Elec 650°F
24" x 24" x 36"	New England	Elec 800°F
24" x 24" x 48"	Blue-M	Elec 600°F
24" x 36" x 24"	Grieve	Elec 500°F
24" x 36" x 24"	Demtec (N <sub>2</sub> )	Elec 500°F
24" x 36" x 24"	AFC (N <sub>2</sub> )	Elec 1250°F
24" x 36" x 24"	Trent	Elec 1400°F
25" x 20" x 20"	Blue-M	Elec 650°F
24" x 36" x 48"	Gruenberg	Elec 500°F
25" x 20" x 20"	Blue-M (Inert)	Elec 1100°F
26" x 26" x 38"	Grieve (2)	Elec 850°F
30" x 30" x 60"	Gruenberg	Elec 450°F
30" x 30" x 48"	Process Heat	Elec 650°F
30" x 38" x 48"	Gruenberg (Inert) (2)	Elec 450°F
30" x 48" x 30"	Surface (3)	Elec 1400°F
30" x 48" x 36"	Surface (Atmos)	Elec 1400°F
30" x 48" x 30"	Surface	Elec 1250°F
36" x 36" x 36"	Grieve (Solvent)	Elec 500°F
36" x 36" x 36"	Blue M Environment Chamber (-18°C to +43°C)	
36" x 42" x 72"	Gruenberg	Elec 450°F
36" x 48" x 36"	Pollution Control Burn Off	Gas 850°F
36" x 48" x 36"	Grieve	Elec 350°F
36" x 48" x 36"	AFC	Gas 1250°F
36" x 48" x 36"	TPS (Environmental) Elec	-40°C to +200°C
36" x 60" x 36"	CEC (2)	Elec 650°F
36" x 84" x 36"	Lindberg (1996)	Gas 800°F
37" x 25" x 37"	Despatch	Elec 500°F
38" x 20" x 26"	Grieve	Elec 500°F
42" x 72" x 36"	Despatch	Elec 1350°F
48" x 30" x 48"	Precision Quincy (2)	Elec 550°F
48" x 34" x 52"	Heat Mach. (2)	Elec 500°F
48" x 48" x 48"	TPS - Environmental	Elec 392°F
48" x 52" x 60"	Despatch	Elec 500°F
48" x 52" x 72"	Despatch (Solvent)	Elec 500°F
48" x 48" x 48"	Lindberg (Argon Atmos)	Elec 1400°F
48" x 48" x 60"	Grieve	Elec 500°F
50" x 50" x 50"	Grieve	Elec 1250°F
55" x 30" x 60"	Precision Quincy (2)	Elec 350°F
68" x 72" x 72"	Gruenberg (4)	Elec 450°F
72" x 120" x 78"	Grieve	Gas 500°F
72" x 180" x 72"	Precision Quincy	Elec 450°F
72" x 252" x 60"	Precision Quincy "Car Oven"	Gas 500°F
96" x 144" x 96"	Powder X	Gas 500°F
108" x 96" x 65"	Eisenmann (4)	Gas 1200°F

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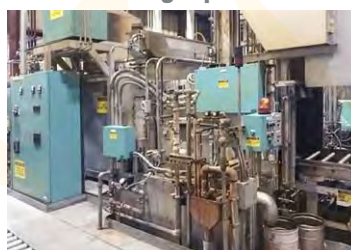
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Dowa Thermotech 1800°F Carburizing, Wash, Temper Furnace Line (2010)

**FURNACE:****Carburize and Quench Model:**

TFC-80-ERT. Carburizing, quenching, carbonitriding, bright quenching.

**Furnace Load Dimensions:**

26"W x 49"L x 24"H

**Furnace Capacity:**

1200 pounds (approx.)

**Tray Dimensions: 48"W x 24"L x 2"D****QUENCH:****Quench Load Dimensions:**

103"W x 71"L x 166"D

**Quench Tank Capacity:**

1800 gallons

**Quench Temperature:**

150°F

**COOLING CHAMBER:**

Sealed with water-tight jacket

**WASHER:**

Spray, Dunk, Wash, Dry

**Model: TW2-264824-D**

Type: Alkali cleaning with drying room

**Load Dimensions:**

26"W x 49"D x 24"H

**Drying Temp:**

210°F - 250°F

**FURNACE:****Model: TFA-264824-L Low**

Temperature Temper Furnace

**Load Dimensions:**

26"W x 49"D x 24"H

**Heated:**

Electric, 40 KW, 58 Amps, one (1) zone

**Temperature: 400°F**

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**Batch Temper Furnaces**

- C0052 Surface Combustion Batch Temper Furnace (30"W x 48"L x 30"H, 1200°F, gas-fired)
- C0068 Despatch Box Furnace (60"W x 72"D x 66"H, 395°F, electric)
- C0113 Lindberg Batch Temper Furnace (48"W x 48"L x 48"H, 1400°F, electric)
- U3644 BeaverMatic Batch Temper Furnace (36"W x 48"D x 36"H, 1500°F, gas-fired)
- V1010 Dow Batch Temper Furnace (30"W x 48"L x 20"H, 1250°F, gas-fired)
- V1024 PIFCO Batch Temper Furnace, Skid Hearth (36"W x 48"L x 30"H, 1200°F, electric)
- V1049 Surface Combustion Temper Furnace (87"W x 87"L x 36"H, 1350°F, gas-fired)
- V1068 Surface Combustion Oil Quench Furnace (30"W x 30"D x 48"H, 1950°F, gas-fired)
- V1081 Lindberg Batch Temper Furnace (20"W x 24"D x 18"H, 1250°F, electric)
- V1090 Lindberg Nitrogen Temper Furnace (24"W x 36"D x 18"H, 1350°F, gas-fired)
- V1095 Surface Combustion Temper Furnace (30"W x 48"D x 30"H, 1250°F, gas-fired)
- V1096 Surface Combustion Temper Furnace (30"W x 48"D x 30"H, 1400°F, gas-fired)
- V1106 Dow Batch Normalizer Furnace (45"W x 84"D x 32"H, 1800°F, gas-fired)

**Batch High-Temp Furnaces**

- U3556 Pacific Industrial Batch High-Temp Furnace (24"W x 36"L x 18"H, 2800°F, electric)
- U3637 Pacific Scientific Batch Temper (30"W x 48"D x 24"H, 1600°F, gas-fired)
- U3643 Surface Combustion Temper Furnace (30"W x 48"D x 42"H, 1400°F, electric, 81kw)
- U3645 Surface Combustion Hi-Temp Furnace (42"W x 60"D x 24"H, 1850°F, gas-fired)
- V1013 Thermolyne High-Temp Batch Furnace (10"W x 14"L x 9"H, 2000°F, electric)
- V1067 Seco Warwick Batch High-Temp Furnace (24"W x 24"H x 36"D, 1800°F, electric)
- V1130 Onspec Slot Forge Furnace (72"W x 96"D x 48"H, 2000°F, gas-fired)

**Batch Oil Quench Furnaces**

- C0086 Huber Car Bottom Furnace (10'4"W x 12'9"D x 8'H, 1800°F, gas-fired)

**Car Bottom Furnaces**

- C0086 Huber Car Bottom Furnace (10'4"W x 12'9"D x 8'H, 1800°F, gas-fired)

**Drop Bottom Furnaces**

- C0069 Enviro-Pak Drop Bottom Furnace (48"W x 48"D x 48"H, 1200°F, electric)
- U3543 Despatch Drop Bottom Furnace (4"W x 6"L x 4"H, 1200°F, electric)

**Internal Quench Furnaces**

- C0064 Lucifer IQ Furnace (18"W x 24"D x 18"H, 1900°F, electric)
- U3569 Surface Combustion IQ Furnace (24"W x 18"H x 36"D, 1750°F, gas-fired)
- U3570 Surface Combustion IQ Furnace (24"W x 36"D x 18"H, 1750°F, gas-fired)
- U3606 Dow/AFC IQ Furnace (30"W x 48"L x 24"H, 1850°F, gas-fired)
- V1046 Surface Combustion IQ Furnace (87"W x 87"L x 36"H, 1850°F, gas-fired)
- V1047 Surface Combustion IQ Furnace (62"W x 62"L x 36"H, 1850°F, gas-fired)
- V1048 Surface Combustion IQ Furnace (62"W x 62"L x 36"H, 1850°F, gas-fired)
- V1062 Surface Combustion Super IQ Furnace (36"W x 72"D x 36"H, 1950°F, gas-fired)
- V1082 Holcroft IQ Furnace with Top Cool (36"W x 48"D x 30"H, 1850°F, gas-fired)
- V1083 Holcroft IQ Furnace with Top Cool (36"W x 48"D x 30"H, 1850°F, gas-fired)
- V1092 Surface Combustion Allcase IQ Furnace (30"W x 48"L x 30"H, 1850°F, gas-fired)
- V1093 Surface Combustion Allcase IQ Furnace (30"W x 48"L x 30"H, 1850°F, gas-fired)
- V1111 Surface Combustion IQ Furnace (30"W x 48"D x 30"H, 1850°F, gas-fired)

**Mesh Belt Brazing Furnaces**

- C0102 JL Becker Mesh Belt Brazing Furnace (30"W x 24'5" heated L x 10"H, 2050°F, electric)
- C0103 JL Becker MB Brazing Furnace w/Exo & Dryer (30"W x 24'5" heated L x 10"H, 2050°F, electric)
- U3529 CI Hayes Mesh Belt Brazing Furnace (18"W x 6"H x 8' heating, 2100°F, electric)
- U3592 JL Becker Mesh Belt Brazing Furnace (12"W x 6"H, 2100°F, electric)
- V1035 Seco Warwick Mesh Belt Brazing Furnace (18"W x 12"H, 2100°F, electric)

**Mesh Belt Tempering Furnaces**

- C0044 CGS Moore Mesh Belt Curing Oven (22"W x 20'L x 10"H, 500°F, gas-fired)
- C0073 Heat Machine Mesh Belt Tempering Furnace (24"W x 10'L x 12"H, 1250°F, gas-fired, PT2501)
- C0074 Holcroft Mesh Belt Tempering Furnace (24"W x 176"L x 12"H, 750°F, gas-fired, PT3136)
- C0075 Industrial Heating Mesh Belt Tempering Furnace (24"W x 22'L x 12"H, 950°F, gas-fired, PT3630)
- C0079 Internat'l Thermal Flat Wire Continuous Furnace (9"W x 10"H, 24' heating, 17' cooling, 650°F, gas-fired)
- C0080 Surface Combustion Mesh Belt Temper Furnace (18"W x 11'H, 13' long, 1000°F, gas-fired)
- C0081 Park Thermal Mesh Belt Temper Furnace (17.5"W x 7'H, 15'8" long, 900°F, gas-fired)
- C0083 Eltropulsa Plasma Furnace System (56"Dia x 80"D, 1022°F, electric)
- C0090 Hengli Mesh Belt Sealing Furnace - Atmosphere (5.9"W x 3.5"H, 2100°F, electric)
- U3638 American Gas Furnace MB Temper Furnace (31"W x 5"H, 17' heated length, 1100°F, gas-fired)
- V1022 Surface Combustion Mesh Belt Tempering Furnace (42"W x 36"D x 12"H, 1350°F, gas-fired)

**Pit Furnaces**

- V1088 Leeds & Northrup Pit Furnace (24" ID x 30" deep, 750°F, electric)

**Roller Hearth & Rotary Furnaces**

- U3550 PIFCO Powered Roller Hearth Temper Furnace (21"W x 12'L x 18"H, 1000°F, electric)
- V1009 Ipsen Continuous Temper Roller Hearth Furnace (24"W x 10'L x 18"H, 1350°F, electric)
- V1091 Finn & Drefflein Rotary Hearth Furnace (13'3"ID x 5'3"ID x 4'W x 2'8"H, 2275°F, electric)

**Steam Tempering Furnace**

- U3616 Degussa Durrerit Steam Tempering Furnace (24"Dia x 48"D, 1200°F, electric)

**Tip Up Furnaces**

- C0043 Industrial Furnace Tip-Up Furnace (8"W x 22'4"D x 6'H, 1800°F, gas-fired)

**Vacuum Furnaces**

- C0013 CI Hayes Oil Quench Vacuum Furnace (24"W x 36"D x 18"H, electric)
- C0027 Pacific Scientific Vacuum Temper Furnace (24"W x 36"D x 24"H, 1450°F, electric)
- C0111 Lindberg Vacuum Furnace (15"W x 24"L x 12"H, 2400°F, electric)
- U3612 AVS Vacuum Annealing Furnace 2-Bar (18"W x 24"D x 12"H, 2400°F, electric)
- U3635 Lindberg Hydrying Gas Generator (6000 CFH Endo, gas)
- V1004 CI Hayes Vacuum Furnace, Oil Quench (18"W x 30"L x 12"H, 2400°F, electric)
- V1128 Ipsen Vacuum Furnace (18"W x 32"D x 12"H, 2400°F, electric)
- V1131 Abar Vacuum Furnace (34"W x 60"D, 2250°F, electric)
- V1135 Abar Vacuum Furnace 2 Bar (72"Dia x 72"Deep, 2400°F, electric)
- V1136 Surface Combustion Vacuum Furnace, 2-Bar (26"W x 36"L x 22"H, 2400°F, electric)
- V1138 Ipsen Vacuum Furnace, 5-Bar (24"W x 36"L x 14"H, 2400°F, electric)

**Endothermic Gas Generators**

- C0093 JL Becker Modular Endo Gas Generator (3-4000/6-8000/9-12000 CFH)
- U3594 AFC-Holcroft Gas Generator (3,000 CFH Endo, gas)

- V1075 Lindberg Gas Generator (3000 CFH Endo)
- V1105 Surface Combustion Gas Generator (5,600 CFH Endo, 1950°F, gas)
- U3647 Lindberg Gas Generator (3000 CFH Endo, 2050°F, gas)
- V3512 Surface Combustion Gas Generator - 5,600 CFH Endo

**Exothermic Gas Generators**

- V1036 Seco Warwick Gas Generator (3,000 CFH Exo, gas)

**Material Handling - Conveyors**

- U3565 Conveyor - Roller (48"W x 20'L)

**Ovens - Cabinet**

- C0037 Grieve Cabinet Oven (36"W x 36"L x 36"H, 650°F, electric)
- U020 Blue-M Oven/Ref (20"W x 20"H x 18"D, (-4°F/400°F)
- U3625 Lindberg Atmosphere Oven (38"W x 38"D x 38"H, 850°F, electric)
- U3629 Cabinet Oven (30"W x 30"D x 36"H, 750°F, electric)
- U3642 Blue-M Cabinet Oven (36"W x 36"D x 36"H, 650°F, electric)

**Ovens - Walk-In**

- C0035 Park Thermal Walk-In Oven (48"W x 48"D x 60"H, 500°F, electric)
- C0038 Despatch Walk-In Oven (54"W x 108"L x 72"H, 500°F, electric)
- C0039 Gehnrich Walk-In Oven (72"W x 96"L x 72"H, 400°F, electric)
- C0108 Park Thermal Walk-In Oven (90"W x 144"D x 72"H, 850°F, gas-fired)

**Freezers**

- V1129 Webber Freezer (-120°F, electric)

**Blowers**

- U018 Twin City Blower (20 HP, RBA-SW, Class 22)

**Charge Cars**

- U3621 Dow Charge Car, DEDP (66"W x 60"D x 54"H)
- V1051 Surface Combustion Charge Car (DEDP, 87"W x 87"L)
- V1085 Holcroft Charge Car (DE/DP, 36"W x 48"D)
- V1112 Surface Combustion Charge Car, SE, 30"W x 48"D

**Scissors Lifts & Holding Stations**

- V1086 Holcroft Scissors Lift & (2) Holding Tables

**Heat Exchanger Systems**

- U030 Graham Systems Heat Exchanger - Plate
- V1104 SBS Heat Exchanger

**Holding & Cooling Stations**

- V1113 Forced Cool Station (30"W x 48"D x 30"H)
- Many other holding stations - ask for details

**Water Cooling Systems**

- U3404 JL Becker Cooling Tower with Tank (Tower: 51"W x 36"L x 64"H, Tank: 72"W x 84"L x 66"H)
- U3595 JL Becker 2-Tank Water Cooling System (tank: 72"L x 36"W x 37"H, 2 Dayton 1HP Motors)
- U3646 HydroThrift, Duplex Pump Base, Water Cooling System
- V1038 Bell & Gossett Shell & Tube Heat Exchanger with Tank

**Washers**

- V1052 Surface Combustion BIQ Washer (87"W x 87"L x 36"H, 180°F, gas-fired)
- V1084 Holcroft Spray/Dunk Washer (36"W x 48"D x 30"H, 190°F, gas-fired)
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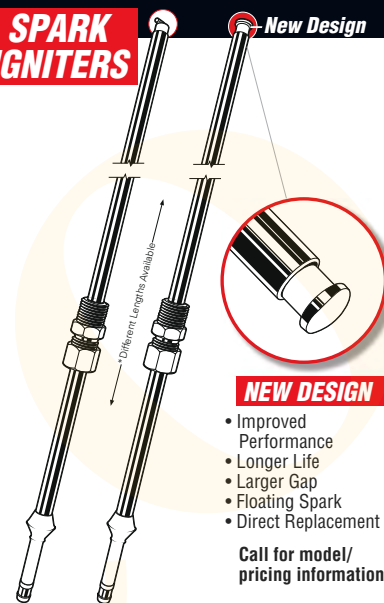
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