Technologies and Processes for the Advancement of Materials

Thermal processing

ISSUE FOCUS ///

PYROMETRY / PROCESS CONTROL / AISTECH PREVIEW

PRINCIPLES OF PYROMETRY

COMPANY PROFILE ///

Dalton Electric Heating Company

APRIL 2019
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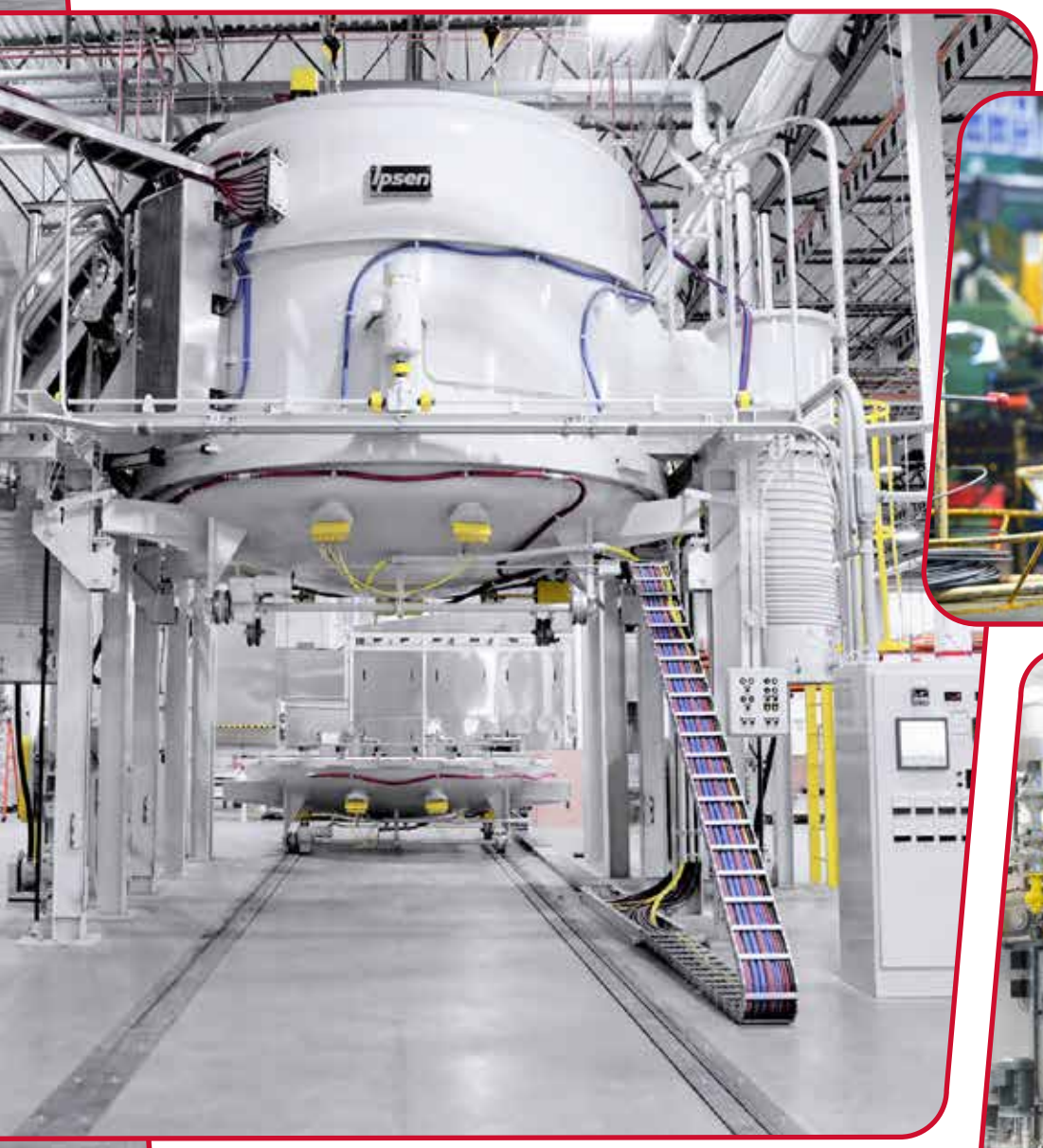

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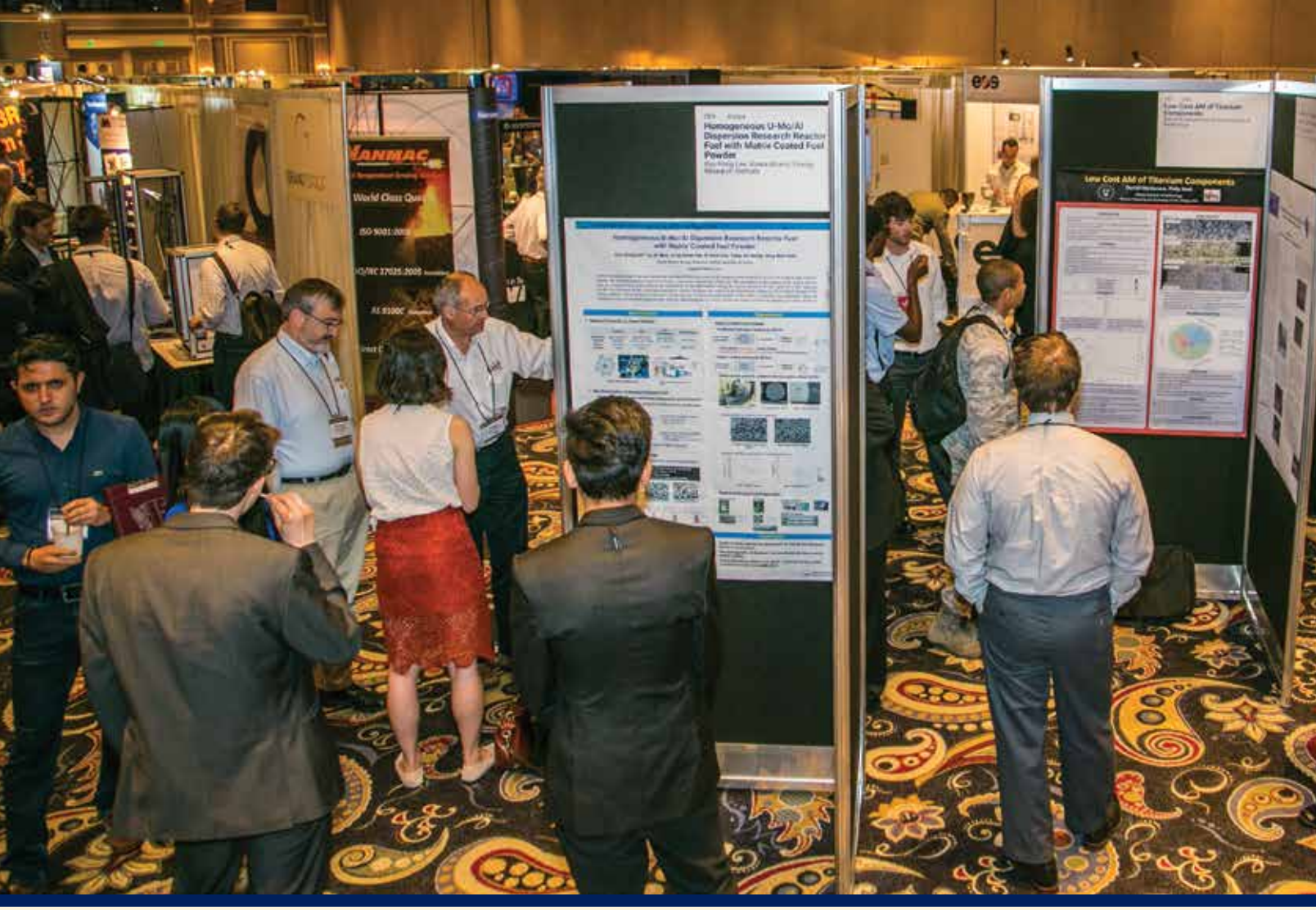

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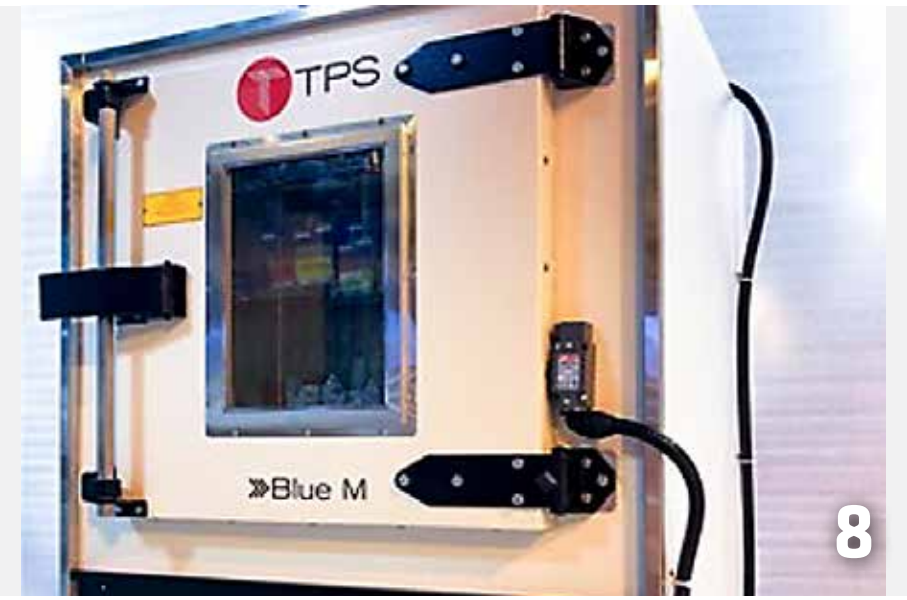
APRIL 2019 VOLUME 8 / NUMBER 4

UPDATE ///

New Products, Trends, Services & Development



- **TPS ships five Blue M ovens to automotive manufacturer.**
- **Abbott Furnace to host brazing symposium in Mexico.**
- **Fastener manufacturer buys AFC-Holcroft furnace.**

Q&A ///

MATTHIAS PASCHER

HARDNESS PRODUCT MANAGER ///
BUEHLER

RESOURCES ///

Industrial Heating Equipment Association (IHEA)

In this section, the national trade association representing the major segments of the industrial heat processing equipment industry shares news of the organization's activities, upcoming educational events, and key developments in the industry.

METAL URGENCY ///

9CrMo steels are critical in addressing energy demand, mitigating greenhouse gas emissions, reducing SO_x and NO_x emissions, and increasing efficiency.

HOT SEAT ///

The metallurgical outcome is just one objective of the auto industry's CQI-9 standard.

QUALITY COUNTS ///

Successful thermal processing means ensuring the final product conforms to the requirements specified by the purchaser.

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FROM THE EDITOR ///

Get ready for AISTech 2019 in Pittsburgh

Pittsburgh will be the place to be in May when AISTech 2019, The Iron & Steel Technology Conference and Exposition, fires up.

The event is expected to feature technologies from all over the world to help steel producers compete in today's extremely competitive global market.

Iron and steel are often building blocks of the heat-treat industry, which is why *Thermal Processing* is happy to promote this show that will provide perspective on the technology and engineering expertise needed to power a sustainable steel industry. Look for a copy of *Thermal Processing* on display at the show.

The April issue of *Thermal Processing* is not only an opportunity to promote industry events that are essential to heat-treating, but it's also shining a spotlight on activities vital to the industry, namely pyrometry and process control.

Our good friend and frequent contributor Jason Schulze has gone above and beyond for this issue as he shares his expertise on how AMS2750E covers a lot of pyrometric territory regarding equipment used for thermal processing.

And his monthly Quality Counts column involves process control. In that, he takes a look at how successful thermal processing means ensuring the final product conforms to the requirements of the purchaser.

Another one of our valued columnists takes a look at process control as well. In his Hot Seat column, Jack Titus reveals how process control is vital to heat-treating and how the metallurgical outcome is just one objective of the auto industry's CQI-9 standard.

That's just a taste of what you'll find in this month's issue of *Thermal Processing*.

Make sure you check us out at AISTech, and hit me up with suggestions at the email below so we can continue to make *Thermal Processing* the best heat-treat source it can be.

And, as always, thanks for reading!

KENNETH CARTER, EDITOR
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CALL FOR ARTICLES Have a technical paper or other work with an educational angle? Let Thermal Processing publish it. Contact the editor, Kenneth Carter, at *editor@thermalprocessing.com* for how you can share your expertise with our readers.

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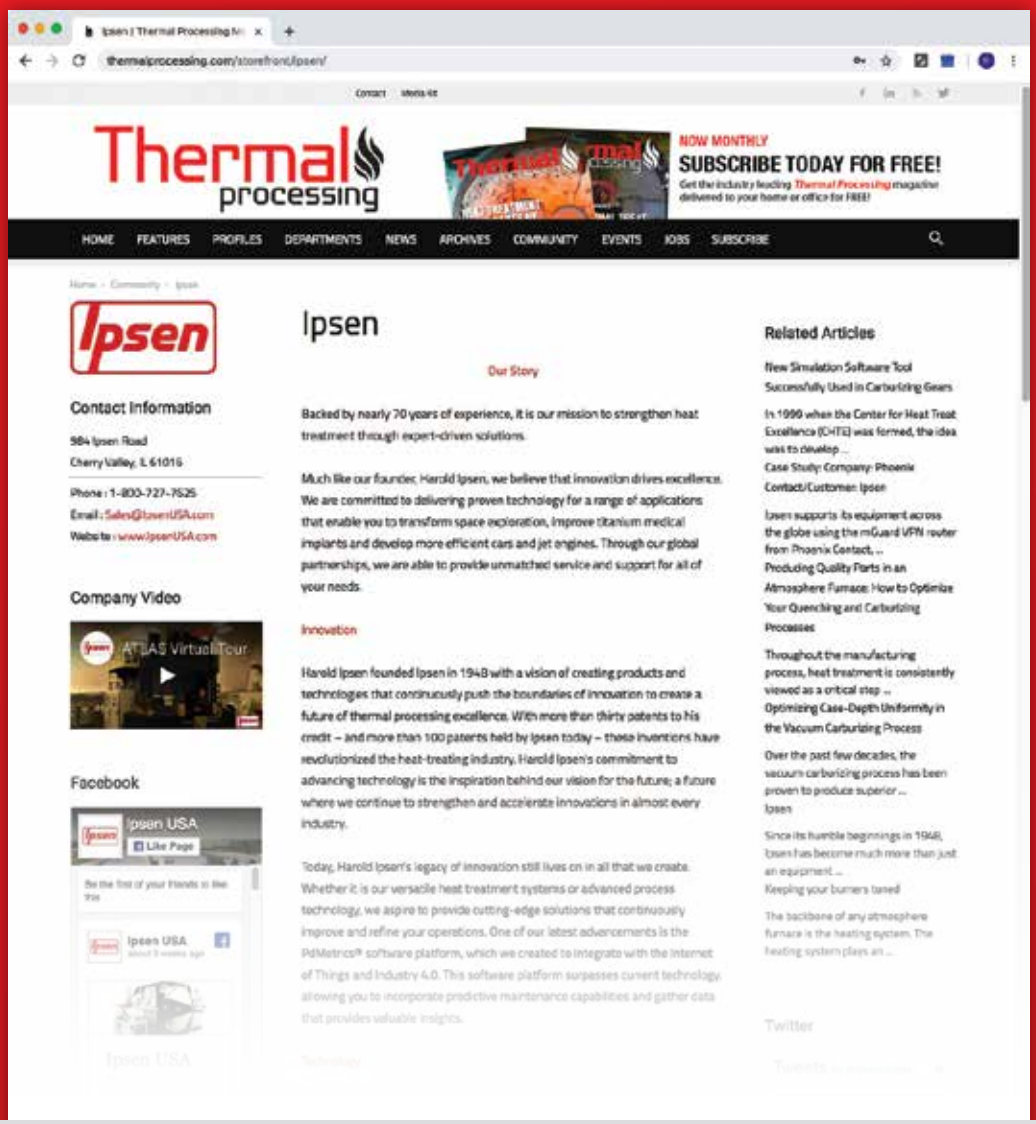


Connect your company to the heat treating industry with a storefront in the Thermal Processing Community.

Storefronts paint a portrait of your company with a 500-word description and include your logo, website link, phone number, email addresses, and videos. Your social media pages such as Twitter and Facebook are integrated with live updates, which may also be re-posted through our social media feeds.

With a community storefront, your company also receives a premium listing in the annual Buyer's Guide published each November. Premium listings feature graphic treatments to draw more attention to your company.

For information on how you can participate in the ThermalProcessing.com community storefront, contact

Dave Gomez – national sales manager
800.366.2185 ext. 207
dave@thermalprocessing.com

Thermal processing

The shipped Blue M industrial ovens have temperature ranges of 15°C above ambient to 350°C. (Courtesy: Thermal Product Solutions)

TPS ships five Blue M ovens to automotive manufacturer

Thermal Product Solutions, a global manufacturer of thermal-processing equipment, announced the shipment of five Blue M standard mechanical convection ovens to a global manufacturer of automotive parts.

These Blue M industrial ovens have temperature ranges of 15°C above ambient to 350°C. The interior work chamber dimensions are 20" W x 18" D x 20" H. They are designed with semi-perforated walls that allow for tuning of the oven airflow to maximize heating rates and uniformity. The airflow in the chambers meets ISO-188, 2007 requirements. Interior lights that are operated by a toggle switch and viewing windows in the doors were added to each of the mechanical convection ovens for easy viewing of the workspace.

The Blue M ovens were customized with rotating carriers (rotisseries) that included special speed control up to 10 rpm. They are rated for NFPA 86 Class B and can heat up to 300°C in 60 minutes or less. Blue M mechanical convection ovens are ideal for many laboratory and industrial oven applications, such as ASTM testing, epoxy curing, moisture drying, UL testing, aging of electronic components and devices, plus many other processes and testing requirements.

"Our customers often have application requirements that do not fall exactly in line with our standard designs, which is why our ability to customize equipment for each customer's manufacturing needs is so important. These Blue M ovens were customized with special rotating carriers and speed control to accommodate the customer's application," said Ashlee Kaczorowski, product manager.

Unique features of the mechanical convection ovens include:

› Differential air pressure switches alert operators before costly problems with batch runs.

› Many different workspace sizes to fit virtually any requirement.

› Quick access for simple inner chamber cleaning.

› Easy-to-use controller for repeatable results and fewer training requirements.

› Reinforced type 304 stainless steel interior resists corrosion and makes cleaning easy.

› Adjustable air intake and exhaust dampers for flexible testing conditions.

› Infinitely variable control from full recirculation to full one-pass to accommodate any processing need.

› Profiling or single setpoint temperature controls offer flexible recipe options.

› Standard air flow switch.

› Safety door switch shuts down heaters and blower when door opens.

› NFPA 86 Class B oven.

› Airflow in chamber meets ISO-188, 2007 requirements.

MORE INFO www.thermalproductsolutions.com

SEND US YOUR NEWS Companies wishing to submit materials for inclusion in Thermal Processing's Update section should contact the editor, Kenneth Carter, at editor@thermalprocessing.com. Releases accompanied by color images will be given first consideration.

Abbott Furnace to host brazing symposium

Abbott Furnace Company will host its Fifth Annual Continuous Brazing Symposium in Puebla, Mexico, May 21-23, 2019. The training event is a gathering opportunity for manufacturers and suppliers to the brazing and powder metal sintering industries. It is an opportunity for those new to the industry as well as seasoned professionals interested in honing their knowledge of brazing.

For two and a half days, attendees will hear from experts in the areas of continuous furnaces, filler metals, belts, CQI-9, furnace atmosphere generation, and atmosphere flow control, troubleshooting, maintenance and optimization. Lecturers are Penn State University adjunct professor Dr. Steve Feldbauer, who serves as Abbott Furnace Company's director of research and development; Miguel Martel, mechatronics engineer at Abbott Furnace Company, Mexico; Victor Zacarias, managing director, Global Thermal Solutions, Mexico; Creed Darling, director, technical sales, Bellman-Melcor LLC; Cory Bloodsworth, director, New Business Development, Cambridge Engineered Solutions; Antonio Mendoza, supplier technical assistance at Ford Motor Company, Mexico; Joel Gutierrez, account manager of Kymera International; and Eric Jossart, director of sales, heat treat at United Process Controls.

Penn State University adjunct professor Dr. Steve Feldbauer

In addition, attendees will be able to interact personally with the lecturers to address more specific questions and troubleshooting issues. Abbott's Symposium is ideal for brazing engineers, maintenance personnel, product designers, and anyone involved in the production of brazed components for the automotive industry.

Abbott Furnace will be hosting its Second Annual Continuous Brazing Symposium in the United States in November 2019.

MORE INFO www.abbottfurnace.com

U.S.-based fastener manufacturer buys AFC-Holcroft furnace

A Midwestern facility of a U.S.-based leader in the manufacture of safety-critical fasteners and assembly solutions has purchased a new MB48-120 mesh belt furnace from AFC-Holcroft.

The new equipment will replace an older AFC-Holcroft installation. The new mesh belt furnace will integrate with existing companion equipment such as a loading system, pre- and post-wash systems, oil quench, and temper furnace.

The new mesh belt furnace will be used in the production of metal fasteners. AFC-

Holcroft mesh belt lines can be customized with a variety of options, including oil and salt quenching. These systems also include the latest energy saving technologies to reduce atmosphere and gas consumption.

Delivery and start-up of the new equipment are expected in the first quarter of 2019.

Founded in 1916, AFC-Holcroft is one of the U.S. market leaders in the production of industrial furnace equipment for ferrous and non-ferrous metals. The company manufactures turn-key heat-treating systems for applications including commercial heat treating, bearings, automotive, aerospace, mining, aluminum heat treatment, gear manufacturing, fastener manufacturing, and alternative energy industries.

MORE INFO www.afc-holcroft.com

Grieve offers 550°F floor-level cabinet oven

The Grieve No. 1030 is a 550ºF floor-level electric cabinet oven currently used for heating large gears at the customer's facility. Workspace dimensions of this oven measure 48" W x 48" D x 60" H. 40 KW are installed in Incoloy-sheathed tubular elements to heat the oven chamber, while a 2,000 CFM, 2-HP recirculating blower provides horizontal airflow across the workload.

This Grieve cabinet oven features 6-inch insulated walls, aluminized steel exterior and interior, and five levels of dual-lane roller conveyor rated at 300 pounds per level.

Controls onboard No. 1030 include a digital indicating temperature controller, manual reset excess temperature controller with separate control contactors, and a recirculating blower airflow safety switch.

MORE INFO www.grievecorp.com

The Grieve No. 1030 550°F floor-level electric cabinet oven. (Courtesy: Grieve)

Seco/Warwick Group reports record order portfolio

The Seco/Warwick Group, one of the five largest manufacturers of equipment for the heat treatment of metals and vacuum metallurgy in the world, reports a record order portfolio of more than $105.3 million after three quarters of 2018.

The Group's sales in the first three quarters of 2018 increased by 10 percent compared to the same period of 2017. The operating profit for this period was approximately $5.3 million, while the net profit was about $3.5 million.

"A good performance and a rich portfolio of contracts, both completed and newly signed, result from a combination of excellent business relationships, a global reputation for proven technology, and consistently building a strong Seco/Warwick brand," said Pawe Wyrzykowski, Seco/Warwick Group CEO.

The strong market position of the Seco/Warwick Group is built not only by factories and companies on three continents, but above all, stable revenues and a record order portfolio for end-to-end solutions in five product categories.

One category of note is atmosphere heat-treatment technology and equipment, the Seco/Warwick product segment that enjoyed robust sales in 2018. The final results reflect great progress for this product segment that has prompted continuing investment in this technology and expansion into new markets.

Projects include:

› The sale of two complete technological lines, each consisting of a two-chamber sealed quench furnace and auxiliary equipment for one of the world leaders in the commercial heat-treating market.

› Delivery of a continuous operating roller hearth window bending line to the Czech Republic and Poland.

› The installation of a fire resistance test furnace for the Scandinavian market.

› The latter product deserves a special distinction, because Seco/Warwick is the market leader most frequently chosen by companies conducting fire resistance tests of their products.

Another product segment of the Group that recorded spectacular sales results is vacuum metallurgy. A significant increase in sales of vacuum induction melting systems (VIM) in 2018 has already become the

success story of the segment. At Purdue University in the United States, the Group installed and commissioned a VIM type furnace with a unique oil cooling system — a furnace for infiltrating samples with a zirconium alloy. VIM also was delivered among other vacuum metallurgy projects to an American company serving the aviation industry.

It was the aerospace industry that built a strong order portfolio, 70 percent of sales, for the Group in 2018, because equipment from the three segments of the Group is devoted to this sector. Particularly noteworthy are furnaces for vacuum heat treatment, which Seco/Warwick sent to customers at least once a week in 2018; 65 percent of the total volume was designed as customized projects. In addition to numerous realizations for the aviation market, the Seco/Warwick vacuum solutions segment has proudly entered the demanding and difficult Japanese market for tool steel components.

The last but equally attractive product group is equipment for the heat treatment of aluminum and controlled atmosphere brazing (CAB). As shown by Seco/Warwick in numerous installations around the world, technical experience and an innovative approach make the CAB solution the preferred joining technology for battery cooling plates within the hybrid electric vehicle (HEV) and electric vehicles (EV) market. Interestingly, Seco/Warwick is the only company in Europe supplying lines dedicated to brazing the aluminum electric car battery coolers.

Seco/Warwick is an award-winning company that has been interested in unconventional and innovative solutions since its inception. The company has developed many intelligent tools to support production processes using artificial intelligence, the Internet of Things (IoT), and the latest concept of Industry 4.0.

Observing the global market trends related to Industry 4.0, Seco/Warwick launched a research and development project aimed at creating a comprehensive management system for predicting maintenance issues for both metal heat treatment and vacuum metallurgy systems, equipped with a unique failure detection system. The effect of this project is the SECO/PREDICTIVE system for monitoring furnaces for heat treatment.

SECO/PREDICTIVE, based on predictive analytics, together with the SECO/LENS® based on augmented reality technology, are the latest solutions of the Group supporting production and service processes.

Awareness of the need to implement advanced and intelligent solutions, often called "the brains" of an entire production line, is constantly growing. Seco/Warwick, as a production company, understands these needs, offering innovations that increase the resilience of companies and their business performance. This was reflected in the results in 2018, where the company recorded an increase in the number of electrical projects by 20 percent com-

pared to the same period in 2017.

Financial data for the full year 2018 will be available in the consolidated periodic report in April this year, which will be posted on the company website.

MORE INFO www.secowarwick.com

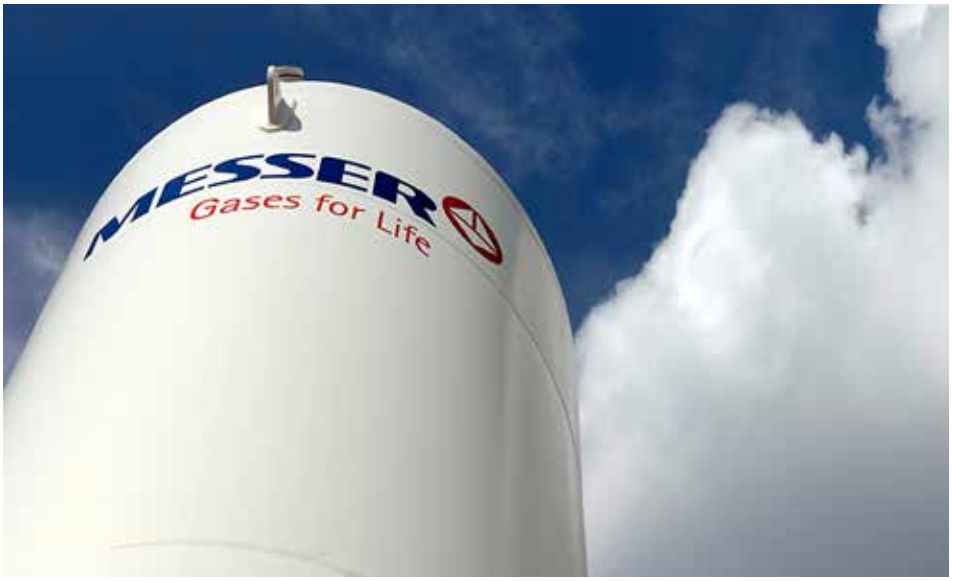
Messer brings gases expertise to Americas

Messer Group and CVC Capital Partners Fund VII recently announced the completion of the planned acquisition of certain businesses in North and South America from Linde plc, launching a new name in the Americas market. Messer Americas offers largely the same products, services and people customers have come to know and trust. Together with Messer Group, the company represents a $3 billion global enterprise that includes presence in the Americas, Europe, and Asia.

"I am proud to serve as CEO of Messer in the Americas, a continuation of my prior role," said Jens Luehring, president and CEO of Messer Americas. "While we have a new name, we draw on a rich heritage of safely and reliably supplying gases, innovative technologies, and application expertise to meet our customer needs. We are a technology and applications leader with the industry knowledge and applications expertise to meet customer needs across industrial, food, medical, chemical, and electronics industries, and our mission is to become the premier supplier of choice in the Americas, with excellent speed to market and an entrepreneurial spirit."

Jens Luehring, president and CEO of Messer Americas

With more than 70 production facilities in five countries across North and South America, Messer Americas is one of the largest industrial gas companies in this region. As part of The Messer Group, the company offers more than 120 years of proven expertise in the safe and reliable production and delivery of industrial, medical, and specialty gases.



Messer gases storage tank. (Courtesy: Messer Group)

MORE INFO www.messergroup.com
www.gasesforlife.de

Ipsen USA names customer service manager

Ipsen USA announced the promotion of Matt Clinite from Midwest regional sales owner to Ipsen customer service sales manager, effective immediately.

The position is new to Ipsen, and in it, Clinite will be responsible for building the Ipsen customer service sales team to provide the best in the industry aftermarket support for parts, engineered solutions and service.

Matt Clinite

Clinite joined the company in June 2014 as a sales engineer and for the past four years has served as the regional sales owner for the Midwest region. Clinite earned his bachelor's degree in business administration from Illinois State University in 2011.

"Since day one, Matt has influenced Ipsen in a positive direction," said Pete Kerbel, vice president of sales, Ipsen USA. "Matt has excelled because of his work ethic and determination to solve problems for customers."

Ipsen's customer service team is responsible for providing customers with comprehensive aftermarket support and services. Clinite has experience and a proven approach to customer service, combined with technical ability.

MORE INFO www.ipsenusa.com

Aluminum manufacturer adds Seco technology

According to the Aluminum Association, the official U.S. trade group, the aluminum industry generates nearly $71 billion a year in direct economic impact in the United States. When all suppliers and related business functions are taken into account, the industry drives $174 billion in economic impact — almost 1 percent of the country's GDP.

An American manufacturer of flat rolled aluminum sheet recently added a new Seco/Warwick sow and T-bar preheat furnace system to achieve maximum product quality, energy savings, and melt safety. The installation puts an exclamation point on Seco/Warwick's support of the growing aluminum sector. Optimum air flow management

and a heating system that promotes efficient heat transfer throughout the work and helps them manage production demands were unique features and benefits of the Seco/Warwick system highlighted by the customer.

"Seco/Warwick has always recognized the importance of designing systems that achieve superior performance to provide customers with maximum product quality, energy savings, and safe operations. Our partnership with this customer enabled us to quickly recognize areas for process improvement and allowed us to collaborate on value solutions for their manufacturing process," said Keith Boeckenhauer, managing director, Seco/Warwick USA.

The furnace includes the patented movable baffle system and fixed base airflow spacers for maximum heat transfer to varying height loads. The system is PLC controlled with remote I/O and dual operator interface control stations.

"For this customer, as well as other aluminum businesses, Seco/Warwick provides innovative solutions to support primary aluminum production, aluminum sheet, plate and foil, aluminum extruded products, and aluminum rolling and drawing mills," said Piotr Skarbi ski VP, Aluminum Process and CAB at Seco/Warwick.

MORE INFO www.secowarwick.com

Seco/Warwick rotary retort furnace proves a success in 2018

The rotary retort technology is designed to produce consistently superior quench hardening performance that is required for fast, economical, uniform heat treating of small parts. It provides the process flexibility to be used for either single or multi-application production. Ideal applications for the Seco/Warwick rotary retort furnace include quench hardening, tempering, and annealing — in 2018, the atmosphere heat-treatment furnace star.

Rotary retort furnaces are used to process an exceptionally wide variety of small parts including screws, nuts, bolts, nails, washers, and coins so they are particularly popular among tooling industry or mints.

The rotary retort furnace can be built as a standalone quench hardening or annealing furnace with its metering loader and integral quench system, or as part of a full harden-quench and draw line with tempering furnace, washer(s), atmosphere generator(s), analyzers, etc.

When it comes to sales of atmosphere systems, for Seco/Warwick, 2018 was a successful year. "We're very pleased with our results in 2018; these results reflect continuing momentum in our business and constitute another record year as a highlight in our journey to maintain a leading market position. More importantly this allows us to keep investing in product development and

Rotary retort technology is designed to produce consistently superior quench hardening performance that is required for fast, economical, uniform heat treating of small parts. (Courtesy: Seco/Warwick)

expansion into new markets," said Jaros aw Talerzak, thermal heat-treatment furnace systems VP at Seco/Warwick.

Constant process technology improvements coupled with expertise and decades of experience allows Seco/Warwick to accommodate the increasing demands of worldwide customers. It is the equipment quality and high level of services that resulted in attracting new and returning customers. One of the latter ones, in 2018, was the main producer of forgings in Central Europe for strategic markets, who invested in single-chamber furnace type PEK. Its special design reduces the consumption of process factors and investment costs while maintaining the high quality of thermally processed parts.

Another project was the manufacturer of high-quality matrix forgings, construction connectors, and manual tools, who purchased a CaseMaster AFS — a multipurpose sealed quench chamber furnace, intended for thermal and thermo-chemical treatment in a controlled endothermic atmosphere.

Extensive experience and modern technologies are what make Seco/Warwick an iconic brand in the production of laboratory furnaces for fire resistance testing. Among customers noticing the significance of reliable fire resistance testing in 2018 were KNAUF SAS, a French leader of the construction material industry; Roxtec, a Swedish leader within sealing solutions for cable and pipe transits, both purchasing a fire resistance test furnace for vertical and horizontal components of building structures; and svt Brandschutz Vertriebsgesellschaft GmbH International, a German supplier of fireproof materials and systems.

Seco/Warwick is a leader in innovative heat-treatment furnaces. In the production of atmosphere heat-treatment solutions, the company uses extended experience and state-of-the-art technology to simplify installations, reduce investment costs, and reduce process utilities consumption.

MORE INFO www.secowarwick.com

Wisconsin Oven ships curing oven to global manufacturer

Wisconsin Oven Corporation announced the shipment of a 2-Zone indirect gas-fired heavy-duty walk-in oven to a global manufacturer in the composite industry. Wisconsin Oven announced that this project passed the stringent temperature uniformity requirements to meet BAC 5621 Class 1 Furnaces and Instrumentation Type D specifications.

The composite curing oven has a maximum operating temperature of 450°F and overall chamber dimensions of 12'0" wide x 35'0" long (with center door raised) x 9'0" high. It uses a horizontal air flow configuration to maximize heating rates and uniformity. Three total guaranteed temperature uniformity tests were performed to ±5°F, each at set points of 150°F, 250°F, 350°F, and 400°F to meet BAC 5621 Class 1 Furnaces and Instrumentation Type D specifications; verified through a 50-point profile (with center door raised), and a 25-point profile (with center door closed) performed separately. All three tests were conducted in an empty oven chamber under static operating conditions.

This industrial oven has sufficient capability to heat 2,000 pounds of material from 70°F to 350°F at an average rate of 10°F per minute. This oven features three total vertical lift, electrically operated doors; the center door (when in the closed/lowered position) separates each zone into individual chambers. When in the raised position, this center door allows the customer to use one main large heating chamber. Each zone's exhaust blowers included both VFDs and modulating dampers to allow a lowered exhaust rate during heating, and capability for accelerated cooling of product during the cooling stage. The vacuum system included two 2 HP rotary vane vacuum pumps, one for each zone, and a Eurotherm controller for controlling the pressure of each vacuum header. This composite curing oven also featured access doors within both end vertical lift doors, personnel safety interior pull cords (to automatically open both end doors), and interior lighting.

"Curing is crucial in the manufacturing process for composite materials. This composite curing oven was designed with 2 zones to give our customer the flexibility to process composite parts of different sizes. It also features an advanced vacuum and control system," said Doug Christiansen, appli-

The composite curing oven has a maximum operating temperature of 450°F and overall chamber dimensions of 12'0" wide x 35'0" long (with center door raised) x 9'0" high.

cation engineer.

Unique features of this composite curing oven include:

› Guaranteed temperature uniformity of ±5°F at setpoints of 150° F through 400°F.

› High efficiency tongue and groove panel assemblies.

› Interior panel skins, ductwork, and oven floor constructed of 304 stainless steel.

› Two indirect industrial air heat burners.

› Programmable logic controller and human-machine interface.

› Programmable recipe temperature controller with auto-tune function.

› Thermocouple jack panels for load temperature monitoring with guaranteed soak feature of leading/lagging part temperatures (to trigger the start of the soak segments).

› Access doors in both end vertical lift doors.

› Interior lighting.

› Chamber divider door to separate zones.

› Turn-key installation service completed at the customer's facility.

› Final temperature uniformity surveys and calibration services performed at the customer's facility by an accredited third-party testing company (once completed system is qualified for production).

This composite curing oven was fully factory tested and adjusted prior to shipment from our facility. All safety interlocks are checked for proper operation and the equipment is operated at the normal and maximum operating temperatures. An extensive quality assurance check list was completed to ensure the equipment met all Wisconsin Oven quality standards.

MORE INFO www.wisoven.com

Third generation takes helm at Gasbarre

Thomas G. Gasbarre has stepped down as chief executive officer of Gasbarre Products, Inc. He has held the position since 1990 when his father, George Gasbarre, the founder of the company, retired.

During his tenure as CEO, Tom Gasbarre steered the company in a forward direction and completed a series of key acquisitions that earned Gasbarre Products a worldwide reputation. He will remain as chief financial officer until his planned retirement at the end of 2020.

As a result, Gasbarre has announced that Tom Gasbarre's son, Alex Gasbarre, has been appointed chief executive officer and is now leading the development and execution of the company's short- and long-term strategies.

Alex Gasbarre has been working at the company in several roles for the last 14 years. His most recent role as president of press & technologies and chief operating officer has given him the opportunity to hone his skills regarding strategic planning, information technology, marketing, human resources, and international sales.

Thomas G. Gasbarre

Alex Gasbarre

Heath Jenkins

Gasbarre has promoted Heath Jenkins to succeed Alex Gasbarre as president, press & automation, and manufacturing technologies. Jenkins has been with Gasbarre for more than three years, and has proven himself a leader with a strong ability to develop an organization. In his earlier role as vice president, sales & marketing for Gasbarre press division, Jenkins has brought attention to the Gasbarre name and promoted sales growth and customer satisfaction for the organization.

"The next generation of leaders at Gasbarre has proven themselves to be very capable, dedicated, and committed to carrying on the 46-year tradition of the company," said Tom Gasbarre. "I believe these changes will position Gasbarre Products, Inc. for continued success for many years to come."

MORE INFO www.gasbarre.com

Seco/Warwick upgrades supplier's key equipment

Seco/Warwick comprehensively updated and simultaneously extended a box furnace's productive longevity, which is a pivotal piece of manufacturing equipment for a leading international participant in the field of precious metals and advanced materials.

The unit was originally manufactured and delivered by Seco/Warwick in 1989 and, thanks to routine maintenance specified by Seco/Warwick, the furnace has operated reliably and productively for three decades. It was used primarily for annealing in the manufacturing of precious metals and advanced materials.

The furnace is a key piece of equipment in the production process and the customer has been happy with the reliability of this equipment. To keep quality standards high, the customer scheduled the furnace to be rebuilt. Seco/Warwick was the first company asked and was also the company selected to do the actual rebuild. The customer is hopeful the furnace will last another three decades with only minor maintenance after the current rebuild.

"Rebuilds of this type are high on our priority list. Because of our team's broad professional services capabilities, we're able to provide good customers with prompt, professional, and timely rebuild and upgrade services that meet their demanding schedule," said Keith Boeckenhauer, managing director at Seco/Warwick USA.

The unit was gutted. New insulation, baffles, and door seals were installed as well as a significant upgrade to the control system including an ultra-modern HMI.

Unique heat treatment equipment modernizations save money. Seco/Warwick offers modernizations and comprehensive refurbishments of its own equipment as well as any solution or equipment for heat treatment of metals and metallurgical vacuum of other manufacturer. Seco/Warwick also offers SECONOMY — a mix of economical and ecological solutions that enable waste heat recovery, reduction of heat loss up to 50 percent, natural gas consumption up to 40 percent, production costs savings

up to 50 percent, and optimization of work performance.

MORE INFO www.secowarwick.com

Solar Manufacturing site for new facility inspected

Solar Manufacturing's new facility is beginning to take shape. With the exterior of the building now fully enclosed, the project is closer to completion.

The nearly 20,000-square-foot two-story office building situated in the front of the manufacturing area is fully enclosed, enabling the next phase of building can begin.

"This plant will be one of the most advanced facilities in the United States for the assembly of vacuum furnaces," Jones said. The new facility is built on the 44-acre Brownfield redevelopment site on the Sellersville Business Campus in Sellersville, Pennsylvania.

The $8 million project is approximately 85 percent complete and the company expects to be operational by late summer or early fall 2019.

MORE INFO www.solarmfg.com

Bill and Myrtle Jones, owners of the Solar Atmospheres family of companies, in the center of the 40,000-square-foot manufacturing area during the most recent site inspection. (Courtesy: Solar Atmospheres)

Wisconsin Oven ships aerospace industry supplier

Wisconsin Oven Corporation announced the shipment of one electrically heated horizontal quench solution treat system to a supplier of the aerospace industry.

The horizontal quench solution treat system has a maximum oven operating temperature of 1,200°F and work zone dimensions of 5'4" wide x 5'6" long x 5'4" high (above the rollers). Guaranteed temperature uniformity of ±5° F at set points of 250°F and 550°F and ±10° F at set points of 980°F and 1,100°F was documented with a nine-point temperature uniformity survey in an empty oven chamber under static operating conditions in accordance with AMS 2750E.

This horizontal quench system was designed to heat a 565-pound gross load consisting of a mixture of aluminum and steel to 1,000°F operating temperature, provide a soak at temperature, and then quickly move the load into a quench tank. A powered pusher/extractor is used to load and unload the oven. A pneumatically operated lift system lowers and raises the load for quenching. This system achieved a quench time from the time the oven door starts to open until the load is fully submerged of less than 9 seconds.

"The horizontal quench system is a cost-saving alternative to drop bottom systems and results in a quicker ROI. It may actually take up less total floorspace than some drop-bottom systems of the same chamber volume," said Gary Hanson, senior application engineer.

The horizontal quench solution treat system has a maximum oven operating temperature of 1,200°F. (Courtesy: Wisconsin Oven)

Unique features of this solution treat system include:

› Quench time that will not exceed 10 seconds from the time the door starts to open until the load is fully submerged.

› Motorized pusher/extractor to charge and discharge the load.

› Pneumatically operated quench tank lift system to lower/raise the load.

› Chiller system to lower quench tank temperature back to 80°F after a load has been quenched.

› Sequence control performed by an Allen-Bradley CompactLogix processor (programmed with Studio 5000 software) with a PanelView Plus 7 standard 10" HMI.

› Eurotherm programmable digital controller with 2 loops of control, one for the oven and one for the quench tank.

This horizontal quench system was fully factory tested and adjusted prior to shipment. All safety interlocks were checked for proper operation and the equipment was operated at the normal and maximum operating temperatures. An extensive quality assurance check list was completed to ensure the equipment met all Wisconsin Oven quality standards.

MOER INFO www.wisoven.com

INDUSTRIAL HEATING EQUIPMENT ASSOCIATION

IHEA events are in full swing this spring

Spring has sprung and the Industrial Heating Equipment Association calendar is filled with events for everyone. If you are involved in the industrial thermprocess industry, join peers and training experts at one of IHEA's events to enhance your skills, increase your knowledge, and stay on top of the most current trends. Complete details and registration information for all IHEA's upcoming events are at: www.ihea.org/events.

FUNDAMENTALS OF INDUSTRIAL PROCESS HEATING ONLINE COURSE

April 15 – May 26 | 6-week course

The online course offers the opportunity to keep current with industrial process heating in the comfort and convenience of your own workplace or home. The course is designed to give flexibility as well as interaction with an instructor and forums to communicate with other students.

This course provides an overview of the fundamentals of heat transfer, fuels and combustion, energy use, furnace design, refractories, automatic control, and atmospheres as applied to industrial process heating.

Students will gain a basic understanding of heat transfer principles, fuels and combustion equipment, electric heating and instrumentation and control for efficient operation of furnaces and ovens in process heating.

Comments from students who have completed the course:

› "Excellent knowledge of the course, instructor with an excellent and quick response."

› "I enjoyed participating in the discussion forums and found them to be a useful addition to the course material."

Industry expert and registered professional engineer Jack Marino will lead students in this 6-week online course. Jack has more than 40 years' experience in the heat-processing business. Marino's knowledge and experience offers invaluable resources that online students can access throughout the course.

Students earn PDHs for passing the course. For a complete listing of the course topics, go to www.ihea.org/event/FundamentalsSpring19.

NFPA 86 UPDATES SEMINAR

May 14

Fabricators & Manufacturers Association | Elgin, Illinois

Join IHEA for this new, one-day seminar that will highlight the recent changes to NFPA 86. If you already have a good knowledge of NFPA 86, this seminar will be a great overview and review of an in-depth summary of the recent changes to the standard and how they affect you. If you are not familiar with NFPA 86, IHEA will conduct the complete 2-day Safety Standards & Codes Seminar this fall in Cleveland (details coming soon).

Noteworthy updates to the following areas:

› Furnace heating systems.

IHEA speakers provide recent changes and updates to NFPA 86. (Courtesy: IHEA)

› Safety equipment and application.

› Programmable logic controller systems.

› Safety shutoff valves.

› Safety controls and devices.

› Commissioning, operations, maintenance, inspection, testing, and auditing.

Instructors for this course are industry experts and committee members involved in the discussions and changes to NFPA 86.

Bryan Baesel presents important information on safety equipment to attendees in industrial manufacturing. (Courtesy: IHEA)

Veteran speaker Aaron Zoeller with SCC said, "NFPA 86 has been the standard in the U.S. for industrial combustion applications since the mid-1900s. It is updated every three to four years to remain relevant with current technologies. While some guidelines have remained consistent for years, new technology in burner controls, PLCs, radiant tubes, etc., has brought important changes in the 2019 edition. Anyone working in the industry should educate themselves on the changes each time a new edition is released."

Kevin Carlisle, Karl Dungs

Kevin Carlisle is the quality manager at Karl Dungs, Inc, a manufacturer of combustion controls such as safety shutoff valves, limit controls, valve proving systems, primary safety controls, and pressure reducing regulators. For the past 20 years, he has been involved in codes and standards such as NFPA 86 "Ovens and Dyers," CSD-1 "Controls and Safety Devices for Automatically Fired Boilers," and CSA B149.3 "Field Approval of Fuel-Related Components on Appliances and Equipment," and he is IHEA's voting representative on the NPFA 86 technical committee and the Safety Standards and Codes committee chairman. In addition, he is the company's representative for site investigations. Carlisle holds a BS in Chemistry with ACS Certification from the University of Madison-Wisconsin.

Bryan Baesel, Honeywell Combustion Safety (formerly CEC)

Baesel is a mechanical engineer who specializes in the design and field inspection of combustion equipment. He is a member of NFPA 85 and NFPA 86 along with several Fortune 100 combustion program teams. Prior to joining CEC, Baesel worked at a foundry and for a natural gas utility.

Franklin Switzer, S-afe, Inc.

Switzer is the owner/president of S-afe, Inc., an independent consulting firm specializing in design, safety and code training, and auditing and testing of industrial combustion systems. Switzer graduated from Rochester Institute of Technology with a BS in Mechanical Engineering Technology and earned his MBA from Anderson University. He started his career with Dresser-Rand Co. then worked at Maxon Corp. for 12 years before he founded S-afe, Inc. in 2002.

Switzer serves as a committee member on NFPA 54 (National Fuel Gas Code), NFPA 85 (Boiler and Combustion Systems Hazards Code), NFPA 86 (Ovens & Furnaces), NFPA 87 (Recommended Practice for Fluid Heaters), and ASME CSD-1 (Controls and Safety Devices for Automatically Fired Boilers). In addition, Switzer is serving as chairman of the newly developed and released NFPA 56 (Standard for Fire and Explosion Prevention During Cleaning and Purging of Flammable Gas Piping Systems).

Aaron Zoeller, Siemens Combustion Controls, Inc (SCC)

Zoeller is the director of Sales for SCC in the Americas. SCC holds seats on the NFPA 85 and NFPA 86 standard committees, and Zoeller is an active member of IHEA's Safety Standards & Codes committee. For nearly 20 years, he has focused on burner, fuel train, and combustion controls system design and support in industrial combustion applications. Prior to joining Siemens in 2010, Zoeller worked in engineering and sales for a major burner OEM. He earned a Bachelor of Science degree in Industrial Technology from Ball State University in Muncie, Indiana.

For complete details and registration information, go to www.ihea.org/event/NFPAUpdate

IHEA CELEBRATES 90 YEARS AT THE 2019 ANNUAL MEETING

If you haven't registered yet, there's still time. Don't miss what promises to be one of our most memorable annual meetings ever as IHEA celebrates 90 years of giving back to the industrial heating industry!

For complete program and registration details, go to: www.ihea.org/event/AM19.

IHEA 2019 CALENDAR OF EVENTS

APRIL 15–MAY 26

Fundamentals of Industrial Process Heating | On-Line Distance Learning Course (six weeks)

APRIL 29–MAY 1

IHEA 2019 Annual Meeting

The Industrial Heating Equipment Association (IHEA) will celebrate its 90th anniversary at the 2019 Annual Meeting. Complete meeting details and registration information can be found at www.ihea.org.
Lido Beach Resort | Sarasota, Florida

For details on IHEA events, go to www.ihea.org/events

INDUSTRIAL HEATING EQUIPMENT ASSOCIATION

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TRIRATNA SHRESTHA
MANAGER OF METALLOGRAPHIC LABORATORY AND CENTRAL COATINGS LABORATORY /// METCUT RESEARCH INC.

The steels are critical in addressing energy demand, mitigating greenhouse gas emissions, reducing SO_x and NO_x emissions, and increasing efficiency.

Heat-treatment of modified 9CrMo steel

The modified 9CrMo steels, such as Grade 91, Grade 92, and HT9, are materials of choice for fossil-fuel-fired power plants and Next Generation Nuclear Plants (NGNP). Both of them are critical in addressing energy demand, mitigating greenhouse gas emission, reducing SO_x and NO_x emissions, and increasing efficiency. NGNPs and supercritical power plants are designed to operate at higher temperature and pressure. Furthermore, these plants are expected to run for longer service periods and designed to have thinner component thickness. Operating temperature of reactor pressure vessels (RPV) in some variant of NGNPs can vary between 300 and 650°C and the vessels will be double the size of typical light water reactors. Efficiency of fossil-fuel-fired power plants strongly depends on temperature and pressure of steam being generated. One percent increase in net efficiency reduces emission of CO_2, NO_x, SO_X, and particulates by 2.4 metric tons, 1.8 metric tons, 1.8 metric tons, and 0.45 metric tons, respectively, while also reducing fuel costs by 2.4 percent [1].

The modified 9CrMo, a ferritic-martensitic (F-M) steel, has tempered martensitic microstructure with a lot of precipitates. These steels have superior elevated temperature creep strength [2,3]; however, their mechanical property is dependent on their ability to maintain tempered microstructure and precipitate distribution and are prone to cracking. Precipitation hardening is one of the main strengthening mechanisms in highly alloyed steels like these. Addition of strong carbide and carbonitride formers such as vanadium (V), niobium (Nb), and titanium (Ti) lead to the precipitation of various precipitates, such as coarser $M_{23}C_6$-type, and finer, thermally stable MX-type precipitates: (Ti,Nb)(N,C), (Nb,V)(C,N), and (V,Nb)(N,C). Coarser precipitates are located at the grain boundaries while finer precipitates are predominantly located in the grain. Smaller interparticle spacing and increased volume fraction of the fine MX carbides enhance the alloy strength. These precipitates obstruct the movement of dislocations, refine grain during normalizing, and delay plastic deformation. However, precipitates such as Z-phase and Laves phase lead to decrease in strength of the alloy by weakening solid solution [4]. Evolution of thermally-induced microstructure can be understood from heat-treatment studies.

Heat-treatment study of the steel helps in understanding its microstructural evolution and mechanical properties as these materials, whether being used for a pressure vessel or boiler component, go through a series of heating and cooling cycles. In this study, mod. 9Cr1Mo steel samples were normalized at 1,040°C for 2 hours, 8 hours, and 20 hours. With longer normalizing time, coarsening of untampered microstructure was observed as shown in Figure 1 and 2. With increased normalizing time, prior austenite grain size and martensite lath size increased. Samples normalized at 1,040°C for 2 hours were tempered at 790°C for 2 hours, 8 hours, and 20 hours to examine the tempered microstructure. The sample tempered at 790°C for 2 hours had tempered microstructure with elongated martensite lath structure as shown in Figure 3. However, with increasing tempering time, martensite-free coarse structure was observed, as seen in Figure 4. During normalizing and tempering of the steel, several carbides, such as $M_{23}C_6$, Ti/Nb/V rich MX-type carbide/carbonitrides precipitate and coarsen resulting in changes in creep strength, ductility, hardness, and microstructure [5-9]. $M_{23}C_6$-type precipitates coarsens at an accelerated rate compared to MX-type precipitates due to higher solubility of iron and chromium and ferritic structure.

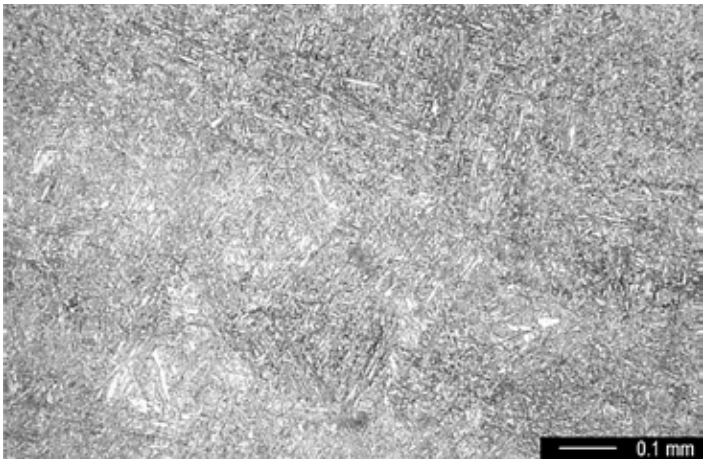

Figure 1: Optical micrograph of sample normalized at 1,040°C for 2 hours.

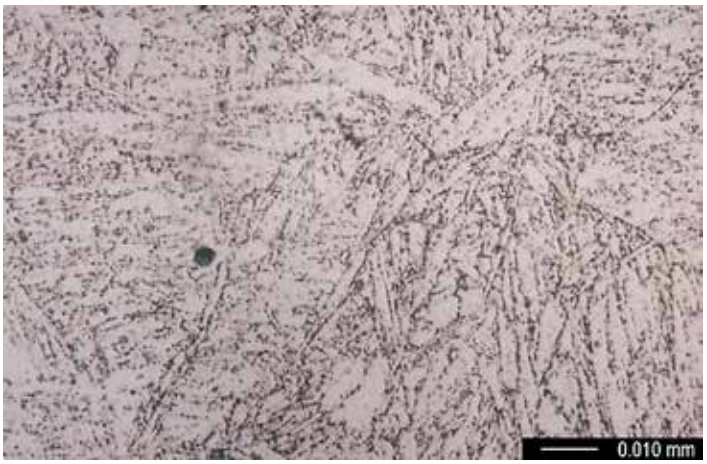

Figure 2: Optical micrograph of sample normalized at 1,040°C for 8 hours.

A decrease in hardness was observed in samples normalized for a longer period, and a similar trend was observed in samples tempered for longer periods, as shown in Figure 5. Samples normalized for 2 hours, 8 hours, and 20 hours had a hardness of 397, 372, and 336 HVN300g, respectively. Samples tempered for 2 hours, 8 hours,

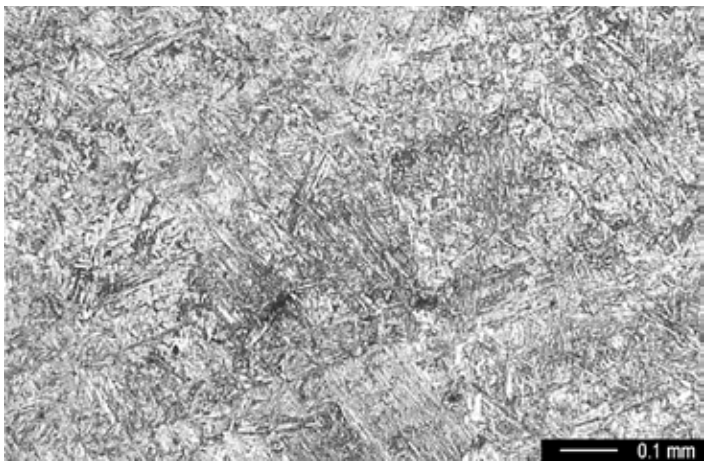

Figure 3: Optical micrograph of sample normalized at 1,040°C for 2 hours and tempered at 790°C for 2 hours.

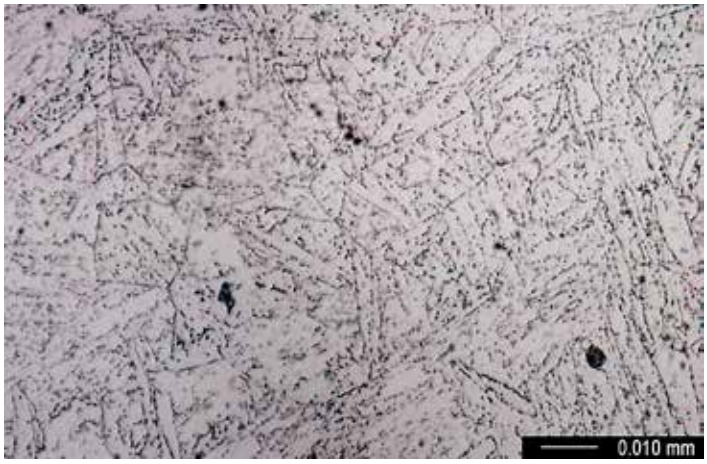

Figure 4: Optical micrograph of sample normalized at 1,040°C for 8 hours and tempered at 790°C for 20 hours.

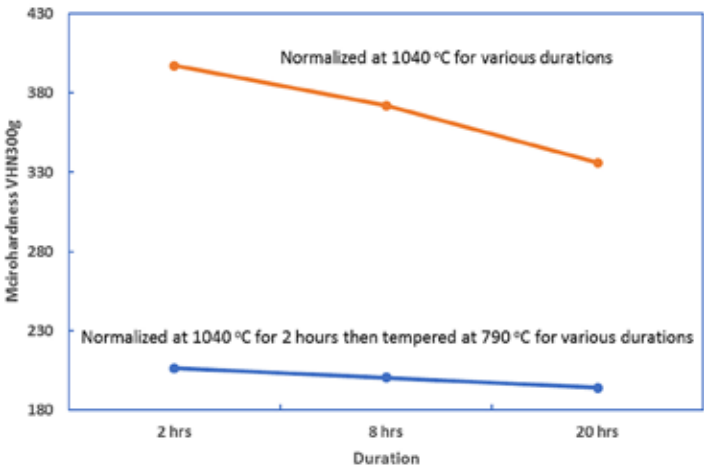

Figure 5: Effect of heat treatment on hardness.

and 20 hours had hardness of 206, 200, and 194 HVN300g. A drop in hardness was observed in tempered samples compared to normalized ones. Significant reduction in hardness was observed for normalized samples compared to tempered samples with respect to test duration. Li et al. have reported hardness change of over 80 HV between as-received and in-service steel. A non-destructive technique using electromagnetic measurement has shown decrease in hardness of over 40 HVN300g with increased initial permeability and decrease in coercivity for a sample tempered at 780°C for 100 hours [10]. Coarsening of microstructure and precipitates, subgrain recovery and its dissolution, and decreased dislocation density have been attributed to lowering hardness [5,11,12]. Distribution of $M_{23}C_6$-type and MX-type precipitates in the matrix plays a significant role in hardness and elevated temperature creep properties. Coarsening of $M_{23}C_6$-type precipitates, which are primarily distributed across grain boundaries, weakens solid solution strengthening and introduces defects in the matrix, while coarsening of MX-type precipitates are not effective in disrupting the flow of dislocations and pinning subgrains.

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JACK TITUS
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The metallurgical outcome is just one objective of the auto industry's CQI-9 standard.

Process control is vital to heat-treating

The definition of process control can only be defined by the experience of the per-son to whom the query is presented. Everyone involved in heat-treating who works with the auto industry knows of the CQI-9 standard that covers a multitude of parameters considered critical by the Big Three automakers. Process control of heat treat, or the metallurgical outcome, is but one of these objectives and is merely a result of what has already been pre-ordained by the success of the previous equipment-manufacturing procedures.

One might ask why a standard such as CQI-9 is required in the first place. The obvious answer is to try and find a manufacturing compliance method that will assure when a case-depth specification of 0.030", +/- 0.005" (0.72 mm, +/- 0.127 mm) is required, it can actually be met by any previously approved supplier in an approved facility. That compliance procedure to the specification is called the Production Part Approval Process (PPAP). How the procedure is carried out can vary according to the specific quality requirements of the product being manufactured — gears, shafts, torsion bars, fasteners, etc.

Generally, a typical part load is agreed upon with a specific number of parts per location in a tray with the process running continuously, or for whatever time period is appropriate. If a nonconforming part is detected during a run, a previously agreed-upon procedure will commence. That can be many things, but usually the equipment supplier will be given the opportunity to correct the suspected reason for noncompliance and either continue the production run from there, if possible, or start from the beginning.

Obviously, before a PPAP, the equipment supplier will be allowed to prepare, debug, or otherwise duplicate a production cycle with a few dummy and real parts to ensure the equipment is as production-ready as possible. Everyone knowledgeable with the equipment knows it's a complex machine and unexpected mechanical issues can occur. However, as long as the event is considered fixable on the fly without affecting a critical outcome, compromises can sometimes be made. After all, all parties concerned want the equipment to perform to expectations within the mandated schedule.

In heat-treating where the parts are processed in furnaces out of sight, sensors are relied on to measure the temperature of the parts as compared to the set point. TCs (thermocouples) are inserted either through the roof, rear, or side wall as close as possible to the parts and are expected to reflect an accurate representation of the part temperature. That small bead that joins the two different metals forming the hot junction will produce a millivoltage depending on the metals corresponding to the temperature.

The heat energy reaching the TC bead is produced by four elements:

- Radiation from the parts in the load.
- Radiation from the heating source, tubes, or electric elements.
- Radiation from the heated atmosphere gas passing over the bead.
- Conductivity of the TC protection cover, usually ceramic or refractory metal, draws heat away from the TC bead toward and through the refractory wall.

In theory, we want the load to provide greatest influence on the TC, and we assume this is so because of the proximity of the TC to the parts. But this condition depends on the furnace type and the interior design.

When a load of parts is charged into a batch furnace, we see the zone TC immediately drop, undoubtedly due to the black parts influencing the TC — again be-cause of its proximity to the load — but also because the refractory and heating source is losing heat to the cold parts. We know that heat energy is transmitted by radiation faster than gas convection, but that's primarily because the emitting source of the radiation, such as radiate tubes, has much more surface area than the gas atmosphere. However, each electron of every atom of gas also has mass and emits radiation, and the mass or quantity of gas that passes over the TC bead contributes to the temperature increase. Thus, the higher the gas velocity, the greater the transfer of heat via convection. It's true, gas and convection have a negative component called a boundary layer, where radiant energy does not — in a true vacuum, that is. So, when a cold load is placed into a hot chamber, the radiant energy from the heating tubes or elements must first heat the gas, and then the gas transports that energy to the parts. Of course, the emissivity of the receiver and emitter has a significant influence on the quantity of energy transmitted.

Granted, as the heat penetrates the parts on the exterior of the load, that heat via conduction will flow through to the colder portions of the parts on the interior of the load. It is radiation by convection that provides the energy to heat the interior of the load, all while the TC is measuring the environment in its proximity of the load.

The dilemma for the heat treater is the accuracy of the sensors used to measure those parameters. TCs, gas analysis equipment, and oxygen probes can be certified to traceable standards. But where chemistry and thermal dynamics are involved, reproducibility is not so easy. Why? No two heat-treating furnaces manufactured in the same facility side-by-side will respond the same way while processing the same recipe. There will be minor variations due to all of the tolerances involved with every manufacturing process.

Every possible precaution is taken along the manufacturing supply chain with all of the ISO standards guiding the procedures. However, when furnaces are constructed, humans, not robots, perform the functions. As talented as they are to approve procedures, it's unlikely two brick masons will apply the "mud" refractory mortar in the identical manner with the exact content of water on every one of the thousands of bricks required in a furnace. The chemical content of the refractory also plays a role. Welding is another

critical function that I've discussed in earlier columns that can affect atmosphere quality, but likely much later in the furnace's operating life.

Another aspect of process control is mechanical function. Furnaces, being self-destructive machines, operate best when in a steady state, i.e. operating at the same temperature continuously 24/7. But that's never the case. Every item or material that makes up the furnace — metal case, rubber, plastic, ceramic, mortar, and refractory — expands and contracts with the heat-treating process. The most susceptible of the mechanical items are the doors, since they are constantly opening and closing thousands of times a month. Most critical are doors that separate the ambient environment from the furnace atmosphere. Second is the inner heat-sealing door; it receives the most wear and tear. In atmosphere furnaces, inner doors are not meant to be gas tight, but rather heat shields to prevent overheating of other components. Atmosphere gas is designed to leak through a designated location, usually at the bottom or a small orifice in the door center. Either way, the leaked atmosphere should pressurize the vestibule that further allows a predetermined leak rate to keep the furnace pressure within proper limits.

The gas sensors, whether they be oxygen probes to measure "oxygen" ppm, infrared analyzers for percent of CO and CO_2, or TCs, all must be accurate within empirical limits known to be acceptable.

As with the devices mentioned above, limit switches, valves, doors, seals, and fans constantly perform their functions all while the materials degrade, shrink, and eventually leak — allowing contamination of the unseen process occurring inside the furnace. This is where the typical understanding of process control really hits home, and we all expect the sensors to measure and correct and compensate for all of the previous processes and procedures in the manufacturing chain.

Concerning the atmosphere, endo is used in this case. Endothermic gas — with its ideal mix of 20 percent CO, 40 percent H_2 and nitrogen, plus critical fractions of CO_2 and H_2O, and nascent oxygen with the proper proportions — produces a specific case depth of carbon at the appropriate temperature. Although minor variations of CO will have little effect on an expected outcome, very minor changes in the CO_2 and H_2O can have a monumental impact. And since those oxidizing components are so paramount to the result, their accuracy is critical. The extent to which heat treaters attempt to control the critical gas compositions is as complex as the heat-treating furnace itself.

Some may argue with my comments here, but my overall goal is to illustrate how over-the-top complex the heat-treating furnace has become since the batch furnace was introduced before World War II. I believe wholeheartedly that since WWII, millions of components requiring heat-treating manufactured for every possible device are still functioning to acceptable standards.

EPILOGUE

We've got to reinvent the heat-treating furnace, get back to the "if it ain't broke, don't fix it" philosophy, and simplify, simplify, simplify.

History has repeatedly illustrated that what starts out complex and large eventually becomes simpler and smaller.

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JASON SCHULZE
METALLURGICAL ENGINEER /// CONRAD KACSIK

Successful thermal processing means ensuring the final product conforms to the requirements specified by the purchaser.

Process quality control in heat treatment

In thermal processing, process quality control is imperative to produce and control conforming product and overall conformance. In this article we will be examining some aspects of this: achieving repeatable results using specific inputs which, in turn, will allow us to validate the process to control outputs.

PRODUCING AND CONTROLLING

Great ideas, whether profitable business deals, products, or personal endeavors, start as good ideas and gradually build into something controlled, compared to the raw idea we first imagined. The ideal New Year's resolution starts this way; commit to losing a specific amount of mass (hopefully fat), and in doing so, you end up researching (that is, if you mean it) how to keep it off. Each idea starts with a premise that, in our readers' terms, will produce conforming product post-thermal processing per customer requirements.

PRODUCT REALIZATION

The initial step is product realization. In the context of heat-treat quality control, this will include a thorough understanding of your customer requirements. A heat treater may receive a batch of widgets with a purchase order stating, "heat treat AMS2770." In order to maintain quality control through the process and deliver a conforming finished product, additional information will be needed. This would include material type as well as the desired final condition (temper, in this case). This initial step can be accomplished by ensuring the contract review process includes steps taken to obtain information from the customer when it is necessary. If your organization is Nadcap-approved, it's important to keep in mind that the AC7102 checklist has specific requirements regarding contract review and what must be included in the applicable procedure.

PROCESS DEVELOPMENT

In this article, I will not be addressing the development process since, in basic heat-treatment, development is not normally performed as the customer/industry specifications are typically followed. Development may be needed for, as an example, braze joints (whether diffusion or standard braze), diffusion aluminide coatings, or bond cycles post-thermal spray.

PROCESS IMPLEMENTATION AND FLOW DOWN

The next step is to document the process established, which will enable you to conform to the customer requirements. This is after any necessary development. These requirements are typically documented in three ways: 1) procedure, 2) work instruction, and 3) traveler (or router).

Instructions documented in a procedure are those that are default requirements and/or requirements that apply to all hardware processed in the equipment. An example of this is vacuum level. You may perform many processes within your vacuum furnace, although regardless of the process, you always require the chamber vacuum be less than 1 micron before applying heat. Another example is load thermocouples. You may require that, no matter what is being processed, a specific minimum number of load thermocouples be used each cycle. These are some examples of what would be inserted into a procedure to maintain control of a thermal process.

An example of requirements to be documented in a work instruction could be specific braze preparation steps. These could include braze joint gap requirements, alloy used, and nickel plating requirements. It could also include loading requirements such as using a composite graphite fixture with ceramic spacers or specific fixturing requirements.

An example of router documentation would include reference to a work instruction (as mentioned above) or a sequence of operations that ensures requirements are met. It may also include documentation of any post-thermal process test results, specific equipment limitations, etc.

PROCESS QUALITY CONTROL

Internal auditing is a check and balance to ensure quality control. This is a requirement of ISO/AS including Nadcap. A procedure should be established that will capture the critical variables of the process from contract review to final inspection. If your process is Nadcap-approved, the procedure should include all elements of Nadcap scope of approval(s). This can be accomplished by requiring the applicable Nadcap checklists be used during the internal audit. If this is not implemented, it can be easy to omit specific requirements.

SUMMARY

Quality control in any thermal process is critical to ensure the final product conforms to the requirements flowed down from the purchaser. Using an outside subject matter expert can help in this process, including training for your staff.

ABOUT THE AUTHOR

Jason Schulze is the director of technical services at Conrad Kacsik Instrument Systems, Inc. As a metallurgical engineer with 20-plus years in aerospace, he assists potential and existing Nadcap suppliers in conformance as well as metallurgical consulting. He is contracted by eQualearn to teach multiple PRI courses, including pyrometry, RCCA, and Checklists Review for heat treat. Contact him at jschulze@kacsik.com.

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Thermal processing

PRINCIPLES OF PYROMETRY

AMS2750E covers a lot of pyrometric territory regarding equipment used for thermal processing. Look closely, and it gets a little tricky.

By JASON SCHULZE

Regarding comprehension, on a scale of 1 to 10, AMS2750E is about a 12. Practically speaking, when an engineer, quality person, or operator picks up a specification, they select that specification because they know what to expect. In other words, if they are heat-treating martensitic corrosion-resistant steel parts, they will choose AMS2759 and AMS2759/5 because they are already aware of the applicable specification that describes details on operations and how to heat-treat.

AMS2750E isn't quite that straightforward. This specification broadly covers pyrometric requirements for equipment used for thermal processing, including temperature sensors, instrumentation, thermal processing equipment, system accuracy tests, and temperature uniformity surveys. AMS2750E is selected when a specification, such as AMS2759, refers to it. It is not a specification that states specific heat-treat temperatures, quench temperatures, and material-testing requirements. AMS2750 is flowed down via other specifications, making it less direct, and therefore, less familiar to some suppliers.

A WAY TO ACCOUNT FOR AND UNDERSTAND REQUIREMENTS

Specification accountability is a process that benefits from a closer look. A breakdown of this process will help account for and understand the requirements within not just AMS2750E, but any specification.

Most quality engineers are familiar with the term "bubbling" as it relates to blueprints. Bubbling a print is a practice in which each requirement is assigned a sequential number. Once this is done on the print, it is logged onto a form that contains the designated number, its associated requirements, the subsequent result and an accept/reject notice. Typically, this is done on machined parts that may have an intermediate process (such as heat-treat) involved in their manufacture.

When an intermediate process is performed, the specification is simply listed as the requirement and an accept designation is applied. The specification itself is not bubbled, but read by an engineer, and the applicable requirements flowed down. One method is to bubble the specification itself. Take each requirement out of the specification and assign it a sequential number. Let's call them "Characteristic Requirements." Some paragraphs may have several requirements within a single paragraph; each would be separated and assigned its own sequential number.

Let's look at an example using: AMS2750E PG 19, PARA 3.4.5.1:

"The displayed temperature indication and/or recording of the sensor being tested as used in production, with appropriate offsets or correction factors, at any operating temperature, shall be compared with the corrected temperature indication of the test sensor on a test instrument."

It may seem that a single requirement is being put forward — but there are actually seven contained within this one paragraph.

They are:

- The displayed temperature indication ...
- and/or recording of the sensor being tested ...
- as used in production ...
- with appropriate offsets or correction factors [option for either]
- at any operating temperature ...
- shall be compared with the corrected temperature indication of the test sensor ...
- on a test instrument.

As a metallurgical engineer, I have performed this task on both AMS2750D and AMS2750E. Revision E ended with 513 characteristic requirements, including tables and figures. Once bubbled, each requirement must be accounted for as it applies to the operations. For example, any requirement regarding a retort furnace would be designated "N/A" if that operation employed only vacuum furnaces. Of course, the continuing issue of comprehension arises at each step of this process. If someone has a poor understanding of pyrometry, it will be difficult to bubble AMS2750E and nearly impossible to successfully complete the process of showing conformance.

178	System Accuracy Test Procedure. The displayed temperature indication…	3.4.5 & 3.5.4.1
179	…and/or recording of the sensor being tested…	3.5.4.1
180	…as used in production…	3.5.4.1
181	…with appropriate offsets or correction factors…	3.5.4.1
182	…at any operating temperature…	3.5.4.1
183	…shall be compared with the corrected temperature indication of the test sensor…	3.5.4.1
184	…on a test instrument.	3.5.4.1

Table 1: Take each requirement out of the specification and assign it a sequential number.

Table 2

Let's look at an example of this in Table 1.

In taking this approach, AMS2750E has 513 characteristics of conformance; 43 pages, 11 tables, 41 related notes, and six figures that exist as both examples, guidance, and requirements. The challenge is how these requirements are set forth in the Nadcap checklist AC7102/8(NC). These requirements are fitted into an eight-page checklist, as shown in Table 2.

This is no fault of PRI. They are auditing to a checklist that, they rightfully assume, the suppliers have prepared for and understand fully. PRI offers training in AMS2750E (via eQuaLearn), including

their interpretations in the pyrometry guide, to accredited suppliers and non-accredited suppliers alike, to ensure companies applying for their initial audit are prepared. This is where an additional challenge resides — comprehension via training and continuous improvement.

SPECIFIC CHALLENGES: THE ALTERNATE SAT PROCESS

My experience throughout revision E of AMS2750 indicates the introduction of the Alternate Systems Accuracy Test (ALT SAT) process seems to have been the most challenging. It is a system put in place that will account for the system variance containing thermocouples replaced each use or more frequently than the standard SAT frequency identified in Table 6 or 7 in AMS2750E.

I've written extensively regarding the specific requirements of the Alternate SAT process. To fully describe it, this entire article would need to be dedicated to its description and reasoning. Following is a general treatment, so other challenges can be addressed:

AMS2750E requires an Alternate SAT on furnace systems containing a thermocouple, which is replaced each use or more often than the Standard SAT requires. As an example, you have a parts (Table 6) furnace designated a Type C, Class 2 furnace that contains a thermocouple in both the high and low locations based on the most recent TUS. Per Table 6, this would then require biweekly SATs (normal frequency). If you used nonexpendable thermocouples and replaced them every 30 days, you would be able to perform a standard SAT and would not be required to conform with the Alternate SAT requirements. If you used expendable thermocouples and replaced them each cycle, you would then be required to conform to the Alternate SAT requirements.

AMS2750E sets forth fairly straightforward requirements. The non-optional requirements are having a furnace preventative maintenance plan in place per AMS2750E and calibrating that specific system where the thermocouple is connected. Then, AMS2750E gives two options to suppliers:

› **A:** Combine (add) the error of the thermocouple wire used with the error of the instrument within the system that the thermocouple is connected to. This calculation should be performed at the points which the instrument is calibrated. That error cannot exceed the SAT tolerance identified in AMS2750E Table 6 or 7 (as applicable). (Figure 1)

› **B:** Or, use the correction factors from the wire in question during each production cycle to the temperature displayed and recorded as the corrected temperature.

Most companies do not want to add correction factors from wire to their systems. So, option A is typically used.

THE SCOPE OF AMS2750E

The scope of AMS2750E may seem straightforward at times, but it can be challenging for some suppliers to understand what AMS2750E actually governs and what it does not govern.

Questions that begin with "Where in AMS2750E does it talk about...?" are not unusual. Some examples are vacuum calibration, quench delay for aluminum heat-treating, leak-rate testing, dew-point measurement, and others. None of those four examples is included within the scope of AMS2750E. These specific requirements can be found both in industry specifications (such as SAE/AMS) as well as prime specifications that are flowed down via purchase order and/or print.

FURNACE INSTRUMENTATION/ CONTROL PER AMS2750E

Quickly after the release of revision E of AMS2750, I was asked if revision E required suppliers to begin replacing their analog (paper) recorders with electronic recorders or data acquisition systems. I can see why this rumor made the rounds, but no, electronic recorders are not specifically required by AMS2750E. It seems the misunderstanding is coming from a) misinterpretation of the specification, and b) the statement made in paragraph 3.2.1.1 of AMS2750E stripping the grandfather clause put forth in revision D regarding furnace instrumentation resolution for analog instruments.

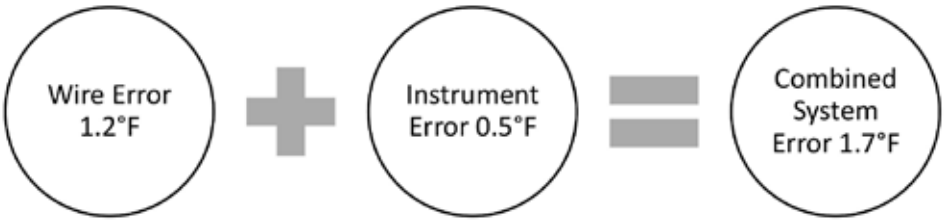


Figure 1: One option for an appropriate offset or correction factor needed to fulfill an AMS2750E requirement.

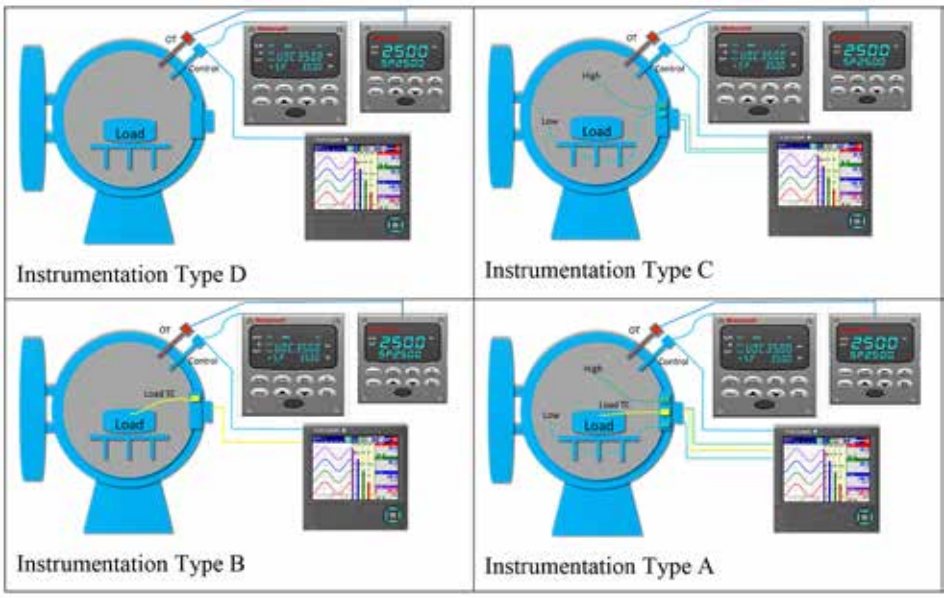


Figure 2: There are many combinations that can be used within a particular instrumentation type.

It's worth mentioning the technological innovations that have appeared in the last 10 years. Several control systems — such as the HC900 paired with SpecView — if programmed correctly, are almost limitless in their flexibility. New electronic automated systems are worth the investment for most suppliers.

INSTRUMENTATION TYPE DESIGNATION

Determining instrumentation type can also be challenging. Questions

AMS2750E sets forth fairly straightforward requirements. The non-optional requirements are having a furnace preventative maintenance plan in place per AMS2750E and calibrating that specific system where the thermocouple is connected.

range from "How do I determine what type of instrumentation I should designate?" to "Can I use extra sensors in an instrumentation configuration and keep the same designation type?" The following will address some of the more common questions.

First, let's address the minimum requirements from AMS2750E.

Instrumentation Type E is an option in AMS2750E but is not permitted when documentation of the thermal cycle is required. In these examples in Figure 2, we will assume Type E is not permitted.

An example: If a supplier has a Type D configuration, they will have the following in each control zone: an overtemperature control, a furnace controller, and a recording device recording the control process variable (actual furnace temperature). A furnace that is designated Type D instrument may still contain a load thermocouple for periodic or all cycles performed. In this case, the furnace could remain a Type D with the addition of a load thermocouple.

AMS2750E (page 17, paragraph 3.3.4) allows the additional thermocouples to be added to the minimum systems of any instrumentation type. In this case, it would be important to keep in mind that, if adding additional thermocouples that are used for product acceptance, they then require calibration as well as a system accuracy test for the additional system.

Another example is a supplier who designates their furnace a Type B system. This would require the same systems as Type D with the addition of a load thermocouple. A supplier could very well designate Type B instrumentation and place the load thermocouples (say they use two in each cycle) in the hot and cold areas.

There are many combinations that can be used within a particular instrumentation type. As long as the supplier has the minimum systems indicated by the instrumentation type and performs AMS270E testing on those specific systems, as well as additional systems used for product acceptance, this would conform to both AMS2750E and Nadcap.

SUMMARY

AMS2750E can be a confusing and complex specification to understand and apply. As with anything else, training and hands-on practice are the best way to master the interpretation and execution of the requirements. Don't be shy — get a second opinion whenever possible. Having open conversations regarding the interpretation is a great way to expand your understanding of the specification.

For more information regarding the Alternate SAT, please feel free to contact me.

ABOUT THE AUTHOR

Jason Schulze is the director of technical services at Conrad Kacsik Instrument Systems, Inc. As a metallurgical engineer with 20-plus years in aerospace, he assists potential and existing Nadcap suppliers in conformance as well as metallurgical consulting. He is contracted by eQualearn to teach multiple PRI courses, including pyrometry, RCCA, and Checklists Review for heat treat. Contact him at jschulze@kacsik.com.

THE VERSATILITY OF THE PIT FURNACE

Pit furnaces provide a wide range of thermal processes for typically far less cost than other types of furnaces.

By BILL ST. THOMAS

Top-loading furnaces, commonly referred to as pit furnaces, have played a major role in the heating treating landscape for the last century or longer. They also perform the widest range of thermal processes compared to other heat-treating furnace designs and configurations. The following overview presents the various processes and reasons why a pit-type furnace would be selected over other designs.

Most commercial and captive heat-treaters use or have used a pit-type furnace for one or more of these applications: tempering, aluminum-solution treating, nitriding, steam treating, annealing, hardening, carburizing, and vacuum heat-treating. Pit furnaces can provide the user with temperature ranges from 250° F to 2,200° F. They can be designed as either gas-fired and electrically heated for most of these applications. They are fitted with retorts for several applications, can cool products in place, and provide the best design for long parts or heavy loads than typically supported with an overhead loading device. They also use the least amount of valuable floor space, which is a key consideration today.

PIT FURNACES

Pit furnaces have been used for tempering (250° F to 1,400° F) and aluminum heat treating (250° F to 1,100° F) for many years due to the easy loading and unloading of parts, which is done by lifting the lid away and hooking the parts out of the furnace. Parts are often forced-air cooled or quenched in water as is the case for aluminum castings.

The cutaway view in Figure 1 illustrates the use of convection heating by a fan and the tunnel effect of the air flow and cylindrical heating chamber. The round heating chamber provides the best natural temperature uniformity and is preferred for densely loaded parts. There are other variations of this method with the elements surrounding the workspace and the fan position on the bottom of the furnace. Again, the pit furnace can be used for long parts where they would be hung from a center-post fixture. Heavy loads are another feature of the pit-temper furnace, since the base of the furnace is solid, and the brickwork can support heavy loads up to 50,000 pounds or more in some cases.

STEAM TREATING

Steam treating (600° F to 1,100° F) is a process used for powered metal parts that require a thin protective or decorative coating such as gun barrels or twist drills. A pit-type furnace designed for steam treating uses an inner liner or retort to contain the steam atmosphere while it is being circulated throughout the load.

These furnaces (Figure 2) are almost always electrically heated and are provided with cooling fans to reduce the part temperature prior to removal. The steam pit furnace uses its lid or cover and a simple sealing device for this application.

In recent years, the steam furnace has been widely used as a clean tempering furnace where only nitrogen gas has been used to purge and keep oxygen out of the chamber for the entire cycle. Cooling fans are also used since the parts are contained inside the retort with nitrogen, and the cooling is accomplished on the outside of

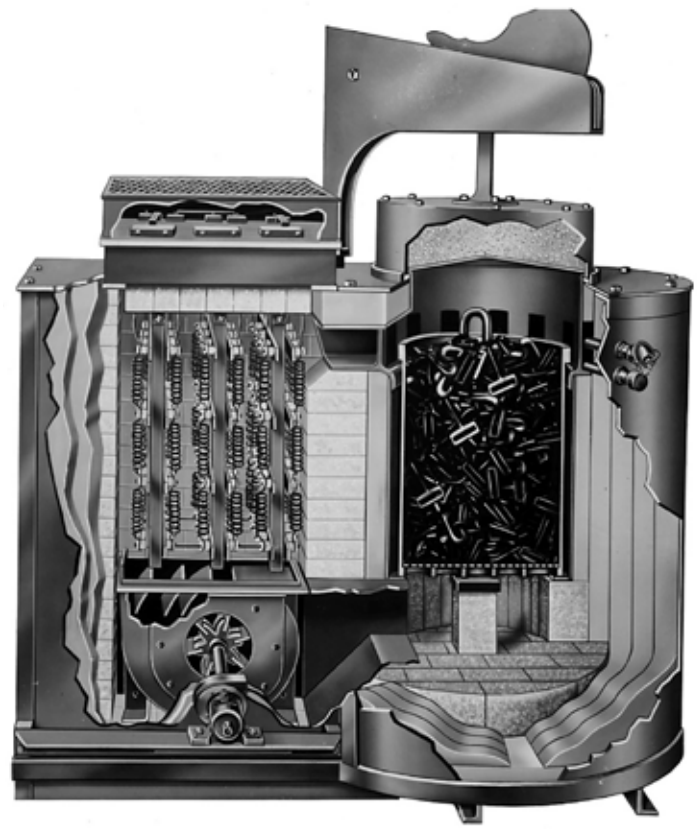


Figure 1 (A&B): Tempering furnace with cutaway view.

the retort by ambient air.

Controlling the temperature and inert gases if used in the above pit type are quite easy with common indicating and controlling instruments, recording devices, and flowmeters. The following pit-type furnaces typically use a variety of atmospheres and one or more devices to control not only temperature but other functions such as time, gas flow, purge, safety, cooling rates, etc.

GAS NITRIDING

Gas nitriding (700° F to 1,100° F) is the most popular heat-treating process in today's heat-treating market. This process provides a thin coating on the steel parts used for high wear or corrosion in the gear market. The lower temperature of about 1,000° F has a very low distortion level on the part compared to gas carburizing in atmosphere with oil or vacuum carburizing with 20 bar quenching where straightening is often required or press quenching is needed.

The nitriding process is done in a retort where ammonia-based gases are used, depending on single or two-stage nitriding. The pit furnace, again, is widely used for long shafts or dense loads. Since the nitriding cycle time can be up to 50-plus hours long, the pit furnace again is often the best choice base on floor space and the use of multiple units. (Figure 3).

HARDENING AND ANNEALING

The hardening (1,500° F to 2,000° F) and annealing (1,300° F to 1,800° F) processes are typically performed in radiant-heat-type furnaces where the heating method is no longer convection. The radiant heat is provided by gas-fired tubes or metallic-rod-type elements. A typical radiant heating element design (Figure 4) shows the furnace heating chamber with the wall-mounted element attached.

These furnaces typically require a protective atmosphere to keep the components free from scale or from de-carburizing when hardening. Both endothermic and nitrogen-methanol blends are used in this type of furnace. Often times, a top-mounted fan is used for better temperature uniformity or mixing of the protective atmospheres. The gas-tight shell and lid provides a perfect seal against any oxygen penetrating the heating chamber. Overhead lifting devices are commonly used to remove loads into a quench tank or companion washer and tempering furnace. Special fixtures, baskets, and center-post devices are common for large loads when hardening. The pit furnace offers a large work capacity for large, long, or heavy loads that other furnace types cannot.

CARBURIZING

The carburizing process (1,600° F to 1,800° F) in pit furnaces is widely used by companies in the power-transmission, movable-machinery, marine, mining, wind-power, and gear markets along with a few commercial heat-treaters. These companies typically have very large capacity units from 16 feet in diameter to 20 feet deep for loads up to 50,000 pounds which makes the pit furnace the only choice.

These furnaces are mostly electrically heated with fully automated temperature controls, carbon probes, ramp and cooling features, etc. Slightly smaller carburizing furnaces also are used since case depths can be up to 0.250 inches deep for carburizing followed by a slow cool required for some specifications prior to further hardening. The enclosed (Figure 5) shows a typical carburize load, special fixture, and stop-off paint prior to loading. These furnace cells typically have a companion re-heating or hardening furnace, oil quench tank, washer, and temper furnaces with an atmosphere generator. By using an overhead crane or gantry device, these cells can provide a very high output and require very little maintenance.

Another design for carburizing is the sealed retort pit furnace

Figure 2: Steam treating with cooling blower.

Figure 3: Gas-nitriding furnace cell.

where smaller furnace diameters up to 50 inches and lengths to 72 inches deep are required. This design (Figure 6) has a retort built into the heating chamber and is surrounded by heating elements and a bottom mounted fan for atmosphere circulation. The lid design uses a sand seal for a gas-tight operation. This homocarb furnace also can be used for hardening and annealing applications.

Pit-type vacuum furnaces are used primarily for annealing or hardening (1,600° F to 2,200° F) of wound or dense loads of tool or specialty products such as saw blades are required. A typical top-loading vacuum furnace in Figure 7 shows a vacuum furnace for products or coils up to 48 inches in diameter and depths to 84 inches of coiled stock loaded in fixtures. The benefit of the vacuum furnace is to remove any oxygen that could cause scale on the nearly finished

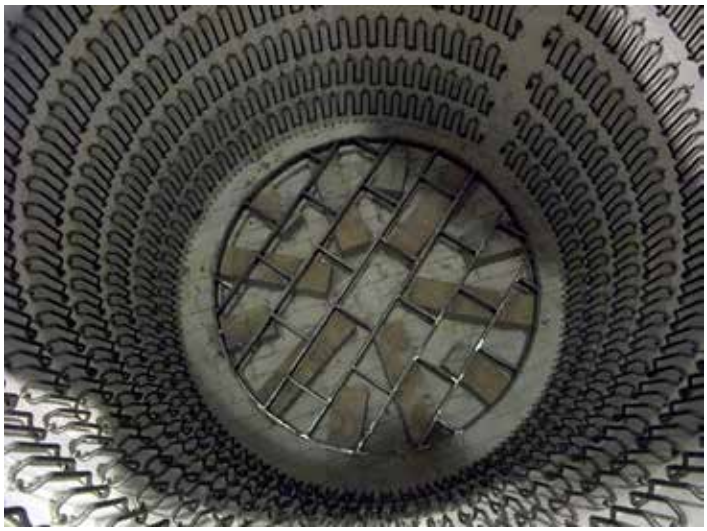


Figure 4: Hardening furnace interior.

Figure 5: Typical pit carburizing load.

products and the best temperature uniformity at the same time.

SUMMARY

To summarize, pit furnaces provide a wide range of thermal processes for typically far less cost than other types of furnaces. They are favored when dense loads or a wide range of parts need to be processed. These furnaces also provide a smaller footprint than a batch or mechanized box-type furnace and require much less service time. Often times, they have the unique ability to provide more than just one thermal process. Lastly, pit furnaces are the only choice when very large, long, or heavy loads require heat-treating.

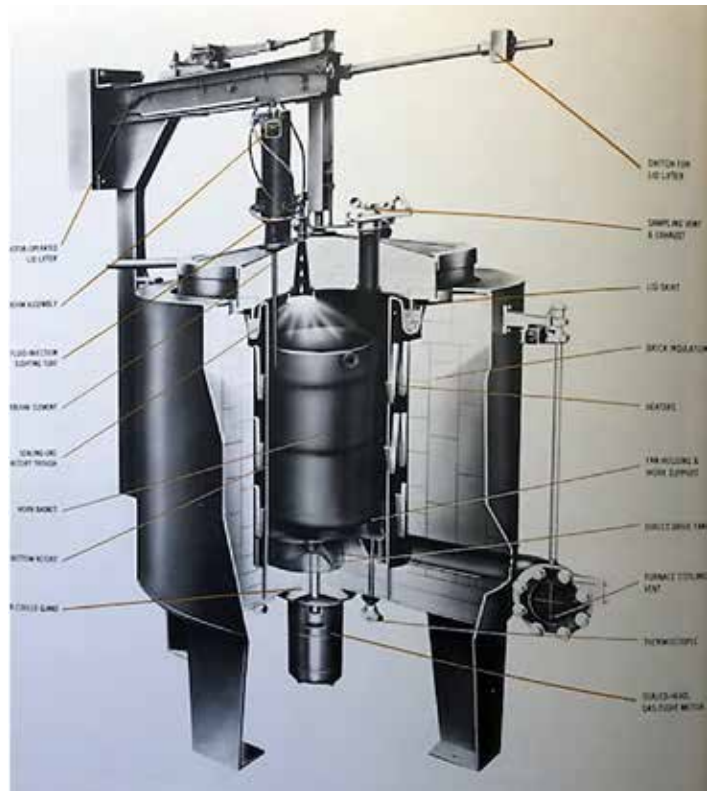


Figure 6: Homocarb furnace (cutaway view).

Figure 7: Vacuum annealing furnace.

ABOUT THE AUTHOR

Bill St. Thomas is business development manager of LindbergMPH Division of Thermal Product Solutions (TPS) based in Riverside, Michigan. He has more than 50 years of experience in the heat-heating market and is a life member of ASM Detroit Chapter.

COMPANY PROFILE ///

DALTON ELECTRIC HEATING COMPANY

CONSISTENTLY PERFORMING AT THE HIGHEST LEVELS

Watt-Flex® split-sheath cartridge heaters. (Courtesy: Dalton Electric Heater Company)

Dalton Electric Heating Company offers its customers uniquely patented heater options with a commitment to first-class service to back it up.

By KENNETH CARTER, Thermal Processing editor

When a company has been around for almost a century, just the sheer number of years of business means it must be doing something right.

But for Dalton Electric Heating Company, getting it right means more than just the history behind the products.

Dalton's patented Watt-Flex® Cartridge Heaters and Diff-Therm® Platen Heaters are used globally in manufacturing industries that include aerospace, automotive, composites, plastics, and more. But it only begins there.

FAMILY-FOCUSED BUSINESS

"Dalton's core philosophy is really built around a new slogan that we just launched last year, which is 'Trust the Dalton Difference,'" said Dalton President Chris Stevens. "What that means is several different aspects. The first aspect is, when you call Dalton, you get a person; you get a live body who you talk to. We're probably one of the few places that you still call today and get a human who knows what you need and can handle the question almost immediately with almost every single person here. Typically, they know you. We have a very long, established relationship with our customers, with our distributors, with our OEM tool suppliers, our suppliers, and also every aspect of our business. We're a small family-focused business."

The other aspect of that Dalton philosophy is doing the impossible, according to Stevens.

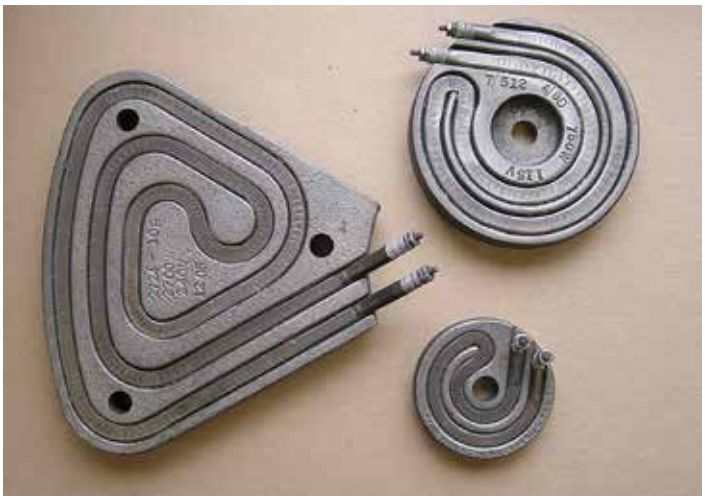
"When somebody calls up on a Friday afternoon and says, 'My customer is down, and they need X,Y, and Z. Can you help us out?' That's when you really see Dalton step up and launch into action and take care of customers," he said. "We've done that numerous times in the short time that I've been here. We have consistent quality. Every single one of our heaters is made to order, made to specification for that particular job, for that particular customer. We have the ability to consistently make a product over and over and over again with the highest craftsmanship and level of care, consistency, and reliability."

DIFF-THERM® HEATER

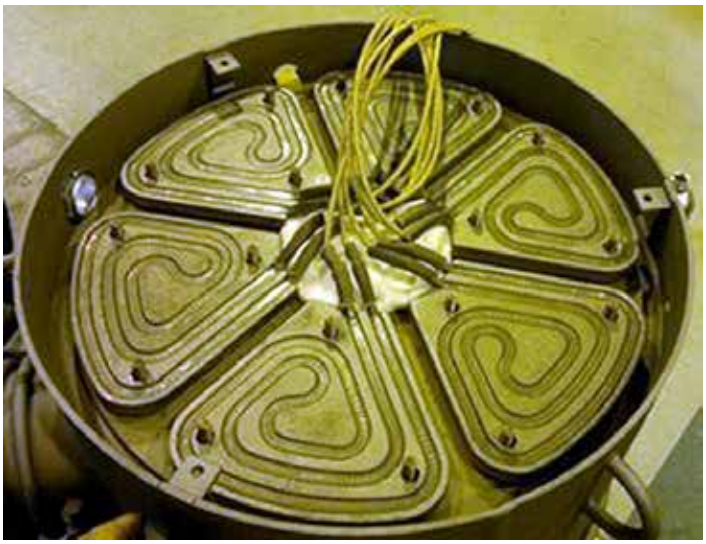
Dalton's history of heating focused on the diffusion pump heating element, according to Stevens, where the diffusion pump heats the silicone oil that then creates a vacuum. That creates the atmosphere used to heat-treat or to apply a coating onto metal or plastic.

The Diff-Therm® Heater, which recently celebrated its 50th year since its patent, has a unique design, he said.

"A traditional diffusion pump heater is a three-piece design where you just have a heating element, a crush plate, and a follower plate," Stevens said. "You bolt all three of those things together with the hopes of transmitting as much heat as you can into the bottom of the pump. We've revolutionized that whole concept of how to get the maximum heat transfer into where you need it. You really want to be able to transfer the heat into the oil, which is what's doing the evaporation and what's creating the vacuum, and that's basically what you're shooting for and what you're trying to achieve."



The Diff-Therm Heater® (Courtesy: Dalton Electric Heater Company)



The bottom of an Agilent HS-20 diffusion pump with six Dalton Diff-Therm® 2448-10R Platen Heaters. (Courtesy: Agilent Technologies – Vacuum Products Division, Lexington, Massachussetts)

With Dalton's casting, first it's formed and then it's pressed into the casting. Dalton punches the tubular heater into the recesses of the casting, giving it an improved contact area and compresses the MgO, which also improves the heat transfer into the casting, according to Stevens. The result is a higher heat transfer that dramatically improves the life of the heater.

"That's what makes our heaters last anywhere from two to five times longer than our competitors," Stevens said.

And those statistics translate to high confidence among Dalton's customers.

CUSTOMER SATISFACTION

"What we get for feedback from our users is, 'I can start up my equipment much faster. I get a much better, consistent, reliable vacuum generated from using your heaters,'" he said. "Of course, the ultimate compliment is, 'They last forever.' Whereas these other heating elements, because they're exposed to air —the worst kind of environment — they're not able to transfer heat away, and it creates a lot of problems for them."

Dalton sells to many of the OEMs that are either on the market today or their equipment is still in use today, according to Stevens. Some of those companies include Alcate, Agilent, Balzers, CVC, Edwards, and Varian.

"They have various size diffusion pumps, so we have configurations that fit onto their unique diffusion pumps," he said. "Basically, all of our parts match up to the standard OEM ones where you can drop out the existing OEM part, and put in our Diff-Therm Platen Heater."

DEDICATED CRAFTSMEN

Dalton's process when working with customers is batch; it's not automated, according to Stevens.

"I think our greatest achievement is our ability to consistently perform at the very highest levels," he said. "We have dedicated craftsmen who really know their craft well, and basically they're doing the same job every day, and they're doing it with the highest levels of expertise. It's almost an artistry that they build — and consistently build — our products to. From a sales achievement standpoint, we are selling into 55 different countries, most of which are countries that are either using a diffusion pump or are in one of our larger markets. It's really been an astounding business from our ability to reach so many different parts of the globe."

GIVING 110 PERCENT

And that ability to go the extra mile does not go unnoticed by Dalton's customers, according to Stevens.

"We had a customer, Siemens, come to us, and they said, 'We have a couple of pumps, and for some reason, I'm not exactly sure why we have this, or why it's there, or what it's doing, but we have some wires that are coming out and basically, the casting is interfering with those wires,'" he said. "We talked to them, and looked at it, and said, 'How about if we just cut out a notch for your wires, right into our casting.' They were like, 'You can do that?' And we said, 'Oh, yeah.' This is a conversation that took place in the morning, and by the end of the week, it was done and shipped out. That's the kind of service level that most people are not accustomed to, and that's the refreshing thing from my standpoint of coming here into Dalton is, our ability to respond is tremendous."

GOING BACK 98 YEARS

Dalton has a number of achievements with its products, but it all began nearly a century ago in 1921 in Salem, Massachusetts, with William H. Dalton. The company soon changed hands around the Great Depression when Walter Churchill took over.

Churchill was instrumental in creating the Diff-Therm Platen Heater, and he received a patent for his creation in 1966.

Beyond his business history, Churchill has a storied past in and of itself. He was born in 1889 and was a World War I bombardier. He passed Dalton Electric on to his 26-year-old son, John Churchill, in 1972.

In 1978, John Churchill patented a split sheath heater design that became Dalton's Watt-Flex.

In the 1980s, the company was acquired by current owners YSA, Inc. Eli Whitney, who started as the lone sales person, became the president of the company and the driving force behind Dalton, according to Stevens.

An Agilent HS-20 diffusion pump. (Courtesy: Agilent Technologies – Vacuum Products Division, Lexington, Massachussetts)

"Since Eli started in 1985, he's generated a 6.6 percent compound annual growth rate over that entire time up until this last year when he retired," he said.

In 1989, Dalton moved to its current location in Ipswich, Massachusetts.

FACING CHALLENGES

As Dalton enters its 100th year and beyond, Stevens expects to see changes in the heat-treat arena, but he added Dalton will meet those changes head on.

"The thing that I see disrupting what's happening now is obviously additive manufacturing," he said. "But there's still going to be a place for both heat treatment and vacuum coating onto parts that have been additive manufactured. I see that the level of sophistication that's going on in heat treatment will continue to evolve and continue to grow. This is an industry that's not going to go away any time soon. Additive manufacturing is a part, and it's an important part, but it's not going to displace everything."

MORE INFO daltonelectric.com

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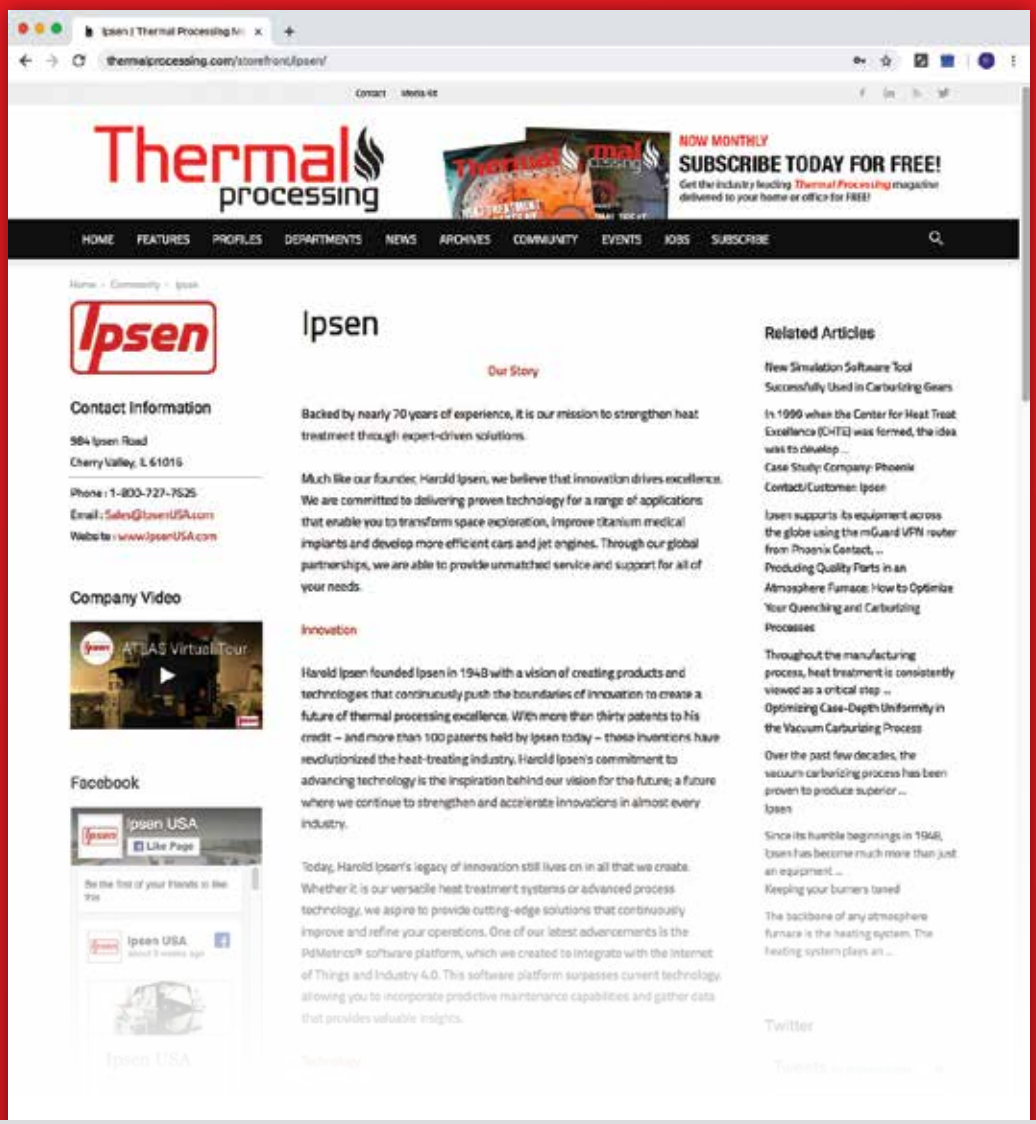

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MATTHIAS PASCHER /// HARDNESS PRODUCT MANAGER /// BUEHLER

"Buehler has launched its new Universal Hardness tester, the UH4000, built for production environments where hardness tests need to be performed fast and accurately."

What is your role at Buehler?
I am the product manager for our hardness testing equipment within Buehler.

Buehler is a global supplier of apparatus for microstructural analysis. Our customers are manufacturing components, for a variety of industries, with a focus on automotive and aerospace. We supply our customers with lab equipment used for sample preparation to analyze the components, the materials, and also to do quantifiable testing regarding the hardness.

Why is hardening important in the heat-treat industry?
Hardening processes on steels and alloys are mainly used for high-friction applications, like gear wheels, engine components, and steering rods. Hardening makes a material suitable for its application. There is a vast amount of materials available that needs to undergo a hardening or heat-treatment process to make the material work for its desired application. To check that a material or the final processed component is suitable, hardness checks need to be performed. Buehler is a premium supplier of hardness testers to support our customers.

What kind of hardness-testing equipment does Buehler offer the heat-treat industry?
We have a portfolio of different kinds of hardness testers, and we have a really long history of manufacturing Wilson hardness machines. We have launched our new Universal Hardness tester, the UH4000, which fits into production environments where hardness tests need to be performed fast and accurately.

What brought about the development of an updated universal hardness tester?
Throughout our complete unit portfolio, we really want to develop products that are based on customer needs, so we reached out to customers. We wanted to understand the customer and the main points they have. We started thinking about how we can improve and simplify this with our new product developments, in this case an improved Universal Hardness machine.

The machine itself has been designed for production floors where you have a multi-shift environment and have big parts and rough conditions — dirty environments. But it can also be used in a university where you have one machine, because in universities you have varied materials to test where you need to have different scales. It depends really on the application, and you can configure the machine as you wish.

It's ultimately a universal machine but was designed for heavy usage. It has a large steel casting frame. The measurement system of the machine is projected underneath with aluminum casting, so it's a really rigid machine.

What is significant about the Wilson UH4000 series?
The overall concept of this kind of machine is that it's manufactured robustly. When you think about a machine that stands next to an induction heat-treatment oven, workers are often working in a three-shift environment. They have components to test, which can be very large. Customers need a machine large enough to hold these parts. That's why the machine itself needs to be very robust. We now have a product that addresses this kind of need from our customers.

The innovative hardness tester also features very fast testing cycles and a newly developed turret to hold several indenters and objectives. The operator can test to a variety of methods without the need for manual indenter/objective changes. The frame is made from a solid casting, along with a sturdy turret cover to protect the turret assembly and the hardness measurement system against outer influences and collisions. The large 300mm (11.8 in.) x 400mm (15.7 in.) T-slot stage and the weight capacity enable testing of large heavy parts.

We have also added some really nice features like an innovative clamping device that clamps the parts prior to testing and during testing, so the part itself is secured and reduces error in testing or potential damage to the indenter.

Overall, the complete machine is controlled by our DiaMet™ software, which has been on the market for a couple of years. It's known for its easy-to-use interface and intuitiveness. When you think about having this machine sitting in a three-shift environment, you want software that is intuitive and does not require extensive training.

What's been the industry reaction to the series so far? And has that versatility been a major attraction?
Everybody's excited about it, especially our global sales teams. They have had a lot of interest from our customers because they see it as the best solution in the market.

The first couple of machines were sold within a short amount of time, and requests are increasing from week to week, confirming Buehler is again capturing the need of our global customer in quality control environments. It's a really great start for us.

MORE INFO www.buehler.com

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