SECO/WARWICK

Invention meets Reliability

CUSTOMER NEWSLETTER

METAL Minutes

Contents

Dear Reader

We are delivering to you a brand new concept of quality news concerning Heat Treatment trends, market, innovations, novelties, changes in industries and technologies as well as clients' feedback, requirements and challenges which are still ahead of us. If you enjoy staying up to date the beginning of a new year is a perfect moment to check the latest and review the cutting edge innovations from the last year.

Our newsletter will start to be published regularly from now on - twice a year. We want to stay closer to you also through this channel of communication. We start with an info graphics showing trade shows where you could have met SECO/WARWICK, see all the premiers and innovations last year and where you can talk to us in the coming months – see the schedule of webinars and events at the end of this newsletter.

Last year game changer for many companies in various industries – UniCase Master® – is presented in details and also in an interview movie – you will find the link below as well. Our external expert and our friend - Gord Montgomery - is going to speculate about next year challenges and market situation for Heat Treatment industries predicting higher growth especially for automotive, aerospace and defense sectors.

Advantages of modern technologies in nitrocarburizing of gears you will find in an external article from TermalProcessing. Human Resources will tell you what valuable assets SECO/WARWICK has gained recently in order to strengthen its managerial capabilities. In the section of clients' case studies you will read about obstacles encountered by one of the companies in Mexico and special requirements of another in India.

If you have any news that you would like to share with us or believe that it's interesting to all our readers, do not hesitate to contact us.

It's all for now, please enjoy reading.

Paweł Wyrzykowski

President and CEO of SECO/WARWICK GROUP

WORLDWIDE PRESENCE

SECO/WARWICK

Invention meets Reliability

OF 2015

SHOWS

NUMBER OF **SHOWS** WHERE SECO/WARWICK WAS AN EXHIBITOR

38

CITIES

35 **CITIES**
SAW SECO/WARWICK TECHNOLOGIES

Beijing, Cleveland, Pune, Long Beach, Chennai, San Diego, Detroit, Las Vegas, Mumbai, Berlin, Bilbao, Changzhou, Birmingham, Czarna, Duesseldorf, Frankfurt, Istanbul, Jihlava, Koeln, Leoben, Manchester, Munich, Poznan, Reims, Shanghai, Venice, Wroclaw, Zbaszyn, Chongqing, Baoji, Taiyuan, Moscow, San Diego, Orlando, Schaumburg

PEOPLE

3400
OF PEOPLE VISITED US DURING THE SHOWS

CONFERENCES

9 WE WERE PRESENT AT **CONFERENCES**

SEMINARS

NUMBER OF **SEMINARS** WHICH SECO/WARWICK ORGANIZED AROUND THE WORLD

5

SPEECHES

NUMBER OF **SPEECHES** WHICH SECO/WARIWCK PEOPLE MADE AROUND THE WORLD

85

TIME OF SPEECHES

WE TALKED OVER **55** **HOURS**

EXHIBITION SPACE

ON **800** **SQ M**
WE PRESENTED OUR SOLUTIONS

DAYS

164 (ALMOST HALF A YEAR)
WE SPENT AT TRADE-SHOWS

WHICH MEANS **1330** **HOURS**
FOR BEING CLOSER WITH OUR CUSTOMERS

SECO/WARWICK

Invention meets Reliability

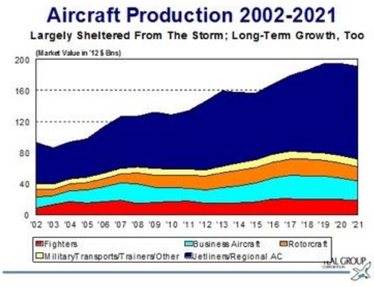
Heat Treating 2016

According to Gord Montgomery, editor of the THE MONTY

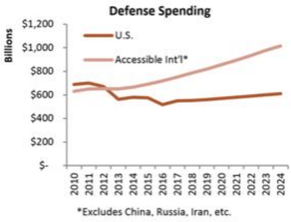
2015 proved to be a year which looked favorably on most captive and commercial heat treaters around the world; most felt sales were up from 2014 or at the very least remained the same. Predictions for the future are always very easy to make and we will fearlessly make a prediction about the health of the industry in 2016. We will start off though by saying that it is difficult to know where you are going when you don't know where you've been. For example, anecdotal evidence tells us that heat treaters did well last year but actual hard and fast numbers are hard to come by. As an example, captive and commercial heat treating is estimated to be roughly $20 billion USD/year in North America with 10% of this being commercial and 90% captive with worldwide heat treating estimated at $60-$80 billion USD/year. The problem is that we have yet to see a breakdown of where these numbers come from or even what is included. As an example does this include steel mills and foundries, or are these number restricted to real heat treating such as carburizing and vacuum heat treating?

Let's try another tack here and backtrack from commercial heat treating whose numbers are easier to pin down. Most areas of the world have a local organization of commercial heat treaters who to varying degrees share information such as individual sales. In North America it is assumed that 10% of the market is commercial and 90% captive-another one of these assumptions which is possible but hard to know for sure (incidentally in Europe the % of the market owned by commercials is larger than 10% and in areas such as Mexico, Indian and China it is lower). So if we start off with sales figures for commercial heat treaters and multiply by 10 (in North America) we should end up with a rough estimate of the total value of heat treating on the continent. Not so fast though-keep in mind that not all commercial heat treaters belong to a local organization and not all share sales figures so we don't know if Peter is stealing from Paul. In other words are the reporting companies seeing increased sales at the expense of the non-reporting members ending up with a zero sum game?

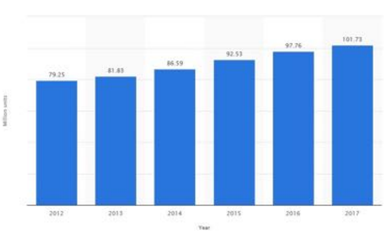
So let's scrap this exercise in futility trying to put a definite number on the value of heat treating and look at it from a completely different standpoint which is that at the end of the day heat treating is part of the manufacturing process and as goes manufacturing so goes captive and commercial heat treating. Worldwide heat treating giant Bodycote (who we believe has the best handle on the size of the heat treating market of any organization in the world) reorganized the company a few years back into business segments defined by the industry served. As an example, the ADE segment consists of aerospace, defence and energy while the AGI segment represents automotive and general industrial.



If we can predict with some certainty how each sector will do in the future we can to some extent make a reasonably accurate estimate about whether our industry will see vibrant growth, stagnation or the desperation of 2009. Out of these five business areas we can see in the graphs below that at least three automotive, aerospace and defense are all on an upward trend, a trend which is expected to continue at least through 2016.



General Industrial covers such a broad spectrum that it is impossible to predict with any certainty where this will go leaving us with energy which as we all know is in the dumpster these days.
Therefore if we consider that 3 out of five business areas are expected to grow in 2016 with one maybe and one definitely not we can with some confidence predict that 2016 should prove to be a reasonably good year for our industry, with of course some areas doing better than others.



Of course life has a habit of popping up and changing the best laid plans of man but at this point we look forward to a good 2016.

Gord Montgomery
gord@themonty.com

Investment in people

In response to continued global growth, affiliated SECO/WARWICK has hired a number of key employees to further strengthen human resource capabilities

In response to our continued global growth affiliated with new technologies, greater competitiveness, new clients and new offices, SECO/WARWICK Group has hired a number of key employees to further strengthen human resource capabilities in 2015. They joined SECO/WARWICK to further impact sales, marketing and operations where we are focused on acquiring new clients while expanding markets and industries.

According to Paweł Wyrzykowski, SECO/WARWICK Group Chief Executive Officer, "We are very happy to have gained these key personalities for SECO/WARWICK. They inspire the further growth of our company and accommodate acceding needs that arise for us as a global player in the thermal business around the world. Since their nominations took place some time ago, we have already had a chance to see them in action and appreciate their contribution within our group of companies. We wish them best of luck in their daily endeavors."

SECO/WARWICK Global Group management, SECO/WARWICK Europe Headquarters

Wojciech Peret,
Group Chief Operations Officer

Wojciech Peret joined the SECO/WARWICK Group as Chief Operating Officer on October 1st this year. He is a graduate of University of Warmia and Mazury in Olsztyn (Mechanical Engineering), Economical University in Wrocław, as well as postgraduate studies in Business Psychology, Executive MBA from Koźmiński University in Warsaw, and Business Coaching. Wojciech gained his professional experience at Alstom Power where he developed his career beginning with engineering positions through Turbine Factory Manager up to Vice President of the Management Board. Wojtek's key areas of responsibility include: equipment project execution, supervision of Aluminum and CAB Business Segment, Supply Chain management, supervision of Aftermarket Business Segment, standardization and modularization (components and processes), personal support to SECO/WARWICK Allied (India), supervision of selected R&D projects (3D printing technologies).

Ludger Oimann,
Sales Director / Sales Development Director

Ludger Oimann serves both the SECO/WARWICK Global Group as Sales Director, and SECO/WARWICK Europe as Sales Development Director. He is a graduate of the Technical University in Aachen, faculty of mechanical engineering. He has spent most of his career in managerial positions at Ipsen International in a variety of roles including project and sales management as well as general management. His most recent assignments included: Sales Manager Atmosphere and Vacuum, President of Ipsen Japan and Vice President of Sales. Mr. Oimann joined SECO/WARWICK on June 1st.

Katarzyna Sawka,
Group Marketing Director

Katarzyna Sawka joined SECO/WARWICK as Group Marketing Director in August. This position has been created due to growing need of marketing coordination for the whole SECO/WARWICK Group. She is a graduate of West Pomeranian University of Technology in Szczecin, faculty of marketing management and marketing research as well as postgraduate of B2B marketing management at Poznan University of Economics. From the beginning of her professional career she has been responsible for marketing and sales, as a specialist, manager, director and Member of Board of Directors or Member of the Supervisory Board. Her marketing experience was always affiliated with the B2B market, at first in automotive, later in high-tech, IT and now heavy industry. Katarzyna worked for DaimlerChrysler Poland where she managed Mercedes-Benz and Chrysler & Jeep brands. She then moved to ADB, a leading Digital TV Technologies corporation, where she held two positions, first as Marketing Manager for Eastern Europe, then later as Global Marketing Director. In August Katarzyna was appointed Director of Group Marketing at SECO/WARIWCK responsible for organizing all marketing and PR activities and overseeing the development and delivery of a fully integrated marketing strategy for the business.

SECO/WARWICK Corporation, United States

Doug Glenn,
Sales & Marketing Director

Doug Glenn joined SECO/WARWICK on April 1st as the Director of Sales & Marketing. His goal has been to create and lead the Sales & Marketing Team to connect SECO/WARWICK with potential customers. Before joining SECO/WARWICK, Doug served as the Publisher of Industrial Heating, the leading magazine of heat treatment industry. During his tenure, he tripled the size of the business from roughly $1million to $ 3million. Doug was also a producer of several industry conferences, trade shows, technical books as well as other industry magazines. One of Doug's recent accomplishments was the founding of FORGExpo (2011), the global forging industry's first virtual tradeshow. He published several articles and was a keynote speaker at many industrial events.

Jason Ackerman,
Chief Operations Officer

Jason Ackerman joined SECO/WARWICK on January 5th. Prior to joining SECO/WARWICK, Jason spent 11 years with GE Transportation in Erie, PA serving in a variety of roles of progressing responsibility including Purchasing Manager, Operations Manager, and Plant Manager. Jason's experience managing complex operations will be well suited for SECO/WARWICK. He is a certified Lean Master Black Belt of Lean Six Sigma, a methodology that relies on a collaborative team effort to improve performance by systematically removing waste.

SECO/WARWICK Retech, China

Liu Yedong,
Sales Director

Liu Yedong joined SECO/WARWICK Group as Sales Director on June 2nd. Mr. Liu majored in metal materials and heat treatment. He started his career in Beijing Machine - tool Research Institute where he focused on material and process selection for key components of machine tools. Later he worked in The Ministry of Machine - building Industry in the international cooperation department, and at Voss GmbH as chief representative in China. Since 1998, he was the Sales Director for Ipsen International in Shanghai.

Shuang Liu (Judy),
Finance Director

Shuang Liu (Judy) assumed the position of Finance Director in SECO/WARWICK Retech. She has more than 10 years working experience in multi-national companies. Majoring in auditing at the Tianjin University of Finance and Economics, she earned a Bachelor Degree. She recently obtained Part II of the ACCA certificate. During her career, Judy gained experience working with the China GAAP, IFRS and best practices for finance working as Finance Manager or Chief Accountant for such companies like: Rool (Tianjin) Steel-Parts Co., Turbomeca (Tianjin) Helicopter Engines. Co., Ltd, NNE Pharmaplan (Tianjin), Tamfelt-GMCC(Tianjin) Paper Machine Clothing Co., LTD.

Technology which challenges conventional case hardening methods...

The UniCase Master® (UCM) is a new approach to reduce the distortion of gears in continuous production that challenges conventional case hardening methods with a single flow, precision case hardening system for high volume manufacturing. Learn more about the process by viewing this video interview with SECO/WARWICK Global Vice President, Maciej Korecki.

play movie

As featured in the Fall/Winter 2015 issue of *Thermal Processing* magazine

Figure 1: Nitrocarburizing system consisting of six retort-style batch furnaces

Nitrocarburizing Gears Using the ZeroFlow Method in Large-Volume Production

By Mark Hemsath, Leszek Maldzinski, Tomasz Przygonski, and Maciej Korecki

Reliable furnace equipment design and innovative ZeroFlow control offers heat treating with lower gas consumption and the lowest emissions in gas nitriding and ferritic nitrocarburizing.

Retort-based nitriding and ferritic nitrocarburizing have been around a long time. Modern day challenges include providing known, repeatable hardness and surface case structures with the lowest possible investment and cost. While combining these factors may be difficult for equipment manufacturers, experience in designing equipment for challenging applications helps ensure meeting customer requirements. Here is a detailed look at Seco/Warwick's use of advanced automation, ZeroFlow control technique, and reliable furnace equipment designs for the production of gears for diesel engines used in trucks, buses, construction machines, boats, and other industrial applications.

AUTOMATED, HIGH-VOLUME SYSTEM DESIGN

Seco/Warwick supplied nitrocarburizing technology using its ZeroFlow method in 2013 (Figure 1) for an automated thermal treatment line for the production of a variety of gears. The line consisted of six large, front-loaded retort-style batch furnaces, a four-chamber vacuum washer, two furnaces for pre-activation in air, additional post cooling of the furnace charges, and an automatic robotic loader/unloader, which ensured charge transport within the system (Figure 2). The automated line also included safety monitoring. System work-space dimensions were 32 inches wide x 32 inches high x 60 inches long with a gross workload capacity of 4,400 pounds, which enabled a production rate of more than 2,000 pounds of gears per hour. Good equipment design and use of ZeroFlow control technology resulted in a successful project.

DESIGN FEATURES

ZeroFlow control technology enables precise control of the nitrocarburizing process, while using a minimum amount of ammonia. The carbon-carrier medium in this instance comes from methanol. Endothermic atmosphere, methane, propane, CO, and CO_2 are some other gases used for nitrocarburizing.

Historically, most gas nitriding (or nitrocarburizing) has been performed in a retort-style chamber. This enables holding the ammonia at an elevated temperature and controlling its release only via a controlled exhaust. Seco/Warwick has decades of experience with these retort systems, including horizontal retorts, vertical pit retorts, and bell-type vertical retorts. All of these furnaces have common design elements, such as a high nickel-content alloy retort to reliably contain the ammonia atmosphere at an elevated temperature without leaking. The retort must also provide a long service life and withstand detrimental gases and temperature cycling as well as continual thermal expansion and contraction. Another common feature in these systems is recirculation fans that mix the atmosphere and provide convection to assist with heating the load.

Vacuum purging is an optional feature to cut cycle time, save gases, and offer additional flexibility, which makes system tightness even more critical and design even more complex. Both horizontal and vertical loading systems can use vacuum purging.

ROLE OF CONVECTION

Gas nitriding (and the related nitrocarburizing) is a complex process. While there have been many process advancements in this area over the years, the combination of various gas reactions and understanding equipment design still present a challenge. Convection plays a significant role in nitriding and nitrocarburizing.

Using dense workloads is the most cost-effective way to heat treat. Getting the workload up to temperature is important, but because gas nitriding is a fairly low temperature process (below 600°C), radiation does not play a significant role in heating a dense load. Also, because nitriding reactions at the metal surface are temperature dependent, all parts must be at the same temperature so that they have the same time-temperature history. This requirement makes equipment design critical. Figure 3 shows a typical flow schematic of a convection system performing well. The equipment designer must make trade-offs between cost, performance, productivity, and quality. However, for gas nitriding, it is not practical to take shortcuts in design for proper convection. Therefore, a fan is not only used for mixing, but it is also used to guide flow to maximize heat transfer from the heated retort walls to the entire load in a uniform manner.

MIXING GASES IN THE LOAD

Dense loads also require aggressive mixing of the gases to maintain nitriding and carbon potentials at the surface of the metals at the required levels [1]. Systems with only a mixing fan are not as effective. As hot gases react with the metal surfaces, their compositions change. Therefore, proper, aggressive mixing within the workload is crucial.

ZeroFlow control senses the changes in overall gas composition and efficiently adjusts the nitriding potential. It is important to have a means to continuously measure the variation in nitriding potential at the sample point in the furnace using a gas-analysis system and make automatic adjustments. Proper convection and mixing ensures that the sample point sees the change in nitriding potential quickly and makes timely adjustments to the gas mixture. It is crucial that the sample point accurately reads the condition of the gases because it is necessary to adjust the nitriding potential at the part surface during heat treating. Ammonia dissociates during the metal surface reactions, and nitrogen (as well as carbon in the case of nitrocarburizing) diffuses into the steel. So, a fresh atmosphere with the correct nitriding potential must be available at the surface. Precise layer control has been demonstrated, especially in the longer second stage transport mechanism, under ZeroFlow adjustment.

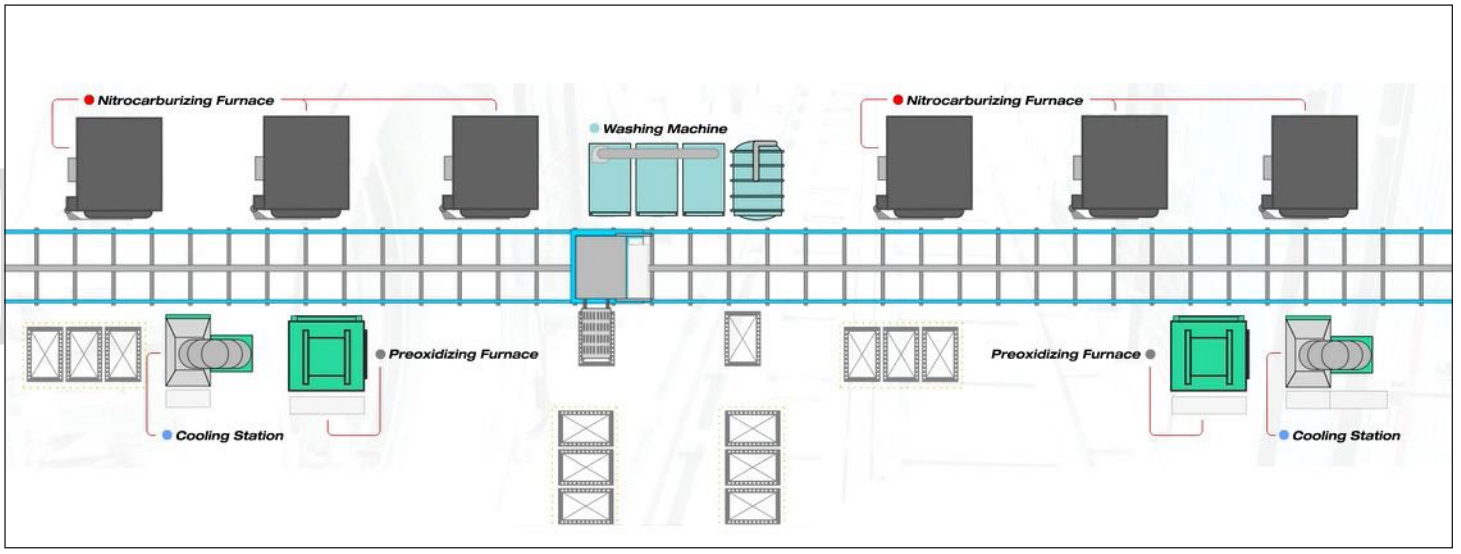
Significantly, ZeroFlow control simplifies managing the nitriding process. The control system manages the correct parameters to deliver repeatable results regardless of the workload size (small, light load or heavy, densely packed load).

With ZeroFlow, only a single gas (raw ammonia) is used. Calculations of how to add a carrier gas, required in older-style systems using nitrogen or dissociated ammonia two-part gases, are not required (see Reference [4] for a discussion of nitriding processes). The simplicity means that no extensive support from the furnace supplier is required to properly nitride, and recipes become repeatable, regardless of load size.

ZEROFLOW CONTROL SAVES GAS AND REDUCES EMISSIONS

Over the years, much has been learned about nitriding (and nitrocarburizing), mainly that nitriding potential must be adjustable to control various reaction kinetics that occur at the steel surface. To control and "mold" the desired nitrogen transport into the steel, methods were developed to adjust or maintain the nitriding potential, which is always changing if no control method is used. Initially, dissociated ammonia (75-percent hydrogen and 25-percent nitrogen) was used [2] and its percentage adjusted together with simultaneously flowing raw ammonia gas into the retort. As nitrogen became less expensive, only nitrogen was flowed with raw ammonia gas as a dilu-

Figure 2: Schematic of nitrocarburizing system



tion method to adjust nitriding potential [3]. These processes worked (although they created a more complex non-equilibrium process), and the extra gases used were not a major concern. Today, using extra process gas is a concern and is an added expense.

Use of less ammonia means less storage and less ammonia emissions as well. Seco/Warwick's advanced systems offer less gas use, lower emissions, good convection design, and high-quality construction. A retort-based system also offers options to add cooling and to use vacuum to speed purging air and save on using expensive gases.

COOLING THE LOAD AND VACUUM PURGING

Vacuum provides a method to purge air at the beginning and end of the cycle. Seco/Warwick developed options to speed the cycle via cooling options. The vacuum-purging option is often chosen to save time and further reduce gas consumption and emissions. Retort and system design are important to allow for constant vacuum pressures. Many factors go into keeping retorts leak-free, but mainly correct alloy selection, allowance in the design for continual thermal cycling, and proper design to support the heavy gross load. The retort also commonly supports the load, further complicating the design. Seco/Warwick designed horizontal and vertical loading retorts that handle fairly heavy loads, allow for thermal expansion, and provide long service life.

Cold air added to the outside of the retort cools not only the retort, but also the furnace portion (elements, insulation, etc.) outside of the retort. This, in turn, cools the load via high convection flows inside the retort, removing heat from the workload and transferring it to the retort walls to be cooled indirectly. While this cooling method is good without the use of water, production can be further improved by directly cooling the hot gases, such as by Seco/Warwick's turbo cooler — an external heat exchanger. This system uses a high-volume fan enclosed in a pressure-tight system to remove hot gases from the retort, pass them through a high-efficiency heat exchanger, and return cold gases to the retort. Heat exchangers are typically water-cooled bundles of finned tubing, such as those used with vacuum quenching cooling systems. The result is an approximate 50-percent reduction in the cooling times, depending on the desired heat removal. In the end, the system is ready faster for the next load to be heat treated, yielding higher production rates.

CASE HISTORY: PROCESS AND RESULTS

The system referred to in Figures 1 and 2 went online in 2014 and is currently operating at full capacity, while meeting the stringent requirements of the automotive industry. It achieved the planned production goal of 1 million gears per year with 99-percent process reliability and 98-percent equipment availability. It has worked continuously with one maintenance break a year. Heat-treated parts meet specification requirements in terms of thickness and hardness of the nitrocarburized layer, structure of the compound layer, and porosity. No deficient gears were found during normal operation. Moreover, fatigue properties improved by about 50 percent (Figures 6 and 7). The heat treating line also achieved desired operation parameters including an 80-percent reduction in the consumption of ammonia from that consumed using the previous method to nitrocarburize (from 160 metric tons per year to 20 metric tons per year). At the same time, only 1 m^3 of methanol is used as the carbon source in exchange for the total elimination of fuel and process gases (methane and propane). The unit cost of heat treatment using the system was reduced significantly by going to an automated batch cell versus a continuous furnace method. This modern heat treating system plus ZeroFlow control also eliminated any environmental, safety-related, and emission of hazardous gases (NOx) issues.

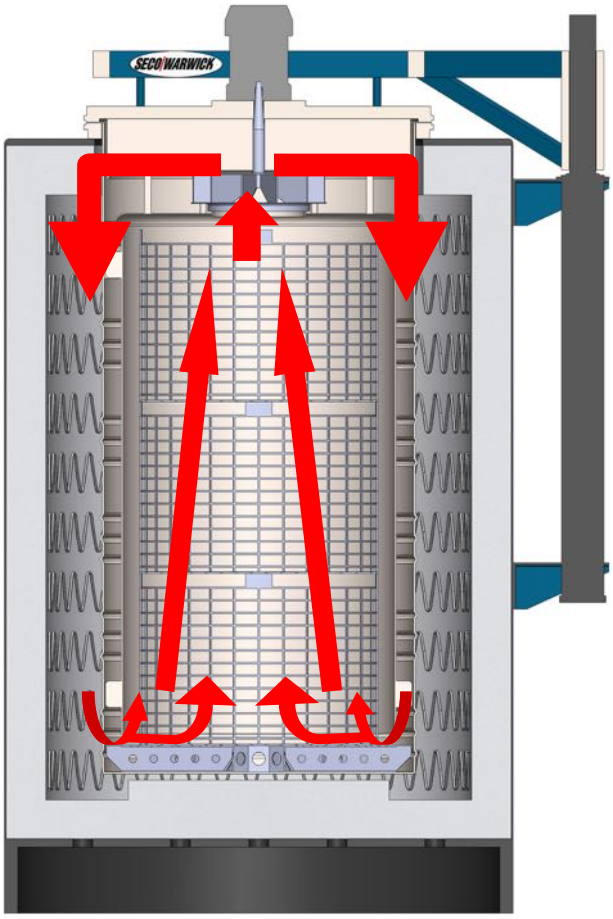


Figure 3: Schematic of pit-type retort nitrider showing gas convection flows

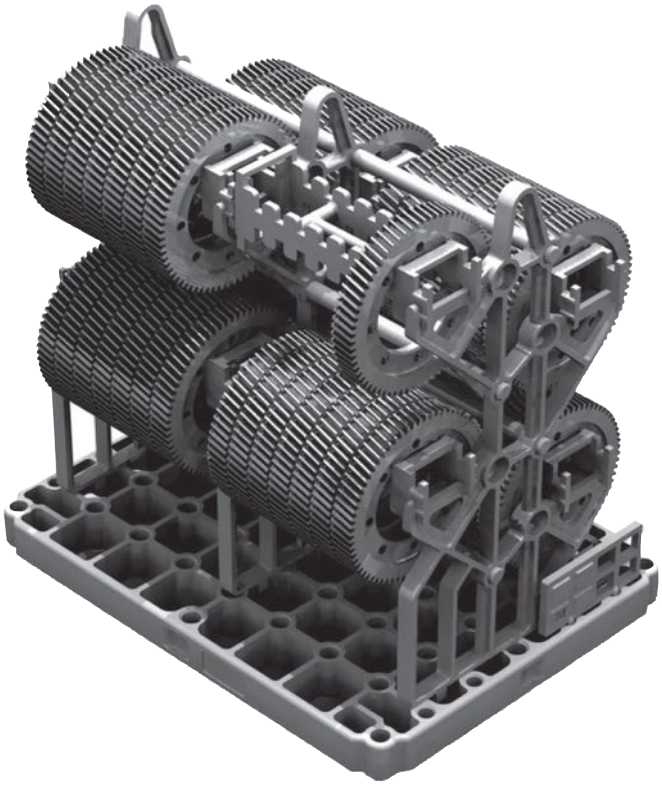


Figure 4: Gears for ferritic nitrocarburizing

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ABOUT THE AUTHORS: Mark Hemsath is the Thermal Group general manager at Seco/Warwick Corp. in Meadville, Pennsylvania. With 30 years of experience in the industrial furnace and heat treat equipment market, he is in charge of all North American atmosphere furnace sales and production.

Leszek Maldzinski, a professor at Poznan Technical University in Poland, has an extensive background in nitriding of steels and serves as science adviser to Seco/Warwick Europe SA. He developed the ZeroFlow concept, which has been implemented in industrial plants all over the world, and he is regarded as one of the leading experts on gas nitriding of steels in the world. He received the Medal of Tadeusz Sendzimir and the Golden Cross of Merit given by the President of the Republic of Poland.

Tomasz Przygonski is the director of Nitriding and Carburizing for Seco/Warwick Europe SA. He has spearheaded the development and commercialization of Seco/Warwick's nitriding and carburizing equipment for over a decade.

Maciej Korecki is the vice president of the Seco/Warwick Group for global vacuum heat treatment equipment and technology. He joined Seco/Warwick in 1991 and served as director of Research and Development from 2005 to 2009 and as director of the Vacuum team in Europe from 2009 to 2011. Dr. Korecki authored numerous international patents on behalf of the company, and he regularly presents technical papers at international conferences on a variety of topics specializing in vacuum furnace technology.

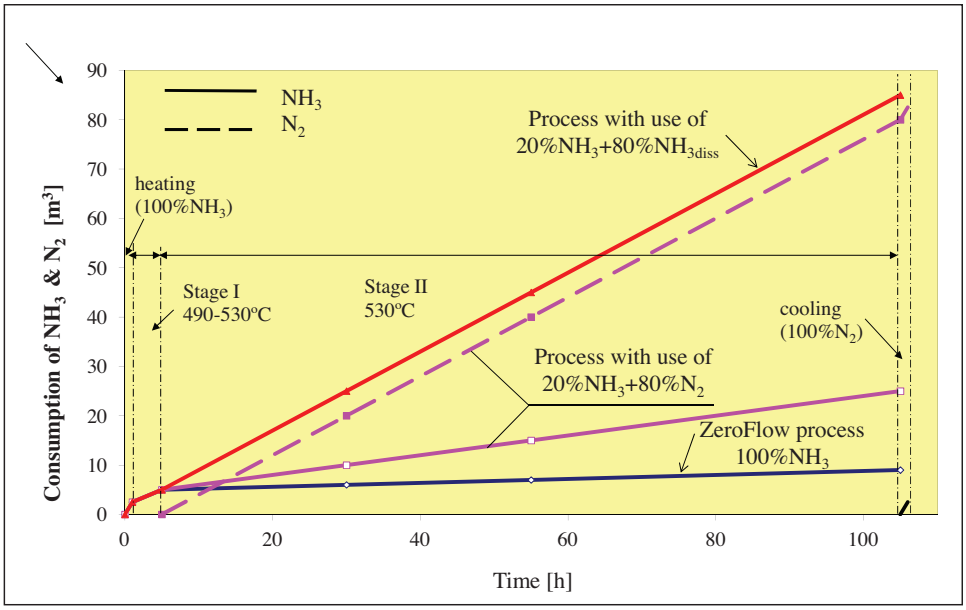


Figure 5: Process-gas consumption for nitriding at 530°C and creating a gamma prime + alpha (γ' + α) layer

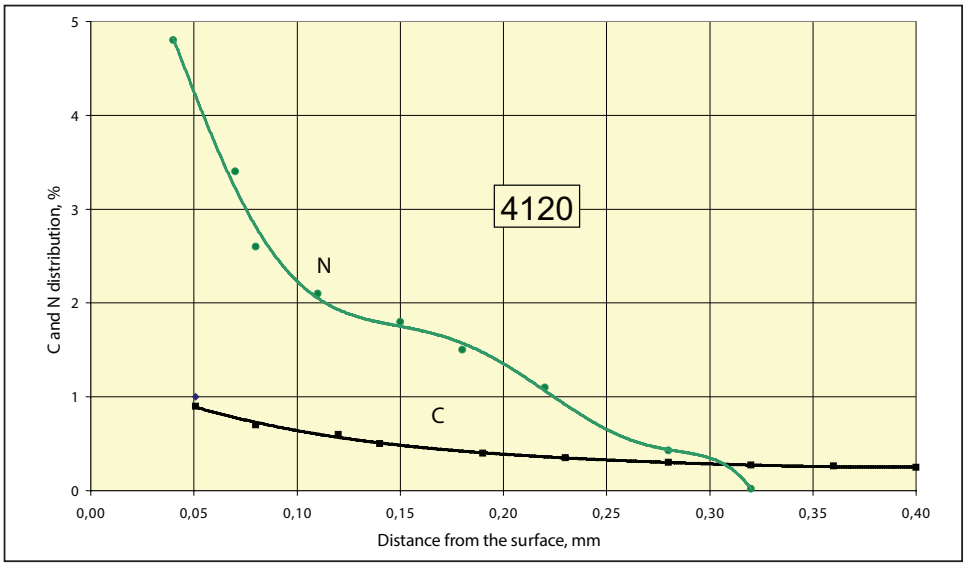


Figure 6: Nitrogen and carbon diffusion at the surface in 4120 alloy steel

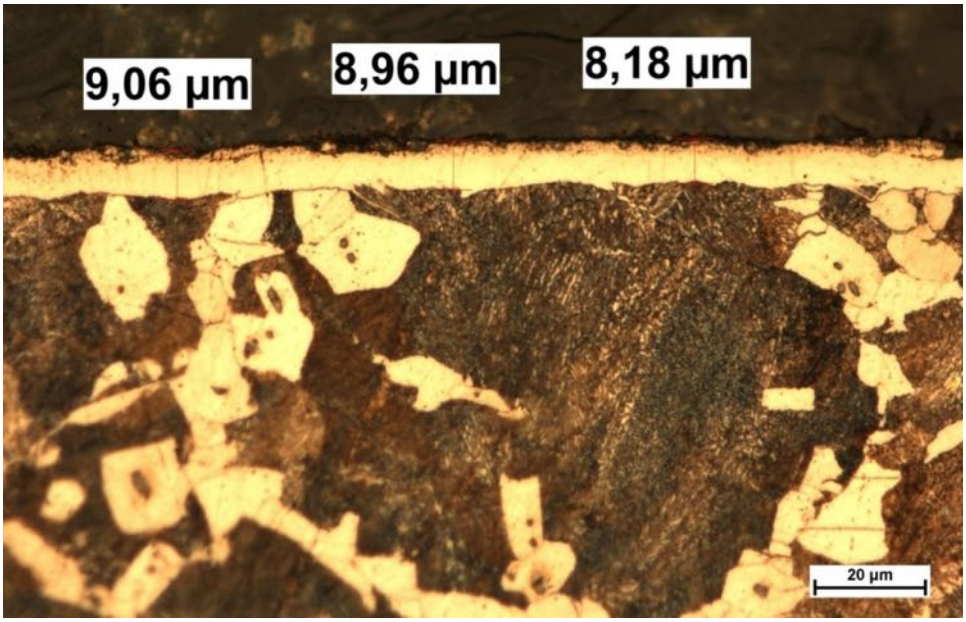


Figure 7: Microstructure of case in nitrocarburized 4120 alloy steel

Bell Furnace System Improves Material Handling and Energy Savings

Kangaro Industries Expands Plant capacity with Bell Furnace System from SECO/WARWICK Allied, India

The Indian division of SECO/WARWICK GROUP has recently secured an order from Kangaro Industries Ltd., Ludhiana for a Bell Annealing Furnace system for staple wires. The new order is a part of Kangaro expansion plan to increase their current wire annealing production capacity and includes two bases with accessories, one bell and one cooling hood. Each new base is designed for 20 metric tons (44,000 pounds) annealing capacity, with nitrogen as the process atmosphere.

Mr. R.G Gupta - Vice President, Kangaro Industries Ltd. expressed, "Our experience working with SECO/WARWICK Allied for our first Bell Annealing Furnace installation for wires in Ludhiana was extremely positive. We could achieve the quality and performance set from the installation resulting in our decision to go with them again for the expansion of our annealing capacity. This time, our expectation is to make the furnace more productive and more economical with respect to the running cost."

SECO/WARWICK Allied Managing Director, Milind Kulkarni commented, "Kangaro Industries is our valued customer-partner in India. We are proud to continue to deliver practical, reliable solutions for our customers that enable them to realize savings in both capital costs and energy consumption while increasing their production capacity."

The Bell furnace offered by SECO/WARWICK is technologically advanced with a specially designed horizontal axis spool multi-stack loading arrangement for wire annealing. The new furnace will have a 20% higher production rating, and will be more economical in terms of energy consumption by utilizing pulse firing technology for the heating system. Installation and commissioning are scheduled at the end of February 2016, with commercial production beginning in March 2016.

Kangaro Industries

Kangaro Industries is a well-known manufacturer & exporter of various stationary products such as staplers, staples, staple removers, paper punches, scissors, carbon papers, gun tackers, pneumatic tools and industrial staples. Learn more at www.kangarokanin.com.

SECO/WARWICK Bell Furnace Systems

SECO/WARWICK Bell Furnaces are known for superior circulation of the inert atmosphere, very good temperature uniformity within the charge, uniform mechanical properties and higher productivity.
SECO/WARWICK Bell Furnaces offer a high quality, reliable solution to wire manufacturers for annealing a higher volume (charge weight) of wire spools / wire coils per batch with excellent mechanical properties and quality. This type of equipment is particularly suited to fastener manufacturing, the bearing industry & other general engineering applications.

Titanium-Aluminide Production

Titanium Aluminides are finding expanded applications in both the aerospace and automotive markets.

Titanium Aluminides are finding expanded applications in both the aerospace and automotive markets. However, this demand has also highlighted many of the issues associated with the production of these alloys, not least of which being material segregation and shrinkage porosity. These are especially prevalent in the production of small diameter round bars used as casting and forging stock. Further contributing to these difficulties, melting systems and the accompanying processes are based on historical context whereby multiple vacuum arc remelt (VAR) steps are performed using compacted electrodes. Needless to say, this is problematic at best and doesn't really solve the underlying issues with the alloy or the cost drivers for production.

Beginning in 2011, Retech Systems, with Ti-Solutions in Bremen, Germany, worked to develop an advanced process to allow for production of small diameter, homogeneous bars in lengths up to 1.2 meters using a plasma arc melting (PAM) system. Specifically directed to demand in automotive and aerospace markets, this work has successfully yielded consistent chemistry, homogeneity, fine grain structure, >99% density and, for some applications, without the need for subsequent VAR or hot isostatic press (HIP) cycles. Additionally, this development work had to be done in a manner that provided not just a technical solution, but real economies of production that included a focus on a commercialize-able processes & products as the end result.

Background:

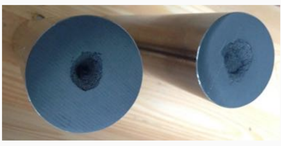
As a result of environmental concerns, new legislation has specifically been aimed at improving performance efficiencies in automobiles as well as aircraft. Titanium Aluminides are consistently finding new uses whereby they provide improved fuel economies through lower mass and enhanced properties. Less mass is specifically important in aerospace where, in some instances it has been suggested that saving 1 lb. in a jet engine can save 4 lbs. in the airframe. Additional performance gains are being realized through lower rotational forces combined with higher rpms. The base Titanium-Aluminide (TiAl) materials we are familiar with, 48-2-2 as an example, are being supplanted by improved alloys tailored to specific applications. Our development has centered on a couple of these; the TNM & RNT family of gamma-Ti alloys.

The Aluminum (Al) content in the gamma-Ti alloy is higher than Ti 6-4, meaning a 10% base mass savings for the same 6-4 volume, 50% mass improvement compared to commonly used Nickel-based alloys, as well as improved high temperature performance and resistance to oxidation. However, that comes with some challenges.

As a result, new techniques really have had to be developed to address the ever more complex designs being incorporated into modern vehicles. Significant attention has been paid to addressing the homogeneity & density issues that have been endemic in much of the currently available material. Further, due to the focus on making the production commercially viable, a cost comparison to those target application materials, such as those Nickel alloys, has been imperative. Finally, downstream demand and time constraints meant theses very specific alloys had to be the focus areas of development for our team.

Challenges:

Conventional methods of alloy production are firmly based on a historical model for larger batches of different Titanium alloys. In such a process, loose feed material is blended and compacted into on-chemistry electrodes and then run through two vacuum arc remelting cycles to produce an ingot which would then subsequently be put through a consumable caster and turned into bars before going to be cast or, alternatively, HIP'd, forged & machined. As can be expected, melting the material three times is expensive, time consuming and has been shown to be a source of inclusions. Further, typical ingots have contained center-line shrinkage, which is well illustrated here, along with significant stratification of elements.



Despite these shortcomings, the process has yielded a useable product. However, it hasn't thus far guaranteed homogeneity, density or been cost effective. As a result, new melting techniques are required to bring down production costs while ensuring quality standards.

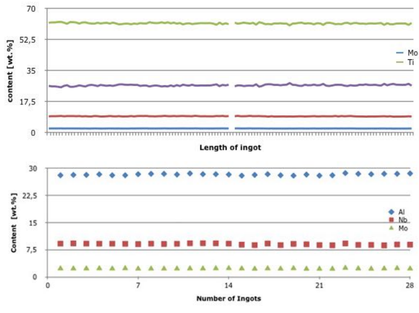
Method:

The Retech / Ti-Solutions team approached this task with very specific goals. The first was a focus on small diameter bar production had to the greatest number of application opportunities as use in forgings, casting and atomization. Second was simple determination that a reduction in the amount of melting steps would be a simple way to bring down costs while also minimizing the proportion of yield losses. Thirdly, elimination of as many of the common issues seen in the conventional production processes would need to be resolved. These include shrinkage porosity, non-homogeneity, thermal stress, poor surface finish and limitations to bar lengths. Finally, we had to embrace the concept of a short development cycle given market growth and application development, industry wide. In essence, we gave ourselves 3 years to get this done. The result is something we call Gamma-PAM (γ-PAM).

Gamma-PAM:

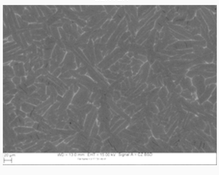
First and foremost, the upstream material is still blended and compacted, however, it is melted just once using a plasma arc melting system. Despite the removal of two traditional melting steps, this process yields > 99% dense, small diameter bars, in this case approx. 2", all while maintaining the alloy homogeneity. Combined with a copper hearth, we further ensure thorough heating without concern for inclusions. Of further interest, the as-cast surface finishes on these ingots has been shown to be easily removed through machining, but as a result of the process, it isn't necessary for forgings. Meaning, this material can be used as-is, or as-cast.

Chemical analysis has shown the produced alloys to be homogeneous not just across the entire length of ingots with 0.2% deviation in Al content, but also consistent between different batches, thus proving the process repeatability.

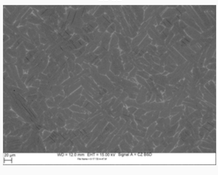


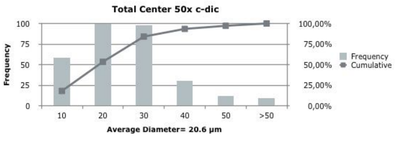
Further microstructure analysis has been shown to be clear and consistent between edge and center sections.

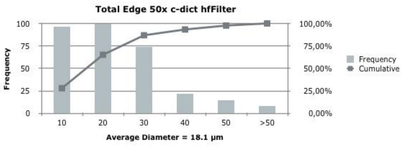
CENTER



EDGE







The pilot scale system installed, at Retech in California, was used for process proof and production of gamma TiAl ingots of up to 1.2 meters (~46 in.) as well as economic model testing. Of course the next step is the determination as to the final configuration of a commercial-scale plasma system in order to address the industry needs at a marketable price. Initially, from our perspective, such a system would probably be able to melt something just south of 200 tons per year and consist of a 2-plasma torch melter pouring into a single mold.

Conclusions:

The simple take away is the idea that it is possible to produce small diameter ingots of gamma-TiAl alloys which are homogenous; which are >99% dense; and actually do meet the density microstructure as well as chemical specifications for automotive and aerospace applications without much, if any, subsequent processing. Further, and maybe most importantly, it is possible to do this in a way that's, in fact, cost effective and could reasonably aid in pushing the use of these alloys throughout a range of industries and markets. This last point has been shown to be valid on the pilot scale and therefore, should be likewise achievable in larger, commercial-scale systems.

Mexican story about the continuous CAB FUrnace System

Mexican story about the continuous CAB line

Carlos Barahona and Jorge Gorocica, both of Air Temp de Mexico (Air Temp), traveled to Mexico with SECO/WARWICK Corp. Controlled Atmosphere Brazing (CAB) Team Leader, Mike Jacobs, to kick off a new furnace installation project that has a long and interesting history.

The story starts over two years ago when Air Temp decided to purchase continuous CAB line for their new Pueblo, Mexico, facility. For some reason, Air Temp, who already had two convection SECO/WARWICK CAB units in their Merida, Mexico facility, decided to purchase the Pueblo system from another company.

From left 沙 楠(Jacky), SECO/WARWICK Retech; Carlos Barahona, Air Temp Director of Operations; Jorge Gorocica, Air Temp Engineering Director; Slawek Wozniak, SECO/WARWICK Retech MD; Mike Jacobs, SECO/WARWICK Corp.

Unfortunately for Air Temp, that non-SECO/WARWICK CAB system did not work so well. In fact, there were problems getting the unit up and running from the start.

Enter Joe Reitinger, CAB field service representative for SECO/WARWICK. Joe was dispatched to fix the other companies furnace when that company could not get the final sign off. Air Temp was in trouble, and SECO/WARWICK was willing to help. Joe finally got the other company's equipment up and running and Air Temp was very happy.

When it was time for Air Temp to purchase yet another continuous CAB unit, they called Joe and SECO/WARWICK to renew a valued, long-standing relationship.

Such was the case when Mr. Barahona and Mr. Gorocica visited the SECO/WARWICK plant in China. They were attending a kick off meeting for their most recently purchased continuous CAB furnace with SECO/WARWICK's global CAB team, currently scheduled to ship to Mexico in Q2 of 2016.

According to Mr. Gorocica and Mr. Barahona, "We selected SECO/WARWICK because they provide the critical service we needed to keep our plant running efficiently." According to SECO/WARWICK's Mike Jacobs, "This project is the result of our global team working together

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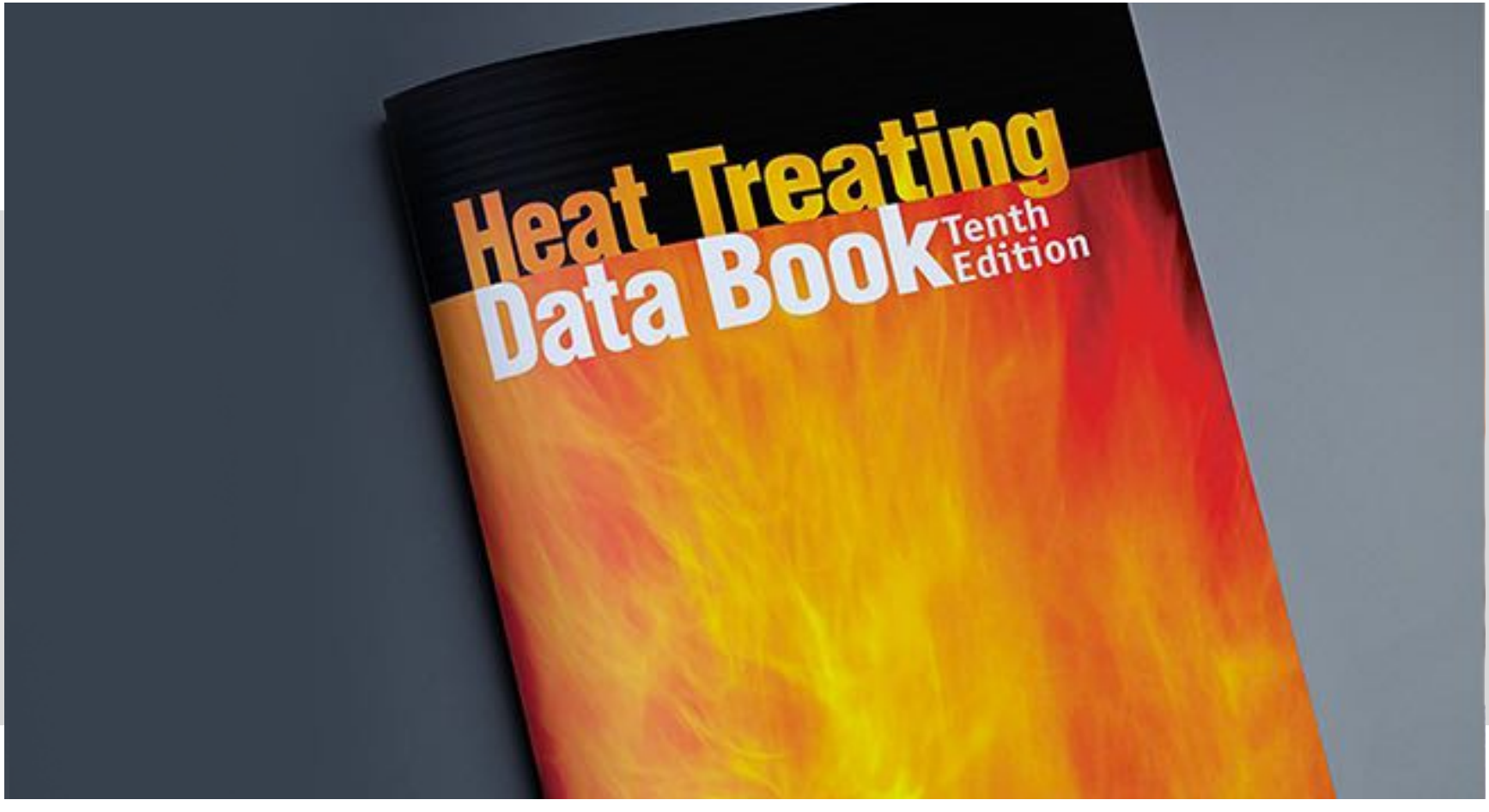

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