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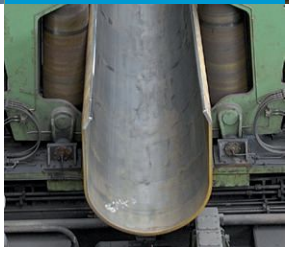

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On the Cover: A work associate positions a heated billet onto the die of a 35,000-pound hammer.

EDITORIAL

Dean M. Peters

Let's Complete Keystone XL Pipeline

When it comes to U.S. energy policy, I am as big a fan as anyone in weaning ourselves from the frenzied feeding at the udder of big oil. Anybody around during the Carter administration can hardly forget the images of long gas lines during the fuel shortages of the late 1970s. As a nation, dependence on oil to run our cars, trucks, buses, trains, planes and ships has eased a bit, but oil still dominates. The U.S. industrial sector, though more energy-diverse than transportation, still depends significantly on oil

The domestic energy profile in 2012 was such that we consumed 95 quadrillion BTUs of energy. Petroleum is still our largest energy source at 37% of that total; natural gas 28%; coal 18%; renewables (including hydropower, wood and waste biomass, biofuels, wind, geothermal, solar and photovoltaics) 9%; and nuclear 8%. The good news is that domestic consumption of renewable energy forms has increased by about 33% in the last five years. The other good news is that our consumption of petroleum has fallen by 12% during the same period.

The bad news, however, is that petroleum remains king of our energy matrix. We still use more of it than any other energy source, and if we combine it with other fossil fuels like natural gas and coal they account for 83% of our energy consumption. Massive changes in the energy mix occur only slowly, so it is my opinion that any enterprise that keeps the U.S. in the global petroleum supply-and-demand equation is worth pursuing.

This brings me to the controversial, proposed Keystone XL pipeline project as an extension of the existing Keystone Pipeline System, which runs from Alberta, Canada, to U.S. refineries in Nebraska, Illinois and Texas. The extension would consist of a 36-inch pipeline running from Hardisty, Alberta, through Montana and South Dakota to Steele City, Neb. It would transport up to 830,000 barrels per day of crude oil from the Western Canadian Sedimentary Basin in Alberta and from the Williston Basin (Bakken) region in Montana and North Dakota to refineries on the Gulf Coast of Texas.

The Keystone XL project has faced opposition from environmental groups and some members of Congress. Since the pipeline extension crosses an international border it must get administration approval from President Obama to proceed. In January 2012, the Obama Administration (favoring its environmental base) rejected the proposal, citing the potential impact on Nebraska's environmentally sensitive Sand Hills region. This led TransCanada Corporation to re-route the proposed pipeline to minimize its environmental impact. This re-routing, incidentally, was approved by Nebraska Governor Dave Heineman in January 2013.

We respect the environmental lobby's position on this project. We also acknowledge its right to *shape* policy, as it already has, but not to *dictate* it. It is understood that pipelines aren't perfect and that accidents or spills can and will happen. That hasn't stopped us yet, nor should it now. The truth of it is the Keystone XL extension will create numerous American jobs and won't fan perdition's flames, as the environmentalists will have us believe.

President Obama has ducked this issue through his first term and re-election campaign, but now it is time for him to let this project proceed.

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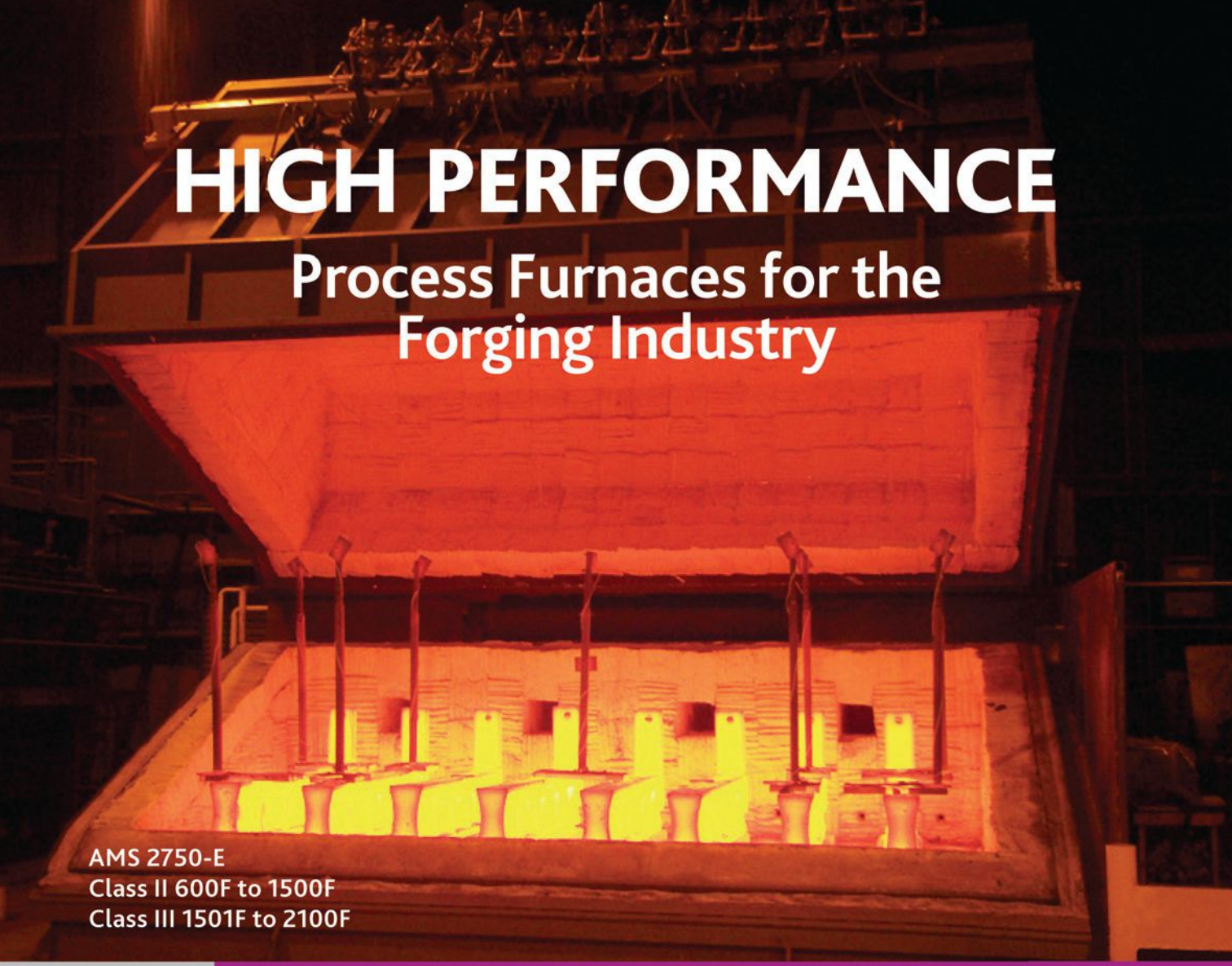

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FIA'S PUBLIC POLICY WATCH

Laurin M. Baker

Tax Reform, EPA Rules and Union Elections

The weather may not be heating up, but issues in Washington sure are.

Comprehensive tax reform has returned to the headlines, the EPA is attempting to regulate greenhouse gases (GHG) using the Clean Air Act (for which it was never intended) and the reconstituted National Labor Relations Board (NLRB) has filed new proposals allowing for "ambush elections" by unions seeking to organize workers. Forgers are potentially impacted by all of these.

After a few months in which tax reform seemed to fade from view, House Ways and Means Chairman Dave Camp (R-MI) jumpstarted the debate again in late February by introducing his long-rumored draft legislation. True to his word, the proposal is comprehensive and bold, and it is sure to draw fire from entrenched interests. Highlights of the proposal are:

- Individual tax brackets are compressed into three – 10%, 25% and 35% for income above $400,000 for individuals or $450,000 for joint filers.
- The corporate rate is 25%, and income from domestic manufacturing is taxed at 25% *regardless of business structure* (S corps, LLCs, other pass-throughs).
- The Alternative Minimum Tax (AMT) is repealed for all taxpayers.
- The R&D tax credit is made permanent at 15% but in a simplified form.
- Last-In, First-Out (LIFO) accounting for inventory is repealed beginning in 2015, but businesses would be allowed to phase in reporting of LIFO reserves as income as follows:
  - Businesses can begin in 2015 but can delay reporting until 2019.
  - The phase-in period is four years.
  - Businesses would report 10% of LIFO reserves in year one; 15% in year two; 25% in year three; and 50% in year four.
  - LIFO reserves would be taxed at 25% rate in the year reported, except that "closely held entities" (those with fewer than 100 owners) would be taxed at 7%.
- The current mortgage interest deduction cap of $1 million would remain in place for all existing loans and refinanced loans prior to 2018, but new loans after that would have a mortgage interest deduction cap of $500,000.

Few observers expect this draft to become law this year, and any tax-reform proposal will certainly undergo substantial changes before it reaches the President's desk. However, it is clear that Rep. Camp has set the floor for debate on tax reform for the foreseeable future

The Forging Industry Association (FIA) has been communicating with members of Congress for the past several years to make sure that the concerns of the forging industry were understood. Now that the draft proposal has been released, FIA will be analyzing it thoroughly in anticipation of its Annual Lobby Day in Washington on April 2-3 to make sure members of Congress understand what works and what doesn't.

Meanwhile, the EPA's proposals to regulate GHGs under the Clean Air Act are moving forward. The first proposal would regulate GHGs from new power plants and would likely prohibit construction of new coal-fired plants. That will surely drive up energy costs across the board, particularly for energy-intensive industries such as steel manufacturing and forging. And as if that weren't enough, the EPA has already announced that its next proposal would regulate GHGs from existing power plants and that it is "looking at" extending such regulations to other industries.

Forgers would be particularly hard hit if these proposals are implemented because of both the higher cost of energy to run forge shops and the increased cost of raw materials such as steel and aluminum. FIA is part of a coalition opposing these heavy-handed regulatory schemes by the EPA, and this issue will also be on our list to discuss with Congress in April.

Finally, to the surprise of no one, the new NLRB has moved rapidly to reintroduce the over-reaching proposals that had previously been rejected either by Congress or by the courts. Notably, the NLRB reissued the so-called "ambush election" rule on Feb. 5. This rule, if adopted, would allow union elections to be held in as few as 10 days after the employer is notified of a unionization effort. Business interests have described this as "card check" via the back door, since Congress has refused to enact the union-backed Employee Free Choice Act (EFCA). FIA has been active in opposing EFCA in Congress, as well as other regulatory over-reach by the NLRB.

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NEWS
Affecting the Forging Industry

Superior Forge & Steel Settles with EPA

The U.S. Environmental Protection Agency (EPA) announced in January 2014 that Superior Forge & Steel Corp. (SF&S), with Pennsylvania plants in New Castle and Pittsburgh, will pay a $61,673 fine as a result of allegations of violations related to the reporting of toxic chemical requirements. Alleged violations occurred in 2010 and 2011 at the New Castle facility and 2011 at the Pittsburgh facility. The EPA alleged the company violated the Emergency Planning and Community Right-to-Know Act (EPCRA), a federal law designed to inform the public and emergency responders about hazardous and toxic chemicals in their communities. SF&S did not admit liability for the violations as part of the settlement.

VSMPO-AVISMA Orders Forging and Ring-Rolling Line

VSMPO-AVISMA of Yekaterinburg, Russia, placed an order with Germany's SMS Meer for a ring-rolling line that will be used in the production of large-OD titanium jet-engine rings from titanium alloys. A combined forging and ring-rolling process will be employed on the new line for the first time. The technology will enable VSMPO to produce rings with complex inside and outside profiles. The new line will allow the company to expand its product offerings to the aerospace industry and enhance its competitiveness. The line, which cuts material consumption when compared to the conventional forging process VSMPO currently uses, is scheduled to be commissioned in the first quarter of 2015.

Lehigh Heavy Forge Invests in ArcelorMittal Steelton

Lehigh Heavy Forge Corp., with its parent company WHEMCO Inc., announced an $11.5 million investment into ArcelorMittal Steelton, part of the world's leading steel and mining company. ArcelorMittal Steelton of Steelton, Pa., operates a mini-mill operation which produces up to 300-ton vacuum-poured ingots that are shipped to Lehigh in Bethlehem, Pa. Lehigh, a global leader in the production of forged steel components, subsequently forms the ingots on its 10,000-ton open-die press, creating a wide variety of products including ship shafts and pressure vessels for the defense market; pressure vessels for the commercial nuclear and petrochemical markets; generator shafts for the power-generation market; and forged-steel rolls for the flat-rolling market.

ATI Acquires Dynamic Flowform

Allegheny Technologies Inc. (ATI) acquired Dynamic Flowform Corp. The Billerica, Mass.-based company uses a precision flow-forming process to produce thin-walled components in net or near-net shapes across multiple alloy systems, including nickel-based alloys and superalloys, titanium and titanium alloys, zirconium alloys, and specialty and stainless alloys. Dynamic Flowform's major markets are aerospace and defense, and oil and gas. Its major products include airframe and jet-engine components and oil and gas drilling and completion tools. According to ATI, Dynamic Flowform is a technology leader in the manufacture of unique parts and components using the alloy systems that are core competencies of ATI.

Turkish Auto Supplier Orders Forging Line

Press manufacturer Schuler received an order, the largest ever by its forging division, from Istanbul-based Parsan Steel Forging and Machining Co. to build what would be one of the most modern forging lines in Europe. The line includes a screw press with a force of 16,000 metric tons. It will be used to produce large truck parts such as crankshafts, front axles, steering knuckles and flanges. The parts will be deburred and calibrated by two hydraulic forging presses, each with 2,500 metric tons of force. Schuler-supplied robots transport preformed parts weighing 150-250 kg (331-551 pounds) between the induction furnaces and the individual presses. The fully automated line, which is scheduled for delivery in early 2015, is approximately 70 meters (230 feet) long.

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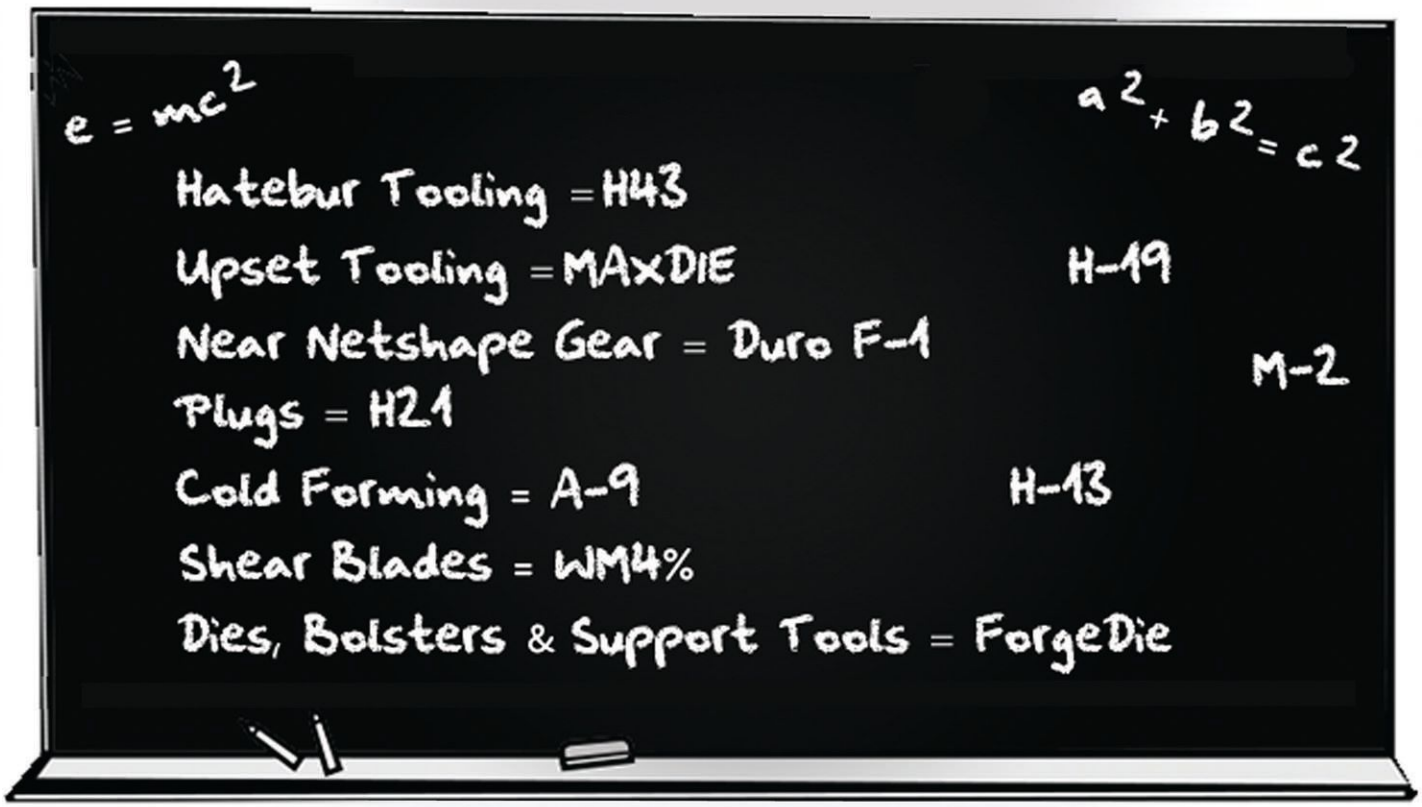

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Pacific Precision Forging Orders Cold-Forging Systems

Maschinenfabrik Sack & Kiesselbach (S&K) of Germany will install two automatic cold-forging systems at Pacific Precision Forging in Jiangsu, China. The turnkey systems are scheduled to start up in the second quarter of 2014. S&K will deliver the feeding unit, transfer system and part lubrication. The first system is an oil hydraulic transfer press model with a 600-metric-ton press force used to calibrate forged bevel gears up to a maximum OD of 70 mm at a rate of 20 parts/minute. The second system is an oil hydraulic transfer press model with a 1,250-metric-ton press force used to calibrate and coin forged synchronic gears up to a maximum OD of 140 mm at a rate of 15 parts/minute.

American Axle Announces New Business Backlog

American Axle & Manufacturing Holdings (AAM) announced that its backlog of new and incremental business launching from 2014 through 2016 is estimated at $900 million in future annual sales. This estimate is attributed to several factors, including:

- Product programs supporting new and existing Jeep and Cadillac models
- Progress on customer diversification initiatives (new orders from Chrysler Group, Daimler Truck, Ford, Honda, Nissan and others)
- Major increase in passenger car and crossover vehicle business (approximately two-thirds of backlog)
- Global market growth (approximately 70% of backlog is for programs sourced outside the U.S.)

AAM values its new and incremental business backlog based on production volume estimates and program design direction provided by its customers. The actual sales value of these awards will depend on product volumes, program launch timing and foreign currency exchange.

Ohio Star Forge Produces its Billionth Part

Earlier this month, Ohio Star Forge (OSF) of Champion, Ohio, produced its billionth part – a 3-pound automotive transmission component for a domestic automaker. The milestone part came off a new Hatebur machine installed in the 33,000-square-foot addition the company made to its facilities and started up late last year. It took 25 years of production for the company to hit the mark, though only nine years were necessary to achieve the second 500 million parts. OSF's parent company is Japan's Daido Steel.

ArcelorMittal Completes ThyssenKrupp Steel USA Deal

ArcelorMittal, together with Nippon Steel & Sumitomo Metal Corp., completed the acquisition of ThyssenKrupp Steel USA, a steel processing plant in Calvert, Ala., after receiving all the necessary regulatory approvals. The $1.55 billion deal will result in a 50/50 joint-venture partnership between the two companies. The plant has a total capacity of 5.3 million tons, including hot rolling, cold rolling, coating and finishing lines.

CALENDAR

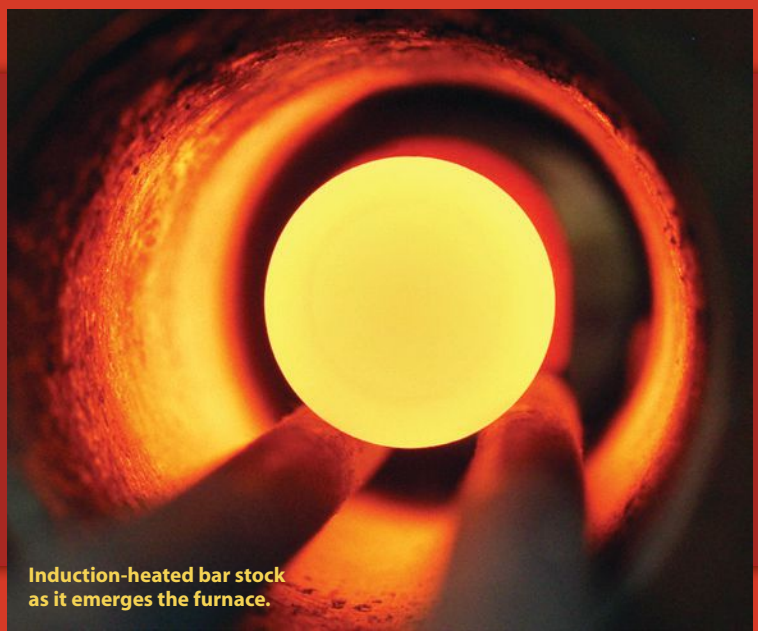
May 3-5 FIA Annual Meeting 2014, Marco Island, Fla.
www.forging.org

May 7-9 ICRF2014 (Ingot, Casting, Rolling & Forging 2nd International Conference), Milan, Italy www.aimnet.it/icrf2014.htm

June 29-July 4 IFC 2014 (21st International Forging Congress), Berlin, Germany
www.ifc2014.org

Sept. 29-Oct. 3 IFM 2014 (19th International Forgemasters Meeting), Tokyo, Japan
www.ifm2014.com

ISO 50001 Highlights Energy Savings for Forgers (part 1)



Induction-heated bar stock as it emerges the furnace.

Dirk M. Schibisch and Loïc de Vathaire – SMS Elotherm; Germany
Adapted by George Burnet – SMS Elotherm; United States

The international ISO 50001 standard puts forth ambitious goals to reduce CO_2 emissions and increase the generation of electricity from renewable energy sources. Energy-intensive manufacturing industries, such as forging, can reduce electricity costs and improve their competitive position through ISO 50001 certification. This first of two articles highlights energy savings available to energy-intensive businesses in the forging industry.

The ISO 50001 standard prescribes management-system standards to achieve continuous improvement in energy performance. It focuses on the processes within an organization to reduce CO_2 emissions, energy costs and other environmental impacts. Global application of this standard could contribute to the efficient utilization of available energy sources and improved competitiveness. Essentially, the stated intent of ISO 50001 is improved energy efficiency, which is defined as the relationship between a plant's performance and the energy used to achieve it.

The standard defines energy-management systems to promote energy efficiency and stewardship while reducing energy costs and achieving financial benefits through compliance with statutory requirements. It encompasses all forms of energy, but this article focuses on electrical, which is the primary form of energy used in induction heating for closed-die forging.

Apparent power (S), or connected load, is the electric power being fed to an electrical consumer. It is taken from RMS values of the electrical current (I) and voltage (U), and it is made up of the actual applied active power (P) and an additional reactive power (Q_{tot}) as follows:

$$S = U \cdot I = \sqrt{P^2 + Q_{tot}^2}$$

It is not just the active power that energy-intensive businesses such as forges are interested in but also the reactive power, which is generated when the current and voltage are not in phase with each other. In Figure 1, the portion of active power is shown over the cosine of the phase angle (cos ϕ), also called the power factor. The following rule of thumb applies: A power factor cos ϕ of 0.9 roughly corresponds to "reactive power = 50% of the active power."

Active power (P) is taken from the supply network if the voltage and current have the same sign. It is fed back into this supply network as a function of the working point of the electrical consumer, either fully or in part, as reactive power (Q) when the signs are opposing. To counteract the reactive power-related losses in the network supply, larger wire sizes are required in the supply lines, together with larger generators and transformers.

Industrial electrical consumers pay for the reactive energy they use as well as the active energy they use. Therefore, it is in the interest of energy-intensive businesses to minimize the reactive power they use. Reactive-power compensation systems can be used, but a better option is working point-independent optimization of the consumer power factor cos ϕ to a constant value close to 1 (barely any reactive power) by choosing suitable circuit topologies to achieve a lasting increase in energy efficiency.

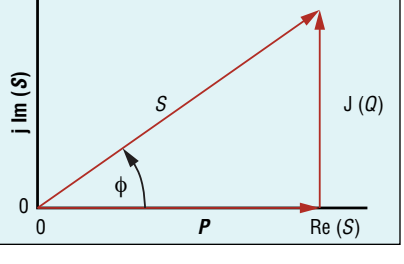


Figure 1. Correlation between active power (P), reactive power (Q), apparent power (S) and phase angle (φ).

Impact of ISO 50001 on the Forging Industry

The forging industry is one of manufacturing's most energy-intensive sectors. The proportion of energy costs relative to the industry's added value is significant. To ensure long-term survival in today's world of rising costs, plant operators would be well advised to control and optimize energy usage.

Although induction furnaces are inherently energy-efficient compared to other technologies, they account for the majority of closed-die forging energy cost. Therefore, forge operators want to ensure that their plants are making the best use of that energy. In practical terms, the following questions often arise:

- What definition of energy efficiency applies to the specific production framework?
- How and at what point is energy consumption measured?
- What influence does the product range and throughput have on energy consumption, and what opportunities does an optimum production strategy offer?

An induction-related energy audit takes into account the overall production situation, identifying the optimum machine setup and providing information on the best production sequence – from an energy point of view – for the various material dimensions. Data generated by the installed energy meter(s) are the basis for this evaluation. The induction-related energy audit also examines the induction furnace design and the components that have a lasting influence on energy consumption.

Conclusion

Work on the efficiency of induction heating has resulted in a system called iZone (see sidebar). In the next and final installment of this article we will examine the systematic efficiencies of the induction heating of forging billets and bars. Additionally, the results of an induction audit will be considered.

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iZone – Intelligent Zone Control of Forge Heating Plants

The overall concept of this system is based on zone heating control, which SMS Elotherm calls iZone. It was developed for the process control of modern induction heating plants. An integrated computer system controls the continuous heating process. Heating coils can be controlled individually, resulting in lower energy consumption rates, consistent with ISO 50001 requirements for energy savings.

The database-supported expert system automatically calculates the parameters required for the heating process to improve energy efficiency and reduce scale formation. The resulting process parameters are then transferred directly into the plant system.

The graphics function integrated into iZone safeguards the process. Using the heating curves individually generated by the operator, the system automatically calculates the process parameters and transfers these directly into the machine control system. Optimized production can then be started straight away at the push of a button.

Another advantage is the running of bars with residual heat. Until now, one had to wait until the bars cooled down to room temperature before they could be reheated to the forging temperature. iZone technology allows warm charging (i.e. the reheating of partially heated bars). For this, the warm bars are automatically transferred back to the induction heating system and the amount of energy required for through-heating is calculated and applied, saving time and energy while reducing scale formation.

SMS Elotherm uses this control system in both billet and bar heating plants and in large-scale quench-and-temper lines for heat treating long products and tubular products.

The iZone system heats circular bar stock.

Rotary Forging Celebrates a Century

Carl Lorentzen,
MJC Engineering & Technology, Inc.,
Huntington Beach, Calif.

Rotary forging is a cold-forming process invented by Edwin Elmer Slick in 1914. Slick Mills were used to form circular products such as railroad wheels and tire molds. More recently, research to further the process is being conducted at the University of Strathclyde's Advanced Forming Research Centre (AFRC) in Glasgow, Scotland. The AFRC recently commissioned and installed a rotary forging system custom-built by California-based MJC Engineering and Technology Inc.

A rotary forging machine is forming an aluminum tube. The upper spindle is initially lowered at 0-degree nutation. Once contact is made, the material extending above the lower mandrel is flared by increasing the nutation angle of the upper spindle (conical section).

Rotary forging is a cold-forming process used to forge round shapes. The process deforms a metal blank using a combination of rotation, rolling and axial compression. It is contrasted from a typical forging process (in which material is compressed to shape between two stationary dies) in that a rotary forge system works the billet between two synchronized, non-parallel (skewed) rotary dies. The skewed dies allow for compression in a concentrated area and thus afford a more efficient (smaller forces are needed) method of metal deformation while producing superior mechanical properties.

Nutation

In the 1970s, Dr. Peter Standring at The University of Nottingham in the U.K. developed an advanced rotary forging machine based on the Euler angles of rotation (nutation, precession and spin), which are used today to determine the position of a body in space, such as a satellite.

Nutation is the inclination of the Earth's axis from the vertical (the axis of tilt). Precession is the movement of the Earth's axis as it rotates around the hypothetical vertical axis. Spin is the rotation of the Earth about its own axis. The possible movements of all rotary forging machines are shown in Figure 1 and, when coupled with a simple uniaxial die closure, can be used to cause significant incremental deformation using low forces compared to other techniques of conventional metal forming.

In the early 1980s, a proprietary industrial rotary forging group was formed at The University of Nottingham. Its members included Rolls-Royce Aerospace, GKN, Ford, TI, Eaton, Timken Europe and Rover Cars. In total, the group was comprised of 22 companies from six countries. Having analyzed the process, the university obtained funding to design and build a 50-ton rotary forging machine in which the angle of the axis of a conical die could be continuously tilted during the deformation process. This "Nutation axis" was microprocessor controlled to run in either direction and at any speed within the machine range. The force advantage over conventional forging was found to be in the range 10-100 times, depending on the geometry of the part being formed. The novel kinematic tooling action could be used to form parts in bulk, sheet and tubular materials. It could also consolidate metal powders to extremely high densities impossible to obtain by any conventional technology.

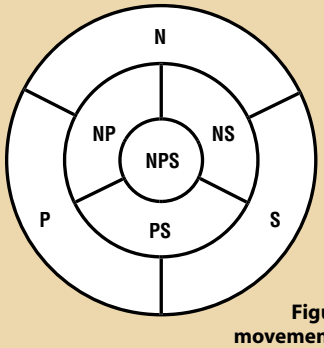

Figure 1. Diagram of the possible movements of rotary forging machines

Teamwork

More than two decades later, an aerospace engineer inquired at Nottingham if there was anyone who might be able to help him with a metal-forming problem. As a result, he stumbled across the flickering embers of the former NIROF team. Although working predominantly in the rotary forging area, they naturally developed a significant interest in the whole "family" of Incremental Deformation Processes (IDP), which includes ring rolling, spinning/flow forming, swaging and cross-wedge rolling.

Rotary-forged workpiece shows the flared edge formed by the conical die on the upper spindle.

The engineer's interest in IDPs was fired by examples of a large number of parts he was shown, of which all had been "incrementally" formed. These, together with the information on how it might be possible to form net- or near-net-shape components (for which his company paid high prices simply to machine up to 95% of it away as waste), set his mind racing. Knowing the product cost base and also having obtained contacts with people who worked in the highly specialized area of IDP, he commissioned the Nottingham team to carry out rotary forging trials on aerospace materials to see if and how they might be formed incrementally.

The key to this leap forward was the ability to move the axis of nutation during a deformation process between 0 and 45 degrees. Previously, all other machines had been mechanically limited to movement of only a few (typically two) degrees of nutation, and the rest had the nutation axis fixed during the process. The angle of nutation on most machines was less than five degrees from the vertical.

Parts and materials formed on the Nottingham NSRF machine were predominantly net- or near-net-shape automotive components of both high and low volume, ferrous and nonferrous. Global manufacturing requirements for smarter, environmentally friendly, energy-efficient and flexible output have once again thrust rotary forging into the "serious consideration" category because of what it can offer to obtain high-added-value, low-cost manufacture.

Table 1. Advantages of rotary forging

Technological	Economic
• Greater deformations • Greater dimensional accuracy: near-net-shape • Material dimension optimization: burr reduction/elimination • Greater surface finish quality (no cracks as a result of impact), incremental • Material hardening and optimized grain structure	• High flexibility – small modifications allow for new geometries • Less investment – smaller presses • Less expensive tooling – tooling geometry simplification • Fewer tooling changes • Fewer energy costs

Rotary Forging Gets a Boost in Scotland

In recent times, the U.K. government sought to retrench its manufacturing expertise around things it could do well, like high-added-value (HAV) manufacturing. The establishment of seven specialist centers around the country resulted in one relating to metal-forming based at the University of Strathclyde's Advanced Forming Research Centre (AFRC) in Glasgow, Scotland.

Starting with an aerospace agenda, the AFRC began a second-phase expansion in 2011 to double its size and extend its range of activities across other industries (automotive, oil/gas, medical). In line with this, the AFRC also sought to expand its technology portfolio to include special-purpose forging equipment, superplastic forming, flow forming and rotary forging.

History of Rotary Forging

At the turn of the 19th century, it was evident that large-diameter circular products like engine and railcar wheels were difficult to produce in the quantity and to the quality required to support railroad infrastructure. Tackling this problem, Edwin Elmer Slick was awarded the first of a series of U.S. patents in 1907 in which he addressed various design embodiments now known collectively by the term "rotary forging." By 1914, Slick had patented and began building the first of four semi-automatic systems at the Cambria Iron Works in Johnstown, Pa. The Slick Mills, as they were known, hot-formed large circular products from railway wheels to tire molds sleeve wheels to gear blanks until the last one was withdrawn from service by Bethlehem Steel in 1982.

Slick's rotary forging machines could produce one fully formed railway wheel in only 55 seconds. The machines were horizontally mounted like a lathe, and the tailstock was inclined at 10 degrees to the headstock axis, which held the wheel die. The tailstock die was a conical section, and the two dies were made to move toward each other along the workpiece axis while being simultaneously rotated about their own axes.

Slick's success in building his rotary forging machine was that he designed and made what were at the time the world's largest thrust races, which were capable of handling the eccentric loads generated by the process. It was these incrementally applied loads that worked over only a part of the face of a wheel at any time. This meant the instantaneously applied forces produced in the process were only a fraction of the forces required by a conventional forging unit working over the entire cross section.

The process remained unchallenged for producing large circular products such as sheaves, tire molds and gear blanks until the 1970s, when the technology was taken up in Japan and elsewhere as an R&D topic at a number of academic institutions. Primary among these was the work done by Dr. Peter Standring at The University of Nottingham in the U.K. He developed a classification system to define all types of rotary forging machines and used it to design and build what was, for many years, the most sophisticated rotary forging machine in the world.

The AFRC performs fundamental and applied research on the forming and forging of metals, primarily for aerospace applications.

Custom Machinery

MJC Engineering and Technology Inc. of Huntington Beach, Calif., a custom machine-tool builder specializing in metal-forming machines, teamed up with the folks at Nottingham to design and build a 200-ton-capacity machine for the AFRC. The company designed a cold-forming rotary forge press that works the material between two synchronized rotary dies that operate at an angle from the parallel. The angle is typically fixed, but it is fully programmable on this custom-designed machine. This configuration allows compression in a concentrated area and provides for more efficient metal deformation, while producing superior mechanical properties in the finished section.

The technology consisted of the top and bottom spindles pivoting from 0-45 degrees, operated by AC vector motors and drives, plus an overall motion control CNC, all supplied by Siemens. The CNC is a Sinumerik 840D, which controls all the axis and spindle motion, hydro and servo positioning valves, plus the synchronization of up to four cylinders for the integrated motion of the rotary dies. In the processing of the workpiece, the control monitors all machine conditions while maintaining the synchronized angles of the twin rotary dies.

In order to avoid the improper deformation of materials during the cold-forming process, programmed motion sequences on the machine must be of high precision. In a manufacturing environment where the high output of parts is critical, this process must remain extremely well-regulated, documented and monitored. The CNC has the capability to upload all data in real time.

During the machine build period, MJC funded work at Nottingham to evaluate the ability of the rotary forging process to form a range of difficult-to-shape "exotic" alloys in the "cold" condition. The results of this work entirely supported the building of the MJC Nutation-Spin rotary forging machine.

In October 2013, the machine successfully completed its on-site trials, and final Glasgow acceptance occurred in January 2014. Although the previously funded MJC work had shown that using limited rotary forging systems could produce surprising deformations of aerospace materials in the cold condition, it was not anticipated how much further such deformations could be taken using the MJC machine. The AFRC's new rotary forging machine is currently processing an assortment of alloys.

The new rotary press from MJC built for the AFRC at the University of Strathclyde in Scotland.

An operator loads a workpiece during a test run on the AFRC machine. Very hard aerospace materials such as Hastelloy and Inconel can be processed by rotary forging.

Looking Forward

Clearly, these are early days in the re-engineering of Slick's pioneering work in rotary forging. As the saying goes, "what goes round comes round." In this case, after exactly 100 years, the global torch of rotary forging machine development has now been picked up by MJC and is back once more where it all began. MJC now has the opportunity to start the next 100-year journey that – given the precision, control systems and improvements in material properties, process simulation and general awareness – ensures huge progress from where we are now.

Author Carl Lorentzen is president of MJC Engineering & Technology, Inc., Huntington Beach, Calif. He may be reached at clorentzen@mjcengineering.com or

SIFCO Eyes Second Century of Operation

SIFCO Industries of Cleveland, Ohio, is the parent of SIFCO Forge (Cleveland), T&W Forge (Alliance, Ohio), Quality Aluminum Forge (Orange, Calif.) and General Aluminum Forge (Colorado Springs, Colo.). The company is a century-old, publicly traded supplier of forged components and machined assemblies for aerospace equipment, helicopters, engines, power generation and communications systems. Its fully integrated capabilities go beyond open- and closed-die forgings, extending to full process and product design services to its customers.

Laser coordinate measuring device is used to verify forging dimensions.

Not far from downtown Cleveland, and not far from Lake Erie's shore, is a complex of industrial buildings that houses SIFCO Forge and the corporate offices of SIFCO Industries. SIFCO Forge is a global supplier of engineered forged components, primarily to the aerospace and energy markets. The company supplies flight-critical forged components and machined assemblies to all the leading aircraft and engine manufacturers around the world. Its products are found on virtually all types of commercial and military fixed-wing aircraft, as well as on helicopters and business jets. SIFCO Forge manufactures numerous products, including an assortment of engine, landing-gear, brake and wheel, transmission and other components.

The Cleveland facility is a significant local provider of jobs, employing 175 associates. The number swells to 190 if corporate staff is included. Work associates are members of the International Association of Machinists and Aerospace Workers.

A forklift delivers bar stock from the receiving yard on a cold, blustery day.

The Path to a Finished Product

The story of SIFCO Forge is probably best told by following a piece of metal through the facility. Incoming raw metal is received from suppliers in the form of long bar stock with primarily round or round-corners square geometric cross sections. The Cleveland plant primarily processes alloy and stainless steels, titanium and Inconel alloys. Last year, 4 million pounds of product shipped from the facility. Of this, about 500,000 pounds were finished titanium parts.

As in virtually every forging facility, an early step in the raw bar stock's path through the plant is the sawing station, where it is cut to length for further processing and preheating as forging billets. The plant uses bar stock in a variety of diameters to produce forgings ranging from 0.5-1,200 pounds in finished weight. When the plant is running titanium parts, sawed lengths of titanium bar are sent to a separate workstation, where they are heated and coated with glass to prevent the excessive and problematic oxidation characteristic of the metal at high temperatures. Glass frit is used for this purpose. The billet coating chips away during subsequent deformation processes.

Round bar stock is cut to length for further processing.

Glass frit is used to coat some billets to prevent unwanted surface oxidation at elevated temperatures.

Hammers and Presses

While billets are being prepped for forging, the appropriate tooling for each production run is located and installed on the press or hammer that will form it into the desired shape. Once the correct die-set is installed in the hammer or press, production can commence.

SIFCO Forge employs a wide range of equipment types and capability ranges tailored to the part size, alloy, configuration and metallurgical requirements. The company's drop hammers range from 2,000-35,000 pounds. SIFCO Forge also utilizes hydraulic presses ranging in size from 750-5,000 tons and a 3,500-ton screw press.

The hammers and presses are fed by forklifts that remove preheated billets from nearby furnaces and place them in the dies for deformation. After deformation is complete, the finished part is stored in a bin for cooling and further processing. Depending on part complexity, multiple forging cycles in dies of progressive feature definition may be required.

SIFCO has full die-making facilities, and dies are cleaned and inspected to determine if they need repair or servicing after every production run. If so, these operations can be done in-house.

Finishing Touches

Newly forged parts run through a myriad of finishing and quality-assurance operations on their way to final inspection. Many raw forgings are processed in a chemical bath to remove residual scale from heating and forming processes. Some parts require finish machining, which is done internally. The company also provides its own heat-treatment services, though some parts may be thermally treated off-site during periods of high production. Dimensional inspections are performed at the coordinate-measuring station, where finished parts are laser-scanned for dimensional accuracy and integrity.

The integrity of parts is verified through the company's metallurgical lab and nondestructive tests such as magnetic-particle inspection and penetrant-dye inspection, depending on the type of material. Magnetic-particle inspection consists of creating an energized field around a part to visualize surface indications. Penetrant-die inspection is a controlled process that applies a dye activator to the surface of non-magnetic parts. (An article about SIFCO's NDT operation, "Solving the NDT Bottleneck at SIFCO Forge," was featured in our August 2013 issue.)

Formalized quality-assurance accreditations are not only key but mandatory to many of SIFCO's customers. Consequently, the company has implemented processes and passed accreditations for ISO-9001/2000, AS9100 and Nadcap's Heat Treat, Non-Destructive Testing and Chemical Processing disciplines.

(Left) A forklift positions a heated billet onto the die of the 35,000-pound hammer. (Right) A work associate positions a heated billet on the tooling mounted on the company's 35,000-pound hammer.

Looking Ahead

SIFCO prides itself in having built its longevity and success on a foundation of technical expertise and customer responsiveness. Its continuous-improvement capabilities are highly valued and very active. The company's SMART (streamlined manufacturing activities to reduce time/cost) program was initiated in 2007. The program blends Lean manufacturing, Six Sigma, Reliability Centered Maintenance (RCM) and Theory of Constraints (TOC) methodologies. More than 150 continuous-improvement events and projects have been completed since 2007. The SMART program was rolled out in 2012 as a corporate-wide business process.

If a customer needs a specific part, SIFCO's engineering team works to see how best it can be produced. The company has made substantial software investments to provide the tools its engineers need to model processes, tooling and techniques to yield finished products.

SIFCO Forge places a high degree of importance on the development of technical talent in design, manufacturing and quality engineering. The company maintains active co-op programs with both Case Western Reserve University and Cleveland State University. In addition to the co-op program, SIFCO Forge is introducing an Engineering Development Program (EDP) so that incoming personnel are exposed to

A Centenarian with a Rich History and Open Heart

In 1913, five men formed a small company in Cleveland, Ohio, for the purpose of applying new scientific principles to improving the strength of metals, specifically through the use of thermal cycles. They called their company the Steel Improvement Company, and it had an industrial next-door neighbor called the Forest City Machine Company, which manufactured hardware for the burgeoning power-transmission industry across the country. Within three years, the neighbors combined to create a new company with new capabilities – Steel Improvement and Forge Company. When this company went public on the American Stock Exchange in 1969, it used its acronym and officially became SIFCO Industries Inc.

Still in its relative infancy during World War I, the company supplied forgings for ordnance, ships and the then-emerging aircraft industry. In post-war 1919, SIFCO's founders convinced C.H. Smith Sr., an Alcoa metallurgist who established the company's first aluminum forging operation, to become SIFCO's sales manager. Smith Sr. cut his teeth opening new markets for the company, and forgings in general, in the forklift industry and in oil and gas operations. In 1925, Smith Sr. became the company's president and relocated it to its current Cleveland facility.

The company weathered the Great Depression by continuing its quest for new markets, including specialized forged products for the still-growing aircraft industry and forged golf-club heads for a sport starting to catch on in the U.S.

Then World War II started. The company was prepared, however, because it had been working with the Naval Ordnance Station in Newport, R.I., to develop torpedoes in the 1930s. SIFCO engineers developed a four-bladed, alloy-steel propeller that could withstand the shock of launch from an aircraft. Consequently, the company supplied every U.S Navy aircraft-launched torpedo propeller in the entire war. SIFCO also collaborated to develop a turbine disk alloy that GE used in its aircraft engines to help the Allies gain air superiority in the conflict.

Smith Sr. passed away unexpectedly at the early age of 55 in 1942. He was succeeded by a young man just six months out of MIT, his son C.H. Smith Jr. The new president was no stranger to SIFCO, having worked there during the 1930s in a number of factory jobs. He learned the business from the ground up and in future years would be remembered for his creativeness, compassion and willingness to get his hands dirty to get the job done.

It was the younger Smith's vision that led to SIFCO's international presence after the war, when he established manufacturing operations in Canada, Argentina, Brazil, India and Europe. Smith Jr. served as a member of the International Labor Organization (ILO), a specialized agency of the United Nations, for decades.

It was Smith Jr.'s leadership that led to several innovative practices. SIFCO became the first company to successfully forge titanium in 1949, and the company also forged complex alloys used in rocket nozzles.

SIFCO's legacy would be incomplete without mention of its charitable foundation. In the spirit of giving back to the communities in which it operates, the SIFCO Foundation was, according to its mission statement, "formed to make charitable contributions to trusts, funds, foundations or corporations in the United States organized and operated exclusively for charitable, scientific, literary, cultural or educational purposes, with special attention directed toward those endeavors in which SIFCO employees are involved."

At the company's centennial celebration last year, SIFCO chairman Jeffrey Gottschall said, "I think I speak for those SIFCO personnel, both here and gone, when I say that we are very proud of our heritage and excited about our future."

Forge hammer shop circa 1930s

Among a plethora of modern commercial equipment, a reminder of the past lingers unobtrusively in a corner.

various technical aspects of the business in the interests of developing future leadership.

To anyone who has visited SIFCO or talked with its management, it would come as no surprise that the company is well positioned in the marketplace as it begins its second century of operation. Jim Woidke, SIFCO's Chief Operating Officer, stated, "We have worked hard the last few years repositioning the company and strengthening our portfolio of businesses. It's this strategic focus that will guide us as we transition into our next 100 years."

FORGE

Shop Capabilities Directory

Company/Contact Information	Type of Forgings Produced				Type of Metals Produced								
	Closed (impression) die	Open die	Seamless rolled rings	Cold forming	Aluminum	Copper, brass & bronze	Low-carbon, low-alloy steels	Microalloy/HSLA steels	Special alloy steels	Stainless steel	Nickel-based superalloys	Titanium	Refractory & other metals (beryllium, zirconium, magnesium, etc.)
C & F Forge Co. 9100 Park Ln., Franklin Park, IL 60131 (773) 625-0930 Fax: (847) 455-0012 info@cfforge.com	★						★			★			
Clifford-Jacobs Forging Co. 2410 N. Fifth St., Champaign, IL 61882 (217) 352-5172 Fax: (217) 352-4629 sales@clifford-jacobs.com www.clifford-jacobs.com	★				★				★	★			
Composite Forgings Ltd. P.O. Box 441457, Detroit, MI 48244-1457 (800) 521-0420; (313) 496-1226 Fax: (313) 496-8599 inquiry@compforge.com www.compforge.com		★				★	★			★		★	
The Dayton Forging & Heat Treating Co. 215 N. Findlay, Dayton, OH 45403 (937) 253-4126; (800) 723-0648 www.daytonforging.com		★					★			★			
Ellwood City Forge 800 Commercial Ave., Ellwood City, PA 16117 (800) 843-0166; (724) 752-0055 Fax: (724) 752-3449 ecfsales@elwd.com www.ellwoodcityforge.com OR www.ellwoodgroup.com		★					★	★	★	★	★		
Ferralloy Inc. 28001 Ranney Pkwy., Cleveland, OH 44145 (440) 250-1900 Fax: (440) 250-1901 salesmgr@ferralloy.com www.ferralloy.com	★	★	★	★			★		★	★			
Forge Products Corp. 9503 Woodland Ave., Cleveland, OH 44104 (216) 231-2600 Fax: (216) 231-0300 sales@forgeproducts.com www.forgeproducts.com		★	★		★	★	★		★	★	★		
High Performance Alloys 444 Wilson St., Tipton, IN 46072 (800) 472-5569; (765) 945-8230 Fax: (765) 945-8294 sales@hpalloy.com www.hpalloy.com		★							★	★	★	★	
Lincoln Forge 18325 Dix-Toledo St., Brownstown, MI 48193 (734) 285-1680 Fax: (734) 285-3311 monicam@lincolnforge.com www.lincolnforge.com	★				★	★	★	★					
McInnes Rolled Rings 1533 E. 12th St., Erie, PA 16511-1747 (800) 569-1420; (814) 459-4495 Fax: (814) 459-8443 sales@mcrings.com www.mcinnesrolledrings.com			★				★	★	★	★			
Meadville Forging Co. 15309 Baldwin St. Extension, Meadville, PA 16335-0459 (814) 332-8200 Fax: (814) 333-4657 lrhoades@meadforge.com www.meadforge.com	★						★	★	★				
Milwaukee Forge LLC 1532 E. Oklahoma Ave., Milwaukee, WI 53207-0210 (414) 744-4565; (414) 744-4566 Fax: (414) 744-4990 sales@milwaukeeforge.com www.milwaukeeforge.com	★						★	★		★			

Types of Forming Lines Run			Primary Business Mode		Ancillary Services Offered							Quality Certifications Achieved					Geographic Sales Coverage							
Presses	Hammers	Ring rollers	Low mix, high volume (mass production)	High mix, low volume (job shop)	Computer design & process simulation	Tool & die production	Heat treating	In-house machine shop	Metallurgical lab services	Testing lab services	Other	ISO	Nadcap	Mil-specs	Automotive (ICQ)	Other	U.S./North America	Latin/South America	Western Europe	Eastern Europe	Africa/Middle East	India	China	Asia
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OTHER
1. AS9100
2. PED Certified
3. AS9100, P.E.D.
4. NDT
5. ISO/TS 16949

FORGE

Shop Capabilities Directory

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Missouri Forge Inc. 500 Hood Industrial Pk., Doniphan, MO 63935 (573) 996-7177 Fax: (573) 996-3303 mike@moforge.com www.moforge.com	★						★	★	★	★			
Moline Forge Inc. 4101 4th Ave., Moline, IL 61265-1997 (309) 762-5506 Fax: (309) 762-5508 mikes@molineforge.com www.molineforge.com	★						★	★					
PC Forge 837 Reuter Rd., Port Colborne, Canada L3K 5V7 (800) 66-FORGE; (905) 834-7211 Fax: (905) 834-5094 sales@pcforge.ca www.pcforge.ca	★				★	★	★		★			★	
Sorel Forge Co. 100 Mccarthy St., Sorel, Canada J3R 3M8 (450) 746-4030 Fax: (450) 746-4092 sales@sorelforge.com www.sorelforge.com		★					★			★			
Trenton Forging Co. ***5523 Hoover Rd., Trenton, MI 48183*** ***(734) 675-1620 Fax: (734) 675-4839*** ***dmoxlow@trentonforging.com*** ***www.trentonforging.com***	★						★	★	★				
Turn-Key Forging & Design Inc. 2300 E. Devon Ave., Elk Grove Village, IL 60007 (847) 228-6999 Fax: (847) 472-9543 info@turnkeyforging.com www.turnkeyforging.com	★						★		★				
Ulven Forging Inc. 6160 S. Whiskey Hill Rd., P.O. Box 425, Hubbard, OR 97032 (800) 248-5836; (503) 651-2101 Fax: (503) 651-2877 ulvenforging@ulvencompanies.com OR mikeu@ulvencompanies.com www.ulvencompanies.com	★	★			★	★	★		★	★	★		
Unit Drop Forge Co. Inc. 1903 S. 62nd St., West Allis, WI 53219 (414) 545-3000 Fax: (414) 545-6318 paul.spitz@unitforgings.com www.unitforgings.com	★						★	★	★	★			
W. Pat Crow Forgings 200 Luxton St., Ft. Worth, TX 76104 (817) 536-2861 sales@wpatcrow.com www.wpatcrow.com	★				★		★	★	★	★	★	★	
Weldaloy Products Co. 11551 Stephens, Warren, MI 48089 (888) 935-3256; (586) 758-5550 Fax: (586) 758-5049 customerservice@weldaloy.com OR sales@weldaloy.com www.weldaloy.com		★			★	★							
Wyman Gordon Forgings Inc. 3097 E. 61st St., Cleveland, OH 44127 (216) 341-0085 Fax: (216) 341-0954 awatson@dropdies.com www.dropdies.com	★				★		★	★	★	★	★	★	

Types of Forming Lines Run			Primary Business Mode		Ancillary Services Offered							Quality Certifications Achieved					Geographic Sales Coverage							
Presses	Hammers	Ring rollers	Low mix, high volume (mass production)	High mix, low volume (job shop)	Computer design & process simulation	Tool & die production	Heat treating	In-house machine shop	Metallurgical lab services	Testing lab services	Other	ISO	Nadcap	Mil-specs	Automotive (ICQ)	Other	U.S./North America	Latin/South America	Western Europe	Eastern Europe	Africa/Middle East	India	China	Asia
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OTHER

1. AS9100
2. PED Certified
3. AS9100, P.E.D.
4. NDT
5. ISO/TS 16949

Ajax-CECO

The #38 Die Forger is the latest update to the popular Die Forger line. It features patented dual inlet and exhaust valves that extend the useful energy range to 10% of rated power while retaining the capacity for the full power potential of this large (8,000-pound falling weight), modern hammer. The added versatility is truly remarkable when compared to older models.

The Die Forger is PLC controlled and programmed with a color HMI for simplicity of operation and enhanced troubleshooting. The Die Forger's productivity is unmatched due to its high blow rate. Its ease of programming makes the operator more efficient because hammer control is under the direction of the PLC. Our users report that you can expect higher quality forgings from this latest Die Forger – a big plus in today's demanding world where quality, price and delivery are critical.

Alfe Heat Treating

Dependability. Quality. Results.

Those three words are often lost in the rush to get to the top, but at Alfe Heat Treating, the largest commercial aluminum heat treater in the U.S., those words are the foundation of everything that we do. We built our business from the ground up, one job at a time, by consistently providing excellent results. From prototypes to large-volume jobs, from castings to forgings, Alfe can handle the work, meeting whatever challenge you bring our way. We work in all industries – aerospace, military, automotive and commercial products – handling both ferrous and nonferrous materials. Quick turnaround times mean most jobs are processed within 48 hours, keeping your production schedule on track.

We've provided parts for projects as big as the space station and as small as replacements for a single airplane. We've worked with the best and brightest in the industry, from Eaton to Boeing, and everything in between. Our long list of approvals and certifications, including Nadcap accreditation and registration to ISO, gives our customers reassurance that every part meets industry specifications and attains world-class quality standards. When you work with Alfe, you work with the best … and you get the best results.

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Full List of Certifications/Approvals can be found on our website.

Ajax TOCCO Magnethermic

Monoforge: All-in-One Forge Heater

The Ajax TOCCO Monoforge design integrates the entire induction system, including the water cooling system, onto a common base for a quick, efficient installation that conserves floor space. Whether you need 500 pounds per hour or 5,000 pounds per hour, heating billets or bar ends, Ajax TOCCO has over 147 years of combined experience to provide systems that meet your requirements for maximum efficiency. Our state-of-the-art systems ensure the optimum temperature uniformity for your billet and bar heating requirements.

Monoforge features include:

- Minimal floor-space requirement
- Turnkey operation
- Built-in heat station
- Built-in power supply
- Built-in pinch roll drive
- Built-in exit conveyor
- Quick change coil(s)
- Integrated PLC
- Optical pyrometer
- Over/under reject

Monoforge options include:

- ForgeView technology
- IGBT power-supply circuitry
- Cooling-water recirculating system
- Loaders/feeders
- Coil shuttle

COR-MET Inc.

Forge Die Repair – Flood-Welding Procedure

COR-MET is a world leader in the manufacture of flux cored welding wire and stick electrodes, specializing in high-deposition alloys for the repair of forging dies and large foundry castings. The flood-welding technique can deposit up to 60 pounds per hour of weld metal using equipment such as the Wire Welding Stick®, Electrode Welding Stick® and Hand Welding Stick®. The consumables available for flood welding include: low-carbon steel, multiple NiCrMo alloys, chrome hot-work alloys and high-nickel-base alloys. The product forms available for flood welding are flux cored wire (3/32", 1/8" and 5/32" diameter) and Stick Electrodes (sizes up to 20 mm diameter x 39" in length).

Typical Flood-Welding Procedure

Preparation: Remove worn or cracked material from the area to be welded. This may be done by air-carbon arc gouging, oxygen acetylene torch or machining.

Preheat: Preheat according to base metal and weld metal chemistry. The most common preheat temperature is 800°F, and the interpass temperature range is 600-800°F.

Welding: Weld with appropriate COR-MET Stick Electrode or Flux Cored Wire. Contact COR-MET for the proper welding alloy and flood welding equipment selection.

Peening: Peen the weld area to reduce shrinkage stresses and crater cracking. Peening will refine the grain structure and is most beneficial while the weld bead is in the red condition.

Post-heat and Cooling: After welding, equalize in the interpass temperature range. Cover with insulation or place in a furnace. Slow cool to room temperature.

Temper: Stress relieve or temper to desired hardness.

**Flood welding is used most effectively for providing labor cost savings.*

The Wire Welding Stick® and The Electrode Welding Stick® are registered trademarks of COR-MET Inc.

Cut Technologies

Cut Technologies of Bellingham, Wash., is one of the leading manufacturers of Cermet circular saw blades. The company's 10,000-square-foot manufacturing facility includes the newest Kahny automatic tipping station with new 270 Vollmer grinding systems. Our unique advanced-technology manufacturing and state-of-the-art Cermet processing delivers blades of unequalled tension stability and level, combined with the very highest in Cermet properties. They are your best choice for high-production cold saw machines (Tsune, Nishijimax, Kasto, Amada, etc.).

Ellwood Specialty Steel

ExELL ForgeDie™ was developed by Ellwood Specialty Steel (ESS) as a new die steel for hot forging applications. Using an economical, low-alloy steel design, ExELL ForgeDie offers cost savings compared to conventional, higher-alloyed die steels. The steel composition, micro-cleanliness and heat treatment have been optimized to provide:

- Resistance to softening at elevated operating temperatures
- Resistance to thermal fatigue
- Good impact toughness
- Hardenability in large cross sections
- Machinability
- Weldability
- Capability for surface hardening

These properties are attainable while using an alloy chemistry that balances the content of expensive elements such as nickel, molybdenum and chromium to achieve desired performance for the end user at an improved cost.

ExELL ForgeDie is processed using clean steel technology, including ladle refining, vacuum degassing and bottom-poured ingot techniques, to produce an alloy with minimum nonmetallic inclusions and internal segregation that dictates a sound, solid as-cast structure. Then, tightly controlled ingot forging practices to die block sizes assure thorough mechanical hot working of the alloy structure so that physical properties are repeatable. Finally, heat-treating processes have been honed to produce prehardened microstructures that can be relied upon to perform in the tough applications of the forging industry while maintaining the machinability desired by die makers. Through its composition, ExELL ForgeDie also enables weld repair and enhanced surface treatments that can extend the useful life of forge tooling.

Since its introduction to the market, more than 25 million pounds of ExELL ForgeDie have been produced and supplied to customers forging a wide variety of products made in impression dies. Hammer shops have reported much improved die wear in their most difficult applications, and press shops have experienced less gross cracking or high-temperature softening when compared to competing steels. In addition, ESS has documented consistent hardenability in large-section blocks and rounds. Surface to center hardness readings of BHN 352-388 (Rockwell C 38-42) assure consistent through-hardening for reliable die sinking and in-press performance.

Tools used to produce impression die forgings are high-value, critical components. To maximize the return on investment, early catastrophic die failure must be avoided and "normal" wear and damage must be minimized. The selection of a steel alloy for forge tooling can be a critical factor in avoiding costly replacement or repair of dies as well as lost production, late deliveries and unhappy customers. Consider what ExELL ForgeDie can do for your impression die forge tooling applications.

H.C. Starck

Extrusion and Forging Toll Conversion Services

H.C. Starck converts more alloys, larger sizes and longer lengths than most companies.

For H.C. Starck, strict conservation of materials facilitates moving metal with extrusion and rotary forging, not removing metal as scrap. These processes save costly machining time and enhance mechanical properties. H.C. Starck's 5,500-ton horizontal extrusion press and 200-ton GFM rotary forge can toll convert the most difficult alloys.

Our extrusion press handles billets from 6 to 17 inches in diameter and up to 38 inches long. CNC-controlled water hydraulics allows for precision speed control from 0.01-12 inches per second. Billets can be extruded from room temperature to 3400˚F. H.C. Starck extrudes nearly any profile, whether it be round, flat, tube or custom.

H.C. Starck's 200-ton GFM rotary forge will accept up to 6.3 inch input diameter in lengths in excess of 10 foot and can forge diameters as small as 1.1 inches. CNC control ensures precise speed and reduction control for repeatability between each bar and each campaign. Metal can be forged from room temperature to 2400˚F. We forge nearly any profile, whether it is a round, square, octagonal, hexagonal or a stepped shaft.

Technology Metals | Advanced Ceramics

High Performance Extrusion and Forging

H.C. Starck is a leader in extrusion and rotary forging with a wide array of competitive advantages like temperatures, input/output sizes, speed, technical expertise, extensive portfolio of alloys and composites, tonnage, near-net shapes and sizes, and markets served just to name a few. Our state-of-the-art extrusion and rotary forge offer precise speed control.

Extrusion
0 to 3500° F
6" to 17" billets
Larger sizes and longer lengths (> 60')
.01" to 12" per second at 5500 tons

Forging
0 to 2500° F
1.1"-6.3" diameters
Superior surface finish
CNC controlled

Metals and Alloys
Cobalt and Nickel Alloys
Titanium Alloys
High Strength Stainless Steels
Cu-Be Alloys and Pure Metals

Learn more by calling **+1 517.279.3668** or email **info@hcstarck.com**.

H.C.Starck

Schuler
Flexible Automation Systems

When compared to forging on hammers or crank presses, screw presses are characterized by their higher flexibility in handling forging tasks, offering more economical solutions to produce a wide variety of parts. Automation systems can further improve process stability and increase production output rates.

Automation systems that can be applied to screw presses include commercial standard robots, hanging robots with additional linear moving axis on suspension frames, and monobeam or walking-beam transfer systems.

The criteria for selection of automation requires understanding the costs and production output rates required and working closely with equipment experts to determine the best fit for your business case. Production rates have been increased when forging large crankshaft and I-beam axles on automated screw-press lines or forging medium-sized parts on screw presses. For higher throughput, robot automation often comes to its limit. Walking-beam systems, known from automated crank presses, can be successfully adapted to screw presses. These systems operate either from front to back or from left to right.

The versatile application of automated screw presses provides an opportunity to position production on the forging performance spectrum between automated hammers and crank presses. Contact the Schuler team to learn more.

Henkel Adhesive Technologies
Lubricant and Cleaning Solutions

Imagine a ball of clay. You can roll it, cut it and mold it into any shape or object. Now imagine a solid block of metal. That block of metal can also be molded and formed via various forging techniques. Only when you incorporate process chemicals/lubricants and cleaners into the entire manufacturing process, however, can the "block of metal" truly be transformed.

For more than 100 years, Henkel has been on the front line of developing best-in-class lubricant and cleaning solutions for the forging industry. Customers are able to achieve lower overall process costs and superior results with Henkel quality solutions under the BONDERITE® brand.

Forging

Henkel offers an extensive line of lubricants for hot, warm and precision forging processes. These products are designed to perform under extreme temperatures and pressure. In addition, Henkel offers synthetic and hybrid products specifically formulated to replace graphitic products where applicable, while providing lubrication and protection to tooling on the toughest forgings.

From forging to extrusion and drawing of steels, nonferrous metals and difficult-to-work superalloys, Henkel's BONDERITE L-FG series die lubricants and release agents (previously known as Deltaforge® and P3 Forge®) are outstanding performers under the most extreme conditions of temperature and abrasion. Benefits include extended die life, enhanced part quality and increased productivity and efficiency.

Machining and Grinding

Henkel's BONDERITE metalworking fluids are designed for steel, cast iron and nonferrous alloys in a variety of industries. From straight oils to synthetics, Henkel's metal removal products contain the necessary additives that meet the needs of light-duty to heavy-duty industry applications.

Henkel's BONDERITE L-MR B-Series of bio-resistant, semi-synthetic, metal-cutting lubricants with extreme pressure and lubricity additives are used for light to heavy applications. Overall, BONDERITE products provide for use in multi-metal applications as well as consistent tooling performance, excellent lubrication, extended system life and improved quality.

Cleaning

The composition of alkalinity, corrosion inhibitors and surfactants provides a durable, low foaming, hard-water stable product for light- to moderate-duty cleaning and protecting needs. Henkel's cleaners are ideal for removing oils and emulsions, drawing compounds, metal chips and pigment off the surface of machined or pressed parts.

Henkel's BONDERITE is the premier brand for surface technology and process solutions, creating competitive advantage across the industrial manufacturing marketplace. Trusted for reliability, sustainability and proven results, BONDERITE processes deliver superior cost-in-use and operational efficiency. If you form, machine, grind, clean and protect a part, Henkel has a process chemical solution to meet the need.

BONDERITE®

FORGE AHEAD

Achieve Process Efficiency, Sustainability, Profitability with Henkel's Complete Value Chain Solutions for Forging.

HENKEL PRODUCTS

BAR STOCK
CUTTING | SHEARING

- LUBRICANTS

HEATING

BILLET COATINGS
- Warm Forging
- Cold Forming

FORGING

DIE LUBRICANTS
- Synthetic Lubricants
- Graphite Lubricants

MACHINING

- MACHINING AND GRINDING FLUIDS

CLEANING | PROTECTION

- CLEANERS
- RUST PREVENTATIVES

FINISHED PART
ASSEMBLY

- ADHESIVES

FOR MORE INFORMATION, PLEASE CALL 866.332.7024 OR VISIT WWW.HENKELNA.COM/METALS.

Henkel Excellence is our Passion

Inductoheat

The InductoForge® modular billet heating system offers flexibility and efficiency with its individually controlled (500-6,000 Hz) power modules. The flexible, modular design results in finer and more accurate control of the billet temperature.

IHAZ™ temperature profile modeling software enables advanced temperature control of the billet heating process. IHAZ software allows you to customize a billet temperature profile (Induction Heat Affected Zone) to best suit your billet or bar heating application. It can also generate optimum running parameters and setpoints for Standby and Cold Start, which are stored as a recipe in the billet heater's PLC.

Additional features and benefits include: optimized utility costs, replacement coil liners, highest possible efficiency, quick release connections, compact and heavy-duty modular design, infinitely variable in-feed drive speed, and reduced downtime and maintenance costs.

Advanced System Control

The PLC "recipe control" system works in conjunction with the IHAZ temperature profile modeling computer software to make the billet heater simple to run. The operator can access stored recipes from the part number or die number identifier. The billet-heater operating parameters are stored in the recipe and together they run the system, thus improving quality control and speeding up the system setup. A true "stopped line" standby system is available for two or more module systems. Manual operation is available for the smaller Inductoheat billet or bar heating systems.

Infeed Systems

Heavy-duty pinch roll and tractor chain drive infeed systems push the billets through the InductoForge coil line at a very accurate rate controlled by a variable-frequency AC motor. Both systems automatically adjust for the diameter of the billet (for quick change-over). A lost motion detector will automatically shut down power to the system if the billets stop moving for any reason.

Hot Billet Extraction

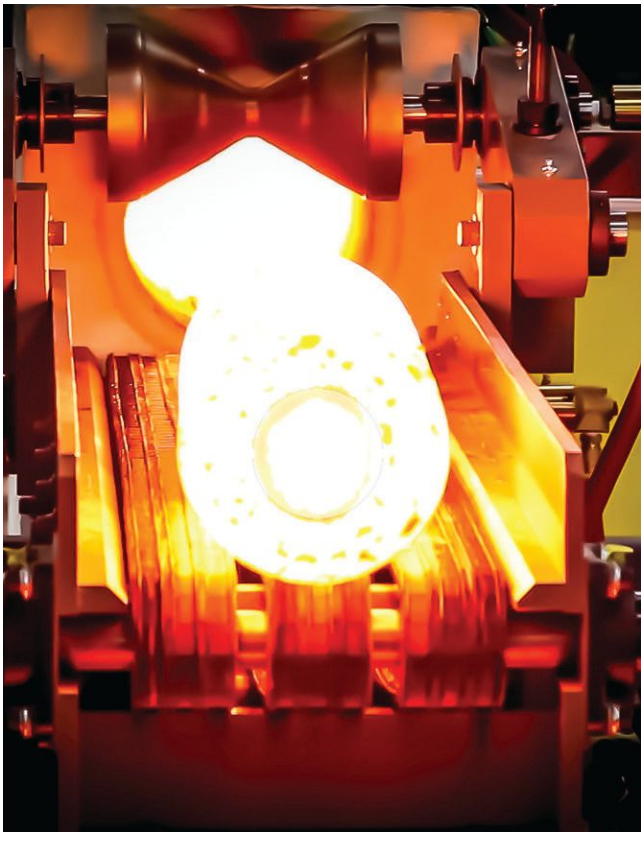
The fast extractor equipment is manufactured to provide many years of low-maintenance operation. Heavy-duty, multi-strand chain works with the gravity pinch wheel to quickly extract parts to ensure uniform heating from the front to the back of the billet (also acting as a weld breaker). The fast extractor comes standard with an infrared temperature-activated accept/reject system. Optional over/under temperature gate is available.

Automatic Billet Feed

Heavy-duty step feeders, bowl feeders, feeder loaders and bin tippers can be added to increase the productivity of the heater by automatically feeding billets from a bin into the coil line. An optional billet weigh system rejects parts that do not meet the acceptable weight range.

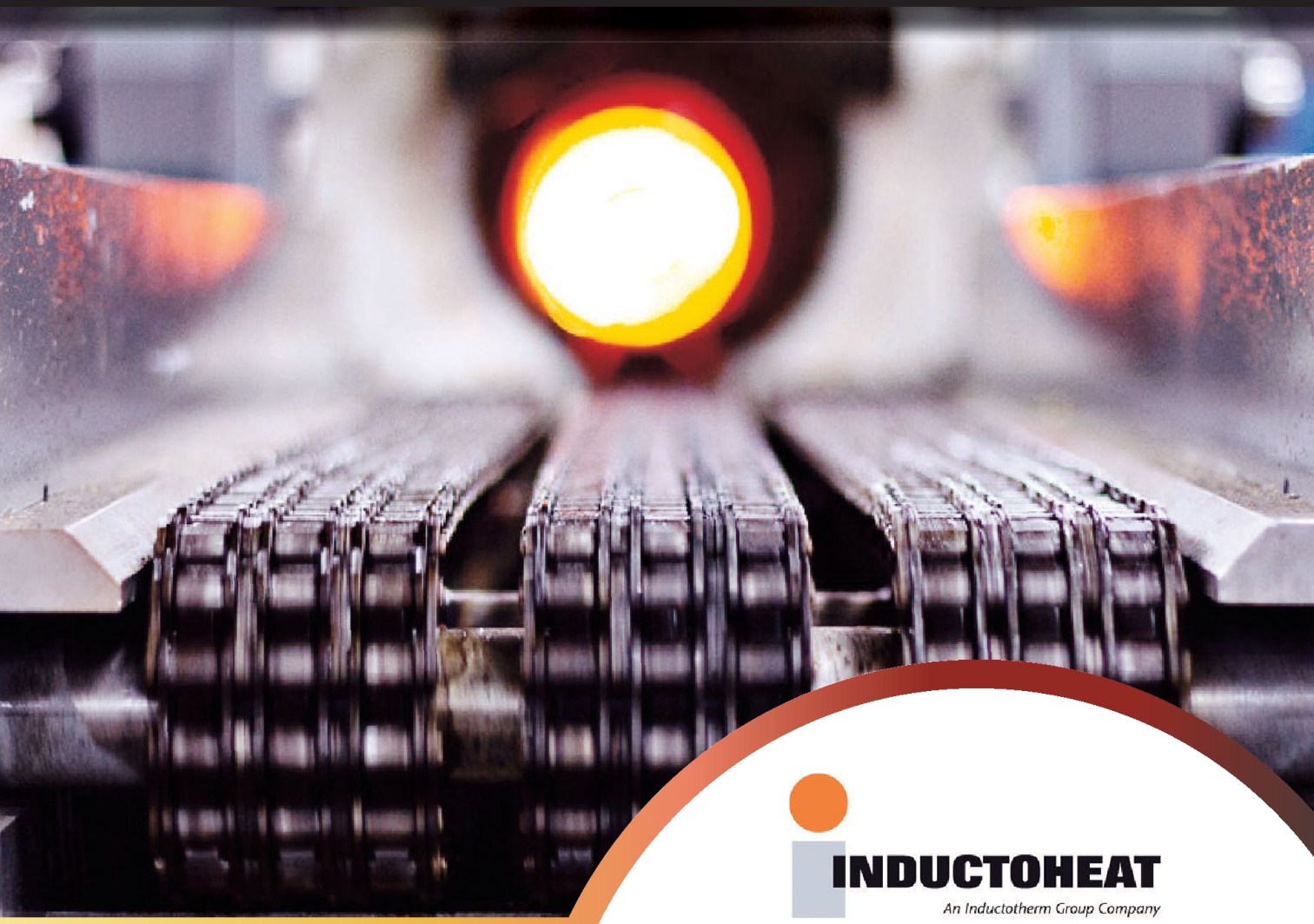
Productivity Enhancements

Optional billet push-out chains or bars and coil shuttles can be included. The billet push-out chain allows almost all of the billets in the line to be heated. The coil shuttle provides a quick method of switching to a different coil size or to a backup coil.



THE NEXT GENERATION

of induction forging temperature control has arrived



INDUCTOHEAT
An Inductotherm Group Company

Better induction forging with iHAZ™ 2.0

This exclusive technology determines optimal machine settings based on material type, application and production requirements.

InductoForge® billet and bar heating systems use this data to produce less waste and more "die friendly" material.

- Reduces waste
- Maximizes production
- Increases operational efficiency
- Enables stand-by & cold start functions
- Customized billet temperature profile
- Predicts and calculates optimal settings

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LASCO Engineering Services

The development of the fully automated forging hammer was considered a monumental achievement in 2002. Now the patented technology has been proven with nearly 30 production lines spread over Europe, Asia and the United States. The forging lines are currently operated in a wide variety of settings, from automotive production to job shops. Recently, LASCO successfully automated a die forger at a U.S. forging company.

Engineering

There are no "cookie cutter" solutions that apply to automation, as every product and company has different demands. LASCO starts the process of automation by listening and observing. Through this process we can understand the tasks that need to be fulfilled. The most important factor for a successful installation of automation is the amount and competency of the engineering. LASCO has a staff of 61 degreed engineers who understand the process of forging and the demands placed on the equipment. The longevity of the equipment is one portion of the process, but making the automation easy to use is equally as important.

Controls

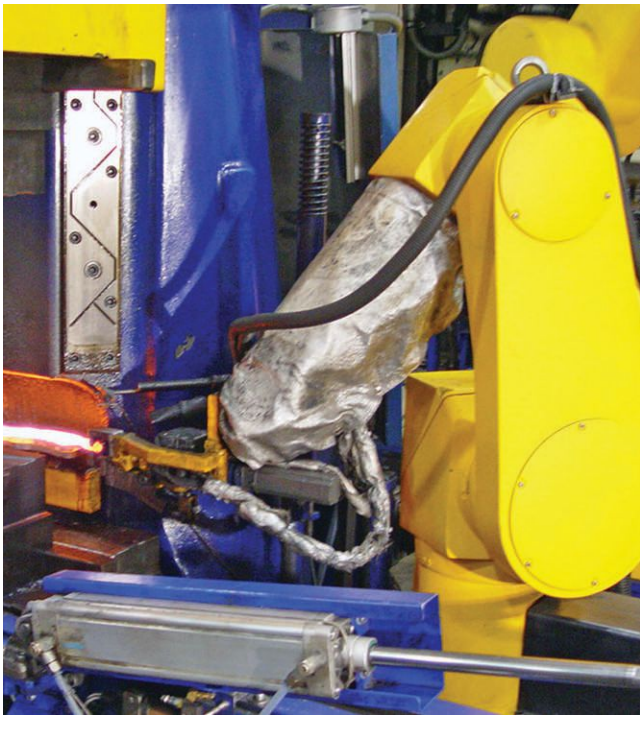
The key to making the automation easy to use is a straightforward control system for the operators and setup people to interface with. The language of the LASCO controls is customized to use the terms the customer is used to, and programming is easy to learn. The operators of the line don't need to go to any robotic programming training to use the system because the whole setup can be conducted through the menu windows of the operator panel. The beginning screen allows the operator to select the number of impressions in the die, what type of impression each one is (flattener, blocker, etc.), the sequence that the impressions are used, etc. As these questions are answered, the program for the robots and the blow sequence and intensity of the hammer is automatically set up for the operator.

Dies

The dies are able to be modified or can easily be designed for the automation process. LASCO engineers provide sketches and rules that can be followed to provide for the automation, then check and help with the design of the first few dies as needed. One benefit to automated systems is a marked improvement in die life. This is attributed to the consistency of the cycle.

Changeover

Everyone is concerned with the amount of labor and downtime associated with changing dies over in the hammer. A patented probe is used to determine the die position in the hammer. Other mechanical adjustments are made easily, and then the program is recalled from the computer's memory. Complete changeover times can be less than an hour.



LASCO UMFORMTECHNIK
WERKZEUGMASCHINENFABRIK

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LASCO Engineering Services LLC 615 Harbor Ave. Monroe, MI 48162 phone 734 241 0094 fax 734 241 1316 mgill@lascoUSA.com www.lascoUSA.com

Nutec Bickley

Advanced Tools for Furnace Design and Optimization of Heat-Treating Processes

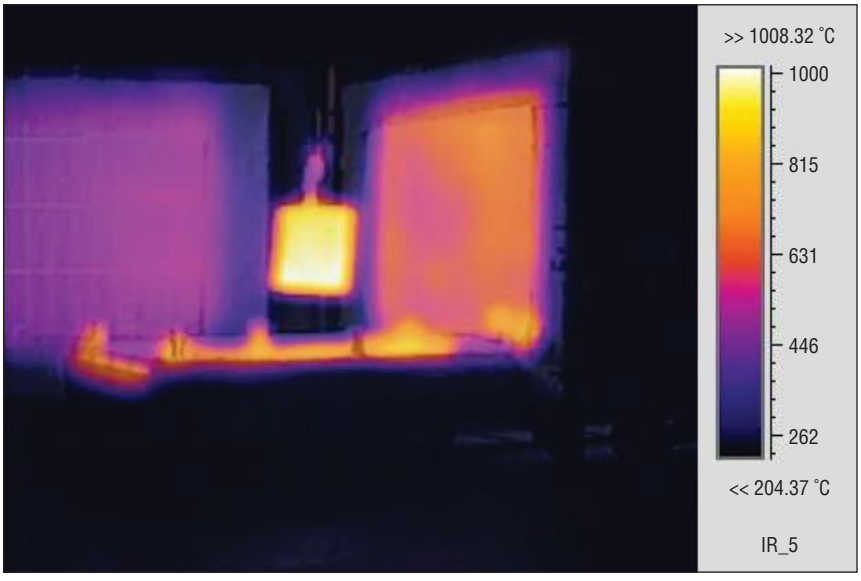
Heat-treating processes usually require very tight temperature uniformities that depend highly on furnace design and control algorithms. Nutec Bickley uses the most advanced tools in computational fluid dynamics (CFD) to optimize furnace geometry, quantity of burners, burner location, exhaust location, etc. In a recent study, we thoroughly investigated the effect of quantity of burners, exhaust location and furnace geometry on the temperature uniformity in a tip-up furnace using CFD.

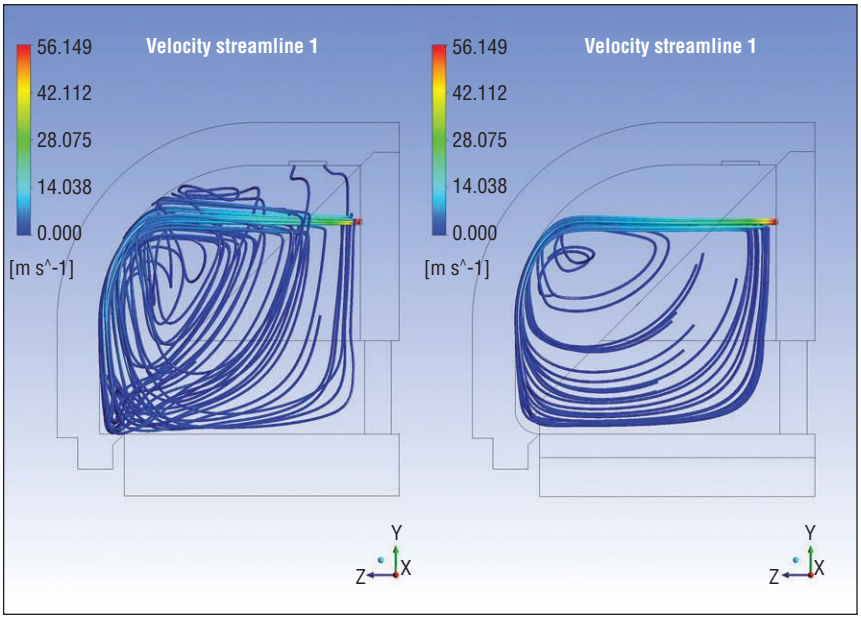
The original configuration with three burners and exhaust flues in the roof was compared with three other designs:

- Five burners across multiple walls and two exhaust flues on the roof
- Three burners on the back wall and an exhaust flue on the back wall
- Original configuration with fiber door seal modified

After a thorough numerical investigation, it was found that the fiber door seal was the best option. This modification was installed in an old tip-up furnace and resulted in improved temperature uniformity from +/- 6°C in the original configuration to +/- 2.5°C with the fiber door seal modified. The main reason for this difference is that with the modified seal the velocity of the products of combustion is not lost when the gases hit the floor and the location close to the back wall is able to receive flow of gases and, therefore, heat.

During furnace commissioning, thermography and flue gases analyses are commonly performed to ensure furnace operation is within the highest standards of energy consumption. Thermography images are a great tool to identify zones where sealing is inefficient and heat losses are higher than normal. In addition, flue gases analysis is used to optimize the combustion processes and ensure emissions are within the standard. Oxygen levels within the furnace are also monitored so that any air infiltration to the furnace is avoided.





NUTEC BICKLEY

ADVANCED HEATING TECHNOLOGY
FURNACES FOR FORGE AND HEAT TREATMENT
PROVIDING GREAT VALUE AT THE RIGHT COST



- ADVANCED HEAT RECOVERY SYSTEMS, SAVINGS UP TO 50% VS COLD AIR.
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Roberts Sinto Corp.

Roberts Sinto Corp. is the North American group company of Sintokogio Ltd., a worldwide family of companies with an international reputation for excellence in the metalworking industry.

As the industries we serve have evolved, we have developed and refined our capabilities and are now able to offer clients a broad range of services and equipment. Our diverse domestic experience, supported by fast and direct channels to worldwide technological advances, enables our customers to draw upon vast global resources for solutions to their manufacturing needs. Products include equipment, consumables, parts and service.

We are an 80-year-old, billion-dollar company employing our global resources and innovative research budgets to offer an unparalleled product offering with experienced product support. Since we are not owned by venture capitalists, we can focus all of our efforts in solving our customers' most important challenges and fit the precise solution to their most varying requirements. The many customer testimonials and collaborative partnerships are a tribute to our basic precept of total customer satisfaction during and after the sale.

Sinto Surface Treatment, a division to Roberts Sinto Corp., focuses on shot-blasting equipment. Among their product line is the CNDR drum blast machine, which features smooth load/unload capabilities, highly efficient finishing due to oscillation during the blast cycle, and a zero pinch design. This family of equipment offers significant cost savings over conventional tumble blast operations.

The CNDR drum blast machine features:

- Significant savings on parts vs. steel-belted tumble blasts
- Lowest maintenance costs of any blast process
- Faster cycle times
- Oscillation and part tumbling to decrease blast times

Faster - Safer - Highly Efficient

Sinto

CNDR Drum Blast increases productivity while decreasing cost at Blackmer

CNDR-22

From left to right: Frank Gonzalez, Bruce Vanderwerf, Andy Vanderwerf, Tom Aument

"With 5 years of operational reliability, since replacing our old Tumble blast machine, we have saved our company over $225,000 and the Sinto Drum Blast Machine had an ROI of under 2 years. Those kind of numbers are easy to sell to Upper Management."

- Tom Aument
Facilities and Maintenance Manager

Features Include:

- **Zero Pinch Design Eliminates Jams**
- **Reduces Maintenance and Minimizes Downtime**
- **Smooth, Reliable Loading and Unloading**

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New Harmony » New Solutions ™

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Simufact-Americas LLC

Simufact-Americas LLC provides on-site training and technical support to companies in North and South America. We teach and guide engineers, tool designers and metallurgists to perform simulations of forging processes with the software package Simufact.forming.

After two days of training, and without the requirement of prior knowledge of simulation, engineers will be familiar with the software and be able to apply it to their companies' manufacturing processes.

One popular application we will highlight is open-die forging, for which Simufact.forming provides a special application module. The objectives of simulations with the open-die forging module are:

- Reduction of development times
- Reduction of scrapped billets
- Reduction of heating times
- Optimization of the number of strokes and reheats
- Prediction and optimization of material properties, such as hardness

In addition, by using simulation, engineers will gain a deeper process understanding, which helps to improve process stability and quality.

The simulation model provides a realistic representation of the shop floor in the virtual world. All aspects of the process are taken into consideration, including the shape of the dies, the shape of the manipulators, the material behavior of the workpiece, the heat generation inside the workpiece during deformation, the heat transfer from the workpiece to the dies, the movement of the manipulators, the spring-loaded control of the manipulators, etc.

The dies, the manipulators and the shape of the ingot are imported directly from any CAD system. The material of the ingot is then selected from a large material library that is included with the software. The material library contains data for carbon steels, low- and high-alloyed steels, austenitic steels, nickel alloys (Inconel, Hastelloy, Waspalloy and Nimonic) and nonferrous metals like titanium, aluminum and copper.

To complete the simulation model, the engineer specifies the details of the forming sequence in a table (Figure 2). The inputs represent a typical schedule of a breakdown/cogging operation, including the number of heats, the annealing temperature, the transport time from furnace to press and the transport time to the furnace in between heats. It is specified how many passes are performed for each heat.

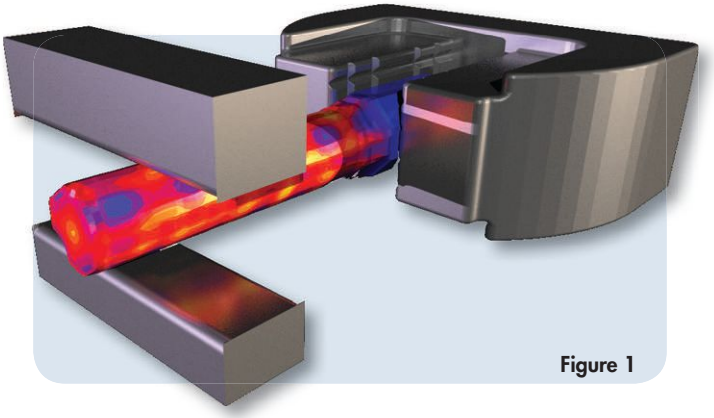


Figure 1

A key aspect to Simufact.forming's ease-of-use is built-in intelligence for the manipulator motions. When designing a breakdown/cogging sequence, the engineer does not initially know how many strokes are required to reach the end of each pass. The reason for this is that the workpiece elongates during the forming process, and the exact amount of elongation is simply not known ahead of time. The simulation will calculate the elongation of the workpiece and automatically adjust the number of strokes required. At the end of each pass, this intelligent control logic will reposition the manipulators over the correct distance to start the next pass.

This automated, intelligent control of the manipulator and die kinematics allows process designers to use Simufact.forming on a routine basis for their forming sequence design and optimization.

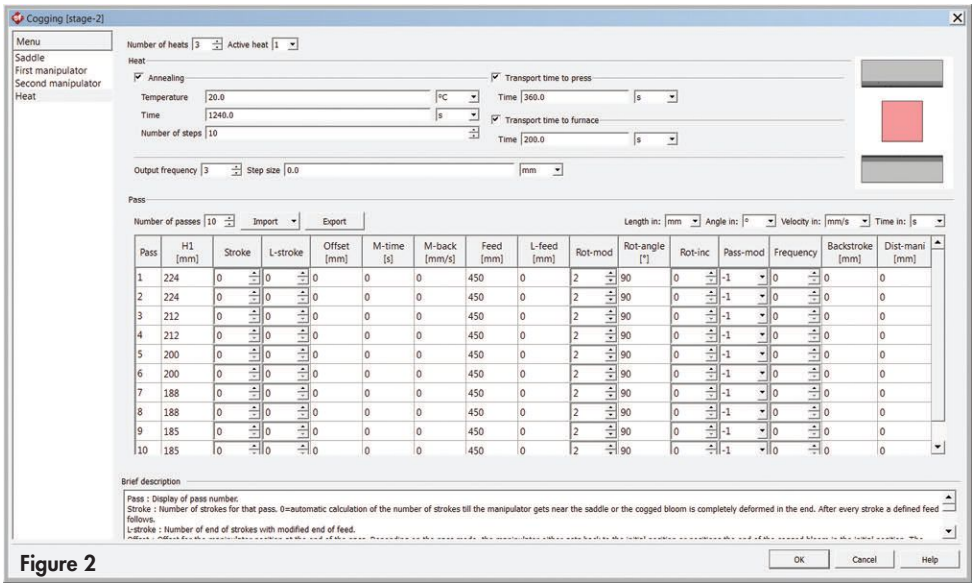


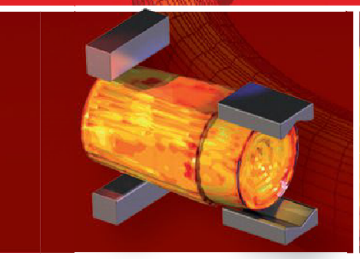
Figure 2

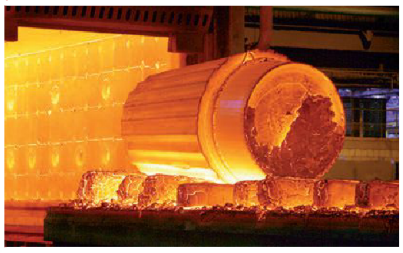
Knowing the Outcome Before You Begin

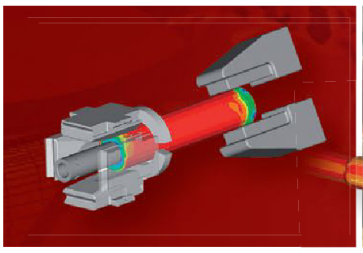
pictures by courtesy of Saarschmiede GmbH Freiformschmiede

Replace Time-Consuming Tryouts by Proven Simulation Methods Optimize Your Manufacturing Processes

HOT FORGING - COGGING - HEAT TREATMENT







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Simufact covers all applications in simulating manufacturing processes. Simufact.forming is the solution for hot forging, cogging and cold forming and provides special modules for open die- and radial forging. Complete your simulation with Simufact.premap, adding comprehensive heat treatment and microstructure capabilities.

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Tech Induction and SMS Elotherm

With the joint venture of Tech Induction and its parent company, SMS Elotherm, we were able to go from the largest induction coil design and repair facility in North America to an international operating facility now offering Elotherm induction machines and equipment.

Not only does Tech Induction sell the ForgeLine®, MetalLine®, LongLine®, TemperLine® and ModuLine®, but their technicians have been trained and educated in the repair and service of these machines and all other OEM induction machines.

Tech Induction has expanded, and continues to grow, their spare-parts department in order to offer customers a fast turnaround on repairs. In addition, Elotherm provides a worldwide service network with current locations in North America, Germany, France, China, India, Brazil and Mexico.

For forging, Elotherm has developed the ForgeLine furnace series, which offers a suitable machine for essentially any product and capacity. All furnaces feature a modular architecture, which can be quickly and efficiently configured to meet individual requirements. EloForge® provides reproducible high quality since all data – such as dimensions, throughput and the temperature of the workpiece to be heated – are stored and immediately available. The continuous feed of the material column is sensed via a feeler roller.

Incorporated with the ForgeLine is cost-reducing and climate-friendly iZone® technology. iZone is a proven Elotherm technology for increasing plant efficiency and lowering manufacturing unit cost, particularly with respect to partial throughputs. Natural resources are also conserved, and the carbon footprint is reduced by iZone's energy efficiency. Elotherm's innovative converter technology, with its uniformly high power factor, contributes to this high operational efficiency.

The heating plants of the EloForge type stand out for their compact design. The converter is either integrated into the substructure or installed on a separate converter cabinet. Due to their compact size and flexibility, EloForge heaters can be integrated perfectly in the manufacturing process.

EloForge heaters fulfill all expectations of the plant operators with regard to high productivity, stable heating processes and highest product quality. By means of individually matched component groups, the heating plants for billet and bars can be adapted exactly to the requirements of the corresponding forging machines. Moreover, Elotherm heaters are known for their proven high availability and maintainability.

Type	Material Diameter (round or sq.)	Throughput	Max Output	Frequency	Complete Heating	Partial Heating	Slug Heating	Bar Stock Section Heating	Bar Heating	Billet Heating	Forging	Hot Shearing	Rolling
EloForge	20 - 100 mm	0.1 - 2.2 t/h	800 kW	1 - 10 kHz	●		●				●		
EloForge L	25 - 160 mm	0.1 - 7.2 t/h	2,800 kW	0.6 - 10 kHz	●		●				●		
EloForge XL	50 - 240 mm	5 - 22 t/h	13,500 kW	0.5 - 2 kHz	●		●			●	●		●
EloBar	18 - 360 mm	0.2 - 25 t/h	8,000 kW	0.6 - 10 kHz	●			●	●		●	●	●
EloForge Individual					●	●	●	●		●	●		●

Elotherm's iZone™ Technology sets industry standards for energy efficient induction heating and reduced production costs. A data bank-supported expert system automatically optimizes and loads the optimal parameter set and heating profile for each process and product..

Elotherm – maximum energy savings.

Elotherm is your reliable partner for innovative induction technologies for Heating, Hardening, Heat Treating, Welding, Annealing and Stirring of metals. Our modular systems give you the freedom to cost-effectively configure equipment for your specific requirements. You can count on Elotherm´s experience and services – worldwide.

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Weld Mold Company

In business since 1945, Weld Mold Company invented the "flood" welding process, as well as the materials that allow forge operators to capitalize on the investment in tooling. By rebuilding and reassigning worn dies and components that fit their press or hammer, our customers have significantly reduced or eliminated their requirements for new die steel while increasing the number of parts per re-sink.

Die-room foremen used to have to replace die steel after as few as three re-sinks, scrapping costly shank and high-feature impression blocks sometimes only months after having received them as new.

There are choices. Not only can you renew just the impression with a Weld Mold material in the original block (maintaining block height and footprint), materials can be selected that can increase the productivity of the impression dramatically. Proper material selection can address specific wear and failure issues.

Weld Mold offers a complete line of flux core and metal core open-arc and gas-shielded tubular wires, as well as coated electrode (stick), MIG and solid and metal core TIG specifically designed for the forging industry. We also manufacture, maintain and repair hard-facing, stainless steel and high-temperature alloys.

Using the Weld Mold "ARM", and "Baseball Bat" electrode in 0.5, 5/8 and 0.75 inch diameter, one customer reports having welded his large hammer dies up to 40 times over nearly 30 years with improved impression performance in the forge, reducing his tooling cost investment significantly.

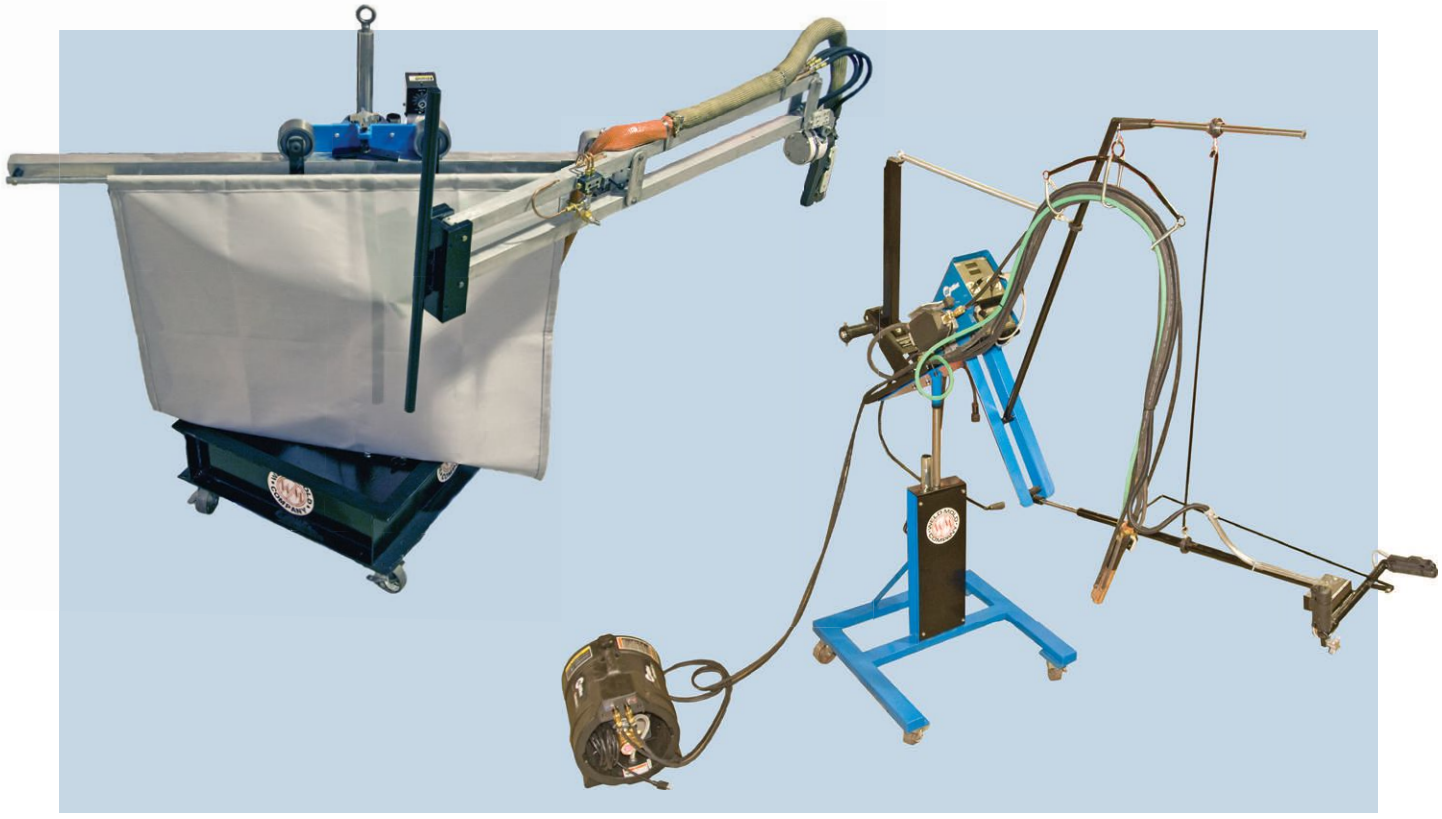
The Weld Mold Manipulator, used by many customers to renew hammer and press dies as well as forging components, is the most efficient way of applying Weld Mold 3/32-inch and 1/8-inch flux cored wire.

By keeping the welder at a comfortable distance from the work and depositions of up to 30 pounds per hour, using 250- and 500-pound drums of material, the Weld Mold Manipulator reduces welder fatigue and positively impacts productivity.

From carbon steel to stainless steel, titanium to aluminum, open-die or closed-die and ring rolling, Weld Mold manufactures alloys that have been proven to improve forging die life, regardless of the material being forged.

The reassignment of obsolete impressions, impression renewal for improved production, and maintaining tolerance in rams, sow blocks and die sets are just some examples of what a forge operator can achieve. Weld Mold can tailor a material and application process to meet your requirements.

Weld Mold – in our seventh decade of service, primarily to the forging industry – is a Michigan-based company serving customers worldwide and shipping from our facility in Brighton, Mich.



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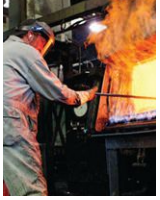


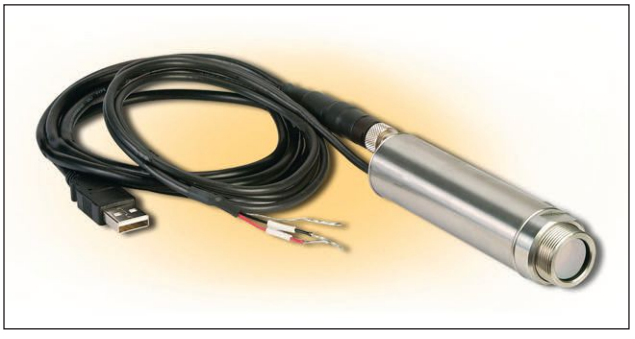
PRODUCTS

Noteworthy Industry Products

Infrared Temperature Transmitter

Omega Engineering

The OS151-USB series measures temperatures from -40 to 1000°C (-40 to 1832°F) accurately and consistently with an outstanding response time of 240 mS. The 4 to 20 mA output is compatible with almost any indicator, controller, recorder or data logger without the need for special interfacing or signal conditioning. The OS151-USB has 15:1 optics, making it suitable for most applications. It is specially designed for distant targets and has an optical resolution of 30:1, and it can measure a spot size of 5 mm (0.20 inch) in diameter at 100 mm (3.9 inches) in distance. All these sensors are fully configurable from a PC using the software and USB cable supplied. This user-friendly software enables the user to set the range and emissivity; compensate for reflected energy; apply filtering; and select max, min, average or instantaneous readings. **www.omega.com**



Induction Heating Software

Ambrell

Version 2.10 of eVIEW induction heating system data-capture software accepts input signals from a data-acquisition unit (DAQ), enabling temperature monitoring and outputs to a spreadsheet to log user-defined alarms. eVIEW allows users to monitor power, frequency, coil operating parameters and temperature. Upper and lower limits can be set for key operating parameters, and users will be notified if a parameter is not operating as expected. All of this information is collected and time-stamped by the program, so users can leverage it for analysis and audit. Along with monitoring temperature, the DAQ provides eVIEW users with additional monitoring options since it accepts a wide range of inputs. For example, speed of the part through the coil can be monitored and position sensors can be used to ensure a part is located in the correct position within the coil. **www.ambrell.com**

Radio Telemetry System

Datapaq

A radio telemetry system provides live temperature data transmission from inside industrial heating or cooling processes in all kinds of industries. Designed for use with the Datapaq Q18 line of data logger, the system is comprised of transmitters

for installation inside the data logger, primary and secondary receivers, and Datapaq Insight™ analysis software. Q18 data loggers measure temperatures between -392 and 2498°F. These versatile units combine fast readings, superb ±32.9°F accuracy and a high resolution of 32.18°F. A large internal memory allows for the logging of up to 50,000 readings per channel. **www.datapaq.com**

Shot Blast Equipment

Viking Blast & Wash Systems

The SH 1545 Spinner Hanger industrial blaster brings new efficiency to consumers with smaller parts. This redesigned unit eliminates the need for a lower screw auger, reducing wear while improving efficiency. The air intake is very aggressive and allows for the application of more than 1,800 CFM, yielding cleaner abrasive and a cleaner cabinet. The drum is made of manganese and is lined with replaceable manganese or AR plate to provide the highest degree of wear resistance. Most applications are covered by the standard offering, but it can also be fitted with a rotary scalping drum, auxiliary abrasive hoppers and 5- or 7.5-HP blast wheels. Safety light curtains are standard with two palm buttons, offering the highest level of safety. **www.vikingcorporation.com**

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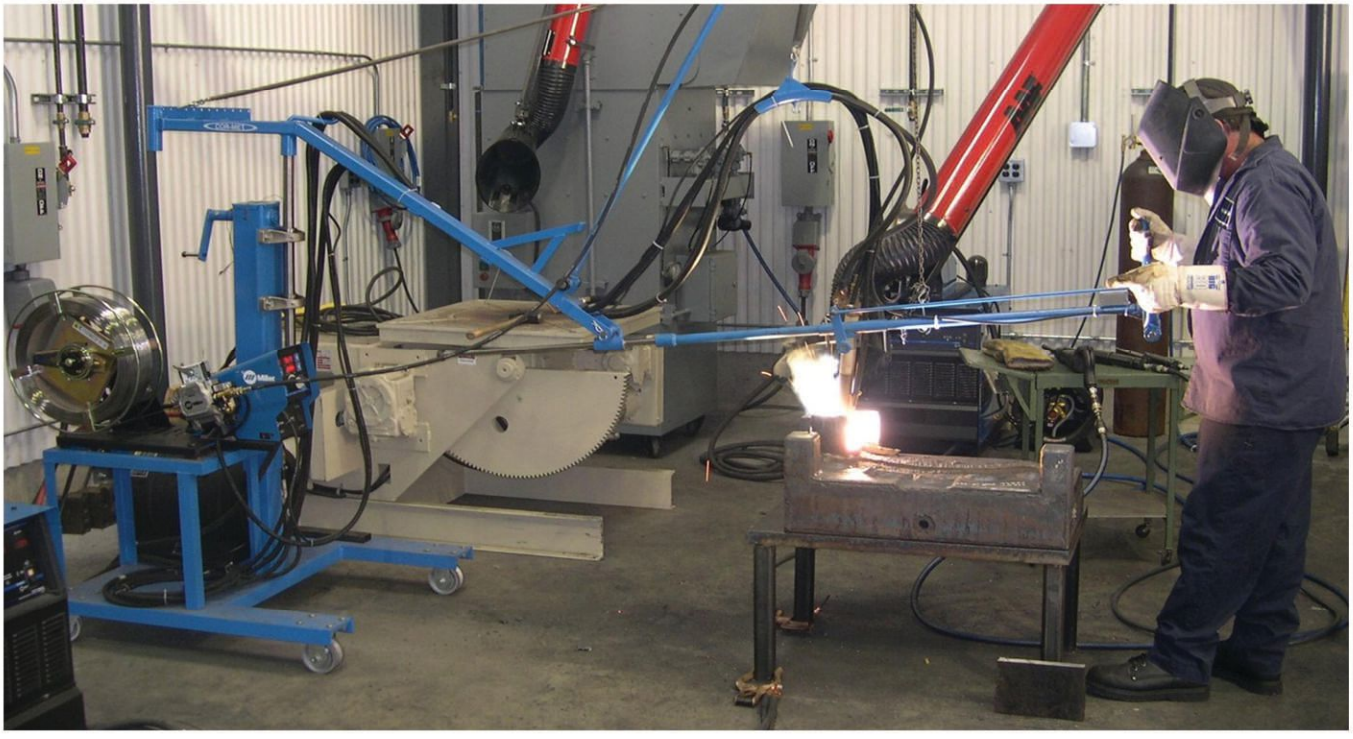

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