

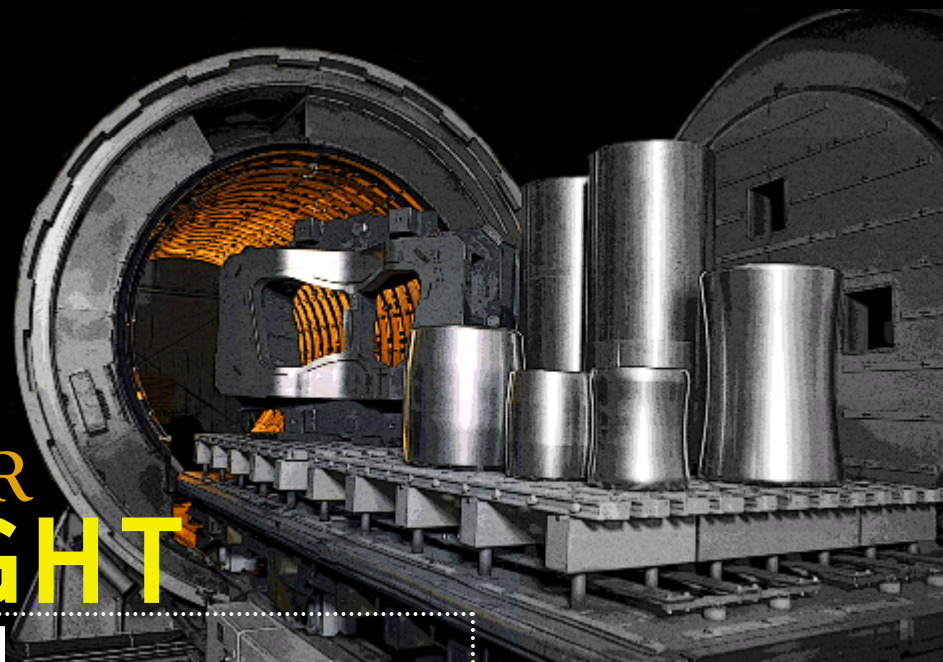
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THE SOLAR SPOTLIGHT



THIRD 24-FOOT VACUUM FURNACE DELIVERED

Solar Atmospheres of Western PA took chamber delivery of its third 24 foot, 75,000 lb capacity furnace. In 2006 Solar added 16,000 square feet of floor space and added its second 24 foot furnace that has been fully operational the past year. Now, the third 24 foot furnace is in place with a planned spring start-up. The new 24 foot furnace is being constructed on site by Solar Manufacturing.

The Hermitage, PA plant specializes in vacuum heat treating and brazing. Started in 2001, Solar Atmospheres' second facility has quickly become the center for large vacuum furnaces. Currently Solar is operating 6', 10', 12', and the three 24 foot long large vacuum furnaces among its total of 12 furnaces. The three 24 foot furnaces have been built to meet the growing demand from titanium producers and the use of titanium for aerospace and other industries. Up to 75,000 lbs of primary / secondary titanium and other metals are annealed or degassed in a single run. Large titanium parts or loads are solution annealed and aged. Other customer requested processes include stress relieving, diffusion bonding, and numerous other thermal processes.

Bob Hill, President of Solar Atmospheres, Western PA anticipates increased usage for the large furnaces. "The explosive demand for titanium structural members and parts in from the military and commercial airline industries requires the capability, processing experience and furnace capacity that Solar has in place. A 36 foot long furnace is in the pipeline and should be operational in 2008. This furnace has a loading capacity of 150,000 pounds!" states Hill. ☀️

A QUARTERLY PUBLICATION BY SOLAR ATMOSPHERES



The new 24-foot vacuum furnace being installed at Solar Atmospheres of Western PA

SOLAR TECHNOLOGY CENTER UPDATE...

The crowning technical achievement of the Technology Center has been taking vacuum carburizing from a truly budding R&D project to production. Munitions and high-tech automotive engine parts are the largest markets serviced. In addition, Solar has had a R&D contract with a major aerospace manufacturer to develop vacuum carburizing processes for high alloy, high quality gears. On another R&D project, Solar was successful in carburizing turbine blades and received a RFQ to perform production work on thousands of blades.

(continued on page three)

SOLAR
ATMOSPHERES

ALUMINUM HEAT TREATING IN VACUUM

Advances in gas quenching continue to expand the materials that benefit from this technology. Fabricators of aluminum are discovering the benefits of minimized distortion and clean parts that vacuum processing offers. Solar Atmospheres, Hermitage, PA, recently solution aged 6061 aluminum from 0 to a T6 condition. This task was accomplished because of the plant's 12 foot furnace and its *Advanced Quenching* capability.

Airwolf Helicopters, Middlefield, OH manufactures aluminum booms for crop dusting. The twelve foot booms included smaller tubing, 1 3/8" dia. x .058 wall thickness, and larger tubing that ranged from 1 5/8" to 2 1/2 " dia. x .058 wall thickness. Because of the thin wall and long length, water quenching would cause extreme distortion and contamination. Solar's large furnaces and *Advanced Quenching* capability were the best alternatives to attain material specifications while

minimizing distortion.

To put the aluminum in solution, Solar uses a nitrogen partial pressure atmosphere in the vacuum furnace and gradually heats the aluminum up to 985° F. The material is held at this temperature and then a 2 bar, helium quench is performed. This brings the material to a T4 condition. While still in the furnace, age hardening is done in a partial pressure nitrogen environment. The aluminum is heated to 350° F and held at that temperature for eight hours. The tubing is quenched in nitrogen. Required properties for the TE condition is an ultimate tensile strength of 42 KSI with yield strength of 35 KSI. Actual results attained were UTS of 42.1 KSI and yield strength of 38.6 KSI

A significant factor that contributed to the success of this job was the thin wall tubing. Solar's *Advanced Quenching* is continually improving and becoming



Tubes of aluminum prepare to be vacuum heat treated

more effective to achieve material specifications while minimizing distortion for oil and water quench materials. ☀️

For comments or questions please contact Mike Drakeley, mjf@solaratm.com or Mike Johnson, mjf@solaratm.com.



PART FOUR: MEASURING THE SUCCESS

Captive heat treating costs are usually determined from accounting's expense column. When compared to the costs of using a commercial heat treater, this is not fair. Not for the heat treater, but for the manufacturers! Not fair, because the manufacturer may not be getting an accurate picture of costs or the loss of added value services provided by commercial heat treating. In other words, not outsourcing may have greater costs with loss of valuable services than what is in the accountant's expense column.

Using the partnership model for a vendor's value in contrast to the expense line is critical to get a more realistic picture of costs. On one side of the ledger is the expense data of outsourcing that can be determined from actual expenses or RFQs. On the other side of the ledger are all the costs of not outsourcing. This includes managerial / personnel expenses, utilities, quality investments, building space, capital acquisition costs (cash flow or financing) and maintenance. Frequently a significant portion of these costs is not isolated in the accounting analysis.

missed as well. This includes the time lost in overseeing heat treat operations from core business activities. Another cost / loss is the value of partnering consultation from a heat treater for metallurgical and processing advice. Lastly, outsourcing heat treatment work offers production flexibility, that is, the ability to quickly expand or contract heat treating processes without capital expenses. The challenge is to measure the disassociated and intangible costs. Value added services and improved productivity must be measured to appreciate the profit potential of outsourcing.

To do this, clarification of business objectives and options are critical to have a better measurements. Is the heat treating manager's time and energy overburdened by this role so that his primary task suffers? Would having a commercial heat treating partner provide assistance, support and expertise, an option? Does expansion or contraction of business without making capital investment or having idle equipment an important factor? Determining the business objectives are critical for an accurate and focused evaluation.

Other costs for not outsourcing are often

All these dissociated or intangible costs are

TECHNOLOGY CENTER *(con't from page one)*

What the Technology Center has achieved with vacuum carburizing of alloy steels, it intends to achieve with vacuum gas nitriding. To date the team has performed several gas nitriding runs in the same retort furnace used to develop vacuum carburizing. The initial results are very promising and efforts are focused at modifying the furnace to measure the amount of ammonia dissociation during the nitriding cycle to better control process parameters and obtain desired microstructures.

Over the past year there was a huge surge in the price of most commodity metals, not the least of which was titanium. While Solar has hydrided refractory metals such as tantalum for years, it had never processed production levels of titanium. This changed with the Technology Center and Special Projects' development of process cycles for vacuum hydriding of titanium scrap metal. Concurrently, the group had to develop a process for dehydrating the brittle hydrided material after it is crushed. This proved to be extremely challenging to perform without sintering the material into a solid block. Both hydriding

and dehydrating of titanium scrap metal at production levels are now performed daily.

New cycle development projects:

1. formation of chromium carbide from chromium and graphite powder at high temperature
2. reduction of chlorine levels from titanium powder
3. gas nitriding of scrap tantalum anodes as a means of passivation.

Other R&D projects now in production:

1. vacuum nitriding of titanium medical implants for improved wear resistance using nitrogen gas (not ammonia)
2. reduction of oxygen, sulfur, and nitrogen from high purity chromium metal flake and powder metal briquettes
3. hydrogen embrittlement susceptibility of alloy steels processed in partial pressure hydrogen gas
4. alpha case formation on select titanium alloys processed at various vacuum levels
5. infiltration of composites for ballistic resistance
6. reduction of oxygen content in molybdenum powder pellets by >27-fold to below 200 ppm
7. vacuum carbonitriding of alloy steels
8. high pressure helium gas quenching of titanium alloy Ti-6AL-4V for ½ inch and less diameter fasteners to improve mechanical properties without the quality

issues associated with water quenching.

The past year has proved to be an exceptionally productive and rewarding year for the Technology Center, especially as a newly formed department in the Solar sphere. The group foresees no decrease in the needs of its efforts to increase the technical capabilities of Solar, and specifically in the areas of surface treatment, hydrogen use in processing, high temperature purification treatments, and high pressure gas quenching. ☀️

10X magnification of vacuum carburized case on part cross section



difficult to measure. However, it is clear that the loss of time, energy, knowledge and business flexibility by investing in a heat treating operation can detract from a manager's and business' primary task. The consequence is less production efficiency and strategic accomplishments. Quite often the manager understands if he is getting the help and expertise he needs to provide the best processing for his company. If the manager has little metallurgical or processing knowledge and experience, the need of the outside heat treating consultant, will have greater value. This evaluation is a reason to consider outsourcing. Overflow work or outsourcing during furnace downtime can have more goals than getting the work done. The challenge is knowing all the costs of owning, running and maintaining a furnace, including disassociated costs, and attaching a value.

Linda Cohen and Allie Young in their book *Multisourcing: Outsourcing to Achieve Growth and Agility* have a chapter, *Measuring Your "Multisourcing" Progress*, [Harvard Business School Press, 2006]. Cohen and Young help clarify the analysis objective with four criteria: "measure, examine, correct and guide."

Measurement requires defining the required expectation and communication on this point is critical. Cohen and Young make the point that focusing on a few critical measurements is important. This emphasizes the need to clarify business objectives to determine if costs have been reduced and added value has been delivered.

The objective of measurement benchmarks is to clarify costs and value added services and evaluate performance. Measurable outsourcing benchmarks include: heat treating charges, turnaround delays, quality oversight and time spent on outsourcing supervision. These measurements would be graded on a weekly or monthly basis. On the other side of the evaluation is the added value of outsourcing such as process innovations or production flexibility. This can be a challenge, but is worth the effort to achieve successful outsourcing.

Other criteria for evaluation will flow from the measurements. *Examination* is an on-going evaluation of the measurement records to have a factual standard. This is critical for the next stage, *correction*. Corrective actions could be

more lead time for the heat treater, better communications, agreement on part cleanliness requirements, or new furnace capabilities and fixturing. This leads to the *guiding* phase of the evaluation. Continual communications between the service provider and the outsourcing company is obvious, but can be lost amidst the daily operating pressures. Through on-going communication in the guidance stage processing improvements are often discovered. This is the partnering model at work.

The decision to outsource has a subjective side that is founded on relationship and trust with the heat treater. This is the foundation of the partnering model. That relationship and trust is built on objective measurements that are determined and fully understood by the outsourcer and the heat treating company. It is equally important to compare all the expenses of captive heat treating with the costs of outsourcing. Placing a value on the value added value services must be understood and measured to effectively evaluate and, thereby, appreciate successful outsourcing.

THE RAINBOW PROMISE

Growing up as a young boy I was fascinated by a rainbow in the sky, but very seldom saw a full arch bow. Normally you would see half an arch and then for only a few minutes. My mother always told me to look for the end of the rainbow, and if you found it, there would be a pot of gold. On several occasions I rode my bicycle to try and find the end of the rainbow, but never made it, as it always was further away and would disappear.

Some years ago I was flying from Indianapolis to Cincinnati in a small turboprop plane, Conair, at something less than 15,000 feet. The sky was broken clouds with spotty rain and some areas of sun. The plane climbed and leveled off. I was sitting in the first seat rear of the pilot's cabin, at a time when they would fly with the cockpit door open. You could clearly see the entire sky in front of the plane, radar screen and all.

About mid-flight we came into an area where a very clear, full arch rainbow appeared at some distance in front of the plane. We flew on and the rainbow became more intense in brightness and larger. Within a few minutes the plane flew directly under the arch and through the rainbow. There were about 20 passengers on the flight and we all broke out in applause.



We know the Rainbow is complex and many books and dissertations have been written about it from a scientific point of view since AD 1000. Much is available on the internet to explain the science of refraction on sunlight, which is credited to Sir Isaac Newton. The rain droplets or prism break the light down from a flat sun spectrum into monochromatic colors from near ultraviolet to near infrared.

The first writing about the Rainbow is from the book of Genesis following the flood. Noah on the Ark for forty days and nights must have been exhilarated with the first sight of sunlight. When the waters had receded and he was again on dry land, the rainbow became God's sign as a promise for Noah, for me, and all who would live on the earth - never again, would mankind be destroyed by the rains and floods.

As the Conair flew through the rainbow, I remembered the Lord's many promises and was comforted. I finally discovered that pot of gold! ☀️

- William R. Jones, CEO

APPROVED!

By Michael Moyer, Corporate Quality Manager

"We are pleased to announce that we have evaluated and approved Solar Atmospheres Inc. as a new supplier for aerospace sub-contracted services." This is a great bit of news to receive when you open up *Outlook* in the morning. Direct approval from an aerospace "prime" for heat treating or brazing work is sought after by heat-treat companies, and Solar is no exception.

Direct approval from a customer, and specifically aerospace primes, complements third-party accreditations such as AS9100, ISO, and NADCAP, and add credibility to your service. Ideally, the third party audits and accreditations will satisfy everyone that you meet the quality grade and can successfully do their work. There are a great many companies, however, that have their own Quality System requirements to do an on-site verification, at least on an "initial" basis. Solar understands this and appreciates the need for a company to verify that their particular quality concerns are met. Nothing takes the place of an on-site visit and getting to know the people in a business relationship. In many ways the quality audit is the foundation for developing a "partnering relationship", which is far better than the old "buyer-seller" relationship.

Solar's "prime" and significant customer approvals include: Boeing (Western PA), Lockheed Martin, GE Aviation, Rolls Royce, GEAE, Pratt & Whitney, Howmet Casting, Northrop Grumman, General Dynamics, Aircraft Braking Systems and Siemens Power. This list is not exhaustive as there are many companies who are 2nd and 3rd-tier (to the primes) that have approved Solar by performing on-site audits. The strongest motivation for aerospace companies to perform regular on-site audits is that this industry requires a "zero-defect" mentality for safety reasons. Other markets sensitive to safety issues are nuclear and medical.

Approvals require maintenance, and vigilance by the Quality Department is critical. Mike Moyer, mam@solaratm.com, heads up this department for Solar's corporate department and currently has the assistance of Mike Johnson mj@solaratm.com, in Western PA. If you have questions regarding Solar's quality approvals or accreditation, please contact either manager. ☀️

Visit the improved quality page at www.solaratm.com

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ALL EYES ON QUALITY: ELECTRONIC SOLUTIONS

By Michael Moyer, Corporate Quality Manager

Taking advantage of technology to achieve continuous improvement has been a hallmark for American manufacturing. In the first 150 years of the American experience, inventions and new discoveries such as the locomotive or electrical power led the way. In the past fifty years, the computer or digital revolution has made its mark. Digital information systems are monumental in this regard, and new developments and applications continue at a frantic pace world-wide.

Industry-specific computer solutions are everywhere, including a company's Quality Management System. At Solar the focus has been to find "paperless" solutions that improve customer service, communication, and quality. The specific focus has been on electronic data collection and completed-order-storage, order-processing, and furnace control and automation.

Solar's "paperless" goal for electronic data collection and completed-order-storage has been accomplished through the use of Eurotherm-Chessell video process recorders and a scanner/software program called E-archive. E-archive has been a huge asset and has given us critical data at our fingertips. A year ago the benefits were just becoming evident and now it is already too easy to take for granted. In the past, when a customer called with a question about an order, information would be written down, then paperwork would be found (not always an easy task), staples pulled, fan-fold charts were opened and then the call was made to go over the data. Sometimes the chart data was hard to read and even compromised. Comparing multiple charts (to each other) would be a huge undertaking, taking up a conference room-size table and hours getting it all out and then back together for filing.

Electronic record retrieval is a simple search, using numerous search criteria. Files are opened and data is examined while the customer is still on the phone. Furnace data-charts are a few short clicks away! To compare furnace data, you can export any channel from any batch into Excel and overlay them in the same graph and email the information to anyone. The savings to Solar and the value added to the customer's operations cannot be overstated.

The next "paperless" target is order-processing. Solar is investigating the use of technology to provide a new and better way of processing our orders. The goals are to increase productivity and further reduce spoilage-causing mistakes that erode customer confidence. The investigation to improve or replace our order-processing software is an effort to streamline operations.

Key needs are in the areas of *paperless shop floor control and bar-coding* to eliminate incorrectly logged order numbers and data. Other key targets are *nonconforming product control and reporting*, with a complete communications module where individual operators, groups of operators, or all operators may receive communications through the system. An operator



would log into the operating system and go through any electronic messages prior to working on a job. The messages will be acknowledged and management would have an acknowledgement record.

Another area of focus is controlling furnace cycles. Again, investigations focus on a recipe database where an engineer can remotely store the furnace recipes. Instead of programming each cycle on the floor, operators could download furnace recipes into the furnace controllers as needed. Of course we still need discrete control at the furnace in case of emergency or system malfunction. However, having the ability to store and retrieve recipes from a secure database, instead of typing in process variables on a job-by-job basis, would add another level of mistake-proofing to our floor processes.

Major improvement has been achieved in the way of electronic records, and we are committed to continue this plight in the name of customer service and satisfaction. An example is Solar's 2007 strategic objective to create a control room where the entire shop may be watched and controlled from one workstation, improving our ability to gather information and react accordingly.

Improving productivity in the 21st Century requires a constant response to the advancements and applications of digital information systems and communications. Solar management continually investigates and implements the new innovations that will improve our production and customer service. ✨

The Mission of Solar Atmospheres is to add significant value to our customer's operations by thermally treating parts, principally in a vacuum environment, with an unwavering commitment to honesty in all relationships.

Guiding Philosophy

We will strive to fulfill this mission while

- ◆ performing our work with an emphasis on quality and responsiveness
- ◆ Operating with an awareness and appreciation of the value of our customer's parts while in our care
- ◆ Forever looking "forward" in the area of technical capabilities
- ◆ Demonstrating a willingness to "accept the challenge"
- ◆ Providing and maintaining a work environment that is safe, clean and reflects our respect for human dignity.
- ◆ Providing our employees with an opportunity for personal growth, challenge and reward
- ◆ Maintaining a workplace that is environmentally friendly
- ◆ Sustaining long-term growth and profitability



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"[Capitalism] is not in itself sufficient to create value. It depends on what human and religious value we, ourselves, bring to our affairs. Insofar as those values fail, we would all descend toward a lawless, inhumane, cut-throat society that will no longer harbor our civilization."

- Bill Ziff as quoted by Rich Karlgard
Forbes Magazine, Feb. 12, 2007

- Francis Bacon

Upcoming Trade Shows...



Springfield, MA
May 22-24
Booth # 2100



Baltimore, MD
June 25-27
Booth # 213



Los Angeles, CA
September 17-20
Booth # TBA



Chicago, IL
November 11-17
Booth # 25053