

# The Shot Peener

www.shotpeener.com  
ISSN 1069-2010  
Volume 21, Issue 4

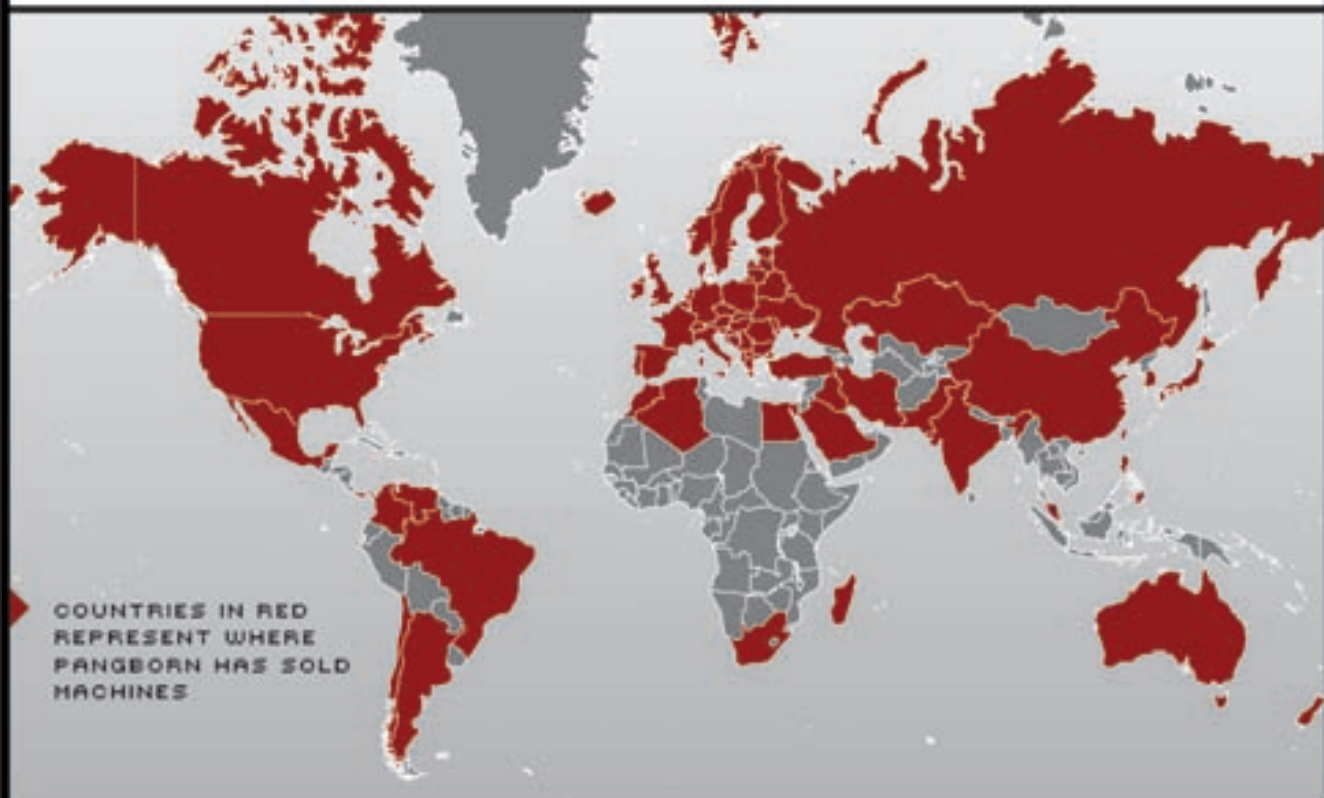
Shot peening as a  
solution for at-risk bridges

**Plus:** An aerospace program takes flight in Singapore

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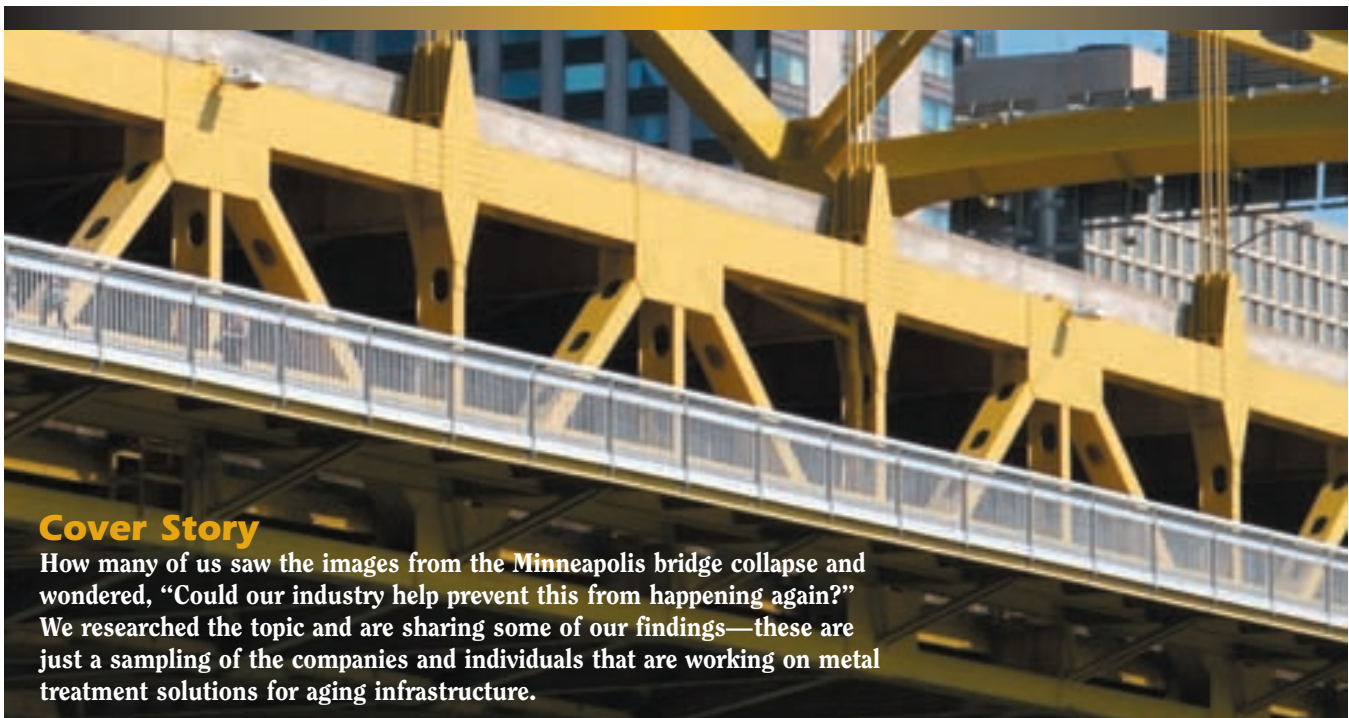
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## Cover Story

How many of us saw the images from the Minneapolis bridge collapse and wondered, “Could our industry help prevent this from happening again?” We researched the topic and are sharing some of our findings—these are just a sampling of the companies and individuals that are working on metal treatment solutions for aging infrastructure.

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The Fort Pitt Bridge is a steel bowstring arch bridge that spans the Allegheny River in Pittsburgh, Pennsylvania. It was constructed from 1956 - 1959 by Pennsylvania Department of Highways.

**Fall 2007**  
**Volume 21, Issue 4**

## The Shot Peener

- 20 years in publication
- Over 5,200 subscribers
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The Shot Peener (ISSN 1069-2010), in print since 1986, is a quarterly publication from Electronics Incorporated with a circulation of over 5,200 subscribers in 85 countries. It is dedicated to raising the awareness and appreciation for the shot peening and abrasive blast cleaning industries.

Contributions to The Shot Peener are always welcome including the announcements of seminars, application notes, joint efforts, and press releases on new products and services. However, while it is our goal to include all newsworthy information in The Shot Peener, we are able to use these items only as space allows and we cannot guarantee their placement in the magazine. Inclusion of articles in The Shot Peener does not indicate that The Shot Peener management endorses, recommends, or disapproves of the use of any particular commercial products or process, or that The Shot Peener endorses or concurs with the views expressed in articles contributed by our readers.

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# The Shot Peener

# Extending the Fatigue Life of Bridges Using Stressonic® Needle Peening

Sylvain Forgues

The recent tragic collapse of the Minnesota Bridge has reminded us of the importance of quality design, manufacturing and inspection in our daily work. The NTSB will make their full investigation and report, but with the first information relating the accident to corrosion and fatigue cracking, it also raises the question whether a technology such as peening might have been used on this type of welded structure. The Electronics Inc. reference library has over 120 papers on the subject of peening welded structure ([www.shotpeener.com/learning/welds.htm](http://www.shotpeener.com/learning/welds.htm)). I would like to take this opportunity to look at the advantages of a special technique, called Stressonic® needle peening, to extend the fatigue life of welded metallic structure.

## FATIGUE LIFE EXTENSION PROGRAMS

Fatigue life extension programs are common in aerospace for aircraft structure and have been used successfully on almost every major fleet. The first step of a program is to assess the damage at critical locations and decide on which action to take. When light damage is found, it is usually removed and the part strengthened in some way. When damage is too extensive, the part is simply replaced altogether. Repairing damage or replacing a part can be very expensive. The key to such a program is to perform improvements before the onset of significant damage. The approach has to be preventative instead of corrective to minimize costs and maximize benefits. The approach used in aerospace can also be used to extend the life of welded metallic structure.

Peening is one of the best preventative treatments available to increase fatigue life. It is very inexpensive compared to replacing or reinforcing a structure and can extend the life of a part or component multiple times. To improve fatigue life significantly, peening must be performed in the initiation phase of a crack development. When cracks are initiating, the compressive residual stress generated by the peening will slow the crack formation. If crack lengths are beyond the compressive layer, the peening will have little impact. Fortunately, the initiation phase of a crack is usually 2 to 3 times longer than the propagation phase (see Figure 1). This provides plenty of opportunities for applying a peening program.

Studies (Ref.1-2) have shown that by blending the surface and re-peening at fixed intervals, the fatigue life of a component is extended more than with a single peening application. This is the objective of a Fatigue Life Extension Programs whether for aircraft structure or on welded metallic structures used in many bridges.

## NEEDLE PEENING WITH STRESSONIC® EQUIPMENT

Because of access constraints, peening the welded structure of a bridge requires small portable equipment that is easy-to-use, generates deep compressive residual stresses and will not leave behind media that can contaminate the environment. Sonats has developed such a machine called the StressVoyager®.

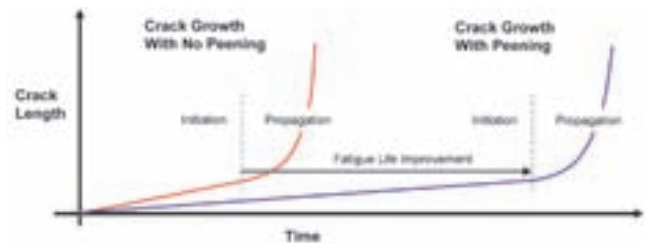


Figure 1. Effect of Peening of Fatigue Life

It uses the Stressonic® process (Figure 2) where electrical energy is transferred to mechanical vibration through a piezo-electric sensor. This sensor vibrates at ultrasonic frequencies (20-40 kHz) but with a very small displacement. The displacement is therefore amplified through a series of boosters to provide useful mechanical movement to needles that perform the peening.

The central unit of the StressVoyager® weighs approximately 44lbs and is often moved around on a small wheeled cart as shown in Figure 3. It requires normal 110V current and

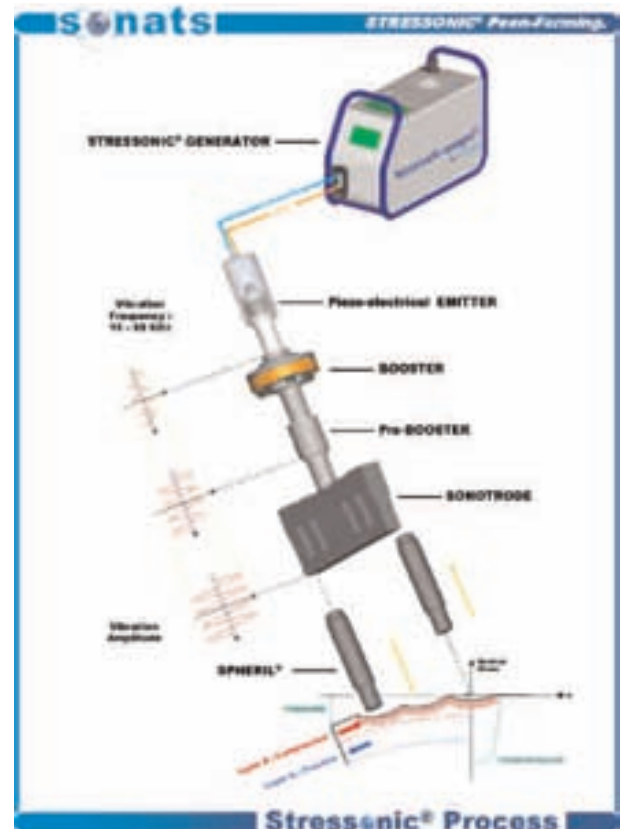


Figure 2. Stressonic® Needle Peening Process

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
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Figure 3. StressVoyager® for Needle Peening



Figure 4. Needle Peening Head

a small quantity of compressed air to cool the peening head. The peening gun weighs roughly 9lbs and feels like a large drill. A needle head is installed at the tip of the gun to do the actual peening (Figure 4). Different sizes of peening needles and head geometries can be used depending on the application. For example, a special angled head has been designed for locations with limited access. The larger needles, also called “spherils”, have a diameter of 0.197” and can generate an intensity of 0.028C or more.

#### FATIGUE RESULTS FOR WELDED JOINTS

A StressVoyager® was used topeen joints representative of welded steel structure (Ref. 3). The needle peening was performed using 0.157” diameter spherils, with a 100% coverage. To achieve optimum benefits and adequate coverage, each weld toe was treated as well as ¾” of the plate on each side of the weld.

The residual stress profile was measured using X-ray diffraction after the needle peening operation. The results can be seen in Figure 5. Results indicate a deep compressive stress level (-45Ksi) at the surface and a total depth of compression of roughly 0.070”. This large depth of compression ensures that the needle peening will be effective when cracks initiate.

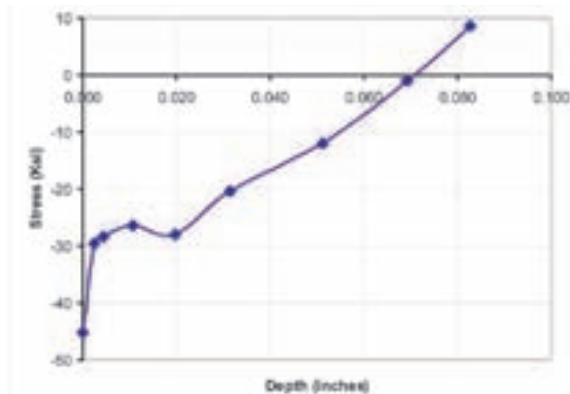


Figure 5. Compressive Residual Stress Distribution Following Needle Peening

Fatigue testing of welded specimens have confirmed the effectiveness of the needle peening process. The fatigue life of the specimens were evaluated both in the “as welded” and the “needle peened” condition. At a delta stress level of 60ksi, the needle peening provides a fatigue life improvement of 15x over the welded condition. This tapers off with higher  $\Delta\sigma$  levels, but is even more important at lower stress levels usually seen in bridges.

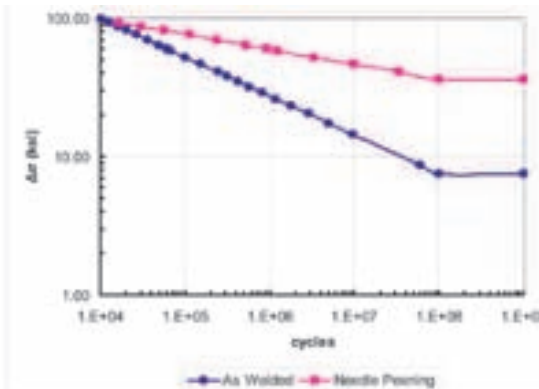


Figure 6. Fatigue Life Comparison of “As Welded” and “Needle Peened” Structure

This fatigue data could also be looked at from a different angle. Federal Highway Administration Statistics (Ref. 4) report a continuous increase in the weight of heavy truck on U.S. roads over the last 35 years. Needle peening can be used to compensate such a weight increase. For a fixed number of cycles, Figure 6 shows that needle peening can withstand a higher stress level. At 10 million cycles, for example, needle peening can withstand a 68% increase in the stress level over welding alone. Using needle peening on bridges would result in an increased level of safety at a very minimal cost.

#### CONCLUSION

Stressonic® needle peening is a great technique to re-establish or extend the life of bridges and other welded structures. The best and most cost-effective approach is to needle peen the welds during the initial fabrication or as a preventative measure before degradation becomes too significant.

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The StressVoyager® is a clean, easy-to-use and very effective tool to increase fatigue life. Testing of welded structure has shown that it provides deep compressive residual stresses and a significant fatigue life improvement.

Used to either prolong the useful life of bridges or to safeguard against ever increasing loads, needle peening is a cost effective technique to increase the safety of our aging infrastructures.

#### REFERENCES

- 1) Forgues, S., Internal report, L-3 MAS Canada.
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- 3) Bousseau, M., Millot, T., "Fatigue Life Improvement of Welded Structures by Ultrasonic Needle Peening Compared to TIG Dressing".
- 4) US Department of Transportation, "Comprehensive Truck Size and Weight Study"



Sylvain Forgues has a Bachelor's degree in Mechanical Engineering and a Master's degree in Applied Mechanics where he studied the beneficial effects of coldworking through 3D non-linear finite element analysis, residual stress measurement by x-ray diffraction and experimental fatigue testing. He started his career at Bombardier Aerospace in Research and

Development and worked on the Aircraft Structural Integrity Program (ASIP) of the CF-18. After 5 years, he transferred to the commercial side where he was in charge of structural in-service issues for the fuselage of the CRJ-200 fleet. In 2002, he became Section Chief of the R&D, Robotics and Software department at L-3 MAS where his team developed and marketed an on-aircraft robotic shot peening system used on the CF-18 and on the CRJ-700.

Mr. Forgues has more recently formed his own company, Shockform Incorporated, which provides innovative fatigue life improvement technologies to companies in Aerospace, Energy and Transportation sectors. Shockform works with Sonats to market Stressonic® Peening technology in North America.

You may contact Mr. Forgues by phone at (450) 430-8000 or by e-mail to [sylvain.forgues@shockform.com](mailto:sylvain.forgues@shockform.com). Mr. Forgues will be presenting Stressonic® peening at the next EI workshop in Arizona and will be available for discussion at the Sonats booth #3.

## Why bridge welds are important

After the bridge collapse in Minneapolis, hundreds of older steel bridges in the U.S. were carefully inspected. Deserving of particular attention were bridges, like the Minneapolis bridge, that were built in the 1960s with welded joints. Earlier steel bridges were bolted together but welding was cheaper, easier and provided more flexibility in how the pieces could be assembled. However, engineers at that time had a limited understanding of how welded joints endured time and stress.

Research in the 1970s revealed that certain welded components were vulnerable to metal fatigue. The I-35W Minneapolis bridge included these types of welded components in locations that were "fracture-critical", meaning that a break in that spot would probably lead to a collapse. However, engineers can design "redundant" bridges that are not vulnerable to the failure of a single part. Fracture-critical bridges are still being designed and built today, and old bridges with fracture-critical components can be rehabilitated instead of replaced, say civil engineers.<sup>1</sup>

There are more than 750 bridges with steel deck trusses, similar to the I-35W, in use in the United States at this time.

<sup>1</sup>The New York Times, August 4, 2007

## UIT process on welds is studied

Considerable research is being conducted on the use of Ultrasonic Impact Treatment (UIT) on welded joints. We've posted one of these papers at [www.shotpeener.com](http://www.shotpeener.com) by three researchers from the University of Stuttgart, Germany. This paper was presented at the 2005 International Association for the Bridge and Structural Engineering Symposium in Lisbon, Portugal. The summary follows.

#### Rehabilitation of Welded Joints by UIT

Due to increasing traffic and life, loading fatigue becomes of high relevance in order to maintain the integrity of existing steel bridge structures. Poor construction details which used to be regarded as less important when applied to road bridges are nowadays often the starting point of fatigue cracks. Repair and strengthening of welded details are thus of great importance in order to extend the life time and safety of existing bridges. For welded details under fatigue loading one effective possibility to do this is the application of local post-weld treatment methods. This paper presents the application of a relatively new post-weld treatment method called "Ultrasonic Impact Treatment" (UIT). The paper summarizes the results obtained on a series of experimental fatigue tests where UIT has been applied in order to extend the life time of partially damaged non-load carrying fillet welded joints.

(For complete paper, go to [www.shotpeener.com](http://www.shotpeener.com))

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# Aerospace Engineering Degree Program Soars

*Nanyang Technological University (NTU) has successfully launched the first aerospace engineering degree program in Singapore.*

Singapore is positioned to become a global aerospace hub and Singapore's Nanyang Technological University (NTU) recognized the need for engineers who are well-trained in the fundamentals of aerospace engineering. The vision for the new program is "to place the School of Mechanical and Aerospace Engineering in NTU in the forefront of aerospace engineering education, research and outreach programs in Asia and the Pacific region."

Dave Barkley, Engineering Manager at Electronics Incorporated and an engineering instructor at Purdue School of Technology, met with Dr. Shaker Meguid at NTU twice in the past two years. Dr. Meguid was the task force leader for the program. When Barkley toured the aerospace division in 2005, the project was little more than a few offices scattered across the campus. But even then, Dr. Meguid and NTU were formalizing plans for a revolutionary aerospace school. When Barkley visited the university this spring, the transformation was astonishing. The new Aerospace Engineering Division includes a Main Aircraft Laboratory which consists of a 14,000 sq. ft. aerospace laboratory on the ground floor, 18 smaller specialized aerospace engineering laboratories and a Hall of Fame/Aviation Gallery on the ground and mezzanine floors. The large aerospace laboratory houses a fighter jet, two helicopters and an Unmanned Aerial Vehicle (UAV) and, together

with the other specialized laboratories, contains the finest and most extensive inventory of actual aerospace components and training equipment available anywhere. Mr. Barkley's reaction was, "where can I sign up?"

Some of the exceptional features of the program include:

## **Hands-On Discovery Course**

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## **Clusters**

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- Aerodynamics, Propulsion and Performance
- Aircraft Maintenance and Reliability
- Aircraft Materials and Structures
- Avionic Systems Engineering

## **Industrial Participation**

Industrial Mentorship provides students with the vital practical link to the aviation industry. Students spend one full semester in an aerospace company in their 3rd year.

## **Emphasis on Design**

Problem-based learning and divergent thinking are very distinctive features of the program.

*Continued on page 12*



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We were fortunate to be able to interview Professor Khin Yong Lam, Chair of School of Mechanical and Aerospace Engineering, and he shared his insights on the NTU program.

**Q: What were your biggest challenges in developing this program?**

**Prof. Lam:** With keen worldwide competition for talent, one of our challenges is to attract and recruit the best faculty staff to develop our program and facilities. We are also working with our overseas partners and local industry on research programs as well as collaborating with renowned institutions worldwide for our student exchange/attachments.

**Q: What were your biggest advantages in creating this program?**

**Prof. Lam:** Ours is the first aerospace engineering degree program in Singapore and was developed in response to the strong demands for professionals in the fast expanding aerospace industry in Singapore.

**Q: What has the reaction been from your first two years of students?**

**Prof. Lam:** Students have been very excited about the multi-disciplinary program which provides them with specialized knowledge and skills in addition to their training on the fundamentals of mechanical engineering.

**Q: Has the local aerospace industry been supportive of the program?**

**Prof. Lam:** With its relevance to industry, the program has received overwhelming support and we will continue to work with the aerospace community.

**Q: How is shot peening covered in the curriculum?**

**Prof. Lam:** We cover the concept of shot peening in varying depth and details across a number of courses: AE2011 - Introduction to Aircraft Design & Manufacturing, AE2009 - Aerospace Materials and AE4011 - Aircraft Design.

**Q: What makes this program different from any other?**

**Prof. Lam:** Our program emphasizes creative, independent and entrepreneurial thinking with our methods of teaching and research. We inject realism into the program by using real aircraft and actual aerospace components among other aerospace training equipment. Our program ensures students develop core competencies in aerospace engineering as well as provides ample opportunities for staff and students to cultivate and nurture close ties with industries via our industrial mentorship scheme and industrial attachment program. Every aerospace engineering student has an industrial mentor and an academic mentor. The industrial mentor is changed each year as the student progresses into the senior years. Therefore in four years, a student would have access to four industrial mentors with varied expertise and would have gained different perspectives of the aerospace industry as well as good job opportunities upon graduation.

*Continued on page 14*



*The airframe section of the NTU Aerospace Engineering Division's Hall of Fame.*

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**Q: How many students can attend the school?**

**Prof. Lam:** The response to our aerospace engineering program has been very strong and our first intake of freshman numbers 85.

**Q: Has enrollment been successful? Is the program popular and in demand?**

**Prof. Lam:** Absolutely in high demand. We have many top high school students applying for our degree program.

**Q: What are your future plans?**

**Prof. Lam:** Continuing our recruitment of faculty to enhance and provide varied core expertise in the aerospace engineering division. Further development of the laboratories to enhance their support of teaching and research. Increase collaborations with industry and research institutions/organizations local and worldwide. Increase student exchange programs with renowned overseas institutions. Development of graduate aerospace engineering degree program. ●

*For more information on the NTU Aerospace Engineering Program, visit [www.ntu.edu.sg/mae/admin/divisions/lae/ae.asp](http://www.ntu.edu.sg/mae/admin/divisions/lae/ae.asp)*



*A Rolls-Royce jet engine in the NTU Aviation Gallery.*



*Left exhibit: Cut-out scaled model of Pratt & Whitney PT6A engine. Right exhibit: Scaled model of Pratt & Whitney PW4000 Turbofan engine.*



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# Hybrid Cleaning/Peening Machines

Kumar Balan

## Problem and a historical approach

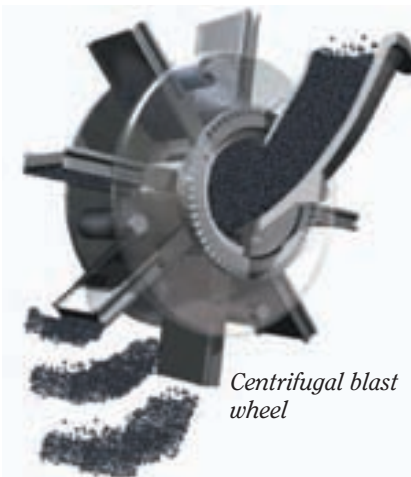
A well-known foundry with a large production throughput, manufacturing complex and intricate profile castings, approached us for a solution to automate their cleaning operation. The casting had a large surface to be cleaned, rendering wheelblast style media propulsion as the logical choice. Tests in our demo lab revealed that almost 80% of the casting could be cleaned using blast wheels. However, during tests, no matter how we located the blast wheels, and even provided them with oscillation, the remaining 20% remained untouched by media from the blast wheels.

We determined that the approach to the solution for this old problem had to be changed. Large work surfaces such as in rail cars, corrugated containers, complex weldments and castings invariably have hidden areas that are hard to access. Such areas include crevices, folds and shallow cavities that are shielded from direct impact of blast media. It is a commonly accepted practice to clean such areas manually in a touch-up station downstream to the wheelblast machine. However, for the customer that has invested significant amounts of capital in installing an automated blast cleaning system, the need to touch-up the part manually is sometimes not acceptable.

Faced with a similar situation with our foundry customer, we sought out to explore other automated options to clean 100% of their castings. Our exposure to the touch-up concept provided the background to use this technique with a certain degree of automation. Two blast nozzles mounted on a three-axis nozzle carriage were used in its dedicated compartment, all within the same blast enclosure. These nozzles cleaned just those areas that required touching-up. The nozzles followed a particular contour programmed by the operator and stored in a distinct technique for retrieval whenever required.

## Definition and variations of a hybrid machine

*A blast machine that capitalizes on the advantage of the wheelblast propulsion technique to clean/peen a majority of the part surface and relies on blast nozzles to complete the process by targeting specific areas untouched by the blast wheels – all in a common enclosure and sharing reclaim and control system components.*



*Centrifugal blast wheel*

The operator waiting downstream of a wheelblast machine to manually clean the unclean areas constitutes a hybrid machine. An automated nozzle manipulator in its own compartment within the blast machine carries the same definition.

Examples of machines that render themselves to hybridization include rotary tables with satellite stations, spinner hangers and other pass-through styles.

## Hybridization - Is this a need-driven concept?

In order to properly address this question, it is important to understand (a) items/features that drive system and process complexity and (b) items that drive the price. Interestingly, the items in both lists are quite similar, and they are:

- Certain reclaim system components such as vibratory classifiers
- Electrical control systems
- Installation space
- Work handling and automation



*Pressure blast nozzles (auto touch-up)*



*Vibratory Classifier - continuous classification for consistent media size*



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Vibratory classifiers in a wheelblast machine (typically for peening applications) are sized to handle a fraction, usually 20% of the total flow. A marginal increase in flow by introducing two blast nozzles, that collectively discharge not more than 50 lbs./min., does not alter the effectiveness of this classifier. Therefore, no additional changes are required to be made with hybridization, especially when compared with having to provide a separate airblast machine with its dedicated reclaim system.

Electrical control systems constitute the single largest investment component in a peening machine. In order to conform to OEM specifications, the sophisticated controls, monitoring and reporting capabilities demanded result in significant manufacturing costs. The cost benefits of sharing control components between the wheel(s) and nozzle(s) in a hybrid machine are significant.

Installation space, particularly in existing production facilities, is always at a premium. If your application calls for touch-up, and if the only solution is an airblast cabinet in addition to your wheelblast machine, a hybrid solution is probably going to benefit you in the long run and cause less interruption to the rest of your process line.

Handling a part more than once adds to the burden of your operating costs. Hybrid machines offer the advantage that, once

loaded, the part exits the machine completely cleaned or peened. Also, your investment on work handling automation such as robots and pick-n-place systems can be more effectively utilized in a hybrid machine.

#### Elements of a hybrid machine

For those of us familiar with a blast machine, the hybrid machine is a simple combination of a wheelblast and airblast machine with commonly shared components.

The wheelblast section of the machine may incorporate single or multiple blast wheels. The wheels propel blast media in a controlled space (blast cabinet). Media is reclaimed by lower and upper reclaim system components, cleaned, stored and fed to the blast wheels.

The airblast component of the machine may incorporate single or multiple nozzles; either fixed or mounted on a multi-axis manipulator. The blast media discharged from the nozzle(s) is conveyed to the same reclaim system and gets pressurized in a dedicated blast tank.

The blast tank outlets have their own flow control valves as do the blast wheels.

#### Some distinct advantages

In addition to the obvious advantages presented by a hybrid solution, the following are not immediately realized.

*Continued on page 20*



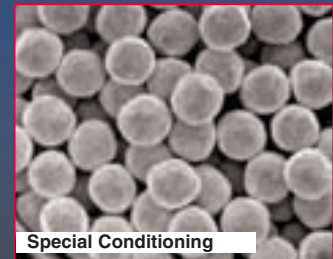
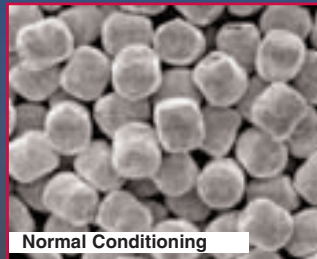
*Part touched-up by nozzles after wheelblast*

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Cycle time savings derived from the fact that both operations – wheelblast and airblast – are carried out under cover of the other. In all applications, it is also possible to operate just the wheelblast part of the machine (important when your part is no longer complex enough to warrant airblast treatment).

Commonality of fixtures is possible because the part doesn't leave the machine until the entire operation is complete.

Labor savings from having a single operator operating a hybrid machine as opposed to multiple operators for multiple machines.

The rigors of certifying a peening machine to a certain specification or audit are extensive. Instead of certifying multiple machines, hybrid machines need to be certified only once for multiple operations.

Blast machines that undergo regular maintenance result in reduced downtime and interruption to your operation. With hybrid machines, the need to maintain multiple machines is avoided.

Training requirement for operations personnel is minimized to a single machine as opposed to multiple machines.

The marginal premium for a hybrid machine, when compared to procuring two separate machines, is therefore well justified by the savings listed above.

#### Some specific applications

- Landing gears, where peening may be required in specific areas or in some cases overall ODs. Additionally, most applications will also require peening main and cross bores. Nozzles with

manipulation can be employed to peen OD areas. However, blast wheels are significantly more productive with their higher flow rate and coverage.

- Aircraft and fabricated auto wheels where blast wheels peen majority of the OD. Areas inaccessible by blast wheels are processed by nozzles.
- Parts with large surface areas and any kind of profile intricacy.

#### Where do we go from here?

With cost pressures from offshore manufacturing, it is time to tap into our history of innovative production skills. Our manufacturing has to get leaner and higher in productivity. In a manufacturing environment where most cost reduction initiatives have been exhausted, hybrid machines open avenues for new savings. Applications, such as the one introduced in the beginning of this discussion, where parts are being handled twice, with manual intervention, provide opportunities to realize immediate savings with the hybrid machine concept. ●



Kumar Balan is a Product Engineer with Wheelabrator Group Equipment/Process Design & Specification Conformance and was named 2006 Shot Peener of the Year. We commend Mr. Balan for advancing proper shot peening practices to the industry.



Operator interface with real-time monitoring in an electric control system

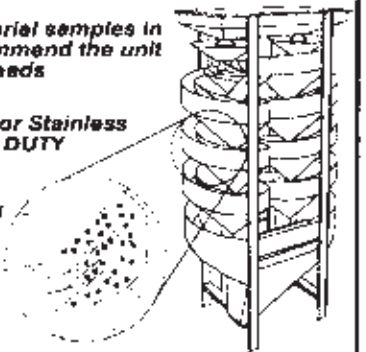


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# Review of Shot Peened Surface Properties

David Kirk

## INTRODUCTION

Shot peening is applied to components in order to induce improvements in their service performance. These improvements depend, to a large extent, on the properties of the shot-peened surface. Peening induces four major effects at the surface of components:

- Hardening
- Structural changes
- Compressive residual stress
- Surface dimpling

Fig.1 is a schematic representation of the effects.

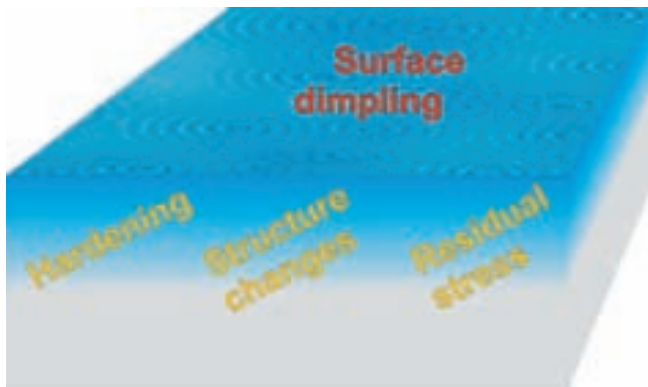


Fig.1. Major surface effects of shot peening.

Peening is, essentially, a surface hardening process that operates by plastic deformation of the component's surface. It follows that the component material must be capable of being plastically-deformed. The deformed surface layer has been called a "magic skin" because it generally imparts remarkable performance enhancement.

The most important service performance property is fatigue resistance – which is influenced by all four surface layer effects.

Fig.2 illustrates the effect of shot peening severity on a service performance property – such as fatigue resistance. Improvement reaches a maximum and then falls as excessive peening is applied. Property improvement does, however, depend upon post-peening factors such as loading, temperature and plastic strain.

Shot peening is a very 'forgiving' process, in the sense that even crude applications generally induce substantial property improvement. Optimal property improvement, however, requires a careful consideration of the peening severity that should be applied to particular components.

This article is a review of the major factors affecting the properties of shot-peened surfaces.

## IMPACTING SHOT EFFECTS

Each shot particle impacting a component's surface has a kinetic energy,  $\frac{1}{2}mv^2$ . Approximately half of this energy is transferred to the surface. Ninety percent of that transferred energy is converted into heat and 10% into the stored energy of cold work. It follows that we can think of the effect as that of a miniature thermal bomb. The plastic deformation creating a dimple occurs in a few

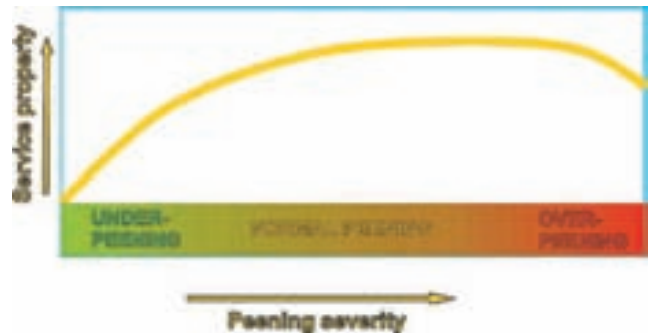


Fig.2. Schematic representation of service property change with peening severity.

millionths' of a second. Heat is generated around the dimple simultaneously – being caused by the plastic deformation. This adiabatic heating is absorbed relatively slowly by the surrounding material, which acts as a heat sink. Fig.3 is an 'artist's impression' of the heat generation distribution.

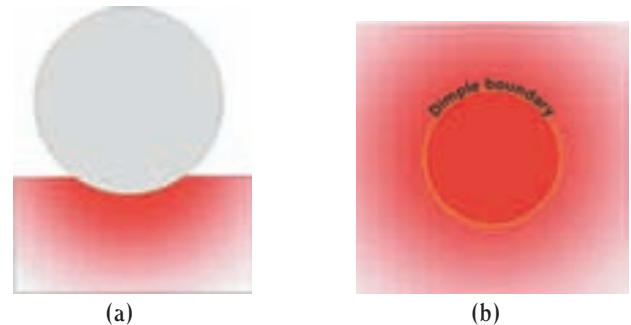


Fig.3. Heat generated just as impact is completed, (a) sectional and (b) plan view.

The maximum temperature in the heated zone will be at the surface and will be affected by multiple impacts which impart additive heat inputs. It is suggested that the temperature rise very near to the peened surface will be sufficient to cause a significant degree of stress-relief.

## WORK-HARDENING and WORK-SOFTENING

Our normal concept of work-hardening is in the context of simple low-strain situations. With standard tensile testing (where deformation is slow and uniform) the resistance to further deformation increases, albeit at a decreasing rate, with increase of strain. This is the standard text-book concept which is explained in terms of increased dislocation content and dislocation movement restrictions. Yield-strength and ultimate tensile strength can then be equated to hardness.

Peening imposes enormous amounts of plastic strain (rapidly and heterogeneously) on the surface layers of component material. With nominal '100% coverage' a large fraction of the surface will have been impacted at least ten times. Each impact corresponds to plastic deformation varying around 100% – equivalent to a plastic strain of 1.0. We therefore have a high-strain situation which requires a different concept of work-

*Continued on page 26*



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hardening (from that associated with tensile testing). Fig.4 illustrates the general features of hardness change with large plastic strain.

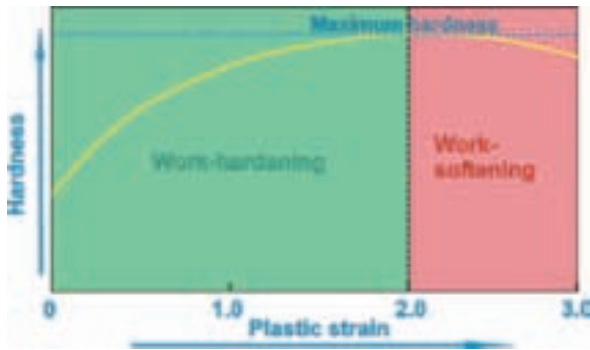


Fig.4 Effect of large plastic strain on hardness.

A maximum hardness is achieved at strains in the region of 2.0. As strain increases, more and more dislocations are being generated but, at the same time, more and more are being annihilated (for example by forcing positive and negative dislocations together). At a certain strain the rate of dislocation generation equals the rate of annihilation, so that we have reached maximum hardness. Larger strains will induce a degree of work-softening.

During peening it is suggested that the extreme surface hardness will reach its maximum value, even before full coverage is achieved, see fig.5.

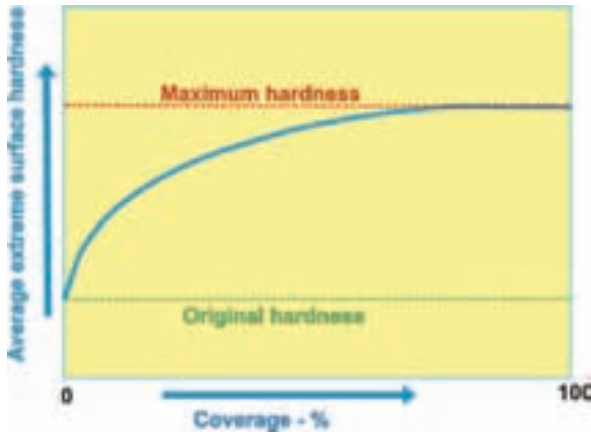


Fig.5. Effect of coverage on extreme surface hardness.

Throughout peening, work-hardening develops to greater depths. An increase of peening severity would not be predicted to increase the maximum surface hardness. It would, however, be predicted to increase the depth of the hardening effect - for full coverage situations. Fig.6 illustrates these predictions.

The massive localised strains, together with the heat generated by impacting shot particles, can induce changes/modifications to the major phases that are present. These changes generally have the effect of lowering the hardness. Peening then involves two mechanisms that affect hardness – peen-hardening and peen-softening. The combination of these two factors is modelled in fig.7. With this model it is assumed that peen-softening is capable of reducing the original material hardness to some minimum value. Superimposed peen-hardening gives a



Fig.6. Effect of peening severity on hardness profile.



Fig.7. Combination of peen-hardening and peen-softening.

hardness profile having a minimum well below the surface. Lower strains below that depth mean that peen-softening becomes less effective.

Some method of hardness measurement is needed in order to quantify hardness changes for specific situations. The commonest methods employed are micro-hardness and x-ray diffraction line breadth.

One exception to softening by peen-induced phase changes is when retained austenite undergoes transformation. Carburised components normally have substantial retained austenite content in the carburised and quenched surface. Peening transforms most of this relatively-soft phase into much harder martensite.

### STRUCTURAL CHANGES

Most metallic engineering components have a relatively-ductile matrix embedded with a variety of hard, relatively-brittle, strengthening, phases. Plastic strain on peening is then concentrated in the matrix. Some 90% of the energy absorbed from impacting shot particles is converted into heat energy. The remaining 10% is largely used to produce a vast increase in the dislocation population. This increase is from about  $10^6$  to about  $10^{10}$  (ten billion) dislocation lines per square millimetre. Such an increase and such numbers are difficult to visualise. On a scale of a square micrometer the increase is by a factor of 1 to 10,000. This scale is used for fig.8 where in (a) there is just one dislocation (represented as a single dot) whereas in (b) there are 10,000.

The dislocation distribution represented in fig.8(b) is extremely non-uniform. High-strain deformation has generated

Continued on page 28



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a sub-grain structure. This is a characteristic feature of heavily-worked metals. Peening changes the structure for each crystal from one of relative perfection to one where we have a 'mashed-up' structure - regions of intense dislocation content (sub-grain boundaries) surrounding regions of merely high dislocation content (sub-grains). When plastic strain has induced maximum hardening the sub-grain size has reached its minimum. The dislocation density in the sub-grain boundaries is then so high that they are semi-amorphous. Further plastic strain does not thereafter increase the dislocation content. We have a situation, because peening is an intermittent process, where impact-generated heat is softening some regions and hardening is occurring in other regions. These mechanisms balance to give a maximum average hardness.

A classic exception (mentioned previously) to the general soft matrix/hard phase mixture is that of carburised components. These generally contain a small proportion of a soft phase, retained austenite, embedded in a hard, martensitic, matrix. Martensite is too brittle to be able to withstand substantial plastic deformation. The major structural change that then occurs is that plastic deformation of the retained austenite phase transforms most of it into martensite.

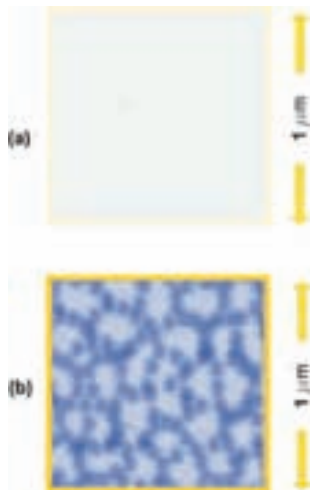


Fig.8. Model of dislocation distributions in (a) un-peened and (b) peened material.

### INDUCED COMPRESSIVE RESIDUAL STRESS

Shot peening induces a characteristic residual stress profile with extreme surface compressive stress at about 50% of the as-deformed yield strength, increasing with depth to about 60% of that yield strength before giving way to balancing tensile stress. Increased peening severity increases the depth at which the maximum compressive stress occurs. Fig.9 shows a typical residual stress profile. This general shape is well-established and varies only in terms of specific values.

It is proposed that the 'general shape' can be explained by the combined action of two factors. These are stress generation and stress relief. Fig.10 illustrates their separate effects.

The actual equations used in fig.10 were  $200 \cdot \exp(-1.5 \cdot x)$  for stress relief and  $-750 + 1250 / (1.5 \cdot \exp(5 \cdot x))$  for stress generation. Fig.9 used exactly the same equations – added together to give:  $\text{Residual stress} = 200 \cdot \exp(-1.5 \cdot x) - 750 + 1250 / (1.5 \cdot \exp(5 \cdot x))$ . The form of the stress relief curve is exponential – which is reasonable since 'recovery' mechanisms are involved. The form of the

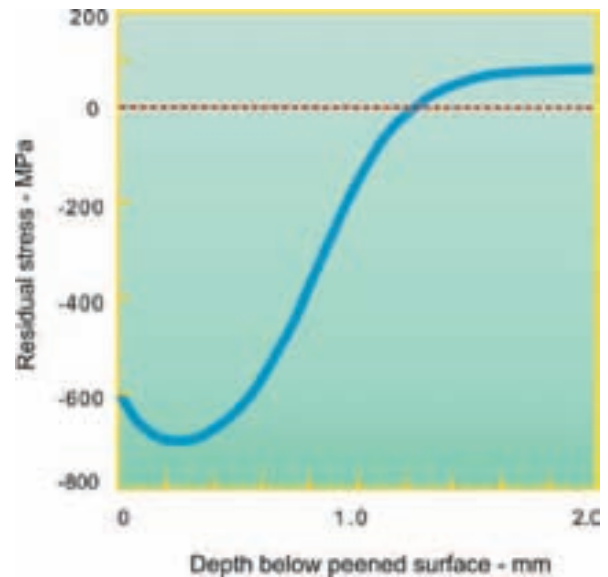


Fig.9. Typical residual stress profile induced by peening.

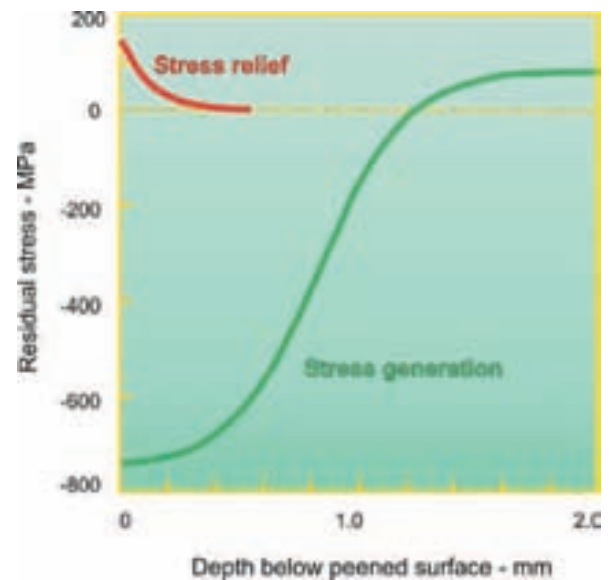


Fig.10. Constituent factors which combine to give the profile shape shown in fig.9.

stress generation curve is sigmoidal – which accommodates the duality of increases in both lateral strain and yield strength as the surface is approached. The relative magnitude of the stress-relief factor would be expected to increase with coverage and peening severity – both giving increases in surface instability, work-softening and induced heating.

### SURFACE DIMPLING

Shot peening induces a surface texture due to the superposition of indentations. Individual indentations have a 'favourable' profile. That is because the profile is made up of smooth curves – as illustrated in fig.11 (page 30). The stress required to make metal flow through a 90° angle is infinitely high. It is therefore impossible for dimples to have sharp-edged ridges.

A peened surface consists of over-lapping dimples, all of which have smooth-profile ridges. Fig.12 illustrates the effect of multiple indentations on surface smoothness. This is a profilometer trace along an Almen strip that has been peened to its

Continued on page 30

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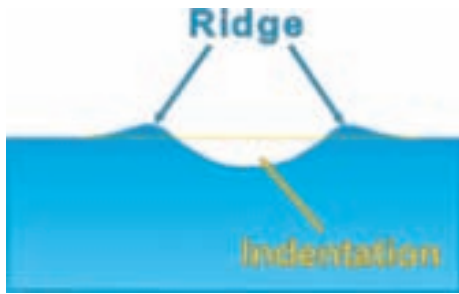


Fig.11. Profile of an individual indentation.

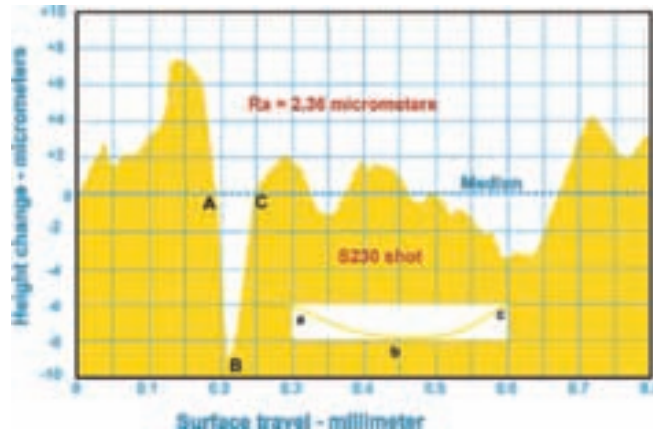


Fig.12. Surface profile of Almen strip peened to saturation point using S230 shot.

saturation point using S230 shot. Apparent roughness is an illusion because the vertical scale of distance is 25 times that of the horizontal scale. The illusion is removed in the inset abc which is an equal-scale version of the indentation ABC.

Roughness can be quantified by deriving the Ra value which, for peened surfaces, is approximately half of the average peak height above the median. Ra values are directly related to the size of shot used.

One considerable advantage of peened surfaces is that they can induce an element of hydrodynamic lubrication between moving parts. Essentially, oil dragged into the dimples generates a load-carrying pressure. This, in turn, reduces surface wear. Fig.13 models the load-carrying pressure effect.

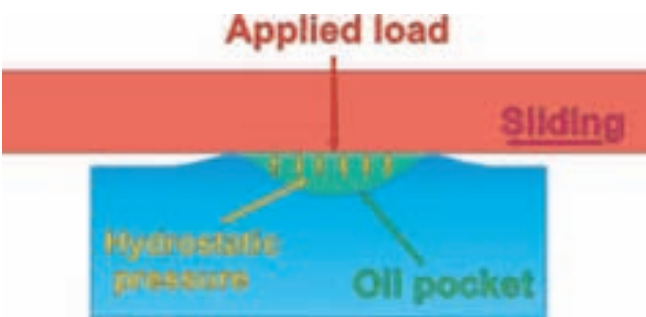


Fig.13. Model of hydrodynamic lubrication in peening dimple.

### STABILITY OF COLD-WORKED SURFACES

It is an inescapable law of physics that all systems try to revert to their lowest energy state. Reversion is accelerated by an increase of temperature. Various specifications, e.g. AMS 2430, indicate maximum post-peening temperatures appropriate to individual materials.

The several properties that have been increased by shot peening are all reduced after peening, to a greater or lesser extent, depending on the temperature. The reduction that normally occurs (in peened components) is achieved by crystallographic processes collectively called “recovery”. Recovery rates reduce exponentially with time and increase with temperature. This exponential effect is illustrated in fig.14. The “unacceptable operating temperature” shown would be equivalent to a stress-relieving temperature.

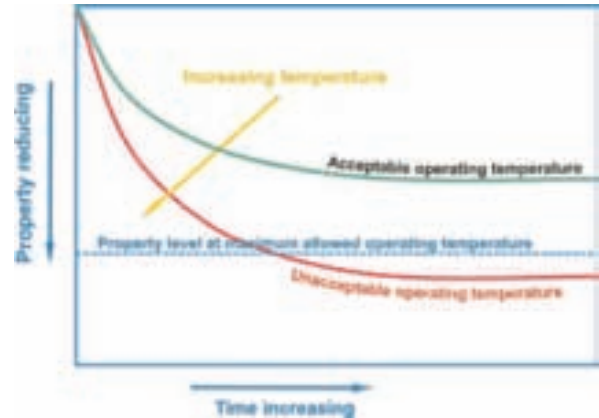


Fig.14. Property reduction caused by recovery.

### DISCUSSION AND CONCLUSIONS

This account has, of necessity, involved broad generalisations about the properties of shot peened surfaces. That is because component materials vary enormously in terms of their physical properties. Nevertheless it is felt that the general features described here are reasonable. The most important of these are that:

- 1) Multiple impacting invokes very high plastic strains with a maximum surface hardness being a characteristic feature.
- 2) The very high strain rates associated with dimple formation induce adiabatic heating that contributes to a degree of recovery of extreme-surface properties.
- 3) Heavily-deformed peened surfaces are thermodynamically unstable – requiring careful control of post-peening service temperatures.
- 4) A combination of strain-softening and surface temperature rise produces a reduction of the extreme surface compressive residual stress level.
- 5) Dimpling of peened surfaces can have a useful influence on high-load lubrication regimes.

There is a temptation to apply the principle of “more is better” in commercial shot peening. This is contrary to evolving knowledge that indicates that optimum service properties are developed by applying coverage that is nearer to the nominal 100% than, say, 300%. ●

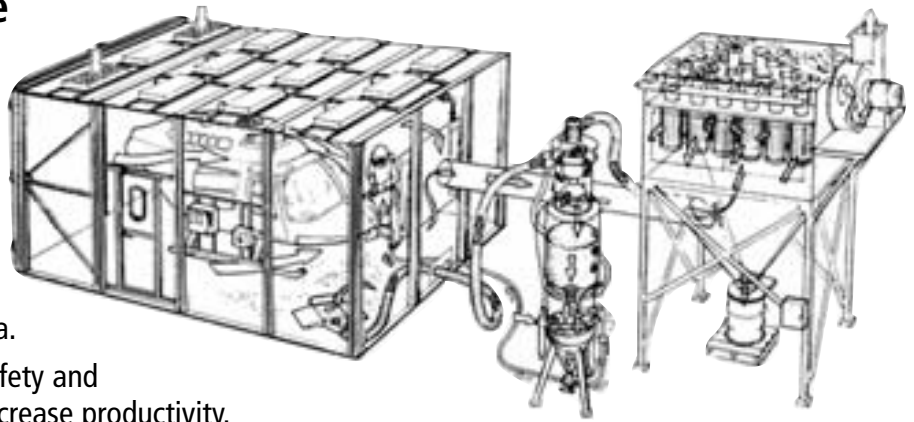


Dr. David Kirk, our “Shot Peening Academic”, is a regular contributor to *The Shot Peener*. Since his retirement, Dr. Kirk has been an Honorary Research Fellow at Coventry University, U.K. and is now a member of their Faculty of Engineering and Computing. We greatly appreciate his contribution to our publication.

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## New concepts for adapting manufacturing processes to a changing market environment

Two of the most important issues currently facing the automotive industry are:

- Reduction of vehicle weight for better gas mileage
- Shortening the times required to bring new vehicles to the market

The automobile companies are meeting these challenges with a combination of new materials, new manufacturing processes and new vehicle designs. This article describes a few examples of innovative shot blast applications helping automotive manufacturers in reaching the above goals.

There is a constant conflict in car design between the customer's desire for increased safety and comfort on the one hand and safety and environmental regulations on the other hand. In this context the design and manufacture of lightweight vehicles plays an essential role in automotive engineering. Increasing raw material cost, shortage of resources, emission guidelines and recycling requirements are just a few topics that are forcing the industry to make the design and manufacture of light vehicles an essential part of their product strategy.

Since the 1980's, aluminum, with its low specific weight of 166 lbs/cubic ft (2.7 kg/liter), has been the most popular material for light car components, including car bodies. New developments by, for example the steel manufacturer Thyssen-Krupp, with high-strength multi-phase steel have led to light weight steel car bodies in 2004.

In recent years, many important engine components like crank cases, cylinder heads and sumps are produced as cast magnesium alloys. With a specific weight of 107 lbs/cubic ft (1.74 kg/liter) the use of magnesium can result in weight savings of up to 25% when compared with aluminum. These changing material specifications require flexible manufacturing systems and the introduction of completely new processing methods.

### High-Performance Surface Finishing for Magnesium Bell Housings

A car manufacturer located in Southern Germany that had previously outsourced the shot blasting of transmission bell housings brought this process back in-house after a move from aluminum die castings to magnesium die castings. This move was made largely because of the need to speed up the production process while at the same time ensuring the highest possible levels of process stability.

This customer commissioned Rosler to design a highly efficient processing system for the deburring and surface finishing of the outer and inner surfaces of transmission bell housings. The Roboblaster RROB 800/1200-6 developed by Rosler met all of the customer's requirements for increased cost effectiveness and quality.

To achieve the tight cycle time of 26 seconds per work piece, the robot was equipped with a special gripping tool.



*Fully automatic blast system for deburring and surface finishing of transmission bell housings. The double gripper can pick up two parts simultaneously.*

The double gripper allows the robot to safely pick up and process two work pieces at a time. The bell housings are carefully moved into the blast chamber and rotate while being blasted. The patented cuff/seal system on the gripper ensures that the blasting chamber is immediately sealed off.

In the chamber, the bell housings undergo concentrated shot blasting for 20 seconds using six high-performance "Hurricane H40" blast wheels. Two of the wheels are mounted on the back wall of the booth in order to ensure that the interior of the housings is effectively shot blasted. During the parts loading/unloading step, pneumatically activated lids cover the blast wheel openings to protect against leakage of shot.

### Surface Hardening of Stabilizer Bars

As already pointed out, reduction of vehicle weight is a key issue in modern car design. A lightweight construction is usually a combination of modern and innovative materials, design features and special manufacturing methods. In the case of stabilizer bars, a material change requires careful analysis of all safety implications and high stress loads this component is subjected to. A market leader in the production of chassis components utilizes shot peening to improve the structural strength and fatigue life of stabilizers made from manganese steel. Improved residual stress values allow a weight reduction and extend the product life span.

Stabilizers are a familiar component of racing cars, where they are used just like suspension units to make individual adjustments to the chassis. The stabilizers reduce body roll that occurs in hard cornering or under extreme changes of load. The result is more precise steering, a reduced tendency to dive in fast corners and improved traction.

The steel tubes, which are around 4 feet long and have an external diameter of 1 – 1.5" and a wall thickness of approximately 0.12 - 0.2", undergo a fully automatic peening process with a Rosler tube shot blasting machine (RDR 100) in a three-shift operation. Rosler has adapted the continuous flow system specifically to meet the customer's processing requirements. The line speed is around 10 feet per minute, which corresponds to a cycle time of 28 seconds for each stabilizer.



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*This blasting machine is used to shot peen stabilizer bars made of manganese steel.*

To ensure even and all-round blast coverage, Rosler utilizes a skew roller parts transport system which rotates the parts and moves them forward at the same time. A high-performance 30 HP H-42 Hurricane blast wheel is used to shot peen the bars.

After peening, the bars pass through a blow-off unit, where any residual abrasive is removed from the outer surface. An abrasive removal unit is used to clear the inside of the bars of any remaining shot, before they are passed on to a robot.

The machine is equipped with two dust collectors that ensure that the level of dust released into the air is kept low enough to return the clean air back into the building.

In order to keep noise levels at 83 DBA or below, the blast wheel has also been fitted with a soundproof hood.

### Efficient Sand Removal

Aluminum is the undisputed leader of the lightweight materials used in the automotive industry. Aluminum components are generally produced as die- or sand-castings.

Sand castings must undergo a thorough sand removal as well as a general surface finishing. In order to automate the process of removing residual sand from a wide range of aluminum parts, and at the same time to ensure the best process stability, a well-known producer of sand cast aluminum components uses a continuous flow wire mesh belt machine (RDGE 800-4) from Rosler. This high-performance machine equipped with four "Hurricane" blast wheels removes not only residual sand from the parts but produces an all-round matte finish.

This particular automotive parts supplier needed a more cost-effective blasting system for this special task. As a result of the wide variety of parts being processed, too much manual labor was involved in loading and unloading the existing overhead rail machine and removing the residual abrasive.



*This skew roller conveyor moves the parts forward and rotates them at the same time.*

The new continuous flow wire mesh belt machine is designed to optimize the sand removal process. In order to remove all traces of sand, the RDGE machine is equipped with an "intelligent" separation system in the form of a continuous flow rotating drum, which is designed similar to a tumble belt machine. This unique system not only tumbles the parts but also moves them forward at a constant speed. The tumbling mill consists of a large number of polyurethane rods which prevent part nicking and damage during the tumbling process.

### Overhead Monorail Machine with Level Adjustment

A cast aluminum component manufacturer no longer uses a horizontal continuous flow system for shot blasting large parts. Instead, a continuous flow overhead rail system with level adjustment, seven hooks and up to 15 parts per hook is used to deburr and surface finish a variety of parts. The RHBD 15/20 T overhead rail machine was designed by Rosler for high-performance, continuous processing of sensitive or very large work pieces. It utilizes 3 blast wheels for intensive and fast blast cleaning. The machine can be integrated into an automatic production line and, because of the level adjustment mechanism, can easily be loaded and unloaded either manually or by robot. ●



*Because of the height adjustment of the monorail transport system, this continuous overhead monorail blast system can be easily loaded, either manually or by robot.*

# Industry News

New Products ■ New Companies ■ Awards ■ Upcoming Events ■ People in the News

New paper from Chinese researchers available at [www.shotpeener.com](http://www.shotpeener.com)

Ru Jilai (Metals and Chemistry Institute of China Railway Science Academy) and Wang Renzhi (Beijing Institute of Aeronautical Materials) have submitted a research paper for distribution at [www.shotpeener.com](http://www.shotpeener.com). We are pleased to reprint the abstract below and the complete paper is available at the web site.

## Effect of Shot Peening On Fatigue Behavior of 7055-T77 Aluminum Alloy

Abstract: The effect of shot peening on 7055-T77 aluminum alloy has been investigated. 7055-T77 is a high strength alloy with microstructure of coarse grains and a pronounced metallurgical texture, both resulting from its thermomechanical processing. Considerable improvement of fatigue strength was achieved with the changes of microstructure and the introduction of compressive residual stresses via shot peening. An x-ray diffraction photographic method was found very useful to measure the depth of the shot peening plastic deformation layer which otherwise is very difficult to measure by customary diffraction methods because of the microstructure and texture..

Keywords: shot peening; texture, fatigue, residual stresses

## Coyote Enterprises launches revamped web site

Coweta, Oklahoma. After several months of hard work and revisions, Coyote Enterprises, Inc. has re-launched their web-site ([www.coyoteparts.com](http://www.coyoteparts.com)). Improvements over the previous site include: pictures and specifications pages for most of the common machines Coyote builds, a parts and assemblies page that includes an alphabetical and numeric parts list, a page for Coyote's popular Rim-Loc blast wheel conversion, a brochures page where viewers can open and print off a two-page pdf brochure, and a specials page that will list items with special pricing or availability. Jim Goff, CEO of Coyote Enterprises, states, "We knew we needed to improve upon our original site, and create a useful tool for our customers and distributors. Almost everyone we work with has some form of internet access, and this gives us a way to provide more information in a convenient and timely fashion. We anticipate future revisions or additions, but this gives us a much better base to work with, and we look forward to any suggestions on how to make our website more beneficial to our customers. Coyote Enterprises, Inc. is in their 9th year of operation and has recently appointed David Horsley as their Sales/Marketing Manager.

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# Planning, Communication and Documentation Lead to a Successful Purchase

Herb Tobben

**I**n my numerous years in this business, I've been fortunate to work with many skillful and intelligent engineers and plant managers, well-schooled in their particular lines of work and areas of expertise. They bring me projects that challenge me, which makes my job interesting, as I enjoy solving problems. While my involvement is always at the front-end of the project, my objective is a satisfied customer for the long-term. Solving the problem in the lab is only part of the successful purchase equation.

Frequently, customers are bringing a process in-house that they had been jobbing out and, as a result, are now investing in new equipment. Much of the time, these customers don't have a complete grasp of the impact of their decision. In the ideal situation, we process their samples and work together to achieve often lofty objectives and expectations.

The early discussions entail general process requirements and whether or not an automated system is needed. Usually, there are two primary drivers leading to the decision to choose automation: high production volume and/or the need for precision processing and exact repeatability. For some jobs, it is essential to produce identical parts each and every time, and that requires removing the human element.

Sometimes, without the customer realizing it, we've worked through a long list of requirements, which, when carefully considered as a whole, form the basis for the design of the machine that will meet their production goals and budget constraints. Whether the process is shot peening or blast cleaning or finishing, the preparation drill remains the same. Fully understanding the process (that's where I come in) and considering the gamut of work-flow issues (considerations and limitations that exist at the customer's facility) are essential to a successful outcome. To help my customers, I've come up with two "top ten" lists of planning considerations.

The first one involves what I call the environmental considerations of their business and workplace, which include:

- 1.** Production objectives—it's important to consider the number of parts that need to be completed in a given period. How the production rate can be met must include allowances for the loading and unloading of parts by the operator. It's important to set reasonable and achievable goals.
- 2.** Available air supply and electrical service—all blast processes require dry air of sufficient volume and pressure for the number and size of nozzles or orifices specified. A baseline for the air supply should be established. It's important to understand that the volume necessary for operation must take into consideration wear of nozzles, which as they wear consume more air. Sufficient electrical amperage is needed to power blowers and other equipment. How much is currently available and will additional amperage be needed?
- 3.** Available space in and around the process area, the height, width, and depth needed for the equipment plus ducting, space available for parts staging, and for access to the equipment for

service and maintenance. Are there ceiling height or other limitations?

- 4.** If the equipment will require a pit, are there water-table issues to consider?
- 5.** Condition of the parts prior to blasting—are they greasy, or hot, or cold, or do they have flashing that might impact the blast process equipment? Hot parts can melt plastic media or be too hot for the operator to handle. As parts cool, condensation can cause moisture issues. Moisture is the enemy of blasting.
- 6.** Pre-process treatment before blasting/peening—how will the degreasing, cooling, warming, or other prep work take place—where and by whom and how will the part be brought to the blast cabinet or room?
- 7.** Post-process part handling—where will the parts go next and how will they get there? Will the same operator who services the blast cabinet be responsible for parts' transport? How will this affect production rate?
- 8.** The production line—how will the blast cabinet fit into the existing work-flow—is there sufficient space for one or more operators to work in the area? Will their movements be efficient?—wasted movement costs money in indirect labor.
- 9.** Skill level of the operator(s)—will they be capable of working with PLCs (programmable-logic controllers) or should the equipment be equipped with manual push-buttons?
- 10.** Budget as it relates to current and future production requirements—it's wise to try to anticipate changes to production requirements in the near and medium term. A rule of thumb might be to build in to the project an increase of 10% to 20%. Sometimes, that is not possible, of course. But the issue should be carefully considered.

The second list involves the process, the technical considerations surrounding the blasting or shot peening, including:

- 1.** Recognizing the need to learn about shot peening and understanding the meaning of intensity, saturation, and coverage.
- 2.** Reading and understanding the applicable specification as well as the requirements shown "on the print" for the part to be processed. For shot peening, there are specific documents that govern all aspects of processing a particular part.
- 3.** Carefully reviewing the geometry of the part that will dictate how the blasting or peening will be done. The shape and size and configuration of the parts impact how they are processed. This is one of the reasons that sample processing in my lab is so important. Each and every part has specific process differences. Some parts have small holes that require pressure blasting with a side-angle lance.
- 4.** Designing and fabricating the part holding fixtures for easy part placement and removal—

*Continued on page 40*



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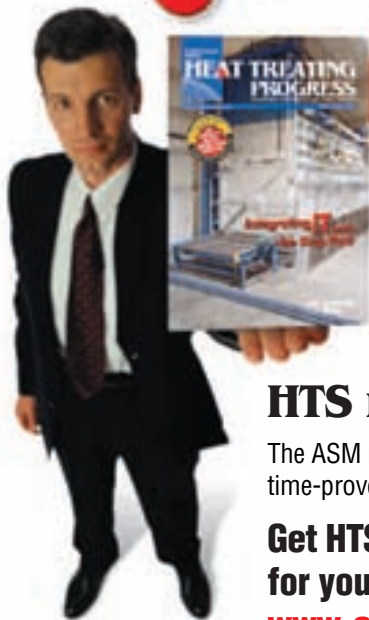
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# Q. Where can you find answers to your heat treating problems?

# A. HTS membership.



Ever tried to straighten out a problem between a material supplier and heat treater when both are pointing at the other guy?

Ever had a good part come back from heat treating distorted or with the wrong properties?

Ever wonder why a part or die just doesn't seem to work right, or try to figure out why a part costs so much?

## HTS membership has the answers.

The ASM Heat Treating Society, the world's largest society for heat treaters, has you covered with time-proven solutions that you can apply TODAY and new ideas that will help you TOMORROW.

**Get HTS membership working for you. Join today at**  
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**Heat Treating Society**

An Affiliate Society of ASM International

the fixturing can impact production rate.

**5.** Is masking necessary—depending upon the desired blasting or peening coverage, designing and fabricating appropriate masking is critical to ensure that the integrity of the part is maintained and covered as necessary and the area to be blasted is properly exposed.

**6.** Selecting the type and size of the blast media. Here again, sample processing is critical to making the proper choice. Lab tests and understanding the environmental considerations that impact media selection would be done during sample processing.

**7.** Is media classification required? In shot peening, keeping a good working mix of media requires classification equipment that will dispose of over-sized or under-sized particles and produce a mix that will ensure process consistency. Separation equipment can also discard unwanted out-of-round or broken media.

**8.** Controlling the process and ensuring repeatability—will the process require computer controls to meet the relevant specifications?

**9.** Achieving desired peening intensity—deciding whether suction or pressure blasting will produce good parts—here again, careful testing and sample processing will dictate how a part needs to be processed.

**10.** Establishing required recordkeeping procedures. Attention to detail is critical in shot peening operations. Specifications frequently dictate the scope and methods to be put into place to satisfy the end user of the parts, which may go into aircraft engines, automobiles, spacecraft, or other equipment that depend on proper procedure to ensure public safety. In summary, if I've learned anything over the years, it is that the human animal detests filling out forms. Unfortunately, this distaste for procedure represents perhaps the greatest obstacle to ensuring a successful outcome.

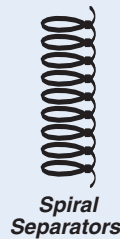
The two lists I've offered are intended to encourage the free flow of information between the customer and the equipment supplier. Each bit of information represents a springboard for development of a comprehensive plan to design and deliver equipment that will achieve the customer's objectives and expectations. Communication is key. Documentation is extremely useful both for the customer and the supplier as, on occasion, personnel changes occur during the procurement process. A seamless transition is possible only when everything is spelled out and documented as the project moves forward. Documentation is useful for design reference and for being the brains that recollect an agreement to certain stipulations. It provides insurance and peace of mind...a small effort for a large pay out. Certainly, each and every investment in new equipment demands a measurable payback. Careful planning, good communication, and diligent documentation are keys to a successful outcome. ●

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Got a question about shot peening, abrasive blasting, or sample processing? Clemco can help. Call **Herb Tobben** at 1-636-239-8172 or email him at [htobben@clemcoindustries.com](mailto:htobben@clemcoindustries.com). Herb Tobben is Sample Processing Manager for the ZERO Automation product line at Clemco Industries Corp. He is a regular speaker at the Electronics Inc. Shot Peening Workshop.

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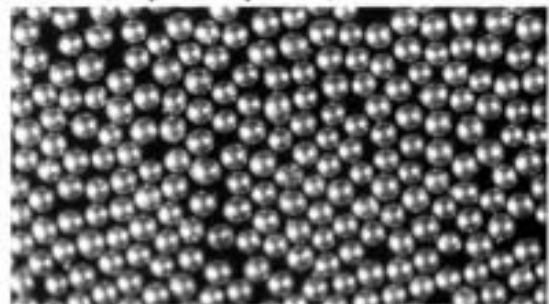
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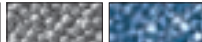

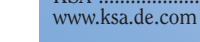



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## The Parting Shot Jack Champaigne

# Crossing the Bridge

### New hotel for upcoming Arizona workshop

We have so many workshop registrations that our original hotel cannot accommodate us and we have found a larger facility. Both hotels are making the transition as smooth as possible for us and our attendees. We will be taking care of all arrangements for registrants and will contact you with information on the new hotel, the Crowne Plaza San Marcos Resort. This is a beautiful resort and a great location for the workshop and trade show. We look forward to seeing you there.

### ICSP10 is quickly approaching

This will be a remarkable event, thanks to the hard work of the organizing committee. As of August 24, 2007, 91 abstracts had been submitted. For those of you that have never attended an International Conference on Shot Peening, it is great way to be on the cutting edge of industry knowledge. For more information, email the Conference Secretary, Dr. Yoshihiro Watanabe, at: [y\\_watanabe@toyoseiko.com](mailto:y_watanabe@toyoseiko.com)

**W**e have a saying in America, "We will cross that bridge when we get to it." It means that we will delay dealing with a problem until we can no longer avoid it. That time is now for our overworked and aging bridges.

At the time of publication, we have no proof that the Minneapolis bridge collapse was due to metal fatigue of crucial weld joints. But our research has yielded that weld joints could be a weakness in U.S. steel truss bridges built in the 1960s. I believe, without a doubt, that a controlled shot peening process is a solution. As Sylvain Forgues mentioned in his article on page four, the library at [www.shotpeener.com](http://www.shotpeener.com) has 120 articles, written by researchers around the world, on the shot peening of welds. Mr. Forgues is the Canadian distributor for the StressVoyager®, a product manufactured by Sonats. The StressVoyager, portable and environmentally-friendly, is ideal for peening bridge welds. "Sadly, sometimes a tragic event like the bridge collapse makes people think outside the box and consider something new like needle peening," said Mr. Forgues. Unfortunately, shot peening is not a widely-used maintenance or repair treatment for U.S. bridges at this time. Since most bridges are government-owned, pursuing this business is difficult and waiting for the business to come to us is frustrating especially when we know that shot peening makes bridges safer and can save lives.

Some in our industry are successfully marketing their services for bridge maintenance/repair and new construction. Metal Improvement Company promotes their on-site shot peening services for welded fabrications, including bridges. Wheelabrator Group is exhibiting at the World Steel Bridge Symposium and Workshops in New Orleans this December. Wheelabrator Group will exhibit shot peening machines for new bridge components. **The Shot Peener** staff is continually exploring new avenues for shot peening products and services. The readership to our magazine is far-reaching and we put the magazine in the hands of people that want to learn about the process and its benefits to their products. We are always amazed at the requests we receive for the magazine from unexpected sources.

That's one of the many reasons **The Shot Peener** will always be a free publication—its purpose is to spread the word to as many people as possible that we have a solution for metal fatigue problems. It's a good feeling to be in a business that can make travel, in so many forms, safer. We can all be confident in crossing that bridge. ●





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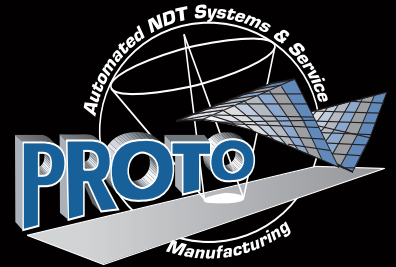
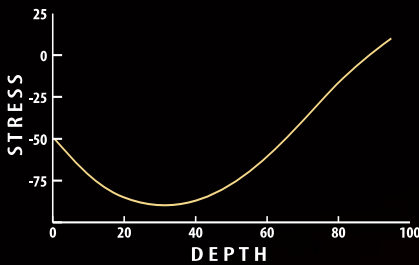


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