Winter 2024
Volume 38, Issue 1 | ISSN 1069-2010

The Shot Peener

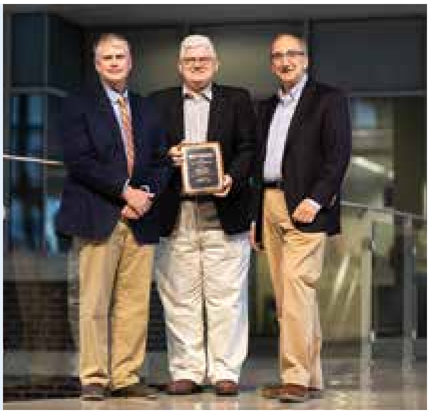
Sharing Information and Expanding Global Markets for Shot Peening and Blast Cleaning Industries

The 2023 Shot Peeners of the Year
Professors David Johnson, Dave Bahr, and Paul Mort of Purdue University

6

The 2023 Shot Peeners of the Year

Congratulations to our 2023 Shot Peeners of the Year—Purdue University Professors David Johnson, Dave Bahr, and Paul Mort. Since 1992, *The Shot Peener* magazine has recognized individuals for their contributions to the shot peening industry and scientific community.



10
Extending the Reach of Conformance
Kumar Balan discusses the basics of conformance to specifications. He also covers his concept for non-aerospace companies he calls "conformance lite."

16
Nanofluids: Bringing Nanotechnology to CNC Machining
A new coolant technology offers advantages in performance, productivity, and environmental friendliness.

18
Shot Peening Research
A team of industry leaders and academics, including Sara Bagherifard and Michele Bandini with Peen Service, and Mario Guagliano with Politecnico di Milano, released their research on Gradient Severe Shot Peening.

26
Hardness Testing
Dr. David Kirk's article concentrates on the applications of the Rockwell test. He addresses the central problem that arises when different companies test nominally identical samples such as batches of Almen strips.

34
An Aerospace Solution
Specializing in blasting large turbine engine components, Clemco Industries' client faced a significant challenge due to a part with a substantial circumference, creating difficulties in reaching specific blasting areas.

40
Press Release
Sinto America announces a significant collaboration between Sinto America and Pulstec USA, building upon their Japanese parent companies' successful alliance that has existed for many years.

42
2023 USA Workshop Highlights
A recap of the workshop through photographs.

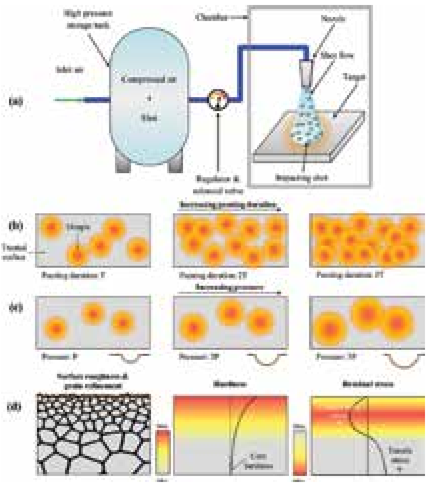


Illustration from the shot peening research article on paper 18

Clemco Industries' client specializes in blasting large turbine engine components

The Opening Presentation of the 2023 USA Shot Peening Workshop

OPENING SHOT
Jack Champaigne | Editor | The Shot Peener

This and That

About Purdue University
Purdue University is one of the top Engineering schools in the United States. In fact, US News and World Report ranked Purdue University as #4 in the 2023 "Best Engineering Schools."* Their School of Materials Science has launched a Center for Surface Engineering and Enhancement (CSEE) and Electronics Inc. is one of the founding members. Several projects at Purdue have already made large contributions to the shot peening industry. A final report on computerized image analysis for shot peening media is being studied by SAE as a possible alternative to sieve analysis and microscope inspection of media.

Purdue will host the 15th International conference on shot peening (ICSP-15) in September of 2025 on the Purdue campus with Professor Dave Bahr as the conference chairman. Learn more about the conference at www.icsp15.org.

*www.usnews.com/best-graduate-schools/top-engineering-schools/eng-rankings

News from Electronics Inc.
The year 2024 will be a big one for Electronics Inc. It's the company's 50th anniversary. EI is very grateful to the employees, customers and vendors that made this milestone possible.

In product news: Model LM MagnaValve for wheelblast machines is now available for 1000 or 2000 lb/min applications. Lower cost and simpler mounting configurations replace the LP and VLP MagnaValves. The valves are compatible with model AC-24 Controller motor amperage control.

SAE News
The Spring meeting for SAE Surface Enhancement will be May 7, 2024 in Troy, Michigan. The Fall meeting will be held October 18th in Colorado Springs, Colorado at The Antlers Hotel after the 2024 Shot Peening Workshop from October 15-17.

2023 USA Workshop
Three people passed the level three shot peening examination. Congratulations to Fred Carrera, Elijah Lisyany, and Nicholas McDaniel. There were over 72 companies in attendance with 118 Achievement Certificates issued.

EI provided the meeting rooms for the SAE Fall meeting at the annual workshop, offering the meeting space for over 30 participants and the WiFi connectivity for WebEx participation for both domestic and foreign members.

The attendees at the 2023 USA Seminar and Workshop in Scottsdale, Arizona.

THE SHOT PEENER

Editor
Jack Champaigne

Associate Editor
Kathy Levy

Publisher
Electronics Inc.

For a free subscription of *The Shot Peener,* go to www.theshotpeenermagazine.com

The Shot Peener
56790 Magnetic Drive
Mishawaka, Indiana, 46545 USA
Telephone: 1-574-256-5001
www.theshotpeenermagazine.com

2023 Shot Peeners of the Year

Professors Dave Bahr, David Johnson, and Paul Mort with Purdue University

CONGRATULATIONS to our 2023 Shot Peeners of the Year—Purdue University Professors Dave Bahr, David Johnson, and Paul Mort. Since 1992, *The Shot Peener* magazine has recognized individuals for their contributions to the shot peening industry and scientific community.

According to Tom Brickley, Vice President of Electronics Inc., "Purdue University is one of the top engineering schools in the United States. For years, these professors have dived into shot peening research beyond the surface (no pun intended) of traditional thinking. They are not only engaged in their own research, they are taking shot peening interest to their students and they founded the leading industry university research alliance for the metal surface finishing industry—the Center for Surface Engineering and Enhancement (CSEE). They will host the 15th International Conference on Shot Peening on the Purdue campus. The EI staff is very pleased that *The Shot Peener* magazine has recognized their contribution to our industry."

Professor Dave Bahr is the head of Purdue University's School of Materials Engineering (MSE) and the Chairman of the 15th International Conference on Shot Peening (ICSP15) to be held at Purdue on September 22-25, 2025. Paul Mort is a Professor of MSE at Purdue and David Johnson is an Associate Professor of MSE at Purdue as well as a Vice-Chairman of ICSP15.

Professor Bahr received his BS and MS in MSE from Purdue University 1992 and 1993, and his PhD in MSE from the University of Minnesota in 1997. He has been Head of the School of MSE at Purdue University since 2012.

Professor Mort received his BS in Ceramic Engineering from the Massachusetts Institute of Technology in 1978 and his PhD in Ceramic Engineering from Rutgers University in 1993.

Professor Johnson received his BS in Engineering Science and Mechanics in 1987, his MS in 1990, and his PhD in 1994 in Metallurgical Engineering from the University of Tennessee. He completed his postdoctoral studies followed by a research associate appointment at Kyoto University for four years, and has been an associate professor at Purdue in the School of MSE for 23 years.

The Shot Peener: Professor Bahr, please tell us about your experiences with shot peening.

PROFESSOR BAHR: My first affiliation with Shot Peening was in 2015 when we established the Center for Surface Engineering and Enhancement (CSEE) at Purdue. CSEE was started with funding from Electronics, Inc. and The Cummins Engine Company to conduct industrially relevant graduate research on shot peening as well as other surface engineering topics. In particular, some of the key results from CSEE's initial phase of operation included some of the first computer simulations of residual stresses that arise during shot peening.

The modeling that took place used finite element analysis as the basis for the derived stress fields. In conjunction with the modeling, extensive experimental was also undertaken to ensure that reasonable correlations existed with the models that had been developed. Since CSEE's initial phase, I've been continued to be involved with a variety of shot peening studies including additional computer peening simulations and development of Almen strip stress analyses. Finally, in my role of Executive Director of CSEE, which now has 13 company members, I've been pleased to be engaged with multiple projects involving shot peening.

The Shot Peener: Professor Mort, please tell us about your experiences with shot peening.

PROFESSOR MORT: My experience with image analysis of particulate material dates back to my technical roles with Procter & Gamble where we implemented image analysis as an in-line process control tool for detergent granulation. Shortly after I arrived at Purdue in 2019, I was introduced to shot peening in conjunction with an undergraduate project—I was the faculty advisor—where we examined the possibility of using image analysis on peening media. Over the course of the subsequent years, I've been engaged in multiple projects involving using image analysis for size and shape characterization for specification development.

The image derived data has also been applied in residual stress modeling and peening simulations using a process-flow sheet. Some of our early stage work with image analysis has facilitated the publication of an initial paper titled "Stress Field Modeling in Context of Industrial Shot Peening" in *The Shot Peener*. This paper was published in July 2023 and co-authored with Langdon Feltner, a PhD student in MSE at Purdue, whose research in shot peening is being funded by CSEE.

The Shot Peener: Professor Johnson, please tell us about your experiences with shot peening.

PROFESSOR JOHNSON: I've enjoyed having the opportunity to be a faculty advisor for several shot peening projects involving both graduate and undergraduate students during the last number of years. Most of the activities have been oriented around the physical modeling of Almen strip attributes.

We've studied the effects of residual stress, hardness, thickness and other parameters to understand peening responses arriving as a result of imparted work. Another aspect of my research has involved the use of the physical models to understand intensity limits for various strips.

The Shot Peener: Is there any additional input the Professors would like to provide?

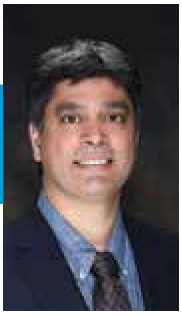
PROFESSOR BAHR: I'm confident I'm speaking for the three of us as well as all the students who have been involved with the shot peening research at Purdue when we express our deep appreciation for being recognized with this prestigious award. All three of us have had great opportunities to be involved with leading companies that are involved in the shot peening industry. We believe it's been "win-win" for both ourselves and the companies and inasmuch look forward to being engaged in shot peening for the long term.

Finally, in preparation for the 2025 International Shot Peening Conference at Purdue, we are planning to submit several papers to *The Shot Peener* to provide more detail about Purdue's efforts in shot peening.

Jack Champaigne, Editor of The Shot Peener magazine, presented the 2023 Shot Peeners of the Year award to Professor Dave Bahr at the 2023 Shot Peening workshop. Professor Bahr accepted the award on behalf of the two other recipients—Professors Paul Mort and David Johnson.

Past Shot Peener of the Year Recipients

2022	Dr. Yoshihiro Watanabe	Toyo Seiko
2021	Michael Schmidt	GE Aviation
2020	Dave Barkley	EI Shot Peening Training
2019	Kelly McClurg	Bell Textron Inc.
2018	Yuji Kobayashi	Sintokogio
2017	Dominic Cimino	Curtiss-Wright Surface Technologies
2016	Colin McGrory	Sandwell UK
2015	Sylvain Forgues	Shockform
2014	Mike Wern	Engineered Abrasives
2013	Scott Hatfield	Medtronic Spinal
2012	Hali Diep	Boeing Research and Technology
2011	James Kernan	U.S. Army Aviation and Missile Research, Development and Engineering Center
2010	Herb Tobben	Clemco Industries
2009	Michelle Bandini	Peen Service
2008	Holger Polanetzki	MTU Aero Engines
2007	Ken l'Anson	Progressive Technologies
2006	Kumar Balan	Wheelabrator Group
	Dr. John Cammett	Materials Engineeering Division, Naval Aviation Depot
2005	Marsha Tufft	GE Aircraft Engines
	Prof. Helmut Wohlfahrt	Technical University of Braunschweig
2004	Walter Beach	Peening Technologies of Connecticut
	Dr. Eng. Katsuji Tosha	Meiji University
2003	Paul Prevey	Lambda Research
	Dr. Niku-Lari	IITT International
2002	David Francis	Metal Improvement Company
	Shaker Meguid	University of Toronto
2001	Dr. David Kirk	Coventry University, U.K.
	Dale Lombardo	GE Aircraft Engines
	Bill Miller	The Boeing Company
2000	Jonathan Clarke	Delta Air Lines
	Prof. Lothar Wagner	Technical University of Brandenburg
1999	Andrew Levers	British Aerospace Airbus
1998	Wolfgang Linnemann	Kugelstrahlzentrum Aachen
1997	Dr. Ing. R. Kopp	Institute Metal Forming of RWTH
1996	Dr. M.C. Sharma	Maulana Azad College of Technology
1995	Dr. Kisuke Iida	Meiji University
1994	Charlie Barrett	Metal Improvement Company
1993	Pete Bailey	GE Aircraft Engines
	Bob Thompson	GE Aircraft Engines
	Jim Whalen	GE Aircraft Engines
1992	Charlie Mason	Menasco Aerospace Ltd.



AN INSIDER'S PERSPECTIVE
Kumar Balan | Blast Cleaning and Shot Peening Specialist

Extending the Reach of Conformance

BASICS OF CONFORMANCE

Industries that manufacture and process mission-critical components are generally better tuned to conformance. Aerospace, Medical, and to an extent, Automotive, are a few examples. The purpose of conformance is to ensure standardization of a process. Conformance also moderates suppliers of parts and services to such industries so that the end-user can rest assured that the inputs have been designed and manufactured to help them achieve standardized and expected results.

The shot peening Industry refers to multiple specifications/documents, including SAE Recommended Practices for Surface Vehicles, AMS for Aerospace Material Specifications, and a healthy cross-referencing between them. SAE and AMS documents cover both process and product specifications. In addition to these primary specifications, most Aerospace primes and Automotive OEMs have their localized specifications that are generally based on the source SAE and AMS documents.

For most that work with these specifications, the compliance process also involves an audit. Aerospace primes and MROs rely on audits such as Nadcap (formerly North American Defence Contractors Accreditation Program) administered by PRI (Performance Review Institute) to validate whether the end user has interpreted and geared their equipment and processes to peen correctly.

WHAT IS INVOLVED?

Though the scope of our discussion will not permit a line-line review of a specification, I have used AMS2430 (Shot Peening) to identify and illustrate some of the key tenets of a process document. This document is one of the successors to AMS13165 and MIL-S-13165C after their cancellation. It validates both manual and automated peening if the former technique is permitted by the part owner.

Foremost among inputs that define any peening (or blast cleaning) process is the blast media. AMS2430 lists criteria to deem whether new and in-process media meets the requirements of screening (size), and shape. If the product fails to meet the requirements, it may be due to bad chemistry, microstructure and a variety of factors that are covered in the product specification (AMS 2431/x), whose conformance is the responsibility of the media supplier with subsequent verification by the end-user. The specification also describes the process to inspect media size and shape. A well-drafted specification describes what needs to be done and how to do it without specifying the exact make of tool that should be used. AMS 2430 is no exception to this rule.

The specification extends its reach to list machine features that will result in a repeatable process. Examples include description of automation (moving part to media stream and vice versa), part presentation, ventilation and alarms. A brief description of shot peening deliverables such as intensity and coverage, their respective measurements/inspections, including masking, is part of this document.

A detailed process parameter sheet requirement list is part of this specification to characterize the process being adopted. This sheet identifies practically every aspect of the process and is a very useful tool to follow during an audit. The process parameter sheet or the technique sheet will be approved by the part owner prior to peening production parts and is also reviewed as part of the audit documentation. The specification also contains information pertaining to verifying intensity at requisite intervals.

It is relevant to note that though the specification (and audit criteria) describes inspection techniques for media size, it does not stipulate that the machine be equipped with a classifier. It does stipulate the frequency of inspection if a classifier (identified as "separator" in the document) is not part of your machine. However, with experience, we do know that conformance is a lot more straightforward with such process control components installed in the machine. The same goes for media flow rate, shape control, velocity, etc.

Distinct appendices are part of this document that describe Manual and Batch Peening. A quick note on batch peening will be relevant here, especially for our Aerospace customers that may be unfamiliar with the process. Batch peening involves peening parts in a barrel or tumblast in multiples without individual fixtures. Parts are exposed at random to the media stream generated commonly by a blast

WE HAVE THE WORLD COVERED
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
HIGH DURABILITY CUT WIRE SHOT (REDUCTION OF WASTE)
NON-DISTRUCTIVE INSPECTION DEVICE (POSITRON SURFACE ANALYSIS)
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
PEENING PROCESS USING NEEDLE PEENING EQUIPMENT FOR WELDED INFRASTRUCTURE (BRIDGE AND VESSEL)
DUST SOLIDIFYING DEVICE. RECYCLING INDUSTRIAL DUST WASTE.
COMING SOON
TOYO SEIKO CO.,LTD
The World's Leading Company for Shot Peening
Thailand
Tel:+66-324-0046
Fax:+66-2-324-0047
info@toyoseiko.co.th
Japan
Tel:+81-567-52-3451
Fax:+81-567-52-3457
toyo@toyoseiko.co.jp
toyoseiko.co.jp
TOYO SEIKO NORTH AMERICA Inc.
South Bend, INDIANA
North America
+1 (574)-288-2000
sales@toyoseiko-na.com
toyoseiko-na.com
TOYO SEIKO SIGNS A PARTNERSHIP DEAL WITH
winoa
preparing tomorrow's surfaces

wheel, and sometimes with nozzles. One of the first applications that discovered shot peening and used it to peen parts was in automotive, and automotive valve springs continue to be peened in batch-type tumblast machines.

When it pertains to audits, most Primes such as Airbus, Boeing, and GE Aviation are subscribers to Nadcap. This means that the Nadcap auditor will validate the specific prime's requirements in the Nadcap checklist (ex. AC7117/x) whenever a question requires such verification. Other than that, an audit such as Nadcap is a thorough evaluation of the entire process with questions that follow the framework of the general specifications.

For those shot peeners outside of the industries identified above, or those simply interested in blast cleaning in a better controlled fashion, the need for specification conformance might seem unnecessary, and even daunting. I have a proposition for such users in the paragraphs that follow.

CONFORMANCE LITE

I was corresponding recently with an Aerospace MRO who kept referring to a potential shot peening machine acquisition as a "sandblasting machine". Though tempted, I took refuge in my recently discovered "maturity with age" trait and refrained more than once from correcting him! But this led me to wonder if he truly believed that the process was simply glorified sandblasting! Those of us that are diligent about peening correctly, and conforming to specifications are justified to be shocked! However, there may be some belief of such a notion, especially outside of mainstream industry adopters.

I do not wish to diminish any industry's propensity and interest to enforce the rigors of specification conformance, but partial conformers do exist. Some continue to seek compliance with cancelled documents such as MIL-S-13165C while others are slowly realizing the need to enforce a structure around what might be passed on as a shot-peened component from their service-provider or in-house peening operation. These are industries that are neither bound by the requirement of an Aerospace grade audit nor conformance to AMS 2430. For example, Audit or specification intimidation could lead to dissuasion and ultimately the lack of adoption altogether of the peening technique. I would like to attempt a leap of faith and propose a "conformance lite" solution to such customers.

Before my inbox gets flooded with admonitions on this approach, let me clarify. I am neither proposing an alternative to commonly used specifications nor a shortcut. My proposal is to draw the common elements of conformance and identify techniques that will help you reap the benefits of a process in conformance without the formality. As a start, let us first identify the key aspects of control that all specifications trace their origin to:

- How hard are you impacting (reference: media, velocity and intensity)?
- Where are you impacting (reference: flow rate, coverage, and masking)?

1. The quality of media used in your peening process will determine the consistency and quality of the layer of compressive residual stress it is expected to create. Uniformity of media size equates to transfer of equal and uniform energy on all part surfaces.
2. Propelling this media at a uniform velocity is the next step, whether it be through a blast nozzle, blast wheel or a flap mounted on a rotary tool (rotary flapper peening).
3. It is important to point out that broken media particles in the above will not only impact the component with lower energy, but also potentially damage (nick) the part surface. All broken particles should be discarded from the process.

So, we are now left to deal with (a) removal of undersized media particles, (b) maintenance of uniform velocity and (c) removal of broken particles (misshapes).

4. Maintenance of constant media flow rate is particularly important in airblast machines since the compressed air that is assisting with the generation of impact energy has to do reduced or increased amount of work based on the quantity of media it has to propel. This is not as critical in a wheelblast machine where the wheel's reliance on the electric motor that is driving it mitigates capacity concerns and is only limited by full load amperage of the motor.
5. Increased media flow leads to faster coverage in both types of media propulsion techniques with only reservations related to part geometry (flooding of tight areas with excessive shot flow).
6. In a shot peening process that leans heavily into conformance, the above is addressed with sub-systems such as vibratory classifiers (size classification), spiralators (removal of sharp particles), flow control valves (MagnaValves, etc.). Process limits installed in control systems associated with these machines monitor, record and report such data, including anomalies when they occur.
7. However, this may not be the case in a cleaning machine though it has been well-intentionally repurposed for shot peening. If this is your situation, consider the following to get closer to your dream process/machine for shot peening:
    a. Decide which of the two processes you are going to dedicate the machine to and be consistent.
    b. If your peening projects involve multiple media sizes, (a) try to dedicate the machine to a single media size. Though switching media sizes is possible, it is time-

consuming, and possibilities of cross-contamination are rife.

c. If your plan involves operating multiple peening machines, and installing classifiers is not an option, establish a practice of offline classification with a universal screening rig consisting of a bucket elevator, airwash separator or drop box, and a classifier of adequate capacity. The screens in this classifier can be replaced to suit the size of media being classified. Keep in mind that classifier capacities are limited, especially with smaller diameter units. Refrain from overloading the system.

d. Establish a similar practice with an offline spiral separator— a unit that also has restricted capacity.

e. If your machines do not have a means for monitoring flow, a portable catch test arrangement can be utilized to carry out this activity shared between multiple machines.

f. Maintaining constant media velocity is unfortunately not easily achieved without proper equipment. There are no reliable alternatives to inverters for blast wheel motors and pressure transducers/sensors in airblast machines to monitor and control media velocity.

To summarize, conformance lite can help you establish the discipline of a well-designed peening operation and lead you along the path to eventual specification adoption. The world outside of shot peening is heavily populated with blast cleaning machines. Can that world benefit from Conformance Lite?

BENEFITS TO BLAST CLEANING

Our belief is that if material is being removed from the component being peened, then something is not being done right. Though blast cleaning does not intend to remove the base material, its purpose is to remove contaminants such as scale, rust, sand, etc. However, the fundamental mechanisms remain unchanged between cleaning and peening, such as the reliance on velocity, size and shape of media, and media flow rate. The differences in process details allow us to use the term "abrasive" in blast cleaning instead of "media" in peening. The advantages of process control, in other words, conformance (lite or otherwise) in blast cleaning can be seen in the following:

- The magic descaling velocity over 30 years ago when I first started in this industry was 240 feet per second. This may have been limited then by wheel and drive arrangements, and a variety of other constraints existing then. Steel used to be cleaned to satisfaction at that abrasive velocity, which should make us question the necessity of some current wheel configurations that generate velocities upwards of 320 feet per second! The relevance of this discussion is in process control. Perhaps some processes suffer from high velocity and overblasting parts with resulting wear of machine components and breakdown/consumption of abrasive. Velocity control, as in shot peening, will definitely keep this in check.
- We can also utilize lessons learnt in relating shot velocity to intensity and transfer it to blast cleaning—use an Almen strip deflection check (likely A strip) every eight hours to determine if your cleaning process (velocity) is repeatable. If you are concerned that your cleaning application uses steel grit (or AlOx grit), rest assured that both the strip and the process are ambivalent to that fact and will unfailingly leave you with a deflected surface and arc height to measure after continued impacts. Our intention is to measure impact energy, and damage to the part due to angular abrasive particles is not an issue as would be in shot peening when non-spherical media is used.
- Blast cleaning thrives on a "work mix" of abrasive sizes, unlike shot peening which relies on uniformity of media size which is commonly monitored and maintained by a vibratory classifier. If this unit is installed in a blast cleaning machine, its purpose will be limited to eliminating large contaminants from the work mix.

SUMMARY

Conformance comes with a cost, but there is value in it even for processes that are not bound by the need to achieve conformance. The world is populated by more blast cleaning than shot peening machines. Majority of those are wheelblast cleaning machines that propel a significant volume of shot per minute. A defined structure to monitor usage by monitoring process parameters will certainly help with justifying the operation and making it profitable.

About Kumar Balan

Kumar Balan is a shot peening and blast cleaning technical specialist. He is currently assisting Ervin Industries achieve business growth in North American and overseas markets.

Mr. Balan has published several technical papers on blast cleaning and shot peening and is a regular contributor to *The Shot Peener* magazine. His expertise is in centrifugal wheel-type and air-type blast cleaning and shot peening equipment. He is a regular speaker at industry conferences and training seminars worldwide. He is also an EI Shot Peening Training Lead Instructor at their international seminars and workshops. Mr. Balan's contributions to the industry were recognized when he was named the 2006 Shot Peener of the Year.

PRO-LOADER

BARREL/DRUM MEDIA TRANSPORT

DESIGNED FOR BULK MEDIA TRANSFER

*Empire's **Pro-Loader** is designed for bulk media transfer in an Empire blast system, with no lifting and minimal attention by an operator.*

Nanofluids:
Bringing Nanotechnology to CNC Machining

New coolant technology offers advantages in performance, productivity, and environmental friendliness

NANOFLUIDS are a new class of coolants that have a carrier liquid, such as water, that are dispersed with nanoparticles. These nanoparticles enhance the heat transfer capabilities of the resulting coolant compared to the carrier liquid alone.[1]

Tool-X is a brand of a nanofluid additive for metalworking fluids that contains trillions of carbon-based nano-onions in solution. Nano-onions are carbon-based nanostructures composed of multiple concentric shells of fullerenes. A fullerene is a form of carbon having a large spheroidal molecule consisting of a hollow cage of atoms.

When used in conjunction with metalworking fluids, these fluid-saturated nano-onions flow between a tool and workpiece to change the characteristics of the metal-working action. The result is longer-lasting tools that cut truer, with more precision, and with less force required than with conventional metalworking fluids. In addition, reworks, tool sharpening, and deburring steps can be reduced or eliminated.

With a nanofluid such as Tool-X, surface finish is improved through lower Ra and fewer and smaller distortions. Feeds and speeds can be increased, often by 25% or more. Tool life is extended. Problems caused by excess heat (white film layers, long chip sizes, metallurgical damage) can be avoided. According to Jim English, President of Tool-X LLC and a former GM engineer, "Nanoparticles are used to dissipate heat from the machining process, transferring that heat from the cutting point to the coolant in the tank. Normally, coolants simply move heat around; they do not transfer heat and controlling heat in this way represents a major difference in the cutting processes where Tool-X is applied."

For manufacturers that want to lower their chemical footprint: "A water-based coolant like Tool-X has only 12 chemical ingredients, in contrast to the 30-40 chemicals in many coolant formulations," said Mr. English. "The next noteworthy advantage is that Tool-X produces little to no foam, because there are no chemicals in the solution to make it foam. And machine operators will recognize there is no noxious smells produced by the cutting fluid. Tool-X includes a nanoparticle component that kills bacteria that may develop in the sumps. The "rotten egg" smell that many cutting fluids develop will never be the result for shops using Tool-X," he added.

These advantages come with a price. According to a Tool-X data sheet, Tool-X metalworking fluids cost more than conventional fluids—as much as twice as much. But the savings that are possible, through extended tool life, increased productivity, and parts with better surface finish and better dimensional accuracy, can provide users with substantial returns on investment.[2]

For more information on Tool-X, contact Jim English by email at jenglish@tool-x.net or call 248-495-4367.

[1] https://en.wikipedia.org/wiki/Coolant#Nanofluids
[2] Tool-X Tech Data Sheet 109

Tool-X Case Study

Customer: A manufacturer of components for robotic tooling solutions for industrial and commercial use.

Application: Horizontal CNC machining 1018 cold-rolled steel in a job shop environment.

Problem: Insufficient material removal rates and poor tool life.

Evaluation Process:
1) The initial evaluation was conducted across two identical CNC machines using a water-based cutting fluid.
2) This side-by-side assessment demonstrated Tool-X's ability to reduce spindle loads, improve the surface finish, extend tool life, and increase material removal rates.

Results: The Tool-X MP-101 nanofluid increased the performance and throughput.
1) Production rates were increased from 75 parts per shift to 125 parts per shift using Tool-X.
2) Tool life was increased from 31 to 250 parts per sharpening.
3) Tooling costs were reduced substantially and production capacity was increased by 67%.

Outcome: After the testing and evaluation over several months, the customer changed to using Tool-X's water-based nanofluids for these key production machines.

Source: Tool-X Case Study 103

Introducing Gradient Severe Shot Peening as a Novel Mechanical Surface Treatment

This article is based on the open access paper by Erfan Maleki[1,4], Sara Bagherifard[1], Okan Unal[2], Michele Bandini[3], Gholam Hossein Farrahi[4,5] and Mario Guagliano[1] (2022), Scientific Reports, Vol. 11 (1), 22035.
The paper is available in its entirety at www.nature.com/articles/s41598-021-01152-2.

[1]Department of Mechanical Engineering, Politecnico di Milano, 20156 Milan, Italy. [2]Department of Mechanical Engineering, Karabuk University, 78050 Karabuk, Turkey. [3]Peen Service Srl, 40138 Bologna, Italy. [4]Materials Life Estimation and Improvement Laboratory, Sharif University of Technology, 11365 Tehran, Iran. [5]School of Mechanical Engineering, Sharif University of Technology, 11365 Tehran, Iran.

SHOT PEENING is widely used for improving mechanical properties especially fatigue behavior of metallic components by inducing surface hardening, compressive residual stresses and surface grain refinement. In air blast shot peening, projection pressure and surface coverage (an index of peening duration) have been considered as major controlling process parameters; the combination of these parameters plays a critical role in the beneficial effects of shot peening. Generally in severe shot peening aimed at obtaining surface grain refinement, constant values of pressure are considered with different peening durations.

Considering very high peening duration, however, the phenomenon of over shot peening, which can be identified with the formation of surface defects could occur. The present study introduces a novel shot peening treatment, here called gradient severe shot peening (GSSP) that instead of using constant projection pressure, implements gradually increasing or decreasing pressures. The gradual increase of the projection pressure acts as a pre-hardening stage for the following higher projection pressure boosting the potential of the material to tolerate the sequential impacts and thus become less prone to the formation of surface defects.

The results of the experiments indicate significant fatigue life improvement obtained for GSSP treated specimens compared to the standard treatment with constant pressure. GSSP avoids the detrimental effects of over-peening, while maintaining the beneficial effects of surface nano-crystallization, surface hardening and compressive residual stresses. The notable difference in fatigue strength enhancement for GSSP treated material can be also attributed to the modulated surface morphology with lower surface roughness compared to a standard shot peening treatment with the same exposure time.

Initially presented in 1940[1], shot peening (SP) is a cold working process in which the surface of the target material is bombarded by impacts of small shots under controlled conditions[2]. This simple and cost-effective process is widely used for improving the mechanical properties of metallic materials such as fatigue, wear, corrosion, etc.[3–6]. Schematic illustration of an air blast SP equipment is shown in Fig. 1a. (Page 20) Variation of peening duration can alter the control parameter of surface coverage; coverage is defined as the ratio between the area that is plastically deformed by the impact to the total exposed area[7].

On the other hand, using a regulator and solenoid valve, the projection pressure of SP process can be controlled to regulate the velocity of the impacting shots and thus the kinetic energy of the shot stream; these are associated with another main control parameter called Almen intensity[8,9]. Figure 1b, c schematically presents the effects of peening duration and projection pressure on the surface of the target material. The kinetic energy of the SP treatment is defined by the mass and velocity of the impacting media. In air blast SP process, high impact velocities can be obtained by increasing the projection pressure or using larger shots[5,10].

In addition, increasing the peening duration will increase the number of the impacting shots on the target leading to higher kinetic energy transmitted to the substrate[11–15]. SP induces surface layer grain refinement and hardening as well as compressive residual stresses in the surface layer of the treated material[16]. However, due to the shot impacts and the generated dimple shaped indents, the surface morphology of the shot peened material changes leading to higher surface roughness[17,18]. Schematic illustration of surface roughness variation, grain refinement, surface layer hardening and induced compressive residual stresses are presented in Fig. 1d.

It has been reported that by increasing the Almen intensity and surface coverage and accordingly raising the kinetic energy of the SP treatment compared to the ones used in the conventional shot peening (CSP), so called severe shot peening (SSP) or high energy shot peening (HESP) processes

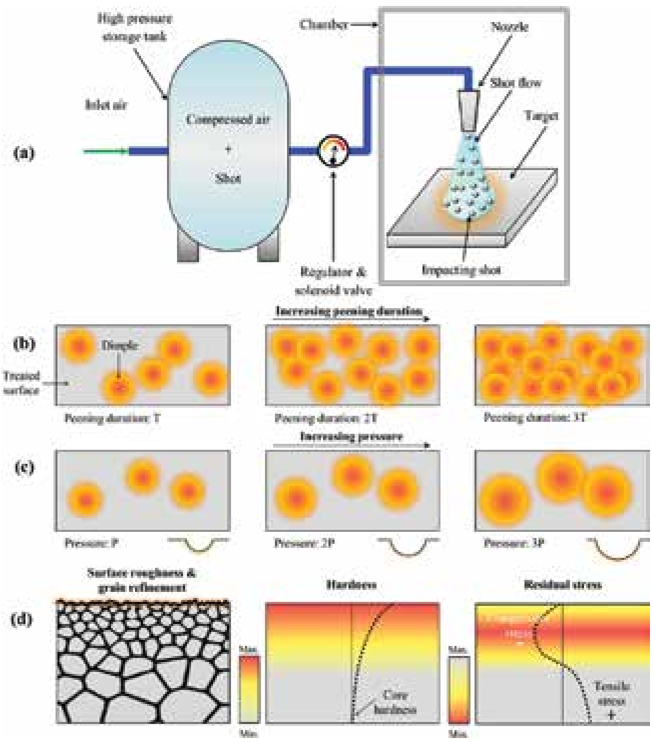


Figure 1. Schematic illustration of (a) air blast SP equipment, effects of SP treatments in terms of increasing the (b) peening duration and (c) projection pressure on the target surface (d) common effects of SP treatment on increasing the surface roughness and inducing surface layer grain refinement, hardening and inducing compressive residual stresses, from left to right.

can be obtained[19,20,21]. SSP generated nano-structured grains on the surface layer[22] and induces higher compressive residual stresses[23]. In addition, SSP was reported to have more beneficial effects compared to CSP in terms of mechanical properties and fatigue behavior improvements, when applied with optimized parameters[24,25,26,27,28,29,30].

However, it was found that by using higher intensities and coverages than the ones considered in SSP, over shot peening (OSP) phenomenon appears. Although, in OSP higher surface hardening and higher compressive residual stresses can be achieved but due to the very high kinetic energy of the shot impacts, multiple surface defects including nano/micro-cracks, and overlaps can form on the treated surface[31]. These defects have high detrimental effects on mechanical properties of the SP treated material, often leading to fatigue strength reduction[32,33,34,35,36,37,38,39].

Figure 2a presents the schematic illustration of different categories of CSP, SSP and OSP processes considering peening duration and projection pressure.

In this study, a novel type of SP, here called gradient severe shot peening (GSSP) is presented for the first time, to the best of the authors' knowledge. In GSSP, instead of

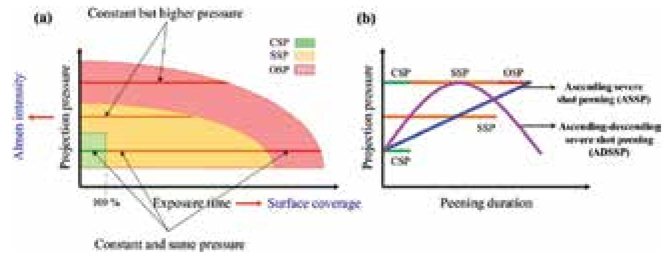


Figure 2. Schematic illustration representing (a) the comparsion of CSP, SSP and OSP in terms of projection pressure and peening duration and (b) variations of projection pressure through the peening duration in novel GSSP treatments of ASSP and ADSSP compared to CSP, SSP and OSP treatments.

using a constant projection pressure, variant pressures are considered. Herein, two different GSSP processes of ascending severe shot peening (ASSP) and ascending-descending severe shot peening (ADSSP) are introduced based on the trends considered for variation of pressure.

The schematic comparisons of the newly presented treatments with standard categories are depicted in Fig. 2b. The projection pressure in ASSP is continuously ascending while in ADSSP it gradually increases to reach a maximum value and then decreases. In these two processes, the detrimental effects of OSP are avoided, while maintaining the beneficial effects of surface nano-crystallization, surface hardening and compressive residual stresses.

The material considered for the investigations is Inconel 718 that is a nickel super-alloy. Inconel 718 has lots of application in different industries such as aviation and aerospace, etc. due its excellent mechanical strength and properties[40,41]. However, surface processing of Ni-based superalloys in particular with mechanical surface treatments is a challenging procedure[42,43,44].

Comprehensive experimental analyses in terms of micro structural characterization, roughness, microhardness and residual stresses measurements as well as axial fatigue tests are performed to compare different categories of treatments based on SP.

Editor's Note: According to Michele Bandini with Peen Service, this project is part of wider research work on several materials. Peen Service has been cooperating with Politecnico di Milano for over 25 years on several aspects of the peening process, looking continuously for new applications and better improvements.

Download the complete paper at www.nature.com/articles/s41598-021-01152-2.

Innovative Peening Systems

IPS is a global leader in building creative, innovative solutions to complex shot peening problems. We have developed easy-to-use, premium, configurable, and custom shot peening machines that are built to last. For decades, we have partnered with some of the top companies and organizations across the globe to develop systems that solve their unique problems. Learn more about bringing your shot peening in-house with IPS.

Why CNC shot peening machines?

1. Higher level of precision
2. Speed
3. Easy-to-use
4. Reduced operating cost

Why IPS?

1. Creative engineering excellence
2. Easy-to-use proprietary software
3. Long-term solution partner
4. Robotic integration capabilities

Authorized System Integrator FANUC

ISO 9001:2015 CERTIFIED COMPANY
PRI Registrar
PERFORMANCE REVIEW INSTITUTE

Authorized CNC System Integrator FANUC

Innovative Peening Systems
5425 Progress Ct., Braselton, GA 30517
770.246.9883
www.ipsmachines.com

Engineered Abrasives®

Manufacturers of the Finest Blast Finishing and Shot Peening Systems

(708) 389-9700 or (773) 468-0440

Email: mwern@engineeredabrasives.com Web: www.engineeredabrasives.com

IATF 16949
ISO 14001
FORD Q1
Certified
Job Services

All Engineered Abrasives® systems are available with the EA® Knowledge System®. The EA® Knowledge System® features computer animation on machine operation and maintenance, including how to do Almen Strips.

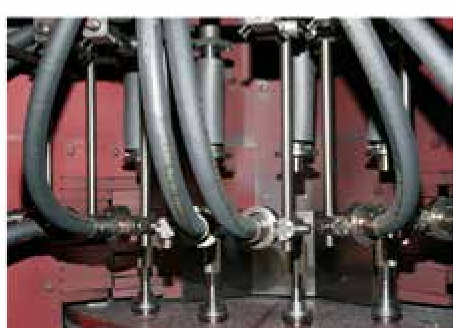
Engineered Abrasives® High-Volume Index Unit with complete Material Handling and Robotic System

60" Index Unit Ring and Pinion Gears for High Volume

8 Pressure Nozzles with MagnaValves®, Buck Elevator, Sweco and Dust Collector

CONTROL by MagnaValve®

All Tooling and Fixtures Tool Steel hardened to 62 RC



Engineered Abrasives® index units are the most durable machines on the market today with all our special features

Patented 72" Index Unit with Shot Flow Controls, Sweco, Bucket Elevator, 8 Nozzles and 16 Spindles. Designed for high-volume shot peening.

Look for RED components and surfaces to be sure you get Engineered Abrasives® quality equipment and OEM parts.

High-volume automotive systems for ring and pinion axle gears

Designed and built by EA®

Two (2) Index Units with complete load and unload Fanuc Robots and Conveyor System

Both machines built and tested on EA® floor

EA® 72" Flex Peener™
4 stations with 4 spindles at each station. Can do different gears on each spindle or all the same for higher volume.

Single Cell Unit, 5 Pressure Nozzles

Bucket Elevator
Sweco System
◀ MagnaValves®

◀ Dual Swing Doors for higher volume

Special safety platforms ▶ for easier maintenance

EA® 72" Index Unit

Introducing
The Smart Valve with SteadyFlow Technology

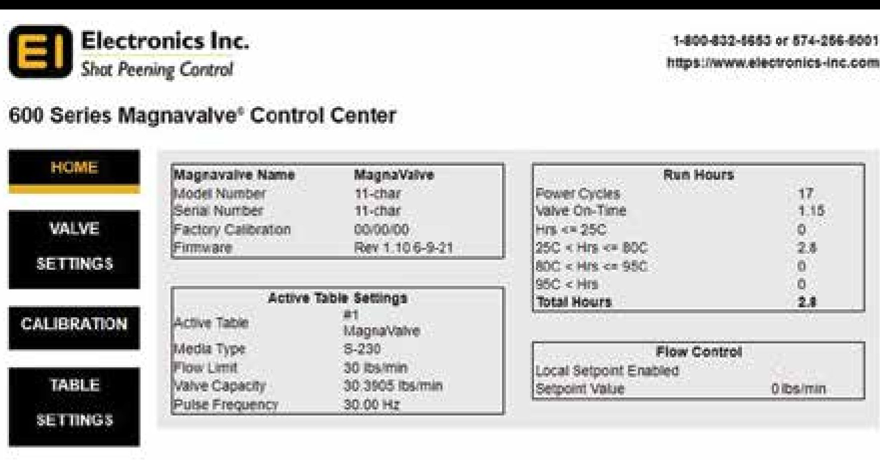
The 678-24
for air-blast machines
Patent Pending

The 678-24 MagnaValve has an embedded web page, a built-in sensor that measures flow rate, a built-in servo, and a flow rate jump-to feature that provides accurate and repeatable flow rates. The flow jump-to feature starts media flow at the desired flow rate instead of ramping up to the desired rate.

MagnaValve®

1-800-832-5653 or 1-574-256-5001
www.electronics-inc.com

MagnaValve is a registered trademark of Electronics Inc.



The Home Screen of the 678-24's web page—its web page is user-friendly and intuitive.

The 678-24 has the same features that make MagnaValves the most dependable and hard-working media valves on the market today, including:

- **Flows most ferrous media**
- **Compliance to specifications is readily attainable**
- **Normally closed**
- **No moving parts for low-maintenance operation**
- **Trusted by OEMs and end-users worldwide**

Electronics Inc.
Shot Peening Control

50th ANNIVERSARY • 1974 - 2024

ACADEMIC STUDY
Dr. David Kirk | Coventry University

Hardness Testing

INTRODUCTION
Fortuitously, for shot peeners, their hardness testers don't measure hardness! Classically, hardness is defined as the resistance of a material to abrasion. Tests such as that of the Mohr's Scale, arranged substances according to their ability to scratch any material below it. Hence diamond heads the scale with a value of 10 whilst talc, with a value of 1, is at the foot of the scale. Methods have later been developed that have much greater precision and accuracy. These, however, are based on the size of indent produced using a known force to an indenter. The applied force divided by the surface area of the indentation gives the so-called hardness value.

The Brinell test, devised in 1900, involves pressing a hardened steel ball into the test piece's surface. Brinell hardness is then given by Applied Force/Surface area of impression. The Vickers Hardness Test uses a diamond in the form of a square-based pyramid. This does not deform to the same extent as does a steel ball. For a given applied force, Vickers hardness value increases as the diagonals of the indentation decrease. Ludvik invented the first differential depth hardness tester in 1908. The Rockwell differential depth hardness tester, devised in the USA in 1914, was aimed at rapid routine testing of samples. This is because the Rockwell value is displayed directly on a scale, without the need for operator intervention. Different combinations of indenter and applied force became available. All of the methods rely on resistance to indentation—which is at the heart of shot peening control.

This article concentrates on the applications of the Rockwell test. A central problem arises when different companies test nominally identical samples such as batches of Almen strips. Proper comparison can only be achieved if the test method employed is precisely identical: ASTM E-18 (USA) and ISO 6508 (International) are appropriate standards.

BASIC PRINCIPLES OF ROCKWELL HARDNESS TESTING
Fig.1 is a schematic representation of the Rockwell's operating principle. A minor force is applied to a diamond indenter, pushing it into the surface of a test piece. This is followed by a major force which pushes the indenter further into the test piece. The corresponding movements of the diamond's position are used to derive a Rockwell hardness value. Standards indicate that the diamond has a tip radius of 0.2 mm and an enclosed angle of 120˚. The tip radius greatly reduces the incidence of tip damage.

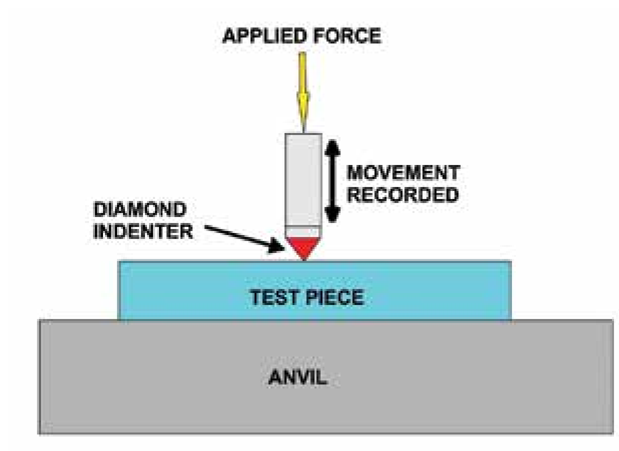


Fig.1. Schematic of Rockwell Diamond hardness testing.

Fig.2 represents the relationship between the three diamond positions, A, B and C, and the depth, D, which is converted into a Rockwell hardness value.

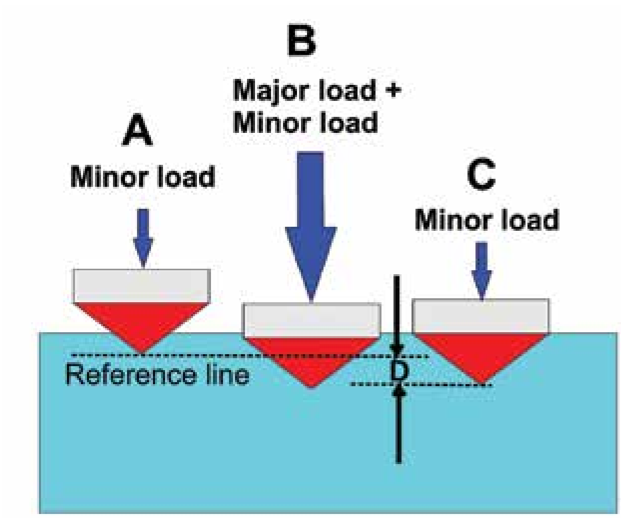


Fig.2. Diamond positions during Rockwell testing.

A minor load is first applied pushing the diamond down into the test piece, A. The depth reached defines the reference line. A major load is then added to the minor load, pushing the indenter much further into the test piece, B. The total load (major plus minor) also causes elastic deformation. This

effect is relieved by removing the major load whilst retaining the minor load, C. The vertical difference between diamond positions at A and C, D, is inverted to give the Rockwell hardness. The smaller the value of D the greater is the resistance to indentation—hardness. The Rockwell test is very cost-effective as it does not need any optical equipment. The depth, D, converts to Rockwell hardness using the formula:

$$\text{Rockwell hardness} = 100 - D(\text{mm})/0.002(\text{mm}) \quad (1)$$

It follows that an error of only 0.002 mm in the measured value of D produces an error of 1 HR unit.

ALMEN STRIP TESTING

Almen strip testing is an excellent example for showing how errors can occur. Every Almen strip has a small amount of pre-bow. The anvil shown in fig.1 is presumed to be perfectly flat. When a strip is placed on the anvil it can be either "curve up" or "curve down". The effect of this on Rockwell measurements is illustrated in fig.3. The pre-bow has been deliberately exaggerated.

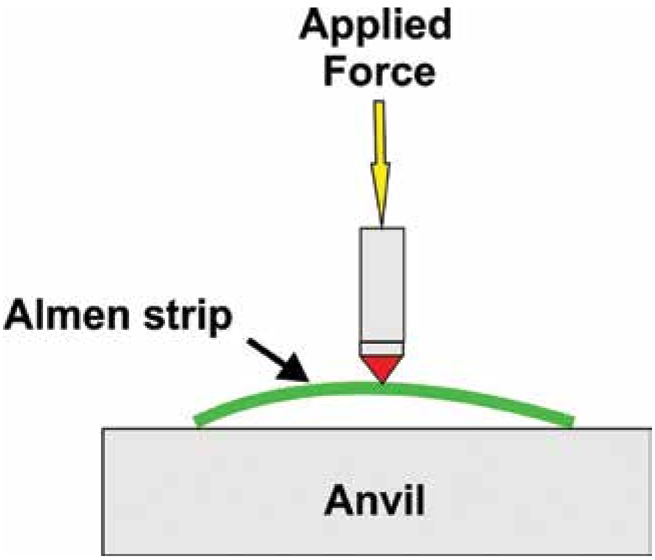


Fig.3. Rockwell indenter applied to curved-down Almen strip.

The minor force applied by the Rockwell indenter, typically 10 kgf, is sufficient to flatten a pre-bowed Almen strip as illustrated in Fig.4.

Elastic flattening will not occur if the strip is curved upwards as illustrated by fig.5.

Table 1 details preliminary tests on Almen strips aimed at confirming the effect of Almen strip pre-bow flattening on indicated Rockwell hardness. The measured curve-down values are all slightly higher than the curve-up values. This indicates that minor load strip flattening induces a small, but significant, increase in the indicated Rockwell diamond hardness value.

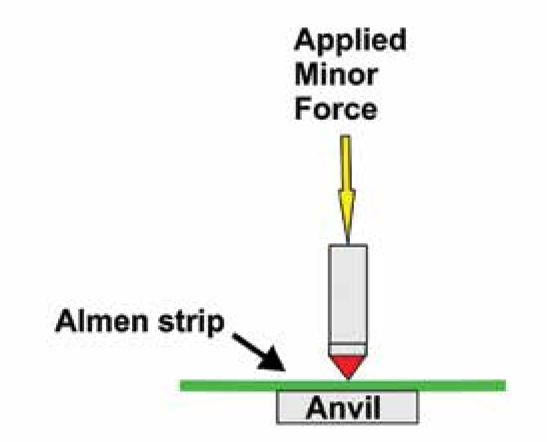


Fig.4. Applied minor force flattening pre-bowed Almen strip.

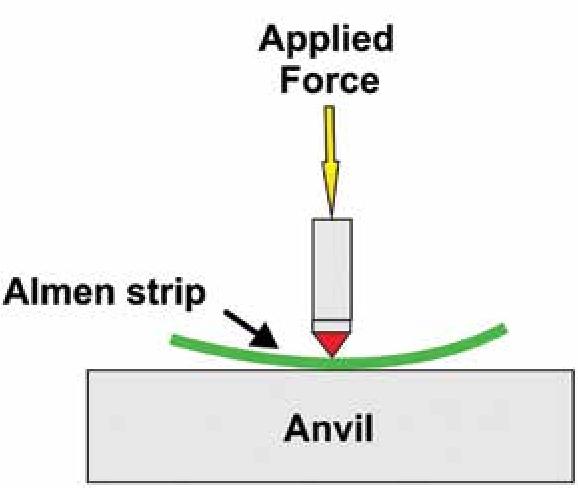


Fig.5. "Curve up" of Almen strip removes elastic flattening error.

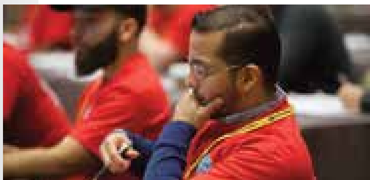
Table 1. Effect of Pre-bow on Rockwell Hardness

Reading Number	Strip A		Strip B	
	Curve Up	Curve Down	Curve Up	Curve Down
1	48.1	49.2	48.0	49.2
2	48.1	48.6	48.3	48.5
3	48.3	49.2	48.3	49.1
Average	48.2	49.0	48.2	48.9
Difference		**+0.83**		**+0.73**

ELASTIC FLATTENING EFFECT ON ROCKWELL HARDNESS

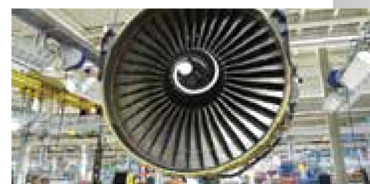
Elastic flattening of pre-bowed strips appears to have a small but significant effect on indicated Rockwell hardness value. This section describes a study that attempts to both confirm and also to explain the effect.

2024
Shot Peening Training



Improve your skills,
reach your professional goals

Learn from expert instructors
on relevant topics



FAA-accepted courses,
Nadcap Partner in Education

Tokyo, Japan .... ***February 13***
Seminar

Juriquilla, Mexico .... ***April 10 - 11***
Seminar

Datteln, Germany .... ***May 14 - 16***
Workshop

Vancouver, Canada .... ***May 22 - 23***
Seminar

Gloucester, United Kingdom .... ***June 26 - 27***
Seminar

Bangkok, Thailand .... ***July 24 - 25***
Seminar

Colorado Springs, Colorado, USA .... ***October 15 - 17***
Workshop

Additional events may be added throughout the year.
Visit www.shotpeeningtraining.com for locations and dates.

Receive certification for achieving a higher level of shot peening education.
Seminar, workshop and on-site training attendees are eligible to take our FAA-accepted shot peening and rotary-flap peening achievement exams.

On-site training programs are also available

Train on your equipment • Can be customized • Includes facility and equipment review
Training can be held any time of year • Ideal for five or more employees

EI Shot Peening Training

www.shotpeeningtraining.com
(574) 256-5001 or 1-800-832-5653

Confirmation of the effect centred on measuring much larger numbers of Almen strips. Different amounts of pre-bow were also included in the study. This showed that the effect of flattening increased with increase in amount of pre-bow.

Tables 2 and 3 summarise the main results of the study.

Table 2. Effect of Elastic Flattening on Indicated Rockwell Hardness of Almen N Strips.

Batch of 10 strips	HRA Hardness Concave	HRA Hardness Convex	Hardness Difference
1	73.81	73.92	+0.11
2	74.28	74.34	+0.06
3	73.79	73.86	+0.07
Average	73.96	74.08	+0.08

Table 3. Effect of Elastic Flattening on Indicated Rockwell Hardness of Almen A Strips.

Batch of 10 strips	HRA Hardness Concave	HRA Hardness Convex	Hardness Difference
1	46.74	46.75	+0.01
2	47.09	47.69	+0.60
3	45.69	47.16	+1.49
Average	46.51	47.20	+0.70

With over a hundred hardness measurements involved, it is clear that testing the convex side of Almen strips results in a larger indicated hardness value than does testing the concave side.

EXPLANATION OF ELASTIC FLATTENING EFFECT ON INDICATED ROCKWELL HARDNESS

This explanation is based on the fact that the minor loading induces strip bending. This bending, in turn, sets up a stress system. The induced stress system involves compression of the previously convex side and tension on the previously concave side.

Fig.6 illustrates how the induced stress system is developed. Application of the Minor Force is expected to be sufficient to flatten a pre-bowed Almen strip as shown as the inset picture. The applied Minor Force applies a bending moment, M. Therefore the upper face of the Almen strip becomes compressed whereas the lower face goes into tension as shown in the main picture. It is the compressed side that is being hardness-tested.

Compression of the upper side involves compressive stress on the indentation. Hence when the Major Force is applied, indentation is then resisted by the combination of this compressive stress and the strip's own inherent resistance to indentation. This combination effect is illustrated by the plan view shown as fig.7.

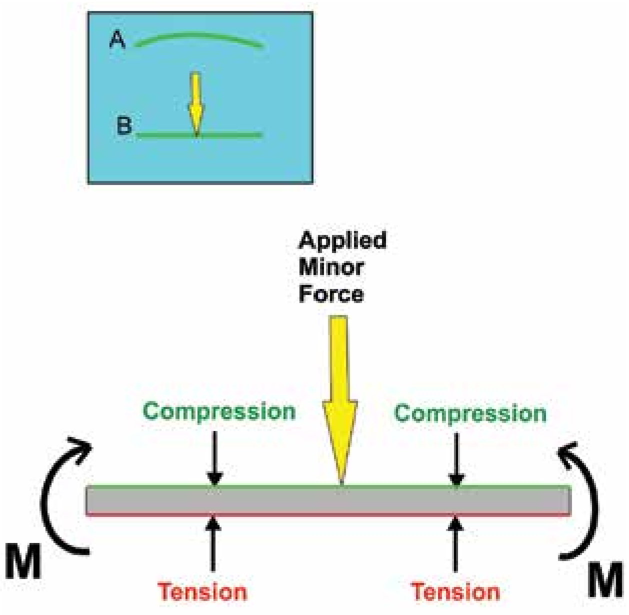


Fig.6. Stress system developed by imposing Minor Force.

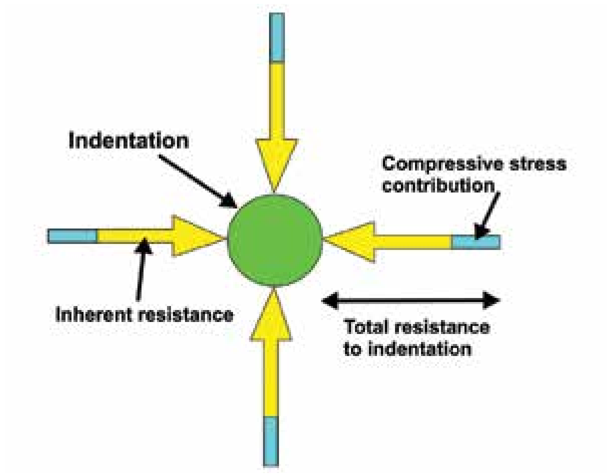
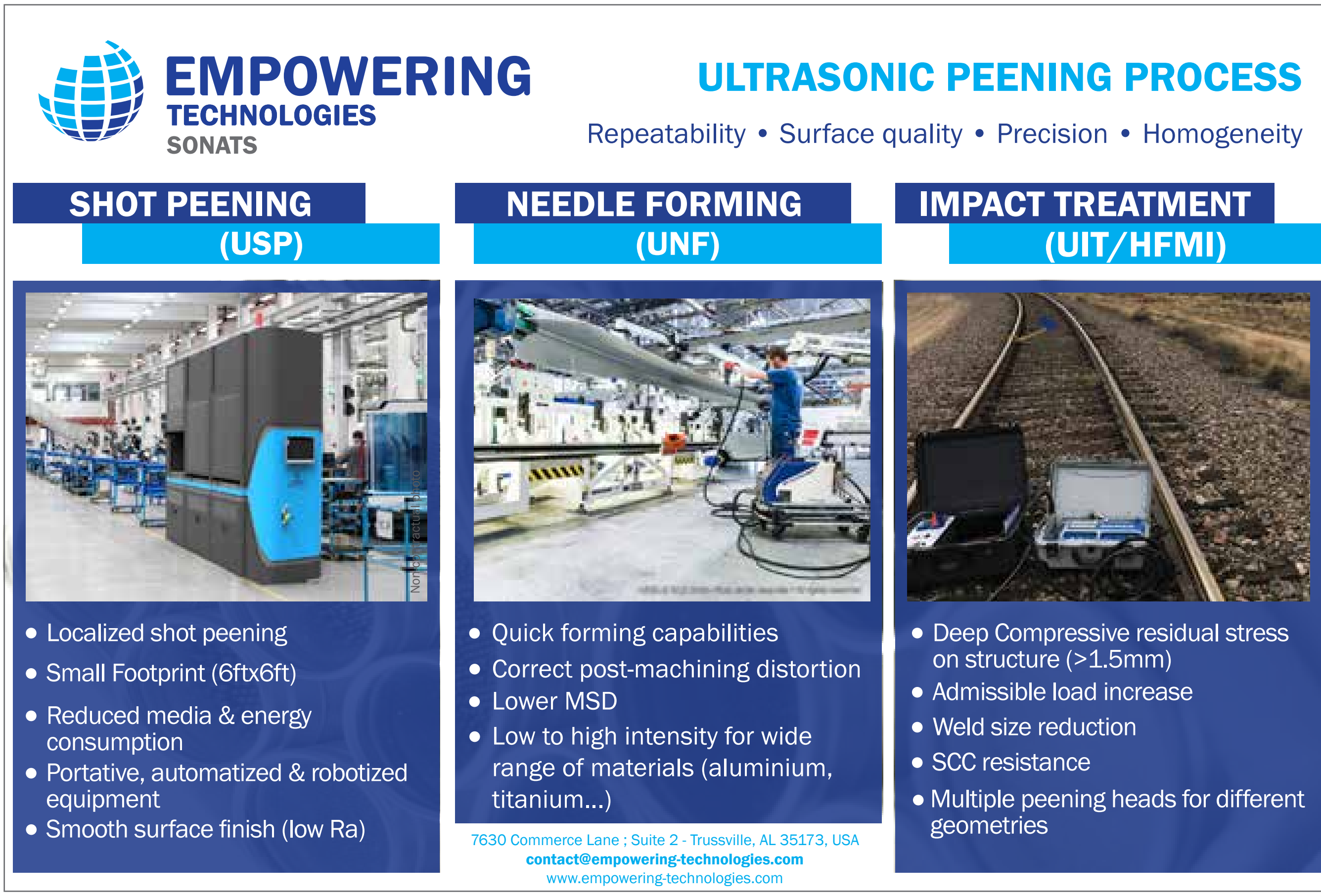


Fig.7. Combination of compressive stress and inherent resistance to indentation.

With the two factors combining to resist indentation, the indicated hardness is slightly increased. The magnitude of the compressive stress contribution depends on two factors. First is the degree of pre-bow. Second is the thickness of the Almen strip. Greater pre-bow increases the contribution. Almen A strips, being thicker than N strips, will also induce a larger contribution. This second factor is illustrated by fig.8. Being thicker, (0.051" cf 0.031"), A strips suffer larger bending moments, M, imposed by the minor load. Hence, larger compressive stress contributions will occur at the surface. Note that the vertical scale of the drawings has been increased for clarification of the effect. Because of the larger induced


EMPOWERING
TECHNOLOGIES
SONATS
ULTRASONIC PEENING PROCESS
Repeatability • Surface quality • Precision • Homogeneity
SHOT PEENING
(USP)
• Localized shot peening
• Small Footprint (6ftx6ft)
• Reduced media & energy consumption
• Portative, automatized & robotized equipment
• Smooth surface finish (low Ra)
NEEDLE FORMING
(UNF)
• Quick forming capabilities
• Correct post-machining distortion
• Lower MSD
• Low to high intensity for wide range of materials (aluminium, titanium...)
IMPACT TREATMENT
(UIT/HFMI)
• Deep Compressive residual stress on structure (>1.5mm)
• Admissible load increase
• Weld size reduction
• SCC resistance
• Multiple peening heads for different geometries
7630 Commerce Lane ; Suite 2 - Trussville, AL 35173, USA
contact@empowering-technologies.com
www.empowering-technologies.com


KSA
process automation
Automated Peen Forming Solutions
www.ksa.de.com
KSA Kugelstrahlzentrum Aachen GmbH · Weststraße 22-24 · 52074 Aachen · Germany

surface compressive stress, Almen A strips will indicate larger Rockwell hardness values as shown in Tables 2 and 3.

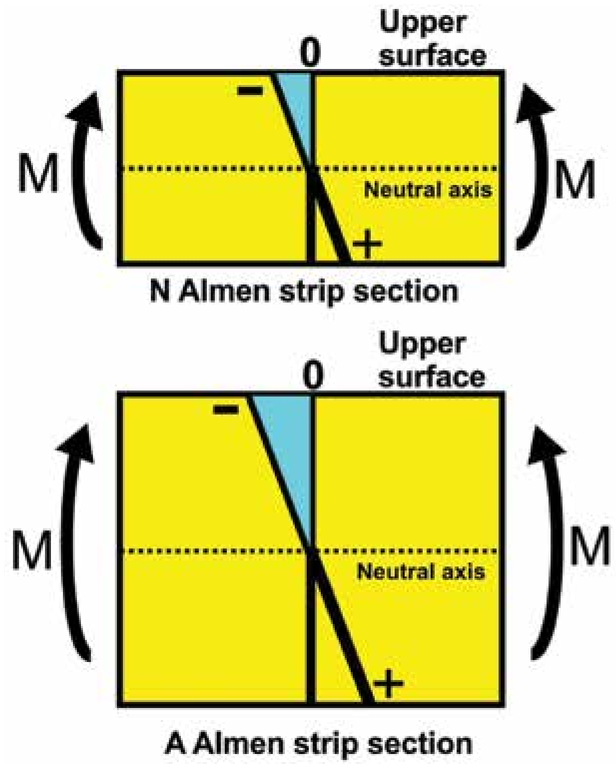


Fig.8. Bending inducing stress system.

DISCUSSION

The Rockwell test was introduced in order to provide a simple, speedy method of indicating component hardness. Operator skill was minimised as it simply required hardness values to be read off from a dial. Load changing, Minor and major, was originally manual. Although Rockwell hardness testing is excellent for its intended uses it has limits on accuracy. Modern Rockwell equipment simplifies operator involvement, with automatic load changes and digital hardness indication. Evolution of the test has increased the precision of indicated hardness without necessarily increasing its accuracy. As an analogy consider a standard wristwatch. Having a second hand increases precision but does not increase accuracy.

There is an excellent publication* by S.R. Low, 107 pages in length, that mainly deals with the large number of errors that can arise that affect Rockwell hardness values. Even standard calibration blocks were shown to vary in hardness over an individual block's test surface.

*S.R. Low, NIST Recommended Practice Guide, Special Publication 960-5 "Rockwell Hardness Measurement of Metallic Materials."

Rockwell hardness measurements should be carried out with the scale that Almen strip standards call for. For example, with SAE-J442 this should be Rockwell C scale for A strips and Rockwell A scale for N strips. Conversion from one to the other can lead to errors.

The tests carried out for this article have shown conclusively that indicated Rockwell hardness values are always slightly higher for measurements made on pre-bowed strips when tested curve down than when tested curve up. The cause of this difference is explained as being due to the compressive stress system that is produced by strip flattening. Increased pre-bow of Almen strips increases the "curve up" to "curve down" hardness difference.

CONCLUSIONS

Three major conclusions can be drawn from this article's study:

(1) Rockwell hardness tests should always be carried out with pre-bowed strips being placed "curve up" on the anvil. If the "curve up" side is not marked then tests should be carried on both sides and the higher reading rejected. Testing is now so quick and easy that this could be preferred to single-side testing.

(2) There are so many sources of error in Rockwell hardness testing that standard specifications should be adequately broad. SAE specifies 44.0 – 50.0 HRc for A-strips, a 6-point range and 72.5 – 76.0 HRa for N-strips, a 3.5-point range. A 3.5 range would appear to present difficulties for process control.

(3) With tighter tolerance requirements of aerospace: for A strips 45-48 HRc and N strips 73-74.5 HRa and a Rockwell hardness tester being "calibrated" per ASTM E18 when measuring within ±1 scale point to the selected certified reference block, the challenge becomes apparent.


NOZZLES
& INSERTS
Will Blast
You Away!
MALYN
SUPER TITAN
QUALITY • SERVICE • PRICE
The MALYN Difference!
Malyn Industrial Ceramics, Inc.
8640 Roll Road • Clarence Center, NY 14032
Tel: 716.741.1510 • Fax: 716.741.8402
MALYN.COM


sentenso
Smart Peening Solutions
Angled Handpiece
for sentenso RotoFlapMaster
Ergonomic. Convenient. Functional.
Achieve more flexibility in rotary flap peening applications.
• single button controls START/STOP and timer
• indicator confirms correct RPM
• reversible motor
• ergonomic touch and feel
• available as supplement
or in RotoFlapMaster equipment kits
Online demonstration using actual parts available.
Smart
Peening
Process Management
Quality Management
Engineering
Training
info@sentenso.de
www.sentenso.com
+49 2363 36650-0

CASE STUDY

Clemco Industries | https://clemcoindustries.com

An Aerospace Solution

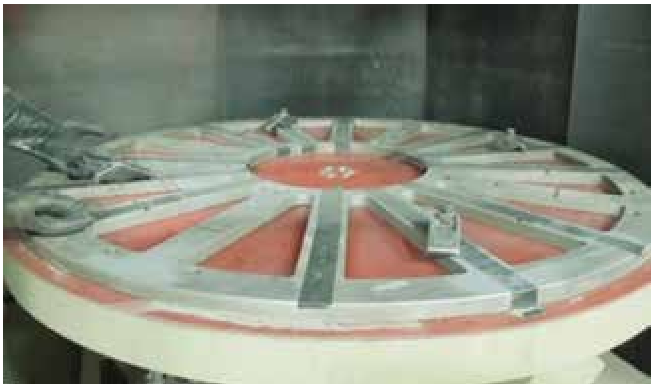
Problem

Specializing in blasting large turbine engine components, our client faced a significant challenge due to a part with a substantial circumference, creating difficulties in reaching specific blasting areas.

Solution

In response, we innovated a solution: a turntable system that seamlessly rotates with a foot pedal and lifts the part into various angles. This design grants operators easy access to critical blast zones. Given that only specific areas require blasting, this targeted approach minimizes overspray into non-target areas. Our turntable not only addresses the pain point of limited accessibility but also enhances precision, ensuring efficient and controlled blasting processes for optimal results.

The modified Zero BNP-7212 Suction Blast Cabinet



The turntable tilts at 30° and 45° angles for pinpoint abrasive blasting

For more solutions in Aerospace, including helicopter rotor blade components, jet plane turbine engine cowl components, and tall turbine engine blades, visit https://clemcoindustries.com/aerospace-solutions.

SAVE THE DATE!

International Conference on Shot Peening

ICSP15

SEPTEMBER 22-25, 2025

Purdue School of Materials Engineering

PRESENTING SPONSOR

Electronics Inc.
Shot Peening Control

ICSP15

SEPTEMBER 22-25, 2025

World class technical program
- Renowned speakers
- Session chair opportunities!

Industry leading exhibits
- Designated exhibition hours
- Booths available

University setting
- Convenient meeting logistics
- Adjacent and nearby lodging

Authors and exhibitors benefits
- Discounted registration rates
- Guaranteed Union Club rooms

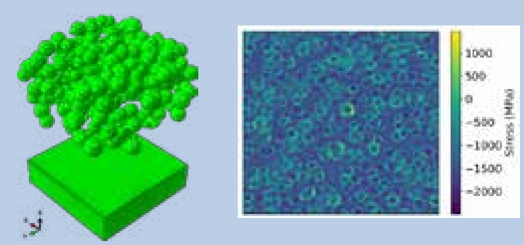
CALL FOR PAPERS & TECHNICAL PROGRAM INFO
davidjohn@purdue.edu

EXHIBITION OPPORTUNITIES
mgruninger@purdue.edu

icsp15.org

CSEE
Center for Surface Engineering and Enhancement

PURDUE UNIVERSITY
School of Materials Engineering



赛普优特
Superior Shot
专注 CONCENTRATE 专业 PROFESSIONAL
只为更好 ONLY FOR BEST CUT WIRE SHOT
• 喷（抛）丸磨料
Shot Peening (Blasting) Media
• 喷（抛）丸设备
Shot Peening (Blasting) Equipment
• 喷（抛）丸服务
Shot Peening (Blasting)
Accessories & Service
ACCORDING TO：
SAE J441
VDFI8001
MIL-S-13265-C
AMS2431/3
AMS2431/4
AMS2431/8
YANCHENG SAIPU METAL PRODUCTS CO.,LTD
ADD：A-13 Minhao Industrial Park 224300
Yancheng Jiangsu China
E-Mail：nabrasive@vip.163.com
www.superiorcutwireshot.com
PARTNER
蝶轩国际
DOSHINE
DAFENG DOSHINE INTERNATIONAL CO.,LTD
ADD：No.1 Wuyi Ave 224100 Dafeng City Jiangsu China
Tel：0086-139-0141-2688
E-Mail：keyneskhu@vip.163.com
www.doshineinternational.com

MIDWESTERN INDUSTRIES, INC.
"The Sizing People" ®
Screening Equipment
Wire Cloth
Replacement Parts
Emergency Shipping
All Your Screening Products In One Place
Midwestern
TOLL FREE
877 - 4 - SIZING
(877-474-9464)
FREE TEST FACILITY
Visit: midwesternind.com
sales@midwesternind.com

Peening Solution
7 Axis Robotic Shot Peening M/c for Landing Gears
7 Axis Robotic Shot Peening M/c for Titanium Alloy Beam
Micro Blasting M/c for Gear Cutting Tools
MEC SHOT
MEC SHOT BLASTING EQUIPMENTS PVT. LTD.
H.O. & Works: E-279, M.I.A., Phase II, Basni
JODHPUR-342 005 (RAJASTHAN) INDIA Mobile # +91 7014731363
mail@mecshot.com
www.mecshot.in

Sinto America and Pulstec USA Join Forces for Zero Defects

Sinto America has announced a significant collaboration between Sinto America and Pulstec USA, building upon their Japanese parent companies' successful alliance that has existed for many years. This exciting collaboration is driven by a shared vision of achieving "zero defects" by verifying surface residual stress characteristics through X-ray diffraction testing technologies (Sinto–Sightia™/Pulstec -μ-X360).

Shot Peening Applications: Sinto America is offering comprehensive solutions from shot peening and inspection services through its National Peening and Technical Metal Finishing companies as well as shot peening and inline testing equipment (Sightia™) through its Roberts Sinto Corporation. The combined knowledge at Sinto America ensures that every aspect of the peening process can be optimized for quality and performance.

Collaboration: This collaboration between Sinto America and Pulstec USA combines expertise from different angles of industry and research for the benefit of both companies' customers. Sinto America's Sightia™ test equipment series and Pulstec's portable μ-X360 X-ray Residual Stress analyzer as well as both companies' resources will now be made available to a broader market, demonstrating our commitment to delivering top-notch solutions to our customers.

Zero Defects Focus: The key focus of this collaboration is to bring about numerous benefits to our customers, including higher product quality ("zero defects") and enhanced efficiency through a broad range of exceptional products and services. Our innovative eco-products and services also support our valued customers in their pursuits of achieving environmental Sustainable Development Goals (SDGs).

Stay tuned for more updates on this partnership between Sinto America and Pulstec USA as we strive to set new industry standards in quality and excellence.

About Sinto America
Sinto America, Inc. is the North American group of companies of Sintokogio, Ltd. Sinto America focuses on six primary markets – Foundry Mold and Core Making, Sand Processing, Bulk Material Handling, Automation, Surface Treatment, and Surface Technologies.

About Pulstec USA
In 1969, Pulstec Industrial Co., Ltd. was incorporated in Hamamatsu City, Shizuoka Prefecture in Japan with a view to manufacture electronic equipment. In 1996, Pulstec USA, Inc. was incorporated in Torrance, California.

2023 Shot Peening Workshop Highlights

Scottsdale, Arizona • October 16 - 18, 2023