

The Shot Peener

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



Setting a Standard with The Almen Strip for 80 Years.

Peening Innovation

COVERAGE
CHECKER



COVERAGE CHECKER

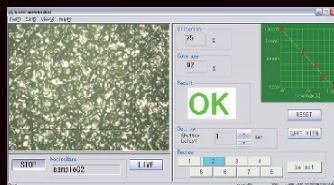
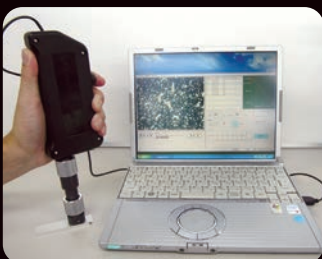
COVERAGE CHECKER the device for easy and precise coverage measurement



UV Light version New arrival!

- UV light version Coverage Checker measures coverage by the fluorescent paint peeling rate, using UV light. Therefore, measurement result will not be affected by surface condition.
- UV light version Coverage Checker can measure the coverage even on oxidized surfaces and uneven peened surfaces, which was difficult to measure with normal version.

Coverage Checker (Original) Easy USB connection to your PC



※PC is not included ※Device image

※Specifications of this device may be changed without notification.



**Positron
Surface
Analyzer**



PSA Type L-II

PSA Type L-P

Non-Destructive Inspection

by Anti-coincidence System
US Patent : US 8,785,875 B2

Application

- Shot peening inspection
(Inspection Depth : Down to 100 micron)
- Evaluation of Fatigue behavior
- Evaluation of sub-nano size defect
- Free volume on Polymer and Glass

Specification

Device size : Type L-II W400 X L400 X H358 [mm]
Type L-P W125 X L210 X H115 [mm]

Positron source : Na-22(under 1MBq)

Option : Autosampler function (4 - 8 stage)

Distributor

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The Almen Strip: An 80+ Year Journey of Setting a Standard

For more than 80 years, the Almen strip has remained the industry's trusted benchmark for measuring shot peening effectiveness. Erik Waelchli explores the history, science, standards, and manufacturing challenges behind this deceptively simple tool, while examining ongoing discussions about accuracy, process verification, and the future of peening measurement technology.



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ICSP16 Set for Gifu, Japan in September 2028

Plans are underway for the 16th International Conference on Shot Peening. Learn key dates and what to expect from this premier global gathering of shot peening professionals.

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Winoa and Toyo Seiko to launch a fully integrated heat treatment line for high durability cut wire in Altena, Germany

Winoa and Toyo Seiko have commissioned a new heat treatment line in Germany, strengthening European production of high-performance cut wire and enhancing supply, service, and technical support for key industries.



Watanabe and Schmidt shaking hands

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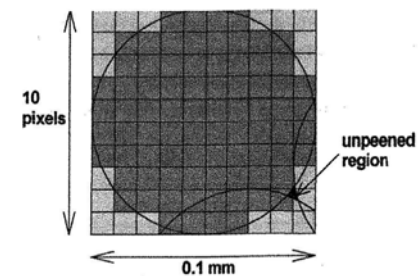
An Insider's Perspective: Saturation Curves and Process Design

Kumar Balan explains why saturation curves remain essential to shot peening process control, offering practical guidance on intensity verification, process design, media selection, and specification development.

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Coverage: Development, Measurement, Control & Significance

In this classic article from 2002, Dr. David Kirk examines how coverage develops, why it matters, and the challenges of measuring and controlling it for effective shot peening.



Pixellation of a 0.1mm diameter indent

THE SHOT PEENER

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



OPENING SHOT

Taylor Bowman | Editor | *The Shot Peener*

Opening Shot

Eighty years is a long time for anything to hold its ground in manufacturing. Processes change, materials evolve, and the tools we rely on are constantly being re-considered, which makes the Almen strip's staying power worth noting.

Since John O. Almen filed his patent in 1942, the strip has served as the industry's trusted benchmark for measuring shot peening effectiveness. No knobs, no electronic circuits, no calibration required. It simply responds to the process, honestly and without prejudice. For a field that depends on precision and repeatability, that kind of reliability is rare.

What strikes me most is not just that the Almen strip has endured, but that it continues to invite serious discussion. Questions about accuracy, process verification, and measurement standards are active conversations in the industry right now, not because the tool has failed, but because our standards for precision keep rising. That is a healthy sign.

It also speaks to something broader about shot peening as an industry. We tend to hold onto what works, examine it honestly, and build from there. The professionals I have had the opportunity to learn from approach the work that way, and I think it shows in how the field has developed over time.

As we mark this milestone, I hope it serves as a reminder of what sound engineering looks like: a simple principle, applied consistently, tested rigorously, and trusted because it has earned that trust.

That is a standard worth carrying forward. ●

THE SHOT PEENER

Editor

Taylor Bowman

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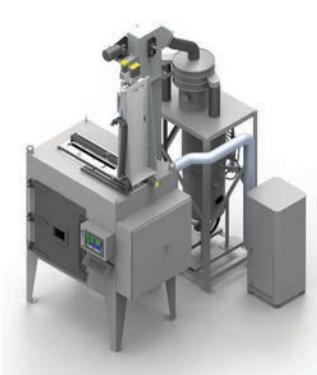
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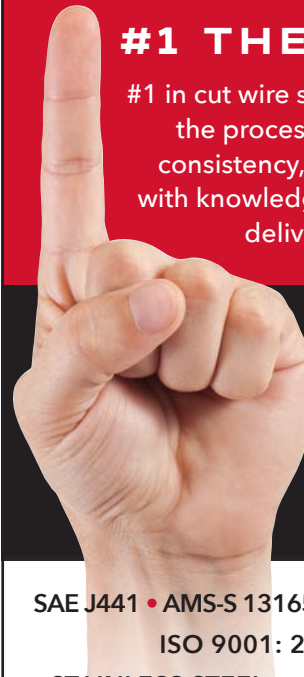
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The Almen Strip: An 80+ Year Journey of Setting a Standard

INTRODUCTION

After intense work, shot-peening engine valve springs for durability, John O. Almen filed for the “Shot Blasting Test”-Patent in 1942. On June 6th 1944 the patent was granted under the number #2,350,440 with its inventor John O. Almen and assignor General Motor Corporation, Detroit MI. With this event GM and John Almen laid the foundation for the industry to follow and challenge, a foundation becoming the basis for the SAE J-442 industry standard. Throughout many years of evolution and refinements of the Almen strip, strip holder, and Almen gauge, the basic principle remained: Peening a standardized strip and measuring its stress-induced deflection. This Almen strip “peen-sensor” has no knobs turn, no electronic circuits to adjust, no calibration is required, yet it responds to all peening parameters, from media velocity, -size, -hardness, -flowrate, nozzle type or size, set-up geometry, exposure time, etc. Exposed to any peening process, the Almen strip’s response is unconditional and without prejudice, truly setting an industry standard.

This Almen strip peen process-performance test is standardized and adopted worldwide across a variety of industries. Industries that manufacture critical components and products we all rely on throughout our daily lives. On millions of technical drawings and technical documents the Almen strip response is “the qualifier” for the peen process. Over the years, processes and their machine control technologies have evolved, demanding more accuracy from Almen strips and its support devices. The following is about the 80+ year journey of the Almen strip.

PEEN-RESPONSE MECHANISM ON ALMEN STRIPS

During peening, sphere-shaped media (shot) bombard the target metal surface, creating craters and compressive stresses at and just below the target surface. These compressive stresses are applied to offset the tensile stresses in cyclic loaded components to extend fatigue life.

When a shot particle hits the metal surface with high kinetic energy, it hammers a crater into the target surface, pushing material radially outward from the crater’s center, compacting the material below, and radially stretching the crater’s surface layer (Figure 1). With it, the shot-peened surface is elongated in all radial directions.

This one-sided Almen-strips surface elongation is bending the strip convexly upward (Figure 2). The arc-height measure as defined by the Almen gauge’s geometry is the Almen arc-height value.

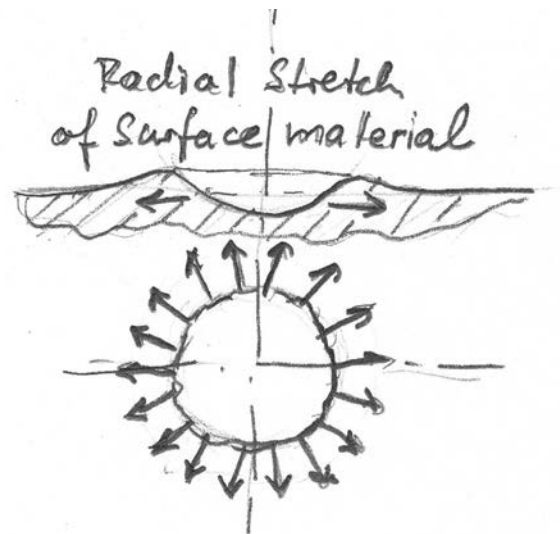


Figure 1 - Radial Material Stretch

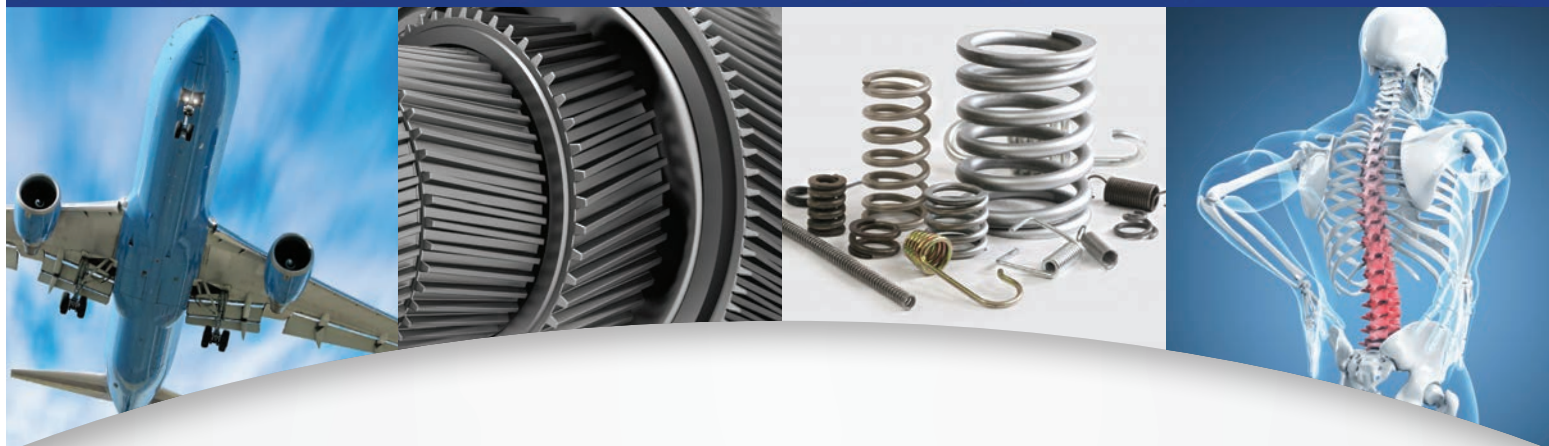


Figure 2 - Convex Bending of the Almen Strip at the Peened Surface

The precision and accuracy (two different things!) of this Almen strip arc-height, also known as the Almen strip peen-response and the related industry standards, are the focus of recent discussions in the industry.

KEY INDUSTRY STANDARDS

The purpose of industry standards is to coordinate information between users, resulting in interchangeable, safe processes and products. Standards are constructed under the supervision of leading industry professionals, who assure standards are technically correct and precise, useful,

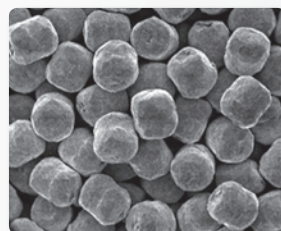


The advantage of Premier Cut Wire Shot

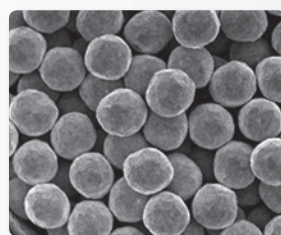
- **Highest Durability** Due to its wrought internal structure with almost no internal defects (cracks, porosity, shrinkage, etc.) the durability of Premier Cut Wire Shot can be many times that of other commonly used peening media
- **Improved Consistency** Highest consistency from particle to particle in size, shape, hardness and density compared to commonly used metallic media.
- **Highest Resistance to Fracture** Premier Cut Wire Shot media tends to wear down and become smaller in size rather than fracturing into sharp-edged broken particles, which may cause surface damage to the part.
- **Lower Dust Generation** Highest durability equals lowest dust levels.
- **Lower Surface Contamination** Cut Wire Shot doesn't have an Iron Oxide coating or leave Iron Oxide residue — parts are cleaner and brighter.
- **Improved Part Life** Parts exhibit higher and more consistent life than those peened with equivalent size and hardness cast steel shot.
- **Substantial Cost Savings** The increase in useful life of Premier Cut Wire Shot results in savings in media consumption and reclamation, dust removal and containment, surface contamination and equipment maintenance.



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practical, applicable, and add value to the industries implementing them.

The SAE-J442/2022 standard defines the fundamental principles and technology of the Almen strip and arc-height measurements and associated and needed equipment and supplies, i.e. Almen strips, gauges, and strip holders, etc. Aside from the Almen strip type (N, A, or C) and the standards' manufacturing tolerances, there are no other parameters to this Almen arc-height "sensor". This standard does not define or standardize peen intensity!

The SAE J443/2024 standard outlines the principle of peen intensity determination, production intensity setup, and peening process verification with related arc-height tolerances. Unfortunately, with the referenced SAE-J2597, it allows for different intensity algorithms, which can create confusion when comparing intensity values, saturation time T1- and 10%-base time T2.

The Almen strip provides test results with considerable reliability, relative to the standards' specifications. For decades it has established a solid and principal reference value for peen arc-height and the related peen-intensity calculation per SAE-J443/J2597.

MANUFACTURING LIMITS

With the required manufacturing tolerances per SAE-J442, Almen strips will have peen-response variation from supplier to supplier, from lot to lot, and to a lesser degree within one lot from the same supplier. Based on research conducted by EI, Almen strips' thickness and hardness are two dominant parameters for peen-response, which prompted the review of key manufacturing processes for these parameters: Cold Rolling process's accuracy limits define the strip thickness variability. Let's compare typical mill strip thickness tolerances to the J-442 specifications for A-1S and N-1S Almen strips of ± 0.0005 " :

- The general standard specification ASTM A682-2002, for high-carbon cold-rolled steel strip, lists Almen strip thickness tolerance as:
 - A-strip Range $(0.051") \pm 0.0014"$
 - N-strip Range $(0.031") \pm 0.0012"$
- Highlighting the challenge to motivate a tonnage-focused cold-roller to roll to tighter tolerance.
- Best web-advertised thickness tolerances capability found:
 - A-strip Range $(0.051") \pm 0.0003"$
 - N-strip Range $(0.031") \pm 0.0002"$

After contacting the mill, these tolerances did not apply to

high-carbon steel.

In the rolling mill, thickness is typically measured and controlled at the strip's center. Tapers on a master coils' center section can be $0.0005"$, up to $0.001"$, eating up the Almen strip thickness tolerance. Therefore, we recognize that current A-1S and N-1S specifications are already at the limit for economical cold rolling.

Testing Hardness with specified Rockwell scales. It is worth noting, the hardness accuracy concerns are not confined to heat-treating process control alone. The tight Almen hardness specifications for A-1S and N-1S grade strips already flounder with the hardness measurement capability, the means available for accurate measurement. Independent test conducted for EI proved the Rockwell method is superior to the unpolished Vickers method.

Unfortunately, for both mid-range HRa and HRC scales relevant for N- and A-type Almen strips, the industry allows hardness measuring equipment to be certified and accepted with an error of ± 1 HRC (ASTM E18 standard - Table A1.3). One should expect every hardness tester to yield same results on a particular strip, but because of this relatively large, acceptable hardness tester calibration error, this is not the case. It is common to have readings vary between properly calibrated hardness testers by ± 1.0 hardness points (theoretically ± 2.0).

Given this calibration situation the realization hits hard:

	<i>N-1S HRa mid-scale</i>	<i>A-1S HRC mid-scale</i>
Hardness Tester Tolerance	± 1.0 HRa	± 1.0 HRC
Almen Strip SAE J442	± 0.75 HRa	± 1.5 HRa

A word on hardness conversion: The ASTM E140 standard regulates hardness conversions. The SAE-J442 standard for Almen strips implies that no conversion is allowed and that all Almen strips hardness measurements to be per HRC or HRa scales for strip hardness and HR30N for decarburization. Therefore, hardness conversions are not acceptable. The ASTM E140 standard states, any conversions are for "reference only" - see ASTM E140 - § 6.3

Furthermore, please note, good practice is to use a small $1/4"$ diameter anvil and measures the strips with "pre-bow-up" (concave up) to minimize any reading-errors due to strip flatness. The inherent small pre-bow curvature needs to be

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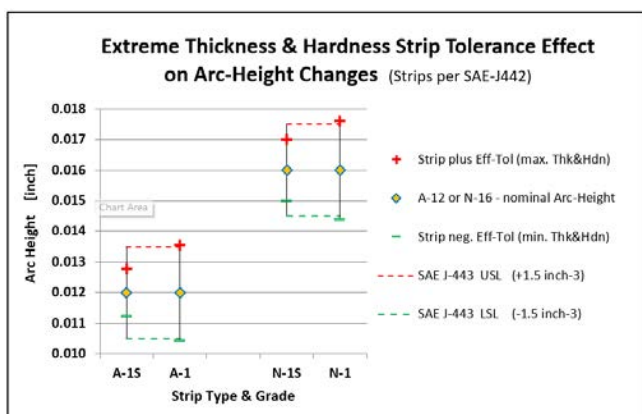
“bow-up” so the strip is not “flattened” under the Rockwell tester’s pre-load, even on an 1/4” anvil. Larger anvils amplify this very issue[4].

PEEN RESPONSE VARIATION

Almen strips peen-performance may vary a minute amount between strip manufactures and between manufacturing lots due to specified manufacturing tolerances. Mainly strip thickness and hardness contribute to response variability, while many other parameters have certain lesser influence, such as surface/sub-surface residual stress, width, short-edge-shape, M-o-E, surface roughness, chemistry, grain structure, etc.

The Almen strip’s behavior is extraordinarily complex in its test setting and has many external factors influencing the Almen strip’s response. Numerous published FEA-simulation and theoretical models have attempted to mathematically define this response. The strip’s clamping technique and geometry between test block and the measuring reference on the Almen gauge make accurate, theoretical models very difficult and possibly controversial.

The SAE- standard J443/2024 (§4.5.2) calls for a verification strip-to-strip response tolerance $\pm 1.5 \times 10^{-3}$ inch (± 0.038 mm) arc-height, this disregarding what Almen strip type is used. Per EI’s research, strip manufacturing tolerances per SAE-442 for grade A1S for thickness combined with hardness alone, eat up over half of this J-443 tolerance, grade A1 strips eat up this tolerance entirely. The more sensitive N-strips fares worse. This is a fallacy of these two standards, which is currently in discussions on several fronts in the industry.



Certain companies implement their own, tighter specifications, ex. $\pm 10\%$ of target arc-height, creating challenges, especially at lower intensities. Resulting considerations: What induced residual stress tolerance; i.e. what component design fatigue-life tolerance can be tolerated? Or are process

verification arc-height tolerances related to target component fatigue-life tolerances, or are other rationales considered?

In paragraph 4.5.2 of SAE-J443/2024 it states: “In all cases, a single strip is subsequently peened for the selected verification time and shall repeat the target arc height to within 0.0015 inch (± 0.038 mm) or other value acceptable to the responsible authority.” Because a perfect Almen strip cannot be manufactured, this tolerance covers both the process and the Almen strip arc-height variability.

Electronics, Inc. publishes peen response data on four (4) random A-strips lots on an annual basis[6]. You can find this data by following the QR-code below, under the tab “Additional Information”. While the LSL and USL are the SAE-J443 (§4.5.2) tolerance $\pm 1.5 \times 10^{-3}$ inch, the extreme values of the actual lot distributions (min. -3sp & max. +3sp) between the four (4) lots are typically well inside of $\pm 1.0 \times 10^{-3}$ inch (0.025 mm) tolerance band.



QR code to A, N, and C Almen Strips on the Electronics Inc. website.

PER LOT PEEN RESPONSE ANALYSIS

While analyzing four (4) lots per year allows a glimpse into the stability of an Almen strip production. A continuous peen-response test process, generating data for each manufacturing lot, could generate usable data for Almen strip users.

Unfortunately, tightening up the SAE-J442 strip manufacturing tolerances have no cost-effective solutions, as technical limits in cold-rolling thickness control, heat-treating and hardness measurement technologies are already challenged as is.

The reality is, while the Almen strips are highly accurate sensors, they cannot be manufactured “perfectly”.

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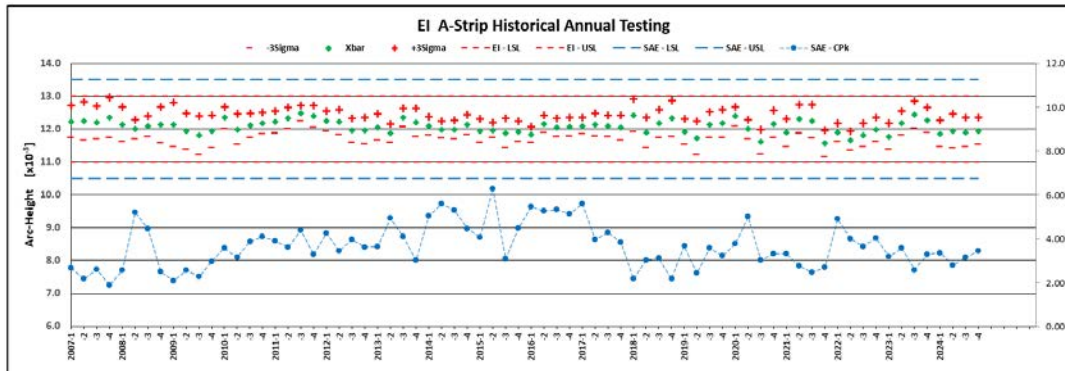


Figure 4. EI's history of four (4) lot tests per year:

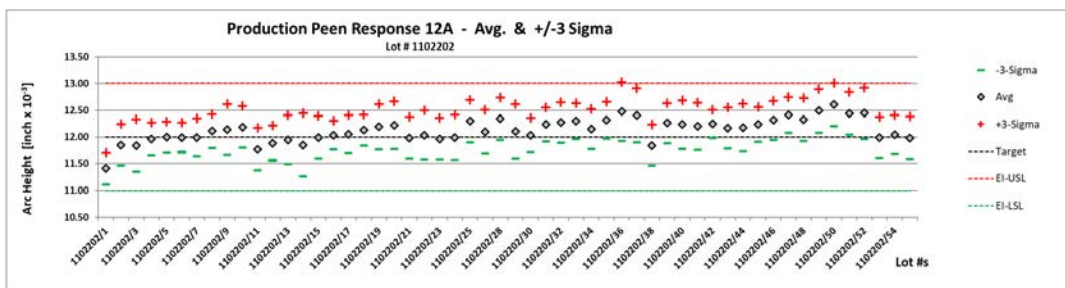


Figure 5. Example of lot - to - lot peen response data-set for a master lot

OUTLOOK INTO THE FUTURE

Electronic equipment is offered in the market to measure arc-height (SAE J442) or peen-intensity (SAE J442 & J443) directly. While these devices can, in certain circumstances, replace Almen strips in process verification, they always need to reference back to an Almen strip arc-height or intensity, which ultimately must be determined with Almen strips.

Many such measuring devices have been disclosed in patents, including US Patents 4,470,292 (Progressive 1984), 5,113,680 (Sinto 1992), 6,640,596 (Sinto 2003), 8,375,757 (Sinto 2013), 9,846,099 (Shockform 2017), 10,837,849 (Electronics Inc 2020), etc.

These devices need calibration to assure a reliable, trustworthy cross-reference to Almen strip arc-height measurements (J442) or Almen strip peen-intensity (J443/J2597). One has to judge; how possible calibration error magnitude compares to the relatively small Almen strip peen-response variations.

LAST THOUGHTS

Almen strips are the only known, un-biased peen-response standard the industry knows today. Until a new knob-less, electronic-less, calibration free and un-biased means to measure peen-process effectiveness is presented to the industry, the Almen strip will hold its place and will continue its standard-setting journey! ●

REFERENCES:

- [1] SAE J442-2022/05 & SAE J442-2026/02
- [2] SAE J443-2025/10
- [3] SAE J2597-2017-09
- [4] ASTM A682-2002
- [5] SHOTPEENER article from Dr. David Kirk "Almen Strip - Hardness Testing" (2024006), published in Volume 38, Issue 1
- [6] A, N and C Certified Almen Strips on Electronics, Inc. Website

About Erik Waelchli, IBD Connection, Inc.

Erik Waelchli is an independent industry advisor with focus on metal-forming and metal processing. Electronics Inc. (EI) has engaged Erik's services, to refine EI's Almen strip production. With EI's management and staff, assisted by PURDUE University, Erik with EI's suppliers reviews, modifies, and develops the related manufacturing processes, for EI to offer a highly accurate, consistent and cost-effective Almen strip to the industry.



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ICSP16 Set for Gifu, Japan in September 2028



ICSP16

16th International Conference on Shot Peening
September 11 – 14, 2028

INTRODUCTION

The global shot peening community has its sights set on Japan as details begin to roll out for the 16th International Conference on Shot Peening (ICSP16). Organized by the Japan Society of Shot Peening Technology (JSSP) and chaired by Yoshihiro Watanabe of TOYO SEIKO CO., LTD., the conference is scheduled for September 11–14, 2028, at the Nagarakawa Convention Center in Gifu, Japan.

CONFERENCE DETAILS

While many program details are still being finalized, the conference website is live and organizers have announced several key dates for prospective presenters and attendees.

Abstract submissions will be accepted through December 31, 2027, with acceptance notifications scheduled for March 31, 2028.

Extended abstracts will then be due by May 30, 2028.

Early registration will remain open until June 30, 2028.

The conference itself will take place from September 11–14, 2028.

ABOUT THE CONFERENCE

ICSP conferences have long served as the premier international forum for the exchange of research, applications, and advancements in shot peening and related surface enhancement technologies. Engineers, researchers, equipment manufacturers, and end users from around the world gather to discuss developments affecting industries ranging from aerospace and automotive to energy, medical devices, and additive manufacturing.

ICSP16 follows the successful 15th International Conference on Shot Peening (ICSP15), which brought together experts from across the globe to share research on process optimization, residual stress measurement, fatigue performance, digital modeling, sustainability, and emerging peening technologies. As the industry continues to evolve, expectations are high that ICSP16 will showcase the latest innovations

while fostering collaboration between academia and industry.

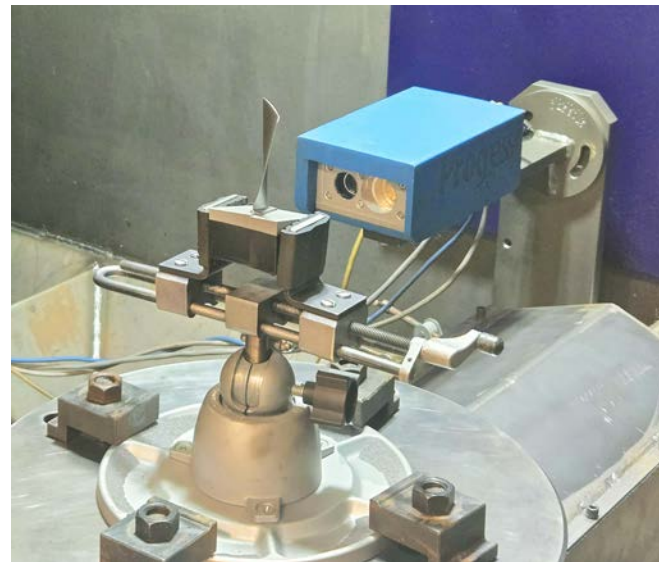
ABOUT THE LOCATION

Gifu, located in central Japan, offers attendees a blend of modern conference facilities and traditional Japanese culture. The Nagarakawa Convention Center, situated near the scenic Nagara River and surrounded by mountain landscapes, will provide an impressive setting for the international gathering.

MORE INFORMATION TO BE ANNOUNCED

Additional details regarding the technical program, keynote speakers, registration, and sponsorship opportunities are expected to be released as planning progresses. For the latest conference information, attendees are encouraged to follow updates from the Japan Society of Shot Peening Technology and the official ICSP16 website at www.scoop-japan.com/kaigi/icsp16/.

The Shot Peener Magazine will continue to provide updates as new information becomes available. ●



Progressive and Tecnar demonstrate the Shotmeter particle velocity measurement system from ICSP15

View ICSP15 Papers & Proceedings

To view the ICSP15 conference proceedings and all published papers, visit <https://www.icsp15.org/>.

Information

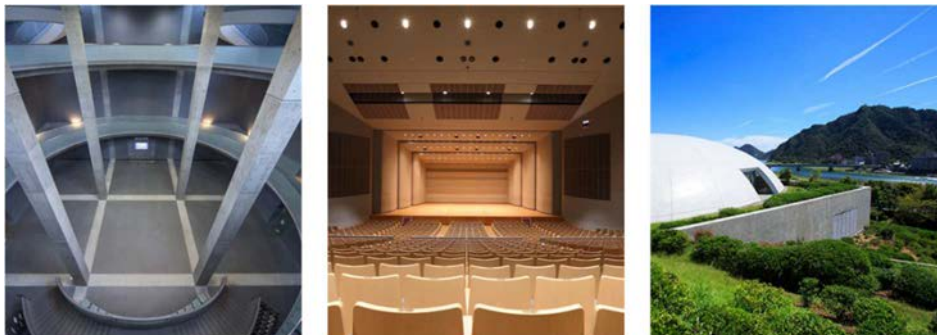
16th International Conference on Shot Peening, 2028 September Gifu, Japan

9/11/2028(Mon)~9/14/2028(Thr)



<https://www.scoop-japan.com/kaigi/icsp16/>

Venue : Nagaragawa Convention Center (Gifu)



Important Date

Abstract Submission Deadline	Dec.31 th 2027
Notification for Abstract acceptance	March 31 th 2028
Deadline for Extended Abstract	May 30 th 2028
Deadline for early registration	June 30 th 2028
Conference	Sept 11 th 14 th 2028

Japan Society of Shot Peening Technology

Winoa and Toyo Seiko to launch a fully integrated heat treatment line for high durability cut wire in Altena, Germany



Altena, Germany – Thursday 23rd April – Winoa and Toyo Seiko today announce the commissioning of a new fully integrated heat treatment (HD) line at its Center of Competence for Cut Wire in Altena, Germany.

Developed thanks to long-term strategic and exclusive partnership with Toyo Seiko and supported by the integration of Frohn since 2024, this milestone marks a decisive step in Winoa's renewed approach to Specialty Abrasives and Peening Media.

This enhanced capability enables the production of high-performance and durable cut wire in Europe, combining proven technical excellence with closer proximity to customers in the automotive, energy and defense industries. It aims to support their future growth while strengthening supply security and service quality from the heart of Europe.

"This project serves naturally to implementing the strategy we have been building over the past years," says Falko Schmidt, CEO of the Specialties Business Unit.

"Through our partnership with Toyo Seiko, we have established a strong foundation in high-performance cut wire. Today, we are taking this one step further by bringing this expertise to Altena, cradle of wire in Germany, to boast European industrial presence and responsiveness. This is what our customers expect today."

Toyo Seiko's expertise and standards, now produced in Europe The Altena facility now delivers full process integration, including:

- Wire sourcing and precision cutting
- Heat treatment (HD process)
- Conditioning (G1, G2, G3 rounding grades)
- Laboratory testing and hardness control supported by Artificial Intelligence (AI)
- Final inspection and packaging

The new heat treatment line combines advanced furnace technology strictly following Japanese processes, quality parameters, and technical support, ensuring consistent and reliable performance for demanding shot peening applications. A strong foundation from which Winoa will continue to develop and adapt solutions to meet evolving customer demands.

Supporting the transformation of key industries

Cut wire is primarily used in shot peening applications, which represent 70% of the demand in automotive, and also significant stake in energy and defense sectors.

As these industries evolve toward lighter materials and more demanding performance requirements, peening & surface treatment play a critical role in ensuring durability and fatigue resistance.

By producing HD cut wire locally, Winoa strengthens its ability to support:

- Increasing technical requirements
- Shorter lead times and greater flexibility
- Reduced transport and environmental footprint
- More predictable and efficient supply

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One integrated European platform

The Altena site, supported by the expert team at Frohn now acts as Winoa's European Center of Competence for cut wire. And together with the Tech Centers in France and Prague, the latter site co-located with the newly established Peening Center, will provide full service along the value chain of our customers

Through its Specialties Business Unit, Winoa offers customers:

- A single commercial entry point, available in all relevant markets
- A harmonized and comprehensive portfolio
- Combined technical and industrial services
- An integrated production and sales capabilities
- A safe testing and trial environment

This structure reinforces Winoa's positioning as a one-stop shop for shot peening and surface preparation solutions. ●

About Winoa

Established in 1961 in France, originally known as Wheelabrator Allevar, Winoa has evolved into the world leader in steel abrasives and metal surface treatment solutions. With a rich history of innovation and expansion, Winoa serves a diverse range of industries, continuously advancing the field of surface preparation through sustainable practices and cutting-edge technologies.

Discover more: winoa.com

About Frohn

Founded in Altena, Germany, Frohn has established itself as a global reference in the manufacturing of high-precision cut wire abrasives for peening and surface treatment. With production sites in Germany, the USA, and China, Frohn is recognized for its technical expertise, product consistency, and commitment to quality. Now part of the Winoa Group, Frohn continues to serve leading industrial sectors with specialized peening solutions worldwide.

About Toyo Seiko

Founded in 1975, Toyo Seiko Co., Ltd. is a global manufacturer of high-quality cut wire and integrated shot peening solutions. With operations in Japan, Thailand, and the United States, the company supports customers worldwide through advanced technology and consistent product quality. As a member of the Miyazaki Seiko Group, a specialist in secondary processing of special steel, Toyo Seiko continues to contribute to manufacturing innovation. In 2025, the company proudly celebrates their 50th anniversary of precision manufacturing excellence.

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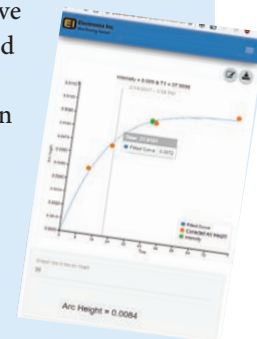
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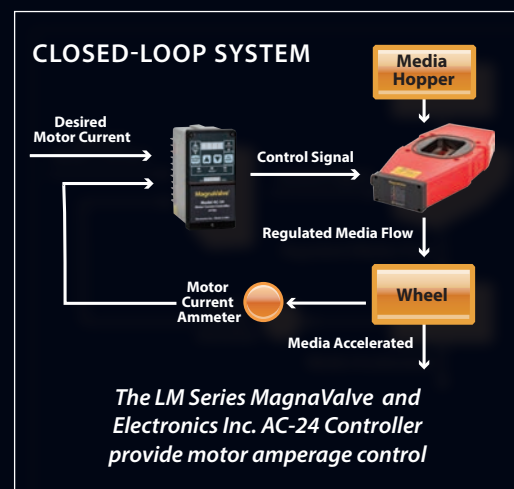
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AN INSIDER'S PERSPECTIVE

Kumar Balan | Blast Cleaning and Shot Peening Specialist

Saturation Curves and Process Design

INTRODUCTION

I am afraid that I must start by sounding like that person I was hoping I would not become, the reminiscing old shot peener, but here we are! For those of us that have spent considerable time in this industry, there are several situations that require the use of kid gloves. To an auditor, it might be the delicate exercise of handing out multiple non-conformances resulting in a failed audit. For a sales engineer, it might be the daunting job of presenting a significantly higher priced revision 6 of the original proposal after the customer has changed the scope as many times. To an installation technician, it might be the tactful task of informing the customer that a spinner hanger would have been a better choice of work handling arrangement for their application than the fixed table that just got installed. For me, it has been the interesting journey of explaining the significance of saturation curves while carefully and non-offensively laying it down that their self-claimed 'peening' operation was doing no more than 'cleaning' components.

More recently, I have been conducting onsite shot peening training for Electronics Inc. and blast cleaning training for Ervin Industries more frequently than before. Each session continues to expose me to some of those gaps seen among novice and experienced users alike. Graphs and charts do little to help with the explanation or mitigate this pain. Therefore, I would like to discuss select fundamental concepts with the aim of making shot peening and blast cleaning more inviting and manageable to users. Just as I started thinking about the framework for this article, I attended the SAE/AMS semi-annual meeting in Troy, MI. Walter Beach, the Chair of both committees had started working on re-writing ARP 7488, Aerospace Recommended Practice – Peening Design and Process Control Guidance. This is intended for use as a reference document, with the OEM specification taking precedence. Walter has covered a variety of process aspects related to shot peening in this document that I wish to incorporate into our discussion. Though these are geared to aerospace users, they apply equally to other industries as well. (Note: Using this reference also adds to the credibility that this article is not AI generated!)

SATURATION CURVES

Process capability index (C_p and C_{pk}) is a statistical metric used to measure the ability of a manufacturing process to produce output that meets specific quality requirements or specifications. It provides a quantitative way to assess how well a process is performing compared to its tolerance limits. I like to think about saturation curves as accomplishing this purpose in shot peening. However, a few facts that are often misunderstood:

1. The Almen strip deflects/bends when impacted by a spray of peening media. When you measure the deflection of the strip with an Almen gage, you are measuring the arc height. This is not the intensity. You need a minimum of four such arc heights (datapoints), obtained by exposing a minimum of four distinct strips to media spray at different exposure times. The nature of exposure will depend on your machine. It could be number of passes, strokes, rotations, cycle etc. With those four data points, you will set about plotting your saturation curve. If you notice, I have not introduced the term 'intensity' yet. That is because, intensity is calculated from the saturation curve. In other words, 'arc height' is a measured value whereas 'intensity' is a calculated value from the saturation curve. SAE J443 has more details.
2. We often talk about the 10% rule when it comes to saturation curves. Unfortunately, this 10% rule has been subject to misinterpretation given its evolution over multiple versions of SAE J443. The current version of this document instructs the user to only accept 10% and nothing less for increase in arc height when the exposure time is doubled. Only then can the arc height be called the intensity of the process. The misunderstanding arises from the language in earlier versions of J443 which allowed upto 10% as acceptable validation. During our shot peening workshops, students are trained to manually plot saturation curves, and to accommodate a variety of drawing skills, we allow a tolerance of 9-11%. In real-world conditions, most of you use computerized curve solvers that help you get to an accurate intensity value at exactly 10%.

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When plotted correctly, the saturation curve gives you the complete bill of health for your process. Let us consider some of the features of this curve:

- The saturation time 'T' (and 2T) times are specific to a set of process parameters. In other words, changing any of the critical parameters that affect the impact energy such as velocity (air pressure or wheel speed/diameter), media size, and media flow rate will require a new saturation curve resulting in a different intensity value. If using the same parameters during periodic plotting of a saturation curve (not to be confused with routine verification using a single strip) results in an intensity value different from the original, it signifies that your process is no longer stable due to a shift in those critical parameters.
- Media contamination is possible in shot peening machines, especially when operating with multiple sizes or hardnesses of peening media that are switched in the same machine. In addition to the possibility of an incorrect media size being accidentally added to a machine, damage to a classifier screen in the form of rips or blinding could result in contamination. In such cases, the emergence of a double knee in your saturation curve demonstrates the first knee for the smaller of the two shot sizes, followed by a second knee for the larger size. This is not an acceptable version of a saturation curve. Had you not attempted to plot a saturation curve, you would not have been able to identify this rather important issue.
- The 'T' time in a saturation curve is not a time measure of how long it will take topeen your actual part. Do not attempt to correlate the size of the Almen strip (3" x 3/4") to the size of your part and arrive at an incorrect cycle time either. Times T and 2T are used to validate your peening process. Actual peening time will depend on the time it takes to achieve 100% denting on actual parts. An old, now corrected prime spec instructed the user topeen the part to the higher of the two – time T and time to achieve 100% coverage. When this instruction was to be used topeen aluminum parts, 100% coverage was achieved much faster than the T time on the saturation curve. The exact opposite can be expected if this instruction were to be followed when peening case hardened parts. Review your spec carefully and discuss such anomalies with your end user.
- Data used to plot the saturation curve (velocity and media flow rate, shot size being constant) are to be transferred to your production process when peening parts, except for exposure time. Exposure or cycle time is dependent on the time it takes to achieve required coverage (min. 100%) on the part.

DESIGNING THE PEENING PROCESS

(adapted from suggested revisions to ARP7488A)

If you are at the vantage point of instructing your peening service provider, drafting specifications, or creating notes on the drawing for your own organization to use in internal process design, consider the following issues faced by shot peeners when evaluating a peening project. Though instructions will be more elaborate than those listed here, the purpose of this list is to identify only those that tend to get ignored or remain ambiguous.

- Does the drawing clearly specify areas to be peened. If there are areas to be masked, are they clearly identified in the drawing? Have locations to determine / verify intensity been identified on the drawing? Are such locations sufficiently open to receive direct impacts from nozzles or blast wheels? Are there areas on your part where peening is optional (and, is overspray permitted)? If any of these instructions are not clear, is there an expectation established with the service provider where you will be provided documentation on their methods and alternate techniques to conform to your requirements?
- Does your part have sharp edges? Edge rollover is undesirable and could result in part failure due to a stress riser. In such situations, consider reducing the intensity requirement in such areas – with approval, of course.
- Are there any thin sections in your part that could potentially warp with the impact of peening media? Thin sections also get peened. However, they may need to be fixtured differently and perhaps peened to a lower intensity. Another option would be topeen simultaneously from both sides of this section.
- Are there sealing areas where dimensional changes due to shot peening are a concern? If so, have they been identified and noted in the drawing?
- Are you specifying a post-peening process?
- Is there a surface roughness value that you would like maintained after peening? If so, are you providing instructions on the permissible finishing process, post-peening?
- Have you specified the sequence requirements? An example could be, 'Shot peen after final heat treat and before coating'.
- Unless you require your peening service provider to take care of some or all of these, parts should be presented to them in a condition that is ready for peening. They

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should be free of grease, dirt, oil, corrosion, burrs, sharp edges, any coatings, plating, or paint.

- Are there specific requirements for chemically cleaning prior to peening?
- Are there specific requirements for chemically cleaning post-peening or is there an added requirement of glass bead peening?
- Processes that could induce tensile stress such as heat treatment and non-destructive testing must be completed prior to peening. When peening, the part dimensions and finish requirements must have already been met.

MACHINE TYPE

The process designer must be cognizant of machine limitations (airblast – suction/pressure and centrifugal wheelblast). Generally, airblast type media propulsion is suited for rotating engine components whereas structural components can be processed in wheel or air machines. Wheelblast machines are commonly used when your peening media is metallic. Peening requirements in holes and slots are met with nozzles and deflector tips, not with blast wheels.

MEDIA TYPE AND SIZE

Four types of peening media are used in shot peening – cast steel shot, conditioned cut wire, glass bead, and ceramic. Cast steel shot and conditioned cut wire, in the metallic type, are both capable of delivering the required intensity with the choice being left to the process designer. In certain cases, the drawing might allow the flexibility to use one or the other to the service provider. When such flexibility is not provided, the service provider is not permitted to choose the media type.

When not specified, the default media hardness is regular (R) at 45 to 52 HRC. However, this may not be suited for hard parts (e.g., case hardened transmission gears) with hardness over 55 HRC. When such hard parts are peened with regular hardness media, the surface will resemble that of a burnished or polished surface posing challenges in visual inspection. It is important to know that high hardness media will achieve the same intensity as regular hardness media when the former is applied at a lower velocity. This knowledge allows you to take advantage of the same particles per lb. and thereby maintaining coverage rate while achieving higher intensity (e.g., going from ASR230 to ASH230).

Media size considerations are several such as:

- Intensity, with the following additional criteria
 - Shape of parts
 - Size of fillets (shot diameter vs smallest fillet on part)

- Finish – at equal intensities, larger media will produce a finer surface finish
- Avoid specifying small media at high intensity on aluminum or magnesium (soft metals). This increases the possibility of damage to the part.

OTHER CONSIDERATIONS

Almen test strips: after settling on a specific manufacturer of Almen test strips that conform to SAE J442, continue using the same strips for the duration of the project. Changing to a different manufacturer, even if the alternative conforms to J442 is likely to yield different results with intensity getting out of range. If a change must be made for uncontrollable reasons, you will need to plot a new saturation curve.

Target arc height: This is the desired measured arc height within the approved intensity range that the process should produce at saturation. Target height selection should be such that it is close to the center of the intensity range, for example, a practical target arc height for an intensity range of 0.012-0.016A might be 0.014A. This will allow normal process variation without drifting out of tolerance during verification.

Verification arc height: This is the measured arc height when in production (verified at least every 8 hours or with new batch of parts). Each verification location will be run to its Target arc height time; the resulting number shall be within 0.0015" of its original value and within the engineering drawing specification range.

Example: If the intensity range is 0.012 – 0.016A and the target arc height is 0.014A, each time this process is verified, the result must be between 0.0125 and 0.0155A.

With multiple intensity verification locations, generally a single target arc height is chosen by selecting the location that has the longest time (T) to reach saturation.

Finally, closing our discussion with the initial topic – saturation curves. Practical considerations might require you to change suppliers, process parameters, machine types etc. With the importance placed on results of the saturation curves, remember that any such change will require plotting a new curve, not just for specification conformance, but also to maintain the validity of your established peening process. ●



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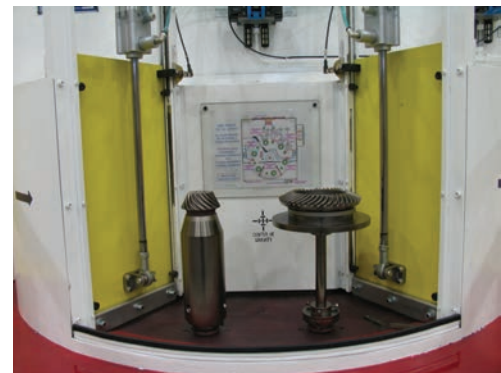


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ACADEMIC STUDY

Dr. David Kirk | Coventry University

Coverage: Development, Measurement, Control & Significance

INTRODUCTION

The prime objective with shot peening is to induce a 'skin' of compressively-stressed material that will improve the service performance of components. A necessary corollary of peening is that the surface is work-hardened by the impacting shot particles. This work-hardening normally improves service performance. On the other hand, excessive work-hardening exhausts the ductility of the surface material, leading to micro-crack formation and a reduction in service performance. As the particles impact the surface, they produce indentations that comprise a proportion of the surface area of the component. The term "coverage" is used to define the proportion of the shot peened surface that has been indented by the impacting shot particles. Hence expressions such as "99% coverage" are meant to indicate that 99% of the surface area has been indented at least once, whilst 1% of the area has not received any impacts at all. Central questions include: "How does coverage develop?" "How can coverage be measured and controlled?" "How does coverage vary?" "What is the optimum coverage" and "How does coverage relate to the required compressive surface residual stress?"

COVERAGE DEVELOPMENT

Coverage development is generally explained using a simple model based on the random production of indentations. This model assumes that identical shot particles impact the surface at a constant rate (measured in impacts per unit area per unit time) producing identical circular indentations and that the indentations are distributed randomly. Fig. 1 shows a schematic representation of coverage developing progressively. In the first second of peening eight circular indentation areas have been produced, sixteen in two seconds, thirty-two in four seconds and sixty-four in eight seconds - equivalent to a constant rate of eight indentations per second. Each indentation has its centre within the outer square and the coordinates of the centres have been assigned using computer-generated random numbers. The inner square gives the true indication of the coverage that has been effected. It should be noted that multiple impacting occurs increasingly frequently as coverage develops.

The total area that has been 'impacted' can be measured using image analysis and, for this specific example, yields values of 15.67, 34.85, 46.87 and 77.10% for 1, 2, 4 and 8s respectively. These values are plotted in Fig.2 together with the coverage curve that relates to an infinitely-large area impacted at the same rate. That coverage curve is based on the Avrami equation (see ref. 1):

$$\text{Coverage} = 100[1 - \exp(-A.R.t)] \quad (1)$$

where A=area of each impact, R is the rate of creation of impacts and t is the peening time.

It can be seen that the four experimental points do not lie precisely on the coverage curve. That is because the points refer to impacts

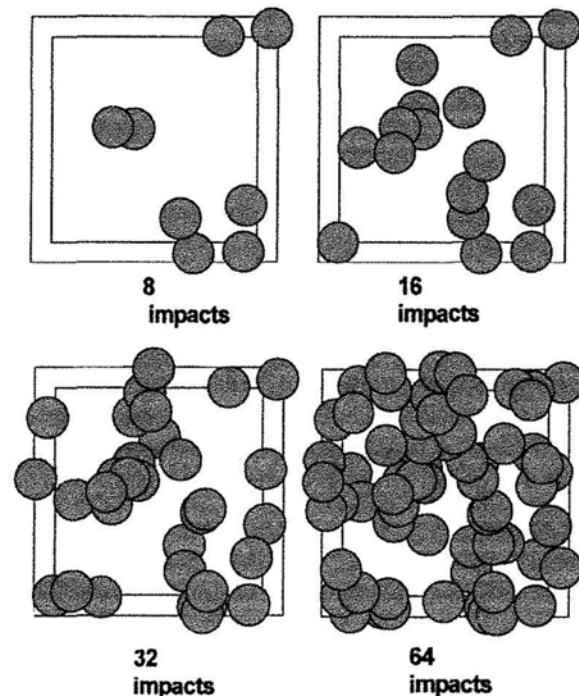


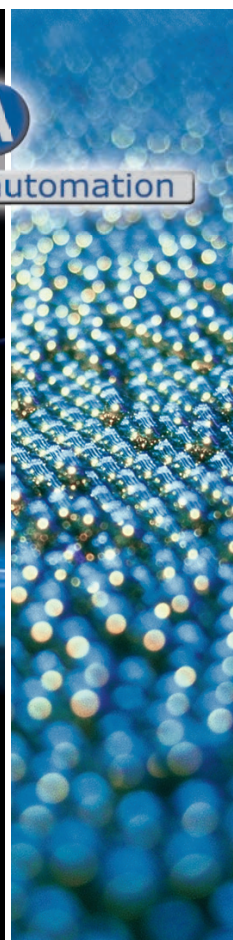
Fig.1 Model of Progressive increase in coverage.



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a finite sample and the curve refers to an infinite sample. This difference is both subtle and important. By way of analogy, consider the throwing of a perfectly-balanced six-sided dice. With six throws we may or may not get just one 'six'. The observed frequency of sixes could vary from zero to six out of six throws! If, on the other hand, we threw the dice an infinite number of times then, for a perfect dice, the frequency would average out precisely at one in every six. With a very large number of throws, the frequency would be very close to one in every six.

As coverage develops so the number of repeat impacts increases. This is shown in Fig.3. The curves are again derived using an 'Avrami model', where identical, circular, indents are being created randomly, but at a constant average rate, over an infinitely large area (see ref.2). With 90% coverage the 'mode' (commonest) number of times a given spot has been impacted is twice, followed by 1, 3, 4, 5 etc. At 99%, the mode value is 4 and at 99.9% the mode value is 7. At 99.9% coverage, a significant number of regions will have been impacted more than twenty times! The model predicts that 100%

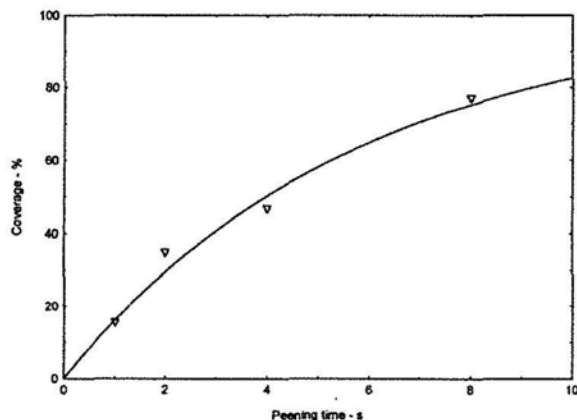


Fig.2 Comparison of coverages measured from Fig.1 with coverage curve prediction.

coverage is never reached - regardless of how long peening has been carried out. That is because we are assuming that an infinitely-large surface area is being peened. With a finite area and a finite number of components, the coverage can be 100% but can never be guaranteed. Even with very intensively-peened components, we can only say that there is a high probability of 100% coverage over the whole of the peened area for an individual component.

It is argued here that we should aim at inducing a coverage that is uniform (in a macro sense) but which has an average value significantly less than 100%. There will be an optimum coverage value, below which represents under-peening and above which represents over-peening. This optimum value

will depend largely on the material being peened. It should be remembered that the prime objective of peening is to produce a compressive 'skin' that optimises service properties, not the vain pursuit of trying to guarantee 100% coverage. That pursuit would involve excessive peening of the component, with the concomitant likelihood of exceeding the ductility of the material and reduction of the benefits of peening.

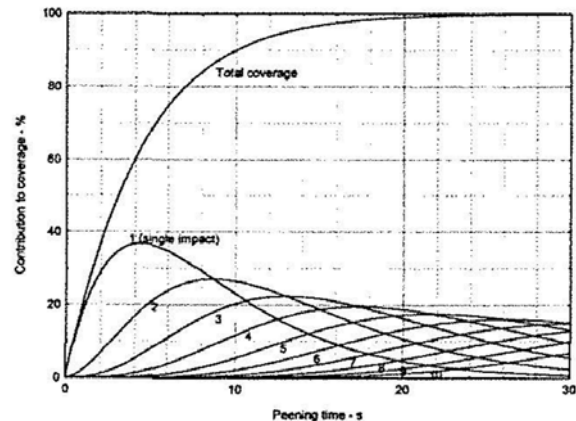
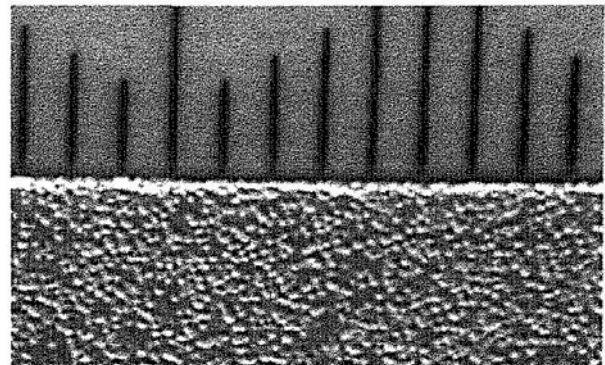


Fig.3 Contributions of different numbers of impacts to total coverage.

COVERAGE CONTROL AND MEASUREMENT

The first problem in controlling coverage is to be able to measure it accurately. Fig.4 shows a lightly-peened specimen at approximately 10x magnification. Because there are substantial areas of unpeened surface, it is possible to make reasonably-accurate measurements on the specimen. Quantitative measurements on such specimens can readily be made using image analysis procedures. Measurement becomes difficult and eventually impossible, however, as coverage approaches 100%. The measurement problems are exacerbated by the unpolished nature of the original surface. Manufacturers will not polish their components just to help coverage measurement! The unevenness of peened surfaces is the most important problem, especially as it prevents uniform focussing. Overlapping dimples have blurred edges that may, or may not, hide tiny unpeened areas.



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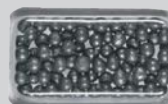
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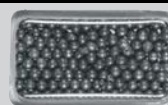
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97% min on No. 12 Screen



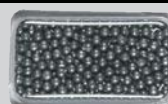
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85% min on No. 12 Screen
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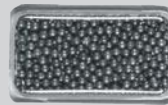
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97% min on No. 16 Screen



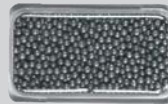
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85% min on No. 16 Screen
96% min on No. 18 Screen



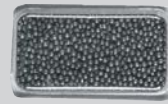
S390 All Pass No. 12 Screen
5% max on No. 14 Screen
85% min on No. 18 Screen
96% min on No. 20 Screen



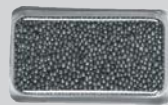
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85% min on No. 20 Screen
96% min on No. 25 Screen



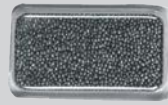
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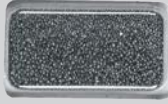
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85% min on No. 30 Screen
97% min on No. 35 Screen



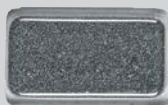
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10% max on No. 25 Screen
85% min on No. 40 Screen
97% min on No. 45 Screen



S110 All Pass No. 30 Screen
10% max on No. 35 Screen
80% min on No. 50 Screen
90% min on No. 80 Screen



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10% max on No. 45 Screen
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Fig.4 Aluminum specimen peened to 34.8% coverage using 5170 shot, viewed at 10x magnification together with a metric ruler having millimetre graduations.

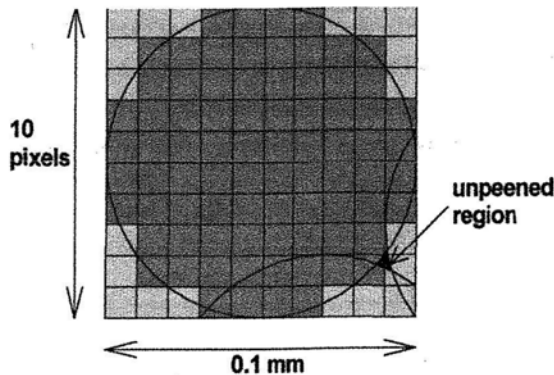


Fig.5 Pixellation of a 0.1mm diameter indent, together with overlapping indents and unpeened region.

It is obviously impossible to measure infinitesimally-small unpeened areas. Measurements involving very small unpeened areas will also be impossible using current technology. Consider, for example, a 10mm by 10mm area that is to be photographed for examination at 10x magnification. The 'on-screen' size of the image at 10x magnification will be 100mm by 100mm. Assume that the camera has a capability of recording a 1 megapixel image. That is equivalent to a 1000 by 1000 pixel square image. Hence, each square millimetre of specimen surface corresponds to 100 by 100 pixels. If we now consider indentations made by, say \$110 or \$170 shot, the indent diameter will be in the region of 0.1mm. That, then, corresponds to a 0.1mm diameter circle inscribed within a square that is imaged by just 10 pixels by 10 pixels. Fig.5 shows a representation of that situation.

If (and it is a very big 'if') the camera were capable of perfect separation of peened and unpeened regions then the indent would appear as the darker pixels (in monochrome) - giving a 'jagged circle'. The 'unpeened region' developed between three overlapping indents, shown in Fig.5, is less than one pixel in any direction and therefore could not be detected. The area of the single 'unpeened region' shown is about 0.1% of the total 0.1 by 0.1mm area. Hence, we see that we could not determine whether the coverage was above 99.9%. Indeed, with ten such small unpeened areas in the overall square we cannot even determine if 99% coverage has been reached.

The precision of quantitative image analysis coverage measurements depends upon the quality of the original image. A low quality image, seen as Fig.6 (a), has been deliberately used in order to illustrate the problems that may arise. The corresponding binary image, shown as Fig.6 (b), is unable to distinguish between the reflectivity of the unpeened areas and

the bottom of the indents. Hence, 'dots' appear in the centre of most of the indent images. Accurate analysis of the image would have to be based on only measuring the enclosed area' of each identified indent (hence including the 'dots' and also ignoring the specks between the indents. Far better, and easier, is to have a good quality image to work on!

Reliable measurements can, however, be made on surfaces that contain a substantial proportion of unpeened area. It is therefore proposed that coverage control can, and should, be based on measurements made on surfaces that have received much less than 99%. The following case study is intended to show how such control could be exercised.

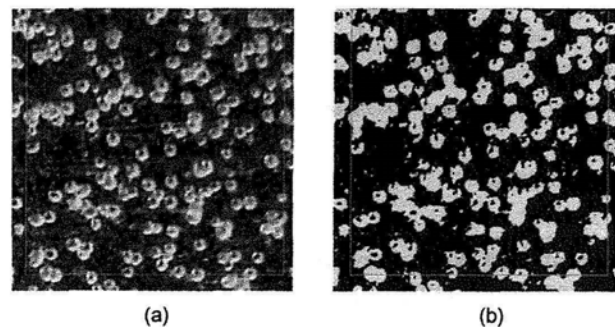


Fig. 6. Optical image (a) and binary image (b) of aluminum peened with \$170 shot, 10x magnification.

CASE STUDY OF COVERAGE CONTROL

A component is to be peened using four identical passes with the aim of imparting precisely 99.9% coverage. The only variable that can be used for control purposes is the rate of flow of shot. Polished strips of material, that are identical in composition and properties to that of the component, are available.

The first step could be to fit a polished test strip into the peening facility - in a similar way to that of fixing Almen strips. The strip is given a single pass at a known, intermediate, rate of shot feed. After peening, several areas of the strip are photographed and image analysed for coverage. The average coverage was found to be, say, 74.6%. We can substitute that value into the Avrami coverage equation (1) to give:

$$74.6 = 100[1 - \exp(-A.R.1)] \quad (2)$$

where the second '1' represents the first pass of the four that are to be applied; A, the area of each indentation, is assumed to be constant and R is directly proportional to the rate of flow of shot.

We can easily solve equation (2) giving us a value for A.R of 1.3548. That value can then be fed back into equation (2) - together with 2, 3 and 4 to represent the subsequent passes.



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That then gives us the total coverages that will have been imparted at each pass -93.344, 98.283 and 99.55% for 2, 3 and 4 passes (at the A. R rate of 1.3548). The coverage after four passes is therefore less than the required 99.9%. We then substitute the required 99.9% into the equation to find the value of A.R that will give us 99.9% coverage. This yields a required A.R value of 1.7269. Comparing that value with 1.3548 tells us that we need to increase the flow rate by some 27.5% in order to achieve precisely 99.9% coverage from four passes. The actual calculations made by the author are shown in Fig.7 where “x” has been used for the initial A.R combination and “y” for the required, adjusted, A.R rate.

If the required coverage had been 99.99% rather than 99.9% then the shot flow rate would have had to be increased by 70.0% (derived using the same procedure as before). For 99.999% coverage the procedure predicts a required increase in shot flow rate of 112.4%. It should be noted that such very high coverage values would very probably exceed the value required for optimum service performance enhancement. Note that ‘A’ has been assumed to be constant throughout each pass. A more sophisticated equation than (1) can be used which would accommodate the probable progressive reduction in dimple size,

Mathcad Worksheet for Peening Coverage

$$100(1 - \exp(-1 \cdot x)) = 74.2$$

$$1.3548$$

$$100(1 - \exp(-2 \cdot 1.3548)) = 93.344$$

$$100(1 - \exp(-3 \cdot 1.3548)) = 98.283$$

$$100(1 - \exp(-4 \cdot 1.3548)) = 99.557$$

$$100(1 - \exp(-4 \cdot y)) = 99.9$$

$$1.7269$$

$$\frac{1.7269 - 1.3548}{1.3548} = 0.275$$

Fig.7
Mathcad'
worksheet
used to
predict
required
change in
shot flow
rate.

COVERAGE AND SURFACE RESIDUAL STRESS

Shot peening of components induces a two-dimensional, highly-beneficial, compressively-stressed surface layer over the whole surface. One major reason why shot peening is so consistent effective is that it is such a ‘forgiving’ process. By that it is meant th:

a complete protective skin of compressive residual stress is inevitable provided that the coverage does not fall to a very low value in any critically-stressed region. Hence, we can always expect improvements in service performance by the shot peening of components. The presence of small areas that have not been impacted does not mean that there are ‘weak points’ in the surface. That is because it is not the dimples that generate the compressively stressed areas but rather the deformation zone under and around the dimples. Fig.8 shows a single impact area, its adjacent deformation zone and a representation of the concentric ‘envelope’ of compressively-stressed material. The level of compressive stress falls the further it is from the centre of the impact area. The intention with Fig.8 is simply to illustrate that both the impact area and the deformation zone have finite dimensions whereas the envelope is infinite (no specific border). The finite dimensions of the impact area are determined by the shot size, energy, material strength, etc. The finite dimensions of the surrounding deformation zone are determined by how far from the impact centre the yield strength has been exceeded - there is therefore a sharp ‘cut-off for plastic deformation. Compressive residual stress values, on the other hand, fall progressively with distance from the centre of the impact area i.e. the maximum compressive stress values will be under the impact area. The fall in stress magnitude away from the

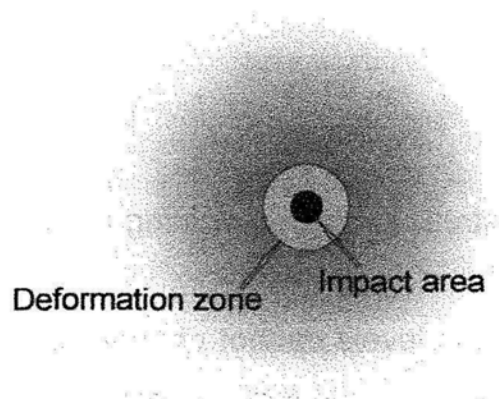


Fig.8 Schematic representation of impact area, deformation zone and surrounding compressively-stressed envelope.

impact area is represented in Fig.9, by means of concentric isostress circles and includes several impact areas - in order to illustrate overlapping stress contours. Due to the “principle of superposition of stresses”, the overlapping stress contours

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will merge to form a Continuity of residual compressive stress over the surface. If the pre-peened surface contained tensile residual stress then that is replaced by the Compressive residual stress induced by peening.

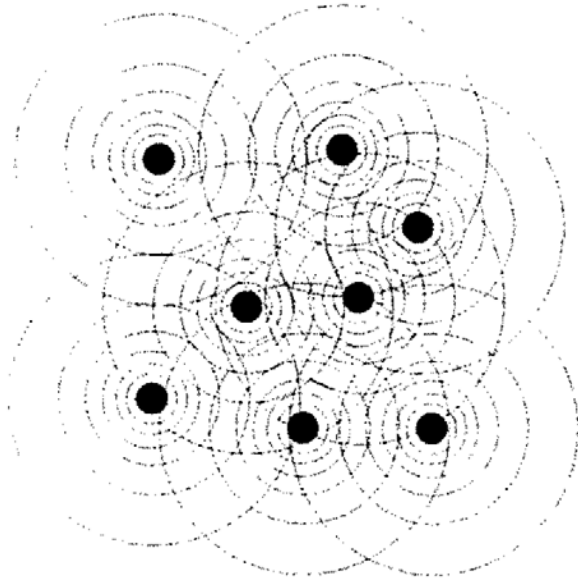


Fig.9 Overlapping compressive isostress circles emanating from several impact zones.

Another important factor is that stress levels cannot change abruptly. It is therefore physically impossible to have regions of tensile surface residual stress, or even regions of very low compressive residual stress, in a shot peened component that has been given a uniform, substantial, coverage.

DISCUSSION AND CONCLUSIONS

The preceding arguments lead to three main conclusions:

1. That there is no need to try to achieve very high coverages for peened components,
2. Effective coverage control can be exercised by measuring the coverage at an early stage, invoking the appropriate coverage formula and then controlling the shot flow rate for a given peening regime and
3. There is an important difference between finite and infinite estimates of coverage.

Accurate measurement of very high coverages is not possible. It would be difficult to imagine a defensible procedure that claimed to identify, let alone ensure, 100% coverage over the whole surface of a peened component. It is important that the optimum coverage should be established for different materials working in different types of service condition. That is because the prime objective is to induce a compressively-

stressed surface 'skin' that optimises service properties. Over-peening will lead to a deterioration of the peened surface, due to the exhaustion of ductility. Under-peening, on the other hand, will correspond to the surface not reaching optimum hardness (by work hardening) and a consequent reduction in the thickness of the 'skin' of compressive stress. It is reasonable to suppose that, for many materials, the optimum coverage will be less than 90%.

Quantitative coverage control could become an effective tool in precision shot peening. A fundamental advantage is that the coverage/peening time curve has such a simple shape with the corresponding Avrami equation having only one variable - assuming fixed dimple diameters. That compares with the complex shape of an Almen saturation curve, which requires three or four parameters for accurate analysis. Hence, only one measurement is needed to predict the progress of the coverage/peening time curve - for constant peening conditions. The use of fixed dimple diameters is a simplification and real peened areas contain dimples with a range of diameters. That does not invalidate the argument that final coverage can be predicted from an intermediate stage of peening. The constant diameter concept can be equated with the average diameter of a range of dimple sizes.

It has been shown that control based on small, but accurate, changes in the shot flow rate could be very efficient. As with most acceptable control procedures it is necessary to have reference standards. Quantitative chemical analysis, for example, relies upon having a range of standard specimens of known composition. Measurements are then expressed relative to that of the nearest available standard.

Reference standards for the coverage control procedure outlined in the case study should include:

1. A set of standard' digital photographs of different materials peened to different, agreed, coverages. The image analysis procedure could then be regulated to match the standards.
2. A set of standard peened specimens, again of different materials peened to different, agreed, coverages. The imaging/analysis technique could then be regulated.

The accuracy of coverage measurements would be improved by employing test strips, of the component material, that had been polished, or at least fine ground. Image analysis procedures should allow for a large number of impact areas to be measured at one time. That is in order to smooth out the difference between a finite sample size and the value predicted for an infinitely-large sample.

Uniformity of coverage over the whole surface is important.







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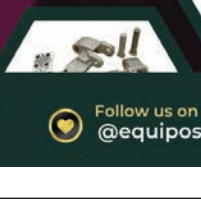
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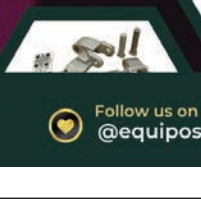

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This can also be monitored more effectively if measurements are made at intermediate stages of peening.

Finally, coverage and peening intensity (as measured by means of Almen saturation curves) are not the same thing. They reflect different aspects of peening control. An accurate knowledge of coverage for a peened component will relate to the integrity of the protective skin' of compressive residual stress. In addition, measurements of coverage refer to the component material itself. Peening intensity, on the other hand, refers to the 'severity' of peening applied to Almen strips - which are, necessarily, of a standard steel specification and condition. ●

Editor's Note: This article is reprinted from the Fall 2002 Shot Peener magazine.

References

- 1 Kirk D and Abyaneh M Y. Theoretical Basis of Shot Peening Coverage Control, Proceedings of the Fifth international Conference on Shot Peening, Oxford, 1993, pp 183-190.
- 2 Abyaneh M Y and Kirk D, Fundamental Aspects of Shot Peening Coverage Control Part Three: Coverage Control versus Fatigue, Proceedings of the Sixth international Conference on Shot Peening, San Francisco, 1996, pp 456-463.



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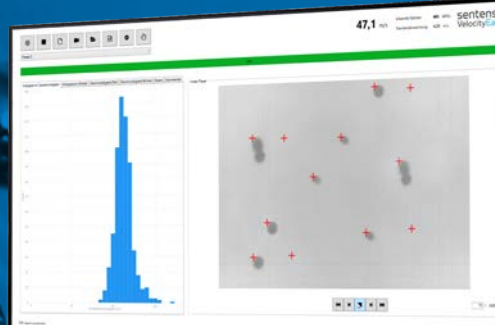
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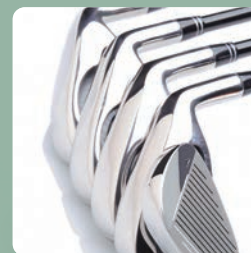
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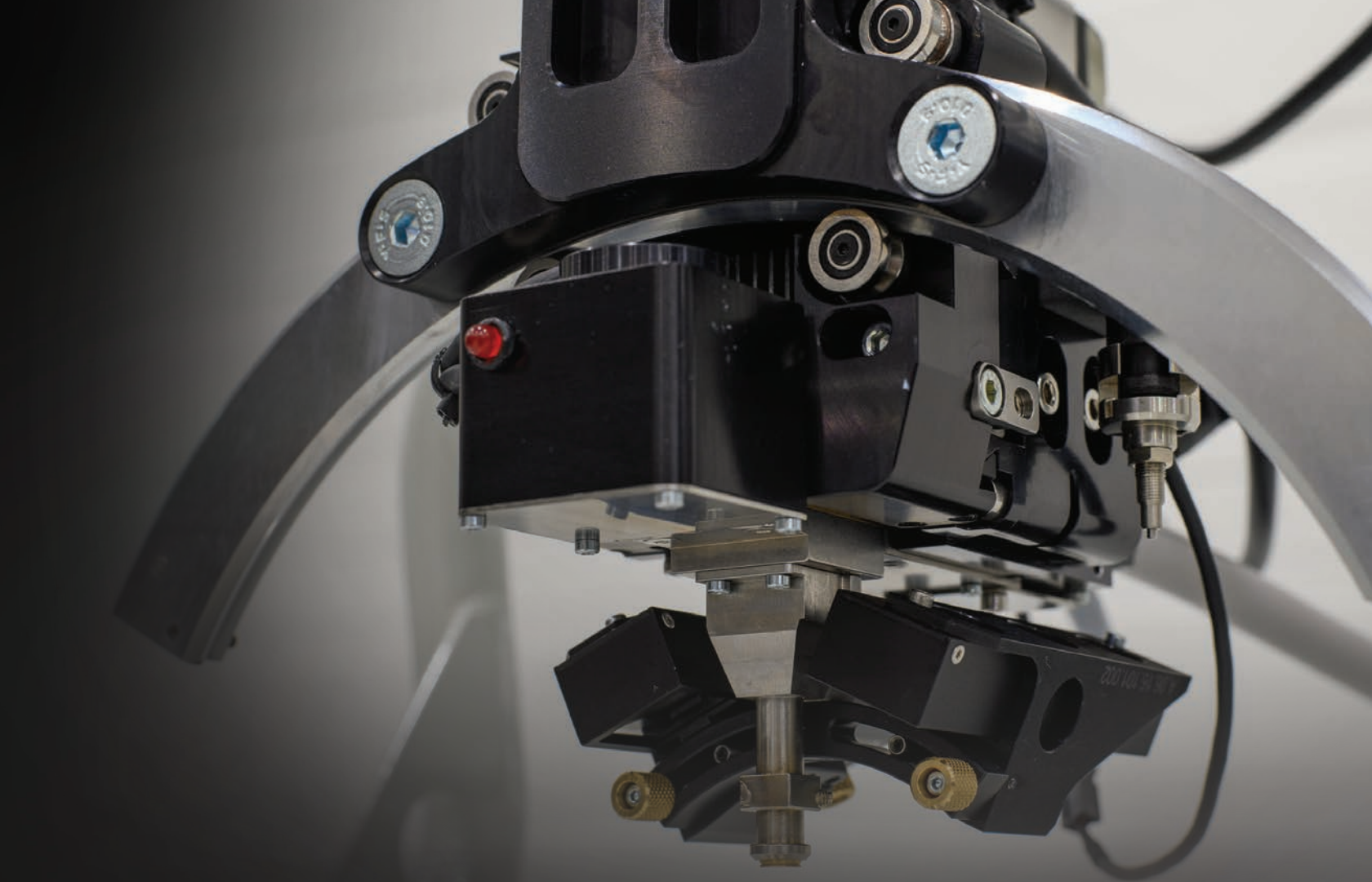
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