Winter 2022
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# The Shot Peener

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


## Michael Schmidt

### The 2021 Shot Peener of the Year

# Peening Innovation

## COVERAGE CHECKER

COVERAGE CHECKER

COVERAGE CHECKER the device for easy and precise coverage measurement

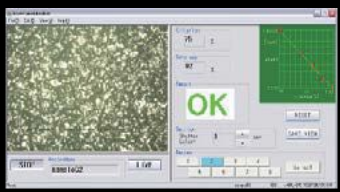

### UV Light version

**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**

| Country | Company | TEL | E-MAIL |
|---|---|---|---|
| USA | Electronics Inc. | +1 574-256-5001 | sales@electronics-inc.com |
| CANADA | Shockform Inc. | +1 450-430-8000 | sales@shockform.com |
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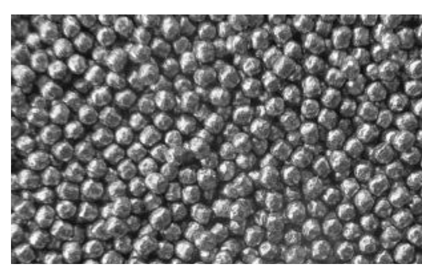

**OPENING SHOT**

*Jack Champaigne | Editor | The Shot Peener*

# The 2021 Workshop

**THE 29TH** Electronics Inc. Shot Peening and Blast Cleaning Workshop and Trade Show was a success. I think everyone was happy to return to this level of normalcy in our industry.

One of my favorite aspects of this year's event was the new technology at the trade show, in the classroom, and even in our photography.

The new technology included the demonstration of Toyo Seiko's coverage checker that utilizes ultraviolet light to enhance the inspection of peened surfaces. The percentage of coverage is displayed as a percentage of surface indenting thus replacing a subjective evaluation with scientific data collection. The image is displayed on a PC or tablet and these can be saved for later retrieval. (See Toyo Seiko's ad on page two for more details.)

And, of course, I have to mention the introduction of EI's new MagnaValve, the 678-24. It was very well received and we are looking forward to placing it into shot peening facilities. (See ad on page 19 for more details.)

New technology in the classroom revolved around additive manufacturing (3D printing). Bill Barker from Rosler Metal Finishing gave a presentation on "Post Processing for Additive Manufacturing."

Conventional metal working leaves tensile stresses in components that have to be converted to compressive stresses by shot peening, roller burnishing, and similar processes. These same rules also apply to 3D printing.

As a side note, 83 exam certificates were issued this year.

And finally, technology made the group photo much easier and safer. The drone provided optimal framing and composition.

**Congratulations, Mike!**
From one boilermaker to another, it's gratifying to give the Shot Peener of the Year award to a Purdue graduate.


*The workshop photo was taken by a drone this year. This was much easier, and safer, than putting a photographer on a ladder.*

**THE SHOT PEENER**

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# 2021 Shot Peener of the Year Michael Schmidt

**Congratulations** to Michael Schmidt—our recipient of the 2021 Shot Peener of the Year award. Since 1992, *The Shot Peener* magazine has recognized individuals for their contributions to the shot peening industry.

"Michael Schmidt received the award because of his contributions to two SAE committees: The Surface Enhancement Committee (SEC) and the Aerospace Surface Enhancement Committee (ASEC)," said Jack Champaigne, Editor of *The Shot Peener* magazine and Chairman of the SEC and ASEC committees. "His contribution has been valuable because of his connection with GE and their rigid specifications. He brings a perspective from the aero-engine community not available elsewhere. He was the driving force in the updates to the SAE J2277 spec on coverage. He has a knack for reading ballot proposals in detail and finding both typographic and technical errors," added Mr. Champaigne.

Mr. Schmidt is a Principal Engineer at GE Aviation and he has been with GE for almost 11 years. His answers to the following questions will give more insight to his contribution to the shot peening and the aerospace communities.

**The Shot Peener**: Why did you join the SEC and ASEC committees?

**Mr. Schmidt**: I attended my first SEC and ASEC conference in conjunction with EI Shot Peen training in 2012. I had recently accepted the role as the Mechanical Surface Enhancement Special Process Technology Leader for GE. The committees provide a unique opportunity for suppliers and OEMs to meet and discuss opportunities and challenges facing the shot peening industry.

When specifications leave room for interpretation that could drive different results, I always strive to achieve common language that doesn't require interpretation. If you sit back on the sideline and don't participate, you can't complain about the outcome. These committees allow all members to have an equal voice to ensure the industry stays on a positive path, supporting the end user whether it is the flying or driving public.

**The Shot Peener**: Has your involvement in the committees benefited GE?

**Mr. Schmidt**: I believe the involvement in the committees has been positive to GE. Everyone on these committees has a voice; it is my role to support the industry and GE Aviation. While we all leave the specifics of our companies at the door, the goal for consistent and quality delivery by peening suppliers to the customer is positive for any manufacturer or processor in the industry. The best way to ensure that is to be a participant in all steps of the process.

**The Shot Peener**: In addition to your contributions to the SEC and ASEC, you are very active in Nadcap. Describe your involvement with Nadcap.

**Mr. Schmidt**: I serve on the Non-Conventional Machining and Surface Enhancement committee for Nadcap. I served as the committee Vice-Chair from February 2015 to February 2017, and then as the committee Chair from February 2017 to February 2019. We kicked off multi-year efforts to update and improve audit check sheets used for supplier audits, and the technology specific handbooks to ensure consistent understanding and application of the Nadcap criteria.

Working in conjunction with the Nadcap Staff Engineer, Mark Hunkele, we were able to develop a more succinct and subjective method to quickly evaluate auditor consistency and focus on the more technical tasks during the meetings. We also began efforts to determine audit length based on risk levels associated with supplier machine counts. Mark continues to be a great asset to the team. All this was in addition to the ongoing efforts to refine, improve, and clarify audit criteria to drive consistent and quality output.

**The Shot Peener**: What are your thoughts regarding receiving the 2021 Shot Peener of the Year award?

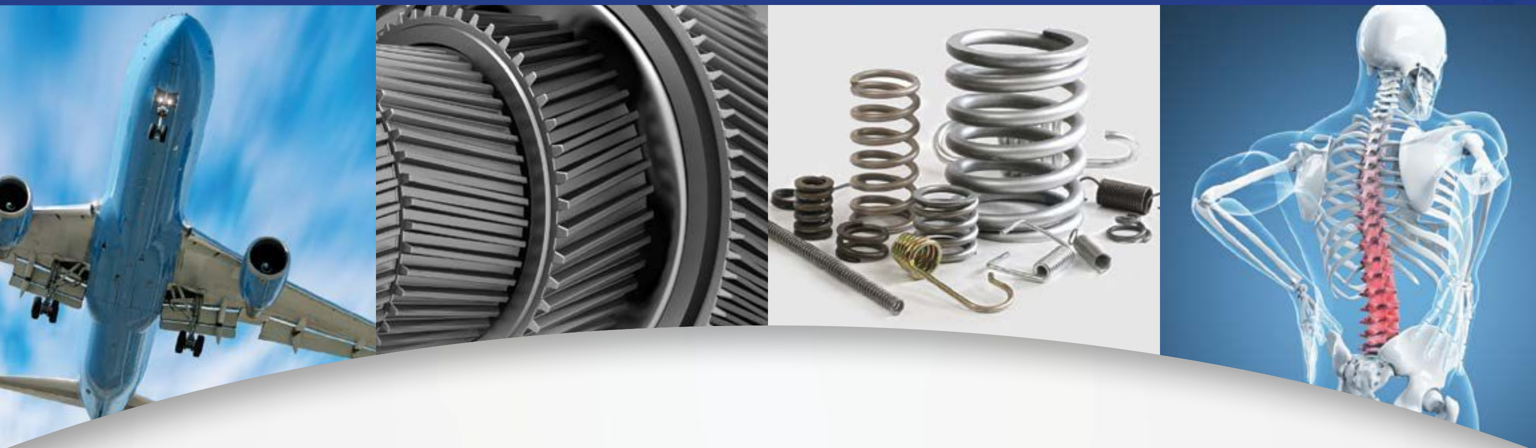
**Mr. Schmidt**: I am honored to receive the 29th anniversary award of the 2021 Shot Peener of the Year. I believe it recognizes both GE Aviation and my commitment to the committees and the technology behind this very critical special process. I feel privileged to be included with my industry peers in receiving this award. Thanks!


*Jack Champaigne, Editor of The Shot Peener magazine, presented the Shot Peener of the Year award to Michael Schmidt at the 2021 Shot Peening Workshop in November.*

PREMIER SHOT COMPANY

1666 Enterprise Parkway Twinsburg, OH 44087

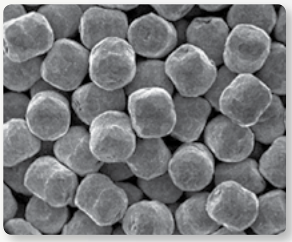
# A Cut Above



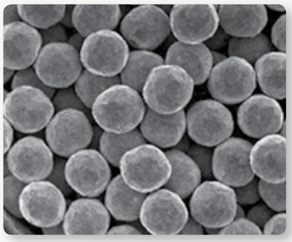
## The advantage of Premier Cut Wire Shot

- **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.

As Cut



Normal Conditioning



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*Dipl.-Ing. Volker Schneidau | Managing Director | www.sentenso.com*

# Visualization and Analysis of Media Speed

**THE SURFACE EFFECTS** of a shot peening process are mainly determined by peening media properties and the velocity and direction of the media particles relative to the surface. Because of the difficulties to determine impact velocity and angle, the U.S. engineer, John O. Almen, invented an alternative parameter to characterize the surface impact—the shot peening Intensity. While this parameter has been used for almost 80 years now, modern process control can substantially be supported by means of media speed analysis. Media velocity can be used to quantify the media impact as it represents the real process value. This approach is legitimate if media quality and impact angle can be considered as fully controlled. This is the case if media quality is well maintained and impact angle is reproducible by reliable nozzle alignment or robotized nozzle movement.

### Limitations to Intensity Determination

Shot peening Intensity is well established and together with media properties and surface coverage it represents one of the three essential parameters to characterize the shot peening process. Still we have to realize that Intensity can be quite a fuzzy figure. There are several limitations to the Intensity representing the real surface impact:

- Two or three dimensional surface curvatures cannot be represented by a flat Almen test strip which is used for determination.
- In fixtures representing the peened part, Almen test strips and holders interfere with the particle stream and reflection and thus lead to unrealistic impact scenarios.
- Saturation curves used to determine Intensity are tending to being stretched and providing unclear values when media size distribution and media speed distribution is not tight enough.

In shot peening machines with controlled nozzle handling, it is often possible to replace Almen fixtures representing the part by Almen strips being placed on fixed positions in the machine and peened under stable conditions. Still the strips have to be peened in several steps and due to the manual measurement procedure, measurement tolerances, and Almen strip tolerances, errors have to be taken into account.

Another problem is that in process development finding the correct Intensity can be a long-lasting procedure of trial and error, with a lot of manual and costly proceedings.

Once the process has been defined, Intensity verification for repeated production needs less strips but still requires manual operations. Intensity verifications can occupy up to 30% of the machine capacity in complex applications. Even new inventions like the E-strip sensor may support Intensity determination in a limited range of applications but requires sensitive equipment and will not solve the problems mentioned above.

### Alternative or Extension to Impact Characterization

The key reason for limited stability of impact characterization by Intensity is its empirical approach. So it is obvious to replace or extend this approach by an analytic method. Provided that media quality is well maintained and the impact angle is controlled by stable part positioning and reliable nozzle arrangement, the media travel speed when reaching the surface is the key figure to determine the impact.

Based on this idea there are several systems in place which analyse the media velocity by means of laser or non-laser particle illumination and photo-electric sensors like in the ISIC from KSA in Germany, the ShotMeter from Progressive in the US, the Tecnar in Canada, or the ShotWatch from Oseir in Finland.

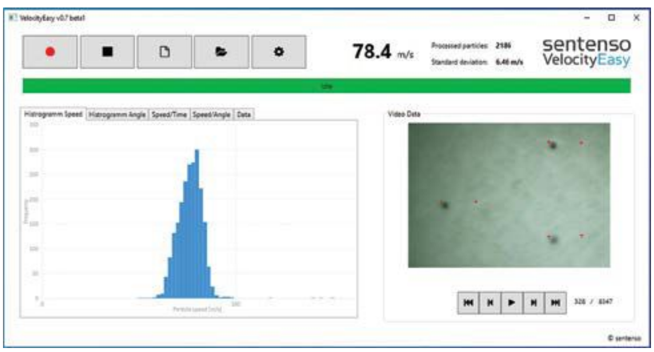
### Particle Tracking with High-Speed Camera and VelocityEasy

sentenso Smart Peening Solutions now presents VelocityEasy, a user-friendly software solution for evaluating video images from a high-speed camera. It is now possible to analyse trajectories and to determine particle velocity range with a comparatively simple measurement setup. This setup consists of a high-speed camera with network connection and a high-intensity illumination unit for recording the fast peening particles which are viewed in incident or backlight.

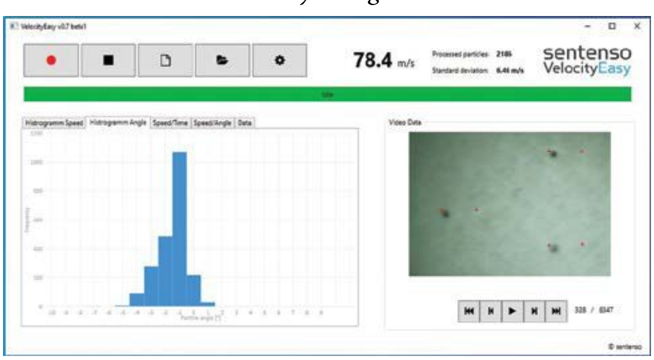
*The VelocityEasy measurement setup*

The particle tracking features include:

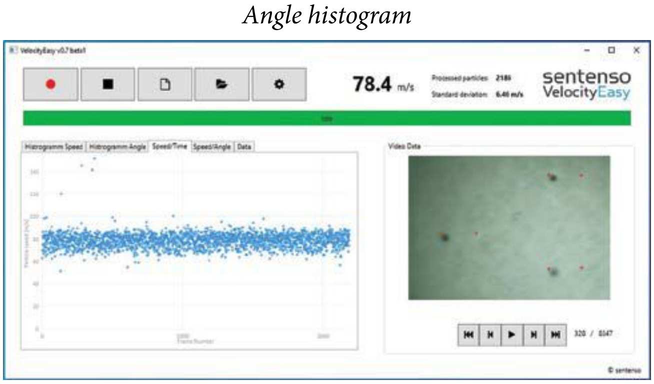
- Visual inspection of particle movements on the video image sequence
- Determination of particle velocity distribution in a histogram
- Determination of particle flight angle distribution in a histogram
- Determination of velocity over recording time in an XY diagram
- Determination of velocity over flight angle in an XY diagram
- Output of measurement data for all detected particles in a log file



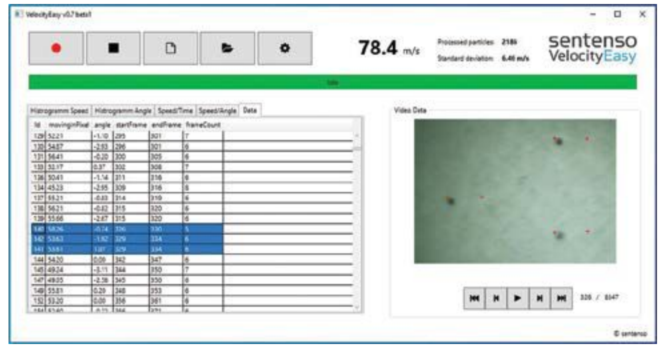

*Velocity histogram*




*Angle histogram*




*Velocity over time diagram*




*Data logging*

These features allow for a detailed analysis of the shot stream from the nozzle which is not a simple and continuous row of particles, but is characterized by its distribution of velocity and direction which can be statistically determined. This data represents a realistic view on the shot stream variety which provides a variety of impact on the surface and which results in a more or less varying Intensity.

VelocityEasy is installed on a Windows operating system and typically needs about one minute computing time to analyze a high-speed video of 500 milliseconds consisting of 8000 individual frames. The measurement can be repeated at any time when the measurement setup is permanently installed in the peening chamber. It can also be used to adapt the parameter set until the desired result has been achieved.

**Process Development**

VelocityEasy will enable the process engineer to perform the following steps:

- Analysis of the media particle stream depending on hose and nozzle geometry, media type, air pressure and media flow rate
- Process optimization by appropriate variation of the above-mentioned parameters
- Optimization of nozzle geometry with regard to the peening target
- Matching of the above-mentioned parameters to the shot peening Intensity
- Adjustment of air pressure to achieve desired media velocity
- Verification of shot velocity and trajectory before production

VelocityEasy automatically communicates with suitable high-speed video cameras and reads out the camera settings. The intuitive user interface allows for the setup of the evaluation algorithm and the program control. Video recording, tracking of the detected individual particles, particle marking on the image sequence, evaluation of the recordings as well as the presentation of all measurement results in the form of values and diagrams all take place automatically.

**Tracking Data Management**
The software also offers extensive additional functions for checking and managing measurement data. These include the integrated video player with the capability for single image analysis, the loading function for existing videos and measurement data sets as well as the debug output with detailed measurement information. The additional functions allow a detailed plausibility check of the results and the subsequent evaluation of existing recordings.

VelocityEasy is prepared for connection to a peening system control. Via the integrated TCP/IP interface, an external system control is enabled to start the software remotely in the current setup and retrieve measurement results. The measurement results can then be further processed within the control system, for example, to check compliance with a desired speed.

sentenso is also ready to supply the associated speed measurement system consisting of an affordable high-speed camera and a measuring channel with lighting unit.

*High-speed camera installed on a peening machine window*

**Outlook**
The video-based analysis of media particle movements will ease and improve process development and control because it provides a more differentiated view on the expected surface impact than just an average velocity value. The knowledge of media travel speed and direction can be used to develop correlations between these parameters and the shot peening Intensity. The velocity analysis is not meant to replace Intensity as an empiric figure but can help to avoid excessive Almen strip testings.

For more information and a product video, please go to www.sentenso.com/velocityeasy.html or use the QR code.

AN INSIDER'S PERSPECTIVE

*Kumar Balan | Blast Cleaning and Shot Peening Specialist*

# Tribal Knowledge in the Blast Industry

**Part Five**

## KEEPING THE MOMENTUM

Producing discussion topics for *The Shot Peener* is no easy task. Physics does not change often, and our industry seldom experiences dramatic breakthroughs! Our cognizant readers and users of cleaning and peening equipment demand that the subject hold universal interest, be globally appealing, and enhance their knowledge banks. To reach the newcomers in our industry, this quote from Albert Einstein, "If you can't explain it simply, you don't understand it well enough," acts as a constant reminder and judge of the author's cognizance and writing abilities! Fortunately, for me, I have always found inspiration from the people I have worked with, currently and in the past. Among those have been industry peers; diverse groups such as Primes, MROs, different tiers in automotive; and service providers (also known as job shops or metal laundries by some).

Part Five of "Tribal Knowledge" is a result of my recent discussions and discoveries at service provider facilities in Canada and the United States. At one end of the spectrum, these shops could be manually cleaning steel fabrications, preparing them for a downstream coating. On the other end of the sophistication scale, a peening job shop could be peening complex aircraft engine parts and other mission critical components. Silently working away, these industry partners are unsung heroes that experience a rich variety of applications and cater to multiple specifications and special user requirements.

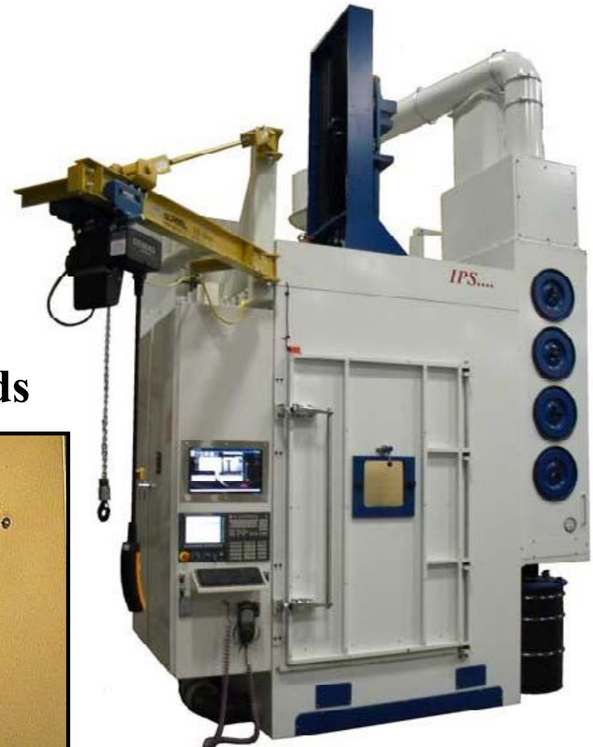
## MACHINE VERSATILITY

My journey starts at VibraFinish in Mississauga, Ontario. Brian McGillivray, the President of VibraFinish, is an active proponent of Vibratory Peening, a technology that has been highlighted and discussed in the past issues of *The Shot Peener*. VibraFinish caters to its automotive clientele in Ontario, Canada and the US with blast cleaning and shot peening services. I met with Clive Graham, their Plant Manager, who brought great clarity to the use of certain equipment types for parts that have conventionally been understood as needing to be cleaned or peened in a machine with a different type of handling system. Clive explained, "A job shop environment faces demands from multiple customers with different part types. As a service provider, we expected to process any part type presented to them with minor adjustments to tooling. An inline versus batch-type spinner arrangement is the most common example. These two machines are generally interchangeable." I will summarize my learnings from Clive as below:

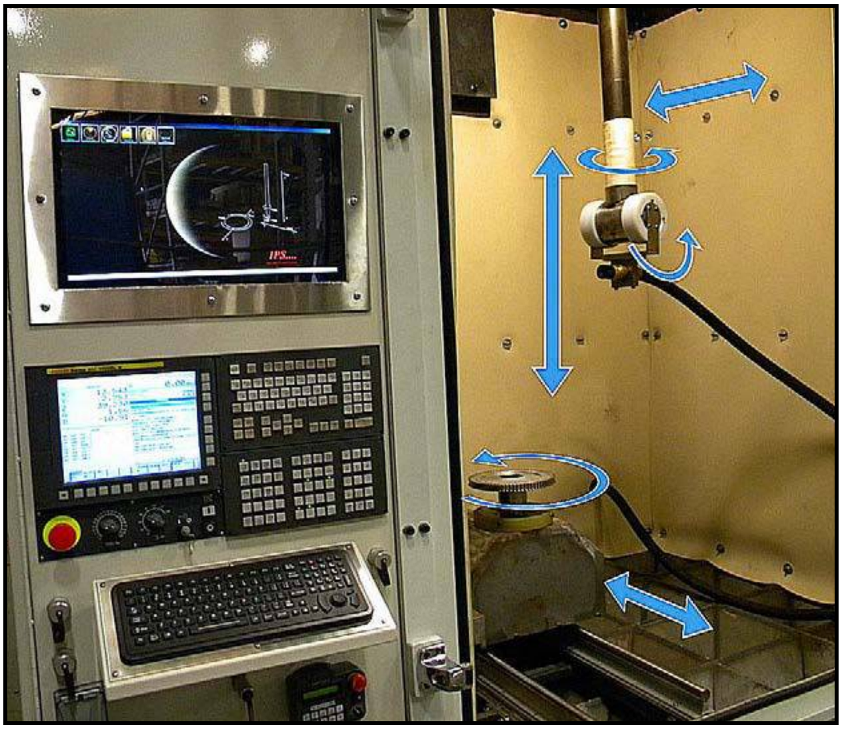
- Parts in the neighborhood of 3' to 5' in length (such as torsion bars) are shot peened in a spinner hanger-type machine where they are held in a birdcage-type fixture within a work envelope that can be physically located inside the blast cabinet. "Though an ideal situation dictates that individual parts be peened by spinning about their own axis, allowing sufficient gaps in between the parts in this birdcage will ensure media penetration/reach and coverage to the inside of the spinning birdcage fixture when it is away from the blast wheel." This was Clive's response to my concern about variable distance of the part from the blast wheel as the fixture spins in the blast stream.
- As we have discussed several times in our previous articles, the capabilities of airblast and wheelblast are distinctly different with the latter commonly used in high-production environments. Clive works with wheel as well as air-type machines. He confirmed that distance has a relatively greater impact on peening results with air-type machines as compared to wheels. "We have seen that intensity varies very slightly between a 12" to 60" stand-off distance with at least two 15" diameter blast wheels. The resultant blast patterns and control cage settings help achieve uniform arc height

*A birdcage-style fixture with multiple long parts fixtured to peen simultaneously*

# Innovative Peening Systems



## High Performance for High Standards



CNC motion allows the nozzle to follow the contour of the part.  This motion provides consistent intensities and coverages to occur with optimal speed and precision.

**IPS....**

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values along the entire part length. We use this style of fixturing in several spinner hanger machines to process long parts."

- Clive added, "We are not strangers to complicated parts that get sent to us for processing. For such parts, we adopt two tricks of the trade: (a) split the cycle by spinning the fixture clockwise and then counter-clockwise and, if available, (b) use the three-position indexer arrangement that automatically re-positions the fixture in three positions within the blast stream, spinning it in all three positions. A combination of all these techniques allows sufficient peening coverage on all types of part geometries."

I too have experience with projects that substituted inline machines with spinner hangers for specific applications. I have to point out to our readers that this is only prevalent in the wheelblast world. There are distinct advantages with each type of work handling, and I will elaborate on those in the table in the next column.

## PRE- AND POST-PROCESSING

Peening Technologies is a shot peening service provider with two plants in East Hartford, Connecticut and a third in Austell, Georgia. During a recent visit to their Connecticut facility, Walter Beach, their Vice President, educated me on their experience with pre-cleaning aerospace parts. Walter Beach is also an active member of the SAE and AMEC committees for Surface Enhancement. "Though our focus is steadfast in conforming our peening process to AMS 2430, 2432 or any other OEM specification, we also carefully consider pre- and post-processing of such parts. AMS 2430 (3.4.3.2), for instance, requires parts to be visually clean prior to peening. It states that if clean parts are not supplied to the processor, either a cleaning method should be specified, or the processor should use a method that is acceptable to the OEM. Some insights into pre-cleaning:

- Adopt a standardized cleaning process with the clear understanding that this may not satisfy the requirement for all parts. This will help standardize the pre-cleaning process. Cleaning should be performed based on the contaminant. Examples include alkaline method (soap solution), isopropyl alcohol, acetone, mineral spirits, or an aqueous-based cleaning solution. A well-documented procedure will provide the framework when a new procedure requiring the use of other chemicals needs to be drafted, and for an audit.
- Nitric acid is often used for post-peen cleaning for Titanium and Aluminum parts, particularly when working with airframes, to remove ferrous contamination. Ensure that the temperature of the acid is specified in your customer's documentation.

| Inline Machine | Spinner Hanger |
|---|---|
| • Commonly a wire mesh belt, rubber belt, roller conveyor or hanger hooks, with the first two being endless versions.<br>• Takes up greater floor space than batch-type spinners.<br>• Parts are placed on the belt, typically conveyed without the need for fixturing. Hangers may require fixturing.<br>• Parts placed on a mesh belt acquire the shadow generated by the belt strands. Blasting between parallel rollers in a roller conveyor can mitigate this.<br>• Though wheels are located on both sides (or top and bottom) of the cabinet, a symmetric set of wheels (typically lower set) can be disabled for parts requiring a single side blast.<br>• Blast pattern generated by four or eight wheels (symmetric pattern of wheel layout) offer compound angles of impact that help with coverage. | • Batch-type spinners provide excellent coverage in a smaller footprint.<br>• Multiple parts can be processed simultaneously and benefit from ricochet blasting in addition to direct impact.<br>• Spinner hangers require special fixtures for parts. Such fixtures could also be loaded/unloaded offline during the blast cycle (in a Y-track style arrangement).<br>• Exposure for certain part styles can be enhanced by several techniques of part presentation discussed above, and also by increasing the exposure time in the blast.<br>• Floor space requirement is a fraction of that required for pass-through machines.<br>• Batch-type spinners minimize the amount of media leakage as compared to pass-through designs that require longer vestibules, curtains, etc., to contain the airborne media particles. |

- Enquire with your customer on the concentration of acid, cleaning time, temperature and all such critical parameters before embarking on a project.
- During post-processing of parts, it is important to know whether the protection needs to be long or short term. In other words, knowing the destination of the part after peening will help you determine the type of oil coating to be applied on the part.

## RE-CALIBRATION OF MAGNAVALVES

Peening Technologies uses cast steel shot as well as cut wire shot as required by their customer specifications. Walter explains the need for re-calibration, "If you are faced with a need to change media suppliers, whether it be between cast shot or cut wire shot suppliers or within each type, it is imperative that you re-calibrate your MagnaValves as part of the change. Even though both media samples might conform to the same AMS requirement, the chemistry and hardness could be ever so different within the allowable range, eliciting a different response from the valve."

On a similar note, I recall a past experience with a customer in Aerospace that could not repeat results within the required range tolerance after switching media suppliers. They then had to re-plot saturation curves with slightly different process parameters to achieve their target.

## INFORMATION FROM CUSTOMER (OR LACK THEREOF)

When contrasting blast cleaning with shot peening during a class that I was instructing at the recent shot peening workshop, I inferred a distinct likeness for peening. My reasoning is that peening has tangible goals, and defined results. On the other hand, the results of blast cleaning are generally subjective. Excessive cleaning creates a dent on the operating cost, and not as damaging as excess shot peening. Please note that the final result in shot peening still depends on the quality of information provided to the shot peener. Not all peening customers are as sophisticated and meticulous as those in Aerospace. This sometimes creates gaps in information that impacts the service provider. Walter Beach lists a few of these gaps with suggestions to fill them.

Intensity verification locations: Walter explains, "A common phrase one hears in this industry is 'it's in the specification.' "I have often explained that the specification is a process document—it is not drafted to discuss your specific part, the tensile stresses involved, and identify potential points of failure. One can expect such information in the drawing, with which we can design a PVT (Part Verification Tool) to mimic the actual part and install Almen blocks with strips to verify arc height in required areas. Without this information, you are literally shooting in the dark." Easier said than done as not all drawings contain this information. Walter suggests that, in such situations, the service provider should draw up the part, and identify areas based on past experience where blocks should be installed. This drawing should then be verified and approved by the end-user before proceeding with fabrication of the PVT and subsequent peening of actual parts. Walter's term for this is "Opinion Based Quality Control"!

During his session on "Best Practices for Shot Peen Process Development," at the recent EI Shot Peening Training Workshop, Walter Beach had several valuable insights that I will list here with relevant explanations:

1. When receiving a Purchase Order (PO) for peening services, ensure that the PO is for your organization, and that the PO reflects the revision level of the engineering drawing. Any mismatch will lead to non-conformance and other complications in the field.
2. When reviewing the engineering drawing, does it state all the required peening process data such as intensity (absolute number or range), coverage percentage, and shot size? This is the bare minimum. Other data that will be useful to have include shot hardness, areas requiring peening, and those that are optional and/or prohibited.
3. Almen strip tolerance (use the correct tolerance range) and whether pre-bow compensation is required (to be recorded) or not permitted.
4. SAE ARP 7488 – review and have a copy of this document. Though not a specification, it has useful data that will help with developing your peening practice.
5. Select a vendor for Almen strips and stay with them. A mixture of strips from different vendors will lead to non-repeatable results. If you base your purchasing decisions for peening supplies on cost alone, it will cost more later!
6. It is important to know the procedure to plot a saturation curve and to interpret it. However, during production runs, make use of a Curve Solver software program.
7. When operating multiple machines and processes, document data on the intensity achievable with combinations of nozzle size, standoff distance, impingement angle, air pressure, media flow rate and media types. This data will be valuable for future projects.
8. When inspecting peened parts, check for coverage and appearance including possible rolled edges. Inspecting inside cavities can be challenging. FOD (foreign object damage) is inspected using mirrors or a borescope. A pin gage (0.025" diameter Flat nose) can be slid down the barrel of the hole to check for rolled edges, with proper care to not score the wall.

## SUMMARY

The feedback from readers on our "Tribal Knowledge" series has been very encouraging. However, information to create individual discussions comes in metered doses! As we continue along this path, it is apparent that there is a thirst and need for this type of previously undocumented information. Our goal should be to collect, preserve and when possible, grow this abundance of knowledge that is currently spread out among a wide human database.

Blast cleaning applications are greater in number than shot peening. Also, the process tends to be more forgiving than peening. Therefore, the tribal knowledge available for cleaning applications surpass that in shot peening. The good news is that the working concepts of the machines remain similar and interchangeable. Most of my respondents for this series have been veterans in the blast cleaning industry.

With the introduction of Walter Beach, a current user of shot peening equipment in this series, it is heartening to note that information is being shared to benefit the broader sector of peening equipment users. I look forward to more feedback from you, the user of this process and equipment, so that together we can learn, thrive, and grow this industry.

# USA Shot Peening and Blast Cleaning Workshop and Tradeshow Highlights

Orlando, Florida • November 1-3, 2021











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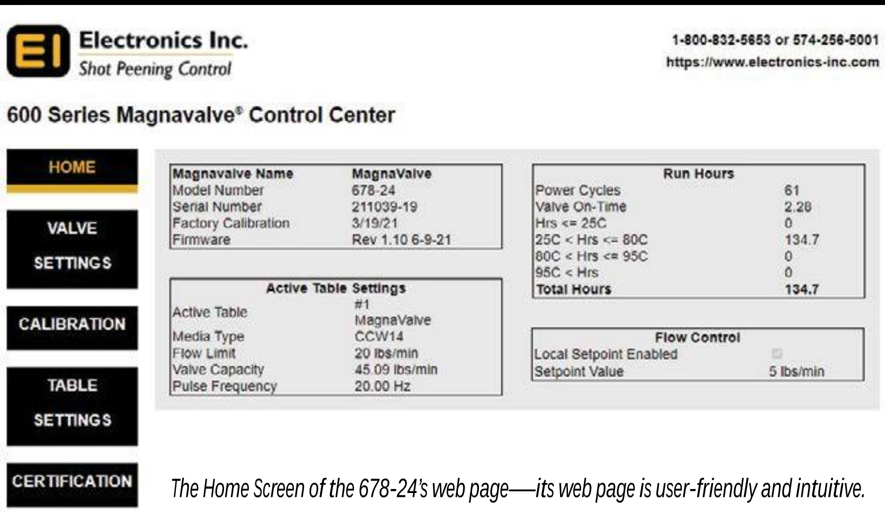


*The Home Screen of the 678-24's web page—its web page is user-friendly and intuitive.*

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

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**Electronics Inc.**
*Shot Peening Control*

*Erik Waelchli | Owner of IBD Connection, Inc. and Electronics Inc. Consultant*

# How Time Affects Almen Strip Arc Height

*A two-year research program explores the validity of archiving Almen Strips*

## INTRODUCTION

Can or should Almen strips be archived? Does the arc height after peening change over time and if yes, by how much? If there is a change, is the change of relevant magnitude?

These questions came up during a weekly engineering meeting at Electronics Inc. (EI). No one had a definitive answer so we initiated a long-term study. The test was started in March, 2019 and was concluded with the last measurement taken on September 23, 2021.

## PROCEDURE

1. Samples
   a. Two A-strip sample sets of twenty (20) pieces each were defined:
      i. EI - A-1 Strip Quality: Lot 026814-26
      ii. EI - A-2 Strip Quality: Lot 034438-86

2. Saturation curves and machine setting
   a. Two saturation curves with 1, 2, 4 and 8 revolutions, were created before the twenty samples were peened – an intensity of 12-A was the target:
      i. A-1 - #1 sat.-curve I = 11.4 / T1 = 2.8349
      ii. A-1 - #2 sat.-curve I = 11.6 / T1 = 3.0499
      iii. A-2 - #1 sat.-curve I = 11.2 / T1 = 2.6465
      iv. A-2 - #2 sat.-curve I = 11.2 / T1 = 3.6838
   b. The intensities were confirmed as stable and the machine settings were chosen at:
      i. Shot type: CCW 28
      ii. Flow rate: 10 lb/min
      iii. Table speed 2 rpm ( 29" pitch diameter)
      iv. Nozzle diameter 0.3125"
      v. Nozzle stand-off distance 6"
      vi. Nozzle angle 90˚

3. Samples Test Run
   a. Two test runs were made as a maximum of 24 strips fit in the turntable of the custom air-blast cabinet in EI's test lab. The first test run had samples 1 through 10 of the A1 and A2 quality, and the second test-run had the samples 11 through 20 of both strip qualities. This way we assured a proper mixing of the samples in both lots.
   b. For an unknown reason, A-2 strips #2 and #10 resulted a significant higher arc-heights (>0.0150") and were therefore ignored.

4. The arc-height measurement cycles
   a. **Immediate:** Samples 1A were measured on 2019-03-25 at 11:50 pm, the A2 samples at 1:45 pm the same day.
   b. **3 – 5 hours later:** Samples A1 first, then A2 at 4:45 the same day
   c. **24 hours later:** Samples A1 & A2 starting measuring at 2019-03-26 - 11:50 pm
   d. **4 days later:** Samples A1 & A2 on 2019-03-29 - 10:00 am
   e. **8 days later:** Samples A1 & A2 on 2019-04-02 - 11:00 am
   f. **17 days later:** Samples A1 & A2 on 2019-04-11 - 10:45 am
   g. **35 days later:** Samples A1 & A2 on 2019-04-29 - 11:40 am
   h. 63 days later: Samples A1 & A2 on 2019-05-27 - 4:30 pm
   i. **120 days later:** Missed this reading
   j. **182 days later:** Samples A1 & A2 on 2019-09-23 - 15:30 pm
   k. **241 days later:** Samples A1 & A2 on 2019-11-21 - 2:30 pm
   l. **301 days later:** Samples A1 & A2 on 2020-01-20 - 3:30 pm
   m. **371 days later:** Samples A1 & A2 on 2020-03-30 - 2:30 pm
   n. **545 days later:** Missed this reading
   o. **731 days later:** Samples A1 & A2 on 2021-03-25 - 2:30 pm
   p. **913 days later:** Samples A1 & A2 on 2020-09-23 - 12:00 pm - **Final**

## RESULTS

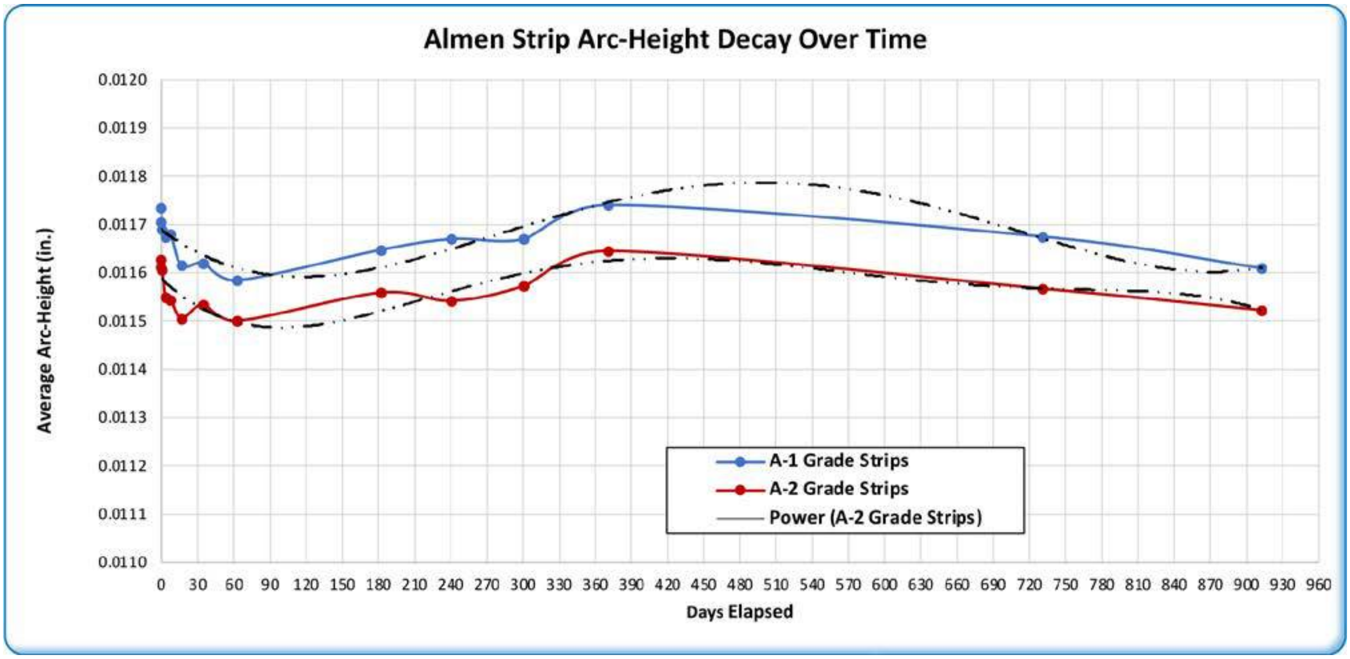
The results are best depicted in graphical form. The graph on page 21 shows the averages of the twenty (20) strips at each test date and a 4th order polynomial trend line for each test set.

While this graph is rather dramatic, the actual numbers and decay percentage are less so.

## DISCUSSION & CONCLUSION

Interesting to note: The arc-height values have decayed rather quickly by up to ~ 1% in 60 days, but then they creeped up to near the original value again in 365 days—one year! Then after 913 days, the decay resettles at around 1%. At this point the test was concluded. The measurements were conducted by two individuals with two different gauges. It could now be argued: Is this 1% error over time significant? It is the author's opinion that there are many other variables affecting the peening result, maybe by much more than this small error. So, with this reporting update the conclusive statement stays the same:

*Almen strips can be archived as the results are only affected by a minimal amount over time.*



**SHOT PEENING RESEARCH**

*Erik Waelchli | Owner of IBD Connection, Inc. and Electronics Inc. Consultant*

# How to Archive Shot-Peened Almen Strips

**AN IMPORTANT ASPECT** of archiving shot-peened Almen strips is the packaging and location for long-term storage. After years of storage, the last thing one wants to find in the archive is a paper envelope with rusted Almen strips, making verification of the arc height test results impossible. So, how should shot-peened strips be packed to prevent rust?

Rust is formed when a moist steel surface meets the oxygen in air. But let's not get into the chemical details; rather let's focus on how to provide an environment where rust is inhibited and prevented.

### Packaging

Several options: Soak the strips in WD-40 or some other oily substance and bag them. While effective, oil and liquids are not conducive to storage in a paper bag. Furthermore, when verification of the arc height is required, cleaning and degreasing will be necessary.

A better approach is the use of desiccant packs or VCI (Volatile Corrosion Inhibitor) paper. Both methods require a sealed storage container so excessive moisture does not enter. In the case of VCI paper, the protective gases cannot escape. Another method is to use a VCI-treated plastic bag.

The effective life of desiccant packs is typically one to three years, depending on the environment. As silica granules absorb moisture, the effectiveness drops.

The VCI paper can last from five to 20 years, depending on how often the sealed environment is disturbed. For longer storage periods, a program may be established where the VCI paper is replaced on a regular basis.

Reusing the original Almen strip cardboard box is a handy way to archive peened Almen strips. (Electronics Inc. puts two pieces of VCI paper in every 50-piece box of Almen strips.) However, a strip of VCI paper and sealed plastic vacuum wrap or zip-lock food storage bag is recommend unless an ideal storage temperature can be provided.

A proper and informative package label is as important as the physical packaging itself. Nothing is more frustrating than to find well-kept strips and not being able to identify them. Some important information elements on the label are:

- Customer and company name
- Job, test, or work-order number
- Quantity of strips in the package
- Information on how long the samples should be archived, and subsequent disposition
- Name of person that performed the testing
- Date when the samples were shot peened

### Storage Environment

Now we come to the second important issue. A wet, damp basement is certainly not an ideal storage location. There are two factors to be considered:

1) Low and stable temperature

2) Relative humidity

A Google search for "recommended paper document archive environment" gave this result: "Ideal temperatures for paper records vary between 65° and 72° Fahrenheit. Relative humidity should be between 40 and 55 percent." This is also a good guideline for Almen strip storage.

A stable temperature is important because when a metal surface cools below the temperature of the surrounding air, condensation may form on its surface. In typical manufacturing facilities where the temperature cools overnight and rises later in the day, the higher humidity will cause condensation to form on the cool metal surface.

Above a certain relative humidity of the air, metal parts can rust rapidly and the corrosion hazard is considerable. Below a critical humidity, the rate of corrosion becomes insignificant. This critical relative humidity is at about 45%.

Aside from well-packed peened Almen strip samples, an air-conditioned and temperature- and humidity-controlled environment can help to keep Almen strip samples in mint condition.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**ACADEMIC STUDY**
*Dr. David Kirk | Coventry University*

# Back to Basics
# Shot Peening in a Nutshell

## INTRODUCTION

This article aims to cover just the basic features of shot peening. Other articles can be referred to for extended accounts. Shot peening is, essentially, a surface work-hardening process. Impacting, high-velocity particles plastically deform the component's surface. This plastic deformation induces changes in the component's properties. The most desirable of these changes is normally the increase in the fatigue strength of the component. Fatigue strength increase is caused by two factors: work-hardening and the compressively stressed surface layer. Shot peening can also be employed to correct small, unwanted component distortion. Shot-peened surfaces necessarily have tiny dents that may or may not be advantageous.

Control of shot peening centers on coverage and intensity. Coverage being the percentage of the surface that is dented and intensity being proportional to the thickness of the plastically deformed surface layer. The plastically deformed surface layer is equivalent to what can be regarded as a "magic skin".

## FATIGUE STRENGTH

Fatigue strength is the level of applied alternating stress that a component can endure before fracturing after a given number of stress cycles. This strength decreases when, as is normal, there is a constant applied stress. Fig.1 illustrates the origin of these two types of stress for a leaf spring on a railway wagon. As the wagon is pulled along the leaf spring suffers cyclic stressing. At the same time the leaf spring suffers a constant applied stress due to the weight of the wagon.

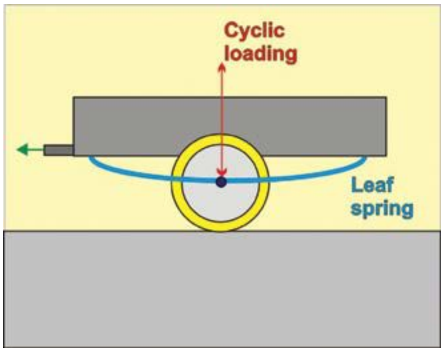


*Fig.1. Leaf spring subjected to both constant and alternating stress.*

## FATIGUE STRENGTH INCREASE INDUCED BY SHOT PEENING

Fig.2 portrays the separate contributions to fatigue strength of work-hardening and compressive residual stress. Without any shot peening the fatigue strength has a maximum value, F.S. A, if there is no constant applied stress. This level of strength falls with increase in constant applied stress level. Fatigue strength is zero if the applied stress level is high enough, of itself, to cause fracture on single loading. Shot peening increases the fatigue strength because of the two stated contributions of work-hardening and compressive surface residual stress. For far too long the increase in fatigue strength induced by shot peening was attributed solely to compressive surface residual stress.

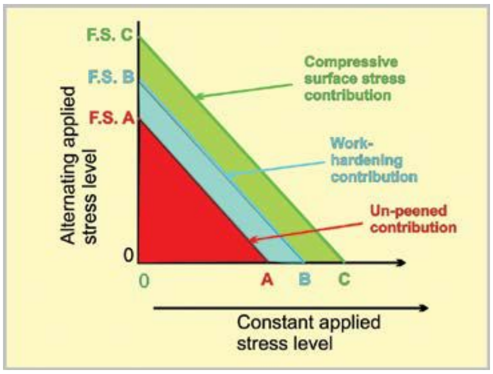


*Fig.2. Increased fatigue strength due to both work-hardening and compressive stress.*

## FATIGUE CURVES

Fatigue curves are used to show how allowable alternating stress levels vary with the number of applied stress cycles. There are two basic shapes of fatigue curves. One, mainly for body-centered-cubic (b.c.c.) metals, such as carbon/low-alloy steels, has virtually straight lines. The other, mainly for face-centered-cubic (f.c.c.) metals, has a continuous curve. Fig.3 summarizes the two shapes. An important feature of b.c.c. curves is that they have a "fatigue limit". Below the fatigue limit level of applied cyclic stress fatigue failure never occurs.

## THE "MAGIC SKIN"

The term "magic skin" has been coined because it expresses the almost unbelievable improvement in fatigue strength that

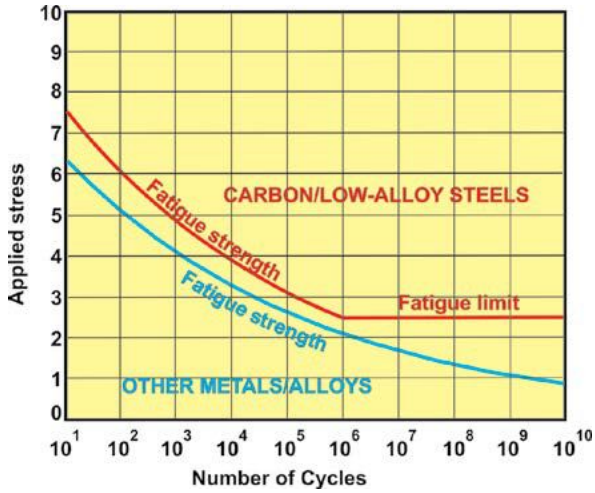


*Fig.3. Two shapes of fatigue curves.*

is induced by shot peening. Hammering away at the surface of a metallic component might be expected to reduce fatigue strength. In practice the reverse is true. Three important parameters of the "magic skin" can be identified—thickness, hardening and compressive residual stress.

## THICKNESS OF COMPRESSED SURFACE LAYER

The thickness of the plastically-deformed surface layer depends on the familiar parameter—"Peening Intensity". Fig.4 shows that the thickness of the compressed surface layer varies almost linearly with Almen arc height. Peening intensity is monitored from the arc height induced in a set of strips—more on that later. For the thinnest compressed layers the thinnest Almen strip, N, is employed. For the thickest compressed layers the thickest Almen strip, C, is employed. Specifications such as J443 indicate the required strip thickness.

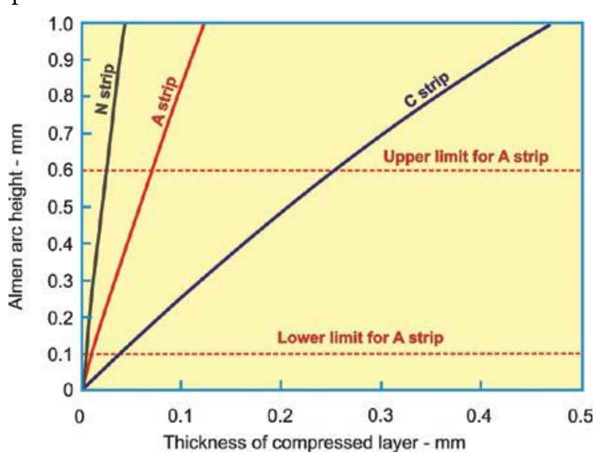


*Fig.4. Effect of induced Almen arc height on thickness of compressed layer.*

It has to be stressed that the quantitative relationship between arc height and layer thickness depends on the component's material. Fig.4 only applies for Almen strip material. For component material the layer thickness will depend upon its elastic modulus and hardness.

## PEENING INTENSITY

Peening intensity and its measurement are such basic aspects of shot peening that they are familiar to shot peeners, being governed by specifications such as J443. Essentially, a set of Almen strips is peened for different lengths of time (or passes) and the induced arc heights are measured to produce a data set. An appropriate mathematical equation is fitted to the data set. The curve of this equation has a point height for which doubling the peening time increases that point height by precisely 10%. This procedure is illustrated by fig.5. For a four-point data set a two-parameter fitting equation is an appropriate choice. Satisfying the 10% rule is illustrated by fig.6 where an arc height h2 is precisely 10% greater than h1 when the effective peening time is doubled (from t to 2t). h1 is then the deduced peening intensity.

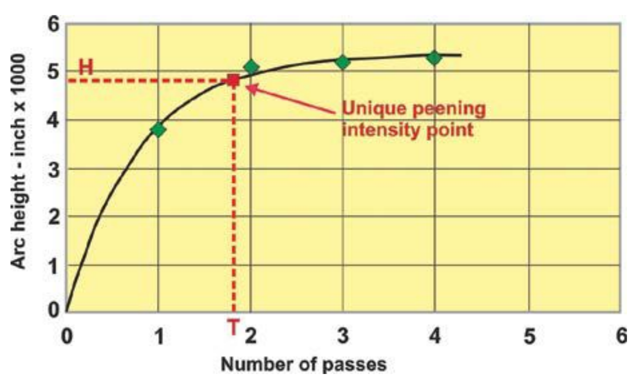


*Fig.5. Four-point data set fitted and analyzed using Solver EXP2P.*

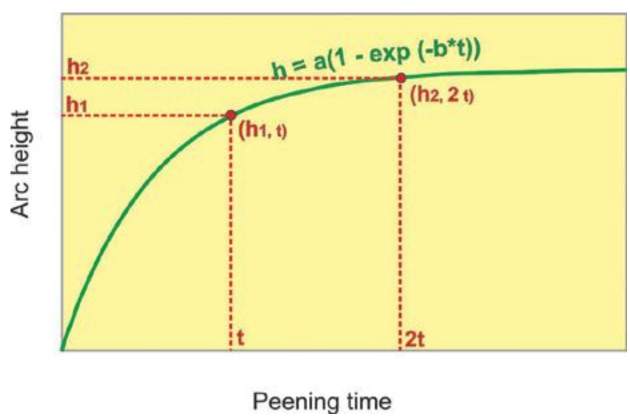


*Fig.6. Application of 10% rule to determine peening intensity as being h1.*

Peening intensity is so important in shot peening that numerous articles have been devoted to it. There is, however, a great difference between good and bad practice when estimating peening intensity. This is illustrated by the following hypothetical case study.

**Company Discussion about**
**Peening Intensity Measurement**

Joe and Brian sat down for a discussion about the Company's procedure for estimating peening intensity. Joe had thirty years of peening experience whereas Brian, fresh from university, had only a few weeks of experience. This experience did, however, include recently attending a Shot Peening Workshop. Joe started off by saying that Brian still had a lot to learn about peening intensity measurement. "Fire away with questions." Brian was very keen so he reeled off a series of questions:

1. "Why do we always use just four strips to estimate peening intensity?" "Because it is the cheapest way in terms of test time and strip cost."
2. "Do we always measure the pre-bow of each strip?" "No, that would also take time and anyway ignoring pre-bows reduces the peening work we have to do to meet customer intensity specifications."
3. "Do we always check the indicated deflection of the Almen gage test block?" "No, again that takes up valuable time and it never seems to vary very much anyway."
4. "How long does it take to measure the arc heights for a set of four peened Almen strips?" "I can do it in well under sixty seconds—watch me."
5. "How often do we have the Almen gauge overhauled?" "Can't remember."
6. "Why aren't there any markings on our Almen strips to identify them?" "Because I buy from the cheapest supplier that I can find."
7. "What if one peened strip in a set has an excessive arc height putting the peening intensity estimate just above customer specification?" "I use a trick of the trade—putting the strip in boiling water for a few minutes. Stress-relief lowers the deflection."

At this point Brian stopped asking questions, being disgusted by the answers. When interviewed later by the company CEO, he explained that he thought that the current peening intensity test procedure constituted bad practice. If he was to be put in charge when Joe retired good practice would have to be substituted. The CEO agreed, saying: "Some customers have been lost recently, having lost confidence in our declared peening intensity values. I'll write to all of our customers telling them about our introduction of a state-of-the-art intensity measurement procedure. Hopefully we will not lose any more customers. We might even get some back."

## COVERAGE

Coverage is defined in SAE J2277 as "The percentage of a surface that has been impacted at least once by the peening media." As peening progresses, coverage increases as a reverse exponential towards 100%. This is illustrated by fig.7 that also pictures the multiple impacting that must occur in any specific area. Coverages of over 98% are very difficult to measure. Hence 98% is termed "full coverage". For the example shown, 98% is achieved with some 8.5 seconds of peening. That coincides with triple impacting (n=3) being the commonest for any given spot on the component. Some areas will have been indented many more times.

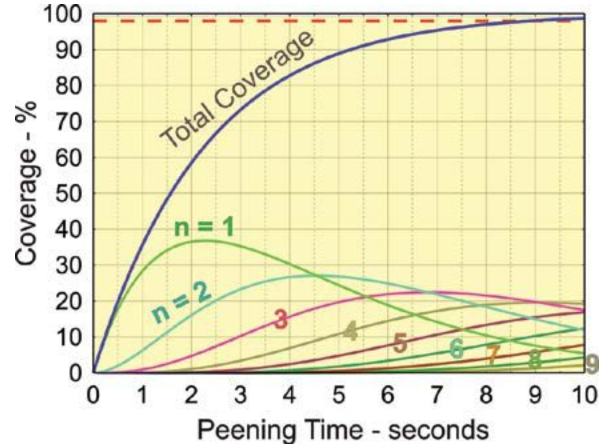


*Fig.7. Contributions of multiple denting to total coverage.*

It is important to appreciate that component fatigue life varies with the percentage coverage that has been applied. Optimum coverage occurs at less than 100% and depends upon component factors such as design, material and stress cycling regime. Fig.8 shows just one example, for which optimum coverage is 87%. Note that property improvement varies little on either side of the optimum coverage.

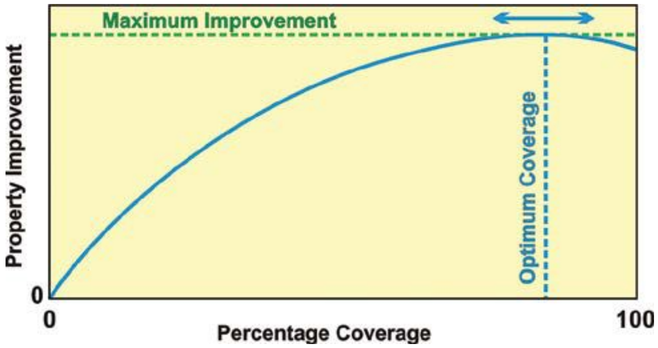


*Fig.8. Example of a property optimization curve.*

Measurement of coverage is a subject in itself. A simple, subjective method is to visually compare areas with those of reference images. Manual lineal analysis is much more accurate and far less subjective. Computer-based lineal analysis is quick, but requires investment in equipment.

## WORK-HARDENING

Shot peening is a surface work-hardening process. Work-hardening is one of the two factors that improve the fatigue


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strength of components; the other being the compressive residual surface stress. Surface work-hardening induces a huge increase in yield strength—several times that which would be predicted by a tensile test. That is because peening deformation has a large compressive component. Work-hardening is almost entirely due to a massive increase in crystal defects called "dislocations". This increase has two characteristics:

**(1) During deformation, dislocations move with the speed of sound** and

**(2) During deformation, dislocations multiply at an astronomical rate.**

As an example, annealed steel containing $10^6$ dislocations per square centimeter may contain $10^{12}$ under a peening dent. That is a million fold increase induced in, say, a thousandth of a second! The influence of dislocations on hardness is described in a previous Shot Peener article ("Work-hardening during Shot Peening," Summer 2017).

Dislocations allow movement to occur with metal crystals. Fig.10 shows the analogy of how a ruck in a very heavy carpet can be used to allow easy movement a bit at a time.

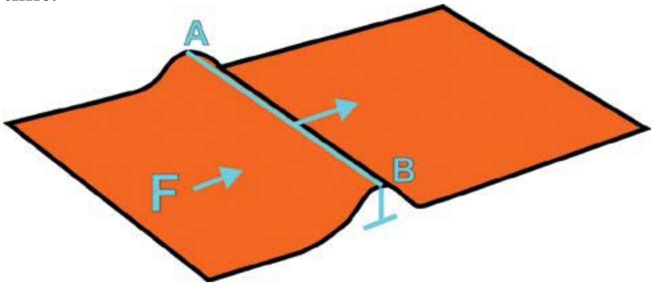


*Fig.9. Ruck-in-carpet analogy of a dislocation line.*

A force, F, applied in the direction shown, moves the ruck to the end of the carpet.

The overall effect of a massive increase in the dislocations can be illustrated by another analogy: Imagine early-morning traffic in a gridded city. With only a low density of traffic, progress is easy. If, however, the traffic density increased tenfold every few seconds flow would rapidly slow down. Vehicles would start to pile up and some would try to use "rat runs"— analogous to the cross-slip of moving dislocations.

The role of dislocations in allowing crystal movement is countered in many aero fan blades. These blades are grown as single crystals so as to be dislocation-free. The absence of dislocations increases the blades' resistance to creep (elongation under stressing at high temperatures).

## RESIDUAL STRESS SYSTEM

Surface residual stress is the second contributor to improved fatigue strength—the other being work-hardening. A residual stress system requires that there is a corresponding residual force system. This vital concept is illustrated by the simple spring model shown as fig.10. Ten identical springs are stretched using a force of 2N on each spring. The total force of 20N is balanced by two springs compressed by 10N each. Note that the compressed springs, shown in green, occupy a smaller area than do the ten compressed springs.

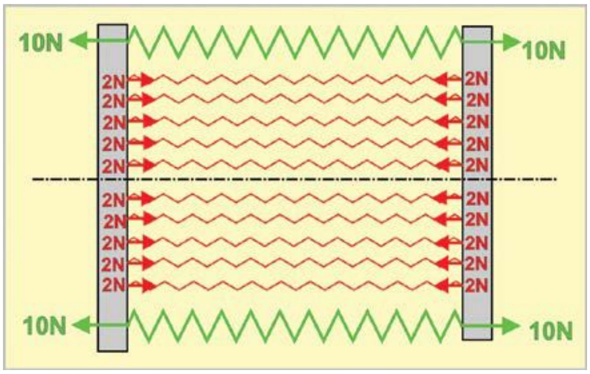


*Fig.10. Spring model of a stable residual force system.*

Stress is force divided by the area over which it acts. The compressive residual stress level in a shot-peened surface is much higher than that below the work-hardened depth. Fig.11 illustrates this feature.

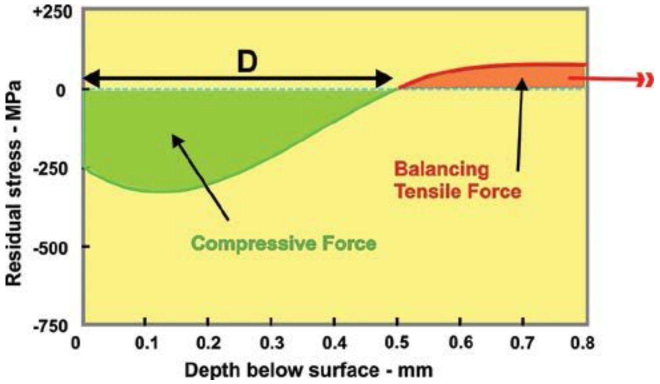


*Fig.11. Typical residual stress system near a peened surface, needed to balance residual forces.*

## SHOT ACCELERATION

Shot has to be accelerated to controllable velocities. The two main techniques are air-blast and wheel-blast. These allow shot to be accelerated to the velocities needed to work-harden component surfaces. General accounts of air-blast and wheel-blast shot acceleration appear in Part 2 of this mini-series. The following introduces the corresponding shot velocity equations.

### Air-blast shot acceleration

The velocity of air-blast accelerated shot, vs, is given as equation (8) on page 28 of the Winter 2007 *The Shot Peener* article.

$$\mathbf{v_S = (1{\cdot}5.C_D.\rho_A.s/d.\rho_S)^{0.5}\,(v_a - v_s)} \qquad (8)$$


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where $C_D$ is the "drag coefficient" (a dimensionless number that depends upon the shape of the object when, for a smooth sphere, $C_D \approx 0.5$), $\rho_A$ is the density of the **compressed** air (1.2 $kgm^{-3}$ times the compression ratio), **s** is the nozzle length, $\rho_S$ is shot density, $v_a$ is the velocity of the air stream and $v_s$ is the velocity of the shot particle.

The most important feature of equation (8) is that there is only one variable quantity for a given shot peening setup. Shot density, nozzle length and velocity of the air stream in the nozzle are all virtually constant. That leaves us with just the density of the compressed air in the nozzle as a variable controlled by adjusting the air compressor.

An analogy for the supremacy of air density is presented as follows. Imagine having one's back to a wind blowing at 10 kilometers per hour. This wouldn't blow one off one's feet. Compare that with standing with one's back to a river of water also flowing at 10 kilometers per hour. Water, being much denser than air, would accelerate one in the direction of flow.

Equation (8) can be employed using a simple Excel program where shot velocity is given by the following formula entry for $v_s$ :

**=B8*((1.5*B2*B4*B3*B7)/(B5*B6))^0.5/(1+((1.5*B2*B4*B3*B7)/(B5*B6))^0.5)**

| ROW | A | B | C |
|---|---|---|---|
| | Parameter | Value | Units |
| 2 | Cd | 0.5 | |
| 3 | Air density | 1.2 | $kgm^{-3}$ |
| 4 | Air pressure | 9 | atm |
| 5 | Shot density | 7860 | $kgm^{-3}$ |
| 6 | Shot diameter | 0.5 | mm |
| 7 | Length | 100 | mm |
| 8 | Air velocity | 200 | $m\ s^{-1}$ |
| **9** | **Shot velocity, vs** | **62.4** | **$m\ s^{-1}$** |

The program can be extended to produce graphs, such as Fig.12.

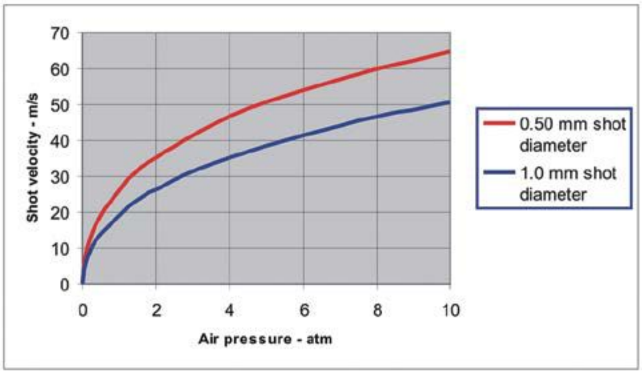


*Fig.12. Variation of induced shot velocity with applied air pressure.*

**Wheel-blast shot acceleration**

Wheel-blast shot acceleration is much more energy-efficient than air-blast shot acceleration which accounts for its continued appeal. A variety of wheel types have evolved but the mechanics involved are generally similar. Normally, blades attached to a rotating wheel throw shot at components. Shot velocity is achieved in two stages: accelerator drum and throwing blades. Particles are fed into peripheral slots formed between the accelerator and a stationary control cage. Centrifugal force keeps the particles pressed into the slots as the accelerator drum rotates. At this stage the shot particles have the rotational velocity of the drum. When a slot reaches the outlet slot in the control cage some shot particles escape onto a throwing blade for the second stage of acceleration, see fig.13.

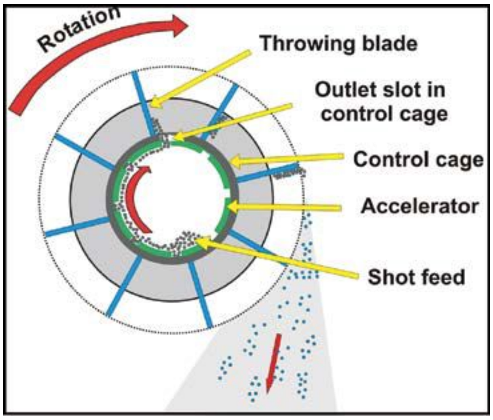


*Fig.13. Wheel-blast system with "open" throwing blades.*

Individual particles leaving the tips of the throwing blades have two velocity components, $V_T$ and $V_R$. These are vectors which combine to give the particle velocity, $V_S$, as illustrated in fig.14. $V_R$ is the radial velocity induced by the centrifugal acceleration and $V_T$ is the tangential velocity (which is equal to the rotational velocity of the blade tip).

The values of $V_T$ and $V_R$ determine both the velocity and movement direction, **θ**, of the thrown shot particles. Tangential velocity, $V_T$, is quite easy to estimate, whereas the radial velocity, $V_R$, requires the application of physical principles (and some simplifying assumptions).

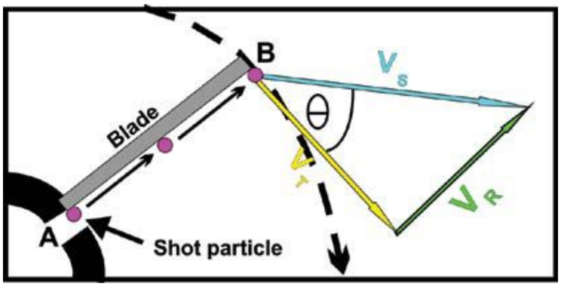


*Fig.14. Vector-combined velocity, $v_s$, for particle leaving blade tip.*

The magnitude of $v_S$ is given by the following equation:

$$V_S = 2.\pi.N(R^2 + 2.R.L - L^2)^{0.5}$$

Where **N** is the r.p.s., **R** is the radius of the circle swept by the blade tip and **L** is the length of the blade. The direction of $\mathbf{V_S}$ is obtained knowing that $\tan\theta = v_R/v_T$.

The ratio of blade length, L, to wheel radius, R, can be termed the "blade/radius aspect ratio". Commercial accelerator-fed machines have wheels with aspect ratios within a range of 30 to 70%. The ratio for a particular machine/wheel affects both the shot's exit velocity, $V_S$, and the exit angle, θ. Fig.15 illustrates the effects of aspect ratio on shot velocity components and exit angle. The curves were derived by plotting equation (8) against aspect ratio. Within an aspect ratio range of 30 to 70%, the thrown shot velocity is predicted to vary from about 123 to 138% of the tangential velocity. The corresponding exit angle range is from 36 to 44˚.

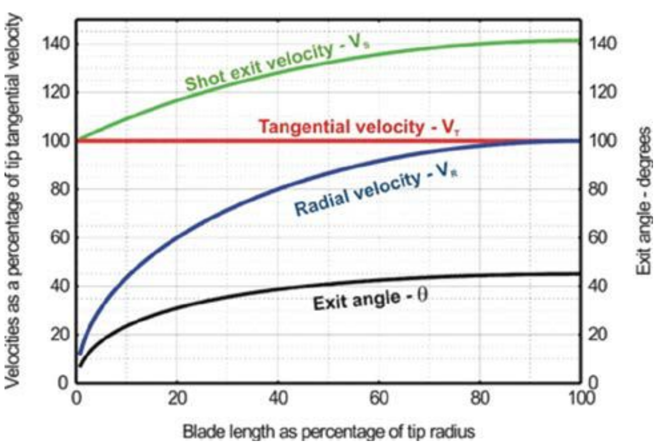


*Fig.15. Effects of blade/radius ratio on induced velocities and exit angle.*

## DISCUSSION

This article has presented the bare bones of several articles previously published in *The Shot Peener*. Quantification can be applied to most controllable peening variables. A basic understanding of those variables is essential for effective control. Several equations have been included that model the variables. Predicted values are, however, not to be regarded as being exact but rather as indications of how parameters can be varied.

Finally, it must be realized that a very important supplementary factor is data storage. An organized data bank is so very useful for reducing the level of guesswork needed to achieve required levels of peening intensity and coverage.


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# Reducing Costs for a Specialty Steel Manufacturer

*with Pellets Stainless Steel Cut Wire Shot and the MagnaValve®*

## THE SITUATION

A special alloy steel rolling, shearing and finishing company uses shot blast equipment with four blast wheels loaded with cast steel shot to prepare the surface of their high-alloy steel sheets. These steel sheets then must be further blasted with aluminum oxide to remove the contaminants left on the surface by the cast steel shot blasting operation.

Management wanted to discontinue the secondary blasting operation in order to improve throughput, handling efficiency, and reduce operating and media costs.

## THE PROPOSAL

Pellets LLC suggested that stainless steel cut wire shot be used to eliminate the contaminants left behind by cast steel shot thus eliminating the need for the secondary aluminum oxide blasting operation.

Convinced this was a good idea, the customer's blast systems were totally cleaned out of cast steel shot and stainless steel cut wire shot was introduced to the blast units. The revised blasting operation was initiated and the sheet finish was terrific, dust levels were significantly reduced, and media was lasting much, much longer.

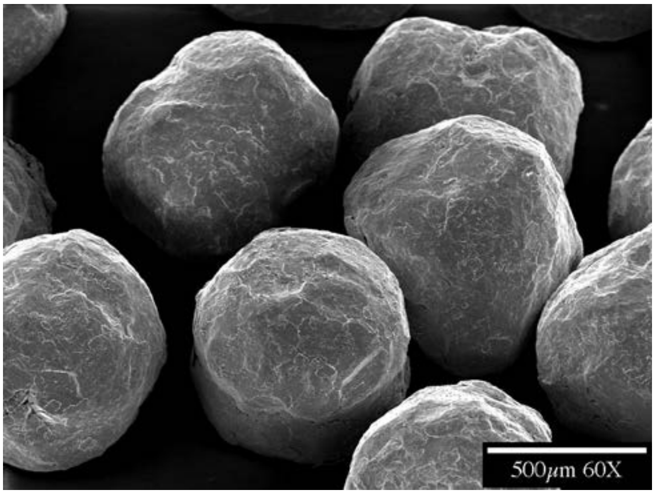
There was a problem, however, with using stainless steel cut wire shot with the company's MagnaValves from Electronics Inc. as they did not efficiently meter stainless steel cut wire. There was significant leakage when shutting down the equipment.

## THE FIX

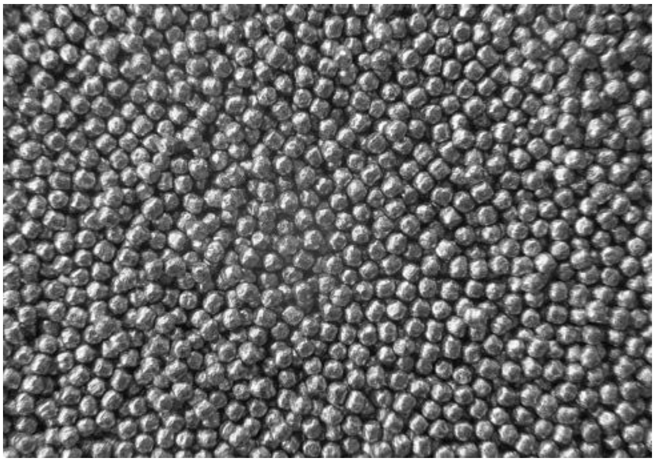
Pellets LLC and Electronics Inc. went to work looking for a solution to this problem. The stainless steel cut wire shot was working beautifully, leaving an excellent clean surface on the steel sheets and producing much less dust but the MagnaValves were not working as they should with the stainless steel cut wire shot.

Jack Champaigne (President of Electronics Inc.) with the help of Tim Deakin (Metallurgical Engineer from Pellets LLC) set up bench tests using a working mix of stainless steel cut wire shot from the customer. After several attempts to optimize a modified MagnaValve, the VLP-24-JR valve was developed and in tests it controlled the stainless steel cut wire flow perfectly.

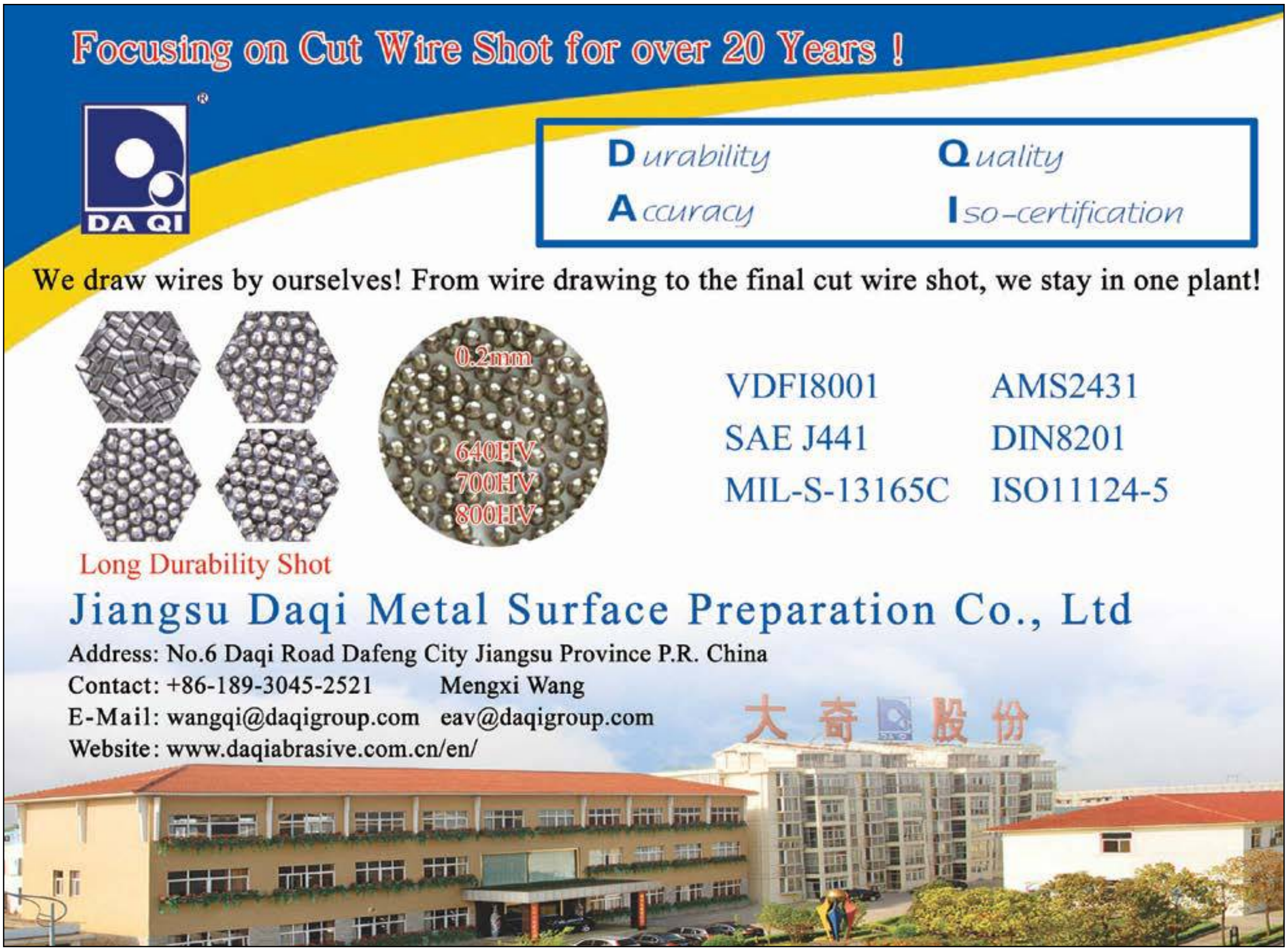
The four MagnaValves at the company's facility were modified with this new concept on a trial basis. The new MagnaValves are working great with the blast equipment and the stainless steel cut wire shot. Each blast wheel is operating at the desired set amps/media flow rates to produce a consistent blast cleaned work piece every time and the leakage issue has disappeared.




*Pellet's conditioned stainless steel cut wire shot at 60X magnification*



*Pellet's SCWC 62*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*Lane Barnholtz | Senior Editor | Clemco Industries Corp. | www.clemcoindustries.com*

# Water (and Media) Under the Bridge

*All was not wine and cheese at a bridge blasting site on the Seine River in France until the contractor purchased a modified Munkebo Vacuum and Recycling System. The Munkebo equipment solved space limitations and setup difficulties under the bridge.*

## PROBLEM

In 2018, a Munkebo customer of 15 years needed to recover and recycle spent steel grit while blasting the concrete and steel structures of a 900-foot bridge. The contractor had a niche business in surface treating small-to-medium-sized bridges. However, the work area on the riverbank beneath this bridge was especially difficult to reach. Furthermore, the work area was too small to fit most portable vacuum and recycling systems, in addition to power and air generators. As a final concern, the riverbank was unstable—too much weight concentrated in one area could cause it to collapse.

## SOLUTION

The contractor purchased an MB-2000 Vacuum System, which is a medium-sized vacuum system that comes with an integrated cartridge filter. The contractor also purchased an additional cyclone separator and a 25-ton storage hopper with a custom-engineered air-wash system installed above the hopper. This vacuum and recycling system met the contractor's needs for the following reasons:

- Space under the bridge was insufficient for a stand-alone recycling system, so Munkebo installed the air-wash system above the storage hopper. The air-wash system removed fines and dust from the spent steel grit before the grit entered the storage hopper.

*Left to right: Power and air generators, 25-ton storage hopper with a custom-engineered air-wash system installed above it, cyclone separator, MB-2000 Vacuum Unit.*

- After the hopper was filled with the recycled steel grit, it could simultaneously refill up to four blast machines.
- Because of Munkebo equipment's modular design, the contractor could configure the system's components into the space restrictions of the work area while also distributing the weight of the equipment so that the riverbank remained stable.
- Even with the space savings and balanced weight distribution achieved by the equipment's configuration, only enough space was safely available for lightweight power and air generators.
- Because Munkebo Vacuum and Recycling Systems are electric-powered, it takes less energy to run them than comparable diesel-powered equipment. This advantage allowed the contractor to use smaller generators that did not create instability on the riverbank.
- Likewise, because Munkebo equipment is electric powered, lighter Munkebo equipment with smaller footprints often can accomplish the same jobs that would require larger and heavier diesel-powered equipment.
- The smaller footprint of the Munkebo equipment also enabled the vacuum and recycling system purchased for the job to easily fit on a standard-sized truck. No special rigging or tie-downs were needed to secure it, and light cranes easily removed and reloaded the equipment from the truck to the work area.

## OUTCOME

The successful results at this job helped the customer grow its niche even further in small-to-medium-sized bridge surface treatment, and it has since purchased more Munkebo equipment.

## ABOUT MUNKEBO

Munkebo is a brand of abrasive vacuum and recovery systems. The company is based in Munkebo, Denmark. It was founded in 1963 and acquired by Clemco in 2008.

Munkebo also manufactures mechanical recovery systems, abrasive cleaning systems, ventilation systems, and other equipment for the abrasive blasting and painting industries.

# ICSP14
# It is Time to Start It Over

**OUR EVERYDAY LIFE** has been deeply affected by the COVID pandemic. We could not imagine the way we lived after the boom of the infections during Winter 2020. Now we can say that we have learned how to live with the virus, using all the possible precautions to prevent the infection and its spread.

One of the most restrictive constraints affecting our lifestyle was the impossibility to travel. This caused the total cancellation of conference calendars. Consequently, ICSP14, initially planned for September 2020, was also postponed to a date to be defined.

In the last year, each of us attended multiple on-line/virtual conferences, either listening to the recorded talks of the speakers or to the live interventions. Then, let me ask you: Are you fully satisfied with this experience? Or are you missing the traditional in-person conferences? I personally am wishing for the in-person conferences with the possibility to directly meet and interact with the people, to drink a coffee discussing scientific and technical subjects, and visiting the sponsor's booths that exhibit latest advancements and interesting devices and tools. I am sure you agree with me.

Now the pandemic is not over but it seems that life is slowly going back to something close to normal; thus, I think it is time to make a decision about ICSP14. Our decision is to organize ICSP14 in-person, on September 4th-7th, 2022!

The decision was not easy, but it is quite encouraging that with the due documents and the required procedure, it is now possible to travel and fly in most countries while taking special measures. We have also verified that we can safely use conference rooms.

This time, the ICSP organizer is Politecnico di Milano (POLIMI) in partnership with Peenservice. The venue is in Milan in the rooms of Campus Bovisa of POLIMI, and I have the honor to be the Chairman of the conference.

We have decided to start the organization of the conference over. We are not considering any longer the abstracts sent in 2020 and we are restarting the Call for the Paper procedure. You can find the details on how to proceed for submitting an abstract at the conference website at www.icsp14.org. We hope that you have maintained the original enthusiasm and that you will submit your abstracts soon.

Indeed, let me say that the expectation for this ICSP14 is high, not only for most recent developments in terms of new materials and the ever-exciting achievements as regards the fatigue strength and life estimation, but especially for the recent innovations in the production environment not yet completely implemented in the manufacturing technology, the so-called 4th Industrial Revolution or I4.0, which is opening new horizons to shot peening.

Bearing this in mind, ICSP14 represents a unique opportunity to the researchers and industry representatives to present their scientific and technological developments on shot peening and surface treatments and to listen to the recent developments and achievements in this field.

Another important subject, intended to become a major topic in the next few years, is the application of shot peening to additive manufactured parts obtained by processes based on powder deposition and melting. This new paradigm for industrial production has many challenges related to the poor quality of the surface that limits the mechanical strength (especially fatigue) and prevents a wider diffusion of these technologies. Shot peening and allied processes are found to be very efficient post-processing treatments for additive manufactured parts. However, the way to set up the treatment and the choice of the optimal process parameters are an unsolved key point to be addressed by academics and industrial engineers.

We expect high interest in the conference next year. Many colleagues and friends have already confirmed their interest and the plenary lecturers have confirmed their outstanding contribution.

Of course, another important aspect that makes a huge difference between on-line and in-presence conferences are the social events. Milan is a wonderful city in the north of Italy. It is the second largest and the most important financial

*People from Milan like to meet up during the evening along the Channel "Naviglio" to enjoy their aperitif with Prosecco wine or Spritz and the delicious Italian food.*

and economic city in the country. It is a well-known international capital of fashion and design as well as a city with many opportunities for shopping. Although less known than Rome or Venice, Milan is quite attractive for history and arts, rich in historical monuments and buildings, with many museums and art exhibitions. In Milan, it is possible to visit *The Last Supper*, the famous masterpiece wall painting by Leonardo da Vinci, and the Cathedral, a masterpiece of Gothic architecture that is well known all over the world.

It is quite interesting to take a walk in the downtown around the historical castle but also in the new districts with innovative buildings, especially in the late summer. ICSP14 is planned for the second week in September during these late summer days. ICSP14 wants to give to the attending people a "taste of Italy", thus a welcome reception is planned at the end of the opening day and the gala dinner is expected in the courtyard of the historical castle in Milan with a cultural visit of the castle itself. A social program for accompanying persons as well as cultural visits and post-conference tours are under development at this moment and will be communicated on the website.

We are working hard to welcome you and offer you an amazing and remarkable experience at ICSP14.

I am looking forward to meeting you at ICSP14!

## Important ICSP14 Dates

| | |
|---|---|
| Submission of abstracts | February 15, 2022 |
| Notification of acceptance | March 15, 2022 |
| Submission of papers | April 30, 2022 |
| Notification of acceptance | May 30, 2022 |
| ICSP14 Conference | September 4-7, 2022 |

Submit abstracts and papers to: submit@icsp14.org

ICSP14 Chairman: Prof. Mario Guagliano
Department of Mechanical Engineering Politecnico di Milano