

The Shot Peener

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



The US Shot Peening and Blast Cleaning Workshop
Celebrating
25 YEARS

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Celebrating 25 Years of the US Shot Peening and Blast Cleaning Workshop



Group photo from 2012 US Workshop in Chicago, Illinois

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What I Have Learned from the Shot Peening Workshops

Kumar Balan reviews the training offerings in our industry and the unique aspects of the US Shot Peening Workshop. Of special interest is his viewpoint on what the blast cleaning community can gain from the workshops.

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Read about the past, present and future of a leader in the screening industry.

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Industry 4.0 Meets Shot Peening

INDUSTRY 4.0 is the German vision for the future of smart factories. RUMP is already applying Industry 4.0 to blasting processes with their automated refill hopper, making it an effective way to ensure shorter and more reliable work processes.

THE SHOT PEENER

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

25th Annual Workshop

THE 25TH ANNUAL US Shot Peening and Blast Cleaning Workshop will be held this November in Indianapolis, Indiana. It's hard to believe that we have had so many classes, and students and instructors participate in this world-class training. The very first workshop was in Atlanta, Georgia.

What made me think that a "workshop" on shot peening would be beneficial? We already had *The Shot Peener* magazine. We already had www.shotpeener.com. I felt like we still needed another way to connect with the industry and by offering classroom training and trade shows we could make a difference.

It didn't take long to extend the workshops to Singapore, Canada, Mexico, Japan, Germany, and England. The interest in the workshops then spilled over into offering on-site training where we could focus on customer-specific issues such as equipment and procedures. We eventually recognized that we needed a separate division of the company under the direction of Dave Barkley. Dave's most popular training involves flapper peening and he has been the primary resource at the SAE meetings on the flapper peening specs (AMS 2590).

Dave maintains our relationship with PRI (Performance Review Institute) through our Partners in Education Program. He also maintains a close relationship with the FAA since we train so many aerospace designers and mechanics. Dave reports that we have issued over 5,000 certificates of training. The following is a list of the instructors at the first workshop in 1991.

Instructor	Organization
Peter Bailey	General Electric
Jim Belisle	3M Company
John Cammett	US Navy
Jack Champaigne	The Shot Peener
John Eckersley	Metal Improvement
Bob Gillespie	Premier Shot
Jim Hensley	Pangborn
Ken Hoffmann	Torit
Ken I'Anson	Blastworks
Dwight Lutsko	Jet Wheelblast
R.D. McCluskey	Churchill International
Steve Paxton	Rotex Inc
Larry Pope	WS Tyler

Correction

We have a correction for Dr. Kirk's article in the Spring Shot Peener, page 30, column two. The correction is in red: "As examples: At 35.6% coverage, single impact (i.e., no overlapping), predominates although more than 1% of the surface has received at least triple impacting. At 88.9% coverage, the largest contribution is now of double impacted areas followed by single impacting, but also with more than **2%** having been impacted at least six times. ●

**JACK CHAMPAIGNE****THE SHOT PEENER****Editor**

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The US Shot Peening and Blast Cleaning Workshop

Celebrating 25 Years

IT WAS A CRAZY IDEA. Bring OEMs, sales reps, process engineers, and machine operators together for three days, feed them sandwiches, and share information on the products and procedures of one of the smallest niches in manufacturing. A niche that services industries that keep their processes more private than politicians with their home phone numbers. Yep, that's gonna work really well.

But, somehow, it did. It's worked for 25 years and, thankfully, the food has greatly improved.

Rather than tell you how the annual Electronics Inc. Shot Peening workshops have benefitted the shot peening industry since the first workshop in 1991 in Atlanta, Georgia, we will let the participants do the telling. The following are the thoughts of exhibitors, instructors and students. They were invited to answer one or more of the following questions:

- 1) How have the US shot peening workshops benefited you personally?
- 2) How have the US shot peening workshops benefited your company or organization?
- 3) In your opinion, how have the US shot peening workshops impacted the shot peening and blast cleaning industries?
- 4) What has been your most memorable workshop experience?

Michele Bandini, Peen Service (Instructor)

It is a long time since I attended my first US workshop. As a rough idea, close to twenty years. A business trip is often a good occasion to meet new people and make new experiences. This is always a good thing and not only from a professional point of view. If it happens that you can have spare time to look at new places and relax, then it becomes perfect.

From a professional point of view, a workshop is always a great time to discuss shot peening or related treatments with people interested in the same topics. As a presenter, I like the question and answer session at the end of each class. It's the time where you understand if you hit the target but, even more important, you can also pick up ideas for new topics to investigate. It is a great way to build knowledge to give answers to real company needs.

Several times I had the occasion to meet people who attended the workshops and each time I found very qualified people. After the workshop, when people come back to their



companies, they can put knowledge into practice, building expertise. In addition, matching and sharing experiences during the workshop is a wonderful way to grow. Companies are made of people.

I had the honour of receiving the "Shot Peener of the Year" award in 2009. Jack and all the other guys at Electronics Inc. organized everything, keeping me completely in the dark. They asked for my picture and my biography, offering strange excuses like "we have to update our database." I had been caught in the net like a fish! I discovered everything during the opening session; I was really astonished. Great, Jack.

Bill Barker, Progressive Surface (Instructor and Exhibitor)

Here is one of my favorite recollections: It was the workshop held in Scottsdale, Arizona back in 1997 I believe. Jack invited all of the speakers and exhibitors to a jeep ride and cowboy dinner out in the desert. Everyone had a really good time with great food and fun company, along with some memorable games of "skill." Charlie Mason just couldn't shoot straight in the quick draw contest (actually not his fault) and Dale Lombardo obliterated a tomahawk-throwing target. Many thanks to EI for some great memories over the past 25 years.



Walter Beach, Peening Technologies (Exhibitor)

I've been attending the workshops since the early 1990s. In that time I've met many great people across the industry and even made a few friends! The ability to network with other people and companies in the shot peening industry is second to none at these events. That's why I've gone back year after year.

For me, as I mentioned, the benefit to Peening Technologies is the networking. This has been a key element for us. We have been able to meet and work with some of the best people and companies the industry has to offer. Not to mention the classroom activities—while some classes are for the newbie, I'm always amazed how there is always something new out there. This is a great place to keep up with current technology and potentially learn where the industry is headed.

In my opinion, EI has done a fantastic job of finding



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a niche role inside of what is already a niche business. EI's products and training have helped remove much of the cloud over what was once described as the "Black Art of Shot Peening." Both continue to evolve as new specifications and technologies are introduced.

While I've always had a good time at all the workshops, if I have to pick just one, I'd have to say it was my first workshop. This was when I met Mr. Jack Champaigne. I'm guessing this was the very first workshop. He took me under his wing from the beginning. Although Jack is more than 20 years my senior, we hit it off right away! (Jack has a gift for relating to people, regardless of their age, education or background.) I could see we shared a similar vision for the shot peening industry and Jack and his team understood many of the problems that plagued the industry. I knew right then that this was the place to be to help us get where we wanted to go. While we may not be there yet, we are a heck of a lot closer than we were 25 years ago, thanks to Jack and his team.

Robert Blomberg, GKN Aerospace Engine Systems Sweden (Student)

I've increased my knowledge about shot-peened processes and new methods like flapperpeen/ultrasonicpeen and needle-peen. I also received a wider contact base. My Level 3 Certificate is appreciated to show auditors.



Shotpeen is a rather unknown method in the world and this is a great place to send employees to increase their knowledge about the process. It is not possible to get local courses in my country.

It's a great place for both suppliers and users to get together. The t-shirt logotype is always a fun thing! The Schwarzenegger t-shirt was one of the best!

John Cammett, Consultant (Instructor)

With great pleasure I report that I have participated as an instructor in each of the twenty-five EI Annual USA Shot Peening Workshops. At last reckoning it seems that I am the only individual who can make this claim. There have been so many memorable events I hesitate to single out any in particular. Let it suffice to say I have thoroughly enjoyed teaching and interacting with students and other workshop participants over the years.



It is especially rewarding to receive compliments and to know thereby that my efforts have been appreciated. I am especially grateful to Jack and the EI staff for the opportunity they have provided me to serve the industry. I have seen much growth in numbers and in technical capability in the industry worldwide over these twenty-five years. The Workshops have been an instrumental part in all of this.

Dan Dickey, Innovative Peening Systems (Exhibitor and Instructor)

My most memorable workshop experience was in 1991, the first workshop in Atlanta. I was one of about a dozen other students. If I remember correctly, we had lunch from Subway that day. I have been attending and associating with the workshop ever since. Twenty-five years is a long time and I cannot remember ever missing one since 1991. The workshop has progressed in many ways since that time. The technology, instruction, organization and companionship have steadily improved every year. I am glad my company has been associated with such a great success and organization.



Sylvain Forgues, Shockform Aeronautique (Instructor and Exhibitor)

I have been attending the US shot peening workshop for more than 10 years now. This annual meeting is one of my favorites because it allows me to feel the pulse of the shot peening community, from suppliers, to competitors, to clients, all in one place.



It is a great place to meet with all the major actors in the community and show our technology to many potential clients. I like to bring my new employees to the US workshop to complete their training on shot peening and blast cleaning and to meet potential clients. Meeting a person face to face to discuss their application is priceless.

The training given at the US shot peening workshops has been instrumental in raising the overall level of knowledge on shot peening and blast cleaning. As president of Shockform, I travel the world to meet with clients. Over the years, I have seen a steady and continuous improvement in the knowledge of most of my clients. I think EI and the shot peening workshops are a big reason for this.

My most memorable US workshop is the one held in October 2015 where I was named the Shot Peener of the Year. I was honored and very proud to receive this award, especially because of the great people that received it before me. I will always remember this moment.

Teddi Gillespie, Premier Shot Company (Exhibitor)

Premier Shot has been attending the workshops for 25 years. Bob Gillespie was a speaker at every one until his death in 2011. We have made numerous friends over the years, and value each and everyone of them. Not only were they there for us during the time after Bob's death, but are still very helpful.



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We always enjoy the workshops. Meeting with people, some for the first time and some that come year after year, is always a pleasure. We are happy to talk to them about our media and it seems we usually get new customers to use our quality shot.

Every workshop is a new experience. Looking back over the years, I think the workshop we had in Arizona where we went to the dude ranch was the most memorable one.

Any workshop that brings quality material to the attendees, like the EI Workshop does, has to have a very positive result in the industry. All of the info to the young people starting out in the industry has to be a good thing.

Thank you to all of the EI personnel that spends hours on these workshops. You have done an outstanding job over the years.

Jeff Girman, Saint Gobain (Instructor)

I think the true benefit of the workshops for me is that it has allowed me to build relationships with prospective customers, other presenters and OEMs, all in one inclusive setting. I have developed many friendships both personal and business related. I have also been able to obtain vast sources of knowledge on shot peening in general that I am able to utilize every day in the field. Over time, the EI workshops has cultivated a fraternal atmosphere that has resulted in a fairly tight knit group.

Most of my experience has been as a presenter at the workshops. It has allowed me to provide more exposure to ceramic shot peening. Although the workshops have evolved over the years, most of the presentations focus more on metallic shot peening than with ceramic shot peening so it has put our product in a unique category.

The workshops have impacted the industry, particularly with shot peening. Many of my customers refer to it as the benchmark for shot peening theory and procedures. This is true even on a global basis.

I don't have one specific memory, however, I have always enjoyed the camaraderie in the evenings with customers, prospects and even some of my competitors.



Jim Harrison, Curtiss-Wright | Metal Improvement Company (Instructor)

I have been participating in EI's Workshops for about 15 years. During that time, I have had the privilege of meeting several pioneers of the shot peening industry. I have enjoyed our discussions, and the things I have learned attending presentations, and the discussions during breaks and after hours, have been invaluable. Knowing who I



can contact about technical issues is a very important resource for me and our customers.

Like Electronics Inc., Metal Improvement Company and Curtiss-Wright Surface Technologies are leaders in the shot peening industry. We feel that quality training, education and instruction in the hows and whys of proper shot peening practices are very important to the ongoing success of our industry.

When I first became involved with shot peening, nearly 35 years ago, there were many operations providing questionable quality and sub-optimal protection due to a lack of knowledge on proper peening techniques. These workshops, along with *The Shot Peener* magazine, have done much to educate both end users and suppliers of this process. As a result, the overall quality of peening that we see today is highly improved.

My most memorable experience has been the sum of the relationships that I have developed both professionally and personally from involvement in these workshops. But traveling to workshops in Canada, Mexico, Singapore and the many different US locations has been a wonderful experience as well. (My favorite place was San Miguel de Allende in Mexico. If anyone gets the opportunity to visit this area, I would highly recommend it.)



Ken l'Anson, Progressive Surface (Instructor and Exhibitor)

Congratulations Electronics Inc. on your 25th Anniversary of the Shot Peening Workshops. I'd like to offer my sincere thanks to Jack Champaigne and the large cast of characters that have made the Workshops a valuable, informative and diet-busting event.

I was one of the early adopters, attending the very first Workshop at the Atlanta Underground so many years ago, and now thinking back, there must be a couple thousand students that have attended since the first one. This success certainly shows that our industry needed a leader to organize and train operators, engineers and executives on the importance of Shot Peening. Jack has been that leader.

Over the years, I've assisted the EI team by expanding the workshops from the annual USA workshop to workshops around the globe. It's been my pleasure to attend the first Workshop, several international Workshops, and I look forward to celebrating the 25th Anniversary this fall in Indianapolis.

Congratulations and thank you for your contribution to our industry!

Brigitte Labelle, Shockform Aeronautique (Exhibitor)

I have been attending EI Workshop since 2006. As my knowledge about peening was not up to date, these Workshops were an important source of information and understanding



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for me. Jack and his team always made it easy to ask questions, as basic as they might be. From new technologies, to new applications and new industries, the workshops are a fantastic opportunity to connect with new customers and colleagues.

From its creation in 2006, Shockform has benefited from exhibiting and training. The workshops are a great opportunity to present our products and ideas, and create alliances with companies and suppliers. The structure of the Workshop is very user friendly and allows for easy discussions and contacts with the attendees.

Of course, having the main workshop in the USA makes it easy for people around the world to gather and learn about the newest technologies and also revisit the basics. There is no other event like the EI Workshop around the world.

My most memorable experience was my first workshop and last year's workshop, when Sylvain Forgues, my associate at Shockform, won the Shot Peener of the Year award.

Lars Larsson, GKN Aerospace Engine Systems Sweden (Student)

Electronics Inc. Shot Peening workshops are a great way to spread the knowledge and the "know-how" around shot peening. To meet and discuss problems and solutions with other shot peening engineers has been really helpful. Other "special processes" should use this way of working to widen the knowledge around the process.

Keep up the good work.

Duncan Painter, Cargolux (Student)

I attended three workshops and earned the Level 3 Achievement Exam Certificate. This has given me a very good knowledge in the Shot Peening methods I require.

With my acquired knowledge, we have been able to set up a Shot Peen department doing Rotary Peening, Boeing Manual Shot Peening, and an automated process for Goodrich wheel repairs. This has saved a lot of time and cost.

If you want the latest and best knowledge from the Shot Peen industry, you must visit the US Workshops.

My most memorable experience was being able to confidently sit for the Level 3 exam.

Terry Reckert, OSB Sales and Consulting (Instructor)

Through nearly a 20-year association with EI and the



workshops, I have been fortunate to establish lasting friendships with many individuals in the peening industry.

We have also been fortunate to establish working relationships with many companies in the peening industry, delivering sieve calibration services and optical imaging systems to optimize the quality control of their media.

There is nothing else like the EI workshops to educate individuals in the industry on all aspects of peening.

The Arizona workshop with Hummer rides in the desert, a chuck wagon dinner, fast-draw competition, and beautiful weather was my most memorable workshop experience.



Herb Tobben, Clemco Industries (Instructor and Exhibitor)

The workshops broadened my knowledge of shot peening specifications and they provide training for new Clemco personal. They have made owners and operators of shot peening job shops aware of the correct procedure for shot peening. Receiving the 2010 Shot Peener of the Year award was my most memorable workshop event.



Philip Waser, Ervin Industries (Instructor)

These workshops have been ideal in assembling the world's most advanced minds for training and establishing good business relationships.

These workshops have taught the technical details of Shot Peening and Blast Cleaning to our Sales and Distribution groups so they can be more helpful to our end-user markets.

We think the EI Workshop's design of continuing education and technology advancement is the most effective way to grow and educate the peening and cleaning markets.

My most memorable workshop experiences have been networking with the people from different companies, processes and applications, including the tours at Delta's repair facility in Atlanta.



Mike Wern, Engineered Abrasives (Exhibitor and host of many Workshop events)

The workshops have furthered my knowledge on peening. As an exhibitor, we've been able to have a good presence in the workshops. The industry has benefited because more people are learning how much it can help strengthen their gears





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blades, discs, springs, etc. My best workshop experience was in Orlando, Florida (I took the Grandkids to Disney World).

Jim Whalen, Progressive Surface (Instructor and Exhibitor)

Personally, I look forward to the Shot Peening workshop every year. I enjoy meeting the new students, and catching up with industry colleagues to keep a pulse on the shot peening industry. Additionally, in every workshop I have attended, I learn something new. Even though I have been involved in Shot Peening for 30 years, the diversity of presenters, students and trade show exhibitors always provides new ideas and insights to this mature but growing industry.

These workshops have had a tremendous impact on the industry. In the early years the workshops were attended by mostly process engineers pretty versed in the technology. But as more and more of these process engineers grasped the benefit of these workshops and promoted them internally, the demographic of the attendees has shifted to a broad range of responsibilities from operators, to engineers, to managers.

This has really elevated the Shot Peening IQ of the industry and has improved everyone's understanding of this critical fatigue improvement process. Peening is better understood and more consistently applied as a direct result of the shot peening workshops educating the industry.

Ron Wright, Wheelabrator (Instructor and Exhibitor)

We have honed our skills and knowledge, resulting in increased recognition in the field, and ultimately more business.

The workshops have created a broad baseline of knowledge for operators, engineers and quality personnel. This has helped establish common rules and protocols across the industry.

My most memorable experience? That's a tough one. However, being recognized as a contributor and meeting new and old customers is definitely the most enjoyable part.

In closing: Kudos to Jack Champaigne. Your crazy idea brought an industry out of the shadows and made it a source of pride and accomplishment (and sometimes even fun!) for so many of us. Thank you. ●



TAKING A GREAT IDEA AND RUNNING WITH IT

Dave Barkley, Director of EI Shot Peening Training, has been instrumental in making the US Workshops successful. Dave oversees all aspects of the US Workshop and conducts classes in fundamental and specialized peening processes, including rotary-flap peening. He even designs the US workshop t-shirts!



Dave Barkley, Director of EI Shot Peening Training

Dave's influence extends beyond the US Shot Peening Workshop. Under his direction, the workshop and seminar programs have expanded in Mexico, Asia and Europe, and on-site training has grown exponentially. His expertise in rotary-flap peening has made it one of the most requested training programs. He is a FAA Safety Team (FAASteam) Representative, specializing in shot peening education, and an active member of the SAE Surface Enhancement Committee.

Dave shares his thoughts on the US Workshop:

It's only since 2009 that I've been at the helm of EI's shot peening training but I've witnessed its history through our archives. Jack Champaigne entered this niche industry and found too many people involved in the shot peening process that didn't have any idea what it did or how important it was. That began to change in 1991 when 13 instructors and 33 students came to the table to begin improving the process.

Since then, the US Workshop has been held every year and is supplemented by smaller seminars, workshops and on-site training all over the world. EI Shot Peening Training will have surpassed 5,500 students by the time this magazine is printed. I think it would be wrong if an article looking back at our 25 years didn't acknowledge those people that helped create, maintain and present our training material. It's a long list and I won't try to name you in fear of missing one. You know who you are and I thank you. Thank you to everyone that's come to our table, and thank you to Jack for providing that table.

The largest benefit I've had from the Workshops has been the friends I've made. It's good to have someone to call when you have a problem. The shot peening industry as a whole has benefited from the networking the Workshop provides. The knowledge and experience that's exchanged at the Workshop has promoted professional control and consistent results of the shot peening process.

My most memorable Workshop is the NEXT one. I always have the next Workshop on my mind, hoping to make it a professional, educational and fun experience. ●



PREMIER

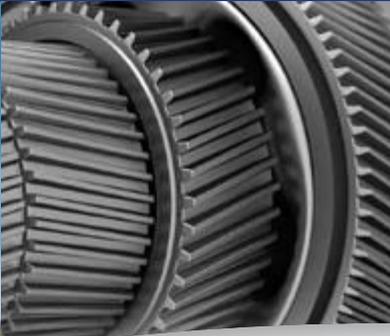


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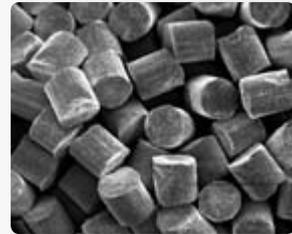
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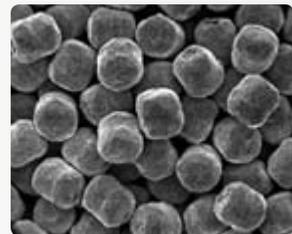


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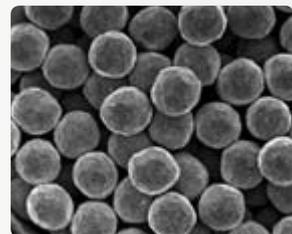
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What I Have Learned from the Shot Peening Workshops

TO QUOTE SOCRATES, the Greek philosopher, “I cannot teach anybody anything, I can only make them think.” Similarly, education and training can be credited as having achieved their main goal if they bring about this effect in students. In an industry like ours, where background theory gets scant mention even in a Production Engineering book, it's not uncommon to witness informal learning opportunities more often than structured courses. Fresh out of school in the mid-90s, as an Engineer with the subsidiary of a large surface preparation company, most of my practical education was through discussions with design draftsmen within the company.

Similarly, the “Subject Matter Experts” (SMEs) that we have come to know within the shot peening and blast cleaning industry have contributed tremendously through informal engagements to proliferate knowledge within this field. As the EI Shot Peening workshop meets for its 25th annual session in the United States, I look forward to gaining more information from these SMEs that could not have been obtained through a formal college program.

Training Patterns in Our Industry

Though every company has its own unique training schedule, the incidences of such programs are generally as follows: (a) specific product training prior to a sale, with an effort to present a potential solution (application centric), (b) factory training during equipment testing at the manufacturer's location and (c) start-up training at site after equipment installation. Empire, for example, has a distributor-focused sales model that places critical emphasis on providing regular training (once or twice a year) on the technology and basic concepts of cleaning and peening in addition to their unique product attributes. Such a program presents a relatively informal yet structured set-up designed for participants to seek basic information without the fear of being ridiculed. As an industry veteran framed it, “the only stupid question is the one that you don't ask!”

The EI Shot Peening workshops, at least in North America, are exactly that—a relatively informal setting with a structured and intensive dose of information. Information at these workshops is not just restricted to peening, but also includes related auxiliary and sub-systems.

Training also takes a customized approach where a particular user of (typically) peening equipment might request training on their equipment at site, relating to their specific application. This is more prominent when the audience size is large and the process is confidential. Such an approach allows for barrier-free transfer of information with the trainer.

As an instructor, I've noticed a higher degree of audience participation in North American workshops. However, with increasing prominence of training overseas, particularly in non-English speaking China, a lot more questions are now raised during and after a class. My Chinese trainer colleagues inform me that the questions are not always to seek basic information. They are also not about technological advances in specific makes of equipment since most training sessions are expected to be commercial-free! Questions revolve around understanding the correct way of carrying out the process. This is very encouraging to a trainer and demonstrates the impact proper training can have on an interested user.

Unique Aspects I Couldn't Have Learned Outside the Workshop

- The SMEs are from companies that compete with each other on a regular basis. Each manufacturer has their own unique way of solving commonly encountered problems. The workshop gives one an opportunity to study each presenter's unique approach when solving a problem. One such example was a presentation by Kevin Young of Progressive Surface. He demonstrated the steps they took to analyze and find the root cause of anomalous arc height readings that didn't match with the historic expectation given a specific set of process parameters. The cause was finally traced to a batch of “A” Almen strips that had undergone improper heat treatment procedure during their manufacture. Instead of hiding behind the classic “anything can happen,” I now have another possibility to explore when things go wrong in the field!
- More valuable information from the workshop was the fact that a particular grade of ceramic manufactured by Saint Gobain could develop comparable levels of intensity and residual stress as commonly used sizes of steel shot. The depth of information presented to substantiate this claim wouldn't have been readily available outside the workshop.



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- The sign of a good SME is always when you see no more than a subtle hint of commercialization in their approach. Workshops always bring out the best in such presenters and greater audience participation only enhances this effect. I have learned very basic, albeit important concepts, such as the difference between arc height and intensity, saturation curves and their relationship to hardness of parts, residual stress and its calculation, S-N curves, treatment techniques post-peening to enhance peening quality, etc., from such instructors and incorporated them in my own classes, too.
- I have truly understood that every engineering problem can have more than one solution, and this is just by observing how my fellow presenters approach commonly known issues.

Can Blast Cleaning Benefit From This Workshop?

The EI US workshop is labeled “Shot Peening and Blast Cleaning Seminar and Workshop.” However, this workshop mainly attracts users of shot peening equipment rather than cleaning equipment. Being a very similar process, I've always wondered if users of the blast cleaning process could derive any benefit from attending a predominantly peening-based workshop?

In an article published by E.A. Borch of Ervin Industries, Inc. (“Effective use of steel shot and grit for blast cleaning” available at ervinindustries.com), he explains that “doubling shot size increases the mass or impact-power per pellet eight times. Conversely, doubling shot size reduces the pellets per pound to one-eighth.” This, to me, is a very effective means of demonstrating the concept of impact energy which governs the mechanism behind blast cleaning and also shot peening. Though we are constrained by specification in selection of media type and size for shot peening, we are at liberty to select the abrasive size for most cleaning applications. Every class at the workshop explains the concept of impact energy in different ways. Let's see how this education will benefit a user of cleaning equipment and optimize their process:

- The application and use of MagnaValves will explain control and monitoring of mass (lb or kg per minute), leading to optimization of media flow rates, reduction in breakdown and lowering of operating costs.
- A course in the effective use of media classifiers will explain the importance of maintaining proper shot size for constant impact energy. I acknowledge that cleaning applications benefit from an operating mix and not the same media size, but maintaining consistent media size is important when surface finish is critical for an application.
- A class in wheelblast machine design and maintenance touches on velocity and the means to control/regulate/monitor it in such machines—a concept, if overlooked, can result in high breakdown rates, component wear and increased operating costs.

This list can get even longer, and the validity of the argument that this workshop will benefit users of cleaning equipment will only get stronger. The knowledge we have gained from peening is applicable to cleaning as well, and one needs to take advantage of that.

The Future of This Workshop

In my earlier articles, we discussed the role of computer controls, robotics, automation and electronics in advancing technological growth in shot peening equipment. Such developments are often discussed in various classes at the workshop. Given the growth in this sector, I can't help thinking that we are merely scratching the surface of what these developments are capable of bringing to our shot peening machines. Other possibilities are noise control, wear resistance, portability, etc. I propose the future of this workshop, in addition to educating its attendees on basic and advanced peening concepts, focus on bringing experts from the fields listed above and educate us on what the future could look like for our equipment.

I would like to end this discussion with a quote from the famous American historian, Daniel Boorstin: “The great obstacle to progress is not ignorance, but the illusion of knowledge.” Incidentally, I heard this quote during Mike Brauss' presentation on Residual Stress at the Shot Peening Workshop. ●

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WPC TREATMENT (Fine Particle Peening) is a shot peening method that improves the mechanical property of metal products. It was jointly developed by Fuji Manufacturing Co., Ltd. and Fuji Kihan Co., Ltd. (Japan Patent No. 1594395, Heat treatment method for surface finishing of the metal products.)

WPC differs from conventional shot peening in that conventional shot peening sprays ferrous media 600 – 800 μm in diameter at a velocity of 70 – 80 m/s, whereas WPC sprays a much harder and finer media of 40 – 200 μm in diameter at a velocity of 200 m/s. Consequently, quick heating and cooling are repeated and a heat-treatment and forging effect with a small-dimpled surface is created.

The Merits of WPC Treatment

The main cause of metal product failure is fatigue. There are many cases where a minute crack occurs on the outermost layer, then it grows and leads to failure. WPC treatment provides a highly compressive residual stress close to the surface layer, and restrains the progression of the cracks at the surface by improving surface roughness and effectively raising the fatigue limit. WPC will lower repair costs due to fatigue failure. WPC improves the fatigue life of components without making them larger and even lowers energy costs and materials usage in some cases since the size and weight of the parts can be reduced.

WPC treatment creates a hard surface that improves abrasion resistance. A lubricant is usually used on the sliding parts of metal products. Under certain conditions, a lubricant dries up and friction occurs. The WPC treatment creates small dimples that hold the lubricant, making a near no-contact state, reducing the oil temperature and preventing friction. When WPC treatment is applied on engine parts and other sliding parts, the slide resistance is lower, increasing the power and providing higher fuel efficiency, and shortening the initial engine running-in period.

WPC treatment improves chip flow around the cutting tools and lowers the meshing sound between the surfaces of gear teeth. It also prevents burns and scratches.

The Mechanism of WPC Treatment

Figure 1 shows the depth direction distribution of the residual stress of the carburized and quenched SCM420 to which conventional shot peening treatment and WPC treatment were applied respectively.

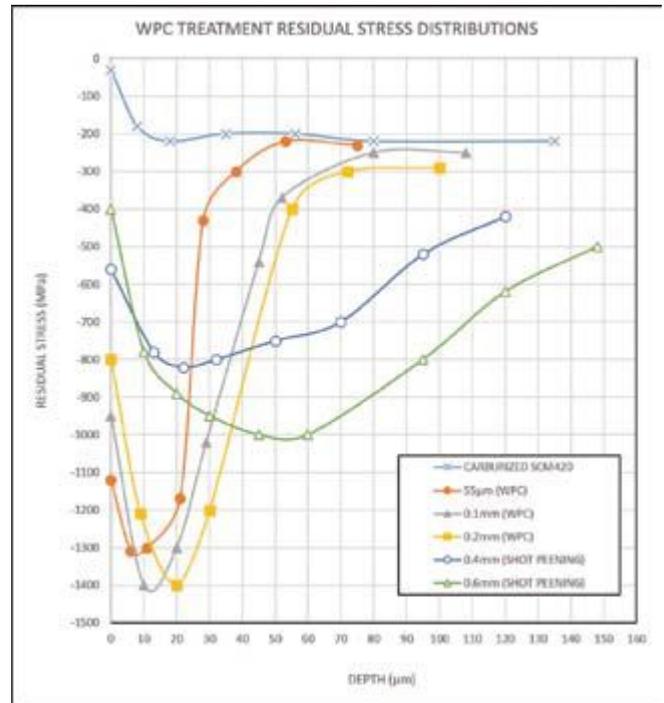


Figure 1.

Whereas residual stress peak is -800 to -1000 MPa in the case of shot-peening, WPC can provide a higher residual stress of -1300 to -1400 MPa. Shot peening has a depth of 20 – 60 μm, and WPC shows 5 – 20 μm. WPC provides high residual stress on the surface layer, and a beneath-the-surface depth of 20 μm. There is a similar trend in the hardness.

Moreover, WPC uses smaller particles than conventional shot peening and they form smaller dimples. For example, when we applied shot peening and WPC treatment on SUS430 under the same conditions, roughness was $R_y=45$ μm in the case of shot peening, but in the case of WPC, it was $R_y=15$ μm, or one-third the roughness of shot peening. Surface hardness for both was HV350.

MoS₂ and the WPC Treatment

Solid lubricants such as Molybdenum Disulfide (MoS₂) can be utilized as media in the WPC process to embed MoS₂ into the product surface. The MoS₂ shot process sprays fine powders of MoS₂ at a high speed against aluminum and other low melting-point materials. The process forms a MoS₂ layer, which does not include a binder, on the outer layer of



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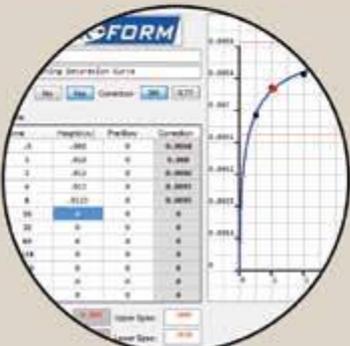
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Figure 2. A piston, automotive gear, connecting rod and coil spring that have received the WPC treatment. The MoS₂ shot process was applied to the piston skirt.

the product. This solid lubricating layer has an improved frictional resistance than a MoS₂ coating with a binder. The MoS₂ shot process is used on pistons' skirt parts, other automotive components, and bearing metal.

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- Over 5 times the life improvement for shafts (SCM)
- 4 times the life improvement for SKD11 punches

Future Prospects for WPC Treatment

WPC treatment is effectively used for automotive components and other metal components. It even extends the life of cutting tools and metal molds. This is the technology that can reduce friction, improve lubricity, and contribute to energy and resource savings by improving the surface strength of metals without making components larger and heavier.

For more information on the WPC treatment, visit www.fujimfg.co.jp/english/wpc.html. ●



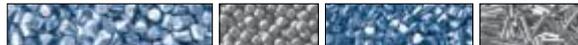

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ACADEMIC STUDY
Dr. David Kirk | Coventry University

Peening Intensity

True Meaning and Measurement Strategy

INTRODUCTION

The two most important quantitative terms for shot peeners are “Coverage” and “Peening Intensity.” “Coverage” has a single, unambiguous, definition: The percentage of the peened area that has been indented at least once. “Peening Intensity,” on the other hand, is defined in several ways. Customers identify peening intensity as being the arc height of a specified point on a so-called “Saturation Curve.” In addition, internet searches for definitions of peening intensity commonly yield “Peening intensity is the measure of the energy of the shot stream”—which is incorrect. This wrongly implies that peening intensity will increase with shot stream flow rate and therefore leads to confusion.

Having accepted a customer-specified value for peening intensity arc height, peeners must employ some sort of measurement strategy. An early definition of strategy is “a high level plan to achieve one or more goals under conditions of uncertainty.” This definition resonates with shot peeners who are constantly faced with having to balance customer requirements for specified intensity with the variability of the factors that affect intensity. An effective strategy is therefore important because the resources available to satisfy customers are usually limited.

Most jobbing shot peeners base their strategy on satisfying specified customer requirements as economically as possible. Relevant specifications, such as SAE J443, allow a range of measurement strategies. Large companies, however, may employ in-house strategies that differ significantly from those embodied in international specifications. Such in-house strategies can be very effective.

This article is essentially in two parts. The first part briefly discusses the true meaning of “Peening Intensity.” The second part considers, in relative depth, a range of peening intensity measurement strategies that are available, together with their “pros and cons.” Finally it is suggested that a combination of set-up and verification strategies offers an improved type of strategy.

TRUE MEANING OF “PEENING INTENSITY”

The true meaning of peening intensity can be expressed as: “the average dent capability of the *individual* shot particles that collectively make up a shot stream.” It does not matter,

for example, if one particle or a million particles are emerging from a nozzle per second. What does matter is the average dent capability of the individual particles. Consider the analogy of being bitten by insects. Angry wasps inflict larger bites than small midges. The average size of each bite is analogous to a peening intensity value. Peen coverage is analogous to the percentage area of skin containing at least one bite. An average wasp weighs 200 times as much as an average midge. Wasp bites would therefore have to be 200 times as large as midge bites to achieve the same coverage rate as can midges. We find with shot peening that the smaller the shot the greater the coverage rate with all other things being equal.

The following is a light-hearted exercise in parallel thinking.

Dent Size Capability of Ship's Cannonballs

Several parallels can be drawn between shot particles and cannonballs. Imagine a man-o-war equipped with three rows of cannons shown schematically in fig.1. A typical



Fig.1. Man-o-war with three rows of cannons.

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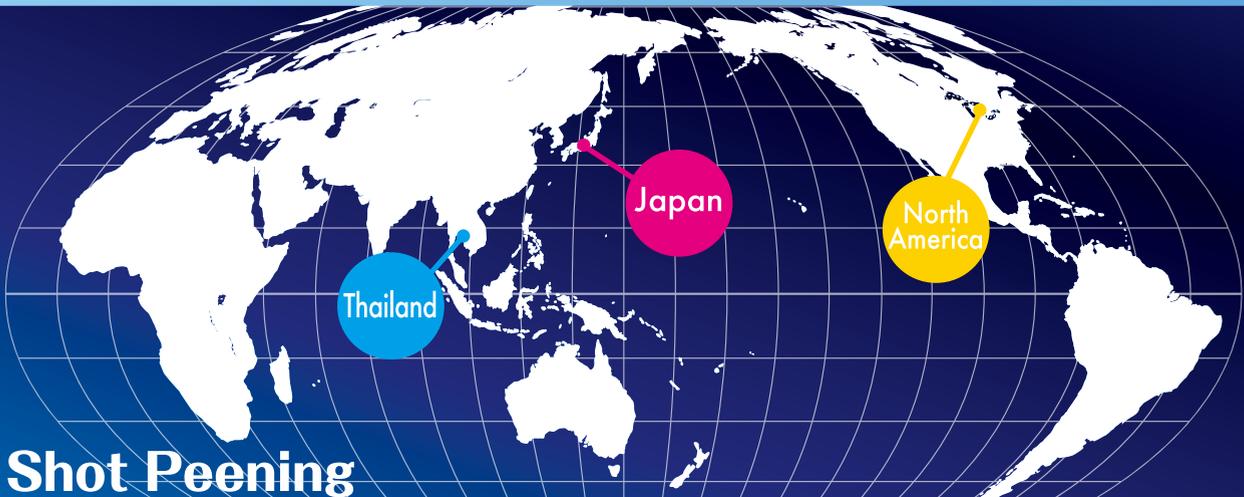


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British man-o-war would have had 42-pounder cannons on the lowest deck, 24-pounders on the middle deck and 12-pounders on the upper deck. Cannonballs weighing 42 pounds would obviously have a greater dent size potential than smaller cannonballs. We can therefore draw a parallel between this and the effect of shot size when shot peening. Larger shot has the capability of generating larger dents than smaller shot provided that it is accelerated to the same velocity.

A second parallel can be drawn between peening coverage and the effect of prolonged cannon firing. The ship's captain would have to consider both the dent size capability of individual cannonballs and the number striking his target. With prolonged firing the target would become more and more covered with dents. Coverage would depend on both the size of dents and the number of dents.

The third, most important, parallel is that the average dent size capability of a cannonball is the equivalent of the average dent size capability (aka peening intensity) of the individual shot particles in a shot stream. Dent size capability does not depend on the number of cannonballs fired nor does that of shot particles. The number fired does, however, affect coverage - which is measured independently.

Quantification of individual cannonball dent size capability was not attempted. With shot peening, however, we do have a quantitative measure of shot dent size capability—peening intensity arc height. This measure accommodates the fact that a shot stream contains vast numbers of particles. It would not be practicable to measure the dent size capability of every individual shot particle and then derive an average value.

A shot stream comprises vast quantities of flying particles. Indirect measurement of the average dent size capability was made possible by John Almen. He realized that it was not practicable to use a method based on measuring dent size. As an alternative he devised a procedure based on the curvature of steel strips induced by the dents. Other things being equal, the greater the dent size the greater is the induced curvature.

Almen's procedure has evolved greatly since it was first introduced in pre-computer days. His concept of a set of identical steel strips peened for different times yielded the familiar "saturation curve" shape for arc heights plotted against peening time. For this shape he decided that the "knee" of the curve could be used as a point for defining peening intensity (aka dent capability). Unfortunately, location of this knee point varied between peen shop operators who were not required to be expert mathematicians. Ideally every operator would have been able to settle on one particular point on the curve. The term "lowest point at which the arc height increases by no more than 10%" therefore entered the vocabulary which reduced, but did not eliminate, variation

of manual knee location. With the advent of readily-available computers, however, operator-variability of knee location can now be eliminated.

The term "knee" was introduced to indicate the region where the "sharpness" of the saturation curve was greatest. Early drawings of saturation curves exaggerated the sharpness of the knee region, making it look nearer to the shape of a human leg (in side view when sitting). Today we have the power of computers to identify one particular point within the knee region: "the point of the curve for which the arc height increases by precisely 10% when the peening time is doubled." This point, H,T, is no longer the measured arc height for a particular peened Almen strip but is a point on a curve that has been fitted to the data points. The difference is indicated in fig.2.

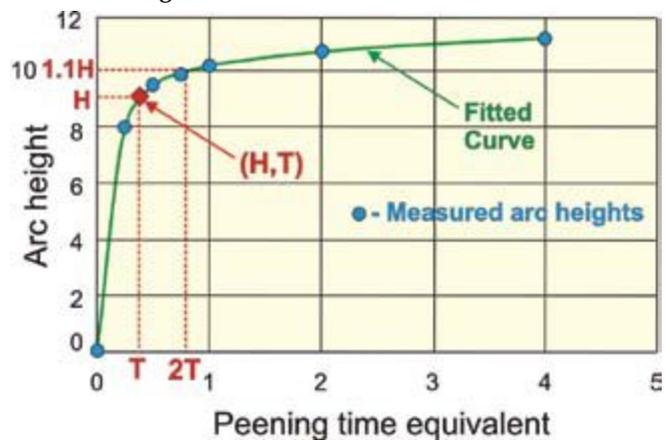


Fig.2. Derived Peening Intensity Point, H,T.

Mathematicians would argue that the point of greatest sharpness of a curve is best determined by the second differential of the curve's equation. This concept must be dismissed in favor of the "10%" point which can be more readily appreciated by non-mathematicians.

Peening intensity measurements are required for two stages of peening operations:

- (1) **Set-up** and
- (2) **Verification**.

For both stages there is a range of available measurement strategies. Within this range a strategy must be selected governed by factors such as: cost of measurement, customer satisfaction and component criticality. These factors overlap as illustrated in fig.3 on page 30.

A secondary use for peening intensity measurements is that corresponding saturation curves are an indication of shot stream stability.

SET-UP MEASUREMENT STRATEGIES

Specifications, such as J442 and J443, regulate the procedure

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Montréal is an aerospace hub and local aerospace companies have agreed to offer site visits as part of the conference. At this time, Bell Helicopter Textron, Bombardier Aerospace, Pratt and Whitney Canada and L3-Communications MAS have agreed to open their doors to conference attendees. Site visits will be included in the registration fee.

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Fig.3. Factors affecting peening intensity strategy selection.

for the estimation of set-up peening intensity. A *minimum* of four Almen strips peened for different times is allowed in order to plot a saturation curve. The actual number used is a key strategy factor.

It is important to appreciate that:

- (1) Every measurement point is subject to variability (even if the shot stream is perfectly constant—which it cannot be) and
- (2) The shot stream itself is subject to variability.

These variabilities are illustrated schematically in fig.4. This figure assumes that this particular shot stream has relatively-low variability—as compared to measurement variability—which is normally the case. A strategy involving low cost/quality Almen strips, inferior gauges and poor attention to technique will obviously introduce a greater measurement variability.

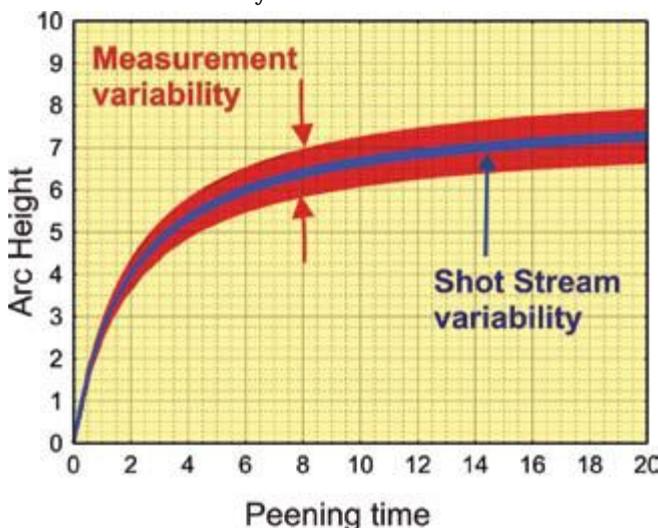


Fig.4 Schematic representation of both measurement and shot stream variabilities.

The basic elements of every set-up strategy are:

- (1) Selection of a curve-fitting program,
- (2) Deciding on the number of data points to be obtained in order to produce the saturation curves and
- (3) Using prior knowledge of similar peening parameters.

(1) Selection of a curve-fitting program

Selection has, normally, to satisfy the requirements of SAE J2597 “Computer Generated Shot Peening Saturation Curves.”

Available curve-fitting programs usually involve a fitting equation that has two parameters **a** and **b**. For example, one commonly-used fitting equation is given by:

$$h = a*t/(b + t) \tag{1}$$

where **h** is arc height, **a** and **b** are the deduced parameters and **t** is the peening time (or its equivalent).

Three-parameter equations are also available but these require more than the absolute minimum of four data points. Fig.5 shows the six-point SAE J2597 Data Set No.10 fitted using three different equations: **A**, **B** and **C** (two being two-parameter equations and one being a three-parameter equation). The second point in the data set is hidden by the derived intensity points because they are very similar.

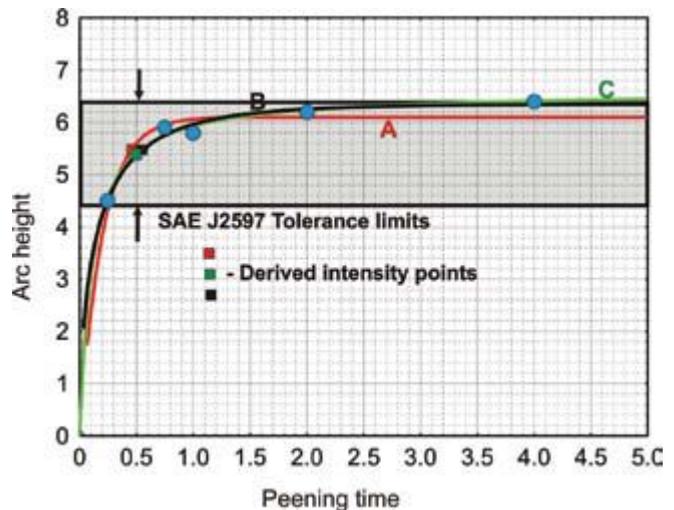


Fig.5. Different fitting equations applied to SAE Data Set No. 10.

Different fitting equations must, by their very nature, have slightly different shapes. This is evident in fig.5, where equation **A** “flattens out” more quickly than do equations **B** and **C**. A (hopefully diminishing) number of peeners cling to the erroneous belief that saturation curves should flatten out quickly. They would therefore prefer to employ fitting equation **A**. That is in spite of the great weight of evidence to the contrary about actual rates of flattening.

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SAEJ2597 “Computer Generated Shot Peening Saturation Curves” requires that a fitting equation has to be capable of deriving a peening intensity value that is within ± 0.001 inch of their published value (0.0054 in the case of Data Set No.10). This surprisingly liberal requirement is included in fig.5. All three fitting equations give derived intensity points that are both well within the required limits and also are very similar to one another. These intensities happen to be 5.49, 5.47 and 5.38 for the fitting equations **A**, **B** and **C** respectively. It is suggested that whatever computer program is used, it should be able to derive intensity values that are close to the published SAE Data Set values—not simply within the permitted range.

(2) Number of data points.

Any decision on the number of data points to be used for set-up procedures has to involve a compromise between measurement cost, customer satisfaction and component criticality. The number of data points has to be at least four in order to satisfy specification requirements. This bare minimum is normal when measurement costs must be kept to a minimum because profit margins are small. Customers would, however, have greater confidence if a larger number of data points were being used. This is particularly important for critically-stressed components. If, however, close control of every peening parameter is being exercised, the use of only four data points has greater validity.

(3) Employing prior knowledge.

Employing prior knowledge is at the heart of every intensity measurement strategy. Prior knowledge can either be stored in a shop foreman’s head or by using some form of data base. Every arc height measurement has commercial value, particularly if it is part of a data base that can filter previous measurements. Prior knowledge is used primarily for setting process parameters. Fig.6 illustrates one method by which prior knowledge can be effectively employed. This uses a Comparator version of one of the Curve Solver Suite programs (available for download at www.shotpeener.com). Assume, here, that specific processing parameters were previously employed and gave the values shown as “Reference Curve.” The same parameters were later employed in a nominally-identical set-up to give, hopefully, similar values. In this particular example the results shown as “Current Curve” and “Reference Curve” are easily compared: the saturation intensities are very similar but the corresponding “T” times are substantially different.

If prior knowledge of appropriate peening parameters is very limited, or even absent, then a preliminary two-strip set-up strategy can be employed. This strategy was described in a previous TSP article (“Two-Strip Setting-up and Verification Program for Peening Intensity”, Fall, 2010). In essence two strips are peened using a “best guess” of peening

variables. A two-parameter saturation curve is then derived. If the intensity yielded by this curve is within the required specification range then further strips can then be peened, at different exposure times, to make up at least the minimum required for a J443 saturation curve.

Prior knowledge can have other uses such as for detecting the drift of peening intensity when using a nominally identical set of peening parameters. During a long run the peening intensity of a set shot stream can drift due to factors such as shot, nozzle and hose wear. Fig.7 is a hypothetical example that shows how drift can be detected provided the measurement strategy results in a low level of measurement variability. Fig.8 on page 34 shows how drift detection would be much more difficult if there was a much higher level of measurement variability. For both figures it is assumed that a dozen repeat intensity measurements were made during a long run of peening with set peening parameters.

VERIFICATION MEASUREMENT STRATEGIES

The two types of verification measurement strategy that are

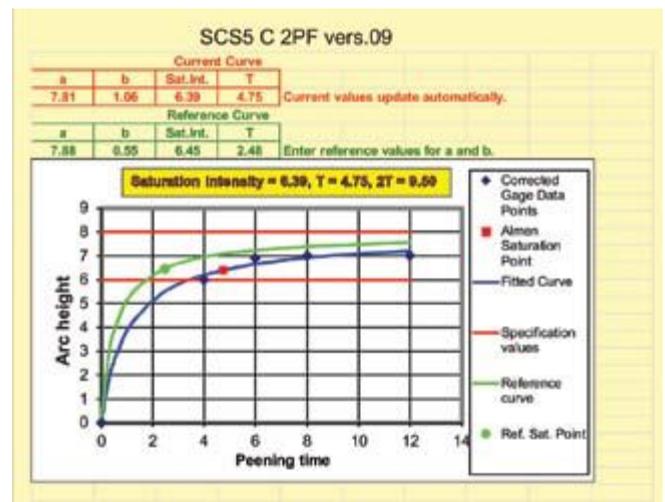


Fig.6. Comparator program illustrating difference between expected and achieved results.

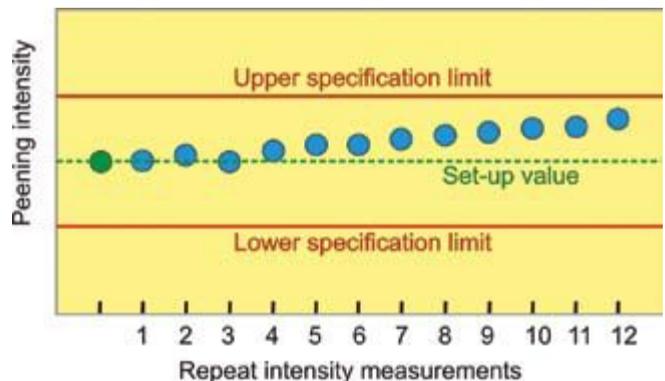


Fig.7. Repeat intensity measurements at required intervals clearly indicating drift.

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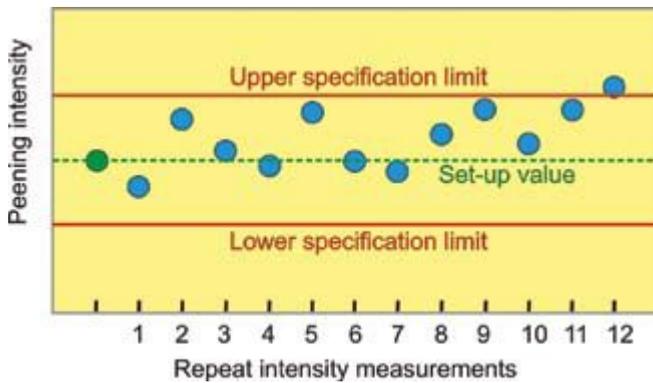


Fig.8. Repeat intensity measurements at required intervals vaguely indicating drift.

allowed in SAE J443 have been described fully in a recent TSP article (“Verification of Peening Intensity”, Fall, 2015). One type of strategy relates to single-holder situations and involves the peening of a single Almen strip. The second type of strategy relates to multi-holder situations with a single strip being peened at each holder.

Single-Holder Strategies

SAE J443 allows two single-holder strategies. The first is that the verification strip is to be peened for the time, T, of the peening intensity point that has been derived from the fitted saturation curve. This is illustrated in fig.9 (obtained using SAE Data Set No.5) where a peening intensity of 6.55 occurs at an amount of peening, T, of 4.71. If the amount of peening was controlled by time then it would be possible topeen a verification strip for 4.71 seconds. If, however, the amount of peening corresponded to integral units, e.g. strokes, then applying 4.71 strokes would not be possible. Hence a second strategy is allowed. This is that the amount of peening applied can be the nearest practicable integer to T—chosen as 5 in fig.9. The arc height being aimed at is to be derived from the saturation curve—which for 5 strokes would be 6.62. This is effectively the “target height” introduced for multi-holder strategies. Derivation of the target height can be done either using a plotted curve or can be calculated if the parameters of the fitting curve equation are known. As an example: for the Solver 2PF equation used in fig.9 ($h = a*t/(b + t)$) the derived parameters were $a = 8.01$ and $b = 1.05$ so that when $t = 5$ we have that $h = 8.01*5/(1.05 + 5)$ or $h = 6.62$.

For both strategies, the arc heights obtained must repeat the value from the saturation curve ± 0.0015 inch.

Multi-Holder Strategy

A single multi-holder strategy is described in SAE J443 for which the same amount of peening is applied to every holder. Arc heights are deduced from the corresponding fixture saturation curves for this fixed amount of peening. These are called “target arc heights.” The arc heights obtained

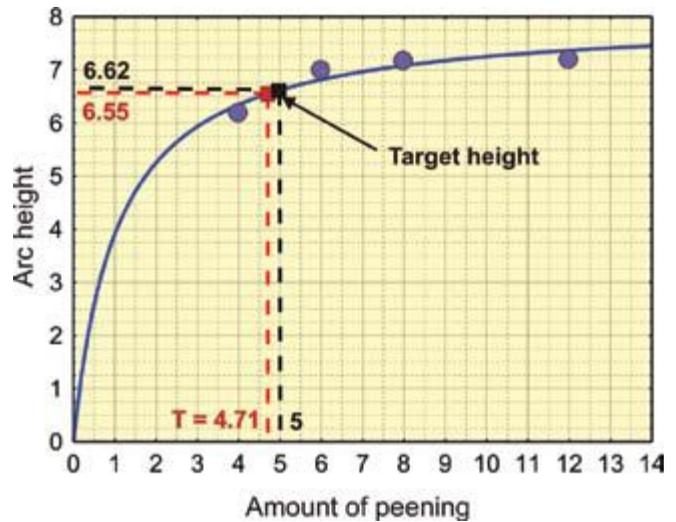


Fig.9. Single-holder verification alternatives

by peening for the fixed amount of peening must repeat the target arc heights to within ± 0.0015 inch. The selected amount of peening can be either a saturation time, T, or an integral number of strokes by agreement with the customer.

COMBINED SET-UP AND VERIFICATION MEASUREMENT STRATEGIES

A combination of set-up and measurement strategies is employed by a least one major shot peening company.

One such combination type of strategy can be summarized as:

- (1) Carry out set-up peening for the chosen number of strips,
- (2) Derive peening intensity and time, T, from the set-up data,
- (3) Determine the appropriate verification amount of peening and
- (4) Peen an additional strip for this verification amount of peening.

Fig.10 (page 34) illustrates this type of combination strategy using the same SAE Data Set as for fig.9.

The 4 points, 1, 2, 3 and 4, are obtained (not necessarily in that order) and curve-fitted. This allows the verification amount of peening to be determined. A fifth strip is then peened for this verification amount of peening. In fig.10 the corresponding arc height is shown as lying exactly on the saturation curve which would not, of course, normally be the case. The obvious advantages of this combined strategy are that (1) we can be doubly confident of the verification arc height and (2) we now have five points that yield a more reliable saturation curve than for the bare minimum four points (noting that the fifth point can be included in a recalculation of the saturation curve).

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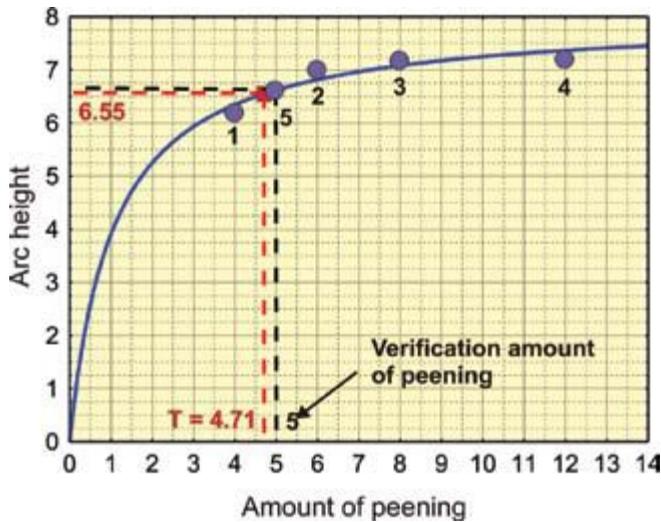


Fig.10. Combination of 4-point set-up and verification amount of peening.

A second combination strategy can be summarized as;

- (1) Carry out a preliminary two-strip set-up strategy based on prior knowledge,
- (2) Derive peening intensity and time, T, from this preliminary set-up data,
- (3) Carry out peening at times indicated from (2) for the additional number of strips required to produce an acceptable saturation curve,
- (4) Plot and analyze the saturation curve,
- (5) Determine the appropriate verification amount of peening and
- (6) Peen an additional strip for this verification amount of peening.

CONCLUSIONS

Peening intensity is a measure of the average dent capability of the individual particles that make up a shot stream. Dent capability varies from particle to particle. The established procedure of deducing the arc height at the “10% point” accurately indicates average dent capability. This procedure is, however, only part of the overall measurement strategies adopted to take account of measurement cost, customer satisfaction and component criticality.

The precision of peening intensity measurement is influenced by the several factors that are involved in an overall measurement strategy. These include quality of Almen strips and gages, gage maintenance, operator training, fitting curve selection, number of points in each data set, employing prior knowledge and verification tactics. Combining set-up and verification peening offers considerable advantages. ●





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Wheelabrator Unveils Heavy-Duty Rotary Screen

ROTARY SCREENS are an important part of the abrasive cleaning cycle in blast machines, sifting out larger chunks of debris, such as core lumps, ahead of airwash and/or magnetic separation. Yet, however essential the rotary screen may be for effective abrasive cleaning, for maintenance managers in foundries, this key piece is also a recurring bugbear.

In heavy-duty environments, rotary screens wear faster and have to be replaced more frequently. As the rotary screen sits fairly deep in the machine, replacing it is usually a major disruption to production. Maintenance time and cost caused by it can be significant.

Wheelabrator has been working closely with a foundry customer, who runs 24/7 operations, to develop a heavy-duty version of our rotary screens. With the new HD Rotary Screen we have drastically increased service life.

We used harder steels in strategic locations and introduced abrasive resistant flighting and end bands, as well



as DOM tubing. The result is an overall sturdier, stronger part with a 50-100% extended service life.

Brian Cappallo, Director of Sales and Service at Wheelabrator Plus, said: "The new HD Rotary Screen is part of our continuous efforts to make life easier for our customers and improve equipment where it matters. For our forge and foundry customers, a heavy-duty rotary screen can make a huge difference thanks to longer service life and its knock-on effects on maintenance cost and machine uptime. By improving performance and service life of every part in both machine and auxiliary equipment, we're helping foundries across America to minimize downtime and run more efficient operations."

The new HD Rotary Screen is currently in advanced testing at selected customer sites and will become available in the coming months. Go to wheelabratorgroup.com for more information. ●



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Indianapolis Motor Speedway Events Planned for US Workshop

DUE TO THE POPULARITY of these events at the 2006 US workshop, Electronics Inc. is again providing free admission into the Indianapolis 500 Hall of Fame museum and the “Kiss the Bricks” bus tour before the start of the Shot Peening Workshop in Indianapolis, Indiana. This year marks the 100th running of the Indy 500 and many improvements have been made to the track in honor of the anniversary. The track tour includes:

- Traveling the full length of the track by bus
- Recorded narration by Donald Davidson, the track historian
- A stop at the “Yard of Bricks” for photographs
- An exclusive drive through Gasoline Alley (the garages for the Indy 500 cars)

The museum tour and track tour will be on Monday, October 31 from 3:00 p.m. to 6:00 p.m. so plan your arrival time in Indianapolis accordingly. Space is limited for these tours—make your reservations as soon as possible. You can register online at www.shotpeeningtraining.com. ●



Mark Ingram, an Engineer at Electronics Inc., at the Indianapolis 500 Hall of Fame museum.



“Kissing the Bricks” is an Indy 500 tradition. (Photographs were taken during the 2006 US Workshop tours.)



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Through the years, Midwestern Industries has become known in the screening industry as “The Sizing People.” As a result of working with hundreds of processing industries, we have become proficient in developing equipment and products for handling coarse, fine, wet and dry materials.

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Midwestern Industries has a long-standing tradition of servicing the screening industry through innovative and customized screening solutions. Evaluating our customers’ needs then applying the appropriate application has been the recipe for success since founder (the late) Vern Riesbeck started the company in 1953 in Massillon, Ohio.

Mr. Riesbeck, an electrician, formed the company by supplying the aggregate industry with one product—screen-heating transformers—an electrical transformer to apply a low-voltage current to screens to reduce blinding from damp materials. Midwestern Industries continues to solve blinding by screen heating as well as developing many other innovations widely used in a variety of screening applications.



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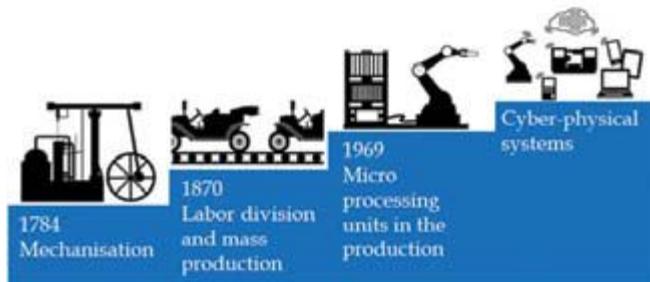
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The required automation technology is improved by the introduction of methods of self-optimization, self-configuration, self-diagnosis, cognition and the intelligent support of workers in their increasingly complex working environment. Involved components actively communicate with each other and are equipped with Artificial Intelligence. Decentralized decision making by cyber-physical systems within Smart Factories help create intelligent object networking and their cooperative organization will coin the industrial production of the future.



Evolution and revolution in production

However, how can Industry 4.0 be applied to shot blasting processes? Step by step, components of shot blasting machines are equipped with highly flexible automation technology. To begin, the RUMP refill hopper is the newest solution for automatic dosage of abrasive, making it an effective way to ensure shorter and more reliable working processes. By permanently communicating with the blasting unit, the replenishment unit avouches a constant abrasive level of different sized steel shot with optimal distribution, which in return leads to significantly more reproducible blasting results on the treated surface. Additionally, thanks to the optimized effect of the blasting media, the blasting process time is reduced by 5-10%.

Avoid Costly Process Instabilities

Often the refill process is done manually and is therefore

operator dependent, which, due to the human input, may not always be consistent. However, replenishment is done when the amount of abrasive is at a critical level or the blast wheels lack supply of abrasive, but certainly not permanently. As a consequence, the operating mixture is very fine before replenishment and afterwards very coarse and without any midsize abrasive.

A shot blasting operation that goes too long without new abrasive replenishment leads to a reduction of the average grain size and lowering of the bunker level. That greatly extends the shot blasting process, because the lack of coarse abrasive also lacks sufficient kinetic energy to remove scale deposits or sand scabs. The roughness of the blasted workpiece decreases.

Consequently, large amounts of new abrasive must be topped up and the distribution of the abrasive mixture shifts completely in the other direction—hardly any fine abrasive, and too much coarse abrasive. The shot blasting process is extended until the necessary surface coverage is reached. The roughness of the blasted workpiece is high.

The RUMP refill hopper was developed to solve these fluctuations in the abrasive mixture and the process results, respectively. It is directly linked to the control of the blasting system and provides new abrasive into the cycle so that the particle size distribution remains constant. The fill level monitor reminds the operator at right time to add a full bag of abrasive. Then the system is filled manually by pouring a complete bag of steel shot into the hopper. The refill hopper unit can be installed on virtually any blasting machine easily and with little effort. It can be situated in any optimal space where it can be refilled with ease. When doing so, the supply tube is simply connected to the abrasive circulatory of the shot blasting machine.

Conclusion

Maintaining a constant operating mix means making sure the hopper is full. And while new abrasive must be added regularly to the mix, the amount of new material added at one time should not be too much to avoid extreme fluctuations. The ability to abide by this principle actually produces a marked effect on the overall profit.

Also, the size distribution of the abrasive particles is a key factor in the quality of the surface preparation achieved by the abrasive, and should be checked regularly and kept constant. The use of smart technology therefore provides essential advantages to optimize the effect of the blasting



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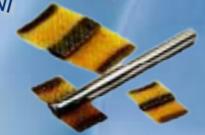
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media and helps ensure high quality of surface treatment. The reduction of the working process time implies a reduction of the production costs. It likewise improves the operating safety of shot blasting machines and paves the way to more effective shot blasting while using fewer resources.

Further Steps

At RUMP, we aim to use Industry 4.0 technologies for the upmost benefit of our customers. Therefore we install modems in the shot blasting machines which allow remote support. The shot blasting machine communicates its current status and whenever preventive maintenance or technical service is required, our service team is informed.

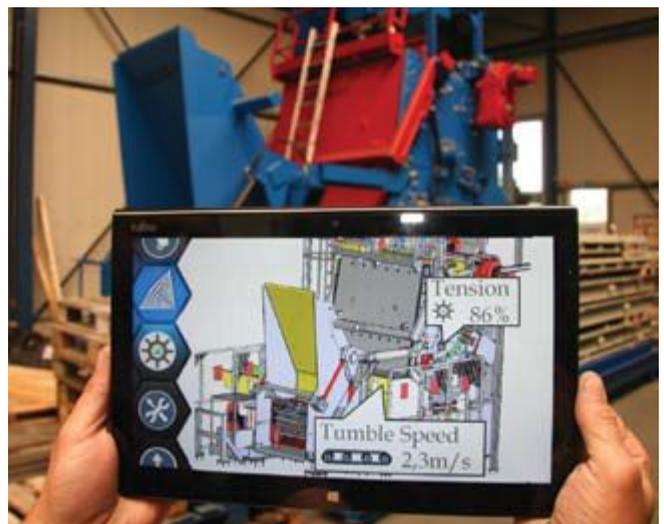
However, the technology of the future may go even further than this. We understand that improvements in the production process require data which can then be used to detect faults and failures. Accordingly, we aim to offer high-end quality service enabling the shot blast machines to make a **self-diagnosis**. Doing so, the machine gains the ability to predict failure and trigger maintenance processes autonomously. In other words, it knows when to replace

a wheel or automatically orders new abrasive. The self-awareness of the components provides the management with more insight on the status of the factory and the current operating conditions.

Another future feature is the **self-configuration**: The shot blasting machine may carry out automatic readjustments concerning the object that is to be blasted. It recognizes the shape, weight and material of the object and performs individual fine-tuning and therefore adapts the abrasive mix and the trajectory in order to optimize the blasting result. Alternatively, this data may be provided by the production system. This may greatly contribute to the efficiency of the internal logistics, as the machine can react immediately to unexpected changes in production.

Thus, intelligent support and the provision of worthwhile data is a key factor to reach just-in-time maintenance and gain zero downtime. Nonetheless, a big challenge of Industry 4.0 is and will remain the reduction of complexity of production systems and processes. Increasing functionality, customization, dynamism and cooperation between production systems make manufacturing more and more difficult to handle and to organize.

Accordingly, the only way of managing this density of individualized industrial production will be implementing decentralized control mechanisms such as more and more autonomous shot blasting equipment. In this regard, modelling plays a key role in managing highly sophisticated technological systems. Appropriate models and IT systems should be deployed in order to provide end-to-end support to the entire value chain. With RUMP and Industry 4.0, the increasing complexity of manufacturing processes will become manageable for the people who work there and a simultaneously attractive, sustainable and profitable production will be ensured. ●



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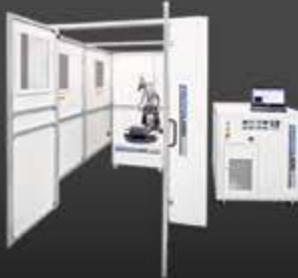
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