

The Shot Peener

Dedicated to sharing information and expanding markets for shot peening and blast cleaning industries

Shot Peening Intensity 101



- What it is
- Why it's important
- How we measure it
- What makes it so confusing—and how to get over it

PLUS:

Shot Peening Coverage Study
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Intensity Review

Intensity is one of the four shot peening process controls—intensity, media, coverage, equipment—and intensity verification is a concept that causes a lot of confusion, especially in relationship to coverage. We will explain intensity in the most basic terms. If you've never understood it before, you will after reading this review.



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Intensity Investigation

Intensity control trips up a lot of shot peening operators. This field report from a visit to a shot peening facility highlights the steps to determine why a perfectly performing process suddenly starts to miss the mark.



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Intensity Review

Definition of Intensity

Shot peening intensity is the measure of the energy of the shot stream—the energy of the shot stream is directly related to the compressive stress that is imparted into a component. It's one of the essential means of ensuring process control. (Intensity is one of four process controls. The other three are Media, Coverage and Equipment.)

How Intensity is Measured

Intensity is measured using Almen strips and an Almen gage. Almen strips are made of SAE1070 spring steel and are classified into three types based on thickness: A, N, and C. An Almen strip is peened on one side only. The residual compressive stress from the peening will cause the Almen strip to bend or arc towards the peened side. The degree of curvature is measured on an Almen gage as shown in Figure 1.

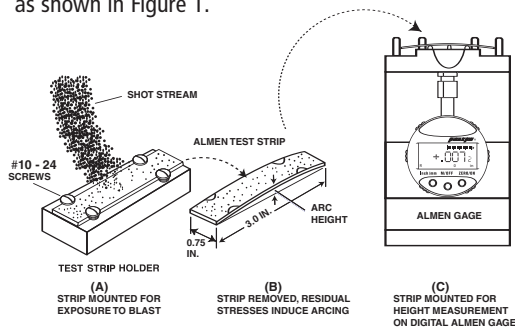


Figure 1. The Almen Strip System

The arc height, as measured by an Almen gage, is the "intensity." The proper designation for intensity is the arc height followed by the Almen strip used. For example: The proper intensity designation for a 0.012" (0.30 mm) arc height using the A strip is 0.012A (0.30A). Often, this is simplified to 12A.

Intensity Verification

Verification of the requested intensity requires the establishment of an intensity saturation curve (graphical plot of arc height versus peening time or other time-based parameter). The saturation curve is plotted with a minimum of four Almen strip arc height readings that were peened with fixed machine settings. Plotting arc heights manually is laborious and often inaccurate. Fortunately, it's also outdated. Illustrated in Figure 2 is the Curve Solver program developed by Dr. David Kirk. Enter the arc height readings from an Almen gage for at least four peened Almen strips into the program and it will compute the saturation point intensity. Figure 2 shows that doubling of the time (2T) from the initial peening time (T) resulted in less than a 10% increase in Almen arc height. This is called the "10% rule" and it means that the process reaches saturation at "T." Saturation establishes the actual intensity of the shot

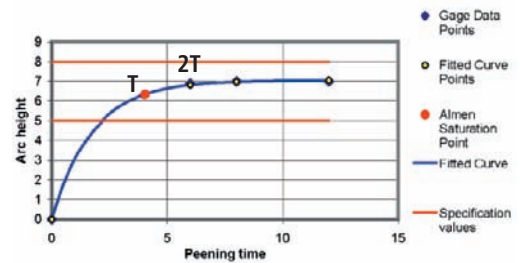


Figure 2. The Curve Solver tabulates the saturation curve. It's free from www.shotpeener.com.

stream at a given location for a particular machine setup. If the intensity is not within the requested tolerance band, then machine adjustments must be made and a new saturation curve generated. Periodic tests, at about every eight hours of operation, should be performed to confirm consistent peening intensity. Since preparation of a saturation curve is time-consuming, a simpler method for verification during periodic testing has been adopted. Simply run one Almen strip for the same peening time "T" that was derived from the saturation curve. Using the example above, the strip would be peened for 4.8 minutes. Any arc height within the range of .005 to .008 would be acceptable for the verification test.

A new saturation curve is required if a new part or setup (a change in machine settings or media) is employed. Read the "Intensity Investigation" article on page 6 to see how the machine and media affect intensity.

Saturation versus Coverage

By far, the concepts of saturation time and coverage cause the most confusion for new and experienced shot peening personnel. First, a definition of coverage: Coverage is the measure of the original surface area that has been obliterated by shot peening dents. If the goal is "100% coverage", the length of machine cycle time to achieve 100% coverage will differ based on the hardness of the material to be peened. Looking at Figure 2, it's easy to see why people get confused about the proper machine cycle time. According to this chart, the saturation point for the arc height (intensity) was achieved at around 4.8 minutes of **peening time**. Do not dwell on this number. Peening time is not the machine cycle time, it's only a graphical tool to establish intensity. Do NOT use it for determining machine cycle time for full coverage.

Intensity is controlled by the machine and media factors that influence the energy of the shot stream. Coverage is controlled by machine cycle time. Saturation intensity and coverage will not necessarily occur at the same time but that is okay. ●

Additional Study Tools

This review is a very elementary discussion on intensity. If you are interested in learning more about shot peening process controls, attend an Electronics Inc. Education Division workshop or schedule on-site training. Contact EI at 1-800-832-5653 or (574)256-5001.

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Intensity Investigation

The Electronics Inc. staff is often called upon to solve shot peening mysteries. The usual villain is a lack of intensity control. Intensity control problems have many sources and the most common are:

1. A lack of understanding of the intensity measurement process
2. Poor media management
3. Equipment maintenance issues

The following field report from an in-house shot peening shop visit has a sampling of problems in each area.

The Mystery

"We can't get our intensity level up to the expected 15-18A intensity range requested by our customer. We used to get it but now we can't. We have a two-wheel machine and we're using cut wire media. We peen the inside surface of a large cylinder. Can you come over and help us?"

The Investigation

The lead investigator for this case was Jack Champagne, President of Electronics Inc. and Editor of *The Shot Peener* magazine. The following is a recap of his field report.

The shop had processed this type of part for a long time and they had performed periodic "intensity checks". I put intensity checks into quotation marks because they never ran saturation curves.

Clue: The industry-standard tool for determining intensity is an Almen saturation curve. Almen strips exposed to the blast stream for only one exposure time are not sufficient to qualify intensity levels for new set-ups.

The company's intensity checks were based on exposure of five strips mounted on a vertical stalk, using the cycle time as the exposure time. I explained the concept of Almen saturation curves and interpretation using the 10% rule and then had them run a proper saturation curve. As expected, the intensity was low, about half of what was needed. But now I had a profile of the current settings and could proceed with my investigation.

I focused next on the media. Since the media was cut wire, I expected to see spherical particles of about the same size. I gathered samples of new media, in-use media and discarded media. The customer did not have a Ro-Tap machine and sieves so I had to wait until I returned to Electronics Inc. to perform a size analysis. However, observation of the media at the site strongly suggested that there were too many smaller sizes in the media mix.

Clue: Intensity will be decreased when using smaller media because smaller media has less mass and impact energy. This makes media management a crucial contributor to intensity control.

Even with this evidence, I wasn't convinced that undersize media was the only deficiency in the quest for a higher intensity. The wheel speed was running at maximum-rated RPM so I couldn't get any more velocity with that adjustment. A quick look at the wheel blades showed some wear but it wasn't excessive. As I pondered the situation, I was told that the blades had been recently replaced. That sounded like a good clue. Then I was told that the wheel liner was also replaced since it showed excessive wear. Okay. Now we're on to something.

Here's what I discovered: During a recent wheel maintenance, the control cage was re-installed at the wrong position. Media was being introduced to the blade prematurely and therefore it was sliding off of the blade inside the wheel housing, causing excessive erosion of the wheel housing liner. The media would then bounce off of the liner before hitting the target (often called the "hot spot") and Almen strips. This condition often moves the hot spot and also reduces the media intensity by about one-third.

I inquired about the cage position and was told that the target misalignment had been noticed but moving the cage seemed to move the hot spot in the wrong direction. Instead of moving the hot spot up with a clockwise adjustment to the control cage, the hot spot moved lower. This can occur when the media

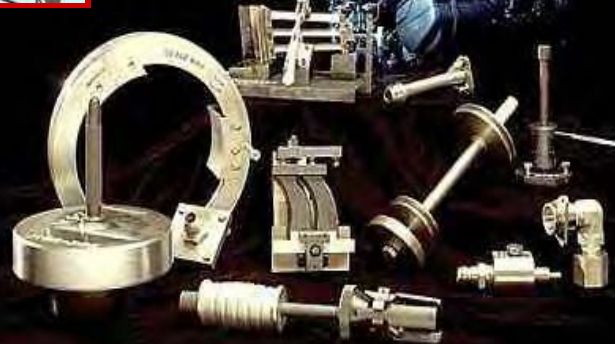
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is hitting the wheel housing liner. So, pieces of the puzzle seemed to be coming together. Readjustment of the control cage was a major contributor to the low intensity problem.

Clue: Consistent and repeatable intensity requires consistent and repeatable machine functions. For example, blast wheels are always mounted in a permanent and rigid location in the blast cabinet. Altering the control cage settings will change the point of blast media discharge from the blast wheel and change the intensity.

But what caused someone to adjust the control cage in the first place? I'm guessing it was probably the low intensity due to undersized media that started the downward spiral. I also learned that the on-machine screen separator had not been inspected recently and it might have been malfunctioning or the screen was not the correct size. By malfunctioning, I mean that the shaking was not proper or that the screen could have been clogged with media trapped in the mesh, thus preventing undersized media from being discharged. Since there were no periodic media inspections with Ro-Tap and sieve screens, there was no awareness of defective media conditions.

So, in addition to the importance of conducting saturation curves, what else can we learn from this investigation? Well, let's consider the machine cycle time. No one seemed to know how it was selected. No one was aware of how to determine 100% coverage. (Dr. Kirk's article on page 24 of this issue is an excellent primer on coverage.) My inspection of peened parts revealed that they had certainly attained at least 100% coverage and much, much more, to the possible detriment of the component.

None of the problems that I encountered at this facility were uncommon. Many companies do not know the variables that affect intensity or know how to conduct a saturation curve. Correcting these problems isn't difficult. I typed up my findings and list of recommendations that included a proper coverage determination, periodic media size and shape inspections and adherence to the appropriate specification (some projects still refer to MIL-S-13165. MIL-S-13165 has been cancelled and replaced by AMS-S-13165. AMS-S-13165 has been cancelled and replaced by AMS 2430). To get up to speed on intensity and coverage, I suggested that my friends acquire copies of SAE documents on both intensity (SAE J443) and coverage (SAE J2277) and send their managers and operators to Electronics Inc. shot peening workshops.

Education is the only defense against shot peening misdemeanors. ●

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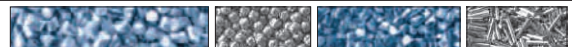
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A Passion for Innovation

Intertape Polymer Group and SONACA Wichita

Once in a while an innovation comes along that is so brilliant, so practical, and solves a problem so effectively, that it becomes the standard. Intertape Polymer Group™ (IPG) BT Series Shot Peening Tape is that kind of innovation.

Intertape is a leading manufacturer of a comprehensive range of tape and film-based products including blast tapes. SONACA Wichita, located in Wichita, Kansas, is one of the many customers realizing the advantages of using Intertape BT100 & BT-146 die cuts in their operation. SONACA is a worldwide leader in the development, manufacturing, assembly and testing of aerospace structures and associated subsystems. The Wichita location manufactures integral stringer and conventional wing skins for many of the major aircraft manufacturers.

A Customer's Challenge

SONACA was using multiple layers of duct tape to mask off sensitive areas of the wings during the shot peening operation to protect those areas from incurring any damage from the blasting process. Once the shot peening process was completed, the duct tape was removed. The process of masking off multiple layers of duct tape and the subsequent removal of the duct tape was a very time-consuming process. Additionally, the duct tape would become brittle and shred into tiny pieces, making it very difficult to remove cleanly after the shot peening process. In most cases, the adhesive residue left behind from the duct tape had to be cleaned from the wing surface, creating an additional labor intensive and time-intensive step in the process.

A Solution to the Challenge

Intertape™ BT100 is a 43-mil thick durable rubber-based product coated with advanced water-based acrylic pressure-sensitive adhesive. Applying the 43-mil thick BT100 product allows for maximum blast / peening time at up to 100 psi. Special rubber allows BT100 to conform tightly around curves and uneven surfaces. The high-tack qualities of the adhesive bonds quickly to clean surfaces to produce a seal that prevents media / peening intrusion.

One of the key attributes that impressed SONACA was the clean removal of BT100 following the shot peening process. It was easily peeled away in one piece without the use of messy solvents or manual "picking" required to remove the product or adhesive residue left behind.

A Demonstrated Cost Savings

SONACA was so impressed after the initial trial and product demonstration that they immediately placed an

order for BT100. They embarked upon an internal cost analysis to verify their intuitive feeling that BT100 would provide both cost and process savings. Although BT100 is more costly from a material standpoint versus duct tape, the productivity enhancements and labor savings benefits far outweighed the material cost. The primary indicator was daily throughput, measured in units per day. As a result of the time savings they achieved by applying BT100, SONACA lowered the cost per unit and increased their production output with no capital expenditure or increase in labor.

Advancing the Solution

In the pursuit of continuous improvement, SONACA discovered that many of the areas on the wing requiring protection from the shot peening process were odd shapes and sizes so to save time in the masking process, they began hand-cutting the BT100 into specific die cut configurations. They soon learned that Intertape's BT146 is identical to the BT100 tested by SONACA except for one feature – BT146 has a polyester liner where the BT100 uses a paper liner. The polyester liner used on BT146 is better suited for die cutting



Intertape Polymer Group's masking products

because the die cut material can be removed from the liner and applied in less time. As a result, SONACA achieved additional productivity enhancements.

"The application of Intertape BT100 tape, as well as our development of numerically controlled precut mask kits using BT146, have reduced our masking labor requirements by as much as 70%. The use of these Intertape BT Series Shot Peening tapes has resulted in improvement in the quality of our products and an increase in customer satisfaction as the result of improved installation "fit." The product compliments our process perfectly," states Scott Bong, Director of Operations for SONACA Wichita.

A Passion for Innovation

Clever design, innovative thinking and attention to detail combine to provide world class solutions. Intertape Polymer Group and SONACA Wichita...two manufacturers focused on innovation and technology come together with a great story demonstrating how working together and sharing excellence is a winning strategy.

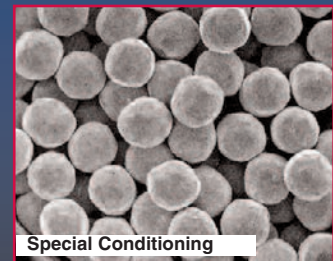
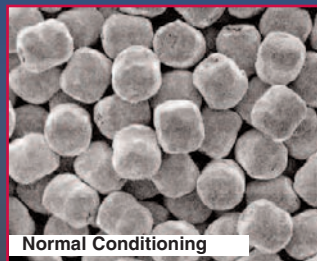
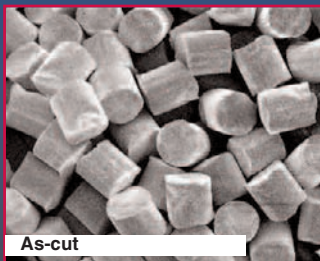
For more information on Intertape Polymer Group shot peening masking products, contact Cindy Stoner, Market Manager, at (901)486-3323. To learn more about SONACA Wichita, go to www.sonacawichita.com. ●

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Eileen LaCova

First Woman to Receive Level III Certification

Shot peening is a good field for women and many women have attended the Electronics Inc. shot peening workshops to further their careers as shot peening operators, researchers and managers. Several women have passed Level I and II shot peening exams. Eileen LaCova is the first woman to have passed the Level III exam. To pass Level III, a workshop attendee must be proficient in supervision topics, audits, advanced shot peening techniques, advanced troubleshooting and advanced shot peening theory.

Ms. LaCova is an Assistant Quality Manager and the Manager of the Shot Peening Department for Lawrence Ripak Co., Inc. in New York state. Lawrence Ripak provides nondestructive testing and metal finishing services. Ms. LaCova's job responsibilities fall into two categories: Shot Peening and Quality Control.

In Shot Peening, Ms. LaCova generates part-specific shot peen technique sheets, reviews aerospace Prime shot peen specifications and incorporates new requirements into internal procedures, assists Prime aerospace auditors in completing their checklists, prepares for Nadcap audits, quotes pricing on shot peening, trains and certifies shot peening personnel, controls the shot peening calibration system, orders all shot peening materials and controls the inventory, works as a flapper (roto) peening certified operator and oversees the shot peening department.

Ms. LaCova is also on the SAE AMEC committee and attends meetings twice a year to help revise and improve surface enhancement specifications.

In Quality Control, Ms. LaCova plans reviews, reviews and signs final processing certifications, provides specification reviews and incorporates new requirements into internal procedures, accommodates auditors for numerous processes, schedules and assists Government Source Inspections, receives and verifies certifications provided for various NDT and prime and paint materials and reviews prime chemical processing specifications and incorporates them into internal procedures.

When asked how she chose a career in shot peening, Ms. LaCova responded: "Actually, I didn't choose it, it chose me. It wasn't planned. At first, I was



Jack Champaigne, Electronics Inc. Education Division, congratulates Eileen LaCova on passing the Shot Peening Level III Certification Exam.

in a clerk position for a shot peening facility. For the first year of employment, I reviewed purchase orders, filled out shop travelers and typed certifications. I was then promoted to Quality Manager where I dedicated myself for 10 years to reading blueprints, writing shot peen techniques, masking parts and sometimes even running machines and manually peening parts. I was also performing nitral temper etch, magnetic particle and penetrant inspection as a Level II technician. Eventually, shot peening became my primary responsibility. Four years ago, I joined Lawrence Ripak. I have developed their shot peening department and had the opportunity to design two shot peening machines for the company."

As you can see from Ms. LaCova's career path, her on-the-job-experience, dedication and hard work prepared her for a rewarding job in shot peening. The Electronics Inc. staff met Ms. LaCova at her first of three shot peening workshops. At the first, she achieved Level I and II certifications. At the second workshop, she passed the difficult Level III certification and she obtained Flapper Peening certification at her third workshop.

"I must emphasize the usefulness of the shot peening workshops. I strongly recommend that anyone in this field utilize these workshops as they are a prime tool for obtaining the newest technology and latest requirements," said Ms. LaCova. In addition, after she introduced the shot peening process to the Lawrence Ripak Company, it was her desire to become certified since certification would eventually become a requirement by the Prime aircraft companies and Nadcap.

"It's not convincing enough to say 'I have 14 years experience.' It could also mean 'I have one year of experience 14 times.' I felt I needed to prove my experience, knowledge and capabilities by obtaining the certifications. With many thanks and appreciation to my current employer, Lawrence Ripak Jr., I now hold these certifications," said Ms. LaCova. ●

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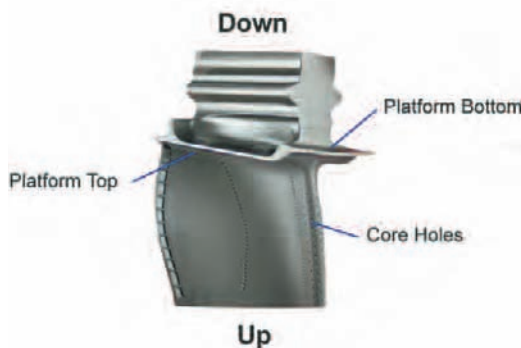
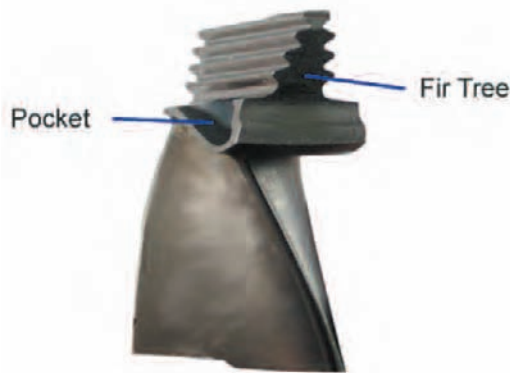
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Anatomy of a Turbine Blade Mask

We look at upside-down drawings and describe the top of the blade platform when it's really the bottom. This is what it's like to work with turbine blade masking. We work primarily on the "bottom" section of the blade when it's held upside-down in the shot peening machine. The upside-down world of turbine blade masking for shot peening requires communication between the blade manufacturer, the shot peening provider, and a masking company like ours, Maxol Studios, LLC. The following is a description of some of the elements and their names. We start with general turbine blade geometry and then move to the parts of a mask.



Blade



Boot: The rubber mask designed to hold the blade in the shot peening machines, turret, carrier or satellite. The boot holds the exposed fir tree of the blade in the focal point center of the shot peen blast, while protecting the actual blade.



Registration Dams: Provide general alignment of two-part boots and, most importantly, stop shot from penetrating into the mask.



Well: Wells are created to add life to a boot. By lowering the bottom of the blade platform into the boot, more boot material is allowed to abrade before an over-spray condition will occur.



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Shown right: Wheelabrator Model® LGA-08 Landing Gear System, picture courtesy of Hawker Pacific Aerospace

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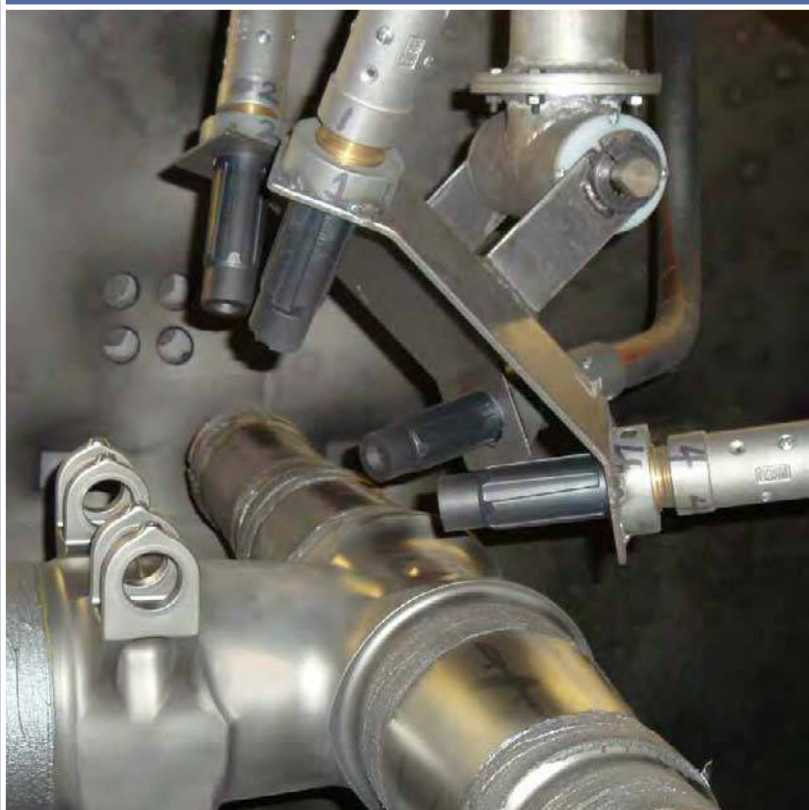
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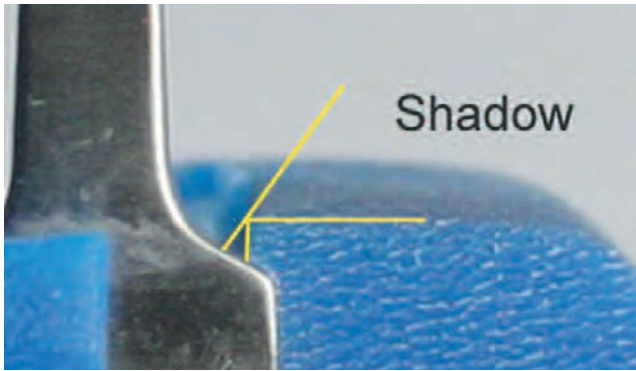
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Shadow: Measure of the depth of the well. If the depth of the well is too high, an under-spray condition will occur due to the shot's inability to get into the corners.



Parting Line: Where two boot parts meet. Typically along the center plane of the boot. Usually quite undulated to follow the complex surfaces of a turbine blade.



Core Sleeve: A thin flexible and reusable rubber glove that covers all the blade with no seams for shot to penetrate. The glove protects the blades inner cores.



Self-Locking Registration: A molded in detail that mechanically holds two parts together. Usually in the form of a "snap".



Compression Clip: A mechanical device that applies compressive force along a parting line. The clip is pressed into the masking boot holding the blade tightly in place.

Skeleton: A molded rigid plastic inner structure that holds the flexible rubber mask elements in place.



By defining and naming some of the elements that make up a shot peen turbine blade mask, Maxol Studios, LLC, hopes to create an open dialogue about mask anatomy and invites

comments, additions, and or corrections. You can contact Maxol Studios LLC by email via mark@maxolstudios.com or by visiting the website at www.maxolstudios.com. ●

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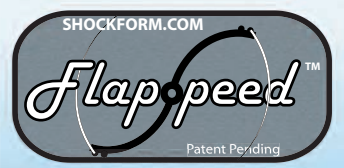
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Back to Basics: Choosing the Right Media

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Call Herb Tobben at 636 239-8172 or submit your request online at www.clemcoindustries.com. Herb Tobben is Sample Processing Manager for Clemco Industries Corp. He is a regular speaker at the EI Shot Peening Workshop.

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Over the past few months, we've all become painfully aware that bullish times are behind us for a while. And thanks to this new cycle, we recognize that along with it comes the need to think differently. We need to make better choices because the choices we make do matter. We're all trying to do more with less and to figure out how to be more efficient. This new way of thinking has a lot of relevance to the blasting business.

For the purposes of this article, we'll take for granted that our customer is going to choose the right equipment, which will be a blast cabinet or blast room—although some customers may need to be reminded that an efficient operation requires efficient equipment as well as an efficient process to deliver the benefits to the bottom line. Buying the least expensive equipment is not always the economical choice. And something as simple as choosing the right media for the job can make an enormous difference.

Every once in a while, it doesn't hurt to revisit even the most basic of principles, and I think now is an appropriate time. How do we choose the right media? Because the sizes and types of surfaces to be blasted are varied and range from small medical devices to enormous earthmoving equipment components, media is not one-size-fits-all. The important considerations are:

- The surface, its composition, hardness, etc.
- The goal of the surface treatment process—paint removal, rust removal, improving surface appearance, shot peening, prep for painting, plating, or bonding.
- The shape and size of the surface.
- The specific requirements of the process that will follow blasting, such as the profile necessary for a specific coating.

Blast media come in many types, sizes, and shapes, all of which are appropriate in different circumstances.

Type:

Media ranges from natural, non-aggressive, soft material to manufactured plastics, glass beads, steel shot, steel grit and aluminum oxide to extremely hard and aggressive silicon carbide.

Size:

Media size is measured in standard sieves, and is described as certain mesh sizes. Mesh refers to the number of openings per square inch in the sieve. The higher the mesh number, the smaller the particle. Media size can also be expressed in microns. Micron refers to the actual size of the particle, so the higher the number the larger the particle. Some media manufacturers label the material in a range of sizes, for example, 20/40 mesh, which will include mostly particles within the specified range, with some particles larger, and some smaller.

For most applications, a working mix of media is used to achieve the desired result. This working mix represents the average media size that results from adding new media to media that has been through a number of cycles. The blast process fractures particles upon impact with the surface, breaking them down to a smaller size. The smaller size will carry less force to the surface and produce a different finish. So, to achieve good results, companies will closely monitor the surface and establish a process to add a certain amount of new media at determined intervals.

It's important to note that larger particles do not necessarily do the job faster. They may cut more deeply or produce a greater indentation, but there will be

Abrasives Characteristics Comparison

Material	Mesh Size	Shape	Density lbs/ft ³	Mohs	Friability	Initial Cost	No. of Cycles	Per Use Cost	Source	Typical Applications
Sil. Sand †	6-270	★	100	5.0-6.0	high	low	1	med.	nat.	Outdoor blast cleaning
Min. Slag	8-80	★	85-112	7.0-7.5	high	med.	1-2	med.	b-p	Outdoor blast cleaning
Steel Grit	10-325	★	230	8.0	low	high	200+	med.	mfg.	Removing heavy scale
Steel Shot	8-200	●	280	8.0		high	200+	low	mfg.	Cleaning, peening
Al. Oxide	12-325	★	125	9.0	med.	high	6-8	med.	mfg.	Cleaning, finishing, deburring, etching
Silicon Carbide	12-325	★	110	9.5	med.	high	5-6	med.	mfg.	Surf. prep on extremely hard substrates
Glass Bead	10-400	●	85-90	5.5-6.0	med.	med.	8-10	low	mfg.	Cleaning, finishing
Plastic	12-80	★	45-60	3.0-4.0	low/med.	high	8-10	med.	mfg.	Paint stripping, deflashing, cleaning
Wheat Starch	12-80	★	45	3.0	med.	med.	12-15	high	mfg.	Paint, adhesive removal; composites
XL-Corn Hybrid Polymer	16-60	★	45	3.0	low	high	14-17	med.	mfg.	Composite paint removal, adhesive deflash
Corn Cob	8-40	★	35-45	2.0-4.5	med.	low	4-5	low	b-p	Removing paint from delicate surfaces

★ = Angular ● = Spherical nat. = Natural b-p = By-product mfg. = Manufactured
 † Consult OSHA regulations before using silica sand as a blast abrasive.

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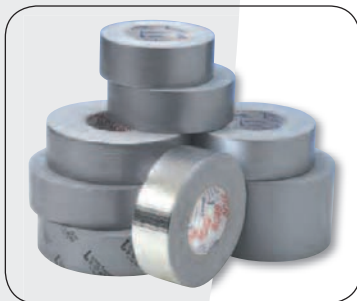


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fewer particles exiting the nozzle or blast gun and hitting the surface, producing areas that are not blasted.

Just as I do in the lab, you should try a variety of sizes to determine what produces the results you are seeking.

Shape:

Media shapes vary and produce different surface effects. Round particles for shot peening create a dimpled effect, and when used for cleaning, do so by impact. Angular particles make defined peak-and-valley patterns, and actually clean by cutting the surface. Angular media may have a variety of configurations, varying in aggressiveness. Other media are oblong.

Density:

Density refers to the mass of the particle or the weight for a specified dimension, usually cubic foot. Glass beads are about 90 pounds per cubic foot, yet steel grit weighs 250 pounds for the same volume. It's true that among the varying media characteristics, density is frequently less important; however, it is critical to match the media to the substrate, as dense media on a thin substrate will distort the surface, damaging it.

Friability:

The friability characteristic has to do with the breakdown rate, which dictates the number of cycles or wear life of the media. The friability of media can be determined by its composition, hardness, and brittleness. Most manufactured media is recyclable. Glass bead, aluminum oxide, steel, and plastic are reusable. Natural media, such as sand, is so friable that it pulverizes in its first pass, creating an extremely dusty work chamber. For this reason, it becomes immediately obvious that sand is a poor choice for blast cabinets and rooms. For safety sake, silica sand should not be used for blasting, due to the free silica that is released upon impact which can cause a fatal lung disease.

Hardness:

The hardness of the media affects its friability as well as its effect on the blast surface. Most media are hardness-rated on the Mohs' scale, which goes from soft, rated 1 (talc), to hard, rated 10 (diamond). Plastic media is rated between 3 and 4; glass bead about 5.5 to 6; steel grit or shot is about 8 (usually measured on the Rockwell C scale); aluminum oxide between 8.9 to 9.2; silicon carbide is about the hardest, coming in around 9.5. The application will dictate whether you want to choose a media softer or harder than the surface being blasted. Media softer than the substrate will not alter the surface. Whereas, media harder than the substrate will alter the surface.

Wear Life:

It is very difficult to make any definitive statement about the number of uses for particular media, because so many factors affect wear life. These factors include air pressure, surface hardness, stand off distance from the part surface, operator skill, angle of impact and most importantly, the efficiency of the reclaiming equipment. Inefficient equipment or improper air flow can send perfectly good media into the dust collector. The chart that accompanies this article lists a general estimate of the number of uses, but a reputable media supplier or firsthand experience will prove to be your best reference.

As you can see, there are many reasons why one media is better than another for a particular application. And it is crucial to carefully evaluate your needs, make sure your compressor and reclaiming equipment are efficient and operating as designed, and your operator is well-trained. Media is a consumable and sometimes quite costly; therefore, ensuring you choose well and get as many uses from it as possible will save you time and money. There's no time like the present to check out your operation and make sure you are operating at peak efficiency. ●



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Shot Peening Coverage: Prediction and Control

INTRODUCTION

For both peeners and customers, coverage is of vital importance. Our central problem is to be able to predict and control coverage so as to reach a specified level. It is not sufficient, however, to reach the specified coverage at just one location. Different locations, subject to greater amounts of peening, would then suffer excessive peening. An efficient, quantitative procedure for coverage prediction and control should be applied at several locations leading, if required, to 'coverage maps' for components. Two basic problems can be associated with coverage prediction and control:

- 1 Specifying and achieving a required level of coverage and
- 2 Specifying and achieving a required distribution of coverage.

This article concentrates on the first problem but includes the second as 'coverage mapping'. The next article in this series concentrates on the second problem but utilizes the procedures proposed to solve the first problem.

Specifying a required level of coverage is a necessary starting point. Unfortunately, the only logical feature of coverage specification appears to be its definition: "Coverage is the percentage of a surface that has been indented at least once". With that as a definition, it appears absurd to talk of factors such as "200% coverage". 100% coverage is impossible to either measure or guarantee for a finite component. All theoretical and practical evidence points to an exponential approach to 100% coverage as the amount of peening is increased. True 100% coverage is possible for a small component, as a statistical freak, but is the exception rather than the rule. It is, on the other hand, reasonable to specify a predicted level of coverage – so long as that level is less than 100%. An alternative target level is the so-called "Full coverage" which is defined as 98% actual coverage.

Achieving a specified, quantified level of coverage at a particular point is possible. It is proposed that such achievement should be based on multiples of the amount of peening

required to achieve a modest, easily-measured level of coverage. The principles underlying this approach are described together with simple computer programs that carry out all necessary calculations and graph plotting.

CAUSE AND EFFECT

Coverage is a classic case of 'cause and effect'. It is caused by impacting shot particles producing a near-random array of indentations. This generates the effect that components are covered, to a greater or lesser extent, with indentations. The extent of the coverage is the subject of specifications such as SAE J2277.

Coverage, our basic 'effect' parameter, is defined as:

C% = the percentage of a surface that has been indented at least once

The ratio of total indent area to target area, **Ar**, our 'cause' parameter, is given by:

Ar = Total indent area/target area.

The difference between the cause and effect parameters is illustrated in fig.1. This shows a model of randomly-distributed circular indentations - equivalent to a photograph of a selected peened area. The corresponding coverage, **C**, happens to be 63% (confirmed using image analysis). The total area of the indentations within the square excluding overlapping is the same as the area of the square. Hence the indent area ratio, **Ar**, is **1.0**.

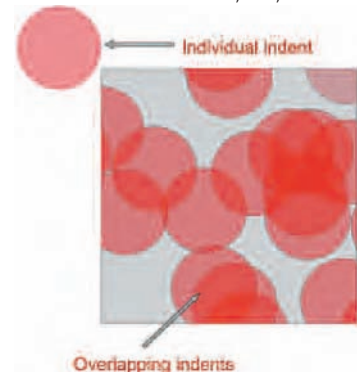


Fig. 1. Model of 63% coverage created by randomly-distributed circular indentations.

Dr. David Kirk is a regular contributor to *The Shot Peener*. Since his retirement, Dr. Kirk has been an Honorary Research Fellow at Coventry University, U.K. and is now Visiting Professor in Materials, Faculty of Engineering and Computing at Coventry University.



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The causative parameter, **Ar**, may be appreciated more readily from the following analogy. Twenty identical bombs are dropped randomly onto a target area of 2000m². Each bomb produces a circular crater of 100m². We therefore have 2000m² of craters produced within the target area of 2000m². The ratio of crater area to target area is therefore equal to **1** (2000m²/2000m²). Aerial photography indicates that about 63% of the target area has been covered by craters (as per Fig.1). A second, identical bombing of the target area is carried out - resulting in about 86% coverage - with the ratio of crater area to target area now equal to **2** (4000m²/2000m²). This analogy illustrates the factor (**Ar**) that governs coverage control: total area of craters divided by target area.

The ratio of total indent area to target area, **Ar**, may be regarded as the amount of peening that has to be done per unit area in order to cause a corresponding amount of coverage. It is a simple linear function of our basic peening variables: average area of individual indents, number of indents per unit area and time of peening. That means, for example, that doubling the time of peening (by either doubling the number of passes or halving the traverse speed) doubles **Ar**.

RELATIONSHIP BETWEEN Ar AND C%

Prediction and control of shot peening hinges on the relationship between **Ar** and **C%**. Equation (1) gives us the established relationship between coverage and indent ratio, **Ar**.

$$C\% = 100[1 - \exp(- Ar)] \quad (1)$$

where: **C** = coverage and **Ar** = ratio of total indent area to target area.

Coverage increases as **Ar** increases. The rate of increase falls with increasing **Ar**. Fig.2 shows the exponential shape of equation (1). Two particular **Ar** ratios, **Ar** = 1 and 4, have been highlighted. If, for example, one pass imposed an indent ratio of 1, we would predict 63% coverage. An indent ratio of 4 would give a predicted 98% coverage. 98% coverage is specified as “full coverage” in J2277.

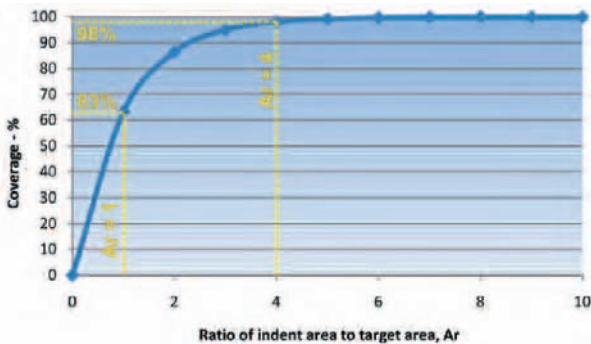


Fig.2 Exponential variation of coverage with ratio of indent area to target area.

Table 1 gives the coverage values shown in fig.2 for corresponding integral values of **Ar**. Coverage values are quoted to three decimal places even though such precision has no practical significance. We cannot measure coverage to three significant figures – they are included purely to indicate that 100% is never reached.

Table 1. Coverage, **C**, for Integral values of Indent Ratio, **Ar**.

Ar	C%	Unpeened - %
1	63.212	36.788
2	86.466	13.534
3	95.021	4.979
4	98.168	1.832
5	99.326	0.674
6	99.752	0.248
7	99.909	0.091
8	99.966	0.034
9	99.988	0.012
10	99.995	0.005

The unpeened percentages (100-C%) have been included in Table 1 as they can be used to explain why 100% is never reached. After applying one pass imposing an **Ar** equal to 1 then 36.788% has not been peened. A second identical pass will peen only 63% of that unpeened 37% (in round figures) – leaving 37% of the 37% unpeened which equals 13.5%. A third pass leaves 37% of that 13.5% unpeened or 5%, and so on. We will always have some material unpeened, however small a percentage.

FULL COVERAGE AND Ar

Full coverage is defined in J2277 as being equivalent to 98% actual coverage. This sets a realistic target for coverage as it is almost impossible to measure coverages higher than 98%. Full coverage is achieved when an indent ratio of 4 is reached – as indicated in fig.1 and Table 1. We can impose an indent ratio of 4 either in a single pass or by repeating a number of identical passes. Both approaches require that at least one coverage measurement is made. This measurement can then be used to adjust peening parameters so as to give ‘full coverage’.

Solving for **Ar** using one coverage measurement is simplified by using equation (2) which is just a re-arrangement of equation (1):

$$Ar = - \ln[(100 - C\%)/100] \quad (2)$$

where **ln** stands for natural logarithm.

If, for example, we measure coverage after a single pass as being 39% then substitution into equation (2) shows that **Ar** equals 0.5. In order to impose an indent ratio of 4 we therefore need to either use 8 identical passes over the same area or to increase the effective flow rate eightfold.

Manual calculation of the number of passes needed to achieve ‘full coverage’ can be avoided - either by using a graphical approach or by using simple computer programs (detailed in a later section). One such graphical approach uses a function that is derived from a modified version of equation (1). The modified version is that:

$$Cn\% = 100[1 - (1 - C1)^n] \quad (3)$$

where **Cn** is the coverage after **n** passes and **C1** is the measured coverage after **1** pass.



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"Great job—I appreciated the classes, the tours and the food."

"The most beneficial classes were 'Coverage', 'Intensity' and 'Putting it all Together'."

"Very positive experience. I would definitely like to return."



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If we substitute $Cn = 98$ into equation (3) and do some re-arrangement we arrive at:

$$C1 = 100[1 - 0.02^{1/n}] \quad (4)$$

Equation (4) has been plotted as fig.3 (using log-log scales to produce a straighter curve). The 'arrowed path', **ABC**, illustrates how, for example, a 39% coverage measured for one pass leads to a predicted 8 passes for 98% coverage.

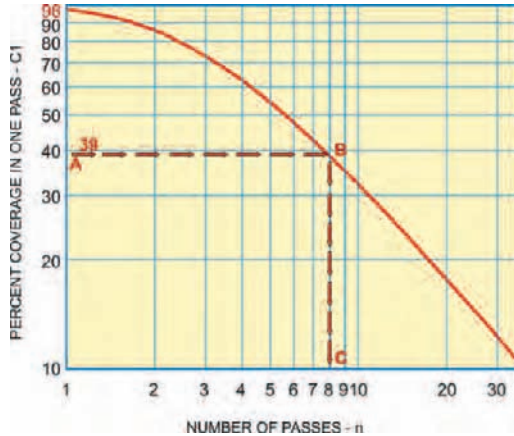


Fig.3 Prediction of number of passes, n , required to induce 98% (full) coverage.

FACTORS AFFECTING INDENT AREA/TARGET AREA RATIO, Ar

Coverage for a specified target area depends only on the indent area/target area ratio, Ar that has been imposed on the component. It follows that any of the three factors that affect Ar can be used to control coverage. These three factors are:

- 1) Peening time, t ,
- 2) Average area of the indentations, a , and
- 3) Indenting rate, n .

There is a very simple relationship between Ar and the three controlling factors:

$$Ar = t \cdot a \cdot n \quad (5)$$

It is worth noting that Ar is what is called a "dimensionless quantity" (i.e., it is a number that has no dimensions). If we multiply together the units for each of the three controlling factors they cancel each other out: $(s) \cdot (m^2) \cdot (s^{-1} \cdot m^{-2}) = 0$. If we can keep any two of the three factors constant then Ar is directly proportional to the third factor. It follows that coverage versus t , coverage versus a and coverage versus n curves must all have the same exponential shape as the coverage versus Ar curve.

1) Peening time, t

Peening time is the simplest of the three control factors to employ. This is because peening time does not affect the other two factors. It is axiomatic that as we increase the peening time then coverage increases. Peening time is the commonest method of controlling coverage. Peening 'time' itself is normally a combination of two parameters: (1) the number of times that the shot stream passes over a given point on the component and (2) the speed at which the

shot stream is moving. If speed is kept constant then we can plot coverage against number of passes, p . If the number of passes is kept constant then we should plot coverage against the reciprocal of speed to maintain the exponential curve shape.

2) Average area of the indentations, a

There is an equation that relates indentation area, a , to shot particle parameters and component hardness, B :

$$a = 2.6 \cdot S^2 \cdot \rho^{0.5} \cdot v / B^{0.5} \quad (6)$$

where S is shot diameter, ρ is shot density and v is shot velocity.

If the only peening variable was shot diameter then this would exert a substantial effect on a and therefore on Ar . In practice, however, shot diameter interacts with the third factor, n . Component hardness is, however, independent of shot stream properties. The harder the component the smaller are the indentations induced by a particular shot stream – reducing Ar and therefore reducing coverage rate.

3) Indenting rate, n .

The number of indentations produced per second per unit area of target can be termed "indenting rate", n . It is a function of shot flow rate, shot stream geometry and shot size. If the shot flow rate and shot stream geometry are kept constant then n is inversely proportional to the cube of the shot diameter, S :

$$n = K/S^3 \quad (7)$$

where K is a constant.

The 'cube effect' arises because particle mass is its volume multiplied by its density and the volume of a spherical particle is proportional to the cube of its diameter.

The separate effects of the three factors t , a and n are depicted in fig.4.

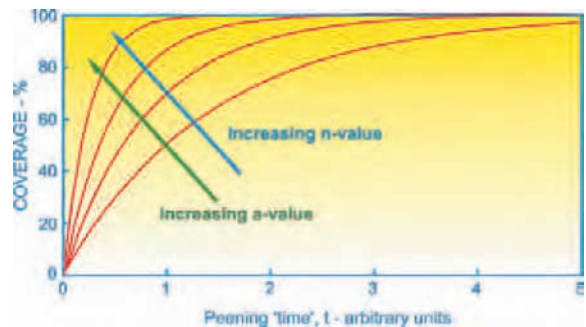


Fig.4 Effects on coverage of peening time, t , average indent area, a , and indenting rate, n .

If we multiply equation (6) by equation (7) then $a \cdot n = M/S$ where M is a constant. Hence, substituting into equation (5):

$$Ar/t = M/S \quad (8)$$

Ar/t is the rate of producing indentation area. Equation (8) is, therefore, a quantification of the well-known expression that "Other things being equal, smaller shot gives faster coverage".

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COMPUTER-BASED PREDICTION PROGRAMS

Simple computer-based programs can be used to produce objective predictions of coverage evolution. Two programs are described here for (1) single-measurements of coverage – preferably at an early stage of peening and (2) multi-measurements of coverage at progressive stages of peening. The programs assume that constant peening conditions are being maintained.

Single-Measurement Coverage Prediction

The indent-to-target area ratio, **Ar**, can be regarded as the product of **A** and **n** so that:

$$Ar = A * n \tag{9}$$

where **A** is the value of **Ar** after one pass and **n** is the number of identical passes.

Equation (2) can then be re-written as:

$$A = \{- \ln[(100 - C\%)/100]\}/n \tag{10}$$

Equation (1) can also be re-written as:

$$C\% = 100[1 - \exp(- A*n)] \tag{11}$$

We can use equation (11) to predict coverage after any number of passes - provided that we have one measurement of coverage available. That measurement allows us to calculate **A**. The value of **A** can be determined by substituting one measured value of **C** for a known value of **n** into equation (10). For example, if **C = 0.58** when **n = 1** then **A = 0.87**. Substituting 0.87 for A into equation (11) gives:

$$C\% = 100[1 - \exp(- n*0.87)] \tag{12}$$

The derived equation (11) can now be used to predict coverage for different values of **n** and thence to construct a coverage curve specific to the single measurement. The Excel-based program for carrying out the procedure is illustrated in fig.5. Different parts of a component will normally show different levels of coverage for a given amount of peening – as discussed later. The ‘single-measurement’ program can be applied to measurements made at different locations on a given component - predicting the passes required to satisfy a specified minimum coverage level. If coverage has been measured after, say, two passes then that is also catered for by the program.

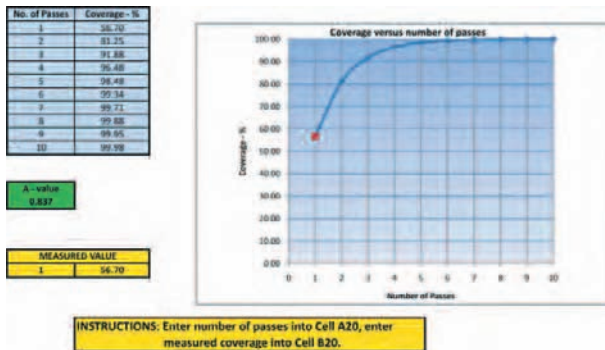


Fig.5 Worksheet of Coverage Predictor program using a Single coverage measurement.

Multi-measurement Coverage Prediction

Several coverage measurements could have been made, at the same location, on a given component that has been

peened progressively using an increasing number of, say, passes. We can then ‘best-fit’ these measurements to the exponential coverage curve - equation (11). The program is illustrated by the worksheet shown as fig.6. This includes two graphs – one of the data points and the corresponding best-fit curve and the other a complete curve based on the deduced ‘best’ value for **A**.

Coverage Mapping

Coverage mapping is becoming increasingly important. Users realize that some parts of a component reach, for example, ‘full coverage’ much earlier during peening than do other parts of the component. This means that some parts may become seriously over-peened. It is virtually impossible to monitor this over-peening since ‘full coverage’ represents an absolute limit for accurate coverage measurement. Single-measurement coverage prediction provides a solution to the problem.

Single measurements of coverage at an early stage of peening – corresponding to a modest, easily-measured, level of coverage – can be carried out at a range of points on a component that are representative of the several geometrical features of the component. These measurements, together with their locations, comprise a ‘coverage map’. The “Single Measurement Coverage Predictor Program” can then be applied to each measurement to indicate the adjustments to the amount of peening that are needed at each point in order to achieve the target coverage. If individual adjustments are not to be made then application of the program would provide an ‘over-peening coverage map’.

As a hypothetical example, consider just two points on a component. At Point 1 the coverage after one pass is measured as 56.7%, leading to a predicted requirement of 5 passes to achieve 98% - as per fig.5. At point 2 the coverage after one pass is measured as 36%, leading to a predicted requirement of 10 passes to achieve 98%. If 10 identical passes are applied to both points then Point 1 will have received twice the necessary amount of peening. Alternatively, the effective peening rate at Point 2 could have been doubled so that both points need only have 5 passes to achieve ‘full coverage’.

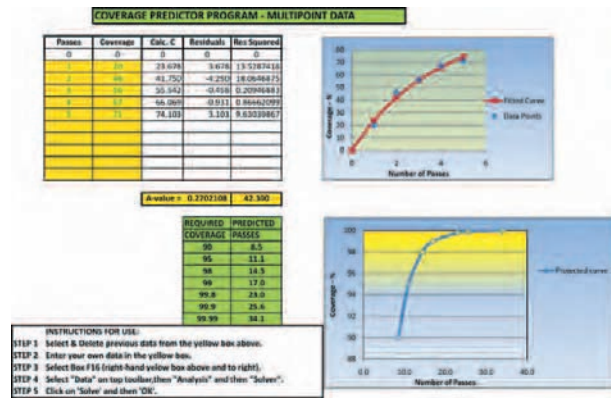


Fig.6 Worksheet of Coverage Predictor program using Multi-measurements.

DISCUSSION

Quantitative coverage prediction and control is becoming increasingly important. There is a growing realization that

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optimum component properties are attained at coverage levels well below 98%. That is due to the avoidance of gross over-peening.

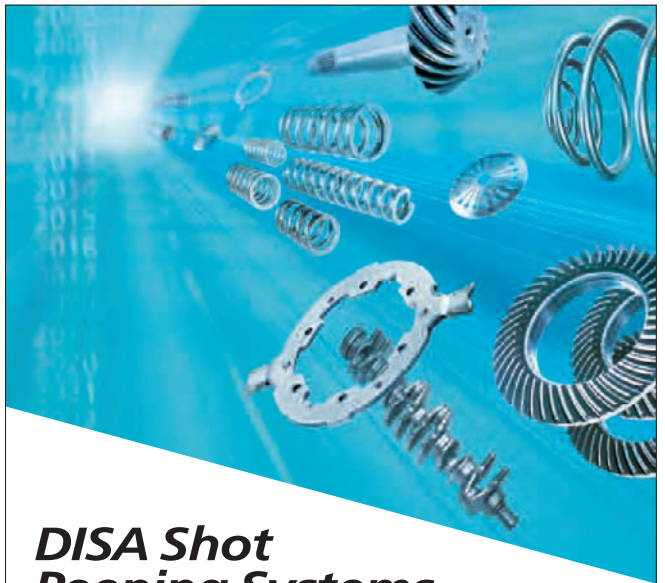
Application of the principle that "All areas of the component shall be 100% covered with indentations when examined in a specified manner" does not ensure a controlled, optimum, amount of coverage. With that approach some regions may have been peened many times more than other regions – the difference cannot be detected. Over-peening can be avoided by making reasonably-accurate coverage measurements, possible in the region of 30 to 60% coverage, followed by planned increases in indent ratio.

An extra advantage of using computer programs is that they can easily be used to accumulate a data base of information. Machine parameters that previously led to established coverage curves can then be accessed.

Shop-floor coverage measurements present a different scenario from those that are possible using laboratory conditions. The availability of low-cost USB microscopes allows, however, shop-floor images to be compared with stored images of reference coverage samples that have previously been image analyzed.

Both the Predictor programs and the Saturation Curve Solver programs are available free at www.shotpeener.com. Free 'Customer support' is available from the author – shotpeener@btinternet.com.

It is important to note that this article is based on the prediction and control of coverage at specific target locations on a component. Coverage will vary with position on a component. This is due to the inhomogeneous way in which shot streams induce coverage at different locations. Analysis of this inhomogeneity will be described in the next article in this series. ●



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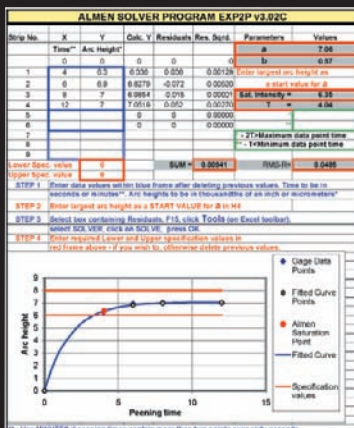
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Industry News

Blast Cabinets Safely Clean and Strip Delicate Surfaces

Langhorne, Pennsylvania. A full line of blast cabinets specifically designed to handle fine media used in cleaning and stripping delicate substrates is now available from Empire Abrasive Equipment Company. The cabinets clean molds, used truck engine parts, used aircraft engine parts, etc. — items that must retain their original dimensions because they will be used again.

These SafeStrip™ cabinets assure even flow of fine abrasives, such as bicarbonate of soda, by creating a differential between vessel pressure and blast pressure that can be adjusted precisely to prevent bridging and produce consistent feed rates.

Empire's SafeStrip cabinet line includes five sizes; working enclosures within larger models exceed 140 cubic feet. The cabinets are available with an array of over 70 factory options that expedite production. Like all of Empire's standard products, they are supported by a three-year warranty.

For more information about SafeStrip cabinets, contact:

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Email: Airblast@empire-airblast.com, Web: www.empire-airblast.com



Empire's SafeStrip blast cabinets, designed to handle fine media, work gently on substrates and the environment.

Rosler Metal Finishing USA Names New General Manager

Battle Creek, Michigan. Paul Rawlinson of Prescott, Merseyside, Great Britain has been named the new general manager of Rosler Metal Finishing USA, LLC. Rawlinson, currently the general manager of Rösler UK, will replace Eugen Holzknacht who decided to hand off the day-to-day responsibility of running Rosler Metal Finishing USA, LLC effective February 2, 2009.

According to Mr. Stephan Rösler, chairman of the Rösler Group "The selection of Mr. Rawlinson to head Rosler Metal Finishing USA, LLC was a natural choice due to his extensive background in the surface preparation industry which dates back to 1978 when he joined the Roto-Finish Europe subsidiary of Cetema Ltd. as a process engineer." Having worked closely as a supplier to many prestigious companies throughout the UK and Far East, Paul believes he understands the high expectations of our customers and attributes his own success to having a hands-on and flexible approach to finding practical and cost effective solutions to applications for which his

30 years experience serves him well. Mr. Rawlinson and his family will be relocating to Michigan and he looks forward to becoming an active member of the North American surface preparation community.

Eugen Holzknacht, the current general manager of Rosler Metal Finishing USA, LLC has served as the company's general manager since October 2003. "Mr. Holzknacht will continue working for the company, mainly supporting Mr. Rawlinson in his new role. In addition, in close cooperation with Mr. Rawlinson and the management of the Rösler Group he will be focusing on strategic and organizational tasks along with special projects." said Mr. Stephan Rösler.

Rosler Metal Finishing USA, LLC a wholly-owned subsidiary of the Rosler Group, is committed to providing the Total Process Solution, a single-vendor surface finishing solution, to businesses who manufacture, process or recondition metal parts. Rosler designs and manufactures all of the components of the Total Process Solution, including mass finishing machines, shot blasting machines, media, compounds, automated loading and unloading devices, waste water treatment systems, and dryers, in addition to providing aftermarket parts, on-site service, overhauls and relines.

Rosler process engineers, using a process analysis and development methodology we call "finding a better way...", analyze customer requirements and develop comprehensive process-based solutions focused on lowering manufacturing costs while increasing product quality. For further information, please visit the company's web site at www.rosler.us. The site offers in-depth information about the company's products and services.

International Scientific Committee for Shot Peening Appoints Jack Champaigne Chairman of 2011 Conference

Mishawaka, Indiana. Jack Champaigne, President of Electronics Incorporated in Mishawaka, Indiana, has been appointed Chairman of the International Scientific Committee for Shot Peening and host of the 11th International Conference on Shot Peening (ICSP-11). The International Conference on Shot Peening is held every three years and ICSP-10 was held in 2008 in Tokyo, Japan. Previous locations have been in Marne la Vallee, France; Munich, Germany; Warsaw, Poland; San Francisco, California, U.S.A.; Oxford, United Kingdom; Garmisch-Partenkirchen, Germany; Chicago, Illinois, U.S.A.; Paris, France; Las Vegas, Nevada, U.S.A.; and Senlis, France.

The goal of the International Scientific Committee for Shot Peening is to promote the dissemination of knowledge and the research activities in shot peening and its allied processes. Shot peening is a cold-working process in which a metal surface is peened to induce compressive stresses and thereby improve fatigue life. Shot peening is used in aerospace, automotive, energy, medical and other industries that need to improve the fatigue properties of metal components. The study of shot peening's benefits and uses are crucial as the need grows for stronger, safer and lighter metal components in transportation, medical and many other manufacturing applications.

The event will attract approximately 250 members from academic institutions and industrial organizations worldwide. Presenters will present research papers on subjects relating to shot peening including applications in automotive, aerospace, energy (nuclear reactive and offshore technology) and welding structures; metal fatigue and fracture studies; alternative processes; and the measurement and control of the process.

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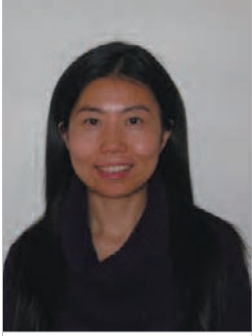
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Why I'm Studying Shot Peening

In 2005, I left Beijing, where I majored in Mechanical Engineering and worked as a Stress Analysis Engineer for over ten years, and moved to Montreal to study. Montreal is renowned for its expertise in the aerospace industry, specifically in aircraft assembly and engine manufacturing. Bombardier Aerospace, the world's third largest commercial aircraft manufacturer, as well as Bell Helicopter Textron Canada, the world's largest producer of civilian helicopters, are both located in Montreal. Montreal is one of the world's largest aerospace hubs, along with Seattle and Toulouse, France. In May 2006, I began my Ph.D. studies at École Polytechnique, associated with University of Montreal. At the same time, I started research at the Aerospace Manufacturing Technology Centre (AMTC) of the National Research Council of Canada (NRC) as a guest worker. The research project is entitled "Finite Element Simulation of Shot Peening and Stress Peen Forming Process." In May, 2007, I attended the Electronics Inc. Shot Peening workshop in Montreal and passed the first level exam.

Shot peening is a cold working process widely used in the aerospace and automobile industries in order to improve metallic components subjected to fatigue loading and stress corrosion cracking or fretting, mainly due to the favourable residual stress. Large numbers of parameters, such as shot size, shot velocity, shot type, target material and peening angle, etc., greatly influence the shot peening effects. In addition, shot peening effectiveness depends greatly on peening intensity and coverage. I took advantage of my ten years of experiences in Finite Element Method (FEM) and developed a more practical shot peening model, with the ability to consider random shot peening

process and to relate peening intensity and coverage to shot peening results. By combining FE modeling with Design of Experiment (DoE), it is possible to study the influence of most shot peening parameters and to optimize the shot peening process.

The peen forming process is an important forming technology in aerospace since there is no need for dies and presses or subsequent thermal processes. For a wing skin, which has a larger curvature in the chordwise direction than in the spanwise direction, a technique called stress peen forming is applied. In stress peen forming, the component is elastically pre-bent along the spanwise direction during peen forming. I have developed a FE model to study the influence of the pre-bending moment on the resulting deformations.

I took part in the 10th International Conference on Shot Peening and presented an article titled "Finite Element Simulation of Shot Peening and Stress Peen Forming Process". In this conference, I found that most of the papers presented and compared experimental results of specimens with and without shot peening. However, few analytical methods and approaches were presented that can predict the peening results as a function of treatment parameters, or that relate the influence of shot peening parameters to the resulting strength improvement obtained by peening. It is very important to analysis this well-controlled shot peening process because it can provide the best peening results and also greatly reduce experimental costs. I have developed an OFDF system (Optimisation of Fatigue strength with DoE and FEM). With this system, it is possible to simulate the real shot peening process, to predict the fatigue limit of the

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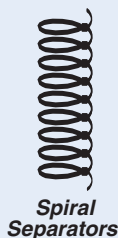
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shot peened component and to optimize the controlled shot peening process.

The center of the global economy is shifting more and more towards Asia, especially to China. With its increasing role in the world economy, China's position in the global competitiveness ranking is attracting widespread attention. I am proud of my country and after graduation, I plan to bring the technology that I have developed in Montreal home in order to contribute to research on shot peening control methods in China.

In China, shot peening methods are used in the automotive and aerospace industries. In automotive manufacturing, shot peening is mainly used to strengthen the fatigue life of coil springs, leaf springs, torsion bars, gears, transmission components, bearings, camshafts, crankshafts, connecting rods, etc. International experience shows that it takes around 10 years for the family car consumption rate to increase from 20% to 60%. For example, United States spent 14 years to increase the rate from 10% to 90%, Japan spent 11 years to increase from 20% to 60%. The same trend may happen in China. By 2021, the urban household consumption of autos could reach around 60%. It is expected that in the next ten years, China's automobile industry will undergo great improvement. At the same time, due to wide application, the shot peening technology will be greatly improved during this period.

The aerospace industry is a significant symbol of the nation's strength. In November 28, 2008, China's first aircraft jet ARJ21-700, which was developed completely independently by the Chinese aerospace industry, made a successful flight in Shanghai. The success of ARJ21-700 represents a new milestone for the Chinese aerospace industry, and with it great research and development experience for building large aircraft. China is thus confident in being able to develop its own large aircraft before 2020. Shot peening is useful for improving different aircraft components, such as gas turbine engines, shafts, landing gears, etc., and will be very important for forming the wing skin during this period.

I appreciate greatly my supervisors, Martin Lévesque at École Polytechnique de Montreal and Claude Perron at Aerospace Manufacturing Technology Centre of the National Research Council of Canada. With their support, I am able to learn very much about the art of shot peening. There are fewer national boundaries for knowledge. I wish that all engineers everywhere in the world would cooperate to improve this technology for the benefit of all. ●

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Pushing the Envelope: The New EI Education Division and ICSP-11

Electronics Inc. is assuming two new responsibilities this year: the Electronics Inc. Education Division and the ICSP-11.

Electronics Inc. Education Division

It's been the best sort of growing pains. Our increased shot peening and flapper peening training pushed us into creating a separate division and hiring more staff to keep us organized and provide resources for continuous improvement.

In some ways, Nadcap is responsible for our growth. Nadcap audits, and all audits, are prompting companies to attain the highest level of shot peening capabilities. One of our trainers, Dr. John Cammett, worked as a Nadcap trainer and is more than qualified to assist companies in shot peening audit preparation.

We trained Nadcap/PRI auditors on the shot peening process in 2001 and 2003 and now we train companies on how to implement the quality processes that will enable them to pass a Nadcap audit. We launched our unique on-site training program for the FAA in 2001. It was the first program of its kind and was developed especially for the FAA. EI training was the first company to be recognized by the Federal Aviation Administration (FAA) as meeting training requirements for FAA employees who audit shot peening processes. It's a nice completion of the circle.

I'm still traveling the world as a trainer and my experience on SAE committees and the new AMEC sub-committee on shot peening specifications gives me insight to students' questions and problems regarding specs.

Cost-effectiveness is driving on-site training right now. If you have three or four employees that need training, send them to the closest workshop. They will benefit from the training



The 2009 Mexico shot peening workshop group.

and networking opportunities. But if you have several employees, it's more cost-efficient for us to come to you. Plus, we can address issues specific to your company and train staff on your equipment.

The cost-effectiveness of flapper peening is really attractive to aerospace companies. We are doing more flapper peening training than ever. We covered the many benefits of flapper peening in the last issue of *The Shot Peener* and why companies need training on this deceptively simple-looking process.

We are also getting more requests for workshops. For example, our distributor in Mexico, Equipos de Abrasion, requested a workshop for their customers. It was a great workshop and the participants are a testament to the growth of the aerospace corridor in Mexico.

ICSP-11

I was appointed Chairman of the International Committee for Shot Peening and host of the 11th International Conference on Shot Peening (ICSP-11).

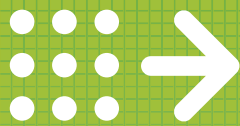
South Bend, Indiana will be a terrific place for the next conference. The EI staff is already working on the many details of organizing the event, including the development of the Organizing Committee. Electronics Inc. hosted ICSP-6 in San Francisco in 1996 and I'm honored to have the opportunity to do it again.

ICSP-11 information will become a regular column in *The Shot Peener* and online at www.shotpeener.com. ●



ICSP-10 attendees: Shi Bin, Wintech Abrasives Manufacturing; Hong Yan Miao, École Polytechnique and Aerospace Manufacturing Technology; Jack Champaigne, Electronics Inc.; and Dr. Yoshihiro Watanabe, Toyo Seiko, Co., Ltd. Dr. Watanabe was the ICSP-10 Organizing Committee Secretary.

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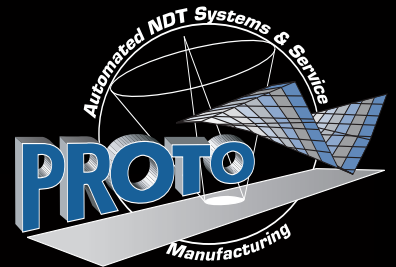
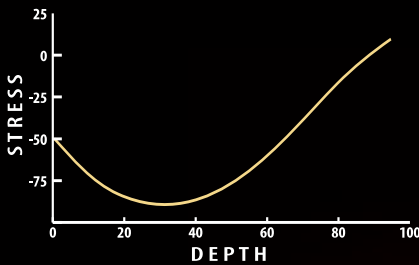


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