The Top Five Things My Customers Are Doing Right

MY JOB IS TO HELP MY CUSTOMERS with their shot peening and blast cleaning challenges. In the course of my work, I have reviewed many shot peening operations. While I can make sure that one aspect of a quality shot peening procedure —the equipment—is properly suited to the application, I often view their shot peening process with skepticism. I've sometimes felt a compelling desire to suggest that a peening operation start all over again. The truth is there has been enough dialog about such misgivings. That said, I am seeing more and more facilities doing numerous things right and it's only fair (and encouraging) to recognize and credit such users for making an effort to create a stable peening operation.

Observations here are not restricted to a specific geography or industry, though by personal exposure, a large part happens to be in Aerospace. There are more than five things being done correctly; this discussion is about five critical ones.

#1 CHOOSING THE RIGHT MEDIA

The market for peening media has been inundated with multiple sources from all over the world. New sources of cast steel shot have emerged, adding to those we have known over the years. An increasing number of suppliers are introducing conditioned cut wire to the industry and promoting its practical benefits. Every peening operation is now faced with more choices than before. However, the specification continues to dictate the type and size of peening media to be used.

I'm seeing more and more operations use the right quality of media in their peening process. Users who would formerly make their purchasing decisions on price alone are realizing the impact their choice will have on their end result. This is an interesting trend because the effect of bad media is immediately seen in the saturation curve, which means such users are following the practice of plotting a proper curve, again as per specifications.

Peening media, as we know, can be classified into "New Media" and "In-Use Media." New Media is further classified into SAE Industrial Grade and SAE Aerospace Grade. Industrial Grade media is dictated by the following specifications: J441 Cut Wire, J444 Cast Steel Shot, J2303 Ceramic Bead and J1173 Glass Bead. Aerospace Grade media ties its conformance to: AMS 2431 (\1 – Cast Steel 42 to 52 HRc, \2 – Cast Steel 55 to 62 HRc, \3 – Cut Wire, \4 – Stainless Cut Wire, \5 – Peening Balls, \6 – Glass Bead and \7 – Ceramic Bead.

Customers in the Aerospace sector are working towards meeting specification requirements for size (vibratory classifier) and shape (spiral separator). It's common now to see a Rotap machine, for verification of size distribution, located within close proximity of the Almen gage. The Almen gage is used to measure the arc height of their test strips when establishing peening intensity.

Some important points about media for facilities that want to improve their shot peening operation:

- Use of non-spec peening media results in inconsistent peening results, affecting repeatability and overall quality of a peening operation.

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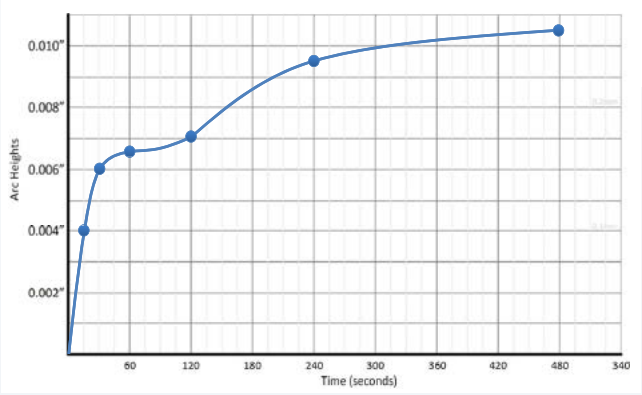
Mr. Balan has published numerous technical papers on blast cleaning and shot peening and is a regular contributor to *The Shot Peener* magazine. His expertise is in centrifugal wheel-type as well as air-type blast cleaning and shot peening equipment. He is a regular speaker at industry conferences and training seminars worldwide. Mr. Balan was awarded **The Shot Peener of the Year** Award at the 16th annual Shot Peening and Blast Cleaning Workshop in 2006.

- Leaving broken media with rounds causes nicks and cuts on parts, leading to localized stress risers and rejected parts.
- Non-spec peening media, when processed through properly sized screens of a vibratory classifier, results in almost half the quantity being rejected and separated to trash.

A proactive user of both shot peening and blast cleaning equipment in Automotive mentioned that their rejected media from a peening process is re-utilized in their cleaning machine which works very well with the resulting blast cleaning operating mix. They added that "operating mix" are bad words in their shot peening operation.

- Improper classification (or in some cases, the lack of classification) of peening media leads to difficulty in plotting saturation curves and achieving saturation. The problem surfaces in the form of a double-knee on the saturation curve due to contamination caused by two different sizes of peening media.



A saturation curve with a "double-knee" caused by contamination from two different kinds of peening media. (Image courtesy of EI Shot Peening Training)

#2 USING ALMEN TEST STRIP HOLDERS THAT MEET SAE SPECS

A majority of customers that shot peen their parts use test strips manufactured to specifications (SAE J442). That leaves us with the other variable in this family; the test strip block or holder.

As per SAE J443 Procedures for Using Standard Shot Peening Test Strip (Rev 2003), point 6.1, "Provide fixture which supports the test strip(s) in a manner to simulate the selected surfaces of the part to be peened. Test blocks shall be mounted on the fixture to duplicate the angle and location of these areas. Setup shall be qualified by placing the test strip setup fixture in the machine in the same orientation to the shot stream that the part will be exposed during processing..."

SAE J441 (point 6.2) cautions the user to monitor the condition of the test fixture for problems such as an uneven surface of the test strip contact area since this could skew arc height values. This also includes any damage to the surface of the test fixture (block/holder), and the possibility of contaminants, including stray peening media, that gets left behind from a previous cycle.

The second part of this variable pertains to mounting the holder onto the test fixture. Though it isn't stipulated, welding is not a suitable means of attaching the block to the fixture. Excessive welding (which is subjective) could warp the block and alter the flatness specification of the block.

Many of my customers have taken notice of all the above. It is now common to see test strip holders that are to spec and, instead of being welded, are screwed on the underside of the test part. Customers are also measuring "pre-bow" values of the test strip before mounting it to the test block. Screws are being checked for wear and replaced when the threads are not able to fasten the strip to the block.

One of my customers mentioned that they no longer find loose test strips in their reclaim system—something that they used to discover on a regular basis!

In addition, and this is important, the condition of test strips and blocks also form part of Nadcap Audit Criteria (AC 7117). This might very well be the driving force for this change.

#3 PAYING ATTENTION TO IMPACT ENERGY

Today's shot peener is equipped with more information than ever before, including the informational website, www.shotpeener.com, workshops conducted around the world, and on-site training programs. Many organizations now recognize the importance of keeping their peening process parameters in check. Through these various forums, it has been well established that the most important aspect we are dealing with is Kinetic or Impact Energy. Its transfer to the component being peened is what shot peening is all about.

Customers are now taking a proactive approach to understand the influences of impact energy rather than jumping to conclusions. They understand the influences of impact energy are the mass of the peening particle and velocity of impact. The mass is determined by the size of peening media and the velocity is determined by the air pressure in an air-peening machine or the wheel speed in a centrifugal wheel type machine. The size of peening media is dictated by the drawing/specification. Therefore, the variable that renders itself to change is the velocity of the stream.

A commercially available velocity meter, the ShotMeter by Progressive Surface, is used in many of the facilities that I visit. Customers are now able to carry out their process with a great amount of predictability even before plotting time-consuming saturation curves.

#4 VALIDATING THE BLAST CLEANING PROCESS WITH ALMEN STRIPS

This section relates to blast cleaning (and other related processes such as etching) and not as much to shot peening, though it's the direct result of lessons learned from shot peening. When shot peening, we use the deflection of the Almen strip as a measure to ultimately determine the impact energy transferred on to the part. Some customers in niche cleaning applications, and those that are familiar with this practice, have also adopted this technique to quantify and validate their cleaning operation.

The results of cleaning can be highly subjective in nature. Validating the quality of cleaning by visual comparators (SSPC/NACE/ISO 8501-1, BSI BS 7079, etc.) though common, are not applied to all cleaning applications. Once again, knowledgeable customers have caught on to the concept of impact energy and use Almen strips to compare arc heights at different times during a shift. They have then used this information to test the consistency of their process.

Though cast steel shot, conditioned cut wire, glass bead and ceramic are the only media types used for shot peening, these customers have used abrasives such as aluminum oxide with Almen strips to validate their cleaning process with acceptable results.

One customer reported an additional benefit to using Almen strips in their blast cleaning process—their operators obtained an acceptable cleaning quality at a lower air pressure. By virtue of this exercise, they reported being able to maintain this pressure (and quality of finish) throughout their shift with a subsequent reduction in operating costs due to lower abrasive and compressed air consumption.

Some blast cleaning operations are using Almen strips to quantify and validate their cleaning operation.

#5 UTILIZING X-RAY DIFFRACTION

Why do we shot peen? A seemingly innocuous question with a straightforward answer—to increase the working life of a component and reduce chances of failure. Drilling down further—the purpose is to introduce residual compressive stress onto a component. We measure this using our representative Almen strip. I'm seeing sophisticated users of this process, particularly in the automotive industries, which have not stopped at Almen strip (and intensity) results. Their goal is measurement of residual compressive stress. Though they continue to use strips for validation, they realize the strips don't tell them about the residual stress, they don't account for upstream processing, and they don't always address shot peening's effects on the geometry of a complex part.

Determination of part coverage (represented as 98% and greater) results from a visual evaluation of the part. Uniformity of coverage is checked with 10X to 30X magnification and through alternate means. Even though visually confirmed uniform coverage means uniform peening, it doesn't necessarily indicate that the process has resulted in a uniform stress state. This is because multiple crystalline planes could exist in a metal that has been shot peened to a particular intensity. A definite measure of the results of shot peening (or residual compressive stress) can be achieved only through X-ray Diffraction.

Therefore, this process has evolved to the point that some users validate with more than Almen strips and saturation curves. X-ray Diffraction techniques can now measure residual stress, not only in a lab environment, but also inline with the shot peening process. As an example, I see equipment from Proto Manufacturing in the field and they are experts in lab, handheld and portable residual stress measurement systems.

SUMMARY

There exist several other aspects of the peening and blast cleaning process that customers are now doing differently for the advancement of their operation. The five identified above were chosen for reasons of criticality and their promise of a new approach to these well-worked processes. Shot peening is gaining popularity outside the traditional Aerospace and Automotive industry sectors, too. On an even more optimistic note, new adopters of the process are "doing it right" the first time. The efforts of professionals to develop peening specifications in such industry sectors outside of Automotive and Aerospace, such as SAE J3020 for Medical Device Shot Peening, are showing encouraging results.

To summarize the requirements for the furtherance of this process, it can be done in three simple terms: Accuracy, Repeatability and Consistency. As long as the initiatives of your peening operation are directed to the achievement of these goals, you will be closer to deriving its valuable benefits.