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A New Standard for Peening Process Control and Operator Interface

SHOT PEENING has been around for over 75 years and for the most part, the way the process is characterized and controlled has remained unchanged since the beginning. While closed loop devices have been developed to control key input variables, until recently the only way to measure the key output variable of intensity was with the Almen strip.

Process Development Process Today

As shot peen users know, developing a saturation curve for an actual component is a trial-and-error process that can be quite time consuming. A set of process parameters is selected based on the specified media and size believed to provide the required intensity. Peening trials at various exposure times are performed to gather enough arc heights to plot a saturation curve. If the resultant intensity or cycle times are not within the specification range, the process is repeated until the desired intensity is achieved.

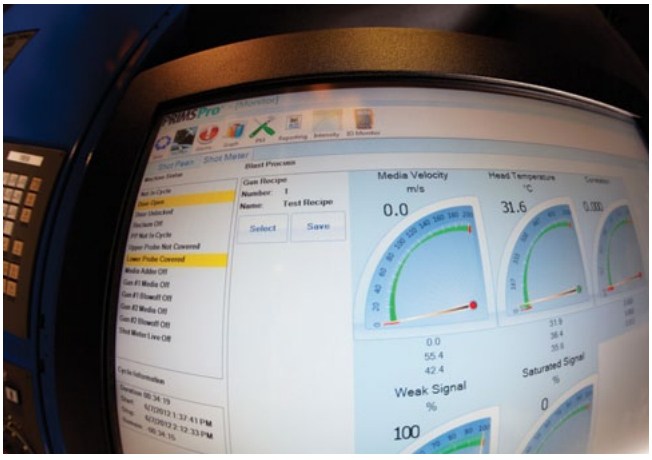
An optimized method has been needed that allows users to quickly dial in the required intensity in a fraction of the time it currently takes.

Traditional Process Control and Troubleshooting

Controlling a developed shot peening process is similar but, instead of creating a saturation curve, the saturation point is validated at some normal frequency using Almen strips. These frequencies vary from once a shift to as often as before each different part type is run. In the case of small lot sizes, running Almen verification strips can take as long as running a part, adding cycle time and cost with little added value. What's worse, if an Almen strip falls outside of the approved range, the process engineer is left with hours of troubleshooting to find the root cause of the process change.

ShotMeter G3

ShotMeter G3, a joint solution provided by Progressive Surface and Tecnar Automation, uses a simple method of particle illumination and two electro-optical sensors of a known spacing to sense particles as they exit the shot peening nozzle. The signals from the two sensors are compared and the resulting phase shift is used to calculate velocity, with accuracy within 1%. There are currently more than 30 ShotMeters in use worldwide.



PRIMS Pro with Integrated ShotMeter

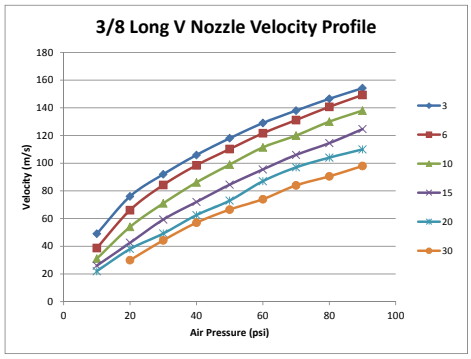
The ShotMeter system is offered as a portable configuration, or integrated with PRIMS Pro, Progressive's process control and integrated monitoring system. Both configurations provide the user with adjustable setpoints and alarms for shot velocity.

Processes Developed in Days, Not Weeks!

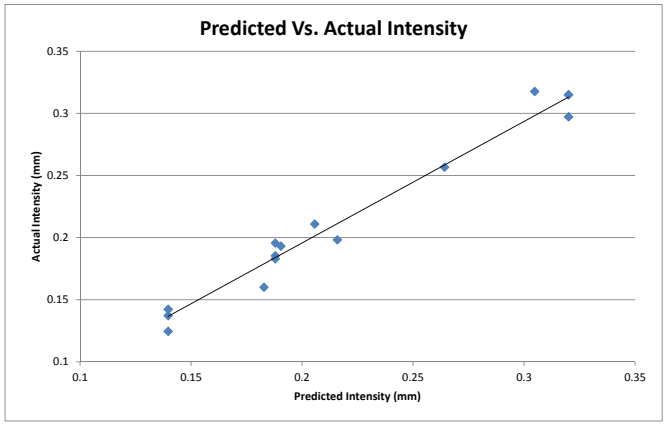
A major aircraft engine manufacturer recently benefitted from reduced development time, thanks to the ShotMeter. The manufacturer purchased a Progressive Surface 6-axis robotic shot peening system and required process recipes for five different intensity ranges at three different impingement angles with three different nozzles. Utilizing traditional methods, developing the 45 distinct saturation curves would have taken several weeks to complete. But with the use of previously developed process models and the ShotMeter, preparing a new development methodology consisted of a few simple steps.

Step 1. Collect a velocity fingerprint for the machine using the velocity profile factors that are unique to that machine (for example, hose length and diameter).

Step 2. Enter the desired angle of impingement and required intensity into our empirically developed process model for the specific media size and type. The output of this model is a target velocity needed to achieve the required intensity.



Machine Fingerprint Chart – Velocity vs Air Pressure



Accuracy of Using the ShotMeter as a Development Tool

Once the target velocity for a particular intensity is known, the process engineer uses the fingerprint data developed in Step 1 to select his air pressure and shot flow.

Using this methodology, no trial and error was needed. We reduced the time required to complete this task from several weeks to just a few days. The customer was able to take delivery of their machine weeks earlier, and was presented with a process model and machine fingerprint to use now and in the future.

ShotMeter as a Troubleshooting Tool

Progressive has delivered ShotMeters to many different customers who use it for research, process characterization and development. Many customers will use the ShotMeter to perform periodic machine health checks or calibrations. This data is used to set nozzle and hose change intervals as well as to verify that air pressure controllers and their closed loop media flow controllers are still working correctly.

A large aerospace customer discovered the advantages of the ShotMeter when they were forced to shut their machine down in order to troubleshoot a problem. They tried changing hoses, nozzles, and shot flow controllers, and could not figure out why their Almen verification strips were not within the required specification. A Progressive Surface service engineer used ShotMeter to check baseline conditions using the velocity fingerprint. With the ShotMeter's help he quickly determined that the machine fingerprint matched, which narrowed the possible causes considerably, to either the media or the Almen strip itself. Since the media had been working without problem in the machine for a long time, it was determined that the root cause of the problem was the Almen strip. Once a new lot of Almen strips was used, the intensities came back to where they were supposed to be. Unfortunately this entire episode cost our customer a couple weeks of lost production. The solution to their problem was quite simple, and easily determined once the ShotMeter was employed as a troubleshooting tool.

Integration with PRIMS Pro

Another advantage of the ShotMeter is its ability to integrate with machine process monitoring software. PRIMS Pro, Progressive's updated software released earlier this year, has many new features including enhanced user-friendly graphics, part queuing, expanded process/image association for individual parts, alarms with diagnostics, and simplified scheduling and tracking of preventive maintenance. To date we have several customers in varying industries, including medical, aircraft engine and airframe, enjoying the improved level of in-process control offered by an integrated ShotMeter.

Before and after each part is processed, the nozzle is moved in front of the ShotMeter sensor head and the velocity is measured, recorded with the process record for that part, and checked against the pre-established process limits. This ensures that the process is consistent and the same as previously determined. If the velocity is recorded outside of the approved range, the part processing is halted and maintenance is called to correct the problem. If the velocity is out of range at the end of the process, then quality is alerted and the part quarantined until proper engineering disposition is made. This new level of process control is becoming the standard for today's lean, quality-driven manufacturing environment.

Conclusions

Since its introduction the marketplace, ShotMeter users have realized its many benefits including:

- Significant reduction in process development time
- Useful aid in troubleshooting process issues, getting machines back to production sooner
- New process monitoring tool in controlling the process beyond the Almen strip

The cost of the ShotMeter is usually recouped very shortly after it is purchased. If you are interested in learning more about the ShotMeter, visit our web site www.progressivesurface.com or contact us at sales@progressivesurface.com. Demo and rental units are available.