The Shot Peening Operator's Checklist

Part two of a two-part series

In Part I (Summer Shot Peener, 2010), we discussed general machine inspections and defined the wear characteristics of the blast cabinet and work fixtures. We then identified their cumulative effect on peening results. Our discussion here will continue with other items on the peening operator's checklist such as blast wheel components, blast nozzles, media and pneumatic circuits.

#1 What to look for in a blast wheel

The year 1932 saw a major breakthrough in the blast cleaning industry with the introduction of the airless abrasive blast wheel. Until that time, compressed air was used to propel abrasive, regardless of the application. With the blast wheel, controlled centrifugal force is used to throw abrasive from a rapidly rotating wheel driven by an electric motor. The variety of applications and productivity requirements dictate the wheel type and connected motor power.

In a blast machine, any component that comes in contact with blast media experiences wear. The blast wheel is the prime example; its components are turning at speeds as high as 3600 RPM. In a blast wheel, the critical parts include the following: (a) cast alloy impeller to accelerate the media, (b) the cast alloy control cage that directs the media and (c) the set of blades that actually propel the abrasive on to the part being cleaned or peened. Let's elaborate on some commonly encountered issues with blast wheels.

The control cage determines the path of the abrasive out of the blast wheel. It is responsible for creating the wheel's "hot spot." The hot spot is the area on a target where maximum energy is transferred from the blast stream. In peening applications, it is important that the hot spot is directed to critical areas where intensity needs to be measured.

Two of the common causes (and cures) of pattern-related problems include:

1) Control cage turned too far in the direction of rotation, causing excess wear on wheel housing end liner at trailing edge of housing. Fix: turn cage CCW as needed to correct error.

2) Control cage too far in the opposite direction of rotation causing excess wear on end liner at leading edge. Fix: Turn cage CW as needed to correct error.

PEENING TIP
Almen strip readings, saturation curves and coverage (visual) are best indicators of control cage settings. If readings are below desired range, or if the part shows insufficient coverage, it's possible that a portion of the blast energy is being wasted by blasting the liners.

Abrasive wear on the impeller must also be monitored. In order to distribute the abrasive onto the blade throwing surface, there must be a "lead" between each impeller segment and its corresponding blade. If an impeller segment wears enough that it becomes parallel with the blade, the abrasive will hit and split on the blade's bottom edge. When abrasive hits the edge, it bounces rather than slides on the blade surfaces, slowing down the flow of abrasive and causing excessive wear.

PEENING TIP
Lower intensity values could be caused by lower media velocities. One of the reasons could be a worn impeller as discussed above.

Loss of control over the blast pattern results in reduced blast efficiency. Longer blast cycles, improper part coverage, reduced intensity, and higher than normal maintenance costs are all directly traceable to blast pattern issues. Wear on the primary wheel parts is the chief cause for a shift in the blast pattern. Therefore, it is important to regularly inspect these parts and replace them before excessive wear results.

Blast wheels operating at less than full amperage, as indicated by the motor nameplate, indicate a problem with abrasive flow to or through the wheel. Two conditions of the blast wheel could result in inefficient blasting—a flooded wheel or a starved wheel.

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Here's a simple test: With the wheel running, turn on abrasive. Turn off abrasive flow and observe the ammeter reading.

- If the amperage increases slightly before falling to "No Load." the problem is a flooded wheel. Possible causes are the abrasive valve is opened too far, a misaligned feed spout, worn impeller, etc.
- If the amperage falls immediately to "No Load," the problem is a starved wheel. This problem could be caused by insufficient abrasive in the storage hopper or any physical interruption to the flow of abrasive through the feed pipe or valve.

#2 Wear of a blast nozzle

Blast nozzles undergo wear just like a blast wheel even though they use a simpler media-propulsion method. Wear of a blast nozzle is indicated by an increase in both nozzle bore and compressed air consumption. This, in turn, leads to higher flow rates of abrasive through the nozzle. Here's a comparison to illustrate this example: a commonly used 3/8" (No. 6) nozzle consumes 182 CFM of compressed air at 90 PSI. The consumption rate at this same pressure increases to 240 CFM when the nozzle bore increases to 7/16", 320 CFM with a 1/2" nozzle, and as high as 720 CFM for a 3/4" diameter.

PEENING TIP

Greater volume of compressed air due to increased bore also increases the media flow rate. At the same air pressure, this will reduce the impact energy and the peening intensity will also be reduced.

Variation in intensity values can be resolved by checking the condition of the blast nozzles on a regular basis using a go and no-go gage. In its simplest form, a drill bit of the same size as the nozzle is inserted into the nozzle to check whether it can be inserted, and the clearance within. It's also important to also check the condition of the blast hoses and couplings at the same time.

#3 The pneumatic circuit

Compressed air peening machines built to conform to commonly used specifications are provided with a closed feedback loop for pressure control. This operator inputs the desired blast pressure as part of the technique / recipe for the part being processed. A pressure transducer (switch) senses the air pressure in the blast tank and compares it with the desired setting. Any variation between the two values is automatically corrected by an Analog Proportional Regulator provided in the main airline to the blast tank.

In addition to this corrective feedback loop, the controls system could also incorporate a setting for bandwidth values (limits). The system could be set to shut down the process if the required pressure is not maintained within a specified time period.

PEENING TIP

The closed feedback loop could be tested by shutting off compressed air supply to the machine and checking to see if the machine shuts down. The damage caused by incorrect compressed air volume or absence of compressed air is devastating to peening results.

#4 Blast tank

Blast tanks used for pressurizing peening media have similar valves for common functions in their operation: the air valve, pressurization valve, sealing valve and flow control valve. The valves operate under high pressure and some come in direct contact with the abrasive. Improper cycling of the blast tank could result in insufficient media in the vessel and the blast nozzle(s). It's important to cycle the tank in manual mode to verify its proper functioning. All valve seals should be inspected on a regular basis and replaced as required upon signs of wear.

All flow control valves have to be calibrated by means of an actual drop test conducted per nozzle or wheel. Drop test flow values should be compared with displayed values on the operator interface and corrections made as required.

#5 Nozzle manipulation

Sophisticated peening systems employ different means of moving blast nozzle(s) to match the contour of the work being peened. This is either carried out by a custom nozzle manipulator or a robot.

Paths followed by such arrangements are resultant of at least three axes, the X, Z and Tilt. Though fully programmable, each axis works off a data table before combining its motion with the other axes. An incorrect axis movement could cause extensive damage to your part.

Make following checks on a periodic basis to ensure effective functioning of the nozzle manipulator:

- Check the proximity switch brackets and ensure that they are all secure and rigid in their locations. A loose proximity switch will incorrectly sense the location of the carriage axis, resulting in potential crashes.
- A dirty proximity switch (photo-eye) could fail to count the teeth of a sprocket, also resulting in a potential manipulator crash.
- Physically check the length of travel of each axis in the manipulator and compare that with the value displayed on the operator interface screen for each axis.
- Regularly check the condition of the belts, sheaves, ball screws or any such arrangement provided for manipulator motion.

In Summary

As this industry evolves, control systems are becoming increasingly intuitive and are able to identify and localize faults with ease. However, this doesn't replace the routine checks covered in this series. Additional process details such as checking the quality and size of peening media, intensity, and saturation curve generation have not been included in this discussion with the assumption that the peening operator is already aware of them.

In a peening machine, there really is no substitute for pro-active inspections and maintenance. The component that you're processing is expensive and significant value has been added to it since the raw material stage.

Establish a routine with your procedures that assures a quality peened part for your customer at all times.