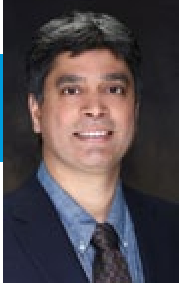


AN INSIDER'S PERSPECTIVE
Kumar Balan | Blast Cleaning and Shot Peening Specialist

The Role of Wheelblast in Shot Peening – Part II

PART I OF THIS SERIES focused on application-centric reasons to help determine the choice of airblast or wheelblast for your shot peening equipment needs. The relatively higher amount of blast media propelled by wheelblast machines resulting in faster production throughput than airblast machines was recognized as a major contributing factor in this choice. An experienced shot peener knows that whether airblast or wheelblast, shot peening is primarily governed by the basic four concepts: (1) How hard we throw (intensity), (2) How much we throw (coverage), (3) What we throw (shape and size of peening media), and (4) Where we throw (targeting and masking). Shot peening relies heavily on controlling these four aspects to achieve repeatable results. Part II of our discussion will focus on the above in relationship to wheelblast machines.

Comparison of Common Parameters
The following table lists the comparable parameters for both types of media propulsion systems.

Wheelblast	Airblast
Blast Wheel • Wheel power • Wheel speed/diameter	**Blast Nozzle** • Nozzle size/bore • Air pressure
Blast Angle • Wheel positioning/location • Wheel oscillation • Control cage setting/ movement	**Nozzle Manipulation** • Follow part contour • Multiple fixed nozzles

Abrasive Velocity - ***how hard we throw***
In a wheelblast machine, the blast wheel propels media like a nozzle does in an airblast machine. Larger diameter blast wheels propel media at high velocities, exhibiting direct proportionality (empirical formula for velocity: wheel diameter in inches x speed in rpm / 180 = approximate velocity in feet per second). Blast wheel motors used in peening machines are almost always fitted with variable frequency drives that allow speed alteration, leading to higher or lower velocities. The power of the motor driving this wheel will determine the media flow rate, also in direct proportionality. The following process parameters are controlled in almost identical ways in both machine types:

- Media flow rate: Flow control valves (e.g., MagnaValve)
- Media classification: Vibratory classifier (for size) and spiral separator (for shape)
- Part exposure: Alteration of conveyor speed, table speed, etc.

Wheel Power and Media Flow – ***how much we throw***
Every blast wheel has an associated "No Load Amps" (NLA) which is the power/amperage required to rotate the wheel without the load of blast media. This value is based on the wheel design. The term "Full Load Amps" (FLA) refers to the maximum amperage that the motor can handle given its horsepower (HP) rating. For example, the FLA of a 20 HP motor is 22.5 and the NLA based on a specific wheel design could be 7 Amps (smaller and more efficient wheel designs have lower NLA). This means that the useful Amps available with this motor is:

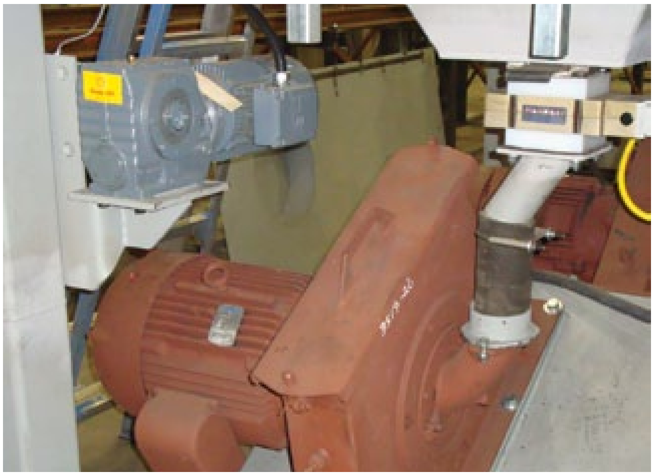
$$22.5 - 7 = 15.5$$

In other words, this wheel can only flow media (lb/minute) to the extent that 15.5 Amps will permit. Greater media flow rate will cause an overload condition in this motor.

User groups in the Automotive sector will find this data of greater relevance than those in Aerospace. This is because the greater emphasis is on higher volumes and production rates in Automotive than Aerospace. Wheelblast peening machines for landing gear or aircraft structures will commonly use motors no greater than 20 or 25 HP, which will include sufficient margins on actual power requirements.

In airblast systems, larger diameter nozzles flow greater amounts of abrasive but in no comparison with the quantity through a blast wheel. Though different manufacturers of airblast machines may claim superiority of their specialty nozzle designs, the basic nozzle design remains similar—commonly used nozzles are either straight bore or venturi. The wheelblast industry, however, is flooded with hundreds of wheel designs, differentiated by the quantity and shape of blades, material of construction, ease of maintenance, design of control cages, impellers and so on.

Media flow rate through blast wheels is monitored and controlled in a closed feedback loop using specialized flow control valves. (MagnaValves by Electronics Inc. perform this function at different operating ranges. The popularly used model VLP-24 operates within 200-1000 lb/min). Similar



A VLP-24 MagnaValve on a wheelblast machine

flow control valves perform the same function at every nozzle (with the valve located at the blast tank outlet) in airblast machines.

It is essential to conduct regular media drop tests in both types of machines. In airblast machines, the nozzle discharges peening media into a calibrated container for a specified amount of time when conducting a drop test. In a wheelblast machine, the blast hose feeding abrasive to the blast wheel feed spout is disconnected at the spout and the abrasive is collected in a drum for a defined time interval. The flow rate must be verified for each wheel. Values in both cases are compared to the digital display on the controller and then adjusted as required.

Media Size Control – *what we throw*

Media size control in a wheelblast machine is accomplished using a Mechanical Vibratory Classifier. Due to the large volume of media propelled by a blast wheel, conventional classifier capacities can't handle 100% of the total flow. Therefore, it is an approved practice to divert a fraction of the total flow through the classifier and achieve "continuous" classification of the peening media.

Tim Carey, Vice-President of Business Development at Midwestern Industries, a leading manufacturer of vibratory classifiers, provided the following capacities chart.

Screen Diameter (Inches)	Shot Capacity (lb/hr)	Grit Capacity (lb/hr)
18	2,010	250
24	4,000	500
30	8,000	1,000
48	20,000	2,500

He also shared the following useful tips. "These capacities are indicative and field conditions could result in lower values. Classifier maintenance is key in achieving repeatable peening results. A tear in the screen, or a screen plugged with foreign objects, could lead to good abrasive being diverted to trash. Such damage could also result in a mix of media sizes and incorrect peening results," Tim said. He suggests the screens be inspected at least once a week for signs of damage.

Airblast machines use classifiers to classify 100% of the media flow. In a wheelblast machine, a flow control valve located upstream to the classifier restricts the flow to a lower value. Even though 100% of the media isn't classified in a wheelblast system, it is continuous and therefore conforms to commonly used shot peening specifications.

Media shape control is carried out by a spiral separator (spiralator). This device design allows only a finite quantity of media to flow through it. The exact capacity varies with size and type of media; it's typically around 20 lb/min. Therefore, the spiralator design is the same regardless of whether it is for a wheelblast or airblast machine.

Masking – *where we throw*

The blast pattern generated by a 15" diameter blast wheel is usually around 30" long by 2"- 2.5" wide. However, dispersion of this pattern and its impact will be in an area larger than the pattern size. This means that anything in the path of this pattern will get impacted. In other words, masking is not as simple as for an airblast machine that provides targeted impact in designated areas. Plugs and caps are commonly used on parts to protect holes, threaded or machined. In some cases, wear-resistant, but ultimately sacrificial shield plates, are strategically located inside the cabinet. These are also used to protect/mask certain areas of the part when physical masking on the part surface is not practical.

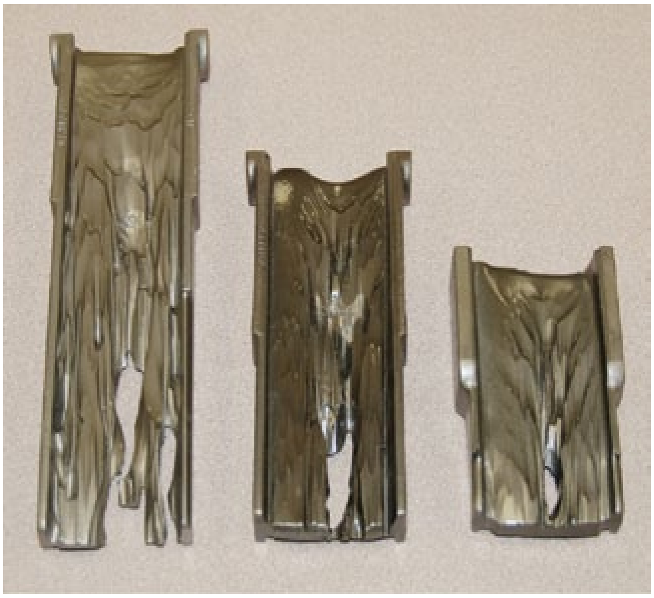
Wheel Part Wear and Its Effect on Peening Results

A dowel pin to identify an 1/8" increase in the bore of a blast nozzle is a common practice. The nozzle with this amount of change in bore is then considered to have enough wear to affect peening results. Nozzle wear also increases compressed air and blast media consumption, making it an undesirable overall outcome, even for cleaning applications. The nozzle and connected hose are then replaced. In a suction blast system, this would involve replacing the airjet in addition to the nozzle. The discussion gets a bit more involved in wheelblast machines.

Design of a blast wheel is relatively complicated and involves a greater number of moving parts. Let's first identify and understand the components of a blast wheel:

- The Feed Spout is located at the center of the wheel and receives abrasive from the storage hopper above the wheel. Though not a critical wear item, it is important to ensure its proper fit to prevent a dangerous shower of leaked abrasive onto the floor below.

- Blast media enters the blast wheel at its center and drops into the rotating Impeller. The impeller accelerates the flow of media stream through the wheel. It is the first in a series of wear items within the wheel.
- Concentric to the impeller is a fixed wheel-type component called the Control Cage. The control cage is designed with an opening along its circumferential width which, when aligned with the rotating impeller, allows the abrasive to exit the impeller and pass on to the blades before leaving the blast wheel. This is a very critical part of the blast wheel since the opening size and orientation determine the exact location of abrasive discharge and subsequent impact on the workpiece. Control cages are available in a variety of angles for the opening to suit the work being processed. The alignment is adjusted and recorded using a clock dial reference marker on the wheel housing. Wear of the control cage could misdirect the blast pattern to an undesirable location on the part or inside the blast cabinet, resulting in cabinet wear. Although control cage wear can be compensated by re-adjusting it using the clock dial, ultimate replacement of the control cage will be required to maintain the location of the blast pattern on the part. In sophisticated peening machines, automatic control cage adjustment is used to compensate for wear, and in some cases the movement is used to generate a sweeping pattern.
- The blast media discharges from the control cage onto the blades that propel it on the work surface. Blades are typically cast alloy steel with a flat surface along the length to allow the abrasive to roll, glide and ultimately discharge from the blast wheel. This causes wear in the blades in the form of grooves, ridges and holes. Any interruption to the smooth flow of abrasive due to damage will result in loss of velocity and directional diversion of media. Extreme wear of wheel components due to lack of maintenance, especially in blades in cleaning applications, will affect the consistency and repeatability of the process. For example, we are aware of the importance of maintaining a specific blast angle—wheel wear will alter this angle, affecting the impact energy and intensity.

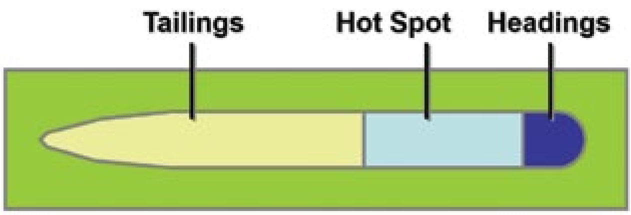


Worn blades

Dave Hannusch, Project Manager at Wheelabrator Group, a global manufacturer of wheel and airblast equipment, has spent many years installing and trouble-shooting wheelblast machines for shot peening applications. "When addressing wheel wear, it is important that all critical parts be replaced at the same time, and not just a worn impeller or blade," he advises. "Blades are all dynamically balanced at Wheelabrator given the high rotational speeds at which some of these wheels operate. For our wheels, we supply a Tune-up Kit (TUK) which includes an impeller, control cage, set of blades and the fastener. With wear, the entire TUK is replaced instead of individual components in the list," he added.

Gibson Abrasive Equipment is another manufacturer of quality wheelblast machines for cleaning and peening applications. Geoff Gibson, General Manager, is emphatic about the importance of identifying wheel wear on time lest one experiences its detrimental effects on peening. He cited two machine examples from their range of equipment for peening. "We have several installations of tumblast machines for engine valve spring peening. Most of these tumblasts have a single wheel on the cabinet roof and the control cage opening is selected and aligned to span about 70% of the length of the tumblast barrel. When we test these machines, we mount Almen blocks with strips on an angle section or flat bar spanning the barrel length. We use this as a benchmark for the future. When the same test fixture is used by the customer at a future date, and if unable to achieve the arc height values as first tested at our plant, we know that components of the wheel are worn. In another example, we supply spinner hanger machines to de-burr shafts and gears with two or sometimes three blast wheels. Wheel wear in such machines will not only lead to improper cleaning (or peening), but will also impact cabinet areas (typically the roof or the floor, depending on the direction of wheel rotation), causing wear. Like the tumblast example, we use a benchmark hotspot sheet from thin gage steel and verify the hotspot location during testing and for future verification to identify a shift in pattern," he said.

By industry definition, when blasting a test sheet, the hot spot is the "blue" area burned on the sheet where the majority of abrasive impact has taken place. This hot spot will shift with wear of wheel components, especially the control cage. Therefore, a satisfactory test sheet used during machine set-up is used as a benchmark when testing the machine in



Blast Pattern Test Sheet

the future for wheel wear. Movement of the hot spot signifies important wear aspects that might lead to adjustments of wheel part replacement.

Summary

Here are the key points of wheelblast equipment for a shot peening application.

- Ideally suited for larger surface areas and when masking isn't needed and overspray isn't a concern
- Mainly for ferrous media
- Open or exposed areas only
- High media flow rates with faster cycles
- Commonly seen in Automotive peening applications
- Media flow, size and shape control similar to airblast machines
- Due to high media flow rate, wheelblast machines are not suited for use with multiple media sizes
- Some applications can be serviced by both wheelblast or airblast. Applications such as Automotive Gear Peening and Landing Gear Peening can be serviced by either wheelblast or airblast.
- Wear of blast wheel parts will affect peening results

If your steel shot/conditioned cut wire peening process calls for coverage in clearly exposed areas without concerns of overspray, and the masking requirements are minimal, it is prudent to consider wheel over air.