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“Six Ways to Better Blasting”

by Mark Hanna

in the

**2013/14
Universal
Metal Finishing
Guidebook**



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cleaning, pretreatment & surface preparation

SIX WAYS TO BETTER BLASTING

BY MARK HANNA, DAWSON-MACDONALD COMPANY, WILMINGTON, MASS.

If your shop regularly uses blast prep, our tips can make your blasting operation clean, effective, and profitable.

1. REDUCE BLASTING COSTS

Here's a paradox no one wants to hear: Maybe, just maybe, your blasting is costing a lot because you've invested too little money (or attention).

It's easy to focus on initial capital costs. But don't overlook operational costs, which can add up quickly. Have a payback timeline in mind, and add your capital costs to projected operational costs over that time horizon – and you may find that a little more investment in equipment can make your operation much more profitable.

So, exactly what are the costs to factor in?

Capital:	Operational:
<ul style="list-style-type: none">• Equipment• Installation & training• Tax & freight• Depreciation	<ul style="list-style-type: none">• Direct labor + any benefits• Media with its incoming freight• Compressed air (electrical)• Maintenance – labor• Maintenance – wear parts• Disposal (spent media & dust)• Opportunity costs

Reduce labor costs

Many owners would guess that material or compressed air cost the most. However, in most situations it is *labor*. So do what is needed to cut down on labor. This can be as simple as investing in an “abrasive upgrade,” a stationary gun holder, a different type of blast gun, or pre-packaged system conversion. But where warranted, a whole new system – perhaps including automation – may also be in order.

Paying a worker to blast six or eight hours a day – when the same work could be accomplished in a fraction of that time – is wasteful. In addition, fewer hours spent blasting will reduce overall consumption of compressed air energy, and media, and save wear and tear.

Understand media

How did you select the media you are using? For some, it's easy: it is in the spec. For others, it's what they've always used. Many people buy media by how much it costs per pound – or bag. That can be a mistake.

Today, there are dozens of media (type & size), and many are excellent. The one that will give you the best results the fastest – and hold up the longest – will also be the cheapest to use, regardless of the initial cost. Select the right media for the job, and your major – sometimes hidden – costs will diminish, because you're blasting fast and clean.

On the other hand, “cheap media” is often slow and dusty, reducing visibility (which increases rework). Inconsistent blast quality and a poor and possibly unhealthy working environment become factors. Add in extra needed maintenance, freight and disposal costs, and saving cents on media makes no sense at all. (See section: “How to Select Blast Media” at the end of this article.)

Bonus savings

A modest operation in New Hampshire was able to save thousands of dollars a year by upgrading to a media that, per pound, is much more expensive to purchase. The savings? They realized their hazardous disposal costs were killing them. Media that yielded similar results – with 15 times the service life – was recommended after determining suitability in the lab. Disposal volume plummeted, enabling the blasting operation to become clean and profitable.

Optimize your compressed air

Loss of production, rework and downtime are all costly – and you may not be aware there's a problem lurking in your compressed air supply.

Compressed air for blast systems must be oil-free and “clean and dry” and that usually means a refrigerated air dryer. Moist air is the source of many blasting ills, especially in high humidity when water condenses easily, contaminating media and causing flash rusting. “Economizing” on the pipe diameter to the blast machine and adding other restrictions such as quick disconnect fittings can reduce performance.

Air compressors have improved significantly. Consult with your supplier: a compressed air audit may reveal potential savings.

Use the correct blast nozzles

The right blast nozzle can greatly increase the utility of your machine, and today there are many that offer gains in production. New ergonomic blast guns for manual cabinets are much easier to use¹. Fan nozzles provide wide spray. Air-induction nozzles eliminate the blasting “hot spot” that can otherwise warp delicate parts and make for slow, streaky blasting. A variety of side-outlet nozzles reach into or behind difficult-to-access areas. Extra long venturi nozzles have been developed to increase production up to 40% over conventional nozzles when

using the same amount of compressed air.

In terms of compressed air consumption, it can be very costly to leave a worn nozzle in place. Be sure to use a durable, high performance nozzle – cheap disposables need frequent replacement, can lead to premature blast hose replacement, tax your compressor, and drive up labor and energy costs.

Extra labor costs can be incurred by not using a large enough nozzle in the first place² – re-evaluate and realign your CFM consumption to your throughput needs.



Figure 1. Simply upgrading to a blast gun designed for productivity and ergonomics yields big bang for the buck³.

2. ACHIEVE CONSISTENT QUALITY

Blasting is a recipe with many ingredients and techniques, so get to know what affects the speed and quality of your individual application.

Variables:

- **Media:** Shape, size, hardness, durability / breakdown rate, ability to be reclaimed for reuse, consistency after repeated usage.
- **Blasting:** Dwell, distance, pressure (PSI), impingement angle, nozzle configuration, operator's visibility. Time between blasting and coating.
- **Substrate:** Material, hardness, malleability, part "geography," and masking requirements.
- **Coating** or corrosion to be removed: Brittleness, toughness, thickness, if it gets gummy when heated by friction, contamination by oils, excess dirt, etc. Changes, lot to lot, in the workpiece.
- **Operator** and maintenance personnel: Technique, training, ability, and work ethic.
- **Compressed air:** Volume (CFM), pressure (PSI), quality, airline restriction.
- **Equipment:** Type and suitability, in-tune or worn, filter condition.

Reclaim your media

To economize, virtually all industrial systems reuse blast media several times over. But media breaks down as it impacts hard surfaces. In dry blasting, debris from the surface of the workpiece becomes pulverized dust. Dust and broken media must be removed, or the process degrades rapidly⁴. This requires a dust collector. On cheaper systems only a fraction of the ambient dust – nearest the blast cabinet's vent – is sucked out. That's not good enough.

To maximize the extraction of dust and undesirable fines from the working media, several kinds of air wash or cyclonic separators are employed in conjunction



Figure 2. Excellent visibility is a result of durable media, well designed & maintained equipment, run by trained operators. Benefit: high production with negligible rework⁵.

with the dust collector – and all particles pass through the separation device. Many (not all) are wear-protected and have adjustable “tune-ability” so that one style reclaimer can work with a variety of abrasives, from soft to harsh, coarse to fine.

Media Make-Up

As you’d imagine on a bell curve, grit size will skew towards fineness over time due to the constant breaking down of the impacted media. The “seasoned abrasive” will be doing the work for you, patterning the surface with the texture of that “working mix.” For that reason, some operations charge the machine with a finer media and feed the make-up with coarser stock to draw the bell curve back into the intended range. Automated systems can be incorporated to constantly trickle in fresh media to “make-up” for the worn abrasive that’s been pulled out of the working mix by the reclaimer – and these “automatic make-up systems” quickly pay for themselves. That’s because, optimally, you should never have to empty the entire load of media for a fresh recharge. Surface quality will remain consistent, too. You can mimic the make-up system on simpler blast cabinets by emptying the dust collector and adding the poundage of dust taken away in fresh, new media – in frequent, small increments.

With wet slurry blasting, blast media can retain its shape and size for long periods of time. One manufacturer of engines has processed more than 2 million small parts while consuming very little ceramic bead.

Select the right pressure and angle

What blast pressure should you use? Depends.

With one-pass (disposable) media on durable parts you may wish to go all out and blast at the highest pressure⁶ in order to save labor costs.

But you may find that blasting at 90 PSI gains little over blasting at 60 PSI. Blasting at the lower pressure will increase the service life of the equipment and your recycled media, keep the media’s “working mix” bell curve centered, and save compressed air. Lower pressure blasting is also more forgiving and gentler on the parts. Experiment within the bounds of the blast specification.

Higher operating pressures can cause rougher surface profiles. Excessive pressure is one of many reasons for “embedment” of abrasive shards, which might lead to coating failure. Embedment can also occur if the media is too friable, or if the wrong blasting method is used.

What difference does it make if you blast at 90-degrees to the surface or some other angle? First, it changes the finish. You “dig” blasting straight on and “scuff” blasting at a low angle, and that affects finish. So keep a consistent angle when possible. In addition, you may find that low angle blasting is faster at removing a coating, since media plows beneath it to lift it off. When blasting at 90-degrees, incoming media is battling media rebounding off of the surface. Those collisions slow blasting rates and fracture media unnecessarily – leading to lower production, higher costs, high dust levels, and inconsistent finishes.

3. CLEAN UP! BLASTING AND “LEAN PROCESS” CAN BE COMPATIBLE

No process can be considered “lean” when a part leaves the work cell, or worse, the factory, for blast processing. The extra handling and time lost in transport and waiting for parts adds unnecessary cost and complexity. With today’s plating, painting, and adhesives, many specs do not allow parts to sit around for more than four hours, and some instruct you to plate within 30 minutes of blasting. You may not achieve that reliably with a blast lab in a remote part of the facility or off site.

There are no two ways about it, blasting can be messy – that’s the traditional reason for it being relegated to a distant room. But there are many very clean blasting operations, and yours can be, too. Today, we can put modern blast equipment *inside* some work-cells – which was unthinkable in the past.

Cabinets have evolved, dust collection can be fortified, and new techniques implemented. Eliminating dust through smart equipment and media selection should be a priority.

A work cell machine can be compact and simple. For example, a powered spindle that rotates your part allows blasting to proceed while your operator attends to other tasks in the cell.

Wet slurry blast⁷ machinery combining wash – blast – rinse in a single step. That is lean. And because these machines are inherently cleaner, they can fit into the process cell, so queuing, steps, and lost time are eliminated.

On other systems, media catch trays, some of which are self-cleaning, can be added, as well as features and controls that keep dust emissions at bay. Vertical sliding doors and doors with delay-timer locks help keep things compact and clean.

Scrap a poorly performing or undersized⁹ dust collector and upgrade to a self-cleaning cartridge model with “surface-loading¹⁰” filters. Consider equipping it with a pulse-cleaning controller¹¹ with monitoring gauge, after-filters (HEPA) and a variable frequency drive with airflow controller¹². It should have a sealed waste drum. Every part of the system should be under negative pressure; some blowers pressurize their dust collector, and a small leak there will make a big mess everywhere.



Figure 3. A work cell machine where a robot does the blasting. This wet slurry blast machine⁸ is compact and clean.

4. BLAST THROUGH THE BOTTLENECK

What’s slowing you down? Is it your material handling, the blast machine, a poor selection of process variables, or something harder to pin down?

Handle it

Whether you’re cleaning large engine housings in a walk-in room or deburring tiny injector nozzles, material handling is critical. And there is a wide variety of tools available that facilitate processing your part’s properties and batch sizes in your working environment. Some of these include:

- **Robotics**
- **Turntables: continuously powered, indexing (satellite) and spinner-hanger**
- **“Lazy Susan” turntables – stationary, with dolly, or powered in-and-out**
- **Crane slots in the roof**



Figure 4. A simple automated blast machine for ID and OD blasting on a wide range of part sizes keeps this job shop blasting in the fast lane. Machine has multiple vertically oscillating guns and PLC controls. A crane slot with powered turntable facilitates material handling. It is shown set up for ID blasting on a jet engine burner can¹³.

- **Inline: belt or roller conveyor, pinch belt, train tracks.**
- **Tumbelt, batch and basket blasters.**
- **Lathe-style, either enclosed in a cabinet, or open with a vacuum-blast work-head.**
- **Custom modifications to better match the cabinet to the part or process, such as tilting turntables, feed-through iris orifice, etc.**

Blast efficiently

Sometimes you just need a blast cabinet on steroids, and that calls for direct-pressure blasting, wheel blasting, or any one of several dynamic approaches to blast prep (equipment, media, training, etc.). Each has limitations to consider, but for covering a lot of tough ground efficiently, they save labor like no other. For instance, those who upgrade to direct-pressure

often find a day's worth of blasting done by morning break. It might be time to audit your operations, call in your blasting expert and re-evaluate, using their local test lab.

Less can be more

A New England machine shop blasted a forged part several times during its routing, and they had picked up a well worn multi-gun automatic blast cabinet as well as two inexpensive blast cabinets for the task. But blasting was still taking too much time. Although they were using an appropriate media, the equipment was inadequate. All of these machines were replaced with a new, centrally-located direct-pressure blast cabinet and a single, well-trained operator. Floor space was reclaimed and the hours spent blasting reduced significantly. Maintaining one machine that was wear-protected from the start became easy to manage.

Automate it

In air blast and wet blast systems, automation often means moving multiple nozzles along the profile of the part, maintaining the optimal stand-off distance and angle of incidence. Nozzles may be fixed – to blast moving parts, attached to linear oscillator or robotic arm, or arrayed in “whirlybird” fashion.

When you eliminate bottlenecks, you may find yourself with lot of extra capacity. That could leave you seeking additional, profitable blasting work.

5. FIND A WAY

Everyone has their own idea of what blasting is. There is suction, direct-pressure, wheel and wet slurry. Manual cabinets, suit-up/walk-in blast rooms, and automation of every description. And more.

Bicarb blasting, dry ice blasting, vacuum blasting, laser coating removal all have their place. Keep in mind that no tool does it all, and some are much better at a particular process than another.

Today there are more choices than ever, and it will pay to work with your local supplier to make sure you have the advantages of modern techniques. Ask for a test to prove the process before making a commitment.

Investigate the properties of different blast media, such as:

- **Particle shape**
- **Hardness & density**
- **Grit size**
- **Durability**

You may find, with testing, that you can strip paint off of glass without etching, eliminate masking, use less topcoat, etc. A good supplier can help you determine the best choice.

Accessing hard-to-reach recessed areas on the workpiece can make blasting frustrating or impossible. Direct-pressure systems are especially useful for blasting inside tubes and odd shapes; specialized nozzles make this possible. And direct-pressure is effective at some distance, so you can effectively blast an area far from the nozzle.

Using a cabinet that is too small will restrict you from moving the end of a part in front of the operator. Custom features can be built into professional-grade blast cabinets to fit the machine to the part or process, as mentioned earlier.

6. SEND YOUR BLAST MACHINE TO REFORM SCHOOL

Blasting with abrasives can be tough on the equipment, but that does not mean consumables and maintenance will be an ongoing problem. The solution is to equip your machinery with appropriate wear protection from the start. That includes heavy-duty hoses, protective linings, rubber curtains, and long-life nozzles. Invest in these and your costs will decrease. You'll spend more time producing and less time fixing.

Larger blast cabinets last longer, too, because the abrasive is not going in "hot" on the cabinet wall, having had time to dissipate its energy.

Automated systems often have a run-time meter to keep track of actual blasting hours. Utilize it to keep a log and anticipate - not react to - your maintenance needs.

Preventive maintenance beats fixing. Set up a schedule. Refer to manufacturer's manuals, and consider farming out PM to experts on a regular, scheduled basis, perhaps spring and fall.

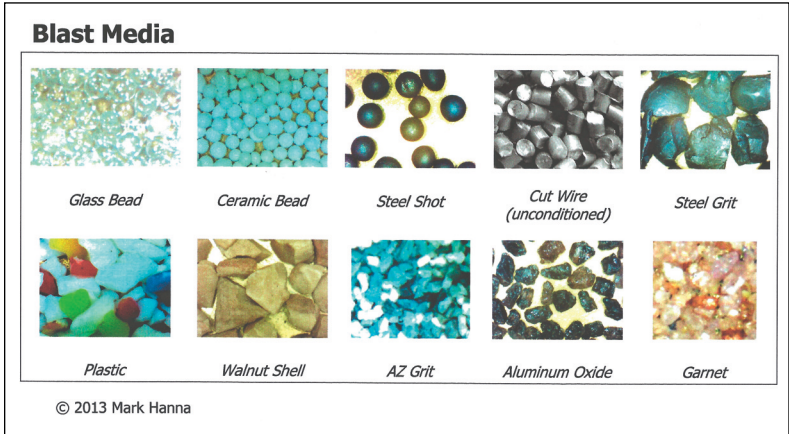


Figure 5. A "Pencil Blast" nozzle with its tank and foot treadle. Micro-blasters make for easy access of detail areas on parts large and small. They are often used for such work as deburring aerospace parts and select coating removal¹⁴.

HOW TO SELECT BLAST MEDIA

Step one in your goal of a cleaner, more effective, and profitable blast prep is selecting the best blast media for the job. As noted earlier in this article, “The media that will give you the best results the fastest – and hold up the longest – will also be the cheapest to use, regardless of the initial cost.”

Variety: With so much to choose from, different blasting media can handle any blast prep requirement.



Various factors go into selecting the most appropriate media, including:

Particle shape: Round mediapeen and sharp media etch. Think “ball-peen hammer” and “chisel” (on a micro, but broad, scale). The medium imparts its reverse image onto the substrate. For brittle coatings or removing light, burrs, etc., a round media will probably work best by “flexing” the coating loose, and it will leave the smoothest finish. To aggressively “cut” the surface and leave a profile of “peaks and valleys” a hard, sharp or blocky media will do best. A soft, blocky media can strip without etching.

Hardness: Relative to the substrate and coating, pick an appropriate media hardness, which ranges from almost 1.0 (the rating for talc) to nearly 10.0 (the rating for diamond, on the logarithmic moh scale).

Optimizing grit hardness

An example of thoughtful hardness selection comes from blasting a fry pan made from an aluminum bottom fused to a stainless sidewall: A melamine plastic media at 4.0 will profile the softer aluminum so that Teflon® will anchor to it, all the while not etching the harder stainless portion of the pan. No masking required: how is that for “lean” manufacturing!

Grit size: Often a too-coarse abrasive is selected, under the theory that larger media will last longer in the system and therefore cost less. However, a finer medium often does the job faster, whereas coarse media will not only take longer, but also require copious amount of primer to cover the rough peaks and

valleys it leaves behind.

The reason finer media often works faster is that, for instance, a fine #10 glass bead (100-170 mesh) has over 300 million particles per pound compared to a coarser #5 glass bead (40-50 mesh) at “only” 7.9 million beads per pound. So, you see, many more particles hit every square inch every second.

Fine media won't work all the time. In circumstances when you need to “power through” a tough coating or severely rusted surface, the momentum of a coarse, dense media particle is the only way to “cut it.”

Also, medical implants such as titanium knees may require a very coarse profile for the human body's bones to “knit” onto successfully. So every application requires a thoughtful analysis of grit size needs.

And, of course, your blasting spec may dictate your mesh size.

Density:

A denser media will carry more of its kinetic energy onto the surface for more power when needed. You can actually save some energy by lowering the PSI when upgrading to a denser media. And, you can safely work on many delicate substrates with low pressure, and soft, low density media such as plastic, walnut, corn cob or bicarb.

Durability – Friability:

A friable medium is more likely to fall apart upon impact. This can be a problem or you can use it to your benefit, depending upon your aim. Dry ice blasting is popular for specific applications, and it takes friability to an extreme – it literally explodes upon contact with the surface, with the expanding volumetric energy getting underneath and lifting lightly adhered contaminants, such as hot plastic deposits inside injection mold cavities – as the media transitions to gas. (Thermal shock of CO₂ at -107 degrees F against a hot residue also helps in these cases.)

Generally, durable media is the best choice. And media that keeps its shape gives the most consistent blasting results and quality finishes over time. Ceramic bead and cut wire are fine examples of high-yield blasting media.

Cost:

Your selection of media directly affects blasting cost. Remember, the best media is fastest and cleanest, and you'll have your priorities right – and be on the road to more profitable blasting.

Divergent needs:

There's no two ways about it. Those shops that need to produce a variety of finishes will have to keep several kinds of media on hand. If production or scale warrants, you may find that you dedicate one machine to aluminum oxide, one to glass bead, etc.

Seek expertise:

Buying media from a distant catalog source that offers no expertise is no way to purchase media. Seek out your local blasting supply house for expertise. And use their local test lab, which should be well stocked with modern blast equipment and a variety of different media.

CONCLUSION

Abrasive blasting can be a cleaner, faster, lower maintenance-intensive process. Labor costs dearly, so reduce it through thoughtful selection of equipment and

media. Rely on local outside sources for expertise. Determine if you want to spend a little extra up front to gain the benefits that better equipment, media, and product support offers: higher quality, higher yield, and an improved work environment.

REFERENCES

1. By ditching the old trigger blast gun and upgrading instead to a more effective gun with a foot treadle, you'll blast faster and lessen the chance of workman's compensation squeezing that trigger for hours on end has lead to claims for carpal tunnel, tennis elbow, etc.
2. Changing nozzle size may necessitate other system changes. Consult your supplier.
3. Photo of ergonomic blast gun courtesy of Kennametal Abrasive Flow Products.
4. Dust is erosive, prevents free-flow of media, clogs filters, slows blasting, and in manual operations, reduces visibility – which is important to speed and quality results, without costly rework.
5. Photo by the author.
6. Most pressure vessels are rated for 125 PSI; some newer ones for 150 PSI.
7. Older designs of wet slurry blasting machines did not have the advantages of today's models. Be sure the one you select is designed for easy maintenance, durability, and clean operation – and is constructed with all-stainless steel (or roto-molded plastics when lower production economics are required). A glandless vortex pump will beat an older design in performance, and be sure the pump is rebuild-able, without tools, in minutes. This is one case where you get what you pay for, and good engineering counts.
8. Photo provided courtesy Wet Technologies, Inc.
9. Sizing the dust collector involves determining the total air flow (CFM) required, friction factors through the system (including ductwork), the air-to-filter ratio (CFM: FT2) appropriate for the particular contaminant, and a variety of other factors. Therefore, adapting surplus collectors to blasting processes should only be done after a complete evaluation. (That would also include the risk of inheriting potentially hazardous dust shipped in with a used collector). The blaster's dust collector should be sized not just to overcome the incoming amount of compressed air, but also create several air changes, up to 10 or more per minute, depending upon the cabinet size. The blower that powers the dust collector must be matched in air flow rate with its reclaimer.
10. UltraWeb® by Donaldson-Torit is the originator, and many consider the best. This style filter prevents submicron particles from bypassing or prematurely clogging the filter media, amongst other benefits.
11. Wild changes in filter loading caused by inattention to the basic operational task of filter purging will lead to fluctuations in the operating conditions, and that can affect quality, cost, and add to the dust burden. For this reason, automating the cleaning cycle, using a narrow on/off band, is recommended.
12. A VFD, when tied in with an airflow controller, keeps air flow consistent, increases the service life of the filters, saves electricity, and ensures that your critical reclaimer system stays “in tune.”
13. Photo by the author.
14. Photo of micro-blast courtesy of Vaniman Manufacturing.

ABOUT THE AUTHOR

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