

The Benefits of Air Blast to Improve the Surface of 3D Metal Parts

In our first paper “Exploring Metal Finishing Methods for 3D-printed Parts,” we offered a broad introduction to mass finishing and abrasive blasting. This application note describes the surface finishing (post processing) problem faced by most 3D printer users and why air blast is the simplest, fastest and most cost effective way to improve the finish.

A Note about Post-Processing: Post Processing has become a “catch all” term in the 3D Industry that implies different meanings. Post processing can refer to (1) support removal (2) surface preparation/refinement (3) cleaning (4) final finishing (plating, anodizing or powder coating). The aim of the finishing methods described in this application note is to improve the aesthetic appearance of the final part. Through the finishing process surface imperfections are removed, such as build lines. Maintaining required tolerances and geometric specifications, while improving the surface finish is of critical importance.

Problem

It is estimated that 85% of metal parts, whether forged, cast, machined or 3D printed, require some sort of finishing process after they have been formed. Despite improvements in forming methods, metal parts have surface imperfections such as machine lines, burrs and sharp edges that need to be removed and smoothed. For 3D printed parts in particular, build lines present a unique finishing challenge. In addition, oxidation (discoloration) from the sintering process may occur. Finally, when a part is 3D printed the surfaces of the model interacting with the support structure or the support raft has a significantly different surface profile than the sides and the top of the part. In this case,

it is desirable to create a more uniform surface finish across the entire part (bottom, sides and top).

There are many types of low volume 3D printer users who will be interested in aesthetically finishing 3D parts, some of them are:

- Engineering firms and manufacturers, who will be printing 3D parts for prototyping and tooling.
- Value Added Resellers, who will be selling 3D printers and printing samples that can be used for marketing
- Contract manufacturers and service bureaus, who will be printing 3D parts for a variety of customers as a value added service

The Benefits of Air Blasting

Desktop Metal blasts many of the parts they produce with their Studio Printer™ for prospective customers and end users. After testing a variety of finishing techniques with parts formed by Desktop Metal’s Studio Printer™, Fortune Metal believes air blast will be the preferred way to refine the surface for the majority of 3D printer users.

1. Air blast is the simplest, fastest and least expensive way to smooth surface lines and bring out better color of 3D parts.
2. Air blast will suit the majority of users, who use printers for prototyping or tooling applications. These low volume users will want to blast an estimated 3-5 parts a week and will prefer finishing parts in-real-time (rather than having to send them out to be finished). While air blast does not offer the super finishes of mass finishing, it does provide a basic finish.

3. Air blast does not require more costly equipment, ceramic and plastic medias, water, compounds and pastes, extensive R&D testing, nor waste water treatment. Parts can be finished within minutes, rather than the more lengthy mass finishing methods. Air blast users will need a blast cabinet, some type of abrasive media and a compressed air source.

Fortune Metal 3D

The Fortune Metal 3D Suction Blast Cabinet improves the surface of 3D metal parts, leaving them with a consistent finish over their entire surface. The cabinet fits into tight office, lab and industrial workspaces, yet is versatile and rugged enough to finish a wide range of parts with complex geometries.



The following features and benefits are notable:

1. The small footprint of the machine enables those in office and lab environments to include a blast cabinet in the same space as the Studio System™.
2. The compact design enables first-time blasters to set up a finishing operation without too much trouble. A quick start video will be available at fortunemetal.com.
3. The industrial quality of the gun body and metering valve enables a superior finish to that normally found in a basic blast cabinet.
4. The blast cabinet can be used with glass beads, aluminum oxide and fine steel shot to provide both a matte and bright finish. A quick change media dump valve allows operators to change media simply.
5. LED Lighting improves visibility.
6. A fixed gun mount allows operators to blast “hands free” when finishing parts with complex geometries.
7. A dust collector and reclaim upgrade is available for those looking to blast for longer periods of time.

FEATURES & COMPONENTS

- 14ga steel construction.
- Interior-mounted blast gun is height and angle adjustable, and also can be detached and hand-held.
- High-output, 50-watt LED light for excellent visibility.
- Flip-up, top-access door with laminated safety-glass view window.
- Safety interlock stops blasting if window is opened.
- Pressure regulator and gauge to monitor and adjust blast pressure for different finishes.
- Moisture separator removes condensed water from air supply.

- Clear media hose allows visibility of media flow.
- Lever-operated valve, quick-drain hopper makes disposing of worn-out media a quick, simple, and clean process. It is designed to release into a standard-size, 5-gallon bucket.

300 CFM DUST-BAG DRUM COLLECTOR

- Optimizes visibility inside the cabinet while blasting.
- Exhaust noise level is approximately 80 dBa when located in an open space.
- BNP® Blast Gun
- Foot-operated pedal.
- Fixed, interior mount is height and angle adjustable. Gun can quickly be detached from mount and then handheld.
- Equipped with a 1/8" air jet and a 5/16" ceramic nozzle. (Air consumption is 21 CFM at 80 psi.)
- Can be fitted with a tungsten-carbide or boron-carbide nozzle, depending on abrasive used.
- Efficiently designed mixing chamber eliminates slugging and uneven media flow.

Note about Compressed Air Requirements

The cabinet for Desktop Metal applications has been designed for a number 4 (1/8") jet with a number 5 nozzle. With a pressure range of 50 to 90 psi the requirements are from 15 to 24 CFM. This translates into a compressor motor size of 5.75 to 9.25 HP motors. Most of Fortune Metal Finishing's tests on Desktop parts have been blasted using 80 PSI. A compressed air source is required for operation of a blast cabinet. If you do not have compressed air in your facility, our recommendation is to buy inexpensive compressors at Home Depot and quieter industrial compressors from Atlas Copco, which can be supplied through Fortune Metal Finishing.

For more information or to request a quote for the Fortune Metal 3D cabinet and abrasive media, please visit fortunemetal.com.

Results

Below you will find finishes you can expect when blasting with glass bead, stainless shot and aluminum oxide media.



Media Finish	Results
#8 Glass Bead	Least aggressive Brightest finish Minimal reduction in build lines
#180 Stainless Shot	Moderately aggressive Less bright, but comparable to glass bead Some reduction in build lines
#60 Aluminum Oxide Grit	Most aggressive Matte grey finish Best blended surface

Air Blast Compared to Mass Finishing Alternatives

Fortune Metal believes that alternative finishing methods to air blasting will be of interest to some studio printer users and to those who invest in Production printing. The quality of mass "media" finishing techniques provide a lower RA and improved aesthetics. However, it is important to understand the cost and complexity of these finishing methods. Seven major surface finishing techniques are described in the below table. We continue to explore all these options as possible solutions depending on finish requirements and part geometry.

Surface Finishing Methods for 3D Parts

Process	Ease of Use/ Finish Time/ Investment	Advantages	Disadvantages
Abrasive Blasting			
Airblast	Simple Minutes ~\$7K-\$15K	Simple to operate and provides a basic finish inexpensively. Does not require water, but does require compressed air.	Only one part can be finished at a time. Simpler versions can be noisy and have limited dust collection.
Wet Blast	Fair Minutes ~\$35K	Process generates no dust and offers good visibility during work. Finish excellence, especially on delicate parts	Waste water sludge; maintenance of pump
Mass Finishing			
Standard Vibratory and Tumble	Fair 24-48 hours ~\$7.5K-\$20K	Multiple parts/batch, lower cost than high energy machines	Very long processing time to see results on 3D parts; edge erosion vs. dimensional tolerance; wastewater requirements
High Energy: Centrifugal Disk	More complex 30 min-6 hours ~\$20K	Multiple parts/batch, faster, excellent cut and jewelry finish	Often multi-step/labor intensive, edge erosion vs. dimensional tolerance; wastewater requirements
High Energy: Centrifugal Barrel	More complex 30 min-3 hours ~\$20K	Excellent cut and finish, significant work can be done quickly	Often multi-step/labor intensive, more set up time required, edge erosion vs. dimensional tolerance; wastewater requirements
Accelerated Chemistry	Complex 2-6 hours ~\$35K	Chemicals intensify vibratory work for both cutting and smoothing. May improve part strength (compare to shot peening). May use high energy or standard vibratory equipment	Chemical formulas require additional expertise and the process often requires multiple steps.
Drag, Stream, Spin Finish	Complex 30 min-3 hours (very intense) \$100K+	Fixtures can position parts at various angles to achieve finish in hard to reach areas.	It takes time and money to build and test fixtures. Spindles limit the number of parts per session.



Privately owned and operated, Fortune Metal Finishing collaborates with parts manufacturers in the Northeast on superior mechanical surface finishing. Fortune Metal processes parts in a finishing job shop in Massachusetts, staffed by experienced technicians or works with manufacturers to set up best-in-class finishing operations inside their companies. In 2018-2019, Fortune Metal partnered with Desktop Metal and Clemco Industries to design an air blast cabinet for the 3D market which launches Fall 2019.

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