# ADVANCED SUSTAINMENT SOLUTIONS

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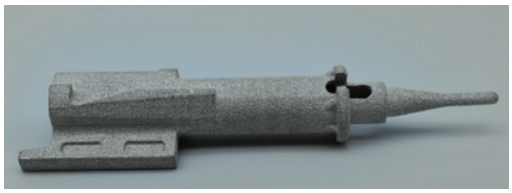
**Binder Jet 17-4 PH Firearms Components**

FreeFORM technologies

REM® Surface Engineering

# BINDER JET 17-4 PH FIREARMS COMPONENTS

## About this part

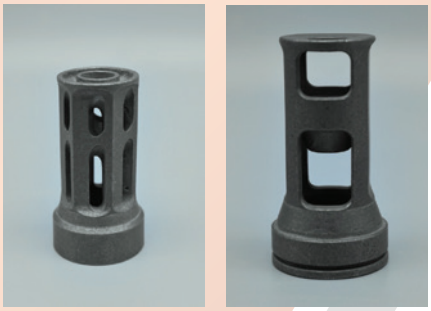


As-Sintered

These 17-4 PH stainless steel parts represent various firearm components fabricated via metal binder jetting technology. Metal binder jetting is an additive manufacturing technology that utilizes an industrial printhead to deposit a liquid binder agent onto a thin layer of metal powder. This binder is deposited in a predefined pattern to construct a component or multiple components in a layer-by-layer approach. Binder jetting offers substantial speed and cost advantages over other powder bed fusion (PBF) based additive manufacturing technologies. Laser and electron beam PBF technologies rely upon single or multiple energy sources to fuse/melt/sinter powder particles, thus limiting the amount of "work" that can be accomplished at any given time to the number of energy sources and their respective beam/spot size. Conversely, in binder jetting, the printhead sweeps across the entire powder bed in a matter of seconds and can fuse a multitude of points with every sweep. After printing, binder jet parts are in a "green state" and must undergo a sintering process to fuse the bound metal particles into a "fully dense" part with the desired material and mechanical properties. Thus, binder jetting is ideally suited to medium and high volume part demands that can be produced in batches.

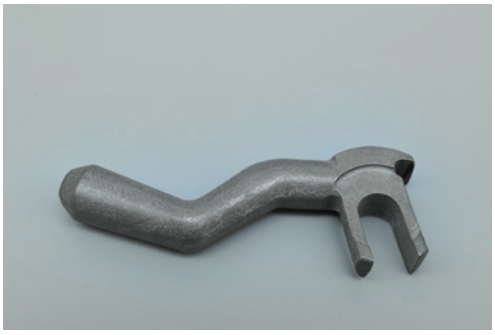
After REM's Polishing

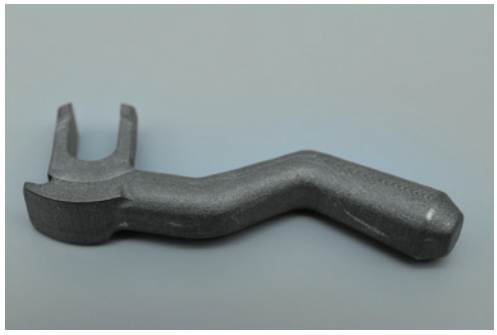
Because of its speed and cost advantages, binder jetting is an attractive option for higher volume applications that may not be a good fit for laser or electron beam PBF technologies, metal injection molding (MIM), or other non-additive manufacturing technologies. While binder jet parts tend to have a lower starting roughness than other metal additive manufacturing technologies, for many applications, there are advantages/requirements to applying a surface finishing or polishing process to further reduce surface roughness.



After Basic Tumbling

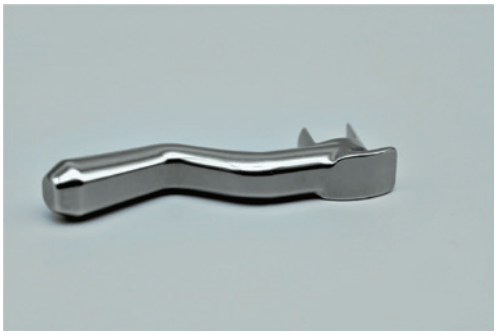
After REM's Polishing





**After Basic Tumbling**

These components were printed by FreeFORM Technologies using their Desktop Metal Shop System™. The Shop System is a binder jetting system designed to integrate into machine shops. It can produce multiple part geometries in a single batch using a tooling-free manufacturing process; this manufacturing approach provides valuable flexibility and productivity at a comparatively low price point as compared to laser and electron beam additive manufacturing systems.



**After REM's Polishing**

After printing, these parts were processed via the Chemical-Mechanical Polishing (CMP) process of REM's Extreme ISF® Process suite of technologies. This surface polishing technology is suitable for low and high volume batch processing, and it offers best in class material removal, roughness reduction, and processing efficiency while minimizing component geometry alteration. REM's CMP technology is easily installed and operated on a manufacturing shop floor and integrates easily into an additive, subtractive, or hybrid-manufacturing environment. REM's CMP technology can produce an isotropic superfinish on components and has known benefits such as roughness and waviness reduction, elimination of layer/staircase texture, removal of foreign object debris (FOD), improvements to part cleanliness, improved coating adhesion, and increased component fatigue life. On 17-4 PH and other stainless steel alloys, REM's technology has been shown to increase the materials corrosion resistance and resistance to stress corrosion cracking. REM's stainless steel surface finishing technology is based on decades of experience in the energy generation and medical industries where thousands of compressor blades, medical tools, and the like have been processed via REM's technology. REM has established CMP material capabilities on steel, stainless steel, titanium, aluminum, copper, and

# FreeFORM
## About the Printer

FreeFORM Technology is a company of engineers, created for engineers. Their mission focuses on bringing the freedom of design to the customer while providing a low cost of ownership and a high speed to market. FreeFORM provides additive manufacturing processes as a service including metal binder jetting, stereolithography (SLA), and fused filament fabrication (FFF) as well as metal injection molding (MIM), toll debinding and sintering services, and engineering services. FreeFORM brings vast powder metal manufacturing experience to the market and offers a range of materials including 17-4P H, 304L, 316L, M2 Tool Steel, and Inconel 718.

# REM SURFACE ENGINEERING
## About the Surface Finisher

REM Surface Engineering (REM) is a family owned, small business with over 60 years of continuous operation specializing in surface finishing and polishing of metal components. REM are the inventors of isotropic superfinishing and their Extreme ISF® Process is the leading metal additive surface finishing process for component performance benefits including increases to fatigue life, increases to corrosion resistance, improvements to part cleanliness, and improvements to fluid flow properties. Past and current customers include NASA, DoD, DoE, and numerous aerospace OEMs/commercial space launch companies. REM has received 7 SBIR grants in the past 4 years including currently active Phase 2 and Phase 3 SBIR's with NASA and the US Air Force. REM is ISO9001:2015, AS9100D Certified and ITAR registered, and is a member of America Makes and the NASA RAMPT Project. REM has business locations in Southington, CT; Merrillville, IN; and Brenham, TX; as well as a sister company located in St. Neots, UK.