APG
Alpha Precision Group
A Division of Nichols Portland, Inc.

APG MANUFACTURES LATHE CHUCK JAWS USING TRITONE'S MOLDJET ADDITIVE MANUFACTURING TECHNOLOGY

KEY HIGHLIGHTS

INDUSTRY
Contract Manufacturing of sintered metal components

THE CHALLENGE
Improve quality of machining operations through improved work-holding design

THE SOLUTION
Lightweight lathe chuck jaw design

SUCCESS
Lowered clamping pressure enables a more accurate machining operation and improved process yield

ABOUT ALPHA PRECISION GROUP (APG)

Alpha Precision Group (alphaprecisionpm.com) was established in 2016 following the merger of Alpha Sintered Metals LLC, Precision Compacted Components Inc., and Precision-Made Products LLC. These legacy companies represent a unique blend of technologies, manufacturing experience, market segmentation and product offerings. With histories dating back 50 years and more, APG companies have been pioneers in material and process improvement technologies that have helped to both shaped and advanced the powder metallurgy industry.

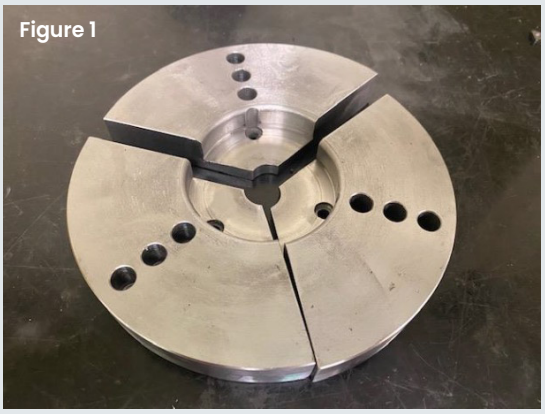
In January 2018, APG expanded its capabilities with the acquisition of Mercury Manufacturing in Wyandotte, MI, thereby establishing a Specialty Valves and Machining Division. This strategic move not only complements APG's existing product lines but also enhances its precision machining capabilities, fostering synergies, and offering expanded solutions to its current customer base.

At APG, dedication to ISO 14001 standards is based on a commitment to long-term sustainability. Raw material (powder metal) is derived from recycled metals – helping to reduce energy consumption and the demands of natural resources. Sintered Metal and Specialty Valve offerings are on-trend with engine designs targeted to reduce emissions and improve fuel economy. Additionally, Metal Injection Molding (MIM) technology affords intricate, fully dense metal forming capabilities with minimal to no material waste.

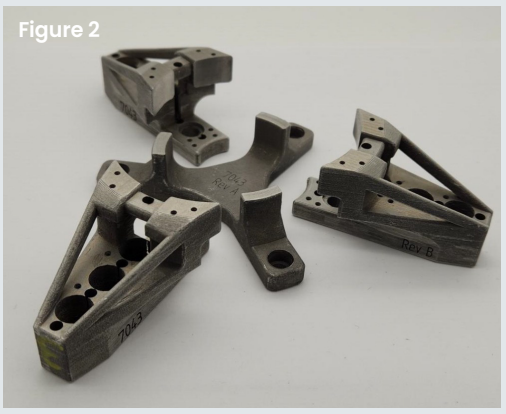
BUSINESS CHALLENGE

One of APG's conventional press and sinter powder metal plants had a challenge with holding critical tolerances when post-sinter machining certain gear components. Conventional mild steel soft chuck jaws were used to hold the gears during machining (see figure 1). Due to the high mass of these jaws, a large centrifugal force was generated as the lathe spun at high RPM. A high clamping pressure was then required to overcome this force to hold the part. The excess clamping force introduced some distortion to the part which made it a challenge to maintain tolerances and overall production yield.

The team connected with APG's Additive group to explore solutions to improve the clamping mechanism



The original, heavy weight chuck design, produced by CNC.



The new lightweight AM manufactured Chuck Jaw using Tritone MoldJet technology.

Figure 1
OD Grip and depth stops are designed into one component.

- Weight of the assembly: **2.13 KG**
- Required Operating pressure: **30 PSI**

Figure 2
A redesigned Chuck Jaw set using separate components for external clamp and depth stops. This design uses a fine lattice geometry throughout the components to maintain rigidity while dramatically reducing weight.

- Total Weight: **0.336 KG (84% reduction)**

OBJECTIVES

The primary objective of the project was to undertake a comprehensive redesign of the chuck jaws, leveraging the inherent design flexibility offered by additive manufacturing techniques. The aim was to significantly reduce the weight of the chuck jaws, thereby capitalizing on the unique capabilities of additive manufacturing to push the boundaries of traditional design constraints. The envisioned lighter chuck jaws would necessitate reduced clamping force during operation, thereby mitigating the risk of workpiece distortion.
This reduction in clamping pressure not only promised to enhance machining capabilities but also offered the potential to improve overall repeatability and yield rates in production processes. By focusing on this strategic redesign initiative, the project sought to unlock a multitude of benefits, ranging from increased operational efficiency to heightened precision and reliability in machining operations.

TECHNICAL SOLUTION

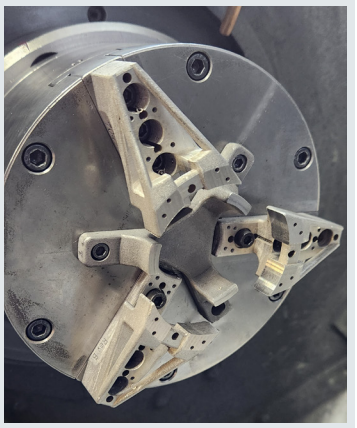
To fully minimize the weight of each component in the system, APG had to redesign the inside of the components as well as the visible outside aspects of the design.
APG engineers used a proprietary lattice geometry throughout the components to achieve this goal. The lattice was enabled by Tritone's unique technology where all the "empty space" in the lattice is occupied by a soluble mold material during the build. This material is eliminated with Tritone's hands-free post process allowing a much lighter structure than could have been produced with competing technologies.

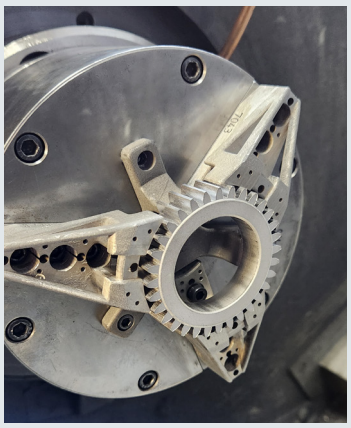
Figure 3
This is the Chuck Jaw's cross section which is latticed to save weight. Tritone's process allows this complex design.

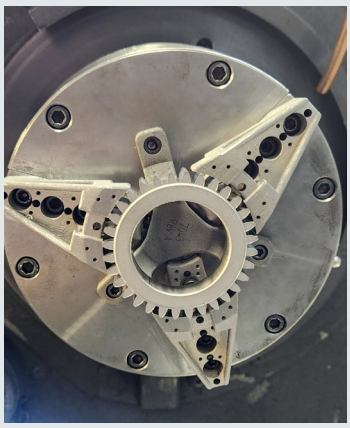
RESULT

The APG Additive engineering team were able to redesign the chuck jaws and depth stops using dFAM principles (Design for Additive Manufacturing).
The result was a weight reduction of 84%, from 2.13 KG to 0.336 KG.
An important piece of APG's light weighting strategy was their use of fine internal lattice geometry inside the jaws. They also determined that breaking up the clamp jaws from the depth stops would improve the nesting consistency.

Figure 4
Replication of Figure 2 for reference purposes.







Figures 5, 6 and 7
Show the new Chuck Jaw set installed on the lathe and with the gear component in position.

BENEFITS

- 84% weight reduction compared to the original jaw design
- Clamping air pressure was reduced by 67% compared to the original design
- Quality of machined features significantly improved.
  - ID size and circularity ~ 140% Improvement
  - Overall thickness and parallelism ~ 125% improvement

APG TESTIMONIAL

> We are thrilled with the results of this program. We look forward to expanding this success internally across our facilities and offering these fixtures on a "turnkey" basis to customers. We have proven the business case as well as the technical capabilities and are excited to help other internal and external customers realize these benefits.
>
> **Joe Taylor, Manufacturing Engineer, APG**

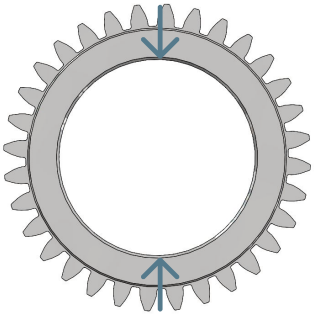
WITH THE SUCCESS OF THIS APPLICATION, APG IS EXPANDING TO OTHER WORK-HOLDING APPLICATIONS IN THEIR PLANTS AND OFFERS LIGHT-WEIGHTED JAW DESIGN/BUILD AS A TURNKEY SERVICE TO CUSTOMERS.

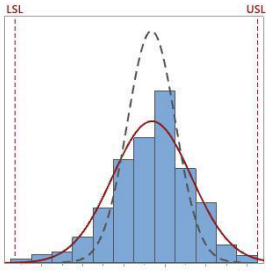
SUCCESS

The lighter chuck jaws had an immediate impact on machining tolerances in this operation. Clamping force was reduced from 30 to 10 PSI (67%) which had the desired results of:

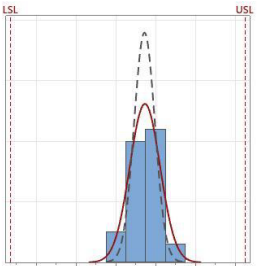
- Tighter tolerances (see tables below)
- Less scrap
- Reduced wear and tear on lathes with a lighter load
- Lower cost than other weight reduction alternates explored

Process Capability Comparison Center Bore, Largest Id

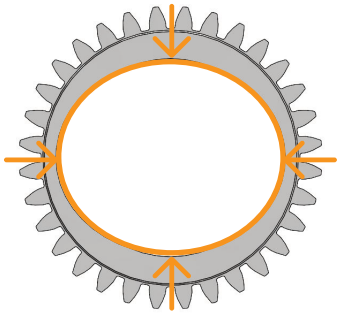


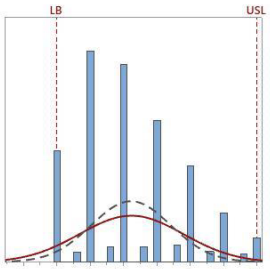


Original Chuck Jaws
Cp: 1.67
Pp: 1.02

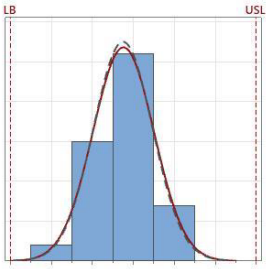


Tritone Chuck Jaws
Cp: 3.75
Pp: 2.58





Original Chuck Jaws
Cp: 1.05
Pp: 0.81



Tritone Chuck Jaws
Cp: 1.97
Pp: 1.45

Note:

- Process Capability is a statistical measurement representing the ability of a process to produce desired results.
- Cp – is a measure of the potential of a process to provide output which is within upper and lower specification limits.
- Pp - is a measure of the actual performance of a process in providing output which is within upper and lower specification limits.

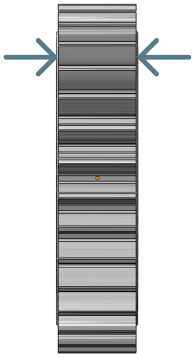
  APG uses a minimum Pp and Cp of 1.33 to deem a process as adequately controlled.

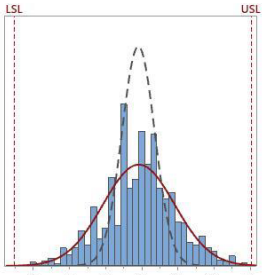
Tritone

SUCCESS

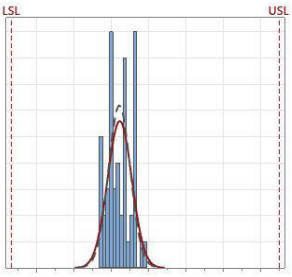
Process Capability Comparison Facing Operation

OAL – Overall Length – the widest measurement front to back



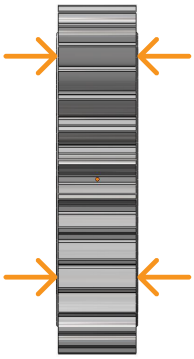


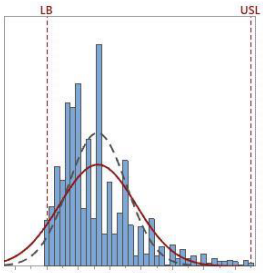
Original Chuck Jaws
Cp: 2.39
Pp: 1.10



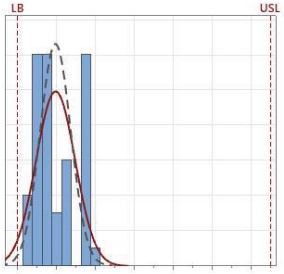
Tritone Chuck Jaws
Cp: 4.07
Pp: 3.68

OAL Parallel Process Capability – Variation of width across part





Original Chuck Jaws
Cp: 1.75
Pp: 1.34



Tritone Chuck Jaws
Cp: 4.66
Pp: 3.66

About Tritone Technologies

Tritone Technologies transforms metal Additive Manufacturing to address the demanding standards and needs of industrial production. The company's innovative technology enables industrial throughput of accurate parts with a range of metal and ceramic materials, suitable for the Automotive, Aerospace, Medical and Consumer Electronics industries.

Founded in 2017, Tritone is led by an experienced team of experts with a track record in driving technology and business growth. Backed by private equity firm Fortissimo, Tritone is a global company and is based in Israel with presence in North America and Germany.