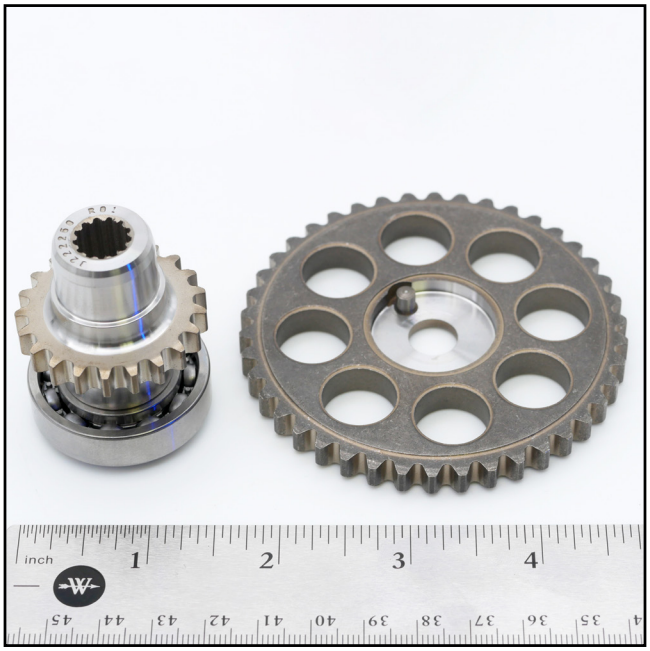
CASE STUDY



A 2019 Award of Distinction Winner in the Hand Tools/ Recreation category for Conventional PM Components

Camshaft & Water Pump Sprocket

Process:
Conventional Powder Metallurgy

Material:
Modified 4300 Low-Alloy Steel Powder

Density:
7.2 g/cm^3

Ultimate Tensile Strength:
1,350 MPa

Apparent Hardness:
45 HRC

End Use and Function

This award-winning component is a camshaft and water-pump sprockets made for the Polaris Slingshot, a three-wheeled, side-by-side moto roadster. These components are some of the most critical engine components on any vehicle. Tensile strength, hardness, and impact toughness are critical and, for powder metallurgy (PM) fabrication, had to meet or exceed requirements previously established with machined, wrought components during prototype development.

Fabrication

The water-pump sprocket was especially challenging, as the customer desired a one-piece shaft/sprocket design. Compaction required a significant amount of powder transfer to the upper punch. The parts are made from a modified 4300 low-alloy steel powder that is warm-die compacted and high-temperature vacuum sintered to a typical density of 7.2 g/cm^3, giving an ultimate tensile strength of 1,350 MPa (195,000 psi), 1.8% elongation, and an apparent hardness of 45 HRC.

Results

The PM components represent a 40% cost saving compared with machining. The PM process offered a net-shape processing opportunity which saved an average of 30%–40% raw material usage versus machining.