

# ALUMINIUM TECHNOLOGY

## HIGH-PERFORMANCE ALUMINUM TECHNOLOGY

Lightweight Aluminum in  
Powder Metallurgy



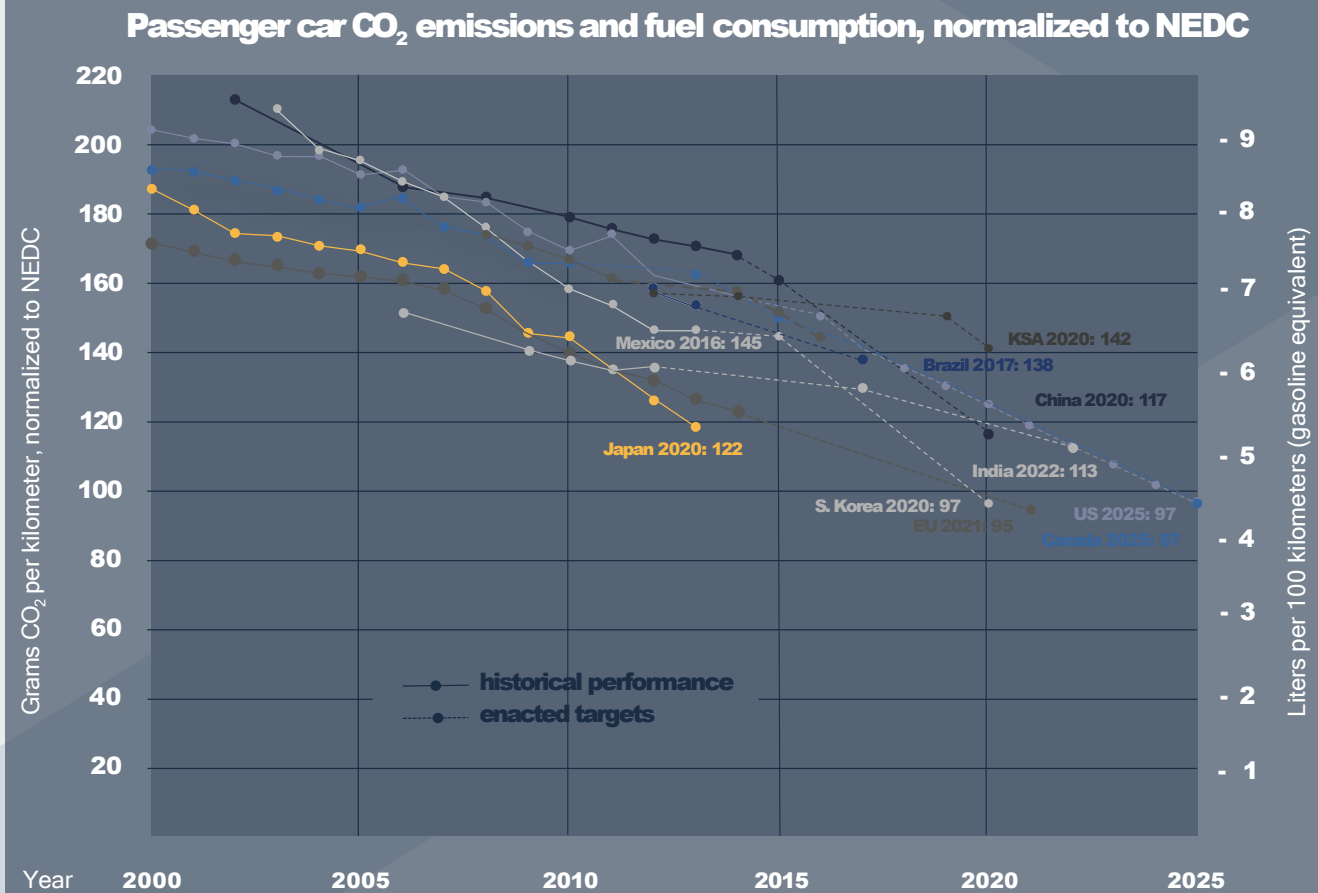
# THE MARKET'S DRIVE TOWARD LIGHTWEIGHT TECHNOLOGY

## > Market Drivers

- > CO<sub>2</sub> emissions and fuel economy standards are mandating vehicle mass reduction
- > Internal combustion engines and hybrid electric vehicle efficiency hinges on smaller engine size, increased transmission speed
- > Reduction in mass reduces energy use for all forms of energy: ICE, Hybrid, and Electric

## > GKN Solutions

- > GKN PM's lightweight technology minimizes component mass without compromising performance
- > GKN's advanced Powder Metallurgy (PM) technology produces high-strength, net-shape parts geared toward ICE, hybrid and vehicle electrification
- > GKN is the leader in PM technology and develops lightweight, high-performance Aluminum materials and products



# COMBINING EFFICIENT PROCESSING WITH ADVANCED LIGHTWEIGHT MATERIALS

## > Why Powder Metallurgy?

### Unrivaled Design Freedom

- > Unique part geometries
- > Simplified product design without compromised functionality
- > High material utilization greater than 90 percent
- > Rapid prototype development, scalable to high-volume production

## > Why GKN PM?

### Aluminum Metal Matrix Composite (Al MMC) Technology

- > Hard ceramic, uniformly distributed within tough Al-alloy matrix
- > Improved static and dynamic performance over conventional Al-alloys
- > Readily forgeable, significantly increasing mechanical performance

### Novel Al-Alloy with High Thermal Conductivity (TC2000 series)

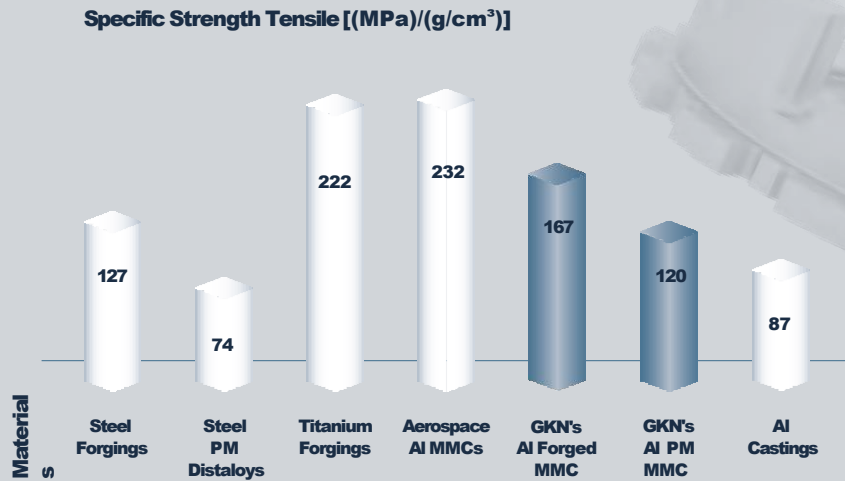
- > Versatile material for thermal management applications



PRODUCT	Net shape	Efficiency	Inertia	Thermal	Mass
Heat Management	●	●		●	
Transmissions	●		●		●
Hydraulic	●	●			●
Engines	●	●	●		●

# MATERIALS – GKN PM'S ALUMINUM MMC

## > Specific Strength

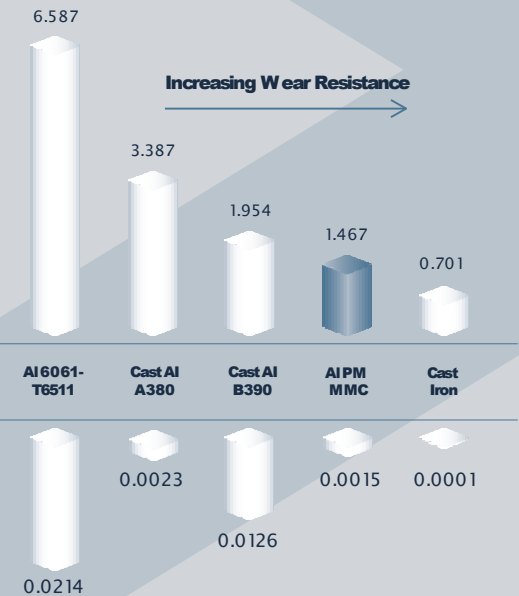


## > Wear Resistance

### ASTM G77 – Block-on-Ring Wear Test

Wear Scar Width (mm)

Mass Change of Ring (g)



> Higher strength-to-weight ratio, allowing for mass reduction and improved vehicle efficiency

> Forging specific strength exceeds steel PM alloys and forgings

> Superior resistance to sliding wear for use in hydraulic applications

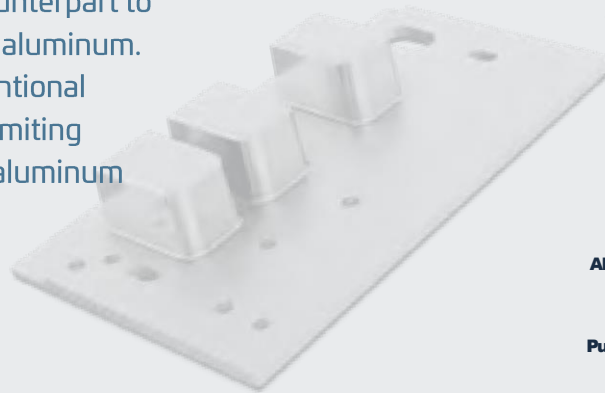
> Minimized oil contamination (no abrasive Si particles), improved pump efficiency

> CTE match with aluminum housing improves overall pump efficiency

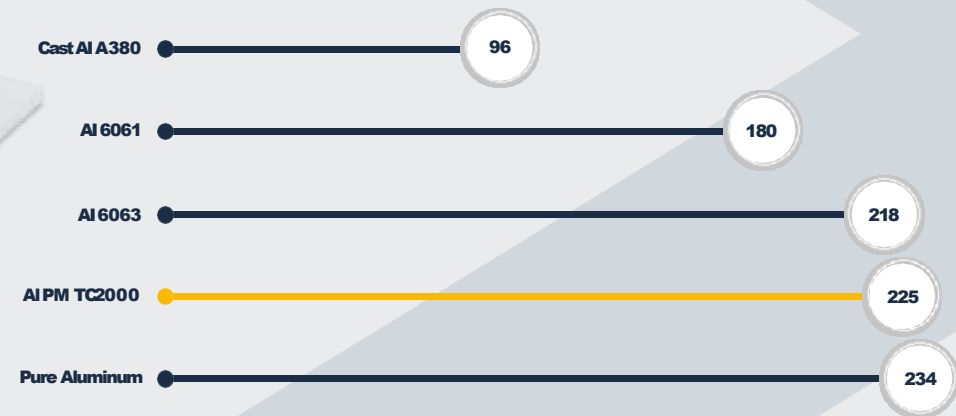
# MATERIALS – GKN PM'S ALUMINUM TC2000 SERIES

## > Thermal Conductivity

GKN's TC2000 is the PM counterpart to commercially pure, wrought aluminum. TC2000 outperforms conventional extrusions and castings by limiting solute impurities within the aluminum matrix.



Thermal Conductivity (W / m-K)



## > Qualitative Benefits



### Formability

Unique, net-shape geometries with excellent tolerance control without costly machining



### Manufacturability

High production volumes with reliable performance



### Green

Minimal material scrap and completely recyclable material, minimizing environmental impact

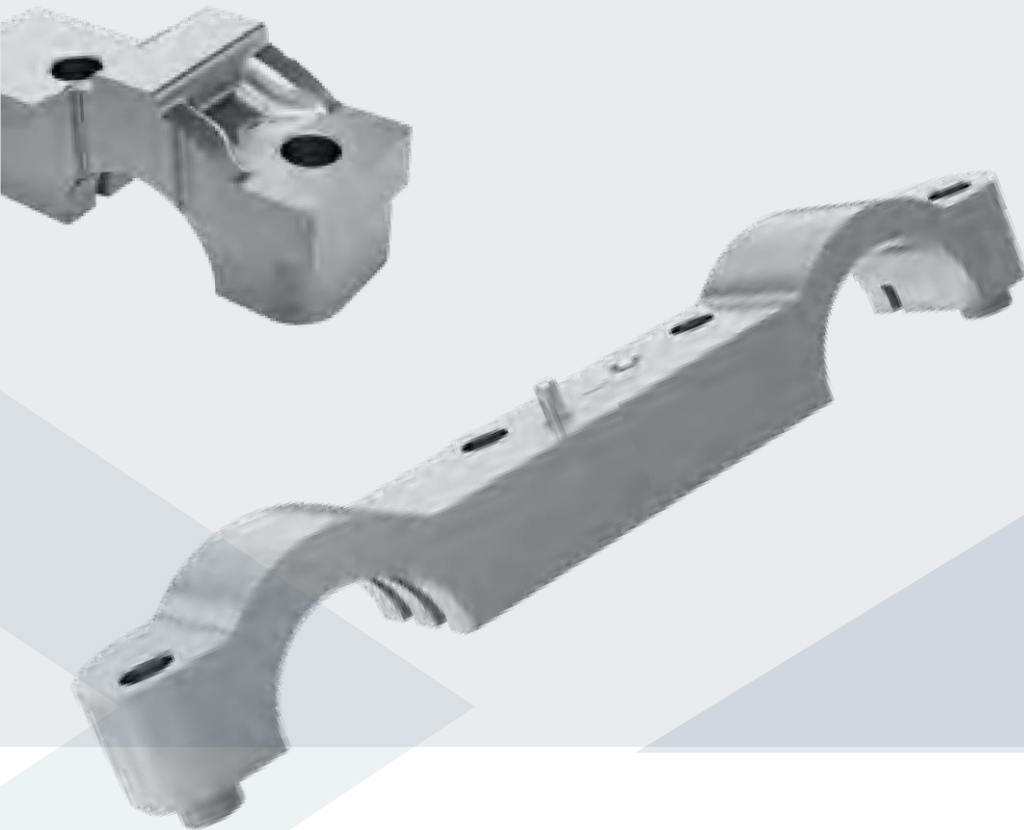


### Design

GKN engineers use modeling and simulation to ensure optimized designs, meeting customer requirements

# LIGHTWEIGHT APPLICATIONS

## *Camshaft Bearing Caps*



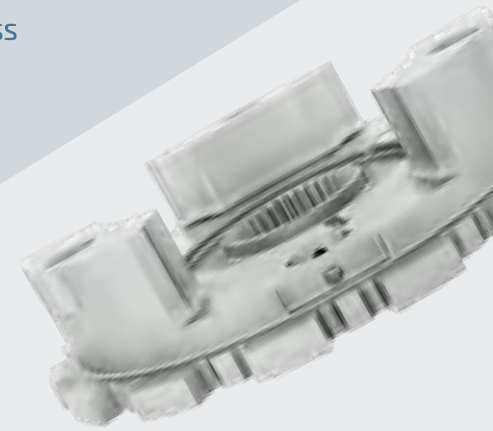
GKN Powder Metallurgy produces over 30 million engine camshaft caps per year, designed to exceed unique customer requirements. Several material options allow for design flexibility to optimize geometric precision, strength, toughness, wear resistance and/or cost.

- > GKN's PM netshape design only requires customer line bore
- > High wear and fatigue resistance (with optional MMC material)
- > Unique Z-loc, for dowel elimination



# LIGHTWEIGHT APPLICATIONS

## > *Planetary Reaction Carrier*



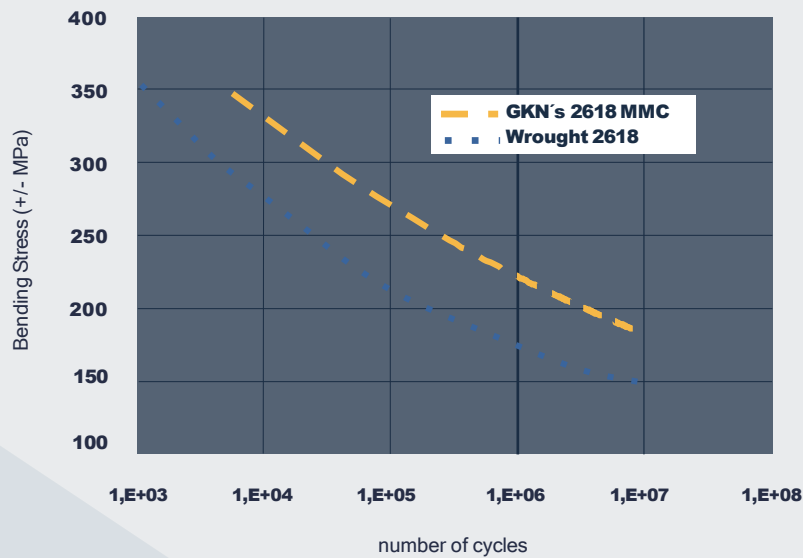
This MPIF award-winning Planetary Reaction Carrier is the first commercial use of powder metal Aluminum MMC material for a carrier application. The technology won the 2018 Grand Prize in the MPIF Design Excellence Awards.

- > Introduction of aluminum reduced the mass of the carrier application by 1 kg
- > High wear resistance and lower inertial mass
- > Maintains strength and fatigue at operating temperature of 150 degrees Celsius
- > Industry-winning dimensional precision

# LIGHTWEIGHT APPLICATIONS

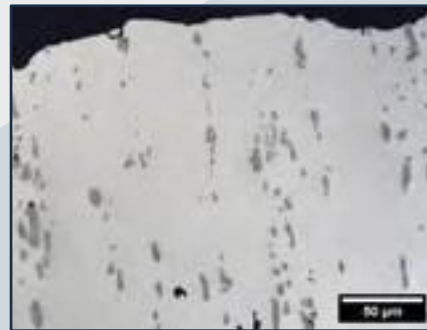
## Forged Products

Bending Fatigue Strength



GKN is in production development of Aluminum forged products:

- > Tailored preform design allows for highly controllable plastic flow
- > Near-net shape, and economical process eliminates subsequent working operations
- > Fatigue properties exceed wrought forged Aluminum



Conventional Forged Material



GKN's Forged MMC Material





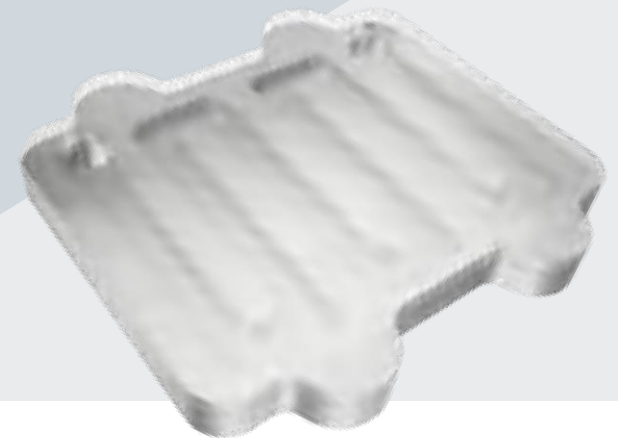
# LIGHTWEIGHT APPLICATIONS

## > Heat Sink



GKN PM's heat sink was developed to replace die cast components for a car radio cooling application.

- > Unique tower and three section sizes, not practical for casting or extrusion
- > Higher thermal conductivity, requiring less thermal mass
- > No machining required, providing cost savings
- > High ductility, reducing risk of cracking during mechanical attachment



# OUR SOLUTIONS



Learn More at  
[www.gknpm.com](http://www.gknpm.com)