

# Si<sub>3</sub>N<sub>4</sub>

## Automotive Engine Components

Automotive engine manufacturers face the ongoing problem of meeting emission standards without sacrificing fuel economy. In order to solve the problem, they must increase fuel injection and cylinder operating pressures. However, when pressure increases occur, metal parts tend to fail because of galling and contact fatigue. The result is poor mechanical reliability and increased warranty cost.

Ceralloy® Silicon Nitride is the material of choice to replace metal parts because it affords higher compressive strength and increased contact fatigue resistance. Silicon nitride also has unique tribological properties versus metals so the net result is improved mechanical reliability and reduced warranty cost.



Property	Result	Benefit
Lightweight	Reduced rotational moment of inertia	Eliminates skidding and galling for cam rollers
	Reduced moment of inertia	Increased horsepower
Low coefficient of friction	Reduced friction	Increased horsepower
Contact fatigue resistance	Increased component life	Improved mechanical reliability
Hardness	Increased wear resistance	Increased mechanical durability

Ceradyne silicon nitride possesses the optimal physical properties to solve high contact stress problems. With its use, warranty issues can be eliminated and engine reliability increased. As a result, silicon nitride has become the premier ceramic for engine applications.

Ceradyne provides custom engineering and prototyping services and has produced high volumes of silicon nitride automotive engine components since 1999. Millions of these components are in hundreds of thousands of engines where they are performing with no field related problems. In order to meet today's high expectations for engine performance and reliability, consider the proven Ceralloy® Silicon Nitride solution.

### Properties

- Lightweight (60% Lighter than Steel)
- High Fracture Toughness
- Wear Resistant
- Low Coefficient of Friction
- Contact Fatigue Resistant

### Applications

- Cam Rollers
- Fuel Pump Components
- Engine Valves
- Check Valves
- EGR Valves
- Valve Seats
- Valve Guides
- And Others

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Property	Ceralloy® 147-31N
<b>Process</b>	Sintered Reaction Bonded
<b>Density (g/cc)</b>	3.2
<b>% Theoretical Density</b>	>99.5
<b>% Open Porosity</b>	0
<b>Purity (% Si<sub>3</sub>N<sub>4</sub>)</b>	92
<b>Mechanical Characteristics</b>	
Flexural Strength (MPa) @ RT	700-800
Weibull Modulus	15-50
Elastic Modulus (GPa)	310
Poisson's Ratio	0.27
Hardness HV (0.3) Kg/mm <sup>2</sup>	1450
Fracture Toughness (MPam <sup>1/2</sup> )	6.0
Abrasive Wear Resistance Parameter**	825
<b>Thermal</b>	
Thermal Expansion Coeff. 10 <sup>-6</sup> /°C, (RT-1000°C)	3.1
Thermal Conductivity (W/mK) @ 25°C	26
Thermal Shock Parameter (°C)***	610
<b>Electrical</b>	
Electrical Resistivity (ohm-cm)	10 <sup>16</sup>
Dielectric Constant	8
<b>Key Features</b>	Strength, Hertzian Contact Strength, Structural Reliability, Net Shape Fabrication
<b>Applications</b>	Automotive Components, Bearings, Wear Components



\* Property values are typical and should not be considered specifications.  
 \*\* Abrasive Wear Resistance Parameter = Fracture Toughness<sup>(0.5)</sup> \* Hardness<sup>(1.45)</sup> \* Elastic Modulus<sup>(1.08)</sup>  
 \*\*\* Thermal Shock Parameter = [Strength \* (1-Poisson's Ratio)] / (Elastic Modulus \* Thermal Expansion Coeff.)



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### Ceradyne Advanced Technical Ceramics

Ceradyne, Inc. (NASDAQ:CRDN) is a publicly traded corporation specializing in development and production of advanced technical ceramics. Manufacturing facilities are based in California, Georgia, Kentucky, Michigan, Germany and France. Ceradyne's advanced ceramics are sought for the most demanding applications in automotive, wear, semiconductor, orthodontic and armor industries.

Ceralloy® 147 Silicon Nitride components are produced in fully dedicated facilities using patented compositions and processing techniques. Plentiful raw materials are coupled with conventional, time-tested ceramic manufacturing processes that produce high quality, cost effective silicon nitride components.