3M Science. Applied to Life.™

Tough under pressure.

3M™ Silicon Nitride 147-31N

A reliable ceramic material for the oil & gas industry

- High strength and fracture toughness
- Corrosion and wear resistance
- Low coefficient of thermal expansion
- High dielectric strength
- Microwave transparency

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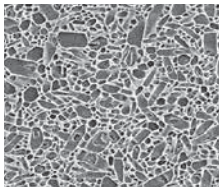
From extreme temperatures and crushing pressures to corrosive chemicals, today's harsh oilfield environments place enormous demands on critical equipment. Since the 1990s, 3M™ Silicon Nitride has been used to extend the life of critical equipment in oil exploration and recovery operations – improving reliability even under the most challenging downhole conditions.



3M™ Silicon Nitride 147-31N plasma etched microstructure, with interlocking needle-like grains

3M™ Silicon Nitride 147-31N is a lightweight, high-strength and chemically inert ceramic material with excellent resistance to abrasion and corrosion. Its high thermal shock resistance and low coefficient of thermal expansion help withstand the extreme temperatures of deepwater operations. 3M silicon nitride 147-31N is also nonmagnetic, has high dielectric strength and offers microwave transparency.

3M silicon nitride materials and components are produced at fully dedicated manufacturing plants in the U.S., using unique compositions and processing techniques. These processes yield a fully dense and nonporous microstructure of interlocking needle-shaped grains. This microstructure toughens the silicon nitride by a crack-deflection process similar to that found in composite materials. The result is a monolithic silicon nitride with extremely high hardness and increased fracture toughness. This can translate to improved mechanical reliability compared to other ceramic materials. 3M silicon nitride 147-31N can be produced in cost-effective, complex net shapes, thereby reducing or eliminating the need for expensive diamond grinding.

Oil and Gas Applications

Telemetry tooling

3M supplies silicon nitride components for use in downhole logging tools where lightweight, electrically resistant, nonmagnetic and high-strength materials are required. This telemetry tooling has been used to log data from wells in excess of 9000 meters deep.

Measuring wheels

3M silicon nitride can be used to replace component alloys in the wheels used to measure oil well depth. 3M silicon nitride 147-31N features excellent wear resistance and a low coefficient of thermal expansion, which are key properties for this application.

Balls for check valves

Check valve balls made of 3M silicon nitride 147-31N are widely used throughout the Permian Basin and other regions to help extend the life of sucker rod pumps used in oil recovery. 3M silicon nitride offers high strength, fracture toughness, and excellent resistance to wear, chemicals and erosion. This helps provide longer component life cycles even under demanding conditions.

Additional applications

Other drilling applications can benefit from the unique properties of 3M silicon nitride 147-31N. For more information on how 3M silicon nitride could help improve the performance of your system, contact your 3M or 3M Technical Ceramics technical representative.

Typical Properties (Not for specification purposes)

Physical Properties	3M™ Silicon Nitride 147-31N
Process	Sinter Reaction Bonded
Density (g/cc)	3.2
% Theoretical Density	98.5
% Open Porosity	0
Purity (% Si_3N_4)	92
Mechanical Properties	
Flexural Strength (MPa) @ RT	800
Weibull Modulus	15–50
Elastic Modulus (GPa)	310
Poisson's Ratio	0.27
Hardness HV (0.3) kg/mm^2	1450
Fracture Toughness (MPam^{½})	6.0
Thermal Properties	
Thermal Expansion Coeff. 10^{-6}/ °C (RT–1000°C)	3.1
Thermal Conductivity (W/mK) @25°C	26
Thermal Shock Parameter (°C)*	610
Electrical Properties	
Electrical Resistivity (Ωcm)	10^{14}
Dielectric Constant	8

* Thermal Shock Parameter = [Strength × (1-Poisson's Ratio)] / (Elastic Modulus × Thermal Expansion Coeff.)

Product is manufactured and sold by 3M Technical Ceramics Inc.

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