

715-6534 to 715-6595

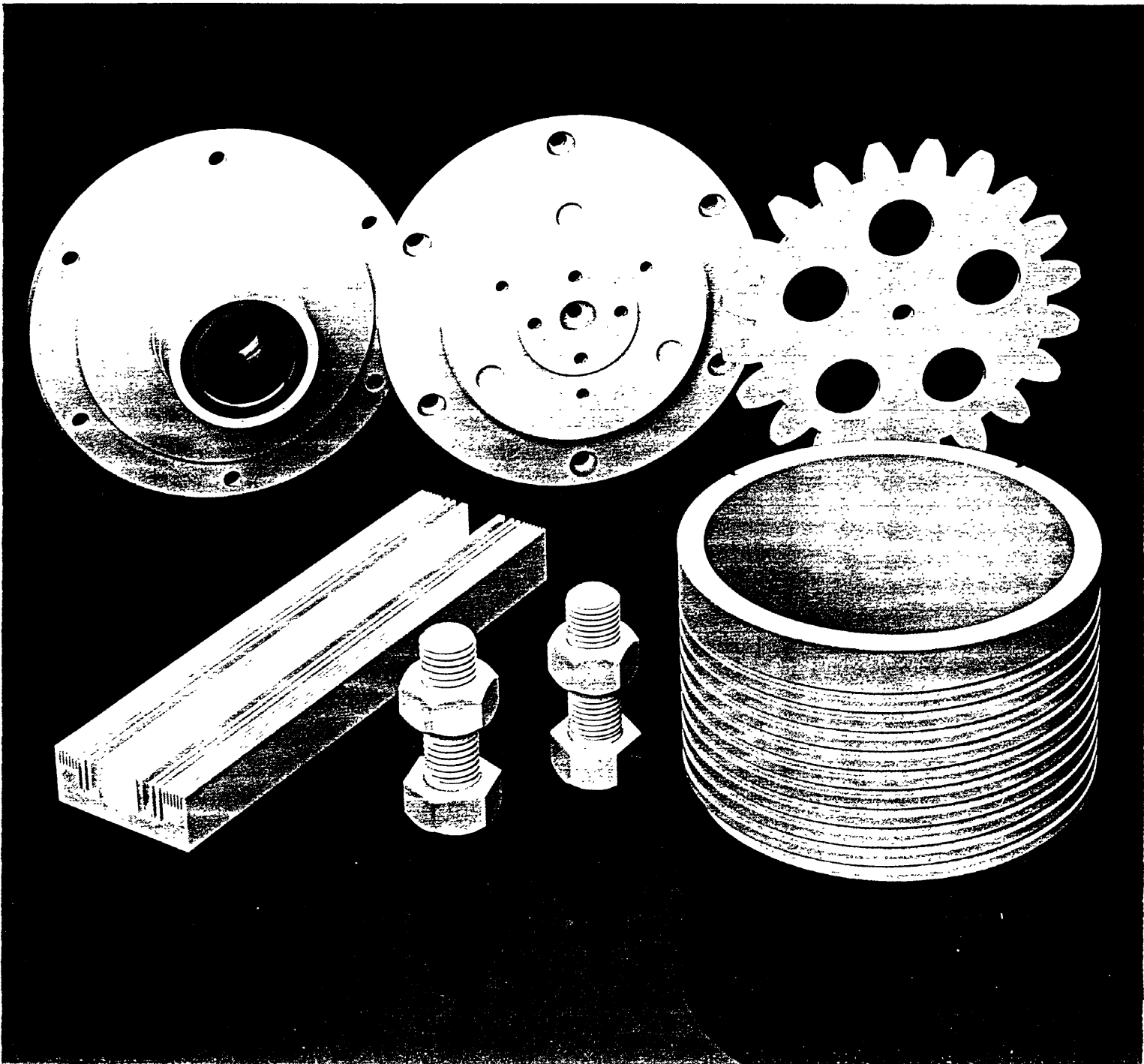
MACHINABLE AlN CERAMIC

# SHAPAL™-M soft

TECHNICAL BULLETIN



PRECISION CERAMICS LTD  
124 ELECTRIC AVENUE  
WITTON  
BIRMINGHAM  
B6 7DZ  
Tel: 0121 323 2851  
Fax: 0121 323 1628

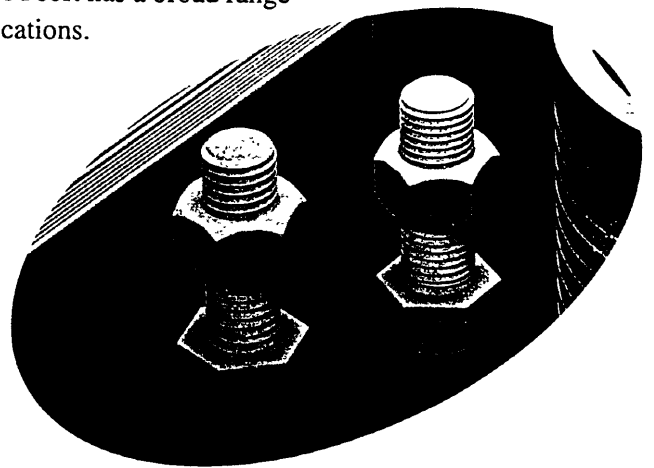


# ***Excellent machinability, high thermal conductivity and high mechanical strength applicable to structural and a broad range of other uses.***

Ceramic materials are distinguished from metals and organic materials for their unique characteristics, but their use is limited because of difficulty in machining as they are generally too hard and brittle.

Recently, some kinds of machinable ceramics have been developed for better machinability and they have attracted special interests. Although they have high machinability, yet they are not applicable in the engineering purposes due to the low bending strength as low as 10kg/mm<sup>2</sup>.

SHAPAL-M soft is a new type of machinable ceramic with high mechanical strength and thermal conductivity. It is made on the basis of the first translucent aluminum nitride ceramic developed in the world by Tokuyama Soda Co., Ltd. Based on its new and unique characteristics, SHAPAL-M soft has a broad range of uses as a structural material and for many other applications.



## ***Machinable AlN ceramic SHAPAL™-M soft***

### **Characteristics:**

**(1) Excellent machinability**

SHAPAL-M soft can be machined by a broad range of methods such as drilling, grinding, turning, milling, etc., to form complex shapes with high precision.

**(2) Excellent sealing ability to vacuum**

**(3) High thermal conductivity**

Approximately five times as much thermal conductivity as that of alumina ceramic.

**(4) High mechanical strength**

Bending strength of 30kg/mm<sup>2</sup>\* is comparable to that of alumina ceramic.

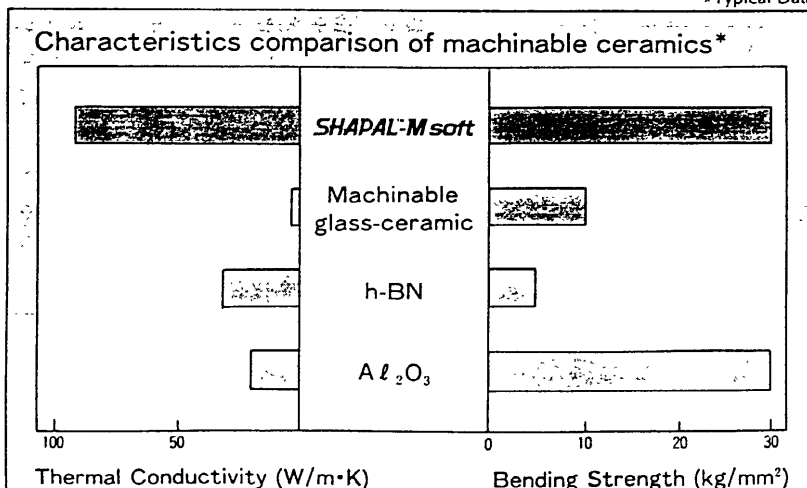
**(5) Excellent electric insulation**

**(6) SHAPAL-M soft is unique compared to other fine ceramics.**

- Low thermal expansion
- High ability in heat resistance
- Low dielectric loss
- Ultra high purity

(SHAPAL-M soft is a composite sintered body of AlN and BN)

\*Typical Data



### **Applications:**

Prototype and or small volume production available for the following.

- (1) Vacuum parts
- (2) Several electronic parts where electrical insulation and heat dissipation are required.
- (3) Fixturing parts where low coefficient of thermal expansion is required.
- (4) Electronic parts where low dielectric constant and dissipation factor are required.
- (5) Heat sink
- (6) Crucibles for vacuum deposition.
- (7) Special refractory parts such as protective tubes.
- (8) A wide range of industrial and structural products.

## Physical Properties (Typical Data)

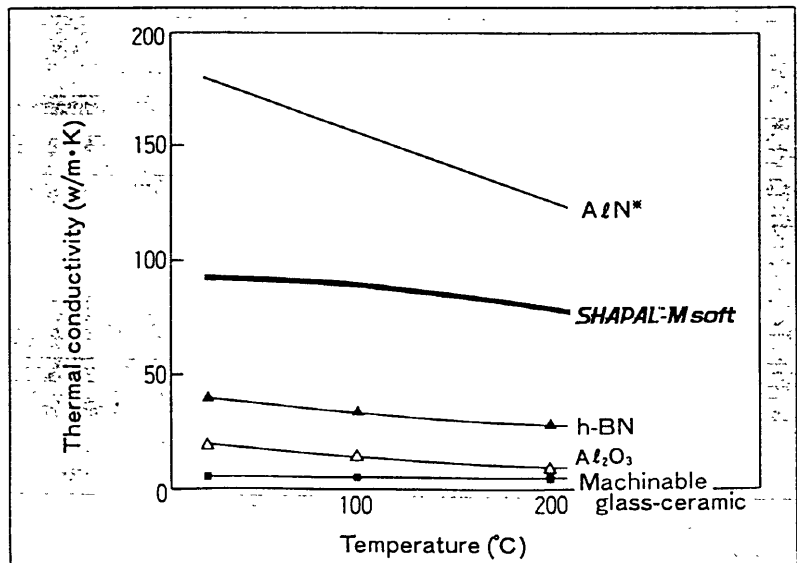
Property	Test Conditions	SHAPAL-M soft	Machinable glass-ceramic	Units
<b>GENERAL</b>				
Density	Corrected to 4°C	2.90	2.52	g/cm <sup>3</sup>
Porosity	25°C	0	0	%
<b>ELECTRICAL</b>				
Volume Resistivity	25°C, DC	10 <sup>12</sup>	10 <sup>14</sup>	Ω cm
Dissipation Factor (tan δ)	25°C, 1MHz	0.001	0.003 (10kHz) 0.007 (8.6GHz)	
Dielectric Constant (ε)	25°C, 1MHz	7.1	5.92 (10kHz) 5.68 (8.6GHz)	
Dielectric Strength	25°C, Sample thickness 1mm, AC	40	40 (thickness 10mil)	kV/mm
<b>THERMAL</b>				
Thermal Expansion Coefficient	RT to 400°C	4.4×10 <sup>-6</sup>	9.4×10 <sup>-6</sup>	/°C
	RT to 600°C	4.8×10 <sup>-6</sup>	11.0×10 <sup>-6</sup>	/°C
	RT to 800°C	5.1×10 <sup>-6</sup>	12.3×10 <sup>-6</sup>	/°C
Thermal Conductivity	25°C	90	1.7	W/m·K
Maximum Use Temp.	in air	1000		°C
	in nonoxidizing atmosphere	1900	1000 (unstressed)	°C
Thermal Shock Resistance ΔT	water quench	400	—	°C
<b>MECHANICAL</b>				
Bending Strength	25°C	30	10	kg/mm <sup>2</sup>
Compressive Strength	25°C	120	35	kg/mm <sup>2</sup>
Modulus of Elasticity	25°C	1.9×10 <sup>4</sup>	6.7×10 <sup>3</sup>	kg/mm <sup>2</sup>
Poisson's Ratio	25°C	0.31	0.27	
Vickers Hardness (Hv)	25°C, 300g	390	230	kg/mm <sup>2</sup>
<b>CHEMICAL DURABILITY</b>				
Resistance to Acid	10% HCl 24hrs, 25°C	0.2	21.5	mg/cm <sup>2</sup> wt.loss
Resistance to Base	10% NaOH 24hrs, 25°C	60	0.3	mg/cm <sup>2</sup> wt.loss

### Purity

Ca	450ppm
Cr	60ppm
Mg	15ppm
Ni	< 5ppm
Fe	20ppm
Si	< 15ppm
O	0.5%

Raw materials selected with particular care and strict manufacturing conditions have made a success to reduce impurities.

### Thermal conductivity vs. Temperature curve.



※ TOKUYAMA product

## Mechanism of Machinability

The layer crystal is to hold fracture caused by cutter from spreading into further depth, thus provides machinability to the material.

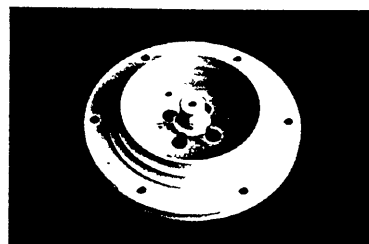
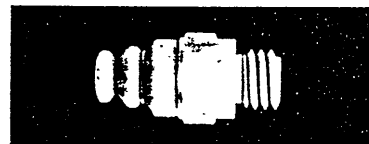
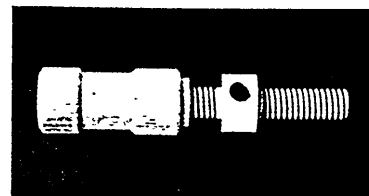


## Variation of material shapes

Blocks	
Parts No.	Size(mm)
MS 5-01	5 × 98 × 98
MS 5-02	5 × 148 × 148
MS 5-03	5 × 300 × 300
MS 10-01	10 × 98 × 98
MS 10-02	10 × 148 × 148
MS 10-03	10 × 300 × 300
MS 15-01	15 × 98 × 98
MS 15-03	15 × 300 × 300
MS 20-01	20 × 98 × 98
MS 20-03	20 × 300 × 300
MS 30-01	30 × 98 × 98
MS 30-03	30 × 300 × 300
MS 40-01	40 × 98 × 98
MS 40-03	40 × 300 × 300

Rod	
Parts No.	Size(mm)
MC 10-01	φ10 × 100Q
MC 10-03	φ10 × 300Q
MC 20-01	φ20 × 100Q
MC 20-03	φ20 × 300Q
MC 30-01	φ30 × 100Q
MC 30-03	φ30 × 300Q
MC 40-01	φ40 × 100Q
MC 40-03	φ40 × 300Q

## Machining examples



**SHAPAL** is a trade mark of Tokuyama Corp.

### Tokuyama Corp.

Electronics Sales Dept.

Shibuya Konno Bldg.

3-1, Shibuya 3-chome, Shibuya-ku, Tokyo 150, Japan

Telephone:03-3597-5135 Facsimile:03-3597-5144

### General Ceramics Inc. : a subsidiary of Tokuyama Corp.

East Coast

Haskell, New Jersey 07420, U.S.A.

Telephone:(201)839-1600 Facsimile:(201)839-5716

West Coast

2770 Coronado Street Anaheim, California 92806, U.S.A.

Telephone:(714)630-2340 Facsimile:(714)630-5730

### Tokuyama Europe GmbH

Oststrasse 10, 40211 Düsseldorf 1, Germany

Telephone:211-161-893 Facsimile:211-357-379

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