

## NUTS AND BOLTS

Goodfellow Ceramic and Glass Division is able to supply ceramic nuts, bolts and washers in both alumina and high strength zirconia materials with a variety of head styles. The characteristics of the two materials are as follows:

Property	Unit	ALUMINA	ZIRCONIA
Composition	weight %	99.8 Al <sub>2</sub> O <sub>3</sub>	5.4 Y <sub>2</sub> O <sub>3</sub>
Density	g/cm <sup>3</sup>	3.89	6.0
Porosity	volume %	Impervious	Impervious
Color		Ivory	Off-white
Hardness	GPa (Knoop)	11.1	11.7
4-point Bend Strength (MOR)	MPa (ksi)	325 (47)	600 (87)
Maximum Service Temperature	°C	1650	2200
Thermal Expansion Coefficient	°C <sup>-1</sup> (25-700°C)	7.5 x 10 <sup>-6</sup>	11.2 x 10 <sup>-6</sup>
Thermal Conductivity (20°C)	W/m·°K (Btu·in/ft <sup>2</sup> ·hr·°F)	35 (242)	2 (14)
Dielectric Strength	Volts/mil	200	51
Dielectric Constant	@1MHz @ 20°C	10.0	28.0
Volume Resistivity	Ohm·cm @ 25°C	10 <sup>14</sup>	>10 <sup>13</sup>
	Ohm·cm @ 300°C	2.5x10 <sup>11</sup>	n/a
	Ohm·cm @ 500°C	5.5x10 <sup>8</sup>	4.8x10 <sup>3</sup>

The sizes shown in **red** in the table below are normally available from stock in alumina on a quick delivery time.

Hexagonal heads are standard – other head styles are available – please refer to the ceramic fastener head styles shown on page 2.

Size – mm	Nut	Washer	BOLT LENGTH - mm									
			5	10	20	25	30	40	50	60	75	
M2	●	●	●	●								
M3	●	●	●	●	●	●						
M4	●	●	●	●	●	●	●	●				
M5	●	●	●	●	●	●	●	●	●			
M6	●	●	●	●	●	●	●	●	●	●		

Special sizes and shapes of threaded components can also be produced – please send us your drawing for quotation.

More...

→ [www.goodfellow-ceramics.com](http://www.goodfellow-ceramics.com)

→ [ceramic@goodfellow.com](mailto:ceramic@goodfellow.com)

## CERAMIC FASTENERS - AVAILABLE HEAD STYLES



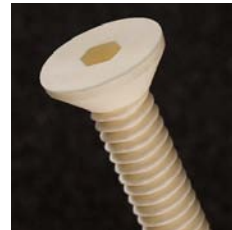
Hex Head  
(standard head style)



Pan Head



Flat Slotted Head



Flat Socket Head



Socket Head



Phillips Pan Head



Cheese Head

Please ensure that the required head style is stated when submitting an inquiry. If not stated we will quote a standard Hex Head.

Refer to page 1 for material characteristics information.

→ [www.goodfellow-ceramics.com](http://www.goodfellow-ceramics.com)

→ [ceramic@goodfellow.com](mailto:ceramic@goodfellow.com)

#### USA

Goodfellow Corporation  
Tel: +1 800 821 2870  
Fax: +1 800 283 2020

#### France

Goodfellow SARL  
Tel: 0800 917 241 (n° vert)  
or +44 1480 424813  
Fax: 0800 917 313 (n° vert)  
or +44 1480 424900

#### Germany

Goodfellow GmbH  
Tel: 0800 1000 579 (freecall)  
or +44 1480 424810  
Fax: 0800 1000 580 (freecall)  
or +44 1480 424900

#### People's Republic of China

Goodfellow Shanghai Office  
Tel: +86 21 6112 1560  
Fax: +86 21 6130 4901

#### UK and all other countries

Goodfellow Cambridge Ltd  
Tel: 0800 151 3115 (Freephone)  
or +44 (0)1480 424888  
Fax: 0800 151 3225 (Freephone)  
or +44 (0)1480 424988

