



## What materials are used in precision ball bearings?

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Several materials can be used to make bearing balls. When considering which material to use, it is important to factor in the cost, hardness, and strength. The most common ball material is 52100 chrome alloy steel. 52100 chrome alloy is versatile in regards to its lower cost, high hardness and strength.

Another commonly used material is stainless steel. When compared to 52100 chrome steel, stainless steel lacks some hardness and strength, but has the added benefit of being resistant to corrosion. Still another ball material, which is growing in use, is ceramic. Ceramics vary widely, but compared to 52100, they are much harder, stronger, lighter, and more resistant to corrosion. The main drawback in using ceramic is its higher cost.

The ball material used depends upon on the application. Most applications would only require 52100 chrome steel. In environments where corrosion is an issue, stainless steel may need to be considered. For the most demanding applications (e.g. high temperature, high stress, high speed, etc.) only a ceramic ball material may suffice.

Some various material properties can be found in Table 1.

**Table 1.** Properties of various precision ball materials.

Material		Typical Hardness	Yield Strength [kpsi]	Ultimate Strength [kpsi]	Elastic Modulus [kpsi]	Density [lbs/in <sup>3</sup> ]	Maximum Operating Temperature* [°F]
Chrome Alloy Steel	52100	60-67 HRC	295	325	29,500	0.283	400
Tool Alloy Steel	M50	60-65 HRC	-	-	29,000	0.288	1000
Stainless Steel	302	25-39 HRC (Cold Worked) 75-90 HRB (Annealed)	40-140	90-185	28,000	0.286	250
	304	25-39 HRC (Cold Worked) 75-90 HRB (Annealed)	42-140	84-185	28,000	0.286	250
	316	25-39 HRC (Cold Worked) 75-90 HRB (Annealed)	42-140	84-185	28,000	0.288	250
	440C	58-65 HRC	275	285	29,000	0.277	900
Ceramic	Alumina Oxide	1365 HV	-	330 C**	54,000,000	0.139	3180
	Ruby Sapphire	1570-1800 HV	-	300 C**	50,000,000-54,000,000	0.144	3250
	Silicon Nitride	1500-2000 HV	-	341 C**	47,000,000	0.116	2552
	Zirconia	1250 HV	-	795 C**	31,000,000	0.219	1800

\* Special process may be required to achieve maximum operating temperature

\*\* C denotes compression

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