

7. Materials for Rolling Contact Bearings

A rolling contact bearing consist of one or more rings and rolling elements (which directly support the loads) and, usually, a cage which keeps the rolling elements at equal intervals. Both rolling and sliding movements occur between these parts.

7.1 Bearing Ring and Rolling Elements

Because of high, repetitive stress to the rolling contact areas, fatigue phenomenon will occur to the bearing material after a duration of operation. Loading stress ultimately dislodges a surface section and the bearing fails. To delay the advent of material fatigue, bearing ring and rolling element materials should have the following properties:

- High level of hardness
- High rolling contact fatigue resistance
- Good wear resistance
- Dimensional stability
- Good mechanical strength

Standard NACHI material for bearing rings and rolling elements is vacuum-degassed, high-carbon, chrome bearing steel. See [Table 7.1](#).

For applications requiring a higher degree of reliability, bearing steel using a vacuum-melting process or electroslag solution (ESR).

The NACHI steel used for standard bearings is SUJ2 (JIS) steel. For large size bearings, SUJ3 or SUJ5 steels are used for hardenability.

If impact resistance is required, SNCM series steel may be used (see [Table 7.2](#)).

In addition to the above, high-speed steel may be used for bearings for applications requiring tolerance to high temperatures.

Stainless steel may be used for bearings operating in a corrosive atmosphere.

Ceramic materials may be used for special applications.

7.2 Cage Material

Materials for cages are required to have the following properties:

- Good wear resistance
- Dimensional stability
- Good mechanical strength



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Cold-rolled steel (see [Table 7.5](#)) is used for pressed cages. High-tensile-strength brass castings or machined-steel are used for machined cages (see [Tables 7.6](#) and [7.7](#)). Polyamide resin are used depending on the type of bearing and the application. For selection of cage material, it is important to consider the operating conditions. Polyamide cages should not be used at temperatures above 120°C or below -40°C. Polyamide cages should not be used in vacuum because they become brittle due to dehydration. Polyamide cages may be affected by the use of specific lubricants.

Brass cages should not be used at temperatures in excess 300°C.
Brass cages are not suitable in Ammonia (e.g. in refrigeration) because Ammonia causes season cracking in brass.

Table 7.1 High-Carbon Chrome Bearing Steel

Table 7.2 Case Hardening Steel

Table 7.3 High-Speed Steel

Table 7.4 Stainless Steel

Table 7.5 Cold Rolled Steel Strip and Cold Rolled Steel Sheet and Plate for Pressed Cage

Table 7.6 High Tensile Strength Brass Casting for Machined Cage

Table 7.7 Steel for Machined Cage

Table 7.1 High-Carbon Chrome Bearing Steel

Standard	Symbol	Chemical composition (%)						
		C	Si	Mn	P	S	Cr	Mo
JIS	SUJ 2	0.95 ~ 1.10	0.15 ~ 0.35	≤ 0.50	≤ 0.025	≤ 0.025	1.30 ~ 1.60	≤ 0.08
	SUJ 3	0.95 ~ 1.10	0.40 ~ 0.70	0.90 ~ 1.15	≤ 0.025	≤ 0.025	0.90 ~ 1.20	≤ 0.08
	SUJ 4	0.95 ~ 1.10	0.15 ~ 0.35	≤ 0.50	≤ 0.025	≤ 0.025	1.30 ~ 1.60	0.10 ~ 0.25
	SUJ 5	0.95 ~ 1.10	0.40 ~ 0.70	0.90 ~ 1.15	≤ 0.025	≤ 0.025	0.90 ~ 1.20	0.10 ~ 0.25
SAE	52100	0.98 ~ 1.10	0.15 ~ 0.35	0.25 ~ 0.45	≤ 0.025	≤ 0.025	1.30 ~ 1.60	≤ 0.10

Table 7.2 Case Hardening Steel

Standard	Symbol	Chemical composition (%)							
		C	Si	Mn	P	S	Ni	Cr	Mo
JIS	SNCM220	0.17 ~ 0.23	0.15 ~ 0.35	0.60 ~ 0.90	≤ 0.030	≤ 0.030	0.40 ~ 0.70	0.40 ~ 0.65	0.15 ~ 0.30
	SNCM420	0.17 ~ 0.23	0.15 ~ 0.35	0.40 ~ 0.70	≤ 0.030	≤ 0.030	1.60 ~ 2.00	0.40 ~ 0.65	0.15 ~ 0.30
	SNCM815	0.12 ~ 0.18	0.15 ~ 0.35	0.30 ~ 0.60	≤ 0.030	≤ 0.030	4.00 ~ 4.50	0.70 ~ 1.00	0.15 ~ 0.30
	SCr420	0.18 ~ 0.23	0.15 ~ 0.35	0.60 ~ 0.85	≤ 0.030	≤ 0.030	–	0.90 ~ 1.20	–
SAE	8620	0.18 ~ 0.23	0.15 ~ 0.35	0.70 ~ 0.90	≤ 0.035	≤ 0.040	0.40 ~ 0.70	0.40 ~ 0.60	0.15 ~ 0.25
	4320	0.17 ~ 0.22	0.15 ~ 0.35	0.45 ~ 0.65	≤ 0.035	≤ 0.040	1.65 ~ 2.00	0.40 ~ 0.60	0.20 ~ 0.30

Table 7.3 High-Speed Steel

Standard	Symbol	Chemical composition (%)											
		C	Si	Mn	P	S	Cr	Mo	V	Ni	Cu	Co	W
AISI	M50	0.77 ~ 0.85	≤ 0.25	≤ 0.35	≤ 0.015	≤ 0.015	3.75 ~ 4.25	4.00 ~ 4.50	0.90 ~ 1.10	≤ 0.15	≤ 0.10	≤ 0.25	≤ 0.25

Table 7.4 Stainless Steel

Standard	Symbol	Chemical composition (%)						
		C	Si	Mn	P	S	Cr	Mo
JIS	SUS440C	0.95 ~ 1.20	≤ 1.00	≤ 1.00	≤ 0.040	≤ 0.030	16.00 ~ 18.00	≤ 0.75

Table 7.5 Cold Rolled Steel Strip and Cold Rolled Steel Sheet and Plate for Pressed Cage

Standard	Symbol	Chemical composition (%)				
		C	Si	Mn	P	S
BAS	SPB 1	≤ 0.10	≤ 0.04	0.25 ~ 0.45	≤ 0.030	≤ 0.030
	SPB 2	0.13 ~ 0.20	≤ 0.04	0.25 ~ 0.60	≤ 0.030	≤ 0.030
JIS	SPCC	≤ 0.12	–	≤ 0.50	≤ 0.040	≤ 0.045

Table 7.6 High Tensile Strength Brass Casting for Machined Cage

Standard	Symbol	Chemical composition (%)									
		Cu	Zn	Mn	Fe	Al	Sn	Ni	Pb	Si	Others
BAS	HB _S CR	55.0 ~ 62.0	33.0 ~ 37.0	2.0 ~ 4.0	0.5 ~ 1.5	0.1 ~ 1.0	0.1 ~ 1.0	≤ 1.0	0.1 ~ 1.0	≤ 0.2	≤ 1.0
JIS	HB _S C1	55.0 ~ 60.0	Residue	≤ 1.5	0.5 ~ 1.5	0.5 ~ 1.5	≤ 1.0	≤ 1.0	≤ 0.4	≤ 0.1	–
	HB _S C2	55.0 ~ 60.0	30.0 ~ 42.0	0.1 ~ 3.5	0.5 ~ 2.0	0.5 ~ 2.0	≤ 1.0	≤ 1.0	≤ 0.4	≤ 0.1	–

Table 7.7 Steel for Machined Cage

Standard	Symbol	Chemical composition (%)				
		C	Si	Mn	P	S
JIS	S25C	0.22 ~ 0.28	0.15 ~ 0.35	0.30 ~ 0.60	≤ 0.030	≤ 0.035