



High-Precision Ball Bearings

GRW
BEARING
MATERIALS



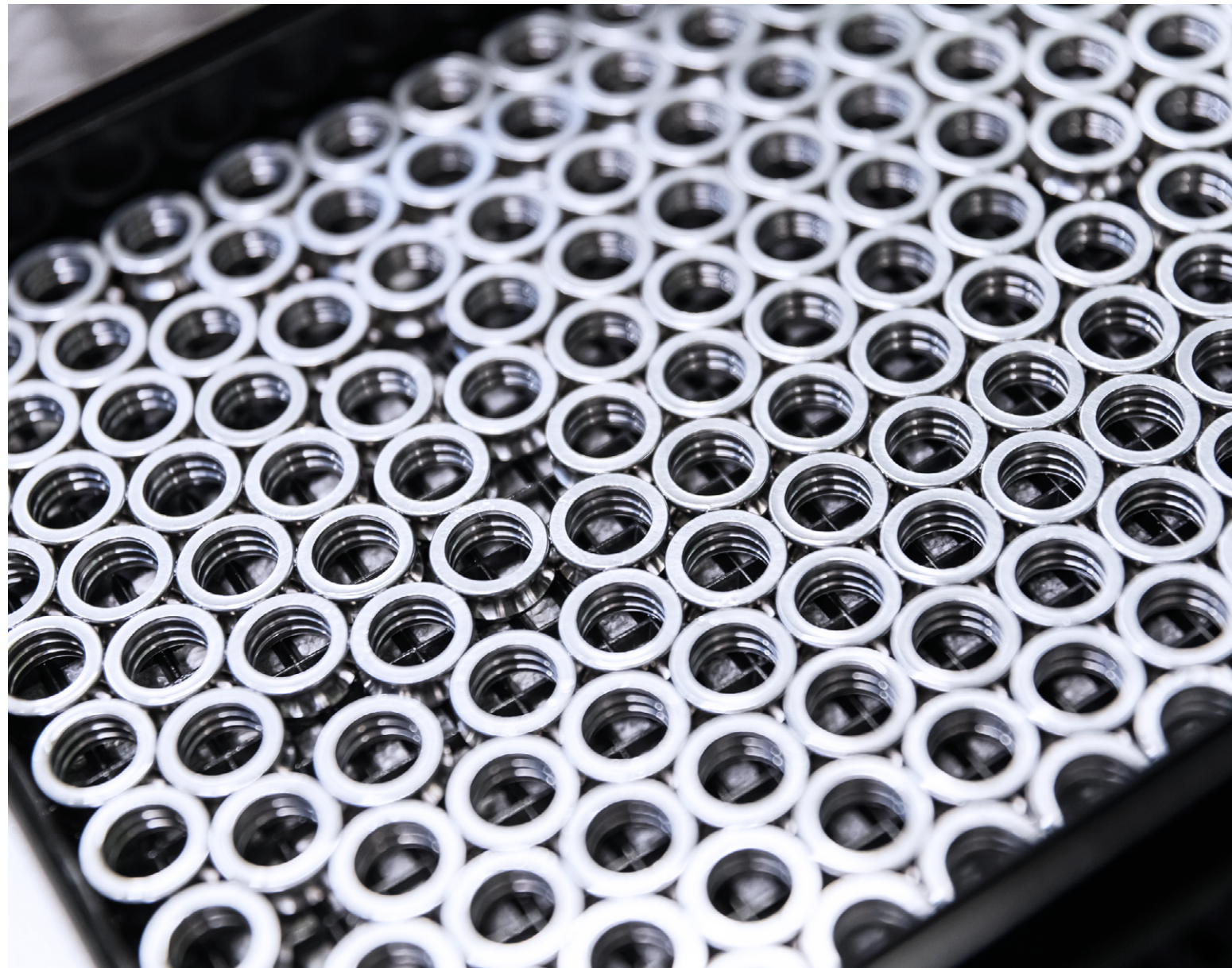
WIDE MATERIAL RANGE TO MEET HIGH STANDARDS FOR PRECISION BEARINGS

Perfect performance demands material of the highest quality.

The correct selection of raw materials, parts and components enables us to provide our customers with consistently high quality products. Our ball bearings are made of chrome steel (100Cr6), stainless steel (X65Cr13 or X105CrMo17), or high Nitrogen corrosion resistant steel (X30CrMoN15-1). Similar load ratings are achieved for all these steel types following ISO and ABMA standards.

It has always been our policy to choose the most advanced material available – for example the alloy SV30 (X30CrMoN15-1). It uses the elements nitrogen, carbon, chrome and molybdenum in an advanced type of alloy composition. Paired with Ceramic balls a bearing can be designed to exceed the boundary conditions of even the most challenging ball bearing applications. The following criteria should be considered during the selection process:

- hardness
- material cleanliness
- fatigue resistance
- workability
- dimensional stability
- corrosion resistance
- wear resistance
- temperature range and capability



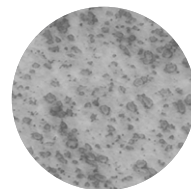
Ceramic balls can be used in conjunction with any of our bearing materials; So called Hybrid Bearings, further extend the solutions GRW can offer. Combine GRW's "know how" with more than 30 different kinds of cage material, hundreds of different lubricants including dry coatings and different packaging's. Anti-friction bearings belong to the most highly stressed components of mechanical engineering. Therefore, extremely high demands are made on the bearing steels, because of the ever-increasing need for longer bearing life and improved running costs. In more aggressive environments, corrosion resistance is highly desirable.

→ CHROME STEEL
Carbon Chrome (100Cr6/52100)

Developed in 1901, 100Cr6 is a basic through hardened chrome steel with a good cost use factor. It is widely used in the industry for components exposed to extreme wear and speed in mechanical engineering or the automotive industry.

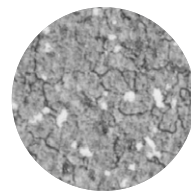
At GRW we use a 100Cr6 with high purity which guaranties a top-quality bearing. This steel is identical to the steel known as 52100. GRW harden the ball bearing steel at roughly 860°C/1580°F and temper it at 160°C/320°F. The particular strengths of this material are its high resistance to static loads and its high achievable hardness.

Note: 100Cr6 / 52100 must be delivered lubricated to avoid corrosion. Dry bearings are not appropriate.



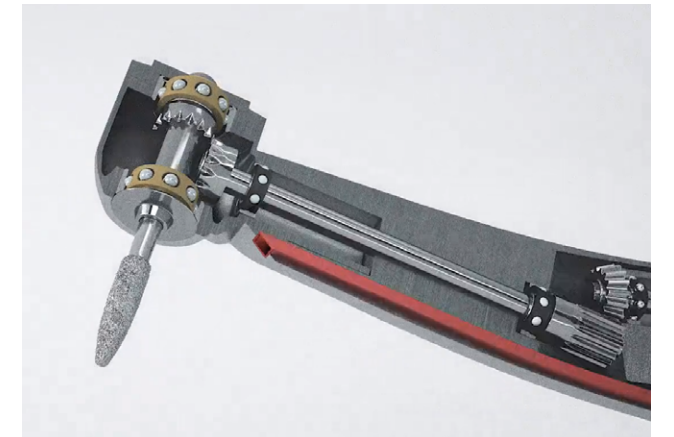
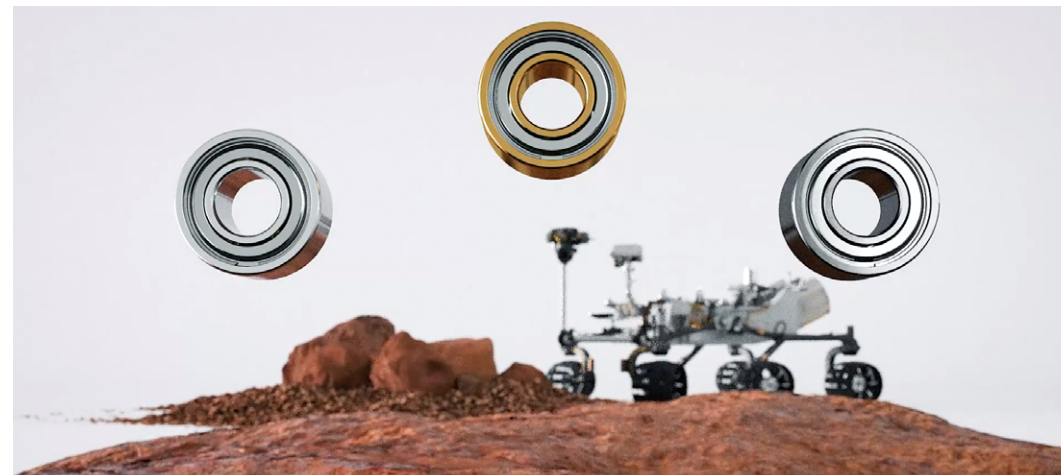
↑ Ball bearing outer rings during visual inspection in production

→ S
Stainless Steel (440C)



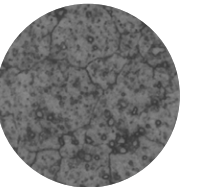
The bearing steel "S" is a martensitic alloy with high carbon content, which makes it well suited for bearings, traditionally found in the aerospace and food sector. The high chromium content forms a passive chromium oxide layer at the surface that provides substantial protection against corrosion; however, it is not totally inert and these alloys can corrode in hostile environments. 440C has a long proven heritage in aerospace applications.

GRW harden the ball bearing steel at over 1000°C/1832°F and temper it at 160°C/320°F with a specially defined tempering process. The particular strength of this material are its low value of retained austenite of <7%, mainly important for aerospace applications and dimensional stability. A decisive factor of the "S" bearing steel is the conformity with AMS 5618.



↑ Contra-angle handpiece for dental applications

→ SS
Stainless Steel (X65Cr13)



Our bearing steel "SS" is the most commonly used bearing steel for miniature ball bearings. It is a martensitic alloy steel with higher carbon content. It is widely used in the industry for cutting tools of any kind, especially for surgical applications.

We harden the ball bearing steel at over 1000°C/1832°F and temper it at 160°C/320°F with a specially defined tempering process. This results in the high-alloy steel achieving its typical characteristics.

The particular strength of this material is its low retained austenite value of <7%. Another strength its better resistance against corrosion, due to its smaller carbides after heat treatment the corrosion resistance is comparable with that of 440C. An additional factor of the "SS" bearing steel is the tested Biocompatibility according to DIN EN ISO 10993-5 and 10993-10.

← Aerospace application: Mars Rover - equipped with deep groove ball bearings made of SS (X65Cr13)

→ SV/SP
High Nitrogen Stainless Steel
(X30CrMoN15-1)

The GRW bearing steel "SV" is a highly nitrogen infused, martensitic alloy that is widely used in aerospace applications, as well as for medical applications. The superior features of high corrosion resistance as well as wear resistance are achieved by partial substitution of carbon with nitrogen. Its low carbon content provides additionally excellent behavior for mixed friction. GRW SV/SP Material - Our premium ring material for your high-tech application.

We harden the ball bearing steel at over 1000°C/1832°F and temper it with a specially defined tempering process. The particular strengths of this material are its high resistance against corrosion and chemicals. An additional factor of the "SV" bearing steel is the tested Biocompatibility according to DIN EN ISO 10993-5 and 10993-10

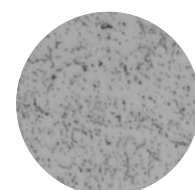
In addition we use the GRW bearing steel "SP", based on the same chemical composition as SV. It is widely used in high-temperature applications for the machine tool industry and other areas. This high-alloy steel achieves its typical characteristics of perfectly stable hot hardness up to 450°C/842°F.

The particular strengths of this material are its good resistance to static loads and effective resistance against corrosion. Additionally high temperature hardness is achieved.



↑ Duplex bearings during transport on a tray

” GRW SV/SP MATERIAL - OUR PREMIUM RING MATERIAL FOR YOUR HIGH-TECH APPLICATION. “

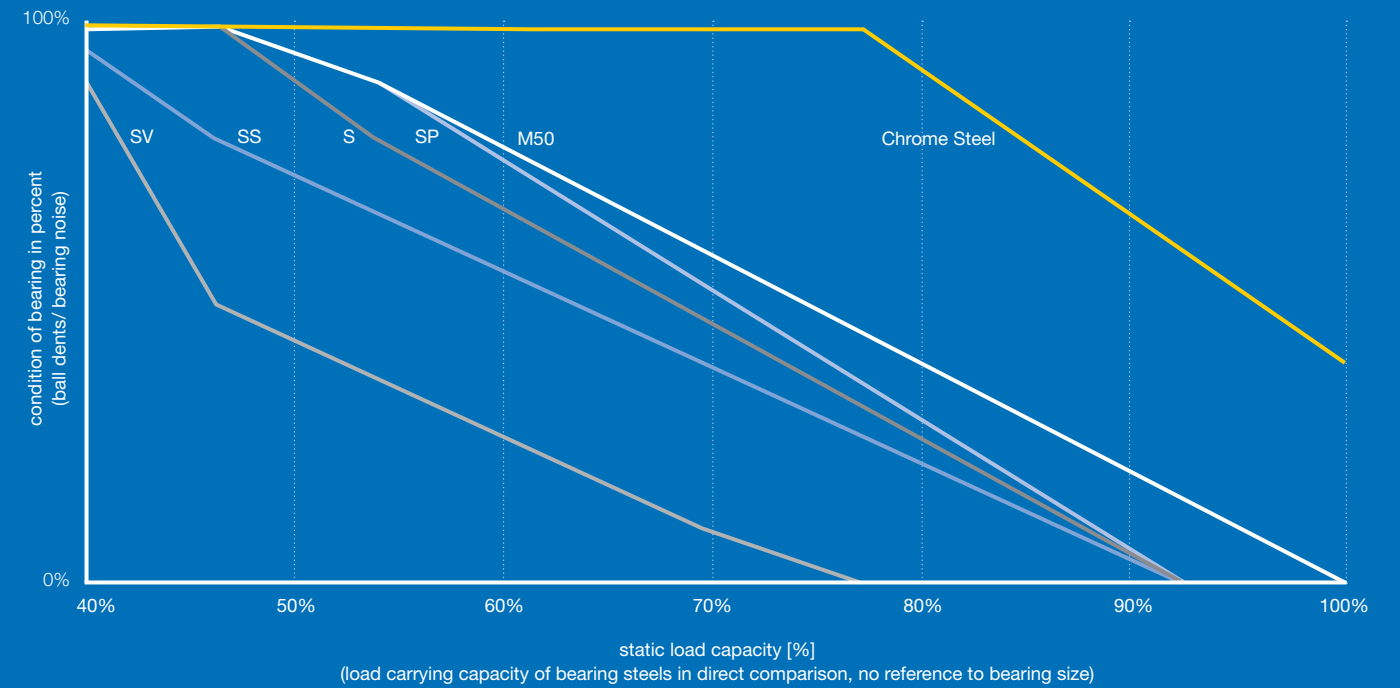


Properties	Chrome Steel	S	SS	SV	SP
Density (g/cm ³)	7.85	7.70	7.85	7.85	7.85
Young's modules (GPa)	210	215	200	218	218
Poisson's ratio	0.28	0.28	0.28	0.30	0.30
Expansion coefficient (x 10 ⁻⁶ K ⁻¹)	10.9	10.4	10.1	10.1	10.1
Temperature resistance (°C / °F)	170 / 340	200 / 400	200 / 400	200 / 400	450 / 800
Corrosion resistance	limited	good	good	very good	good
Hardness (HRc)	>60	>58	>58	>58	>58

GRW BEARING MATERIALS OFFER CLASS LEADING HIGH TEMPERATURE STRENGTH AND CORROSION RESISTANCE

Chrome Steel SS SV SP S M50

STATIC LOAD CAPACITY

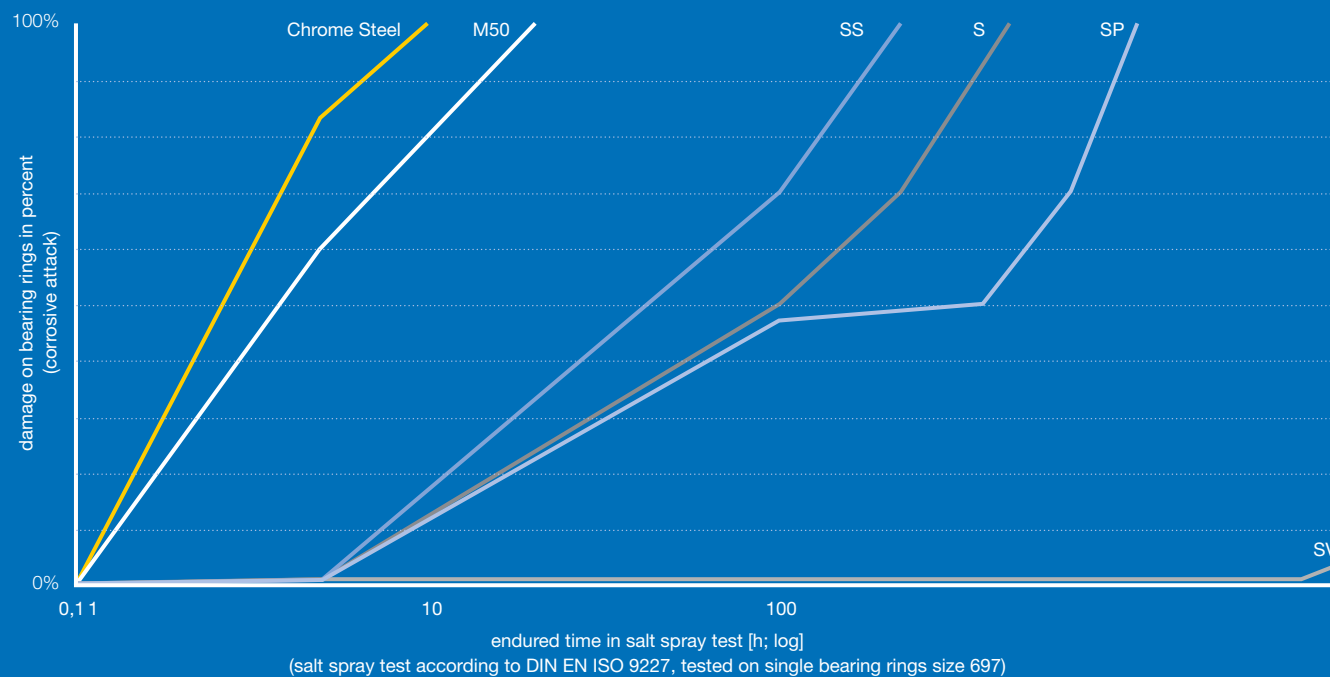


static load capacity [%] (load carrying capacity of bearing steels in direct comparison, no reference to bearing size)

● Chrome Steel ● SS ● SV ● SP ● S ● M50



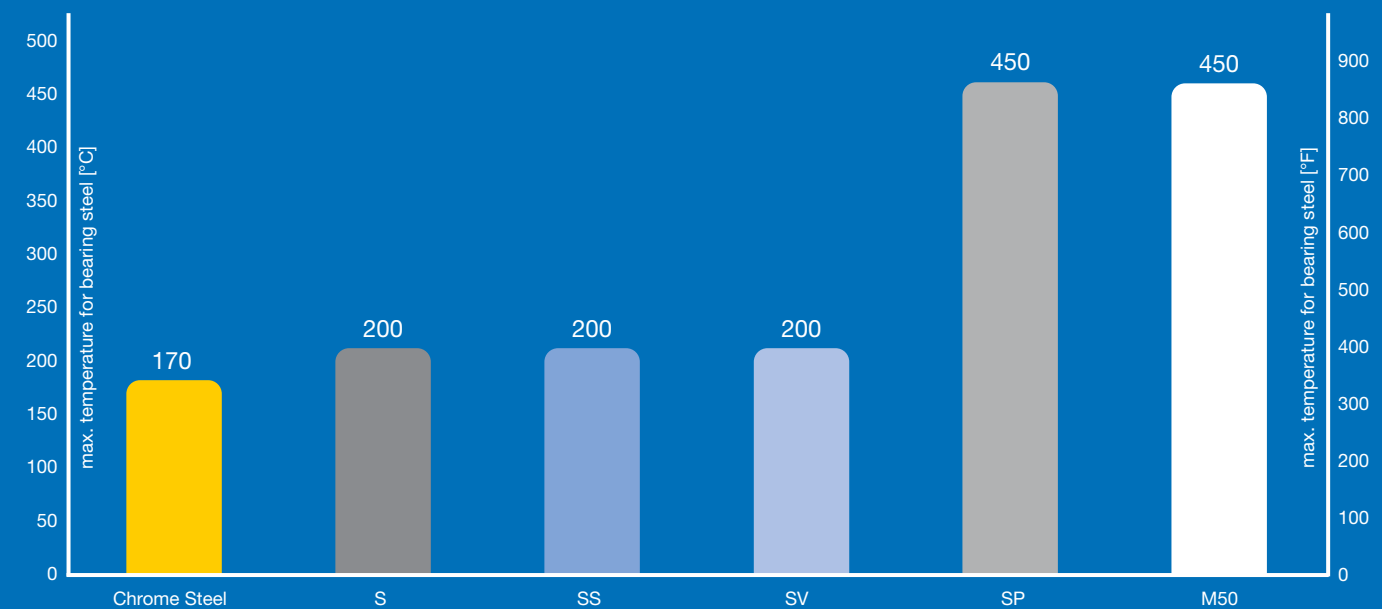
TEST RESULTS FOR CORROSION RESISTANCE



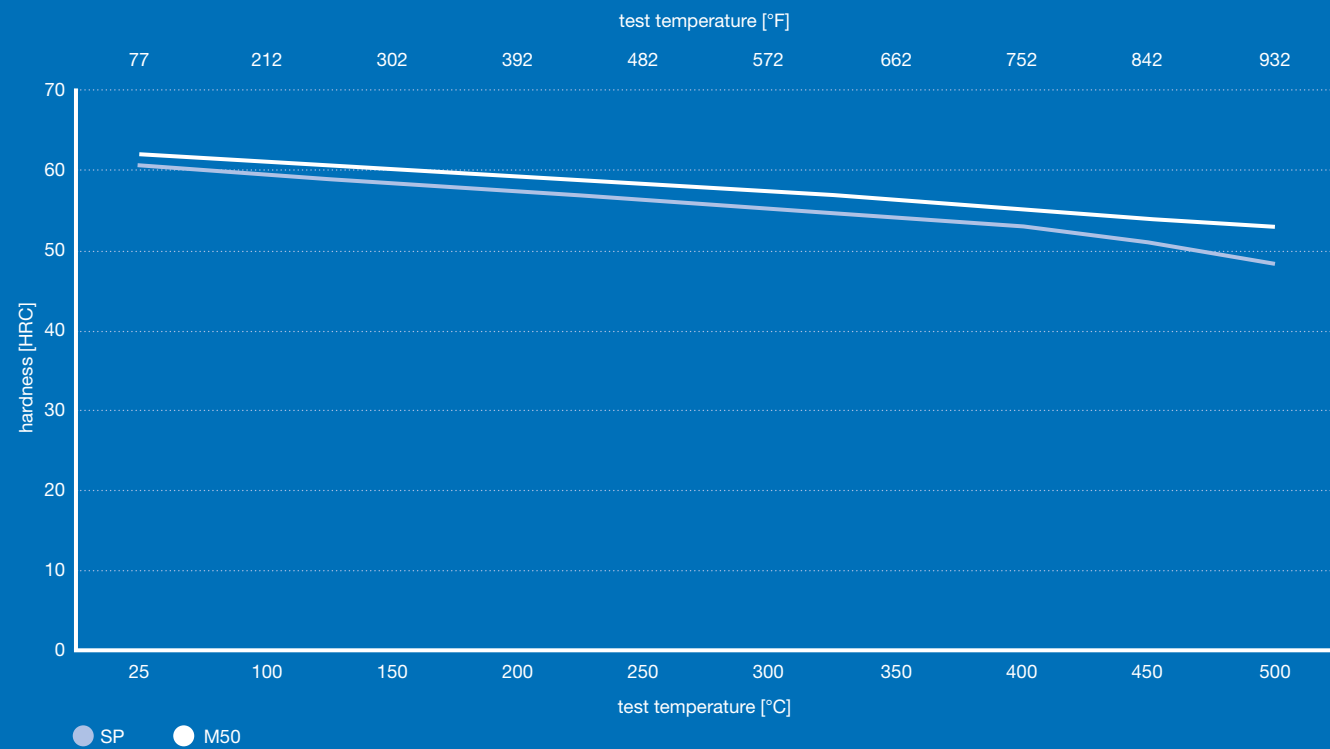
endured time in salt spray test [h; log] (salt spray test according to DIN EN ISO 9227, tested on single bearing rings size 697)

● Chrome Steel ● M50 ● SS ● S ● SP ● SV

TEMPERATURE STABILITY



HOT HARDNESS



EXAMPLES OF APPLICATIONS

APPLICATION	CHROME STEEL	S	SS	SV	SP
Medical					
Dental application			×	×	×
Surgical equipment			×	×	
Blood pump				×	
X-Ray					×
Aviation and Aerospace Industry					
Space application		×	×	×	×
Measurement systems		×	×	×	×
Fans (aerospace)	×		×		
Model jet					×
Chemical industry					
Flow meter			×	×	
Hostile environment				×	
Mechanical engineering					
Spindle bearing	×				×
Turbo charger		×	×	×	×
Vacuum application			×	×	×
Turbo molecular pump	×			×	×
Electric motor	×		×	×	

× = Common steel for this basic application

1) Only for applications without direct contact to any organisms

Please note that this matrix only gives examples of cases in which the respective steels are currently usually used. There is no guarantee of transferability to applications in individual cases. Each application must be designed in consultation with one of our specialists at GRW in each individual case.



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