Stainless Steel SP Series

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Abstract

WIB has continually been challenged to develop and deliver advanced technical solutions capable of withstanding highly demanding industrial environments, particularly those characterized by extreme humidity and/or saline atmospheres. Under such conditions, conventional stainless steels exhibit accelerated corrosion mechanisms, leading to premature material degradation and a significantly reduced operational lifespan of the bearing assemblies.

Objective

WIB's primary objective has been to overcome corrosion challenges by developing a stainless steel with significantly enhanced resistance to rust, thereby extending the service life of our bearing solutions. With the introduction of the **SP Series**, our goal has been successfully achieved.

Development and Experimental Findings

The new treatment is a low-temperature process for the surface hardening of stainless steels based on the diffusion of nitrogen into the steel. Nitrogen is a potent interstitial alloying element that exerts a highly beneficial influence on the microstructure and properties of steels. Its incorporation into stainless steel is particularly advantageous for bearing applications, primarily due to its ability to enhance corrosion resistance while concurrently improving mechanical performances.

From a microstructural perspective, nitrogen significantly alters the precipitation behavior during heat treatment compared to carbon. In conventional carbon-chromium bearing steels, such as AISI 52100 or martensitic stainless grades like AISI 440C, heat treatment leads to the formation of coarse chromium-rich carbides (such as $M_{23}C_6$ or M_7C_3 types). These carbides tend to precipitate along grain boundaries, resulting in chromium depletion zones, which markedly reduce localized corrosion resistance. In contrast, nitrogen-alloyed stainless steels develop a refined precipitation structure. Upon hardening and tempering, chromium nitrides (such as CrN and Cr_2N) precipitate instead of carbides. These nitrides are typically finer, more uniformly dispersed, and thermodynamically more stable in nitrogen-rich matrices.

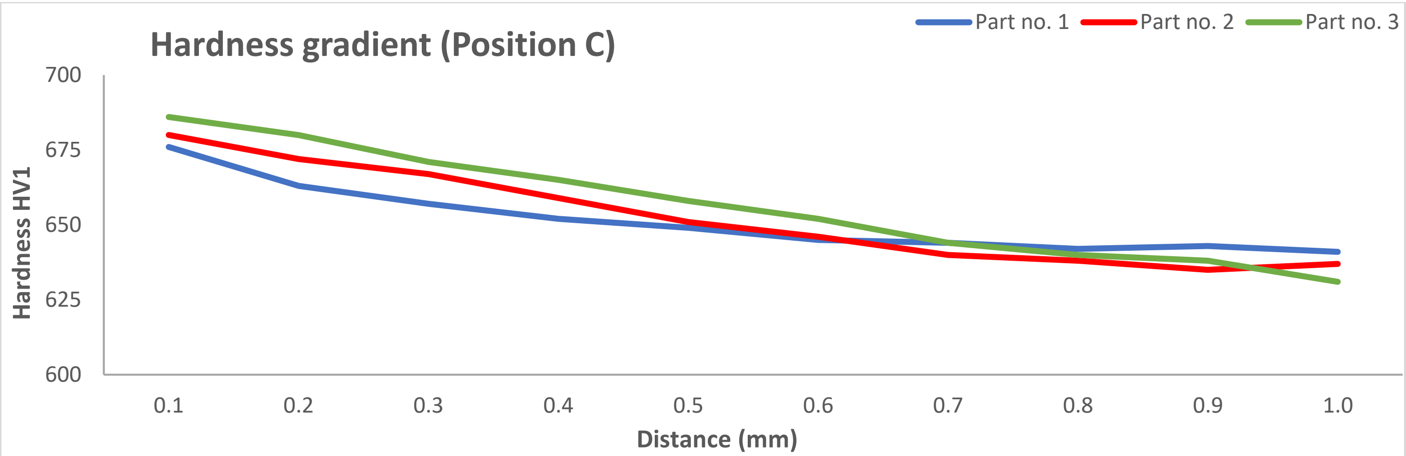
Comparison of various bearing steels

Bearing steel	Corrosion resistance	Wear resistance	Fatigue strength
100Cr6 (conventional bearing steel)	-	-	+
440C (stainless bearing steel)	+	+	+
SP Series	++	+	+
-low ; +medium ; ++high			

WIB’s SP grade undergoes a proprietary heat treatment and quenching process, which gives it maximum hardness on the surface, gradually decreasing towards the center of the piece, while maintaining very good ductility in the steel.

Hardness measurements were performed on three rings at different depths from the surface: face ring (A), core ring (B) and up to 1 mm under the ring surface (C).

Measurement position						
Measurement item	Part no.	M1	M2	M3	Average	
Face hardness HV1 Position A	1	738	741	733	737	
	2	732	736	749	739	
	3	745	747	742	745	
Core hardness HV1 Position B	1	642	649	643	645	
	2	649	647	632	643	
	3	642	642	640	641	
Gradient hardness HV1 Position C	1	*0.1 mm*	*0.2 mm*	*0.3 mm*	*0.4 mm*	*0.5 mm*
		676	663	657	652	649
		0.6 mm	*0.7 mm*	*0.8 mm*	*0.9 mm*	*1.0 mm*
		645	644	642	643	641
	2	*0.1 mm*	*0.2 mm*	*0.3 mm*	*0.4 mm*	*0.5 mm*
		680	672	667	659	651
		0.6 mm	*0.7 mm*	*0.8 mm*	*0.9 mm*	*1.0 mm*
		646	640	638	635	637
	3	*0.1 mm*	*0.2 mm*	*0.3 mm*	*0.4 mm*	*0.5 mm*
		686	680	671	665	658
		0.6 mm	*0.7 mm*	*0.8 mm*	*0.9 mm*	*1.0 mm*
		652	644	640	638	631

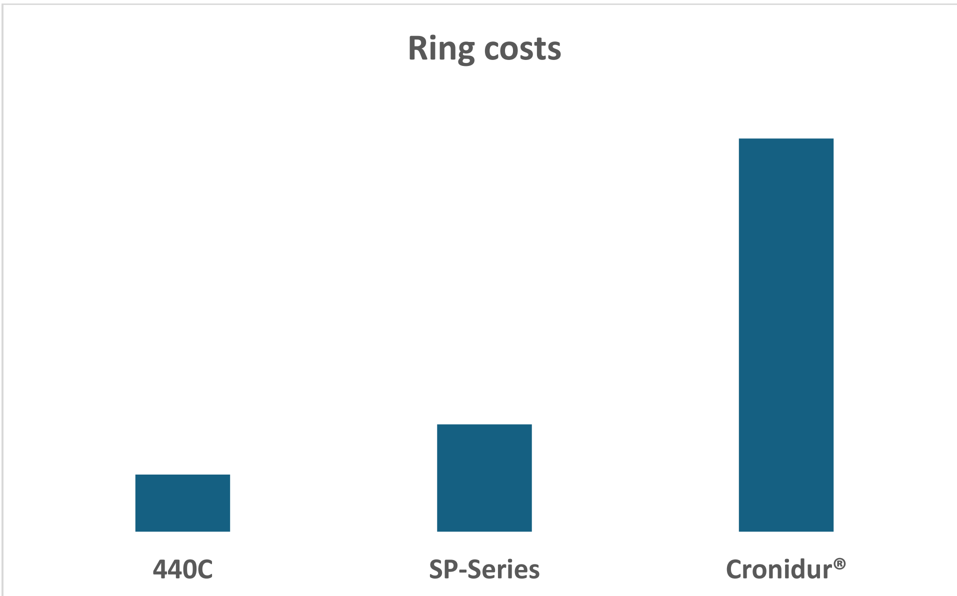


A corrosion resistance test was performed in accordance with ISO 9227, which specifies the method for conducting neutral salt spray (NSS) testing to evaluate the corrosion resistance of metallic materials. Test specimens consisted of rings fabricated from AISI 440C (standard stainless steel) and SP-grade steels. Prior to testing, all samples were cleaned and degreased to ensure consistent surface conditions. The specimens were placed in a salt spray chamber and subjected to continuous exposure to a 5% sodium chloride solution mist at 35°C for a duration of 120 hours. After the exposure period, the samples were removed and inspected for signs of corrosion products, particularly iron oxides and rust formation.

The results of the salt spray test confirm that SP-grade steel has superior corrosion resistance, with no evidence of corrosion compared to the high-corroded 440C stainless steel.

Conclusion

WIB engineers have developed a new stainless steel grade, referred to as **SP Series**, specifically engineered to enhance corrosion resistance relative to AISI 440C stainless steel. The SP-grade was designed to achieve corrosion performance comparable to that of Cronidur® alloys, while offering a more cost-efficient alternative.



This development aims to meet the demands of high-performance applications requiring increased reliability and extended bearing service life in corrosive operating environments.