

Improved coilability and corrosion resistance of critical spring applications with Bezinal® XC and Bezinal® XP coated wire

Authors: F. Verhoeve, V. Vermeersch

Abstract

Bezinal® XC and Bezinal® XP are a new range of zinc aluminum coated wire that has been especially designed for critical spring applications. While Bezinal® XP excels in corrosion and cathodic protection; Bezinal® XC maintains its coating integrity even under heavy deformation and high stress-relieving temperatures. As these properties remain fully intact after processing, no post-coating is required. To guarantee the quality of their performance, both coatings have been subjected to several test runs and a wide variety of tests specifically relevant to spring manufacturing e.g. salt spray, Kesternich, humidity, outdoor exposure, coiling tests, etc.

Introduction

Bekaert has been producing wire for spring manufacturers for several decades. By working closely with our customers, we have become familiar with the challenges and needs in this particular trade. Using these insights in combination with our advanced testing capabilities, we have the ability to develop new products that can improve the critical properties of springs. The most recent result of these efforts was the creation of an update to our classic Bezinal® coated spring wires: Bezinal® XP and Bezinal® XC.

Bezinal® XP coated wire for reliable, superior corrosion resistant springs

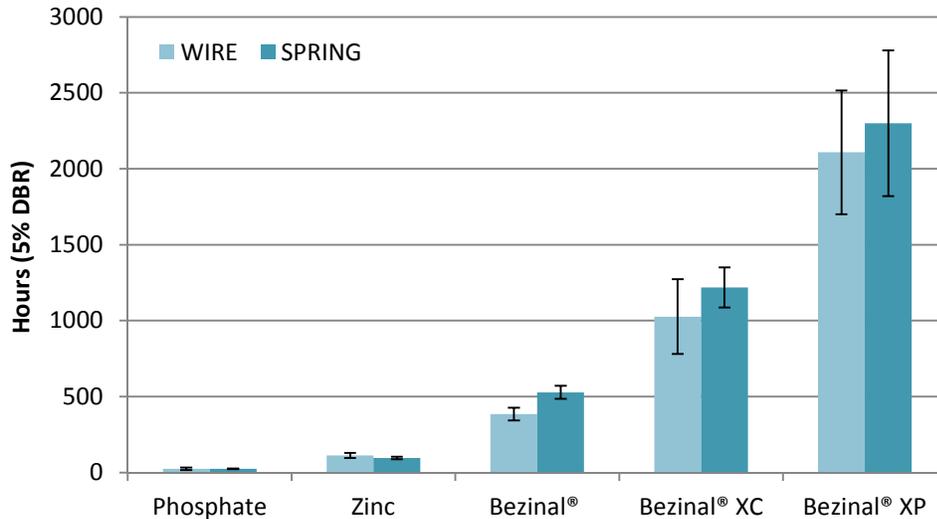
Corrosion is perceived as the primary cause of break-downs, malfunctions and premature failures. Choosing a wire with the right corrosion protection is essential for the success of your business.

For spring applications used in highly humid or alkaline environments (e.g. automotive springs, industrial springs, etc.), Bekaert developed Bezinal® XP. Its advanced properties offer superior corrosion resistance, excellent cathodic protection at grinded and cut edges and improved white rust protection.

Corrosion performance of Bezinal® XP vs traditional hot dip coatings

To simulate the real-life corrosion performance of Bezinal® XP compared to other metallic-based coatings, Bekaert performed accelerated lab-tests on coated wire with a similar diameter of 1, 2 to 5 mm and springs with diameters of 10xD and pitch = 1xD. Both wire and springs were covered with an equal coating thickness of $\pm 10 \mu\text{m}$. The tests included salt spray testing (ASTM B117/DIN50021/ISO9227), Kesternich testing (ASTM G87/DIN50018/ISO3231), humidity chamber testing (ISO6270-2) and outdoor exposure testing.

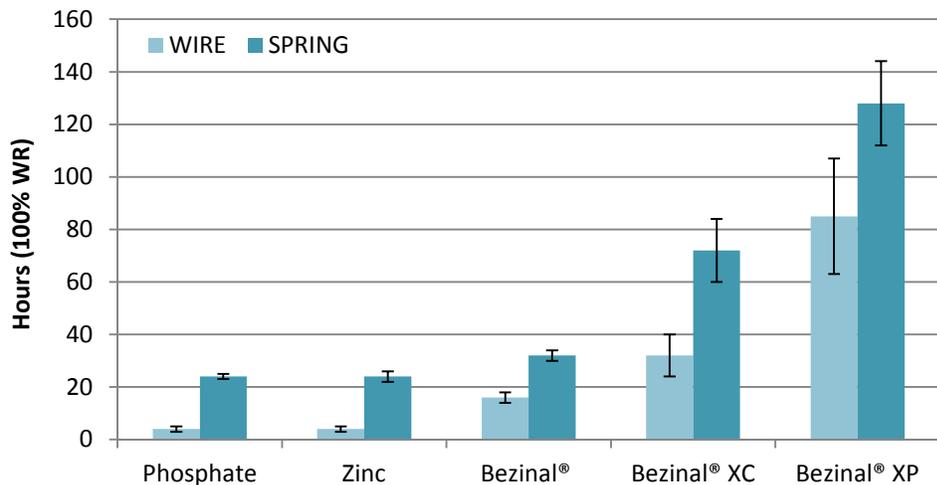
For the salt-spray testing, the samples were evaluated at 5% dark brown rust (DBR). As demonstrated in the results below, Bezinal® XP and Bezinal® XC outperformed regular Bezinal® at minimum by a factor of 2-4 and zinc by a factor of 12 or more. Also, this coating maintains its corrosion resistance even after heavy deformation and heat exposure, eliminating the need for complex, expensive and environmentally damaging post-coating processes.



Salt spray test according to ASTM B117 data on wire diameters ranging from 1.2-5 mm.

White rust protection

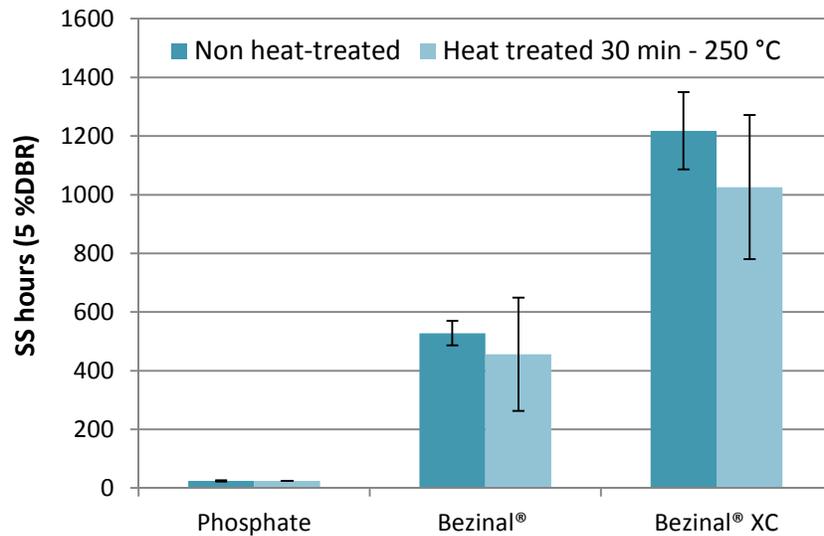
Because Bezinal® coatings contain aluminum they are especially resistant to white rust or storage stain which particularly affects coiled wire. The graph below compares the performance of products coated with the Bezinal® range of coatings to products coated with traditional hot dip coatings when exposed to humid conditions. This test was performed in a humidity chamber at a temperature of 35 °C and a saturated humidity of RH 100%. As shown below, Bezinal® XP coated springs lasted nearly 5x longer than traditional coatings before showing 100% white rust.



Humidity chamber in hours: wire diameters ranging from 1.2-5 mm and spring diameter of 10xD, pitch = 1xD) covered with 10µm coating using ISO6270-2.

Bezinal® XC coated wire for high-end, critical springs

To improve the coilability of springs, Bekaert developed Bezinal® XC. Even under heavy deformation and exposure to high stress-relieving temperatures, the coating is able to maintain its integrity and high corrosion protection level (see the salt spray graph below).

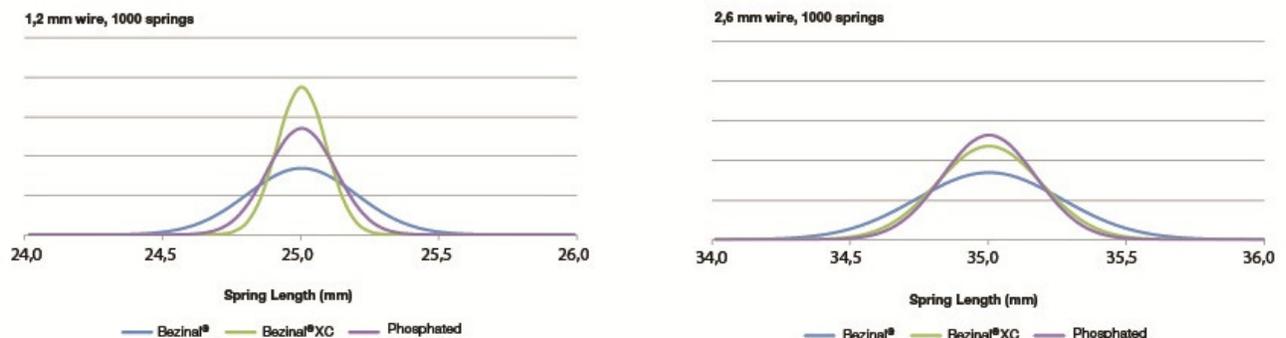


Average hours of salt-spray exposure before 5%DBR; wire diameter of springs = 2.6 mm; spring types used: springs after 30 min of heat treatment at 250 °C and non-treated springs.

Moreover, Bezinal® XC coated wire has reduced flaking and limited dust formation when coiled as compared with wire coated with zinc or even our standard Bezinal® coatings. The beneficial end results are less machine cleaning time and higher production efficiencies, especially in cases where optical measurement systems are used. Therefore, Bezinal® XC coated wire can in some cases equal the performance of non-metallic coated wire (phosphated).

The coilability test

The graphs below show the average standard deviation of the spring length per 1000 springs. Similar to phosphated wire, Bezinal® XC significantly reduces the overall spread on spring dimensions. Its advanced properties substantially improve the dimensional stability of the manufactured springs and reduce spring rejection rates.



Conclusion

The advanced Bezinal® coatings XC and XP hold excellent properties for spring wire applications. Bezinal® XP features high-end corrosion resistance that can be maintained for processing parameters corresponding typically with spring making as well as for highly relevant end-customer applications. Bezinal® XC coated wire, on the other hand, exhibits very high coiling properties and can in some cases reach equal performance of non-metallic coated wire (phosphated). Bezinal® XC shows the best coilability resistance for all Bezinal® types tested.

Bekaert (www.bekaert.com) is a world market and technology leader in steel wire transformation and coatings. Bekaert (Euronext Brussels: BEKB) was established in 1880 and is a global company headquartered in Belgium, employing more than 25 000 people worldwide. Serving customers in 120 countries, Bekaert pursues sustainable profitable growth in all its activities.

Contact: filip.verhoeve@bekaert.com - +32(56)766197