Application Note EDXRF1812

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EDXRF1812 - Phosphorus on Steel

Scope

This application note demonstrates the measurement of phosphorus (P) conversion coating on galvanized steel using NEX QC+.

Background

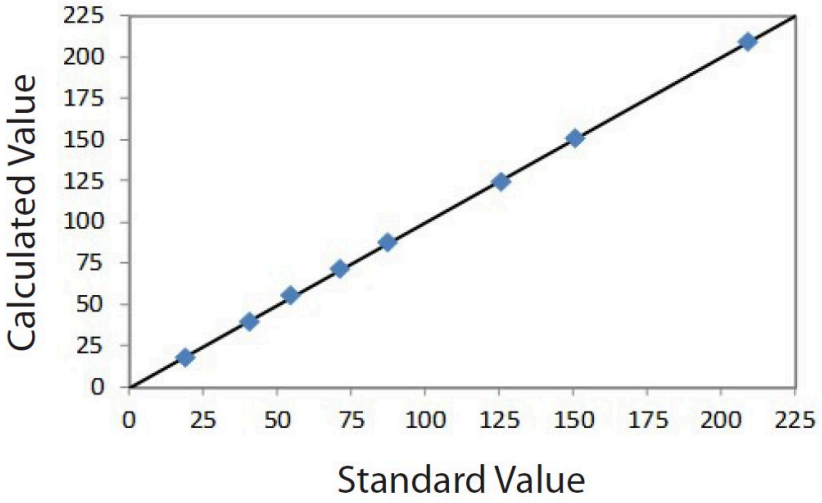
Aluminum and steel are often coated with a protective conversion coating, also called passivate or passivation coating, to prevent oxidation and corrosion of the base metal. Conversion coatings include chromium (Cr), titanium (Ti), vanadium (V), manganese (Mn), nickel (Ni), phosphorus (P), or zirconium (Zr). A phosphate coating may be applied to minimize wear on cutting tools and stamping machines.

Aluminum is often coated for use in aircraft parts, aluminum window frames, and other similar industries where the aluminum is exposed to weathering. Steel for the automotive industry is typically first galvanized with a zinc coating before the conversion coating is applied. Protected steel is also used for outdoor sheds and other similar uses where steel is exposed to weathering. Conversion coating also helps in the retention of paint for the final finished product.

Calibration – standard range in air

An empirical calibration was built using a set of standards assayed by careful weigh-strip-weigh. The bare, galvanized steel sample with no P coating was measured to generate a special background correction that automatically compensates for the specific amount of background in each sample measured.

Element: P Units: mg/m²		
Sample I.D.	**Standard value**	**Calculated value**
18	18.61	18.154
40	40.55	40.005
54	54.15	55.224
71	71.07	71.618
87	87.19	87.550
125	125.70	124.447
150	150.20	150.219
208	208.80	209.054



Correlation plot P on steel

Recovery and repeatability

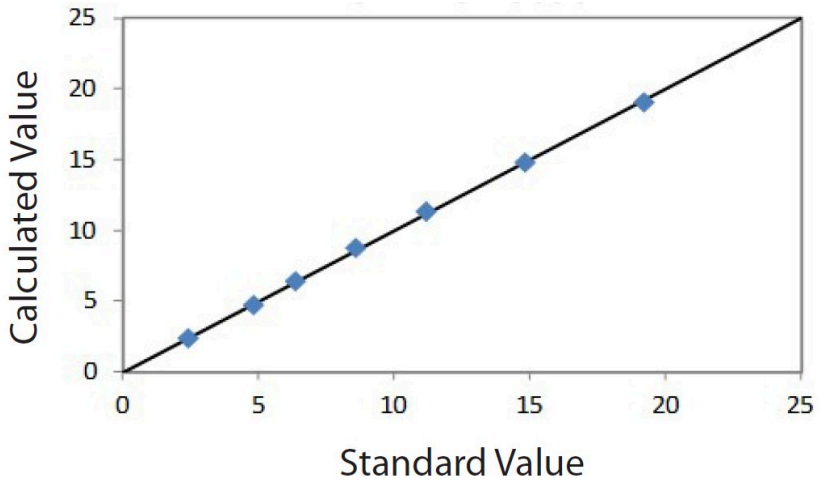
To demonstrate repeatability (precision), the low- and high-calibration standards were chosen. Each sample was measured in a static position for ten repeat analyses with typical results shown below.

Element: P Units: mg/m²				
Sample I.D.	**Standard value**	**Average value**	**Std. dev**	**% Relative**
18	18.61	18.840	0.166	0.9
208	208.80	208.545	0.518	0.2

Calibration – low range in air

An empirical calibration was built using a set of standards assayed by careful weigh-strip-weigh. The bare, galvanized steel sample with no P coating was measured to generate a special background correction that automatically compensates for the specific amount of background in each sample measured.

Element: P **Units: mg/m²**		
Sample I.D.	**Standard value**	**Calculated value**
2	2.39	2.314
4	4.79	4.674
6	6.37	6.444
8	8.58	8.698
11	11.17	11.299
14	14.82	14.770
19	19.17	19.092



Correlation plot low P on steel

Recovery and repeatability

To demonstrate repeatability (precision), the low- and high-calibration standards were chosen. Each sample was measured in a static position for ten repeat analyses with typical results shown below.

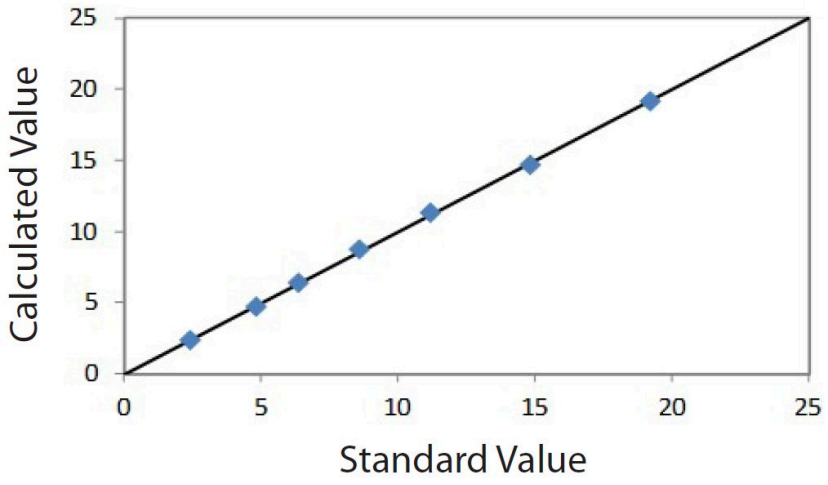
Element: P **Units: mg/m²**				
Sample I.D.	**Standard value**	**Average value**	**Std. dev**	**% Relative**
2	2.39	2.329	0.026	1.1

19	19.17	19.119	0.042	0.2

Calibration – low range in helium

An empirical calibration was built using a set of standards assayed by careful weigh-strip-weigh. The bare, galvanized steel sample with no P coating was measured to generate a special background correction that automatically compensates for the specific amount of background in each sample measured.

Element: P **Units: mg/m²**		
Sample I.D.	**Standard value**	**Calculated value**
2	2.39	2.304
4	4.79	4.738
6	6.37	6.426
8	8.58	8.692
11	11.17	11.263
14	14.82	14.722
19	19.17	19.143



Correlation plot ultralow P on steel

Recovery and repeatability

To demonstrate repeatability (precision), the low- and high-calibration standards were chosen. Each sample was measured in a static position for ten repeat analyses with typical results shown below.

Element: P **Units: mg/m²**

Sample I.D.	Standard value	Average value	Std. dev	% Relative
2	2.39	2.386	0.013	0.5
19	19.17	19.150	0.031	0.2

Sample surface and positioning

Aluminum may be surfaced with different patterns to give products various esthetic looks or physical properties. Such surfacing techniques may leave the aluminum smooth, may be brushed aluminum with a directional grain pattern, or may be a hatched or another pattern. The samples demonstrated here had a brushed directional grain pattern.

Conclusion

The performance shown here demonstrates NEX QC+ provides excellent sensitivity and performance for the measurement of phosphorus conversion coatings on galvanized steel.

Related products

NEX QC II Series

Compact, intuitive benchtop EDXRF for everyday elemental testing