ZINC PHOSPHATING

ILLUSTRATIVE DOCUMENT ON THE CHARACTERISTICS OF ZINC PHOSPHATING TREATMENT

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1 - PURPOSE AND GENERAL INFORMATION

PURPOSE

Phosphate conversion coatings are applied to metals either as a final finish or as an intermediate layer for subsequent coatings. Their functions are:

a) to provide corrosion resistance

b) to improve the adhesion of paints and other organic finishes

c) to facilitate cold forming operations such as drawing and extrusion

d) to modify surface friction properties in order to aid sliding

GENERAL INFORMATION

ZINC PHOSPHATING primarily aims to improve the corrosion resistance of the base metal and also provides an excellent pre-painting base, enhancing the adhesion of paints and similar coatings.

Since it does not cause significant hydrogen embrittlement, it is well suited to facilitate the cold forming of iron and steel. In wire and tube drawing, deep drawing, and cold extrusion, zinc phosphating is an essential step in the manufacturing process. The current levels and speeds of deformation would be difficult to achieve without prior phosphating.

THE ZINC PHOSPHATE CONVERSION TREATMENT provides only short-term corrosion protection. For more effective protection, appropriate additional treatments are required depending on the intended use of the phosphated surface—for example, the application of protective oils or waxes. In fact, the phosphate layer formed on the surface is firmly bonded to the base metal and, due to its absorbent nature, it becomes impregnated with lubricant and retains it strongly. These post-treatments should preferably be carried out on the phosphated components immediately after the process to prevent the formation of corrosion spots.

REFERENCE STANDARD: UNI ISO 9717

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2 - APPLICATION METHODS

The Zinc Phosphate Conversion Coating is produced by immersion in baths containing the appropriate solutions, with agitation of the solutions themselves..

During processing, the bath becomes enriched with iron, which results in the deposition of a mixed iron/zinc layer on the surface.

The presence of iron, in addition to affecting the chemical conversion of the phosphate layer, also influences the initial reaction rate on the base metal and the nucleation of the crystals.

The chemical attack on the base metal, necessary to form the phosphate conversion layer, primarily takes place on the micro-asperities left by mechanical processing. As a result, the treatment not only forms the coating but simultaneously improves the surface finish of the material.

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3 - PHOSPHATE COATING THICKNESS

It is not possible to define in advance a minimum or maximum limit for the thickness and weight of the phosphate coating, as these vary depending on:

- the material of the part and its surface condition

- previous mechanical and chemical treatments

- the operational conditions of the phosphating process

The company standard requires a thickness not less than 6 microns and not greater than 8 microns, unless otherwise specified by the customer. In such cases, a tolerance of ±2 microns applies to the specified thicknesses.

THICKNESS IS DETERMINED USING THE MAGNETIC METHOD ACCORDING TO UNI ISO 2178.

The weight of the phosphate coating, expressed in mg/dm² and divided by a factor of 1.4, approximately corresponds to its thickness in microns, as measurable with the magnetic method.

When designing a component, it should be noted that the phosphate layer is formed partially at the expense of the base metal. A portion - ranging from 1/2 to 2/3 of the coating thickness - protrudes above the original dimensions of the part.

Note: The roughness specified in technical drawings always refers to the surface before phosphating. Roughness measurements taken after phosphating are not considered indicative.

REFERENCE STANDARD: UNI ISO 9717
UNI ISO 2178

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4 - PHOSPHATE COATING APPEARANCE

The phosphate layer must have a uniformly velvety appearance with a dark grey color.

Color variations observed on the same part, within the specified limits, do not constitute grounds for rejection.

The layer must consist of a compact, uniform microcrystalline structure, approximately prismatic with rounded edges, and must be free of stains, uncoated areas, scratches, dust, or powdery residues.

Minor variations in the appearance of the phosphate coating, due to surface irregularities of the base metal or contact with supports during the phosphating process, are common and are not normally indicative of significant quality fluctuations.

Phosphate layers composed of large crystals surrounded by very small ones must be excluded.

After oil removal, the phosphate layer must not show yellow ochre dust (which would indicate the presence of sludge in the phosphating bath).

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5 - PHOSPHATE COATING CONTINUITY

By their nature, phosphate layers are porous; however, excessive porosity can compromise the effectiveness of the coating.

The continuity of the coating can be assessed through salt spray testing in accordance with **UNI ISO 9227**.

The exposure time - applied to parts free from oil or other protective agents - must be agreed upon directly between the customer and the supplier.

As a general guideline, the following exposure times can be used:

MANGANESE PHOSPHATING: Up to 5 microns = 1 hour
From 6 to 10 microns = 1.5 hours

For comparative testing of samples immersed in protective oil, indicative exposure times are 48–72 hours.

At the end of the specified exposure periods, the samples must be free from any signs of oxidation visible to the naked eye at normal reading distance.

Note: The results of this test do not determine anti-seizure performance—which can only be evaluated under actual operating conditions - but solely the effectiveness of corrosion protection.

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UNI ISO 9227

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6 - TESTS AND INSPECTIONS

THICKNESS

Thickness is measured using the magnetic method in accordance with **UNI ISO 2178.** The coating thickness (including the phosphate layer) must be between 6 and 8 microns across all points of the significant surface.

VISUAL INSPECTION

The coating must appear uniform across the entire significant surface and be dark grey in color.

CORROSION TESTS

The test consists of exposing the parts to salt spray in accordance with **UNI ISO 9227.**

Visible rust spots detectable with the naked eye at normal reading distance must not appear before 48–72 hours of exposure.

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UNI ISO 2178
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