The Process of Zinc Thermal Diffusion

The zinc thermodiffusion is a thermal diffusion coating process, where metal objects are heated with a zinc-powder mixture of zinc dust and additives in a container.

Essentially, the Thermission thermal diffusion process follows the standard «DIN EN ISO 17668 zinc diffusion coatings on ferrous products – sherardizing». The thermal diffusion process deviates from the standard in the following points:

1. Temperature range 280-390°C
2. Zinc coating 4 µm to 25 µm (no class division)
3. Additional measuring method X-ray according to DIN EN ISO 3497

The process is conducted in closed, slowly rotating containers at temperatures of about 280°C to 390°C. Before the thermal diffusion process, the parts must be cleaned of contaminations such as oil, scale, rust, etc. The surface condition of the material, the mass of the components and the process parameters of the thermal diffusion can influence the thickness, the surface finish and roughness as well as the physical and mechanical properties.

During the process, zinc reacts with the metallic surface. In doing so, a zinc micro-alloy with a coating thickness of 4 µm to 25 µm is created on the components. Depending on requirements, the coating thickness can be controlled by the quantity of zinc dust, process time and temperature.

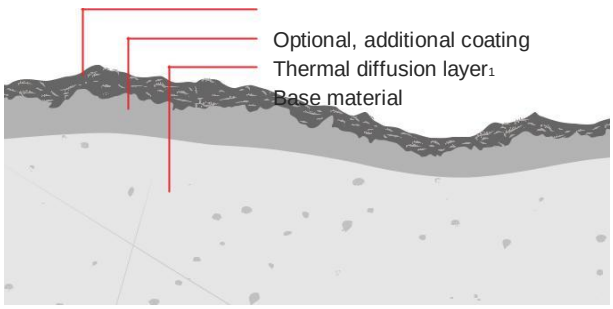
With the zinc thermal diffusion, complex geometries or hard to access places, such as cavities, threads or screw heads can also be coated with an even zinc layer. Depending on the size and geometry, the parts can be coated as goods in bulk or as rack material.

After the zinc thermal diffusion the container is cooled off. In the case of goods in bulk, the container filling is then emptied via a sorting facility, whereby the components are separated from process materials (zinc powder and aluminum granulate). In the case of rack material, the rack with the components is removed from the container and then the components from the rack. The process materials are then passed to a cycle for the next process.

After separating the components, they are cleaned. Subsequently, the thermal diffused components have a matt-grey look when finished. Depending on the requirements, the thermal diffused components then undergo passivation (chrome-VI free), which serves as conversion coating for subsequent sealing or topcoat coatings.

Due to the dry-running process of the zinc thermal diffusion method, the danger of hydrogen embrittlement for high-strength steels with tensile strengths >1000 MPa can be excluded, as hydrogen is not added during pre-treatment or during coating and passivation.

Cross section of zinc thermal diffusion



1 Thermal diffusion layer:
Micro alloy of zinc and base material

The zinc thermal diffusion generates a homogenous diffusion coating which guarantees an extremely resistant corrosion and wear protection.

Depending on the base material, the structure and proper-ties of the substrate can be improved.

Corrosion resistance

Depending on the material and used application of passivation and seal/topcoat, 1,000 to 3,000 hours can be achieved in the salt spray test (DIN EN ISO 9227). Passivations without chrome-VI are used.

Surface preparation

A coating is only as good as the surface to which it is applied.

Therefore, the substrate surface must be prepared before the coating process – i.e. getting rid of corrosion pro¬-ducts, scale, oil, lacquers, etc. To achieve this surface preparation, the following methods can be applied:

– Organic or aqueous, alkaline solvent degreasing in combination with ultrasonic cleaning
– Abrasive blasting
– Staining, as a rule but not exclusively, with acids

Coating thickness measurement

Zinc coating thicknesses of 4 µm to 25 µm are created, dependent on the quantity of zinc dust, process time and temperature.

In the case of serial deliveries for bulk goods parts the coating thickness is measured in accordance with DIN EN ISO 3497. With flat components such as rack goods, the magnetic procedure is executed in accordance with DIN EN ISO 2178.

The measured coating thickness is displayed as mean value. Individual measuring points are not significant, in particular for parts which are coated in bulk.
In supplement, the grammage of the coating can be determined with the gravimetric procedure (DIN EN ISO 1460:1995-01).

Depending on customer requirements, microscopic cross-sections (DIN EN ISO 1463-2004) can be used for special quality controls or special tests.

The correlation factor between the X-ray measurement and the microscopic method is material-dependent and is determined for every material.

Environmentally friendly production process

The procedure is completely free of Chrome-VI and CMR-materials (carcinogenic, mutagenic, reproduction-toxic substances). All process-related materials are recyclable and are not subject to any special disposal requirements.

Applied methods of measurement

DIN EN ISO 3497
Metallic layers
Measurement: X-ray fluorescence method

DIN EN ISO 2178
Non-magnetic coatings on magnetic base metals
Measurement: Magnetic procedure (Permascope)

DIN EN ISO 1460:1995-01
Metallic coatings, hot-dip galvanizing on ferrous materials
Measurement: Gravimetric procedure to determine the grammage

DIN EN ISO 1463 – 2004
Metal and oxide layers Measurement: Microscopic procedure