

## Adhesion Test - Applicable for coatings formed during hot dip galvanizing

### General information

There are several factors that can affect steel's reactivity during hot dip galvanizing, and thus, also the adherence between the coating and steel. These include, among other things, the chemical composition of the steel, heat treatments during manufacture of the steel or product, as well as surface roughness. In general, the coating's tendency toward brittleness and flake-off increases with the percent of zinc-iron layer in the coating, as well as with the coating's thickness.

Checking the adhesion between the steel and the zinc layers is no easy task. This branch standard has been developed to provide a unified method for determining adhesion, and is based on the best technology currently available on the market.

### Scope

The branch standard is applicable when checking the adhesion of the zinc coating created during hot dip galvanizing, and is done in accordance with the EN ISO 1461 standard. Adhesion checks are done with an impact driver that is constructed according to the German DIN 50978 standard of October 1985. Since adhesion is dependent on steel type, which influence on the thickness and structure of the layer, this shall be taken into consideration during evaluation.

The structure and scope of the test can either be agreed upon with the customer or done as a routine control.

### Testing tools

The impact driver consists of a hammer set at a 90-degree angle, a compression spring, a guide bushing and a firing mechanism (see figure). The impact driver is placed at a right angle to the test object before firing. The impact force is  $0.60 \text{ J} \pm 3\%$  and the mass is  $0.2 \text{ kg} \pm 3\%$ . This is obtained with a  $1.6 \times 12.5 \times 115 \text{ mm}$  compression spring, in accordance with DIN 2098. It is important that the tests are carried out on a stable base, as any elasticity in or shifting of the test object (or base) can cause inaccurate results.

### Execution

a) Flat components or cylindrical parts equal to or greater than 200 mm:

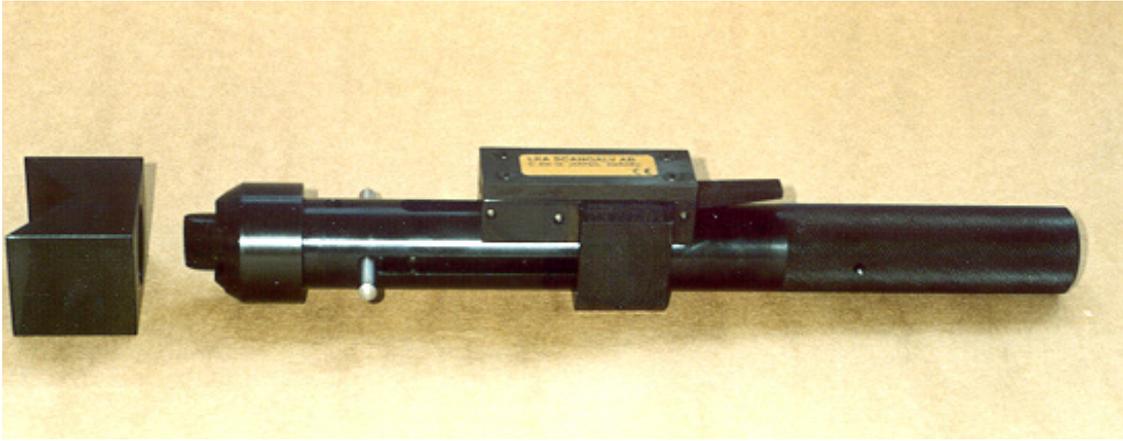
For each test area, at least 3 impact tests are performed, within a 12 mm distance, along a common line (marked with the aid of the included stamp). Testing may not be carried out closer than 12 mm to the end surfaces. The tests shall be conducted on a stable base, with the impact driver at a right angle. It is of utmost importance that the 12 mm distance is maintained, as this is the basis for the evaluation. The sight notch on the impact driver facilitates being able to follow the stamped distances.

b) Cylindrical components <200 mm

At least 3 impact tests are conducted on a common axis along the cylinder's longitudinal plane, separated by 12 mm. Here, the right angle application of the impact gun is of utmost importance to the test result. In general, according to a).

### Requirements

It should be noted that stretched or bent surfaces generally show poorer adhesion than flat surfaces. To obtain a good picture of the adhesion, a minimum of two, but preferably three, test areas should be impact tested with three impact tests.



*Impact driver for adhesion testing.*

***In general, the following is applicable when assessing adhesion:***

- Zinc layer with pure zinc on the top (shiny surface) – A narrow and short mark, with or without minor flaking of the zinc, is present in the zinc layer. If the layer separates from an area larger than 2 millimetres from the point of impact, then the adhesion is impaired.
- Zinc layer with a mixed shiny and dark surface (mottled) – The zinc may flake, to a larger degree, around the impact point, especially on the darker spots. If the zinc flakes away from a surface area exceeding 50 % (6 mm) of the distance between the impact points, then the adhesion is impaired.
- A zinc layer with a grey, dull surface – this layer is much harder than the pure zinc layer and, thus, more sensitive to impact. If the zinc layer separates from more than 75% (9 mm) of the surface between the two impact points (a distance of 12 mm), then the adhesion is considered to be impaired. However, do take note if the flaking occurs between the steel and the zinc layers or between the zinc-iron layer. In the latter case, the adhesion to the steel is better (the remaining alloy layer can be measured for verification).

**Material requirements**

As the zinc layer's structure depends on the chemical composition of the steel, conducted heat treatments and surface conditions etc., this branch standard is only applicable for hot dip galvanized material, where the suitability of the steel for hot dip galvanizing can be supported and any pre-treatments can be verified. It should also be pointed out that the steel's bulk analysis only provides a guideline value. It is the steel alloy content in the outermost surface, which is a few micrometres deep, that determines the zinc coating's thickness and its alloy layers.

**Calibration**

The impact driver shall be calibrated once each calendar year. During calibration, a valid certificate shall be provided by a recognised testing facility that shows that the test impact driver meets the applicable requirements.

**More information is provided by Nordic Galvanizers, +46 (0)8 446 67 60  
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