Hot Dip Galvanizing Data Sheet GA

1.2 The Galvanizing Process

Introduction

Hot dip galvanizing is a process in which steel or cast iron components are protected against corrosion by a zinc coating applied by dipping them in a bath of molten zinc.
Good results can be obtained only if certain precautions are taken.

- Design and construction must be suitable for galvanizing.
- Maximum dimensions must take account of the size of galvanizers' baths.
- Maximum weights must take account of transportation requirements and handling requirements during galvanizing.
- Suitable steels must be used.
- Care must be taken about the surface condition of the steel.

Although galvanizers have learned to be inventive and ingenious in handling difficult shapes and lengths, customers can improve the quality of finished articles by taking care of those things which are under their control. A customer must be sure that the fabrication is suitable for galvanizing and that there is no paint, welding slag, anti spatter paint or similar contaminant on the work. Also, steel sent for galvanizing should be as free of oil or grease as is possible to achieve.
The maximum dimensions of a steel fabrication which can to be galvanized depend on the size of available galvanizing baths, just as the maximum permissible weight of each fabrication is restricted by the capacity of the lifting gear and the vehicles used for transport.

Stages of the process

In most of the United Kingdom, Eire and the remainder of Europe hot dip galvanizing plants operate as service providers who apply corrosion protecting galvanized coatings to their customer's work (diagram 1). The various stages of the process are shown in diagram 2, although there may be variations between individual galvanizers. Plants which specialise in hot dip galvanizing small components may differ considerably from this outline.
In the initial stages of the process fabrications or castings delivered to the galvanizer are subjected to an initial examination and sorted to enable the galvanizer to arrange his work programme in the most efficient way.

Degreasing/rinsing

Where steel delivered for galvanizing shows residues of grease or oil this is removed in a degreaser or by some alternative method of cleaning. Aqueous alkaline or acidic degreasing agents are usually employed. Organic degreasing systems are uncommon. After degreasing the steel fabrication is washed in a water bath to avoid transfer of degreasing solvent to the next stage.

Pickling

Pickling removes rust and scale, which are the most common corrosion products contaminating the surface of steel fabrications. Pickling is usually done in dilute hydrochloric acid and the objective is to produce a chemically cleaned surface prior to galvanizing. The pickling time depends on the degree of rust on the article and concentration of the pickling solution. In general, pickling baths are operated at ambient temperature.

Rinsing

After chemical cleaning by pickling the work is again washed in a water bath to minimise the transfer of any acid residues to subsequent stages of the process.

Flux treatment

The application of flux immediately follows the pickling and rinsing stages. Flux serves to remove any remaining traces of impurities and provides a final intensive cleaning of the steel surface. Flux in galvanizing serves the same purpose as flux in soldering. It increases the wettability of the surface of the steel to the liquid zinc. The flux usually consists of an aqueous solution of chlorides, principally a mixture of zinc chloride and ammonium chloride.

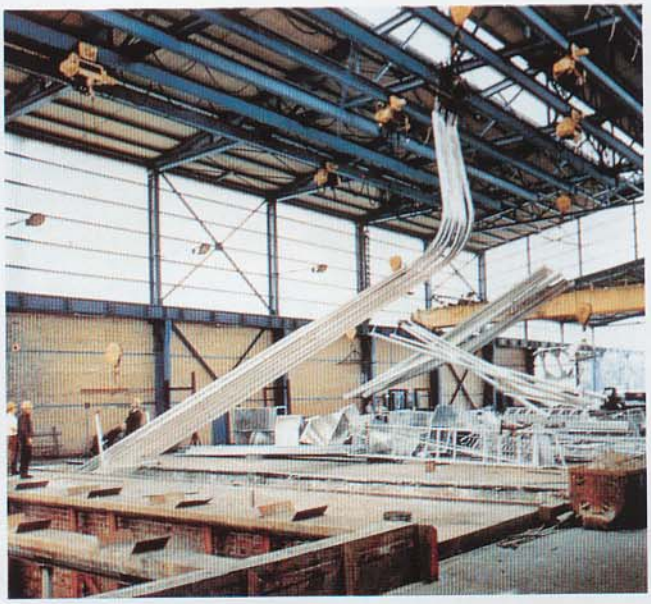

Fig. 1: Internal view of a galvanizing works.

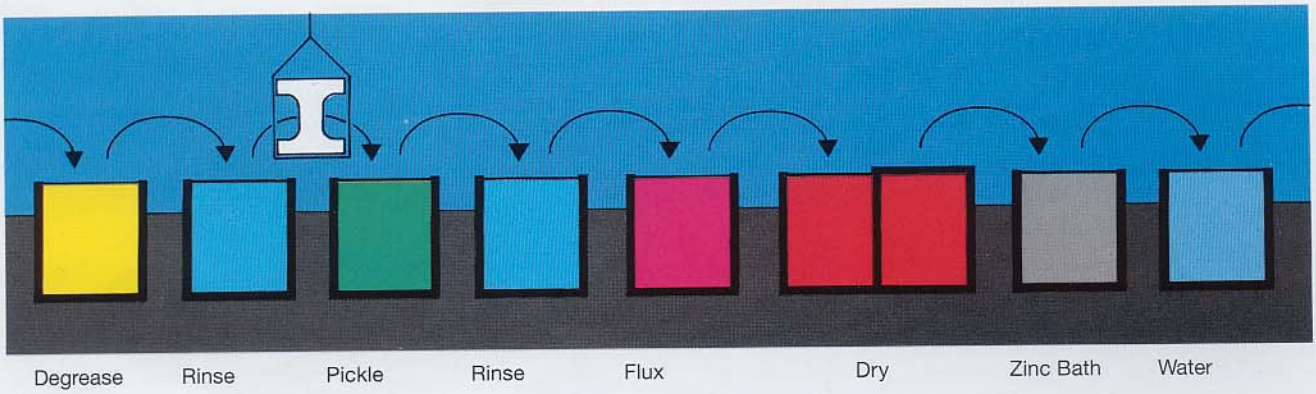

Fig. 2: Schematic diagram of the hot dip galvanizing process. (Variations may occur among different plants.)

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Flux is applied to the materials to be galvanized in different ways. For example, in most galvanizing operations flux is contained in aqueous solution in a tank and the work to be galvanized is dipped into it. Alternatively, it can be sprayed onto the surface of the work-piece as a liquid, sprayed in powder form or the article to be galvanized may be immersed in the zinc by passing it through a layer of molten flux which floats on the surface of the zinc. This latter process is known as wet galvanizing.

Drying

After immersion in the flux tank steel articles for galvanizing are dried and become coated with a thin film of flux. In many hot dip galvanizing works waste gases from the burners heating the galvanizing bath are used for heating degreasers and drying ovens.

Galvanizing

The galvanizing operation takes place in a bath of molten zinc, the temperature of which is controlled in most works in the range 440 °C to 460 °C (zinc has a melting point of approximately 419 °C). In galvanizing works which operate the high temperature process the zinc temperature may exceed 560 °C. The analysis of metal in the bath must comply with ruling national or European Standards and is a least 98.5 % Zn.
The galvanizing process causes the formation of a coating consisting of layers of zinc – iron alloy caused by the reaction of zinc with iron in the steel. As the galvanized components are withdrawn from the molten zinc a further layer of metal of a composition similar to that of the zinc in the bath remains on the surface.
The time for which the steel fabrication is immersed depends, among other factors, on its weight and on the thickness of the steel sections. In any event, the article being galvanized remains in the molten zinc until it has attained a temperature identical to that of the bath. Naturally, the surface of the zinc in the bath becomes covered with a thin layer of oxide and flux residues while the galvanized article is under the surface. This surface layer is removed to ensure that the galvanized article does not become contaminated with flux residues and dross on removal from the zinc.

Cooling and checking

The galvanized steel, which by now is very hot, is either left to cool in the air or is immersed in a water bath.

Fig. 3: Galvanizing bath within fume extraction enclosure.

The final stages of the process are checking for quality and weighing. Galvanizing which complies with BS 729 or with the proposed European Standard must consist of a continuous coating and must comply with coating thickness criteria. Also, any unwanted pick-up of zinc ash or flux residues is removed. Finally, the galvanized material is weighed, because the galvanized weight is normally used as the basis for pricing.

Results

The thickness of the zinc coating is a fundamental criterion of the quality of a hot dip galvanized coating. It is normally measured in microns (1 micron = 1/1000 mm), although the coating thickness may occasionally be expressed in terms of weight measured in gm^{-2}.

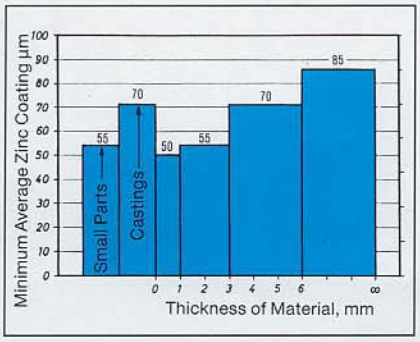

Fig. 4: Permissible minimum zinc coatings on steel of varying thicknesses according to DIN 50976. For material thicknesses of 1 mm, 3 mm and 6 mm the permitted minimum is the highest value given in the figure.

The minimum acceptable thicknesses for finished coatings are to be found in BS 729: Hot Dipped Galvanized Coatings of Iron And Steel Articles (diagram 4).
It occasionally happens that small defects in the galvanized coating need rectification. This is usually done by the application of a zinc rich paint or other proprietary material. If a customer has special requirements regarding appearance or coating thickness it is necessary for the customer and the galvanizer to agree on these before the order is accepted, because both have implications on cost and price.

Variants of the process

Although the majority of galvanizing plants can accept a wide variety of shapes and weights of steel fabrications, some are semi-automated or fully automated for galvanizing long runs of tubes, standard steel sections and particularly small components such as screws, nuts and wire nails.

Literature:

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