



MISCONCEPTIONS

Miss Conception puts it "straight"

"Miss Conception" rectifies incorrect impressions concerning hot dip galvanizing.

If you require a thicker hot dip galvanized coating you should specify it as C4 or C5 (in terms of ISO 9223) hot dip galvanizing!

True or false?

When pre-cleaned steel is dipped into molten zinc at about 450°C a chemical reaction takes place whereby a coating structure comprising a series of iron/zinc alloys, overcoated with a relatively pure zinc layer is metallurgically bonded to the steel substrate. Coating thickness and appearance are therefore mainly influenced by the laws of metallurgy, where the chemical composition of the steel, steel thickness and surface roughness, play the major roles.

Composition and the Metallurgy of the Steel

Some carbon steels are more reactive to molten zinc and in spite of the modern steel making continuous casting process, this phenomenon still occurs. With the continuous casting process, either silicon or aluminium is added to the steel as a de-oxidising agent. These steels are respectively known as aluminium-killed and silicon-killed steels. Aluminium-killed steel generally includes all flat steel up to 4.5mm thick, which can end up being used to manufacture tubes, etc. Silicon-killed steel generally includes all hot rolled profiled steel and flat plate greater than 4.5mm thick. While aluminium additions to steel have no effect on the coating structure and thickness of a galvanized coating, the same cannot be said for silicon, where certain amounts of silicon can have a major effect on increased alloy growth during hot dip galvanizing. Phosphorus in graded steel is usually less than 0.001%, which at this level rarely has an effect on alloy growth either with silicon or on its own. However in steel where phosphorus exceeds 0,02% (generally some of the commercial grade steels) reactivity to molten zinc will increase.

Thickness of the Steel

The thickness of the steel influences the coating thickness. Generally, the thinner the steel the thinner the coating. This applies especially to aluminium-killed steels. One reason for this is that articles fabricated from thinner steels, generally require shorter immersion times. Although relatively infrequent, it is for this reason that when reactive thinner steels are welded to non-reactive thicker steels, inordinately thicker coatings may result on the thinner steel. There is a far greater possibility that non-reactive thinner steel is welded to reactive thicker steel and the resultant thicker coating on the thicker steel may be aesthetically less acceptable and prone to brittleness and

therefore potential damage, particularly on edges. Mechanical manipulating, including rolling, bending and heat treatment, plus any welding of the steel, can lead to different reactions in the zinc bath.

Surface Condition

Varying surface roughness of the steel leads to variations in thickness of the coating. The rougher the surface of the steel, the thicker the coating. Depending on the type of steel and the surface profile, preparation treatment such as abrasive blasting can result in a 10 to 15% thicker coating. Steel that has been severely attacked by rust, or over pickled, also results in increased coating thickness.

Although the galvanizer to a degree can influence the resultant coating thickness, his influence is mostly limited. For instance he can:

- ◆ **Extend the immersion time**
 1. For most silicon-killed steels a longer immersion time will produce a thicker coating.
 2. However, with some semi-reactive silicon-killed steels the immersion time required to produce the initial coating thickness, may have to be doubled in order to achieve a marginal increase in coating growth. This would obviously impact on the productivity and hence profitability of the galvanizer.
 3. If the steel is aluminium-killed (very little silicon and no phosphorus – low reactivity) longer immersion times will not necessarily produce a thicker coating. *See figure 25.*
- ◆ **Speed up the withdrawal rate.** (Slow withdrawals result in thinner coatings, faster withdrawals thicker coatings). Most galvanizers have a crawl speed installed on their crane control so that it is easy for the crane operator to adhere to the norm of slow withdrawal, so increasing the withdrawal rate may not be practical.
- ◆ **Depending on the facility,** the components length and the crane hook height, the preferred angle of exit is about 35 to 45° angled to the horizontal, some galvanizers may find this impractical or not achievable due to plant restraints.

Although SANS 121 (ISO 1461) has no reference to a heavy duty coating, by popular

request from the South African specifier a heavy duty coating was required mostly for mining or coastal conditions. This has been included in the South African Bureau of Standards - General and Specific Permit Conditions issued to all Mark Scheme Holders, whereby a heavy duty coating of at least 25% greater than that given in ISO 1461, (not centrifuged) can be achieved without compromising specification conformity.

Although a heavy duty coating can be requested particularly with thick steels, a thick coating of in excess of 25% in most instances is common! Should this requirement be critical, samples should be galvanized to achieve the required coating thicknesses, the results monitored subsequent to discussions and then suitable instructions implemented.

Therefore, should a specifier require a coating thickness in excess of that set out in SANS 121 (ISO 1461), a heavy duty coating may be specified. This is done in accordance with the "General and Specific Permit Conditions", by the South African Bureau of Standards issued to all Mark Scheme Holders. In addition for practical purposes, the requirement should also be discussed with the galvanizer prior to finalizing the order. For a number of technical and practical reasons and steel types, a heavy duty coating may not always be achieved.

In addition the specifying of a C4 or C5 hot dip galvanized coating is incorrect because it relates to ISO 9223 – Corrosion of metals and alloys – Corrosivity of atmospheres – Classification, which by its title is a classification of atmospheres and although a thicker hot dip galvanized coating (or duplex coating) is necessary for long term durability in these atmospheres it is not the manner in which to specify such a coating!

Note: All steel can be hot dip galvanized but should the specifier require a particular result, eg. architectural quality, the correct steel grade must be specified, see table 16.

Due to space constraints figure 25 and table 16 have not been included in this article, kindly refer to the Association's "Steel Protection by Hot Dip Galvanizing and Duplex Coating Systems".