GalvInfoNote	Treatments for Enhancing Formability
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Introduction

The surface of zinc and zinc alloy-coated steel sheet can be treated using one or more of many methods. **This GalvInfoNote deals with surface treatments to enhance the formability of coated sheet**. Other treatments are used for different reasons, namely:

- Improving uniformity of appearance (see GalvInfoNote 2.8)
- Imparting resistance to storage stain (see GalvInfoNote 2.10)
- Preparing galvanize for field painting (see GalvInfoNote 2.11)
- Pretreatments for metallic-coated sheet (see GalvInfoNote 2.12)
- Treatments for resistance to handling and fingerprint marks (see GalvInfoNote 2.13)

While most of the above treatments are performed directly on the hot-dip line after the metallic coating has been applied, some can also be carried out on separate process lines/facilities, or in the field.

There are a number of surface treatments to improve formability of coated sheet.

Oils

Oils are applied to coated sheet for two reasons – primarily to aid subsequent forming, but also to improve storage stain resistance. In most cases, oils designed to be applied to coated sheet are formulated to achieve both of these goals, even though storage stain resistance benefits of oil are generally limited to excluding condensation water from penetrating between coiled or stacked sheet surfaces. It is important to note that oils are not effective in preventing damage from bulk water (rain, splashing, flood, etc.).

In the case of coated sheet used by the automobile industry, it is always produced without surface passivation (chemical treatment) applied to the surface. This is because many passivation treatments interfere with spot welding and painting operations. Unpassivated sheet is at great risk of water damage if it gets wet. Oiling at the coating line usually provides enough protection so that condensation moisture cannot penetrate between sheets or laps and cause storage stain.

Oils applied to the surface of metallic-coated steel sheet provide lubricity to aid subsequent roll forming or stamping operations. Some end uses require heavy oiling, while most need only a very small amount. Oil exuding from the sidewalls and dripping onto warehouse floors is a problem with heavy oiling. Oil reduces galling, scratching, and fracturing during fabrication. The steel supplier applies the oil on the coating line just before the sheet is recoiled. Typically, it is applied using a device that first atomizes the oil, and then deposits it on both sheet surfaces in a controlled manner using electrostatic forces. This allows close control of the amount of oil deposited on the surface.

Most oils used to aid forming of coated sheets are referred to as mineral or “slushing” oils. There are many different brands with varying viscosity and levels of volatile components and rust inhibitors. Other oils with a high volatile content are designed to evaporate when the sheet is exposed to the air and hence are called “vanishing” oils. Some oils are thixotropic and partially solidify after they are applied. They do not exude from the coil walls after application. Details regarding the best oil to use for an application can be obtained from oil suppliers.

Soap Lubricants

Soap lubricants are also known as **dry film lubes** and their purpose is to provide superior lubrication during difficult forming operations. They are based on alkaline chemistry and are usually roll-applied at

the exit end of a coating line using an aqueous solution followed by drying. The end use determines the aim coating weight. One problem with these coatings is absorption of moisture in humid environments. This could lead to surface corrosion and problems during forming. Their typical use is on prepainted sheet although they can be applied to zinc-coated sheet for difficult forming applications.

Dried-in-Place Phosphate Coatings

These are phosphate coatings designed specifically to aid the formability of coated sheet. They consist of tri-metal (Zn-Mn-Ni), microcrystalline phosphate crystals that are applied from aqueous solution using rubber rolls. Coating weights are typically between 0.5 and 1.5 g/m^2. After the roll application these films are dried using IR or convection ovens. Usually the phosphate coating is oiled with a mill oil in order to prevent moisture pick-up and subsequent corrosion. After parts are formed they can be cleaned and rephosphated prior to painting.

Acrylic Coatings

Acrylic polymer coatings are water-borne solid films applied at coating weights of between 150-350 mg/in^2. They are of two types; permanent and alkaline-removable. During application on the coating line they require a peak metal temperature of at least 125ºC to drive off the water so as to inhibit moisture migration through the coating. Characteristically they have low friction coefficients and therefore do not require oiling to achieve their excellent formability enhancement. These coatings offer excellent storage and transit corrosion protection. The permanent versions of these treatments are paintable unless they were formulated with silicon pigments or wax. Standard alkaline cleaners easily remove non-permanent varieties, which can then be phosphate treated and/or painted.

A source of additional information on formability enhancing mill-applied surface treatments can be found in Appendix X2 of ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process, available at www.astm.org.