Cominco Metals

A Division of Cominco Ltd.

A COMPARISON OF TOUCH-UP MATERIALS FOR GALVANIZED PRODUCTS

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Justification

Hot dip galvanized coatings are specified to provide corrosion protection to iron and steel structural shapes, fabricated articles and miscellaneous fittings, hardware and similar items. Occasionally during in-plant processing these shop-applied coatings are marred by bare spots or other minor imperfections that will allow the exposed steel to corrode if left untreated. The coatings can be scarred if the galvanized products are mishandled during shipping. They can also be damaged by post-galvanizing operations such as welding carried out for assembly of large structures or for field erection. Regardless of the cause of coating damage, restoration of corrosion protection is recommended.

When re-galvanizing of the affected product would be impractical or costly, such as with large structural members, industry practice usually allows for the repair of the exposed area. A survey of hot dip galvanizers concluded that galvanized coatings are generally repaired using one of three methods - application of zinc-rich paint, coating the affected area with solder, or spraying the bare spot or damaged area with metallic zinc. While all of these materials are widely used, very little has been documented on the application, properties and performance of the materials when used to repair galvanized coatings.

Several products used commercially to touch up and repair galvanized coatings have been rated in a study undertaken by Cominco. This report summarizes the results of the program.

Test Program

Thirteen materials used by galvanizers, fabricators and structural steel erectors to touch up and repair galvanized coatings were selected for testing. These included 8 zinc-rich paints, 4 solders, and sprayed zinc metal.

A total of 20 combinations of product application were studied. Practices evaluated included two standards of steel surface preparation for paints and solders, and 1- and 2-coat applications of zinc-rich paints applied by brush or spray where applicable. Top-coating of selected products with aluminum paint for cosmetic effects was also explored.

Each of the materials was applied to galvanized steel test coupons that had been prepared with areas on their surfaces to simulate bare spots and zinc coating damage due to post-galvanizing welding.

Manufacturers' recommendations were followed to apply proprietary repair materials and typical industry practices were used for other products.

The study involved preparation and examination of 350 test coupons to rate the touch-up materials in terms of ease of application and to characterize the performance of the applied coatings.

Property Evaluation and Performance

Ease of Application

Each product was assigned a rating based on properties considered significant.

The zinc-rich paints, as a group, rated highest for ease of application. They were assessed according to packaging, ease of mixing, wettability of the bare spot or weld bead and surrounding area, fluidity, and levelling qualities of the paint film.

Metallizing was rated marginally lower than zinc-rich paints because special equipment is required to spray the metallic zinc, additional in-plant ventilation is needed to handle zinc fume generated during spraying, and the equipment could be cumbersome for field repair.

Solders were rated lowest for ease of application in the Cominco evaluation. Factors considered were ease of heating the bare spot or simulated weld area, wetting of the steel by the solder and, where applicable, the need to remove solder flux residues. Difficulties were experienced in applying the solders but to a large extent these seemed to be related to the heating of the relatively large touch-up areas chosen for the tests. The solders might be rated higher for actual post-galvanizing touch-up or field repairing of smaller bare spots.

Adhesion

The adhesion of each touch-up material was determined by Pivoted Hammer and V-scribe test. Coating adhesion was rated according to the extent of peeling of the segment of touch-up material between a pair of hammer impressions, or between two sides of a V-groove.

Coating adhesion was good for all of the products tested but some paint films had a tendency to flake on impact, particularly where very thick coatings had been applied.

Abrasion Resistance

The abrasion resistance of each touch-up material was rated by ASTM test procedure D 968 - "Determination of Abrasion Resistance of Paint by the Falling Sand Method," with the exception that G-40 steel grit was used in place of sand. The volume of steel grit required to abrade 1 mil of thickness from the coating was taken as a measure of abrasion resistance.

Sprayed metallic zinc was rated highest of the three types of materials tested, but it was less than half as abrasion resistant as a galvanized coating. The solders and zinc-rich paint films offered only a fraction of the abrasion resistance of metallized zinc. Solders, as a group, were marginally better than zinc-rich paints.

Corrosion Resistance

The touch-up materials were evaluated by accelerated corrosion tests (salt spray and humidity), and short-term atmospheric exposure testing.

Some test coupons were exposed for 1000 hours in a salt spray cabinet according to the ASTM Specification B 117 - "Standard Method of Salt Spray (Fog) Testing." Other coupons were tested for 1000 hours in a humidity cabinet according to ASTM Specification D 2247 - "Standard Method for Testing Coated Metal Specimens at 100% Relative Humidity."

Most of the candidate materials performed satisfactorily in the accelerated corrosion tests and these results were generally supported by the results of atmospheric exposure testing that had been carried out for 6 months at the time of reporting.

The ability of the materials to provide cathodic protection to exposed steel surfaces was determined in atmospheric exposure tests after making a scratch in the applied coating to expose bare steel. Metallized zinc was the only material tested that rated high in this property. Coatings of zinc-rich paints and solders provided very little sacrificial protection, so both groups were rated medium-to-low. Some high-zinc solders out-performed paints.

Of the three groups of touch-up materials tested, sprayed metallic zinc provided superior overall corrosion protection. Zinc-rich paints and solders were rated somewhat lower.

The atmospheric exposure testing is continuing on the roof-top exposure site at Cominco Metals' Product Research Centre. The site atmosphere is rated "mild industrial."

Application Guidelines

The application of zinc-rich paints and metallized coatings is not limited by the size of geometry of the exposed steel to be treated, whereas solders are more effective for repairing relatively small areas. The effectiveness of repair with solders is dependent on the ability of the applicator to uniformly heat the affected area to a suitable temperature without oxidizing the bare steel.

The integrity of zinc-rich paint films can be adversely affected if they are applied under certain ambient conditions. High relative humidity and relatively low temperature during application might be of concern. Most manufacturers offer guidelines for applying zinc-rich paints and these should be heeded in the interest of good film adhesion.

Caution should also be exercized when spraying metallic zinc during periods of high relative humidity as coating adhesion can be impaired if the abrasive-prepared surface is allowed to oxidize. The tendency of a freshly cleaned surface to oxidize will be greater at higher humidity and may be of concern if the time between surface preparation and coating application is unduly extended.

Metallized coatings should only be applied to surfaces blast cleaned to a white metal (SSPC - SP5) finish. Performance will be impaired if lower standards of surface preparation are used.

Zinc-rich paints and solders also perform best when applied to steel surfaces blast cleaned to a white metal finish. However, adequate performance can be achieved with some zinc-rich paints applied to steel surfaces blast cleaned to a commercial (SSPC-SP6) finish.

Solders should be applied only to steel surfaces that are free of millscale and other surface residues.

Coating Application

Relatively thick coatings of zinc-rich paint and sprayed metallic zinc will be required to provide satisfactory protection from damage and corrosion. Coatings of adequate thickness are usually produced by applying several layers of the repair material.

Since it is not possible to apply multiple coats of solders, coating thickness will be limited. If fluxed solders are used it is imperative that the flux residues be removed after the coating has been applied.

Selection Considerations

The selection of a material for touch-up or repair of galvanized coatings should be made after considering the specific requirements of each application. None of the materials commonly used in the industry should be expected to perform as well as hot dip galvanized coatings in all areas. However, each material likely will provide satisfactory performance in at least one property relevant to the repair of galvanized coatings.

A galvanized coating provides a physical barrier to corrosion and corrodes preferentially to exposed steel when the coating is breached. Sprayed metallic zinc is the only material tested that provided cathodic corrosion protection equivalent to that of a galvanized coating. Coatings of zinc-rich paints and solders of adequate thickness provided satisfactory barrier protection but cathodic protection was relatively low.

While corrosion protection provided by a repair material will be the primary consideration, adhesion of the applied coating will be important. Scratch and impact resistance, used as a measure of coating adhesion, was good for all the materials tested and was equivalent to that of a galvanized coating.

Galvanized coatings are made up of an outer layer of zinc that resists impact and a series of iron-zinc alloy phases that are hard. As hardness and abrasion resistance tend to be directly related it is unrealistic to expect the relatively soft materials used for touch-up or repair to resist abrasion to the same extent as galvanized coatings.

Of the materials tested sprayed metallic zinc will provide the highest abrasion resistance. Zinc-rich paints and solders will provide relatively little resistance to abrasion.

Compared to galvanized surfaces, coatings of solder provide the best color match, but an acceptable and almost inconspicuous color match can be obtained by top-coating the touched up area with aluminum paint.

The table below provides qualitative performance ratings for metallized zinc, zinc-rich paints and repair solders.

COMPARATIVE PERFORMANCE RATINGS

	Metallizing	Paint	Solder
Corrosion Protection - Barrier	Very Good	Very Good	Medium
- Sacrificial	Excellent	Low	Medium-Low
Adhesion	Very Good	Very Good	Very Good
Abrasion Resistance	Medium	Very Low	Low
Appearance Match	Medium	Very Low	Good