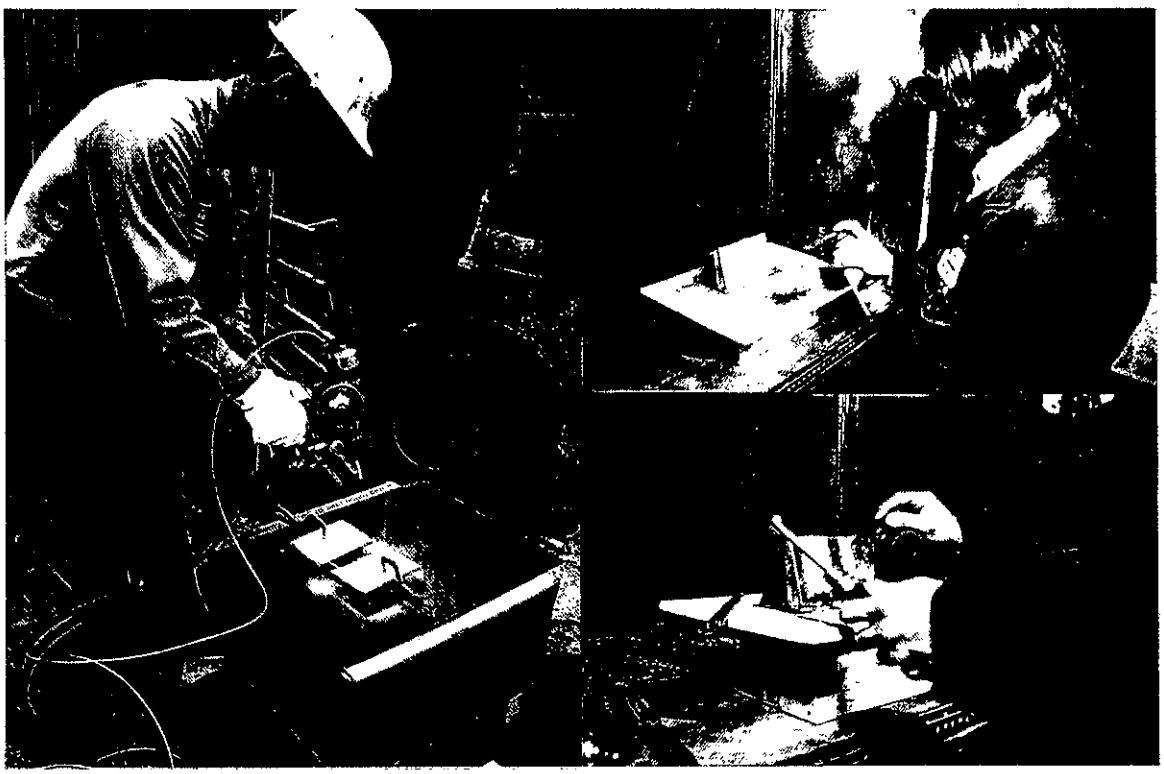
Cominco Metals

090070

A COMPARISON OF TOUCH-UP MATERIALS FOR GALVANIZED PRODUCTS



Touch-up materials being applied to test coupons. Zinc metallizing (left), zinc-rich paint (top right), and Lead-Tin-Zinc solder (bottom right)

Hot dip galvanized coatings provide excellent corrosion protection to iron and steel structural shapes, fabricated articles, miscellaneous fittings, hardware and similar items. Occasionally during in-plant processing, this shop-applied coating is marred by small bare spots or other minor imperfections. Galvanized coatings can also be damaged in the field from mishandling during shipping or from post-galvanizing operations such as welding. Regardless of the cause of coating damage, restoration of corrosion protection in these affected areas is recommended.

When re-galvanizing the product would be impractical or costly, such as with large structural members, industry practice allows for repair of the exposed area provided it falls within certain size limitations agreed upon between the customer and the galvanizer. A survey of hot dip galvanizers concluded that galvanized coatings are generally touched-up using one of three types of products - zinc-rich paints, lead-tin-zinc solders, or thermally sprayed metallic zinc (metallizing).

A study was undertaken by Cominco's Product Technology Centre to evaluate some of the more commonly used touch-up materials and compare their performance to the surrounding hot dipped galvanized coating. The touch-up materials were applied to bare spots and weld-damaged areas on galvanized steel test coupons. A complete list of the materials tested is given in Table 1. The touch-up materials were evaluated based on 5 criteria: ease of application, appearance, adhesion, abrasion and corrosion resistance.

Zinc metallizing was found to provide the best overall performance, particularly in abrasion resistance and cathodic protection. Zinc-rich paints have provided good barrier protection but are weak in abrasion resistance. Solders as a group were difficult to apply and did not provide satisfactory corrosion protection.

ORGANIC ZINC-RICH PAINTS				
Product Code	Generic Type	Application Form	Zn Content % by Volume	Wt. % of Zn in Dry Film
Ab	Zn-rich epoxy	brush	52	95
As	Zn-rich epoxy	spray	52	95
Bb	Zn-rich epoxy	brush	n.a.	95
Bs	Zn-rich epoxy	spray	n.a.	95
Cb	Zn-rich chlorinated rubber	brush	45	n.a.
Db	Zn-rich phenoxy	brush	36	86
Eb	Zn-rich chlorinated rubber	brush	n.a.	92-95
Fs	Zn-rich epoxy	spray	n.a.	92

SOLDERS			
Product Code	Generic Type	Description	% Metallic Zn (approx.)
G	Galvanizing Powder	Mixture of Pb-Sn-Zn powder (60%) with flux (40%)	50
H	Galvanizing Stick	Mixture of Pb-Sn-Zn powder (75%) & flux (25%) compressed into 5/8 x 5/8 x 4 in. sticks	20
I	Galvanizing Stick	Sticks of Pb-Sn-Zn alloy, 1/4 x 1/4 x 14 in.	30
J	Galvanizing Stick	Sticks of Pb-Sn-Zn alloy, 1/4 x 1/4 x 18 in.	30

METALLIZING			
Product Code	Generic Type	Equipment	Metal Wire
M	Combustion Flame Metal Spraying	Flame Spray Gun	1/8 in. diameter zinc wire

Application

Zinc-rich paints were on average easier to apply than metallizing. This was mainly due to the extra ventilation and equipment that the metallizing process required. Solders were considerably more difficult to apply than the other two materials. Difficulty was encountered heating up the bare spot without oxidizing the exposed steel or damaging the surrounding galvanized coating. In addition, since the solders are molten when applied, the resultant coatings are inherently very thin.

Appearance

Solders provided the best colour match and blending in with the surrounding galvanized surface when they were applied uniformly. Although the other two coatings were more conspicuous, much of the colour contrast could be eliminated by top-coating the touch-up material with aluminum spray paint.

Adhesion

Coating adhesion was determined using the pivoted hammer and V-scribe tests. Coatings were rated according to the amount of peeling observed between hammer impressions and scribe lines. Coating adhesion was good for all of the products tested although some paint films had a tendency to flake during the hammer test when 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 by the Falling Sand Method", with the exception that G-40 steel grit was used instead 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 materials tested, although it was still 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 based on two accelerated corrosion tests and one atmospheric exposure test in a light industrial environment. Both accelerated tests were 1000 hours in duration, one in a salt spray cabinet according to ASTM B 117 and the other test in a humidity cabinet according to ASTM D 2247.

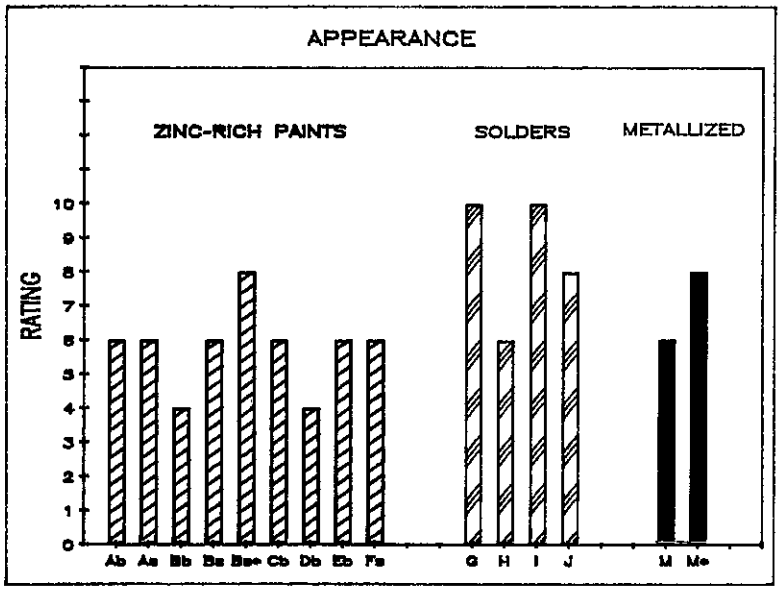
Most touch-up materials tested performed well in the accelerated tests. Three of the eight zinc-rich paints and one of the four solders did not perform satisfactorily in the accelerated corrosion tests.

After three years of atmospheric exposure the metallized and zinc-rich paint products have completely protected the coated steel areas from red rust corrosion. All four solders tested have allowed various degrees of red rust over the coated areas ranging from moderate to severe.

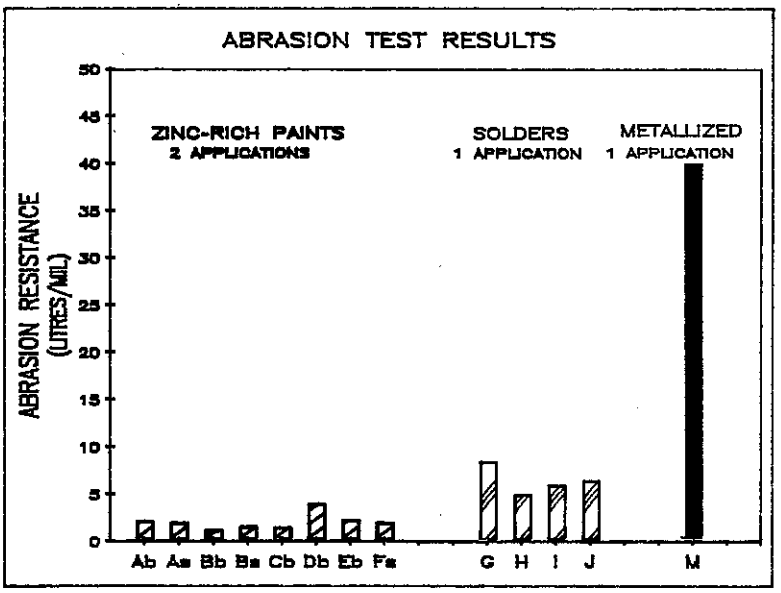
Vertical lines were scribed on the touch-up products to determine whether the applied coatings could provide cathodic or sacrificial protection to the exposed steel. The scribe marks on the galvanized and metallized samples have shown only a light dusting of red rust after three years of exposure. The scribe marks on most of the zinc-rich paint and solder samples have completely red rusted. No lateral creepage of rust beyond the scribe lines has been observed. One solder product, containing a very high percentage of zinc, and one zinc-rich paint coating that was very thick, have provided an acceptable level of cathodic protection to the steel for a period of up to two years of exposure.

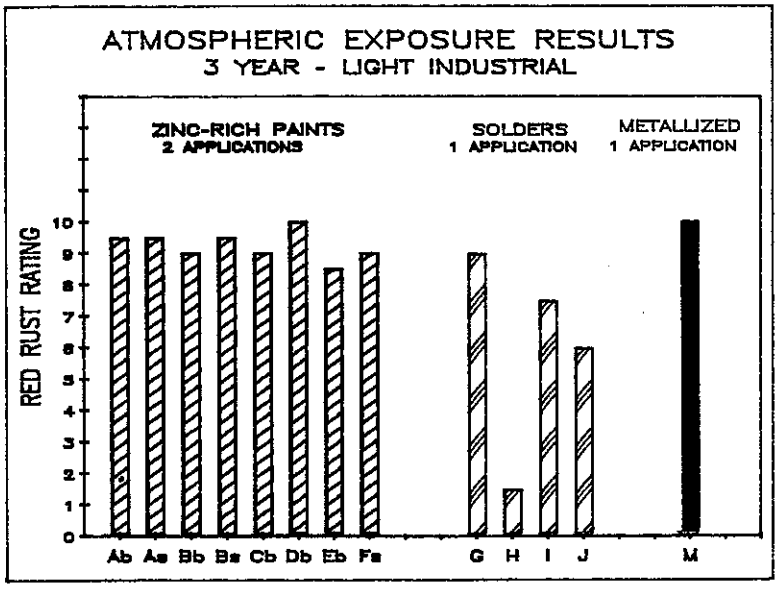
Conclusion

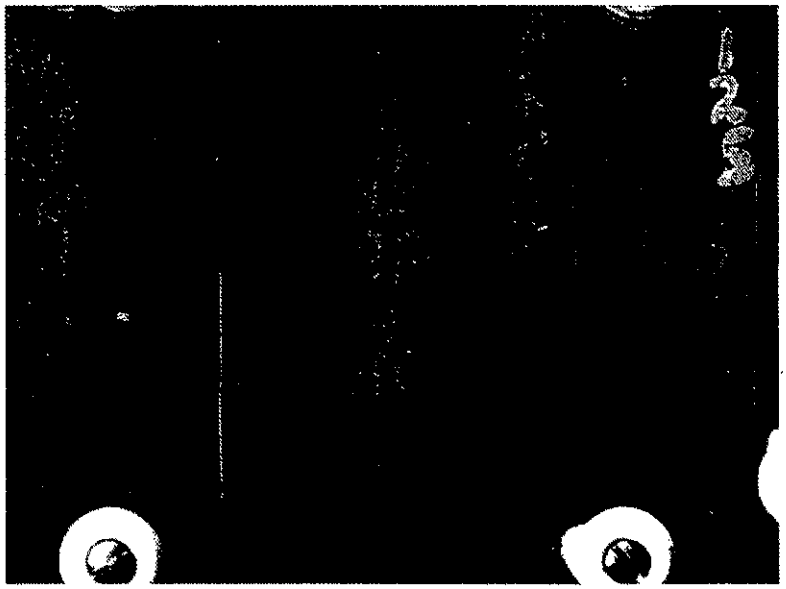
None of the touch-up materials tested were able to perform as well as hot dip galvanizing in all aspects of testing.



* *aluminum paint top coat*

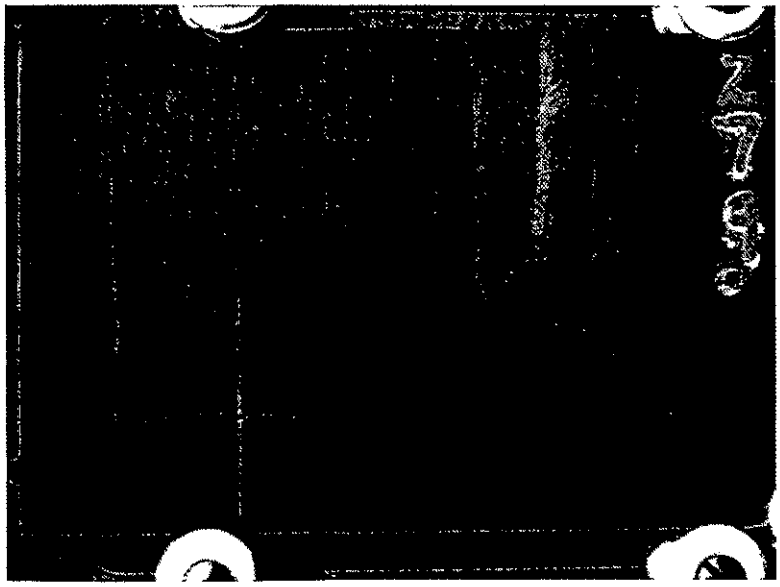




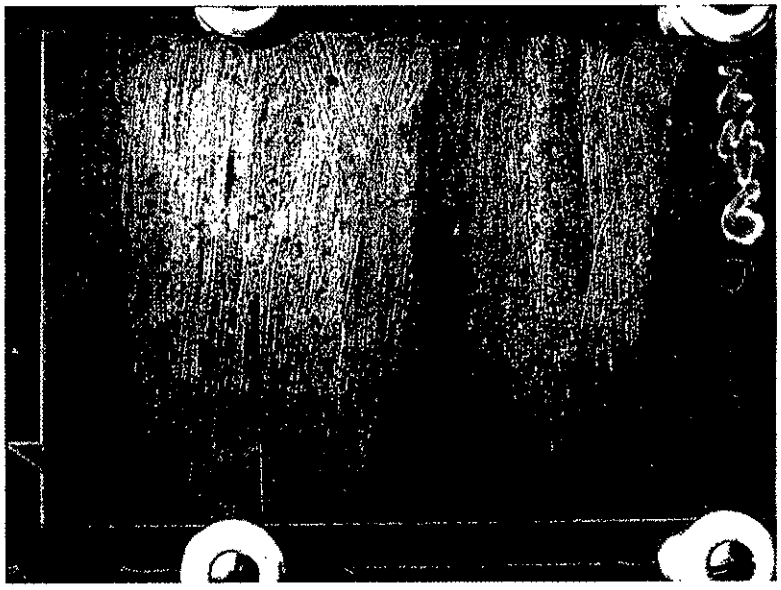


The zinc-rich paints have given good barrier protection to date, but generally have been deficient in providing cathodic protection. Solders that contain a very high loading of zinc are capable of providing cathodic protection, but the coatings tested were too thin to provide the long term corrosion (barrier) protection that would approach that of a hot dip galvanized coating.

Thermally sprayed zinc was best able to match the overall performance of the hot dip galvanized coating. Metallizing was equivalent to galvanizing in all corrosion tests, including cathodic protection. Metallized coatings were also many times more abrasion resistant than either zinc-rich paint or solder.



Test coupons after three years of exposure in a light industrial environment. Zinc-rich paint (above), zinc thermal spray (right) and Lead-Tin-Zinc solder (bottom).



Cominco Metals
A Division of Cominco Ltd.
1500-120 Adelaide Street W.
Toronto, Ontario CANADA
M5H 1T1
Telephone: (416) 869-1850
Fax #: (416) 862-8553