**Answer**

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Zinc coatings are widely used because of their versatility, resistance to corrosion and abrasion, and ease of application. Inorganic zinc coatings (IOZ) are particularly attractive to many users. However, in spite of their proven resistance to adverse weather conditions and to wear, maintenance is imperative for structures coated with these products.

After long exposure, the most common failure observed on IOZ is pinpoint rusting. It develops slowly but can spread to a large area if not stopped. Pinpoint rusting may be the result of low dry film thickness (dft) or even holidays.

Several factors may contribute to this problem. First of all, IOZ is usually applied in a single coat at a DFT of 50 to 100 µm (2 to 4 mils), which allows no margin for spraying mistakes. In addition, the coating's gray color may be difficult to distinguish from freshly blast-cleaned steel, especially in poor lighting. Also, the sprayed passes may overlap unevenly.

Repairs differ for new and aged coatings of IOZ.

Repairs of holidays or skips in a new coating usually involve small areas that are prepared by power tool cleaning. Paint manufacturers often recommend power tool cleaning to a thorough (St 2) or very thorough (St 3) standard in accordance with ISO 8501-1 (Preparation of Steel Substrates Before Application of Paints and Related Products—Visual Assessment of Surface Cleanliness—Part 1: Rust Grades and Preparation Grades of Uncoated Steel Substrates and of Steel Substrates After Overall Removal of Previous Coatings), or in accordance with SSPC-SP 3 (Power Tool Cleaning).

Surface preparation should be followed by brush (not roller!) application of an IOZ repair coating to a specified DFT. However, since IOZs do not form films as well as organic binders, their use should be limited to small zones. Attention must be given to proper removal of dust, to proper overlapping onto the existing coating, and, of course, to environmental conditions during application.

The situation is different when treating aged coatings. During years of service, the porous IOZ coating can become sealed as zinc particles are encapsulated by oxides and carbonate reaction products. This condition, combined with a high surface density, can cause adhesion problems between original and repair coatings. Therefore, it is necessary to expose the zinc in lower lay-

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**Question**

What is the best procedure for touching up rusted, untopcoated inorganic zinc-rich coatings?
ers of the original coating so it can react with the repair coating. This is done by abrasive blasting, which also removes corrosion and provides a proper profile for good adhesion. Many people think SSPC-SP 7 (brush-off blast cleaning) is sufficient. It is adequate for feathering edges, but it is not thorough enough to remove rust. Hence, SSPC-SP 6 (commercial blast cleaning, which is the equivalent of Sa 2), in my opinion, is the minimum requirement.

Sometimes open abrasive blasting is not possible or is too expensive. Vacuum blasting could be used, but its production rate on structural steel can be low. Therefore, it is better to limit its use to small areas. Disc sanding also could be used for limited areas. In that case, selection of proper disc grain size is important to avoid polishing. Reduction of surface roughness while disc sanding is unavoidable, so it is good to treat the area with a needle gun with enough force to add some roughness but not enough to gouge the surface. A needle gun also is a good tool for cleaning corners, angles, bolts, rivets, etc., but slowness of this operation is a drawback.

Application of a new IOZ coating must be done with care by skilled painters. The recommended method is spraying with a nozzle fan angle of not more than 30 degrees. Good workmanship is essential to provide the required DFT on cleaned steel, proper coverage on feathered areas, and no overlapping on unprepared zones.

Feathered areas are particularly sensitive, since excessive thickness there can cause the coating to crack, while overlapping onto unprepared surfaces can lead to quick detachment.

If done well, however, touching up an IOZ coating is always a good investment that can provide excellent performance for many years.

Answer
J.M. Keijman,
Ameron International,
Geldermalsen,
The Netherlands:
The procedure for touching up rusted, untopcoated inorganic zinc-rich coatings depends on various factors in relation to service conditions and the progress of the rust or corrosion of the steel substrate.

Tank Linings
Most untopcoated inorganic zinc-rich coatings or zinc silicates are used as tank linings.

Surfaces with rust all over should be blast cleaned to Sa 2 1/2–Sa 3.
(SSPC-SP 10, Near-White, to SSPC-SP 5, White Metal) followed by application of a full coat of a zinc silicate at the original dry film thickness.

The same procedure is preferred for localized repairs of isolated rust spots. When blast cleaning is not feasible, power tool cleaning with a needle gun, disc sander, etc., followed by application of a zinc silicate coating, is an alternative.

It should be noted, however, that coating performance is proportional to the quality of surface preparation.

Solvent-borne zinc silicates are recommended for maintenance and repair of zinc silicate tank linings. Water-borne zinc silicates are less tolerant on existing inorganic zinc-rich coatings, particularly when residues of cargoes are still present in the pores of the old coating.

**Elevated Temperatures**
Untopcoated zinc silicates also are used to protect steel at elevated temperatures. The same repair procedures as for tank linings are recommended.

**Atmospheric Exposure**
Single coats of untopped inorganic zinc-rich coatings also are used to protect steel structures exposed to atmospheric environments at ambient temperatures.

When a major part of the structure is corroded, blast cleaning to Sa 2 1/2 (SSPC-SP 10) followed by application of a full coat of a zinc silicate coating is recommended. When blast cleaning is not possible, alternatives include power tool cleaning or high-pressure water washing followed by application of a surface-tolerant epoxy.

For repair of localized rust spots, power tool cleaning, such as disc sanding, followed by application of a zinc silicate is recommended. As an alternative, a zinc epoxy can be used, preferably with an additional epoxy topcoat. Also, surface-tolerant epoxies can be used to repair mechanically cleaned local damage of zinc silicate coatings.

**Answer**
Antonio M. Tolotto,
Technical Director,
BOAT S.p.A.,
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Zinc-rich paints differ from other coatings used for steel protection. Their action is not limited to the formation of a barrier between the surface and the environment.

The effectiveness of other coating types ceases where the paint film is damaged. As a result, underfilm cor-

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roson may occur. However, where a zinc-rich paint film is damaged, the uncoated area may continue to be protected if the damage is not wide, and the edges of the surrounding film may continue to be protected against underfilm corrosion.

This is because the electrochemical potential of zinc is lower than that of steel. When these two metals are connected in an electrolytic solution, the zinc protects the steel by the cathodic protection process. When the film is damaged, the zinc on the surrounding area sacrifices itself to protect the uncoated area for some time and prevents the progression of underfilm corrosion by producing reaction salts.

A zinc-rich primer requires correct formulation, of course, plus very close and widespread contact with the painted surface. Blast cleaning is the only suitable surface preparation method for this purpose.

Inorganic zinc primers can be classified into two types: waterborne (based on lithium and potassium silicates) and solvent-borne (based on partially hydrolyzed ethyl silicate).

These coatings are widely used as
a) a single coat for protection of tanks for chemical products (usually solvents);
b) a primer for long-lasting paint systems or for untopcoated systems; or
c) a shop primer.

In the first case, the water-borne type is preferred. In the other two cases, the solvent type is generally used.

SSPC–PS Guide 12.00, Guide to Zinc-Rich Coating Systems, says untopcoated IOZ primers may be suitable for use in the following environments:
• 1A—interior, normally dry;
• 1B—exterior, normally dry;
• 2A—frequently wet, fresh water;
• 2B—frequently wet, salt water;
• 3B—atmospheric chemical exposure (pH 5 to 10); and
• 3D—chemical exposure, solvents.

Coming to the question after this long introduction, I would cite two completely different examples.

Example I

The coating is still intact and rusting has occurred where the coating has suffered damages. The main purpose of touching up an inorganic zinc-rich primer is to repair the film integrity by maintaining its specific electrochemical characteristics. However, it is necessary to distinguish among different possible uses of the coating, as follows.

a) As a single coat for the protection of tanks for chemical products (3D)—This use requires maximum protection, and it is necessary to repair the continuity of film characteristics everywhere. Vacuum blasting or, for minor touch-up areas, needle gun preparation can be used. Application of the same inorganic zinc-rich paint must be done carefully, with particular attention to overlapping areas.

b) As a coating for use in environments 1A, 1B, 2A, 2B, or 3B—The above-mentioned procedure could be used here as well, because it provides good protection. However, it is expensive because of the surface preparation methods involved and the skill of the operator required for applying the coating. If that procedure is not feasible, mechanical preparation according to SSPC–SP 11 (Power Tool Cleaning to Bare Metal) or SSPC–SP 3 (Power Tool Cleaning) can be used, feathering the transition from thick film touch-up areas to bare steel by grinding. Then, touch-up with an organic zinc coating, especially a two-component epoxy type, is useful. Although organic zinc-rich coatings have lower
film conductivity than inorganic zinc-rich coatings, the organic products offer the advantage of adhesion on power tool-cleaned surfaces. Two-component epoxy zinc-rich coatings can be applied at up to 75 micrometers (3 mils) DFT.

c) As a shop primer—Inorganic zinc shop primers are widely used for newbuildings. Compared with conventional shop primers, they offer technical and economic advantages. Procedures suggested by coating manufacturers provide for systematic touch-up with an epoxy zinc-rich coating on welded and damaged areas. This procedure ensures electrical continuity of the film and complete coverage. The only exception to this procedure would be when a chemical-resistant topcoat is applied in a 3D exposure environment.

Example II

Considerable spread of rusting is evident. The coating is in one of the following environments: 1A, 1B, 2A, 2B, or 3B, and it has been in service for several years when the decision is made to repair it by the least expensive method (i.e., without abrasive blasting and complete renewal of the original coating). In this case, the remaining zinc paint on the surface should be considered as an ordinary primer. The following procedure could be suggested:

• surface preparation for removal of all rust, salts, oil and grease, pollutants, and loose materials;
• touch-up of bare steel areas with an epoxy mastic surface-tolerant coating plus a full coat of the same product over the entire surface to create an even barrier; and
• application of a finish coat, if needed.

Conclusion

Summing up, please note that I did not mention the well-known over-
coating difficulties of inorganic zinc-rich primers (i.e., curing, porosity), since they are not applicable to fully cured and aged inorganic zinc films.

Reference