

and realizing the benefits of a duplex system. Information on preparing after-fabrication, hot-dip galvanized steel surfaces for duplex coatings can be found in ASTM D 6386, *Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting*. In general, surface cleaning and profiling are characterized below.

When cleaning a galvanized surface prior to painting, the goal is to remove any dirt, grease, or oils. At the same time, make sure not to remove too much of the galvanized coating. Alkaline, ammonia, and solvent cleaning are the most common ways of removing dirt from a galvanized surface. As some cleaners may react differently with different paint systems, the paint manufacturer should be consulted for specific reaction problems.



The visible hot-dip-galvanized-steel elements of the Muskingum River Parkway, Zanesville, Ohio, have been painted over, including the handrails, railing, and girders. The girders' beige color complements the color theme of the brick-work supports for the structure.

Oil, grease, and dirt can be removed by using an alkaline solution in the pH range of 11 to 12 but not greater than 13, as this will damage the zinc coating. Most alkaline-cleaning solutions are nominally 2 percent to 5 percent sodium compounds with small additions of emulsifying or chelating agents. The solution is applied through dipping, spraying, or brushing. If brushing is used, apply the solution with a soft bristle brush, preferably made of nylon, not copper or steel bristles. If dipping or spraying the solution, the temperature range that works best is between 140°F and 185°F. For newly galvanized steel, a water-based emulsifier will remove contaminants.

Mineral spirits, turpentine, high flash naphtha, and other typical solvents also will clean galvanized surfaces — provided

they are applied with lint-free rags or soft bristle brushes, which must be changed often to prevent reapplying the contaminants. A solution of 1 percent to 2 percent ammonia applied with a soft bristle brush is typically reserved for cleaning parts with zinc skimmings. This residue is caused when a piece of steel is removed from the galvanizing kettle, and it picks up particles of oxidized zinc from the bath surface. Ash residue must be removed prior to painting. After cleaning, thoroughly rinse the surface with hot water and allow to dry completely.

Surface profiling

To provide a good adhesion profile for the paint, the galvanized surface must be flat with no protrusions and slightly roughened to provide an anchor profile. During the removal of the galvanized article from the zinc bath, the excess zinc runs down the edges and can sometimes build up at a protrusion or irregular edge. The zinc also can form tears at the edge where it drains. These high spots and tears should be removed by grinding with hand or power tools. Care must be taken during this operation to ensure the galvanized coating is not removed below the specified thickness.

An abrasive sweep or brush blast will roughen the typically smooth galvanized surface after cleaning. Do not confuse sweep blasting with the near-white blasting, which is used to clean non-coated steel before applying paint systems and will remove the galvanized coating. For sweep blasting, the particle size should range between 200 and 500 microns. Successful materials used include aluminum/magnesium silicate; organic media such as corn cobs and walnut shells; or minerals such as corundum, limestone, and sands with a Mohs hardness of 5 or less. Again, care should be taken to prevent removing too much of the zinc coating. If the sweep angle becomes nearly perpendicular to the galvanized part, blasting can quickly remove the protective zinc rather than the zinc oxide particle on the surface. The process

is best performed by an experienced applicator.

The temperature of the galvanized part when blasting can have a significant effect on the finished surface profile. Sweep blasting while the galvanized part is still warm from the galvanizing process, 175°F to 390°F, provides an excellent profile for painting. Ambient conditions for sweep blasting are recommended to be less than 50 percent relative humidity and a minimum temperature of 70°F.

Sealers, coatings, and primers

Two-part epoxy penetrating sealers are sometimes used to form a 50 micron thick coating on the galvanized surface

and hydroxides, as well as etch the galvanized surface. Primers should be applied to form a protective layer 7 to 13 microns thick. If the thickness exceeds 13 microns, paint adhesion can become a problem. Because field application results in thick and irregular protective layers, this process is best done in shop conditions. When using wash primers, follow the manufacturer's directions for maximum performance.

Acrylic passivation uses an acidic acrylic solution to passivate the galvanized surface and roughen the smooth zinc coating. It should be applied approximately 1 micron thick to a clean galvanized surface and should dry completely before applying paint to the surface.

Selecting paint

Engineers typically specify the needed paint system. There are many options depending on the intended use of the duplex-coated part, the application method and place for the paint system, environmental concerns, and aesthetics. Many paint companies offer good paint systems that are designed to work with galvanized steel. "Paint Combinations" below lists some paints that work together, but users should consult the manufacturer for the proper paint selection.

The secret to excellent performance of painted galvanized steel is surface preparation. A new to 48-hour-old galvanized surface can be painted after a roughening procedure. If it has been exposed to the environment for more than one year, dirt, grease, and oils must be removed first. To paint galvanized steel that is between two days and one year requires more surface prep to achieve quality duplex system performance. ■

10 Paint Combinations

The following provides 10 combinations of paint systems designed to work with galvanized steel, but it doesn't include all available combinations. Consult your manufacturer.

1. Wash primer + Acrylic latex
2. Wash primer + Acrylic solvent-based topcoat
3. Wash primer + Epoxy topcoat
4. Epoxy primer + Acrylic latex topcoat
5. Epoxy primer + Acrylic solvent-based topcoat
6. Epoxy primer + Epoxy topcoat
7. Epoxy primer + Polyurethane topcoat
8. Inorganic zinc-rich primer + Epoxy topcoat
9. Inorganic zinc-rich primer + Epoxy intermediate coat and polyurethane topcoat
10. Waterborne acrylic primer + Waterborne acrylic topcoat

after cleaning. These products can be particularly effective as surface treatment methods on surfaces that have had zinc oxide and zinc hydroxide removed during the cleaning process. Follow the manufacturer's instructions for application, and always use a topcoat over the penetrating sealer.

Zinc phosphating is a conversion coating that passivates the zinc surface and blocks the formation of zinc oxides. The phosphate treatment is applied by immersion, spray, or soft bristle brush and left on the galvanizing surface between three and six minutes.

The surface is then washed with clean water and allowed to dry completely. Although this treatment type is appropriate for most paints, it does not perform well with zinc-rich paints.

Wash primer treatments use a metal conditioner to neutralize surface oxides

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