Surface preparation, together with the related process of removing existing coatings, always ranks as one of the most critical steps in successful coatings application. The objectives of these processes are twofold: to clean and roughen the substrate according to the specified requirements.

The methods used to prepare surfaces for coating application may clean and roughen simultaneously—as with abrasive blast cleaning. At other times, these steps must be performed separately, as with chemical stripping. In either situation, cleaning and roughening must be treated as two distinct acceptance criteria. For example, there may be situations where the level of cleaning is adequate, but the roughness may be insufficient or excessive to facilitate proper adhesion of newly applied coatings. Alternatively, the surface roughness may be adequate, but the level of cleaning may be inadequate.

**Surface-preparation methods**

Surface-preparation methods can range from simple solvent cleaning to hand and power-tool cleaning; from dry and wet abrasive-blast cleaning to chemical stripping; and from water jetting to other, more nontraditional methods, such as sponge jetting and cryogenic blast cleaning with dry ice pellets.

The degree of cleaning required for a given project specification depends on the service environment (the environment in which the coating system must provide sufficient performance), the composition and properties of the coating system, and the intended service life of the installed coating.

**Hand-tool cleaning**

Hand-tool cleaning, typically employed in relatively minor touch-up repairs for maintenance painting activities, is done with wire brushes, scrapers, and other tools that do not depend on electric or pneumatic power to operate. Hand tools are only intended to remove loosely adhering materials; when the substrate is steel, this includes corrosion products, old paint, and mill scale. Hand tools used on steel are not intended to roughen the substrate and produce a surface profile or “anchor” pattern to facilitate adhesion of newly applied coatings. For
softer substrates such as wood, hand tools may produce sufficient roughening for paint application.

**Power-tool cleaning**

Power-tool cleaning is typically performed with grinders, pneumatic chisels, needle scalers, rotoblast tools, and other mechanisms that require an electric or pneumatic power source to operate. Most of these tools can remove both loosely and tightly adhering corrosion products, paint, and mill scale from steel surfaces. Some of these tools can also produce a small anchor pattern on steel surfaces. Additionally, these tools can be equipped with vacuum ports and hoses for attachment to filtered vacuums so that the fine, airborne particles that are created during surface-preparation activities are collected at the point of generation.

Power-tool cleaning is typically employed for maintenance repairs of small areas, but can also be used when methods such as abrasive blast cleaning are not an option.

**Dry abrasive blast cleaning**

Blast cleaning with dry abrasive media is one of the most common methods for preparing a surface for coating. Abrasive blast cleaning can be used to roughen an existing coating for subsequent overcoating, or to completely remove everything from the substrate, including the existing corrosion products, coating, and mill scale.

Abrasive blast cleaning is the most productive of all surface-preparation methods, in volume terms. Thousands of square feet of surface can be prepared for coating in a single work shift. The hardness and mass of the abrasive media, combined with the velocity of the abrasive as it exits a nozzle at high speed, generates high levels of energy. As the abrasive media impact a surface, they can remove existing coating layers, corrosion, and mill scale, while simultaneously generating a surface profile or anchor pattern.

The level of cleanliness that is achieved is ultimately determined by the distance that the nozzle is held from the surface and the “dwell time” that the operator employs. The depth and shape of the surface profile is determined by the type and size of the abrasive media employed, as well as the hardness of the surface being prepared. Therefore, selection of the correct type and size of abrasive media is critical. Selecting an abrasive size that is too small will generate a surface profile that is too shallow, and selecting a too-large abrasive will create a surface profile that is too deep. The abrasive type and size ultimately selected should be tested before production to verify that the specified surface profile depth and shape can be achieved.

Typically, harder abrasives—those designed to achieve complete coating removal and an adequate profile—include steel grit, steel shot, and mineral abrasives such as coal slag and garnet. Softer abrasives, which are typically used to remove loose coatings and other loose material from a substrate, include aluminum/magnesium silicate, corn cobs, walnut shells, limestone, or some mineral sands.

Another mineral abrasive—usually used in the form of beads—is glass. Although not frequently employed, glass-bead blasting can be used to clean and prepare certain glass, plastic, rubber, and metal surfaces. The manufacturers of glass-bead abrasives should be consulted for specific applications suitable for their materials.

An alternative to blasting with traditional dry abrasives is “sponge blasting,” which uses proprietary blast media and equipment manufactured by Sponge-Jet Inc. According to Sponge-Jet, the sponge media “is an open-celled, water-based polyurethane impregnated with abrasives.” A variety of sponge abrasive materials are available to achieve various levels of cleaning. The nature of the sponge material can allow for greatly reduced levels of dust and airborne contaminants during the blasting process.

**Shot blasting for concrete floors**

Another variation of dry abrasive blast cleaning is shot-blast cleaning with self-contained centrifugal wheel blast units. Such units employ a vacuum system to contain the abrasive and debris, and are well suited for use on large, horizontal surface areas such as concrete floors. The machines prepare a strip of surface ranging from several inches up to 30 inches in width in one pass. This method of surface preparation can remove any existing coatings, in addition to roughening the concrete surface.

**Pressurized water cleaning**

Pressurized water cleaning is a good method for cleaning surfaces, but it cannot etch a profile into the surface. Water jetting, however, can restore an existing surface profile. The common levels of cleaning are:

- **LPWC:** Low-Pressure Water Cleaning (up to 5,000 psi);
- **HPWC:** High-Pressure Water Cleaning (5,000–10,000 psi);
- **HPWJ:** High-Pressure Water Jetting (10,000–30,000 psi); and
• UHPWJ: Ultra-High-Pressure Water Jetting (>30,000 psi).

The degree of cleanliness that can be achieved with water varies widely, depending on the pressure of the water used. Selecting the water pressure is dependent on the adhesion of the existing coating to the surface, the desired level of cleanliness, and the project specification requirements.

Surface rust can be removed using water jetting, but this will not remove intact mill scale; this requires mechanical removal or selection of a coating system that can be applied to intact mill scale and still perform adequately in the service environment.

Low-pressure water cleaning (LPWC) or “pressure washing” is often specified for projects where “overcoating” is possible—where the existing coating is salvageable and is left in place to serve as part of the maintenance coating system for the structure. LPWC can be very effective in removing dirt, chalking, bird droppings, and other contaminants from the surfaces, although mechanical agitation of the surface during LPWC is often required to ensure adequate removal.

The other three levels of water jetting, all involving high pressure, are used primarily to remove coatings. Waste generation is minimized when the water is captured, filtered and reused. The debris that is created is limited to the materials removed from the surface. This is desirable if the coating to be removed contains toxic metals.

It must be noted that, because of its use of water, water jetting will cause steel surfaces to flash rust. Therefore, the flash rusting must either be accepted as part of the process—with coatings selection focused on materials that are tolerant to this condition—or the use of a rust inhibitor may be considered, taking care to ensure that the inhibitor is compatible with the coating system to be applied to the prepared surfaces.

When low-pressure water cleaning is used to clean and remove loose materials from substrates such as wood and masonry, adjustments in water pressure (generally lower), stand-off distance, and the type and size of tips for the cleaning wand are necessary to avoid damaging the substrate.

Chemical stripping
Chemical stripping, like water cleaning, does not generate a surface profile and will not remove rust or mill scale from a steel surface. Therefore, mechanical methods of surface preparation may be required after the coating has been removed with chemicals. Chemical stripping is often chosen where other methods, such as abrasive blast cleaning, are not possible due to the surrounding environment or where damage to a softer substrate (e.g., wood) would be likely.

The proper selection and use of a chemical stripper is important for successful removal of existing coatings. Stronger strippers, which typically contain methylene chloride, will remove almost any coating, but are the most hazardous in terms of environmental and worker exposures. These materials, often known as “aircraft” strip-
pers, have been used in the commercial aircraft industry to remove coatings from the exterior of aircraft fuse-
lages.

Other strippers are typically caustic materials (high pH) that break down and soften the coating’s resin to facili-
tate removal. Multiple applications can be required, depending on the coating system and thickness. Neutralization of the surface following removal of the stripper, however, is required for proper coating application and adhesion.

A variety of “environmentally friendly” chemical strippers are available that are characterized by neutral pH and little odor. These materials may work more slowly on thicker films and also require several applications to remove all coating layers. A neutralizing step may also be needed with these strippers.

Industry standards
All of the surface-preparation methods discussed here are the subject of applicable industry standards or guid-
ance that defines their use (see adjacent table). It should be noted that some methods are covered by multiple standards, such as processes involving power-tool cleaning and abrasive-blast cleaning.

As suggested in this discussion, a good understanding of the various surface preparation methods and their applicable uses is needed when determining the best approach for a coating project. In addition, referencing applicable industry standards is recommended.

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