An Introduction to Coatings and Paints

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An Introduction to Coatings and Paints

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1. SELECTION OF COATINGS

1.1 SELECTION CRITERIA. The best selection of a coating system for a particular service is determined by a variety of factors. These include desired properties, work requirements and limitations, safety and environmental restrictions, compatibilities, and costs.

1.1.1 DESIRED FILM PROPERTIES. In selecting a coating system, the first consideration is the desired properties of the system for the particular service. Desired properties may include one or more of the following aspects:

- Resistance to exterior weathering (chalking; color and gloss retention)
- Water, fuel, or chemical resistance
- Abrasion, heat or mildew resistance
- Appearance (color, gloss, and texture)
- Drying time
- Ease of application and maintenance

1.1.2 WORK REQUIREMENTS OR LIMITATIONS. The following work requirements or limitations may have to be considered:

- Type of surface preparation
- Access to work
- Drying times
- Necessary applicator skills
- Necessary equipment
- Scaffolding for access to work

1.1.3 SAFETY AND ENVIRONMENTAL RESTRICTIONS. It will be necessary to conform to all prevailing safety and environmental regulations concerning materials and processes to be used for surface preparation and for coating application.

1.1.4 COMPATIBILITIES. Coating systems must be compatible with the surfaces to which they are applied. Coating incompatibility can cause failures at or just after application or after

a much longer time. Failures occurring just after application are due to solvent incompatibility or wetting problems. Failures associated with slow chemical reactions, such as those occurring between alkaline surfaces (e.g., concrete and galvanized steel) and oil-based paints or mechanical property mismatches (e.g., a rigid coating applied over a more flexible one) cause failure in a longer timeframe. The failure more often is peeling. For existing coatings being repainted, compatibility generally means that topcoats should be of the same generic type or curing mechanism as undercoats. One exception to this rule is inorganic zinc coatings. Since inorganic zinc coatings frequently do not bond well to themselves, it is safest to repair them with zinc-rich organic coatings. A simple test to classify coatings is to determine solvent sensitivity using an methylethyl ketone (MEK) or acetone rub test. To do this, soak a cloth in MEK or acetone, rub it against the existing paint, and visually check for pick up of paint. The paint is classified as "solvent soluble" if paint is picked up, and as "solvent insoluble" if not. Another practical method of ensuring topcoat solvent compatibility is to coat a small test area of the existing coating with the paint selected for the work. If situations permit, this test is preferred over the MEK rub test because it is specific for the surface to be repainted. The test area should be visually inspected the following day (or preferably after 3 or more days) for bleeding of undercoat, wrinkling, loss of adhesion, or other coating defects. Although most incompatibility problems are apparent in a couple of days, some types of incompatibility may not become apparent for several months or until after a change of seasons. These types are usually associated with mechanical film properties.

1.1.5 COSTS. Life cycle cost has always been one of the most important considerations in selection of coating systems. Life cycle costs include original surface preparation, materials, and application and necessary maintenance throughout the life of the coating system. Today, the expense of containment of old paint during its removal and disposal of debris that is often considered to constitute hazardous waste must be included. This usually means that the system with the maximum maintainable life is the best choice.

1.2 SPECIFICATIONS FOR LEAD- AND CHROMATE-FREE COATINGS WITH VOC LIMITS. The coating specifications listed are lead- and chromate-free and have limitations on their contents of VOC.

1.3 RECOMMENDATIONS FOR DIFFERENT SUBSTRATES. This discussion provides general recommendations for wood, concrete and masonry, steel, galvanized steel, and aluminum surfaces. The recommended dry film thickness (dft) in mils is provided for coating specification recommended for a particular substrate. Referenced standards for coatings provide for lead- and chromate-free products that are low in VOCs. Although such requirements may not be necessary at all projects currently, such requirements may occur in the near future. In making local repairs of damaged coatings, loose paint should be removed by scraping with a putty knife before lightly sanding or abrasive blasting any exposed substrate and feather-edging existing sound paint to obtain a smooth transition with the repaired area. Coats of repair material should be extended 1 inch onto the surrounding sound coating.

1.3.1 RECOMMENDATIONS FOR WOOD. Oil-based and waterborne coatings and stains (frequently called latex) perform quite well on new wood. A two-coat system, paint or stain, is normally applied. However, as additional coats are applied to resurface or repair weathered paint, the film thickness may become sufficient to reduce the total flexibility to the point that results in disbonding of the total paint system from the surface. Thus, when topcoating or making localized repairs, no more coating should be applied than necessary to accomplish the desired goal. Surface preparation of new wood normally consists of lightly hand sanding or power sanding, carefully controlled so that it does not damage the wood. Sanding is also appropriate for preparing weathered surfaces for refinishing and for spot repairing areas of localized damage.

1.3.1.1 OIL-BASED PAINTS. Historically, wood has been successfully painted with oil-based products that penetrate the surface well. These coatings are very easy to apply.

1.3.1.2 WATER-EMULSION PAINTS. More recently, latex coatings have been found to be very effective in providing attractive, protective finishes. They are also less affected by moisture than are oil-based finishes and are generally more flexible and thus less susceptible to cracking as the wood swells and contracts with moisture changes. A problem sometimes arises when repairing or topcoating existing smooth alkyd coatings with latex paints. To obtain

good intercoat adhesion, it may be necessary to lightly sand the existing paint and/or apply a surface conditioner containing tung oil or some other oil that wets surfaces well before applying the first coat of latex paint.

1.3.1.3 SEMI-TRANSPARENT STAINS. Because oil-based and waterborne paints form continuous films, they may form blisters or disbond because of moisture in the wood attempting to escape. Semi-transparent stains do not form continuous films on wood and so do not have this problem. Thus, they are a good alternative on new wood. Additional coats applied over the years or heavybodied stains will, however, form continuous films.

1.3.1.4 CLEAR FLOOR FINISHES. A variety of clear floor finishes are available from MFMA Heavy-Duty and Gymnasium Finishes for Maple, Beech, and Birch Floors. Suppliers on the attached list must be contacted to determine VOC content. Surface preparation for hard wood floors is described in detail In the *Unified Facilities Guide Specifications* which are available for download without charge at www.wbdg.org.

1.3.2 RECOMMENDATIONS FOR CONCRETE AND MASONRY SURFACES. Concrete and masonry surfaces, as well as those of stucco, plaster, wallboard, and brick, can be coated with a variety of systems depending upon the desired purpose and appearance. Surface preparation is usually accomplished by power washing with aqueous detergent solution to remove dirt and other loose materials. Any oil or grease will have to be removed by solvent or steam cleaning; any mildew, by scrubbing with bleach; and any efflorescence or laitance, by brushing, followed by acid treatment.

1.3.2.1 WATERBORNE COATINGS. A two-coat waterborne (latex) system provides an attractive breathing film that is normally less affected by moisture in the concrete than non-breathing systems. The latex material is a self-primer in this service, unless otherwise stated. Alkyd and other oil-based coatings should not be applied directly to concrete or masonry surfaces, because the alkalinity in the concrete will hydrolyze the oil in the binder and cause the coating to peel. However, they can be applied over concrete or masonry surfaces primed with waterborne coatings to produce a tougher, more washable finish.

1.3.2.2 ELASTOMERIC COATINGS. Elastomeric, waterborne acrylic coating systems also perform well to seal and protect concrete/masonry surfaces and are normally very low in VOCs. They can successfully bridge fine or larger caulked cracks. There are no federal specifications for them.

1.3.2.3 TEXTURED COATINGS. Textured coatings system can bridge fine cracks and waterproof from wind-driven rain. They are normally applied over a primer recommended by the supplier to insure good adhesion. They are available in a variety of textures and may be waterborne or oil or rubber-based products with a VOC limit of 250 grams per liter.

1.3.2.4 EPOXY COATINGS. A two-coat epoxy system will seal and protect concrete/masonry surfaces well. An aliphatic urethane finish coat should be used rather than the second epoxy coat on exterior surfaces to improve the weatherability.

1.3.3 RECOMMENDATIONS FOR STEEL. Presently, a high-performance coating system is recommended to prolong the service before it becomes necessary to remove and replace it. Costs in coating removal, especially where there are restrictions on abrasive blasting, are very high. Abrasive blasting is always preferred to alternative methods of preparing steel surfaces for painting. It cleans the steel and provides a textured surface to promote good primer adhesion. A commercial blast specified by the Steel Structures Painting Council [re-named the Society for Protective Coatings in 1997] (SSPC) is (SSPC SP 6) is normally adequate for alkyd and epoxy primers for a moderate environment. A near-white blast (SSPC SP 10) is required for epoxies, including zinc-rich epoxies, exposed to a severe environment such as marine atmospheric or water or fuel immersion. Some manufacturers may specify a white metal blast (SSPC SP 5) for particular coatings for special applications. It is important that a contract specification does not conflict with the coating manufacturer's written directions. A white metal blast (SSPC SP 5) is recommended for zinc-rich inorganic primers. If abrasive blasting cannot be done, then power tool cleaning to bare metal (SSPC SP 11) is recommended. It provides a surface cleanliness and texture comparable to those of a commercial blast (SSPC SP 6). Hand tool cleaning (SSPC SP 2) or power tool cleaning,

however, may be adequate in making localized repairs.

1.3.3.1 ALKYD SYSTEMS. In the past, many steel structures with atmospheric exposures were coated with an alkyd or other oil-based system. Three-coat alkyd systems provided adequate protection in moderate atmospheric service. On new painting, they are being replaced in significant part by epoxy systems that provide longer protection. Alkyd systems, however, will still be used in large volume for repairing old deteriorated alkyd systems.

1.3.3.2 EPOXY COATING SYSTEMS. A three-coat epoxy system provides good interior service in harsh as well as moderate environments. An aliphatic urethane finish system is used in place of the third epoxy coat in exterior service to provide greater resistance to deterioration by ultraviolet light. Several different epoxy mastic systems, some aluminum-filled, have been used successfully on steel structures. However, there is no specification for one at this time.

1.3.3.3 ZINC-RICH COATINGS. Good protection from corrosion and abrasion can be provided by zinc-rich inorganic coatings. They perform well un-topcoated in a variety of environments except acidic or alkaline. They may be topcoated with an acrylic latex finish coat to provide a variety of color finishes. Epoxy (for interior) or epoxy and aliphatic urethane (for exterior) topcoats may also be used. Localized repair of inorganic zinc systems is usually accomplished with a zinc-rich organic coating to permit good bonding to any exposed steel, inorganic coating, or organic topcoats.

1.3.4 RECOMMENDATIONS FOR GALVANIZED STEEL. Galvanized steel corrodes very slowly in moderate environments but may be painted with organic coating systems to provide color or additional corrosion protection, particularly in severe environments. It should never be coated directly with an alkyd paint, because the alkalinity on the surface of the galvanizing will hydrolyze the oil in the binder, degrading the binder, and cause paint peeling. New galvanizing should be solvent or steam cleaned (SSPC SP 1, Solvent Cleaning) to remove any grease or oil before coating. Older, un-topcoated galvanizing should be power washed to remove any dirt or loose zinc corrosion products. Any loose coatings should also be

removed by power washing or scraping and sanding to produce a clean, sound surface. Rust should be removed by waterblasting or careful abrasive blasting to limit the removal of galvanizing.

1.3.4.1 EPOXY SYSTEMS. Two coats of epoxy will provide long-term protection to galvanizing in interior service, as will one coat of epoxy and one coat of aliphatic urethane to galvanizing in exterior service.

1.3.4.2 WATERBORNE SYSTEM FOR GALVANIZING. Two coats of latex paint will provide a pleasing appearance and good protection to galvanized steel in moderate environments. They are easy to apply.

1.3.5 RECOMMENDATIONS FOR ALUMINUM. Aluminum surfaces corrode very slowly in moderate environments. They may be coated to provide color or additional protection, particularly in severe environments. Epoxy and epoxy/urethane systems perform well in interior or exterior service, respectively. Alkyd systems usually require surface pretreatments containing toxic materials. Because aluminum surfaces are relatively soft, they should not be cleaned by blasting with conventional abrasives or grinding to avoid damage. Any grease or oil should be removed by solvent or steam cleaning (SSPC SP 1). Dirt and other loose contaminants should be removed by power washing. Existing coatings are best removed by careful blasting with a soft abrasive (e.g., plastic). Alkaline strippers should never be used, because they will attack the aluminum.