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Standard Guide for Painting Inspectors (Metal Substrates)[1]

This standard is issued under the fixed designation D 3276; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide is intended as an information aid to painting inspectors in carrying out their task efficiently. It includes the key elements of surface preparation, coatings application, and final approval for both field and shop work. The items should be selected that are pertinent to the specification of a particular job.

NOTE 1—For additional helpful information, refer to the following documents:

Manual of Coating Work for Light-Water Nuclear Power Plant Primary Containment and Other Safety-Related Facilities[2]

New Concepts for Coating Protection of Steel Structures[3]

D 16 Terminology Relating to Paint, Varnish, Lacquer and Related Products[4]

D 4538 Terminology Relating to Protective Coatings and Lining Work for Power Generation Facilities[5]

SSPC-PA Guide 3 A Guide to Safety in Paint Application[6]

Steel Structures Painting Manual Vol 1 Good Painting Practice[6]

Steel Structures Painting Manual Vol 2 Systems and Specifications[6]

Manufacturers Specifications and Instructions (made available to the inspector for reference to special requirements for proper application)

Material Safety Data Sheets (needed to ensure that personnel take necessary precautions in handling hazardous materials). Available from Materials manufacturer.

1.2 Certain industries or owners may require certified inspection personnel. See Guide D 4537 for establishing procedures to certify inspectors for coatings work in nuclear facilities.[5]

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.5 This guide is arranged in the following order:

[1] This guide is under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.46 on Industrial Protective Coatings.

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[2] ASTM, 1979.

[3] *ASTM STP 841*, ASTM, 1984.

[4] *Annual Book of ASTM Standards*, Vol 06.01.

[5] *Annual Book of ASTM Standards*, Vol 06.02.

[6] Available from SSPC: The Society for Protective Coatings, 40 24th Street, Pittsburgh, PA 15222.

2. Referenced Documents

2.1 *ASTM Standards:*

D 16 Terminology Relating to Paint, Varnish, Lacquer, and Related Products[4]

D 1186 Test Methods for Nondestructive Measurement of Dry-Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base[4]

D 1212 Test Methods for Measurement of Wet Film Thickness of Organic Coatings[4]

D 1400 Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Base[4]

D 1475 Test Method for Density of Liquid Coatings, Inks, and Related Products[4]

D 1730 Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting[7]

D 2092 Guide for Treatment of Zinc-Coated (galvanized) Steel Surfaces for Painting[5]

D 2200 Pictorial Surface Preparation Standards for Painting Steel Surfaces[5]

D 3359 Test Methods for Measuring Adhesion by Tape Test[4]

D 4138 Test Methods for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive Means[5]

D 4212 Test Method for Viscosity by Dip-Type Viscosity Cups[4]

D 4285 Test Method for Indicating Oil or Water in Compressed Air[5]

D 4414 Practice for Measurement of Wet Film Thickness by Notch Gages[4]

D 4417 Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel[5]

D 4537 Guide for Establishing Procedures to Qualify and Certify Inspection Personnel for Coating Work in Nuclear Facilities[5]

D 4538 Terminology Relating to Protective Coatings and Lining Work for Power Generation Facilities[5]

D 4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers[5]

D 5064 Practice for Conducting a Patch Test to Access Coating Compatibility[5]

D 5162 Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metal Substrates[5]

2.2 *Occupational Safety and Health Administration (OSHA) Standard:*

29 CFR 1910.1200 Hazard Communication[8]

2.3 *SSPC Standards:*[6]

SSPC-SP 1 Solvent Cleaning

SSPC-SP 2 Hand Tool Cleaning

SSPC-SP 3 Power Tool Cleaning

SSPC-SP 5/NACE 1 White Metal Blast Cleaning

SSPC-SP 6/NACE 3 Commercial Blast Cleaning

SSPC-SP 7/NACE 4 Brush-off Blast Cleaning

SSPC-SP 10/NACE 2 Near-White Blast Cleaning

SSPC-SP 11 Power Tool Cleaning to Bare Metal

SSPC-SP 12/NACE 5 Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating

SSPC-PA 1 Paint Application Specifications

SSPC-PA 2 Measurement of Paint Thickness with Magnetic Gages

SSPC-Vis 1-89 Pictorial Surface Preparation Standards for Painting Steel Surfaces

SSPC-Vis 3 Visual Standard for Power- and Hand-Tool Cleaned Steel

SSPC-Paint 27 Basic Zinc Chromate-Vinyl Butyral Wash Primer

SSPC-Guide 6 Guide for Containing Debris Generated During Paint Removal Operations

SSPC-Guide 7 Guide for the Disposal of Lead Contaminated Surface Preparation Debris

3. Significance and Use

3.1 This guide is intended as a reference for those concerned with the inspection of industrial coating work. Many of the details covered may be in a specification for a particular project. A specification for coating projects should include the coatings to be used. A checklist for use in the field is included as an appendix.

4. Preparation for Inspection

4.1 The guide describes the duties of the inspector and discusses inspection methods, both visual and instrumental,

[7] *Annual Book of ASTM Standards*, Vol 02.05.

[8] Available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402-9328.

that can be used to determine that the specification requirements have been met by the painting contractor.

4.2 Before painting is started the project engineer should provide the inspector with information from the official plans and specifications as to coating type, thinner to be used, mixing ratios to be used, specified application thickness, primer, tie coat, topcoat, time between coats, surface preparation, method of application, and any special precautions to be followed such as limits on ambient conditions. These details should be recorded in an inspector's record book to eliminate any misunderstanding between the inspector and the contractor.

4.3 The inspector should obtain copies of Materials Safety Data Sheets for all products that will be used on the project, review any hazard communications program in accordance with 29 CFR 1910.1200 that will apply to the project, and review other safety information related to the work that will be performed by the contractor. The inspector should examine these materials and be supplied with appropriate protective equipment and devices.

5. Surface Preparation Methods and Requirements

5.1 *Surface Preparation* is one of the most important factors affecting the performance of coatings. The specifier determine the proper level in accordance with the expected service life and type of coating specified.

5.1.1 *Pictorial Standard D 2200 (SSPC-Vis 1-89)* should be provided to the inspector on a job involving blast cleaning of structural steel. The standard is used by the inspector to assist in determining whether the degree of surface preparation specified in a contract has been attained by the contractor. For large jobs it is recommended that before work starts, an actual steel sample of adequate size be blasted to the satisfaction of the project engineer. This blasted surface should be protected by a clear acrylic coating or encased in plastic and used for reference purposes as the work progresses.

5.2 *Factors Affecting Coating Performance*—There are a number of factors that should be considered to ensure a proper painting job.

5.2.1 *Cleanliness*—Many materials, if not removed from the surface, will affect the life of the coating. These include oil, grease, soil, weld spatter, and slag, that make it impossible to obtain proper adhesion to the metal surface. Deposits of salt (such as chlorides and sulfates) should be removed, or long-term coating performance will be seriously affected. SSPC issues detailed surface preparation specifications that cover methods for solvent cleaning, hand and power tool cleaning, as well as the various methods of blast cleaning.

5.2.2 *Mill Scale*, the bluish-black oxide resulting from the hot-rolling process, is a constant source of trouble leading to coating failure. This scale is very brittle and can crack or loosen due to temperature changes (both in fabricating and weathering in the field) leading to failure of the coating.

5.2.3 *Surface Profile*—The texture of the metal surface has a significant effect on the performance of coatings, since it increases the surface area to which the coating can develop adhesion. In fact, the term "anchor pattern" is sometimes used to describe the depth of profile. Profile varies both with the type and size of the abrasive used. Coarser abrasives generally produce a coarser and deeper profile. Deep profiles are advantageous for adhesion, but require more coating to fill in the valleys and cover the peaks of the profile; they cannot be used with low-build coatings that do not cover the peaks even when several coats are applied. A general recommendation is that the surface profile should be one quarter to one third of the dry film thickness of the coating system. This recommendation does not apply if the resulting profile would be too great. The angularity (sharpness) and density of the profile may affect adhesion. Methods for measuring surface profile can be found in Test Methods D 4417.

5.3 *Cleaning Procedures*—Safety precautions are not addressed separately for each of the following cleaning methods. Each has its own safety-related hazards, and U.S. Occupational Health and Safety Administration regulations should be followed. Materials Safety Data Sheets (MSDS) for the solvents and cleaning compounds provided by the manufacturer should also be consulted for proper worker protection.

5.3.1 *Chemical Cleaning*—Solvents are used to remove oil, grease, and related materials. The solvent is applied to the surface by wiping or scrubbing with rags or brushes. The contaminants should be removed (not simply spread out) by a thorough wiping of the affected areas with cloths saturated with clean solvent. Contaminated cloths should not be dipped into clean solvent. The cleaning should be repeated with clean rags and fresh clean solvent. Emulsions, cleaning compounds, steam cleaning, or similar methods and materials may also be used. Where emulsion cleaners, soaps, or detergents are used, they should be removed completely by washing with clean hot water. SSPC SP-1 covers cleaning procedures using these materials.

5.3.1.1 *Solvent Vapor Cleaning* is a procedure that can be adapted to a production line or piecework operation. Vapor cleaning removes all soluble contaminants but does not disturb the natural oxide film. If this film should be removed, mechanical cleaning will be necessary as well. The part to be cleaned is placed in the saturated vapor above the heated solvent so that the solvent vapor condenses on the metal surface. Vapor degreasing does not remove particulate matter, so parts should be wiped to remove any insoluble soils. Vapor degreasing has the advantages over solvent wiping in that hot solvents are used and the solvent condensation removes oils without recontamination.

5.3.2 *Hand Tool Cleaning* is the method used for the removal of loose mill scale, loose rust, loose or otherwise defective coating, weld flux, slag and spatter from metal surfaces by hand brushing, hand sanding, hand chipping or scraping using wire, fiber or bristle brushes, sandpaper, steel wool, hand scrapers or chisels, and chipping hammers. Material is considered tightly adherent if it cannot be lifted with a dull putty knife. SSPC provides a detailed specification, SSPC-SP 2. A visual standard, SSPC-VIS3, may be used to assist in determining compliance.

5.3.2.1 Hand tool cleaning requires that all weld flux, tar, oil and grease, and other greasy contaminants be removed first by solvent cleaning (5.3.1).

5.3.2.2 Wire brushes should be rigid enough to clean the surface thoroughly, and shaped to penetrate into all corners and joints. Brushes should be kept free of all materials that may clog the wires of the brush.

5.3.2.3 Hand scrapers should be made of tool steel, tempered and ground to a sharp edge, and should be of the proper size and shape to enable cleaning to be done as specified. Scrapers should be kept sharp at all times.

5.3.3 *Power Tool Cleaning* is a method used for the removal of loose mill scale, loose rust, loose or otherwise defective coating, and weld flux from metal surfaces by power wire brushes, power impact tools, power grinders, power sanders, or by a combination of these methods. Material is considered tightly adherent if it cannot be lifted with a dull putty knife. SSPC-SP 3 is the detailed specification for power tool cleaning. A visual standard, SSPC-VIS3, may be used to assist in determining compliance.

5.3.3.1 *Power Tool Cleaning* requires that all oil, grease, weld flux, and other contaminants be removed first by solvent cleaning (5.3.1). Hand tool cleaning in accordance with 5.3.2 may be used prior to power tool cleaning.

5.3.3.2 All equipment should be suitable for the configuration of the work to be cleaned and maintained free of material that clogs the wire or disks making them ineffective. All impact tools should be kept sharp.

5.3.4 *Power Tool Cleaning to Bare Metal* is a method used for the total removal of coating, rust, and mill scale. It also requires a minimum of 1-mil anchor profile. Surface cleaning, power tools, and surface profile producing media are used to obtain the specified finish. Surface cleaning power tools consist of non-woven abrasive wheels and discs, coated abrasive discs or sanding pads, coated abrasive fly wheels, and coated abrasive bands. Surface profile producing media consist of rotary impact flap wheel assemblies and needle guns. SSPC-SP11 is the detailed specification for power tool cleaning to bare metal.

5.3.4.1 Depending on the initial condition of the surface and existing profile conditions, it may be necessary to use one or both of the types of power tools. All oil, grease, weld flux, and other contaminants should be removed first by solvent cleaning (5.3.1). Hand tool cleaning (5.3.2) or power tool cleaning (5.3.3) may be used prior to power tool cleaning to bare metal.

5.3.4.2 All equipment should be suitable for the configuration of the work to be cleaned and maintained free of material that clogs the wire or discs making them ineffective. Needle guns require 2-mm diameter needles to produce a suitable surface profile.

5.3.4.3 The finished surface should be bare, bright metal. Slight residues of rust and paint may remain in the lower portions of pits if the original surface was pitted. SSPC-Vis 3 is a visual standard to assist in determining compliance. Surface profile is determined by procedures in 6.1.1.

5.3.5 *Blast Cleaning* is used to remove coating, rust and mill scale from a metal surface and to provide a roughened surface by striking the surface with a stream of small, hard abrasive particles such as (dry) sand, grit, or shot.

5.3.5.1 One method utilizes compressed air, special blast nozzles, and abrasive. Water may be injected into the air stream to control dust. In another method used primarily in fabricating shop, wheels propel the abrasive centrifugally against the work. The minimum and maximum particle size of the abrasive may be specified as a means of controlling the surface profile.

5.3.5.2 Blast cleaning requires that all oil, grease, and weld flux be removed by solvent cleaning (5.3.1). The compressed air used for blast cleaning should be free of condensed water or oil by making certain that separators and traps are in working order. Test the compressed air supply in accordance with Test Method D 4285.

5.3.5.3 Blast-cleaning operations should be performed so that no damage is done to the completed portion of the work. Blast cleaning is often performed from the top to bottom of the structure and should only be carried on downwind from any recently painted areas. Dry blast cleaning operations should not be conducted on surfaces that will be wet after blasting and before painting. Dew point should be at least 3°C (5°F) above the steel temperature.

5.3.5.4 The degree of blast cleaning required should be at least equal to the appropriate surface preparation specification and the applicable visual standard. Standards from ASTM, SSPC, and National Association of Corrosion Engineers (NACE) are listed below in Table 1. Note that Pictorial Surface Preparation Standards D 2200 is divided into two methods. Method A describes photographic standards available from International Standards Organization (ISO) Pictorial Surface Preparation Standards. Method B describes photographic standards available from SSPC. The two sets of photographs are not directly comparable.

TABLE 1 Comparison of Surface Preparation Standards

Preparation Guide	SSPC	ASTM D 2200		NACE
		Method A[A]	Method B[B]	
Blast clean to white metal	SSPC-SP 5	Sa 3	SP 5	1
Blast clean to near-white metal	SSPC-SP 10	Sa 2½	SP 10	2
Commercial blast cleaning	SSPC-SP 6	Sa 2[C]	SP 6	3
Brush-off blast cleaning	SSPC-SP 7	Sa 1	SP 7	4

[A] Method A is ISO/Swedish Standard.
[B] Method B is SSPC Vis 1-89.
[C] Pictorial Standard Sa 2 shows mill scale and conflicts with SSPC definition of commercial blast (SP 6), which does not allow mill scale.

5.3.5.5 Blast cleaned surfaces should be examined for any traces of oil, grease, or smudges; where present, the contaminants should be removed by solvent cleaning (5.3.1). Surfaces that have been dry blasted should be brushed with clean brushes, blown with compressed air free of oil and moisture, or vacuum cleaned to eliminate any traces of blast products, dust, or dirt from the surface. This also serves to remove abrasive from pockets and corners.

5.3.5.6 Blast cleaned surfaces should be further treated, primed or painted on the same day they are blasted, preferably

within 8 h, or in any event before any visible flash rusting occurs. Reblasting will be necessary on any surface if rust bloom forms before coating can be applied.

5.3.6 *Pressurized Water Cleaning*—A high pressure water blast using potable water, either with or without an abrasive injected into the stream, is used as an alternative to open blasting, since it reduces the release of dust into the atmosphere. Pressures over 137 900 KPa (20 000 psi) are needed to achieve total coating removal when using only water. Pressurized water alone will not remove mill scale efficiently, or impart an anchor profile. Inhibitors may be added to the water to prevent flash rusting. The surface should be dried or allowed to dry before coating. SSPC-SP 12/NACE5 defines the various levels of cleanliness that can be achieved with pressurized water.

5.4 *Cleaning and Preparation of Various Surfaces*—Before application of any coating, all surfaces to be coated should be thoroughly cleaned and properly prepared to the requirements of the specification. All dust, dirt, oil, grease, moisture, soot, tar, or other contaminants should be removed from unpainted surfaces. Previously painted surfaces should be similarly cleaned of all foreign matter; all deteriorated coating should be removed as well. Mortar or cement drippings from earlier repairs should be removed by mechanical or chemical means. Tree limbs or other growth obstructing the structure should be cut away to provide ready access.

5.4.1 *Steel Surfaces*—Removal of rust and scale should be done in the manner and to the degree specified, that is, hand, power tool, or blast cleaned.

5.4.1.1 On complex structures, all dirt and debris should be removed from pockets, crevices, obstructed areas such as gusset plates and connections, and tops of horizontal surfaces. Blasting debris that accumulates on horizontal surfaces should be removed. Special attention should be placed on examining hard to reach areas, the back side of nuts and bolts, sides of members in close proximity to other members or walls, and undersides of members.

5.4.2 *Galvanized Surfaces* that are to be painted should be cleaned and then treated in accordance with the specified method in Guide D 2092. Alternatively, the surface may be allowed to weather a minimum of 6 months before cleaning and painting.

5.4.3 *Aluminum Surfaces*:

5.4.3.1 Complete removal of oil and grease and, for unanodized aluminum, treatment is essential. Vapor degreasing or immersion in an alkaline or acid cleaning solution are commonly used in shop work. In the field, water wash followed by solvent, steam or detergent cleaning is a good starting point.

5.4.3.2 Vinyl wash primer is one of the metal pretreatments commonly used on unanodized aluminum. The material is described in Practices D 1730, Type B, Method 8 and is covered by SSPC in Paint 27. Lead pigmented primers should never be used over aluminum surfaces. The minimum treatment for aluminum is Type B, Method 3 of Practices D 1730, which describes the use of an alcoholic phosphoric acid cleaner.

5.4.4 *Precautions in Preparing Unpainted and Previously Painted Surfaces*—Cleaning should proceed by sections, bays, or other readily identifiable parts of the work. The cleaning of each section, bay, or part of the work should be entirely completed, inspected, and accepted before any coating is applied. The specification should contain limits on the amount or area that can be cleaned and painted at one time. The system of alternately cleaning and painting short sections by one workman is not good practice since this can lead to surface or intercoat contamination.

5.4.4.1 If traffic, or any other source, produces an objectionable amount of dust, it is customary to control the dust by using tarpaulins, etc., for a sufficient distance around the structure and take any other precaution necessary to prevent dust and dirt from coming into contact with the cleaned or freshly painted surfaces. It may sometimes be necessary to clean newly coated surfaces using some of the specified methods between the various coats.

5.4.4.2 Some areas to be painted or repainted may be exposed to chemical fumes and, if so, should be washed with water before painting. Washing may also be necessary between coats of paint.

5.4.4.3 Residual contaminants present on pitted steel can be a problem. Chloride from deicing salts or a marine environment, and sulfate contamination from air pollution have been recognized as main factors in premature breakdown of existing coating systems. High-pressure water blasting is often used to remove these contaminants.

5.4.4.4 Current regulations require containment and collection of surface preparation debris for disposal. When the existing coating contains regulated heavy metals such as lead or chromium, or other regulated compounds such as organotin, special precautions and handling of debris may be necessary. Inspection of contaminant and disposal requirements, especially site storage requirements, are part of a Coating Inspector's activities. SSPC 6(CON)[6] and 7(DIS)[6] present information useful to the inspector and sections of these guides may be referenced in the specification. On lead removal projects, inspectors should be familiar with OSHA requirements for their own health and safety.

5.5 *Inspection of Surfaces Prior to Field Painting*:

5.5.1 *New Construction*—It should be emphasized that the first coat should be applied to the cleaned surfaces before any soiling or deterioration can occur. If painting is done outside, the cleaned areas should receive the first protective coat well before nightfall brings lower temperatures and possible moisture condensation on the surfaces. When surface preparation and painting are carried on indoors, overnight delays between coating and painting may be permissible except on blast-cleaned surfaces.

5.5.1.1 Shop-coated steel that has been shipped to the erection site should be stored on blocks to prevent contact with the ground, and where it is least likely to be marred, scratched, or subjected to harmful contamination by grease, oil, salt, etc. Insofar as practicable, the steel should be stored to avoid the formation of waterholding pockets. If outdoor storage lasts for several months, the inspector should check the integrity of the coating from time to time and verify that deficiencies are corrected in accordance with the contract document. The

length of time between shop priming and erection and subsequent topcoating should be kept to a minimum to avoid the problem of intercoat adhesion.

5.5.1.2 Immediately before applying the first field coat, the shop-coated surfaces should be cleaned of dust. If necessary to remove grime and oil substances, they can be wiped, steam cleaned, power washed with detergents or cleaned with solvents selected so as not to soften the film appreciably. Miscellaneous scratches and breaks in the shop coat, including those occasioned by field welds, bolts, or rivets, should be cleaned, feathered and touched-up as specified before the steel receives the first overall field coat.

5.5.1.3 The inspector should ensure that field rivets have been cleaned of slag and weld spatter. It is important that every coat of the system be applied over dry, soil-free surfaces, and that all previous coats be free of mechanical damage. Great care should be exercised to prevent trapping corrosive salts under or between coats.

5.5.1.4 The inspector should determine whether the specifications are being followed with reference to the painting or prohibition of painting of contact surfaces in bolted or riveted surfaces of construction. He should ensure that surfaces not in contact but that will be made inaccessible by assembly or erection, have received the full number of specified coats before they become inaccessible.

5.5.2 *Maintenance Repainting*—In most cases, maintenance repainting will consist of spot-cleaning and priming of small isolated areas of deterioration, followed by application of one overall new finish coat to all surfaces of the structure. The inspector of maintenance repainting should be alert for several conditions not encountered in the painting of new work.

5.5.2.1 Sound coating not intended to be removed should not be damaged by cleaning operations on adjacent areas. This is particularly important with spot-blast cleaning.

5.5.2.2 The junctions between sound coating and spot-cleaned areas should present a smooth, feathered appearance. The application of coating to spot-cleaned areas should overlap the old, adjacent coating to a slight extent to ensure full coverage of the cleaned areas. Before the overall finish coat is applied, the inspector should ensure that oil, grime, dust, and other contaminants are cleaned from the old coating surfaces.

5.5.2.3 Adhesion of the newly applied coat to the old coating should be carefully checked. Practice D 5064 presents the procedure for evaluating adhesion of maintenance coatings.

5.5.2.4 Under the direction of the engineer, the inspector may explore beneath the surface of the existing or new coating film for covered-over rust or loosening of the old film, and where he discovers such conditions, require that the surface be cleaned and repainted.

5.5.2.5 The effect of the newly applied coating on the old underlying coating should be noted. Any coating that shows curling, lifting, or wrinkling should be reported to the engineer immediately since it may have to be removed and the area repainted. If the defects are general, rather than existing in a few isolated areas, use of a different type of coating may be necessary.

6. Coating Storage and Handling

6.1 *Storage of Coating and Thinner*— All coatings and thinners should be stored in areas or structures that are well-ventilated and not subject to excessive heat, open flames, electrical discharge, or direct rays of the sun. Storage should be in compliance with applicable regulations and the manufacturer's written instructions. Materials susceptible to damage at low temperatures should be stored to prevent freezing, such as in heated areas. Too high a storage temperature reduces the shelf life of the coating. If a coating is stocked for a considerable length of time (several months), it is desirable to invert the containers at monthly intervals. This will prevent hard settling and thus make mixing quicker and easier when the coating is to be used.

6.1.1 Coating containers should remain unopened until needed, and the oldest should be used first. The manufacturer's written instructions should be followed regarding shelf life. Coatings that have livered, gelled, or otherwise deteriorated during storage should not be used. If a particular material is in question, do not use it until it has been tested by the manufacturer or independent laboratory and found to be satisfactory.

6.1.2 Where a skin has formed in the container, the skin should be cut loose from the sides of the container, removed, and discarded. If it is felt that the skins are thick enough to have a practical effect on the composition, the remaining paint should not be used until it has been tested and found to be satisfactory.

6.2 *Mixing of Coatings*—All coatings should be thoroughly and completely mixed in clean containers before use. Where there is noticeable settling, and mixing is done either by power agitators or by hand, most of the vehicle should be poured off into a clean container. The pigment is then lifted from the bottom of the container with a clean, broad, flat paddle, lumps broken up and the pigment thoroughly mixed with the vehicle present. The poured-off vehicle should returned slowly to the original container with simultaneous agitation. It is also useful at this point to mix or pour repeatedly from one container to another (boxing) until the composition is uniform. The bottom of the original container should be inspected for the unmixed pigment. Two component paints should be mixed by agitation only, and not with boxing. After the individual components are homogenous, they are intermixed with agitation in the order stated in the manufacturer's instructions, that is, add Part B to Part A. The coating should not be mixed or kept in suspension by means of an air stream bubbling under the coating surface.

6.2.1 Some coatings may require straining after mixing, to ensure homogeneity and to remove skins and foreign matter. The strainers should be of a type to remove only skins, etc., but not to remove pigment. For example, a 297- μm (50-mesh) strainer is normally satisfactory for most coatings, unless some specific size is required in the specification. Containers should be covered when not in use, to reduce volatile losses and skinning.

6.2.2 Coatings should be agitated enough during application to ensure homogeneity. Some materials may even require constant agitation during use.