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NACE INTERNATIONAL
THE CORROSION SOCIETY

Standard
Recommended Practice

Considerations in the Selection and Evaluation of Rust Preventives and Vapor Corrosion Inhibitors for Interim (Temporary) Corrosion Protection

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Foreword

Almost every manufacturing plant that deals with ferrous and nonferrous metal needs to protect parts, components, equipment, or subassemblies from corrosion. In most metal-working plants, parts in process spend approximately 50 to 80% of the time awaiting further processing. Humidity, heat, perspiration, and airborne contaminants, as well as cutting oil and coolant residues, can attack the unprotected metal.

Interim coatings have been used for more than 50 years throughout the world to protect ferrous and nonferrous parts, assemblies, components, etc., for periods of time from a few days to more than a year. Because they are designed for temporary use, interim coatings can be used to protect metal between manufacturing processes and during storage and shipping. The interim coatings are normally removed prior to final painting, plating, fabrication, or construction.

The proper selection of an interim coating provides the corrosion prevention required during processing, shipping, and prior to painting. The purpose of this standard recommended practice is to inform industry of considerations in the selection and performance criteria of interim coatings. Quality control criteria are listed to enable the manufacturer and user to select appropriate test procedures to maintain prescribed standards. This standard is intended to assist the new buyer or user as well as the experienced user of interim coatings in the proper selection and evaluation of these coatings.

This NACE standard was originally prepared by NACE Task Group T-6H-42, a component of Unit Committee T-6H on Coating Materials for Atmospheric Service. It was reaffirmed in 1993 and technically revised in 2000. It is issued by NACE International under the auspices of Group Committee T-6 on Protective Coatings and Linings.

In NACE standards, the terms *shall*, *must*, *should*, and *may* are used in accordance with the definitions of these terms in the *NACE Publications Style Manual*, 3rd ed., Paragraph 8.4.1.8. *Shall* and *must* are used to state mandatory requirements. *Should* is used to state that which is considered good and is recommended but is not absolutely mandatory. *May* is used to state that which is considered optional.

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Contents

Section 1: General

1.1 This standard provides recommended selection factors, surface preparation requirements, and references to applicable standard evaluation and quality control tests for interim coatings (rust preventives and vapor phase corrosion inhibitors) that provide temporary corrosion protection to parts, such as finished machine tools, boilers, turbines, diesel engines, transportation equipment, earth moving equipment, and other machinery, during shipment and storage.

1.2 Interim coatings deposited on parts in process are normally from 0.5 to 75 µm (0.02 to 3.0 mils) thick. Some heavy-duty interim coatings, wrappers, and wax-petrolatum tapes may be up to 2,000 µm (80 mils) thick, while a vapor corrosion inhibitor (VCI) may provide protection with only the thickness of a molecule. These coatings may contain proprietary rust-preventive additives to improve their inherent corrosion-preventive ability.

1.3 The type of interim coating selected depends on performance requirements. Typical performance requirements include that the coating can be easily applied, provide corrosion prevention for the exposure and handling conditions outlined, and be removed more readily than conventional coatings. Because there are many types of interim coatings available, the best choice for a particular application depends on the degree of protection required and storage and time considerations, as well as shipping and removal requirements. Interim coatings are applied in the shop or on site by dipping, wiping, brushing, or spraying the component with the rust preventive.

Section 2: Types of Interim Coatings

The types of interim coatings can be outlined as follows:

2.1 Inhibited Fluids (includes natural and synthetic oils and aqueous fluids)

(a) Lubricating rust-preventive oils
(b) Slushing oils (ferrous and nonferrous coil and sheet protective coatings)
(c) Water emulsion compounds
(d) Aqueous fluids

2.2 Wax/Oxidized Petroleum Fractions

(a) Hot-melt or 100% solids
(b) Waterborne
(c) Solventborne
(d) Wax/petrolatum tapes

2.3 Asphaltic Material

(a) Hot-melt or 100% solids
(b) Waterborne
(c) Solventborne

2.4 Polymer

(a) Hydrocarbons
(b) Alkyds
(c) Acrylics
(d) Esters
(e) Elastomers

2.5 Miscellaneous

(a) Concentrates
(b) Inhibitors
(c) Greases

2.6 Vapor phase inhibitors (VPIs) or volatile corrosion inhibitors (VCIs)

2.6.1 Some interim coatings contain VPIs that help the coating function properly. VPIs also protect uncoated surfaces.

2.6.2 VPIs are normally in the form of crystals, powders, tablets, VPI-impregnated polymeric film, extruded film, emitters, etc. Products that are protected are usually electrical or electronic equipment, spare parts, engine bearings or components, etc. These products may be packaged in containers.

Section 3: Selection Factors for Interim Coatings

3.1 A comprehensive review of the factors that influence the selection of the interim coating should be done to ensure that the proper choice is made. The following details should be used as a checklist prior to specification or use of an interim coating:

3.2 Product to Be Coated

3.2.1 Product Description

3.2.1.1 Determine the type of metal to be coated.

3.2.1.2 Determine the size, shape, and finish or surface preparation of the metal.

3.2.1.3 Determine whether moisture or other foreign material is present on the metal.

3.2.2 Product Environment

3.2.2.1 Determine where the product to be coated will be stored or transported prior to use. Different exposure conditions require dramatically different grades of interim coatings. For example, products to be stored outdoors normally require heavier films, whereas thin films are used for products stored indoors.

3.2.2.2 If a product is to be stored indoors, determine the type of environmental conditions that will be present and the severity of exposure:

(a) Acid
(b) Alkali
(c) Humidity
(d) Salt
(e) Temperature
(f) Dirt/dust
(g) Solvent exposure
(h) Abrasion

3.2.2.3 If the product is to be stored in a shed or other outdoor covered area, determine the type of environmental conditions that will be present, in addition to those listed in Paragraph 3.2.2.2, and the severity of exposure:

(a) UV light
(b) Precipitation

3.2.2.4 If the product will be stored outdoors, determine the type of environmental conditions that will be present, in addition to those listed in Paragraphs 3.2.2.2 and 3.2.2.3, and the severity of exposure.

3.2.2.5 If the product is to be transported, determine the types of aforementioned and additional conditions that will be present (e.g., abrasion by gravel or other material).

3.3 Duration of Protection

3.3.1 In environments that decrease coating thickness or compromise the integrity of the coating over time, a thicker initial film or the use of a high-performance coating is generally needed if long-term protection is required.

3.3.2 Thickness or grade of the coating depends on many factors besides duration of use. For the purposes of this standard, duration of protection is defined as follows:

3.3.2.1 Short-term protection is considered to be three months or less.

3.3.2.2 Moderate-term protection is considered to be three to twelve months.

3.3.2.3 Long-term protection is considered to be more than twelve months.

3.4 Handling Requirements

3.4.1 Different types of coatings necessitate different methods of product handling, packaging, storage, removal, etc. Therefore, manufacturers, shippers, and end users of a protected part or component have distinct preferences and requirements depending on the type of interim coating used.

3.4.2 Damage to the interim coating that occurs during or after handling should be repaired.

3.4.3 Drying time may be critical, depending on how soon the protected products are packaged or exposed to environmental conditions.

3.4.4 Coating Types

(a) Firm
(b) Hard
(c) Soft
(d) Tacky
(e) Oily
(f) Dry
(g) Waxy

(h) Grease-like
(i) Ultrathin
(j) Molecular

3.4.5 Coating Appearances

(a) Translucent
(b) Transparent
(c) Opaque
(d) Pigmented
(e) Dyed
(f) Only discernable to trained individuals

3.5 Coating Application Methods

3.5.1 The method of application may dictate the type of coating selected. For example, dipping the product in an interim coating may offer the most complete protection, but if the component is large or of intricate configuration, dipping may be impractical. The most efficient methods of application include:

(a) Dip
(b) Spray (e.g., airless-pressure, air, electrostatic)
(c) Brush
(d) Flow
(e) Roll
(f) Float
(g) Wipe and wrap

3.6 Removal

3.6.1 Because most interim coatings are eventually removed, ease of removal is of critical importance when considering which coating to select. Thin, oily coatings and water emulsions provide the thinnest films and are normally easy to remove. Alkaline cleansers are usually sufficient for total removal. Heavier, weather-resistant coatings are usually removed with aliphatic or aromatic solvents.

3.6.2 A company specifying or using the coating may not be immediately concerned with removal because another division or a foreign company may be performing the removal. However, ease of removal is a vital consideration in the selection process. Before a final selection is made, the ability to remove the film, the cost of removal, and the handling required for removal of the film must be determined.

3.6.3 The following are the methods used to remove interim coatings. The user of the coating should consult the coating manufacturer for specific removal recommendations.

(a) Alkaline cleanser
(b) Vapor-phase degreaser
(c) Solvent wash
(d) Abrasive blast cleaning
(e) Water jetting
(f) Wet abrasive blast cleaning
(g) Power or hand tool cleaning
(h) Steam cleaning
(i) Lubricating oil
(j) Ultrasonic cleaning

3.6.4 Some interim coatings are not intended for removal. For example, bearings for automotive and aeronautical applications are often preserved in a rust-inhibitive grease or wax that is compatible with the lubricant or gear lubricant in the final part or assembly.

3.7 Special Requirements

3.7.1 Special factors, such as health risks, safe disposal of the coating residue, compatibility with other coatings, etc., play an important part in the selection decision.

3.7.2 Any special requirements that figure in the selection of the interim coating should be determined. The following are some of the details (in addition to those in Paragraphs 3.1 through 3.6) that may require consideration:

(a) Fingerprint neutralization;
(b) Weldability;
(c) Paintability;
(d) Disposal, including environmental concerns in the disposal of coating residue (e.g., the residue might be a hazardous waste regulated by the Resource Conservation and Recovery Act (RCRA)[1] because of leachable barium content as measured in the EPA[(1)] Toxicity Characteristic Leaching Procedure Test);
(e) Volatile organic content (VOC);
(f) Worker safety;
(g) Compatibility with other components (e.g., rubber);
(h) Halogen content;
(i) Abrasion resistance; and
(j) Lubrication.

[(1)] United States Environmental Protection Agency (EPA), 401 M Street, SW (1105), Washington, DC 20460

Section 4: Surface Preparation

4.1 The length of protection offered by interim coatings is correlated to surface preparation. For optimum performance, interim coatings should be applied to clean, dry metal. All contaminants, including lubricants, fingerprints, dirt, dust, water, and other residues, should be removed to prevent staining or corrosion of the part, component, or finished assembly. One or more of the following cleaning methods should be used prior to coating, as recommended by the manufacturer:

(a) Vapor-phase degreasing – SSPC[(2)]-SP 1[2]
(b) Petroleum solvent wash – SSPC-SP 1
(c) Emulsifiable cleansers – SSPC-SP 1
(d) Alkaline cleaners – SSPC-SP 1
(e) Other aqueous cleansers
(f) Abrasive blast cleaning – NACE No. 1/SSPC-SP 5,[3] NACE No. 2/SSPC-SP 10,[4] NACE No. 3/SSPC-SP 6,[5] NACE No. 4/SSPC-SP 7,[6] NACE No. 8/SSPC-SP 14.[7]
(g) High-pressure water jetting – NACE No. 5/ SSPC-SP 12[8]
(h) Hand or power tool cleaning – SSPC-SP 2,[9] SSPC-SP 3[10]
(i) Steam cleaning – SSPC-SP 1

4.2 If the metal is not clean and dry, the interim rust preventive should have properties that compensate for the lack of a clean and dry surface (e.g., coatings applied to wet surfaces should be water-displacing).

Section 5: Evaluation Tests for Coatings

5.1 Once the basic assessment of coating factors has been made (see Section 3), if applicable, additional testing should be conducted to match the correct coating to the specific set of needs. For example, a specifier may request an interim coating to provide 300 hours of salt spray protection, resistance to water immersion, a flash point of 60°C (140°F), water displacement capability, stain resistance (nonferrous metal), and easy removal. The properties and pertinent standard test procedures listed in Table 1 should be used to match each property requirement with possible coatings. By successive testing, a suitable coating can be determined by a process of elimination.

Section 6: Quality Control

6.1 The laboratory tests provided in Table 2 should be used, if applicable, to ensure that interim coatings are in accordance with specifications established by manufacturers and agreed on by users.

(2) The Society for Protective Coatings (SSPC), 40 24th Street, 6th Floor, Pittsburgh, PA 15222-4643.

Table 1: Evaluation Tests According to Property

Property to be Evaluated	Test Procedures Standard
Solids	ASTM[(A)] D 1644[11] (Modified to use 2-gram sample)
Humidity	ASTM D 1748,[12] DIN[(B)] 50017[13]
Salt spray	ASTM B 117,[14] DIN 50021[15]
Viscosity	ASTM D 445[16] (Kinematic)
Specific gravity	ASTM D 287[17]
Weathering	FED-STD-791 Method 1401,[18] Method 6151
Pour point	ASTM D 97[19]
Flow point	MIL-C-16173[20]
Fire point	ASTM D 92[21]
Flash point	ASTM D 92, ASTM D 93[22]
Resistance to chipping by gravel	SAE[(C)] J-400[23]
Hardness	ASTM D 1321[24] (Needle penetration)
Cold impact	ASTM D 2794[25] (Specify temperature)
Cold flexibility	ASTM D 522[26] (Specify temperature)
Water immersion	ASTM D 1308[27]
pH	ASTM D 1293[28]
Acid number	ASTM D 664,[29] ASTM D 974[30]
Base number	ASTM D 664, ASTM D 974
Vapor pressure	ASTM D 323[31]
Detergent wash	ASTM D 1308
Penetration	ASTM D 217[32] (Cone)
Melt point	FED-STD-791 Method 1401, ASTM D 127[33]
Water content	ASTM D 96,[34] ASTM D 95[35]
Sag	FED-STD-791 Methods 4493 and 4494
Dielectric strength	ASTM B 77[36]
Freeze/thaw	ASTM D 2243,[37] ASTM D 2337[38]
Solvent/alkali/acid wash	ASTM D 1308
Creepability	MIL-C-0083933[39]
Lubricating oil miscibility	MIL-C-16173 or MIL-C-11796[40]
Lubricity	ASTM D 2266[41]
Water displacing	FED-STD-791, Method 3007
Stain	MIL-C-22235[42]
Sprayability	FED-STD-791, Method 4331
Removability	MIL-C-16173
Volatility/evaporation rate	ASTM D 3539[43]
Vapor inhibiting ability	FED-STD-101C[44] Method 4031 (Procedure B)
Vapor phase protection	MIL-P-46002[45]

[(A)] American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.
[(B)] Deutches Institut fur Normung (DIN), Postfach 1107, D-1000 Berlin 30, Germany.
[(C)] Society of Automotive Engineers (SAE), 400 Commonwealth Drive, Warrendale, PA 15096.

Table 2: Quality Control Tests

Property to Be Evaluated	Test Procedures Standard
Solids	ASTM D 1644 (Modified to use 2-gram sample)
Humidity	ASTM D 1748, DIN 50017
Salt spray	ASTM B 117, DIN 50021
Viscosity	ASTM D 445 (Kinematic)
Specific gravity	ASTM D 287
Weathering	FED STD 1401 Method 6151
Evaporation rate	User criteria
Pour point	ASTM D 97
Flow point	MIL-C-16173
Fire point	ASTM D 92
Flash point	ASTM D 92, ASTM D93
Application requirements	User criteria
Resistance to chipping by gravel	SAE J-400
Hardness	ASTM D 1321 (Needle penetration)
Cold impact	ASTM D 2794 (Specify temperature)
Cold flexibility	ASTM D 522 (Specify temperature)
Water immersion	ASTM D 1308
pH	ASTM D 1293
Acid number	ASTM D 664
Base number	ASTM D 664
Vapor pressure	ASTM D 323
Detergent wash	ASTM D 1308
Penetration	ASTM D 217 (Cone)
Melt point	FED-STD-791 Method1401, ASTM D 127
Infrared scan	User criteria
Filtration	User criteria
Color	ASTM D 1500[46]
Trace elements	Atomic absorption/mass spectrometer
Sulfated ash	ASTM D 874[47]
Vapor Inhibiting ability	FED-STD-101C Method 4031 (Procedure B)

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