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Standard
Recommended Practice

Considerations in the Selection and Evaluation of Interim Petroleum-Based Coatings

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Foreword

The purpose of this recommended practice is to inform industry of considerations in the selection and performance criteria of interim petroleum-based coatings. Quality control criteria are listed to enable the manufacturer and user to select appropriate test procedures to maintain prescribed standards.

Interim petroleum-based coatings, formulated specifically for temporary corrosion prevention, have been used for more than 50 years to prevent a wide variety of corrosion problems. The type of coating selected depends on performance requirements, traditionally, that the coating can: (1) be easily applied, (2) provide corrosion prevention for the exposure and handling parameters outlined, and (3) be removed more readily than conventional coatings.

Interim petroleum-based coatings are used throughout the world to protect ferrous and nonferrous parts, assemblies, components, etc., for a few days up to a year or even more. Because they are designed for temporary use, interim petroleum-based coatings can be used to protect metal between manufacturing processes and/or during storage and shipping, and then are normally removed prior to final painting, plating, fabrication, or construction. They are widely used on finished machine tools, boilers, turbines, diesel engines, transportation equipment, earth moving equipment, and other machinery during shipment and storage.

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Section 1: General

1.1 Almost every manufacturing plant that deals with ferrous and nonferrous metal needs to protect parts, components, equipment, or subassemblies from corrosion. In most metalworking plants, parts in process spend approximately 50 to 80% of the time awaiting further processing. Humidity, perspiration, and airborne contaminants, as well as cutting oil and coolant residues, can attack the unprotected metal. The proper selection of an interim petroleum-based coating provides the corrosion prevention required during processing, shipping, and, where applicable, prior to painting.

1.2 Interim petroleum-based coatings are applied in the shop or on-site by dipping, brushing, or spraying the component with the rust preventive. Because there are many types of these coatings available, the best choice for a particular application depends on the degree of protection required and storage and time parameters, as well as shipping and removal requirements.

1.3 Rust-preventive coatings deposited on parts in process are normally from 0.5 to 75 μm (0.02 to 3.0 mils) thick. These coatings are usually made from petroleum-based compounds such as waxes, petrolatums, asphalt, or mineral oil. These bases contain proprietary rust-preventive additives to improve their inherent corrosion-preventive ability.

1.4 To ensure the highest level of corrosion prevention for parts or components in process, the items should be clean and dry prior to coating. 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.

1.5 Since most interim petroleum-based coatings are eventually removed, ease of removal is of critical importance when considering which coating to select. Thin, oily films and water emulsions provide the thinnest films and are normally easy to remove. Alkaline cleaners are usually sufficient for total removal. When heavier, weather-resistant films are required, they are normally removed with aliphatic or aromatic solvents. In a third method, a part for assembly is coated for an indefinite period of time. This would be the case for bearings in automotive and aeronautical applications. Bearings 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.

1.6 The following recommended practice will assist the new buyer or user as well as the experienced user of interim petroleum-based coatings in the proper selection and evaluation of these coatings.

Section 2: Types of Interim Petroleum-Based Coatings

The categories of interim rust preventives can be outlined as follows:

2.1 Inhibited Oil

- 2.1.1 Lubricating rust-preventive oils
- 2.1.2 Slushing oils (ferrous and nonferrous coil and sheet protective coating)
- 2.1.3 Water emulsion compounds

2.2 Wax/Oxidized Petroleum

- 2.2.1 Hot-melt or 100% solids
- 2.2.2 Waterborne
- 2.2.3 Solventborne

2.3 Asphaltic

- 2.3.1 Hot-melt or 100% solids
- 2.3.2 Waterborne
- 2.3.3 Solventborne

2.4 Polymer

- 2.4.1 Hydrocarbon
- 2.4.2 Alkyd
- 2.4.3 Acrylic
- 2.4.4 Esters
- 2.4.5 Elastomers

2.5 Miscellaneous

- 2.5.1 Concentrates
- 2.5.2 Inhibitors
- 2.5.3 Greases
- 2.5.4 Vapor phase inhibitors (VPIs)

2.5.4.1 Some petroleum-based coatings contain VPIs which help the coatings function properly.

2.5.4.2 VPIs are normally in the form of crystals, powders, tablets, impregnated wrapping paper, etc. Items that are protected in this manner are usually precision instruments. These items may be packaged in airtight containers or placed in covered indoor storage.

Section 3: Surface Preparation

3.1 The length of protection offered by interim rust preventives is correlated to surface preparation. For optimum performance, interim petroleum-based coatings should be applied to clean, dry metal. One or more of the following cleaning methods should be used prior to coating, as recommended by the manufacturer.[1]

3.1.1 Vapor phase degreasing - SSPC-SP 1[2]

3.1.2 Petroleum solvent wash - SSPC-SP 1

3.1.3 Emulsifiable cleaners - SSPC-SP 1

3.1.4 Alkaline cleaners - SSPC-SP 1

3.1.5 Abrasive blasting - NACE 1, 2, 3, 4,[3] SSPC-SP 5, 6, 7, 10[4]

3.1.6 Waterblasting - high-pressure water[5]

3.1.7 Hand or power tool cleaning - SSPC-SP 2,[6] SSPC-SP 3[7]

3.1.8 Steam cleaning - SSPC-SP 1

Section 4: Selection Criteria for Interim Petroleum-Based Coatings

4.1 A comprehensive review of the factors that will influence the selection of the coating should be done to ensure that the proper choice is made. This criteria selection should be used as a checklist prior to specification or use of an interim petroleum-based coating or product. Sections 4.2 and 4.3 provide more information regarding the item to be protected.

4.2 Product Description

4.2.1 Determine whether the metal to be coated is ferrous or nonferrous.

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

4.3 Product Environment

4.3.1 Determine where the item to be coated will be stored prior to actual use. Different exposure conditions require dramatically different grades of interim petroleum-based coatings. For example, products to be stored outdoors will normally require heavier waxy films, whereas thin, oily films are used for items stored indoors.

4.3.2 If an item is to be stored indoors, determine which type of environmental conditions will be present.

4.3.2.1 Acid

4.3.2.2 Alkali

4.3.2.3 High humidity

4.3.2.4 Salt

4.3.2.5 Temperature

4.3.2.6 Dirt/dust

4.3.2.7 Solvent exposure

4.3.3 If the item will be stored outdoors, determine which type of environmental conditions will be present.

4.3.3.1 Ultraviolet (UV) light

4.3.3.2 Precipitation

4.3.3.3 Salt

4.3.3.4 Acid

4.3.3.5 Alkali

4.3.3.6 Temperature

4.3.4 If the item is to be stored in a shed or other outdoor covered area, determine which type of environmental conditions will be present.

4.3.4.1 UV light

4.3.4.2 Precipitation

4.3.4.3 Salt

4.3.4.4 Acid

4.3.4.5 Alkali

4.3.4.6 Temperature

4.3.4.7 High humidity

[1] Complete sources of these standard methods are given in Appendix A.
[2] SSPC-SP 1 - "Solvent Cleaning"
[3] NACE Standard TM0170, "Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive"; NACE Standard TM0175, "Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grit and Shot"
[4] SSPC-SP 5 - "White Metal Blast Cleaning"; SSPC-SP 6 - "Commercial Blast Cleaning"; SSPC-SP 7 - "Brush-Off Blast Cleaning"; SSPC-SP 10 - "Near-White Blast Cleaning"
[5] NACE Standard RP0172, "Surface Preparation of Steel and Other Hard Materials by Water Blasting Prior to Coating or Recoating"
[6] SSPC-SP 2 - "Hand Tool Cleaning"
[7] SSPC-SP 3 - "Power Tool Cleaning"

4.3.4.8 Abrasion by gravel or other material

4.4 Duration of Protection

4.4.1 If a longer protection time is required, a thicker or a higher performance coating is generally needed.

4.4.2 Thickness or grade of the coating depends on many factors besides duration of use. In general, however, for the purpose of this document, the protection times are defined as follows:

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

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

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

4.5 Handling Requirements

4.5.1 Different film types necessitate different methods of product handling, packaging, storage, removal, etc.

4.5.2 Manufacturers, shippers, and the end users of the protected part or components have distinct preferences or requirements for film types because of the reasons listed in Paragraph 4.5.1.

4.5.3 Film Types

4.5.3.1 Firm

4.5.3.2 Hard

4.5.3.3 Soft

4.5.3.4 Tacky

4.5.3.5 Oily

4.5.4 Film Appearances

4.5.4.1 Translucent

4.5.4.2 Transparent

4.5.4.3 Opaque

4.5.4.4 Pigmented

4.6 Coating Application Methods

4.6.1 The method of application may dictate the type of coating selected. For example, dipping the item in an interim petroleum-based coating may offer the most complete protection, but if the component is large or of intricate configuration, dipping may be impractical.

4.6.2 Determine the most efficient method of application.

4.6.2.1 Dip

4.6.2.2 Spray

4.6.2.3 Brush

4.6.2.4 Flow

4.6.2.5 Roll

4.6.2.6 Float

4.7 Removal

4.7.1 In most applications, interim petroleum-based coatings are eventually removed. However, a company specifying or using the coating may not be immediately concerned with removal because another company division or a foreign company may actually remove the coating. Ease of removal is a vital parameter 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.

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

4.7.2.1 Alkaline cleanser

4.7.2.2 Vapor phase degreaser

4.7.2.3 Solvent wash

4.7.2.4 Abrasive blast

4.7.2.5 Water blast

4.7.2.6 Wet abrasive blast

4.7.2.7 Power or hand tool cleaning

4.7.2.8 Steam cleaning

4.7.2.9 Lubricating oil

4.8 Special Requirements

4.8.1 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.

4.8.2 Any special requirements that figure in the selection of the interim petroleum-based coating should be determined. The following parameters, although not all-inclusive and in addition to the parameters covered in Paragraphs 4.1 through 4.7, may require consideration:

4.8.2.1 Fingerprint neutralization

4.8.2.2 Weldability

4.8.2.3 Paintability

4.8.2.4 Disposal

4.8.2.5 Volatile organic content (VOC)

4.8.2.6 Worker safety

4.8.2.7 Compatibility with other components (e.g., rubber)

4.8.2.8 Halogen content

Section 5: Evaluation Tests for Coatings

5.1 Once the basic assessment of coating criteria has been made (per Section 4), additional testing should be conducted to match the correct coating to the specific set of needs. For example, a specifier may request an interim petroleum-based 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. In this example evaluation list, test procedures indicated in Paragraphs 5.2.3, 5.2.15, 5.2.10, 5.2.31, 5.2.32, and 5.2.34, respectively, may be applied. The properties and pertinent standard test procedures listed below should be used where applicable to match each property requirement with possible coatings, and by successive testing, arrive at a suitable coating by process of elimination.

5.2 Evaluation Tests According to Property

Property to be Evaluated	Test Procedures Standard[8]
5.2.1 Solids	ASTM D 1644 (Modified to use 2-gram sample)
5.2.2 Humidity	ASTM D 1748, DIN 50017SK
5.2.3 Salt spray	ASTM B 117, DIN 50021
5.2.4 Viscosity	ASTM D 445 (Kinematic)
5.2.5 Specific gravity	ASTM D 287
5.2.6 Weathering	Fed. STD 141, Method 6151
5.2.7 Pour point	ASTM D 97
5.2.8 Flow point	MIL-C-16173D
5.2.9 Fire point	ASTM D 92
5.2.10 Flash point	ASTM D 92, ASTM D 93
5.2.11 Gravelometer	SAE J-400
5.2.12 Hardness	ASTM D 1321 (Needle penetration)
5.2.13 Cold impact	ASTM D 2794 (Specify temperature)
5.2.14 Cold flexibility	ASTM D 522 (Specify temperature)
5.2.15 Water immersion	ASTM D 1308
5.2.16 pH	ASTM D 1293
5.2.17 Acid number	ASTM D 664, ASTM D 974
5.2.18 Base number	ASTM D 664, ASTM D 974
5.2.19 Vapor pressure	ASTM D 323
5.2.20 Detergent wash	ASTM D 1308
5.2.21 Penetration	ASTM D 217 (Cone)
5.2.22 Melt point	Fed. STD 791-1401, ASTM D 127
5.2.23 Water content	ASTM D 96, ASTM D 95
5.2.24 Sag	Fed. STD 141-A Methods 4493 and 4494
5.2.25 Dielectric strength	ASTM B 77
5.2.26 Freeze/thaw	ASTM D 2243, ASTM D 2337
5.2.27 Solvent/alkali/acid wash	ASTM D 1308
5.2.28 Creepability	MIL-C-0083933
5.2.29 Lubricating oil miscibility	MIL-C-16173D or MIL-C-11796B
5.2.30 Lubricity	ASTM D 2266
5.2.31 Water displacing	Fed. STD 791, Method 3007
5.2.32 Stain	MIL-C-22235A
5.2.33 Sprayability	Fed. STD 791B, Method 4331
5.2.34 Removability	MIL-C-16173D
5.2.35 Volatility/evaporation rate	ASTM D 3539

[8] Sources identified in Appendix A.

Section 6: Quality Control

6.1 The following laboratory tests should be used where applicable to ensure that interim petroleum-based coatings are in accordance with specifications established by manufacturers and agreed upon by users.

6.2 Quality Control Tests	Property Procedure[9]
6.2.1 Solids	ASTM D 1644 (Modified to use 2-gram sample)
6.2.2 Humidity	ASTM D 1748, DIN 50017SK
6.2.3 Salt spray	ASTM B 117, DIN 50021
6.2.4 Viscosity	ASTM D 445 (kinematic)
6.2.5 Specific gravity	ASTM D 287
6.2.6 Weathering	Fed. STD 141, Method 6151
6.2.7 Evaporation rate	User criteria
6.2.8 Pour point	ASTM D 97
6.2.9 Flow point	MIL-C-16173D
6.2.10 Fire point	ASTM D 92
6.2.11 Flash point	ASTM D 92, ASTM D-93
6.2.12 Application requirements	User criteria
6.2.13 Gravelometer	SAE J-400
6.2.14 Hardness	ASTM D 1321 (Needle Penetration)
6.2.15 Cold impact	ASTM D 2794 (Specify temperature)
6.2.16 Cold flexibility	ASTM D 522 (Specify temperature)
6.2.17 Water immersion	ASTM D 1308
6.2.18 pH	ASTM D 1293
6.2.19 Acid number	ASTM D 664
6.2.20 Base number	ASTM D 664
6.2.21 Vapor pressure	ASTM D 323
6.2.22 Detergent wash	ASTM D 1308
6.2.23 Penetration	ASTM D 217 (Cone)
6.2.24 Melt point	Fed. STD 791-1401, ASTM D 127
6.2.25 Infrared scan	User criteria
6.2.26 Filtration	User criteria
6.2.27 Color	ASTM D 1500
6.2.28 Trace elements	Atomic Absorption/ Mass Spectrometer
6.2.29 Sulfated Ash	ASTM D 874

APPENDIX A
Sources for Reference Documents

1. American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19103.

2. NACE International, P.O. Box 218340, Houston, TX 77218-8340.

3. Deutches Institut fur Normung (DIN), Postfach 1107, D-1000 Berlin 30, Federal Republic of Germany.

4. Society of Automotive Engineers (SAE), 400 Commonwealth Drive, Warrendale, PA 15096.

5. Steel Structures Painting Council (SSPC), 4516 Henry St., Suite 301, Pittsburgh, PA 15213-3728.

6. Federal Test Method Standards, Attn. AMXMR, TMS, Commanding Officer, Army Material and Mechanics Research Center, Watertown, MA 02172.

7. MIL-C-16173 D, Corrosion Preventive Compound, Solvent Cutback, Cold Application, Commander, Naval Sea Systems Command, SEA 311.2, DOD Standardization Program and Documents Branch, Washington, DC 20362.

8. MIL-C-0083933A (MR) Corrosion Preventive Compound, Cold Application (For Motor Vehicles), U.S. Army Armament Research and Development Command (DR DAR-TST-S), Dover, NJ 70801.

9. MIL-C-22235A, Corrosion Preventive Oil, Nonstaining, Commander, Naval Ship Engineering Center, (CODE 6124) Center Bldg., Prince George's Center, Hyattsville, MD 20782.

10. MIL-C-11796B, Corrosion Preventive Compound, Petrolatum, Hot Application, Director, Army Materials and Mechanics Research Center, Attn: DRXMR-LS, Watertown, MA 02172.

[9] Sources identified in Appendix A.