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SSPC: The Society for Protective Coatings

TECHNOLOGY UPDATE NO. 3

Overcoating

1. Scope

1.1 This technology update discusses the risks associated with the maintenance painting practice known as overcoating. Factors affecting overcoating application, service and costs are discussed.

1.2 This document is intended to serve as a resource for facility owners and others charged with developing and implementing maintenance painting programs.

1.3 Overcoating is one of several maintenance painting options. This document is not intended to provide a detailed description or comparison of the relative merit and cost considerations of overcoating versus other maintenance painting options. For a more complete and detailed discussion of maintenance painting practices, the reader should refer to SSPC-PA Guide 5, Guide to Maintenance Painting Programs.

2. Description and Definitions

2.1 DESCRIPTION

2.1.1 This document contains discussions of the risks associated with overcoating, methods of assessing risk, and means by which risks may be managed and reduced.

2.1.2 Overcoating is generally defined as the practice of painting over an existing coating as a means of extending its useful service life. Overcoating may be a cost-effective alternative to complete coating removal and repainting. When the old coating contains lead, cadmium, or chromium, overcoating may be a particularly attractive option due to economic considerations. Overcoating presents certain risks as well (see risk definition below).

2.2 DEFINITIONS

For the purposes of this document, the following definitions will be used:

Coating stress: The tension that a coating has, which is capable of being imparted to the steel substrate or other coating.

Embrittled coating: Coating that has degraded to a friable condition but still has enough elasticity to adhere to the substrate or existing coating.

Flaking: The detachment of small pieces of the coating film, usually preceded by cracking, checking or blistering.

Loose coating: Coating that has delaminated and disbonded from the substrate or other coats, but has not fallen off.

Marginally adherent coating: A coating that exhibits tape adhesion of 2A or less (per ASTM D 3359), such that the overcoating risk is moderate or high.

Overcoating: Application of coating materials over an existing coating in order to extend its service life, including use of the appropriate cleaning methods. The procedure includes preparation of rusted or degraded areas, feathering edges of existing paint, low-pressure water washing of the entire structure to remove contaminants, application of a full intermediate coat over repaired areas, and optional application of a full topcoat over the entire structure. Overcoating may be a cost effective alternative to complete coating removal and repainting. When the old coating contains lead, cadmium, or chromium, overcoating may be a particularly attractive option due to economic considerations. Overcoating presents certain risks as well.

Repaint: Complete removal of the existing coating system followed by application of a new coating system (including appropriate cleaning methods.)

Risk: As used herein, "risk" refers to the chance that the overcoated system (old paint plus newly applied overcoat) will either fail catastrophically (e.g., delamination of the system) or will not provide the desired period of protection (e.g., early rust back).

Spot repair: A procedure entailing surface cleaning of isolated corrosion or paint breakdown areas using appropriate cleaning methods, and subsequent coating of these areas.

Zone painting: A procedure entailing surface preparation using appropriate cleaning methods and painting of a defined area of a structure. Zone painting may involve (a) many spot repairs within a defined area or (b) removal of all coating in a defined area, followed by application of a new coating system to that area.

3. Discussion

3.1 RISKS ASSOCIATED WITH OVERCOATING

3.1.1 Delamination: A primary risk associated with overcoating is that the overcoating system could cause delamination. If a delamination failure occurs, the overcoating investment is lost. Delamination is difficult to predict; however, an understanding of the underlying principles will help the coatings engineer reduce the chance of a delamination failure.

Delamination is primarily the result of internal stresses in the overcoat material being transferred to underlying or existing coating layers. Internal stress occurs as the applied paint shrinks. Several factors affect the degree of internal stress in the overcoat material, including the type of coating, the formulation, the film-forming conditions, the temperature and the coating's age and thickness. A good example of an increased internal stress is the oxidative curing of alkyds. Temperature fluctuations may also affect the level of internal stress. Brittle coatings are more apt to crack during temperature changes. The application of an overcoat may also affect the internal stress of the existing coating because the stress present in the overcoat is transmitted to the existing coating.

The internal stress of the overcoat is counteracted by its adhesion to the existing coating. A loss of adhesion of the existing paint system at either the steel/coating interface or within the layers of the existing coating may result in cracking of the overcoat.

Good overcoating systems should be designed so that there is higher tensile strength and rigidity in the existing or original coating than in the overcoat.

3.1.2 Early Rust Back or Poor Coating Performance: Another primary risk involved in overcoating is that the system will not provide an adequate period of service. The overcoat may not experience a catastrophic failure, such as delamination, but nonetheless may fail prematurely because of the severity of the service environment. This type of degradation may be manifested by pinpoint rust, undercutting at small breaks in the coating system, or blistering. The amount and type of surface preparation used prior to applying the overcoat can also affect the degree of protection afforded by the overcoat material.

3.2 FACTORS AFFECTING RISK IN OVERCOATING

3.2.1 Influential Factors: The risk of delamination or other coating failure described in 3.1 is influenced by the condition of the existing coating, substrate factors, compatibility of new and old system, the type of structure and the exposure environment, etc.

3.2.2 Condition of Existing Coating

3.2.2.1 Existing Conditions: Visual and physical inspections, patch testing, and previous experience with similar systems for the expected exposure and conditions are proven tools in assessing the risk.

3.2.2.2 Existing Coating System Type (Oil, Alkyd, Vinyl, Epoxy, Urethane): It is important to be able to determine if multiple coating system types exist on the structure and to identify them in order to determine basic chemical composition, so that the proper overcoat system can be selected and special hazardous conditions can be identified.

3.2.2.3 Thickness: Thicker, aged coatings tend to be more highly stressed. Strong peeling forces can be generated during curing and aging of the overcoat. When overcoated, thicker, more highly stressed coatings are more likely to delaminate than thinner coatings with lower internal stress. Delamination may also be caused by thermal cycling that may disrupt the integrity of thick, aged coatings that have been overcoated. Rapid thermal cycling may accelerate system deterioration. Thicker, more highly stressed coatings are also more likely to sustain damage from blast media or other mechanical processes. This often results in a subsequent loss of adhesion that may affect the performance of the overcoat system.

3.2.2.4 Number of Coating Layers: Many layers of paint increase the chance of poor intercoat adhesion and may lead to delamination.

3.2.2.5 Coating Age: Depending on the curing mechanism, certain coatings tend to embrittle more with age than others. Alkyds are particularly susceptible to embrittlement with age.

3.2.2.6 Chalking and Erosion: Epoxy and alkyd coatings may chalk and erode with prolonged exposure. Generally this does not present a problem for overcoating as long as the loose chalk is removed prior to painting. Even severely eroded coatings with exposed primer may be good candidates for overcoating, provided the remaining coating has good adhesion and rusting is nominal.

3.2.2.7 Delaminated Paint Films: Paint films that exhibit delamination or other undesirable characteristics, such as cracking, are not good candidates for overcoating.

3.2.2.8 Coating Brittleness: Embrittled coatings tend to crack, providing sites for stress-induced peeling.

3.2.2.9 Coating Adhesion: The adhesion of the existing coating to itself and to the substrate is a critical factor. However, it is difficult to precisely define a satisfactory adhesion value. At present, adhesion is generally evaluated by either ASTM D 3359 or ASTM D 4541. Systems exhibiting low adhesion values in these tests are more likely to delaminate when overcoated than are aged coatings with higher adhesion values. Generally, the aged coating system will fail at its weakest point. Coating type, age, thickness, and surface preparation all affect the adhesion of the aged coating system.

3.2.2 Substrate Factors and Corrosion Pattern: The condition and type of the substrate under the existing coating system must be determined. Mill scale, because it is smooth and slick, generally presents the weakest point of adhesion of the coating, even if the mill scale itself is tightly adherent to the steel. Filiform rust or undercutting could continue beneath the film unless the source is removed. The condition of the substrate may affect the performance of the overcoat system. Generally, the more corrosion present, the higher the degree of surface preparation required. This may cause localized problems on structures that were not cleaned uniformly prior to receiving the original coating. Localized rusted areas may dictate a different strategy than would spot rust over the entire surface area. There is a point at which it may no longer be cost-effective to overcoat.

3.2.3.1 Surface Preparation: The performance of the system is influenced by surface preparation prior to initial coating application. A surface that was previously blast cleaned is more likely to have satisfactory adhesion values, and is generally a better overcoat candidate, than a surface with existing mill scale.

3.2.3.2 Surface Contaminants: Surface contaminants, such as chloride and sulfates, can lead to decreased coating life and vastly accelerated corrosion, while grease and oil can result in poor wetting and adhesion of the overcoating system. Coatings differ widely in their ability to protect under these conditions. The problems associated with surface contaminants are not necessarily specific to overcoating; however, contaminants are less likely to be removed during overcoating because typically much less surface preparation is done. Less surface preparation holds down costs and reduces environmental and worker exposures to hazardous dusts. Extensive surface preparation is also more likely to cause mechanical damage to an old, marginally adherent, embrittled coating that may later delaminate.

3.2.3.3. Pitting: Pits often contain active corrosion cells (due to chlorides or sulfates) which can cause early failure of overcoat materials.

3.2.4 Coating Compatibility: Patch testing is a good method of determining whether the new coating is compatible with the existing one. The test should be performed so that the worst-case exposure to the patch is achieved. A method for patch testing is described in SSPC-PA Guide 5 and ASTM D 5064. (See Appendix A.1.2 for an example utilizing a test patch.)

3.2.5 Type of Structure

3.2.5.1 Configuration of Surfaces: Wide planar areas may delaminate first, particularly if the coating is applied over mill scale.

3.2.5.2 Flexing: The rigidity of the coated surface affects how the internal stresses in the coating are translated to interfaces. Flexible beams and wide planar areas tend to contribute more stress to a coating system than more angular, smaller planar areas.

3.2.6 Exposure Environment: The coating selected must be able to withstand the environmental conditions to which it will be exposed, as well as the surface conditions over which it is applied. Rapid thermal cycles tend to stress aged coatings, causing delamination at the weaker interfaces.

3.3 APPLICATION, SERVICE AND COST CONSIDERATIONS: The items below should be considered when determining whether overcoating is the most appropriate maintenance strategy for a particular situation.

3.3.1 Application Considerations

3.3.1.1 Limitations on Surface Preparation Methods: In some locations, because of noise or emission considerations, some methods of surface preparation cannot be used. As a result, complete removal and replacement of existing coating may not be an option. The preferred treatment would then be a limited surface preparation and overcoating.

3.3.1.2 Limitations on Application Methods: Some environmental or local restrictions prohibit certain application methods or coating products. It must be determined if the permissible application methods (e.g., brushing and rolling) are suitable for the overcoating product selected or considered.

3.3.1.3 Overcoatability of the Coating: Certain existing coatings can only be overcoated after major surface preparation such as scarifying the surface by sweep blasting or power tool cleaning. This situation may reduce or eliminate the economic and environmental advantages of the overcoat strategy.

3.3.2 Service Considerations

3.3.2.1 Expected Remaining Service Life of the Structure: The specifier should determine the remaining service life (in years) of the structure. The cost of overcoating (including surface preparation, containment, materials, application, etc.), may not be justified for a structure to be replaced or decommissioned in a short time.

3.3.2.2 Expected Life of the Overcoat System (in years): The expected service life of the overcoat system is also a critical factor. Unfortunately there is a high degree of uncertainty in these projections. This uncertainty can be conveyed by assigning a range of years for the overcoating system lifetime (e.g., 4-12 years).

3.3.2.3 Risk Threshold of Failure: The specifier must recognize that there is some chance of a catastrophic or premature failure of an overcoat system. Overcoating may not be a viable option if the risk of a coating failure cannot be tolerated. While the decision to use an overcoating strategy is independent of the lead paint issue (lead may not be present), the presence of lead makes all the options more costly. If the overcoat causes a catastrophic failure, the environmental risks are significantly increased. There are various means to reduce the risk of a catastrophic failure. For example, total removal of a poor to marginally adhered existing coating, with new coatings subsequently applied, provides less risk than some overcoat strategies.

3.3.3 Cost Considerations

3.3.3.1 Comparing Cost of Overcoating and Full Removal: The specifier should estimate the cost of overcoating versus the cost of total removal of coating versus replacement of the steel. Assessment of these options, along with expected coating lifetimes and risks of failure, will aid in determining if overcoating is the most cost-effective option. If the overcoat option causes a catastrophic failure, not only is the cost of the investment lost, additional costs for repair and environmental cleanup could be incurred.

3.3.3.2 Continued Presence of Lead: Another important difference between overcoating and full removal is that full removal permanently eliminates the lead hazard. If the structure is coated with material that must be treated as a hazardous waste, such as a lead-based coating, a latent hazard will exist (whether or not an overcoating system is applied) until the lead-based coating is removed. In cases requiring elimination of potential hazards resulting from disturbance of lead-based coatings, overcoating is not a feasible maintenance strategy.

3.3.3.3 Necessity of Structural Preservation: The specifier should determine if the structure is still needed or whether demolition or abandonment is a possibility. This option will also entail costs; in particular, there would be a need to address worker handling of the lead coated structure components.

3.3.3.4 Cost and Logistics of Structural Replacement: Depending on where a structure is in its design life, it may be more cost-effective to replace the structure than to repaint or overcoat it. Factors such as usage, alternate traffic routes (for bridges), and the availability of alternate structures can affect this decision. The costs for demolition must also be taken into account.

3.3.3.5 Urgency of Action: The specifier should also determine if maintenance can be put off for a period of time.

3.4 Assessing Risk in Overcoating: The coatings engineer may assess the risk associated with overcoating by compiling historical data, performing visual and physical inspections, and by applying coating test patches.

3.4.1 Coating History and Previous Overcoat Experience: The designer should compile as much historical information on the aged coating, surface preparation, and structure as possible. Historic data is commonly available on types of coating, number of coating layers, coating thickness, surface preparation, periodic maintenance, and periodic inspections. It should be determined if lead or any other hazardous material is present in order to properly assess the risks. If other structures have been painted in a similar or identical manner and subsequently overcoated, this information may also be useful. Information specific to the structure's exposure environment such as the presence of acid precipitation, chemical splash or vapors, or wind-borne or de-icing salts, may also be useful.

If no historic records of coating types exist, ASTM D 5043 can be used to determine the types of coatings on the structure.

The original surface preparation and substrate condition may be determined by using a chemical paint stripper to remove the aged coating from a small area. Intact mill scale, underfilm corrosion, and blast profile can then be determined in this way.

3.4.2 Visual Inspection: A quantitative visual inspection of the aged coating system should be conducted to determine the extent of degradation including underfilm corrosion, chalking, peeling, flaking, cracking, checking, rusting, and blistering. Visible surface contaminants including mildew, debris, grease, and oil should be identified. Representative components or areas of the structure should be individually evaluated. ASTM D 5065 provides a detailed description of the visual inspection techniques that should be utilized.

3.4.3 Physical Inspection: A physical inspection of the structure and aged coating system should be conducted to determine the film thickness, number of layers of paint, adhesion, underlying substrate condition, coating type, and presence of soluble salt contamination. The number of test locations examined must be enough to provide a representative picture of all major conditions existing on the structure.

Table 1 in Appendix A.1 contains a simple algorithm for assessing the risk of overcoating based on film thickness and adhesion of the existing coating. Coatings are categorized by thickness in three ranges: 0 to <10 mils (0 to 254 micrometers), 10 to 20 mils (254 to 508 micrometers), and >20 mils (>508 micrometers). Adhesion is measured in accordance with ASTM D 3359 and film thickness by SSPC-PA 2. The algorithm works on the principle that the risk of failure increases with increasing film thickness and decreasing adhesion. Risk is categorized as OK (essentially no risk), LR (low risk), MR (moderate risk), HR (high risk), and NO (not a candidate for overcoating). See Appendix A, section A.1.1.

Alternatively, ASTM D 4541 can be used to assess the adhesion of the aged coating. In a survey of SSPC member paint manufacturers, minimum tolerable pull-off adhesion values of 50 to 300 psi (340 to 2040 kPa) were cited as necessary for overcoating. Lenhart and El-Naggar have suggested the pull-off adhesion values of 100 to 200 psi (680 kPa to 1360 kPa) are marginal for overcoating and that adhesion of 250 to 600 psi (1700 to 4080 kPa) is acceptable for overcoating.

The thickness of the aged paint system may also be determined using ASTM D 4138. The method is convenient for assessing the number and thicknesses of individual coating layers.

Various methods have been used to determine the level of soluble salt contamination on steel structures including swabbing retrieval, retrieval by magnetic limpet cell, and retrieval by adhesive blister patch cell. The percent retrieval is dependent on the method of retrieval, degree of contamination, and the length of time the salt has been on the surface. Ionic concentration may be determined by measuring the conductivity of the extracted fluid, using ion selective electrodes, or by using proprietary indicator test strips for chloride (silver dichromate indicator) and sulfate (2,2'-bipyridine indicator).

3.4.4 Conducting a Patch Test: One or more patch tests should be performed to assess the risk of overcoating. Representative areas or components of the structure should be selected for testing. It is important that any test patch include the feathered edges of the existing paint at prepared rusted or degraded areas. Areas in poorer condition as well as areas that typify the overall condition of the aged coating should be selected for evaluation. The condition of areas to be evaluated should be characterized using the visual and physical methods described in Sections 3.4.2 and 3.4.3. Surface preparation methods and overcoating materials should be selected for evaluation. The selected overcoat materials should be applied to the prepared test areas, inspected after cure, and documented. The test patches should be inspected a second time after 6 to 12 months of exposure. The test exposure period should span at least one winter season. ASTM D 5064 and SSPC-Guide 9, Section 6.2.2, provide more detailed descriptions of patch testing. See Appendix A, Section. A.1.2, Method B for a procedure utilizing a patch test.

Interpretation of patch test results is rather straightforward. Delaminated test patches imply a very high risk. Intermediate levels of risk are indicated by poor or reduced levels of intercoat or substrate adhesion. Signs of early rusting or blistering may also indicate a high risk associated with overcoating. Other warning signs include wrinkling, mudcracking, lifting, and peeling.

3.5 Mitigating Risk in Overcoating: The methods described above in sections 3.4.1 through 3.4.4 are useful in assessing the degree of risk associated with overcoating. If the risks associated with overcoating are deemed acceptable to the owner, then specific actions can further mitigate the risks associated with the process. Surface preparation, coating selection, and inspection are key elements in reducing the risk associated with overcoating.

3.5.1 Surface Preparation: Surface preparation methods should be selected to minimize damage to the aged coating while providing a clean surface free of contaminants, corrosion, and poorly adherent coating. Sweep and brush-off blasting may disrupt the adhesion or fracture the aged coating, leading to failures of the overcoat system. Similarly, when spot or area cleaning using an abrasive method, care should be taken not to allow blast media to impinge on areas adjacent to the cleaning zone. The cleaning method indicated during patch testing should be specified.

3.5.2 Coating Selection: Coating materials with a high degree of internal stress should not be used for overcoating. Overcoat materials should have good penetration and wetting characteristics. They should have relatively low film thicknesses, good flexibility, and should not contain strong solvents. Some commercially available coatings have been specifically formulated for overcoating. Some products have been validated in use as overcoats and should be considered as candidates. Many types of products are sold for overcoating including acrylic latex, calcium sulfonate alkyd, epoxy, oil and oil modified alkyd, polyurethane, polyester, wax, petrolatum tape, urethane-latex, and epoxy-urethane coatings. The epoxy coatings are predominant in terms of the number of coatings available. Within this class there are thicker film epoxy mastics and the relatively low-build unpigmented penetrating epoxy sealers. Overcoating materials should also afford adequate corrosion protection in the intended service environment. The coating material indicated during patch testing should be specified.

3.5.3 Surface Preparation and Coating Inspection: As with any painting job, a thorough inspection of the prepared and painted surfaces should be conducted. The removal of soluble salts and other surface contaminants should be verified, in compliance with contract documents or a mutually agreed-upon procedure. A maximum permissible level of soluble salt contamination should be specified. Special attention should be paid to wet film thickness application to ensure that the DFT is within the specified range. The adhesion of the overcoat system should be determined and compared to the values obtained from the patch tests.

3.5.4 Risk Management: Risk management involves determining which of the factors listed in Sections 3.2 and 3.3 apply to the maintenance situation in question, determining their relative importance, and balancing these factors with the considerations described in Section 3.4.

In many cases overcoating has been used inappropriately. Because of the potentially large initial cost savings associated with overcoating, when compared to containment and complete removal, the temptation to overcoat is high. The large initial cost difference between these maintenance options has meant that owners are more tolerant of the risks involved in overcoating. Owners should first properly assess the risks associated with overcoating. If overcoating risks are deemed acceptable, then the facility owner should take additional steps to mitigate the risk of overcoating.

4. Conclusion

When considering whether to overcoat, factors affecting the internal stresses of the original coating and the overcoat must be considered, as should alternatives to overcoating. The lowest risk is likely to be associated with the highest cost, due primarily to the surface preparation and containment required. The highest risk will probably be associated with lower cost options due to the lower surface preparation costs. The specifier is urged to consider preventive maintenance programs in which surfaces are painted when they first show signs of degradation. At this stage, little or no surface preparation is needed, the existing paint exhibits good adhesion and all risks are minimized.

5. Disclaimer

5.1 This technology update is for information purposes only. It is neither a standard nor a recommended practice. While every precaution is taken to ensure that all information furnished in SSPC technology updates is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the technology update itself.

5.2 This technology update does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for ensuring compliance with all governmental regulations.

6. Referenced Standards

6.1 SSPC AND JOINT STANDARDS:

PA 1	Shop, Field, and Maintenance Painting of Steel
PA 2	Measurement of Dry Paint Thickness with Magnetic Gages
PA Guide 4	Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems
PA Guide 5	Guide to Maintenance Painting Programs
SP 1	Solvent Cleaning
SP 2	Hand Tool Cleaning
SP 3	Power Tool Cleaning
SP 5/NACE No. 1	White Metal Blast Cleaning
SP 6/NACE No. 3	Commercial Blast Cleaning
SP 7/NACE No. 4	Brush-Off Blast Cleaning
SP 10/NACE No. 2	Near-White Blast Cleaning
SP 11	Power Tool Cleaning to Bare Metal
SP 12/NACE No. 5	Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating
Guide 6	Guide for Containing Debris Generated During Paint Removal Operations
Guide 7	Guide for the Disposal of Lead-Contaminated Surface Preparation Debris

6.2 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:

D 522	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
D 610	Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
D 1654	Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
D 2370	Standard Test Method for Tensile Properties of Organic Coatings
D 3359	Standard Test Methods for Measuring Adhesion by Tape Test
D 3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
D 4138	Standard Test Method for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive Means
D 4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion-Testers
D 4940	Standard Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives
D 5043	Standard Test Methods for Field Identification of Coatings (Withdrawn 1997)
D 5064	Standard Practice for Conducting a Patch Test to Assess Coating Compatibility
D 5402	Standard Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rub
D 5065	Standard Practice for Assessing the Condition of Aged Coatings on Steel Surfaces

6.3 OTHER PUBLICATIONS

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A. APPENDICES

A.1 METHODS FOR ASSESSING OVERCOATING RISK

A.1.1 Method A: Assessing Risk Based on Adhesion and Thickness. This method assesses the risk of failure from overcoating using a combination of adhesion and film thickness of the existing coating. The thickness is categorized as <10 mils (254 micrometers), 10-20 mils (254-508 micrometers), and >20 mils (508 micrometers). The degrees of adhesion are based on ASTM D 3359. The principle is that the risk of failure is greater for thicker films and lower adhesion. The data are organized into a matrix shown in Table 1. The risks are categorized as: OK = essentially no risk, LR = low risk, MR = moderate risk, HR = high risk, NO = integrity too poor to salvage. This method is intended primarily for oil and alkyd coatings. The method has not been independently verified, but is believed to represent good practice based on field experience.

See Section A.2.1 for an example of the use of this table.

A.1.2 Method B: Assessing Risk of Overcoating Using a Patch Test and Other Parameters. This method features a patch test to assess the compatibility of the new overcoat with the existing coating. This method is used when the specifier has identified one or more candidate systems (including surface preparation and coating material) which are to undergo field evaluation on a small area of the structure.

The following steps are typically followed:

1. Identify structures to be evaluated for the potential of overcoating.
2. Identify representative portions of the structure for locating patch tests.
3. Assess condition of existing coatings using one or more of the methods described previously (e.g., adhesion, film thickness, age, number of layers, coating type, physical condition, presence of contaminants).
4. Select method or methods of surface preparation.
5. Select overcoat material and method of application.
6. Conduct and document patch testing (e.g., based on ASTM D 5064 or SSPC-Guide 9, Section 6.2.2).
7. Assess condition of existing coating/overcoat system using similar techniques (adhesion, coating degradation, appearance).
8. Analyze results.
   - Determine which existing condition or conditions are appropriate for being overcoated.
   - Assign relative ratings to surface preparations and overcoat material.
   - Determine adequacy of test procedure and results.
9. Select maintenance painting strategy.
   - Decide on overcoating, full removal, or other option.
   - If overcoating is decided upon, determine surface preparation and material to use.

A.2 PAINTING SCENARIOS: The following two hypothetical examples outline how the decision to overcoat can be made. The first example describes the criteria for deciding whether or not to overcoat a simple bridge. The second example describes the decision-making process for a water tank overcoat, based on field evaluation of test patches.

It is assumed, in both cases, that overcoating the structure is economically feasible (i.e., the overcoating is significantly less expensive than removal of the existing lead paint coating). It is also assumed that the structures will not be demolished, decommissioned, or undergo a major structural rehabilitation for at least 10 years. In the bridge example, it is assumed that the structure cannot be taken out of service (i.e., that replacement is not a possibility at this point), and that preservation has been presumed.

A.2.1 Bridge Painting Using Risk Table: This example uses a simple bridge and presents the criteria for deciding whether or not to overcoat.

1. Structural Factors: Determine where the structure is in its life expectancy. Is any major rehabilitation, such as a deck repair or widening, scheduled to take place? Can the structure be taken out of service completely, or does overcoating have

TABLE 1
RISK OF SALVAGING EXISTING COATING BASED ON ADHESION/THICKNESS CHARACTERISTICS

ADHESION CLASSIFICATION			COATING THICKNESS		
ASTM D 3359 Method B* * (using 5 mm guide)	**Percentage Removed**	**ASTM D 3359 Method A**	**< 10 mils (< 254 μm)**	**10-20 mils (254-508 μm)**	**> 20 mils (> 508 μm)**
5B	0%	5A	OK	OK	OK
4B	1% to 5%	4A	OK	OK	OK
3B	6% to 15%	3A	OK	OK	OK
2B	16% to 35%	2A	LR	LR	MR
1B	36% to 65%	1A	MR	HR	HR
0B	> 65%	0A	NO	NO	NO

OK = essentially no risk
LR = low risk
MR = moderate risk
HR = high risk
NO = integrity too poor to salvage

* Method B is not recommended for use on films above 5 mils in thickness unless otherwise agreed upon between the contracting parties.

to be performed while maintaining traffic flow? Is the structure historically significant? Does the location of the structure affect the choice of removal method?

2. Condition of Steel: Determine the condition of the steel surface from both a coatings aspect and a structural aspect. Are there fatigue-prone areas that must be addressed? Has there been excessive section loss?

3. Condition of Coating: What is the adhesion rating of the existing coating? How much rust is present and how is it distributed (is it localized or spread over the entire structure?) What is the thickness of the existing coating?

4. Environmental Factors: Determine whether there are any special environmental considerations that should be addressed (e.g., proximity to sensitive water body or residences).

It is possible to develop a strategy based on the amount of rust and paint to be removed. This strategy is based on the cleaning of rusty areas to an SSPC-SP 6 and the removal of loose or non-adherent coatings. The strategy is keyed to the percentage of surface area that is rusted and degraded.

0–1% Rust: If the coating, based on its adhesion rating and thickness, has an OK risk based on the risk table (Table 1, Section A.1.1), overcoating will be most successful. This is a “paint when it doesn’t need re-painting” situation, and should be the lowest-cost option with the least amount of risk. The use of a surface-tolerant coating with washing of the surfaces is very viable in such an instance.

If the rating is NO, this is not a likely candidate for overcoating or any coating. This is a possible “do nothing” situation. Because the existing coating is providing excellent corrosion protection, although poorly adhered, there is no imminent danger of section loss except (possibly) in localized areas, and some type of spot or zone repair may be considered. The paint work needs to be deferred until a total removal is warranted or replacement of the structure is viable during a major rehabilitation.

If the risk rating is MR or LR, the decision-maker’s attitude toward risk will enter into the scenario. Spot or zone painting is an option, but full overcoating has to be questioned.

1-15% Rust: The amount of surface preparation has just gone up, and so has the cost. If the adhesion and thickness ratings are OK, overcoating of this structure is an excellent alternative. A decision will have to be made as to the type of surface preparation needed, e.g., minimal scraping or blasting.

If the risk rating is NO, the paint job needs to be deferred until a total removal is done or replacement of the steel is viable under a rehabilitation.

If the risk rating is MR or LR, spot or zone painting may be less risky than a full overcoat, depending on rust distribution. The service life remaining has to be weighed against the cost of a total removal now or in the future.

16+% Rust: At this amount of surface preparation, the cost of spot or zone painting is approaching that of full removal of the existing paint. The AASHTO Bridge Painting Guide indicates that, whenever the surface preparation area exceeds 15 to 20 percent of the surface area, the economics are such that a total removal of the lead paint is the most viable option. Overcoating may not be as viable an alternative, depending on the type of surface preparation specified. The overcoating of a structure having such extensive corrosion should probably be limited to structures with less than 10 years of expected remaining service life. Otherwise, do nothing until a full removal or replacement is an option.

A.2.2 Water Tank Painting Using Test Patch Method: This example is of a potable water tank with a lead containing coating system, requiring repair of the coating system. The owner wishes to repaint the structure with minimal impact on the surrounding sensitive area. The owner has agreed to conduct a patch test to determine the viability of proposed overcoating systems. The following procedure has been utilized to determine a recommended course of action.

1. Structure and Coating History

A. The structure is a potable water tank (elevated).
B. The tank has been coated with a three-coat alkyd system using a lead-containing primer.
C. The tank was last painted 18 years ago.

2. Evaluation of Existing Coating System

A. The coating thickness of the existing coating was measured and determined to be between 9 and 12 mils (229 and 305 micrometers).
B. Adhesion testing was performed on representative areas of the structure, using ASTM D 4541. The tensile adhesion was determined to be satisfactory on the intact portion of the coating.
C. Chips were taken from the structure for analysis of the existing coating.
D. Analysis revealed that the generic type of the coating was oil-containing alkyd.
E. Analysis determined the presence of 11% lead by weight in the total film. No cadmium or chromium was detected.

3. Selection of Maintenance Options

A. Overcoating Options. In this example, the recommended coating was a two-coat waterborne acrylic, which was claimed to be compatible over existing alkyd paint and over tight rust and mill scale. A penetrating sealer to improve wetting and adhesion of the acrylic coating was also recommended. Three alternate precleaning methods were selected as follows:

- No precleaning
- Solvent cleaning per SSPC-SP 1
- Detergent cleaning per SSPC-SP 1

The visibly degraded and rusted areas would be cleaned by power tool cleaning according to SSPC-SP 3.

B. Removal Option. With this option, the entire surface would be cleaned to bare metal using SSPC-SP 11, "Power Tool Cleaning to Bare Metal." A two coat waterborne acrylic would then be applied over the power tool cleaned surface.

C. Full Removal and Abrasive Blast Cleaning Option. This option would require full containment and ventilation, and would cause major disruptions to the tank operation and the nearby area. This option was eliminated prior to the patch testing.

4. Patch Testing

A. Three areas representative of the coating and steel condition were selected for patch testing. The areas were approximately 2 x 3 ft (610 cm x 914 cm).

B. The patches were prepared using the methods identified above:

- No precleaning
- Solvent cleaning
- Detergent cleaning

C. The penetrating primer and the two-coat waterborne acrylic were applied by conventional spray application over the areas in B.

D. The patches were allowed to weather for approximately five months, running from October to March.

5. Patch Test Evaluation

A. Tensile adhesion tests (ASTM D 4541) were conducted on the patch test areas.

B. The adhesion increased from an average of 300 psi to 800 psi (2040 to 5440 kPa) compared to the testing before the application of the penetrating sealer. The adhesion of the surfaces cleaned by solvent cleaning and detergent cleaning were about equal (i.e., 300 psi [2040 kPa] in both cases) and were slightly greater than the area which received no cleaning (e.g., 200 psi [1360 kPa]).

C. There was no visible delamination or cracking of the existing coating.

6. Decision

On the basis of the above information, the owner decided on the following system:

- Detergent cleaning of the entire surface
- Power tool cleaning (SSPC-SP 3) of the visibly degraded or peeling coating and the rusted areas.
- Penetrating sealer over the entire surface.
- Two coats of waterborne acrylic over the entire surface.

COATING HISTORY

	Original Coating System	First Maintenance Coating System	Second Maintenance Coating System
Surface Preparation			
Year Applied			
Primer			
Midcoat			
Topcoat			

Indicate how coating systems were identifed:

☐ Historic Records
☐ ASTM D 5043
☐ Other (describe) ____________________

Risk Assessment (use Table 1 of SSPC-TU 3, Technology Update on Overcoating)

☐ Essentially no risk
☐ Low Risk
☐ Moderate Risk
☐ High Risk
☐ Integrity Too Poor To Salvage

Remarks:

INSPECTION OF COATING SYSTEM TO ASSESS RISK OF OVERCOATING

Inspector:____ Date: ___________________________

Structure:____ Hazardous Coating Present? (circle one): Yes No

Describe Overall Environment: ________________________________

ASSESSMENT OF STRUCTURE

Structure Component	Describe Local Environment	Rust SSPC-VIS 2	Underfilm Corrosion ASTM D 1654	Peeling	Blistering ASTM D 714	Cracking/ Checking ASTM D 660/ D 661	Chalking ASTM D 4214	Film Thickness SSPC-PA 2 or ASTM D 4138	Adhesion ASTM D 3359 or ASTM D 4541	Level of Salt Contamination (List Method Used)	Condition of Underlying Substrate