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10.0 IN-HOUSE INSPECTION GUIDELINES

10.1 Why Inspect?

Inspection of coatings work is extremely important because it creates an environment in which the Contractor's personnel know they will be checked, audited, and monitored. This keeps people honest and more diligent even when they do not intend to do less than acceptable work. In short, quality practices and good workmanship will be enforced to some level of intensity. For in-house inspection, the level or extent of inspection is largely a decision that will vary as a coatings project proceeds based on the discretion and experience of the HRSD inspector. It is partly a good thing that the Contractors don't know what level of quality auditing to expect. But also, it is very important to inspect or audit the Contractor's work in a supportive and non-adversarial manner. For example, don't wait to inspect and reject abrasive blast cleaning of steel until a large percentage of the surface area has been completed. Rather, inspect soon after the Contractor starts that work to be sure that HRSD and the Contractor agree on what looks acceptable or not acceptable. In short, inspection ensures quality through enforcement of the specified requirements and that is why we inspect; to ensure quality coating work.

10.2 Quality Control Inspection vs. Quality Assurance Auditing and the HRSD Inspector.

Quality Control is the front-line checking, measuring, evaluating, and inspecting of ongoing coatings work to control and ensure that the requisite quality attributes of the work as specified are met in the field. Quality Assurance is the role in the quality process that involves auditing, monitoring and verification of the quality control process to assure that it is working. The HRSD inspector will at various times need to perform either the Quality Control role or the Quality Assurance role. Which role will be determined by the ongoing quality of the work in a given project, a Contractor's past performance at HRSD facilities, the criticality of the coatings work, or by the complexity of the coatings work. If things are going well and all spot checks indicate good quality work, the Q.A. role should do quite nicely. This involves reviewing the Contractor's daily Q.C. reports and spot checking the ongoing surface preparation or application work, etc. If on the other hand, the HRSD inspector has continually or frequently found that the Contractor's work has not met the specified requirements, then the Q.C. role will need to be performed more diligently. The Q.C. role involves actual performance of the various Q.C. inspection tests, observations, comparisons, and measurements outlined in the "Pocket Manual" found under Subsection 10.5 of this Coatings Manual. The underlying goal of in-house inspection for this Coatings Program is for the HRSD inspection personnel to mostly serve in the Q.A. role on most HRSD coatings projects while having the knowledge and tools to perform good Q.C. inspection where necessary to enforce the specification requirements. This can be accomplished through familiarity with this coatings manual, in-house inspection training, and use of the Pocket Manual and Inspection "Tool Box" to be provided to all HRSD inspection personnel.

10.3 When To Use In-House Inspection.

The guidelines for using in-house inspection are as follows:

A. When the coatings work is fairly straight-forward and not technically challenging for HRSD Personnel or is not extremely critical from a corrosion protection standpoint. The training provided by HRSD to its personnel will give those individuals the basic inspection and testing skills needed to properly inspect or audit most coatings projects effectively. Also, projects like headspace linings in primary clarifiers or grit tanks where especially high H_2S gas exposures are commonplace are good candidate jobs for using third party inspection services. This is not only because the lining work is critical and complex, but because adequate inspection will typically require more of a time commitment than HRSD personnel can afford.

B. When the scope of the coatings work being performed is such that it can be covered by HRSD personnel without cutting into the time necessary for completion of their other daily duties. This generally means an hour or two every other day will be sufficient for the inspections and tests to be performed.

C. When the scope of the coating work being performed is concentrated in a given area sufficiently for in-house personnel to cover the inspections. Conversely, if the work is spread out between five parts of the plant remote from one another and the scope of the work is large scale (several tanks and building areas).

D. When the coating work being performed is largely focused on aesthetics or housekeeping such as office interior or building exteriors or the work is maintenance coating work in focus (localized, small overall area touch-up painting).

E. Use In-House inspection for projects which involve the following standard HRSD Coating Systems: A-1, E-1, E-2, E-3, E-4, E-1-G, E-1-NF, E-2-C, E-3-NF, E-4-C, EU-1, EU-1-FRP, EU-1-G, EU-1-NF, FP-3, HT-1, HT-2, L-1, L-1-W, L-2, L-2-W, L-3, L-4, MIOX-1, S-1, TW-1, TW-1-P.

Please review each project carefully and separately before making the decision to use in-house inspection for the coatings systems listed above. Weigh your decision based on the other parameters discussed above under items 10.3 A. through D. and on the criticality and complexity of the coatings work as discussed in the "Pocket Manual" found in Subsection 10.5 herein.

10.4 Minimum Training Requirements for HRSD Inspectors.

The recommended minimum training requirements for HRSD inspectors are as follows:

A. Complete the HRSD Coatings Manual Usage and Inspection Classroom Training and Hands-On Inspection Workshop and Pass the Associated Test. This involves 16 hours of training.

or

B. Successfully complete Level I of the NACE International Coatings Inspection Program.

and

C. Must attend the HRSD Coatings Inspection Refresher Course once every two years. This involves 8 hours of training.

D. Must have a complete Inspection "Tool Box" available for his or her use as outlined in Subsection 10.7 of this Coatings Manual.

10.5 Pocket Manual for In-House HRSD Coatings Inspection.

A. General

This Pocket Manual on quality control inspection for coatings projects covers all of the major inspection activities and tests to be monitored or performed by in-house HRSD inspection personnel. The key inspection activities and tests are as follows:

- Monitoring Ambient Conditions.
- Determining Oil or Water in Compressed Air.
- Determining Degree of Cleanliness for Blast Cleaned Steel.
- Determining Degree of Cleanliness of Power and Hand Tool Cleaned Steel.
- Determining Degree of Cleanliness for Steel Surfaces Prepared by Waterjetting.
- Determining Degree of Cleanliness for Steel Surfaces Prepared by Wet Abrasive Blast Cleaning.
- Measuring or Determining Steel Surface Profile.

- Testing Concrete Surface Tensile Strength before coating application.
- Determining Concrete Surface Profile.
- Evaluation of Degree of Cleanliness of Concrete Substrates.
- Measuring Surface pH on Steel and Concrete Substrates.
- Testing for Soluble Salt Contaminants on Steel Substrates.
- Testing for Residual Moisture in Concrete Substrates.
- Monitoring the Mixing and Thinning of Coatings.
- Measuring Wet Film Thickness of Coatings.
- Measuring Dry Film Thickness of Coatings on Metal Substrates.
- Measuring Dry Film Thickness of Coatings on Concrete Substrates.
- Calculating Dry Film Thickness on Concrete Substrate from Coating Spreading Rate (Coverage) or from Wet Film Thickness.
- Measuring Coating Adhesion.
- Discontinuity or Holiday Testing of Coatings.
- Testing for Cure of Coatings.

The actual test methods and procedures for using the instruments and standards for each test or inspection activity are described in Chapter 8 of SSPC's handbook entitled, *The Inspection of Coatings and Linings, Second Edition*. This handbook should be a standard component of each HRSD inspector's "Tool Box".

This pocket manual further provides recommended inspection hold points and guidance on the level and type of inspection effort that should be expended on various coatings projects. HRSD Inspection Personnel are not expected to perform every inspection activity, test, or measurement for every aspect and portion of the scope of work for a given coatings project. Rather, they are expected to closely audit the Contractor's quality control program execution during the project to ensure that the main quality checks required by the Specifications, Section 7 and the Coating System Guidelines, are being properly made by the Contractor. Hence, HRSD inspection personnel must be knowledgeable in the use of the major inspection and testing methods and instruments. With the right know how, HRSD inspection personnel can witness

(tests being performed by the Contractor's personnel) or perform the actual tests and interpret the results properly. By closely monitoring the Contractor's coatings work and quality control, HRSD personnel can greatly enhance and help ensure the quality of coatings projects at HRSD facilities.

B. Inspection Hold Points for Coatings Projects

At various key stages of coatings work, inspections should be made to ensure that the proper quality of previous portions of the work has been achieved prior to the Contractor's personnel proceeding with the work. These key stages are called Hold Points. They refer to stages of the work when the Contractor should stop to permit a careful inspection prior to progressing. In other words, hold for inspection at key points in the work. The typical Hold Points for all Coatings Projects are as follows:

1. Environment and Site Conditions – Have the weather or environmental conditions within the structure been checked for compliance with the coating work? This involves ambient air and humidity checks as well as checks on site conditions such as proper protective measures for surfaces not to be coated and safety requirements for personnel.

2. Pre-Surface Preparation – Checking of pre-surface preparation conditions. Can the proposed surface preparation method remove existing coatings and/or contaminants? Check to see if substrate repairs will be necessary to move forward. Is the substrate contaminated with oil or grease or soluble salts, etc.?

3. Monitoring of Surface Preparation – Spot checking for degree of cleanliness, surface profile, and surface pH testing, where applicable. Also, the cleanliness of compressed air should be checked for lack of oil and moisture.

4. Post Surface Preparation – Measure and inspect for proper degree of cleanliness and surface profile as specified in Section 7 and the Coating System Guidelines for the project.

5. Monitoring of Coatings Application – This is mainly checks on wet film thickness and general film quality (visual inspection) for lack of runs, sags, pinholes, holidays, etc. as the application work proceeds.

6. Post Application Inspection – Identify any defects in application work including pinholes, holidays, excessive runs or sags, and any other problems such as inadequate or excessive film thickness areas.

7. Post Cure Evaluation – This includes an overall Dry Film Thickness Survey, and adhesion testing, Holiday Detection, or cure testing as

required based on the type of project and the specific requirements in the specifications in Section 7.

8. Follow-up to Corrective Actions and Final Inspection. This involves reinspection of all corrective coating work performed by the Contractor to repair defects identified at prior Hold Points 6 or 7. This activity also combines with it the final careful visual inspection along with any follow-up tests like holiday detection, DFT surveys, etc.

C. Level of Inspection Effort

The level of inspection effort for any given coatings project will vary quite widely depending upon three major factors as follows:

1. Criticality of the Coatings Work – If the coatings work involves protection of metal or concrete substrates which will be exposed to severely corrosive conditions or the previous coating work failed prematurely or the structure to be coated is difficult to access, the criticality of the work is high. In such cases, all the hold points listed above should be enforced and the level of inspection effort will be more extensive. If the work involves recoating offices or touch-up coating work for maintenance purposes, the level of inspection effort can be greatly reduced.

2. Contractor's Past Performance - If the Contractor doing the work has demonstrated excellent quality control in the past on other HRSD coatings projects, (and continues to perform well on the subject project), the level of inspection effort can likely be reduced to brief visual inspections and periodic witnessing of testing efforts and quick reviews of the Contractor's Q.C. reports. Conversely if the Contractor is unknown or has performed poorly on past HRSD projects, the level of inspection effort should be more extensive and rigorous. This would involve actually performing Q.C. tests on a spot check basis along with careful auditing of the Contractor's daily reports and inspection efforts.

3. Complexity of Coatings Work - If the coating work involves numerous termination details at leading edges, joints, or surface material changes (i.e. metal to concrete) or the coating must be applied using plural component spray equipment or careful ambient condition control is required to complete proper cure of the coating system, the level of inspection effort should be high and involve all eight hold points. If on the other hand, the work involves application of straight forward coating systems such as E-1, E-2, E-3, E-4, L-1, L-2, and several others applied by brush roller, or airless spray, the level of inspection effort can be reduced to periodic checks and review of the Contractor's Q.C. reports. In these cases, the Hold Points are still a good idea, but the HRSD inspection will only require a few minutes for each hold point. Coating Systems such as

E-5, E-5-C, E-6, FP-1, FP-2, PU-1 and VE-1 are generally considered to be of higher complexity for application and should be more rigorously inspected using Third Party Inspection resources.

HRSD personnel are encouraged to carefully review these three factors when planning inspection coverage of various coatings projects.

The level of inspection effort should be carefully considered for recoating versus touch-up coating work. Typically, touch-up coating work can be inspected with a minimal level of effort if it involves large contiguous surfaces like tank or building exteriors that are very accessible. However, if the access is difficult, the level of inspection effort may need to be increased. Also, touch-up coating work can have high criticality and can be highly complex. In such cases, the level of inspection effort should be more intense. However, if the work involves simple touch-up of structural steel in a mild environment, use your discretion and simply spot check the work periodically. Recoating work almost always will require a greater level of inspection coverage and application of all eight hold points to ensure the proper quality of work.

D. Key Inspection Guidelines

1. Monitoring Ambient Conditions

Purpose

Monitoring Ambient Conditions is important such that conditions are appropriate for proper application and cure of protective coatings. Coating System Manufacturers (CSMs) typically provide written air and surface temperature and relative humidity ranges for the use of their products. Generally speaking, most all coatings require that surface temperature be at least 5 degrees above the dew point temperature (and not be falling) for proper application conditions. Applying coatings when the ambient air or surface conditions are out of those ranges recommended by the CSM can result in premature coating failures.

Frequency of Inspection

Surface temperatures should be monitored at the site of coatings work at the beginning of each shift in which coatings are applied, and at least, once every two hours thereafter during the shift. This information should be reported in the Contractor's daily inspection reports. The HRSD inspector should spot check the ambient conditions described herein and review the Contractor's reports for compliance with the manufacturer's recommended ambient condition requirements. These requirements are typically listed on the products data sheets. Third Party inspectors should perform the measurements every 2 hours of the shift.

Instruments and Referenced Standards

- Sling or electric psychrometers are used to determine the relative humidity and dew point. These are used in conjunction with psychrometric tables to obtain the actual values. These instruments are used in accordance with ASTM E337. Digital psychrometers are also readily available for measuring surface temperature, relative humidity, and dew point, but their use should be limited to indoor or enclosed space use as their performance is affected by outdoor conditions like wind. Hydrothermographs are also available for measuring and recording temperature and humidity.

- Temperatures for surfaces are measured using surface thermometers or digital thermometers.

2. Detecting Oil Or Water In Compressed Air

Purpose

When compressed air is used for abrasive blast cleaning or directly for coating application, the air should be checked for the presence of oil and/or water. This is essential as the presence of either water or oil can detrimentally affect coating adhesion and/or proper cure if carried onto the substrate.

Frequency of Inspection

This should be checked daily on each shift once the compressor(s) have reached operating temperature. This test should be repeated each time the compressors are shut down and started again. The HRSD inspector should spot check to be sure the Contractor performs the checks. Third Party inspectors should perform the checks each time the compressors are started.

Instruments and Referenced Standards

The HRSD inspector should check to be certain that water traps and dryers for compressors are being used. The inspector should use the blotter in accordance with ASTM D4285 to determine if oil or water contaminations are present. A white absorbent material like a white blotter (filter paper) is used for this quality check.

3. Determining Degree Of Cleanliness For Blast Cleaned Steel

Purpose

It is essential to verify that the proper degree of cleanliness for blast cleaning is being achieved during surface preparation. The inspection should verify that the specified level of degree of cleanliness is being attained. Degree of cleanliness is critical to coating performance under various exposure conditions. Use the visual standards from SSPC to compare the specified degree of cleanliness to the actual surface cleanliness being achieved in the field.

Frequency of Inspection

Degree of cleanliness should be checked several times per shift by the Contractor as the blast cleaning work proceeds. The HRSD inspector should spot check surface preparation routinely each day and apply a Hold Point to it as outlined earlier in this Manual. The Third Party inspector should actually inspect for degree of cleanliness several times per shift and establish Hold Points with the Contractor as the work proceeds.

Instruments and Referenced Standards

The degree of cleanliness is examined visually and compared to visual standards developed by SSPC. Table 1 provides a summary of the SSPC Surface Preparation Specifications. SSPC-VIS-1 is the Visual Standard to be used for making the degree of cleanliness comparisons for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning. New photographs have been added to this Guide which illustrate cleanliness of previously painted surfaces. SSPC-VIS-2 is the visual standard to be used for evaluating the degree of rusting on painted steel surfaces.

Table 1 below provides a summary of SSPC Surface Preparation Specifications for Metal and Concrete Surfaces.

TABLE 1

Summary of SSPC Surface Preparation Specifications

Surface Preparation Specifications	Description
SP 1 Solvent Cleaning	Removal of oil, grease, dirt, soil, salts, and contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
SP 2 Hand Tool Cleaning	Removal of loose rust, loose mill scale, and loose paint to degree specified by hand chipping, scraping, and wire brushing.
SP 3 Power Tool Cleaning	Removal of loose rust, loose mill scale, and loose paint to degree specified by power tool chipping, descaling, sanding, wire brushing, and grinding.
SP 5/NACE No. 1 White Metal Blast Cleaning	Removal of all visible rust, mill scale, paint, and foreign matter by blast cleaning by wheel or nozzle (dry or wet) using sand, grit or shot.
SP 6/NACE No. 3 Commercial Blast Cleaning	Blast cleaning until at least two-thirds of the surface is free of all visible residues with only staining permitted on the remainder.
SP 7/NACE No. 4 Brush-Off Blast Cleaning	Blast cleaning of all except tightly adhering residues of mill scale, rust, and coatings, while uniformly roughening the surface.
SP 8 Pickling	Complete removal of rust and mill scale by acid pickling, duplex pickling, or electrolytic pickling.
SP 10/NACE No. 2 Near-White Blast Cleaning	Blast cleaning nearly to White Metal cleanliness, until at least 95% of the surface is free of all visible residues with only staining permitted on the remainder.
SP 11 Power Tool Cleaning to Bare Metal	Complete removal of all rust, scale, and paint by power tools, with resultant surface profile.
SP 12/NACE No. 5 Surface Preparation and Cleaning Of Metals by Waterjetting Prior to Recoating	Defines four degrees of cleaning of visible contaminants (similar to SP 5, 6, 7, and 10). An appendix describes three levels of surface cleanliness for non-visible soluble salt contamination.
SP 13/NACE No. 6 Surface Preparation of Concrete	Description of inspection procedures prior to surface preparation, methods of surface preparation, inspection, and classification of prepared concrete surfaces.
SP 14/NACE No. 8 Industrial Blast Cleaning	Between SP 7 (brush-off) and SP 6 (commercial). The intent is to remove as much coating as possible, but contaminants difficult to remove can remain on 10 percent of the surface.
SP 15 Commercial Grade Power Tool Cleaning	Specification for power tool cleaning intermediate between SSPC-SP 3 and SSPC-SP 11. Some random staining and tightly adherent materials are permitted to remain on the surface. A surface profile of 1 mil (25 micrometers) is required.

4. Determining The Degree Of Cleanliness For Power And Hand Tool Cleaned Steel

Purpose

The cleaning of steel by Power and Hand Tools is used when conditions such as access or on-going equipment operations in an area prevent the use of abrasive blast cleaning or waterjetting, etc. As such, it is very important to ensure that hand and power tool cleaning is carefully exercised and that the proper visual standards are met. Use the SSPC visual standards to compare the specified degree of cleanliness to the actual surface cleanliness being achieved in the field. SSPC-VIS-3 is the visual standard used for degree of cleanliness comparisons for Power or Hand-Tool Cleaned Steel. When hand and power tool cleaning is used, the inspector should check to be certain that the tools used are clean (free of oil and grease, etc.) Also, check to be sure the tools are the proper size and type for the job at hand. Hand tools should not cause gouging of steel. Scrapers should be kept sharp.

Frequency of Inspection

Degree of cleanliness should be checked several times per shift as the hand and power tool cleaning work proceeds. The HRSD inspector should spot check the Contractor's work at least a couple of times per shift. The Third Party inspector should inspect for degree of cleanliness several times per shift.

Instruments and Referenced Standards

The degree of cleanliness is examined visually and compared to the Visual Standards developed by SSPC. The specified degree of cleanliness for Hand Tool and Power Tool Cleaning are described below:

SP 2 – Hand Tool Cleaning: Removal of loose rust, loose mill scale, and loose paint to degree specified by hand chipping, scraping, sanding, and wire brushing.

SP 3 – Power Tool Cleaning: Removal of loose rust, loose mill scale, and loose paint to degree specified by power tool chipping, descaling, sanding, wire brushing, and grinding.

5. Determining Degree Of Cleanliness For Steel Surfaces Prepared By Waterjetting

Purpose

Verification of the degree of cleanliness for steel surfaces prepared by waterjetting prior to recoating is essential due to the impact on coating performance as well as the risk of flash rusting or rust back if proper use of a corrosion inhibitor is not exercised. The inspector should verify that the specified degree of cleanliness (SSPC-SP-12) is being accomplished in the actual work.

Frequency of Inspection

Degree of cleanliness should be checked several times per shift by the Contractor as the waterjetting work proceeds. The HRSD inspector should check surface preparation at least twice per shift and apply a Hold Point to the work as outlined earlier in this pocket manual. The Third Party inspector should inspect for degree of cleanliness several times per shift and establish a Hold Point.

Instruments and Referenced Standards

The degree of cleanliness is examined visually and compared to visual standards developed by SSPC. SSPC-VIS-4, Guide and Reference Photographs for steel surfaces prepared by waterjetting is the guide standard to use. It provides color reference photographs of six initial conditions and four levels of cleaning by waterjetting for each condition. The four degrees of cleaning from SSPC-SP-12 for visible contaminants are similar to SP5, SP6, SP7, and SP10. An appendix is also included which describes three levels of surface cleanliness for non-visible soluble salt contamination.

6. Determining Degree Of Cleanliness For Steel Surfaces Prepared By Wet Abrasive Blast Cleaning

Purpose

Wet abrasive blast cleaning is mainly used to abrasive blast where dusting must be minimized and to ensure better visibility during surface preparation work. It can also be a useful preparation method for removing soluble salts during cleaning. The degree of cleanliness must be cautiously verified for this surface preparation method especially because flash rusting can occur if proper use of a corrosion inhibitor is not exercised. Use the visual standards from SSPC to compare the specified degree of cleanliness to the actual surface cleanliness being achieved in the field.

Frequency of Inspection

Degree of cleanliness should be checked several times per shift by the Contractor as the wet abrasive blast cleaning proceeds. The HRSD inspector should check surface preparation twice per shift and apply a hold point to the work as outlined previously in this pocket manual. The Third Party inspector should inspect for degree of cleanliness several times per shift and establish a Hold Point.

Instruments and Referenced Standards

The degree of cleanliness is examined visually and compared to visual standards developed by SSPC. SSPC-VIS-5, Guide and Reference Photographs for Steel Surfaces prepared by Wet Abrasive Blast Cleaning is the guide standard to use. It provides color reference photographs that depict two initial conditions (Rust Grades) and two degrees of wet abrasive blast cleaning for each initial condition. Determine the initial condition by comparison. Then after wet abrasive blasting determine whether the degree of cleanliness meets WAB-6 or WAB-10.

7. Measuring Steel Surface Profile

Purpose

The HRSD inspector should verify that the specified surface profile has been achieved. Surface profile is the distance from the peaks to the valleys created by blast cleaning. The greater the surface profile, the greater the surface area of the steel which promotes good coating adhesion. Too little surface profile often causes poor coating adhesion while too much surface profile can result in pinpoint rusting at the peaks where the coating system was insufficiently thick.

Frequency of Inspection

Surface profile should be verified by the Contractor daily at least three or four times (spot checks) or when blast cleaning methods, pressures, or abrasive media changes occur. The HRSD inspector should spot check this a couple of times per shift. The Third Party inspector should measure profile 3 or 4 times each shift.

Instruments and Referenced Standards

There are three common methods for determining surface profile for steel. They are all described in ASTM D4417 and are by order of preference as follows:

- Replica Tape (Method C)
- Comparators (Method A)
- Profile Depth Gauge (Method B)

The Replica Tape method is the most commonly used method. It uses deformable plastic tape bonded to a backing that is provided in three varieties (coarse, extra coarse, and extra coarse plus) for measuring various profile depths. The deformable side of the tape is rubbed onto the substrate with a rigid stick. This creates a reverse replica of the profile. The tape is then measured with a spring micrometer. Replica tape is used for surface profiles of 5 mils in depth or less. This is the recommended surface profile measurement method to be used by HRSD inspectors.

The Profile Comparator method involves the use of a visual comparator to the blast cleaned steel surface. The most widely used comparator is the Keane Tator Surface Profile Comparator. It consists of a plate with several leaves differing in profile depth and labeled as such, i.e. 1 to 1.5 mils. The comparator is placed on the surface and is visually compared to the prepared surface with lighted magnification. Comparator surfaces are prepared using steel grit, grit slag, or steel shot and are labeled as such because the appearance will vary according to the type of abrasive media used.

The Surface Profile Depth Gauge method is a depth micrometer used to physically measure profile depth. It is very inaccurate and is seldom used. It is not recommended for use by HRSD inspectors.

8. Testing Concrete Surface Tensile Strength Before Coating Application

Purpose

The purpose of this test is to verify that the concrete surface is sound enough to receive protective coatings. This is done by measuring the surface tensile strength with a portable adhesion tester.

Frequency of Inspection

This testing should be done after the substrate has been manually sounded with a hammer or chain to identify hollow, dull sounding areas or other differences in sound. Then the adhesion tests should be done only at those areas where dull hollow sounds occur or where visual inspection or sounding otherwise indicated degradation of the concrete substrate. This should be done by the Contractor once per job with the HRSD and/or Third Party inspector present.

Instruments and Referenced Standards

Elcometer Adhesion Testers, HATE Gauges, or other portable adhesion testers which comply with ASTM D-4541 are used for this evaluation. Also, the Dyna Tester can be used for this evaluation in accordance with CSA A23.26B.

9. Determining Concrete Surface Profile (CSP)

Purpose

As with steel substrates, surface profile on concrete substrates is critical to good coating adhesion and coating performance. The purpose of this evaluation is to ensure good coating system adhesion.

Frequency of Inspection

This determination should be made during the progress of the surface preparation work at least once per hour by the Contractor and the Third Party inspector. The HRSD inspector should make this check a couple of times each shift during surface preparation work and apply a Hold Point prior to coating application for a final surface preparation quality check.

Instruments and Referenced Standards

Following surface preparation, concrete surfaces for coating or surfacing can be checked for concrete surface profile (CSP) via visual comparison to molded replicates. These rubber replicas are available from the International Concrete Repair Institute (ICRI). These standards range in roughness from a low end of CSP 1 up to a high level of CSP 9. The standard includes surfaces prepared to varied levels by grinding, acid etching, shotblasting, scarification, and scabbling. They cover CSPs for suitable application of sealers, coatings, overlays, and mortars. ICRI 03732 provides a method selector which indicates the recommended CSPs for these products as well as the surface preparation methods to obtain those CSPs.

10. Evaluation Of Degree Of Cleanliness Of Concrete Substrates

Purpose

General concrete cleanliness needs to be verified as part of the surface preparation inspection effort. The degree of cleanliness for concrete largely refers to absorptiveness, the presence of grease or oil, and dusting.

Frequency of Inspection

Degree of cleanliness should be checked routinely by the Contractor or the Third Party inspector. The HRSD inspector should spot check this at least a couple of times per shift during surface preparation work.

Instruments and Referenced Standards

Before conducting any specific tests, use a visual cleanliness inspection to determine whether all contaminants have been completely removed. A water-break test is another judge of general cleanliness. Mist the surface to be tested.

When water gathers in lenses for about 25 seconds before flowing out and being absorbed by the substrate, the surface is clean. If it forms droplets, or a "break," the surface is contaminated with grease, oil, or some other sort of water insoluble materials.

Grease and Oil

Use an ultraviolet (black) light test to detect invisible grease or oil on cleaned concrete surfaces. Shine an ultraviolet light directly against the surface. A bright yellow or green fluorescence indicates the presence of grease or oil.

Dusting

Dust is caused by concrete deterioration or the abrasive used in blast cleaning. Since it is often the same color as the underlying concrete it can be difficult to detect visually.

Dust adversely affects adhesion of cementitious surfacers, penetrating primers, and coatings if it is not removed. Wipe and pressure-sensitive tape testing are methods of dust detection.

Wipe Testing. Wiping cleaned concrete with a contrasting color cloth, such as felt, will pick up any residual dust for visual evaluation. This is similar to the ASTM D4214 for chalking.

Pressure-Sensitive Tape Test. Dusting can also be detected with the pressure-sensitive tape test described in ISO Standard 8502-3 for steel surfaces.

Press clean, adhesive cellophane tape against the cleaned concrete surface and remove and compare it to visual standards. If the amount of dust collected exceeds the specification limit, more dust must be removed.

Residual Acid After Etching

Horizontal concrete surfaces are often acid etched or cleaned, as described in ASTM D4260. Although the etched surfaces are rinsed afterward with fresh water some excess acid and acid salts formed during neutralization may still remain to induce topcoat blistering or otherwise affect adhesion and general performance.

To detect residual acid, conduct the test described in ASTM D4262. Refer to Appendix F in the Coatings Manual. Wet the concrete surface with potable water and place a pH test strip in it. After the color develops on the test strip (almost immediately), compare it to the standard colors on the chart.

11. Measuring Surface pH On Steel And Concrete Substrates

Purpose

pH is an important substrate check for concrete and steel especially where those substrates are exposed to hydrogen sulfide gas and wastewater. Acidic contamination or attack of substrates can promote premature coating failures if it is not detected and removed. pH testing is the simplest way to check for acid contamination.

Frequency of Inspection

Surface pH measurements should be taken by the Contractor at least once for every 100 square feet of area to be coated. The HRSD inspector should spot check by performing pH measurements as needed to verify the Contractor's Q.C. activities, but otherwise should check to be sure the Contractor has been performing the tests routinely. The Third Party inspector should perform these tests at the same frequency as the Contractor.

Instruments and Referenced Standards

The pH tests are run using pH test paper or strips which are placed into potable water applied over the steel or concrete surfaces. After a color change occurs, the test strip is compared to the standard colors on the pH chart. Even though ASTM D4262 was developed as the Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces, it provides an appropriate procedure for the measurement of pH of concrete surfaces which have not been chemically etched and for steel surfaces as well.

12. Testing For Soluble Salt Contamination On Steel Substrates

Purpose

Testing for Soluble Salt Contamination on Steel Surfaces is important because the presence of such salts can promote blistering and adhesion related failures of coating systems. The method for removal of soluble salts is covered in Section 3.0 of the Coatings Manual and in the Section 7.0 Specifications. The test method is covered in your Inspection Tool Box.

Frequency of Inspection

The frequency of Soluble Salt Testing by the Contractor should generally be once for every 250 square feet of surface area to be coated. The HRSD inspector must also use discretion regarding the number and spacing of tests. For example if the structure to be coated varies in its normal exposure (some areas are headspaces and some are subjected to wastewater immersion), more tests should be performed on the normally immersed surfaces. Also if testing has shown soluble salt concentrations are just below the threshold for detrimental levels, more frequent tests should be performed to be sure any potential problems are identified. The HRSD or the Third Party inspector should be present for these tests.

Instruments and Referenced Standards

Testing for soluble salts for wastewater related steel surfaces mainly involves chlorides and sulfates. The testing involves identification of fixed 6 inch x 6 inch surface area followed by extraction of soluble salts from that area using either a swabbing technique or a latex cell (Bresle patch) and a syringe. Those methods for extraction as well as the analysis methods (use of specific test strips) are fully described in SSPC's book called the Inspection of Coatings and Linings and SSPC Guide 15 describes several extraction procedures.

13. Testing For Residual Moisture In Concrete

Purpose

Because excess moisture present in concrete substrates can detrimentally affect coating cure and adhesion, it is very important to test for it.

Frequency of Inspection

There are several methods for determining concrete moisture content. Each method offers varying guidance on frequency of testing. The Contractor should follow the guidance given by the standards used. The Plastic Sheet Method Test, which will be the test most commonly used by the HRSD Inspector, calls for one test area per 500 square feet. The calcium chloride test calls for three test locations for areas up to 1000 square feet and one additional test for each 1000 sq. ft. or fraction thereof. The Third Party inspector should be present for or perform the same number of tests as the Contractor per the used standards.

Instruments and Referenced Standards

Here are the most common test methods:

ASTM D4263 Plastic Sheet Test. A simple "go/no go" test for moisture in concrete. Tape an 18-inch (450-mm) square clear plastic sheet to a representative section of the concrete. If, after 16 hours, condensation appears on the underside of the sheet, or the concrete is darkened, it is too wet for coating.

Moisture Meter Tests. One of the most accurate moisture meter tests involves drilling holes in the concrete and filling them with a conductive gel. Two metal probes are set in the gel and connected to a moisture meter. Electrical conductivity is then measured through the concrete bridge between the probes to determine moisture content.

Another moisture meter test relies on a radio wave transmitted through the concrete. Since these waves are absorbed by water molecules, transmission time is an indicator of moisture content.

ASTM F1869 Calcium Chloride Test. A small dish containing a measured weight of anhydrous calcium chloride is placed on a concrete test area and covered with a larger clear, impermeable cover. After 72 hours, the dish is reweighed to determine how much moisture has been absorbed. Using the known area covered, the transmission rate in pounds of water per 1,000 ft.^{2} (g per m^2) per 24 h is determined. Most flooring and coating manufacturers accept a value of 3 1b/1,000 ft.^{2}/24 (15 g/m^2/24 h) or less.

Relative Humidity Test. This test is performed by sealing an insulated box against the concrete and measuring the relative humidity in it with a calibrated capacitance-based humidity gauge after 16-24 hours. If the relative humidity is 75%, the concrete has the acceptable moisture level of 5%.

14. Monitoring the Mixing and Thinning of Coatings

Purpose

The HRSD inspector should monitor the Contractor's activities with respect to verifying that coating materials are properly stored and are properly mixed. Also, check to be sure the products have not exceeded their shelf lives. Proper mixing of coating materials is important for both single component and multi-component coating materials. The single component products often have settled constituents and the multi-components involve a resin and a hardener or catalyst (for polymerization) as well as a part C consisting of aggregates or fillers. Proper mixing can affect proper application and film build properties as well as adequate cure and the expected development of the coating's chemical and physical properties.

Frequency of Inspection

Proper mixing should be checked by either reviewing the Contractor's Q.C. inspection forms or by actually observing to see that the Contractor's personnel follow the mixing ratios and mixing and thinning instructions prescribed by the CSM. This check should be made once per shift by the HRSD inspector or more often when convenient. This check should be made routinely by a Third Party inspector.

Instruments and Standards

There are no instruments used to monitor proper mixing unless you were to measure coating material viscosity. This should not be necessary in the field for the HRSD inspector. Instead, visually check to be sure the coating materials are the specified or approved products. Check to be sure the shelf life has not been exceeded. Observe the actual mixing and thinning operations to verify that the CSM's instructions from the product data sheets or product labels are being strictly followed. Check to be certain the Contractor's Q.C. reports reflect quality checks on proper mixing, mixing ratios, and thinning of the coating materials.

15. Measuring Wet Film Thickness Of Coatings

Purpose

Measuring wet film thicknesses is an important and early way to determine if the proper dry film thickness requirements will be met. By knowing the wet film thickness and the percent solids by volume for a coating, the dry film thickness of each coat of material can be determined. Many protective coatings are 100 percent solids by volume so that the wet film thickness often represents the dry film thickness.

Measuring wet film thickness on steel is relatively easy using notch gauges. For concrete, it is much more difficult due to the extent of surface profile and porosity of those substrates. Measuring wet film thickness on concrete can be performed using notch gauges, but it is best to calculate dry film thickness from coverage rates. See item 18 in this Pocket Manual.

Frequency of Inspection

The frequency of wet film thickness measurements by the Contractor or a Third Party inspector should generally be once for every 50 square feet of coating system surface area. The important point here is for the HRSD inspector to perform WFT measurements immediately after coating application starts to check the Contractor's coverage rate for each coat in the standard coating system. The HRSD inspector should use application start-up as a Hold Point as should the Third Party inspector.

Instruments and Referenced Standards

Wet film thickness is typically performed using notched WFT gauges which are made with four sided metal teeth of varying heights cut into the edges. The detailed procedure for WFT measurement using notched gauges is provided in Chapter 8 of SSPC's book, "The Inspection of Coatings and Linings" and in ASTM D4414. When performing WFT measurements for quick drying or rapid curing coatings, be careful as the WFT measurements may actually be a little lower than the actual WFT.

When measuring WFT measurements on concrete, make more frequent measurements than you would for steel surfaces. And double-check for findings by calculating the Coating Spreading rate as indicated under Measure Dry Film Thickness of Coatings on Concrete Substrates.

16. Measuring Dry Film Thickness On Metal Substrates

Purpose

Achieving the specified dry film thickness is critical to long-term coating performance. And because wet film thickness and dry film thickness can vary based on VOC and percent solids content, it is essential that the DFT be carefully checked on metal substrates.

Frequency of Inspection

Dry film thickness measurements should be taken at a minimum of two locations for every 100 sq. ft. of metal surface area by the Contractor and a Third Party inspector. The actual spot readings should be performed in accordance with SSPC-PA-2 which require three readings to be averaged at each spot measurement location. For large, flat, or otherwise uniform areas, up to five separate spot measurements should be taken for every 100 sq. ft. This includes tank surfaces and building facade surfaces where large coated surface areas are involved. Any unusually high or low readings that cannot be repeated should be discarded and the mean should be taken as the spot measurement.

The HRSD inspector should ensure the Contractor has taken the necessary number of DFT measurements and recorded them by area. And the HRSD inspector should spot check the Contractor's work for DFT. If discrepancies are identified, perform more frequent DFT measurements.

Instruments and Referenced Standards

On steel substrates, DFT can be measured using magnetic pull-off or constant pressure probe DFT instruments. Both are non-destructive. The use of DFT gauges for non-conductive coatings applied to ferrous metal substrates is described under SSPC-PA-2 and in ASTM D1186. The magnetic DFT gauges will generally be the type used by HRSD inspection personnel.

Dry film thickness can also be performed destructively using a Tooke gauge. Its use is defined in ASTM D4138. The Tooke gauge is only used when confirmation of DFT is needed when the other gauges being used are in question with respect to accuracy and proper calibration. When discrepancies are found between the HRSD measurements and the Contractor's measurements, check the calibration of both instruments being used by the respective parties against one another using rising calibration shims.

For non-ferrous metal substrates, DFT is measured using gauges based on eddy current methods. The use of these gauges is described in ASTM D 1400.

17. Measuring Dry Film Thickness On Concrete Substrates

Purpose

As with metal substrates, achieving proper coverage and dry film thickness over concrete substrates is essential to good coating performance and substrate protection.

Frequency of Inspection

DFT measurements should be taken by the Contractor or a Third Party inspector at least once for every 100 sq. ft. of surface area to be coated or more often when discrepancies are found. The HRSD inspector should verify that the Contractor has taken the measurements and recorded them by area. The HRSD inspector should spot check the Contractor's work for DFT. If discrepancies are identified, perform more frequent DFT measurements.

Instruments and Referenced Standards

Concrete coatings cannot be measured with magnetic dry film thickness gauges because concrete is not magnetic and the surface is too rough to produce an accurate reading. Instead, the other methods described here may be used.

Tooke Gauge. The paint inspection (PIG), or Tooke, gauge described in ASTM D4138 employs a specially angled blade that cuts completely through the coating and exposes the width of each coat for visual measurement using a microscope with a calibrated reticule in the eye piece. The coating dry film thickness is then calculated from the cutter tip (1x, 2x, or 10x).

Microscopic Measurement. Remove a section of the total coating system with attached concrete and examine its cut edge beneath a microscope with a calibrated reticule in the eye piece. Like the Tooke gauge method, several measurements must be averaged because of variations in the concrete surface texture.

Ultrasonic Measurement. Non-destructive instruments detect ultrasonic reflection differences between the coating surface and the concrete/coating interface. Coating thickness is directly related to the amount of time it takes the ultrasonic pulse to reflect back to the instrument. This equipment has a typical dry film thickness range of 2-175 mils (50 um-4mm).

Unless the coating is soft, a coupling agent is required to transmit the ultrasonic pulse from the instrument into the coating. Water is an ideal coupling agent for smooth, thin coatings and glycol gel is usually best for rougher, thicker coatings. Again, several measurements must be averaged to account for surface roughness. Periodic gauge calibration with standard shims, as described in ASTM D6132 is highly recommended.

18. Calculating Dry Film Thickness On Concrete Substrates From Wet Film Thickness Or Coating Spreading Rate (Coverage).

Purpose

These calculation methods are particularly useful for checking the dry film thickness of coatings applied over concrete. This is because measuring DFT on concrete is difficult due to its non-magnetic basis and the fact that surface roughness can vary so widely on concrete.

Frequency of Inspection

This should be checked once for every 100 sq. ft. of area to be coated by the Contractor or a Third Party inspector. The HRSD inspector should only have to spot check these quality checks.

Instruments and Referenced Standards

Calculation from Wet Film Thickness. Immediately after coating, use a notch gauge as described in ASTM D4414 to measure the wet film thickness of a coating. The dry film thickness can then be calculated by multiplying the wet film thickness by the percent solids by volume of the coating (in decimal form).

Calculation from Coating Spreading Rate (Coverage). Dry film thickness can also be calculated if the spreading rate and the percent solids by volume are known. This measurement technique is common when self-propelled equipment will be used to apply lines of traffic paint to pavements.

Dry film thickness (DFT) can be calculated from the following equations.

$$\text{DFT (mils)} = \frac{1604 \frac{\text{mil-ft}^2}{\text{gal}} \bullet P}{S} \quad \text{or} \quad \text{DFT (mils)} = \frac{1604 \bullet V \bullet P}{A}$$

Where:

P = percent volume solids written as a decimal
S = spreading rate in ft^2 per gal
V = volume of coating used in gallons
A = area covered in square feet

Example 1: For a coating containing 70% solids by volume applied at a spreading rate of 160 ft^2/gal, the theoretical DFT is computed to be 7 mils.

$$\frac{1604 \bullet 0.70}{160} = 7$$

Application of Coating to Steel Panel. Another method of measuring coating dry film thickness involves placing a steel plate on the concrete surface while it is being coated. After curing, the dry film thickness is measured from the steel plate with a conventional magnetic dry film thickness gauge as described in SSPC-PA-2.

19. Measuring Coating Adhesion Using Portable Adhesion Testers

Purpose

Measuring coating adhesion is the same for all substrates. Coating adhesion testing is particularly important for coating systems which will be exposed to immersion conditions, highly corrosive vapor or liquid splash or spillage conditions, or where new coatings are applied over older, aged coatings. This testing will not be required for all coatings work, but should be performed whenever the following standard HRSD coating systems are applied: E-5, E-5-C, E-6, FP-1, FP-2, PU-1, and VE-1. Good coating adhesion is critical to good coating performance. Therefore, adhesion testing should be performed when there is any concern about the quality of the surface preparation work for all standard HRSD coating systems or whenever critical coating systems like those listed above are to be installed.

Frequency of Inspection

Adhesion testing should be performed by the Contractor and/or Third Party inspector once for every 100 sq. ft. of surface area to be coated for metal or concrete substrates for critical coating systems and more often if poor, unacceptable results are obtained. Also, adhesion testing should be performed more frequently when questions about the quality of the surface preparation work have been identified. The Contractor should be required to perform adhesion testing when HRSD requires it or when concerns over adhesion are raised by the HRSD inspector. The HRSD inspector should be present when these tests are performed.

Instruments and Referenced Standards

Tape Tests. ASTM D3359 presents two methods for determining coating adhesion. Method "A" is for field use and Method "B" for laboratory use on coatings with a dry film thickness no greater than 5 mils (125 um).

To use Method A, cut an "X" completely through the coating to reach the metal or concrete surface and apply pressure-sensitive tape over the cut. After pulling the tape back sharply, assess the amount of coating it removes on a quantitative range from 0 (all lost) to 5 (none lost).

Method B is very similar only this time a matrix of lines is cut through the coating to reach the metal surface before the pressure-sensitive tape is applied and a quantitative measurement taken. In the lab, the sample is compared to standard drawings.

Portable Adhesion Testing Devices. Portable adhesion testers provide another method of deriving quantitative measurements of concrete or metal substrate coating adhesion in accordance with ASTM D4541. A loading fixture (dolly) is secured to the coating with an adhesive. After the adhesive is cured, force is gradually applied to the fixture until disbondment occurs. The coating may or may not have been carefully scored around the fixture in advance of the test. The breaking force and the type of failure found is noted as one or more of the following:

- Concrete (substrate) cohesive failure (for concrete substrates only).
- Coating cohesive or intercoat failure (within the coating system).
- Failure at coating/adhesive interface.
- Fixture adhesive failure (cohesive failure of the adhesive applied to the fixture or failure at the fixture adhesive/coating interface).
- Failure at the concrete/coating or steel/coating interface.

Many coating manufacturers require a minimum psi of 300-400 (2.1-2.8 MPa) for their coatings and at least 10% of the compressive strength, if failure occurs within the concrete.

Cutting and Picking. Cutting and picking a coating provides rough, subjective information about adhesion. Use a sharp knife to cut into the coating then attempt pick and pry it from the concrete surface. It is then possible to rate adhesion as good, poor, or questionable. While not very precise, this method can be useful.

20. Discontinuity Or Holiday Testing Of Coatings

Purpose

Under immersion conditions or corrosive vapor or splash/spillage or wetting/drying conditions, the film quality of coatings over metal or concrete substrates is very important. Missed areas (holidays) or pinholes through the coatings are pathways for premature coating failure and substrates attack or degradation. Therefore, under critical coating conditions, the testing of coating systems for discontinuities is very important. This applies to standard HRSD coating systems E-5, E-5-C, E-6, FP-1, FP-2, PU-1, and VE-1, but can also apply to several of the other standard systems where corrosive or immersion conditions are involved.

Holiday or Discontinuity Testing should remain the Contractor's responsibility on HRSD projects.

Frequency of Inspection

The frequency of discontinuity testing should be 100% of all coated surface area. This should be performed by the Contractor and/or by the Third Party inspector and at least representative portions of this testing should be witnessed by the HRSD Inspector. If frequent discontinuities are identified, the HRSD inspector should observe more of the testing and the retesting once the discontinuities have been repaired by the Contractor.

Instruments and References Standards

Holiday or discontinuity detection is generally conducted after the intermediate or final coat has been applied and has sufficiently cured. When detected, the holidays should be marked for repair by the Contractor. If holidays are detected in an intermediate coat, they must be repaired prior to final or finish coat application. Holiday detection on ferrous-metal surfaces can only be performed on non-conductive coatings.

Holiday detection equipment falls into two categories: one is low voltage (wet sponge) and the other is high voltage (spark) testers. The low voltage equipment is used on coatings that are 20 mils (.5mm) thick or less DFT. The high voltage equipment is used on coatings that are thicker than 20 mils. ASTM D5162 describes the requirements for holiday detection on metallic substrates. Holiday detection on concrete substrates is covered under ASTM D4787. The detectors

used for concrete also follow the rules for low voltage and high voltage as defined above for metallic substrates. The detectors have an electrical energy source, an exploring electrode, a ground to the concrete, and a ground wire. The exploring electrode is passed slowly over the coated surface to detect holidays. Sometimes a conductive primer or underlayment filled with graphite or metal particles is directly applied to concrete before the non-conductive coating to assist with the detection of holidays on concrete substrates.

Low-Voltage Holiday Detectors. Low-voltage (5-90v) holiday detectors are used on coatings with 20 mils (500 mm) or less dry film thickness. The detector is powered by a battery and uses a wet open-cell sponge as the exploring electrode. An alarm sounds when a holiday allows an electrical circuit to be completed through the coating.

High-Voltage Holiday Detectors. There are two types of high-voltage holiday detectors-the pulsating DC with a voltage range of 1,000-40,000 and the continuous DC with a voltage range of 1,000-15,000. In both cases, the detector is a visual or audible indicator, or both. Use the voltage setting that the coating supplier recommends or determine it through the methods described in ASTM D4787. Too great a voltage can damage the coating.

21. Testing For Cure Of Coatings

Purpose

If coatings do not properly cure, they cannot develop the physical and chemical properties necessary for their intended resistance to chemical physical or thermal exposure conditions. Therefore, proper cure of coatings must be ensured. While this is largely accomplished by ensuring that the proper ambient and substrate conditions are provided during coating application and cure times, there are times when the proper cure should be further checked. This is especially true if the HRSD inspector believes the right conditions for proper cure were not maintained by the Contractor.

Frequency of Inspection

The frequency of checks for proper cure should be largely left up to the Third Party or HRSD inspector's discretion based on conditions and the extent of coating work considered suspect. But as a general rule when you suspect improper cure, test once for every 25 to 50 square feet of coated surface area.

Instruments and Referenced Standards

The simple tests described below are useful in establishing whether a coating has fully cured.

Solvent-Rub Test. The MEK-rub test (ASTM D4752) was developed to determine the cure of ethyl silicate (inorganic) zinc-rich coatings on steel surfaces. It can be modified for use in determining whether other thermosetting coatings have fully cured on any substrate. Rub a piece of cotton cheese-cloth soaked in MEK or any other appropriate solvent back and forth several times on the coated substrate. Fully cured epoxies, polyurethanes, and other two-component thermosetting coatings will not dissolve onto the cheese-cloth. Softening of such a coating indicates that the cure is incomplete. This test cannot be used on thermoplastic coatings, since they are, by definition, soluble in strong solvents.

Hardness Test. Hardness pencils (ASTM D3363) can be used to determine if a thin-film coating is fully cured. For thicker films, the durometer (ASTM D2240) or Barcol impressor tests (ASTM D2583), both of which use indentation instruments, are very appropriate to use.

Sanding Test. The sanding test is suitable only for those coatings that cure to a hard finish. When these coatings are sanded, they form a dust when fully cured. If uncured, they "gum-up" the sandpaper.

10.6 Documentation System for In-House Inspection

The documentation system for the In-House HRSD Inspection includes two types of documents. One is for actual detailed Quality Control Inspection documentation. This is the Daily HRSD Coating Work Inspection Report included under subsection 10-6 of the Coatings Manual. The other is the Quality Assurance type checklist to be used when HRSD personnel are auditing the Contractor's Q.C. Inspection Work. This is called the In-House Inspection Checklist for Coatings Projects. It is included in this Pocket Manual and in subsection 10-6 of the Coatings Manual. The use of the Daily Coating Work Inspection Report or the Checklist will be determined based on your discretion as to the level of inspection effort required for the project. Refer to Subsection 9.5 C. of this Coatings Manual for guidance on the level of inspection effort required.

HRSD IN-HOUSE INSPECTiON
DAILY COATINGS WORK INSPECTION REPORT
(to be filled out electronically)

Sheet of
Date:

PROJECT INFORMATION

Project: _____

Contractor: _____

Project Location: _____

Inspector's Name: _____

DAILY MANPOWER INFORMATION

Foreman: _____

Number of Workers: _____

Hour Started: _____

Hour Finished: _____

Comments: _____

DAILY WORK PROGRESS INFORMATION

Work Description: (Work Completed, Location, and Referenced Drawing Numbers)

_____

HRSD IN-HOUSE INSPECTION
DAILY COATINGS WORK INSPECTION REPORT
(to be filled out by hand)
Sheet _____ of _____

_____
Date

PROJECT INFORMATION

Project: _____

Contractor: _____

Project Location: _____

Inspector's Name: _____

DAILY MANPOWER INFORMATION

Foreman: _____

Number of Workers: _____

Hour Started: _____

Hour Finished: _____

Comments: _____

_____

_____

_____

DAILY WORK PROGRESS INFORMATION

Work Description: (Work Completed, Location, and Referenced Drawing Numbers)

_____

_____

_____

_____

_____

_____

HRSD IN-HOUSE INSPECTION
ENVIRONMENTAL CONDITIONS RECORD
(to be filled out electronically)

Sheet _____ of _____

Date: _____

	Location 1	Location 2
Description of Area		
Ambient Temperature (F^O)		
Surface Temperature (F^O)		
% Relative Humidity		
Dew Point(F^O)		
Weather Description		
Acceptable to Proceed with Work		

	Location 3	Location 4
Description of Area		
Ambient Temperature (F^O)		
Surface Temperature (F^O)		
% Relative Humidity		
Dew Point(F^O)		
Weather Description		
Acceptable to Proceed with Work		

HRSD IN-HOUSE INSPECTIONS
ENVIRONMENTAL CONDITIONS RECORD
(to be filled out by hand)

Sheet _____ of _____

Date:_____

	Location 1	Location 2
Description of Area		
Ambient Temperature (F^O)		
Surface Temperature (F^O)		
% Relative Humidity		
Dew Point(F^O)		
Weather Description		
Acceptable to Proceed with Work		

	Location 3	Location 4
Description of Area		
Ambient Temperature (F^O)		
Surface Temperature (F^O)		
% Relative Humidity		
Dew Point(F^O)		
Weather Description		
Acceptable to Proceed with Work		

HRSD IN-HOUSE INSPECTION
SURFACE PREPARATION RECORD
(to be filled in electronically)

Sheet _____ of _____
Date:_____

	Location 1	Location 2
Description of Area		
Time Inspected		
Required Surface Preparation		
Degree of Cleanliness		
Surface Profile		
Achieved Surface Preparation		
Degree of Cleanliness		
Surface Profile		
Surface Preparation Approved	☐ **Yes** ☐ **No***	☐ **Yes** ☐ **No***

	Location 1	Location 2
Description of Area		
Time Inspected		
Required Surface Preparation		
Degree of Cleanliness		
Surface Profile		
Achieved Surface Preparation		
Degree of Cleanliness		
Surface Profile		
Surface Preparation Approved	☐ **Yes** ☐ **No***	☐ **Yes** ☐ **No***

***Areas Requiring Rework (where, what type rework, etc):**
Surface Preparation Instruments and Standards Used:

HRSD IN-HOUSE INSPECTION
SURFACE PREPARATION RECORD
(to be filled in by hand)
Sheet _ of _____
Date: _____

	Location 1	Location 2
Description of Area		
Time Inspected		
Required Surface Preparation		
Degree of Cleanliness		
Surface Profile		
Achieved Surface Preparation		
Degree of Cleaniness		
Surface Profile		
Surface Preparation Approved	☐ **Yes** ☐ **No***	☐ **Yes** ☐ **No**

	Location 1	Location 2
Description of Area		
Time Inspected		
Required Surface Preparation		
Degree of Cleanliness		
Surface Profile		
Achieved Surface Preparation		
Degree of Cleanliness		
Surface Profile		
Surface Preparation Approved	☐ **Yes** ☐ **No***	☐ **Yes** ☐ **No***

***Areas Requiring Rework (where, what type rework, etc):** _____

_____

_____

_____

Surface Preparation Instruments and Standards Used: _____

_____

_____

_____

_____

HRSD IN-HOUSE INSPECTION
SURFACE pH TEST RESULTS
(to be filled in electronically)

Sheet _____ of _____

Date:________

LOCATION		
TIME INSPECTED		
pH REQUIREMENTS		
MEASURED pH		

LOCATION		
TIME INSPECTED		
pH REQUIREMENTS		
MEASURED pH		

LOCATION		
TIME INSPECTED		
pH REQUIREMENTS		
MEASURED pH		

LOCATION		
TIME INSPECTED		
pH REQUIREMENTS		
MEASURED pH		

LOCATION		
TIME INSPECTED		
pH REQUIREMENTS		
MEASURED pH		

HRSD IN-HOUSE INSPECTION
SURFACE pH TEST RESULTS
(to be filled in by hand)
Sheet ________of __________

Date:___________________________

LOCATION		
TIME INSPECTED		
pH REQUIREMENTS		
MEASURED pH		

LOCATION		
TIME INSPECTED		
pH REQUIREMENTS		
MEASURED pH		

LOCATION		
TIME INSPECTED		
pH REQUIREMENTS		
MEASURED pH		

LOCATION		
TIME INSPECTED		
pH REQUIREMENTS		
MEASURED pH		

LOCATION		
TIME INSPECTED		
pH REQUIREMENTS		
MEASURED pH		

HRSD IN-HOUSE INSPECTION
COATING APPLICATION RECORD
(to be filled out electronically)

Sheet of
Date:

Location/Area Coated:

Application Start _____	Coating Temperature _____
Application End _____	Coverage Rate _____
Product _____	% Solids by volume _____
Batch Nos. _____	Wet Film Thickness Required _____
Quantity Mixes _____	Wet Film Thickness Achieved _____
Type/ % Thinner _____	Work Accepted _____
Viscosity _____	Work Rejected (if so, list why below) _____

Rejected work: _____

HRSD IN-HOUSE INSPECTION
COATING APPLICATION RECORD
(to be filled out by hand)

Sheet _____ of _____
Date:_____

Location/Area Coated: _____

Application Start _____	Coating Temperature _____
Application End _____	Coverage Rate _____
Product _____	% Solids by volume _____
Batch Nos. _____	Wet Film Thickness Required _____
Quantity Mixes _____	Wet Film Thickness Achieved _____
Type/ % Thinner _____	Work Accepted _____
Viscosity _____	Work Rejected (if so, list why below) _____

Rejected work: _____

_____

_____

_____

_____

_____

_____

_____

_____

HRSD IN-HOUSE INSPECTION
COATING CURING RECORD
(to be filled electronically)

Sheet of

Date:

PRODUCT	LOCATION/AREA COATED	CURE TIME PRIOR TO RECOATING ____HRS.@____ ^{o}F	ACCEPTABLE FOR RECOAT (IF NOT, LIST WHY BELOW)
		hrs @	☐ Yes ☐ No
		hrs @	☐ Yes ☐ No
		hrs @	☐ Yes ☐ No
		hrs @	☐ Yes ☐ No
		hrs @	☐ Yes ☐ No
		hrs @	☐ Yes ☐ No
		hrs @	☐ Yes ☐ No
		hrs @	☐ Yes ☐ No
		hrs @	☐ Yes ☐ No
		hrs @	☐ Yes ☐ No

Location/Area	Reason for Non-Acceptance

HRSD IN-HOUSE INSPECTION
COATING CURING RECORD
(to be filled in by hand)

Sheet _____ of _____

Date: _____

PRODUCT	LOCATION/AREA COATED	CURE TIME PRIOR TO RECOATING ____HRS.@____ ^{o}F	ACCEPTABLE FOR RECOAT (IF NOT, LIST WHY BELOW)
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

Location/Area	Reason for Non-Acceptance

HRSD IN-HOUSE INSPECTION
POST - CURE INSPECTION RECORD
(to be filled electronically)
Sheet of

Date:

DRY FILM THICKNESS

LOCATION/AREA COATED	REQUIRED DRY FILM THICKNESS (MILS)	ACHIEVED DRY FILM THICKNESS (MILS)	ACCEPTABLE (IF NOT, LIST WHY BELOW)
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

Location/Area	Reason for Non-Acceptance

PINHOLE TESTING

LOCATION/AREA	# OF ALLOWABLE DISCONTINUITIES PER GIVEN AREA	# OF DISCONTINUITIES PER GIVEN AREA)	NON-ACCEPTABLE

Comments: (list any/all film quality related problems and extent/location of affected areas)

HRSD IN-HOUSE INSPECTION
POST - CURE INSPECTION RECORD
(to be filled electronically)
Sheet of

Date:

DRY FILM THICKNESS

LOCATION/AREA COATED	REQUIRED DRY FILM THICKNESS (MILS)	ACHIEVED DRY FILM THICKNESS (MILS)	ACCEPTABLE (IF NOT, LIST WHY BELOW)
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

Location/Area	Reason for Non-Acceptance

PINHOLE TESTING

LOCATION/AREA	# OF ALLOWABLE DISCONTINUITIES PER GIVEN AREA	# OF DISCONTINUITIES PER GIVEN AREA)	NON-ACCEPTABLE

Comments: (list any/all film quality related problems and extent/location of affected areas)

HRSD IN-HOUSE INSPECTION
POST - CURE INSPECTION RECORD
(to be filled in by hand)
Sheet _____ of _____

Date:_____

DRY FILM THICKNESS

LOCATION/AREA COATED	REQUIRED DRY FILM THICKNESS (MILS)	ACHIEVED DRY FILM THICKNESS (MILS)	ACCEPTABLE (IF NOT, LIST WHY BELOW)
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

Location/Area	Reason for Non-Acceptance

PINHOLE TESTING

LOCATION/AREA	# OF ALLOWABLE DISCONTINUITIES PER GIVEN AREA	# OF DISCONTINUITIES PER GIVEN AREA)	NON-ACCEPTABLE

Comments: (list any/all film quality related problems and extent/location of affected areas)

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HRSD IN-HOUSE INSPECTION
DAILY COATING INSPECTION REPORT (fill out by electronically)

PHOTOGRAPH RECORD

PROJECT/CLIENT:	Date:	Page of
LOCATION:	Project #:	Copy to:
CAMERA TIME/DATE VERIFIED: ☐ YES ☐ NO ☐ N/A	Inspector:	☐ QC Manager ☐ Client ☐ Project Manager ☐ Other _____
PERMISSION REQ: ☐YES ☐NO	Inspection Company:	
FILM DEVELOPER:		
#: DATE:		
CAMERA: EXPOSURES: DISK#:		

#	LOCATION	AREA	COMMENT
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NUMBER ON FORM MUST MATCH WITH PICTURE

_____ Inspector's Name	_____ Inspector's Signature Date

HRSD IN-HOUSE INSPECTION
DAILY COATING INSPECTION REPORT (fill out by hand)

PHOTOGRAPH RECORD

PROJECT/CLIENT:	Date:	Page _____ of _____
LOCATION:	Project #:	Copy to:
CAMERA TIME/DATE VERIFIED: ☐ YES ☐ NO ☐ N/A	Inspector:	☐ QC Manager ☐ Client ☐ Project Manager ☐ Other _____
PERMISSION REQ: ☐YES ☐NO	Inspection Company:	
FILM DEVELOPER:		
# / DATE:		
CAMERA: / EXPOSURES: / DISK#:		

#	LOCATION	AREA	COMMENT
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NUMBER ON FORM MUST MATCH WITH PICTURE

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INSPECTOR'S SIGNATURE DATE

IN-HOUSE INSPECTION CHECKLIST FOR COATINGS PROJECTS
FOR HRSD INSPECTORS

1. Environment and Site Conditions Checks

    a. Will the environmental conditions be suitable for application and cure of the coating system(s)?

    b. Will the environmental conditions prevent flash rusting of steel surfaces?

    c. Will the site conditions be acceptable for the surface preparation methods, i.e. protection of other surfaces not to be prepared?

    d. Will the site conditions be acceptable for coating system application? Have surfaces not to be coated been protected?

    e. Can the work be safely accomplished under the actual site conditions?

2. Pre-Surface Preparation Checks

    a. Can the specified surface preparation methods remove the existing coatings and/or substrate contaminants?

    b. Does the substrate require repair or restoration before the coating system can be applied?

    c. Will the surface preparation methods remove the loose or degraded concrete, masonry, or corrosion products as required for coating system application?

    d. Is the substrate contaminated with oil, grease or soluble salts?

3. Monitoring of Surface Preparation

    a. Has the degree of cleanliness been achieved?

    b. Has the Contractor inspected for degree of cleanliness and surface profile and recorded the findings as specified in Section 7?

    c. Has the surface profile specified been achieved?

    d. Has the surface pH been checked and has it met the specified results?

    e. Has the compressed air been checked for the absence of oil or moisture? Were the results acceptable?

4. Post Surface Preparation Checks

   a. Have the specified degree of cleanliness, surface profile, and surface pH measurement been achieved in the field?

   b. If there are unacceptable areas of surface preparation, have they been identified and corrected?

5. Monitoring of Coatings Application

   a. Has the wet film thickness been checked and does it meet the specified requirements? If the WFT is difficult to measure, has the proper coating coverage been achieved?

   b. Is the coating system film quality good or are there too many runs, sags, pinholes, holidays, etc.? Please be specific.

   c. Is the proper equipment being used for coating system application?

   d. Is the application equipment being used properly?

6. Post Application Checks

   a. Are there any defects in the applied coating system such a pinholes, holidays, excessive runs or sags, cracks, color variations, embedded dirt or other debris, or other problems? Be specific.

   b. Are there areas of excessive film thickness or inadequate film thickness in the coating work? Be specific by location.

7. Post Cure Checks

   a. Has an overall DFT survey been performed and what are the results? What was the DFT average and range of DFT readings? Is corrective action required to achieve the specified DFT ranges for the coating system?

   b. Was adhesion testing necessary? If yes, what were the results? Be specific by location.

   c. If adhesion test results were below acceptable limits, what corrective action will be taken?

   d. Has proper cure of the coating system been checked? If there were problems, what will be the corrective action? Be specific.

   e. Was holiday detection required for this coatings work? If so, what were the results? Be specific by location. If there were problems, what will be the corrective action plan?

8. Follow-up To Corrective Actions/Final Inspection

a. Have all defects identified by the inspection steps above been corrected or repaired properly?

b. If yes, have all corrected defects been reinspected and confirmed as meeting the specification requirements?

10.7 The Inspection "Tool Box"

All HRSD personnel responsible for coatings projects will receive coatings inspection training and will be equipped with the inspection tool box. Each tool box will include the following materials, references, instruments, and equipment:

- A copy (pocket size) of the Pocket Manual from Part 10.5 of this Coatings Manual.
- Surface thermometer.
- Sling or digital psychrometer.
- Digital thermometer.
- White blotter paper.
- SSPC-VIS-1, Visual Standards for Blast Cleaned Steel.
- A 5-in-1 tool.
- SSPC-VIS-2, Visual Standard for Evaluating the Degree of Rusting on Painted Steel Surfaces.
- SSPC-VIS-3, Visual Standard for Power or Hand Tool Cleaned Steel.
- SSPC-VIS-4, Visual Standard for Degrees of Cleaning for Steel Surfaces Prepared by Waterjetting.
- SSPC-VIS-5, Visual Standard for Steel Surfaces Prepared by Wet Abrasive Blast Cleaning.
- Replica Tape and Spring Micrometer for Surface Profile.
- Portable Adhesion Tester.
- Copy of ICRI 03722 plus Rubber Replicas of various levels of Concrete Surface Profiles (CSPs).
- pH indicating papers or pencils for measuring surface pH plus bottle of distilled H_2O.
- Clean white rags – for testing for surface cleanliness.
- Pressure sensitive tape.
- Ultraviolet Black Light – to detect oil and grease in concrete substrates.

- Surface contamination test kit for soluble salt testing of steel or other metal substrates.
- Copy of ASTM D4263 – Plastic Sheet Test and plastic and tape for conducting this concrete substrate moisture test.
- Wet Film Thickness Gauges for varied coating system thicknesses.
- A DFT Gauge, most likely a magnetic DFT gauge for ferrous metals and an eddy current type gauge for non-ferrous metals.
- A copy of ASTM D3359 for Adhesion Testing using tape plus the tape and a razor knife.
- Holiday Detection Equipment for high or low voltage pinhole or discontinuity testing. These instruments will likely be shared by more than one or two HRSD facilities.
- A Solvent Rub Kit for checking coating system cure.
- The Inspection of Coatings and Linings, a handbook from SSPC – Second Edition.
- Copies of various SSPC and NACE reference and standards documents.