



SSPC Guide for Planning Coatings Inspection

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SSPC Guide for Planning Coatings Inspection

Introduction

Inspection is a key component in job quality monitoring. Proper inspection and testing and recording tells the story of what happened at the job site: documenting when the work was done, where it was done on the structure, when it was in conformance with requirements, and when it was out of spec. Without good inspection data, all parties are hard-pressed to figure out what was done and the quality monitoring process collapses.

Like any vital process, good inspection doesn't just happen. It requires planning. You cannot show up at the job site and figure it out as you go. This does not mean that initial inspection plans cannot change as a result of unknown conditions at the job site or changes in contract requirements (change orders) but without a clear plan going in, there's little chance the inspection will accomplish its intended goal of telling the project story in the finest detail. A well-thought-out inspection and test plan greatly increases the likelihood that key inspections and tests are done and properly recorded.

This guide is intended to assist coating and lining inspection companies, contractor quality control personnel, and owners in developing a key tool to ensure that coating and lining inspection is the best it can be. This tool will provide the contractor with guidance on how to plan to do comprehensive QC which will provide a record of objective evidence that it has met contract requirements. It also helps the contractor to track progress of the job and to support payment of invoices for conforming work done. Good inspection reports give the facility owner confidence that quality assurance functions (e.g., procedural conformity surveillance; auditing) can be performed with the best available information. Complete inspection reports will support both the contractor and the owner in claims for extra payment, warranties both implied and express, and latent defects later.

Good inspection practice greatly reduces the risk of premature coating failure. When failure does occur, good inspection data will help identify the potential cause. Without such data, hundreds of hours of expensive forensic analysis and destructive testing may be required to identify the cause of the failure.

The primary examples used in this document focus on inspection of painted steel structures. However, a model that can be readily adapted to inspection of coatings applied to concrete substrates appears in the appendix. As with any model forms, it is important to view them only as examples. A complete analysis of the project job specification is required to develop a good inspection and test plan. Inspection report forms (IRs) must also be adapted to the job at hand.

Some Key Terms

Owner. Organization that owns the structure, administers the long-term coatings program, and prepares the specification for new and maintenance painting.

Quality assurance inspector. The inspector working on behalf of the owner to ensure contractor conformity to specification requirements.

Quality control inspector. The inspector working on behalf of the contractor to ensure that the job is in conformance to the specification requirements and any deviations from conforming work are corrected.

Corrective action. Action to identify the root cause of a nonconformity, to eliminate the root cause, and to follow-up to ensure that the cause does not recur.

Non-conformity. Interim or final work that fails to fulfill contract requirements and requires rework or repair, or must be scrapped.

Latent defect. A flaw or imperfection discovered after delivery.

Warranty. Written guarantee of integrity of a product and the producer's responsibility for repair or replacement of deficient parts. In contract law, an **implied** warranty is a term for certain assurances that are presumed to be made in the sale of products, including fitness for a particular purpose. An **express warranty** is a standard guarantee from the seller of a product that specifies the extent to which the quality or performance of the product is assured and states the conditions under which the product can be returned, replaced, or repaired.

Responsibilities for Project Quality Management

Owner's Role and Responsibilities

Project Specification. The facility owner for whom the work is to be done is responsible for providing the coating or lining project specification. The specification may actually be prepared by the owner's engineering staff, a private consultant, or a coating manufacturer. The specification writer must design the work to be done and prepare a set of requirements that will help ensure that the final coating product meets all of the owner's needs. The specification writer should also be responsible for continuously reviewing requests for information concerning technical issues and all specification submittals. Prior to the start of work, the owner should hold a pre-construction conference with all parties to the contract to ensure that they review and understand all specification requirements. Any concerns about the specification should be expressed at that time.

Quality Assurance. If the owner has the resources to perform quality assurance using independent inspection, the owner should utilize qualified company or contracted third-party inspection personnel to verify for the contract administrator that the work-to-date conforms to specification requirements. This will permit the contract administrator to coordinate the necessary actions to keep the project continuously moving forward. Owners who do not have the resources to use qualified, independent inspection for quality assurance should instead use surveillance techniques (e.g., auditing for procedural conformity) as a viable alternative to independent inspection.

Contractor's Role and Responsibilities

The painting contractor is usually responsible for buying the specified coating/lining and

surface preparation materials, preparing the surface for coating, and mixing and applying the materials in accordance with the requirements of the specification. The contractor is also responsible for self-inspection (quality control), testing, and documentation, as required by the specification, to ensure that the coating or lining work-to-date meets specification requirements and that all specified procedures have been followed. The contractor's staff usually provides these services, but, sometimes, an independent, certified coating inspector is hired. For each non-conformity detected by the inspector, the contractor must invoke corrective action which includes:

- Determining the root cause and a plan to prevent recurrence of the non-conformity.
- Preparing and implementing a corrective action request (CAR) for tracking and documenting each step in the corrective action (CA) for the non-conformity.

Coating Inspector's Role and Responsibilities (Quality Assurance)

General Responsibilities. A certified coating QA inspector must verify that the result of the coating or lining work performed by the contractor that the inspector observes meets all of the project specification requirements, i.e., to provide project quality assurance. Additional information on coating inspectors' responsibilities and techniques to be used can be found in the SSPC publication *The Inspection of Coatings and Linings*.

Making Measurements and Observations. The inspector measures and observes to ensure conformance of the work-to-date to the project requirements. The project requirements dictate the tests and procedures to be followed, in addition to stating acceptance criteria such as required surface profile range or dry film thickness range.

Documentation of Findings. Inspection data are often recorded in the inspector's logbook as they are taken and then transferred onto inspection forms. The documentation must include all inspection findings, especially non-conformities, in a clear, concise, and timely manner, so that findings are easily understood and not confusing, lost, or forgotten. If a problem arises, this information can be a key component to its resolution, especially in avoiding litigation. Copies of the documentation are periodically forwarded to responsible contractor and owner quality assurance personnel. The owner personnel review these documents to gain assurance that both the original work and any corrective actions are in conformance with specification requirements. Thus, the inspector serves both the owner and the contractor project quality management systems.

Inspection Planning for Specific Coating Projects

The Need for an Inspection Plan

Inspectors require detailed planning to conduct their work both thoroughly and efficiently. This is best accomplished by preparing and implementing a systematic

inspection and test plan with a format that covers all phases of the work in sequence. The inspection plan must match the contractor's work plan and schedule, so that the inspector is prepared to monitor each phase of the contractor's work.

Developing an Inspection and Test Plan

Scope of Inspection Plan. Prior to the start of project work, the contractor prepares, for the owner's approval, a work plan that covers all phases of the work and completely and accurately describes all of the individual processes that make up each work phase. This plan converts the project specification requirements into a practical document for field use. The inspector must prepare an inspection plan to supplement the contractor's work plan.

Plan Schedule. The inspection plan should include a project schedule for all phases of the work to match the schedule of the contractor's work plan, so that the inspector is ready in advance without causing any delays in work production. The inspection plan systematically lists the inspection hold points, test methods, and acceptance criteria for each procedure in each phase of the project work.

Plan Format. There is no standard format for an inspection plan, since plans may vary significantly with different types of work to be done. A chart containing the following three columns is usually adequate for most projects:

- **Inspection Check or Hold Points.** Identification of inspection check points for each phase of work (e.g., surface preparation, coating application, curing).
- **Inspection Method.** Industry standards, instrumentation, and/or specific test methods or procedures required by specification.
- **Acceptance Criteria.** Project specification requirements that must be met.

Review and Approval of Inspection and Test Plan. Coating projects often require project-specific inspection plans to be submitted to the owner for review and acceptance before the start of a project. If the contract does not require submission of an inspection and test plan, the inspector should still prepare one. An organized inspection plan, even for the smallest job, will help to assure a more efficient and comprehensive inspection with limited delays or items overlooked.

Process Control Procedures (PCPs)

Process control procedures are project-specific documents prepared by the contractor and approved by the owner (if a contract requirement) before work begins. They may be used in place of or to supplement the contractor's work plan. They typically contain:

- Contract data and the project specification
- Process descriptions and required equipment
- Inspection and test plan
- Actions/authorization for addressing non-conformities

- Requirements for worker safety, environmental control, and waste management

The inspector must be familiar with these procedures and utilize the relevant information in them to work efficiently.

Items Required for Inspection Plan Implementation

Required Documents

The inspector should become familiar with the surface preparation and coating or lining application requirements, inspection and test methods required, and the characteristics of the material being applied. Before the start of project work, the inspector should assemble and completely understand these documents:

- The project specification (including all amendments and pertinent appendices)
- Standards referenced in project specification (SSPC, NACE, ASTM, etc.)
- Manufacturer's product data sheets for each material used at the job site (e.g., coatings, thinner, abrasives, repair materials)
- Other appropriate coating or lining procedures from the manufacturer
- Test methods and inspection equipment required by the specification
- Material Safety Data Sheets (MSDSs) for each product
- Applicable building codes

The project specification lists all published test methods or procedures to be used. While it may permit the inspector to choose between different options, in all cases, it does list the test requirements. The standard test methods and procedures are usually consensus documents of the American Society for Testing and Materials (ASTM), SSPC: The Society for Protective Coatings, or other technical societies.

Equipment Required for Inspection

The required test methods describe the necessary instruments and procedures for performing these tests. Depending upon the materials being applied and type of structure or equipment to be coated, the specification requirements and the instrument requirements may vary from one coating project to another. The most frequently used coating inspection equipment and instruments are:

- Telescoping Mirror (Multiple sizes)
- Pictorial surface preparation standards (e.g, SSPC-VIS 1, 3, 4, or 5)
- Replica tape and spring micrometer
- Surface profile comparator
- Psychrometer with psychrometric charts or tables
- Air and surface thermometers

- Hypodermic needle gage for determining air/abrasive pressure at the nozzle
- Equipment for soluble salt extraction and analysis
- Film thickness gages calibrated by the manufacturer and shims or standard plates for verifying gage accuracy
- P.I.G. gage
- Flashlight and mirror
- Light meter
- Holiday detector

These instruments should be kept clean and operational with instrument serial numbers and dates of last factory calibration noted as required. For example, serial numbers and calibration verification of DFT gages should be noted in the daily inspection documentation. The inspector should also carry spare batteries, bulbs, thermometers, and other expendable items so that work is not delayed due to inspection equipment malfunctions.

Inspection Check or Hold Points

Definition

Inspection hold points are critical periods during the project when further work is stopped until the work-to-date has been inspected and the contractor authorized to proceed. Hold points will vary with the coating and lining material being applied and the type and nature of the work and will reflect the requirements of the specification. The hold points listed here should be considered as basic for most work; however, additional inspection points may be added or substituted, as needed for the particular project:

- Pre-surface preparation
- Post-surface preparation
- Coating conditions for application
- Coating application
- Post-application of coating
- Post-curing

Pre-Surface Preparation (Prior to start of work) Hold Point

The pre-surface preparation inspection hold point occurs after the substrate is prepared for cleaning. This hold point includes detecting grease, oil, or soluble salt deposits, metal imperfections (such as scabs, hackles/slivers, delaminations, and metal damage), inaccessible areas, and other problem areas. It indicates whether the substrate has been fully prepared for surface preparation. Dew point and surface temperature measurements should be taken immediately prior to allowing surface preparation to proceed, to help assure that moisture will not condense on prepared surfaces.

Post-Surface Preparation Hold Point

This inspection hold point follows surface preparation. It verifies that the degree of cleanliness and surface profile meet the requirements of the project specification. Depending on the steel, more in-depth inspection may be necessary to identify metal imperfections that become visible after blast cleaning, such as “hackles and slivers.” These imperfections can require scraping and/or grinding with re-blast cleaning.

Surface Condition for Coating Hold Point

This inspection hold point occurs immediately prior to the coating or lining application and establishes whether the previously approved surfaces have become re-contaminated with such things as embedded abrasive, dust and dirt, oil, flash rusting, sweat marks, inspection markings, salt, etc. The inspector should also verify that prevailing ambient conditions and surface temperature are acceptable before the coating is mixed by the production crew and are likely to remain acceptable during the work shift.

Coating Application Hold Point

During coating application, ambient conditions and wet film thickness readings should be monitored to be consistent with project specification requirements. The application should also be checked to determine if the contractor’s PCP is being followed and if there are any defects in the wet film.

Post-Coating Application Hold Point

The post-coating application inspection hold point follows the application of each coat. It is required to check that the film thickness is within the specified range and to determine if each individual coat is ready to receive the next coat, i.e., is within the manufacturer’s stated recoat window and is free of intercoat contamination. Such observed imperfections as overspray, pinholes, lack of adhesion, insufficient film thickness, etc., should be corrected at this point.

Post-Curing Hold Point

The post-curing hold point will verify that the final dry film thickness requirement of the coating system has been met. It will also include a visual inspection of the coating or lining for surface defects. When the coating is used as a tank lining or other critical service, a pinhole/holiday check is usually required to detect any surface imperfections requiring repair. Several tests are available for determining if the coating system has completely cured.

Final Inspection Hold Point

A final inspection will verify that all touch-ups or other corrective actions satisfactorily meet project specification requirements.

Example of Coating Inspection Plan

General Description

The following example of an inspection plan covers all phases involved in the application of an amine-cured epoxy system which may be used as a protective coating or as a lining on steel. The information provided serves only as a guide for the inspector in writing an inspection plan for a particular project. It lists the chronological sequence of inspection activities to be followed during the total inspection of the coating or lining operation. It begins with the requirements of the inspector prior to the start of the actual project production and continues through surface preparation, coating application, and curing. The plan includes the inspection hold points required by the specification, the test method or procedure to be followed, and the specification acceptance criteria.

Phase Inspection

When performing the required inspection activities, each phase of the work is inspected and approved before proceeding with the next phase. In this way, corrective action requests for any non-conformities revealed by the inspection are issued so the work can be corrected to conform to the project specification, re-inspected, or scrapped before proceeding with the next phase and plans developed and actions taken to avoid recurrence as the work progresses.

Pre-Surface Preparation Inspection Plan and Supplemental Notes

COATINGS INSPECTION PLAN

Coating Material: AMINE-CURED EPOXY COATING
Substrate: CARBON STEEL

INSPECTION HOLD POINT	INSPECTION METHOD	ACCEPTANCE CRITERIA
Surface Preparation and Application of Amine- Cured Epoxy		
A. PRIOR TO THE START OF WORK		
1. Coatings Materials		

a. Age and Identification	Visually inspecting can labels.	As specified by the project specification , e.g., not more than one year since manufacture; manufacturer's name, code number, and batch number.
b. Condition in Container	1. Visually inspecting and stirring can contents. 2. Checking viscosity by dipping cup (ASTM D4212), if required.	1. Absence of skins, settling, lumps, and foreign matter. 2. Viscosity in range acceptable to manufacturer.
c. Storage Conditions	Visually inspecting storage area.	Covered area protected from damage, moisture, direct sunlight and with temperatures in specified range, e.g., between 40 and 100°F.
2. Abrasive Materials	SSPC-AB 1, 2, 3; vial test of ASTM D4940.	Clean, dry, oil-free abrasives meeting the requirements of SSPC-AB 1, 2, or 3 and ASTM D4940.
3. Touch-Up Materials	1. Visually inspecting and stirring can contents. 2. Checking viscosity by dipping cup (ASTM D4212), if required.	1. Those permitted by the project specification in good condition. 2. viscosity in range acceptable to manufacturer.
4. Thinners, Solvents, and Cleaners	Visually inspecting materials and can labels.	As permitted by the specification with product numbers legible on containers.

The first hold point addresses the materials to be used in the project. This includes the coating or lining materials themselves, any touch-up or repair materials, thinners, and the abrasives/cleaners to be used to prepare the surface. The inspector must verify that the correct materials are on-site and are in good condition.

Material mix-ups do not occur often in field work, but are more likely to occur in shop work, where a shop warehouse may store many different coating or lining materials. The shelf life of a coating or lining material is defined as the length of time from its manufacture until its time of use. The inspector must verify that the material is within its shelf life and will remain current during the course of the application. This is not usually a problem on small jobs, but on a job that extends over a long period of time, the material may exceed its shelf life prior to completion of the work.

Coating and lining materials must be properly labeled. Containers with missing or illegible labels should be set aside and disposed of properly. All coating and lining materials should have legible batch numbers printed on the label. These batch numbers

are extremely important in identifying a material in the event that a problem arises. The batch number is usually a several-digit number, occasionally consisting of both letters and numbers. The inspector should record all batch numbers in the reports, before the containers are opened.

Dented containers do not have to be rejected unless the dents are so severe that the containers have leaked or the contents have been exposed to the atmosphere. If leakage or exposure has occurred, the material must be rejected. Such materials must be segregated and removed from the area containing good materials.

The storage temperature range of most coating and lining materials is usually specified either in the specification or on the manufacturer's product data sheet. Touch-up or repair materials are not always identical to the coating or lining materials initially applied.

The inspector should check the abrasive to be used for surface preparation, when abrasive blast cleaning is specified. The specification may require that the abrasive conform to one or more of the requirements of SSPC-AB 1, 2, or 3. In all cases, the abrasive should be inspected for labeled name and size range and freedom from moisture, oil, and other visible contaminants. Note that the SSPC surface cleanliness standards for dry abrasive blast cleaning invoke the abrasive cleanliness requirements of SSPC AB1, AB2, and AB3.

COATINGS INSPECTION PLAN (CONTINUED)			
Coating Material:	AMINE-CURED EPOXY COATING		
Substrate:	CARBON STEEL		
INSPECTION HOLD POINT	INSPECTION METHOD	ACCEPTANCE CRITERIA	
A. PRIOR TO THE START OF WORK (continued)			
5. Equipment Readiness			
a. Environmental Control	Air and surface temperature, dew point, and RH (ASTM E337) must be taken at start of work and every four hours or at intervals listed in the specification.	As listed in specification. Typically, surface temperature at least 5°F above dew point and 50-100°F during application and curing.	
	Visual inspection for functioning ventilation/dehumidification equipment.	Blowers, filters, dehumidifiers to meet specification requirements. RH	

		typically no more than 80% .
b. Abrasive Blast Cleaning Equipment	1. Safe, properly sized equipment. 2. ASTM D4285 for clean air. 3. Hypodermic needle gage test for air pressure at nozzle.	1. Manufacturer's recommended equipment. 2. Clean blotter. 3. Manufacturer's recommended pressure, e.g., 90 to 100 psig.
c. Spray Equipment	Visual inspection.	Mfg. recommended size; airless guards

The next table is a check of the equipment the applicator and/or inspector will need to accomplish their work. The environmental control equipment should be capable of maintaining the specified relative humidity, temperature, and dew point. The abrasive blast cleaning and spray application equipment should be those required by the specification or recommended by the manufacturer. One very frequent cause of poor coating or lining application is the use of incorrect or worn spray equipment. The blotter test and hypodermic needle gage test (listed in the table above) are used to ensure a clean compressed air supply and operation under optimum conditions.

COATINGS INSPECTION PLAN (CONTINUED)		
Coating Material:	AMINE-CURED EPOXY COATING	
Substrate:	CARBON STEEL	
INSPECTION HOLD POINT	INSPECTION METHOD	ACCEPTANCE CRITERIA
A. PRIOR TO THE START OF WORK (continued)		
5. Equipment (continued)		
d. Inspection instruments required		
Psychrometers and psychrometric tables	ASTM E337 and manufacturer's instructions.	Typically, surface temperature at least 5°F above dew point and RH not over 80%.
Contact, remote, or recording thermometers	Following manufacturer's instructions.	As required by the specification, typically 50-100°F during application and curing.
Standards for abrasive	Required SSPC-SP	Good comparison to

blast cleaning.	standard and SSPC-VIS 1.	specification description and pictorial standard.
Profile measurement equipment: 1. Replica tape and micrometer. 2. Metal comparator disc and lens, or profile depth gage.	ASTM D4417, Method C, A, or B (in preferred order)	Measurements in range permitted by specification.
Wet and dry film thickness gages	1. ASTM D4414 [WFT]. 2. SSPC-PA 2 [DFT].	1. Used only as an aid in obtaining acceptable dry film thickness. 2. DFT in range specified.
Low and high voltage holiday detector.	ASTM D5162	All holidays detected marked, repaired, re-inspected, and approved

The next part of the inspection plan covers the pre-inspection of the completed surface immediately prior to the start of abrasive blast cleaning.

Surface Preparation Inspection Plan and Supplemental Notes

COATINGS INSPECTION PLAN (CONTINUED)		
Coating Material: AMINE-CURED COATING Substrate: CARBON STEEL		
INSPECTION HOLD POINT	INSPECTION METHOD	ACCEPTANCE CRITERIA
B. SURFACE PREPARATION		
1. Cleaning to remove grease or oil.	1. Ultraviolet light or water break test described in SSPC Inspection Manual.	1. No contamination visually detected or complete flow-out of water.
2. Blast Cleaning		
a. Blast Cleanliness: 1. General cleanliness. 2. Soluble salt surface concentration.	1. Visual inspection using SSPC-VIS 1. 2. Extraction and analysis systems required by specification and described in SSPC-Guide 15 and SSPC Inspection Manual.	1. Good comparison to visual standard and to SSPC-SP specification description. 2. Surface salt concentrations at or below allowable level.

b. Surface Profile	ASTM D 4417, Method C, A, or B (in preferred order).	Surface profile required (e.g., 1.0 to 3.0 mils) by specification.
c. Abrasive Cleanliness	ASTM D4940 (vial test); SSPC AB 1, 2, or 3.	No floating oil sheen, color, or suspended material visually detected.
d. Blast Cleaning Operations	Visual observations	Conformance to PCP

Surface preparation includes the removal of visible grease or oil deposits, in accordance with the requirements of SSPC-SP 1, prior to the start of abrasive blast cleaning. The blast cleaned surface must conform to the specified degree of cleanliness in the SSPC standard required by the specification and must have the specified surface profile. Also, the soluble salt concentration on the surface must not exceed the specified limit (when soluble levels are specified).

COATINGS INSPECTION PLAN (CONTINUED)		
Coating Material:	AMINE-CURED EPOXY COATING	
Substrate:	CARBON STEEL	
INSPECTION HOLD POINT	INSPECTION METHOD	ACCEPTANCE CRITERIA
B. SURFACE PREPARATION (continued)		
4. Removal of Dust and Blast Cleaning Products	ISO 8502.3 (tape test)	As required by specification.
5. Environmental Conditions		
a. Substrate Temperature	Thermometer; manufacturer's instructions.	Surface temperature at least 5°F above dew point and in range required by specification or manufacturer's product data sheet.

b. Dew Point	ASTME337. Temp. and dew point must be taken at start of work and every 4 hours or at time intervals required by specification.	Surface temperature at least 5°F above dew point.
6. Protection of Surfaces and Equipment	Visual Assessment	Visual observation. Surfaces and equipment not to be coated must be protected from abrasive blast cleaning and coating overspray.

The protection of surfaces and equipment not to be prepared or coated is important. All necessary masking or other protection should be in place and inspected prior to the start of any surface preparation.

The final step of surface preparation, prior to the application of the coating or lining, is to ensure that the surface is free of all dust or other contaminants. In addition, the inspector must verify that the surface is free of unacceptable embedment, sweat marks, and oil contamination from air tools and from the operating mechanisms of access equipment (spiders or sky climbers). The inspector should be alert for imperfections in the base material that may be revealed by the surface preparation, such as laminations (also called hackles or slivers).

Coating Application and Curing Inspection Plan and Supplemental Notes

COATINGS INSPECTION PLAN (CONTINUED)		
Coating Material:	AMINE-CURED COATING	
Substrate:	CARBON STEEL	
INSPECTION HOLD POINT	INSPECTION METHOD	ACCEPTANCE CRITERIA
C. COATING INSPECTION		
1. Mixing of coatings	Visual observations	Containers not to be opened except for inspection or immediate use.

	Visual observations	Mix in accordance with specification/manufacture's instructions. Mix each component separately prior to mixing combined materials. Mix only complete pre-measured units, i.e., full containers.
	Visual observations	Mix until smooth and free from lumps, typically with a slow speed stirrer. Strain through a suitably sized screen, if necessary.
2. Environmental Conditions	Temperature (and dew point, and RH) taken at start of work and every four hours.	Within range listed in specification/manufacture's product data sheet. Surface temperature at least 5°F higher than the dew point temperature.
	ASTM E337	Relative humidity as specified, typically no more than 80% during coating/curing

When the surface has been approved for the application of coating or lining, the materials to be used should be brought from storage to the work area in unopened containers. The containers should remain unopened until just prior to mixing. Under no circumstances should the applicator attempt to mix partial containers. Only complete, factory-measured units should be mixed.

Some applicators may attempt to proportion a small quantity of coating material for touch-up rather than use a full 5-gallon container to save material. Most coating or lining manufacturers supply materials in 1-gallon, or smaller, containers for this purpose, along with the appropriate amount of catalyst or hardener required. Components of two- or three-component materials should be mixed separately and in the proper order, in accordance with the manufacturer's instructions. Some materials require straining prior to mixing.

Induction time (sometimes called "sweat-in time") is the period after mixing multiple-component coatings that is allowed to elapse before application. The induction time simplifies coating application to vertical surfaces and ensures complete curing. If an induction time is required at the particular application temperature, this will be noted on the coating or lining manufacturer's product data sheet.

Temperatures of the individual components of a coating or lining should be within the range of the specification or manufacturer's product data sheet before mixing.

COATINGS INSPECTION PLAN (CONTINUED)		
Coating Material:	AMINE-CURED EPOXY COATING	
Substrate:	CARBON STEEL	
INSPECTION HOLD POINT	INSPECTION METHOD	ACCEPTANCE CRITERIA
C. COATING INSPECTION (continued)		
3. Application		
a. Number of coats	Visual inspection, preferably with adjacent coats of different colors	Visually conforming to specification.
b. Checking coated surfaces for cleanliness before topcoating	Coated before surface becomes contaminated by moisture, dirt, rust, oil or grease	Visually conforming to specification.
c. Complete curing	ASTM D3363 (pencil hardness); ASTM D2240 (durometer hardness); ASTM D5402 (solvent resistance).	Within minimum and maximum range of specification.
d. Force curing	Substrate temperature monitored manually or with a recording thermometer.	Time and temperature as specified.
e. Touch-up	Verified visibly and/or with a holiday detector.	As required by specification.

The specified number of coats, the timing of the applications, time and temperature of any force curing that may be required, and touch-up requirements are specified in the inspection plan.

Wet film thickness readings (usually done by the painter) are required as the coating or lining work proceeds so the painter can adjust technique and settings to achieve conforming coating thicknesses. However, it is still necessary to verify the required dry film thickness of each coat as soon as it has cured sufficiently for measuring. Coatings and linings applied too heavily are susceptible to incomplete curing, trapping of solvents, and later blistering, cracking, and/or peeling. Coatings and linings are applied in multiple coats to minimize the possibility of pinholes in different coats penetrating to the substrate. Contrasting colors for adjacent coats will help in the detection of skips or thin areas.

The curing time between coats is of utmost importance. If a coating or lining is applied too soon over the previous coat, solvents in the underlying coating may be trapped there, or the underlying coat may be lifted or otherwise adversely affected. In the case of most coatings, the succeeding coats must be applied before the underlying coats have cured to a stage at which inter-coat adhesion is significantly reduced.

When force-curing of a coating or lining is required, the final curing temperature must be carefully monitored and recorded. The temperature specified is usually the substrate temperature, and this can vary greatly from surface to surface, depending on the configuration of the object being cured and on the method and equipment being used to accelerate the cure. Remote thermometers are best used to measure temperatures of uncured coatings. Note that remote thermometers have an optimal measuring distance which must be observed by the operator.

Tank bottoms sitting on concrete slabs or on sand beds, tank saddle supports, and reinforced sections around openings or brackets are all notorious heat sinks. When force-curing a lining, the temperature is normally raised in measured increments (for example, a 40° F rise in temperature every 30 minutes) until the desired temperature is reached and then maintained there for the required period of time.

COATINGS INSPECTION PLAN (CONTINUED)		
Coating Material:	AMINE- CURED EPOXY COATING	
Substrate:	CARBON STEEL	
INSPECTION HOLD POINT	INSPECTION METHOD	ACCEPTANCE CRITERIA
C. COATING INSPECTION (continued)		
4. Applied Coatings		
a. Dry Film Thickness	Calibration, verification of accuracy, measurements, and frequencies as required by SSPC-PA 2.	As required in the project specification (e.g., primer: 3-5 mils).
b. Film	Visual estimation of extent of	Visually conforming to

Imperfections	sags, voids, drips, overspray, loss of adhesion, blistering, peeling, etc. Standard photographs may be helpful.	specification.
c. Film holidays	ASTM D5162 (low-voltage holiday detector)	All holidays detected marked, repaired, re-inspected, and approved.

The final part of the inspection plan covers the determination of the dry film thickness of the applied coating or lining system in accordance with the procedures in SSPC-PA 2. The inspector is often required to make an inspection of the coated surface for coating or lining imperfections, such as overspray, major runs or sags, drips, blistering, pinholes, any loss of adhesion, inadequate cure, etc. Any such imperfections must be corrected and approved as conforming to the project specification.

When the coating application is to be used as a tank lining or in other severe chemical service, a holiday test for pinholes or other film discontinuities is usually required. Any holidays, pinholes, or other imperfections revealed by this test must be marked with grease-free chalk or other suitable means and repaired and re-inspected for conformance to the specification.

The inspector should look for areas lacking easy access that are difficult to blast or coat, such as brackets, or behind pipes, inside channels, etc. A telescoping mirror can be useful in inspecting areas not readily visible. The coating of structural steel in a fabricator's yard may be straight forward, but the lining of a tank interior can be much more complicated. Inspectors should look for imperfections first in irregular areas and then continue with the inspection of the large, flat surfaces. They should never accept the premise that, "Since the coating on the walls of a tank looks good, the limited-access or difficult-to-coat areas are also good." Rust stains running down a tank wall after six months in service will be a testament to an incomplete inspection.

Tips For Minimizing Problems

Use of Pre-Construction Conference to Clarify Requirements and Authorizations for the Inspector and Other Personnel

All coating projects should start with a pre-construction conference that includes the owner, contractor, coating manufacturer, and inspection personnel. Items that should be discussed include:

- Procedures for clarification of any vague, inadequate, or conflicting specification requirements.
- RFIs and RFDs (requests for information or deviation from the specification).

- Identification of personnel conducting different phases of the project work and the extents of their authority.
- An inclusive list of “difficult-to-access” and “obstructed” surfaces, along with a “procedure” for dealing with each area or location. The procedure should include surface preparation, acceptance criteria, and coating system (e.g., non-blasted areas may not be suitable for zinc-rich primers).
- Responsibilities for supplying materials and equipment, including access and safety equipment.
- Work hazards associated with the project and safety controls to be utilized to avoid accidents and injuries.
- Procedures for resolving disagreements at the job.
- Procedures for issuing corrective action requests (CARs).
- Procedures for processing change orders and notifying the appropriate parties.

At this time, the inspector should make sure that the extent of inspection responsibilities is defined and precisely how to perform each task is completely understood.

Addressing Deviations from the Specification

Coating inspectors should document and report but not approve deviations from specification requirements without proper written authorization unless they are assigned additional responsibilities. They should not tell contractor personnel how to do their work or otherwise interfere with their work.

Assistance from the Manufacturer

If inspectors are not familiar with the products being used and desire more information than provided in the manufacturer’s product data sheets, they can request it from the manufacturer. However, the contractor is the party who should request field support from manufacturers in applying their products, if they consider it important.

Appendix: Sample Inspection Plan for Concrete Substrates

Equipment Required for Concrete Inspection

- Visual Profile Coupons for surface preparation (ICRI CSP 1-9)
- Profile Replica Putty and micrometer (TCP)
- Dew Meter/Psychrometer with psychrometric charts or tables, as necessary
- Air, surface, and paint thermometers
- Water drop test/black light
- pH test
- Acoustics test
- Impact hammer
- Calcium Chloride test/RH test

- Anemometer/Volometer
- Light meter
- WFT gages for concrete
- Ultrasonic Film Thickness (DFT) gages calibrated by the manufacturer and shims for verifying the accuracy
- Tooke or Paint Inspection Gage (PIG)
- Flashlight and pocket magnifier
- Holiday detector
- Adhesion test equipment
- ISO 8502-3 Dust Test
- Slip Meter
- Covermeter

Inspection of Pre-Surface Preparation

Note: Soundness of concrete is always checked before beginning any coatings job (ASTM D4541 and ACI 503R).

COATINGS INSPECTION PLAN		
Coating Material: _____ Substrate: <u>CONCRETE</u>		
INSPECTION HOLD POINT PRIOR TO THE START OF WORK	INSPECTION METHOD	ACCEPTANCE CRITERIA
1. Coatings Materials		
a. Age, identification, and condition of containers.	1. Visually inspect container labels. 2. Condition of container.	1. As specified by the project specification , e.g., not more that one year since manufacture; manufacturer's name, code number, and batch number; no missing labels, all in tact. 2. No dents or leaks.
b. Condition of paint in container.	1. Visually inspect and stir container contents. 2. Check viscosity.	1. Absence of skins, settling, lumps, and foreign matter. 2. Viscosity in range acceptable to manufacturer. 3. Coating temp. as specified.

c. Storage conditions for all materials.	1. Visually inspect storage area. 2. Check ambient conditions.	1. Covered area -- protected from damage, moisture, direct sunlight. 2. Temperatures in specified range, e.g., between 50 and 100°F.
2. Abrasive Materials		
a. Identification and Cleanliness.	1. Name and size of abrasive. 2. SSPC-AB 1, 2, or 3. 3. Verify doable field test of SSPC-AB 1, 2, or 3, i.e., oil, ASTM D4940.	1. As permitted by the specification. 2. Requirements of SSPC-AB 1, 2, or 3 are compliant per manufacturer's data. 3. Doable SSPC-AB 1, 2, or 3 field tests verify cleanliness, i.e., rust, oil, ASTM D4940.
3. Wash Water		
a. Cleanliness	1. Supply source. 2. Cleanliness.	1. Factory DI water as specified. 2. Conductivity as specified.
4. Crack Fill Materials		
a. Age, identification, and condition of containers.	1. Visually inspect container labels. 2. Condition of container.	1. As specified by the project specification , e.g., not more than one year since manufacture; manufacturer's name, code number, and batch number; no missing labels, all in tact. 2. No dents or leaks.
b. Condition of fill material in container.	1. Visually inspect contents.	Those permitted by the project specification in good condition.
5. Thinners, Solvents and Cleaners		
a. Age, identification, and condition of containers.	1. Visually inspect container labels. 2. Condition of container.	1. As specified by the project specification , e.g., not more than one year since manufacture; manufacturer's name, code number, and batch number, no missing labels, all in tact. 2. No dents or leaks.
6. Equipment and Test Equipment Readiness		

a. Condition of Environmental Equipment.	1. Visual inspection for functioning ventilation or dehumidification equipment. Test A/C-Heater. 2. Temperature, dew point, and RH (ASTME337) must be taken at start of work and every four hours, or at intervals listed in the specification.	1. Blowers, filters, dehumidifiers to meet specification requirements. RH typically no more than 80%. A/C-Heater as listed in specification and in working order. 2. Typically, temperature at least 5°F above dew point and 50-100°F during application and curing.
b. Condition of Blasting/Washing Equipment.	1. Safe, whip check, properly sized equipment. 2. ASTM D4285 for clean air or ASTM D4940. 3. Wedge-shaped orifice gage test for nozzle size. 4. Hypodermic needle gage test for air pressure at nozzle.	1. Manufacturer's recommended equipment. 2. Clean blotter or meets conductivity requirement. 3. Maximum 2 nozzle size increase in nozzle number or flat fan nozzle as specified. 4. Specified blasting pressure, e.g., 70 to 80 psig or minimum 3000 psig water pressure.
c. Condition of Paint Spray Equipment and Crack Fill Equipment.	Visual inspection.	Mfg. recommended size; airless guards, gages working.
d. Inspection instruments required.	1. Dew meter or Psychrometer and psychrometric tables. 2. ASTM E337 and manufacturer's instructions.	1. Within calibration limits; 2. Typically, temperature at least 5°F above dew point and RH not over 80%.
	3. Water drop 4. Black light	3. Penetrates. 4. Does not fluoresce.
	5. Calcium chloride. 6. Insitu RH test.	5. Building acclimatized –test duration 72 hours as required by specification, typically 3 pounds or less. 6. Building acclimatized –test duration 72 hours as required by specification, typically 75% or less.
	7. pH test	7. As required by specification typically 8-10 pH.
	8. Contact, remote, or recording thermometers.	8. Following directions of manufacturer and, as required by the specification, typically 50-100°F during application and

		curing.
	9. TCP Profile Replica putty and micrometer. 10. ICRI CSP 1-9.	9. As required by specification. 10. Visual comparators.
	11. Wet film strips. 12. Ultrasonic dry film thickness gages. 13. SSPC-PA 9.	11. Used only as an aid in obtaining acceptable dry film thickness. 12. Within gage tolerance. 13. As specified – e.g., Level 4 (no maximum--within 75% minimum thickness.)
	14. Low/high voltage holiday detector. 15. ASTM D5162 or NACE RP0188.	14. As specified. 15. All holidays to be marked, repaired, re-inspected, and approved.

Inspection of Surface Preparation

COATINGS INSPECTION PLAN		
Coating Material: _____		
Substrate: <u>CONCRETE</u>		
INSPECTION HOLD POINT DURING SURFACE PREPARATION	INSPECTION METHOD	ACCEPTANCE CRITERIA
1. Environmental Conditions		
a. Substrate Temperature	Thermometer manufacturer's instructions	Not required in the specification.
b. Dew Point	ASTM E337, Temp. and dew point must be taken at start of work and every 4 hours, or at time intervals required by specification.	Not required in the specification.

c. Protection of Surfaces and Equipment	Surfaces and equipment not to be coated must be protected from abrasive blast/water cleaning and coating overspray.	Visual observation.
2. Cleanliness		
a. Cleaning to remove grease/oil (SSPC-SP 1).	1. Ultraviolet light 2. Water drop test described in SSPC Inspection Manual.	1. No Contamination 2. Complete flow-out.
b. Abrasive cleanliness.	1. ASTM D 4940 (vial test 1:1 volume ratio). 2. SSPC-AB 1, 2, or 3.	1. No floating oil sheen, color or suspended material visually detected. 2. Requirements of SSPC-AB 1, 2, or 3 are compliant per manufacturer's data.
c. Shot blast cleanliness.	1. ASTM 4940 (vial test 1:1 volume ration)	1. No oil sheen, turbidity, or floating material.
d. Water cleanliness	Vial test – potable water	Less than 500 microSiemens, clear.
2. Profile		
a. Blasted/Shot blasted/Washed profile.	1. TCP Replica Putty 2. ICRI CSP visual coupons.	1. Surface profile required (e.g., 56-75 mils). 2. Visual - Matches CSP 4-5.
Blasting/Shot blasting/Water washing operations	Visual observations.	Conformance to PCP.
c. Removal of dust and blast products.	1. ISO 8502-3. 2. Clear tape test.	1. As required by specification. 2. As agreed upon by owner.
3. Finish of Surface Preparation		
a. Prepared surface cleanliness.	1. Water drop. 2. Black light.	1. Penetrates. 2. Does not fluoresce.

b. Moisture Vapor Emission/RH test. Plastic sheet method.	1. Calcium chloride. 2. Insitu RH test. 3. Sheet sealed against surface for 16 hours.	1. Building acclimatized –test duration 72 hours as required by specification, typically 3 pounds or less. 2. Building acclimatized –test duration 72 hours as required by specification, typically 75% or less. 3. Visually inspect underside of sheet and the concrete for presence of moisture.
c. pH of concrete surface.	Electronic/ pH strip test.	As required by specification typically 8-10 pH.

Inspection for Coating Application

COATINGS INSPECTION PLAN (CONTINUED)

Coating Material: _____

Substrate: CONCRETE

INSPECTION HOLD POINT DURING INSPECTION	INSPECTION METHOD	ACCEPTANCE CRITERIA
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**1.
Environmental
and Surface
Conditions**

Temperature, RH	Surface, ambient temperature, dew point temperature, and RH, taken at start of work and every four hours afterward.	Within range listed in specification/manufacturer's product data sheet.
	ASTM E337	Relative humidity as specified, typically no more than 80% during coating/curing.

**1. Mixing of
Coatings**

a. Lighting Containers	SSPC Guide 12 Visual observations	Light as required (20 foot candles). Containers not to be opened except for inspection or immediate use.
b. Mix single components and multi-components.	Visual observations. Coating temp. check.	Mix in accordance with specification/manufacture's instructions. Mix each component separately prior to mixing combined materials. Mix only complete pre-measured units, i.e., full containers. Check that coating is at recommended temp. found on product data sheet.
c. Sweat-in/dwell time, pot life.	1. Time. 2. Visual observation.	1. Record mix time –for pot life, dwell. 2. Mix until smooth and free from lumps, typically with a slow speed stirrer. Strain through a suitably sized screen, if necessary.

3. APPLICATION

a. Lighting	SSPC Guide 12	Lighting as specified (20 foot candles).
b. Number of coats and colors of each coat.	Visually inspect colors.	Visually conforms to the specification.
c. First coat color and WFT.	1. Color 2. WFT	1. Blue – Conforms to specification. 2. WFT gages –conforms to specification.
d. First coat cleanliness/amine blush prior to top coating.	1. Visually check for moisture, dust, rust, fish eyes, and amine blush contamination. 2. Ultrasonic DFT test.	1. No visible moisture, dust, rust, fish eyes, amine blush, or contamination. 2. Verify accuracy - DFT measurements conform to SSPC PA 9.
