1986

Structural Steel Painting Inspection Manual for Zinc-Silicate Systems

Iowa Department of Transportation
Highway Division
Office of Materials

INTRODUCTION

The purpose of this manual is to provide information to assist painting inspectors with their inspection of the painting of structural steel bridges using a zinc-silicate primer and vinyl topcoat. It is intended to provide an insight to the complexities of these modern coatings and the difficulties that can arise with their use.

The manual includes information about the paints, surface preparations required, application of the paints, and inspection duties. Some of the material presented is of a technical nature and may appear to be of little pratical value to the inspector on the job. Experience has shown, however, that a basic knowledge of all aspects concerning the paints and painting operations will prove valuable to the competent inspector.

The information contained herein should not be considered as specification requirements but is intended to assist the inspectors in their interpretation.

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ZINC-SILICATE PAINTING INSPECTION

PART I - PAINTS

A. ZINC-SILICATE PRIMER

1. General: Zinc-silicate is the name used by the Iowa DOT for paints known in the industry as self-cured, solvent based, inorganic zinc rich primers. These coatings are noted for their excellent corrosion protection of steel and abrasion resistance and are considered to be as close to a permanent primer as is now available. They are also currently considered to be environmentally acceptable.

2. Composition: Zinc rich coatings can be divided into organic or inorganic classes according to the resin or binder used. The organic coatings have organic binders (carbon based compounds) such as linseed oil, epoxy resins, vinyl resins, etc. The inorganic coatings have binders consisting of compounds based on substances other than carbon such as silica. The pigment used in both classes is metallic zinc and the solvents used in zinc-silicate paints are alcohols or similar liquids. Petroleum solvents or water are not compatible.

3. Specified Types: Specifications allow the use of either two-component or single component types. The two-component type is supplied with the pigment packaged separately to be mixed at the time of application. The pot life varies with temperature and is usually about eight hours at 77 degrees F, but can be as low as one or two hours on a hot summer day. The single component type is packaged ready-to-use.

4. Characteristics:

   a) A zinc-silicate film does not dry in the usual sense but cures to a hardened state by reacting with moisture in the surrounding air. When the film is applied, the solvents evaporate rapidly and the film appears to be dry. At this stage, the binder has not cured and the film can be easily removed. The time required for thorough curing depends on the ambient temperature and relative humidity. The paint film must be thoroughly cured before it is topcoated (see Section B under "Paint Applications" for test to check curing).

   b) The cured zinc-silicate film is not continuous but is an open lattice network which allows electrical contact between zinc particles and between zinc and steel. The zinc can thus sacrifice itself for the steel without disturbing the integrity of the coating. This porous film will not blister or peel because it

allows free transfer of air and vapors. However, bubbling of a topcoat can occur if air or vapors are entrapped in the film.

c) A zinc-silicate film without topcoat will form deposits of white zinc salts on the surface when the film is allowed to weather for an extended period of time. These salt deposits slow down further sacrifice of zinc but must be removed, if excessive, to obtain adhesion of the topcoat.

d) Intercoat adhesion between two coats of zinc-silicate paint is marginal because a cured film can absorb the binder of a second application so that adhesion will not occur. It is necessary to thin the primer (up to two quarts per gallon) before using it for a second application.

B. VINYL FINISH COATS

1. General: The vinyl topcoats are quick-drying paints characterized by the flexible and tough film they form. These coatings reduce the need for sacrificial action of the zinc in the primer and thus increase the life of the painting system.

2. Composition: Vinyl paints are made by dissolving solid vinyl resins in strong solvents. There are many types of vinyl resins available from which these paints can be made and the proper type must be used to obtain adhesion to zinc-silicate primer. Vinyl paint from approved suppliers are formulated for this purpose. Generally, the vinyl paint supplied to a project will be made by the same producer as the primer over which it is to be applied. This is a desirable situation but vinyl paint from other approved suppliers may be used.

3. Specified Types: Two types of vinyl paint are specified. The hi-build type is formulated to provide maximum film thickness per coat. The enamel type is formulated to provide maximum resistance to weather and sunlight exposure.

4. Characteristics:

a) A vinyl paint film dries solely by solvent evaporation. It dries to touch in about 20 minutes but will retain a small amount of solvent which dissipates slowly over an extended time period.

b) A vinyl film, regardless of age, remains soluble in the original solvents. A second application will redissolve some of the initial coat and excellent intercoat adhesion results.

c) Vinyl paints have poor wetting properties and must be applied to a surface free from dust, loose zinc pigment, and other foreign matter.

d) Vinyl paints contain a low volume of film-forming solids. The hi-build type requires nine to 10 mils wet film to obtain three mils dry. The enamel requires about five mils wet to obtain one mil dry.

e) Vinyl paints require four to six hours dry time at 77 degrees F before coating. Cooler temperatures will require longer drying periods but in any event, overnight drying should be adequate.

C. ACCEPTANCE PROCEDURES

1. General: Paints for this system are accepted for project use on the basis of certification from an approved supplier. Materials Office I.M. 482.02 covers acceptance procedures and includes a list of approved suppliers which is updated periodically. A copy of this I.M. appears in the appendix.

2. Information Required for Acceptance: Project numbers and the name to whom the paint was shipped, as given on certifications, may not correspond to the project being inspected because of paint stock transfers, etc. Therefore, paint may be accepted for project use if the batch numbers to be used are covered by any shipment certification from an approved supplier.

3. Obtaining Certification Copies: A master file of all paint certifications is maintained at the Central Laboratory in Ames. Copies are available upon request, if needed, by providing the name of the paint manufacturer and batch numbers.

4. Using Paint Without Certification: Batch certifications are not always immediately available at the time the contractor wishes to begin painting. Painting can be allowed in this situation, if the paint is from an approved supplier and the contractor understands that applied paint found not acceptable must be removed. The Central Materials Office should be notified so that certifications covering the paint can be obtained as soon as possible.

D. SAMPLING

1. Required Samples: Sampling in the field is unnecessary unless a paint appears questionable in some respect. Monitor sampling and testing is scheduled and handled by Central Laboratory Personnel.

2. Procedure: Representative samples of these paints are difficult to obtain because of fast evaporating solvents and pigment settlement. The best sample is an unopened original container.

E. MIXING AND THINNING

1. Mixing During Application: It is usually difficult to keep zinc-silicate paints homogeneous during application because the heavy zinc pigment may settle rapidly. Agitated paint pots are recommended. If an agitated pot is not used, the zinc-silicate paint should be manually mixed, occasionally, while it is being applied. Vinyl paint only requires initial mixing.

2. Thinning for Proper Application: Thinning of both paints is often required to obtain proper application. Conventional thinners such as mineral spirits are not compatible with either paint and special solvents may be used. During hot or windy conditions, a slow-evaporating solvent may be used to obtain a sprayable consistency. Thinning will lower the dry film build-up that can be obtained for an applied volume of paint.

PART II - SURFACE PREPARATION

A. PURPOSE

Steel surfaces are cleaned prior to application of paints to obtain the best performance of the coatings consistent with the economics of expected exposure and preparation costs. Complete removal of all foreign matter is expensive and is not normally required for good performance of coatings on highway bridges. Zinc-silicate and vinyl paints, unlike conventional coatings, do require a good grade of cleaning and special surface preparation considerations.

B. CLEANING METHODS

Descriptions of various cleaning methods appear in the Appendix.

1. Solvent Cleaning

a) This method includes wiping surfaces with a solvent-soaked rag and the use of high pressure water. It is used to remove dirt, salt, deposits, grease and other similar contaminants. Solvent cleaning should precede blast cleaning to remove heavy grease deposits or if the abrasive is recirculated.

b) Petroleum solvents or chlorinated hydrocarbons are commonly used to remove grease and oil. The rags and solvents should be clean to avoid spreading these contaminants on the surface.

c) High pressure water may be used to remove dirt and salt deposits. If detergent or soap is used, any residual soap film must be removed.

2. Hand and Power Tool Cleaning

a) This method includes the use of wire brushes, scrapers, grinders, etc. Its use is limited to small areas for touch-up cleaning or repair work. Abrasive blasting is preferred, even for small areas, but practicality may dictate hand tool use.

b) Wire brushes and scrapers are used to remove loose rust, zinc salt deposits, or poorly bonded paint.

c) Grinders are used to remove mill scale from small areas protected by holding devices during blast cleaning or to remove small defects on the steel surface that are exposed by the blasting process. The ground surface should be rough to allow adhesion of the primer.

3. Abrasive Blast Cleaning

a) This method involves propelling abrasives at the surface with a centrifugal wheel or by air blast. It is used for the overall cleaning of the steel in preparation for the prime coat and may also be used for touch-up cleaning and repair work. The abrasive used includes sand, grit, and steel or iron shot.

b) Sand is the only abrasive used to clean existing structures. River sand and white silica sand are the types commonly used. Silica sand is the most efficient and cleanest sand to use but river sand is the least expensive.

c) Grit and shot are used only in the fabricating shops where recovery is possible. Grit provides a rough sharp, angular profile on the steel surface to which the primer can best adhere.

d) Shot has more impact power than grit and is often added to grit to aid in mill scale removal. New shot must not be used alone because the spherical shape tends to produce a peened surface to which the primer will not adhere.

4. Sweep or Brush-Off Blasting

a) This method consists of a single, light pass of the blasting nozzle which is intended to slightly etch an existing paint film with a minimum of film removal.

C. CLEANING FOR PRIMER APPLICATION

1. General: Zinc silicate paint requires an abrasive blast cleaned surface to obtain good adhesion and effective corrosion control. Adhesion depends not only on removing non-adherent or incompatible contaminants, but on providing a surface to which the film can

mechanically bond. To provide cathodic protection, the zinc must be in intimate contact with the steel, so most of the contaminants should be removed.

Cleaning of new steel in the fabricating shops is usually excellent because of the surfaces of new steel are more uniform and most shops use the centrifugal wheel equipment. The surfaces on existing structures, however, vary considerably in the amount of corrosion that may be present and also involve removal of old paint. Uniform inspection on different structures that is carried out to the letter of the specification is, therefore, difficult to attain. Each situation must be judged separately with the primary considerations of obtaining a surface to which the primer can adhere and provide protection.

2. Specified Cleaning: Specifications call for steel cleaning in accordance with the Steel Structures Paint Council Specification SSPC-SP10, entitled "Near-White Blast Cleaning". The following is the definition of this grade of blast cleaning as quoted from that specification:

> "Near-white blast cleaning is a method of preparing steel surfaces which, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, and paint. Generally, evenly dispersed very light shadows, streaks, and discolorations caused by stains of rust, stains of mill scale, and stains of previously applied paint may remain on no more than 5% of the surface.

3. Applying the Cleaning Definition: Describing a degree of blast cleaning that calls for less than complete removal of foreign matter is difficult because the descriptive terms are necessarily relative. The judgement decisions required to apply such a definition can therefore lead to misunderstandings. The following comments concern application of the cleaning definition:

   a) The foreign matter remaining on the cleaned surface should be slight. The shadows, streaks, and discolorations referred to are all very thin residues of contaminants that remain after removal of rust, mill scale, or old paint.

   b) All old paint must be removed except for the slight residues allowed in the definition. These residues should be limited to those remaining in the bottom of the surface profile pits. Zinc-silicate paint will not adhere to any smooth surface such as an old paint film.

c) An objective method of measuring the amount of surface that complies with the 5 percent requirements is not available. The percentage must be determined by a visual estimate made from an overall view of the surface. This judgement cannot be made with exactness, but it is intended that the slight amounts of foreign matter remaining should be distributed uniformly over the surface and not concentrated in any area.

d) The color and sheen of a prepared surface will not normally be uniform. The natural color of the blasted steel may vary, may be changed by the abrasives used, and a bright blasted surface may dull rapidly. Discolorations due to rust stains or old paint residues can usually be distinguished by their specific colors, while mill scale oxides appear as dark or black spots.

e) Photographic standards are helpful when the standard photo is carefully compared with photos showing bracketing grades of cleaning. Their practical use is somewhat limited, however, because they cannot show all situations that may occur.

f) Old paint on existing structures should be allowed to remain in the cracks between steel members such as a rivet head and a plate or between a splice plate and web. This may not always be possible, but any old paint remaining in the crack will help maintain a seal.

4. Surface Profile Height

a) Profile height is the distance between the high and low points (peaks and valleys) of a blast-cleaned surface. If this dimension is too small, the primer may not bond. It it is too large, the possibility of a thin film over the peaks is increased.

b) A nominal profile height of 1.0 to 2.5 mils is specified to indicate the minimum height for good primer adhesion and that a low profile is desirable. In practice, however, a profile height less than 1.0 mil is difficult to attain and a reasonable height over 2.5 mils is of little concern if the film thickness is as specified. Profile height measurements are therefore not recommended except in unusual circumstances.

c) The dry film thickness measured by magnetic gage is indicative of the thickness of the film over the profile peaks of average height. The possibility of a film thin enough to allow rusting, even on the highest peaks, is minimal if proper thickness measurements show compliance.

d) A high profile will require the painter to apply more paint to obtain the specified film thickness. Paint quantities figured on the basis of a smooth surface will not be adequate.

5. Cleaning After Blasting: Dust, abrasives, and other loose blast products should be removed from the surface with brushes, compressed air, or by vacuum before primer is applied.

D. CLEANING THE PRIMER FILM

1. Primer Film Build-Up: When necessary to apply additional primer to obtain proper film thickness, some preparation of the initial coat may be necessary. The cleaning required depends on the curing status and the extent of weathering of the initial coat as follows:

   a) If the initial coat has not fully cured or has not weathered for an extended time, no cleaning is necessary unless contamination has occurred. This should be the case on all maintenance repainting projects.

   b) If the prime coat has weathered for an extended time as is found on new bridge construction, the fully cured initial coat should be brush-blasted before applying additional primer. Wire brushing can be used for small areas.

      NOTE: Thinning of the primer is required for any second application. See item (d) under characteristics of zinc-silicate paint, page 2.

2. Primer Touch-Up

   a) Unprimed field connection parts on new construction, including rivet heads, bolt heads, etc. are cleaned after erection by sand blasting before applying the prime coat.

   b) To repair damaged areas of the prime coat, the area should be sweep-blasted before touch-up with primer. Small areas may be cleaned with a wire brush, etc.

   c) Pinpoint rusting, also called "salt and pepper rusting" occurs if the primer film thickness is not sufficient to cover the highest peaks of the blast profile. All rust should be removed by sweep-blasting before applying additional primer.

3. Preparation for Vinyl Topcoat

   a) On new construction this cleaning involves removal of white zinc salts, dirt, dust, grease, etc. High-pressure water is the preferred cleaning method, except cleaning with petroleum solvents is necessary for oily deposits. Hand cleaning may be used for small areas.

b) On existing structures this cleaning normally consists of removing dirt and dust. It may also involve removing loose zinc particles resulting from dry sprayed or over-sprayed primer. Cleaning methods include hand cleaning, high pressure air, and high pressure water.

E. CLEANING THE VINYL TOPCOAT FILM

1. Topcoat Film Build-Up or Touch-Up

a) Removal of contaminants by solvent washing is normally the only cleaning necessary. Small damage areas, not seriously involving the underlying prime coat, do not require any special cleaning.

b) If the vinyl topcoat has lost adhesion to the primer, the area should be sweep-blasted (silica sand preferred) to remove any remaining loose vinyl paint leaving feathered edges. Small areas may be hand cleaned. Removal of primer during this operation should be kept to a minimum.

2. Repairing Both Topcoat and Primer Film: If it is necessary to repair a prime coat that has been topcoated, the repair area should be sweep-blasted before applying the approved organic zinc-rich primer. This repair primer does not require special cleaning before application of the vinyl topcoat.

3. Preparation for Vinyl Enamel Coat: Removal of contaminants by solvent washing is the only cleaning necessary.

PART III - PAINT APPLICATION

A. WEATHER CONDITIONS

1. Temperature

a) A minimum surface temperature of 40 degrees F is specified for painting. This limit helps assure a moisture and frost-free painting surface and is intended to allow the primer an opportunity to cure in a reasonable time.

b) If the temperature falls below the minimum during the curing or drying period, damage to either paint is unlikely. However, the curing rate of the zinc-silicate paint will be slow and should be checked carefully.

c) A maximum temperature is not specified, but high temperatures can cause application problems such as dry spray or pinholes. These problems can be avoided by thinning and proper application techniques.

d) Any corrective action deemed necessary because of temperature related failure should be based on indicated damage and not on temperature measurements.

2. Moisture

a) Both paints must be applied to a dry surface. This can be determined by the following test: Lightly moisten a small area with a damp cloth and observe evaporation and drying. The surface may be considered dry if the applied dampness evaporates and decreases in area within 15 minutes.

b) Damage to either paint is not likely to occur from moisture once the paint has been applied. Zinc-silicate paint can be moistened in a short time after application without affect, except for a faster curing rate. Vinyl paint is usually sufficiently dry within 20 minutes to avoid moisture damage.

c) A wet paint film exposed to moisture should be permitted to dry. Damage such as erosion or permanent discoloration may require repainting.

d) To avoid expensive recleaning of steel, application of primer over cleaned steel should be allowed, at the contractor's option, if the weather becomes threatening. Damage to the prime coating is extremely unlikely in such situations, but this should not preclude discontinuing painting for safety, traffic protection, or other reasons.

B. CURING TIME OF PRIMER

1. General: The zinc-silicate film must be thoroughly cured before topcoat is applied. Higher temperatures or humidities both speed up the curing process. The coin hardness test given below is used to officially determine the extent of curing.

2. Coin Hardness Test: A zinc-silicate film cures from the bottom to the top and uncured film on the surface can be easily scraped away. This is the basis for the coin hardness test with the following procedure:

Scrape the film with the edge of a coin using moderate pressure and observe the amount of film removed (appears as powdered zinc). If the amount removed is practically nil, the film is considered thoroughly cured.

The following notes concern application of this test:

a) Different types and sources of zinc-silicate paint vary in the hardness of the cured film. Heavy pressure on the coin during the test can remove cured film of the softer types.

b) Dry sprayed zinc must be brushed off before testing.

c) The scraped area should have a shiny, polished appearance indicating that portion of the film that has fully cured.

3. Accelerating Curing: Occasionally a zinc-silicate film will not cure in a reasonable time. When this occurs it is recommended that the film be sprayed with a water mist using a Hudson sprayer or similar equipment. This procedure will greatly accelerate the curing process and will not injure a film that is at least one hour old. The surface must be allowed to dry before subsequent paint is applied.

C. FILM THICKNESS

1. General: Film thickness is a critical measurement for determining the adequacy of a paint film to protect steel. A thicker film will generally provide a longer protective life. The specified film thickness for each coat of paint is obviously important, but in practical situations, the relative importance of these measurements varies as follows:

a) The total combined thickness of the primer and topcoat is the most critical measurement because it essentially decides the life of the paint system.

b) On new construction, the thickness of the prime coat applied in the fabrication shop is critical because this film will be required to withstand weathering for an indefinite period of time before it is topcoated. The proper film thickness will avoid pinpoint rusting and minimize field repairs.

c) On existing structures the prime coat will normally be topcoated within a short time. Therefore, prime coat measurements in this case, although important, are not as critical as those on new construction.

2. Specifications

a) The specifications require a 3-mil average dry film thickness for each coat and a minimum of 2.5 mils at any point. The thickness measurement at a point consists of the average of at least five instrument readings taken in a small area (4-inch diameter or less). Individual gage readings are not valid by themselves. The 3-mil requirement refers to the average thickness found on a large test area, one side of a beam web for example. This overall average thickness is obtained by averaging several point results taken at selected small areas representative of the larger test area.

b) It is not intended that the thickness of vinyl topcoats be determined separately, but rather the total thickness of all paint applied. The overall average thickness and paint thicknesses of the two or three coats must meet the minimums specified. Deficient total thickness is corrected by adding more vinyl paint.

3. Gage Operation

a) The procedure for using the magnetic film thickness gage is given in Materials Office I.M. 332, included in the appendix. Valid measurements with this gage depend on use with close attention to procedure details.

b) The gage must be calibrated with a paint film standard obtained at the Central Laboratory. These standard films are painted over a sandblasted surface and the stated film thickness related to actual readings taken with a gage calibrated against certified thickness standards obtained from the National Bureau of Standards.

c) Central Laboratory studies indicate that proper measurements made with a gage calibrated with the paint film standard will give film thickness results that includes the paint about 0.5 mil below the average peak height of the blast profile.

4. When to Make Measurements: The ideal time to make film thickness measurements is when the coating has thoroughly cured or dried. The vinyl paint dries reasonably hard in about four hours, so the time delay before measurements are taken is normally not a problem. The primer appears to dry rapidly, but curing is much slower and the film will shrink slightly during the curing period. Preliminary thickness measurements can usually be made about two hours after application to determine any need for film-build. Final measurements should be made after the film has been found to be fully cured.

5. Measurement Test Areas

a) Test areas should be selected to represent the various components of the structure, with consideration of the exposure to which they will be subjected. Surfaces directly exposed to weathering such as outside web surfaces should always be checked. The bottom surface of the bottom flange is a difficult area to paint and should also be checked. Any steel above the bridge deck should be checked to at least a height of six feet.

b) A test area may be any designated size of continuous flat surface such as a web on one side of a beam or one side of a small beam stiffener. Large areas can be divided into smaller areas at the discretion of the inspector. For example, if an initial check on a web indicated a thin coat at one end, this end could be

redesignated as a separate test area and be rechecked. If found deficient, it would only be necessary to repaint that end of the web.

c) The number of test areas selected will depend on the size and complexity of the structure, but should always be sufficient to reasonably assure the inspector that the proper amount of paint is being applied. If a deficient area is found, this warrants increasing the number of test areas.

6. Point Measurements

a) Point measurements should be randomly distributed over the test area. The exact locations are decided solely by the inspector.

b) The number of point measurements made within a test area depends on the dimensions of the area. Usually three to five points are sufficient.

D. APPLICATION PROBLEMS

1. Dry Spray

a) Dry spraying occurs when semi-dry particles of paint hit and stick to the surface. The contributing factors are fast evaporating solvents, hot ambient temperatures, and the distance the paint gun is held from the surface being painted. On hot days it is advisable for the painter to thin the paint for application. Dry spray, however, usually occurs on the web where the painter fans the gun as he paints along the beam. The dry spray appears at the ends of the swing of the gun where it is farthest from the beam. Dry-sprayed areas can usually be recognized by a shadowy appearance of glossy and dull areas of light and dark areas.

b) Dry-sprayed zinc-silicate paint produces a lumpy texture on the surface caused by semi-adherent zinc particles which can usually be removed by rubbing with the hand. To assure topcoat adhesion, the loose zinc particles must be removed by wiping, brushing, or high-pressure water. In severe cases, it may be necessary to clean the surface by sweep-blasting followed by repainting.

c) A dry-sprayed vinyl film is more porous than a sound film and provides a bad appearance. It should be corrected by applying a new coat of highly thinned vinyl paint.

2. Overspray: Overspray occurs when sprayed paint misses the target and lands semi-dry on other steel or painted surfaces in close proximity. When this occurs with the primer, the resulting loose particles of zinc must be removed before paint is applied to the affected surface. A stiff bristle brush can be used for removal or, in extreme cases, a wire screen. Loose particles should be removed with compressed air.

3. Mud-Cracking: Mud-cracking of a zinc-silicate film occurs when it is too thick. This is most likely to occur in areas where paint is applied from several directions such as inside corners. The condition appears as a network of cracks in the film. To repair, the film must be scraped back to soundly bonded paint and the area recoated, if necessary, to obtain minimum film thickness.

4. Topcoat Bubbling

   a) Vinyl paint films dry from the top to the bottom and thus tend to form an impermeable skin on the surface. This surface skin may trap air or absorbed solvent in the porous zinc-silicate film or may trap solvent within the vinyl film itself. When the trapped air or solvent escapes, bubbles are formed in the coating. This phenomenon occurs when the topcoat is applied to thick and is enhanced by exposure to the heat of the sun and by dry-sprayed zinc-silicate paint.

   b) If the vinyl paint is properly thinned and applied at a rate suitable for the ambient conditions, the bubbles formed will break and the film will reseal. If the bubbles do not break, they will remain as blisters after the topcoat dries, leaving a poor appearance. Poor adhesion of the vinyl paint or pinholes can also result.

   c) The need for repair of a bubbled or blistered topcoat depends on the presence of pinholes. When pinholes are formed or if a broken blister reveals the underlying prime coat, the blisters should be removed using a scraper and the area repainted with highly thinned vinyl paint. If appearance is the only problem, it is usually better not to attempt repairs. In any event, when bubbling first appears, corrective action should be taken before painting continues.

   d) Bubbling of the topcoat is traceable to improper application of the coating or to application under poor ambient conditions. Weathering of the prime coat prior to topcoating, as occurs on new construction, usually allows zinc salts to seal the porous surface of the primer which helps eliminate the bubbling problem. Bubbling can be avoided by one or more of the following procedures: (1) remove all dry-sprayed zinc particles from the surface of the prime coat, (2) apply a thin mist coat of vinyl paint to seal the prime coat and allow to dry for at least 20 minutes prior to application of the full coat, or (3) thin the vinyl paint up to 50% and apply the coat in two or more applications. Allow at least 1/2 to 1 hour drying time between applications.

5. Topcoat Adhesion: Good adhesion of vinyl paint to the primer is generally achieved if the paint wets and penetrates the primer film. The amount of thinning of the vinyl paint is important in this regard. It must be thin enough to penetrate and to allow air and solvent to escape. If it is too thin, the coating may run or sag. The amount of thinning required is primarily related to ambient and surface temperatures and wind conditions.

   The adhesion of vinyl paint to the primer increases with time as the last traces of solvent evaporate. Ultimate adhesion may not be reached for at least a month. In the early stages it may be easily scraped off but if it cannot be easily peeled off in sheets, good adhesion should eventually result. An easily removed sheet of vinyl film that has a coating of zinc on the back side indicates dry-sprayed primer or an uncured primer film.

   Application of the vinyl enamel will soften the film of hi-build vinyl paint and temporarily lower its adhesion. Release of the trapped solvent is a slow but sure process and will eventually result in normal adhesion.

   The following list summarizes the cause of topcoat adhesion failure:

   a) Use of an improper type of vinyl paint.

   b) Application to an improperly cleaned primer film.

   c) Application over frost or moisture.

   d) Application to an uncured primer film.

   e) Application over dry-sprayed primer or overspray.

   f) Application on a hot surface causing premature evaporation of solvent before penetration.

PART IV - INSPECTION

A. GENERAL

Painting cannot be adequately inspected by visual observation of the final product because a poor paint job often looks the same as a good one. Early failures due to poor workmanship often occur after the work has been completed and has been paid for. It is necessary, therefore, to inspect the work as it progresses if there is to be any reasonable assurance that a paint job was completed as specified.

The paints used with this sophisticated system are subuject to some unique application problems not found when using conventional paints. To provide competent inspection of the operations, the inspector must receive special training regarding the use of these paints and the inspection procedures.

B. RECORDS

The inspector should keep a daily log containing pertinent information concerning the painting and related operations. A complete record will be valuable to the inspector and the engineer if disputes arise as the work progresses and is also essential for any future evaluations of the painting.

In addition to the standard project information (project number, location, contractor, etc.), the record should include the following where applicable:

1. General Information

a) Notes on safety, traffic protection, etc.

b) Cleaning equipment used (wheelabrator, sand blast, etc.).

c) Abrasive used (river sand, silica sand, shot, grit, etc.).

d) Notes on cleaning procedures (removal of dust, grease, etc.).

e) Paints to be used (manufacturer, batch numbers, etc.).
f) Paint mixing and thinning procedures used (agitated pot, hand mixing, amount of thinning, etc.).

g) Application equipment used (airless spray, conventional spray).

2. Daily Details

a) Weather conditions (ambient temperature and humidity, sky conditions, wind, etc.).

b) Notes on surface preparation (area cleaned, general surface condition, any unusual phenomenon).

c) Surface temperature at time paint was applied.

d) Location on structure of area painted.

e) Paints applied (batch numbers, thinning, etc.).

f) Dry film thickness measurements (test area description, point thickness values, average thickness).

g) Primer curing time allowed before topcoating.

h) Application problems encountered (dry spray, bubbling, etc.).

i) Corrective actions taken to avoid application problems or to make repairs.

C. INSPECTOR DUTIES

1. General: The inspector's primary job is to recognize and report sub-specification work. Unfortunately, it cannot always be assumed that the painter is completely knowledgeable about the paints to be applied and the specifications governing their application. Discussion with the contractor before the work begins, to clarify such things as degree of surface preparation, curing times, film thickness requirements and corrective actions to be taken if problems arise, will help avoid inspection difficulties.

   Experience and good judgement are of particular importance for inspection of this painting system. Technical assistance from the Central Materials Office should be sought if unusual problems arise.

2. Summary of Responsibilities: The major responsibilities of the painting inspector may be summarized as follows:

   a) Record keeping.

   b) Approval of traffic control procedures.

   c) Acceptance of paints.

   d) Approval of surface preparation before paint is applied.

   e) Checking cure of primer before topcoating or shipment from fabricating shop.

   f) Visual inspection of each coat of paint for defects.

   g) Determining film thicknesses.

3. Inspection Equipment: The inspector will need the following equipment:

   a) Field notebook.

   b) Surface temperature thermometer.

   c) Dry-film gage and paint thickness standard.

   d) Pocket knife.

4. Scheduling Inspection: It is not always possible for the inspector to be on the job at all times because of other commitments and duties. Obviously it is important for the inspector to be familiar with the painter's operational schedule and for the painter to have a clear understanding of what the inspector wishes to check. An agreement between the inspector and painter can then be established so that the inspector can at least be present at the critical times and any hold-up of painting operations can be avoided.

OFFICE OF MATERIALS—INSTRUCTIONAL MEMORANDUM

INSPECTION AND ACCEPTANCE OF PAINTS FOR THE ZINC-SILICATE PAINTING SYSTEM (4182.02 AND 4182.03)*

GENERAL

Acceptance of paints for painting structural steel with the zinc-silicate painting system will be on the basis of certification from an approved paint producer, subject to satisfactory results obtained from testing monitor samples.

Producer and product approval shall be obtained before paints can be furnished to projects.

PRODUCER AND PRODUCT APPROVAL

Producer and product approval will be based on information supplied by the producer and the results of tests made by the Central Materials Laboratory. Both zinc-silicate paint and foliage green vinyl finish coating must be accepted before approval is given.

The paint producer shall submit to the Materials Office, product data for both types of paint showing compliance with all specification requirements. The information provided shall also include the producer's name, brand name of each paint, indentification number of each paint, and mixing instructions for any two-component paint involved.

In addition, the producer shall submit to the Central Materials Laboratory, a sample (at least one quart) of both types of paint. Standard color chips for foliage green are available from the Materials Office on request.

When the producer and products have been accepted by the Materials Office, the approval will remain in effect indefinitely, unless withdrawn because of deficient test results on monitor samples, unsatisfactory field results traceable to the paint, or failure to comply with paint acceptance procedures. If a change is made in the manufacturing process or formulation of either paint originally approved, the change must be reported to the Materials Office for decision on continuance of the approval. This decision shall be made before such paints are furnished for projects.

PAINT ACCEPTANCE PROCEDURES

The paint producer shall furnish three copies of a certification document for each shipment intended for use on Iowa projects. The document shall include

the following information concerning the shipment:

1. Date of shipment
2. Name of painting contractor or company to which shipment was made
3. Brand names of product identification numbers
4. Batch or lot numbers
5. Quantity of paints

In addition, the document shall bear the following certification statement and the signature of a responsible company representative:

CERTIFICATION STATEMENT

We hereby certify that the products herein described have been previously approved in accordance with the procedures established by the Iowa Department of Transportation and that they comply with the applicable specifications.

Signed_____

The three copies of the document prescribed above shall be mailed, at the time of shipment, to the Materials Office in Ames, who will forward one copy to each District Office and Project Engineer who have work scheduled by the contractor or company involved.

Paint shipments from an approved producer, which are documented as outlined above and appear otherwise satisfactory may be incorporated in the work.

MONITOR SAMPLING AND TESTING

Producers which actively supply paints for projects shall be required to submit samples of paint to the Central Materials Laboratory on request. These samples shall be randomly selected at a minimum rate of one (1) per fifteen (15) batches shipped.

In addition, monitor samples may be requested from the project destination or fabricating shop. Such samples may be taken by District Highway Division personnel, the painting contractor, or the fabricator. Paint which the project engineer believes to be questionable may be sampled at any time.

All monitor samples shall consist of unopened containers. Maximum sample size shall be 5 gallons or a 5-gallon kit for two-component paint. Samples taken within the state may be returned after testing.

Test results not in reasonable close conformity with the specifications will be considered sufficient cause to discontinue use of the batch represented and to require sampling of additional batches for evaluating the continuance of producer and product approval. Article 1105.05 of the Standard Specifications applies in case paint not in reasonably close conformity has been used.

APPENDIX A

APPROVED PRODUCERS AND PRODUCTS FOR ZINC-SILICATE PAINTS AND VINYL FINISH COATS

Carboline Company
328 Handley Industrial Ct.
St. Louis, MO 63144

- Carbo Zinc SP81, single pack
- Carbo Zinc D10, single pack
- Carbo Zinc 11, two-comp.
- High-build vinyl, fol. grn. or white
- Vinyl enamel, fol. grn.

Mobil Chemical Corp.
901 N. Greenwood Avenue
Kankakee, IL 60901

- Mobilzinc Uni-Pak, 13-G-10W, single pack
- Mobilzinc 7, 13-F-12, two-comp.
- High-build vinyl, 583-G-806, fol. grn.
  583-W-801,white
- Vinyl enamel, 580-G-801, fol. grn.

Cook Paint and Varnish Co.
Box 389
Kansas City, MO 64141

- Galva-Pac No. 300, 411-A-300, single pack
- Galva-Pac No. 101, 411-A-101, two-comp.
- High-build vinyl, 900-G-477, fol. grn.
  900-W-475, white
- Vinyl enamel, 900-G-478, fol. grn.

Carbit Paint Co.
927 W. Blackhawk St.
Chicago, IL 60622

- Inorganic zinc rich primer, Carbit 5-E-6, single pack
- High-build vinyl, Carbit 5-G-6, fol. grn.
  Carbit 5-W-2, white
- Vinyl enamel, Carbit 5-G-5, fol. grn.

Diamond - Vogel
Box 247
Burlington, IA 52601
Inorganic zinc primer, NM-0507, single pack
Hi-Build vinyl, NE-6601, fol. grn., NE-1608, white
Vinyl enamel, NE-6605, fol. grn.

Jordan Paint Mfg. Co.
7250 Franklin
Forest Park, IL 60130
Inorganic zinc rich primer, 13-8-027, two-comp.
High-Build vinyl, 09-2-004, fol. grn. or white
Vinyl enamel, 09-2-005, fol. grn.

Redlands Prismo Corporation
2675 Martin Street
East Point, GA 30344
Inorganic zinc primer, 707, two-comp.
High-build vinyl, ST1A.01, fol. grn. or white
Vinyl enamel, ST1A.02, fol. grn.

Ameron
Corrosion Control Division
Brea, CA 92621
Dimetcote E-Z II-A, single pack
Dimetcote 9, two-comp.
Vinyl High Build, Iowa D.O.T., Commodity Code 1757100, fol. grn.
or Commodity Code 3003600, white
Vinyl Enamel, Iowa D.O.T., Commodity Code 1757000, fol. grn.

OFFICE OF MATERIALS—INSTRUCTIONAL MEMORANDUM

METHOD OF TEST
MEASURING COATING THICKNESS BY MAGNETIC GAGE
Field Test Procedures for Lab. Test Method 803

SCOPE

This test method describes the field test procedure for determining the thickness of a nonmagnetic coating on a magnetic substrate by use of a magnetic thickness gate.

APPARATUS

1. "Inspector" gage with 0 to 25 mil range or "Mikrotest" gage with 0 to 40 mil range.
2. Calibration standards consisting of coatings of known thicknesses bonded to the substrate or plastic shims of known thickness and specimen of uncoated base metal (see section on standards).

INSTRUMENT OPERATION

1. Check magnet tip to be sure it is clean.
2. Place rubber housing of magnet on coated surface at spot to be measured with rear contact point of gage on same surface or other surface in same plane. Position gage so magnet is perpendicular to surface at contact point (see notes 1 and 2).
3. Stabilize gage in above position with finger and/or thumb placed on housing near magnet (see figure 1). Hold gage steady with firm but gentle downward pressure while operating (see note 3).
4. Engage magnet to specimen surface according to gage instructions.
5. Slowly rotate dial clockwise until magnet breaks contact. Separation can be heard or it can be seen by watching colored pip at front of gage (see note 3).
6. Obtain thickness measurement from dial using same reading mark used for calibration (stationary or movable compensator).

CALIBRATION STANDARDS

The calibration standard used should be selected after consideration of the following factors:

1. Film Composition. Standard film composition should be about the same as the coating being tested: i.e. zinc films for galvanizing and paint films for painting. Plastic shims should only be used for curved surfaces coated with a paint type material (not galvanizing).

2. Film Thickness. Standard Film Thicknesses should be as close as possible to thickness being measured. The approximate recommended thicknesses are:

Range of Sample Thickness, mils	Approx. Standard Thickness, mils
0.3 - 1.5	1
1.5 - 3.5	2
2.5 - 5.5	4
4 - 8	6
8 - 12	10

3. Substrate. Substrate of standards should have the same magnetic properties, surface texture (sandblasted, smooth, etc.), curvature, and effective thickness as material being tested (see notes 4 and 5).

INSTRUMENT CALIBRATION

1. Select standard film of proper composition, thickness, and substrate.

2. Determine the average of 5 readings taken at different spots on the standard film, using stationary reading mark on gage.

3. If gage has movable compensating reading mark, set dial to indicate step 2 average on stationary mark and without moving dial, set compensator to indicate film thickness of standard. Subsequent test measurements are read using compensating mark (see note 6).

4. If gage doesn't have compensating mark, determine difference between standard film thickness and step 2 average. Use this difference to correct subsequent test results (see note 6).

TEST PROCEDURE

1. Calibrate gage as outlined above (see note 7).

2. Select a small area (about 4 inch diameter or less) on smoothest portion of test surface and remove all foreign material. Avoid areas difficult to clean.

3. Make at least 3 individual thickness measurements within the small area. These readings should be taken at different spots (see note 8).

4. Average all individual readings obtained within the small area and apply any calibration correction. This average is the test result for that point on the surface (see note 9).

5. To obtain an overall coating thickness for a large area, average several step 4 point results taken at selected small areas representative of test area (see note 10).

REPORTING RESULTS

Report test results to the nearest 0.1 mil. A zinc coating thickness in mils may be converted to ounces per square foot by dividing by (1.7).

NOTES AND PRECAUTIONS

1. Instrument Position. Gage position during measurements, i.e. upright, horizontal, or upside down, may affect results. Calibration for different positions should be verified. Gage should be positioned parallel to longitudinal axis of cylindrical specimens.

2. Edge Effect. Measurements should not be taken closer than 1/4 inch from edges or inside corners.

3. Instrument Operation. Different finger pressures applied to hold gage and different rates of rotating the gage dial may affect results. Separation of magnet from surface should occur only while dial is moving slowly and smoothly. Operation technique and measurement consistency can be checked by repeated readings taken without changing gage position. Calibration by same operator who makes test measurements will reduce or eliminate these variations.

4. Effective Substrate Thickness. Substrate thicknesses of 0.030 inch or more are equivalent. This effective thickness for flat specimens may be increased by placing the specimen on a flat layer of material with similar magnetic properties. Gage must be calibrated on a substrate of same thickness if sample measurements are taken on speciments less than 0.030 inch thick.

5. Curvature Effect. For measurements on curved surfaces the gage should be calibrated on a standard with similar curvature or with a shim placed on similarly curved base metal. Measurements may be made on cylindrical specimens of 1 inch diameter or more, using calibration with flat standard and subtracting 0.3 mil from result.

6. Measurement Corrections. Best results are obtained when compensation or applied corrections are small. Gages can be adjusted at the Central Laboratory.

7. Calibration Frequency. To assure proper performance, calibrate gage before each use and at frequent intervals during use.

8. Number of Measurements. The number of readings that should be taken depends on the uniformity of the coating thickness. For example, ten readings are recommended for galvanizing on culvert metal and five readings are taken on paint over a sandblasted surface.

9. Valid Measurements. Only averages of several individual measurements taken in the point area are valid results. Individual measurements that are obviously too high may result from gage vibration and should be discarded and rerun.

10. Test Areas. A test area on which an overall average coating thickness is determined may be of any designeated size of continuous flat surface or curved surface of the same radius. To avoid unnecessary coating repairs it may be desirable to divide a large test area into smaller inspection units.

11. Instrument Care. Magnetic gages are delicate instruments and should be handled as such. Store in the case provided when not in use.

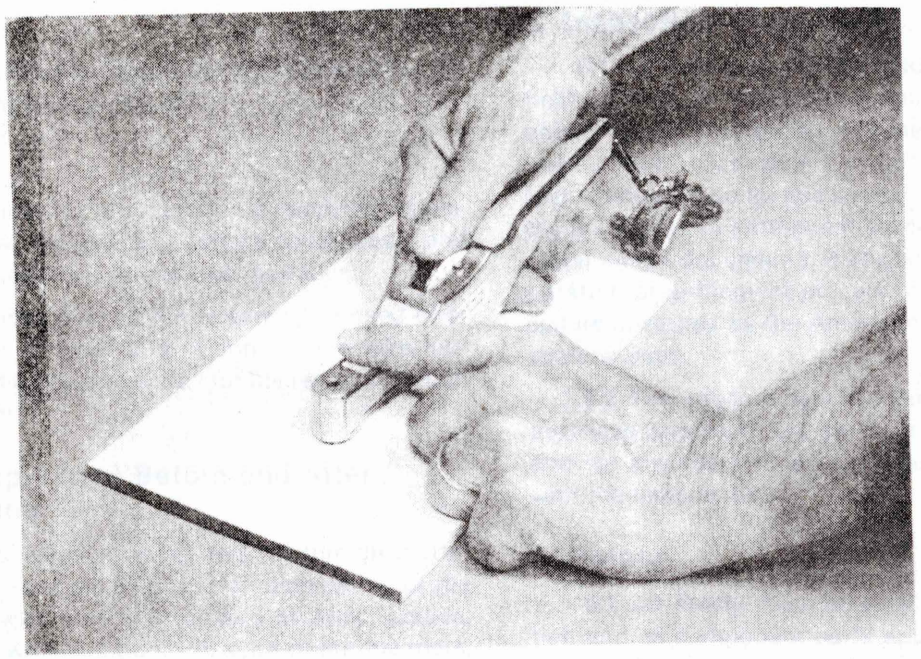

Figure 1. Operation of Film Thickness Gage

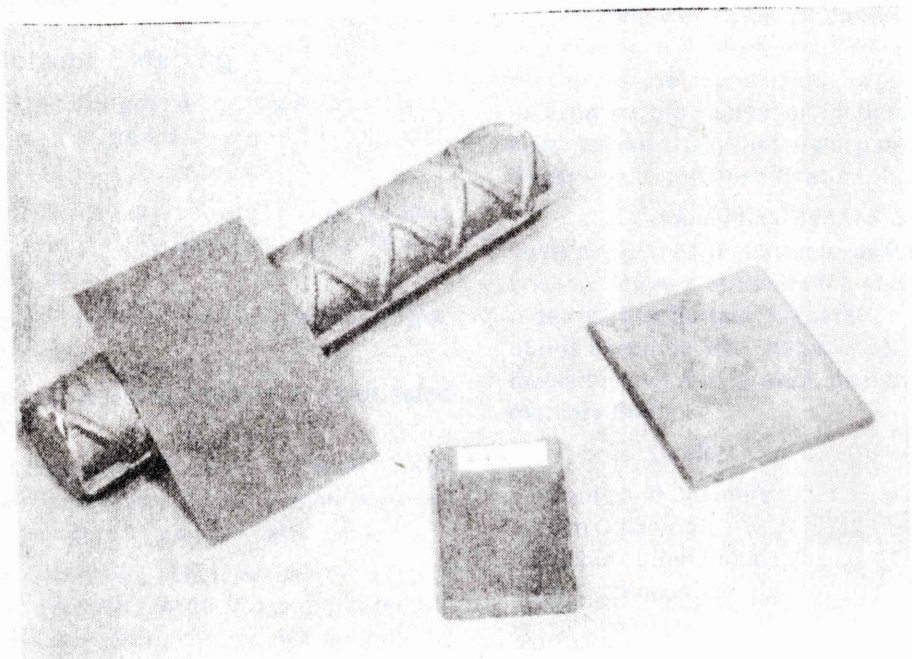

Figure 2. Various Calibration Standards

Steel Structures Painting Council

SURFACE PREPARATION SPECIFICATION NO. 1

Solvent Cleaning

1. Scope

1.1 This specification covers the requirements for the solvent cleaning of steel surfaces.

2. Definition

2.1 Solvent cleaning is a method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from steel surfaces.

2.2 It is intended that solvent cleaning be used prior to the application of paint and in conjunction with surface preparation methods specified for the removal of rust, mill scale, or paint.

3. Surface Preparation Before and After Solvent Cleaning

3.1 Prior to solvent cleaning, remove foreign matter (other than grease and oil) by one or a combination of the following: brush with stiff fiber or wire brushes, abrade, scrape, or clean with solutions of appropriate cleaners, provided such cleaners are followed by a fresh water rinse.

3.2 After solvent cleaning, remove dirt, dust, and other contaminants from the surface prior to paint application. Acceptable methods include brushing, blow off with clean, dry air, or vacuum cleaning.

4. Methods of Solvent Cleaning

4.1 Remove heavy oil or grease first by scraper. Then remove the remaining oil or grease by any of the following methods:

4.1.1 Wipe or scrub the surface with rags or brushes wetted with solvent. Use clean solvent and clean rags or brushes for the final wiping.

4.1.2 Spray the surface with solvent. Use clean solvent for the final spraying.

4.1.3 Vapor degrease using stabilized chlorinated hydrocarbon solvents.

4.1.4 Immerse completely in a tank or tanks of solvent. For the last immersion, use solvent which does not contain detrimental amounts of contaminant.

4.1.5 Emulsion or alkaline cleaners may be used in place of the methods described. After treatment, wash the surface with fresh water or steam to remove detrimental residues.

4.1.6 Steam clean, using detergents or cleaners and follow by steam or fresh water wash to remove detrimental residues.

5. Inspection

5.1 All work and materials supplied under this specification shall be subject to timely inspection by the purchaser or his authorized representative. The contractor shall correct such work or replace such material as is found defective under this specification. In case of dispute the arbitration or settlement procedure established in the procurement documents, if any, shall be followed. If no arbitration or settlement procedure is established, the procedure specified by the American Arbitration Association shall be used.

5.2 The procurement documents covering work or purchase should establish the responsibility for testing and for any required affidavit certifying full compliance with the specification.

6. Safety

6.1 All safety requirements stated in this specification and its component parts apply in addition to any applicable federal, state, and local rules and requirements. They also shall be in accord with instructions and requirements of insurance underwriters.

7. Notes

7.1 While every precaution is taken to insure that all information furnished in SSPC specifications is as accurate, complete, and useful as possible, the SSPC cannot assume responsibility or incur any obligation resulting from the use of any materials, paints, or methods specified therein, or of the specification itself.

7.2 A Commentary Section is available (Chapter 2 of Volume 2 of the Steel Structures Painting Manual) and contains additional information and data relative to this specification. The Surface Preparation Commentary is not part of this specification. The table below lists the subjects discussed relevant to solvent cleaning and appropriate Commentary Section.

Subject	Commentary Section
Solvents and Cleaners	11.1 through 11.1.3
Steam Cleaning	11.1.4
Threshold Limit Values	11.1.5
Film Thickness	10.0

Steel Structures Painting Council

SURFACE PREPARATION SPECIFICATION NO. 2

Hand Tool Cleaning

1. Scope

1.1 This specification covers the requirements for the hand tool cleaning of steel surfaces.

2. Definitions

2.1 Hand tool cleaning is a method of preparing steel surfaces by the use of non-power hand tools.

2.2 Hand tool cleaning removes all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife.

2.3 SSPC-Vis 1 or other visual standards of surface preparation agreed upon by the contracting parties may be used to further define the surface.

3. Reference Standards

3.1 The standards referenced in this specification are listed in Section 3.4 and form a part of the specification.

3.2 The latest issue, revision, or amendment of the reference standards in effect on the date of invitation to bid shall govern unless otherwise specified.

3.3 If there is a conflict between the requirements of any of the cited reference standards and the specification, the requirements of the specification shall prevail.

3.4 STEEL STRUCTURES PAINTING COUNCIL (SSPC) SPECIFICATIONS:

SP 1	Solvent Cleaning
Vis 1	Pictorial Surface Preparation Standards for Painting Steel Surfaces

4. Surface Preparation Before and After Hand Tool Cleaning

4.1 Before hand tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP 1.

4.2 After hand tool cleaning and prior to painting, reclean the surface if it does not conform to this specification.

4.3 After hand tool cleaning and prior to painting, remove dirt, dust, or similar contaminants from the surface. Acceptable methods include brushing, blow off with clean, dry air, or vacuum cleaning.

5. Methods of Hand Tool Cleaning

5.1 Use impact hand tools to remove stratified rust (rust scale).

5.2 Use impact hand tools to remove all weld slag.

5.3 Use hand wire brushing, hand abrading, hand scraping, or other similar non-impact methods to remove all loose mill scale, all loose or non-adherent rust, and all loose paint.

5.4 Regardless of the method used for cleaning, if specified in the procurement documents, feather edges of remaining old paint so that the repainted surface can have a reasonably smooth appearance.

5.5 If approved by the owner, use power tools or blast cleaning as a substitute cleaning method for this specification.

6. Inspection

6.1 All work and materials supplied under this specification shall be subject to timely inspection by the purchaser or his authorized representative. The contractor shall correct such work or replace such material as is found defective under this specification. In case of dispute the arbitration or settlement procedure established in the procurement documents, if any, shall be followed. If no arbitration or settlement procedure is established, the procedure specified by the American Arbitration Association shall be used.

6.2 The procurement documents covering work or purchase should establish the responsibility for testing and for any required affidavit certifying full compliance with the specification.

7. Safety

7.1 All safety requirements stated in this specification and its component parts apply in addition to any applicable federal, state, and local rules and requirements. They also shall be in accord with instructions and requirements of insurance underwriters.

8. Notes

8.1 While every precaution is taken to insure that all information furnished in SSPC specifications is as accurate, complete, and useful as possible, the SSPC cannot assume responsibility or incur any obligation resulting from the use of any materials, paints, or methods specified therein, or of the specification itself.

Steel Structures Painting Council
SURFACE PREPARATION SPECIFICATION NO. 3
Power Tool Cleaning

1. Scope

1.1 This specification covers the requirements for the power tool cleaning of steel surfaces.

2. Definition

2.1 Power tool cleaning is a method of preparing steel surfaces by the use of power assisted hand tools.

2.2 Power tool cleaning removes all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife.

2.3 SSPC-Vis 1 or other visual standards of surface preparation agreed upon by the contracting parties may be used to further define the surface.

3. Reference Standards

3.1 The standards referenced in this specification are listed in Section 3.4 and form a part of the specification.

3.2 The latest issue, revision or amendment of the reference standards in effect on the date of invitation to bid shall govern unless otherwise specified.

3.3 If there is a conflict between the requirements of any of the cited reference standards and the specification, the requirements of the specification shall prevail.

3.4 STEEL STRUCTURES PAINTING COUNCIL (SSPC) SPECIFICATIONS:

SP 1	Solvent Cleaning
Vis 1	Pictorial Surface Preparation Standards for Painting Steel Surfaces

4. Surface Preparation Before and After Power Tool Cleaning

4.1 Before power tool cleaning, remove visible oil, grease, soluble welding residue, and salts by the methods outlined in SSPC-SP 1.

4.2 After power tool cleaning and prior to painting, reclean the surface if it does not conform to this specification.

4.3 After power tool cleaning and prior to painting, remove dirt, dust, or similar contaminants from the surface. Acceptable methods include brushing, blow off with clean, dry air, or vacuum cleaning.

5. Methods of Power Tool Cleaning

5.1 Use rotary or impact power tools to remove stratified rust (rust scale).

5.2 Use rotary or impact power tools to remove all weld slag.

5.3 Use power wire brushing, power abrading, power impact or other power rotary tools to remove all loose mill scale, all loose or non-adherent rust, and all loose paint. Do not burnish the surface.

5.4 Operate power tools in a manner that prevents the formation of burrs, sharp ridges, and sharp cuts.

5.5 Regardless of the method used for cleaning, if specified in the procurement documents, feather edges of remaining old paint so that the repainted surface can have a reasonably smooth appearance.

5.6 If approved by the owner, use blast cleaning as a substitute cleaning method for this specification.

6. Inspection

6.1 All work and materials supplied under this specification shall be subject to timely inspection by the purchaser or his authorized representative. The contractor shall correct such work or replace such material as is found defective under this specification. In case of dispute the arbitration or settlement procedure established in the procurement documents, if any, shall be followed. If no arbitration or settlement procedure is established, the procedure specified by the American Arbitration Association shall be used.

6.2 The procurement documents covering work or purchase should establish the responsibility for testing and for any required affidavit certifying full compliance with the specification.

7. Safety

7.1 All safety requirements stated in this specification and its component parts apply in addition to any applicable federal, state, and local rules and requirements. They also shall be in accord with instructions and requirements of insurance underwriters.

8. Notes

8.1 While every precaution is taken to insure that all information furnished in SSPC specifications is as accurate, complete, and useful as possible, the SSPC cannot assume responsibility or incur any obligation resulting from the use of any materials, paints, or methods specified therein, or of the specification itself.

Steel Structures Painting Council

SURFACE PREPARATION SPECIFICATION NO. 6

Commercial Blast Cleaning

1. Scope

1.1 This specification covers the requirements for commercial blast cleaning of steel surfaces.

2. Definition

2.1 Commercial blast cleaning is a method of preparing steel surfaces which, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, and paint. Generally evenly dispersed very light shadows, streaks, and discolorations caused by stains of rust, stains of mill scale, and stains of previously applied paint may remain on no more than 33% of the surface. Slight residues of rust and paint may also be left in the craters of pits if the original surface is pitted.

3. Appearance of the Completed Surface

3.1 The surface shall be roughened to a degree suitable for the specified paint system.

3.2 The appearance of the surface may be affected by the particular blasting abrasive used. Uniformity of color may be affected by the grade, original surface condition, and configuration of the material being cleaned, as well as by discolorations from mill or fabrication marks, and the shadowing from blast cleaning patterns.

3.3 SSPC-Vis 1 or other visual standards of surface preparation agreed upon by the contracting parties may be used to further define the surface.

4. Reference Standards

4.1 The standards referenced in this specification are listed in Section 4.4 and form a part of the specification.

4.2 The latest issue, revision, or amendment of the reference standards in effect on the date of invitation to bid shall govern unless otherwise specified.

4.3 If there is a conflict between the requirements of any of the cited reference standards and the specification, the requirements of the specification shall prevail.

4.4 STEEL STRUCTURES PAINTING COUNCIL (SSPC) SPECIFICATIONS:

SP 1	Solvent Cleaning
Vis 1	Pictorial Surface Preparation Standards for Painting Steel Surfaces

5. Surface Preparation Before and After Blast Cleaning

5.1 Before blast cleaning, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP 1.

5.2 After blast cleaning and prior to painting, perform the following:

5.2.1 Remove visible deposits of oil, grease, or other contaminants (See Section 5.1).

5.2.2 Remove dust and loose residues from dry abrasive blast cleaning. Acceptable methods include brushing, blow off with clean, dry air, or vacuum cleaning. (When compressed air is used for blow-off, use and maintain moisture and oil separators and traps to provide a clean and dry air supply.)

5.2.3 If the surface was wet abrasive blast cleaned, rinse with fresh water to which sufficient corrosion inhibitor has been added to prevent rusting, or with fresh water followed by an inhibitive treatment. Supplement this cleaning by brushing, if necessary, to remove any residues.

5.3 Rectify surface imperfections which become visible after blast cleaning as specified in the procurement documents.

6. Blast Cleaning Methods and Operation

6.1 METHODS:

6.1.1 Dry abrasive blasting using compressed air, blast nozzles, and abrasive;

6.1.2 Dry abrasive blasting using a closed cycle, recirculating abrasive system with compressed air, blast nozzle, and abrasive, with or without vacuum for abrasive recovery;

6.1.3 Dry abrasive blasting, using a closed cycle, recirculating abrasive system with centrifugal wheels and abrasives;

6.1.4 Wet abrasive blasting using compressed air, blast nozzles, water, and abrasive followed by rinse (see Section 5.2.3).

6.2 OPERATION

6.2.1 When compressed air is used for nozzle blasting, use and maintain moisture and oil separators and traps to provide a clean, dry air supply.

6.2.2 Perform blast cleaning operations so that no damage is done to partially or entirely completed portions of the work.

7. Blast Cleaning Abrasives

7.1 ABRASIVES SHALL CONFORM TO THE FOLLOWING REQUIREMENTS:

7.1.1 The abrasive shall be free of corrosion-producing contaminants and also free of oil, grease, or other deleterious contaminants.

7.1.2 Selection of abrasive size and type shall be based on the type, grade, and surface condition of the steel to be cleaned, and on the finished surface to be produced for the subsequent paint system.

7.1.3 The cleanliness and sizing of the abrasive shall be maintained to insure compliance with this specification.

8. Inspection

8.1 All work and materials supplied under this specification shall be subject to timely inspection by the purchaser or his authorized representative. The contractor shall correct such work or replace such material as is found defective under this specification. In case of dispute the arbitration or settlement procedure established in the procurement documents, if any, shall be followed. If no arbitration or settlement procedure is established, the procedure specified by the American Arbitration Association shall be used.

8.2 The procurement documents covering work or purchase should establish the responsibility for testing and for any required affidavit certifying full compliance with the specification.

9. Safety

9.1 All safety requirements stated in this specification and its component parts apply in addition to any applicable federal, state, and local rules and requirements. They also shall be in accord with instructions and requirements of insurance underwriters.

10. Notes

10.1 While every precaution is taken to insure that all information furnished in SSPC specifications is as accurate, complete, and useful as possible, the SSPC cannot assume responsibility or incur any obligation resulting from the use of any materials, paints, or methods specified therein, or of the specification itself.

10.2 A Commentary Section is available (Chapter 2 of Volume 2 of the Steel Structures Painting Manual) and contains additional information and data relative to this specification. The Surface Preparation commentary is not part of this specification. The table below lists the subjects discussed relevant to commercial blast cleaning and appropriate Commentary Section.

Subject	Commentary Section
Abrasive Selection	5.0
Degree of Cleaning	11.0
Film Thickness	10.0
Inhibitors	9.0
Maintenance Painting	3.2
Rust Back	8.0
Surface Profile	6.0
Visual Standards	7.0
Weld Spatter	4.1

Steel Structures Painting Council

SURFACE PREPARATION SPECIFICATION NO. 7

Brush-Off Blast Cleaning

1. Scope

1.1 This specification covers the requirements for brush-off blast cleaning of steel surfaces.

2. Definition

2.1 Brush-off blast cleaning is a method of preparing steel surfaces which, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose paint. Tightly adherent mill scale, rust, and paint may remain on the surface.

2.2 Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife.

3. Appearance of the Completed Surface

3.1 The surface shall be roughened to a degree suitable for the specified paint system.

3.2 The entire surface shall be subjected to the abrasive blast. The remaining mill scale, rust, or paint shall be tight and the surface sufficiently abraded to provide good adhesion and bonding of the specified paint system.

3.3 SSPC-Vis 1 or other visual standards of surface preparation agreed upon by the contracting parties may be used to further define the surface.

4. Reference Standards

4.1 The standards referenced in this specification are listed in Section 4.4 and form a part of the specification.

4.2 The latest issue, revision, or amendment of the reference standards in effect on the date of invitation to bid shall govern unless otherwise specified.

4.3 If there is a conflict between the requirements of any of the cited reference standards and the specification, the requirements of the specification shall prevail.

4.4 STEEL STRUCTURES PAINTING COUNCIL (SSPC) SPECIFICATIONS:

SP 1	Solvent Cleaning
Vis 1	Pictorial Surface Preparation Standards for Painting Steel Surfaces

5. Surface Preparation Before and After Blast Cleaning

5.1 Before blast cleaning, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP 1.

5.2 After blast cleaning and prior to painting, perform the following:

5.2.1 Remove visible deposits of oil, grease, or other contaminants (See Section 5.1).

5.2.2 Remove dust and loose residues from dry abrasive blast cleaning. Acceptable methods include brushing, blow off with clean, dry air, or vacuum cleaning. (When compressed air is used for blow-off, use and maintain moisture and oil separators and traps to provide a clean and dry air supply.)

5.2.3 If the surface was wet abrasive blast cleaned, rinse with fresh water to which sufficient corrosion inhibitor has been added to prevent rusting, or with fresh water followed by an inhibitive treatment. Supplement this cleaning by brushing, if necessary, to remove any residues.

5.3 Rectify surface imperfections which become visible after blast cleaning as specified in the procurement documents.

6. Blast Cleaning Methods and Operations

6.1 METHODS:

6.1.1 Dry abrasive blasting using compressed air, blast nozzles, and abrasive;

6.1.2 Dry abrasive blasting using a closed cycle, recirculating abrasive system with compressed air, blast nozzle, and abrasive, with or without vacuum for abrasive recovery;

6.1.3 Dry abrasive blasting, using a closed cycle, recirculating abrasive system with centrifugal wheels and abrasives;

6.1.4 Wet abrasive blasting using compressed air, blast nozzles, water, and abrasive followed by rinse (see Section 5.2.3).

6.2 OPERATION

6.2.1 When compressed air is used for nozzle blasting, use and maintain moisture and oil separators and traps to provide a clean, dry air supply.

6.2.2 Perform blast cleaning operations so that no damage is done to partially or entirely completed portions of the work.

7. Blast Cleaning Abrasives

7.1 ABRASIVES SHALL CONFORM TO THE FOLLOWING REQUIREMENTS:

7.1.1 The abrasive shall be free of corrosion-producing contaminants and also free of oil, grease, or other deleterious contaminants.

7.1.2 Selection of abrasive size and type shall be based on the type, grade, and surface condition of the steel to be cleaned, and on the finished surface to be produced for the subsequent paint system.

7.1.3 The cleanliness and sizing of the abrasive shall be maintained to insure compliance with this specification.

8. Inspection

8.1 All work and materials supplied under this specification shall be subject to timely inspection by the purchaser or his authorized representative. The contractor shall correct such work or replace such material as is found defective under this specification. In case of dispute the arbitration or settlement procedure established in the procurement documents, if any, shall be followed. If no arbitration or settlement procedure is established, the procedure specified by the American Arbitration Association shall be used.

8.2 The procurement documents covering work or purchase should establish the responsibility for testing and for any required affidavit certifying full compliance with the specification.

9. Safety

9.1 All safety requirements stated in this specification and its component parts apply in addition to any applicable federal, state, and local rules and requirements. They also shall be in accord with instructions and requirements of insurance underwriters.

10. Notes

10.1 While every precaution is taken to insure that all information furnished in SSPC specifications is as accurate, complete, and useful as possible, the SSPC cannot assume responsibility or incur any obligation resulting from the use of any materials, paints, or methods specified therein, or of the specification itself.

10.2 A Commentary Section is available (Chapter 2 of Volume 2 of the Steel Structures Painting Manual) and contains additional information and data relative to this specification. The Surface Preparation Commentary is not part of this specification. The table below lists the subjects discussed relevant to brush-off blast cleaning and appropriate Commentary Section.

Subject	Commentary Section
Abrasive Selection	5.0
Degree of Cleaning	11.0
Film Thickness	10.0
Inhibitors	9.0
Maintenance Painting	3.2
Rust Back	8.0
Surface Profile	6.0
Visual Standards	7.0
Weld Spatter	4.1

Steel Structures Painting Council

SURFACE PREPARATION SPECIFICATION NO. 10

Near-White Blast Cleaning

1. Scope

1.1 This specification covers the requirements for near-white blast cleaning of steel surfaces.

2. Definition

2.1 Near-white blast cleaning is a method of preparing steel surfaces which, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, and paint. Generally, evenly dispersed very light shadows, streaks, and discolorations caused by stains of rust, stains of mill scale, and stains of previously applied paint may remain on no more than 5% of the surface.

3. Appearance of the Completed Surface

3.1 The surface shall be roughened to a degree suitable for the specified paint system.

3.2 The appearance of the surface may be affected by the particular blasting abrasive used. Uniformity of color may be affected by the grade, original surface condition, and configuration of the material being cleaned, as well as by discolorations from mill or fabrication marks, and the shadowing from blast cleaning patterns.

3.3 SSPC-Vis 1 or other visual standards of surface preparation agreed upon by the contracting parties may be used to further define the surface.

4. Reference Standards

4.1 The standards referenced in this specification are listed in Section 4.4 and form a part of the specification.

4.2 The latest issue, revision, or amendment of the reference standards in effect on the date of invitation to bid shall govern unless otherwise specified.

4.3 If there is a conflict between the requirements of any of the cited reference standards and the specification, the requirements of the specification shall prevail.

4.4 STEEL STRUCTURES PAINTING COUNCIL (SSPC) SPECIFICATIONS:

SP 1	Solvent Cleaning
Vis 1	Pictorial Surface Preparation Standards for Painting Steel Surfaces

5. Surface Preparation Before and After Blast Cleaning

5.1 Before blast cleaning, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP 1.

5.2 AFTER BLAST CLEANING AND PRIOR TO PAINTING, PERFORM THE FOLLOWING:

5.2.1 Remove rust which becomes visible when viewed without magnification.

5.2.2 Remove visible deposits of oil, grease, or other contaminants (see Section 5.1).

5.2.3 Remove dust and loose residues from dry abrasive blast cleaning. Acceptable methods include brushing, blow off with clean, dry air, or vacuum cleaning. (When compressed air is used for blow off, use and maintain moisture and oil separators and traps to provide a clean and dry air supply.)

5.2.4 If the surface was wet abrasive blast cleaned, rinse with fresh water to which sufficient corrosion inhibitor has been added to prevent rusting, or with fresh water followed by an inhibitive treatment. Supplement this cleaning by brushing, if necessary, to remove any residues.

5.3 Rectify surface imperfections which become visible after blast cleaning as specified in the procurement documents.

6. Blast Cleaning Methods and Operation

6.1 METHODS:

6.1.1 Dry abrasive blasting using compressed air, blast nozzles, and abrasive;

6.1.2 Dry abrasive blasting using a closed cycle, recirculating abrasive system with compressed air, blast nozzle, and abrasive, with or without vacuum for abrasive recovery;

6.1.3 Dry abrasive blasting, using a closed cycle, recirculating abrasive system with centrifugal wheels and abrasive;

6.1.4 Wet abrasive blasting using compressed air, blast nozzles, water, and abrasive followed by rinse (see Section 5.2.4).

6.2 OPERATION

6.2.1 When compressed air is used for nozzle blasting, use and maintain moisture and oil separators and traps to provide a clean, dry air supply.

6.2.2 Perform blast cleaning operations so that no damage is done to partially or entirely completed portions of the work.