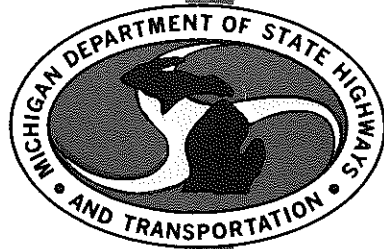


11/2/58

ALTERNATE, MORE ECONOMICAL REPAINTING  
SYSTEMS FOR BRIDGE STRUCTURAL STEEL  
(First Progress Report)



**TESTING AND RESEARCH DIVISION  
RESEARCH LABORATORY SECTION**

ALTERNATE, MORE ECONOMICAL REPAINTING  
SYSTEMS FOR BRIDGE STRUCTURAL STEEL

(First Progress Report)

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A Highway Planning and Research Investigation  
Conducted by the Michigan Department of Transportation  
In Cooperation with the U. S. Department of Transportation,  
Federal Highway Administration

A Cooperative Project Between the  
Testing and Research and Maintenance Divisions

Research Laboratory Section  
Testing and Research Division  
Research Project 76 G-219  
Research Report No. R-1123

Michigan Transportation Commission  
Hannes Meyers, Jr., Chairman; Carl V. Pellonpaa,  
Vice-Chairman; Weston E. Vivian, Rodger D. Young,  
Lawrence C. Patrick, Jr., William C. Marshall  
John P. Woodford, Director  
Lansing, July 1979

## INTRODUCTION

In May of 1976, a proposal was submitted to the Federal Highway Administration, U. S. Department of Transportation, by the Michigan Department of Transportation for a Highway Planning and Research Project to be conducted by the Department's Maintenance and Testing and Research Divisions. The primary objective of the project was to determine by field evaluation whether a structural steel coating system, based on a one or two-coat application can provide a rust-preventive system whose service life protection is comparable to the Department's currently specified four-coat system when applied at equivalent dry-film thickness.

This preliminary report describes the application of the coatings on the structure selected for the experiment and makes general observations concerning the project. Further reports will describe the durability of the coatings as determined by periodic observations of the structure. The contents of this report reflect the view of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

### The Problem

The Michigan highway system has about 2,500 bridges utilizing painted steel as structural members. Current specifications require that the steel be painted with a four-coat paint system. The service life of this paint system has averaged about 15 years. Dividing 2,500 bridges by 15 years shows the average, annual maintenance repainting work load as 167 bridges. This work load has never been approached by the Department, which suggests we are accumulating a backlog.

Currently, we are unaware of a paint system that would increase the average service life of 15 years on our structures; thus, the indicated alternative is to lower the cost of maintenance repainting without lowering the service life of the repainting.

### Scope

The four-coat system generally specified for maintenance repainting of bridge structural steel is the same as specified for new construction. The steel is prepared for painting by blast cleaning, and the paints are based on a combination linseed oil-alkyd vehicle; most contain some lead compounds in the pigmentation. The lead compounds are incorporated in

the paints because they confer rust inhibition to the dried films. However, there is the possibility that the lead pigments will be banned in the future because of inherent toxicity; thus, the Department should evaluate alternate coating systems in case of that eventuality (a secondary objective of the project). This four-coat paint system can be applied by brush, roller, or spray. Four days of good drying weather are required between applications of succeeding coats of paint.

In an effort to lower the cost of maintenance repainting, a one-coat and a two-coat paint system that utilize petroleum based vehicles conforming to SSPC-PS 8.01, "Specification for a Rust Preventive Thick-Film Coating System" are being evaluated. Auto underbody rustproofers are a type meeting this specification; the combination wax-greases, used by the Army and Navy to store rifles, are another type meeting this specification. The type we propose to use must be applied by spray, including airless spray. It dries to a firm film by evaporation of the thinner.

Besides SSPC-PS 8.01 specification coatings being used as auto underbody rustproofers and for protection of machine components during long-term storage, coating materials of this type are being used by cities and counties for the protection of bridge structural steel with evaluation results not sufficiently documented to be meaningful. We are not aware of coating materials of this type being evaluated by any of the state highway departments for the protection of bridge structural steel.

Evaluation of the merits of the proposed one and two-coat systems will be based on the in-service exposure of structural steel on a bridge in need of maintenance repainting. The Department's standard four-coat system will also be applied on the structure for comparative purposes.

### Benefits

The test coating system conforming to SSPC-PS 8.01 specifications is a lower cost system than the Department's currently specified four-coat system since the paint is of marginally lower cost and application costs would be significantly lower by a reduction from the standard four to the test-proposed one or two coats. It is estimated that savings for maintenance repainting of bridge structural steel would be upwards of 30 percent for the test systems, at equal dry-film thickness of coating.

A secondary benefit would be a reduction of the hazardous traffic blockages required for each maintenance repainting of a structure, since the number of coat applications are fewer for the test systems.

## Research Procedure

A bridge in southern Michigan was selected which was in need of its first maintenance repainting. This was a four-span grade separation structure of the dual type, providing four test areas of equal exposure severity on the four interior spans over traffic lanes. These test areas are as shown in the figure in Appendix A.

After removing all old paint and rust by sandblasting, the following systems were applied to the four test areas, respectively:

Area 1) Reference System - the Department's standard four-coat system, using an aluminum topcoat to a total dry-film thickness of 5+ mils.

Area 2) Reference System (secondary) - one coat of inorganic zinc primer meeting requirements of MIL-P-23236 Specification to a 2.5 mil thickness. After drying, topcoat to a total dry-film thickness of 5 mils with an aluminum vinyl meeting requirements of SSPC No. 8, or approved equal.

Area 3) One coat of SSPC-PS 8.01, unpigmented, to a dry-film thickness of 5 mils. After drying, topcoat to a total dry-film thickness of 10 mils with the SSPC-PS 8.01, pigmented with aluminum.

Area 4) One coat of SSPC-PS 8.01, pigmented with aluminum, to a dry-film thickness of 6 mils. Multipasses of the spray gun are anticipated to obtain this thickness in one coat.

The above test paint systems were applied under contract by a professional applicator. The Department provided personnel to collect data on man-hours spent to apply the coatings for an economic analysis. These personnel also noted the ease of application and any problems encountered during application.

Regarding the above test areas, No. 4 should determine whether the petroleum coating, applied in one coat, would be at satisfactory dry-film thickness uniformity, and whether it would dry without alligating (similar to mud cracking in clays).

Test Area No. 3 should provide information on whether the petroleum coating, applied in two coats, shows improvement over No. 4 regarding thickness uniformity and alligating.

Test Areas 1 and 2, using Reference Paint Systems, would provide a base by which to judge comparative performance of test systems 3 and 4.

Area No. 2 reference system was included since it gave promising performance in a 1973 test maintenance repainting on an I 94 structure. It is a possible alternate two-coat system, though more expensive than the SSPC-PS 8.01 petroleum based system.

The performances are to be determined by periodic annual inspections for an additional five years.

## PROJECT STUDY

### Initial Phase

After the proposal was reviewed and approved by the Department and by the Federal Highway Administration, a bridge was selected and painting specifications for the Contract Proposal were drafted.

The bridge selected was S01 of 38103 carrying Sargent Rd over I 94 several miles east of Jackson. It is a standard grade separation built in 1960 and was in need of its first maintenance repainting. It is a four-span structure 213 ft long consisting of 33-in. and 26-in. rolled I-beams with a structural steel weight of about 122 tons.

For this study, the bridge steel consisting of eight rows of longitudinal beams was subdivided into four equal areas as shown in Figure 1 of Appendix A.

Painting specifications covering the four test areas are presented in Appendix A, and are copied from the Project Proposal. The coating system for Test Area 1 is the Department's standard four-coat system for the construction or maintenance painting of bridge structural steel and is the control system for the study. It is based on a red lead primer with all four coats utilizing an alkyd-linseed oil vehicle. Test Area 2 can be considered as utilizing a second control system since the Department has experimented with it on several structures since 1973; it is a two-coat system based on an inorganic zinc-rich primer and vinyl topcoat. Test Areas 3 and 4 use a heretofore untested coating being applied: a) in a single coat for lowest possible application cost; and, b) in a two-coat application to determine if thickness uniformity is improved thereby.

### Coatings Applications

A contract was awarded on August 18, 1976, to Abhe and Svoboda, Inc. of Prior Lake, Minnesota for \$22,900 with work scheduled to begin about September 13, 1976. However, since the contractor was working on three

other Department contracts covering repainting of bridges in the Detroit area, work on the test bridge repainting was postponed beyond early October. At this point, Department representatives were considering delaying the project until 1977. The contractor, however, gave a firm commitment to start work on October 11, 1976, and was given approval to do so. Actually, preparation of bridge steel by sandblasting did not begin until October 13, though delivery of equipment and signing was made on October 11 and 12 with the contractor learning he would have to coordinate lane blockage with another contractor concluding a pavement resurfacing project in the vicinity.

The chronology of the test cleaning and painting is given in Appendix B. It is to be noted that except for the first few days when one assistant was added, the work crew consisted of only two men. The weather was colder than normal for this time of year, extending into December 10, 1976 when the painting was completed.

#### Thickness Measurements of Coatings

The dry-film thickness of the coatings were not determined immediately after application because with the exception of the inorganic zinc-vinyl system, they were too soft for magnetic gage determinations.

No attempt was made to measure film thicknesses until March 15, 1977, when a cursory inspection was made. Measurements were taken at both ends of the structure where the surfaces could be checked without lift equipment. These measurements indicated that film thicknesses for the four-coat system were adequate but were marginal for the two-coat inorganic zinc-vinyl system. Measurements of film thicknesses for the petroleum based systems (one and two-coat) were quite erratic with many low measurements. Also, many areas were showing rust, particularly on flange edges.

It was intended that a more comprehensive inspection would be made as soon as possible using a 'cherry picker.' This was scheduled for April 28, 1977 but was cancelled because the equipment had to be used elsewhere. Because it was considered very important to determine the reason for the rusty areas as soon as possible, Research Laboratory personnel met with the representative of the producer of the petroleum based coating, at the job site April 29, 1977, to examine the areas in question.

Since an Elcometer film gauge does not work well on soft films, a wet film thickness gauge was used to check the areas in question. After checking, an aerosol of the same material was used to repair any damage to the

film. The results of this investigation showed that all rusty areas examined had film thicknesses of from less than 1 to 2 mils.

It was recommended that the contractor be asked to repair Areas 3 and 4 as follows:

1) use compressed air to remove dust and dirt from the tops of bottom flanges,

2) wipe rusted areas with solvent-dampened rags to remove rust deposited on coating surface,

3) recoat rusted areas and any other areas found to be deficient in film thickness using specified airless spray equipment.

The contractor returned to correct the film deficiencies on June 7, 1977. In addition to repairing the rusty areas, he applied an additional coat to both Areas 3 and 4.

On September 9, 1977, a van-mounted cherry picker was used to make extensive film thickness measurements on all areas. An Elcometer magnetic film gauge was used on Areas 1 and 2, and a wet film thickness gauge was used on Areas 3 and 4. Measurements obtained are shown in Appendix C.

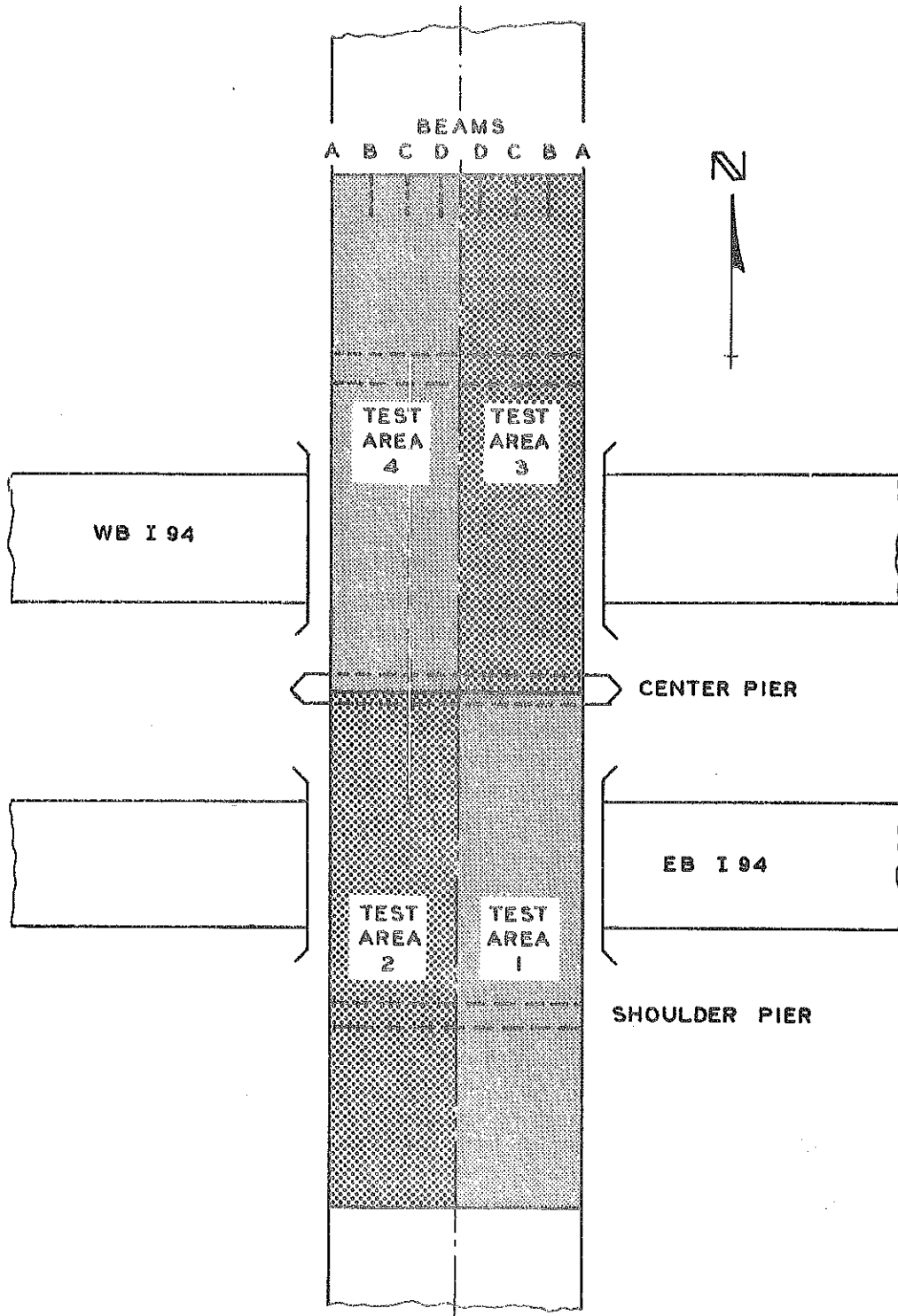
The above measurements show that the four-coat control system (Area 1) which was applied by roller is relatively uniform in thickness although some measurements of less than the specified minimum of 5.4 mils were recorded. The secondary control system (inorganic zinc-rich primer and vinyl topcoat) in Area 2, which was spray applied, showed many areas with measurements of 2 mils compared to the specified minimum of 5 mils.

Area 3 had film thickness measurements of 9 to 20+ mils compared to the specified minimum of 10 mils and Area 4 had measurements of 5 to 20 mils compared to the specified minimum of 6 mils.

Biannual inspections in 1978 and 1979 have shown that the materials applied by spray (Areas 2, 3, and 4) are showing some rust and rust staining in locations where the film thicknesses are inadequate. Also, there are a few areas where failure is occurring due to application of the coating over debris from the sandblasting operation. The four-coat oil-alkyd system (used as a control) and which was applied by roller, has a reasonably uniform and adequate film thickness and has shown no signs of failure.



APPENDIX A



Test paint areas on S01 of 38103 (Sargent Rd) over I 94 east of Jackson.

SUPPLEMENTAL SPECIFICATIONS  
FOR  
CLEANING AND PAINTING STEEL STRUCTURES  
(Using a Four-Coat Paint System)

Test Area No. 1 on S01 of 38103 Structure

Description

This work will consist of complete blast cleaning and painting metal surfaces of existing structures, including downspouts, sign brackets, and utility conduits where called for in the proposal, and excluding hand railing and chain link enclosures.

The work shall be done in accordance with the 1976 Michigan Standard Specifications for Highway Construction except as otherwise provided in the proposal.

Materials

The Paint shall conform to the following specifications:

No. 1-69 Red Lead Paint, Section 8.17 of the current Standard Specifications.

No. 2MP(65) Brown Maintenance Paint, Section 8.17 of the current Standard Specifications.

No. 3-65 Gray Paint, Section 8.17 of the current Standard Specifications.

No. 5-57 Aluminum Paint for Structural Steel-Finish Coat, Section 8.17 of the current Standard Specifications.

The Painting System

The Painting System shall consist of the following:

1. Prime all cleaned steel with No. 1-69 Red Lead Paint.
2. Apply second coat with No. 2MP(65) Brown Maintenance Paint.
3. Apply third coat with No. 3-65 Gray Paint.
4. Apply fourth (finish) coat with No. 5-57 Aluminum Paint.

Cleaning of Structure

The steel surfaces to be painted shall be blast cleaned.

All old paint shall be removed from the steel surfaces by an approved blast cleaning apparatus. Blast cleaning shall also remove all mill scale, rust, and stain and shall be sufficient to give the appearance of unpolished cast aluminum, near white.

Care must be taken during these operations to protect freshly painted surfaces, galvanized fence enclosures at Pedestrian bridges, and any adjacent concrete from blast cleaning damage. Scaling hammers are permissible to remove heavy scale, but heavier type chipping hammers that would extensively scar the metal shall not be used.

Abrasives used for blast cleaning shall be either clean dry sand, mineral, or manufactured grit meeting the following minimum requirement:

The gradation of the abrasives shall be such that 100% shall pass the No. 12 sieve and not more than 5% shall pass the No. 40 sieve.

Any residue resulting from blast cleaning shall be removed before any paint is applied. The blast cleaned surface shall be given a coat of No. 1-69 Red Lead Paint preferably within 24 hours after blast cleaning, but in any event, before any visible rusting occurs.

#### Painting of Structures

After the steel surface has been cleaned and approved by the Engineer, the paint shall be applied by brush or roller so as to produce a uniform, even coating bonded with the metal and shall be worked into all corners and crevices. Succeeding coats shall also be so applied. All painting must be done in a neat and workmanlike manner.

Mixing Paint - Paint shall be thoroughly mixed before application by stirring by hand or by mechanical agitators and by "Boxing" back and forth between containers. Mixing shall be done as far as possible in the original containers and shall be continued until all of the pigment is in suspension. The paint shall be frequently stirred during this application to prevent segregation.

Thinning Paint - Paint as delivered in containers when thoroughly mixed is ready for use. If it is necessary in cool weather to thin the paint in order that it shall spread more freely, this shall be done only by heating in hot water or on steam radiators, and liquid shall not be added nor removed unless permitted by the Engineer.

Application of Paint - Paint shall be applied only when the air temperature is above 40°F. It shall be applied upon dry surfaces and upon metal free from frost and shall not be applied when the air is damp or misty or

otherwise, in the opinion of the Engineer, unsatisfactory for the work. Painting shall not be done when the metal is hot enough to cause the paint to blister and produce a porous paint film.

Not less than 4 days of good drying time shall elapse after application of No. 1-69 Red Lead Paint before any succeeding coat of paint may be applied.

Not less than 4 days of good drying time shall elapse after the application of each coat of No. 2MP(65) Brown Paint or No. 3-65 Gray Paint before any succeeding coat of paint may be applied.

Coating Thickness - The dry film thickness of each coat of No. 1 or No. 2 Paint shall not be less than 1.5 mils; the dry film thickness of No. 3 Paint shall be not less than 1.2 mils, and the dry film thickness of the No. 5 Paint shall be not less than 1.2 mils. The thickness of the coatings will be determined by the Engineer by use of a magnetic dry-film thickness gauge. If the required minimum dry film thicknesses are estimated by the Engineer from a wet film during paint application by use of a wet film thickness gauge, then the following conversions will apply:

- a. The dry thickness of 1.5 mils of No. 1-69 film requires an initial minimum wet thickness of 2.0 mils.
- b. The dry thickness of 1.5 mils of No. 2MP(65) film requires an initial minimum thickness of 2.1 mils.
- c. The dry thickness of 1.2 mils of No. 3-65 film requires an initial minimum wet thickness of 1.8 mils.
- d. The dry thickness of 1.2 mils in No. 5-57 paint film requires an initial minimum wet thickness of 2.0 mils.

Metal rollers or clamps and all other fastening devices for scaffolds and equipment attached to the structural steel which will mar or damage freshly painted surfaces will be prohibited. It will be required that rubber rollers or other protective devices, as approved by the Engineer, be used on scaffold fastenings for the purpose of protecting the freshly painted surfaces.

#### Protection of Work

Pedestrian and vehicular or other traffic upon or underneath the structure shall be protected as provided in Section 1.05.13 of the 1976 Standard Specifications for Highway Construction. All portions of the structures (superstructure, substructure, slope protection, and highway appurtenances) shall be protected against splatter, splashes, and smirches of paint or paint materials by means of protective covering suitable for the purpose.

Similar protection shall be afforded any highway appurtenances that could be damaged by blast cleaning operations. The Contractor shall be responsible for any damage caused by his operations to vehicles, persons, or property.

During blast cleaning operations, provisions must be made by the Contractor to protect existing traffic from any hazards resulting from the blast cleaning operations. These provisions shall include a type of barrier system which would protect against direct blasting of vehicles or pedestrians, eliminate abrasive materials and debris from falling on the traveled portions of the pavement, and prevent the spreading of abrasive materials and debris in the area which would create a traffic hazard. At the pre-construction meeting, the Contractor must submit a plan detailing the method of protection to be used.

Whenever the intended purposes of the protective devices are not accomplished, work shall be suspended until corrections are made. In addition, any abrasive material and debris deposited on the pavement, shoulders, or slope paving in the working area must be removed before those areas are reopened to traffic.

Employees performing the blast cleaning operations shall be provided with an air-supplied sand blasting hood approved by the U. S. Bureau of Mines. The air supply system shall include, but not be limited to, the following approved safety features: air line filter, pressure reducing valve with gauge, and pressure release valve. Air supply to the employee shall not be contaminated with harmful materials or elements.

The Contractor shall carry the minimum insurance as specified in Article 1.07.08, Damage Liability and Insurance, of the 1976 Standard Specifications for Highway Construction.

#### Method of Measurement

"Cleaning of Steel Structures" will be measured as a unit, for each structure.

"Painting of Steel Structures" will be measured as a unit, for each structure.

"Cleaning and Painting Utility Conduits" will be measured as a unit, for each structure.

The type of structure, span, width of roadway, and tons of steel may be shown on the plans or in the proposal as information for the bidder. The estimate of materials and labor for each structure is entirely the responsibility of the bidder.

## Basis of Payment

"Cleaning of Steel Structures" will be paid for at the contract lump sum price, which price shall be payment in full for furnishing all the labor, materials, and equipment to blast clean the structural steel and provide all the necessary health and safety equipment as specified herein.

"Painting Steel Structures" will be paid for at the contract lump sum price, which price will be payment in full for furnishing all the labor, materials, and equipment to paint the structural steel and provide all the necessary health and safety equipment as specified herein.

"Cleaning and Painting Utility Conduits" will be paid for at the contract lump sum price, which price will be payment in full for furnishing all labor, materials, and equipment required to blast clean and paint the utility conduits where called for in the proposal and to provide all the necessary health and safety equipment as specified herein.

(Experimental)

SUPPLEMENTAL SPECIFICATIONS  
FOR  
CLEANING AND PAINTING STEEL STRUCTURES  
(Using a Two-Coat Paint System)

Test Area No. 2 on S01 of 38103 Structure

Description

This work will consist of complete blast cleaning and painting metal surfaces of existing structures, including downspouts, sign brackets, and utility conduits where called for in the proposal, and excluding hand railing and chain link enclosures.

The work shall be done in accordance with the 1976 Michigan Standard Specifications for Highway Construction except as otherwise provided in the proposal.

Materials

The Paint shall conform to the following specifications:

No. 11 Inorganic Zinc Primer, specifications attached.

No. 936 Aluminum Paint for Structural Steel-Finish Coat, specifications attached.

The Painting System

The Painting System shall consist of airless spray application of the following:

1. Prime all cleaned steel with No. 11 Inorganic Zinc Paint (green).
2. Apply second coat with No. 936 Aluminum Vinyl Finish Paint.

Cleaning of Structure

The steel surfaces to be painted shall be blast cleaned.

All old paint shall be removed from the steel surfaces by an approved blast cleaning apparatus. Blast cleaning shall also remove all mill scale, rust, and stain and shall be sufficient to give the appearance of unpolished cast aluminum, near white.

Care must be taken during these operations to protect freshly painted surfaces, galvanized fence enclosures at Pedestrian bridges, and any



adjacent concrete from blast cleaning damage. Scaling hammers are permissible to remove heavy scale, but heavier type chipping hammers that would extensively scar the metal shall not be used.

Abrasives used for blast cleaning shall be either clean dry sand, mineral, or manufactured grit meeting the following minimum requirement:

The gradation of the abrasives shall be such that 100% shall pass the No. 12 sieve and not more than 5% shall pass the No. 40 sieve.

Any residue resulting from blast cleaning shall be removed before any paint is applied. The blast cleaned surface shall be given a coat of Zinc-Rich Paint preferably within 8 hours after blast cleaning, but in any event, before any visible rusting occurs.

#### Painting of Structure

After the steel surface has been cleaned and approved by the Engineer, the paint shall be applied by airless spray so as to produce a uniform, even coating bonded with the metal and shall be worked into all corners and crevices. Succeeding coats shall also be so applied. All painting must be done in a neat and workmanlike manner.

Mixing Paint - Paint shall be mixed in accordance with producer's directions and be thoroughly mixed before application by stirring by hand or by mechanical agitators and by "Boxing" back and forth between containers. Mixing shall be done as far as possible in the original containers and shall be continued until all of the pigment is in suspension. The paint shall be frequently stirred during this application to prevent segregation.

Thinning Paint - Paint when thoroughly mixed is ready for use. If it is necessary in cool weather to thin the paint in order that it shall spray more freely, this shall be done only in accordance with producer's recommendations.

Application of Paint - Paint shall be applied only when the air temperature is above 40°F. It shall be applied upon dry surfaces and upon metal free from frost and shall not be applied when the air is damp or misty or otherwise, in the opinion of the Engineer, unsatisfactory for the work. Painting shall not be done when the metal is hot enough to cause the paint to blister and produce a porous paint film.

Not less than 2 days of good drying time shall elapse after the application of the Zinc-Rich Paint before the second coat of paint may be applied.

Coating Thickness - The dry film thickness of each coat of No. 11 or No. 936 Paint shall not be less than 2.5 mils. The thickness of the coatings will be determined by the Engineer by use of a magnetic dry-film thickness gauge. If running and/or sagging occur when the coatings are

spray applied in one coat, the paint shall be applied in 2 passes of the gun, separated by several minutes.

Metal rollers or clamps and all other fastening devices for scaffolds and equipment attached to the structural steel which will mar or damage freshly painted surfaces will be prohibited. It will be required that rubber rollers or other protective devices, as approved by the Engineer, be used on scaffold fastenings for the purpose of protecting the freshly painted surfaces.

#### Protection of Work

Pedestrian and vehicular or other traffic upon or underneath the structure shall be protected as provided in Section 1.05.13, Health and Safety Requirements, of the 1976 Standard Specifications for Highway Construction. All portions of the structures (superstructure, substructure, slope protection, and highway appurtenances) shall be protected against splatter, splashes, and smirches of paint or paint materials by means of protective covering suitable for the purpose. Similar protection shall be afforded any highway appurtenances that could be damaged by blast cleaning operations. The Contractor shall be responsible for any damage caused by his operations to vehicles, persons, or property.

During blast cleaning operations, provisions must be made by the Contractor to protect existing traffic from any hazards resulting from the blast cleaning operations. These provisions shall include a type of barrier system which would protect against direct blasting of vehicles or pedestrians, eliminate abrasive materials and debris from falling on the traveled portions of the pavement, and prevent the spreading of abrasive materials and debris in the area which would create a traffic hazard. At the pre-construction meeting, the Contractor must submit a plan detailing the method of protection to be used.

Whenever the intended purposes of the protective devices are not accomplished, work shall be suspended until corrections are made. In addition, any abrasive material and debris deposited on the pavement, shoulders, or slope paving in the working area must be removed before those areas are reopened to traffic.

Employees performing the blast cleaning operations shall be provided with an air-supplied sand blasting hood approved by the U. S. Bureau of Mines. The air supply system shall include, but not be limited to, the following approved safety features: air line filter, pressure reducing valve with gauge, and pressure release valve. Air supply to the employee shall not be contaminated with harmful materials or elements.

The Contractor shall carry the minimum insurance as specified in Article 1.07.08, Damage Liability and Insurance, of the 1976 Standard Specifications for Highway Construction.

### Method of Measurement

"Cleaning of Steel Structures" will be measured as a unit, for each structure.

"Painting of Steel Structures" will be measured as a unit, for each structure.

"Cleaning and Painting Utility Conduits" will be measured as a unit, for each structure.

The type of structure, span, width of roadway, and tons of steel may be shown on the plans or in the proposal as information for the bidder. The estimate of materials and labor for each structure is entirely the responsibility of the bidder.

### Basis of Payment

"Cleaning of Steel Structures" will be paid for at the contract lump sum price, which price shall be payment in full for furnishing all the labor, materials, and equipment to blast clean the structural steel and provide all the necessary health and safety equipment as specified herein.

"Painting Steel Structures" will be paid for at the contract lump sum price, which price will be payment in full for furnishing all the labor, materials, and equipment to paint the structural steel and provide all the necessary health and safety equipment as specified herein.

"Cleaning and Painting Utility Conduits" will be paid for at the contract lump sum price, which price will be payment in full for furnishing all labor, materials, and equipment required to blast clean and paint the utility conduits where called for in the proposal and to provide all the necessary health and safety equipment as specified herein.

### Source of Materials

1. No. 11 Inorganic Zinc Primer is identified by producer as Carbo Zinc 11 (green). It is a self-curing, zinc-filled inorganic coating furnished in two containers, which are mixed just before use. The mixed paint must be used within 10 hours, or be discarded.

- (1) Mixing: Mix thoroughly before spraying.
- (2) Spraying: The paint container must include a stirrer to keep pigment in suspension.
- (3) Theoretical Coverage per Gallon: 1,000 mil-sq ft.
- (4) Clean-Up Solvent: Producer's recommendation.
- (5) Producer: Carboline of St. Louis, Missouri.

Michigan Representative: Paint, Coatings Associates, Inc.  
7214 W. Vernor  
Detroit, Michigan 48209

2. No. 936 Aluminum Vinyl Finish Paint is identified by producer as Polyclad 936-1 Aluminum furnished in one container.

- (1) Mixing: Mix thoroughly before spraying.
- (2) Theoretical Coverage per Gallon: 550 mil-sq ft.
- (3) Clean-Up Solvent: Producer's recommendation.
- (4) Producer: Carboline of St. Louis, Missouri (as above).

(Experimental)

SUPPLEMENTAL SPECIFICATIONS  
FOR  
CLEANING AND PAINTING STEEL STRUCTURES  
(Using a One-Coat and a Two-Coat Paint System)

Test Areas No. 3 and No. 4 on S01 of 38103 Structure

Description

This work will consist of complete blast cleaning and painting metal surfaces of existing structures, including downspouts, sign brackets, and utility conduits where called for in the proposal, and excluding hand railing and chain link enclosures.

The work shall be done in accordance with the 1976 Michigan Standard Specifications for Highway Construction except as otherwise provided in the proposal.

Test Area No. 3

Materials

The Paint shall conform to the following specifications:

No. 506G Rust Preventive, specifications attached.

No. 680 Aluminum Rust Preventive-Finish Coat, specifications attached.

The Painting System

The Painting System shall consist of airless spray application of the following:

1. Prime all cleaned steel with No. 506G Rust Preventive (Brown).
2. Apply second coat with No. 680 Aluminum Rust Preventive Finish Paint.

Test Area No. 4

Materials

The Paint shall conform to the following specifications:

No. 680 Aluminum Rust Preventive, specifications attached.

## The Painting System

The Painting System shall consist of airless spray application of the following:

1. Coat all cleaned steel with No. #80 Aluminum Rust Preventive.

## Cleaning of Structure

The steel surfaces to be painted shall be blast cleaned.

All old paint shall be removed from the steel surfaces by an approved blast cleaning apparatus. Blast cleaning shall also remove all mill scale, rust, and stain and shall be sufficient to give the appearance of unpolished cast aluminum, near white.

Care must be taken during these operations to protect freshly painted surfaces, galvanized fence enclosures at Pedestrian bridges, and any adjacent concrete from blast cleaning damage. Scaling hammers are permissible to remove heavy scale, but heavier type chipping hammers that would extensively scar the metal shall not be used.

Abrasives used for blast cleaning shall be either clean dry sand, mineral, or manufactured grit meeting the following minimum requirement:

The gradation of the abrasives shall be such that 100% shall pass the No. 12 sieve and not more than 5% shall pass the No. 40 sieve.

Any residue resulting from blast cleaning shall be removed before any paint is applied. The blast cleaned surface shall be given a coat of Zinc-Rich Paint preferably within 8 hours after blast cleaning, but in any event, before any visible rusting occurs.

## Painting of Structure

After the steel surface has been cleaned and approved by the Engineer, the paint shall be applied by airless spray so as to produce a uniform, even coating bonded with the metal and shall be worked into all corners and crevices. Succeeding coats shall also be so applied. All painting must be done in a neat and workmanlike manner.

Mixing Paint - Paint shall be mixed in accordance with producer's directions and be thoroughly mixed before application by stirring by hand or by mechanical agitators and by "Boxing" back and forth between containers. Mixing shall be done as far as possible in the original containers and shall be continued until all of the pigment is in suspension. The paint shall be frequently stirred during this application to prevent segregation.

Thinning Paint - Paint when thoroughly mixed is ready for use. If it is necessary in cool weather to thin the paint in order that it shall spray more freely, this shall be done only in accordance with producer's recommendations.

Application of Paint - Paint shall be applied only when the air temperature is above 40°F. It shall be applied upon dry surfaces and upon metal free from frost and shall not be applied when the air is damp or misty or otherwise, in the opinion of the Engineer, unsatisfactory for the work. Painting shall not be done when the metal is hot enough to cause the paint to blister and produce a porous paint film.

Not less than 1 day of good drying time shall elapse after the application of the Primer before the second coat of paint may be applied.

Coating Thickness - The total dry film thickness of the coating systems shall be not less than 6.0 mils for Test Area No. 4, and not less than 10.0 mils for Test Area No. 3. On Test Area No. 3, the Primer shall provide about half of the required total thickness. If running and/or sagging occur when the coatings are spray applied in one coat, the paint shall be applied in 2 passes of the gun, separated by several minutes.

Metal rollers or clamps and all other fastening devices for scaffolds and equipment attached to the structural steel which will mar the painted surfaces will be prohibited.

#### Protection of Work

Pedestrian and vehicular or other traffic upon or underneath the structure shall be protected as provided in Section 1.05.13, Health and Safety Requirements, of the 1976 Standard Specifications for Highway Construction. All portions of the structures (superstructure, substructure, slope protection, and highway appurtenances) shall be protected against splatter, splashes, and smirches of paint or paint materials by means of protective covering suitable for the purpose. Similar protection shall be afforded any highway appurtenances that could be damaged by blast cleaning operations. The Contractor shall be responsible for any damage caused by his operations to vehicles, persons, or property.

During blast cleaning operations, provisions must be made by the Contractor to protect existing traffic from any hazards resulting from the blast cleaning operations. These provisions shall include a type of barrier system which would protect against direct blasting of vehicles or pedestrians, eliminate abrasive materials and debris from falling on the traveled portions of the pavement, and prevent the spreading of abrasive materials and debris in the area which would create a traffic hazard. At the pre-construction meeting, the Contractor must submit a plan detailing the method of protection to be used.

Whenever the intended purposes of the protective devices are not accomplished, work shall be suspended until corrections are made. In addition, any abrasive material and debris deposited on the pavement, shoulders, or slope paving in the working area, must be removed before those areas are reopened to traffic.

Employees performing the blast cleaning operations shall be provided with an air-supplied sand blasting hood approved by the U. S. Bureau of Mines. The air supply system shall include, but not be limited to, the following approved safety features: air line filter, pressure reducing valve with gauge, and pressure release valve. Air supply to the employee shall not be contaminated with harmful materials or elements.

The Contractor shall carry the minimum insurance as specified in Article 1.07.08, Damage Liability and Insurance, of the 1976 Standard Specifications for Highway Construction.

#### Method of Measurement

"Cleaning of Steel Structures" will be measured as a unit, for each structure.

"Painting of Steel Structures" will be measured as a unit, for each structure.

"Cleaning and Painting Utility Conduits" will be measured as a unit, for each structure.

The type of structure, span, width of roadway, and tons of steel may be shown on the plans or in the proposal as information for the bidder. The estimate of materials and labor for each structure is entirely the responsibility of the bidder.

#### Basis of Payment

"Cleaning of Steel Structures" will be paid for at the contract lump sum price, which price shall be payment in full for furnishing all the labor, materials, and equipment to blast clean the structural steel and provide all the necessary health and safety equipment as specified herein.

"Painting Steel Structures" will be paid for at the contract lump sum price, which price will be payment in full for furnishing all the labor, materials, and equipment to paint the structural steel and provide all the necessary health and safety equipment as specified herein.

"Cleaning and Painting Utility Conduits" will be paid for at the contract lump sum price, which price will be payment in full for furnishing all labor,



materials, and equipment required to blast clean and paint the utility conduits where called for in the proposal and to provide all the necessary health and safety equipment as specified herein.

Source of Materials

- A. 1. No. 506G Rust Preventive is identified by producer as Tectyl 506G.
- 2. Mix thoroughly before spraying.
- 3. Spray Apparatus - Use heavy duty 20:1 to 50:1 ratio pump with 4-1/2" or larger air motor; and material hose 3/8" I.D. minimum. Roto clean nozzles with 0.018" to 0.021" tungsten carbide tips are recommended.
- 4. Theoretical Coverage per Gallon - 600 mil-sq ft.
- 5. Clean-Up Solvent - Producer's recommendation.
- 6. Producer: F. A. Scott of Ashland Petroleum Co.  
2785 Prairie Drive  
Adrian, Michigan 49221
  
- B. 1. No. 680 Aluminum Rust Preventive is identified by producer as Tectyl MC 680.
- 2-6. As above.

**APPENDIX B**

**CHRONOLOGY OF TEST  
CLEANING AND PAINTING**

CHRONOLOGY OF TEST CLEANING AND PAINTING  
STEEL I-BEAMS OF SARGENT RD OVER I 94

1. October 11-12, 1976. Delivery of blasting and painting equipment, sand, signing, and supplies to job site.

2. October 13-16. Removal of old paint and rust by sandblasting on Areas 1 and 2, beginning at center pier. Initial work was rated as sub-standard, which the contractor corrected, and, thereafter, supplied the required grade of blast cleaning (near-white).

3. October 18-20. Blast cleaning completed early on the 18th. Primer application on Area 1 by roller and on Area 2 by airless spray. Topcoat application on Area 2 by airless spray.

4. October 22-23. Sandblasting had begun on south spans of Areas 3 and 4 over interior shoulder on 22nd, then over traffic lane on 23rd. Coatings were applied by airless spray over cleaned steel with the paint supplier helping to determine correct film thickness.

5. October 25-26. Blast cleaning and application of coatings over passing lane of I 94, on Areas 3 and 4.

6. October 28-30. Blast cleaning and application of coatings over north spans of Areas 3 and 4. On two east beams of Area 3 aluminum was substituted for brown primer (used up). Application of aluminum over brown primer on Area 3 south span. Application of 2 MP brown on Area 1. Application of more vinyl topcoat on north half of Area 2 because the coating was too thin. Application of aluminum topcoat on Area 3 north span.

7. November 16-20. After being prevented from continuing by project staff, contractor complied by submitting required reports. Application of No. 3 Gray to Area 1 with touch-up on the 20th.

8. November 26-27. Light rain, with cold the following week.

9. Decmeber 6. Application of aluminum finish coat on north span of Area 1 by brush and roller. Spray applied on interior beams of south span. Application of more vinyl topcoat on south half of Area 2 because coating was too thin.

10. December 10. Application of aluminum finish coat on fascia of south span of Area 1 by brush and roller. Touch-up of aluminum on Area 1, where required. Touch-up several spots with aluminum on Areas 3 and

4. This concluded the painting, with the contractor required to do some clean-up.

11. Contractor returned June 7, 1977, to correct film deficiencies in Test Areas 3 and 4. In addition to repairing thin and rusty areas, an overall second coat was applied to the beams of Areas 3 and 4.

APPENDIX C

TEST AREA 1  
 FILM THICKNESS MEASUREMENTS,  
 MILS (ELCOMETER)  
 MDOT Four-Coat System

	Beam	Web	Top of Lower Flange	Bottom of Lower Flange
10 to 12 ft From Center of Bridge	A	5.0	9.0	6.0
	B	6.0	6.0	5.0
	C	6.0	9.0	5.0
	D	7.0	9.0	6.0
20 to 24 ft From Center of Bridge	A	6.0	8.0	5.0
	B	6.0	7.0	6.0
	C	7.0	5.0	8.5
	D	5.0	6.5	7.0
Over Passing Lane	A	5.5	8.0	8.0
	B	5.6	7.0	6.0
	C	6.0	7.0	6.0
	D	5.0	8.0	5.0
8 to 10 ft From South Abutment	A	7.0	7.0	5.0
	B	7.0	7.0	5.0
	C	7.5	8.0	5.0
	D	5.0	6.5	5.0

TEST AREA 2  
 FILM THICKNESS MEASUREMENTS,  
 MILS (ELCOMETER)  
 Carbozinc No. 11 and Polyclad 936-1 Topcoat

	Beam	Web	Top of Lower Flange	Bottom of Lower Flange
10 to 12 ft From Center of Bridge	A	5.0	4.0	5.0
	B	3.0	3.5	3.5
	C	2.5	3.0	4.0
	D	3.0	3.0	4.5
20 to 24 ft From Center of Bridge	A	3.5	3.0	3.5
	B	4.0	3.5	5.5
	C	5.5	3.5	6.0
	D	3.5	3.0	2.0
Over Passing Lane	A	4.5	4.0	3.0
	B	5.0	5.0	5.5
	C	5.0	4.0	5.5
	D	5.0	5.0	4.5
8 to 10 ft From South Abutment	A	2.0	4.0	4.0
	B	3.5	3.5	3.0
	C	2.5	2.5	4.5
	D	5.0	3.0	2.5

TEST AREA 3  
 FILM THICKNESS MEASUREMENTS,  
 MILS (WET FILM GAUGE)  
 Tectyl 506G Plus Tectyl MC 680 Aluminum

	Beam	Web	Top of Lower Flange	Bottom of Lower Flange
Over Passing Lane	A	18	12	20+
	B	12	10	20
	C	20	16	12
	D	14	16	20
20 to 24 ft From Center of Bridge	A	20+	20+	20+
	B	18	20	20+
	C	16	9	10
	D	10	10	20
8 to 10 ft From Center of Bridge	A	16	16	20+
	B	20+	12	20+
	C	18	10	20+
	D	20	10	16



TEST AREA 4  
 FILM THICKNESS MEASUREMENTS,  
 MILS (WET FILM GAUGE)  
 Tectyl MC 680 Aluminum

	Beam	Web	Top of Lower Flange	Bottom of Lower Flange
Over Passing Lane	A	12	12	12
	B	7	6	10
	C	5	6	12
	D	14	14	14
20 to 24 ft From Center of Bridge	A	8	8	14
	B	8	6	14
	C	14	8	20
	D	18	8	20
8 to 10 ft From Center of Bridge	A	8	8	12
	B	10	8	16
	C	12	6	16
	D	16	16	16