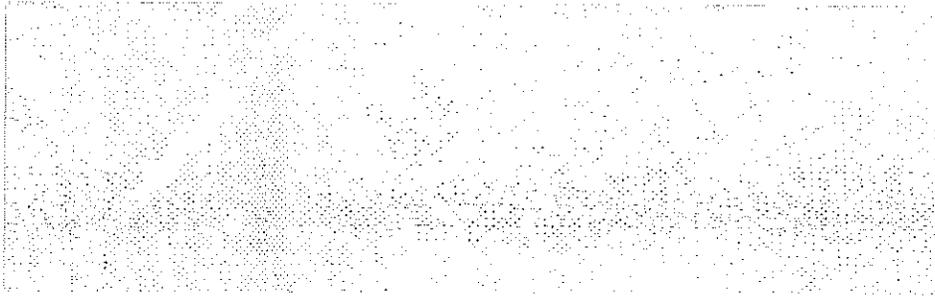


ALTERNATE REPAINTING SYSTEMS
FOR BRIDGE STRUCTURAL STEEL



**TESTING AND RESEARCH DIVISION
RESEARCH LABORATORY SECTION**



TG153 .B37 c. 5
Alternate, more economical
repainting systems for
bridge structural steel

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FOR BRIDGE STRUCTURAL STEEL

F. J. Bashore

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-1212

Michigan Transportation Commission
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Lawrence C. Patrick, Jr., Vice-Chairman;
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Lansing, March 1983

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INTRODUCTION

In May 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 could provide a rust-preventive system whose service life protection would be comparable to the Department's then specified four-coat system when applied at equivalent dry-film thickness.

This report describes the application of the coatings on the structure selected for the experiment and discusses observations from periodic inspections made over a period of six years. The contents of this report reflect the views of the author, who is 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 3,000 bridges utilizing painted steel as structural members. Specifications current in 1976 required that the steel be coated with a four-coat paint system which had an average service life of about 15 years. This would indicate a need for an average annual maintenance recoating work load of 200 bridges. Since this number has never been approached, it is obvious that we are accumulating a large backlog.

There are two possible alternatives to alleviate the problem. One solution is to lower the overall recoating cost and the other is to significantly increase the service life.

Scope

The four-coat system which was formerly specified for maintenance repainting of bridge structural steel was also specified for new construction. The steel was blasted to a near-white and the coatings were based on a combination linseed oil-alkyd vehicle, all containing lead compounds in the pigmentation. It has become increasingly obvious that alternatives to lead-pigmented materials would be desirable because of the latter's inherent toxicity. This system could be applied by brush, roller, or spray

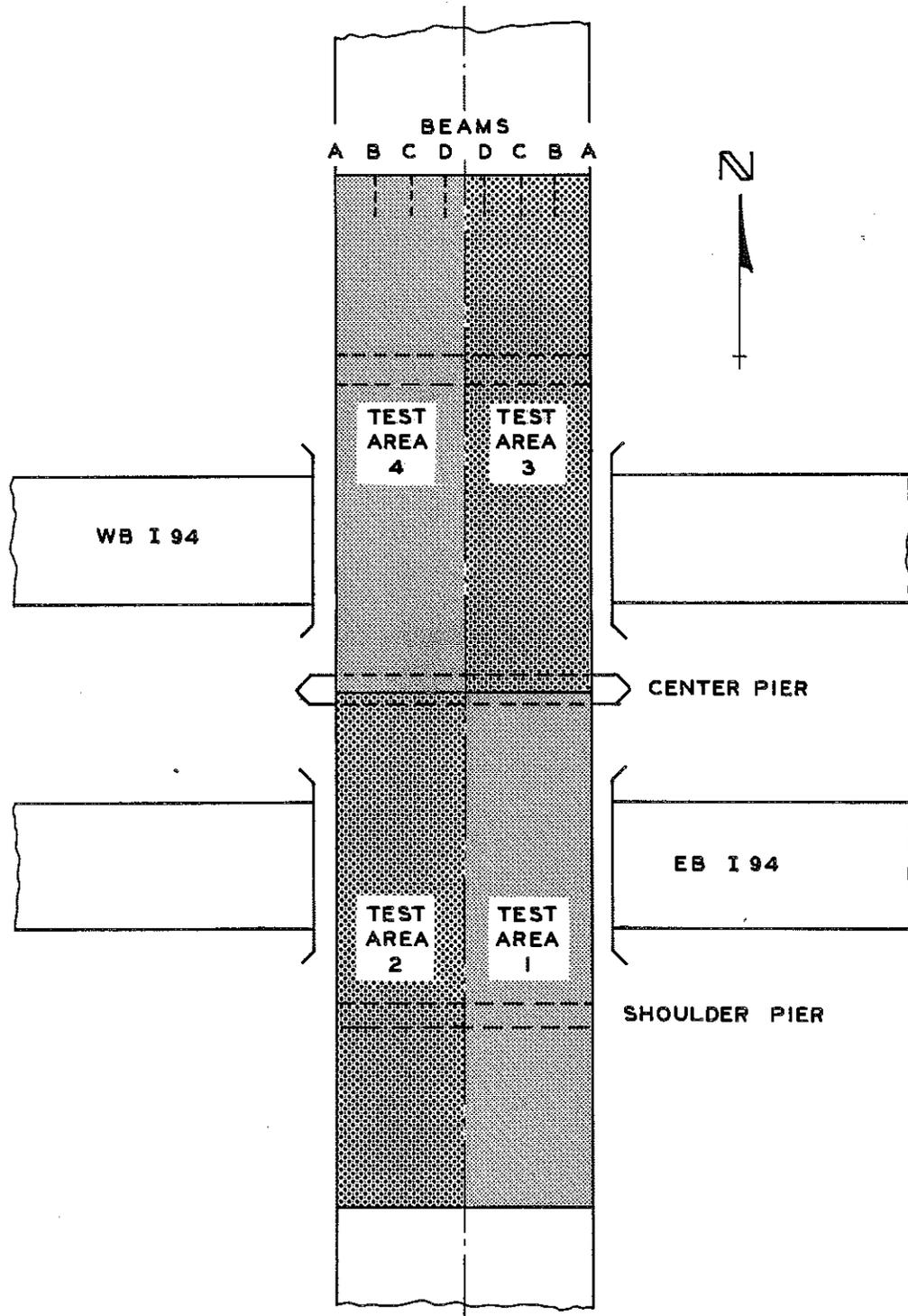


Figure 1. Test paint areas on S01 of 38103 (Sargent Rd) over I 94 east of Jackson.

and required four days of good drying weather between applications of succeeding coats of paint.

In an effort to lower the cost of maintenance repainting, a one-coat and a two-coat system that utilizes petroleum wax based vehicles conforming to SSPC-PS 8.01, "Specification for a Rust Preventative Thick-Film Coating System," were evaluated. Coatings of this type had been used by cities and counties for the protection of bridge structural steel with results not sufficiently documented to be meaningful. We were not aware of coatings of this type being evaluated by other state agencies.

A two-coat inorganic zinc rich primed, vinyl topcoated system was included as a secondary standard since this type had shown encouraging results on several experimental installations in Michigan. This system has the advantage of fewer coats and thus lowers the cost of application because of fewer traffic closures, and also offers the potential of a longer service life.

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, carrying Sargent Rd over I 94 east of Jackson, providing four test areas of equal exposure severity on the four interior spans over traffic lanes. These test areas are as shown in Figure 1.

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 rich 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.

Test Area No. 4 was intended to determine whether the petroleum wax based coating, applied in one heavy coat, would produce a satisfactory dry-film thickness uniformity, and whether it would dry without 'alligatoring' (similar to mud cracking in clays).

Test Area No. 3 was intended to provide information on whether the petroleum wax based coating, applied in two coats, would show improvement over No. 4 regarding thickness uniformity and alligatoring.

Test Areas 1 and 2, using Reference Paint Systems, were intended to provide a base by which to judge comparative performance of test systems 3 and 4. The Test 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 wax based system.

The performances were to be determined by biannual inspections for a period of 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 (S01 of 38103) 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.

Painting specifications covering the four test areas are presented in Appendix A, as included in the Project Proposal. The coating system for

Test Area 1 was 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 had 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 petroleum wax based 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 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 rich-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 wax 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 wax based coating, at the job site April 29, 1977, to examine the areas in question.

Since an Elcometer film gage does not work well on soft films, a wet film thickness gage 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 less than 2 mils, with some areas less than 1 mil thick.

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 gage was used on Areas 1 and 2, and a wet film thickness gage was used on Areas 3 and 4. Measurements obtained are shown in Appendix C.

The above measurements showed that the four-coat control system (Area 1) which was applied by roller was 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.

On July 7, 1978, some of the areas of Area 2 found to be deficient in film thickness using an Elcometer magnetic film gage in 1977 were re-checked with a newly acquired Tooke gage. These measurements confirmed the earlier findings.

Observations from Biannual Inspections

Inspections in 1978 and 1979 showed that Areas 2, 3, and 4 were showing some rust and rust staining in locations where film thicknesses were inadequate. There were also a few areas where failure was occurring due to application of coatings over debris from the sandblasting operation. It is probable that the four-coat oil-alkyd system (Area 1) was also applied over debris in some areas as well, but since it was applied by roller, the debris would have been wetted much better by the mechanical action of the roller.

Subsequent inspections continuing to the second quarter of 1982 have shown a steady progression of earlier failures. The following are the descriptions of each area after six years service. Photographs showing typical appearances of the four areas are shown in Figures 2 through 5.

Area 1) Four-Coat Oil-Alkyd System - There are no areas of noticeable failure. Materials were applied by roller, and painters were experienced in this type of application which required little skill.

Area 2) Two-Coat Inorganic Zinc Rich-Vinyl System - There are a few areas of rusting which can all be attributed to application errors such as insufficient film thickness and application over debris from sandblasting (Fig. 6).

Area 3) Two-Coat Petroleum Wax Based System - This area ultimately received a third coat because of many areas found to be deficient in film thickness after the first winter. There are numerous areas showing rust and rust staining. This includes areas where material was applied over debris from sandblasting (Fig. 7) along lower flange edges and edges of

cover plates on the bottom of lower flanges, and around hackles that had not been removed after sandblasting.

Area 4) One-Coat Petroleum Wax Based System - This area also ultimately received a second coat for the same reasons cited for Area 3 above. The comments made for the condition of Area 3 also apply for this area, although to a slightly higher degree, probably because of generally thinner film thicknesses as shown in Appendix C.

CONCLUSIONS

The primary objectives of this research project were not achieved to our satisfaction because of inadequate or incomplete surface preparation and the lack of good application technique on the part of the painters. Both are vital to the performance of spray applied coatings.

The satisfactory performance of the four-coat linseed oil-alkyd system for six years was expected since our experience has shown that this system, reasonably well applied, lasts 15 years on the average before repainting is indicated. Although it would be expected that the initial incomplete cleaning will ultimately shorten its service life, the effect is not expected to be evident soon.

The service life of the above type of coating is now academic to the Department since it is no longer specified for either maintenance repainting or new construction. The decision was made to change to coatings containing no lead compounds and generally requiring only two coats. These have proved to be initially less expensive and also have the potential, if properly applied, of longer service life.

Our observations show that we have obtained much better performance with the two-coat inorganic zinc rich-vinyl system compared to the petroleum wax based system, both with the same inconsistency in application. Since costs other than those of the coating materials are the major part of maintenance repainting, it would appear that the petroleum wax based coating would not be a good choice. Although the objective of comparing the performance of the different coating materials was not ideally achieved, much valuable information has been obtained from this project and others to help in the development of more effective specifications. An example of a current specification is given in Appendix D.

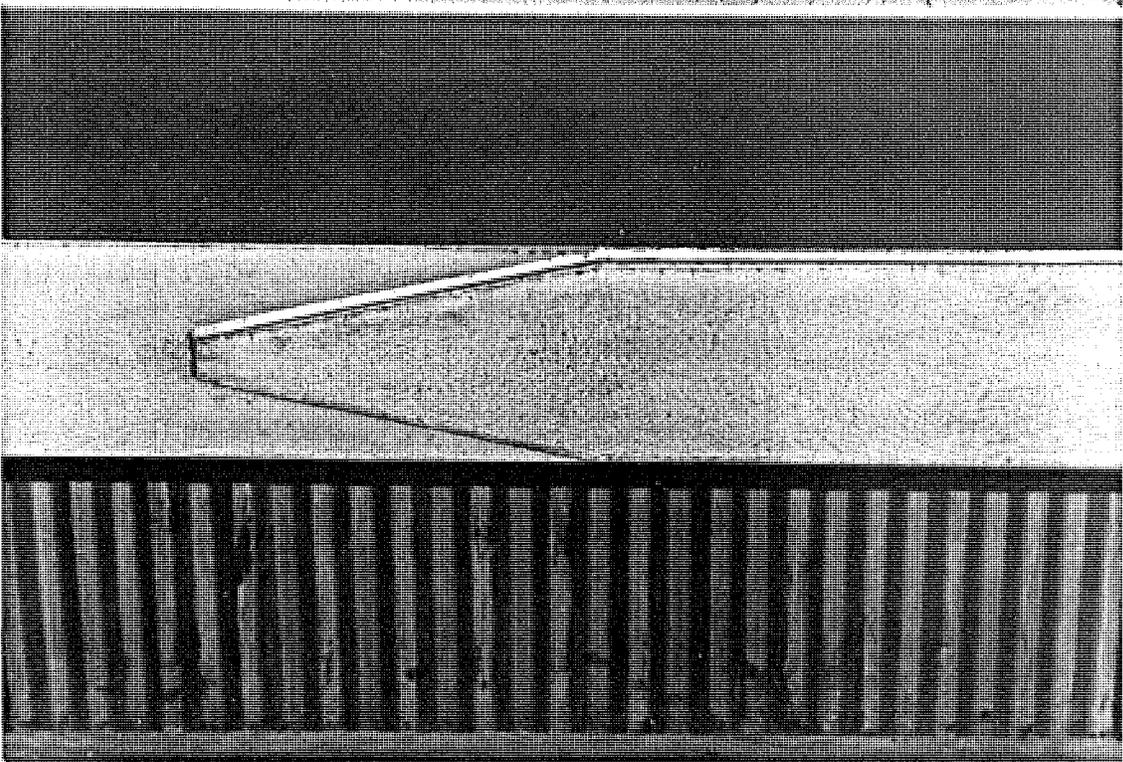


Figure 2. Area 1) Four-coat oil-alkyd shows no failure after six years.

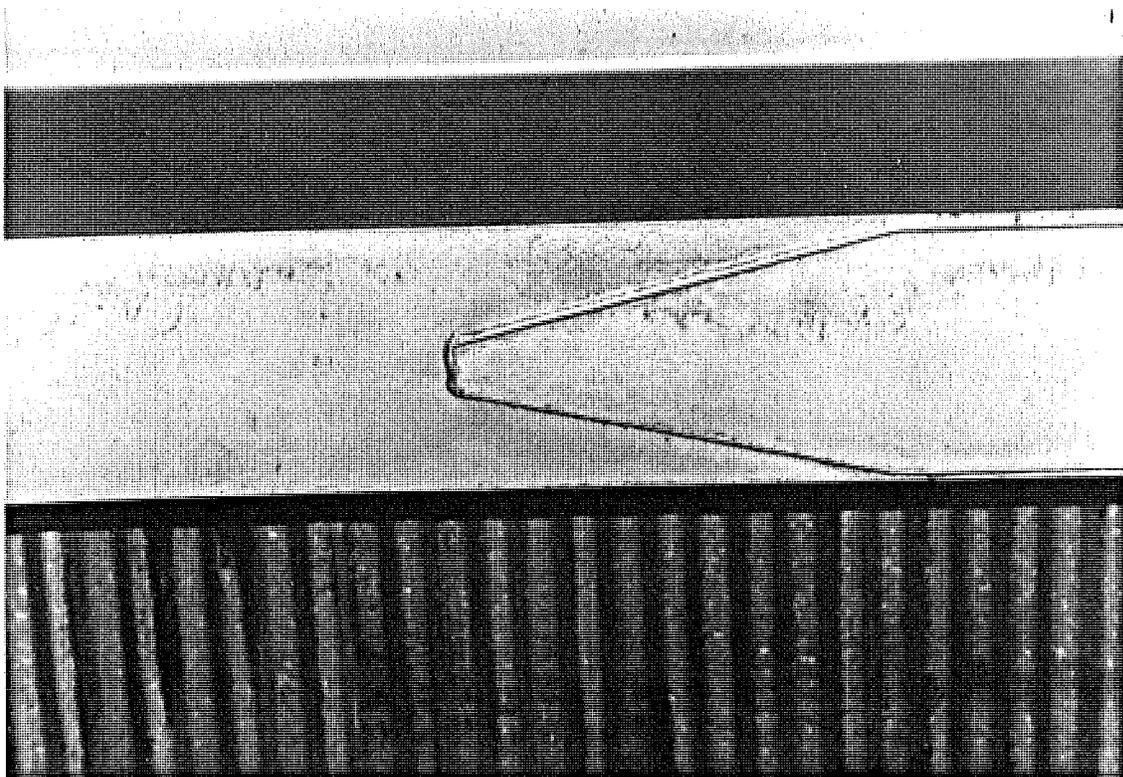


Figure 3. Area 2) Two-coat inorganic zinc rich-vinyl shows little evidence of failure after six years.

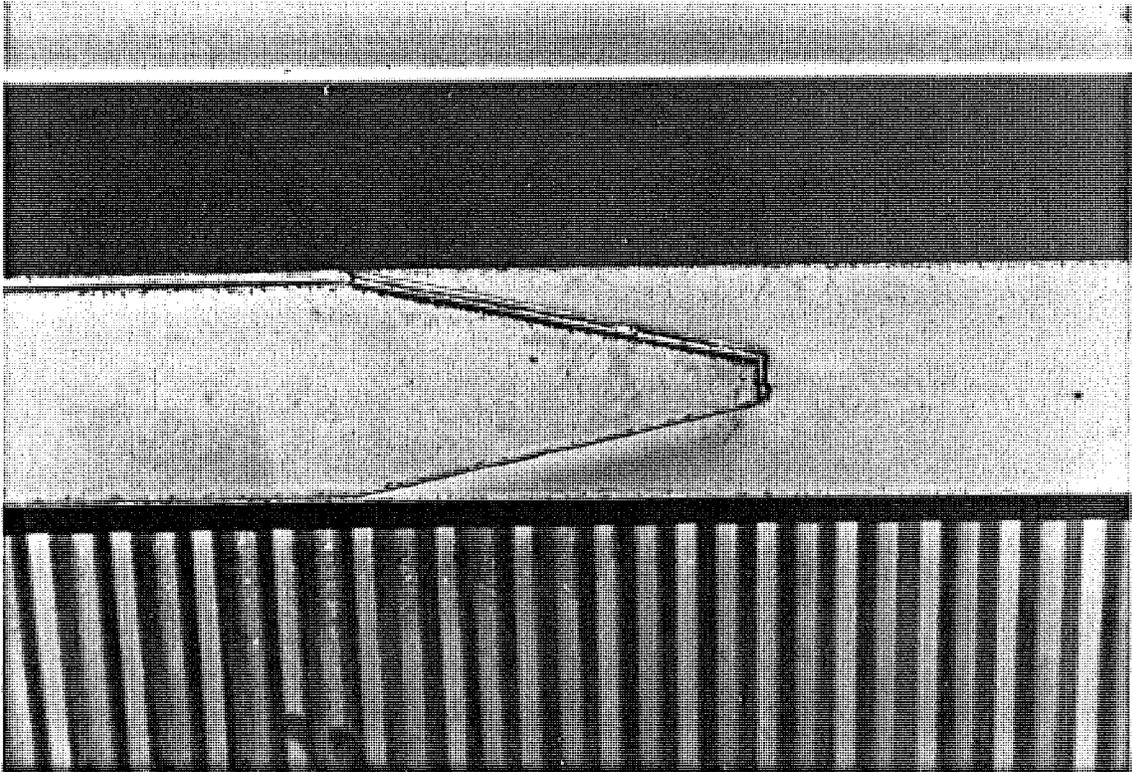


Figure 4. Area 3) Two-coat petroleum wax based system is beginning to show rust on flange and cover plate edges.

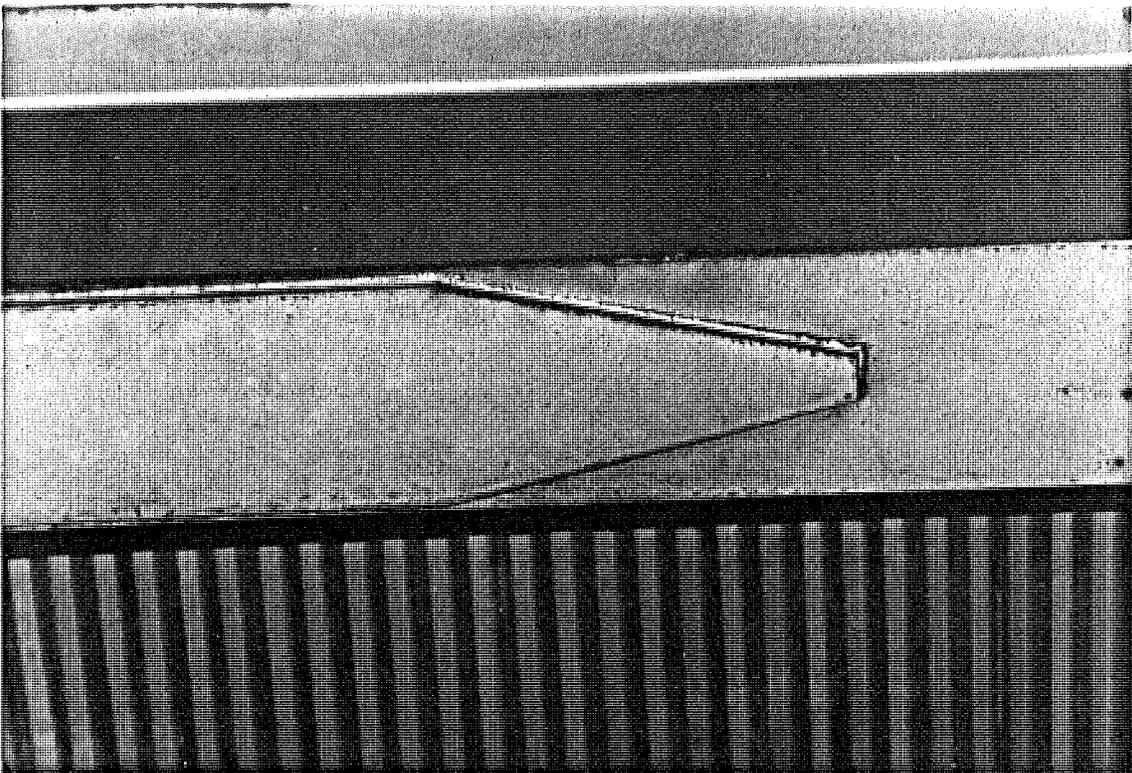


Figure 5. Area 4) One-coat petroleum wax based system shows rust on flange and cover plate edges.

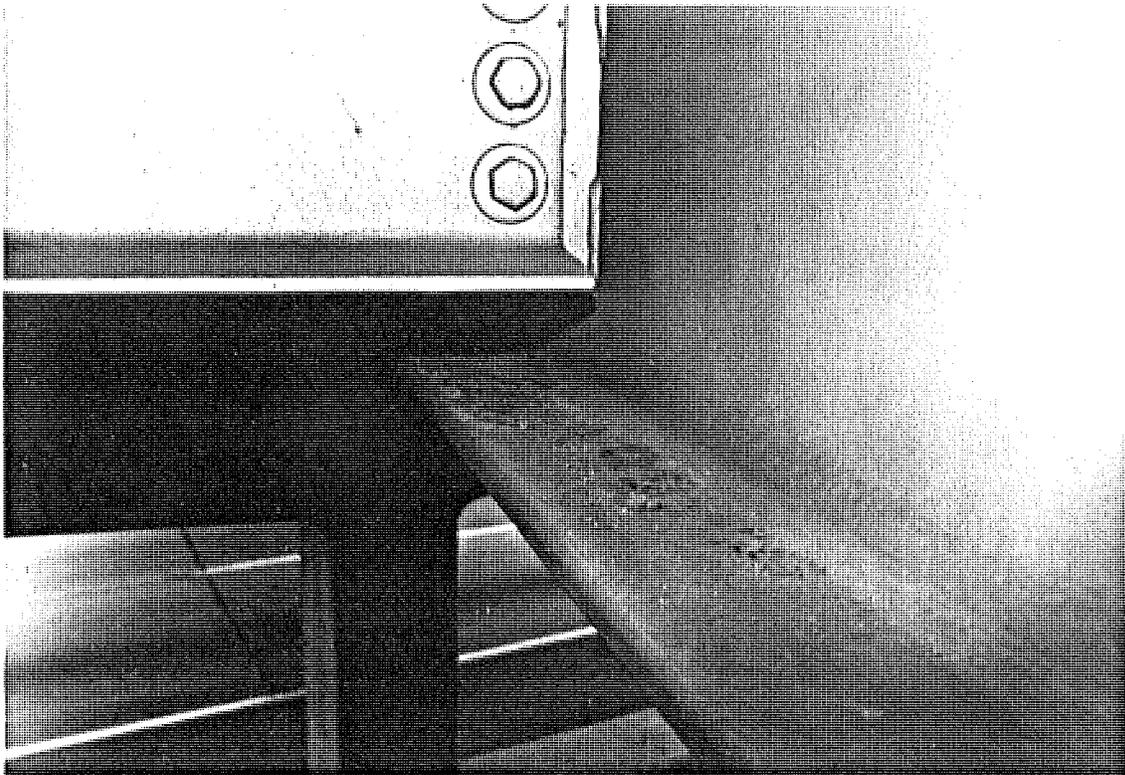


Figure 6. Area 2) Two-coat inorganic zinc rich-vinyl applied over debris from sandblasting on top of lower flange.

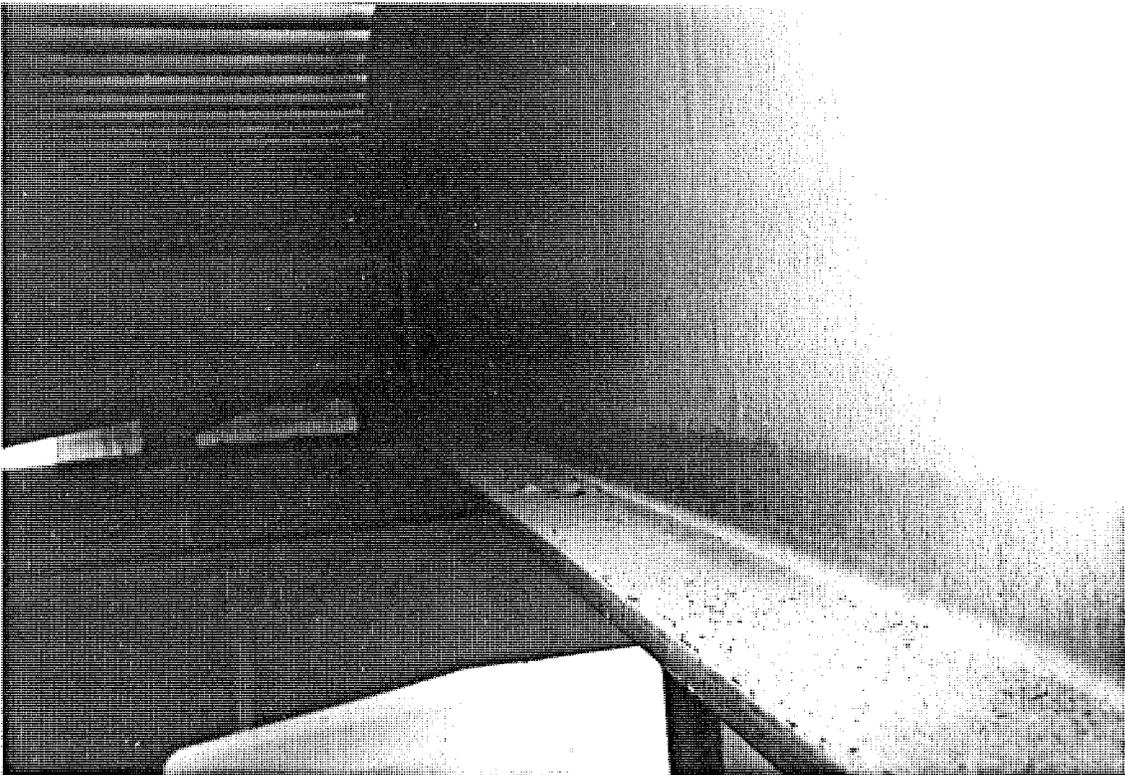


Figure 7. Area 3) Two-coat petroleum wax based system applied over debris from sandblasting on top of lower flange.

APPENDIX A

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. 680 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. December 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
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
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
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
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
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
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
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
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
A	18	12	20+
B	12	10	20
C	20	16	12
D	14	16	20
Over Passing Lane			
A	20+	20+	20+
B	18	20	20+
C	16	9	10
D	10	10	20
20 to 24 ft From Center of Bridge			
A	16	16	20+
B	20+	12	20+
C	18	10	20+
D	20	10	16
8 to 10 ft From Center of Bridge			

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

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

APPENDIX D

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
CLEANING AND COATING EXISTING STEEL STRUCTURES

a. Description.-This work shall consist of the complete blast cleaning and coating of the metal surfaces of existing steel structures, including downspouts and all brackets. Utility conduits shall also be cleaned and coated according to this specification but shall be done only when called for on the plans. This work excludes hand railings and chain link fence enclosures.

Terminology used herein is in accordance with the definitions used in Volume 2, Systems and Specifications, of the SSPC Steel Structures Painting Manual.

b. Coating System.-The Contractor shall select a complete coating system (primer, tie coat when recommended by the manufacturer, and topcoat) from one of the approved coating systems listed on the last page of this special provision.

The color for the vinyl topcoat shall be color number 25200 from Federal Standards Number 595a dated January 2, 1968.

c. Cleaning of Structures.-Surfaces to be coated shall be cleaned of all oil, grease, and dirt with clean petroleum solvents and then blast cleaned to a near-white finish which is defined as follows:

A finish from which all paint, oil, grease, dirt, mill scale, rust, corrosion products, oxides, or any other foreign matter have been removed except for very slight shadows, very slight streaks, or slight discolorations; at least 95% of each square inch of the surface shall have the appearance of a surface blast cleaned to a white metal finish and the remainder shall be limited to the light discolorations mentioned above (for reference, see NACE No. 2 or SSPC-SP10-63).

All fins, tears, slivers, and burred or sharp edges that are present on any steel member, or that appears during the blasting operation, shall be removed by grinding and the area reblasted to give a 2-mil surface profile.

Scaling hammers may be used to remove heavy scale but heavier type chipping hammers which would excessively scar the metal shall not be used.

Abrasives used for blast cleaning shall be either clean dry sand, steel shot, mineral grit, or manufactured grit and shall have a gradation such that the abrasive will produce a uniform profile of 1 to 2 mils, as measured with Testex Replica Tape.

All abrasive and paint residue shall be removed from steel surfaces with a good commercial grade vacuum cleaner equipped with a brush-type

cleaning tool, or by double blowing. If the double blowing method is used, the exposed top surfaces of all structural steel, including flanges, longitudinal stiffeners, splice plates, hangers, etc., shall be vacuumed after the double blowing operations are completed. The steel shall then be kept dust free and primed within 8 hours after blast cleaning.

Care shall be taken to protect freshly coated surfaces, bridge bearing components, hand railings, galvanized fence enclosures, all appurtenances, and any adjacent concrete from blast cleaning operations. These areas shall be protected from blast cleaning operations by masking. Blast damaged primed surfaces shall be thoroughly wire brushed or if visible rust occurs, reblasted to a near white condition. The wire brushed or blast cleaned surfaces shall be cleaned and reprimed.

For structures with piers, a minimum of 5 feet on each side of the piers shall be blast cleaned on the same day and primed as a unit to prevent damage to previously primed surfaces.

d. Mixing the Coating. -The coating shall be mixed with a high shear mixer (such as a Jiffy mixer), in accordance with the producer's directions, to a smooth, lump free consistency. Paddle mixers or paint shakers are not allowed. Mixing shall be done, as far as possible, in the original containers and shall be continued until all of the metallic powder or pigment is in suspension.

Care shall be taken to ensure that all of the coating solids that may have settled to the bottom of the container are thoroughly dispersed. The coating shall then be strained through a screen having openings no larger than those specified for a No. 50 sieve in ASTM E 11. After straining, the mixed material shall be kept under continuous agitation up to and during the time of application.

e. Thinning the Coating. -The coating is supplied for normal use without thinning. In cool weather, if necessary to thin the coating for proper application, the thinning shall be done in accordance with the manufacturer's recommendations.

f. Conditions for Coating. -Coating shall only be applied when the following conditions have been met:

1. Temperature. -The temperature of the air and the steel shall be above 40 F but shall not be so hot as to cause blistering of the coating.
2. Humidity. -The coating shall not be applied when the relative humidity is greater than 85 percent nor when a combination of temperature and humidity conditions are such that moisture condenses on the surface being coated. If there is any doubt whether such conditions exist, the following test shall be performed. Using a damp cloth, apply a clearly defined, thin film of water to a small area. If the film evaporates within 15 minutes, the surface may be coated.

g. Coating of Structures. -After the entire surface to be coated has been cleaned and approved by the Engineer, the primer shall be applied with the spray nozzles and pressures recommended by the producer of the coating system, so as to attain the film thickness specified. The minimum dry film thickness for the primer shall be 2.5 mils and for the topcoat shall be 3.5 mils. The dry film thickness will be determined by use of a magnetic film thickness gage. The gage shall be calibrated on the blasted steel with plastic shims approximately the same thickness as the minimum dry film thickness. A Tooke film thickness gage may be used to verify the coating thickness when requested by the Engineer. If the Tooke gage shows the primer coat to be less than the specified minimum thickness, the total coating system will be rejected even if the total dry film thickness exceeds the 6-mil minimum.

If the application of coating at the required thickness in one pass produces runs, bubbles, or sags, the coating shall be applied in multiple passes of the spray gun, the passes separated by several minutes. Where excessive coating thickness produces "mud-cracking," such coating shall be scraped back to soundly bonded coating and the area recoated to the required thickness.

All dry spray shall be removed, by sanding if necessary. In areas of deficient primer thickness, the areas shall be thoroughly cleaned with power washing equipment, as necessary to remove all dirt; the areas shall then be wire brushed, vacuumed, and recoated.

A minimum of two days of proper drying conditions will be required between the application of the primer and the topcoat.

After the steel is primed, it shall be vacuumed again before topcoating. If for any reason this vacuuming does not remove all the accumulated dust and/or dirt, or if in the opinion of the Engineer the surface is unfit for topcoating, the surface shall be scrubbed with a mild detergent solution (any commercial laundry detergent) and thoroughly rinsed with water before the surface is topcoated.

All coating shall be done in a neat and workmanlike manner as described in SSPC-PA 1-64, producing a uniform, even coating which is bonded to the underlying surface.

All metal coated with impure, unsatisfactory or unauthorized coating material, or coated in an unworkmanlike or objectionable manner shall be thoroughly cleaned and recoated or otherwise corrected as directed by the Engineer.

h. Provisions for Field Inspection. -The Contractor shall furnish and erect scaffolding meeting the approval of the Engineer to permit inspection of the steel prior to and after coating.

Rubber rollers, or other protective devices meeting the approval of the Engineer, shall be used on scaffold fastenings. Metal rollers or clamps

and other types of fastenings which will mar or damage freshly coated surfaces shall not be used.

i. Protection of the Work.-Pedestrian, vehicular, and other traffic upon or underneath the structure shall be protected as provided under Sub-section 1.05.13 of the 1979 Standard Specifications. All portions of the structures (superstructure, substructure, slope protection, and highway appurtenances) shall be protected against splatter, splashes, and smirches of coating, or coating material 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, the Contractor shall make provisions for protecting 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.

Whenever the intended purposes of the protective devices are not being 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 shall 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 gage, and pressure release valve. Air supply to the employee shall not be contaminated with harmful materials or elements.

j. Measurement and Payment.-The completed work as measured for CLEANING AND COATING EXISTING STEEL STRUCTURES will be paid for at the contract unit price for the following contract item (pay item).

<u>Pay Item</u>	<u>Pay Unit</u>
Cleaning Existing Steel Structures	Lump Sum
Coating Existing Steel Structures	Lump Sum
Cleaning and Coating Existing Utility Conduits	Lump Sum

Cleaning Existing Steel Structures, Coating Existing Steel Structures, and Cleaning and Coating Existing Utility Conduits will be measured and paid for as a unit for each structure.

APPROVED COATING SYSTEMS

Coating System:

Primer: Mobilzinc Uni-Pac 13-G-10W
Topcoat: Val-Chem Hi-Build Vinyl, 83 Series
Producer: Mobile Chemical Company
Maintenance and Marine Coatings Department
Area Representative: Ron Mizerek Ph. (419) 475-5369

Coating System:

Primer: Dimetcoat EZ-II
Topcoat: Amercoat 99R
Producer: Ameron Protective Coatings Division
Brea, California 92621
Area Representative: Bob Marshall Ph. (313) 886-5555

Coating System:

Primer: Galvasil 1581S
Topcoat: Hempanyl 5616
Producer: Hempel Industrial Coatings
Area Representative: Jeffery A. McKenna
Hempel Marine Paint
Foot of Curry Avenue
Wallington, NJ 07057
Ph. (201) 939-9411