

R-691

OFFICE MEMORANDUM



MICHIGAN
DEPARTMENT OF STATE HIGHWAYS

January 20, 1969

LAST COPY
DO NOT REMOVE FROM LIBRARY

To: R. L. Greenman
Testing and Research Engineer

From: L. T. Oehler

Subject: Evaluation of Electrostatic Spray Equipment in Painting Highway Steel.
Research Project 66 NM-162. Research Report R-691.

Technical Introduction

Electrostatic spray painting has found increasing use indoors by the metals industry for the past 20 years. It uses a spray gun modified with an electrode that charges the issuing paint particles, which are then guided to the grounded target. Power to the gun electrode is supplied by an accessory voltage pack, or transformer. These two items are main differences between electrostatic and standard spray equipment.

The alleged advantages of the process are, (1) minimization of overspray, (2) more uniform film thickness, (3) probable fewer coats for the same thickness.

To our knowledge, use of the equipment in outdoor painting has generally not been exploited except for specialty work, such as repainting chain-link fencing.

Project Background

Subject topic was presented to the New Materials Committee at its December 15, 1966 meeting by; (a) your memorandum of December 7, 1966 transmitting our review of December 1, and (b) orally by S. M. Cardone. After discussion, the Committee authorized a field evaluation of this method of paint application on a bridge structure in need of maintenance repainting.

Since the only State painting contractor known to be using this type of equipment, Decorators & Painters, Inc., was located in St. Joseph, it was expedient to select a bridge in the Kalamazoo District for the test. Accordingly, in cooperation with District personnel, bridge S02 of 39022, carrying Lovers' Lane over I 94 on the southern outskirts of Kalamazoo, was chosen in June 1967. This was a four-span structure built in 1956, consisting of six rows of girders, with the structural steel weighing about 90 tons. The condition of the paint system was considered as average for a rural 11-year old structure (Figure 1). There were older vicinity structures in greater need of repainting, but none were as conveniently located for project personnel.

Subsequently, Department personnel from the Kalamazoo District, C. H. Voss, J. Badaluco, F. R. Russel, and from Lansing, S. M. Cardone, A. J. Permoda and A. R. Gabel met with the contractor's representatives, S. Piontek and W. Daigler, to familiarize the contractor with the bridge location and design, and to discuss details of the painting project.

The details covered such items as:

1. What equipment model was best suited for the job.
2. What paint was to be specified.
3. Contractor's costs and financing of the repainting.
4. How was the work to be subdivided.

These were resolved accordingly, numbered to correspond with the above:

1. After a visit to the contractor's shop on August 2, 1967, for a test equipment and paint demonstration, it was decided that the Ransburg No. 2 Process Gun, as owned by him, was probably of too low capacity for bridge painting. The contractor then agreed to provide higher capacity spray equipment for evaluation at the bridge site. It would be a Ransburg R-E-H gun, airless-electrostatic.

2. Some hedging occurred in selection of the paints, for several reasons:

- (a) The electrical conductivity of the paint must be adapted to the spray gun that is used. This is controlled in formulation, and mostly by choice of solvent.
- (b) Early in the discussions, it was decided to use a two-coat paint system, with each coat applied at 2-1/2 mil dry thickness. This required paints that would dry satisfactorily, without defects such as wrinkling, at the heavier than standard thickness.
- (c) Final decision was to use MDSH Paints No. 2MP(1) Brown for the primer and No. 3A(1) Gray for the topcoat, with modifications to make them adaptable for the particular spray gun model that would be used.
- (d) At the contractor's request, the Department would supply the paints for the project. Subsequently Standard Detroit Paint Co. cooperated in formulating and producing the paints as given in the Appendix.

3 and 4. On August 14, 1967 the contractor submitted a bid of \$7,125 covering labor and equipment to repaint the bridge steel, on modified Class A Maintenance Painting Specifications requiring complete blast cleaning. The Department accepted the bid under an Experimental Negotiated Contract to be financed by Heavy Maintenance funds. The Proposal covering the work was signed by the contractor on September 22, 1967. Under the agreement, the Department was to furnish the paint, and the signs required by the contractor for maintaining traffic.

Painting the Bridge

A pre-construction meeting between Department and contractor personnel was held on October 10, 1967 in the Kalamazoo office, during which the contractor scheduled start of painting operations for Monday, October 16.

The contractor started by blast-cleaning and priming the south end-span of the structure (Figure 2). The R-E-H gun (airless-electrostatic) and associated equipment, borrowed and leased by the contractor, could not be adjusted to apply the primer under electrostatic attraction, i. e., the gun operated almost exclusively as an airless spray.

Switching to the No. 2 Process Gun provided marginal improvement in electrostatic attraction, but insufficient flow capacity to be practical. Accordingly, use of this equipment was discontinued.

The contractor returned to the R-E-H gun in painting the adjoining bridge steel in the span over EB I 94, while trying to obtain technical assistance to improve the electrostatic attraction features of the gun. Meaningful assistance could not then be obtained from the producer of the equipment or his representatives. By mutual consent, the Department and contractor agreed to stop work for the season after priming the two South spans to specification requirements for thickness. This touch-up was completed on December 4, 1967, though production painting had essentially stopped a month earlier. At least part of the difficulty experienced with the project could be blamed on the unexpected delays in not starting until October 16th, and generally poor weather conditions for painting after that.

During the Winter shutdown of the project, the contractor endeavored to learn more about the adjustment of the equipment--and the R-E-H gun in particular--by attending a short two-day training school operated by the producer. He took a sample of our primer paint for evaluation at the school. Subsequently, we were informed that the primer applied satisfactorily at the school, though a film build-up of 2-1/2 mil dry-thickness could not be obtained in a series of successive passes without incurring running. Applying the primer in two installments, separated by about 15 minutes, would yield a good film, however, as we discovered earlier on the project.

Before resuming the painting, the District Engineer felt that improved inspection of the project could be obtained by assigning an Engineer, G. F. Kays, to the project. Subsequently, this was found to be beneficial. Resumption of the painting project in 1968 was delayed from Spring to Fall due to a trade union strike. After partial settlement of the strike, the contractor began blast-cleaning and priming operations on the remaining north spans of the bridge, on September 3, 1968. Again trouble was experienced in getting the electrostatic attraction to operate on the primer. Technical assistance was requested and obtained from the producer, whose representatives, L. E. Stovall and E. Nagy, gave some help on September 9 in making equipment adjustments that control spray application. These variables are: (1) pressure on airless-spray part of equipment, (2) size and flare of tip orifice, and (3) viscosity and conductivity of the paint. Making these adjustments still gave only marginal improvement in application of the primer, which was completed on the two north spans of the structure on September 13, 1968.

Between rain and illness, the contractor used the following week to replace the primer on the two south spans that developed rust-back during a Winter of exposure. This was confined to the lower flange areas of the beams with about 60 percent of those areas needing replacement in the roadway span, and about 30 percent in the end span. The performance of the primer in those areas was somewhat disappointing.

Application of the topcoat was done the following week (September 23rd) first on the north spans and then on the south spans. The wrap-around or electrostatic attraction feature of the spray, though not as good as originally expected, was noticeably improved over that operative on the primer. The reason is unknown, though it bears further investigation.

After completing the topcoat, an inspection was made by the Department which showed that, (a) some minor running had occurred which was not considered harmful, (b) most beam areas had the specified 5-mil thickness, and (c) top surfaces of the lower flange area were generally about 1-mil deficient in thickness.

The Department requested the contractor to apply an additional brush coat of paint to the latter areas, which he did on October 14 and 15, 1968 thereby completing the painting. Subsequently, a post-construction meeting was held in the Kalamazoo office to review the project, especially in regards to meeting the original objective.

Summary and Conclusions

The report conclusions ought to supply an answer to whether the project objective was met, which was, "to field evaluate the ability of electrostatic

spray equipment to facilitate the painting of bridge structural steel" as determined by measurable factors, such as (a) minimization of paint overspray, (b) providing more uniform film thickness, (c) allowing application of fewer coats for same thickness, and (d) economics and difficulties of the process.

Project data covering these factors are presented below and numbered to correspond with the above:

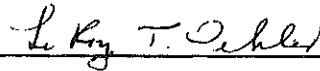
- (a) From data presented in the Appendix relative to consumption of paints on the project, it is noted that (87-56) = 31 gal of primer was wasted as overspray when the R-E-H gun operated as an airless spray, and (57-51) = 6 gal of topcoat was wasted as overspray when the same gun operated as an electrostatic airless spray. These data prove that the electrostatic feature of the gun significantly reduces the amount and the nuisance of paint overspray.
- (b) Data were not obtainable from the project relative to the ability of the electrostatic paint gun to provide more uniform film thickness, but observations indicate that the improvement would be only minor.
- (c) Even though the project utilized fewer than usual coats (2) of heavier than standard thickness (2-1/2 mil), this was accomplished by a special application technique not confined to electrostatic spray equipment. Actually, we found that the electrostatic equipment is less adapted to application of heavy paint thicknesses since it must use thinner paints to encourage electrostatic attraction. The thinner paints are, in turn, subject to running and sagging at a heavy thickness.
- (d) The R-E-H electrostatic-airless spray equipment costs about \$2,000 more than straight airless equipment of same capacity, and must be amortized during use. In addition, the equipment is technically more complicated and requires a higher degree of training in maintenance and operating personnel.

In conclusion, it is difficult to weigh the plus features against the minus features of the electrostatic spray equipment as determined in subject field tests. In retrospect, as a first step, we should have conducted smaller scale tests in close cooperation with the technical staffs of producers of the electrostatic equipment, especially since a feeling developed that neither the painting contractor nor Bennett Industries, who use the equipment in shop painting of fabricated steel, are research-oriented to the point of fully exploiting the potential of this equipment.

Recommendations

In accordance with above statement, it is felt that the electrostatic spray equipment has undetermined potential in the painting of highway structural steel. To determine its potential, we recommend close collaboration with any one producer of this type equipment willing to cooperate, and participation in any field testing he would recommend. The testing should endeavor to determine why the green topcoat performed better than the brown primer in the original field tests.

TESTING AND RESEARCH DIVISION



Director - Research Laboratory

LTO:sjt

Appendix

PAINTS USED ON PROJECT

A. Primer No. 2MP(1) Brown type, modified TT-P-615d Type 3.

Pigment, percent by weight:	
Basic Lead Sil. Chr.	42.67
Iron Oxide (85% Fe ₂ O ₃)	3.47
Zinc Oxide	3.47
	49.61

Vehicle	
Alkyd resin solids (TT-R-266, type 3)	20.15
Alkyd volatile, Mn. Spts.	20.15
Toluene	9.33
Drier and anti-skin	.59
Anti-settling & others	.17
	50.39

PVC -----	39%
Wt/gal.-----	12.15 lb.
Consistency---	66 K. U.
Vol. Solids ---	44.5%
Conductivity --	in range recommended for R-E-H gun

Theoretical consumption $\frac{90 (140 \text{ ft}^2 / \text{T}) (2-1/2 \text{ mils})}{710 \text{ mil ft}^2 / \text{gal.}} = 45 \text{ gals.}$

Expected consumption (if brush applied) = 1.25 Theoretical = 56 gals.

Actual consumption = 87 gals.

B. Topcoat No. 3A(1) Gray modified:

Pigment, percent by weight:	
Titanium dioxide	12.2
Basic Lead Sil. Chr.	12.2
Calcium carbonate	3.8
Tinting colors	3.6
	31.8

Vehicle

Milthix #3000 resin solids	34.3
Resin volatile, L. O. Mn. Spts.	18.5
Toluene	6.1
VM&P Naphtha	6.0
Mineral Spirits	2.5
Additives	0.8
	<hr/>
	68.2

PVC ----- 19%
Wt/gal.----- 9.8 lbs.
Consistency--- 62 K. U.
Gloss ----- 46
Vol. Solids --- 48.8%
Conductivity -- in range recommended for R-E-H gun

Theoretical consumption $\frac{90 (140 \text{ ft}^2 / \text{T}) (2-1/2 \text{ mils})}{780 \text{ mil ft}^2 / \text{gal.}}$ = 40.5 gals.

Expected consumption (if brush applied) = 1.25 Theoretical = 51 gals.

Actual consumption = 57 gals.



Figure 1. Condition before repainting of original paint system on test bridge. Paint system was 11-yr old.



Figure 2. Beginning of repainting operation on south end-span of test structure. The brown paint (right) is newly applied by the electrostatic spray equipment.