Highway Bridge Painting

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Long life, moderate maintenance, and attractive appearance of structural steel highway bridges can all be enhanced by reference to a checklist of basic principles. Although little or no painting of structures may be required in a hot, dry, rural atmosphere, a carefully designed coating system is necessary where moisture, de-icing salts, and industrial or automotive contaminants are present in abnormal amounts. Even in these latter cases, however, economical protection can readily be obtained through use of the wider choice of materials and methods now available, including designs free of moisture-collecting crevices, pockets, or unprotected areas; more rapid and economical sandblasting and other methods for surface preparation in shop, field, or maintenance practice; chemical pretreatments where special corrosion resistance is required; primers and topcoats based on the tried and true oil-base vehicles and on field-proven newer vehicles and pigmentations, consistent with the type of surface preparation and service environment; better or cheaper methods of application, inspection, and maintenance painting at regular intervals.

The checklist of things to avoid includes painting over dirt, loose rust, grease, or loose millscale; use of short-oil quick-drying primers over rusty hand-cleaned steel; too-long interval between priming and top-coating of phenolic paint systems; designs which bring drippings from concrete or from de-icing salt into prolonged contact with inadequately protected surfaces.

For the highway engineer to make best use of continually improving materials and methods, it is first necessary that there be better dissemination of known information and the development of simpler and better specifications. In addition there should be continual impartial evaluation of new products and the study of special problems, such as painting of welded bridges, protection of hand-cleaned (or rusty) steel, comparison of field versus shop priming, evaluation of brine-resistant paints, comparison of alternate application methods, and study of application under adverse humidity-temperature conditions. This kind of program will make both structural steel and protective coatings still more versatile for highway construction and maintenance.

● FOR MANY highway engineers, the painting of steel structures represents an important but very specialized field to which they can devote only a limited amount of time and study. The purpose of this paper, therefore, is to summarize some of the more important steel painting information presently available, and to suggest where further information can be obtained.

The most important considerations in the painting of highway bridges are: 1. Recognition of the environment of the structure; 2. Influence of the bridge design upon corrosion and painting; 3. Choice of the surface preparation; 4. Application methods; 5. Choice of the coating system itself. These factors apply both to the original shop and field painting and to maintenance painting. Each of these factors will be discussed briefly, much of the material being taken from the Steel Structures Painting Manual (1, 2) which is widely used as a reference in structural steel painting problems. This Manual is organized, cross-referenced and indexed in such a way that it can be used by one who is unfamiliar with the Manual and even with painting technology. Examples will also be taken from the current research and testing programs and reports of the Steel Structures Painting Council. Many of the cases involving railroad bridges are directly applicable to highway bridges. It is hoped, however, that in our future program more highway bridges can be included.

ENVIRONMENT

The first step in considering any paint problem is recognition of whether the structure will be exposed in a rural, industrial or marine atmosphere or whether it will be exposed to a special condition, such as brine salt, fumes, abrasion, soil, moisture, blast or the like. The environment may vary radically from one part of a highway bridge to another and may therefore require more than one paint system, particularly on the prime coat. For example, the steel piling may be under the water while the understructure is splashed by waves and the superstructure is exposed to the atmosphere only. It has also been shown repeatedly that the parts of the structures subjected to frequent salt drippings ordinarily require much more careful maintenance than those which are exposed to the atmosphere only.

Most bridges are subject to high humidity or fumes. The highway bridge may present a different problem from the railroad bridge, but the similarities are greater than the differences. Appearance is more of a factor on highway bridges and the color may be selected to harmonize with topographic features, to provide a two-tone effect or to be as obvious as possible for safety reasons.

In the selection of a paint system for a specified application the Painting Manual lists 9 principal classifications. For each of these, a description is given in Volume 2 of the surface preparation covered, the recommended paints and paint system for this application, and comments on the advantages and limitations of each primer recommended. The 9 classifications are as follows:

1. Dry interiors;
2. Normally dry but exposed to the weather;
3. Frequently wet or exposed to high humidity;
4. Continuously wet or immersed in fresh water;
5. Hand-cleaned steel immersed or exposed to condensation;
6. Continuously wet or immersed in salt water;
7. Underground;
8. Rust-proofed;
9. Chemical exposure.

In addition, separate cross-referencing is shown for cases where special properties are required, such as abrasion resistance, anti-sweat properties, anti-fouling, use over galvanized metals, high surface temperature, linings, etc. The alphabetical index lists recommendations for about 400 different kinds of surfaces and structures.

Chloride salts, often used on the highways for de-icing, are also used by the railroads in most refrigerator cars. Here the continually melting ice results in spraying corrosive brine along the railroad right-of-way. A wide variety of coatings having the necessary brine resistance is now available.

In a different approach to the problem, work done by the Association of American Railroads (10) and the Armour Research Foundation has shown that it is possible to reduce greatly the corrosiveness of railroad brines (or de-icing salts) by adding small amounts of chromates or phosphates directly to the salt. The use of such inhibitors adds substantially to the cost of the salt, however, and has not been adopted by the railroads or generally by most public authorities.

Several years ago a test was undertaken on 2 bridges of the Missouri Pacific Railroad near St. Louis for the specific purpose of evaluating synthetic brine-resistant coatings which could be applied over sandblasted or over wirebrushed surfaces. Figure 1 shows one of the bridges on which many alternative paint systems were tested. Subsequent to this a similar test was undertaken on the Seaboard Airline Railway over 2 bridges in the southeastern U. S., both of which were hand-cleaned (Fig. 2). After several years' experience with these 2 tests it was concluded that a wide variety of coatings provides successful protection over sandblasted surfaces. Even over a hand-cleaned surface, good protection can be obtained if the systems are carefully retouched every few years. A report on the Missouri Pacific work is being published this month in the annual bulletin of the American Railway Engineering Association.

Where severe environmental factors such as brine drippings are not present, many years of maintenance-free service can be obtained with less expensive materials applied

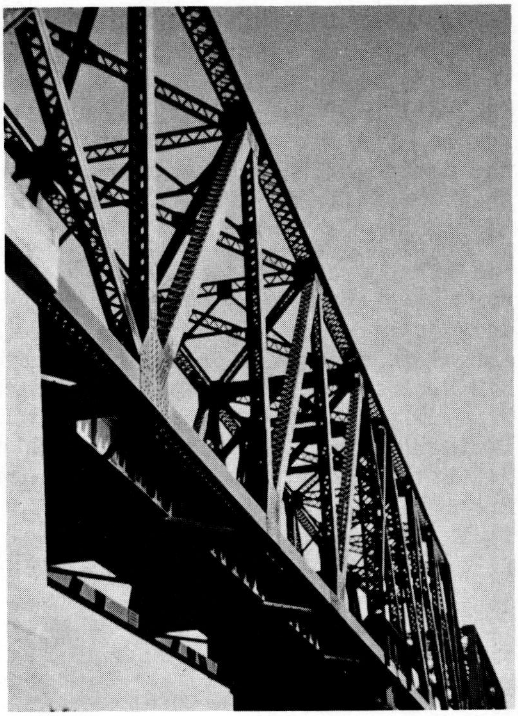

Figure 1. One of the through truss span test bridges (sand-blasted) near St. Louis for evaluation of brine-resistant paints.

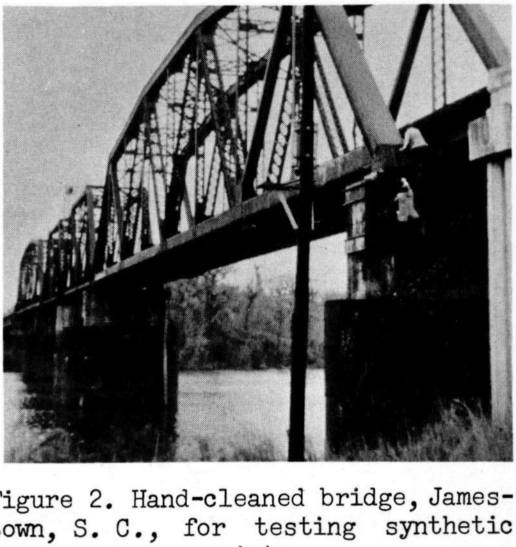

Figure 2. Hand-cleaned bridge, Jamestown, S. C., for testing synthetic paints.

over hand-cleaned surfaces. This is illustrated (Fig. 3) by the test being conducted on 3 bridges of the Santa Fe Railway near Kansas City in which several proprietary paints are being evaluated. Over the past 7 years even the less durable types of coatings have been effective. Retouching at intervals up to 10 years should be adequate on such surfaces. Evaluation of proprietary coatings is also being followed over the past several years on 2 bridges on the Southern Railway System. Depending upon the design of the bridge itself, it is possible to test from 1 to more than 30 different coating systems on a comparable basis.

Tests are also used to evaluate the performance of paint, metallizing and other protective coatings under specialized environmental conditions. For example, the top portions of bridges which support either a concrete deck or timber railway ties are sometimes subjected to a combination of abrasion, condensation and brine drippings. An expensive test was undertaken on a Chicago Great Western bridge (Fig. 4) this year, in which more than 20 protective systems were evaluated, including adhesive tapes, metallizing, vinyls, Neoprene, chlorinated rubber, epoxies and other resistant materials. To a considerable extent the results of this test should be applicable to highway bridges.

These tests also illustrate dramatically that the life of the paint system is affected by the amount of sheltering of the surface and by the details of design.

TABLE 1

YEARS TO FAILURE OF PAINT FILMS ON STEEL IN MARINE ATMOSPHERE
EFFECT OF COPPER CONTENT

Steel	Surface Condition	Primer Pigment Red Lead[a]	Primer Pigment Zinc Chromate[b]
High strength Low alloy[d]	Hot-rolled	6.5	c
C1020 Cu (struct. copper)	" "	5.0	5.0
C1020 (struct. carbon)	" "	4.0	4.0
High strength Low alloy[d]	Cold-reduced	c	c
C1005 Cu (copper)	" "	c	c
C1005 (carbon)	" "	c	c

[a] TTP86aI.

[b] Similar to SSPC-Paint 11-55T.

[c] Paint film unbroken after 8 years.

[d] Cor-Ten.

DESIGN

Proper protection of steel structures begins with the design of the structure. Some features which should be eliminated are crevices which can neither be protected nor sealed off; pockets on bolted joints, channels, flat surfaces and the like where moisture cannot drain properly; and steel in contact with concrete surfaces in such a way that a firm bond cannot be obtained.

An increasingly large number of modern highway bridges employ large amounts of welding in their fabrication or erection. Figure 5 shows a few typical welded highway bridge structures. In order to determine the factors necessary for good paint performance over welds, a comprehensive study was undertaken by the Council, in which more than 1,100 welded specimens were prepared with various combinations of welding rods, surface preparation, primer paints, and special pretreatment (Fig. 6). N. Morgan of the Bureau of Public Roads is chairman of the subcommittee on this study. After 2 years of exposure, the factors which lead to good paint performance over welds have been determined and are soon to become the subject of a separate report. Good painting is obtained if any one of several steps is taken. First, welds made with some electrodes require no special treatment. Second, all weld slag and other residues should be removed from the weld area by sandblasting or by power wirebrushing, if practicable. If not, any one of a number of simple surface treatments, such as washing with dilute chromic or phosphoric acids followed by a water rinse, should be used. Surprisingly, washing with plain water is very effective over welds which have not been properly cleaned. The method of paint application appears to have little effect, but there are differences in the performance of various primers. It is indicated that the occasional difficulties encountered in painting over welds are largely due to failure to remove small amounts of alkaline slag deposits caused by the electrode coating.

Figure 3. Proprietary paints in relatively sheltered location on rolled beam deck spans. (One of 3 test bridges near Kansas City.)

The designer should avoid placing a steel-concrete interface at an area, such as an expansion joint, where relative motion will occur between the concrete and steel, especially when moisture or condensation will be present.

To date, it has not usually been economically feasible to help solve the bridge painting problem by the use of corrosion-resistant alloys in place of the usual carbon structural steel. For some time it has been known, however, that the presence of small amounts of copper (for example, 0.2 percent) greatly reduced the corrosion rate of the bare metal. More recently it is indicated that at least in some environments, this small amount of copper in the base steel also lengthens the life of the protective coating film applied to it. Table 1 shows this effect of copper content upon the life (2 percent of film ruptured) of 2 types of structural steel primers. It also shows that both the red lead and the zinc chromate

TABLE 2

SURFACE PREPARATION SPECIFICATIONS

Specification	Subject	Contents
SSPC-SP 1-52T	Solvent cleaning	Solvent wiping, immersion, end spraying; vapor degreasing; alkaline, emulsion, and steam cleaning; paint stripping.
SSPC-SP 2-52T	Hand cleaning	Hand chipping, scraping, sanding, and wirebrushing.
SSPC-SP 3-52T	Power tool cleaning	Power tool chipping, descaling, sanding, wirebrushing, and grinding.
SSPC-SP 4-52T	Flame cleaning of new steel	Flame dehydrating and cleaning followed by wirebrushing.
SSPC-SP 5-52T	Blast cleaning to "white" metal	Nozzle (dry, wet, or vapor) or centrifugal blast cleaning using sand, synthetic abrasives, crushed iron or steel grit and shot.
SSPC-SP 6-52T	Commercial blast cleaning	Blast cleaning with removal of rust and millscale only to degree specified.
SSPC-SP 7-52T	Brush-off blast cleaning	Blast cleaning with removal of considerably less rust and millscale.
SSPC-SP 8-52T	Pickling	Sulfuric, hydrochloric, and phosphoric acid pickling; duplex pickling and electrolytic pickling.
SSPC-SP 9-52T	Weathering	Exposure to weather to remove millscale by rusting. Must be followed by other cleaning methods. Commercial blast cleaning recommended.

primers lasted considerably longer over the high-strength low-alloy steel than they did on the C1020 structural carbon steel having less copper (9).

SURFACE PREPARATION

Table 2 shows the standard surface preparation specifications. These are, of course, described in considerable detail in the Steel Structures Painting Manual (2), and in a previous paper to the Highway Research Board by Bigos (4). The first specification, solvent cleaning, removes oil, grease, dirt and soil, salts and residues of contaminants, but does not remove millscale. Hand cleaning removes rust, millscale and paint that are loose, whereas power tool cleaning removes these along with a portion of the more adherent millscale, rust and paint. Flame cleaning tends to remove some of the tight millscale and to dehydrate the surface before painting. Blast cleaning to white metal completely removes all rust, millscale and foreign matter, whereas the commercial blast cleaning may leave slight residues of tight millscale and rust. With brush-off blast cleaning, considerable residues of tight millscale and rust are tolerable. Pickling, if properly done, removes rust and millscale completely, and in some operations also passivates the surface. Council specification SSPC-SP9-52T "Weathering," is a procedure in which millscale is removed by allowing the steel to rust before being cleaned and painted. It is recommended that weathering be followed by commercial blast cleaning.

Hand cleaning is usually most economical for small areas where power is not available or where the setup time is excessive. Cleaning in most other cases with a sandblast or power tool not only does a much better job, but is also less expensive.

A number of the current SSPC field investigations are concerned with the effect of variations in surface preparation upon primer performance. One of these tests, which has just been set out for exposure (Fig. 7), is an effort to determine what paints can give the best protection to inexpensively prepared steel surfaces, even those containing some degree of rust. Each of 60 specification and proprietary paints was applied to 20 specimens including sandblasted steel, adherent millscale, descaled-and-rusty steel, and hand-cleaned specimens with degrees of rust combined with millscale.

In a related, but unusual research project recently reported by the Council before the American Chemical Society, it was shown that ordinary iron rust could be substituted for commercial iron oxide pigment in various primer formulations without injury to durability (Fig. 8).

Two other Council tests involve shipping fabricated steel unpainted, allowing the millscale to weather away partially on the structure before cléaning and priming. It has been found that the millscale can be removed more easily after weathering and that cleaning and priming can then be done just before the usual field painting. This is essentially a comparison between Surface Preparations No. 2 "Hand Cleaning" followed by shop painting in comparison with No. 9 "Weathering" followed by cleaning and field painting. The first such test (Fig. 10) is under way near Breckenridge, Minnesota in which the first 3-deck girder spans have been shop primed and the other 3 spans have been weathered, cleaned and painted. In a similar comparison near Rayland, Ohio, each of 4 different primers has been used over both hand-cleaned and blasted surfaces. Previous work (5) shows that, at least in some environments, weathering results in reduced paint life unless followed by blasting or the equivalent.

Figure 4. Some of the test areas on protection of top flanges, Chicago Great Western Rwy., Byron, Illinois.

APPLICATION METHODS AND PRETREATMENTS

Table 3 outlines the SSPC Pretreatment and Application specifications. Numerous studies have

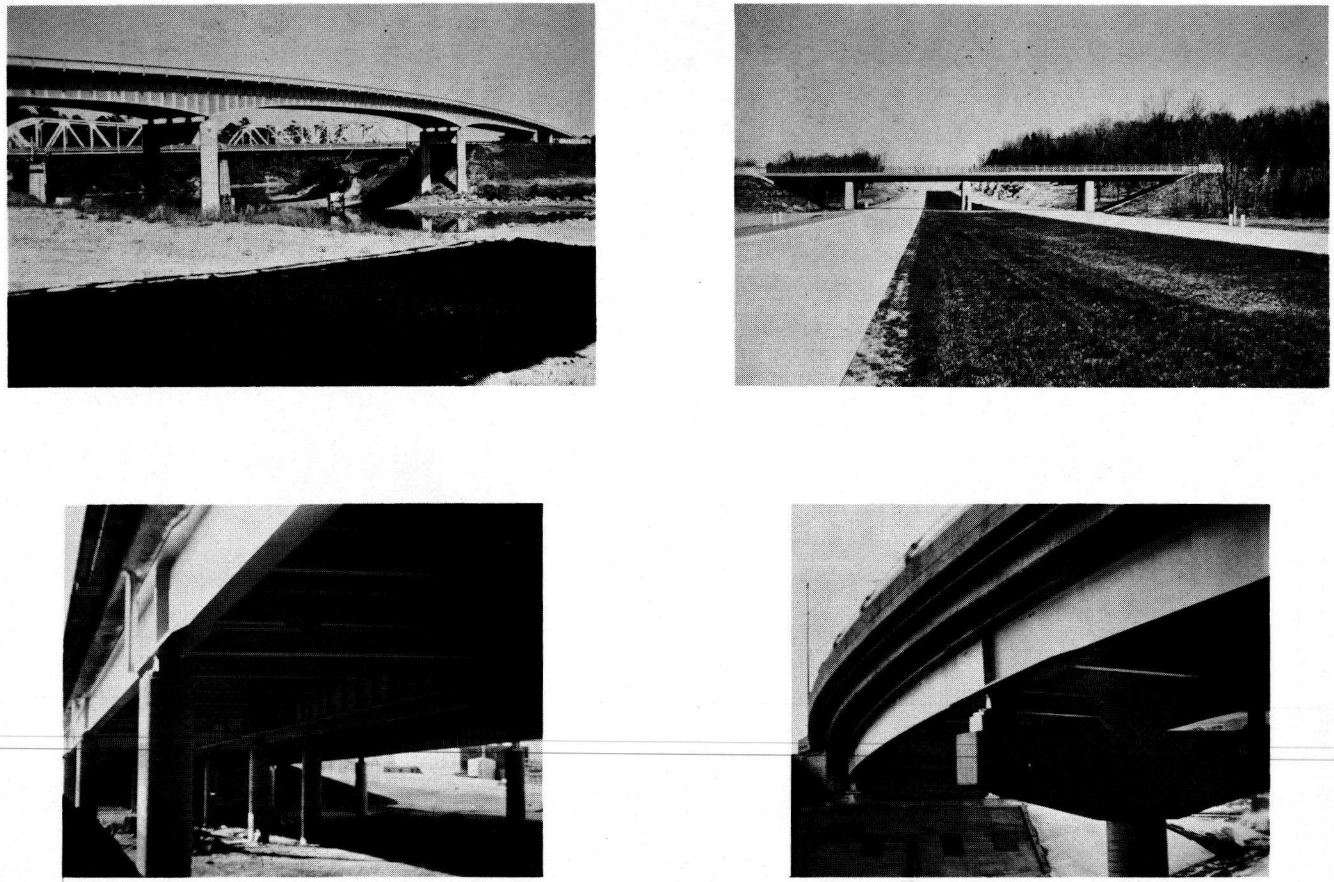

Figure 5. Upper Left: Prize-winning continuous plate girder bridge in Houston. Upper Right: One of several hundred welded bridges on N. Y. Freeway. Lower Photos: Curved plate girders on Kansas Turnpike structures (aluminum topcoat over iron oxide primer). SSPC tests give added assurance of paint performance over such welded structures.

shown that while pretreatments increase the probability of getting a good painting job, an improperly designed surface pretreatment can be worse than nothing. This was illustrated on a test conducted in cooperation with the Association of American Railroads on a New York Central Railway bridge, using a proprietary flush-off type of pretreatment. Other work, however, has shown that proper pretreatment results in more consistent results, especially in severe environments. With unweathered galvanized steel, pretreatment is very important.

TABLE 3

PRETREATMENT AND APPLICATION SPECIFICATION

Specification	Subject	Contents
SSPC-PT 1-53T	Wetting oil treatment	Covers application of wetting oils to surfaces, from which all rust and millscale have not been removed, to improve adhesion and bond of paint.
SSPC-PT 2-53T	Cold phosphate surface treatment	Covers application of phosphoric acid treatments to passivate steel surfaces which have been thoroughly cleaned.
SSPC-PT 3-53T	Basic zinc chromate vinyl butyral wash-coat.	Covers application of wash primer to thoroughly cleaned steel; improves adhesion and bond of paint; reduces underfilm corrosion.
SSPC-PT 4-53T	Hot phosphate surface conversion	Covers hot conversion by zinc or iron phosphate solutions to form crystalline surface for improvement of paint bonding and reducing of underfilm corrosion.
SSPC-PA 1-53T	Shop, field, and maintenance painting	Completely covers all phases of paint storage, mixing, thinning, application by brush or spray in shop or field, permissible temperatures and humidities, drying, and protection of painted steel.

There are considerable differences of opinion on the relative merits of application by brush, spray, hot spray, airless hot spray, paint roller, cold airless spray and dip application. With properly formulated paints several spraying methods are used satisfactorily. Some structures have features which are difficult to cover properly by spraying alone, so brush striping or brushing following spraying of these areas is sometimes recommended. Labor costs are reduced by cold spraying and still further by hot spraying or airless cold spray. Hot spray also claims advantages in savings of thinner, reduced overspray and heavier films, but requires a proper formulation to avoid trapping of solvents or dry spray. The Council is undertaking a special project in which the various methods will be compared.

No matter which method of paint application is used, proper care is necessary in order to be sure that the paint is not under- or overthinned,

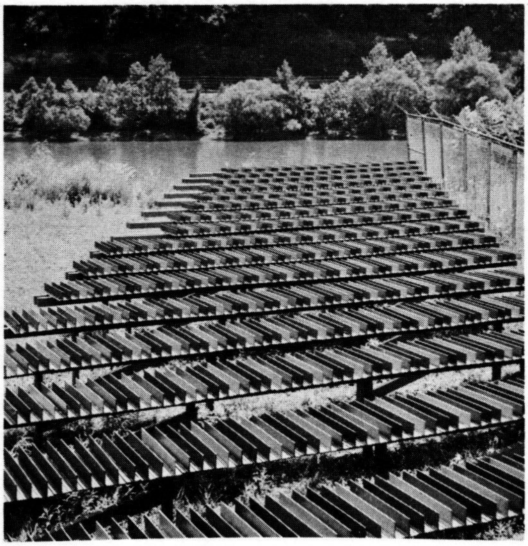

Figure 6. Test panels for determining best methods for painting of welds. (Neville Island, Pittsburgh, Pennsylvania.)

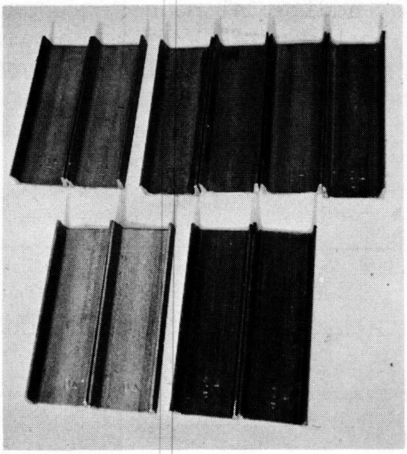

Figure 7. Hand-cleaned channel irons for testing paints on rusty steel. Two are sand-blasted; two have new adherent millscale; two are sand-blasted and rusted; four have combined rust and millscale. 120 such sets are exposed.

that no holidays or gaps are left in the film, and, most important, that the proper film thickness is applied uniformly.

Painting is preferably not applied at ambient temperatures below 40 F for several reasons: (1) possibility of condensed moisture or frost on surfaces; (2) thick viscosity requiring excessive thinning; and (3) slowness of drying. Upper application temperature limits are not set. Painting on dew-covered surfaces, particularly on the shaded side of a structure in the morning, is to be avoided. Further work is indicated to determine what upper limit, if any, should be set on humidity during painting.

Safety requirements are listed in each specification and provide a valuable checklist of precautions against toxic materials, flash fires, and the like.

PRIMERS AND PAINT SYSTEMS

A summary of the SSPC specification primers is listed in Table 4. Table 5 is a list of the SSPC paint systems, which include recommended combinations of surface preparation, pretreatment, primers, intermediate and top coats. The paint systems provide a very wide choice of primers suitable for individual requirements. In Table 5, however, only one of the alternatives is listed for each system.

Paint systems are applied to structural steel for both protection and appearance. The theory of corrosion and its prevention, described in Volume 1 of the Council's Painting Manual, will not be repeated here. Briefly, for corrosion of steel to take place, both oxygen and moisture must be present, together with minute electrical potential differences which are usually present in the surfaces themselves. Protective coatings may prevent corrosion by setting up a partial barrier to the passage of moisture and oxygen; usually, however, they also protect by one or more of the following additional means: pigmentation to set up a corrosion-inhibiting film on the metal surface; sacrificial pigments (such as zinc) which are used up electrolytically as they protect the steel; electrically insulating films; films resistant to oxidation and chemicals.

TABLE 4

SSPC PRIMERS

Primer	Pigment	Approx. Pigment (% by Wt.)	Vehicle Solids	Approximate Set to Touch (hr)	Dry through (hr)	Minimum Surface Prep. Recommended
SSPC-Paint 1-55T	Red lead 100%	77.5	Raw linseed oil	6	72	Hand cleaning
SSPC-Paint 2-55T	Red lead 75% Iron oxide 25%	75	Raw linseed oil (2 parts) Alkyd varnish (1 part)	4	24	Hand cleaning
SSPC-Paint 3-55T	Red lead 75% Iron oxide 25%	75	Fractionated linseed oil		24	Hand cleaning
SSPC-Paint 4-55T	Red lead 75% Extender 25%	63	Raw linseed & Bodied linseed oil		24	Hand cleaning
SSPC-Paint 5-55T	Zinc dust 80% Zinc oxide 20%	75	Phenolic varnish	2	6	Blast cleaning or pickling
SSPC-Paint 6-55T	Iron oxide 67% Red lead 24% Extender 9%	60	Phenolic varnish	4	12	Blast cleaning or pickling
SSPC-Paint 7-55T	Zinc dust 50% Zinc oxide 20% Iron oxide 30%	63	Phenolic varnish	2	6	Blast cleaning or pickling
SSPC-Paint 8-55T	Aluminum 100%	6.7	Vinyl	1/4	1	Blast cleaning
SSPC-Paint 9-55T	Titanium dioxide 100%	12	Vinyl	1/4	1/2	Blast cleaning
SSPC-Paint 10-55T	Zinc yellow 35% Red lead 2.5% Iron oxide 30% Extenders 32.5%	43	Phenolic varnish	4	20	Hand cleaning
SSPC-Paint 11-55T	Iron oxide 40% Zinc yellow 40% Extender 20%	50	Raw linseed oil Alkyd varnish (equal pts.)	6	24	Hand cleaning
SSPC-Paint 12-55T	Inorganic filler		Asphalts	4	72	Blast cleaning
SSPC-Paint 13-55T	Iron oxide 60% Red lead 12% Zinc yellow 3% Mg. silicate 25%	55.5	Tung oil ester gum varnish Raw & bodied linseed oil	4	8	Nominal

In each instance, however, a firm bond must be obtained between the metal and the coating. If the metal is at all rusty the paint vehicle is required to have a high degree of wetting ability, such as that obtainable by raw linseed oil. Unfortunately, many of the best wetting vehicles do not have outstanding moisture resistance or chemical durability. For this reason, various types of treated oils and oil-synthetic vehicle combinations have been used as compromises. In addition, it may also be possible to combine the wettability of oil base paints with the durability of synthetics by the use of an additive to the synthetic paint. To date, no spectacular results have been noted through the use of additives, but the Council is following the evaluation of several of these in the hopes that such a combination will be obtained. A test involving several hundred fabricated panels, with rivets, welds and crevices, has been set up (Fig. 9) specifically to evaluate the effect of additives in phenolics, alkyds, epoxies and other synthetic types of paint. These tests have not been under way long enough for conclusive results to be obtained. Another test being followed by the Council involves painting of a large Crane Runway in Pittsburgh to evaluate the effect of a wetting oil type of pretreatment. To date, no advantage is apparent as compared with the use of a prime coat in place of the pretreatment.

A fast-drying, poor-wetting synthetic paint should not be used over a poorly cleaned steel surface. Such a poor combination can easily be avoided, either by specifying thorough surface preparation (with inspection) or by specifying, as a second best, a raw linseed oil-based paint with inhibitive pigment applied over hand-cleaned steel.

Another combination to be avoided is the use of a hard-surface phenolic primer with too long an interval between the application of the first and second coats. The Manual recommends addition of cellosolve or the equivalent to the delayed coat, especially for water immersion application.

Figure 8. Exposure of 16 paints in which rust was substituted for commercial iron oxide.

REPAINTING PRACTICE

Spring is the customary time for the annual inspection of highway bridges. At this time the effect of ice, de-icing salts and other winter damage can be assessed in time for repairs and painting the following summer. Special attention should be given to points subject to dampness, condensation and drainage, and in particular to rivet heads or points adjacent to masonry.

Table 6 is a very general guide to a decision on whether to touch up, completely repaint, or otherwise repair the painted surface. This decision also depends on how the surface was originally prepared. If the primer is of a contrasting color with the topcoat, as it should be, incipient failures become more apparent. It is poor economy to let the paint deteriorate to a point where

TABLE 5

TYPICAL SSPC PAINT SYSTEM ALTERNATIVES

SSPC PS	Paint System	Minimum Surface Prep. Recommended	Pre-Trmt	Primer (Alternate)	Second Coat (Alternate)	Third Coat (Alternate)
1	Oil base	Hand Cleaning	None	SSPC-Paint 1-55T;	SSPC-Paint 1-55T;	Standard Aluminum
2	Alkyd	Blast Cleaning or Pickling	None	TT-P-86a Type III	TT-P-86a Type III	Aluminum Alkyd
3	Phenolic	Blast Cleaning or Pickling	None	TT-P-86A Type IV	TT-P-86a Type IV	Aluminum Phenolic
4	Vinyl	Blast Cleaning or Pickling	Wash Primer	MIL-P-15929 A	MIL-P-15929 A	SSPC-Paint 8-55T
5	For hand-cleaned water immersion	Hand Cleaning	None	SSPC-Paint 10-55T	SSPC-Paint 10-55T	Aluminum Phenolic
6	For vessels	Blast Cleaning or Pickling	None	USMA 52 MA-401a Type 1 Fourth Coat:	USMA 52 MA-401a Type II (USMA 52 MA-403a, Antifouling)	USMA 52 MA-401a I
7	For mild exposure	Hand Cleaning	None	SSPC-Paint 13-55T	None	None
8	Rust preventives	Unpainted surfaces requiring protection	None	USMA 52 MA-602a Type B (Rustproofing Compound)	None	None
9	Bituminous	Blast Cleaning or Pickling	None	SSPC-Paint 12-55T	None	None

TABLE 6

ROUGH GUIDE FOR REPAINTING

Degree of Rusting or Area Exposed	Cleaning and Painting Recommended
No rusting	Solvent clean if necessary. Apply 1 or 2 coats of finish paint, depending upon conditions.
Slight rusting in localized areas	Spot clean and spot prime. Apply 1 or 2 over-all coats of finish paint as necessary.
25% to 50% rusting in localized areas	Spot clean and spot prime. Apply 1 over-all coat of priming paint, and 1 or 2 coats of finish paint as necessary.
Over 50%	Remove as much old paint as is practical. Apply 2 priming coats and 1 finish coat, or 1 priming coat and 2 finish coats as necessary.
Where there is large area of sound adhering paint, which is not too thick to be detrimental	Spot clean bad areas. Apply enough coats of rust inhibitive primer over these areas to build them up to a satisfactory level, then 1 or 2 over-all finish coats.

Figure 9. Testing additives to synthetic resin paints—designed to combine wetting with durability. Fabricated panels have rivets, crevices and welds.

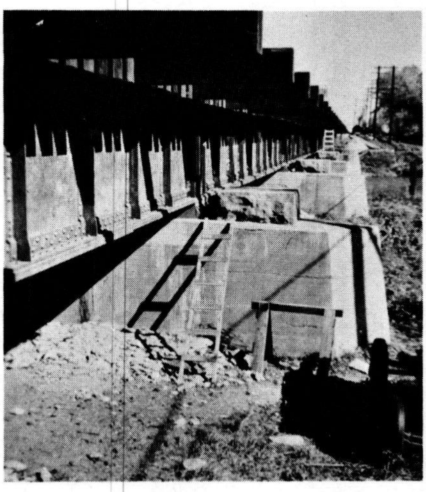

Figure 10. Three spans of this deck girder bridge were shop primed. The other three were weathered nine months before being cleaned and painted.

rust shows at all, or particularly, as shown in Figure 11, to a point where extensive surface preparation is required. Due to the high cost of surface preparation, the total cost of repainting in such a case in terms of dollars per sq ft here is invariably higher than if painting is carried out at more timely intervals.

TABLE 7

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4	Practical Aspects, Use, and Application of Paints	A. J. Eickhoff and J. Bigos
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STEEL STRUCTURES PAINTING MANUAL

This Manual consists of 2 volumes, the first of which is a practical encyclopedia of economical and satisfactory painting methods. Some idea of the scope of this volume can be obtained from Table 7, which shows a condensed Table of Contents. Volume 1 contains a separate chapter on the painting of highway structures, including the factors involved in various environments, types of structures, labor considerations, paint life expectancy obtained, etc. Volume 2 has been discussed. It includes the paint systems which give good results in various applications as well as an indexed guide to the selection of suitable systems for various types of structures and exposure conditions. It contains detailed specifications which have been widely adopted throughout the world for surface preparation, pretreatment, paint application, paint formulations and paint systems. For contract purposes the individual specifications may be referred to SSPC number only, or they may be included in whole or in part in the over-all construction specifications. They are also well integrated with AASHO specifications.

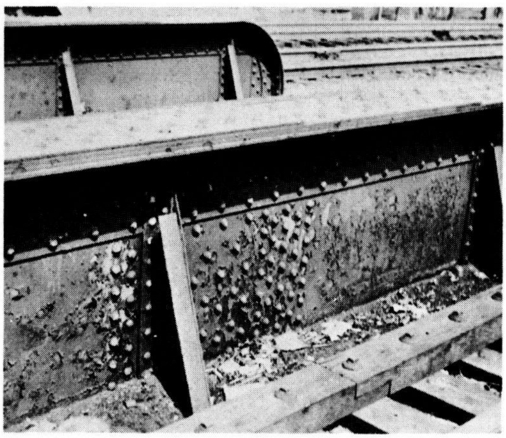

Figure 11. Painting has been deferred too long on this through girder for most economical maintenance painting.

CONCLUSION

A knowledge of the best materials and methods presently available for painting of steel structures, as presented, for example, in the Steel Structures Painting Manual, can contribute much to the appearance, life and low maintenance of highway bridges. In addition, however, it is mandatory that improved specifications and new experimental work be continued in order to take advantage of the vast amount of development work by coatings manufacturers and associated industries. Much work of this kind remains to be done.

First, new coatings, products and methods must continually be evaluated. Secondly, special applications such as painting of welds, protection of load-bearing surfaces, salt-resistant finishes, etc., must be investigated. Thirdly, further information is still needed on such basic questions as painting of hand-cleaned steel, protection of millscaled or rusty surfaces, economics of maintenance painting and durability versus application method.

Most of the structural steel painting studies carried out by the Council in cooperation with other industries are equally applicable to highway bridge painting. Continued cooperation, therefore, between highway engineers and the Council will result in both improved research and better highway structures.

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