

PROTECTIVE COATINGS FOR STRUCTURAL STEEL
Third Progress Report

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PROTECTIVE COATINGS FOR STRUCTURAL STEEL

Third Progress Report

This progress report continues the presentation of data on performance, in accelerated laboratory tests, of a number of specification and proprietary structural steel primers and coatings of interest to the Department. Previous evaluations conducted in three earlier test series under this research project were reported in Research Report Nos. R-260 (July 1956) and R-361 (August 1961). The coatings tested in the fourth and fifth series, discussed in this report, were received for evaluation by the Research Laboratory Division from 1960 through early 1964. Some were transmitted by the Committee for Investigation of New Materials.

Primers and topcoats received in this four-year period were evaluated in two series since according to policy, coatings scheduled for evaluation are allowed to accumulate to form groups of sizes that can be conveniently handled in laboratory equipment. Those received prior to 1962 were evaluated in 52 primer-topcoat systems under Series 4, in tests completed at the Laboratory's former MSU campus location about July 1, 1962, just before moving to the current location in Lansing. Paints received after those in Series 4, through early 1964, were evaluated at the Lansing laboratory in 60 additional systems as Series 5. These tests were completed about October 1, 1964.

Series 4 systems included the Department's standard system of red lead primer and aluminum topcoat, which served as a control standard, plus modifications to provide information for possible revision of specifications. Primers based on basic lead silico chromate and zinc-rich pigments were evaluated. Also included were coatings based on latex, neoprene, polysulfide, and vinyl binders, and topcoats based on epoxy and polyurethane resins. Many System 4 coatings were proprietary formulations.

Series 5 systems included the Department's standard system of red lead primer and aluminum topcoat plus modifications, No. 2 MP primer plus modifications, about 10 proprietary zinc-rich primers, a latex wash primer, and several vinyl coatings. Also included were coatings based on grease, asphalt, neoprene, and hypalon binders, and topcoats based on vinyl-alkyd and epoxy modifications. Many Series 5 materials were also proprietary formulations, some of which were evaluated under the New Materials Committee program.

Laboratory Test Procedure

Test systems were applied to steel panels in two coats, consisting of a primer and a topcoat, prior to evaluation in laboratory equipment. The application was made on duplicate 2-3/4 by 6 in. panels, cut from flat, 16-gage, hot-rolled steel, which is the grade used for bridge structural steel and hand railings. Most systems were evaluated on hand-cleaned panels, which were power-wire-brushed using a soft wheel to remove occasional rust spots, then wiped with an alcohol-moistened cloth to remove any perspiration stains, and finally degreased in a trichloroethylene vapor bath just before application of primers. Some primers, notably the zinc-rich and vinyls, were evaluated on blast-cleaned panels, in accordance with paint manufacturer's instructions. Most paints were applied by brushing, the application method commonly used in coating Department bridge steel, although a few were applied by spray gun since they were not suited to brush application. After at least six days of primer drying, the panels were topcoated and then edge-sealed to preclude coating breakdown or staining from those areas, and allowed to dry for about three weeks before testing.

After drying, the better panel of the pair prepared for each system was selected for testing, while the other was set aside to serve as a control for comparison purposes at the end of the weathering tests. The panel selected to undergo accelerated tests received a vertical scratch through the coating to the metal. A complete test cycle consisted of 200 hr of exposure in the Weather-Ometer (continuous artificial sunlight with 9-min water spray each hour), followed by 50 hr at 95 F in a salt spray-humidity cabinet. The coated panels were exposed to seven such cycles, for a total exposure of 1400 hr of Weather-Ometer and 350 hr in the cabinet. At the conclusion of laboratory tests, the panels were photographed with their respective control panels to show the amounts of degradation during test exposure (Figs. 1 and 2), and were rated.

Performance Ratings

To assign numerical values to the conditions of coatings systems after the tests, observers (J. Badaluco, A. J. Permoda, R. L. Snider) rated the panels for three factors:

1. Topcoat appearance, taking into consideration fading, chalking, and gloss change.
2. Amount of coating breakdown on the panel face.
3. Extent of rusting and rust creepage at the vertical scratch.

Each factor was rated numerically on a 10-to-0 scale, with 10 denoting perfect condition and 0 complete failure. For convenience, these three ratings were added into a single total value indicating the overall merit of the coating system, with the highest total representing the best-performing system. These totals, tabulated in Tables 1 and 2, are averages for the three observers. Individual average factor ratings are also listed in these tables, as is the relative rank of the systems, and source of the proprietary coatings.

Series 4 Test Results

Of the 52 systems listed in Table 1 and shown in Fig. 1, 15 were classified as "very good" (in this case defined as having received 24 points or more of a possible 30-point maximum performance rating), and carry the highest potential for Department use:

Rank 1 - 26 points

- System 5: MSHD 1A red lead primer and proprietary epoxy aluminum topcoat
- System 10: MSHD 1C modified red lead primer and MSHD 5B aluminum alkyd topcoat
- System 34: Proprietary one-package zinc-rich gray primer and MSHD 5B aluminum alkyd topcoat
- System 39: Proprietary one-package zinc-rich gray primer and proprietary premixed aluminum topcoat
- System 42: Proprietary two-package red-lead zinc-dust primer and proprietary epoxy aluminum topcoat.

Rank 2 - 25 points

- System 1: MSHD 1A red lead primer and MSHD 5B aluminum alkyd topcoat (Department and test standard)
- System 4: MSHD 1A red lead primer and proprietary two-package aluminum topcoat
- System 12: MSHD 1C modified red lead primer and MSHD 5B aluminum alkyd topcoat (primer modified)
- System 14: MSHD 1C modified red lead primer and MSHD 5B aluminum alkyd topcoat (different primer modification than System 12)
- System 19: Fed. Spec. TT-P-615b Type I basic lead silico chromate orange primer and MSHD 5B aluminum alkyd topcoat

TABLE 1
IDENTIFICATION AND PERFORMANCE OF TEST COATING SYSTEMS
SERIES 4 COATINGS (Received 1960-1962)

Test System	Identification	Composition	Drying Time, hr	System Thickness, mils	Appearance			Ratings*			Rank	Remarks
					Appearance	Face Rusting	Scratch Rusting	Total**				
1	Primer: 60 PR-62	MSHD No. 1A red lead	48	1.9	7.0	10.0	8.0	25	2	Standard MSHD system		
	Topcoat: 60 PR-112	MSHD No. 5B alkyl aluminum	18	3.0								
2	Primer: 60 PR-62	MSHD No. 1A red lead	48	1.9	8.0	9.0	6.0	21	6	Topcoat from Deveboise Co.		
	Topcoat: 60 PR-159	Decosteel No. 595 stainless steel grey	12	4.4								
3	Primer: 60 PR-62	MSHD No. 1A red lead	48	2.2	8.0	7.0	8.0	23	4	Topcoat from Republic Powdered Metals Co.		
	Topcoat: 61 PR-80	No. 301XS quick dry aluminum	4	4.1								
4	Primer: 60 PR-62	MSHD No. 1A red lead	48	1.6	7.0	10.0	8.0	25	2	Topcoat from Du Pont		
	Topcoat: 61 PR-146	No. 166-220 two-package aluminum	12	3.0								
5	Primer: 60 PR-62	MSHD No. 1A red lead	48	1.6	8.0	10.0	8.0	26	1	Topcoat from H. B. Fuller Co.		
	Topcoat: 61 PR-2	Resiweld No. 224 two-package epoxy aluminum	6	4.7								
6	Primer: 60 PR-62	MSHD No. 1A red lead	48	1.3	7.0	10.0	6.0	23	4	Topcoat from Harrison Development Co.		
	Topcoat: 61 PR-67	No. 100 two-package polyurethane green	6	3.6								
7	Primer: 60 PR-62	MSHD No. 1A red lead	48	1.8	7.0	9.0	6.0	22	5	Topcoat from Truscon Laboratories		
	Topcoat: 61 PR-142	Bar-Ox No. RB-1183 green	24	4.0								
8	Primer: 60 PR-62	MSHD No. 1A red lead	48	1.8	7.0	3.0	7.0	17	10	Topcoat from National Lead Co.		
	Topcoat: 56 PR-146	Basic lead silico chromate alkyl-to green	36	3.6								
9	Primer: 60 PR-62	MSHD No. 1A red lead	48	2.1	8.0	10.0	8.0	(26)	--	Topcoat from National Lead Co.		
	Topcoat: 60 PR-70	Basic lead silico chromate alkyl linseed oil green	12	4.0								
10	Primer: 61 PR-131B	MSHD No. 1C modified red lead	42	2.2	8.0	10.0	8.0	28	1	Primer from Hammond Lead Products, Inc.		
	Topcoat: 60 PR-112	MSHD No. 5B alkyl aluminum	18	3.5								
11	Primer: 61 PR-131B	MSHD No. 1C modified red lead	42	2.6	8.0	10.0	7.0	(25)	--	Primer from Hammond Lead Products, Inc.		
	Topcoat: 61 PR-142	Bar-Ox No. RB-1183 green	24	4.9								
12	Primer: 61 PR-133J	MSHD No. 1C modified red lead	42	2.5	8.0	9.0	8.0	25	2	Primer from Hammond Lead Products, Inc.; topcoat from Truscon Laboratories		
	Topcoat: 60 PR-112	MSHD No. 5B alkyl aluminum	18	3.1								
13	Primer: 61 PR-133J	MSHD No. 1C modified red lead	42	2.4	4.0	10.0	7.0	(21)	--	Both coats from Hammond Lead Products, Inc.		
	Topcoat: 61 PR-154	No. 61-38 basic lead silico phosphate alkyl phenol white	10	6.3								
14	Primer: 61 PR-134I	MSHD No. 1C modified red lead	48	1.9	7.0	10.0	8.0	25	2	Primer from Hammond Lead Products, Inc.		
	Topcoat: 60 PR-112	MSHD No. 5B alkyl aluminum	18	3.5								
15	Primer: 60 PR-152	No. L-272 two-package zinc chromate epoxy yellow	6	2.2	5.0	8.0	7.0	20	7	Primer from Kish Industries, Inc.; topcoat from H. B. Fuller Co.		
	Topcoat: 61 PR-1	Resiweld No. 221 two-package epoxy white	6	5.0								
16	Primer: 61 PR-75	No. 40-514 two-package epoxy red lead	6	2.3	6.0	9.0	7.0	22	5	Primer from Kish Industries, Inc.; topcoat from H. B. Fuller Co.		
	Topcoat: 61 PR-1	Resiweld No. 221 two-package epoxy white	6	5.8								

* Rated on scale from 10 to 0, with 10 = no deterioration and 0 = complete failure.

** Parenthesized ratings in this column identify systems damaged or removed from exposure early in test.

TABLE 1 (Cont.)
IDENTIFICATION AND PERFORMANCE OF TEST COATING SYSTEMS
SERIES 4 COATINGS (Received 1960-1962)

Test System	Identification	Composition	Drying Time, hr	System Thickness, mils	Ratings*				Rank	Remarks	
					Appearance	Face Rusting	Scratch Rusting	Total**			
17	Primer: 60 PR-130 Topcoat: 60 PR-130	No-Ox-Iid alkyd aluminum No-Ox-Iid alkyd aluminum	180 180	5.2	0.0	0.0	0.0	0.0	(0)	--	Both coats from Dearborn Chemical Co.
18	Primer: 61 PR-154 Topcoat: 61 PR-154	No. 61-38 basic lead silico phosphate alkyd phenol white No. 61-38 basic lead silico phosphate alkyd phenol white	10 10	2.8 5.4	5.0	9.0	6.0	6.0	20	7	Both coats from Hammond Lead Products, Inc.
19	Primer: 60 PR-161 Topcoat: 60 PR-112	No. TT-P-615b Type I orange MSHD No. 5B alkyd aluminum	30 18	1.5 2.8	8.0	10.0	7.0	7.0	25	2	Primer from National Lead Co.
20	Primer: 60 PR-162 Topcoat: 60 PR-112	No. TT-P-615b Type II brown MSHD No. 5B alkyd aluminum	18 18	1.9 3.0	7.0	10.0	6.0	6.0	23	4	Primer from National Lead Co.
21	Primer: 60 PR-162 Topcoat: 61 PR-68	No. TT-P-615b Type II brown No. 110 GC-10 two-package polyurethane white	18 6	1.9 3.0	6.0	9.0	7.0	7.0	22	5	Primer from National Lead Co.; topcoat from Harrison Development Co.
22	Primer: 61 PR-77 Topcoat: 61 PR-78	No. 69 cement red No. 20 cement silver gray	24 24	2.0 4.2	4.0	3.0	7.0	7.0	14	12	Both coats from Themec Co.
23	Primer: 61 PR-114 Topcoat: 60 PR-112	Tuff-Cote No. 486 latex red MSHD No. 5B alkyd aluminum	6 18	1.3 2.7	8.0	9.0	6.0	6.0	23	4	Primer from Asphalt Products Co.
24	Primer: 61 PR-135 Topcoat: 61 PR-136	No. 1P-49-21-1 latex red No. 1P-49-10-1 latex gray	(a) (a)	1.8 3.2	7.0	4.0	4.0	4.0	15	11	Both coats from Dow Chemical Co.
25	Primer: 61 PR-135 Topcoat: 61 PR-137	No. 1P-49-21-1 latex red No. 1P-15-59-1 latex aluminum	(a) (a)	1.9 5.0	9.0	8.0	4.0	4.0	21	6	Both coats from Dow Chemical Co.
26	Primer: 61 PR-147B Topcoat: 61 PR-147A	Bom-Kote black Bom-Kote aluminum	1 (a)	1.4 2.4	8.0	10.0	4.0	4.0	22	5	Both coats from Bom-Kote Co.
27	Primer: 61 PR-147A Topcoat: 61 PR-147A	Bom-Kote aluminum Bom-Kote aluminum	(a) (a)	1.0 1.8	8.0	9.0	5.0	5.0	22	5	Both coats from Bom-Kote Co.
28	Primer: 61 PR-140 Topcoat: 61 PR-141	No. V-54 red lead No. 705-5005 premixed aluminum	24 18	2.8 4.9	8.0	8.0	1.0	1.0	17	10	Both coats from Du Pont
29	Primer: 61 PR-140 Topcoat: 61 PR-146	No. V-54 red lead No. 166-220 two-package aluminum	24 18	2.1 4.0	8.0	8.0	2.0	2.0	18	9	Both coats from Du Pont
30	Primer: 61 PR-145 Topcoat: 61 PR-141	No. 373-853 antoxide red No. 705-5005 premixed aluminum	30 12	1.3 4.5	8.0	9.0	8.0	8.0	25	2	Both coats from Du Pont
31	Primer: 61 PR-145 Topcoat: 61 PR-146	No. 373-853 antoxide red No. 166-220 two-package aluminum	24 18	1.3 2.0	7.0	10.0	6.0	6.0	23	4	Both coats from Du Pont
32	Primer: 61 PR-150 Topcoat: 61 PR-151	No. 525-14 iron oxide red No. 303-63 two-package "dri-spray" aluminum	12 1	1.9 3.5	6.0	9.0	5.0	5.0	20	7	Both coats from Tropical Paint Co.

* Rated on scale from 10 to 0, with 10 = no deterioration and 0 = complete failure.
** Parenthesized ratings in this column identify systems damaged or removed from exposure early in test.
(a) Poor brushability.

TABLE 1 (Cont.)
IDENTIFICATION AND PERFORMANCE OF TEST COATING SYSTEMS
SERIES 4 COATINGS (Received 1960-1962)

Test System	Identification	Composition	Drying Time, hr	System Thickness, mils	Appearance	Ratings*			Rank	Remarks
						Face Rusting	Scratch Rusting	Total**		
33	Primer: 61 PR-150	No. 525-14 iron oxide red	24	1.6	6.0	9.0	6.0	21	6	Both coats from Tropical Paint Co.
	Topcoat: 61 PR-152A	No. 525-03 gray	48	3.8						
34	Primer: 61 PR-110	Chem-Zinc one-package zinc gray	6(b)	4.4	6.0	10.0	10.0	26	1	Primer from Truscon Laboratories
	Topcoat: 60 PR-112	MSHD No. 5B alkyd aluminum	18	6.5						
35	Primer: 61 PR-110	Chem-Zinc one-package zinc gray	6(b)	4.3	6.0	10.0	9.0	25	2	Both coats from Truscon Laboratories
	Topcoat: 61 PR-155	Chem-Bar premixed aluminum	6	5.5						
36	Primer: 61 PR-111	No. 430 two-package zinc rich gray	1(b)	3.9	5.0	8.0	9.0	22	5	Both coats from Products Research Co.
	Topcoat: 61 PR-112	No. 434 two-package aluminum	1	5.0						
37	Primer: 61 PR-116	Galvanox zinc rich gray	1(b)	3.4	6.0	9.0	9.0	24	3	Primer from Subox, Inc.
	Topcoat: 60 PR-112	MSHD No. 5B alkyd aluminum	18	4.3						
38	Primer: 61 PR-139	ZRC one-package zinc gray	1(b)	1.8	7.0	8.0	10.0	25	2	Primer from Sealube Co.
	Topcoat: 60 PR-112	MSHD No. 5B alkyd aluminum	18	2.6						
39	Primer: 61 PR-139	ZRC one-package zinc gray	6	1.8	7.0	10.0	9.0	26	1	Primer from Sealube Co.; topcoat from Truscon Laboratories
	Topcoat: 61 PR-155	Chem-Bar premixed aluminum	4	3.1						
40	Primer: 60 PR-161	No. TT-P-615b Type I orange	30	1.6	6.0	9.0	4.0	19	8	Both coats from National Lead Co.
	Topcoat: 58 PR-143	Basic lead silico chromate alkyd linseed oil gray	18	3.7						
41	Primer: 59 PR-117	No. 304 two-package red lead-zinc dust primer	18	1.6	7.0	10.0	8.0	25	2	Primer from Lead Industries Assn.
	Topcoat: 60 PR-112	MSHD No. 5B alkyd aluminum	18	3.2						
42	Primer: 59 PR-117	No. 304 two-package red lead-zinc dust primer	18	2.3	8.0	10.0	8.0	26	1	Primer from Lead Industries Assn.; topcoat from H. B. Fuller Co.
	Topcoat: 59 PR-200	Resiweld No. 224 two-package epoxy aluminum	6	4.6						
43	Primer: 60 PR-161	No. TT-P-615b Type I orange	30	1.5	6.0	10.0	6.0	22	5	Primer from National Lead Co.; topcoat from H. B. Fuller Co.
	Topcoat: 60 PR-159	Decosteel No. 595 stainless steel gray	12	3.8						
44	Primer: 61 PR-156B	Magna-Bond gray	pre-coated	---	0.0	0.0	7.0	(7)	--	Panel pre-coated by Magna-Bond, Inc.
	Topcoat: 61 PR-156B	Metallic vinyl	pre-coated	2.5						
45	Primer: 61 PR-157	Eponol 55 aerosol red oxide	4	2.3	8.0	9.0	7.0	24	3	Primer from Shell Chemical Co. of New Jersey; topcoat from H. B. Fuller Co.
	Topcoat: 59 PR-200	Resiweld No. 224 epoxy aluminum	2	3.2						
46	Primer: 60 PR-161	No. TT-P-615b Type I orange	30	2.0	5.0	9.0	5.0	19	8	Primer from National Lead Co.
	Topcoat: 62 PR-1	MSHD No. 25B green	40	3.8						
47	Primer: 58 PR-185A	No. E-3-775 basic lead silico chromate orange	24	2.3	5.0	10.0	7.0	22	5	Primer from Eagle-Picher Co.; topcoat from Hammond Lead Products Co.
	Topcoat: 62 PR-3	No. 61-49 basic lead silico phosphate phenol gray	12	3.0						

* Rated on scale from 10 to 0, with 10 = no deterioration and 0 = complete failure.

** Parenthesized ratings in this column identify systems damaged or removed from exposure early in test.

(b) Panel sandblasted before coating

TABLE 1 (Cont.)
IDENTIFICATION AND PERFORMANCE OF TEST COATING SYSTEMS
SERIES 4 COATINGS (Received 1960-1962)

Test System	Identification	Composition	Drying Time, hr	System Thickness, mils	Appearance	Ratings*			Rank	Remarks
						Face Rusting	Scratch Rusting	Total**		
48	Primer: 62 PR-5	No. R-243 basic lead silicate white	18	2.7	4.0	10.0	5.0	19	8	Both coats from Eagle-Picher Co.
	Topcoat: 62 PR-6	No. R-251 basic lead silicate white	18	3.1						
49	Primer: 58 PR-185A	No. E-3-775 basic lead silico chromate orange	24	1.0	5.0	9.0	6.0	20	7	Both coats from Eagle-Picher Co.
	Topcoat: 62 PR-6	No. R-251 basic lead silicate white	18	3.0						
50	Primer: 62 PR-7	No. 611 polysulfide buff	24(a)	2.5	3.0	9.0	7.0	19	8	Both coats from Products Research Co.
	Topcoat: 62 PR-7	No. 611 polysulfide buff	24(a)	8.0						
51	Primer: 62 PR-8	No. 505 neoprene black	18	1.0	6.0	8.0	6.0	20	7	Both coats from Products Research Co.
	Topcoat: 62 PR-8	No. 505 neoprene black	18	2.0						
52	Primer: 60 PR-62	MSHD No. 1A red lead	48	1.8	3.0	4.0	5.0	12	--	Topcoat from National Lead Co.; applied to only half of panel face
	Topcoat: 60 PR-162	No. TT-P-615b Type II brown	16	3.5	8.0	8.0	7.0	23		

* Rated on scale from 10 to 0, with 10 - no deterioration and 0 = complete failure.

** Parenthesized ratings in this column identify systems damaged or removed from exposure early in test.

(a) Poor brushability

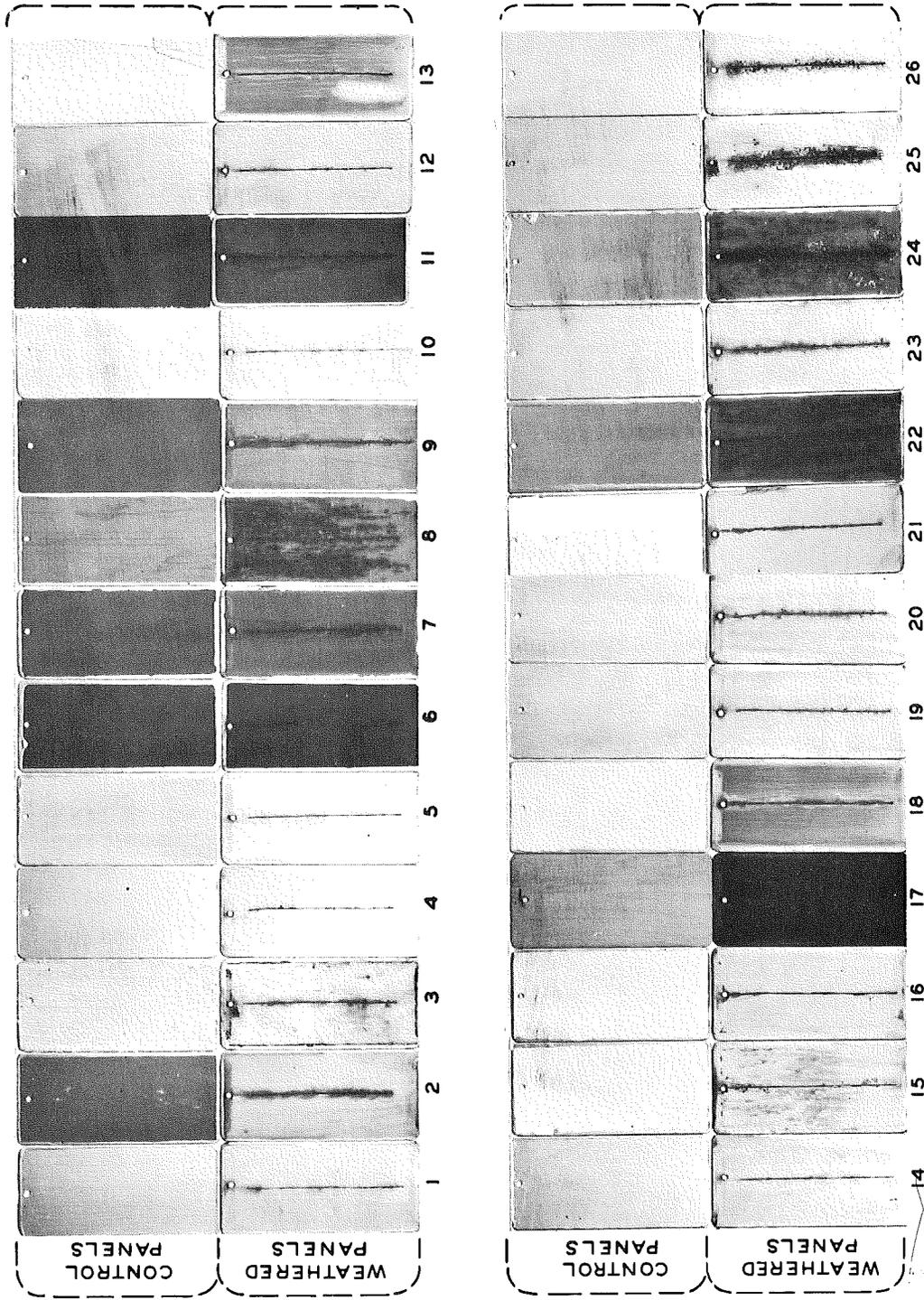


Figure 1. Series 4 panels with unexposed control panel above in each pair, and test-weathered panel with vertical scratch below (identification and performance ratings in Table 1).

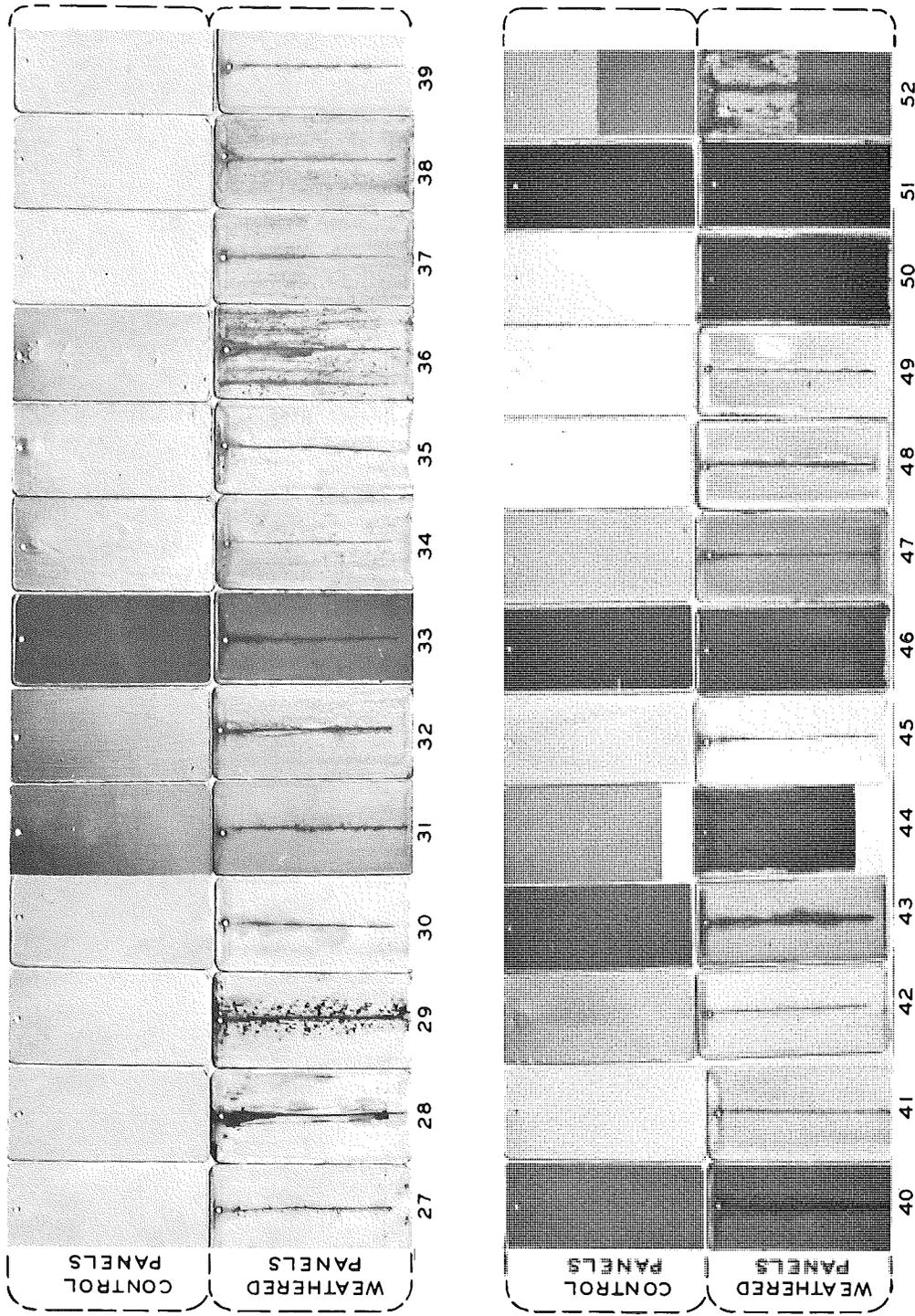


Figure 1 (cont.). Series 4 panels with unexposed control panel above in each pair, and test-weathered panel with vertical scratch below (identification and performance ratings in Table 1).

- System 30: Proprietary specially inhibited "antoxide" brown primer and premixed aluminum topcoat
- System 35: Proprietary one-package zinc-rich primer and premixed aluminum topcoat from same producer
- System 38: Proprietary one-package zinc-rich primer and MSHD 5B aluminum alkyd topcoat
- System 41: Proprietary two-package red-lead zinc-dust primer and MSHD 5B aluminum alkyd topcoat.

Rank 3 - 24 points

- System 45: Proprietary aerosol-spray epoxy brown primer and proprietary two-package epoxy aluminum topcoat.

Of these 15 "very good" systems, it may be noted that the primer classification regarding pigmentation was as follows: eight based on red lead, four on zinc powder, one on basic lead silico chromate, one on a patented ion-absorber, and one on a special brown in aerosol spray. All were aluminum topcoated, with the two-package epoxy formulation in System 5 giving a marginal superiority of 1 point over MSHD 5B aluminum alkyd topcoat in System 1. Unfortunately, the colored topcoats in Systems 9 and 11, which appeared to have the best potential, were inadvertently damaged during the test. Replacement panels did not undergo full testing and thus their Table 1 entries are not comparable to other system listings.

Among the other coating systems, 17 earned "good" performance ratings of 23 points (Nos. 3, 6, 20, 23, 31, 52), 22 points (Nos. 7, 16, 21, 26, 27, 36, 43, 47), and 21 points (Nos. 2, 25, 33). Of these systems, several included colored topcoats (Nos. 6, 7, 21, 33, 43, 47), and several were based on two-package polyurethane resins.

The other 20 coatings earned poorer ratings, although most were in the "fair" category. The poorest system, No. 17, was based on an aluminum grease type coating, very slow drying, which was rated at 0 points at the end of the fifth cycle, before completion of the tests. Also removed at the end of the fifth cycle because of pinpoint rusting on the face was System 44, a vinyl-topcoated panel prepared by the manufacturer, rated next poorest at 7 points.

Finally, Series 4 systems included several novel paints, such as the stainless steel pigmented topcoat (Systems 2, 43) which gave poorer performance than MSHD 5B aluminum. Also evaluated were three latex paint systems, including two (Nos. 23, 25) that earned "good" ratings; however No. 25 did poorly in a limited companion field test on bridge steel when applied in Fall weather on M 71 near Vernon.

Series 5 Test Results

Selection and testing of Series 5 coating systems differed from Series 4 procedures in several particulars. A total of 53 systems were applied to duplicate panels and tested in the same manner as in Series 4; these were designated "Group F" of Series 5, with that letter added as a suffix to the paint system number (e.g., 1F, 2F, etc.). This series also included another seven systems designated as "Group E"; these were chosen from 19 systems which had already begun a long-term outdoor (rooftop) exposure. When that test began one year earlier, extra panels had been prepared and seven of these 12-month-cured 5E subgroup panels were now tested in laboratory equipment along with the 53 newly coated 5F panels. Two MSHD standard coatings were included in both subgroups of Series 5 (Nos. 53E and 1F, 54E and 5F).

Further, the test and Department standard system scored 0.5 points higher in Series 5 tests than in Series 4 tests, so the cutoff between "good" and "very good" classifications was raised from 24 to 24.5 points (out of a possible maximum 30-point rating). Similarly, the cutoff between "good" and "fair" classifications was raised from a rating of 21 to 21.5 points. The higher ratings were tentatively ascribed to difference in operation of the Weather-Ometer which used circulating distilled water in Series 4 tests in the MSU laboratory, and one-pass-flow tap water at the Lansing laboratory.

With these qualifications, then, of the 60 coating systems listed in Table 2 and shown in Fig. 2, the following 15 systems were classified as "very good" and carry the greatest potential for Department use:

Rank 1 - 27.2 points

System 37F: Proprietary one-package zinc-rich gray primer and proprietary vinyl-alkyd gray topcoat (on hand-cleaned steel)

Rank 2 - 27.0 points

System 34F: Proprietary one-package zinc-rich gray primer and premixed aluminum topcoat from same producer (on blast-cleaned steel)

Rank 3 - 26.7 points

System 40F: Proprietary three-package zinc-rich epoxy gray primer and proprietary vinyl-alkyd gray topcoat (on blast-cleaned steel)

TABLE 2
IDENTIFICATION AND PERFORMANCE OF TEST COATING SYSTEMS
SERIES 5 COATINGS (Received 1960-1964)

Test System	Identification	Composition	Drying Time, hr	System Thickness, mils	Ratings*				Rank	Remarks
					Appearance	Face Rusting	Scratch Rusting	Total**		
1F	Primer: 63 PR-190	MSHD No. 1A(1) red lead	48	3.5	8.0	10.0	7.5	25.5	9	Standard MSHD system
	Topcoat: 60 PR-112	MSHD No. 5B alkyd aluminum	18	4.5						
2F	Primer: 63 PR-190	MSHD No. 1A(1) red lead	48	3.5	7.8	7.3	6.4	21.5	26	Topcoat from Buckman Laboratories, Inc.
	Topcoat: 63 PR-146	No. 11 M1-G32 Busan green	48	6.0						
3F	Primer: 63 PR-190	MSHD No. 1A(1) red lead	48	2.4	8.8	10.0	6.2	25.0	11	Topcoat from Tropical Paint Co.
	Topcoat: 63 PR-185	No. 308-17 frost green aluminum	18	5.5						
4F	Primer: 63 PR-190	MSHD No. 1A(1) red lead	48	2.3	5.8	6.7	4.8	17.3	34	Topcoat from Hughson Co.
	Topcoat: 62 PR-226A	Chemglaze polyurethane green	6	4.3						
5F	Primer: 63 PR-190	MSHD No. 1A(1) red lead	48	3.2	5.3	8.0	5.7	19.0	34	Former standard MSHD system
	Topcoat: 58 CH-913	MSHD No. 4A green	48	6.0						
5FA	Primer: 63 PR-190	MSHD No. 1A(1) red lead	48	3.5	5.0	8.0	7.0	20.0	32	"Automatic F 43" additive (62 PR-233) from Karison Automatic Water Conditioner, Inc.
	Topcoat: 58 CH-913	MSHD No. 4A green (with additive)	18	4.7						
6F	Primer: 63 PR-190	MSHD No. 1A(1) red lead	48	2.8	5.3	10.0	6.5	21.8	24	Topcoat from National Lead Co.
	Topcoat: 63 PR-209	MSHD No. 3A(1) gray	24	6.0						
7F	Primer: 63 PR-20	MSHD No. 2A(3) modified brown lead	40	2.0	7.8	10.0	7.4	25.2	10	Primer from Hammond Lead Products, Inc.
	Topcoat: 60 PR-112	MSHD No. 5B alkyd aluminum	18	2.7						
8F	Primer: 63 PR-22	MSHD No. 1A(2) red lead with yellow iron oxide	36	1.9	7.8	10.0	6.2	24.0	17	Primer from Hammond Lead Products, Inc.
	Topcoat: 60 PR-112	MSHD No. 5B alkyd aluminum	18	2.7						
9F	Primer: 63 PR-22	MSHD No. 1A(2) red lead	36	2.6	7.8	10.0	6.9	24.7	13	Primer from Hammond Lead Products, Inc.; topcoat from Dow Corning Corp.
	Topcoat: 63 PR-76	No. XP-7 silicone-alkyd green	36	4.5						
10F	Primer: 63 PR-23	No. 63-01D basic lead silico phosphate-talc-linseed-oil white	18(a)	4.0	7.8	10.0	7.4	25.2	10	Primer from Hammond Lead Products, Inc.
	Topcoat: 60 PR-112	MSHD No. 5B alkyd aluminum	18	6.5						
11F	Primer: 63 PR-24	No. 63-01E basic lead silico phosphate-Busan-linseed-oil white	18(a)	4.0	7.3	10.0	7.5	24.8	12	Primer from Hammond Lead Products, Inc.
	Topcoat: 60 PR-112	MSHD No. 5B alkyd aluminum	18	6.4						
12F	Primer: 63 PR-159	No. T-13879 Verrazano brown	24	2.4	7.3	10.0	6.7	24.0	17	Primer from National Lead Co.
	Topcoat: 60 PR-112	MSHD No. 5B alkyd aluminum	18	3.1						
13F	Primer: 63 PR-159	No. T-13879 Verrazano brown	24	1.8	7.0	10.0	7.0	24.0	17	Both coats from National Lead Co.
	Topcoat: 62 PR-244	Basic lead silico chromate alkyd linseed-oil green	24	5.0						
14F	Primer: 63 PR-208	MSHD No. 2MP(1) brown	12	3.0	5.0	9.7	4.6	19.3	33	Primer from National Lead Co.
	Topcoat: 63 PR-160	Aroclint 505-24260 two-package epoxy green	18	7.0						
15F	Primer: 63 PR-208	MSHD No. 2MP(1) brown	12	2.4	5.0	9.7	6.0	20.7	30	Both coats from National Lead Co.
	Topcoat: 63 PR-209	MSHD No. 3A(1) gray	24	4.0						

* Rated on scale from 10 to 0, with 10 = no deterioration and 0 = complete failure.
** Parenthesized ratings in this column identify systems damaged or removed from exposure early in test.
(a) Poor brushability.

TABLE 2 (Cont.)
IDENTIFICATION AND PERFORMANCE OF TEST COATING SYSTEMS
SERIES 5 COATINGS (Received 1960-1964)

Test System	Identification	Composition	Drying Time, hr	System Thickness, mils	Ratings*			Rank	Remarks
					Appearance	Face Rusting	Scratch Rusting		
16F	Primer: 62 PR-236	No. 69 special red primer	24	1.9	6.7	10.0	7.8	24.5	Both coats from Themec Co.
	Topcoat: 63 PR-237	No. 36 aluminum	24	3.4					
17F	Primer: 62 PR-236	No. 69 special red primer	24	1.3	5.5	10.0	8.8	24.3	Both coats from Themec Co.
	Topcoat: 62 PR-238	No. 893 phenolic aluminum	24	3.0					
18F	Primer: 62 PR-236	No. 69 special red primer	24	1.4	6.8	8.3	7.9	23.0	Primer from Themec Co.; topcoat from Structure Coatings, Inc.
	Topcoat: 63 PR-144	Gum-Tex 000 smooth tan	72	10.0					
19F	Primer: 62 PR-148	P-A-Cote 4-Tify red primer	12	0.5	6.3	8.7	4.0	19.0	Both coats from Protex-A-Cote Co.
	Topcoat: 62 PR-147	P-A-Cote two-package Porcelon 100 epoxy aluminum	24	1.5					
20F	Primer: 63 PR-149	MSHD No. 1A(8) Busan red lead	36	2.3	8.0	9.7	8.5	26.2	Primer from Buckman Laboratories, Inc.
	Topcoat: 60 PR-112	MSHD No. 5B alkyd aluminum	18	3.5					
21F	Primer: 63 PR-149	MSHD No. 1A(8) Busan red lead	36	2.0	6.7	6.3	6.8	19.8	Both coats from Buckman Laboratories, Inc.
	Topcoat: 63 PR-150	No. 25 titanium dioxide-Busan white	36(6)	5.5					
22F	Primer: 63 PR-148	MSHD No. 2MP(2) Busan brown	36	1.9	8.0	10.0	7.7	25.7	Both coats from Buckman Laboratories, Inc.
	Topcoat: 63 PR-146	Alkyd Unseed-oil Busan chromate oxide green	24	3.2					
23F	Primer: 63 PR-179	Charcote C1C-21X neoprene red	12	2.0	6.8	9.7	7.0	23.5	Primer from Charleston Rubber Co.; topcoat(d) from Carboline Co.
	Topcoat: 60 PR-158	Carboline 1230 vinyl-alkyd gray	4	4.2					
24F	Primer: 62 PR-157	Penetrol all-weather red oxide primer	24	2.2	6.3	4.7	2.3	13.3	Both coats from Flood Co.
	Topcoat: 62 PR-158	Penetrol two-package aluminum	36	1.7					
25F	Primer: 63 PR-183	Tropilcon 201-02 two-package Hypalon black	4	1.4	7.0	9.7	5.8	22.5	Both coats from Tropical Paint Co.
	Topcoat: 63 PR-184	Elastikote premixed aluminum	4	1.7					
26F	Primer: 63 PR-139A	Witcogard asphaltic black binder	18(8)	8.0	8.0	3.5	6.5	(12.0)	Binder for "Witcoguard" (guard rail) coating, from Witco Chemical Co.
	Topcoat: 63 PR-139A	Witcogard asphaltic black binder	18(8)	8.0					
27F	Primer: 63 PR-138	Kencote 60 hydrocarbon brown	40	1.2	7.0	3.0	1.0	(11.0)	Both coats from Kendall Refining Co.
	Topcoat: 63 PR-138	Kencote 60 hydrocarbon brown	40	3.0					
28F	Primer: 63 PR-188	No. 604-21B yellow latex wash primer	18(c)	1.5	6.7	5.3	5.7	17.7	Primer from Bethlehem Steel Co.; topcoat from National Lead Co.
	Topcoat: 63 PR-208	MSHD No. 2MP(1) brown	12	3.4					
29F	Primer: 60 PR-142	Corps of Engineers V-776 vinyl gray	1(b)(c)	1.4	6.3	9.0	5.5	20.8	Both coats from Frazer Paint
	Topcoat: 60 PR-142	Corps of Engineers V-776 vinyl gray	1(b)	3.1					
30F	Primer: 60 PR-142	Corps of Engineers V-776 vinyl gray	1(b)(c)	2.9	7.0	10.0	6.5	23.5	Primer(d) from Frazer Paint; topcoat(d) from Carboline Co.
	Topcoat: 60 PR-158	Carboline 1230 vinyl-alkyd gray	1	4.0					
31F	Primer: 62 PR-221	Rust Ban 191 two-package zinc gray	8(a)(c)	3.9	6.2	9.0	10.0	25.2	Both coats from Humble Oil and Refining Co.
	Topcoat: 62 PR-222	No. 671 QD two-package epoxy gray	24	7.3					

* Rated on scale from 10 to 0, with 10 - no deterioration and 0 = complete failure.

** Parenthesized ratings in this column identify systems damaged or removed from exposure early in test.

(a) Poor brushability.

(b) Spray-applied.

(c) Panel sandblasted before coating.

(d) Under field test on M 76 bridge structural steel.

TABLE 2 (Cont.)
IDENTIFICATION AND PERFORMANCE OF TEST COATING SYSTEMS
SERIES 5 COATINGS (Received 1960-1964)

Test System	Identification	Composition	Drying Time, hr	System Thickness, mils	Ratings*			Rank	Remarks	
					Appearance	Face Rusting	Scratch Rusting			
					Total**					
32F	Primer: 62 PR-194	Tropichlor 723-33 two-package zinc-rich gray	8 ^(c)	1.4	8.3	8.7	8.0	25.0	11	Both coats from Tropical Paint Co.
	Topcoat: 63 PR-186	Tropichlor 723-07 marine green	18 ^(a)	3.3						
33F	Primer: 62 PR-193	No. TT-P-641 two-package galvanized gray primer	8 ^(c)	3.0	6.0	6.3	8.9	21.2	28	Both coats from Tropical Paint Co.
	Topcoat: 63 PR-187	Rhinamel 887-17 green	18	4.2						
34F	Primer: 63 PR-132	Galv-Tal Z-99 zinc gray	18 ^(c)	1.7	7.8	10.0	9.2	27.0	2	Both coats from United Paint & Chemical of Michigan
	Topcoat: 63 PR-133	Alum-O-Lite Z-100 premixed aluminum	18	2.5						
35F	Primer: 62 PR-141	Permalastic PX-1142 epoxy zinc gray	8 ^(c)	1.0	7.2	8.0	10.0	25.2	10	Primer from Permalastic Co.; topcoat from Humble Oil and Refining Co.
	Topcoat: 62 PR-222	Humble 671 two-package QD epoxy gray	24	4.0						
36F	Primer: 61 PR-110	Chem-Zinc gray	8 ^(c)	3.7	7.5	9.5	9.3	26.3	5	Primer from Truscon Laboratories; topcoat ^(d) from Carboline Co.
	Topcoat: 60 PR-158	Carboline 1230 vinyl-alkyd gray	4	5.0						
37F	Primer: 63 PR-75	Liquid Galvanize zinc gray	18	2.5	7.5	10.0	9.7	27.2	1	Primer from Ross Chemical Co.; topcoat ^(d) from Carboline Co.
	Topcoat: 60 PR-158	Carboline 1230 vinyl-alkyd gray	4	4.5						
38F	Primer: 63 PR-158	No. 6-207 galvanized portland cement gray	24	3.4	8.0	9.7	8.5	26.2	6	Primer from Pittsburgh Plate Glass Co.
	Topcoat: 60 PR-112	MSHD No. 5B alkyd aluminum	18	3.5						
39F	Primer: 63 PR-140	Metalhide UC-8864 two-package zinc gray	18 ^(c)	2.4	7.0	8.8	10.0	25.8	7	Primer from Pittsburgh Plate Glass Co.; topcoat from Humble Oil and Refining Co.
	Topcoat: 62 PR-222	Humble 671 two-package QD epoxy gray	24	3.3						
40F	Primer: 63 PR-141	Aquapon epoxy UC-9683 three-package zinc gray	18 ^(c)	4.0	7.2	9.5	10.0	26.7	3	Primer from Pittsburgh Plate Glass Co.; topcoat ^(d) from Carboline Co.
	Topcoat: 60 PR-158	Carboline 1230 vinyl-alkyd gray	4	7.0						
41F	Primer: 63 PR-129	Zincate 13F-1180 two-package zinc silicate gray	48 ^(c)	1.6	6.0	4.7	7.8	18.5	35	Both coats from Socony Paint Products Co.
	Topcoat: 63 PR-127	Harmony 12G-10 Panorama green	24	2.9						
42F	Primer: 63 PR-176	No. 1PC 1108 vinyl white	1 ^{(b)(c)}	1.7	6.0	9.7	6.3	22.0	23	Both coats from Jessop Steel Co.
	Topcoat: 63 PR-178	No. 1PC 1112 vinyl gray	1 ^(b)	7.5						
43F	Primer: 63 PR-176	No. 1PC 1108 vinyl white	1 ^{(b)(c)}	1.6	7.3	8.8	6.6	22.7	20	Both coats from Jessop Steel Co.
	Topcoat: 63 PR-177	No. 1PC 1105 vinyl green	1 ^(b)	5.8						
44F	Primer: 61 PR-110	Chem-Zinc gray	8 ^(c)	3.0	5.8	9.7	6.5	22.0	23	Primer from Truscon Laboratories; topcoat from Archer-Daniels-Midland Co.
	Topcoat: 63 PR-160	Aroflint 505-24260 two-package green.	18	8.8						
45F	Primer: 63 PR-136	Keacote 60 hydrocarbon brown	40	3.0	9.0	9.0	2.0	(20.0)	--	Primer from Kennoll Refining Co.; topcoat from Jessop Steel Co.
	Topcoat: 63 PR-178	No. 1PC 1112 vinyl gray	1 ^(b)	4.5						
46F	Primer: 63 PR-210	Zincilate 101-R three-package zinc silicate gray	8 ^(c)	2.2	7.8	10.0	8.7	26.5	4	Primer from Industrial Metal Protectives, Inc.; topcoat ^(d) from Carboline Co.
	Topcoat: 60 PR-158	Carboline 1230 vinyl-alkyd gray	4	4.2						

* Rated on scale from 10 to 0, with 10 - no deterioration and 0 = complete failure.

** Parenthesized ratings in this column identify systems damaged or removed from exposure early in test.

(a) Poor brushability.

(b) Spray-applied.

(c) Panel sandblasted before coating.

(d) Under field test on M 78 bridge structural steel.

TABLE 2 (Cont.)
IDENTIFICATION AND PERFORMANCE OF TEST COATING SYSTEMS
SERIES 5 COATINGS (Received 1960-1964)

Test System	Identification	Composition	Drying Time, hr	System Thickness, mils	Appearance	Ratings*			Rank	Remarks
						Face Rusting	Scratch Rusting	Total**		
47F	Primer: 63 PR-188 Topcoat: 60 PR-142	No. 604-21B yellow latex wash primer Corps of Engineers V-776 vinyl gray	18(c) 1(b)	1.0 4.1	5.8	8.2	7.3	21.3	27	Primer from Bethlehem Steel Co.; topcoat(d) from Carbofine Co.
48F	Primer: 64 PR-19 Topcoat: 64 PR-20	Markal DA-8 red primer Markal DA-9 gray	24(c) 24	2.5 5.0	5.8	9.7	6.2	21.7	25	Both coats from Markal Co.
49F	Primer: 64 PR-19 Topcoat: 64 PR-21	Markal DA-8 red primer Markal DA-19A gray	24 24	6.5 6.5	8.3	9.3	6.6	24.2	16	Both coats from Markal Co.
50F	Primer: 63 PR-190 Topcoat: 64 PR-14	MSHD No. 1A(1) red lead Rust Inhibitive aluminum	48 24	3.0 4.5	7.5	10.0	7.3	24.8	12	Topcoat from Acme Quality Paints Inc.
51F	Primer: 64 PR-23 Topcoat: 64 PR-24	Caco N-11 white primer Caco N-700 neoprene gray	18(a) 1	0.5 6.1	5.0	4.0	3.0	(12.0)	--	Both coats from Gates Engineering Co.
52F	Primer: 64 PR-22 Topcoat: 64 PR-25	Caco NA-62 neoprene asphalt black Caco H-2 two-package hypalon aluminum	72(a) 1	6.0 7.3	7.7	10.0	7.0	24.7	13	Both coats from Gates Engineering Co.
53E	Primer: 63 PR-190 Topcoat: 60 PR-112	MSHD No. 1A(1) red lead MSHD No. 5B alkyd aluminum	48 18	--- 3.3	8.0	10.0	8.3	26.3	5	Standard MSHD system (see also System 1F)
54E	Primer: 63 PR-190 Topcoat: 58 CH-913	MSHD No. 1A(1) red lead MSHD No. 4A green	48 48	--- 4.1	5.3	7.7	6.0	19.0	34	Former standard MSHD system (see also System 5F)
55E	Primer: 63 PR-190 Topcoat: 56 PR-146	MSHD No. 1A(1) red lead No. 11M1-G32 Busan green	48 48	--- 4.4	6.2	9.7	6.4	22.3	22	Topcoat from National Lead Co.
56E	Primer: 63 PR-190 Topcoat: 60 PR-70	MSHD No. 1A(1) green Basic lead silicochromate titanium dioxide alkyd green	48 48	--- 4.5	7.0	9.7	6.0	22.7	20	Topcoat from National Lead Co.
57E	Primer: 63 PR-20 Topcoat: 63 PR-76	MSHD No. 2A(3) modified brown lead No. XP-7 silicone alkyd green	40 36	--- 4.2	7.3	10.0	7.4	24.7	13	Primer from Hammond Lead Products, Inc.; topcoat from Dow Corning Corp.
58E	Primer: 63 PR-20 Topcoat: 63 PR-128	MSHD No. 2A(3) modified brown lead No. 44A7 green aluminum	40 18	--- 4.2	8.7	9.7	6.3	24.7	13	Primer from Hammond Lead Products, Inc.; topcoat from Socony Paint Products Co.
59E	Primer: 63 PR-20 Topcoat: 63 PR-160	MSHD No. 2A(3) modified brown lead Aroclint 505-24280 two-package epoxy green	40 18	--- 5.0	5.8	9.7	6.3	21.8	24	Primer from Hammond Lead Products, Inc.; topcoat from Archer-Daniels-Midland Co.

* Rated on scale from 10 to 0, with 10 = no deterioration and 0 = complete failure
** Parenthesized ratings in this column identify systems damage or removed from exposure early in test

(a) Poor brushability

(b) Spray-applied

(c) Panel sandblasted before coating

(d) Under field test on M 78 bridge structural steel

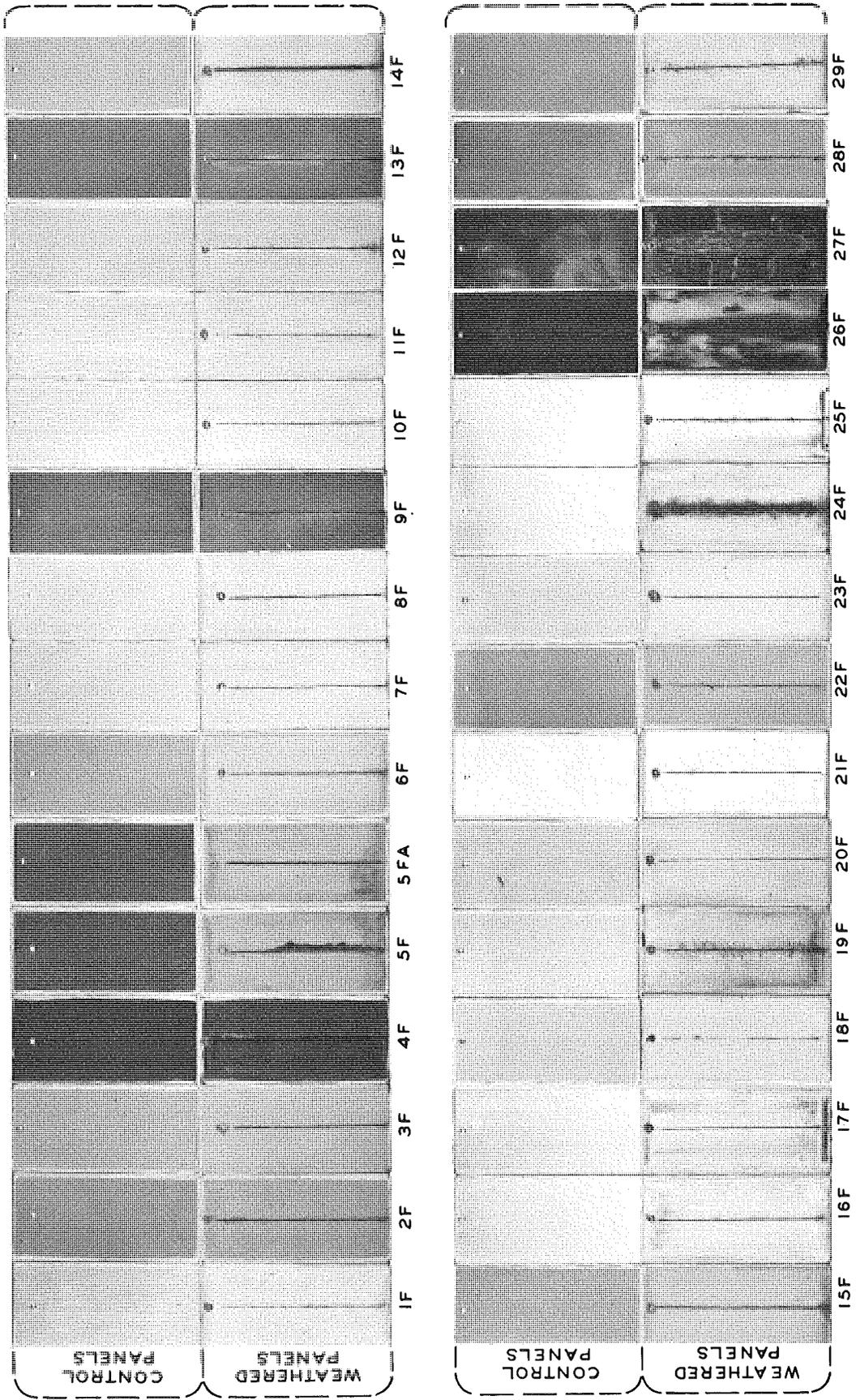


Figure 2. Series 5 panels with unexposed control panel above in each pair, and test-weathered panel with vertical scratch below (identification and performance ratings in Table 2).

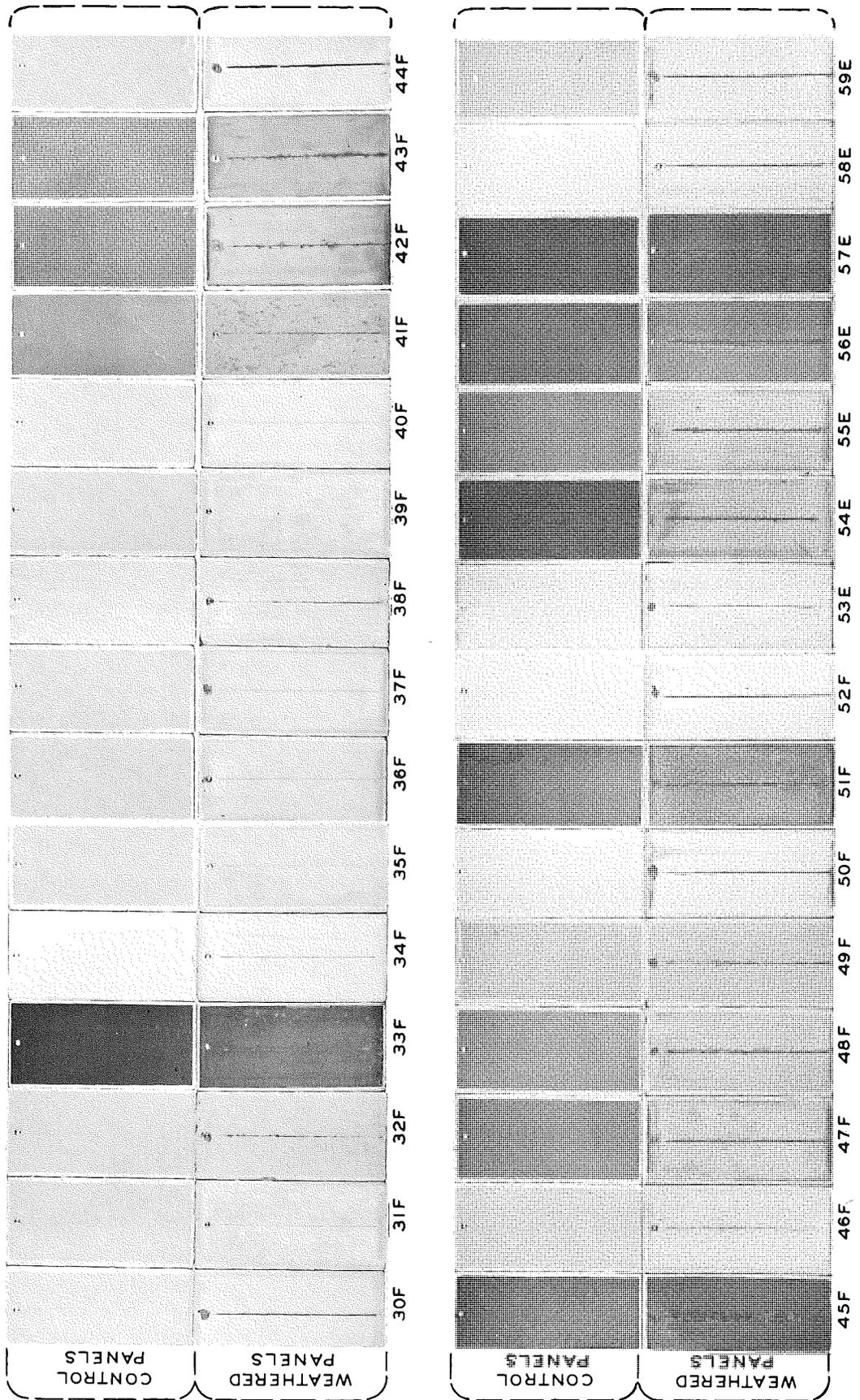


Figure 2 (cont.). Series 5 panels with unexposed control panel above in each pair, and test-weathered panel with vertical scratch below (identification and performance ratings in Table 2).

Rank 4 - 26.5 points

System 46F: Proprietary three-package zinc-rich post-cured silicate gray primer and proprietary vinyl-alkyd gray topcoat (on blast-cleaned steel)

Rank 5 - 26.3 points

System 36F: Proprietary one-package zinc-rich gray primer and proprietary vinyl-alkyd gray topcoat (on blast-cleaned steel)

System 53E: MSHD 1A(1) red lead primer and MSHD 5B aluminum alkyd topcoat (Department and test standard); cured in laboratory for 1 year before test

Rank 6 - 26.2 points

System 20F: MSHD 1A(3) red lead primer (borate extender modified) and MSHD 5B aluminum alkyd topcoat

System 38F: Proprietary mixed zinc oxide-portland cement galvanizing gray primer and MSHD 5B aluminum alkyd topcoat

Rank 7 - 25.8 points

System 39F: Proprietary two-package zinc-rich gray primer and proprietary two-package epoxy gray topcoat (on blast-cleaned steel)

Rank 8 - 25.7 points

System 22F: MSHD 2MP(2) brown primer (borate extender modified) and proprietary alkyd green topcoat from same producer

Rank 9 - 25.5 points

System 1F: MSHD 1A(1) red lead primer and MSHD 5B aluminum alkyd topcoat (Department and test standard); see also longer-cured System 53E above

Rank 10 - 25.2 points

System 7F: MSHD 2A(3) brown lead primer (extender modified) and MSHD 5B aluminum alkyd topcoat

System 10F: White basic lead silico phosphate and other pigments in linseed oil as primer, and MSHD 5B aluminum alkyd topcoat

System 31F: Military specification two-package zinc silicate gray primer and two-package epoxy gray topcoat from same producer (on blast cleaned steel)

System 35F: Proprietary one-package zinc-rich epoxy gray primer and proprietary two-package epoxy gray topcoat (on blast cleaned steel)

Of these top-ranked 15 systems, eight had zinc-rich based primers, four were red lead based, and one each had primers based on basic lead silico chromate pigment, basic lead silico phosphate white pigment, and proprietary mixed zinc oxide-portland cement pigment in a linseed oil vehicle.

Topcoats of these "very good" systems included a variety of types. Fortunately, past experience had indicated that performance of the zinc-rich primed systems could be marginally improved by proper selection of compatible topcoats. This accounts for high ratings of several such systems in Series 5; among eight of the best systems that were so primed, four were topcoated with a gray vinyl-alkyd (also used to topcoat a zinc-rich primer on an M 78 test bridge), three with a gray two-package epoxy, and one with a premixed aluminum. Of the other seven highest rating systems, six had aluminum-type topcoats, and one an alkyd green enamel.

Comparing the two panels for the test and Department standard system, it was noted that the one cured for 12 months before testing (No. 53E) earned 0.8 point higher rating than the panel coated just before testing (No. 1F).

In addition to the 15 best-rated systems just described, another nine earned "very good" ratings ranging from 25.0 to 24.5 points, including Nos. 3F, 9F, 11F, 16F, 32F, 50F, 52F, 57E, and 58E. These also carry high potential for Department use.

In addition to the 24 "very good" rated systems, another 18 earned "good" ratings ranging from 24.2 to 21.5 points of the possible 30-point maximum. Systems having higher ratings in this classification were Nos. 8F, 12F, 13F, 17F, 18F, 23F, 30F, 43F, 49F, and 56E. Those earning lower ratings were 2F, 6F, 25F, 42F, 44F, 48F, 55E, and 59E. The remaining 18 systems had poorer ratings, although most were in

the "fair" category. All completed the full seven cycles in laboratory equipment, except the following four poorest systems:

1. No. 27F, based on an unpigmented hydrocarbon binder, removed at the end of the first cycle because of alligating and creepage from the scratch, and corrosion of the bared areas.

2. No. 51F, based on a gray neoprene topcoat, removed at the end of the first cycle because of alligating and rusting in the scratch area.

3. No. 45F, consisting of an unpigmented hydrocarbon primer and a vinyl topcoat, also removed at the end of the first cycle, because of film migration from the scratch and rusting in the bared area.

4. No. 26F, based on a proprietary asphaltic binder, removed at the end of the fourth cycle because of face rusting and discoloration (graying).

Finally, Series 5 coatings included four vinyl systems: Nos. 29F and 30F, which were primed with the M 78 test bridge coating, and a proprietary vinyl in Nos. 42F and 43F. The last three were rated in the "good" category and No. 29F in the "fair" category. Poorer ratings than expected for these systems were probably due to lack of rust inhibitive pigments in the primers which contributed to lower "scratch rusting" quality ratings. This series also evaluated a proprietary latex type wash primer in Systems 28F and 47F. It earned a borderline "good" rating (No. 47F) when topcoated with a vinyl, and only a "fair" rating (No. 28F) when topcoated with MSHD 2MP(1) brown.

Summary

Laboratory accelerated weathering tests conducted to evaluate paint systems and modifications thereto, showed the following:

1. The Department's current paint system of 1A(1) red lead primer and 5B aluminum alkyd topcoat was surpassed in performance ratings by very few other systems.

2. A primer based on a basic lead silico chromate pigment (MSHD 2MP type) gave performance comparable to 1A(1) red lead primer. Added experience in the use of this pigment, and resultant revisions, should contribute to marginal improvement.

3. Some zinc-rich primed systems showed marginal superiority over the red lead primed systems, notably in Series 5 tests when past experience permitted selection of particularly suitable topcoats. A strong point of the zinc-rich primer is its ability to stifle base corrosion at a break in the film. These primers show good potential.

4. Under conditions of these tests a proprietary latex wash primer gave only average performance.

5. The four vinyl systems (two of which were based on Corps of Engineers specifications) evaluated in Series 5 tests gave "good" but not "very good" performance. These paints earned only average ratings in scratch rusting, probably due to absence of rust inhibiting pigments in their formulas.

6. Colored non-aluminum topcoats appear to require selection of particularly suitable primers for best performance, while aluminum topcoats are less dependent on primers. However, some colored topcoats gave "very good" performance, particularly a gray enamel based on a combination vinyl-alkyd vehicle (brushable), a gray two-package epoxy enamel, and a green alkyd enamel.

7. A two-package epoxy aluminum topcoat was slightly superior to No. 5B aluminum. This and the three topcoats mentioned in Item 6, are recommended for future field tests.

Coating Systems under Current Testing

For information purposes, the following coatings are under current Laboratory evaluation:

1. Series 5E coatings (nineteen in all), consisting mostly of colored topcoats have been in rooftop exposure at the Laboratory since early 1963. A progress report will be issued on these less accelerated tests, when data become available.

2. Colored topcoats used on bridge steel at Port Huron, Detroit, and Grand Rapids are currently under laboratory accelerated tests, supplementing field exposure test at the Fisher Expressway bridge. A supplemental progress report on these tests also will be issued.