October 27, 1967

NATIONAL BUREAU OF STANDARDS REPORT

9637

Examination of

"GALVAN" SAMPLES

By

W. F. Gerhold
Engineering Metallurgy Section

To

Department of State
Agency for International Development

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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Examination of

"GALVAN" SAMPLES

Submitted by

Department of State
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Reference: (a) Department of State, Agency for International Development, letter dated September 1, 1967.

Material: Four "Galvan" (paint-coated steel alloy) samples that had been procured from various sources were submitted under Reference (a). The number and procurement source of each sample are given in Table 1.

Table 1. Identification of "Galvan" samples as reported by reference (a)

Sample No.	Source	Sample size, inches (approx.)
1	Ngo Van Hoai No. 88 Phat Diem Street Saigon (Sales Agent)	1 3/4 x 1 1/8
2	Thuan-Phong No. 32 MacCuu Street Cholon (Corrugating firm)	1 5/8 x 2 5/8
3	CIB/USAID/Vietnam	1 1/4 x 2 1/4
4	Unknown	6 3/4 x 8 5/8

Visual examination of the finish on the "Galvan" samples indicated that it had a crackle or wrinkle configuration. The samples were reported to be representative of material that is claimed to be and sold as a substitute for galvanized sheet for use in Vietnam. It was requested that: (1) the chemical composition of the coating be determined, (2) tests be conducted to determine the coating adhesion and (3) salt spray tests be conducted to determine the corrosion protection afforded the steel alloy base metal by the coating as compared with that of a zinc coating on steel (galvanized steel).

Chemical Analyses: A general qualitative spectrochemical analysis was made for the pigment in the "Galvan" coating. The results of this analysis, given in Table 2, revealed that the major constituent was aluminum. No analysis was made of the vehicle.

Table 2. Chemical analysis of the pigment used in the "Galvan" coating

Elements Detected	%
Aluminum	> 10
Silver	< 0.001
Boron	< 0.001
Calcium	0.01 - 0.1
Chromium	0.001 - 0.01
Copper	< 0.001
Iron	0.01 - 0.1
Magnesium	0.01 - 0.1
Manganese	< 0.001
Silicon	0.1 - 1
Titanium	0.1 - 1
Vanadium	0.01 - 0.1
Zinc	Not detected

Tests: Only one sample, No. 4, was large enough for the various tests requested. Therefore, all tests reported herein pertain to this sample only.

Salt Spray (Fog) Tests: In order to compare the corrosion resistance of the "Galvan" coated steel with that of galvanized (zinc-coated) steel, salt spray tests were conducted in accordance with the conditions specified in ASTM Standard Method of Salt Spray (Fog) Testing, ASTM Designation: B117-64.

Three specimens, each, 2" x 3" were sheared from the "Galvan" Sample No. 4 and 3 specimens having the same dimensions were sheared from a commercially procured 30 gage sheet of galvanized steel. The specimens were then divided into three lots each containing one "Galvan" specimen and one galvanized steel specimen. The first lot was exposed in the as-received condition; the second lot was exposed after one surface was scribed deep enough to penetrate the coating to the base metal; and the third lot was exposed after two reverse bends (simulating corrugations) were made on each specimen.

Examination of these specimens after 24 hours exposure revealed that the "Galvan" coated specimens had: (1) blistered at scattered areas, (2) that the base metal was rusted at these areas, and (3) that the scribed area and the sheared edges had rusted.

Examination of the galvanized steel specimens after the same exposure period did not reveal any corrosion of the base metal on any of the specimens exposed. There were scattered areas on the surface which contained gray or grayish-white corrosion products. These corrosion products are of a type expected for the corrosion of zinc. The lack of rust or a yellow corrosion product at the scribed area and at the sheared edges indicates that the zinc is galvanically protecting the steel base-metal.

Coating Adhesion: Specimens were sheared from "Galvan" Sample No. 4 for flexibility and adhesion determinations.

Adhesion was determined in accordance with the Tentative Method of Test for Adhesion of Coatings of Paint, Varnish, Lacquer and Related Products (ASTM Designation: D2197-63T) by pushing the coated specimen beneath a rounded stylus or loop which was loaded in increasing amounts (10 Kg maximum load) until the coating was sheared from the substrate surface. The results of this test indicate good adhesion in that the maximum load was reached without shearing the coating.

Flexibility of the coating was determined by bending, a coated specimen, double (180°) rapidly over a 1/8 inch mandrel. These are the most severe conditions described in method 6221 of Federal Test Method Standard No. 141a for paint and related materials. There was no cracking, chipping or flaking of the "Galvan" coating in this test.

Conclusions: Results of the examination of a "Galvan" sample indicated that the coating has good adhesion and flexibility.

Chemical analysis revealed that the coating was aluminum pignmented. Aluminum pigmented coatings, usually of the leafing type, have been used successfully to protect steel alloys from corrosion. Corrosion protection of leafing type aluminum pigmented coatings is provided by their resistance to moisture penetration. Non-leafing aluminum pigmented coatings which are used to obtain crackle or wrinkle finishes may not provide this corrosion resistance, in that moisture may more readily penetrate the vehicle.

Salt spray tests conducted to determine the corrosion resistance of the "Galvan" coated sample and to compare this resistance with that of galvanized (zinc-coated) steel indicated that the zinc coating on the galvanized steel affords greater corrosion protection to the steel alloy base metal than does the "Galvan" coating. After 24 hours exposure the "Galvan" specimens had rusted at the sheared edges and at a scored area on the coated surface. In addition the coating had blistered at scattered areas and rust discoloration was observed at these blistered areas indicating that the salt solution had penetrated the coating. There was no rusting of the steel alloy base metal or blistering of the zinc coating on any of the galvanized steel specimens exposed in the salt spray tests.

It is not possible to determine from the laboratory conducted salt-spray tests the period of time required to produce initial corrosion of the steel alloy base metal under actual environmental conditions on either the "Galvan" coated sample or the zinc-coated (galvanized steel) sample. This is dependent upon too many variables such as air pollutants, humidity and rainfall and temperature which may vary from area to area in any location. In addition, initial corrosion of either material is not necessarily a criteria for life expectancy of the material in service. Complete penetration of the sheet material would be a better criteria. In consideration of this latter case, the zinc-coated (galvanized steel) material would have a longer life expectancy.


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