Case Study: ASTM A742 Test Report

The following case study shows test results and analysis of Tee Group Films' polymer coated 14-guage galvanized metal, conducted by third party laboratory, Evans Analytical Group (EAG) Coatings Solutions.

SAMPLE LOG-IN

The following sample was received and logged in as follows:

Sample #: 007948
Sample Description: Polymer coated, 14-gauge galvanized metal

ANALYSIS CONCLUSIONS

The polymer coated, galvanized metal was subjected to testing in accordance to ASTM A742 specifications. We focused on several areas of testing: adhesion, impact, thickness of coating, holidays, abrasion resistance, imperviousness, freeze/thaw, weatherability and resistance to microbial attack.

There was no spalling, cracking or disbanding found with the adhesion of impact testing. Film thickness of the polymer layer is 327.3 microns, and the zinc layer is 49.02 microns. Holidays (pinholes) were non-existent in the coating. The abrasion testing found that 400 liters of falling sand removed 1 mil (25.4 microns) of the polymer. Imperviousness tests proved to have no effect on the coating, as corrosion and/or film degradation was absent. Both freeze/thaw cycle testing and QUV (weatherability testing) showed there were no visible detrimental effects to the coating after exposure. Microbial attacks also had no visible effect on the film after 21 days.

ANALYSIS RESULTS AND DISCUSSION

Adhesion

Adhesion is the state in which interfacial forces, which may consist of valence forces or interlocking action, or both, hold two surfaces together. Adhesion is very important to coatings. If the coating does not adhere to the substrate, then the coating no longer serves its purpose by exposing the underlying substrate to environmental hazards.

Following the method provided in ASTM A742, three (3) 2"x8" coupons were cut for testing. The coupon and .5 in mandrel were brought to the correct temperature, before bending the coupon over the mandrel for a 180° bend. We then cut outside the bend to analyze for coating adhesion. The steel sample was bent over the mandrel and sliced with a razor blade at temperatures of 0°, 77° and 122° F. No spalling, cracking or disbanding was seen from the adhered coating.

Impact

Impact resistance assesses the resistances of a coating to cracking, detachment from the substrate or deformation caused by a sudden physical force. ASTM A742 tests a coating's impact resistance that it might be subjected to in service.

Our work with impact testing follows ASTM A742; however, an additional testing at -40° F was added to ensure the coating had a strong physical resistance. Two 6"x6" coupons were cut from the sample. These were brought to temperature, run through an impact tester with a 0.625 in diameter punch and energy of 35 inch-pounds. The impact covered both direct and reverse impact. The results are provided in Table 1.

Table 1
Results for Impact Testing

Temp. (° F)	Comments
- 40°	No spalling, cracking or delamination was observed—reverse and direct impact.
77°	No spalling, cracking or delamination was observed—reverse and direct impact.

Dry Film Thickness
The Dry Film Thickness (DFT) is absolutely essential in determining physical characteristics of a coating. Knowing the thickness gives analysis to abrasion, evenness, chemical resistance and much more. Conducted in reference to ASTM D1005, DFT is analyzed through the use of a micrometer.

We tested the DFT on the smooth side of the original sample piece provided. A cross section was removed, encapsulated, ground and polished for micro-examination (ASTM E3-01). Seven samples were recorded and averaged to get the thickness provided. DFT data are shown in Table 2.

Table 2
Averages for Dry Film Thickness

Type Film Measured	DFT (microns)
Polymer Coating	327.3
Metal Substrate	49.02

Holidays
Holidays, also known as pinholes, can be detrimental to a coating's physical resistance. They have the ability to increase a coating's surface area, allowing for chemical attacks to eat into a film far quicker. Additionally, they can hinder structural strength and affect gloss levels. Testing was in accordance to ASTM A742 Holiday Test Section 9.4, which referenced ASTM G62.

We measured a 12" sample in order to test for pinholes, using a nominal voltage of 67.5 V. We found no holidays (pinholes) per square foot.

Abrasion Resistance
ASTM D968 covers the determination of the resistance of organic coatings to abrasion produced by abrasive (sand) falling onto a plane rigid surface. This resistance is measured in the amount of abrasive used to remove a unit of film thickness, and is useful in determining the abrasion strength of a coating.

We ran a 6”x4” coupon of the sample through the falling sand abrasion test, according to the ASTM provided. We poured 1600 liters of silica sand on the coating (sitting at a 45° angle). We found that 1600 liters of sand removed 4 mil of the coating. The coating’s abrasion is therefore: 400L/1 mil.

Imperviousness
The imperviousness of a coating to chemical reagents shows a form of chemical resistance that represents what might be expected of a coating throughout its lifespan. It’s a particularly useful insight to see the chemicals/conditions where this coating can be utilized. ASTM D543 describes how to test for imperviousness.

Three 4”x6” coupons were cut from the sample provided, and each tested with one of three different solvents: a 10% sodium chloride solution, a 10% sodium hydroxide solution and a 30% sulfuric acid solution. The solutions were placed on each coupon for a 48 hour period. After 48 hours, the substrate was rinsed and an analysis was performed for corrosion or degradation of the polymer coating

Table 3
Results for 48-hr Imperviousness Testing

Chemical Reagent Used	Comments
10% sodium chloride	No corrosion or degradation observed.
10% sodium hydroxide	No corrosion or degradation observed.
30% sulfuric acid	No corrosion or degradation observed.

Freeze/Thaw Cycles
Changing temperatures can have a dramatic effect on a coating’s physical properties. Rapid expansion/retraction of molecules can break bonds and ultimately degrade coatings. When considering coatings with exterior applications, resisting freezing and thawing while providing the coating’s original properties is very important.

As conducted per ASTM A742, 100 freeze/thaw cycles were completed on a 6”x6” coupon of the coated substrate. Each 0° F cycle lasted 8 hours, followed by 16 hours of soaking in a water bath at room temperature. After the 100 cycles were complete, we found that no spalling, disbanding, or other detrimental effects were observed.

Weatherability
Weatherability testing involves the simulation of environmental forces on a coating, highlighting how that coating will uphold in exterior applications. UV rays, in particular, have a tendency to break bonds in coatings. The degradation of a coating through UV can affect adhesion, abrasion, yellowing and much more.

As discussed prior to testing, the weatherability test provided in ASTM A742 was replaced with a standard UV test procedure. Samples of the polymer coating were placed in the QUV chamber for a period of 7 days (84 cycles). Each cycle within the QUV consisted of: 102 minutes of dry UV exposure at 60° C, followed by 18 minutes of darkness at 40° C. At the end of testing, there was no visible observation that UV exposure affected coating.

Microbial Resistance
Bacterial breakdown is another common source for coating failure. In accordance to ASTM A742, G22 should be used to test the polymer coating for microbial resistance.

Following the methods provided, a 4”x6” sample of the coating was incubated for 21 days and then visually inspected. There were no visible effects of bacterial attack of the coating after the 21 day incubation period.