POLYfuze GRAPHICS™

BY POLYFUZE GRAPHICS™ CORP.

TEST DATA REPORT

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Permeability is the crucial component of longevity and well-functioning durable label. This test report outlines Polyfuze Graphics Corporations (PGC) testing methods and acceptance criteria for Polyfuze (Heat Applied) Fusion Label Permeability. We expanded the ASTM Standards to other evaluations such as PGC Permeability Test Standards outlined in this report providing assistance to customers when choosing labels that are truly Permanent compared to other label manufacturers producing pressure-sensitive adhesive labels (PSA), hot-stamp foil, heat transfers and In Mold Labels (IML).

This report describes the performance requirements, performance test approach and results for Polyfuze (Heat Applied) Fusion Labels. In addition to (ASTM D3359-09, ASTM G7, ASTM D4587-11) additional destructive testing (Appendix A) was conducted in order to determine Label exposure to harsh daily use and effect on permeability. All activities were conducted in a manner that simulated malicious use of Labels.

Test results were monitored Identifying any deviations from baseline; such as Label Structure, Permeability and Visual Quality (i.e. Crisp Edges, Blushing, Zero - Slight Color Fastness, Zero label loss during crosshatch). For a Labels to be considered acceptable they should retain their original structure without any variations from baseline.

Reference: ASTM D3359-09, ASTM G7, ASTM D4587-11, PGC Permeability Test Standards

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Test Number	Test Name	Test Specification	Results
1	PGC Permeability Test Standards Cleaner Fluids Test	4 hr soak at 23° C in degreaser, 4 hr soak at 23° C in car wash fluid, 4 hr soak at 23° C in bug/tar remover	Zero Variation from Baseline. VIEW
2	PGC Permeability Test Standards Windshield Washer Fluid Test	4 hr soak at 23 °C	Zero Variation from Baseline. VIEW
3	PGC Permeability Test Standards Engine Oil Test	4 hr soak at 100° C	Zero Variation from Baseline. VIEW
4	PGC Permeability Test Standards Brake Fluid Test	4 hr soak at 23 °C	Zero Variation from Baseline. VIEW
5	PGC Permeability Test Standards Fuel Test	+ 168 hr soak in regular fuel and then tape tested using the ASTM D3359-09 Adhesion test	Zero Variation from Baseline. VIEW ASTM D3359-09 - 5B Classification 0% loss
6	PGC Permeability Test Standards Transmission Fluid Test	4 hr soak at 100° C	Zero Variation from Baseline. VIEW
7	PGC Permeability Test Standards Ethanol Test	12 hr soak at 23° C in 90% Ethyl alcohol solution	Zero Variation from Baseline. VIEW

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Test Number	Test Name	Test Specification	Results
8	PGC Permeability Test Standards Diesel Fuel Test	+ 168 hr soak in diesel fuel and then tape tested using the ASTM D3359-09 Adhesion test	Zero Variation from Baseline. VIEW ASTM D3359-09 - 5B Classification 0% loss
9	PGC Permeability Test Standards Temperature Cycle Test	30 minutes at 120 °C 15 minutes at 23 °C 30 minutes at -30 °C 15 minutes at 23 °C Repeated for two more cycles then tape tested using the ASTM D3359-09 Adhesion test	Zero Variation from Baseline. VIEW ASTM D3359-09 - 5B Classification 0% loss
10	PGC Permeability Test Standards Humidity Test	666 hr condensation cycle at 50°C, after 1333 hr QUV cycle from test 13, the sample was then tape tested using the ASTM D3359-09 Adhesion test	Zero Variation from Baseline. VIEW ASTM D3359-09 - 5B Classification 0% loss
11	PGC Permeability Test Standards Heat Test	7 days at 120 °C	Zero Variation from Baseline. VIEW
12	PGC Permeability Test Standards Color Fastness Test	400 hrs in QUV, 8 hr at 70° C (158° F) with an irridiance of 1, 4 hours at 50° C w/condensation	Delta E Color Change .69 Munsell blue N2.5 Zero Variation from Baseline. VIEW

Test Number	Test Name	Test Specification	Results
13	ASTM D4587-11 Artificial Weathering Test	1333 hr cycle in QUV with irradiance = 1 at 70º C. plus 666 hr condensation cycle in test 10	Zero Variation from Baseline. VIEW
14	ASTM - G7 Natural Weathering Test	ASTM - G7; Exposure amount: ~ 72,000 Langley's; Exposure Type: Florida at 5° south - open backed; duration = 6 months,	Zero Variation from Baseline. VIEW
15	PGC Permeability Test Standards Pressure Wash Test	Subjected to 3 minutes at 1200 psi, 49 C (120 F) maximum temperature, the nozzle was placed at a 90 degree angle, six inches in distance from the sample, then tape tested using the ASTM D3359-09 Adhesion test	Zero Variation from Baseline. VIEW ASTM D3359-09 - 5B Classification 0% loss

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Appendix A
PGC PERMEABILITY HARSH ENVIRONMENT TESTING

With LSE polyolefin plastics continually preferred over steel and other materials in the manufacture of durable goods; their resistance to environmental and chemical exposures, must be taken into account. There are three distinct characteristics that make them difficult to label conventionally.

1. Low Surface Energy (nothing sticks)
2. High Coefficient of Thermal Expansion/Contraction (18 times more than metal)
3. High VOC Outgassing (de-laminating gases)

With that in mind, labeled durable goods, especially those with safety/warning information, encounter multiple exposures throughout their useful life. Because numerous labeling standards, including UL 969, mandate labels be permanent for the expected life use of specific durable goods, it is of utmost importance that:

A. All label validation testing shall be performed on production intent labels located on production intent components, installed using the production process in lieu of high surface energy test panels such as steel, aluminum or glass.

B. Labeled LSE polyolefin durable goods undergo many different exposures throughout real life-use. Adhesion to a substrate is only as good as what's protecting the adhesion or bond from exposure so in order to best simulate true permanence. PGC Permeability Harsh Environment Testing requires that each labeled test panel undergo an ASTM D3359 crosshatch test followed by malicious exposures (ie: labeled LSE polyolefin test panel first undergoes an ASTM D3359 crosshatch tape test followed by an aggressive exposure such as Pressure Washing. Another LSE polyolefin test panel first undergoes an ASTM D3359 crosshatch tape test followed by chemical soak test etc.)

1. Crosshatch Tape Test.
   - o ASTM D3359 checks for initial label adhesion and separation while simultaneously simulating scratching and gouging a label encounters during life-use. Make cuts at 1/8" above the label and ending 1/8" below including each side. Following ASTM D3359 procedures, use appropriate tape and record results.

2. Extreme Temperature Exposure Cycle
   - o First conduct an ASTM D3359 Crosshatch Tape Test and then expose to a Low/High Temperature Cycle Test at 2 hrs.
     -40°C followed by 2 hrs. 77°C repeating the cycle for a total of 120 hrs. After test is completed, use appropriate tape specified in ASTM D3359 and conduct tape test over previously crosshatched and exposed label and record results.

3. Pressure Wash Test
   - o First conduct an ASTM D3359 Crosshatch Tape Test and then expose to a Pressure Washer set at 1200 psi and 49°C. Pressure wash entire label area from 6" at 90° nozzle angle for 3:00 minutes. After test is completed, use appropriate tape specified in ASTM D3359 and conduct tape test over previously crosshatched and exposed label and record results.

4. Salt Water / Water Immersion Exposure
   - o First conduct an ASTM D3359 Crosshatch Tape Test and then expose to salt water by completely immersing the test panel for the prescribed time. After immersion test is complete, dry the sample completely and use appropriate tape specified in ASTM D3359 to conduct tape test over previously crosshatched and exposed label and record results.

     Salt Water Immersion - 2160 hrs.

5. Chemical/Solvent Exposure
   - o First conduct an ASTM D3359 Crosshatch Tape Test and then expose to one of the following chemicals, solvents or fuels by completely immersing the test panel for the prescribed time. After the immersion test is complete, dry the sample completely and use appropriate tape specified in ASTM D3359 to conduct tape test over previously crosshatched and exposed label and record results. Repeat this procedure for each chemical, solvent, fuel and oil immersion test below as necessary:

Cooking Oil	- 168 hrs.
Detergent (dishwasher)	- 168 hrs.
Detergent (laundry)	- 168 hrs.
Lubricating Oil	- 168 hrs.
Hydraulic Fluid	-168 hrs.
Gasoline	-168 hrs.
Diesel Fuel	-168 hrs.
2 Cycle Engine Oil	-168 hrs.
Lacquer Thinner	-168 hrs.
Toluene	-168 hrs.
Methyl Ethyl Ketone	-168 hrs.
Acetone	- 168 hrs.
Methanol	- 168 hrs.
n-Hexane	-168 hrs.
Ethyl Acetate	-168 hrs.
Ethylene Dichloride	- 168 hrs.
Diethyl Ether	- 168 hrs.
Ammonium Hydroxide (20%)	-168 hrs.
ASTM Reference Fuel C	-168 hrs.
2-Nitropropane	-168 hrs.
Acetic Acid (glacial)	-168 hrs.
Furfural	-168 hrs.
Brake Fluid	-168 hrs.
Turpentine	-168 hrs.
Kerosene	-168 hrs.
Muriatic Acid 20 baume 31.45%	-168 hrs.
Alkali Solution (pH 13)	-168 hrs.

6. UV/Condensation
   - o ASTM D4329, ASTM D4587 or ASTM D2565-16. First conduct an ASTM D3359 Crosshatch Tape Test and then expose to one of the UV / Condensation Cycle Test shown above for a minimum of 2000 hrs. When test is complete, use appropriate tape specified in ASTM D3359 and conduct tape test over previously crosshatched and exposed label and record results.