

## ASTM D3359 Adhesion Testing MIGS® / Polyfuze® Polymer Fusion Label Technology

### TECHNICAL RESPONSE ON ASTM D3359 ADHESION TESTING AND POLYMER FUSION LABELING

#### Overview of ASTM D3359 for Labels:

ASTM D3359 is a widely used test method designed to assess the adhesion of coatings on metallic substrates. The procedure involves applying and removing pressure-sensitive tape over a crosshatch or X-cut in the coating and evaluating the amount of material removed. However, when applied to labels on polyolefin thermoplastics, the test is often simplified inappropriately, failing to capture real-world durability.

#### How ASTM D3359 Has Been Reduced for Labels on Plastics

Because adhering to polyolefin thermoplastics is inherently difficult due to their low surface energy, thermal expansion, and outgassing properties, an aggressive crosshatch tape test like ASTM D3359 typically removes adhesion-based labels, proving them ineffective. To counter this, several standards often reference this test but remove the crosshatching altogether, reducing it to a simple tape-over-the-label peel test.

This modification assumes that all labeling methods rely on adhesion or bonding, artificially allowing traditional labels to pass while ignoring their fundamental weaknesses on polyolefins. This approach fails to reflect real-world performance and durability, reinforcing why ASTM D3359 itself highlights issues with assessing coatings (labels) applied to plastics.

#### Distinguishing Quality Assurance from Long-Term Performance

Many label performance criteria—both in industry standards and among label suppliers promoting their products as "permanent" for polyolefin thermoplastics—rely on Peel Adhesion Tests such as ASTM D3330/D3330M or FTM1 and FTM2. These tests, however, differ significantly in purpose and scope.

**ASTM D3330** – An Initial Test: This method evaluates whether a label initially sticks to a surface and is used primarily for quality assurance rather than long-term durability. Adhesion is assessed by measuring the force required to remove the label.

**5.1** These test methods are tools for quality assurance use. Given specific pressure-sensitive tape and a requirement in terms of the minimum or maximum peel value expected for this tape, the data from the test can be used in conjunction with acceptance criteria.

**1.2** These test methods provide a means of assessing the uniformity of the adhesion of a given type of pressure-sensitive adhesive tape. The assessment may be within a roll of tape, between rolls, or between production lots.

**ASTM D3359** – Long-Term Testing: Unlike ASTM D3330, this method assess adhesion after exposure to environmental factors, mechanical stress, and intentional crosshatch cuts. These tests provide insight into long-term performance and real-world durability.

**5.1** In order for a coating to fulfill its function of protecting or decorating a substrate, the coating must remain adhered to the substrate. Because the substrate and its surface preparation (or lack thereof) have a drastic effect on the adhesion of coatings, a method to evaluate adhesion of a coating to different substrates or surface treatments, or of different coatings to the same substrate, is of considerable usefulness in the industry.

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**1.3** These test methods are used to evaluate whether the adhesion of a coating to a substrate is adequate for the user's application. They do not distinguish between higher levels of adhesion for which more sophisticated methods of measurement are required.

### Why Adhesion-Based Labeling Methods Fail ASTM D3359 on Polyolefin Thermoplastics

Traditional labeling methods—including pressure-sensitive adhesives (PSA), heat transfers, hot stamp foils (heat-activated adhesives), screen and pad printing (curable adhesives), and UV inks (UV-curable but adhesion-based)—all depend on adhesion to the polyolefin substrate. However, polyolefins possess a Teflon®-like resistance to adhesion, making these methods prone to failure under ASTM D3359 testing.

**Crosshatch Testing Reveals Weak Bonds:** Adhesion-based labels and coatings may initially appear secure but peel away under tape pull conditions.

**No Long-Term Durability Guarantee:** A label that passes adhesion testing on a different substrate (such as metal or treated plastic) may still fail on polyolefin thermoplastics.

**Surface Energy Challenge:** Unlike metals and other higher surface energy materials, polyolefins inherently resist bonding, meaning labels relying on surface adhesion degrade over time.

### How ASTM D3359 Proves Polymer Fusion Labeling

Polymer Fusion Labels operate fundamentally differently from adhesion-based labels. Instead of adhering to the surface, they molecularly fuse with polyolefin thermoplastics, becoming a homogeneous part of the substrate itself. ASTM D3359 evaluates adhesion based on a 0B-5B classification scale, which rates the extent of material detachment after tape pull.

**Polymer Fusion Labels Achieve 5B Ratings:** Unlike adhesion-based labels, Polymer Fusion Labels exhibit completely fused edges with no detachment of the fused material.

**Adhesion-Based Labels Exhibit Material Loss:** Traditional labels are more likely to exhibit material removal, where label fragments adhere to the tape and detach from the substrate, with scores varying depending on adhesive chemistry, surface preparation, and environmental conditions.

**Fusion Prevents Detachment:** While adhesion-based labels degrade under testing, Polymer Fusion Labels remain permanently fused—removal would require damaging the plastic itself.

### Why MIGS®/Polyfuze® Chooses ASTM D3359 for Testing

Despite ASTM D3359 not being designed for plastics, we at MIGS®/Polyfuze® use it strategically to expose the shortcomings of adhesion-based labels while validating the performance of Polymer Fusion Labels.

**Proof of Fusion:** The inability to remove a Polymer Fusion Label without damaging the plastic itself confirms the technology's superiority. It truly is a tattoo for plastic.

**Industry Education:** Many labels claiming “permanence” fail this test on polyolefins, highlighting their misleading claims.



## **ASTM D3359 Adhesion Testing** **MIGS® / Polyfuze® Polymer Fusion** **Label Technology**

**Competitive Differentiation:** By applying a known standard to an unintended material, we reveal the inadequacy of adhesion-based solutions and the true permanence of fusion confirms true molecular integration—removal requires damaging the plastic itself.

### **Conclusion: ASTM D3359—A Test of Failure for Adhesion, A Test of Success for Fusion**

ASTM D3359 was never meant to validate adhesion on polyolefin thermoplastics, and it consistently proves the failure of conventional labels that rely on surface bonding. However, when used to validate Polymer Fusion Labels, the test highlights a fundamental difference—fusion is not adhesion, and true permanence is achieved only when a label becomes part of the plastic itself.

At MIGS®/Polyfuze®, we challenge industry norms by using ASTM D3359 not as an adhesion test but as a fusion confirmation test. If a label claims to be “permanent” on polyolefin thermoplastics but fails ASTM D3359, it was never permanent to begin with.