DIAMON-FUSION INTERNATIONAL
"Innovation that Ignites Business"

INDEPENDENT TESTING REPORT

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WINDSHIELD WIPER BLADE ABRASION TEST

OVERVIEW

The key metric utilized to measure the performance of hydrophobic coatings is the "contact angle", defined as the angle at which a liquid/vapor interface meets the solid surface and can be represented, as illustrated in Figure 1, as the angle α between the normal vector of a sphere (water droplet) at a point where a plane is tangent to it and the normal vector of the plane.

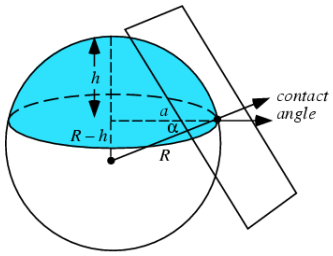

Figure 1: Contact Angle Definition

As the contact angle of a surface increases, the more hydrophobic (or water repellant) that surface becomes. For example, water sheeting on glass has a 0^{o} contact angle while a perfect water droplet sphere on a surface would have close to a 180^{o} contact angle so that the water would literally roll off the surface and create "zero wettability" (with very limited durability however).

TEST METHODOLOGY

Diamon-Fusion International contracted an independent testing laboratory, Architectural Testing, Inc., in late 2009 to evaluate its ***Diamon-Fusion® ULTRA*** protective glass coating for contact angle in accordance with ASTM C 813-90 (Reapproved 2004) – *Standard Test Method for Hydrophobic Contamination on Glass By Contact Angle Measurement*.

Samples pre-treated with ***Diamon-Fusion® ULTRA*** were provided to Architectural Testing for testing purposes. For contact angle measurement per ASTM C 831, a precisely measured amount of distilled water (0.04ml) was placed on the test surface and the profile of the drop/surface interface was viewed under magnification. A rotating angular scale within the objective of the measuring device was lined up with the advancing angle of the drop and compared to the surface. The resulting angle was then identified on both the left and right sides and recorded.

All preparation and evaluation of the coatings and glass panels were at lab ambient conditions of 70 +/- 2^{o}F and 50 +/- 5% RH. Each test was conducted on three replicate samples to verify the repeatability of findings. Each panel was wiped one time with a lint-free dry cloth prior to the initial evaluation. No other cleaning process was utilized on the glass throughout testing.

Samples were subjected to cyclic linear sweeping motions of a weighted standard single-edge rubber windshield wiper blade. Each sample was placed into the wiper blade sweeping apparatus, and the weighted windshield wiper blade was set on top of the coated surface. The weight of the wiper blade and support measured 0.33 pounds. Architectural Testing obtained force measurements from several automotive wiper blade arms and determined that the average force was 0.3 pounds per 4" section.

The wiper blade segment measured 4" long and was replaced for each product set. Water was applied to the surface in sufficient quantity that the surface was swept clean during the wiper blade pass. The wiper blade picked up water at the end of each stroke to cause the leading edge to always remain wet as it passed over the surface of the test sample and swept it clean. This action simulated the typical conditions of a glass windshield exposed to road spray or precipitation and the subsequent sweeping actions of a wiper blade. The device was then set to operate a total of 1,000 cycles. The cyclic sweeping operation was repeated at cycle totals of 2,000, 4,000, and 8,000 cycles, and the contact angles measured and recorded.

RESULTS

Diamon-Fusion® ULTRA samples maintained contact angles demonstrating superior hydrophobicity at all measurement points:

- Initial Contact Angle: **110.3°**
- 1,000 Cycles: **92.3°**
- 2,000 Cycles: **92.4°**
- 4,000 Cycles: **90.8°**
- 8,000 Cycles: **90.1°**