Rhopoint ID Application Notes

ABRASION ON TRANSPARENT MATERIALS

Overview

Transparent materials such as acrylic (PMMA), polycarbonate (PC) and glass play an important part in our every day life. They are commonly used in a wide range of industries including electronics, packaging, building, medical, automotive and aerospace.

According to their function, these materials are generally required to allow an undistorted and visually clear image of the content that is behind. In some applications it can be critical for safety reasons and for others, to allow excellent viewing quality of products and/or information. Indeed some applications require a combination of obscurity and full transparency for instance smart glass. For each application the correct selection of polymers and resins used to manufacture the material is essential in ensuring optimum mechanical and physical properties.

Abrasion resistance of PMMA and PC presents challenges to the manufacturer and may require modifications to be made to the polymers or the use of coatings on the surface to improve wear characteristics.

Taber Model 1700

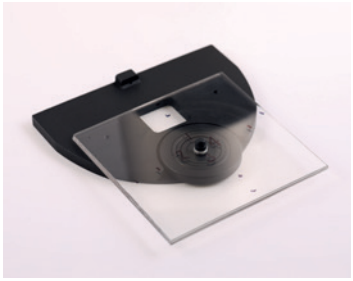
To simulate wear, a test method - the Taber Abrasion test to ASTM D1044 utilising CS-10F wheels was adopted. Taber tests involve mounting a flat to a turntable platform that rotates on a vertical axis at a fixed speed. Two abrasive wheels, applied at a specific pressure, traverse a complete circle on the specimen surface. The resulting abrasion marks form a pattern of crossed arcs in a circular band that cover an area approximately 30 cm^2. At the end of the test, the change in transparent quality, mainly haze, is measured using a hazemeter.

As the orientation of a hazemeter conforming to ASTM D1003 is typically horizontal, a special mounting adaptor needs to be used to hold the sample to the measurement port. The Rhopoint ID, thanks to its high correlation to ASTM D1003 is a vertically oriented instrument making sample mounting quick and very easy allowing compatible measurements to now be made.

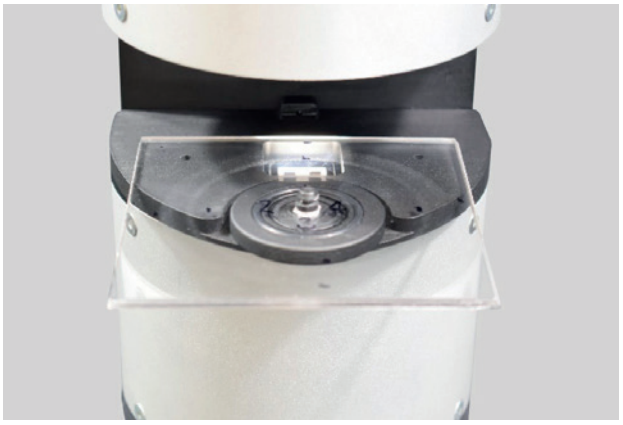
OTHER APPLICATION NOTES:
- Surface roughness and bulk scatter
- Distance Haze
- PET bottles

Taber Model 170 - Image courtesy of Taber Industries

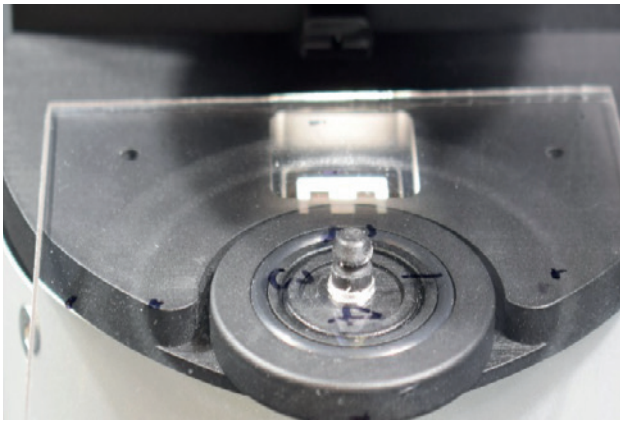
PROCESS Example – PMMA



STEP 1: Customer supplied samples of rotary abraded (using Taber Model 1700) and non-abraded PMMA material were tested. The Abrasion Adaptor, available as an optional accessory, allowed the samples to be mounted and easily rotated over the graticule for ASTM equivalent haze (H_{ASTM}) measurement.

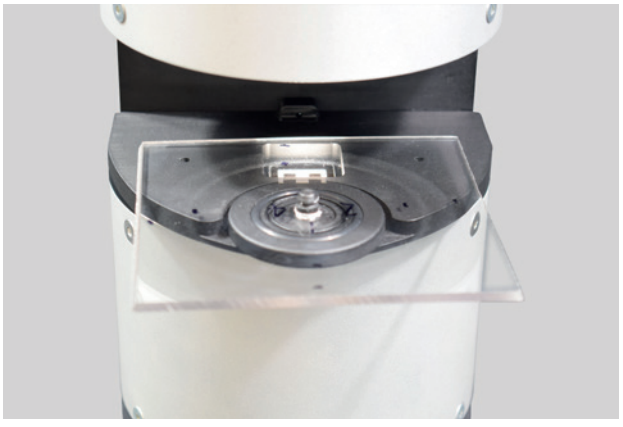


Quadrant 1

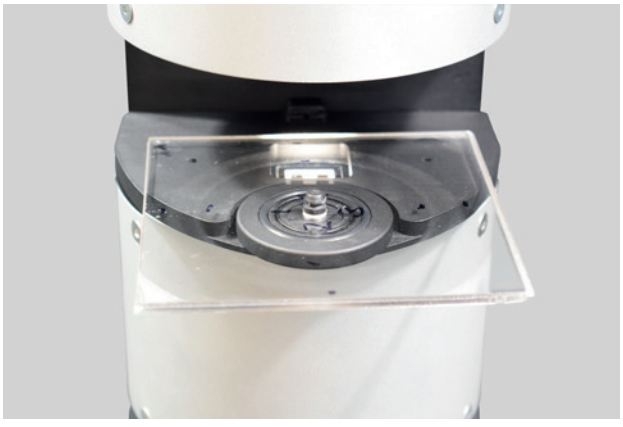


Quadrant 2 Close up

STEP 2: The abraded sample was mounted onto the table and a measurement taken.



Quadrant 3

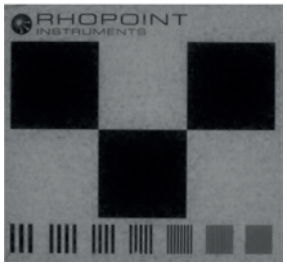


Quadrant 4

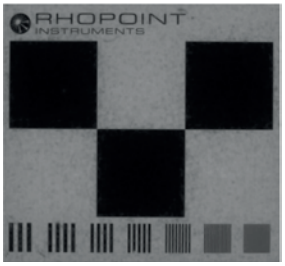
STEP 3: The table was then sequentially rotated 90 degrees each time and further measurements made. This process was then repeated for the non-abraded sample for comparison.

RESULTS Example – PMMA

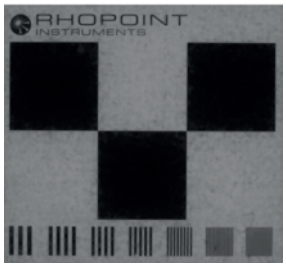
Abraded sample



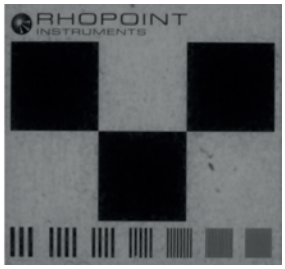
Side 1



Side 2



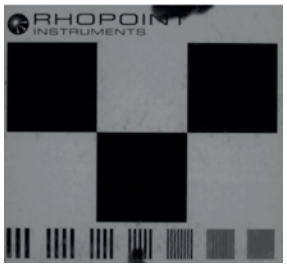
Side 3



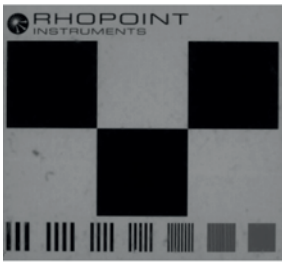
Side 4

Sharpness	Transmission	Haze (H_{ASTM})	Sample
71.74	89.2	22.22	Taber S38, Acrylic. 50 cycles, Quadrant 1
76.09	89.9	18.18	Taber S38, Acrylic. 50 cycles, Quadrant 2
72.22	89.3	21.77	Taber S38, Acrylic. 50 cycles, Quadrant 3
75.37	89.0	20.82	Taber S38, Acrylic. 50 cycles, Quadrant 4

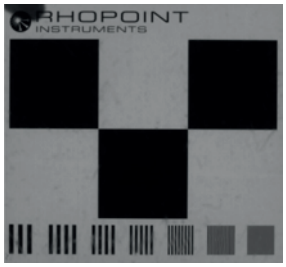
Non-abraded sample



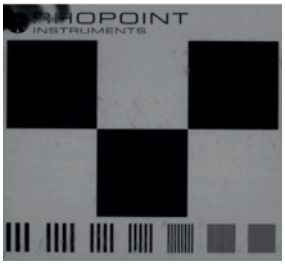
Side 1



Side 2



Side 3



Side 4

Sharpness	Transmission	Haze (H_{ASTM})	Sample
93.34	89.7	4.15	Taber S38, Acrylic. Non-Abraded, Quadrant 1
92.43	89.9	3.59	Taber S38, Acrylic. Non-Abraded, Quadrant 2
92.27	90.0	3.86	Taber S38, Acrylic. Non-Abraded, Quadrant 3
91.79	90.3	4.47	Taber S38, Acrylic. Non-Abraded, Quadrant 4

Observations of results

The measurement data shows the reduction in optical quality due to Taber abrasion. The abraded sample shows a higher Haze and lower Sharpness value indicating surface roughness is present; the hardness of the material surface being insufficient over the test cycle to withstand the abrasion. Matching the material formulation to the application allows quality improvements and cost savings.

Features of the Rhopoint ID

No moving parts
Eliminates risk of mechanical failure

Stand-alone instrument
Small footprint reduces space required in laboratory

Lightweight
Easy to move in the laboratory or production line

Resistant and durable
Made from durable, recyclable materials

Touch screen
Single measurement time of 2 seconds to measure ALL parameters (up to 15 seconds on a comparable sphere instrument)

Large mounting area
Minimal sample preparation required possible to measure non flat samples without bending or deforming.

Fully sealed optics
Ideal for measuring liquid samples and solid materials impervious to damage through accidental spillage

KEY FEATURES
✓ Measure and quantify abrasion on transparent materials
✓ Rhopoint ID can fully characterise the change in optical quality caused by abrasion
✓ ASTM D1003 equivalent haze measurement
✓ Excellent correlation with standard ASTM D1003 sphere-based measurements
✓ Simple sample mounting. Fast, accurate and repeatable measurement
✓ Samples can be simply mounted directly onto graticule or onto optional table for measurement
✓ Measured data and images allow visual comparison of haze change due to abrasion
✓ Extensive information available for analysis

FULL PRODUCT DETAILS

VIEW DATA SHEET