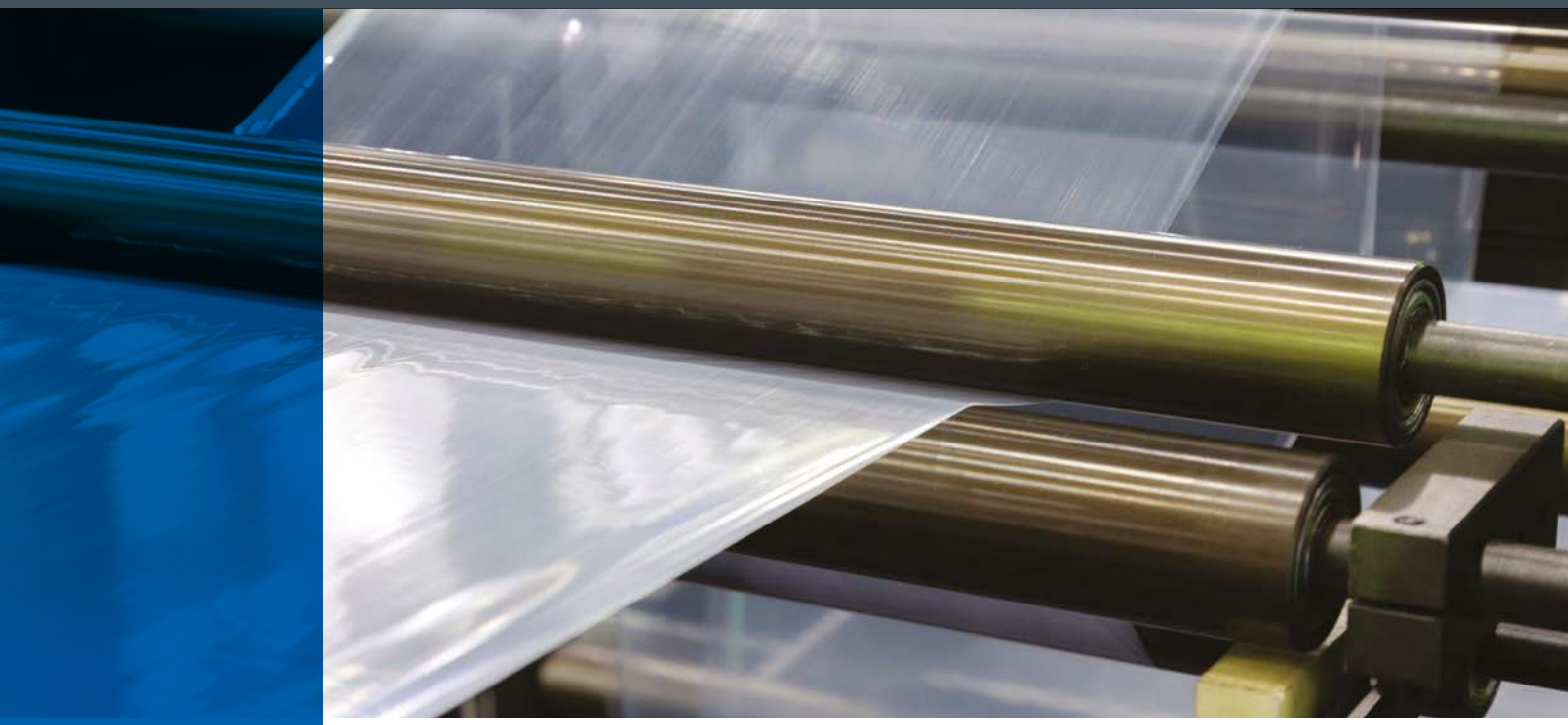
Rhopoint ID Application Notes

SURFACE ROUGHNESS AND BULK SCATTER



Overview

The visual quality (Haze and Sharpness) of a transparent plastic material can be impaired by surface roughness and/or internal optical irregularities.

Surface roughness is often imparted to the material during manufacture, similarly internal irregularities can be due to due to crystallization or caused by inhomogeneities (i.e. density difference, fillers, pigments) in the material bulk.

To improve processes or materials it is useful to identify exactly where the reduction in optical quality originates. The ID Surface roughness test can isolate and measure the effects of surface roughness on each side as well as the effects of bulk scatter in the material.

Cast Film Surface Roughness

The surface properties of a cast film can be affected by the condition of the chill roll used to cool the material after extrusion and the temperature control during the cooling process.

OTHER APPLICATION NOTES:
- PET bottles
- Distance Haze
- Abraded Samples

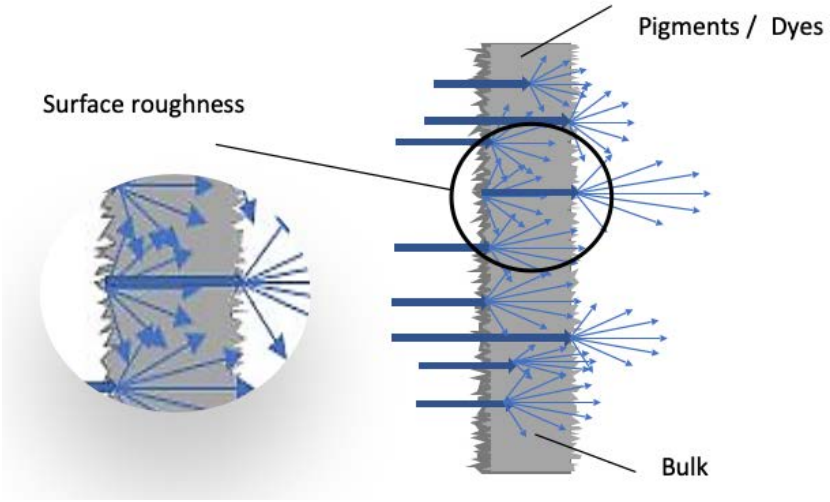
The extrusion process

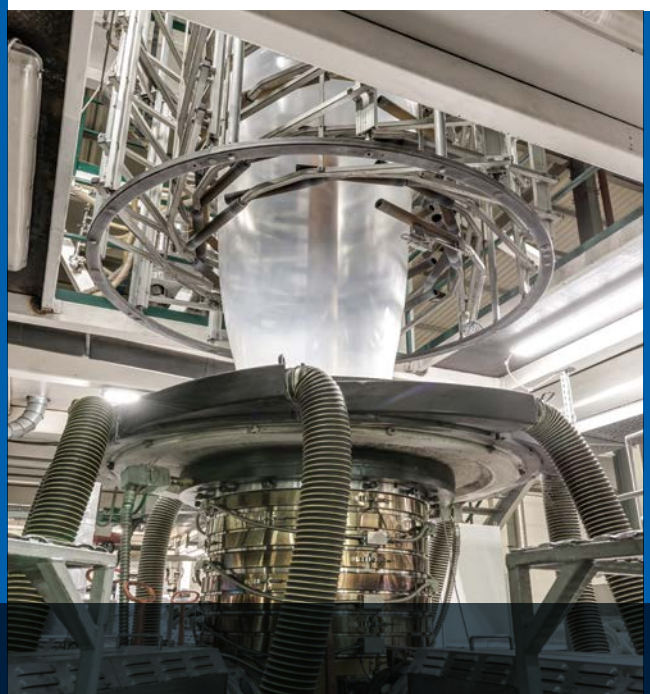
1 The extrusion process for making blown polyethylene film and bags starts with pushing the molten plastic through an annular slit die to form a continuous thin walled tube of plastic called a bubble.

2 The bubble is inflated with air to the desired diameter and drawn vertically up a tower through a high-speed air ring which cools it before passing through nip rolls where it is flattened to its lay-flat width.

3 The collapsed lay-flat tube is then transported back down the tower by external rollers. The thickness of the film is controlled by the speed at which it is pulled from the die. The width of the film is controlled by the amount of air that is inserted in the bubble. As blown film freely flows during the process surface roughness is mainly caused by the melt-flow characteristics and crystallization of the material during cooling.

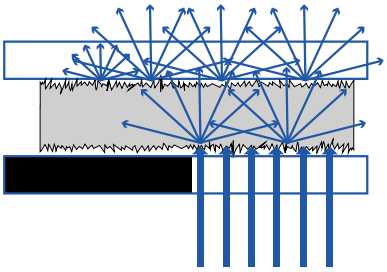
4 It is therefore essential that in-process controls are optimised to ensure consistent product quality; the surfaces of the slit dies and chill rollers should be consistently free from wear or damage and the plastic melt homogeneity, blow-up ratio and cooling rate should be correctly controlled.





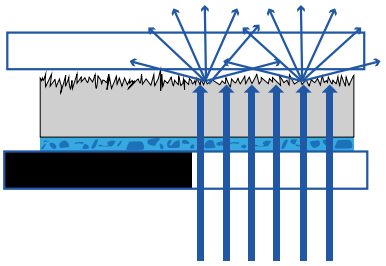
As film manufacture is a high-speed process it is critical that any quality problems are identified quickly to reduce wastage

Rhopoint ID method for isolating bulk and surface scatter



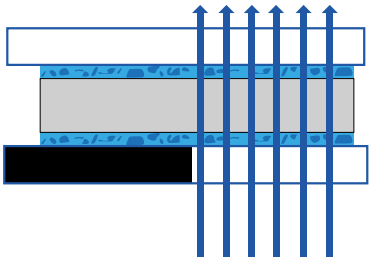
Bulk and Surface Scatter (both faces)

Haze and Sharpness due to bulk and surface scattering from both faces.



Bulk and Surface Scatter (top face)

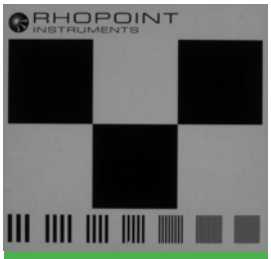
- Refractive index matched oil removes effects of surface roughness from bottom face.
- Haze and Sharpness due to bulk and surface scattering from top face only.



Bulk Scatter

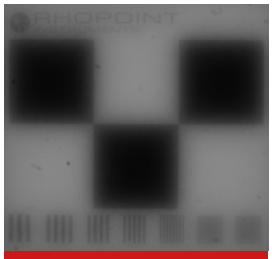
- Refractive index matched oil removes effects of surface roughness from both faces.
- Haze and Sharpness due to scattering in the bulk of the material.

Example – PMMA Film roughness



PRISTINE
(Roughness 4nm RMS)

GOOD
(Roughness 15nm RMS)



POOR
(Roughness 180nm RMS)

STEP 1: Three different samples of 0.25-mm-thick PMMA chemically etched film were used to simulate the effects of surface roughness. Each sample was tested using Rhopoint ID-L.

The optional sample analysis plate accessory can be used to investigate the surface roughness and bulk scattering properties within the film.

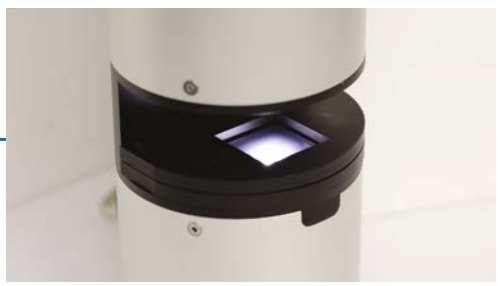
STEP 2: The two-piece accessory allows plastic film samples to be trapped within two optically clear glass slides mounted in the unit.

Low viscosity oil is used to remove any surface roughness from each side of the film in turn to identify which side has surface roughness present.

One half of the analysis plate without sample is mounted onto the Rhopoint ID and the unit tared.

A small amount of oil is applied to the glass slide in the analysis plate and the film placed on top and moved to ensure no air bubbles are present underneath.

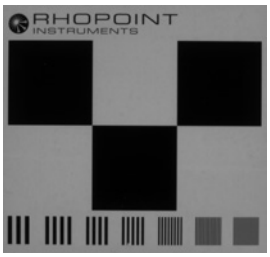
STEP 3: The analysis plate is placed into the Rhopoint ID measurement aperture and a measurement is taken.



RESULTS Example – PMMA Film roughness

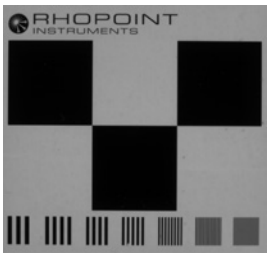
PRISTINE

Measurement Results



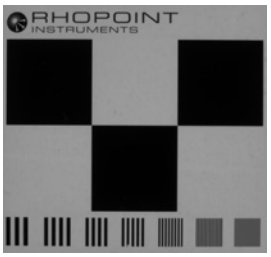
Film Sample Only

Sharpness	97.6
Transmission	93.8
Haze	0.87



One side oiled

Sharpness	99.5
Transmission	99.6
Haze	0.19



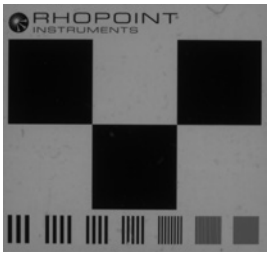
Both sides oiled

Sharpness	98.0
Transmission	98.7
Haze	0.2

With oil applied to both sides of the PRISTINE sample the haze value reduced slightly indicating that there was almost no surface roughness present. Transmission and Sharpness values were consistently high.

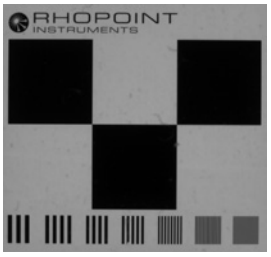
GOOD

Measurement Results



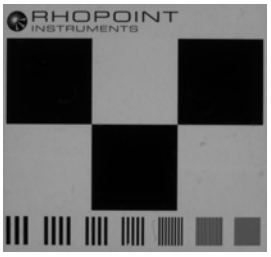
Film Sample Only

Sharpness	95.4
Transmission	91.4
Haze	7.97



One side oiled

Sharpness	99.0
Transmission	99.7
Haze	0.35



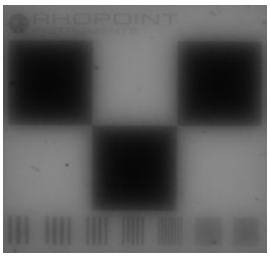
Both sides oiled

Sharpness	97.8
Transmission	99.1
Haze	0.34

The Haze value for the GOOD film sample only was high and with oil applied to one side this dropped significantly indicating that surface roughness was present. When applied to the other side there was no change to the haze value. Sharpness and Transmission were consistently high.

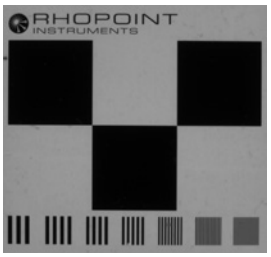
POOR

Measurement Results



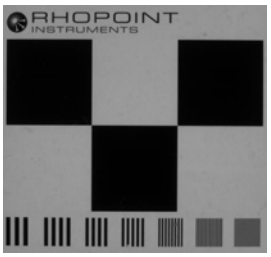
Film Sample Only

Sharpness	10.7
Transmission	92.6
Haze	56.1



One side oiled

Sharpness	98.3
Transmission	98.6
Haze	1.5



Both sides oiled

Sharpness	96.6
Transmission	98.6
Haze	0.7

The haze value for the POOR film sample only was very high and with oil applied to one side this dropped significantly indicating surface roughness was present on this side. Sharpness also increased. With oil applied to the other side the haze value dropped further indicating that there was a much smaller amount of surface roughness present.

As the etched film samples tested were produced from the same material there was no noticeable change in the Sharpness value of the oiled material measurements indicating a consistency in bulk properties.

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
✓ Analysis / detection of surface roughness caused by in-process failure
✓ Measured data and images allow visual confirmation of potential surface issues
✓ Sample movement between measurement ports not required
✓ Isolating each surface side identifies roughness and defects caused by manufacturing process
✓ Greater amount of information available for identification and reporting purposes
✓ Easy to use and clean, use of vertically mounted oil filled cuvettes not required

FULL PRODUCT DETAILS

VIEW DATA SHEET

TRY BEFORE YOU BUY

We offer two options for you to try out the Rhopoint ID before buying.

1. **Online demonstration:** Online presentation of the Rhopoint ID with your samples measured LIVE on Zoom, TEAMS or Skype. Includes consultation with an application specialist.

2. **Factory sample testing:** Send in samples of your material for testing and receive a comprehensive test report.

Arrange a demo

Ready to receive a quote? **Click here**

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