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RHOPOINT iD

Imaging transmission appearance meter

- Optical measurement of transparent materials that correlates to human perception

How does the Rhopoint ID work?

The world's first imaging transmission appearance meter measures optical transparency correlated with visual perception.



The measurement sample is placed in contact with, or spaced from, the target graticule. The instrument captures images and uses optical analysis to quantify loss of transparency, i.e. *Illumination Diffusion*.

The Rhopoint ID uses a new metric termed *Illumination Diffusion (ID)*, developed at ETH Zürich, in response to an industry call to find an improved method for characterising the transmission characteristics of transparent materials.

The cloudy, "hazy" appearance of transparent materials is an important attribute that determines their suitability for applications. For example, packaging materials are typically required to be maximally transparent in order to reproduce the vivid colours and finer details of the product, while for cosmetics a high opacity may be desired. The conventional methods for quantifying the appearance of transparent materials typically employ a dedicated "haze-meter" instrument configured to quantify the amount of light scattered over a certain range of angles from the direction of the incident beam.

Although long-established, this test method suffers from a number of weaknesses. First, being based on an arbitrary range of scattering angles, the definition of "haze" does not correlate directly to the human perception of transparency. Second, the "haze" metric completely fails to capture the variation of a material's transparency with the separation distance between said material and the viewed object – an important feature for packaging materials which specifically target contact or non-contact applications. Finally, a typical instrument outputs a single value averaged over a large, ~5 cm^2 specimen area which limits its effectiveness as an optical quality control tool for detecting local defects.

Rhopoint ID addresses all of the issues above and quantifies the loss of transparency as *Illumination Diffusion (ID)*, precisely capturing the visual effects of diffuse scattering of illumination light as it passes through a material. Based on an imaging method, it is configured to specifically match the human perception of transparency. The instrument outputs in-contact optical properties, as well as their variation with specimen-to-object separation distance, while on-demand probing local or spatially-averaged specimen areas.

How Illumination Diffusion works

The Rhopoint ID uses a technique and metric termed *Illumination Diffusion*.

A backlit, high accuracy, reference target graticule functions as the viewed object, creating a highly defined pattern of light intensities with optimally sharp transitions between the backlit and masked areas.

A sample placed in direct contact (or at the desired separation) with the graticule is photographically imaged, with image analysis then used to quantify the reduction in sharpness of the backlit-to-masked (i.e., light-to-dark) transitions of the graticule compared with its reference image.

The output is a simple single-scale ID value, with the overall scale specifically matching the resolution of a human eye at a typical viewing distance.

An illustration of the ID test methodology is shown on the right:
Image 1: The reference is target graticule with no material sample
Image 2: A sample with reduced optical quality
Image 3: A sample with reduced optical quality and containing a defect area.

Note that, unlike for Rhopoint ID, with conventional measuring methods the reduction in optical quality caused by the defect in Image 3 would be averaged into the overall output.



Image 1

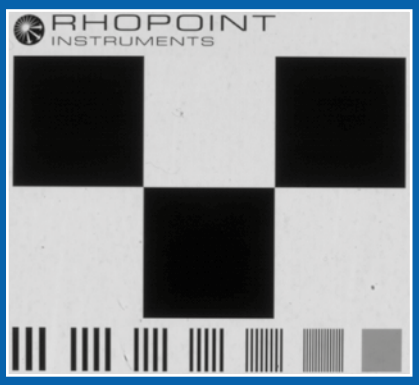


Image 2

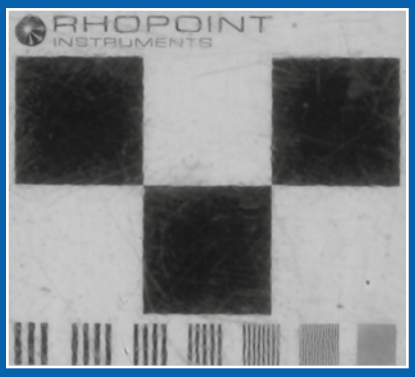
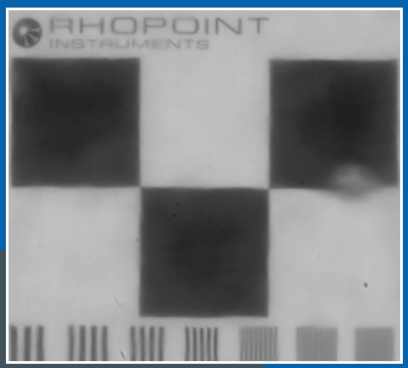


Image 3



Data examples for plastic films

Contact appearance - A direct measurement of the appearance of an object viewed through an in contact material.

Non-contact appearance - A measurement of the appearance of an object viewed through a material with an air gap or spacing between the two.

The relationship between contact and non-contact appearance cannot be assessed by current haze and clarity instrumentation. Haze and clarity values measured with other instruments are impossible to directly relate to visibility of an object viewed through the material in contact or at any specific distance.

As plastic packaging is used both in contact and with air gaps between the product and protective film, the new ID measurement is a significant step forward for this industry sector when developing or specifying films for different applications.

The following examples show the relationship between air gap size and appearance for a number of different polymer films.

ID values are measured on the Rhopoint ID using spacers to replicate the air gap between the product and material in the final application.

Using this method the ID provides a single scale to evaluate appearance at any distance from in- contact and with up to 40mm air gap.

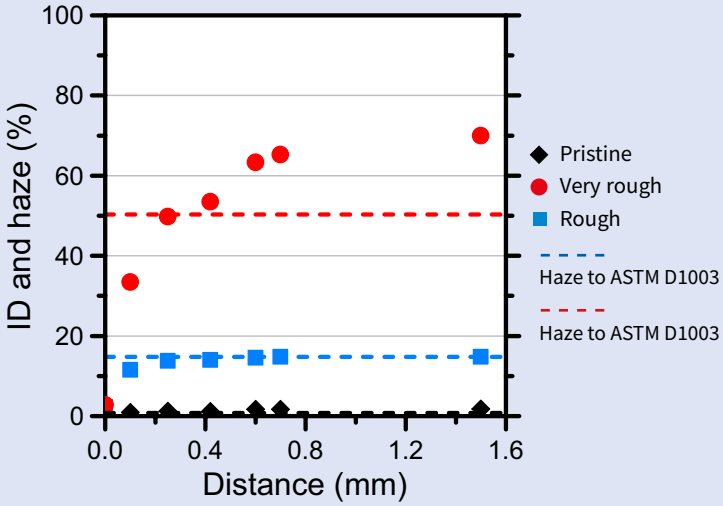
The ID-L variant additionally provides statistical analysis of results as well as images of the test graticule that can be visually assessed and used in reports outlining material characteristics.

By using the Rhopoint ID, the packaging technologist can choose and specify a protective film that performs best for their application in a way that correlates precisely to the eye of the consumer.

Effect of surface roughness

Data is shown for PMMA films (0.25 mm thickness) with a varying degree of roughness on the surface facing the graticule. Surface roughness primarily affects out-of-contact visual appearance:

• Rhopoint ID enables accurate quality control and product specifications depending on the intended end-use (whether *in*-or *out*-of-contact).
• The instrument also makes possible optical diagnostics of *surface* or *internal* defects in polymer articles, as well as detecting wear in processing equipment such as molds or chill rolls.





Pristine (1mm)



Rough (1mm)



Very rough (1mm)

Measure optical appearance correlated to human vision

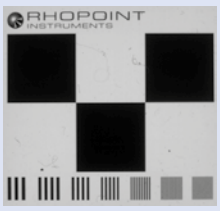


Image 1: Pristine film, 1mm air gap, measured with Rhopoint ID

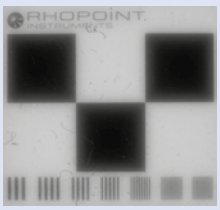


Image 2: Very rough film, 1mm air gap, measured with Rhopoint ID

Semicrystalline polymer films

Data is shown for polyethylene and polyester films (comparable 50–80 µm thickness). Analysis of ID provides a more comprehensive picture of visual appearance than is possible with conventional instruments:

- While it is difficult to combine the "haze" and "clarity" values generated by conventional instruments into a single meaningful measure of transparency, Rhopoint ID quantifies visual appearance using a single scale that correlates with human perception.
- Contact and out-of-contact ID are not necessarily correlated for all materials (e.g. the cross-over in ID data for the films above).
- Precise material selection for the desired applications.



Polyethylene (in contact)



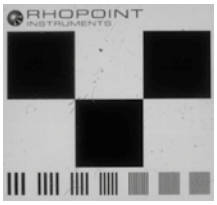
PET (in contact)



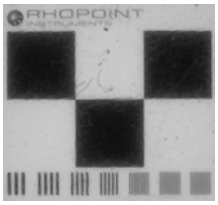
Polyethylene (8mm air gap)



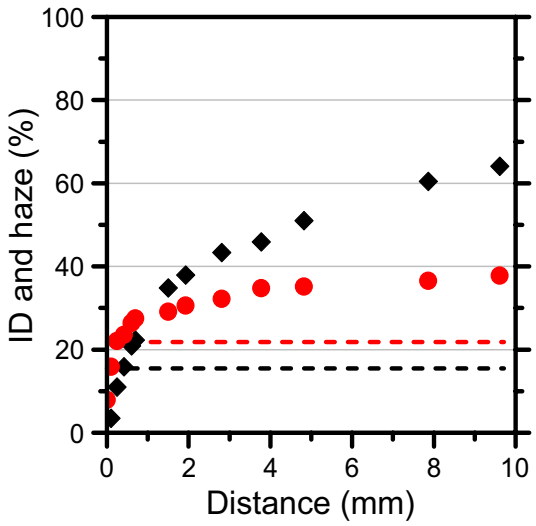
PET (8mm air gap)

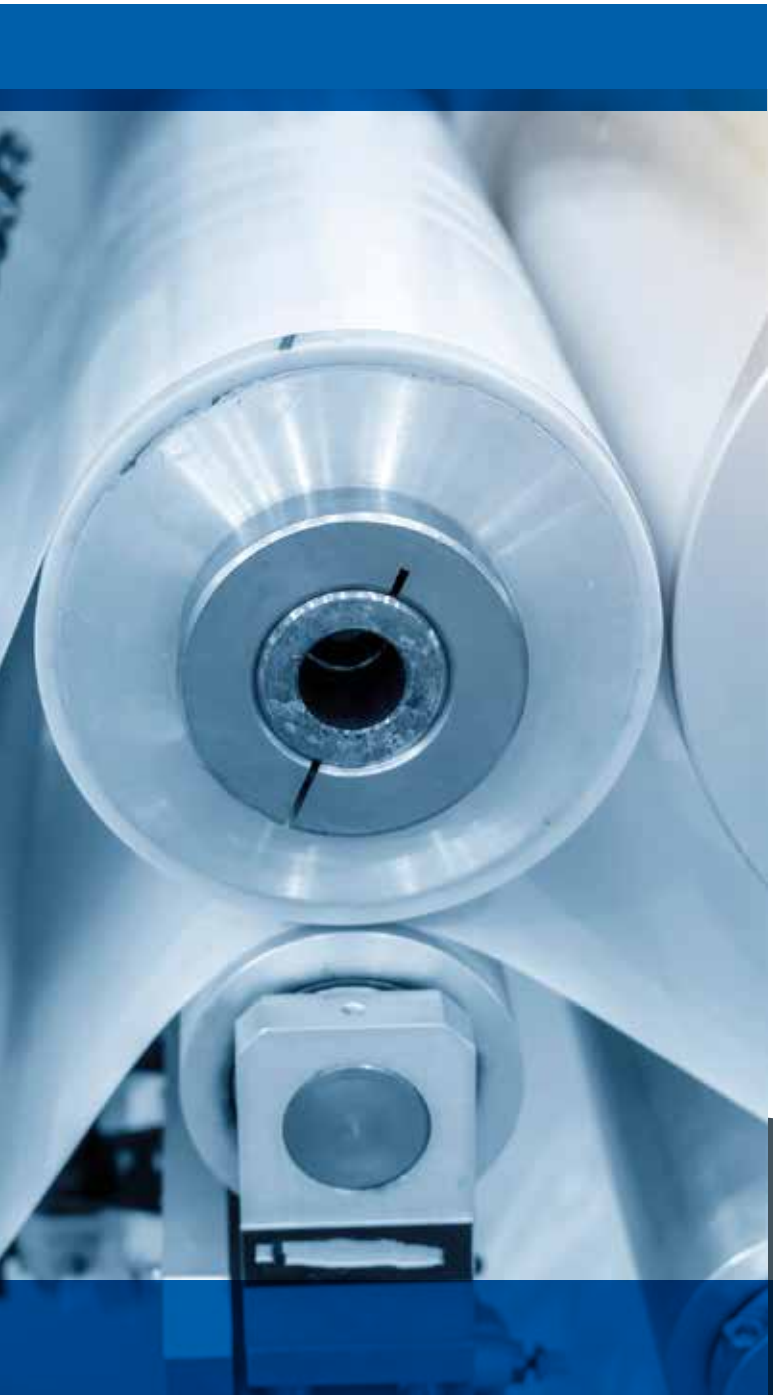


Polyethylene film in contact measured with Rhopoint ID



Polyethylene film, 8mm air gap measured with Rhopoint ID





The Rhopoint ID-E and Rhopoint ID-L explained

	Rhopoint ID-E	Rhopoint ID-L
Operate in stand-alone mode	✓	✓
Software for advanced analysis		✓
Measures (ID) with the sample material in contact with test target	✓	✓
Replicate real world conditions with a user variable gap between the sample material and test target		✓
Suitable for sheeted materials up to 300µm thickness	✓	✓
Live view makes it easy to position test sample and locate specific areas of interest		✓
Save, reload and compare test data and images		✓
Measure multiple samples with batch and trend analysis		✓
Assess and compare test materials with a specially designed visual test area on the target image		✓
Measure sample homogeneity and directionality in detailed sample results and images		✓
Measure any planar material with thickness up to several mm		✓



It is often required to quantify the appearance characteristics of small components, defined coloured or printed areas on a material. The Rhopoint ID-L measures ultra small areas for optical quality; the live view screen allows these small parts or areas to be positioned perfectly for accurate measurement.



Applications



Films

Blown and extruded films often exhibit unwanted directionality, an effect which reduces appearance quality and may reduce other important characteristics such as strength and barrier properties.

Directionality can be reduced or eliminated with optimised process parameters: Rhopoint ID-L can measure in-situ during set up and manufacture to improve the quality of film production.



Rigid plastics

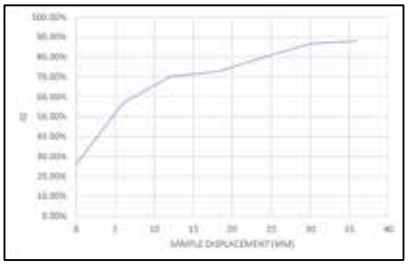
Rigid plastics are used to protect and transport goods, with their see-through qualities governed by formulation and process parameters (temperature, dwell time etc).
The Rhopoint ID-L with batch and quality control is an invaluable tool in the plastics development or manufacturing facility.



Packaging showing variable air gaps between the product and protective film

Air gaps

Depending on the application, flexible packaging can be used in contact with, or with an air gaps between, the protected item. Rhopoint ID is the only instrument on the market that can determine the final appearance of the packed item in these conditions.



A graph showing the evolution of ID with air gap distance



Other materials

Many consumer goods have components which require close control of their see-through optical characteristics. Rhopoint ID can be used to quantify the appearance of glass, plastics and other transparent and translucent materials, including liquids and suspensions.

Specifications

	Measurement Specification ID	Measurement Specification T
Range	0-100%	0-100%
Repeatability	0.05 SD*	0.05 SD*
Reproducibility	0.10 SD*	0.10 SD*
Resolution	0.001	0.001
Effective operating range	Materials T→60%	

	ID-E	ID-L
Measurement Mode	Contact Only	Contact and Non Contact
Non Contact Distance	N/A	Up to 40mm
Material Thickness	←300µm	←30mm
Software	N/A	Rhopoint ID-Analysis
Connection	N/A	USB/ Ethernet LAN
Spatial Resolution	12µm	
Imaged Area	20mm x 20mm	
Min Area - ID	12x8mm	6x2mm
Min Area -T	12x8mm	2x2mm
Image Format	N/A	16 Bit Tiff
Image Size	N/A	1280x1024
Operating Temperature	10-40°C	
Dimensions h x Ø	470 x 125 mm	
Weight	4.15 Kg	
Packed Weight	7 Kg*	
Power	110/230V	
Included Accessories	Check Standard	Check Standard

Product	Included accessories	Order code
Rhopoint ID-E	Calibration check	A3100-002
Rhopoint ID-L	3 x 2mm distance spacers #	A3100-001

* draft specification # Custom spacers available on request





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