Introduction

Transparency

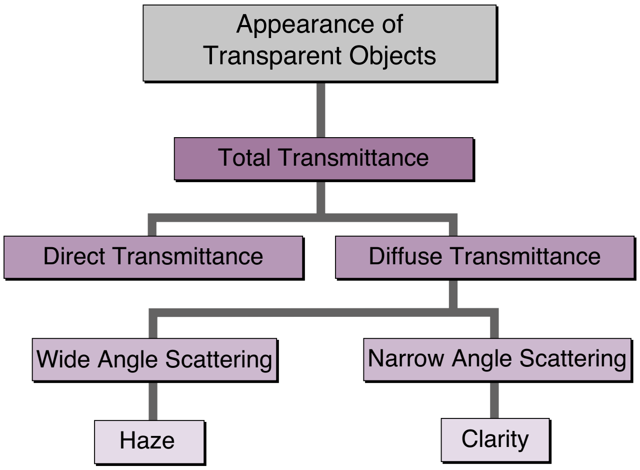
The appearance of a transparent product is defined by its application. Packaging film used in the food industry should be very clear and transparent, while film for grocery bags should be translucent and diffuse the light. Therefore, different raw materials are selected and processed under certain conditions.
The absorption and scattering behavior of the transparent specimen will determine how much light will pass through and how objects will appear through the transparent product.

Total Transmittance

Total transmittance is the ratio of transmitted light to the incident light. It is influenced by the absorption and reflection properties, example:

Incident light	**100 %**
– Absorbtion	**-1 %**
– Reflection	**-5 %**
Total Transmittance	**= 94 %**

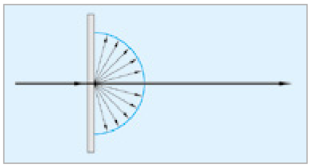
The totally transmitted light consists of the directly transmitted and the diffused components. Depending on the angular distribution of the diffused portion, a transparent plastic will appear differently.
Visual perception can clearly differentiate two phenomena: Wide angle and narrow angle scattering.



TRANSPARENCY

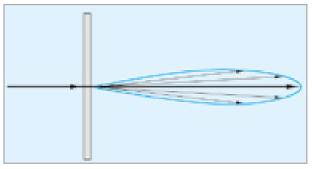
Haze: Wide Angle Scattering

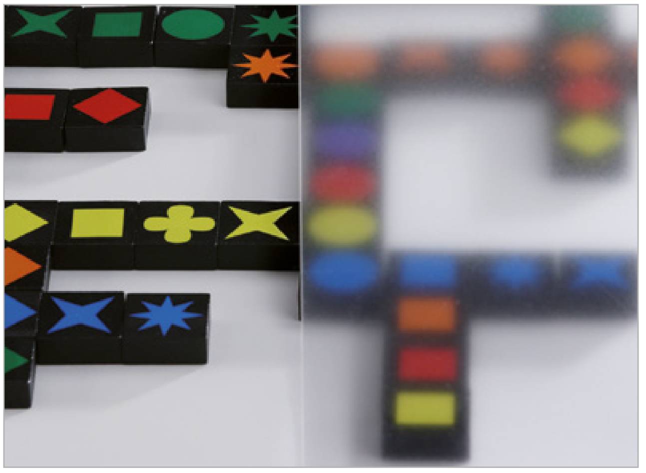
Light is diffused in all directions causing a loss of contrast. ASTM D 1003 defines haze as that percentage of light which in passing through deviates from the incident beam greater than 2.5 degrees on the average.



Clarity: Narrow Angle Scattering

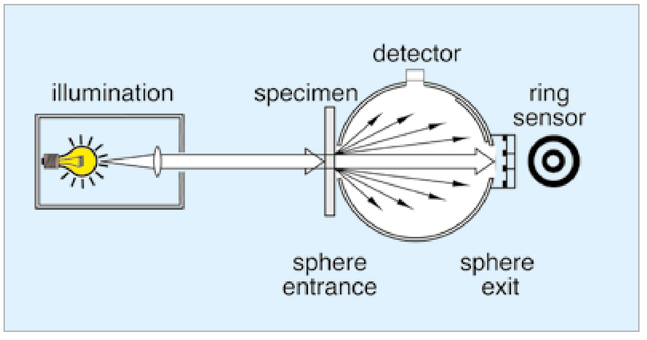
Light is diffused in a small cone with high concentration. This effect describes how well very fine details can be seen through the specimen. The see-through quality needs to be determined in an angle range smaller than 2.5 degrees.





Objective Measurement of Transparency

Measurement and analysis of haze and clarity guarantee a uniform and consistent product quality and help analyze influencing process parameters and material properties, e.g. cooling rate or compatibility of raw materials.
The figure on the right hand side shows the measurement principle of the haze meter: A light beam strikes the specimen and enters an integrating sphere. The sphere's interior surface is coated uniformly with a matte white material to allow diffusion. A detector in the sphere measures total transmittance and transmission haze. A ring sensor mounted at the exit port of the sphere detects narrow angle scattered light (clarity).



Standard Methods

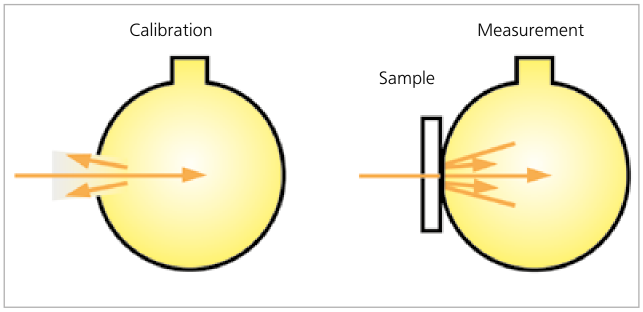
The measurement of Total Transmittance and Transmission Haze is described in international standards. Two different test methods are specified:

- ISO 13468 Compensation method
- ASTM D1003 Non-compensated method

The compensation method takes the light reflected on the sample surface into account. Differences between the two methods can be approximately 2 % Total Transmittance on clear, glossy samples.

ASTM D 1003

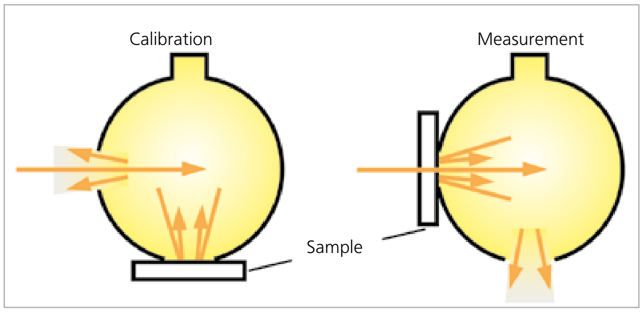
Measurement conditions are different during calibration and actual measurement. During calibration, part of the light escapes through the open entrance port of the hazemeter. While taking a measurement, the entrance port is covered with the sample. Thus, the amount of light in the sphere is increased by the light reflected at the sample surface.



No compensation: Different Sphere Efficiency

ISO 13468

Measurement conditions are kept equal during calibration and measurement due to an additional opening in the sphere. During calibration the sample is placed at the compensation port. For the actual measurement, the sample is changed to the entrance port. Thus, the so-called sphere efficiency is independent of the reflection properties of the sample.



Compensation Port: Same Sphere Efficiency

Two Standard Methods in one Unit

The haze-gard i objectively measures Total Transmission and Haze according to the ASTM and ISO standard methods. The new optical design allows simultaneous measurement without placing the sample to a separate compensation port.